Carmen Johnson
32-08 2/8/12

RCRA/Perm/Co ID # Date Doc ID#
DIN

Glaxo

Research Triangle Park, North Carolina

RCRA Permit Application

Volume 2 of 2 Appendices

SIRRINE ENVIRONMENTAL CONSULTANTS
Raleigh, North Carolina

Carmen Johnson
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RCRA PERMIT APPLICATION

VOLUME 2 OF 2
APPENDICES

FOR

GLAXO INC.
RESEARCH TRIANGLE PARK, NORTH CAROLINA

DECEMBER 1989

SIRRINE ENVIRONMENTAL CONSULTANTS
RALEIGH, NORTH CAROLINA

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1. WASTE DISPOSAL RECORD

GLAXO HAZARDOUS MATERIALS DISPOSAL RECORD

Container #———— Laboratory #———— Investigator————————

General Material Description————————————————————
(halogenated solvents, nonhalogenated solvents, acid, alkaline, poison, etc)

Physical Form (solid, liquid, gas, gel, etc.)————————————

NO HAZARDOUS MATERIALS MAY BE DISPOSED VIA THE SEWER OR THE NORMAL TRASH. IF YOU ARE UNSURE OF THE HAZARDOUS NATURE OF A MATERIAL, CONTACT THE HEALTH AND SAFETY OFFICE AT 941-4038.

GENERAL INSTRUCTIONS:

1. Material Description must be by chemical name.
2. Segregate waste as much as possible (halogenated solvents, non-halogenated solvents, individual chemicals etc.)
3. For mixed waste, each component and its percentage must be listed.

DATE	INITIALS	MATERIAL DESCRIPTION	VOLUME

GLAXO RADIOACTIVE WASTE DISPOSAL RECORD

Container #_____ Lab #_____ Principal Investigator_____

Waste Classification (Mark Only ONE):

_____ DRY SOLID - Paper, plastic, glass. NO LIQUID. NO BIOLOGICALS. NO LEAD.
_____ AQUEOUS LIQUID - Water soluble, nonhazardous. NO SOLIDS.
_____ ORGANIC LIQUID - Liquid other than the aqueous. NO SOLIDS.
_____ SCINTILLATION VIALS - Placed in flats. Lids must be TIGHT.
_____ BIOLOGICAL - Carcasses, tissues, blood, etc. Must be frozen in bags.

GENERAL INSTRUCTIONS:
1. Use a separate form for EACH container.
2. Enter requested information for EACH addition to the waste container.
3. Waste classifications MUST NOT be mixed.
4. Segregate P-32 waste from all other isotopes.
5. Chemical composition must be listed for: liquid wastes (eg, methanol, toluene, water); solid waste (eg, salts, enzymes, proteins); scintillation vials - solvents (eg, Scintiverse, methanol, toluene). If a mixture of chemicals is present, % of each must be given.

DATE	ISOTOPE	ACTIVITY (uCi)	CHEMICAL COMPOSITION (Give % If Mixture)	INITIALS

TOTALS BY ISOTOPE:		

This waste is packed according to Glaxo Radiation Safety Requirements.

_____

SIGNATURE

2. MATERIAL SAFETY DATA SHEETS - SOLVENT WASTE

ACETONITRILE
ACETONITRILE
ACETONITRILE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
(201) 796-7100

DATE 09/24/88
PO NBR: 31109/ REL 38
ACCT: 311488-17
INDEX: 14882650334
CAT NO: A9964

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 75-05-8

SUBSTANCE: ACETONITRILE

TRADE NAMES/SYNONYMS:
CYANOMETHANE; ETHANENITRILE; ETHYL NITRILE; METHANECARBONITRILE; METHYL CYANIDE; U003; STCC 4907405; UN 1648; NA 1648; A-999; A-998; A-24; O-1034; A-21; ACC00170

CHEMICAL FAMILY:
NITRILE, ALIPHATIC

MOLECULAR FORMULA: C2-H3-N MOL WT: 41.05

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ACETONITRILE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
ACETONITRILE:
40 PPM (70 MG/M3) OSHA TWA
40 PPM (70 MG/M3) ACGIH TWA (SKIN); 60 PPM (105 MG/M3) ACGIH STEL (SKIN)
20 PPM (34 MG/M3) NIOSH RECOMMENDED 10 HOUR TWA

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH SWEET, ETHER-LIKE ODOR.

BOILING POINT: 179 F (81 C) F (-46 C)

SPECIFIC GRAVITY: 0.8) 20 C

EVAPORATION RATE: (BU ACE) TY IN WATER: MISCIBLE

ODOR THRESHOLD: 40 PPM ← TYPE

SOLVENT SOLUBILITY: ALCOH(ENE, CHLOROFORM

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 42 F (5.6 C) (CC) UPPER EXPLOSIVE LIMIT: 16%

LOWER EXPLOSIVE LIMIT: 3% AUTOIGNITION TEMP.: 975 F (524 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL; DO NOT SCATTER THE MATERIAL. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 28).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS A FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING POISONOUS VAPORS. IF FIRE IS UNCONTROLLABLE OR CONTAINERS EXPOSED TO DIRECT FLAME, EVACUATE FOR A RADIUS OF 1500 FEET. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH

EDITION).

FIRE FIGHTING PHASES: USE DRY CHEMICAL, ALCOHOL FOAM, OR CARBON DIOXIDE; WATER MAY BE INEFFECTIVE, BUT WATER SHOULD BE USED TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF A LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROTECT MEN ATTEMPTING TO STOP A LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES AND TO DILUTE SPILLS TO NON-FLAMMABLE MIXTUES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

ACETONITRILE:
10 MG/24 HOURS SKIN-RABBIT IRRITATION; 500 MG OPEN SKIN-RABBIT MILD IRRITATION; 20 MG OPEN EYE-RABBIT SEVERE IRRITATION; 2730 MG/KG ORAL-RAT LD50; 7551 PPM/8 HOURS INHALATION-RAT LC50; 1250 MG/KG SKIN-RABBIT LD50; 570 MG/KG ORAL-HUMAN TDLO; 160 PPM/4 HOURS INHALATION-HUMAN TCLO; 850 MG/KG INTRAPERITONEAL-RAT LD50; 16,000 PPM/4 HOURS INHALATION-DOG LCLO; 5000 MG/KG SUBCUTANEOUS-RAT LD50; 269 MG/KG ORAL-MOUSE LD50; 1680 MG/KG INTRAVENOUS-RAT LD50; 2693 PPM/1 HOUR INHALATION-MOUSE LD50; 175 MG/KG INTRAPERITONEAL-MOUSE LD50; 700 MG/KG SUBCUTANEOUS-MOUSE LDLO; 612 MG/KG INTRAVENOUS-MOUSE LD50; 18 GM/M3 INHALATION-CAT LC50; 2828 PPM/4 HOURS INHALATION-RABBIT LC50; 177 MG/KG ORAL-GUINEA PIG LD50; 5655 PPM/4 HOURS INHALATION-GUINEA PIG LC50; 9100 MG/KG SUBCUTANEOUS-FROG LDLO; REPRODUCTIVE EFFECTS DATA (RTEC); MUTATION DATA (RTEC); CARCINOGEN STATUS: NONE.

ACETONITRILE IS A CHEMICAL ASPHYXIANT. POISONING MAY AFFECT THE CENTRAL NERVOUS SYSTEM. PERSONS WITH A HISTORY OF FAINTING OR CONVULSIONS MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ACETONITRILE:
ASPHYXIANT.
4000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- VAPORS MAY CAUSE NOSE AND THROAT IRRITATION, FLUSHING OF THE FACE AND A FEELING OF TIGHTNESS IN THE CHEST, COUGH, NAUSEA, VOMITING OF BLOOD OR BILE-LIKE SUBSTANCE, DIZZINESS, RAPID RESPIRATION, HEADACHE, DROWSINESS, HYPOTENSION, PARALYSIS, RAPID PULSE, SHOCK AND UNCONSCIOUSNESS. DEATH IN CONVULSIONS MAY OCCUR WITHIN 4 HOURS. INHALATION OF LARGE AMOUNTS MAY CAUSE IMMEDIATE UNCONSCIOUSNESS, CONVULSIONS AND DEATH WITHIN 1-5 MINUTES DUE TO CENTRAL NERVOUS SYSTEM DEPRESSION. RATS EXPOSED TO 750 PPM FOR 8 HOURS SHOWED PROSTRATION, CONVULSIVE SEIZURES AND PULMONARY HEMORRHAGE. ANIMAL STUDIES ALSO INDICATE LIVER DAMAGE MAY OCCUR. PREGNANT HAMSTERS EXPOSED TO ACETONITRILE RESULTED IN

POST-IMPLANTATION MORTALITY, FETOTOXICITY AND DEVELOPMENTAL ABNORMALITIES INVOLVING THE CENTRAL NERVOUS SYSTEM AND MUSCULOSKELETAL SYSTEM IN OFFSPRING.
CHRONIC EXPOSURE- NO HUMAN DATA AVAILABLE. RATS REPEATEDLY EXPOSED TO 665 PPM FOR 7 HOURS DAILY DEVELOPED PULMONARY INFLAMMATION. LIVER AND KIDNEY CHANGES WERE ALSO REPORTED.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ACETONITRILE:
IRRITANT.
ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION AND MAY BE ABSORBED IN TOXIC AMOUNTS TO CAUSE DELAYED SYMPTOMS OF DIZZINESS, RAPID RESPIRATION, VOMITING, FLUSHING OF THE FACE, HEADACHE, DROWSINESS, HYPOTENSION, RAPID PULSE, UNCONSCIOUSNESS AND CONVULSIONS. THE LIQUID APPLIED TO THE BELLY OF RABBITS CAUSED ERYTHEMA.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ACETONITRILE:
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE SMARTING OF THE EYES AND THE LIQUID MAY CAUSE IRRITATION. A DROP IN RABBIT EYES CAUSED SUPERFICIAL, REVERSIBLE INJURY.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ACETONITRILE:
ACUTE EXPOSURE- INGESTION OF LARGE AMOUNTS MAY CAUSE IMMEDIATE UNCONSCIOUSNESS, CONVULSIONS AND DEATH WITHIN 1-5 MINUTES. LESSER AMOUNTS MAY CAUSE DIZZINESS, RAPID RESPIRATION, VOMITING, FLUSHING OF THE FACE, HEADACHE, DROWSINESS, HYPOTENSION, METABOLIC ACIDOSIS, RAPID PULSE AND UNCONSCIOUSNESS. DEATH IN CONVULSIONS MAY OCCUR WITHIN 4 HOURS. ADMINISTRATION TO PREGNANT HAMSTERS RESULTED IN POST-IMPLANTATION MORTALITY AND MUSCULOSKELETAL DEVELOPMENTAL ABNORMALITIES.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSIVE, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER. INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
THE FOLLOWING ANTIDOTE(S) HAVE BEEN RECOMMENDED. HOWEVER, THE DECISION AS TO WHETHER THE SEVERITY OF POISONING REQUIRES ADMINISTRATION OF ANY ANTIDOTE AND ACTUAL DOSE REQUIRED SHOULD BE DETERMINED BY QUALIFIED MEDICAL PERSONNEL.

FOR CYANIDE POISONING:
IF SYMPTOMS OF CYANIDE POISONING ARE PRESENT, ADMINISTER AMYL NITRITE (AMYL NITRITE PERLES) BY INHALATION FOR 15 TO 30 SECONDS OF EVERY MINUTE, WHILE SODIUM NITRITE SOLUTION IS BEING PREPARED. DISCONTINUE AMYL NITRITE AND IMMEDIATELY INJECT 10 ML OF A 3% SOLUTION SODIUM NITRITE INTRAVENOUSLY OVER A PERIOD OF 2 TO 4 MINUTES. IF NECESSARY, INJECT A NON-STERILE SOLUTION. DO NOT REMOVE THE NEEDLE. CAUTION: APPROPRIATE ADJUSTMENTS IN THE DOSE SHOULD BE MADE ON A BODY WEIGHT BASIS. THROUGH THE SAME NEEDLE INFUSE INTRAVENOUSLY 50 ML OF A 25% AQUEOUS SOLUTION OF SODIUM THIOSULFATE. THE INJECTION SHOULD TAKE ABOUT 10 MINUTES. OTHER CONCENTRATIONS (5 TO 50%) ARE PERMISSIBLE IF THE TOTAL DOSE IS HELD AT APPROXIMATELY 12 GRAMS. OXYGEN THERAPY MAY BE OF VALUE IN COMBINATION WITH NITRITE AND SODIUM THIOSULFATE THERAPY. IF SYMPTOMS RECUR, THE INJECTIONS OF NITRITE AND THIOSULFATE MAY BE REPEATED AT HALF THE ABOVE DOSES. IN VERY SEVERE POISONINGS IT IS SAFER AND PERHAPS MORE EFFICIENT TO KEEP REPEATING THE THIOSULFATE INJECTIONS INSTEAD OF THE NITRITE (GOSSELIN, SMITH, HODGE, CLINICAL TOXICOLOGY OF COMMERCIAL PRODUCTS, 5TH ED.). ANTIDOTE SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

REACTIVITY

REACTIVITY:
ACETONITRILE:
  MODERATELY REACTIVE UNDER NORMAL CONDITIONS, BUT MAY BECOME UNSTABLE AT ELEVATED TEMPERATURES.

INCOMPATIBILITIES:
ACETONITRILE:
  BROMINE PENTAFLOURIDE: VIOLENT DECOMPOSITION.
  NITRIC ACID AND DINITROGEN TETROXIDE IN THE PRESENCE OF INDIUM CATALYST: POSSIBLE EXPLOSION.
  NITROGEN-FLUORINE COMPOUNDS: POSSIBLE EXPLOSION.
  IRON (III) PERCHLORATE: VIOLENT RACTION.
  PERCHLORIC ACID: VIOLENT REACTION.
  SULFURIC ACID: VIOLENT CONDENSATION UPON HEATING.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE HIGHLY TOXIC HYDROGEN CYANIDE AND TOXIC OXIDES OF CARBON.

POLYMERIZATION:
ACETONITRILE:
  POLYMERIZATION IS SUSPECTED.

STORAGE AND DISPOSAL

STORAGE: PROTECT AGAINST PHYSICAL DAMAGE. OUTSIDE OR DETACHED STORAGE IS PREFERABLE. INSIDE STORAGE SHOULD BE IN A STANDARD FLAMMABLE LIQUIDS STORAGE ROOM. SERARATE FROM OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION AND POISON HAZARD INDOORS, OUTDOORS OR IN SEWERS.

RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

USUAL SHIPPING CONTAINERS:
GLASS BOTTLES, IRON DRUMS, TANK CARS, TANK TRUCKS, TANK BARGES
(NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

ACETONITRILE:
400 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S)
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) WITH A FULL FACEPIECE.
ANY POWERED-AIR PURIFYING RSPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S) WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN THE CONTINUOUS-FLOW MODE.

2000 PPM- ANY AIR-PURIFYING RESPIRATOR FULL FACEPIECE RESPIRATOR (GAS MASK) WITH CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

4000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 09/06/84 REVISION DATE: 07/12/88

-ADDITIONAL INFORMATION-

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ACETONE
ACETONE
ACETONE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-64-1

SUBSTANCE: ACETONE

TRADE NAMES/SYNONYMS:
DIMETHYLFORMALDEHYDE; DIMETHYLKETAL; DIMETHYL KETONE; BETA-KETOPROPANE; PROPANONE; 2-PROPANONE; PYROACETIC ETHER; B-KETOPROPANE; RCRA U002; STCC 4908105; UN 1090; A-949; A-40; A-20; A-19; A-946; A-18; A-18-S; A-18-SK; A-11; A-11-S; A-16-P; A-16-S; C3H6O; ACC00140

CHEMICAL FAMILY:
KETONE, ALIPHATIC

MOLECULAR FORMULA: C-H3-C-O-C-H3

MOLECULAR WEIGHT: 58.08

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ACETONE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
ACETONE:
1000 PPM (2400 MG/M3) OSHA TWA
750 PPM (1780 MG/M3) ACGIH TWA; 1000 PPM (2375 MG/M3) ACGIH STEL
250 PPI MMENDED 10 HOUR TWA

5000 P(REPORTABLE QUANTITY
SUBJEC1 NUAL TOXIC CHEMICAL RELEASE REPORTING

TYPE ↑

CAL DATA

DESCRIPTI OLATILE LIQUID WITH A CHARACTERISTIC,

SWEETISH, SWEETISH TASTE.

BOILING P 139 F (-95 C)

SPECIFIC

VAPOR PRESSURE: 180 MMH RATE: (BUTYL ACETATE=1) 14.4

PH: NEUTRAL IN SOLUTION VERY SOLUBLE

TYPE ←

ODOR THRESHOLD: 20 PPM

SOLVENT SOLUBILITY: SOL CHLOROFORM, BENZENE, MOST OILS, DIMETHYLFORMAMIDE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: -4 F (-20 C) (CC) UPPER EXPLOSIVE LIMIT: 13%

LOWER EXPLOSIVE LIMIT: 2.5% AUTOIGNITION TEMP.: 869 F (465 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS A FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS; KEEP UPWIND. IF FIRE IS UNCONTROLLABLE OR CONTAINERS ARE EXPOSED TO DIRECT FLAME, EVACUATE TO A RADIUS OF 1500 FEET. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

ACETONE:
500 PPM EYE-HUMAN IRRITATION; 395 MG OPEN SKIN-RABBIT MILD IRRITATION; 3950 UG EYE-RABBIT SEVERE IRRITATION; 20 MG/24 HOURS EYE-RABBIT MODERATE IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MILD IRRITATION; 500 PPM INHALATION-HUMAN TCLO; 12000 PPM/4 HOURS INHALATION-MAN TCLO; 10 MG/M3/6 HOURS INHALATION-MAN TCLO; 440 UG/M3/6 MINUTES INHALATION-MAN TCLO; 2857 MG/KG ORAL-MAN TDLO; 1159 MG/KG UNREPORTED-MAN LDLO; 5800 MG/KG ORAL-RAT LD50; 8 GM/KG ORAL-DOG LDLO; 3000 MG/KG ORAL-MOUSE LD50; 5340 MG/KG ORAL-RABBIT LD50; 20 GM/KG SKIN-RABBIT LD50; 110 GM/M3/1 HOUR INHALATION-MOUSE LCLO; 1297 MG/KG INTRAPERITONEAL-MOUSE LD50; 8 GM/KG INTRAPERITONEAL-DOG LDLO; 500 MG/KG INTRAPERITONEAL-RAT LDLO; 1576 MG/KG INTRAVENOUS-RABBIT LDLO; 5500 MG/KG INTRAVENOUS-RAT LD50; 4 GM/KG INTRAVENOUS-MOUSE LDLO; 5000 MG/KG SUBCUTANEOUS-GUINEA PIG LDLO; 5 GM/KG SUBCUTANEOUS-DOG LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS);
CARCINOGEN STATUS: NONE.
ACETONE IS A SKIN, EYE AND MUCOUS MEMBRANE IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. THE USE OF ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS. PERSONS WITH CHRONIC RESPIRATORY OR SKIN DISEASES MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ACETONE:
IRRITANT/NARCOTIC. 20,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- VAPOR CONCENTRATIONS AROUND 1000 PPM MAY CAUSE SLIGHT TRANSIENT IRRITATION OF THE UPPER RESPIRATORY TRACT. EXPOSURE TO 12,000 PPM HAS CAUSED THROAT IRRITATION AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH WEAKNESS OF THE LEGS, HEADACHE, DIZZINESS, DROWSINESS, NAUSEA AND A GENERAL FEELING OF MALAISE. OTHER POSSIBLE EFFECTS FROM EXPOSURE TO HIGH CONCENTRATIONS INCLUDE DRYNESS OF THE MOUTH AND THROAT, INCOORDINATION OF MOTION AND SPEECH, RESTLESSNESS, ANOREXIA, VOMITING, SOMETIMES FOLLOWED BY HEMATEMESIS, HYPOTHERMIA, DYSPNEA, SLOW, IRREGULAR RESPIRATION, SLOW, WEAK PULSE, PROGRESSIVE COLLAPSE WITH STUPOR, AND IN SEVERE CASES, COMA. LIVER DAMAGE MAY BE INDICATED BY HIGH UROBILIN LEVELS AND JAUNDICE. KIDNEY DAMAGE MAY BE INDICATED BY ALBUMIN AND RED AND WHITE BLOOD CELLS IN THE URINE. BLOOD GLUCOSE LEVELS MAY BE AFFECTED AND FATAL KETOSIS IS POSSIBLE.
CHRONIC EXPOSURE- WORKERS EXPOSED TO 500 PPM/6 HOURS/6 DAYS EXPERIENCED MUCOUS MEMBRANE IRRITATION, AN UNPLEASANT SMELL, HEAVY EYES, OVERNIGHT HEADACHE, AND GENERAL WEAKNESS ACCOMPANIED BY HEMATOLOGIC CHANGES. RECOVERY OCCURRED IN SEVERAL DAYS. WORKERS EXPOSED TO 1000 PPM FOR 3 HOURS/DAY FOR 7-15 YEARS REPORTED CHRONIC INFLAMMATION OF THE RESPIRATORY TRACT, STOMACH AND DUODENUM, DIZZINESS, LOSS OF STRENGTH, AND ASTHENIA. DROWSINESS, VERTIGO, SENSATION OF HEAT, AND COUGHING HAVE ALSO BEEN REPORTED FROM CHRONIC EXPOSURE TO LOW CONCENTRATIONS. ANIMAL STUDIES SHOW ADVERSE EFFECTS ON FERTILITY WHEN FEMALES WERE EXPOSED CHRONICALLY DURING PREGNANCY.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ACETONE:
IRRITANT.

-ACUTE EXPOSURE- CONTACT WITH THE LIQUID CAUSED MILD IRRITATION IN RABBITS. CELLULAR DAMAGE TO THE OUTER LAYERS OF THE EPITHELIUM WITH MILD EDEMA AND HYPEREMIA HAS BEEN DEMONSTRATED IN HUMANS, BUT WAS READILY REVERSIBLE. SMALL AMOUNTS MAY BE ABSORBED THROUGH INTACT SKIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS WITH DRYING, CRACKING, AND ERYTHEMA DUE TO THE DEFATTING ACTION. THE AMOUNT ABSORBED THROUGH THE SKIN INCREASES DIRECTLY WITH THE FREQUENCY AND EXTENT OF THE EXPOSURE. 2 OF 3 GUINEA PIGS EXPOSED BY SKIN CONTACT FOR 3 WEEKS DEVELOPED CATARACTS BY THE END OF THREE MONTHS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ACETONE:
IRRITANT.
ACUTE EXPOSURE- IN HUMANS, VAPORS PRODUCE ONLY SLIGHT IRRITATION WHEN THE CONCENTRATION IS AT OR BELOW 1000 PPM. HOWEVER, HIGH VAPOR CONCENTRATIONS HAVE CAUSED CORNEAL EPITHELIAL AND CONJUNCTIVAL INJURY IN ANIMALS. LIQUID SPLASHED IN HUMAN EYES CAUSES AN IMMEDIATE STINGING SENSATION AND, IF WASHED PROMPTLY, DAMAGE ONLY TO THE CORNEAL EPITHELIUM CHARACTERIZED BY MICROSCOPIC GRAY DOTS AND A FOREIGN BODY SENSATION, WHICH HEALS COMPLETELY IN 1-2 DAYS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO THE VAPORS MAY CAUSE IRRITATION OR CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ACETONE:
NARCOTIC.
ACUTE EXPOSURE- MAY CAUSE A FRUITY ODOR OF THE BREATH AND MUCOUS MEMBRANE AND GASTROENTERIC IRRITATION. IN ACUTE CASES, A LATENT PERIOD MAY BE FOLLOWED BY RESTLESSNESS AND VOMITING PROCEEDING TO HEMATEMESIS AND PROGRESSIVE COLLAPSE WITH STUPOR. HEPATORENAL LESIONS HAVE BEEN REPORTED. THE BLOOD GLUCOSE LEVEL MAY BE AFFECTED AND KETOSIS MAY BE FATAL. 10-20 MILLILITERS HAVE BEEN TOLERATED WITHOUT ILL EFFECTS. 200 MILLILITERS HAVE CAUSED STUPOR WITHIN A HALF HOUR, FLUSHED CHEEKS, SHALLOW RESPIRATION, AND COMA WHICH LASTED FOR 12 HOURS. RENAL GLUCOSURIA PERSISTED FOR 5 MONTHS.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
ACETONE:
ACIDS: INCOMPATIBLE.
AMINES (ALIPHATIC): INCOMPATIBLE.
BROMINE: VIOLENT REACTION WITH EXCESS AMOUNTS OF BROMINE.
BROMINE TRIFLUORIDE: EXPLOSION ON CONTACT.
BROMOFORM: VIOLENT REACTION IN PRESENCE OF BASES (E.G. POTASSIUM HYDROXIDE).
CHLOROFORM: VIOLENT REACTION IN PRESENCE OF A BASE.
CHROMIUM TRIOXIDE: IGNITION ON CONTACT AT AMBIENT TEMPERATURE.
CHROMYL CHLORIDE: INCANDESCENT REACTION.
DIOXYGEN DIFLUORIDE + SOLID CARBON DIOXIDE: EXPLOSION AT -78 C.
HEXACHLOROMELAMINE: POSSIBLE EXPLOSION.
HYDROGEN PEROXIDE: EXPLOSION.
NITRIC ACID: IGNITION.
NITRIC + ACETIC ACID MIXTURE: POSSIBLE EXPLOSION.
NITRIC + SULFURIC ACID MIXTURE: VIOLENT OXIDATION.
NITROSYL CHLORIDE: EXPLOSIVE REACTION.
NITROSYL PERCHLORATE: IGNITION AND EXPLOSION.
NITRYL PERCHLORATE: IGNITION AND EXPLOSION.
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
PERMONOSULFURIC ACID: EXPLOSION.
PLASTICS: INCOMPATIBLE.
PLATINUM + NITROSYL CHLORIDE: POSSIBLE EXPLOSION.
POTASSIUM-TERT-BUTOXIDE: IGNITION.
RAYON: INCOMPATIBLE.
SODIUM HYPOBROMITE: EXPLOSION.
SODIUM HYPOIODITE: POSSIBLE EXPLOSION.
SULFUR DICHLORIDE: VIOLENT REACTION.
SULFURIC ACID AND POTASSIUM BICHROMATE: IGNITION.
THIODIGLYCOL + HYDROGEN PEROXIDE: POSSIBLE EXPLOSION.
THIOTRIAZYL PERCHLORATE: POSSIBLE EXPLOSION.
1,1,1-TRICHLOROETHANE: EXOTHERMIC CONDENSATION BY A BASIC CATALYST.
TRICHLOROMELAMINE: POSSIBLE EXPLOSION.
SEE ALSO KETONES.

KETONES:
ACETALDEHYDE: VIOLENT CONDENSATION REACTION.
NITRIC ACID + HYDROGEN PEROXIDE: FORMATION OF EXPLOSIVE PRODUCT.
PERCHLORIC ACID: VIOLENT DECOMPOSITION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

****STORAGE****

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

****DISPOSAL****

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262. EPA HAZARDOUS WASTE NUMBER U002.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

6250 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

12,500 PPM- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

20,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE

DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 09/06/84 REVISION DATE: 06/27/88

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BENZENE
BENZENE
BENZENE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 71-43-2

SUBSTANCE: **BENZENE**

TRADE NAMES/SYNONYMS:
BENZOL; CYCLOHEXATRIENE; BENZOLE; PHENE; PYROBENZOL; NITRATION BENZENE; PHENYL HYDRIDE; MINERAL NAPTHA; PYROBENZOLE; PYROBENZOLE; BENZOLENE; BICARBURET OF HYDROGEN; COAL NAPHTHA; MOTOR BENZOL; B-426; 13065; B-243; B-245-S; B-245; B-411; ACC02610

CHEMICAL FAMILY:
HYDROCARBON, AROMATIC

MOLECULAR FORMULA: C6-H6 MOL WT: 78.08

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: BENZENE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
10 PPM OSHA TWA; 25 PPM OSHA CEILING; 50 PPM/10 MIN OSHA PEAK;
0.1 PPM (0.32 MG/M3) NIOSH RECOMMENDED 8 HOUR TWA;
1 PPM (3.2 MG/M3) NIOSH RECOMMENDED 15 MINUTE CEILING;
10 PPM (30 MG/M3) ACGIH TWA; 25 PPM (75 MG/M3) ACGIH STEL (NOTICE OF INTENDED CHANGE 1985-1986)
LISTED BY ACGIH AS AN INDUSTRIAL SUBSTANCE SUSPECT OF CARCINOGEN POTENTIAL FOR MAN.

PHYSICAL DATA

DESCRIPTION: COLORLESS TO LIGHT-YELLOW LIQUID WITH AN AROMATIC ODOR.

BOILING POINT: 176 F (80 C) MELTING POINT: 42 F (6 C)

SPECIFIC GRAVITY: 0.9 VAPOR PRESSURE: 74.6 MMHG @ 20 C

EVAPORATION RATE: (CCL4=1) 1.0 SOLUBILITY IN WATER: 0.1%

ODOR THRESHOLD: 1.5-5 PPM VAPOR DENSITY: 2.8

SOLVENT SOLUBILITY: ACETONE, ALC, CS2, CCL4, CHL, ETHER, ACETIC ACID

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE AND MODERATE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK. VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASHPOINT.

FLASH POINT: 12 F (-11 C) UPPER EXPLOSIVE LIMIT: 8.0%

LOWER EXPLOSIVE LIMIT: 1.5% AUTOIGNITION TEMP.: 928 F (498 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE WATER IN FLOODING QUANTITIES AS A FOG; SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER; APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING HAZARDOUS MATERIALS; KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. EVACUATE DOWNWIND FOR LEAKS (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

FIRE FIGHTING PHASES: DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE. WATER MAY BE INEFFECTIVE. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF A LEAK OR SPILL HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROVIDE PROTECTION FOR THE MEN ATTEMPTING TO STOP THE LEAK. WATER SPRAY MAY BE USED

TO FLUSH SPILLS AWAY FROM EXPOSURES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

TOXICITY

20,000 PPM/5MIN INHALATION-HUMAN LCLO; 194 MG/KG UNKNOWN ROUTE-MAN LDLO; 4894 MG/KG ORAL-RAT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); SUSPECT ANIMAL CARCINOGEN (IARC); HUMAN CARCINOGEN (IARC, NTP).

CASE REPORTS AND AN EPIDEMIOLOGICAL STUDYHAVE ESTABLISHED A RELATINSHIP BETWEEN BENZENE EXPOSURE AND LEUKEMIA.

BENZENE CAUSES SSKIN IRRITATION, CENTRAL NERVOUS SYSTEM DEPRESSION, BONE DEPRESSION, AND LEUKEMIA. EXPOSURE TO COMMERCIAL BENZENE OR BENZENE-CONTAINING MIXTURES MAY DAMAGE THE HEMATOPOIETIC SYSTEM.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NARCOTIC/LEUKEMOGEN. 2000 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.

ACUTE EXPOSURE- 200-500 PPM HAS CAUSED CENTRAL NERVOUS SYSTEM DEPRESSION WITH DIZZINESS, WEAKNESS, HEADACHE, CONFUSION, NAUSEA AND VOMITING. CONCENTRATIONS ABOVE 3000 PPM IRRITATE THE RESPIRATORY TRACT. SEVERE EXPOSURE MAY RESULT IN NAUSEA, EUPHORIA, STAGGERING, SPEECH DISTURBANCES, CONVULSIONS, MYDRIASIS, AND COMA. DELAYED PULMONARY EDEMA, KIDNEY DAMAGE AND CEREBRAL EDEMA ARE POSSIBLE. SINGLE EXPOSURE TO 66 GM/M3 OF COMMERCIAL BENZENE WAS LETHAL IN MAN WITHIN 5-10 MINUTES.

CHRONIC EXPOSURE- LONG-TERM EXPOSURES TO LOW CONCENTRATIONS HAVE BEEN OBSERVED TO HAVE AN INITIAL STIMULANT EFFECT ON THE BONE MARROW, PRODUCING AN INCREASE OF ERYTHROCYTES, LEUKOCYTES, OR PLATELETS, FOLLOWED BY A DEPRESSANT EFFECT PROGRESSING TO APLASTIC ANEMIA, LEUKOPENIA, PANCYTOPENIA AND THROMBOCYTOPENIA. SYMPTOMS MAY INCLUDE DIZZINESS, NAUSEA, HEADACHE, ANOREXIA, WEIGHT LOSS, AND ABDOMINAL DISCOMFORT. MORE SEVERE INTOXICATIONS MAY CAUSE WEAKNESS, VISUAL DISTURBANCES, PALLOR, DYSPNEA ON EXERTION, FATIGUE, NERVOUSNESS, AND IRRITABILITY. PETECHIAE, EPISTAXIS, BLEEDING GUMS, ABNORMAL MENSTRUAL BLEEDING, AND DARK URINE ARE POSSIBLE IMMUNOTOXIC EFFECTS MAY INCREASE SUSCEPTIBILITY TO INFECTIONS. EFFECTS APPEAR REVERSIBLE FROM EARLY STAGES OF BLOOD DYSCRASIAS; HOWEVER, EXPOSURE TO HIGH DOSES FOR LONGER PERIODS OF TIME MAY CAUSE PANCYTOPENIA WHICH RESULTS FROM APLASIA OF BONE MARROW AND IS CONSIDERED TO BE IRREVERSIBLE. SEE HUMAN CARCINOGENIC AND ANIMAL CARCINOGENIC, HUMAN AND ANIMAL REPRODUCTIVE EFFECTS AND HUMAN AND ANIMAL TUMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID: REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/NARCOTIC/LEUKEMOGEN.
ACUTE EXPOSURE- LIQUID MAY DEFAT THE KERATIN LAYER AND CAUSE ERYTHEMA, VESICULATION, AND DRY, SCALY DERMATITIS. THOUGH SLOWER THAN MUCOUS MEMBRANE ABSORPTION, DERMAL ABSORPTION MAY CAUSE NARCOTIC EFFECTS, BUT USUALLY LESS SEVERE THAN INHALATION. BENZENE APPLIED TO GUINEA PIG SKIN ELICITED INCREASED DERMAL PERMEABILITY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY RESULT IN A DRY, SCALY DERMATITIS, PURPURA, POSSIBLE SECONDARY INFECTIONS AND LESIONS RESEMBLING FIRST- OR SECOND-DEGREE BURNS. THE POSSIBILITY EXISTS THAT BENZENE IS A SKIN SENSITIZER. PROLONGED ABSORPTION MAY CAUSE ANEMIA OR POSSIBLY LEUKEMIA. SEE HUMAN AND ANIMAL CARCINOGENIC, HUMAN AND ANIMAL MUTAGENIC, ANIMAL REPRODUCTIVE EFFECTS AND HUMAN AND ANIMAL TUMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- VERY HIGH CONCENTRATIONS OF VAPORS MAY CAUSE IRRITATION AND SMARTING OF THE EYES. DROPLETS CAUSED MODERATE BURNING, BUT ONLY SLIGHT TEMPORARY INJURY TO THE EPITHELIAL CELLS. IN RABBIT EYES, DIRECT APPLICATION CAUSED ONLY SLIGHT INJURY. RARELY, HEMMORRHAGE IN THE RETINA AND CONJUNCTIVA ARE FOUND IN SYSTEMIC POISONING, POSSIBLY ACCOMPANIED BY NEURORETINAL EDEMA AND PAPILLEDEMA.

CHRONIC EXPOSURE- CASE REPORTS SUGGEST BENZENE EXPOSURE MAY BE ASSOCIATED WITH RETROBULBAR NEURITIS OR OPTIC NEURITIS. 50% OF RATS EXPOSED TO 50 PPM FOR MORE THAN 600 HOURS DEVELOPED CATARACTS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
IRRITANT.
ACUTE EXPOSURE- INGESTION MAY CAUSE NAUSEA, VOMITING, SORE THROAT, ABDOMINAL PAIN, AND DIARRHEA. THIS SUBSTANCE HAS PRODUCED REPRODUCTIVE EFFECTS IN EXPERIMENTAL ANIMAL (RATS) FEEDING STUDIES.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSIVE, GIVE HIM LARGE QUANTITIES OF WATER TO DILUTE. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
NORMALLY STABLE BUT MAY BECOME UNSTABLE AT ELEVATED TEMPERATURES AND PRESSURE.

INCOMPATIBILITIES:
OXIDIZERS, OF WHICH THE FOLLOWING ARE EXAMPLES:

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
WILL NOT OCCUR.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONTACT WITH OR STORAGE WITH STRONG OXIDIZERS.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
PROVIDE VENTILATION AND RESPIRATORY PROTECTION. SHUT OFF IGNITION SOURCES. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER INERT ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE CONTAINERS TIGHTLY AND LABEL FLAMMABLE. FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF SPILL AS IS PRACTICAL AND EFFECTIVE, IN ORDER TO REDUCE THE VOLUME OF MATERIAL FOR LATER SISPOSAL. NO SMOKING, FLAMES, OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL IS INVOLVED IN FIRE:
  APPLY FLOODING QUANTITIES OF WATER AS A FOG.
  USE FLOODING QUANTITIES OF WATER TO COOL ALL CONTAINERS INVOLVED.
  APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE.
  DO NOT ALLOW RUN-OFF WATER TO CONTAMINATE SEWERS OR WATER SOURCES.
  EXTINGUISH WITH DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE.

WHEN MATERIAL NOT INVOLVED IN FIRE:
  KEEP OPEN FLAMES, SPARKS OR OTHER IGNITION SOURCES AWAY.
  DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
  BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
  STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
  KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR PROCESS ENCLOSURE TO MEET PERMISSIBLE EXPOUSRE LIMIT. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
  10 PPM- SUPPLIED-AIR RESPIRATOR.
          SELF-CONTAINED BREATHING APPARATUS.

  50 PPM- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
          SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

1000 PPM- TYPE C SUPPLIED-AIR RESPIRATOR OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS-FLOW MODE.

2000 PPM- TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

ESCAPE- GAS MASK WITH A CANISTER PROVIDING PROTECTION AGAINST BENZENE (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER). SELF-CONTAINED BREATHING APPARATUS.

CLOTHING:
PROTECTIVE CLOTHING MUST COMPLY WITH OSHA REQUIREMENT FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT (29CFR1910.1018(J)). SHOULD BE WORN AS NECESSARY TO PREVENT ANY POSSIBILITY OF CONTACT.

GLOVES:
GLOVES MUST COMPLY WITH OSHA REQUIREMENTS FOR PROTECTIVE WORK CLOTHING AND EQUIPMENT. (29CFR1910.1018(J)). SHOULD BE WORN AS NECESSARY TO PREVENT ANY POSSIBILITY OF CONTACT.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
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CYCLOHEXANE
CYCLOHEXANE
CYCLOHEXANE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 110-82-7

SUBSTANCE: CYCLOHEXANE

TRADE NAMES/SYNONYMS:
HEXAHYDROBENZENE; HEXAMETHYLENE; HEXANAPHTHENE; BENZENE HEXAHYDRIDE; U056; STCC 4908132; UN 1145; C-552; C-553; C-555; C-620; O-2093; ACC05870

CHEMICAL FAMILY:
HYDROCARBON, ALICYCLIC

MOLECULAR FORMULA: C6-H12

MOLECULAR WEIGHT: 84.18

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CYCLOHEXANE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
CYCLOHEXANE:
300 PPM (1050 MG/M3) OSHA TWA
300 PPM (1050 MG/M3) ACGIH TWA

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A MILD, SWEET ODOR RESEMBLING CHLOROFORM OR BENZENE. BOILING POINT: 179 F (81 C) MELTING POINT: 44 F (7 C)

SPECIFIC GRAVITY: 0.779 VOLATILITY: 100% VAPOR PRESSURE: 95 MMHG @ 20 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: <0.01%

ODOR THRESHOLD: 0.41 PPM VAPOR DENSITY: 2.90

SOLVENT SOLUBILITY: SOLUBLE IN METHANOL, ETHANOL, ETHER, ACETONE, BENZENE, LIGROIN, CARBON TETRACHLORIDE

VISCOSITY: 0.914 CP @ 72 F

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

MODERATE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: -4 F (-20 C) (CC) UPPER EXPLOSIVE LIMIT: 8.4%

LOWER EXPLOSIVE LIMIT: 1.3% AUTOIGNITION TEMP.: 473 F (245 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS FOG, SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER; APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS KEEP UPWIND. IF FIRE IS UNCONTROLLABLE EVACUATE TO A DISTANCE OF 1500 FEET. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

CYCLOHEXANE:
1548 MG/2 DAYS-INTERMITTENT SKIN-RABBIT IRRITATION; 12705 MG/KG ORAL-RAT LD50; 813 MG/KG ORAL-MOUSE LD50; 5500 MG/KG ORAL-RABBIT LDLO; 77 MG/KG INTRAVENOUS-RABBIT LDLO; MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE.
CYCLOHEXANE IS AN EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. PERSONS WITH A HISTORY OF CHRONIC RESPIRATORY, LIVER, KIDNEY, OR SKIN DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE. ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS.

EPIDEMIOLOGICAL STUDIES INVOLVING PETROLEUM REFINERY WORKERS INDICATE PERSONS WITH ROUTINE EXPOSURE TO PETROLEUM OR ONE OF ITS CONSTITUENTS MAY BE AT AN INCREASED RISK TO THE DEVELOPMENT OF BENIGN NEOPLASMS, DIGESTIVE SYSTEM CANCERS, AND SKIN CANCER, PARTICULARLY MELANOMA.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CYCLOHEXANE:
IRRITANT/NARCOTIC. 10,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF LOW CONCENTRATIONS MAY CAUSE IRRITATION OF THE EYES, NOSE, AND RESPIRATORY TRACT. EXPOSURE TO CONCENTRATIONS ABOVE 12,000 PPM MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION WITH EXCITEMENT, HEADACHE, DIZZINESS, DULLNESS, NAUSEA, VOMITING, NARCOSIS, COMA, AND POSSIBLE DEATH DUE TO RESPIRATORY FAILURE. LETHAL CONCENTRATIONS TO ANIMALS CAUSED GENERALIZED VASCULAR DAMAGE WITH SEVERE DEGENERATIVE CHANGES IN THE HEART, LUNGS, LIVER, KIDNEYS, AND BRAIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO CONCENTRATIONS ABOVE 300 PPM MAY PRODUCE MILD IRRITATION OF THE EYES AND UPPER RESPIRATORY TRACT. REPEATED EXPOSURES CAUSED MICROSCOPIC CHANGES IN THE LIVER AND KIDNEYS, LETHARGY, LIGHT NARCOSIS, DIARRHEA, AND SOME DEATHS IN ANIMALS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CYCLOHEXANE:

IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION WITH REDNESS AND DRYNESS. MASSIVE APPLICATIONS TO RABBIT SKIN HAVE PRODUCED MICROSCOPIC CHANGES IN THE LIVER AND KIDNEYS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH LIQUID CYCLOHEXANE MAY CAUSE IRRITATION, DEFATTING OF THE SKIN, AND A DRY, SCALY, FISSURED DERMATITIS.

AN EPIDEMIOLOGICAL STUDY OF PETROLEUM REFINERY WORKERS HAS REPORTED ELEVATIONS IN STANDARD MORTALITY RATIOS FOR SKIN CANCER ALONG WITH A DOSE-RESPONSE RELATIONSHIP WHICH INDICATES AN ASSOCIATION BETWEEN ROUTINE WORKPLACE EXPOSURE TO PETROLEUM OR ONE OF ITS CONSTITUENTS AND SKIN CANCER, PARTICULARLY MELANOMA.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CYCLOHEXANE:
IRRITANT.
ACUTE EXPOSURE- CYCLOHEXANE HAS NO NOTABLE IRRITANT EFFECTS ON HUMAN EYES, NOR ON RABBIT EYES TESTED BY EXPOSURE TO CONCENTRATIONS OF 11 MG/M3. CONTACT WITH LIQUID OR HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION, WITH TEARING AND REDNESS, AND A MILD CONJUNCTIVITIS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CYCLOHEXANE:
NARCOTIC.
ACUTE EXPOSURE- INGESTION OF CYCLOHEXANE MAY CAUSE SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION WITH EXCITEMENT, HEADACHE, DIZZINESS, DULLNESS, NAUSEA, VOMITING, NARCOSIS, COMA, AND POSSIBLE DEATH DUE TO RESPIRATORY FAILURE. ASPIRATION MAY CAUSE CHEMICAL PNEUMONITIS. LETHAL DOSES TO ANIMALS CAUSED GENERALIZED VASCULAR DAMAGE WITH SEVERE DEGENERATIVE CHANGES IN THE HEART, LUNGS, LIVER, KIDNEYS, AND BRAIN.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
CYCLOHEXANE:
NITROGEN DIOXIDE (LIQUID): POSSIBLE EXPLOSION.

OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
PLASTICS, RUBBER, COATINGS: MAY BE ATTACKED.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262. EPA HAZARDOUS WASTE NUMBER U056.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

REDUCE VAPOR AND FIRE HAZARD WITH FLUOROCARBON WATER FOAM.

AIR SPILL:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER SPILL:
LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL

BOOMS.

APPLY DETERGENTS, SOAPS, ALCOHOLS OR ANOTHER SURFACE ACTIVE AGENT TO THICKEN SPILLED MATERIAL.

APPLY UNIVERSAL GELLING AGENT TO IMMOBILIZE TRAPPED SPILL AND INCREASE EFFICIENCY OF REMOVAL.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

CYCLOHEXANE:

1000 PPM-	ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S). ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND ORGANIC VAPOR CARTRIDGE(S).
7500 PPM-	ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.
10,000 PPM-	ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER. ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE. ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/02/84 REVISION DATE: 06/29/88

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N,N-DIMETHYLFORMAMIDE
N,N-DIMETHYLFORMAMIDE
N,N-DIMETHYLFORMAMIDE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 68-12-2

SUBSTANCE: **N,N-DIMETHYLFORMAMIDE**

TRADE NAMES/SYNONYMS:
N-FORMYLDIMETHYLAMINE; NSC 5356; DIMETHYL FORMAMIDE; DMF; DMFA; U-4224; ACC07860

CHEMICAL FAMILY:
AMIDE

MOLECULAR FORMULA: C3-H7-N-O MOL WT: 73.11

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=2 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: N,N-DIMETHYLFORMAMIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
N,N-DIMETHYL FORMAMIDE:
10 PPM (30 MG/M3) OSHA (SKIN) TWA
10 PPM (30 MG/M3) ACGIH (SKIN) TWA

PHYSICAL DATA

DESCRIPTION: COLORLESS, MOBILE LIQUID WITH A FAINT AMINE ODOR.

BOILING POINT: 307 F (153 C) MELTING POINT: -78 F (-61 C)

SPECIFIC GRAVITY: 0.9 VAPOR PRESSURE: 3.7 MMHG @ 25 C

EVAPORATION RATE: (BU AC = 1) 17 TTE PH: 6.7 IN 0.5M SOLUTION

SOLUBILITY IN WATER: MISCIBLE ODOR THRESHOLD: 100 PPM VAPOR DENSITY: 2.5

SOLVENT SOLUBILITY: ALCOHOL, ETHER, BENZENE, CHLOROFORM, ACETONE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT TO MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

FLASH POINT: 136 F (58 C) UPPER EXPLOSIVE LIMIT: 15.2% @ 100 C

LOWER EXPLOSIVE LIMIT: 2.2% @ 100 C AUTOIGNITION TEMP.: 833 F (455 C)

FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE DRY CHEMICAL, CARBON DIOXIDE, OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 26).

USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND.
(BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE IN SURFACE TRANSPORTATION, 1981).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TOXICITY

100% CONCENTRATION/ 24 HOURS SKIN-HUMAN MILD IRRITATION; 10 MG/24 HOURS SKIN-RABBIT IRRITATION; 20 MG EYE-RABBIT IRRITATION; 2800 MG/KG ORAL-RAT LD50; 2000 MG/KG INTRAVENOUS-RAT LD50; 5 GM/KG SKIN-RAT LD50; 1400 MG/KG INTRAPERITONEAL-RAT LD50; 3750 MG/KG ORAL-MOUSE LD50; 3800 MG/KG INTRAMUSCULAR-MOUSE LD50; 9400 MG/M3/24 HOURS INHALATION-MOUSE LC50; 4500 MG/KG SUBCUTANEOUS-MOUSE LD50; 500 MG/KG INTRAPERITONEAL-CAT LD50; 1000 MG/KG INTRAPERITONEAL-RABBIT LD50; 4720 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTEC); REPRODUCTIVE EFFECTS DATA (RTEC); CARCINOGEN STATUS: NONE.
N,N-DIMETHYL FORMAMIDE IS AN EYE, MUCOUS MEMBRANE AND SKIN IRRITANT AND

A HEPATOTOXIN. POISONING MAY AFFECT THE CENTRAL NERVOUS SYSTEM. CONSUMPTION OF ALCOHOLIC BEVERAGES MAY ENHANCE THE SYSTEMIC EFFECTS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/HEPATOTOXIN/NEUROTOXIN. 3500 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.

ACUTE EXPOSURE- MAY CAUSE FLUSHING OF THE FACE, HEADACHE, DIZZINESS, INCOORDINATION, NAUSEA, VOMITING, ANDOMINAL PAIN AND SPASMS, CONSTIPATION, DIARRHEA, HYPERTENSION AND HEPATOMEGALY.

CHRONIC EXPOSURE- MAY CAUSE HEADACHE, DIZZINESS, ANOREXIA, AND HYPERTENSION. SEE ANIMAL MUTAGENIC AND REPRODUCTIVE EFFECTS REFERENCE IN TOXICITY SECTION.

FIRST AID: REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE- MAY CAUSE REDNESS, PAIN, AND DESQUAMATION OF SKIN. SKIN ABSORPTION MAY CAUSE CONSTIPATION, DIARRHEA, HYPEREMIA, ABDOMINAL PAIN, AND HYPERTENSION. WORKER WHO WAS SPLASHED WITH THE LIQUID ON OVER 20% OF THE BODY SURFACE INITIALLY SUFFERED ONLY DERMAL IRRITATION AND HYPEREMIA; ABDOMINAL PAIN BEGAN 62 HOURS AFTER THE EXPOSURE AND BECAME PROGRESSIVELY MORE SEVERE, WITH VOMITING; THE BLOOD PRESSURE WAS ELEVATED TO 190/100; THE EFFECTS GRADUALLY SUBSIDED AND ENTIRELY ABATED BY THE SEVENTH DAY AFTER EXPOSURE.

CHRONIC EXPOSURE- MAY CAUSE DERMATITIS FROM DEFATTING ACTION. PROLONGED EXPOSURE MAY CAUSE NEUROTOXIC EFFECTS AND POSSIBLE LIVER DAMAGE. PREGNANT RATS EXPOSED FOR 3 DAYS EXHIBITED FETAL DEATHS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT

ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION AND REDNESS. DIRECT CONTACT WITH A SOLUTION OF 75% CONCENTRATION OR GREATER MAY CAUSE IRRITATION WITH CONJUNCTIVAL EDEMA. A SOLUTION OF GREATER THAN 75% CONCENTRATION APPLIED TO RABBIT EYES PRODUCED SEVERE IRRITATION. ONE DROP OF 100% SOLUTION PLACED IN RABBIT EYE FOLLOWED IN TWO MINUTES BY IRRIGATION PRODUCED ONLY EDEMA OF THE CORNEA, RETURNING TO NORMAL IN TWO DAYS.

CHRONIC EXPOSURE- PROLONGED CONTACT WITH VAPORS OR LIQUID MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS

(APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
IRRITANT/HEPATOTOXIN/NEUROTOXIN.
ACUTE EXPOSURE- MAY CAUSE HEADACHE, DIZZINESS, INCOORDINATION, NERVOUSNESS, NAUSEA, VOMITING, ABDOMINAL SPASMS, BURNING SENSATION IN THE EPIGASTRIUM FOLLOWED BY TENDERNESS AND PAIN, PARTIAL PARALYSIS, MALAISE, AND POSSIBLE LIVER DAMAGE.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:

PHOSPHORUS OXYCHLORIDE: EXPLOSIVE REACTION ON MIXING.
TERT-ALKYL AZIDES: PREPARATORY HAZARD ABOVE 200 C (DIMETHYL FORMAMIDE AND ALKYL NITRATE MIXTURES ARE SHOCK SENSITIVE AND HIGHLY EXPLOSIVE).
TRIETHYLALUMINUM: EXPLOSIVE REACTION ON HEATING.
PHOSPHORUS TRIOXIDE: VIOLENT REACTION AFTER CHARRING.
CARBON TETRACHLORIDE: VIOLENT REACTION ABOVE 65 C.
CHROMIC ANHYDRIDE: VIOLENT REACTION.
HALOGENATED HYDROCARBONS: VIOLENT REACTION IN THE PRESENCE OF IRON.
SULPHINYL CHLORIDE: VIOLENT REACTION.
OXIDIZERS: VIOLENT REACTION.
METHYLENE DIISOCYANATE: VIOLENT POLYMERIZATION.
BROMINE: DANGEROUS EXOTHERMIC REACTION.
SODIUM: VIGOROUS REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC OXIDES OF CARBON AND NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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CONDITIONS TO AVOID

AVOID HEATING TO DECOMPOSITION AND CONTACT WITH OR STORAGE WITH INCOMPATIBLE SUBSTANCES.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION AND/OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
EXPOSURE LIMIT TO 100 PPM- SUPPLIED-AIR RESPIRATOR.
- SELF-CONTAINED BREATHING APPARATUS.

500 PPM- SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE, HELMUT OR HOOD.
- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

3500 PPM- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 06/12/85 REVISION DATE: 06/17/86

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1,4-DIOXANE
1,4-DIOXANE
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 123-91-1

SUBSTANCE: **1,4-DIOXANE**

TRADE NAMES/SYNONYMS:
DIOXANE; DIETHYLENE DIOXIDE; GLYCOL ETHYLENE ETHER; 1,4-DIETHYLENE DIOXIDE; TETRAHYDRO-P-DIOXIN; TETRAHYDRO-1,4-DIOXIN; DIOXYETHYLENE ETHER; DIETHYLENE ETHER; P-DIOXANE; D-111; D-116; D-134; D-53; D-53-S; D-56-S; ACC26970

CHEMICAL FAMILY:
ETHER, HETEROCYCLIC

MOLECULAR FORMULA: C4-H8-O2 MOL WT: 88.11

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=1 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: 1,4-DIOXANE PERCENT: 100.0

OTHER CONTAMINANTS: DOES NOT CONTAIN AN INHIBITOR TO RETARD PEROXIDE FORMATION

EXPOSURE LIMITS:
100 PPM (360 MG/M3) OSHA TWA (SKIN);
25 PPM (90 MG/M3) ACGIH TWA (SKIN); 100 PPM (360 MG/M3) ACGIH STEL (SKIN)
(NOTICE OF INTENDED CHANGE 1984-1985)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A FAINT ETHER-LIKE ODOR.

BOILING POINT: 214 F (101 C) MELTING POINT: 53 F (12 C)

SPECIFIC GRAVITY: 1.0 VAPOR PRESSURE: 27 MMHG @ 20 C

EVAPORATION RATE: (BU ACETATE=1) 2.7 SOLUBILITY IN WATER: SOLUBLE

ODOR THRESHOLD: 150 PPM VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: SOLUBLE IN THE COMMON ORGANIC SOLVENTS.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
A DANGEROUS FIRE AND MODERATE EXPLOSION HAZARD WHEN EXPOSED TO HEAT, FLAME, OR BY CHEMICAL REACTIONS WITH INCOMPATIBLE SUBSTANCES. VAPOR-AIR MIXTURES ARE EXPLOSIVE. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASHBACK. DIOXANE FORMS EXPLOSIVE PEROXIDES DURING STORAGE AND USE, AND UNLESS PROPER PRECAUTIONS ARE TAKEN IT CAN EXPLODE WHEN REDISTILLED.

FLASH POINT: 54 F (12 C) UPPER EXPLOSIVE LIMIT: 22%

LOWER EXPLOSIVE LIMIT: 2.0% AUTOIGNITION TEMP.: 356 F (180 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
FLAMMABLE LIQUID- DO NOT ATTEMPT TO EXTINGUISH FIRE UNLESS SPILL FLOW CAN BE STOPPED. USE FLOODING QUANTITIES OF WATER AS A FOG AND TO COOL ALL CONTAINERS INVOLVED IN FIRE. APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE. APPLICATION OF SOLID STREAMS OF WATER WILL REDUCE THE FLAMMABILITY OF THE REAGENT.

TOXICITY

4200 MG/KG ORAL-RAT LD50; 470 PPM/3 DAYS INHALATION-HUMAN LCLO; 7600 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); TUMORGENIC DATA (RTECS); ANIMAL CARCINOGEN (IARC); SUSPECT HUMAN CARCINOGEN (NTP); 1,4-DIOXANE IS CARCINOGENIC IN RATS AND GUINEA PIGS BY ORAL ADMINISTRATION, PRODUCING MALIGNANT TUMORS OF THE NASAL CAVITY AND LIVER IN RATS AND TUMORS OF THE LIVER AND GALL BLADDER IN GUINEA PIGS.
1,4-DIOXANE IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT, NEPHROTOXIN, AND HEPATOTOXIN.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/HEPATOTOXIC/NEPHROTOXIC.

200 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
ACUTE EXPOSURE- 300 PPM IRRITATES THE EYES, NOSE, AND THROAT. EXCESSIVE CONCENTRATIONS AT LONG EXPOSURE PERIODS MAY CAUSE DROWSINESS, DIZZINESS, HEADACHE, NAUSEA, VOMITING, AND LIVER/KIDNEY DAMAGE

CHRONIC EXPOSURE- BY ANALOGY TO THE EFFECTS OBSERVED IN ANIMALS, REPEATED-SHORT TERM EXPOSURE TO 1000 PPM MAY PRODUCE DAMAGE TO THE KIDNEYS AND LIVER; FATALITIES HAVE OCCURED IN HUMANS FROM LIVER DAMAGE AFTER EXPOSURE TO 470 PPM FOR 3 DAYS AND OTHER DEATHS HAVE BEEN RECORDED AFTER 60 DAYS HIGH EXPOSURE TO 1,4-DIOXANE. SEE HUMAN AND ANIMAL CARCINOGENIC, ANIMAL MUTAGENIC AND TUMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- THE LIQUID IS READILY ABSORBED THROUGH THE SKIN WITH NO IRRITATING EFFECTS IN MOST INDIVIDUALS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED SKIN CONTACT MAY RESULT IN DRYING AND CRACKING DUE TO THE DEFATTING ACTION. SEE HUMAN AND ANIMAL CARCINOGENIC, ANIMAL MUTAGENIC AND TUMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- EXTERNAL CONTACT WITH THE EYE HAS CAUSED NO SERIOUS DISTURBANCES. IRRITATION IS NOTED ONLY AT CONCENTRATIONS GREATER THAN 220 PPM. TESTING BY APPLICATION TO RABBIT EYES CAUSED MILD, TEMPORARY INJURY GRADED 4 ON A SCALE OF 1-10 AFTER 24 HOURS.

CHRONIC EXPOSURE- NO KNOWN EFFECTS IN HUMANS.

INGESTION:
MODERATELY TOXIC.
ACUTE EXPOSURE- SWALLOWING THE LIQUID MAY CAUSE DROPLETS TO ENTER THE LUNGS (ASPIRATION) WITH THE RISK OF PNEUMONIA. THE SUBSTANCE MAY ALSO CAUSE SORE THROAT, NAUSEA, AND ABDOMINAL PAIN.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL CONDITIONS. HIGHLY VOLATILE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRES AND EXPLOSIONS. WILL FORM EXPLOSIVE PEROXIDES.

INCOMPATIBILITIES:
VIOLENT REACTION WITH SULFUR TRIOXIDE. EXPLOSIVE REACTION WITH HYDROGEN AND NICKEL CATALYST ABOVE 200 C. EXPLOSIVE COMPOUNDS MAY BE FORMED IN REACTIONS WITH DECABORANE, SILVER PERCHLORATE, AND TRIETHYNYL ALUMINUM. EXPLOSIVE PEROXIDES WILL FORM SLOWLY IN THE REAGENT DURING STORAGE. EXPLOSURE TO AIR ACCELERATE THE FORMATION.

DECOMPOSITION:
COMBUSTION ESTIMATED TO FORM CARBON MONOXIDE AND CARBON DIOXIDE, WHICH ARE TOXIC AND REACTIVE GASES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****
CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

EXPOSURE TO AIR WILL ACCELERATE THE FORMATION OF PEROXIDES. KEEP CONTAINERS TIGHTLY CLOSED. DO NOT HEAT OR DISTILL WITHOUT TESTING PEROXIDE LEVELS FIRST.

****
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF THE SPILL AS IS PRACTICAL AND EFFECTIVE, IN ORDER TO REDUCE THE AREA CONTAMINATED AND THE AMOUNT OF MATERIAL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL NOT INVOLVED IN FIRE:
- KEEP OPEN FLAMES, SPARKS OR OTHER IGNITION SOURCES AWAY.
- DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
- BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
- STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
- KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMIT REQUIREMENTS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
EXPOSURE LIMIT TO 200 PPM-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY GAS MASK PROVIDING PROTECTION AGAINST ORGANIC VAPORS.

ANY ESCAPE SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/14/85 REVISION DATE: 11/14/85

-ADDITIONAL INFORMATION-

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ETHYL ACETATE
ETHYL ACETATE
ETHYL ACETATE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 141-78-6

SUBSTANCE: ETHYL ACETATE

TRADE NAMES/SYNONYMS:
ACETIC ESTER; ACETIC ETHER; ETHYL ETHANOATE; ETHYL ACETIC ESTER; VINEGAR NAPHTHA; ACETIC ACID ETHYL ESTER; ACETIDIN; RCRA U112; STCC 4909160; UN 1173; E-124; E-130; E-145; E-189; E-145-S; E-191; E-195; C4H802; ACC08750

CHEMICAL FAMILY:
ESTER, CARBOXYLIC, ALIPHATIC

MOLECULAR FORMULA: C-H3-C-02-C2-H5

MOLECULAR WEIGHT: 88.11

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ETHYL ACETATE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
ETHYL ACETATE:
400 PPM OSHA TWA
400 PPM ACGIH TWA

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: TRANSPARENT, COLORLESS, VOLATILE LIQUID HAVING A FRAGRANT, REFRESHING, SLIGHTLY FRUITY ODOR AND A PECULIAR, FRUITY, BURNING TASTE.

BOILING POINT: 171 F (77 C) MELTING POINT: -119 F (-84 C)

SPECIFIC GRAVITY: 0.902 VAPOR PRESSURE: 100 MMHG @ 27 C

EVAPORATION RATE: (BUTYL ACETATE=1) 6.0 SOLUBILITY IN WATER: 8.7%

ODOR THRESHOLD: 0.0056-50 PPM VAPOR DENSITY: 3.04

SOLVENT SOLUBILITY: SOLUBLE IN ETHANOL, ACETONE, CHLOROFORM, ETHER, BENZENE, FIXED OILS, VOLATILE OILS

VISCOSITY: 0.45 CPS @ 20 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME. VAPOR-AIR MIXTURES ARE READILY EXPLOSIVE. VAPORS ARE HEAVIER THAN AIR, AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 24 F (-4 C) (CC) UPPER EXPLOSIVE LIMIT: 11.5%

LOWER EXPLOSIVE LIMIT: 2.2% AUTOIGNITION TEMP.: 800 F (426 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS A FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

ETHYL ACETATE:
400 PPM EYE-HUMAN IRRITATION; 400 PPM INHALATION-HUMAN TCLO; 1600 PPM/8 HOURS INHALATION-RAT LC50; 45 GM/M3/2 HOURS INHALATION-MOUSE LC50; 61 GM/M3 INHALATION-CAT LCLO; 77 MG/M3/1 HOUR INHALATION-GUINEA PIG LCLO; 5620 MG/KG ORAL-RAT LD50; 11 GM/KG ORAL-RAT LD50 (38MKAJ); 4100 MG/KG ORAL-MOUSE LD50; 4935 MG/KG ORAL-RABBIT LD50; 5500 MG/KG ORAL-GUINEA PIG LD50; 709 MG/KG INTRAPERITONEAL-MOUSE LD50; 5000 MG/KG SUBCUTACEOUS-RAT LDLO; 3000 MG/KG SUBCUTANEOUS-CAT LD50; 3000 MG/KG SUBCUTANEOUS-GUINEA PIG LD50; MUTAGENIC DATA (RTECS).
CARCINOGEN STATUS: NONE.
ETHYL ACETATE IS AN EYE AND MUCOUS MEMBRANE IRRITANT. IT IS ALSO A CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE LIVER AND KIDNEYS. PERSONS WITH A HISTORY OF CHRONIC RESPIRATORY DISEASE, SKIN DISEASE, OR ANEMIA MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ETHYL ACETATE:
IRRITANT/NARCOTIC. 10,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF 400 PPM FOR 3-5 MINUTES HAS CAUSED RESPIRATORY TRACT IRRITATION IN HUMANS. LOW VAPOR CONCENTRATIONS MAY ALSO CAUSE HEADACHE, COUGHING, DIZZINESS, DROWSINESS, AND SHORTNESS OF BREATH. HIGH CONCENTRATIONS MAY CAUSE NARCOTIC EFFECTS, ANESTHESIA, UNCONSCIOUSNESS, AND RENAL AND HEPATIC DAMAGE. PATHOLOGIC FINDINGS HAVE INCLUDED MARKED HYPEREMIA OF THE RESPIRATORY TRACT, PULMONARY EDEMA, HEMORRHAGIC GASTRITIS, AND HYPEREMIA OF THE SPLEEN AND KIDNEYS.
CHRONIC EXPOSURE- NO ADVERSE SYMPTOMS WERE OBSERVED IN WORKERS EXPOSED TO 375-1500 PPM FOR SEVERAL MONTHS. ANIMAL STUDIES INDICATE THAT 4450 PPM FOR 1 HOUR DAILY FOR 40 DAYS CAUSED SECONDARY ANEMIA, LEUKOCYTOSIS, AND LIVER AND KIDNEY DAMAGE. IN RARE INSTANCES, REPEATED EXPOSURE MAY RESULT IN SENSITIZATION WITH MUCOUS MEMBRANE IRRITATION AND ECZEMATOUS ERUPTIONS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ETHYL ACETATE:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE IRRITATION WITH REDNESS AND DEFATTING ACTION ON THE SKIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DEFATTING DERMATITIS. IN RARE INSTANCES, REPEATED EXPOSURE MAY RESULT IN SENSITIZATION WITH ECZEMATOUS ERUPTIONS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ETHYL ACETATE:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY CAUSE IRRITATION, WITH REDNESS, PAIN, AND LACRIMATION. EXPOSURE TO 400 PPM MAY CAUSE A SENSATION OF IRRITATION IN HUMANS. APPLICATION OF 2 DROPS TO RABBIT CORNEAS, FOLLOWED 2 MINUTES LATER BY RINSING WITH WATER, CAUSED IMMEDIATE FINE OPTICAL IRREGULARITY OF THE CORNEAL EPITHELIUM, WHICH RETURNED TO NORMAL

IN 2 DAYS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS AND CORNEA CLOUDING. WORKERS CHRONICALLY EXPOSED TO 15-50 MG/L AND 20-80 MG/L OF AMYL ACETATE EXPERIENCED HYPEREMIA OF THE BULBAR CONJUNCTIVA. RABBITS EXPOSED TO THE VAPOR AT CONCENTRATIONS WHICH WOULD BE SCARCELY TOLERABLE TO HUMANS CAUSED NO CORNEAL DAMAGE DESPITE BEING EXPOSED FOR 8 HOURS/DAY FOR 5 DAYS/WEEK FOR A PERIOD UP TO 7 WEEKS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ETHYL ACETATE:
NARCOTIC.
ACUTE EXPOSURE- INGESTION OF SMALL AMOUNTS MAY CAUSE SORE THROAT, ABDOMINAL PAIN, AND DIARRHEA. LARGE AMOUNTS MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION, WITH DIZZINESS, HEADACHE, WEAKNESS, FATIGUE, DROWSINESS, AND UNCONSCIOUSNESS. POISONING MAY CAUSE CONGESTION OF THE LIVER AND KIDNEYS.
CHRONIC EXPOSURE- ANIMALS FED 1000 MG/KG FOR 1 MONTH SHOWED NO EFFECTS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
ETHYL ACETATE:
ACIDS (STRONG): FIRE AND EXPLOSION HAZARD.
ALKALIS (STRONG): FIRE AND EXPLOSION HAZARD.
BASES (STRONG): FIRE AND EXPLOSION HAZARD.
CHLOROSULFONIC ACID: EXOTHERMIC REACTION.
LITHIUM TETRAHYDROALUMINATE AND 2-CHLOROMETHYLFURAN: POSSIBLE EXPLOSION.
NITRATES: INCOMPATIBLE.
OLEUM: EXOTHERMIC REACTION.
OXIZIDERS (STRONG): FIRE AND EXPLOSION HAZARD.
POTASSIUM TERT-BUTOXIDE: POSSIBLE IGNITION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

****STORAGE****

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

****DISPOSAL****

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D001

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CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES

THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

FOR ETHYL ACETATE:

1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND ORGANIC VAPOR CANISTERS.
ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGES.

10,000 PPM- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/09/84 REVISION DATE: 05/18/88

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ETHYL ALCOHOL, DENATURED
ETHYL ALCOHOL, DENATURED
ETHYL ALCOHOL, DENATURED

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

SUBSTANCE: **ETHYL ALCOHOL, DENATURED**

TRADE NAMES/SYNONYMS: ETHANOL, DENATURED; GRAIN ALCOHOL, DENATURED; ETHYL HYDROXIDE, DENATURED; ETHYL HYDRATE, DENATURED; ALGRAIN, DENATURED; ANHYDROL, DENATURED; METHYL CARBINOL, DENATURED; COLOGNE SPIRITS, DENATURED; FERMENTATION ALCOHOL, DENATURED;

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

PERCENT: 88.0	COMPONENT: ETHYL ALCOHOL CAS# 64-17-5
PERCENT: 4.6	COMPONENT: METHYL ALCOHOL CAS# 67-56-1
PERCENT: 0.9	COMPONENT: ETHYL ACETATE CAS# 141-78-6
PERCENT: 0.9	COMPONENT: METHYL ISOBUTYL KETONE CAS# 108-10-1
PERCENT: 0.9	COMPONENT: AVIATION GAS CAS# NOT ASSIGNED
PERCENT: 4.6	COMPONENT: WATER

EXPOSURE LIMITS:
ETHYL ALCOHOL:
1000 PPM OSHA TWA

1000 PPM ACGIH TWA
METHYL ALCOHOL:
200 PPM OSHA TWA
200 PPM ACGIH TWA (SKIN); 250 PPM ACGIH STEL (SKIN)
200 PPM NIOSH RECOMMENDED TWA; 800 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID BOILING POINT: 172 F (78 C)

MELTING POINT: -172 F (-114 C) SPECIFIC GRAVITY: 0.8

VAPOR PRESSURE: 40 MMHG @ 20 C EVAPORATION RATE: 1.4 (TTE)

SOLUBILITY IN WATER: COMPLETE SOLVENT SOLUBILITY: BENZENE, ETHER, ACETONE

ODOR THRESHOLD: 5-10 PPM VAPOR DENSITY: 1.6

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE/NEGLIGIBLE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

FLASH POINT: 57 F (14 C) (CC) UPPER EXPLOSION LIMIT: 19%

LOWER EXPLOSION LIMIT: 4.3% AUTOIGNITION TEMP.: NON AVAILABLE

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE DRY CHEMICAL, CARBON DIOXIDE, OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS; KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

ETHYL ALCOHOL: 20 PPM EYE-HUMAN IRRITATION; 400 MG OPEN SKIN-RABBIT IRRITATION; 500 MG/24 HOUR SKIN-RABBIT SEVERE IRRITATION; 79 MG EYE-RABBIT IRRITATION; 100 MG/4 SECONDS EYE-RABBIT (RINSED) MODERATE IRRITATION. 2000 MG/KG ORAL-CHILD LDLO; 50 MG/KG ORAL-MAN TDLO; 1430 UG/KG ORAL-MAN TDLO; 256 GM/KG/12 WEEKS ORAL-WOMAN TDLO; 20,000 PPM/10 HOURS INHALATION-RAT LC50; 7060 MG/KG ORAL-RAT LD50; 20 GM/KG SKIN-RABBIT LDLO; 7800 MG/KG ORAL-MUSE LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORGENIC DATA (RTECS); CARCINOGEN STATUS: NONE. AN EYE AND RESPIRATORY IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT.
METHY ALCOHOL: 5 PPM EYE-HUMAN IRRITATION; 500 MG/24 HOUR SKIN-RABBIT MODERATE IRRITATION; 40 MG EYE-RABBIT MODERATE IRRITATION; 340 MG/KG ORAL-HUMAN LDLO; 13 GM/KG ORAL-MAN LDLO; 86,000 MG/M3 INHALATION-HUMAN TCLO; 5628 MG/KG ORAL-RAT LD50; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 20 GM/KG SKIN RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGENIC STATUS: NONE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CARCINOGEN/NARCOTIC/IRRITANT.
25,000 PPM METHYL ALCOHOL IS IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- ETHYL ALOCOHL MAY CAUSE NASAL IRRITATION, COUGH, AND AT HIGH LEVELS, A FEELING OF SUFFOCATION. CENTRAL NERVOUS SYSTEM DEPRESSION MAY OCCUR.

METHYL ALCOHOL MAY CAUSE SYMPTOMS OF INEBRIATION. WITHIN 12-18 HOURS, HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS OCCUR, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS, NARCOSIS, AND OTHER SIGNS OF CENTRAL NERVOUS SYSTEM DEPRESSION. SEVERE ABDOMINAL, BACK, AND LEG PAINS, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS, AND BRONCHITIS MAY ENSUE. APATHY OR DELERIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA, AND CONVULSIONS OCCUR RARELY. BLURRED OR DIMMED VISION HAS OCCURED, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS, AND PHOTOPHOBIA. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA, AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION, AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FORM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO ETHYL ALCOHOL MAY CAUSE RESPIRATORY IRRITATION, HEADACHE, AND SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION, SUCH AS LACK OF CONCENTRATION AND SOMNOLENCE.

METHYL ALCOLOL MAY CAUSE VISUAL IMPAIRMENTS AS DESCRIBED IN ACUTE INHALATION.
SEE ANIMAL MUTAGENIC, REPRODUCTIVE EFFECTS AND TUMORIGENIC DATA REFERENCES IN THE TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION.

SKIN CONTACT:
IRRITITANT/NARCOTIC.

ACUTE EXPOSURE- ETHYL ALCOHOL CAUSES NO IMMEDIATE IRRITATING EFFECTS.
METHYL ALCOHOL MAY DEFAT THE SKIN AND CAUSE MILD DERMATATIS. IT IS READILY ABSORBED THROUGH THE SKIN AND MAY CAUSE SYMPTOMS AS WITH ACUTE INHALATION, PRINCIPALLY ACIDOSIS, CENTRAL NERVOUS SYSTEM DEPRESSION AND OPTIC NEURITIS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO ETHYL ALCOHOL MAY CAUSE DERMATITIS.
METHYL ALCOHOL MAY CAUSE ECZEMA, REDNESS, AND SCALING.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE- ETHYL ALCOHOL VAPORS AT 5,000-10,000 PPM MAY CAUSE TEMPORARY IRRITATION. DIRECT CONTACT MAY CAUSE IMMEDIATE BURNING, LACRIMATION, LACRIMATION, TEMPORARY INJURY OF THE CORNEA AND HYPEREMIA OF THE CONJUNCTIVA.
METHYL ALCOHOL MAY CAUSE SUPERFICIAL CORNEAL LESIONS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO ETHYL ALCOHOL MAY CAUSE CONJUCTIVITIS.
BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS, AND PHOTOPHOBIA MAY OCCUR FROM INHALATION, SKIN ABSORPTION, OR INGESTION OF METHYL ALCOHOL.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE- ETHYL ALCOHOL MAY CAUSE EMOTIONAL LABILITY AND DECREASED INHIBITIONS, WITH EXHILARATION, BOASTFULNESS, TALKATIVENESS, REMORSE, AND BELLIGERENCY. MODERATE INTOXICATION LEADS TO IMPAIRED MUSCULAR COORDINATION, SLOWED REACTIONS, SLURRED SPEECH, ATAXIA, AND SLIGHT VISUAL DISTURBANCE. SEVERE POISONING RESULTS IN SENSORY DISTURBANCE OR LOSS, WITH VERTIGO AND DIPLOPIA, FLUSHING OF THE FACE, RAPID PULSE, SWEATING, NAUSEA AND VOMITING, AND INVOLUNTARY DEFICATION AND URINATION. CENTRAL NERVOUS SYSTEM DEPRESSION IS INDICATED BY DIZZINESS, DROWSINESS, STUPOR, AND OTHER SIGNS OF NARCOSIS, PROGRESSING TO COMA, WITH IMPAIRED OR ABSENT TENDON REFLEXES. CONVULSIONS MAY OCCUR FROM HYPOGLYCEMIA. THE PUPILS MAY BE NORMAL OR DILATED. SHOCK MAY FOLLOW, WITH HYPOTENSION, TACHYCARDIA, COLD PALE SKIN, AND HYPOTHERMIA. RESPIRATION MAY BE SLOW. DEATH MAY OCCUR FROM RESPIRATORY OR CIRCULATORY FAILURE OR FROM ASPIRATIONPNEUMONITIS.
RECOVERY FROM POISONING MAY BE ACCOMPANIED BY HEADACHE, GASTRITIS, INFECTTION, OR PSYCHOSES WITH UNCONTROLLABLE FEAR, INSOMNIA, TREMORS, AND RESTLESSNESS, FOLLOWED BY VISUAL, AUDITORY, OR GUSTATORY HALLUCINATIONS. EXAGGERATED REFLEXES, TACHYCARDIA, AND CONVULSIONS ARE POSSIBLE.
METHYL ALCOHOL MAY CAUSE SYMPTOMS AS WITH ACUTE INHALATION FROM ACIDOSIS, AND CENTRAL NERVOUS SYSTEM DEPRESSION. BLURRED OR DIMMED VISION, FOLLOWED

BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS, AND PHOTOPHOBIA MAY OCCUR. CARDIAC DEPRESSION, PERIPHERAL NEURITIS, LIVER AND KIDNEY DAMAGE AND CEREBRAL AND PULMONARY EDEMA ARE POSSIBLE. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NONFATAL INTOXICATION.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSING, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER. INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. THEN GIVE 1 OUNCE (30 ML) OF MILK OF MAGNESIA.

REACTIVITY

REACTIVITY:
GENERALLY STABLE UNDER NORMAL CONDITIONS. HIGHLY VOLATILE. CONTACT WITH STRONG OXIDIZERS AND INCOMPATIBLES MAY CAUSE FIRES AND EXPLOSIONS. THE SUBSTANCE REACTS WITH ALKALI METALS TO LIBERATE FLAMMABLE HYDROGEN GAS.

INCOMPATIBILITIES:
VIOLENT REACTION WITH NITRIC ACID, ACETYL CHLORIDE, AND ACETYL BROMIDE. IGNITION MAY OCCUR IN REACTIONS WITH BROMINE PENTAFLUORIDE, CHROMIC ANHYDRIDE, CHROMYL CHLORIDE, PERMANGANIC ACID, PLATINUM, POTASSIUM DIOXIDE, POTASSIUM-TERT-BUTOXIDE, AND HYDROGEN PEROXIDE/SULFURIC ACID MIXTURES. EXPLOSIONS MAY OCCUR FROM REACTIONS WITH ALUMINUM SESQUIBROMIDE ETHYLATE, BROMINE PENTAFLUORIDE, CALCIUM HYPOCHLORITE, HYDROGEN PEROXIDE-SULFURIC ACID MIXTURES, IODINE-MERCURIC OXIDE MIXTURES, MANGANESE PERCHLORATE-2,2-DIMETHOXY PROPANE MIXTURES, SOME PERCHORATES RECRYSTALLIZED FROM ETHANOL (SUCH AS SILVER PERCHLORATE AND URANYL PERCHLORATE), PERCHLORIC ACID, PERMANGANATES TREATED WITH SULFURIC ACID, PERMANGANIC ACID, POTASSIUM SUPEROXIDE, SODIUM HYDRAZIDE, AND SULFURIC ACID-SODIUM DICHROMATE MIXTURES. EXPLOSIVE COMPOUNDS MAY BE FORMED IN REACTIONS WITH AMMONIUM HYDROXIDE-SILVER(I) OXIDE MIXTURES, HYDROGEN PEROXIDE, IODINE-PHOSPHORUS, SILVER/NITRIC ACID, AND SILVER NITRATE. CHROMYL CHLORIDE CAUSES ETHANOL AND AMMONIA TO IGNITE. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRES OR EXPLOSIONS. REACTIONS WITH ALKALI METALS LIBERATE FLAMMABLE HYDROGEN GAS. (ETHYL ALCOHOL)

VIOLENT REACTIONS WILL OCCUR WHEN METHYL ALCOHOL REACTS WITH CALCIUM CARBIDE, MAGNESIUM, AND CYANURIC CHLORIDE. METHANOL AND BERYLLIUM HYDRIDE REACT INTENSELY @ 200 C. REACTIONS WITH BROMINE ARE INTENSELY EXOTHERMIC. THERE IS A CHANCE FOR POSSIBLE IGNITION WHEN METHANOL REACTS WITH NICKEL IN THE PRESENCE OF NICKEL CATALYST. REACTIONS WITH CHLOROFORM/SODIUM HYDROXIDE MIXTURES IS EXPLOSIVE AND REACTIONS WITH CHROMIC ANHYDRIDE HAVE EXPLOSIVE CAPABILITIES. CONTACT WITH STRONG OXIDANTS MAY CAUSE FIRE AND EXPLOSION. (METHYL ALCOHOL)

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
WILL NOT OCCUR.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF

FIRE. VAPOR EXPLOSION AND POISON HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS.

RESPIRATOR:
33,000 PPM (LOWER EXPLOSIVE LIMIT)- SUPPLIED-AIR RESPIRATOR WITH SEPARATE AIR SUPPLY.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
OPERATIONS WITH A RESPIRATOR ARE NOT RECOMMENDED ABOVE THE LOWER EXPLOSIVE LIMIT (3.3%).

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOOGLES TO PREVENT THIS LIQUID FROM CONTACTING THE EYE. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 11/14/85 REVISION DATE: 11/14/85

-ADDITIONAL INFORMATION-
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American Burdick & Jackson
Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

ETHYL ETHER

emergency telephone no. 312/973-3600 (American Scientific Products)
chemtrec telephone no. 800/424-9300
information telephone no. 616/726-3171 (American Burdick & Jackson)

I. Identification

chemical name Ethyl Ether — molecular weight 74.12
chemical family Ether — formula $C_4H_{10}O$
synonyms Diethyl Ether, Ether, Ethoxyethane
DOT proper shipping name Ethyl Ether
DOT hazard class Flammable Liquid
DOT identification no. UN1155 — CAS no. 60-29-7

II. Physical and Chemical Data

boiling point, 760mm Hg. 34.55°C — freezing point -117.4°C — evaporation rate (BuAc=1) > 10
vapor pressure at 20°C 442 mm Hg — vapor density (air = 1) 2.6 — solubility in water @ 20°C 6.89%
% volatiles by volume ca 100 — specific gravity (H_2O = 1) @ 20°C 0.713 — stability Unstable
hazardous polymerization Not expected to occur.
appearance and odor Clear, colorless liquid with a sweet, pungent odor.
conditions to avoid Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid Oxidizing agents and strong acids.

hazardous decomposition products Incomplete combustion can generate carbon monoxide and other toxic vapors. Explosive peroxides can form after standing or upon exposure to air or direct sunlight.

III. Fire and Explosion Hazard Data

flash point. (test method) -45°C (Tag closed cup) — auto ignition temperature 160°C
flammable limits in air % by volume: lower limit 1.8 — upper limit 48.0
unusual fire and explosion hazards Extremely volatile and extremely flammable. Can form heat sensitive peroxides which may explode on concentrating or evaporating.

extinguishing media Carbon dioxide, dry chemical or foam.

special fire fighting procedures Wear full protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers. Keep fire-exposed containers cool with water spray. Treat as flammable gas. Surroundings must be kept cooled below 160°C to extinguish an ether fire and prevent reignition.

IV. Hazardous Components

	%	TLV	CAS no.
Ethyl Ether plus stabilizer (see supplement)	ca 100	400 ppm	60-29-7

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American Burdick & Jackson — Subsidiary of American Hospital Supply Corporation — 1953 South Harvey Street Muskegon, MI 49442

V. Health Hazards

Occupational Exposure Limits

OSHA	8-hour PEL	-	400 ppm
	Ceiling	-	not listed
	Peak	-	not listed
ACGIH	TLV-TWA	-	400 ppm
	TLV-STEL (15-min)	-	500 ppm
NIOSH	TLV-TWA	-	not listed
	TLV-C	-	not listed

Concentration Immediately Dangerous to Health

OSHA/NIOSH	19,000 ppm

Odor Threshold

NSC & OHS	1.0 ppm
NIOSH	0.33 ppm

Carcinogenic, Mutagenic, Teratogenic Data

Positive mutagen (RTEC)

Primary Routes of Entry

Ethyl ether may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation: Exposure can cause headache, nausea, vomiting, loss of consciousness, and in very high concentrations, death due to respiratory paralysis.

Eye Contact: Liquid and high vapor concentration can cause irritation.

Skin Contact: Prolonged or repeated skin contact can cause irritation and dermatitis through defatting of skin.

Ingestion: Symptom information is inadequate/unknown.

Effects of Overexposure

Ethyl ether is a mild eye and mucous membrane irritant, primary skin irritant, and central nervous system depressant. Acute exposure can cause anesthetic effects such as vomiting, excitement, unconsciousness, coma, respiratory paralysis, and death. Chronic exposures may produce central nervous system disturbances.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals susceptible to dermatitis.

Emergency First Aid

Inhalation: Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.

Eye Contact: Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.

Skin Contact: Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.

Ingestion: Call local Poison Control Center for assistance. Contact physician immediately. Never induce vomiting or give anything by mouth to a victim unconscious or having convulsions.

VI. Safety Measures and Equipment

Ventilation: Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.

Respiratory: Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).

Eyes: Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.

Skin: Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, neoprene or Buna-N offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to ethyl ether may require additional protective equipment.

Storage: Ethyl ether should be protected from temperature extremes and direct sunlight. Proper storage of ethyl ether must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, ethyl ether should be stored in an acceptably protected and secure flammable liquid storage room. Periodically check for peroxides in stored material and prior to use, especially before concentrating or heating.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.

Waste Disposal: Dispose of ethyl ether as an EPA hazardous waste. Hazardous waste numbers: U117(Ignitable); D001(Ignitable).

VIII. Supplement

If stabilized, contains either:

a) ca 2% ethanol
Ethanol has a TLV of 1000 ppm (ACGIH).
Ethanol is a suspected carcinogen and teratogen (NIOSH).

b) 1 ppm butylated hydroxytoluene (BHT)

Revision Date: 1/85

KEY

ca	Approximately	STEL	Short Term Exposure Level
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average
PEL	Permissable Exposure Level	BuAc	Butyl Acetate

NSC National Safety Council ("Fundamentals of Industrial Hygiene", 1983)
OHS Occupational Health Services ("Hazardline")

**FORMALDEHYDE SOLUTION,
**FORMALDEHYDE SOLUTION,
**FORMALDEHYDE SOLUTION,

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
(201) 796-7100

DATE 12/11/87
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CAT NO: F79500

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 50-00-0

SUBSTANCE: **FORMALDEHYDE SOLUTION, 37%**

TRADE NAMES/SYNONYMS:
FORMALIN; FORMIC ALDEHYDE; FORMOL; METHANAL; METHYL ALDEHYDE; METHYLENE GLYCOL; METHYLENE OXIDE; TETRAOXYMETHYLENE; OXOMETHANE; OXYMETHYLENE; F-79; F-79-P; ACC50003

CHEMICAL FAMILY:
ALDEHYDE, ALIPHATIC

MOLECULAR FORMULA: C-H2-O MOL WT: 30.03

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=2 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: FORMALDEHYDE PERCENT: 37

COMPONENT: METHANOL PERCENT: 15

COMPONENT: WATER PERCENT: 48

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
FORMALDEHYDE: 3 PPM OSHA CEILING;
2 PPM ACGIH CEILING (BUT SEE NOTICE OF INTENDED CHANGE TO 1 PPM WITH ADDITION OF SUSPECT HUMAN CARCINOGEN RATING)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A PUNGENT ODOR.

BOILING POINT: 214 F (101 C) SPECIFIC GRAVITY: 1.08 PH: 2.8 - 4.0

SOLUBILITY IN WATER: MISCIBLE ODOR THRESHOLD: 1.0 PPM

VAPOR DENSITY: 1.04

SOLVENT SOLUBILITY: SOLUBLE IN ALCOHOL, AND ACETONE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

REACTION OF FORMALDEHYDE WITH NITROGEN DIOXIDE, NITROMETHANE, PERCHLORIC ACID AND ANILINE, OR PEROXYFORMIC ACID YIELDS EXPLOSIVE COMPOUNDS.

FLASH POINT: 130 F (54 C) UPPER EXPLOSIVE LIMIT: 73%

LOWER EXPLOSIVE LIMIT: 7% AUTOIGNITION TEMP.: 806 F (430 C)

FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT GET WATER INSIDE CONTAINER. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 29).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUNATITIES OF WATER; APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING HAZARDOUS VAPORS OR DUSTS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

STOP FLOW OF GAS (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

36 MG/KG ORAL-WOMAN LDLO; 8 PPM INHALATION-HUMAN TCLO; 800 MG/KG ORAL-RAT LD50; 590 MG/KG INHALATION-RAT LC50; 270 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); DEFINITE ANIMAL CARCINOGEN (IARC); INDEFINITE HUMAN CARCINOGEN (IARC, NTP). FORMALDEHYDE HAS CAUSED SQUAMOS CELL CARCINOMAS OF THE NASAL CAVATIES IN RATS. THE EVIDENCE FOR CARCINOGENICITY IN HUMANS IS INADEQUATE.

FORMALDEHYDE IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT. IT IS ALSO A SKIN AND RESPIRATORY SENSITIZER.

HEALTH EFFECTS AND FIRST AID

INHALATION:
TOXIC/IRRITANT. 100 PPM (FORMALDEHYDE) IMMEDIATELY DANGEROUS TO LIFE OR HEALTH

ACUTE EXPOSURE- FORMALDEHYDE IN VAPORS OR MIST AT CONCENTRATIONS OF 1 PPM CAUSE MUCOUS MEMBRANE AND RESPIRATORY TRACT IRRITATION WITH TEARING AND MILD TINGLING SENSATIONS IN THE NOSE AND THROAT. HIGH CONCENTRATIONS MAY CAUSE COUGH, HEADACHE, NAUSEA, WEAKNESS, PALPITATION, DYSPNEA, BURNING OF THE NOSE AND THROAT, BRONCHITIS, PULMONARY EDEMA, PNEUMONITIS AND DEATH.

CHRONIC EXPOSURE- MAY CAUSE MUCOUS MEMBRANE IRRITATION. THERE IS EVIDENCE THAT SUGGESTS THAT CHRONIC FORMALDEHYDE INHALATION MAY PROMOTE THE FORMATION OF SQUAMOUS CELL NASAL CARCINOMAS, AND MAY CAUSE CIRRHOSIS OF THE LIVER AND CHRONIC HEART DISEASE. SEE HUMAN AND ANIMAL CARCINOGENIC AND ANIMAL MUTAGENIC, REPRODUCTIVE EFFECTS, AND TUMORIGENIC REFERENCES IN TOXICITY SECTION. FORMALDEHYDE CAUSES RESPIRATORY TRACT SENSITIZATION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE- MAY CAUSE IRRITATION. SENSITIZATION DERMATITIS MAY OCCUR IN PREVIOUSLY EXPOSED WORKERS. LESIONS MAY OCCUR DUE TO A SUDDEN ECZEMATOUS REACTION ON THE EYELIDS, FACE, NECK, SCROTUM, AND FLEXOR SURFACE OF THE WHICH MAY COME ONLY A FEW DAYS AFTER EXPOSURE. ECZEMATOUS REACTIONS MAY ALSO OCCUR AFTER A NUMBER OF YEARS ON THE HANDS, WRISTS, FOREARMS, AND PARTS OF THE BODY THAT ARE EXPOSED TO FRICTION FROM CLOTHING. SHRINKING OF THE MUCOUS MEMBRANES, AND NECROSIS MAY OCCUR.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE HARDENING AND CRACKING OF THE SKIN, AND SENSITIZATION DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- FORMALDEHYDE VAPORS OR MISTS MAY CAUSE IRRITATION AND MILD

LACRIMATION. CONCENTRATIONS OF 10 PPM CAN BE WITHSTOOD FOR ONLY A FEW MINUTES AND CAUSES PROFUSE LACRIMATION IN ALL SUBJECTS. OCCULAR DAMAGE HAS BEEN STATED TO RESULT WITH EXPOSURE TO FORMALDEHYDE VAPORS. SOLUTIONS OF 25-44% SPLASHED IN THE EYES MAY CAUSE BURNS, SEVERE INJURY AND CORNEAL DAMAGE.

CHRONIC EXPOSURE- MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
TOXIC/IRRITANT.
ACUTE EXPOSURE- MAY CAUSE BURNING IN THE MOUTH AND ESOPHAGUS, NAUSEA AND VOMITING, SEVERE ABDOMINAL PAIN, DIARRHEA, VERTIGO, ANURIA, UNCONSCIOUSNESS, JAUNDICE, ALBUMINURIA, HEMATURIA, ACIDOSIS, AND CONVULSIONS. LIVER AND KIDNEY DAMAGE MAY OCCUR. DEATH OCCURS FROM CIRCULATORY FAILURE. A MEAN FATAL DOSE IS ABOUT 2 OUNCES (60 76) OF 37% SOLUTION.

FIRST AID- IF VICTIM IS CONSCIOUS AND NOT CONVULSIVE, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. FROM SITTING POSITION, HEAD MUST BE LOWER THAN HIPS TO PREVENT ASPIRATION. KEEP PATIENT WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE AT ORDINARY PRESSURES UP TO THE BOILING POINT, 101 C. A POWERFUL REDUCING AGENT, ESPECIALLY IN THE PRESCENCE OF ALKALI. REACTS VIOLENTLY WITH STRONG OXIDIZERS. REACTS WITH HYDROCHLORIC ACID FORMING BIS(CHLOROMETHYL) ETHER, A POTENT CARCINOGEN.

INCOMPATIBILITIES:
FORMALDEHYDE:
NITROMETHANE: FORMS EXPLOSIVE COMPOUND.
PEROXYFORMIC ACID: FORMS EXPLOSIVE COMPOUND.
MAGNESIUM CARBONATE: EXPLOSIVE REACTION DUE TO PRESSURE INCREASE.
NITROGEN DIOXIDE: EXPLOSIVE REACTION IN THE REGION OF 180 C.
HYDROGEN PEROXIDE: VIOLENT REACTION.
STRONG OXIDIZERS: VIOLENT REACTION.
HYDROCHLORIC ACID: FORMS HIGHLY TOXIC BIS(CHLOROMETHYL) ETHER.

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION WIL NOT OCCUR FOR THE MATERIAL WITHOUT A COPOLYMER.

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CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE.

VAPOR EXPLOSION HAZARD INDOORS.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. PROVIDE VENTILATION AND WEAR PROTECTIVE EQUIPMENT. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE CONTAINERS AND LABEL "COMBUSTIBLE AND CANCER HAZARD". FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF THE SPILL AS IS PRACTICAL AND EFFECTIVE IN ORDER TO REDUCE THE AREA CONTAMINATED AND THE AMOUNT OF MATERIAL SPILLED. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY. KEEP OUT OF SEWERS AND WATER SOURCES.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
EXPOSURE LIMIT TO 30 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ACID GAS CARTRIDGE AND A FULL FACEPIECE.
GAS MASK WITH AN ACID GAS CANISTER (CHIN-STYLE, FRONT-, OR BACK-MOUNTED CANISTER).
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

> 30 PPM INCLUDING IDLH CONCENTRATION TO 100 PPM- TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS FLOW MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
WEAR IMPERVIOUS CLOTHING IF THERE IS REASONABLE PROBABILITY OF CONTACT WITH SOLUTION.

GLOVES:
WEAR IMPERVIOUS GLOVES IF THERE IS REASONABLE PROBABILITY OF CONTACT WITH SOLUTION.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

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HEXANES
HEXANES
HEXANES

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 110-54-3

SUBSTANCE: HEXANES

TRADE NAMES/SYNONYMS:
N-HEXANE; NCI-C60571; HEXYLHYDRIDE; NORMAL HEXANE; SKELLYSOLVE B; STCC 4908183; UN 1208; H-300; H-334; H-292; H-291; N-3; ACC10951

CHEMICAL FAMILY:
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C6-H14

MOLECULAR WEIGHT: 86.20

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: HEXANES PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
500 PPM (1800 MG/M3) OSHA TWA (N-HEXANE);
50 PPM (180 MG/M3) ACGIH TWA (N-HEXANE);
500 PPM (1800 MG/M3) ACGIH TWA (OTHER ISOMERS OF HEXANE);
1000 (3600 MG/M3) ACGIH STEL (OTHER ISOMERS OF HEXANE);
97 PPM (350 MG/M3) NIOSH RECOMMENDED TWA (ALKANES);
500 PPM (1800 MG/M3) NIOSH RECOMMENDED 15 MINUTE CEILING (ALKANES)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID, FAINT ODOR, VERY VOLATILE

BOILING POINT: 136 F (58 C) MELTING POINT: -139 F (-95 C)

SPECIFIC GRAVITY: 0.7 VAPOR PRESSURE: 124 MMHG @ 20 C

SOLUBILITY IN WATER: INSOLUBLE VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: ALCOHOL, CHLOROFORM, ETHER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: -7 F (-22 C) (CC) UPPER EXPLOSIVE LIMIT: 7.5%

LOWER EXPLOSIVE LIMIT: 1.1% AUTOIGNITION TEMP.: 437 F (223 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

5000 PPM/10 MINUTES INHALATION-HUMAN TCLO; 120 GM/M3 INHALATION-MOUSE LCLO; 28710 MG/KG ORAL-RAT LD50; 9100 MG/KG INTRAPERITONEAL-RAT LDLO; 5 PPM EYE-HUMAN IRRITATION; TERATOGENIC DATA (RTEC); CARCINOGEN STATUS: NONE.
HEXANE IS A MILD EYE, MUCOUS MEMBRANE AND SKIN IRRITANT. ACUTE EXPOSURE MAY CAUSE NARCOSIS AND GASTROINTESTINAL IRRITATION. CHRONIC INHALATION MAY CAUSE PERIPHERAL NEUROPATHY. ALCOHOL MAY ENHANCE THE TOXIC EFFECTS OF THE CHEMICAL.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC. 5000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- MAY CAUSE IRRITATION OF THE UPPER RESPIRATORY TRACT, LIGHT-HEADEDNESS, NAUSEA, VOMITING, NARCOSIS AND HEADACHE. IN HUMANS, 2000 PPM FOR 10 MINUTES PRODUCED NO EFFECTS, BUT 5000 PPM RESULTED IN DIZZINESS AND A SENSATION OF GIDDINESS. OTHER REPORTS ARE OF SLIGHT NAUSEA HEADACHE AND IRRITATION OF THE EYES AND THROAT AT 1400-1500 PPM. IN INDUSTRIAL PRACTICE, MILD SYMPTOMS OF NARCOSIS, SUCH AS DIZZINESS, HAVE BEEN OBSERVED WHEN CONCENTRATIONS EXCEED 1000 PPM, BUT NOT WHEN THEY FELL BELOW 500 PPM. HUMAN EXPOSED TO 5000 PPM/10 MINUTES HAD HALLUCINATIONS AND DISTORTED PERCEPTIONS.

CHRONIC EXPOSURE- PROLONGED EXPOSURE MAY CAUSE PERIPHERAL NEUROPATHY. REPORTS OF THREE CABINET MAKERS DEVELOPED SYMPTOMS OF PERIPHERAL NEUROPATHY AFTER EXPOSURE TO HEXANE VAPOR IN AN ENCLOSED WORKROOM OVER A PERIOD OF 2-4 MONTHS; AIR SAMPLES INDICATED AN AVERAGE CONCENTRATION OF 650 PPM, WITH OCCASIONAL PEAKS TO 1300 PPM. THERE WAS PROGRESSIVE WEAKNESS AND NUMBNESS ON THE EXTREMITIES, HYPOACTIVE DEEP TENDON REFLEXES, AND TWO OF THE THREE EXPOSED HAD BILATERAL FOOTDROP; IMPROVEMENT OCCURRED AFTER CESSATION OF EXPOSURE. MAY CAUSE CARDIAC SENSITIZATION. NEONATES OF RATS WHO HAD BEEN EXPOSED EXHIBITED REDUCED WEIGHT GAIN AND BEHAVIORAL ABNORMALITIES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
HEXANES:
IRRITANT.
ACUTE EXPOSURE- LIQUID IS DEFATTING ON THE SKIN AND MAY CAUSE IRRITAITON.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
HEXANES:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT WITH THE LIQUID MAY RESULT IN IRRITATION, REDNESS, TEARING, AND PAIN. VAPORS MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- INGESTION MAY RESULT IN NAUSEA, VOMITING, SWELLING OF THE ABDOMEN, HEADACHE AND OTHER SIGNS OF CENTRAL NERVOUS DEPRESSION. ASPIRATION DURING VOMITING MAY CAUSE DELAYED PULMONARY EDEMA AND CHEMICAL PNEUMONIA WITH POSSIBLY SEVERE CONSEQUENCES. BONE MARROW DAMAGE AND MYOCARDIAL SENSITIZATION MAY OCCUR.

CHRONIC EXPOSURE- NONE REPORTED IN HUMANS. FEEDING STUDIES ON PREGNANT RATS EXHIBITED FETOTOXICITY OF THE FETUSES.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UP TO THE BOILING POINT, 58 C, AT ORDINARY PRESSURES.

INCOMPATIBILITIES:
STRONG OXIDIZERS: VIOLENT REACTION.

HEXANE:
DINITROGEN TETRAOXIDE: POSSIBLE EXPLOSION.
STRONG OXIDIZERS: VIGOROUS REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND RESTRICT ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:

1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE.
SUPPLIED-AIR RESPIRATOR.
SELF-CONTAINED BREATHING APPARATUS.

5000 PPM- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

ESCAPE- GAS-MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT OR BACK-MOUNTED CANISTER).
SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 05/23/85 REVISION DATE: 06/24/88

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ISO-AMYL-ALCOHOL
ISO-AMYL-ALCOHOL
ISO-AMYL-ALCOHOL

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 123-51-3

SUBSTANCE: **ISO-AMYL-ALCOHOL**

TRADE NAMES/SYNONYMS:
3-METHYL-1-BUTANOL; ISOBUTYL CARBINOL; ISOAMYLOL; ISOPENTANOL;
2-METHYL-4-BUTANOL; 3-METHYL BUTANOL; 3-METHYL BUTAN-1-OL;
ISOBUTYL CARBINOL; ISOPENTYL ALCOHOL; FERMENTATION AMYL ALCOHOL;
ISOAMYL ALCOHOL; A-393; 18-X; ACC11550

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C5-H12-O MOL WT: 88.2

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=2 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=2 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ISO-AMYL ALCOHOL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
100 PPM (360 MG/M3) OSHA TWA;
100 PPM ACGIH TWA; 125 PPM ACGIH STEL

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A DISAGREEABLE ODOR AND A PUNGENT,
REPULSIVE TASTE. BOILING POINT: 505 C @ 750 MMHG

MELTING POINT: -179 F (-117 C) SPECIFIC GRAVITY: 0.8

VAPOR PRESSURE: 2.8 MM @ 20 C SOLUBILITY IN WATER: SLIGHTLY SOLUBLE

ODOR THRESHOLD: 7.0 PPM VAPOR DENSITY: 3.0

SOLVENT SOLUBILITY: ALCOHOL, ETHER, ACETIC ACID, CHLOROFORM, BENZENE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE HAZARD AND SLIGHT EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAMES.

FLASH POINT: 109 F (43 C) UPPER EXPLOSIVE LIMIT: 9.0% AT 100 C

LOWER EXPLOSIVE LIMIT: 192% AUTOIGNITION TEMP.: 662 F (350 C)

FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE DRY CHEMICAL, ALCOHOL FOAM, OR CARBON DIOXIDE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED. USE FLOODING AMOUNTS OF WATER AS FOG; SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS; KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

150 PPM EYE-HUMAN IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 20 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION; 150 PPM INHALATION-HUMAN TCLO; 1300 MG/KG ORAL-RAT LD50; 4250 MG/KG ORAL-RABBIT; 3970 MG/KG SKIN-RABBIT; CARCINOGEN STATUS: NONE.
ISO-AMYL ALCOHOL IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT, AND A CENTRAL NERVOUS SYSTEM DEPRESSANT. PERSONS WITH A HISTORY OF CHRONIC RESPIRATORY DISEASE MAY BE AT AN INCRASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC. 8000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- MAY IRRITATE EYES, NOSE, THROAT, OR UPPER RESPIRATORY TRACT, OR CAUSE HEADACHE, DIZZINESS, FAINTNESS, DROWSINESS, OR NAUSEA. SEVERE EXPOSURE MAY CAUSE NARCOSIS, CONFUSION, OR BONE MARROW DAMAGE, OR MAY BE FATAL BY LONG-TIME EXPOSURE.

CHRONIC EXPOSURE- HAS NOT BEEN REPORTED IN HUMANS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION. (DRIESBACH, HANDBOOK OF POISONING, 11TH ED.).

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION AND DEFATTING OF SKIN.

CHRONIC EXPOSURE- MAY CAUSES DERMATITIS WITH DEFATTING OF SKIN.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION AT LEVELS OF 150 PPM.

CHRONIC EXPOSURE- MAY CAUSE DERMATITIS.

FIRST AID- WASH EYE IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE- MAY CAUSE HEADACHE, DIZZINESS, NAUSEA, DIARRHEA, OR VOMITING. SEVERE EXPOSURE MAY CAUSE NARCOSIS AND UNCONSCIOUSNESS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
REACTS NON-VIOLENTLY UNDER NORMAL CONDITIONS. MAY REACT VIGOROUSLY WITH REDUCING MATERIALS.

INCOMPATIBILITIES:
CONTACT WITH STRONG OXIDIZING AGENTS MAY RELEASE TOXIC CARBON MONOXIDE.

DECOMPOSITION:
WHEN HEATED TO DECOMPOSITION, ISOAMYL ALCOHOL PRODUCES ACRID SMOKE AND FUMES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****
CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION AND/OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S) WITH A FULL FACEPIECE.

5000 PPM- GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT OR BACK-MOUNTED).
SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, MOUNTED HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE, HELMET, OR HOOD.

8000 PPM- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE, OPERATED IN PRESSURE-DEMAND, POSITIVE PRESSURE, OR CONTINUOUS FLOW MODE.

ESCAPE- GAS MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE, OR FRONT OR BACK-MOUNTED CANISTER).
SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN A PRESSURE DEMAND OR POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 02/10/85 REVISION DATE: 06/28/85

-ADDITIONAL INFORMATION-

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American Burdick & Jackson

Material Safety Data Sheet

MATERIAL SAFETY DATA SHEET

ISO-OCTANE

emergency telephone no. 312/973-3600 (American Scientific Products)
chemtrec telephone no. 800/424-9300
information telephone no. 616/726-3171 (American Burdick & Jackson)

I. Identification

chemical name Iso-Octane molecular weight 114.23
chemical family Aliphatic Hydrocarbon formula C_8H_{18}
synonyms 2,2,4-Trimethylpentane, TMP
DOT proper shipping name Iso-Octane
DOT hazard class Flammable Liquid
DOT identification no. UN1262 CAS no. 540-84-1

II. Physical and Chemical Data

boiling point, 760mm Hg. 99.24°C freezing point -107.39°C evaporation rate (BuAc=1) ca 5
vapor pressure at 20°C 41 mm Hg vapor density (air = 1) 3.9 solubility in water @ 25°C 0.0002%
% volatiles by volume ca 100 specific gravity (H_2O = 1) @ 20°C 0.692 stability Stable
hazardous polymerization Not expected to occur.
appearance and odor Clear, colorless liquid with a mild hydrocarbon odor.
conditions to avoid Heat, sparks, open flame, open containers, and poor ventilation.

materials to avoid Strong oxidizing agents.

hazardous decomposition products Incomplete combustion can generate carbon monoxide and other toxic vapors.

III. Fire and Explosion Hazard Data

flash point, (test method) -12°C (Tag closed cup) auto ignition temperature 415°C
flammable limits in air % by volume: lower limit 1.0 upper limit 6.0
unusual fire and explosion hazards Volatile and flammable.

extinguishing media Carbon dioxide, dry chemical or foam.

special fire fighting procedures Water will not be effective in fighting a fire and may spread it, but a water spray can be used to cool exposed containers. Wear full protective clothing and self-contained breathing apparatus. Heat will build pressure and may rupture closed storage containers.

IV. Hazardous Components

	%	TLV	CAS no.
Iso-Octane	ca 100	383 ppm (see supplement)	540-84-1

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American Burdick & Jackson Subsidiary of American Hospital Supply Corporation 1953 South Harvey Street Muskegon MI 49442

V. Health Hazards

Occupational Exposure Limits

OSHA	8-hour PEL	-	500 ppm
	Ceiling	-	not listed
	Peak	-	not listed
ACGIH	TLV-TWA	-	383 ppm
	TLV-STEL (15-min)	-	not listed
NIOSH	TLV-TWA	-	75 ppm
	TLV-C	-	385 ppm

See Supplement

Concentration Immediately Dangerous to Health

OSHA/NIOSH	not listed

Odor Threshold

NSC & OHS	not listed
NIOSH	not listed

Primary Routes of Entry

Iso-octane may exert its effects through inhalation, skin absorption, and ingestion.

Industrial Exposure: Route of Exposure/Signs and Symptoms

Inhalation: Exposure can cause dizziness, nausea, incoordination, stupor, and unconsciousness.

Eye Contact: Liquid and high vapor concentration can be irritating.

Skin Contact: Repeated or prolonged skin contact can cause irritation and dermatitis through defatting of the skin.

Ingestion: Can cause gastrointestinal tract discomfort.

Effects of Overexposure

Iso-octane is a mild eye and mucous membrane irritant, primary skin irritant, and central nervous system depressant. Acute exposure causes irritation, narcosis, and gastrointestinal tract irritation.

Medical Condition Aggravated by Exposure

Preclude from exposure those individuals susceptible to dermatitis.

Emergency First Aid

Inhalation: Immediately remove to fresh air. If not breathing, administer mouth-to-mouth rescue breathing. If there is no pulse administer cardiopulmonary resuscitation (CPR). Contact physician immediately.

Eye Contact: Rinse with copious amounts of water for at least 15 minutes. Get emergency medical assistance.

Skin Contact: Flush thoroughly for at least 15 minutes. Wash affected skin with soap and water. Remove contaminated clothing and shoes. Wash clothing before re-use, and discard contaminated shoes. Get emergency medical assistance.

Ingestion: Call local Poison Control Center for assistance. Contact physician immediately. Aspiration Hazard - Do not induce vomiting.

VI. Safety Measures and Equipment

Ventilation: Adequate ventilation is required to protect personnel from exposure to chemical vapors exceeding the PEL and to minimize fire hazards. The choice of ventilation equipment, either local or general, will depend on the conditions of use, quantity of material, and other operating parameters.

Respiratory: Use approved respirator equipment. Follow NIOSH and equipment manufacturer's recommendations to determine appropriate equipment (air-purifying, air-supplied, or self-contained breathing apparatus).

Eyes: Safety glasses are considered minimum protection. Goggles or face shield may be necessary depending on quantity of material and conditions of use.

Skin: Protective gloves and clothing are recommended. The choice of material must be based on chemical resistance and other user requirements. Generally, Buna-N offers acceptable chemical resistance. Individuals who are acutely and specifically sensitive to iso-octane may require additional protective equipment.

Storage: Iso-octane should be protected from temperature extremes and direct sunlight. Proper storage of iso-octane must be determined based on other materials stored and their hazards and potential chemical incompatibility. In general, iso-octane should be stored in an acceptably protected and secure flammable liquid storage room.

Other: Emergency eye wash fountains and safety showers should be available in the vicinity of any potential exposure. Ground and bond metal containers to minimize static sparks.

VII. Spill and Disposal Data

Spill Control: Protect from ignition. Wear protective clothing and use approved respirator equipment. Absorb spilled material in an absorbent recommended for solvent spills and remove to a safe location for disposal by approved methods. If released to the environment, comply with all regulatory notification requirements.

Waste Disposal: Dispose of iso-octane as an EPA hazardous waste. Hazardous waste number: D001(Ignitable).

VIII. Supplement

There is presently no OSHA standard established for iso-octane occupational exposure levels. The values given for the ACGIH/OSHA/NIOSH PEL and TLV-TWA are for petroleum distillates.

Revision Date: 1/85

KEY

ca	Approximately	STEL	Short Term Exposure Level
na	Not applicable	TLV	Threshold Limit Value
C	Ceiling	TWA	Time Weighted Average
PEL	Permissable Exposure Level	BuAc	Butyl Acetate

NSC National Safety Council ("Fundamentals of Industrial Hygiene", 1983)
OHS Occupational Health Services ("Hazardline")

ISOPROPYL ALCOHOL
ISOPROPYL ALCOHOL
ISOPROPYL ALCOHOL

MATERIAL SAFETY DATA SHEET

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CHEMICAL DIVISION
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-63-0

SUBSTANCE: ISOPROPYL ALCOHOL

TRADE NAMES/SYNONYMS:
ISOPROPANOL; LUTOSOL; PETROHOL; DIMETHYLCARBINOL; IPA; AVANTIN; PROPAN-2-OL; ALCOSOLVE 2; AVANTINE; 2-PROPANOL; ALCOJEL; ISOHOL; N-PROPAN-2-OL; SEC-PROPYL ALCOHOL; PRO; STCC 4909205; UN 1219; A-415; A-416; A-417; A-426; A-419; A-432; A-451; A-519; A-520; ACC12090

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C3-H8-O

MOLECULAR WEIGHT: 60.11

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: ISOPROPYL ALCOHOL (ISOPROPANOL) PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
400 PPM (980 MG/M3) OSHA TWA
400 PPM (980 MG/M3) ACGIH TWA; 500 PPM (1225 MG/M3) ACGIH STEL
400 PPM NIOSH RECOMMENDED 10 HOUR TWA;
800 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: TRANSPARENT, COLORLESS, MOBILE LIQUID WITH A CHARACTERISTIC MILD ALCOHOLIC ODOR AND A SLIGHTLY BITTER TASTE. BOILING POINT: 180 F (82 C)

MELTING POINT: -129 F (-89 C) SPECIFIC GRAVITY: 0.785

VAPOR PRESSURE: 40 MMHG @ 23.8 C SOLUBILITY IN WATER: SOLUBLE

ODOR THRESHOLD: 50 PPM VAPOR DENSITY: 2.1

SOLVENT SOLUBILITY: SOLUBLE IN ETHANOL, ETHER, CHLOROFORM, ACETONE, BENZENE; INSOLUBLE IN SALT SOLUTIONS.

VISCOSITY: 2.1 CP @ 25 C

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

FLASH POINT: 53 F (12 C) (CC) UPPER EXPLOSIVE LIMIT: 12.7% @ 93 C

LOWER EXPLOSIVE LIMIT: 2.0% AUTOIGNITION TEMP.: 750 F (399 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM

(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
10 MG EYE-RABBIT MODERATE IRRITATION; 16 MG EYE-RABBIT IRRITATION; 500 MG SKIN-RABBIT MILD IRRITATION; 14,432 MG/KG ORAL-MAN TDLO; 223 MG/KG ORAL-HUMAN TDLO; 5272 MG/KG ORAL-MAN LDLO; 3570 MG/KG ORAL-HUMAN LDLO; 2770 MG/KG UNREPORTED-MAN LDLO; 5045 MG/KG ORAL-RAT LD50; 12800 PPM/3 HOURS INHALATION-MOUSE LCLO; 12000 PPM/8 HOURS INHALATION-RAT LCLO; 12800 MG/KG SKIN-RABBIT LD50; 5120 MG/KG INTRAVENOUS-DOG LDLO; 4797 MG/KG ORAL-DOG LD50; 1963 MG/KG INTRAVENOUS-CAT LDLO; 1088 MG/KG INTRAVENOUS-RAT LD50; 10 MG/KG ORAL-RABBIT LDLO; 3600 MG/KG ORAL-MOUSE LD50; 6000 MG/KG SUBCUTANEOUS-MOUSE LDLO; 1509 MG/KG INTRAVENOUS-MOUSE LD50; 1184 MG/KG INTRAVENOUS-RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS).
CARCINOGEN STATUS: NONE. STRONG-ACID MANUFACTURING PROCESS: KNOWN HUMAN CARCINOGEN (NTP); HUMAN SUFFICIENT EVIDENCE (IARC). WORKERS INVOLVED IN THE MANUFACTURING OF ISOPROPYL ALCOHOL BY THE STRONG-ACID PROCESS, INVOLVING THE FORMATION OF ISOPROPYL OILS, SHOWED AN INCREASE IN PARANASAL AND LARYNGEAL CANCERS.
ISOPROPYL ALCOHOL IS A AN EYE AND MUCOUS MEMBRANE IRRITANT AND MAY BE IRRITATING TO THE SKIN. IT IS A CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE KIDNEYS. ISOPROPYL ALCOHOL POTENTIATES THE EFFECTS OF CARBON TETRACHLORIDE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
IRRITANT/NARCOTIC. 12,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
- ACUTE EXPOSURE- HUMAN SUBJECTS EXPOSED TO 400 PPM FOR 3-5 MINUTES HAD MILD IRRITATION OF THE NOSE AND THROAT. AT 800 PPM THE IRRITATION WAS NOT SEVERE BUT UNCOMFORTABLE. INHALATION MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION WITH DIZZINESS, INCOORDINATION, HEADACHE, CONFUSION, PERSISTANT NAUSEA AND VOMITING. REFRACTORY NARCOSIS, AREFLEXIA, FLUSHING, RESPIRATORY TRACHEOBRONCHITIS, DEPRESSED RESPIRATION, HEMATEMESIS, OLIGURIA FOLLOWED BY DIURESIS, AND TENDERNESS AND EDEMA OF THE MUSCLES MAY ALSO OCCUR. SEVERE EXPOSURE MAY CAUSE COMA. DEATH MAY OCCUR BY RESPIRATORY ARREST. MICE EXPOSED TO 3250 PPM FOR 460 MINUTES DEVELOPED ATAXIA AND NARCOSIS.
- CHRONIC EXPOSURE- MICE SUBJECTED TO 10900 PPM ISOPROPYL ALCOHOL IN AIR FOR ABOUT 4 HOURS/DAY UNTIL THEY HAS ACCUMULATED 123 HOURS OF EXPOSURE WERE NARCOTIZED BUT SURVIVED. REVERSIBLE FATTY CHANGES WERE OBSERVED IN THE LIVER. THERE HAS BEEN AN INCREASED INCIDENCE OF CANCER OF THE PARANASAL SINUSES, AND POSSIBLY OF THE LARYNX, IN THE MANUFACTURE OF ISOPROPYL ALCOHOL BY THE STRONG ACID PROCESS, INVOLVING THE FORMATION OF ISOPROPYL OILS. IT IS NOT CLEAR WHICH SUBSTANCES ARE RESPONSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
NARCOTIC.
- ACUTE EXPOSURE- CONTACT WITH THE SKIN MAY CAUSE SLIGHT IRRITATION. SLIGHT ERYTHEMA OCCURRED AFTER SINGLE APPLICATION TO RABBIT SKIN. THE SUBSTANCE MAY BE ABSORBED AND IN LARGE QUANTITIES CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, NAUSEA, VOMITING AND DEPRESSED RESPIRATION. HYPOTENSION, OLIGURIA FOLLOWED BY DIURESIS AND, IN SEVERE CASES, COMA MAY OCCUR.
- CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMATITIS DUE TO THE DEFATTING ACTION ON THE SKIN. REPEATED AND PROLONGED EXPOSURE TO

THE SKIN OF RABBITS CAUSED SLIGHT ERYTHEMA, DRYING, AND SUPERFICIAL DESQUAMATION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
IRRITANT.
- ACUTE EXPOSURE- 400-800 PPM MAY CAUSE IRRITATION. IN RABBIT EYES, A DROP CAUSED MILD TRANSITORY INJURY AND A 50% AQUEOUS SOLUTION AFTER 3 MINUTES CAUSED MODERATE IRRITATION.
- CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO VAPORS MAY CAUSE CONJUNCTIVITIS. PROLONGED CONTACT WITH A 70% SOLUTION CAUSED CONJUNCTIVITIS, IRITIS, AND CORNEAL OPACITY.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
NARCOTIC.
- ACUTE EXPOSURE- INGESTION MAY CAUSE ABDOMINAL PAIN, HEMATEMESIS, NAUSEA, VOMITING, AND HEMORRHAGE. CENTRAL NERVOUS SYSTEM DEPRESSION MAY OCCUR WITH HEADACHE, DIZZINESS, FLUSHING, INCOORDINATION, STUPOR, CONFUSION, HYPOTENSION, AREFLEXIA, NARCOSIS, ANESTHESIA, AND DEPRESSED RESPIRATION. SEVERE AMD PROLONGED SHOCK MAY LEAD TO SERIOUS OR FATAL RENAL DAMAGE AFTER SEVERAL DAYS. OLIGURIA FOLLOWED BY DIURESIS AND COMA MAY OCCUR. ASPIRATION IS A SERIOUS THREAT AND DANGEROUS COMPLICATION IN CLINICAL ISOPROPYL POISONINGS, EVEN THOUGH THIS SUBSTANCE, WHEN DILUTED TO 70% OR LESS, HAS A LOW ASPIRATION HAZARD IN ANESTHETIZED RATS. DEATH MAY OCCUR FROM RESPIRATORY PARALYSIS.
- CHRONIC EXPOSURE- NO ADVERSE EFFECTS RESULTED IN HUMANS FOLLOWING DAILY INGESTION OF 2.6 AND 6.4 MG/KG FOR 6 WEEKS. RATS THAT INGESTED 0.5 TO 10.0% ISOPROPYL ALCOHOL IN DRINKING WATER FOR 27 WEEKS SHOWED DECREASED BODY WEIGHT. EFFECTS ON THE REPRODUCTIVE SYSTEM, FERTILITY, AND THE EMBRYRO OR FETUS HAVE BEEN REPORTED FOLLOWING REPEATED ADMINISTRATION TO FEMALE RATS PRIOR TO MATING OR DURING GESTATION. EFFECTS ON THE NEWBORNS HAVE BEEN REPORTED FROM EXPOSURE FOR 26 WEEKS PRIOR TO MATING IN BOTH MALE AND FEMALE RATS.

- FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
MAY SLOWLY PEROXIDISE ON EXPOSURE TO AIR AND UNDER NORMAL STORAGE CONDITIONS. AN EXPLOSION HAZARD MAY EXIST IF THE SUBSTANCE IS DISTILLED OR ALLOWED TO EVAPORATE TO DRYNESS.

INCOMPATIBILITIES:
ISOPROPYL ALCOHOL (ISOPROPANOL; 2-PROPANOL):
- ALUMINUM: DISSOLUTION IS EXOTHERMIC.
- BARIUM PERCHLORATE: FORMATION OF EXPLOSIVE COMPOUND.
- 2-BUTANONE (METHYL ETHYL KETONE): ACCELERATES THE PEROXIDATION OF THE ALCOHOL, RESULTING IN THE FORMATION OF POTENTIALLY EXPLOSIVE PRODUCTS IF THE MIXTURE IS ALLOWED TO EVAPORATE TO DRYNESS.
- CHROMIUM TRIOXIDE (GRANULAR): IGNITION.
- COATINGS: MAY BE ATTACKED.
- DIOXYGENYL TETRAFLUOROBORATE: IGNITION AT AMBIENT TEMPERATURES.
- HYDROGEN + PALLADIUM (PARTICLES): IGNITION ON EXPOSURE TO AIR.
- HYDROGEN PEROXIDE: FORMATION OF EXPLOSIVE COMPOUND.
- KETONES: MARKEDLY INCREASES THE POSSIBILITY OF PEROXIDATION.
- NITROFORM (TRINITROMETHANE): DISSOLVES LIBERATING HEAT AND POSSIBLY EXPLODING.
- OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
- OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
- OXYGEN (GAS): AUTOXIDATION, ON EXPOSURE TO LIGHT, RESULTS IN FORMATION OF KETONES AND POTENTIALLY EXPLOSIVE HYDROGEN PEROXIDE.
- PHOSGENE: IN THE PRESENCE OF IRON SALTS, MAY EXPLODE.
- PLASTICS: MAY BE ATTACKED.
- POTASSIUM TERT-BUTOXIDE: IGNITION.
- RUBBER: MAY BE ATTACKED.
- SODIUM DICHROMATE + SULFURIC ACID: EXOTHERMIC REACTION WITH POSSIBLE INCANDENSCENCE.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

PRESERVE IN TIGHT CONTAINERS, REMOTE FROM HEAT. (U.S. PHARMACOPEIA, NATIONAL FORMULARY, 1985).

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D001.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

ISOPROPYL ALCHOL:

1000 PPM- ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND ORGANIC VAPOR CARTRIDGE(S).

10,000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

12,000 PPM- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 02/26/85 REVISION DATE: 06/27/88

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METHANOL
METHANOL
METHANOL

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-56-1

SUBSTANCE: **METHANOL**

TRADE NAMES/SYNONYMS:
METHYL ALCOHOL; WOOD ALCOHOL; METHYL HYDROXIDE; CARBINOL; MONOHYDROXYMETHANE; WOOD SPIRIT; WOOD NAPHTHA; U154; UN 1230; ACC14280

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C-H4-O MOL WT: 32.04

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYL ALCOHOL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
200 PPM OSHA TWA
200 PPM NIOSH RECOMMENDED TWA
200 PPM ACGIH TWA (SKIN); 250 PPM ACGIH STEL

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS LIQUID; CHARACTERISTIC ALCOHOL ODOR.

BOILING POINT: 147 F (64 C) MELTING POINT: -144 F (-98 C)

SPECIFIC GRAVITY: 0.8 VAPOR PRESSURE: 97 MMHG @ 20 C

EVAPORATION RATE: (ETHER=1) 5.9 (TTE) SOLUBILITY IN WATER: SOLUBLE

ODOR THRESHOLD: 100 PPM VAPOR DENSITY: 1.1

SOLVENT SOLUBILITY: ETHER, BENZENE, ALCOHOL, KETONES, ORG SOLVENTS

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE/NEGLIGIBLE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.
FIRE AND EXPLOSION HAZARD BY REACTION WITH STRONG OXIDIZERS.
VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.
VAPOR-AIR MIXTURES ARE EXPLOSIVE.

FLASH POINT: 52 F (11 C) (CC) UPPER EXPLOSIVE LIMIT: 36.5%

LOWER EXPLOSIVE LIMIT: 6.0% AUTOIGNITION TEMP.: 725 F (385 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY OR FOAM: FOAM IS PREFERRABLE.

FIREFIGHTING:
FLAMMABLE LIQUID (POISONOUS)- WEAR RESPIRATORY EQUIPMENT. DO NOT ATTEMPT TO EXTINGUISH FIRE UNLESS SPILL FLOW CAN BE STOPPED. USE FLOODING QUANTITIES OF WATER AS A FOG AND TO COOL ALL CONTAINERS INVOLVED IN FIRE. APPLY WATER FROM AS FAR A DISTANCE AS POSSIBLE. APPLICATION OF SOLID STREAMS OF WATER MAY SPREAD FIRE.

TOXICITY

5 PPM EYE-HUMAN IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 40 MG EYE-RABBIT MODERATE IRRITATION; 340 MG/KG ORAL-HUMAN LDLO; 868 MG/KG UNKNOWN-HUMAN LDLO; 5628 MG/KG ORAL-RAT LD50; 64,000 PPM/4 HOURS INHALATION-RAT LC50; 1000 PPM INHALATION-MONKEY LCLO; 500 MG/KG SKIN-MONKEY LDLO; 20 GM/KG SKIN-RABBIT LD50; 8600 MG/M3 INHALATION-HUMAN TCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGEN STATUS: NONE.

METHYL ALCOHOL IS A EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT AND A CENTRAL NERVOUS SYSTEM DEPRESSANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NARCOTIC. 25,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INTOXICATION BEGINS WITH A STATE OF INEBRIATION. WITHIN 12-18 HOURS, HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS OCCUR, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS, AND OTHER SIGNS OF NARCOSIS, THEN SEVERE ABDOMINAL, BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS. APATHY OR

DEATH MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS OCCUR FREQUENTLY. BLURRED OR DIMMED VISION HAS OCCURRED WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSTION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION. BLINDNESS IS CAUSED AT 800 TO 1000 PPM. 50,000 PPM WILL PROBABLY CAUSE DEATH IN 1 TO 2 HOURS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE SYMPTOMS SUCH AS BLURRED VISION, CONTRACTION OF VISUAL FIELDS AND SOMETIMES, COMPLETE BLINDNESS. SEE MUTAGENIC DATA AND ANIMAL REPRODUCTIVE EFFECTS DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- CONTACT WITH LIQUID CAN PRODUCE DEFATTING AND A MILD DERMATITIS. READILY ABSORBED THROUGH INTACT SKIN TO CAUSE NARCOSIS, OPTIC NEURITIS AND ACIDOSIS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED SKIN CONTACT PRODUCES ECZEMA, REDNESS AND SCALING. CHRONIC ABSORPTION MAY RESULT IN VISUAL IMPAIRMENT AND OPTIC NEURITIS. SEE MUTAGENIC DATA AND ANIMAL REPRODUCTIVE EFFECTS DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- EYE CONTACT WITH METHANOL HAS CAUSED SUPERFICIAL CORNEAL LESIONS. INGESTION, INHALATION OR SKIN ABSORPTION MAY RESULT IN BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA. 5 PPM AND 40 MG CAUSE MODERATE IRRITATION IN EYES OF HUMANS AND RABBITS RESPECTIVELY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS. VISUAL IMPAIRMENT AS DESCRIBED ABOVE MAY INDICATE CHRONIC EXPOSURE BY INGESTION, INHALATION OR SKIN ABSORPTION.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE- MAY CAUSE DELAYED SYMPTOMS OF HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS, FOLLOWED BY NAUSEA,

VOMITING, DIARRHEA, DIZZINESS, AND OTHER SIGNS OF NARCOSIS. SEVERE ABDOMINAL, BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS MAY OCCUR. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS HAVE OCCURRED RARELY. BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA MAY OCCUR. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. ALSO GIVE SODIUM BICARBONATE (BAKING SODA), 2 TEASPOONFULS IN WATER.

REACTIVITY

REACTIVITY:
STABLE AT ORDINARY PRESSURES UP THE BOILING POINT, 64 C.

INCOMPATIBILITIES:
OXIDIZERS AND OTHER MATERIALS, EXAMPLES FOLLOW:

METHANOL:
- CHLOROFORM AND SODIUM HYDROXIDE: EXPLOSIVE REACTION.
- CALCIUM CARBIDE: VIOLENT REACTION.
- MAGNESIUM: VIOLENT REACTION.
- CYANURIC CHLORIDE: VIOLENT REACTION.
- BERYLLIUM HYDRIDE: INTENSE REACTION AT 200 C.
- BROMINE: INTENSE EXOTHERMIC REACTION.
- CHROMIC ANHYDRIDE: POSSIBLE EXPLOSIVE REACTION.
- NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF CATALYTIC AMOUNTS.

DECOMPOSITION:
COMBUSTION PRODUCTS INCLUDE TOXIC/HAZARDOUS GASES OF FORMALDEHYDE, CARBON MONOXIDE AND CARBON DIOXIDE.

POLYMERIZATION:
WILL NOT OCCUR.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION AND POISON HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. PROVIDE VENTILATION. WEAR RESPIRATORY PROTECTION. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER NON COMBUSTIBLE, ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL, CLOSE TIGHTLY AND LABEL 'FLAMMABLE'. FOR LARGER SPILLS, DIKE AS CLOSE TO SPILL AS PRACTICAL TO MINIMIZE ENVIRONMENTAL CONTAMINATION. NO SMOKING, FLAMES OR FLARES IN HAZARD ARES. KEEP OUT OF SEWERS AND WATER SOURCES.

WHEN MATERIAL IS INVOLVED IN FIRE:
DO NOT ATTEMPT TO EXTINGUISH FIRE UNLESS SPILL OR LEAK FLOW CAN BE STOPPED.
USE FLOODING QUANTITIES OF WATER AS A FOG.
APPLICATION OF SOLID STREAMS OF WATER MAY SPREAD FIRE.
USE FLOODING QUANTITIES OF WATER TO COOL ALL CONTAINERS INVOLVED IN FIRE.
APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE.
EXTINGUISH WITH DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE.
DO NOT ALLOW RUN-OFF WATER TO CONTAMINATE SEWERS OR WATER SOURCES.

WHEN MATERIAL NOT INVOLVED IN FIRE:
KEEP OPEN FLAMES, SPARKS OR OTHR IGNITION SOURCES AWAY.
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:

2000 PPM- SUPPLIED-AIR RESPIRATOR.
SELF-CONTAINED BREATHING APPARATUS.

10,000 PPM- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

> 10,000 PPM, INCLUDING THE IDLH LEVEL, 25,000 PPM (2.5%)-
TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN POSITIVE PRESSURE MODE OR IN CONTINUOUS-FLOW MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR IMPERVIOUS CLOTHING AS NECESSARY TO AVOID ANY POSSIBILITY OF CONTACT WITH SOLUTIONS OR MISTS.

GLOVES:
WEAR PROTECTIVE GLOVES AS NECESSARY TO AVOID REPEATED OR PROLONGED CONTACT

WITH SOLUTION OR MIST. PREFERRED MATERIALS: BUTYL, NEOPRENE AND NITRILE RUBBER GLOVES.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) OR SPLASH-PROOF SAFETY GOGGLES WHERE THERE IS REASONABLE PROBABILITY OF CONTACT WITH LIQUID OR MIST. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/25/85 REVISION DATE: 03/19/86

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CALVIN OVERCESH

DATE: 10/12/89
CUST # 232882 P.O. #

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 29529-9 NAME: METHYL ETHER, 99+%
CAS # 115-10-6
MF: C2H6O

SYNONYMS
DIMETHYL ETHER (DOT) * ETHER, DIMETHYL * ETHER, METHYL * UN 1033 (DOT) * WOOD ETHER *

TOXICITY HAZARDS

RTECS # PM4780000
METHYL ETHER
TOXICITY DATA
IHL-RAT LC50:308 GM/M3 TOXID9 1,79,81
IHL-MUS LC50:386 PPM/15M EJTXAZ 8,287,75
REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1989

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE HARMFUL.
FIRST AID
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
ADDITIONAL INFORMATION
ACTS AS A SIMPLE ASPHYXIANT. SYMPTOMS OF OVEREXPOSURE INCLUDE DIZZINESS, DISORIENTATION, HEADACHE, EXCITATION, CENTRAL NERVOUS SYSTEM DEPRESSION AND ANESTHESIA.

PHYSICAL DATA

MELTING POINT: -141 C
BOILING POINT: -24.8 C
VAPOR DENSITY: 1.62
VAPOR PRESSURE: 4000.0 MM @ 20 C
APPEARANCE: COLORLESS GAS

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 662 F
LOWER EXPLOSION LEVEL: 3.4%
UPPER EXPLOSION LEVEL: 27%

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CATALOG # 29529-9 NAME: METHYL ETHER, 99+%

EXTINGUISHING MEDIA
DO NOT EXTINGUISH BURNING GAS IF FLOW CANNOT BE SHUT OFF IMMEDIATELY. USE WATER SPRAY OR FOG NOZZLE TO KEEP CYLINDER COOL. MOVE CYLINDER AWAY FROM FIRE IF THERE IS NO RISK.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
DANGER: FLAMMABLE HIGH-PRESSURE LIQUID AND GAS.
UNUSUAL FIRE AND EXPLOSION HAZARDS
MAY FORM EXPLOSIVE MIXTURES WITH AIR.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG ACIDS
HALOGENS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA AND KEEP PERSONNEL UPWIND.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SHUT OFF LEAK IF THERE IS NO RISK.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
CAUTION: NO-RETURN CYLINDER. DO NOT REUSE. EMPTY CYLINDER WILL CONTAIN HAZARDOUS RESIDUE. FOLLOW PROPER DISPOSAL TECHNIQUES.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
MECHANICAL EXHAUST REQUIRED.
NIOSH/MSHA-APPROVED RESPIRATOR IN NONVENTILLATED AREAS AND/OR FOR EXPOSURE ABOVE THE ACGIH TLV.
DO NOT BREATHE GAS.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
CYLINDER TEMPERATURE SHOULD NOT EXCEED 125 F(52 C).
STORE AND USE WITH ADEQUATE VENTILATION.
CONTENTS UNDER PRESSURE.

ADDITIONAL PRECAUTIONS AND COMMENTS

WARNING: SUCK-BACK INTO CYLINDER MAY CAUSE RUPTURE.
USE BACK-FLOW-PREVENTIVE DEVICE IN PIPING.
USE WITH EQUIPMENT RATED FOR CYLINDER PRESSURE, AND OF COMPATIBLE MATERIALS OF CONSTRUCTION. CLOSE VALVE WHEN NOT IN USE AND WHEN EMPTY.
MAKE SURE CYLINDER IS PROPERLY SECURED WHEN IN USE OR STORED.
ADDITIONAL INFORMATION
MAY FORM EXPLOSIVE PEROXIDES ON EXPOSURE TO AIR. REACTS EXPLOSIVELY

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CATALOG # 29529-9 NAME: METHYL ETHER, 99+%

WITH OZONE, FLUORINE, AND CHROMIC ANHYDRIDE.

---------- REGULATORY INFORMATION ----------

NOT APPLICABLE

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1-BUTANOL
1-BUTANOL
1-BUTANOL

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 71-36-3

SUBSTANCE: **1-BUTANOL**

TRADE NAMES/SYNONYMS:
N-BUTYL ALCOHOL; 1-BUTANOL; N-BUTANOL; BUTANOL; HYDROXYBUTANE; METHYLOLPROPANE; BUTAN-1-OL; BUTYL HYDROXIDE; BUTYL ALCOHOL; N-HYDROXYBUTANE; PROPYLMETHANOL; PROPYLCARBINOL; A-383; A-384; A-400; A-399; A-399-S; A-398; ACC15400

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C4-H10-O MOL WT: 74.12

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: 1-BUTANOL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
100 PPM OSHA TWA; 50 PPM ACGIH TWA (SKIN)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A STRONG CHARACTERISTIC PUNGENT ODOR

BOILING POINT: 244 F (118 C) MELTING POINT: -128 F (-89 C)

SPECIFIC GRAVITY: 0.8 VAPOR PRESSURE: 4.2 MM HG @ 20 C

EVAPORATION RATE: (BU ACETATE=1) 0.46 SOLUBILITY IN WATER: 7.7% (TTE)

ODOR THRESHOLD: 11 PPM VAPOR DENSITY: 2.6

SOLVENT SOLUBILITY: ETHANOL, ETHER, ORGANIC SOLVENTS

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
HIGHLY FLAMMABLE. DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR OXIDIZERS. MODERATE EXPLOSION HAZARD WHEN EXPOSED TO FLAME. ABOVE 84 F EXPLOSIVE VAPOR-AIR MIXTURES MAY FORM. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 84 F (29 C) UPPER EXPLOSIVE LIMIT: 11.2%

LOWER EXPLOSIVE LIMIT: 1.4% AUTOIGNITION TEMP.: 650 F (343 C)

FLAMMABILITY CLASS(OSHA): IC

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

50 PPM EYE-HUMAN IRRITATION; 20 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION; 1620 UG EYE-RABBIT SEVERE IRRITATION; 405 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 25 PPM INHALATION-HUMAN TCLO; 790 MG/KG ORAL-RAT LDLO; 8000 PPM/4 HOURS INHALATION-RAT LC50; 3000 MG/KG ORAL-MOUSE LDLO; 4200 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE.

N-BUTYL ALCOHOL IS AN EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. PERSONS WITH A HISTORY OF CHRONIC RESPIRATORY OR SKIN DISEASE MAY BE AT INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NARCOTIC. 8000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF VAPOR CONCENTRATIONS OF 25 PPM MAY CAUSE MILD IRRITATION TO THE RESPIRATORY TRACT AND NOSE. 50 PPM MAY BE OBJECTIONABLE AND CAUSE HEADACHES. NO SYSTEMIC EFFECTS HAVE BEEN REPORTED BELOW 100 PPM. HIGH CONCENTRATIONS MAY CAUSE DELAYED PULMONARY EDEMA AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH DIZZINESS AND DROWSINESS.

CHRONIC EXPOSURE- NO EFFECTS REPORTED IN HUMANS. SEE MICROORGANISM MUTAGENIC REFERENCE IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- SKIN CONTACT WITH MAY CAUSE REDNESS, DRY SKIN AND DERMATITIS AND MAY BE ABSORBED THROUGH INTACT SKIN. ABSORPTION OF LARGE QUANTITIES MAY RESULT IN NARCOSIS CHARACTERIZED BY DIZZINESS AND DROWSINESS.

CHRONIC EXPOSURE- PROLONGED OR REPEATED CONTACT MAY CAUSE CRACKING AND DERMATITIS. SEE MICROORGANISM MUTAGENIC REFERENCE IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH EFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IF DIZZINESS AND DROWSINESS OCCUR.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- THE LIQUID SPLASHED IN THE EYE MAY RESULT IN REDNESS, PAIN AND LACRIMATION.

CHRONIC EXPOSURE- EXPOSURE TO CONCENTRATIONS BETWEEN 50-200 PPM MAY CAUSE IRRITATION WITH LACRIMATION, BLURRED VISION AND PHOTOSENSITIVITY. CIRCUMSTANTIAL EVIDENCE POINTS TO THE VAPOR AS A CAUSE OF A SPECIAL VACUOLAR KERATITIS. THIS CONDITION IS CHARACTERIZED BY VERY FINE TRANSPARENT VACUOLES WHICH RESEMBLE TINY BUBBLES OF GAS IN THE EPITHELIAL LAYERS OF THE CORNEA. IN SOME PATIENTS THERE ARE NO COMPLAINTS, BUT IN SEVERE CASES PAIN AND LACRIMATION ARE ASSOCIATED MOST MARKEDLY WITH FIRST OPENIND THE EYES IN THE MORNING. VISION IS USUALLY UNEFFECTED AND THE VACUOLES DISAPPEAR WITHIN A FEW DAYS AFTER CESSATION OF EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE- INGESTION MAY CAUSE ABDOMINAL NAUSEA, VOMITING, ABDOMINAL PAIN, DIARRHEA, AND POSSIBLY NARCOSIS. LIVER AND KIDNEY DAMAGE MAY OCCUR IF LARGE AMOUNTS ARE INGESTED.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT.

REACTIVITY

REACTIVITY:
GENERALLY STABLE UNDER NORMAL CONDITIONS. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRES AND EXPLOSIONS. REACT WITH ALKALI METALS LIBERATING FLAMMABLE HYDROGEN GAS.

INCOMPATIBILITIES:
1-BUTANOL
ALKALI METALS: LIBERATES FLAMMABLE HYDROGEN GAS; SHARPLY INCREASES PRESSURE.
ALUMINUM: LIBERATES FLAMMABLE HYDROGEN GAS; SHARPLY INCREASES PRESSURE.
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.
CHROMIC ANHYDRIDE: IGNITION REACTION.
CHROMIUM TRIOXIDE: IGNITION REACTION.
T-BUTANOL: POSSIBLE EXPLOSION HAZARD.

DECOMPOSITION:
COMBUSTION PRODUCTS INCLUDE HAZARDOUS VAPORS OF CARBON MONOXIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL NOT INVOLVED IN FIRE:
KEEP OPEN FLAMES, SPARKS OR OTHER IGNITION SOURCES AWAY.
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMIT REQUIREMENTS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
EXPOSURE LIMITS TO 1000 PPM-
- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE AND A FUME OR HIGH EFFICIENCY FILTER AND A FULL FACEPIECE.

5000 PPM- GAS MASK WITH A CHIN-STYLE, FRONT-, OR BACK-MOUNTED ORGANIC VAPOR CANISTER:
SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

8000 PPM- TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS-FLOW MODE.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- GAS MASK WITH A CHIN-STYLE, FRONT-, OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY ESCAPE SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/14/85 REVISION DATE: 10/18/85

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 109-66-0

SUBSTANCE: **N-PENTANE**

TRADE NAMES/SYNONYMS: PENTANE; AMYL HYDRIDE; SKELLYSOLVE A; UN 1265; P-399; P-400; P-393; O-4062

CHEMICAL FAMILY:
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C5-H12 MOL WT: 72.15

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=1 FIRE=4 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

PERCENT: 99.2 COMPONENT: N-PENTANE

OTHER CONTAMINANTS: 0.8% AROMATIC HYDROCARBONS

EXPOSURE LIMITS:
750 PPM-2250 MG/M3 ACGIH STEL; 600 PPM-1800 MG/M3 ACGIH TWA; 1000 PPM-2950 MG/M3 OSHA TWA; 1800 MG (ALKANES)/M3/15 MINUTES NIOSH RECOMMENDED CEILING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID, GASOLINE-LIKE ODOR

BOILING POINT: 97 F (36 C) MELTING POINT: -202 F (-130 C)

SPECIFIC GRAVITY: 0.6 VAPOR PRESSURE: 441 MM @ 68 F

SOLUBILITY IN WATER: INSOLUBLE

SOLVENT SOLUBILITY: ALCOHOL, ETHER, ACETONE, BENZENE, CHLOROFORM

ODOR THRESHOLD: 10 PPM VAPOR DENSITY: 2.5

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE/SEVERE EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: -40 F (-40 C) UPPER EXPLOSION LIMIT: 7.8%

LOWER EXPLOSION LIMIT: 1.4% AUTOIGNITION TEMP.: 500 F (260 C)

FLAMMABILITY CLASS(OSHA): IA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. EVACUATE DOWNWIND FOR LEAKS (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

446 MG/KG INTRAVENOUS-MOUSE LD50; CARCINOGEN STATUS: NONE.
N-PENTANE IS A MILD EYE, MUCOUS MEMBRANE AND SKIN IRRITANT, AND CENTRAL NERVOUS SYSTEM DEPRESSANT. ACUTE EXPOSURE IRRITATES EYES AND NOSE. EXTREME CONCENTRATIONS PRODUCE DROWSINESS AND OTHER SYMPTOMS OF NARCOSIS. CHRONIC SKIN EXPOSURE MAY CAUSE DERMATITIS (DEFATTING EFFECTS OF THE CHEMICAL). INGESTION MAY CAUSE DROPLETS TO ENTER THE LUNGS (ASPIRATION) WITH THE RISK OF PNEUMONIA. PERSONS WITH CHRONIC RESPIRATORY OR SKIN DISEASE MAY BE AT INCREASED RISK FROM EXPOSURE. ALCOHOLIC BEVERAGES ENHANCE THE TOXIC EFFECTS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT. 5000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- NAUSEA, VOMITING, COUGHING AND PULMONARY IRRITATION PROGRESSING TO PULMONARY EDEMA, BLOODY SPUTUM, AND BRONCHIAL PNEUMONIA WITH FEVER AND COUGH. PNEUMOTHORAX AND EMPHYSEMA MAY COMPLICATE RECOVERY. INHALATION OF LARGE AMOUNTS MAY PRODUCESYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION AND IRRITATIONAND INCLUDE WEAKNESS, DIZZINESS, SLOW AND SHALLOW BREATHING, UNCONSCIOUSNESS AND CONVULSIONS.

CHRONIC EXPOSURE- DIZZINESS, WEAKNESS, WEIGHTLOSS, ANEMIA, NERVOUSNESS, PAIN IN THE LIMBS, PERIPHERAL NUMBNESS AND PARESTHESIA.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND REST. GET MEDICAL ATTENTION. (DREISBACH, HANDBOOK OF POISONING, 11TH ED.)

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- DUE TO THE DEFATTING EFFECTS OF THE CHEMICAL IRRITATION, PAIN AND CRACKING OF THE SKIN MAY OCCUR. THE SUBSTANCE MAY BE ABSORBED CAUSING SYMPTOMS SIMILAR TO THOSE OF INHALATION INCLUDING CENTRAL NERVOUS SYSTEM DEPRESSION AND NARCOSIS.

CHRONIC EXPOSURE- DUE TO THE DEFATTING EFFECTS OF THE CHEMICAL, PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTILNO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE MILD IRRITATION AND REDNESS.

CHRONIC EXPOSURE- PROLONGED CONTACT WITH VAPORS MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
IRRITANT.
ACUTE EXPOSURE- NAUSEA, VOMITING, COUGHING, GASTROINTESTINAL IRRITATION, PULMONARY IRRITATION PROGRESSING TO PULMONARY EDEMA, BLOODY SPUTUM, AND BRONCHIAL PNEUMONIA (ASPIRATION) WITH FEVER AND COUGH. IF A LARGE AMOUNT (OVER 1 ML/KG) IS INGESTED AND RETAINED, SYMPTOMS OF CENTRAL NRVOUS SYSTEM DEPRESSION AND IRRITATION OCCUR AND INCLUDE WEAKNESS, DIZZINESS, SLOW AND SHALLOW BREATHING, UNCONSCIOUSNESS, AND CONVULSIONS. VENTRICULAR FIBRILATIONS CAN OCCUR AFTER INGESTON.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE AT LEAST UP TO THE BOILING POINT, 36 C.

INCOMPATIBILITIES:
OXIDIZERS: VIGOROUS REACTION.

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC AND/OR HAZARDOUS GASES.

POLYMERIZATION:
NONE KNOWN.

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
5000 PPM - GAS-MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER).
- SUPPLIED-AIR RESPIRATOR.
- SELF-CONTAINED BREATHING APPARATUS.

ESCAPE- GAS-MASK WITH AN ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER).
- SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 03/20/85 REVISION DATE: 06/28/85

-ADDITIONAL INFORMATION-

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PETROLEUM ETHER
PETROLEUM ETHER
PETROLEUM ETHER

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 8032-32-4

SUBSTANCE: **PETROLEUM ETHER**

TRADE NAMES/SYNONYMS:
NAPHTHA DISTILLATE; NAPHTHA, SOLVENT; NAPTHA; BENZIN; PETROLEUM ETHER; PETROLEUM NAPHTHA; AROMATIC SOLVENT; PETROLEUM BENZIN; UN 2553; P-480; E-139; E-139-S; ACC18330

CHEMICAL FAMILY:
HYDROCARBON, ALIPHATIC

MOLECULAR FORMULA: C5-H12/C6-H14/C7-H16

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=3 REACTIVITY=0 PERSISTENCE=1

COMPONENTS AND CONTAMINANTS

COMPONENT: PETROLEUM ETHER PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
500 PPM (2000 MG/M3) OSHA TWA;
350 MG/M3 NIOSH RECOMMENDED TWA; 1800 MG/M3/15 MIN NIOSH RECOMMENDED CEILING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH AN ODOR LIKE GASOLINE OR KEROSENE.

THE ODOR IS CONSIDERED AN ADEQUATE WARNING PROPERTY.

BOILING POINT: 95 F (35 C) MELTING POINT: <-40 F (<-40 C)

SPECIFIC GRAVITY: 0.6 VAPOR PRESSURE: 400-425 MMHG @ 20 C

SOLUBILITY IN WATER: INSOLUBLE ODOR THRESHOLD: 5 PPM VAPOR DENSITY: 2.5

SOLVENT SOLUBILITY: ALCOHOL,BENZENE,CHLOROFROM,CARBON DISULFIDE,CCL4

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: <0 F (<-18 C) UPPER EXPLOSIVE LIMIT: 5.9%

LOWER EXPLOSIVE LIMIT: 1.1% AUTOIGNITION TEMP.: 550 F (228 C)

FLAMMABILITY CLASS(OSHA): IA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER. APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

TOXICITY

27 MG/KG INTRAVENOUS-MAN LDLO; 2500 MG/KG INTRAPERITONEAL-MAMMAL LDLO;

CARCINOGEN STATUS: NONE.
PETROLEUM ETHER IS A EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT. EXPOSURE MAY AFFECT THE CENTRAL NERVOUS SYSTEM. INGESTION OF ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT. 10,000 PPM IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
ACUTE EXPOSURE- HIGH CONCENTRATIONS CAUSE NAUSEA, VOMITING, COUGH, AND PULMONARY IRRITATION PROGRESSING TO PULMONARY EDEMA, BLOODY SPUTUM, AND BRONCHIAL PNEUMONIA WITH FEVER AND COUGH. PNEUMOTHORAX AND EMPHYSEMA MAY COMPLICATE RECOVERY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURES MAY CAUSE DIZZINESS, WEAKNESS, WEIGHT LOSS, ANEMIA, NERVOUSNESS, PAINS IN THE LIMBS, PERIPHERAL NUMBNESS, AND PARESTHESIAS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- IRRITATION AND DRYNESS MAY OCCUR FROM THE DEFATTING ACTION OF THE LIQUID.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES. WASH AFFECTED AREAS WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IF REDNESS OR IRRITATION PERSISTS, GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- HIGH VAPOR CONCENTRATIONS MAY CAUSE IRRITATION AND REDNESS. THE VARIOUS LIQUID HYDROCARBONS OF THE SUBSTANCE CAUSE LITTLE OR NO INJURY ON DIRECT EXTERNAL CONTACT WITH THE EYE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE VAPOR MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:

ACUTE EXPOSURE- IF A LARGE AMOUNT (OVER 1 ML/KG) IS INGESTED AND RETAINED, SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION AND IRRITATION OCCUR AND INCLUDE WEAKNESS, DIZZINESS, SLOW AND SHALLOW RESPIRATION, UNCONSCIOUSNESS, AND CONVULSIONS. VENTRICULAR FIBRILLATION CAN OCCUR.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
PETROLEUM ETHER:
NITROGEN TETROXIDE: POSSIBLE EXPLOSION.
STRONG OXIDANTS: EXTREMELY VIOLENT REACTIONS.

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
WILL NOT OCCUR.

CONDITIONS TO AVOID

CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS LISTED ABOVE AND EXCESSIVE HEAT.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
PROVIDE VENTILATION AND RESPIRATORY PROTECTION. SHUT OFF IGNITION SOURCES. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER INERT ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE CONTAINERS TIGHTLY AND LABEL FLAMMABLE. FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF SPILL AS IS PRACTICAL AND EFFECTIVE, IN ORDER TO REDUCE THE VOLUME OF MATERIAL FOR LATER SISPOSAL. NO SMOKING, FLAMES, OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
EXPOSURE LIMIT TO 1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACE-PIECE AND AN ORGANIC VAPOR CARTRIDGE.

5000 PPM- GAS MASK WITH A CHIN-STYLE ORGANIC VAPOR CANISTER.

>5000 PPM INCLUDING IDLH- SELF CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR USE EQUIVALENT RESPIRATOR.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
(NOTE THET 1% IS VERY CLOSE TO LOWER EXPLOSIVE LIMIT OF 1.1%)

CLOTHING:
WEAR IMPERVIOUS CLOTHING IF THERE IS REASONABLE PROBABILITY OF CONTACT WITH SOLUTION.

GLOVES:
PROTECTIVE GLOVES AS NECESSARY TO AVOID REPEATED OF PROLONGED CONTACT WITH LIQUID. PREFERRED MATERIALS: NEOPRENE, AND MITRILE RUBBER GLOVES, PVA, OR PLASTIC.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/14/85 REVISION DATE: 06/24/87

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PHENOL
PHENOL
PHENOL

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 108-95-2

SUBSTANCE: **PHENOL**

TRADE NAMES/SYNONYMS:
CARBOLIC ACID; HYDROXYBENZENE; PHENIC ACID; PHENYLIC ACID; PHENYL HYDRATE; MONOHYDROXYBENZENE; UN 1671; ACC18380

CHEMICAL FAMILY:
PHENOL

MOLECULAR FORMULA: C6-H6-O MOL WT: 94

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=2 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: PHENOL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
5 PPM (19 MG/M3) OSHA TWA (SKIN);
20 MG/M3 NIOSH RECOMMENDED TWA
5 PPM (19 MG/M3) ACGIH TWA (SKIN); 10 PPM (38 MG/M3) ACGIH STEL (SKIN) (NOTICE OF INTENDED CHANGE 1985-1986)

PHYSICAL DATA

DESCRIPTION: COLORLESS TO PINKISH, HYGROSCOPIC CRYSTALLINE SOLID WITH A SHARP, SWEET, TARRY ODOR. THE ODOR IS CONSIDERED AN ADEQUATE WARNING.

BOILING POINT: 359 F (182 C) MELTING POINT: 106 F (41 C)

SPECIFIC GRAVITY: 1.07 VAPOR PRESSURE: 0.36 MMHG @ 20 C

EVAPORATION RATE: (BU ACETATE=1) >100 PH: ABOUT 6

SOLUBILITY IN WATER: 8.4% ODOR THRESHOLD: 0.05 PPM VAPOR DENSITY: 3.2

SOLVENT SOLUBILITY: ALCOHOL, ETHER.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OXIDIZERS OR BY CHEMICAL REACTION WITH IMCOMPATIBLE SUBSTANCES. YIELDS FLAMMABLE VAPORS WHEN HEATED, WHICH WILL FORM EXPLOSIVE MIXTURES WITH AIR ABOVE 174 F. CONTACT WITH STRONG OXIDIZERS MAY CAUSE FIRES AND EXPLOSIONS.

FLASH POINT: 174 F (79 C) (CC) UPPER EXPLOSIVE LIMIT: 8.6%

LOWER EXPLOSIVE LIMIT: 1.7% AUTOIGNITION TEMP.: 1319 F (715 C)

FLAMMABILITY CLASS(OSHA): IIIA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
POISON B (DOT) BY SKIN ABSORPTION. WEAR PRESONAL PROTECTIVE EQUIPMENT. DO NOT TOUCH MATERIAL.

MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 53).

EXTINGUISH USING AGENT INDICATED. USE FLOODING AMOUNTS OF WATER AS A FOG. AVOID BREATHING DUSTS AND FUMES FROM BURNING MATERIAL; KEEP UPWIND. (BUREAU OF EXPLOSIVE, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
POISON B

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
POISON

TOXICITY

500 MG/24 HOURS SKIN-RABBIT SEVERE IRRITATION; 535 MG OPEN SKIN-RABBIT SEVERE IRRITATION; 5 MG EYE-RABBIT SEVERE; 140 MG/KG ORAL-HUMAN LDLO; 414 MG/KG ORAL-RAT LD50; 316 MG/M3 INHALATION-RAT LC50; 669 MG/KG SKIN-RAT LD50; 177 MG/KG INHALATION-MOUSE LC50; 300 MG/KG ORAL-MOUSE LD50; 74 MG/M3 INHALATION-MAMMAL LC50; 850 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS).

PHENOL IS A STRONG EYE, MUCOUS MEMBRANE, AND SKIN IRRITANT AND CONVULSANT NEUROTOXIN. IT CAN DAMAGE THE LIVER AND KIDNEYS. MEDICAL CONTROL SHOULD EMPHASIZE THE CENTRAL NERVOUS SYSTEM, LIVER, KIDNEYS, AND SKIN. RAPIDLY ABSORBED THROUGH THE SKIN, AND IN MANY CASES FATAL IF NOT TREATED RAPIDLY AND EFFECTIVELY.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NEUROTOXIN. 100 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.

ACUTE EXPOSURE- PHENOL DOES NOT FREQUENTLY CONSTITUTE A SERIOUS RESPIRATORY HAZARD IN INDUSTRY BECAUSE OF ITS LOW VOLATILITY. HOWEVER, NOTE THE LOW IDLH, (100 PPM), WHICH HAS BEEN ASSIGNED (ABOVE). VAPORS MAY IRRITATE THE NOSE, AND THROAT, WITH COUGHING. TOXIC AMOUNTS WILL PRODUCE VOMITING, COMA AND CONVULSIONS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED INHALATION OF VAPORS MAY LEAD TO THE SAME EFFECTS AS FROM ACUTE POISONING. SEE MUTAGENIC DATA, ANIMAL REPRODUCTIVE EFFECTS DATA AND ANIMAL TUMORIGENIC DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/NEUROTOXIN.

ACUTE EXPOSURE- SKIN ABSORPTION IS A PRIMARY ROUTE OF ENTRY FOR THE LIQUID, VAPOR, OR SOLID. DIRECT CONTACT PRODUCES PAINLESS ERYTHEMA OR CORROSION. IT IS RAPIDLY ABSORBED, CAUSING SWEATING, THIRST, NAUSEA, VOMITING, DIARRHEA, STUPOR, SHOCK, EXCITATION, CYANOSIS, HYPOTENSION, COLLAPSE, COMA, CONVULSIONS, HEMOLYSIS, AND/OR PULMONARY EDEMA. IF DEATH IS NOT IMMEDIATE FROM RESPIRATORY FAILURE, LIVER AND KIDNEY DAMAGE OCCURS WITH JAUNDICE AND OLIGURIA OR ANURIA.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY PRODUCE DERMATITIS. PROLONGED ABSORPTION HAS CAUSED ANOREXIA, WEIGHT LOSS, WEAKNESS, MUSCLE ACHES AND PAIN, LIVER DAMAGE AND DARK URINE. SEE MUTAGENIC DATA, ANIMAL REPRODUCTIVE EFFECTS DATA AND ANIMAL TUMORIGENIC DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- BRIEF, INTERMITTENT INDUSTRIAL EXPOSURE TO VAPOR CONCENTRATIONS OF 48 PPM HAVE CAUSED MARKED IRRITATION TO THE EYES. LIQUID OR SOLID PHENOL IN CONTACT WITH THE EYES MAY CAUSE SEVERE DAMAGE AND BLINDNESS.

CHRONIC EXPOSURE- CHRONIC EXPOSURE HAS CAUSED GRAY DISCOLORATION OF THE SCLERA. CONJUNCTIVITIS MAY OCCUR.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CORROSIVE/NEUROTOXIN.
ACUTE EXPOSURE- INGESTION MAY RESULT IN SEVERE BURNS OF THE MOUTH AND THROAT. PROFUSE SWEATING, INTENSE THIRST, NAUSEA AND VOMITING, DIARRHEA, CYANOSIS, EXCITATION, HYPOTENSION, ABDOMINAL PAIN, CONVULSIONS, AND COMA MAY FOLLOW. JAUNDICE AND OLIGURIA OR ANURIA INDICATE LIVER AMD KIDNEY DAMAGE. A 1 GRAM DOSE MAY BE FATAL (ADULT HUMAN).

FIRST AID- IF VICTIM IS CONCIOUS AND NOT CONVULSIVE, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER. INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. THEN GIVE 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
OXIDIZERS AND OTHER MATERIALS, EXAMPLES FOLLOW:
VIOLENT REACTIONS CAN OCCUR WITH PEROXYDISULFURIC ACID, PEROXYMONOSULFURIC ACID, 1,3-BUTADIENE AND BORONTRIFLUORIDE DIETHYL ETHER COMPLEX. VIOLENT CONDENSATION REACTIONS OCCUR WITH ACETALDEHYDE. ALUMINUM TRICHLORIDE AND NITROBENZENE MIXTURE CAUSES EXPLOSIONS AND AN INTENSE EXOTHERMIC REACTION; INTENSE EXOTHERMIC REACTION AND IGNITION OCCURS WITH CALCIUM HYPOCHLORITE. PHENOL WILL ATTACK SOME FORMS OF PLASTIC, RUBBER, COATINGS, AND METALS. HOT LIQUID PHENOL WILL ATTACK ALUMINUM, MAGNESIUM, LEAD, AND ZINC METALS. REACTIONS WITH REDUCING AGENTS GIVE OFF FLAMMABLE HYDROGEN GAS. CONTACT WITH STONG OXIDIZERS MAY CAUSE FIRES AND EXPLOSIONS.

DECOMPOSITION:
COMBUSTION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

POLYMERIZATION:
WILL NOT OCCUR EXCEPT IN CONTACT WITH ALDEHYDES, NOTABLY FORMALDEHYDE.

****

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. CONTAINERS MAY EXPLODE IN HEAT OF FIRE. AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING

ALDEHYDES. AVOID HEATING TO THE POINT WHERE AN UNACCEPTABLE CONCENTRATION OF PHENOL VAPOR OR MIST IS REACHED.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. PROVIDE VENTILATION. WEAR PERSONAL PROTECTIVE EQUIPMENT. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS TAKE UP WITH SAND R SODA ASH OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE CONTAINERS TIGHTLY AND LABEL "POISON". FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINERS AND CLOSE TIGHTLY AND LABEL "POISON". MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE AS CLOSE AS POSSIBLE TO THE SOURCE TO MINIMIZE ENVIRONMENTEL CONTAMINATION. PUMP LIQUID INTO CONTAINERS. ETC. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING. KEEP OUT OF SEWERS AND WATER SOURCES.

PROTECTIVE EQUIPMENT

VENTILATION:
PROCESS ENCLOSURE, LOCAL EXHAUST, OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
50 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) AND A DUST AND MIST FILTER.
SUPPLIED-AIR RESPIRATOR.
SELF-CONTAINED BREATHING APPARATUS.

>50 PPM, INCLUDING IDLH LEVEL, 100 PPM- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMANDOR OTHER POSITIVE PRESSURE MODE OR USE EQUIVALENT RESPIRATOR.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR IMPERVIOUS PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR IMPERVIOUS PROTECTIVE GLOVES TO PREVENT ANY POSSIBILITY OF CONTACT WITH THIS SUBSTANCE. PREFFERED MATERIAL: NEOPRENE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF SAFETY GOGGLES AND A FACESHIELD TO PREVENT ANY POSSIBILITY OF CONTACT WITH THIS SUBSTANCE. DO NOT WEAR CONTACT LENSES WHEN HANDLING CHEMICALS.
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

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PROPYLENE GLYCOL
PROPYLENE GLYCOL
PROPYLENE GLYCOL

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 57-55-6

SUBSTANCE: **PROPYLENE GLYCOL**

TRADE NAMES/SYNONYMS: 1,2-PROPANEDIOL; METHYL GLYCOL; 1,2-PROPYLENE GLYCOL; MONO-PROPYLENE GLYCOL; 1,2-DIHYDROXYPROPANE; PG 12; METHYLENE GLYCOL; PROPANE-1,2-DIOL; ALPHA-PROPYLENEGLYCOL; TRIMETHYL GLYCOL; SIRLENE; P-355

CHEMICAL FAMILY:
HYDROXYL, ALIPHATIC

MOLECULAR FORMULA: C3-H8-O2 MOL WT: 76.11

CERCLA RATINGS (SCALE 0-3): HEALTH=0 FIRE=1 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

PERCENT: 100 COMPONENT: PROPYLENE GLYCOL

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS, HYGROSCOPIC, VISCOUS LIQUID WITH A

SLIGHTLY ACID TASTE. BOILING POINT: 369 F (187 C)

MELTING POINT: -76 F (-60 C) SPECIFIC GRAVITY: 1.0

VAPOR PRESSURE: 0.8 MMHG @ 20 C SOLUBILITY IN WATER: MISCIBLE

SOLVENT SOLUBILITY: MISCIBLE WITH AL, ACE, CHL. SOLUBLE IN ETHER, BZ.

VAPOR DENSITY: 2.6

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE AND EXPLOSION HAZARD UNDER NORMAL CONDITIONS. EXPLOSIVE VAPOR-AIR MIXTURES MAY FORM ABOVE 39 C.

FLASH POINT: 210 F (99 C) UPPER EXPLOSION LIMIT: 12.5%

LOWER EXPLOSION LIMIT: 2.6% AUTOIGNITION TEMP.: 700 F (371 C)

FLAMMABILITY CLASS(OSHA): IIIB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
NO ACUTE HAZARD. MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. AVOID BREATHING VAPORS OR DUSTS; KEEP UPWIND.

TOXICITY

500 MG/24 HOURS EYE-RABBIT MODERATE IRRITATION; 500 MG/7 DAYS SKIN-HUMAN MILD IRRITATION; 104 MG/3 DAYS INTERMITTENT SKIN- HUMAN MODERATE IRRITATION; 10%/2 DAYS SKIN-MAN IRRITATION; 79 GM/KG/56 WKS INTERMITTENT ORAL-CHILD TDLO; 20 GM/KG ORAL-RAT LD50; 24 GM/KG ORAL-MOUSE LD50; 20 GM/KG ORAL-RABBIT LDLO; 20800 MG/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE DATA (RTECS); CARCINOGEN STATUS: NONE.

PROPYLENE GLYCOL IN LARGE DOSES MAY CAUSE SYMPTOMS OF INTOXICATION, AFFECT THE CENTRAL NERVOUS SYSTEM, KIDNEYS, AND CAUSE BLOOD DISORDERS. THE LIQUID MAY IRRITATE EYES AND RESPIRATORY TRACT, AND MAY BE ABSORBED THROUGH THE SKIN.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.

ACUTE EXPOSURE- INHALATION OF THE SUBSTANCE MAY CAUSE RESPIRATORY AND THROAT IRRITATION. HIGH VAPOR CONCENTRATIONS MAY CAUSE CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, AND DROWSINESS.

CHRONIC EXPOSURE-REPEATED EXPOSURE MAY CAUSE NYSTAGMUS, LYMPHOCYTOSIS, AND UNCONSCIOUSNESS. SEE ANIMAL MUTAGENIC AND REPRODUCTIVE REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE- IRRITATION AND DRYNESS MAY OCCUR FROM THE DEFATTING ACTION OF THE LIQUID.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH THE SUBSTANCE MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES. WASH AFFECTED AREAS WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). IF REDNESS OR IRRITATION PERSISTS, GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE REDNESS AND IRRITATION.

CHRONIC EXPOSURE- MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:

ACUTE EXPOSURE- THE INITIAL SYMPTOMS IN MASSIVE DOSAGE (OVER 100 ML IN A SINGLE DOSE) ARE THOSE OF ALCOHOL INTOXICATION. THESE SYMPTOMS SOON PROGRESS TO VOMITING, CYANOSIS, HEADACHE, TACHYPNEA, TACHYCARDIA, HYPOTENSION, PULMONARY EDEMA, MUSCLE TENDERNESS, STUPOR, ANURIA, PROSTRATION, AND UNCONSCIOUSNESS WITH CONVULSIONS. HYPOGLYCEMIA MAY OCCUR. DEATH MAY OCCUR WITHIN A FEW HOURS FROM RESPIRATORY FAILURE OR WITHIN THE FIRST 24 HOURS FROM PULMONARY EDEMA. PATIENTS WHO HAVE PROLONGED COMA OR CONVULSIONS MAY HAVE IRREVERSIBLE BRAIN DAMAGE. MASSIVE DOSES MAY CAUSE INTRAVASCULAR HEMOLYSIS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
MAY REACT WITH OXIDIZING MATERIALS.

DECOMPOSITION:
OXIDIZES WHEN HEATED TO FORM PEROXIDES AND PROPIONALDEHYDE.

POLYMERIZATION:
NOT KNOWN TO OCCUR.

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CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT OR FLAMES.
CONTAINER MAY EXPLODE IN HEAT OF FIRE.
VAPOR EXPLOSION HAZARD INDOORS

****
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
HIGH LEVELS- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CANISTER AND A FULL FACEPIECE.
SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE.

GLOVES:
PROTECTIVE GLOVES ARE NOT REQUIRED BUT RECOMMENDED.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 03/15/85 REVISION DATE: 06/28/85

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PYRIDINE
PYRIDINE
PYRIDINE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 110-86-1

SUBSTANCE: PYRIDINE

TRADE NAMES/SYNONYMS:
AZINE; AZABENZENE; U196; STCC 4909277; UN 1282; O-4350; P-368; P-368-S; P-369; P-369-S; ACC19990

CHEMICAL FAMILY:
PYRIDINE

MOLECULAR FORMULA: C5-H5-N MOL WT: 79

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: PYRIDINE PERCENT: >99

EXPOSURE LIMITS:
PYRIDINE:
5 PPM OSHA TWA
5 PPM (15 MG/M3) ACGIH TWA

1000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH A SHARP, PENETRATING, NAUSEOUS ODOR.

BOILING POINT: 239 F (115 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 0.98 VAPOR PRESSURE: 18 MMHG @ 20 C

SOLUBILITY IN WATER: MISCIBLE ODOR THRESHOLD: 1 PPM VAPOR DENSITY: 2.7

SOLVENT SOLUBILITY: MISCIBLE WITH ETHANOL, ETHER, ACETONE, BENZENE.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 68 F (17 F) (CC) UPPER EXPLOSIVE LIMIT: 12.4%

LOWER EXPLOSIVE LIMIT: 1.8% AUTOIGNITION TEMP.: 900 F (480 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG.

SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREAHTING TOXIC VAPORS, KEEP UPWIND.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: 49CFR173.118

TOXICITY

PYRIDINE:
10 MG/24 HOURS OPEN SKIN-RABBIT MILD IRRITATION; 2 MG OPEN EYE-RABBIT SEVERE IRRITATION; 891 MG/KG ORAL-RAT LD50; 4000 PPM/4 HOURS INHALATION-RAT LCLO; 1121 MG/KG SKIN-RABBIT LD50; 870 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; 1099 MG/KG INTRAPERITONEAL-MOUSE LD50; 866 MG/KG INTRAPERITONEAL-RAT LD50; 420 MG/KG INTRAVENOUS-MOUSE LD50; 1000 MG/KG SUBCUTANEOUS-RAT LD50; 1500 MG/KG ORAL-MOUSE LD50; 4000 MG/KG ORAL-GUINEA PIG LDLO; 1250 MG/KG SUBCUTANEOUS-MOUSE LD50; 360 MG/KG INTRAVENOUS-RAT LD50; 880 MG/KG INTRAVENOUS-DOG LD50; 15 MG/KG INTRAPERITONEAL-RABBIT LDLO; MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE.
PYRIDINE IS A MUCOUS MEMBRANE AND EYE IRRITANT, PRIMARY SKIN IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE LIVER, KIDNEYS AND HEART.

HEALTH EFFECTS AND FIRST AID

INHALATION:
PYRIDINE:
IRRITANT/NARCOTIC. 3600 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- LOW VAPOR CONCENTRATIONS MAY CAUSE IRRITATION TO THE NOSE AND RESPIRATORY TRACT. HIGH VAPOR CONCENTRATIONS MAY CAUSE NARCOSIS WITH DIZZINESS, DROWSINESS, HEADACHE AND POSSIBLY UNCONSCIOUSNESS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO 6-330 PPM HAS CAUSED TRANSIENT HEADACHE, VERTIGO, NERVOUSNESS, INSOMNIA, NAUSEA, VOMITING, ABDOMINAL DISCOMFORT, BACK PAIN AND URINARY FREQUENCY WITHOUT EVIDENCE OF LIVER OR KIDNEY DAMAGE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
PYRIDINE:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- CONTACT WITH THE LIQUID MAY CAUSE REDNESS AND IRRITATION. IT MAY BE ABSORBED THROUGH INTACT SKIN TO CAUSE SYSTEMIC EFFECTS OF HEADACHE, DIZZINESS AND DROWSINESS. SOME PYRIDINES MAY INDUCE PHOTOSENSITIVITY IN PREVIOUSLY EXPOSED PERSONS.
CHRONIC EXPOSURE- PROLONGED OR REPORTED EXPOSURE MAY CAUSE DERMATITIS. PHOTOSENSITIZATION MAY OCCUR IN PREVIOUSLY EXPOSED PERSONS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
PYRIDINE:
IRRITANT.
ACUTE EXPOSURE- THE VAPOR IS IRRITATING TO THE EYES AND LIDS. DIRECT APPLICATION HAS CAUSED INJURY RANGING FROM MODERATE IRRITATION TO SEVERE DAMAGE WITH SCARRING OF THE CONJUNCTIVA, PERMANENT STROMAL OPALESCENCE, SUBEPITHELIAL VASCULARIZATION, AND CORNEAL NECROSIS. A 40% SOLUTION CAN CAUSE CORNEAL NECROSIS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
PYRIDINE:
NARCOTIC.
ACUTE EXPOSURE- SMALL DOSES MAY CAUSE MILD ANOXIA, NAUSEA, FATIGUE AND MENTAL DEPRESSION. INGESTION OF SEVERAL OUNCES HAS CAUSED SEVERE VOMITING, DIARRHEA, HYPERREFLEXIA, DELERIUM, PULMONARY EDEMA AND DEATH IN 43 HOURS. IT MAY ALSO CAUSE NARCOSIS WITH DIZZINESS, DROWSINESS AND UNCONSCIOUSNESS.
CHRONIC EXPOSURE- ORAL ADMINISTRATION OF 1.8-2.5 ML/DAY/2 MONTHS, USED IN TREATING EPILEPSY, CAUSED SEVERE LIVER AND KIDNEY DAMAGE. LARGE DOSES ACT

AS A HEART POISON, WHEREAS SMALLER DOSES STIMULATE THE BONE MARROW TO INCREASE PRODUCTION OF BLOOD. REPEATED FEEDING TO ANIMALS HAS RESULTED IN FATALITIES FROM LIVER AND KIDNEY DAMAGE.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
PYRIDINE:
- CHROMIC ANHYDRIDE: EXPLOSIVE REACTION OR IGNITION.
- MALEIC ANHYDRIDE: EXPLOSIVE REACTION.
- PERCHROMATES: EXPLOSIVE REACTION.
- PERCHLORIC ACID: EXPLOSIVE REACTION.
- SILVER PERCHLORATE: FORMS SHOCK SENSITIVE SOLVATED SALT.
- TRIFLUOROMETHYL HYPOFLUORITE: FORMS HIGHLY EXPLOSIVE BY-PRODUCT.
- FLUORINE: INCANDESCENT REACTION.
- BROMINE TRIFLUORIDE: FORMS SPONTANEOUSLY FLAMMABLE SOLID.
- STRONG ACIDS: VIOLENT REACTION.
- STRONG OXIDIZERS: VIOLENT REACTION.
- OLEUM: VIGOROUS REACTION.
- BETA-PROPIOLACTONE: VIGOROUS REACTION.
- SULFURIC ACID: VIGOROUS REACTION.
- CHLOROSULFONIC ACID: VIGOROUS REACTION.
- NITRIC ACID: VIGOROUS REACTION.
- DINITROGEN TETRAOXIDE: ATTACKS PYRIDINE.
- PLASTICS; RUBBER; COATINGS: SOME FORMS ARE ATTACKED BY PYRIDINE.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC CYANIDES AND OXIDES OF CARBON AND NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

STORAGE: PROTECT AGAINST PHYSICAL DAMAGE. OUTSIDE OR DETACHED STORAGE IS PREFERRED. INSIDE STORAGE SHOULD BE IN A STANDARD FLAMMABLE LIQUIDS STORAGE ROOM OR CABINET. ISOLATE FROM POWERFUL OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

PYRIDINE:
125 PPM- SUPPLIED-AIR RESPIRATOR OPERATED IN CONTINUOUS-FLOW MODE.

POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).

250 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH FULL FACEPIECE AND ORGANIC VAPOR CARTRIDGE(S).
AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE.
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE.

3600 PPM- SUPPLIED-AIR RESPIRATOR WITH HALF-MASK AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AN AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/24/84 REVISION DATE: 06/29/88

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TETRAHYDROFURAN
TETRAHYDROFURAN
TETRAHYDROFURAN

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 109-99-9

SUBSTANCE: TETRAHYDROFURAN

TRADE NAMES/SYNONYMS:
FURAN, TETRAHYDRO-; BUTANE, ALPHA, DELTA-OXIDE; CYCLOTETRAMETHYLENE OXIDE; FURANIDINE; OXACYCLOPENTANE; OXOLANE; TETRAMETHYLENE OXIDE; THF; U213; STCC 4908290; UN 2056; T-397; T-397-S; T-400; T-424; ACC23010

CHEMICAL FAMILY:
FURAN DERIVATIVE

MOLECULAR FORMULA: C4-H8-O

MOLECULAR WEIGHT: 72.10

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=1 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: TETRAHYDROFURAN PERCENT: >99

OTHER CONTAMINANTS: WATER; 0.025% BUTYLATED HYDROXYTOLUENE

EXPOSURE LIMITS:
TETRAHYDROFURAN:
200 PPM (590 MG/M3) OSHA TWA
200 PPM (590 MG/M3) ACGIH TWA; 250 PPM (735 MG/M3) ACGIH STEL

1000 POUND CERCLA SECTION 103 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: COLORLESS, VOLATILE, MOBILE LIQUID WITH A FAINT, ETHER-LIKE, FRUITY ODOR. BOILING POINT: 151 F (66 C) MELTING POINT: -163 F (-108 C)

SPECIFIC GRAVITY: 0.8892 VAPOR PRESSURE: 145 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE = 1) 5.8 SOLUBILITY IN WATER: VERY SOLUBLE

ODOR THRESHOLD: 20 PPM VAPOR DENSITY: 2.5

SOLVENT SOLUBILITY: SOLUBLE IN ETHANOL, ACETONE, DIMETHYL SULFOXIDE, DIETHYL ETHER, BENZENE, ALCOHOLS, KETONES, ESTERS, ETHERS, HYDROCARBONS

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 6 F (-14 C) (CC) UPPER EXPLOSIVE LIMIT: 11.8%

LOWER EXPLOSIVE LIMIT: 2% AUTOIGNITION TEMP.: 610 F (321 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY NOT BE EFFECTIVE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND. EVACUATE TO A RADIUS OF 1500 FEET FOR UNCONTROLLABLE FIRES. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

ALCOHOL FOAM (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIAL, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.119
EXCEPTIONS: NONE

TOXICITY

TETRAHYDROFURAN:
25,000 PPM INHALATION-HUMAN TCLO; 21,000 PPM/3 HOURS INHALATION-RAT LC50; 24,000 MG/M3/2 HOURS INHALATION-MOUSE LCLO; 2816 MG/KG ORAL-RAT LD50; 2900 MG/KG INTRAPERITONEAL-RAT LD50; 1900 MG/KG INTRAPERITONEAL-MOUSE LD50; 500 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; MUTAGENIC DATA (RTECS).
CARCINOGEN STATUS: NONE.
TETRAHYDROFURAN IS AN EYE AND MUCOUS MEMBRANE IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. POISONING MAY AFFECT THE LIVER, KIDNEYS AND RESPIRATORY SYSTEM. CONSUMPTION OF ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS. PERSONS WITH A HISTORY OF CHRONIC RESPIRATORY OR SKIN DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
TETRAHYDROFURAN:
IRRITANT/NARCOTIC. 20,000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE- INHALATION OF HIGH VAPOR CONCENTRATIONS MAY CAUSE SORE THROAT, COUGHING, HEADACHE, DIZZINESS, NAUSEA, WEAKNESS, CENTRAL NERVOUS SYSTEM DEPRESSION, UNCONSCIOUSNESS, AND POSSIBLE ASPHYXIATION. SYMPTOMS ARE READILY REVERSIBLE UPON REMOVAL FROM EXPOSURE. CONCENTRATIONS ABOVE 25,000 PPM PRODUCED ANESTHESIA WITH PROLONGED INDUCTION, PROFUSE SALIVATION, VOMITING, MARKED FALL IN BLOOD PRESSURE, POOR MUSCULAR RELAXATION, RESPIRATORY STIMULATION, AND NARCOSIS IN EXPERIMENTAL ANIMALS. THERE WAS A SMALL MARGIN OF SAFETY BETWEEN ANESTHESIA AND DEATH. TECHNICIANS PERFORMING THESE EXPERIMENTS COMPLAINED OF SEVERE OCCIPITAL HEADACHES AND DULLNESS.
CHRONIC EXPOSURE- 3000 PPM FOR 8 HOURS/DAY FOR 20 DAYS PRODUCED IRRITATION OF THE UPPER RESPIRATORY TRACT. LIVER AND KIDNEY DAMAGE WERE REPORTED, BUT MAY HAVE BEEN DUE TO IMPURITIES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
TETRAHYFROFURAN:

ACUTE EXPOSURE- LIQUID APPLIED TO THE SKIN OF 196 PERSONS WAS ESSENTIALLY NONIRRITATING. AQUEOUS SOLUTIONS IN CONCENTRATIONS ABOVE 20% CAUSED IRRITATION WHEN APPLIED TO RABBIT SKIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY DEHYDRATE AND DEFAT THE SKIN AND CAUSE DERMATITIS. IT IS BELIEVED THAT LIVER DAMAGE MAY RESULT FROM SKIN ABSORPTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
TETRAHYDROFURAN:
IRRITANT.
ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION AND LIQUID MAY CAUSE IRRITATION OR POSSIBLE BURNS.
CHRONIC EXPOSURE- REPEATED OR PROLONGED VAPOR EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
TETRAHYDROFURAN:
NARCOTIC.
ACUTE EXPOSURE- INGESTION MAY CAUSE GASTROINTESTINAL IRRITATION, SORE THROAT, ABDOMINAL PAIN, NAUSEA, VOMITING, DIARRHEA, DIZZINESS, HEADACHE, AND DULLNESS. UNCONSCIOUSNESS MAY RESULT FROM VERY LARGE QUANTITIES. ASPIRATION INTO THE LUNGS DURING VOMITING MAY CAUSE SEVERE LUNG IRRITATION AND POSSIBLE DELAYED CHEMICAL PNEUMONITIS. LIVER AND KIDNEY DAMAGE ARE POSSIBLE.
CHRONIC EXPOSURE- THE FOOD, DRUG AND COSMETIC ACT PERMITS USE FOR FABRICATION OF ARTICLES FOR PACKAGING, TRANSPORT, OR STORING OF FOODS IF THE RESIDUAL AMOUNT DOES NOT EXCEED 1.5% OF THE FILM. NO ADVERSE EFFECTS HAVE BEEN REPORTED IN HUMANS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES IF PEROXIDATION IS INHIBITED. IF UNINHIBITED, MAY FORM EXPLOSIVE ORGANIC PEROXIDES WHEN EXPOSED TO AIR. IF DISTILLED OR EVAPORATED TO DRYNESS, AN EXPLOSION MAY OCCUR.

INCOMPATIBILITIES:
TETRAHYDROFURAN:
ACIDS: REACTION AND POSSIBLE POLYMERIZATION.
BORANE-TETRAHYDROFURAN COMPLEX: POSSIBLE EXPLOSION ON STORAGE.

BROMINE: VIGOROUS REACTION.
HAFNIUM TETRACHLORIDE: VIOLENT EXOTHERMIC REACTION.
LITHIUM ALUMINUM ALLOYS: EXPLOSION.
LITHIUM ALUMINUM HYDRIDE (LITHIUM TETRAHYDROALUMINATE): POSSIBLE IGNITION.
METALLIC HYDRIDES: POSSIBLE EXPLOSION WHEN HEATED.
OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.
PLASTICS, RUBBER, COATINGS: SOME FORMS ATTACKED.
POTASSIUM DIOXIDE AND 2-AMINOPHENOL: POSSIBLE EXPLOSION.
POTASSIUM HYDROXIDE: POSSIBLE EXPLOSION IN PRESENCE OF PEROXIDE CONTAMINANTS.
SODIUM HYDROXIDE: POSSIBLE EXPLOSION IN PRESENCE OF PEROXIDE CONTAMINANTS.
SODIUM TETRAHYDROALUMINATE: POSSIBLE VIOLENT EXPLOSION.
TITANIUM TETRACHLORIDE: VIOLENT EXOTHERMIC REACTION.
ZIRCONIUM TETRACHLORIDE: VIOLENT EXOTHERMIC REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
MAY POLYMERIZE EXOTHERMICALLY IN CONTACT WITH SOME ACIDS.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

STORE IN ACCORDANCE WITH 29 CFR 1910.106.

BONDING AND GROUNDING: SUBSTANCES WITH LOW ELECTROCONDUCTIVITY, WHICH MAY BE IGNITED BY ELECTROSTATIC SPARKS, SHOULD BE STORED IN CONTAINERS WHICH MEET THE BONDING AND GROUNDING GUIDELINES SPECIFIED IN NFPA 77-1983, RECOMMENDED PRACTICE ON STATIC ELECTRICITY.

PROTECT AGAINST PHYSICAL DAMAGE. STORE IN A COOL, DARK, AND WELL VENTILATED AREA, AWAY FROM SOURCES OF HEAT. OUTSIDE OR DETACHED STORAGE IS PREFERABLE. INSIDE STORAGE SHOULD BE IN A STANDARD FLAMMABLE LIQUIDS STORAGE ROOM OR CABINET. PERIODICALLY CHECK FOR PEROXIDE CONTENT AND MAINTAIN BELOW 1% BY ADDING INHIBITOR. SEPARATE FROM OXIDIZING MATERIALS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40CFR 262. EPA HAZARDOUS WASTE NUMBER U213.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

TETRAHYDROFURAN:

1000 PPM- ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).

5000 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

10,000 PPM- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.

20,000 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN A PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/29/84 REVISION DATE: 06/28/88

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TOLUENE
TOLUENE
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MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 108-88-3

SUBSTANCE: **TOLUENE**

TRADE NAMES/SYNONYMS:
TOLUOL; PHENYL METHANE; METHYL BENZENE; METHYLBENZOL; METHYLBENZENE; PHENYLMETHANE; T-290; T-289; T-313; T-330; T-324; T-324-S; T-324-SK; T-323; T-323-S; ACC23590

CHEMICAL FAMILY:
HYDROCARBON, AROMATIC

MOLECULAR FORMULA: C7-H8 MOL WT: 92

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: TOLUENE PERCENT: 100

OTHER CONTAMINANTS: TECHNICAL GRADES OFTEN CONTAIN BENZENE.

EXPOSURE LIMITS:
200 PPM OSHA TWA; 300 PPM OSHA CEILING; 500 PPM OSHA PEAK;
100 PPM ACGIH TWA; 150 PPM ACGIH STEL
100 PPM NIOSH RECOMMENDED TWA; 200 PPM NIOSH RECOMMENDED 10 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH AN AROMATIC, BENZENE-LIKE ODOR. THE ODOR IS NOT CONSIDERED AN ADEQUATE WARNING PROPERTY.

BOILING POINT: 231 F (111 C) MELTING POINT: -139 F (-95 C)

SPECIFIC GRAVITY: 0.9 VAPOR PRESSURE: 22 MMHG @ 20 C

EVAPORATION RATE: (BU. AC=1) 0.446 SOLUBILITY IN WATER: 0.05%

ODOR THRESHOLD: 2 PPM VAPOR DENSITY: 3.2

SOLVENT SOLUBILITY: ACETONE, BENZENE, ALCOHOL, ETHER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME OR OXIDIZERS.
MODERATE EXPLOSION HAZARD WHEN EXPOSED TO FLAME OR INCOMPATIBLES.

FLASH POINT: 40 F (4 C) UPPER EXPLOSIVE LIMIT: 7.1%

LOWER EXPLOSIVE LIMIT: 1.3% AUTOIGNITION TEMP.: 896 F (480 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING QUANTITIES AS FOG, SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

WATER MAY BE INEFFECTIVE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
FLAMMABLE LIQUID

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
FLAMMABLE LIQUID

TOXICITY

4000 PPM/4 HR INHALATION-RAT LCLO; 5000 MG/KG ORAL-RAT LD50; 14 GM/KG SKIN-RABBIT LD50; REPRODUCTIVE EFFECTS DATA (RTECS); MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE.

TOLUENE IS A CENTRAL NERVOUS SYSTEM DEPRESSANT AND SKIN IRRITANT. TOLUENE MAY BE ABSORBED INTO THE BODY BY INHALATION, INGESTION, AND THROUGH THE SKIN. THE USE OF ALCOHOLIC BEVERAGES MAY ENHANCE THE TOXIC EFFECTS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC. 2000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH

ACUTE EXPOSURE- THE MOST RAPID ROUTE OF ENTRY IS THROUGH THE PULMONARY SYSTEM AND THE LEVEL REQUIRED TO PRODUCE NARCOSIS CAN EXIST WITHOUT ASSOCIATED RESPIRATORY TRACT IRRITATION. ODOR DETECTION IS INSUFFICIENT FOR WARNING DUE TO FATIGUE. 100 PPM PRODUCED HALLUCINATIONS OR DISTORTED PERCEPTIONS, CHANGES IN MOTOR ACTIVITY AND PSYCHOPHYSIOLOGICAL CHANGES. 200-600 PPM FOR UP TO 8 HOURS CAUSED MILD UPPER RESPIRATORY TRACT IRRITATION, FATIGUE, WEAKNESS, CONFUSION, HEADACHE, NAUSEA, ANOREXIA, BAD TASTE, LASSITUDE, IMPAIRED COORDINATION AND REACTION TIME, PARESTHESIAS OF THE SKIN, HILARITY, EUPHORIA, DIZZINESS, AND DILATED PUPILS. 800 PPM CAUSED RAPID IRRITATION, NASAL MUCOUS SECRETION, METALLIC TASTE, DROWSINESS AND IMPAIRED BALANCE. AFTEREFFECTS INCLUDING NERVOUSNESS, MUSCULAR FATIGUE AND INSOMNIA PERSISTED FOR SEVERAL DAYS. A WORKER FOUND UNCONSCIOUS AFTER EXPOSURE TO HIGH VAPOR CONCENTRATION FOR 18 HOURS DEVELOPED HEPATIC AND RENAL DAMAGE WITH MYOGLOBINURIA. RECOVERY WAS COMPLETE WITHIN 6 MONTHS. HEMATOLOGICAL EFFECTS OCCUR RARELY WITH EXPOSURE TO HIGH CONCENTRATIONS. EXTREME INHALATION MAY CAUSE DEATH BY PARALYSIS OF THE RESPIRATORY CENTER, BUT GENERALLY RECOVERY FOLLOWS REMOVAL FROM EXPOSURE. ABSORBED TOLUENE IS DEPOSITED IN ADIPOSE TISSUE AND THE CENTRAL NERVOUS SYSTEM. TOLUENE INHIBITS MITOCHONDRIAL OXIDATIVE PHOSPHORYLATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE CAUSES IRRITATION OF MUCOUS MEMBRANES, EUPHORIA, HEADACHE, VERTIGO, NAUSEA, ANOREXIA AND ALCOHOL INTOLERANCE. IN CONTRAST TO BENZENE, THERE IS NO DEFINITIVE EVIDENCE TO LINK TOLUENE EXPOSURE TO PERMANENT HEMATOLOGICAL DAMAGE. HOWEVER, ANEMIA AND LEUKOPENIA WITH BONE MARROW HYPOPLASIA HAVE BEEN REPORTED OCCASSIONALLY, BUT MAY BE DUE TO BENZENE CONTAMINATION. A 16 YEAR OLD BOY EXPOSED TO BENZENE-FREE TOLUENE OVER A 9 MONTH PERIOD DEVELOPED FATIGUE, WEAKNESS, DIZZINESS AND LEUKOPENIA. FRENCH PHARMACEUTICAL WORKERS EXPOSED TO TOLUENE FUMES DEVELOPED LEUKOPENIA AND ESPECIALLY NEUTROPENIA. WITHIN 6 MONTHS, THEY SHOWED INCREASED COAGULATION TIME AND DECREASED PROTHROMBIN LEVEL. PERIODONTAL EFFECTS WERE ALSO NOTED. ANEMIA, PETECHIAE AND ABNORMAL BLEEDING MAY OCCUR. IN SOME CASES, CARDIAC SENSITIZATION MAY OCCUR. SEVERAL CASES OF SUDDEN DEATH HAVE BEEN REPORTED IN "GLUE-SNIFFERS" RESULTING FROM CARDIAC ARREST DUE TO VENTRICULAR FIBRILLATION WITH LOSS OF CATECHOLAMINES. HEPATOTOXIC AND NEPHROTOXIC EFFECTS MAY OCCUR. SEVERE REVERSIBLE LIVER AND KIDNEY INJURY OCCURED IN A GLUE SNIFFER OF 3 YEARS. HOWEVER, WORKERS EXPOSED FOR MANY YEARS TO 80-300 PPM SHOWED NO EVIDENCE OF LIVER DYSFUNCTION. CONTINUED REPEATED INHALATION OF TOLUENE TO THE POINT OF EUPHORIA HAS CAUSED IRREVERSIBLE ENCEPHALOPATHY WITH ATAXIA, TREMULOUSNESS, EMOTIONAL LABILITY AND DIFFUSE CEREBRAL ATROPHY. INTENTIONAL TOLUENE SNIFFING CAN PRODUCE RENAL TUBULAR DEFECTS WITH

METABOLIC ACIDOSIS, ELECTROLYTE ABNORMALITIES AND POTASSIUM LOSS. SEVERE MUSCLE WEAKNESS LEADING TO LIMB PARALYSIS AND CARDIAC ARRHYTHMIAS MAY RESULT FROM THE HYPOKALEMIA; HOWEVER, SENSORY FUNCTION AND TENDON REFLEXES ARE NOT IMPAIRED. GASTROINTESTINAL EFFECTS INCLUDE ABDOMINAL PAIN, NAUSEA, VOMITING AND HEMATEMESIS. NEUROPSYCHIATRIC EFFECTS INCLUDE: LETHARGY, HALLUCINATIONS AND COMA; OR HEADACHE, DIZZINESS AND SYNCOPE; OR PARESTHESIAS AND PERIPHERAL NEUROPATHY; OR CEREBELLAR SIGNS, SUCH AS ATAXIA. A HIGHER INCIDENCE OF CHROMOSOME CHANGES WAS OBSERVED IN WORKERS EXPOSED TO TOLUENE IN A ROTOGRAVURE PLANT UP TO TWO YEARS AFTER CESSATION OF EXPOSURE. CHRONIC INHALATION OF TOLUENE BY PREGNANT RATS AND MICE RESULTED IN FETOTOXICITY AND FETAL MUSCULOSKELETAL ABNORMALITIES. SEE ANIMAL MUTAGENIC AND ANIMAL REPRODUCTIVE EFFECTS REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE
TOLUENE: CONTACT WITH THE LIQUID MAY CAUSE IRRITATION, SCALING, CRACKING AND DERMATITIS. SKIN ABSORPTION DOES OCCUR, BUT IT IS NOT A MAJORROUTE OF ENTRY IN MOST CASES. IT IS GENERALLY TOO SLOW TO PRODUCE SIGNS OF ACUTE SYSTEMIC TOXICITY. PARESTHESIAS OF THE SKIN MAY OCCUR FROM VAPOR EXPOSURE.
ETHYL ACETATES: PROLONGED SKIN CONTACT MAY CAUSE DRYNESS AND IRRITATION. SENSITIZATION DERMATITIS MAY OCCUR IN PERSONS PRIVIOUSLY EXPOSED.
ETHYL ALCOHOL: DIRECT CONTACT CAUSES NO IMMEDIATE IRRITATING EFFECTS.

CHRONIC EXPOSURE:
TOLUENE: REPEATED OR PROLONGED CONTACT WITH THE LIQUID MAY CAUSE DEFATTING OF THE SKIN, RESULTING IN A DRY, FISSURED DERMATITIS. TEN TO TWENTY APPLICATIONS TO RABBIT SKIN PRODUCED SLIGHT TO MODERATE IRRITATION AND SLIGHT NECROSIS. AN AMOCO 10 YEAR PEIDEMIOLOGICAL STUDY ON >10,000 PETROLEUM REFINERY WORKERS EXPOSED TO HEAVY OILS AND/OR LIGHT AROMATIC HYDROCARBONS, REPORTS A SIGNIFICANT INCREASE IN MORTALITIES FROM SKIN CANCER AND MELANOMA IN PARTICULAR AND FROM BENIGN NEOPLASMS AND DIGESTIVE SYSTEM CANCERS. THE OBSERVED ELEVATIONS IN SKIN CANCER MORTALITIES, ALONG WITH THE DOSE-RESPONSE RELATIONSHIP, SUPPORT THE POSSIBILITY THAT CONTACT WITH PETROLEUM OR ONE OF ITS CONSTITUENTS IS ASSOCIATED WITH SKIN CANCER AND MELANOMA IN PARICULAR.
ETHYL ACETATE: REPEATED CONTACT MAY CAUSE SENSITIZATION DERMATITIS.
ETHYL ALCOHOL: PROLONGED CONTACT WITH ETHYL ALCOHOL MAY PRODUCE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- THE LIQUID SPLASHED IN HUMAN EYES CAUSED TEMPORARY CORNEAL DAMAGE AND CONJUNCTIVAL IRRITATION WITH COMPLETE RECOVERY WITHIN 48 HOURS. THE VAPORS MAY CAUSE NOTICABLE SENSATION OF IRRITATION AT 300-400 PPM; MILD IRRITATION AND LACRIMATION AT 400 PPM; BUT, EVEN AT 800 PPM

IRRITATION IS SLIGHT. THE LEVEL REQUIRED TO PRODUCE NARCOSIS CAN EXIST WITHOUT ASSOCIATED EYE IRRITATION. EXTREMELY HIGH CONCENTRATIONS MAY CAUSE BLURRING OF VISION AND LACRIMATION. CATS EXPOSED TO SUBLETHAL VAPOR CONCENTRATIONS FOR 6 HOURS DEVELOPED FINE VACUOLES IN THE CORNEAL EPITHELIUM WHICH WERE REVERSIBLE WITHIN 24 HOURS OF REMOVAL FROM EXPOSURE. LIQUID IN RABBIT EYES PRODUCED SLIGHT TRANSIENT CONJUNCTIVAL IRRITATION, BUT NO DETECTABLE CORNEAL DAMAGE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS. RARELY, OCULAR DISTURBANCES, SUCH AS "REDDENING OF THE VISION", HAVE OCCURRED.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CORROSIVE.
ACUTE EXPOSURE- WHILE INGESTION OF THE LIQUID IS UNLIKELY IN ORDINARY INDUSTRIAL USE, THE HIGHLY CORROSIVE NATURE OF THE SUBSTANCEWILL PRODUCE SERIOUS BURNS OF THE MOUTH AND ESOPHAGUS. THERE MAY BE PAIN IN THE ABDOMEN FOLLOWED BY VOMITING AND DIARRHEAOF DARK PRECIPITATED BLOOD. ASPHYXIA CAN OCCUR FROM SWELLING OF THE THROAT. PERFORATION OF THE ESOPHAGUS AND STOMACH CAN OCCUR.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
STRONG OXIDANTS AND METAL ALKALIS, EXAMPLES FOLLOW.

TOLUENE:
ACIDS, MIXED: RUNAWAY OR EXPLOSIVE NITRATION REACTION.
NITRIC ACID, IN COMBINATION WITH SULFURIC ACID: EXPLOSIVE PRODUCTS.
1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDIN-2,4-DIONE: EXPLOSIVE OR VIOLENT REACTION.
TETRANITROMETHANE: EXTREMELY VIOLENT EXPLOSIVE REACTION.
SILVER PERCHLORATE: MAY FORM HYDROCARBON-METAL PERCHLORATE COMPLEX, AN EXPLOSIVE PRODUCT.
NITROGEN TETROXIDE: POSSIBLE EXPLOSION.
ALLYL CHLORIDE IN THE PRESENCE OF DICHLOROETHYL ALUMINUM OR ETHYLALUMINUM SESQUICHLORIDE: POSSIBLE EXPLOSION.
BROMINE TRIFLUORIDE FROZEN SOLID AT -80 C: VIOLENT REACTION.
URANIUM HEXAFLUORIDE: VIOLENT OR VIGOROUS REACTION WITH THE SEPARATION OF CARBON.
NITRIC ACID: INTENSE REACTION.
NITRONIUM PERCHLORATE: EXPLOSIVE REACTION.
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
WILL NOT OCCUR.

****
CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS LISTED ABOVE AND EXCESSIVE HEAT.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. PROVIDE VENTILATION AND RESPIRATORY PROTECTION. STOP LEAK IF YOU CAN DO WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT, NON-COMBUSTIBLE MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE CONTAINERS AND LABEL THEM "FLAMMABLE". FOR LARGER SPILLS, DIKE AS CLOSE TO SPILL AS IS PRACTICAL AND EFFECTIVE IN ORDER TO REDUCE THE AREA CONTAMINATED AND THE VOLUME OF MATERIAL FOR LATER DISPOSAL. NO SMOKING, FLAMES, OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL IS INVOLVED IN FIRE:
- APPLY FLOODING QUANTITIES OF WATER AS A FOG.
- USE FLOODING QUANTITIES OF WATER TO COOL ALL CONTAINERS INVOLVED.
- APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE.
- DO NOT ALLOW RUN-OFF WATER TO CONTAMINATE SEWERS OR WATER SOURCES.
- EXTINGUISH WITH DRY CHEMICAL, ALCOHOL FOAM OR CARBON DIOXIDE.

WHEN MATERIAL NOT INVOLVED IN FIRE:
- KEEP OPEN FLAMES, SPARKS OR OTHER IGNITION SOURCES AWAY.
- DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
- BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
- STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
- KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMIT REQUIREMENTS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF. DO NOT USE ODOR DETECTION AS A SUBSTITUTE FOR MORE RELIABLE MONITORING METHODS.

RESPIRATOR:
EXPOSURE LIMIT TO 500 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE.
SUPPLIED-AIR RESPIRATOR.

SELF-CONTAINED BREATHING APPARATUS.

1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND AN ORGANIC VAPOR CARTRIDGE.

>1000 PPM INCLUDING THE IDLH LEVEL, 2000 PPM (0.2%)- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE. (NOTE THAT LOWER EXPLOSIVE LIMIT IS 1.3%)

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE. RECOMMENDED MATERIALS: PVA AND VITON.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
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-ADDITIONAL INFORMATION-

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XYLENES
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XYLENES

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 1330-20-7

SUBSTANCE: **XYLENES**

TRADE NAMES/SYNONYMS: OXYLOL; DIMETHYLBENZENE;

CHEMICAL FAMILY:
HYDROCARBON, AROMATIC

MOLECULAR FORMULA: C8-H10 MOL WT: 106

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

PERCENT: 17.5 COMPONENT: ORTHO-XYLENE

PERCENT: 47.1 COMPONENT: META-XYLENE

PERCENT: 22.0 COMPONENT: PARA-XYLENE

PERCENT: 12.6 COMPONENT: ETHYL BENZENE

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
100 PPM (435 MG/M3) OSHA TWA; 100 PPM ACGIH TWA;
150 PPM (655 MG/M3) ACGIH STEL

PHYSICAL DATA

DESCRIPTION: LIGHT COLORED OR COLORLESS MOBILE LIQUID WITH AN AROMATIC

ODOR BOILING POINT: 278-290 F(139-141 C)

SPECIFIC GRAVITY: 0.86 VAPOR PRESSURE: 10 MMHG @ 25 C

EVAPORATION RATE: (ETHYL ETHER=1) 0.1 SOLUBILITY IN WATER: INSOLUBLE

SOLVENT SOLUBILITY: ABSOLUTE ALCOHOL, ETHER, BENZENE

ODOR THRESHOLD: 0.5 PPM VAPOR DENSITY: 3.6

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 79 F (26 C) UPPER EXPLOSION LIMIT: 1.1%

LOWER EXPLOSION LIMIT: 6.6% AUTOIGNITION TEMP.: 982 F

FLAMMABILITY CLASS(OSHA): IC

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE WATER IN FLOODING AMOUNTS AS FOG, SOLID STREAMS MAY SPREAD FIRE. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

200 PPM EYE-HUMAN IRRITATION; 100% CONCENTRATION SKIN-RABBIT MODERATE IRRITATION; 87 MG EYE-RABBIT MILD IRRITATION; 5 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION; 200 PPM INHALATION-HUMAN TCLO; 10000 PPM/6 HOURS INHALATION-HUMAN LCLO; 4300 MG/KG ORAL-RAT LD50; 5000 PPM/4 HOURS INHALATION-RAT LC50; 1700 MG/KG SUBCUTANEOUS-RAT LD50; 1570 UG/KG INTRAPERITONEAL-MOUSE LD50; 2000 MG/KG

INTRAPERITONEAL-GUINEA PIG LDLO; 2000 MG/KG INTRAPERITONEAL-MAMMAL LDLO; MICROORGANISM MUTATION DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGEN STATUS: NONE. XYLENE IS A MILD EYE AND MUCOUS MEMBRANE IRRITANT, A PRIMARY SKIN IRRITANT, AND CENTRAL NERVOUS SYSTEM DEPRESSANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.

ACUTE EXPOSURE- MAY CAUSE DIZZINESS, INCOORDINATION, LOSS OF BALANCE, IRRITATION OF RESPIRATORY TRACT AND POSSIBLE UNCONSCIOUSNESS, COMA AND DEATH FROM RESPIRATORY FAILURE FROM EXCESSIVE EXPOSURE.

CHRONIC EXPOSURE- MAY CAUSE HEADACHE, LOSS OF APPETITE, DROWSINESS, NERVOUSNESS AND PALLOR. SEE REFERENCE TO ANIMAL REPRODUCTIVE EFFECTS DATA AND MICROORGANISM MUTATION DATA IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE- PRACTICALLY NON-TOXIC BY SKIN ABSORPTION. MAY IRRITATE AND DEFAT THE SKIN.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE IRRITATION. DEFATS THE SKIN.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- HIGH VAPOR CONCENTRATIONS OR LIQUID CONTACT MAY CAUSE SEVERE EYE IRRITATION.

CHRONIC EXPOSURE- REPREATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.

ACUTE EXPOSURE- INGESTION CAUSES A BURNING SENSATION IN THE MOUTH AND STOMACH, WITH NAUSEA, VOMITING, SALIVATION, AND POSSIBLY HEMATEMESIS. SUBSTERNAL PAIN, COUGHING, AND HOARSENESS ARE POSSIBLE. ASPIRATION MAY RESULT IN HEMORRHAGIC PNEUMONITIS. NARCOSIS MAY OCCUR, WITH SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION AS DESCRIBED IN ACUTE INHALATION. COMA, LIVER AND KIDNEY DAMAGE MAY OCCUR.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE AT ORDINARY PRESSURES UP TO THE BOILING POINT, 139 C.

INCOMPATIBILITIES:
NITRIC ACID: INTENSE EXOTHERMIC REACTION IN THE PRESENCE OF SULFURIC ACID.
1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLIDINDIONE: POSSIBLE EXPLOSION.

DECOMPOSITION:
COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
NOT KNOWN TO OCCUR.

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CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

REDUCE VAPOR AND FIRE HAZARD WITH FLUOROCARBON WATER FOAM.

AIR SPILL:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER SPILL:
LIMIT SPILL MOTION AND DISPERSION WITH NATURAL BARRIERS OR OIL SPILL CONTROL BOOMS.

APPLY DETERGENTS, SOAPS, ALCOHOLS OR ANOTHER SURFACE ACTIVE AGENT TO THICKEN SPILLED MATERIAL.

APPLY UNIVERSAL GELLING AGENT TO IMMOBILIZE TRAPPED SPILL AND INCREASE EFFICIENCY OF REMOVAL.

USE ACTIVATED CARBON TO ABSORB SPILLED SUBSTANCE THAT IS DISSOLVED.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMIT REQUIREMENTS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:

1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE AND A FULL FACEPIECE.

5000 PPM- GAS MASK WITH A CHIN-STYLE, FRONT-, OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

10,000 PPM- TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

ESCAPE- GAS MASK WITH A CHIN-STYLE, FRONT-, OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE.

GLOVES:
PROTECTIVE GLOVES ARE NOT REQUIRED BUT RECOMMENDED.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

-ADDITIONAL INFORMATION-

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CARBON TETRACHLORIDE
CARBON TETRACHLORIDE
CARBON TETRACHLORIDE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
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EMERGENCY CONTACTS
GASTON L. PILLORI
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DATE 10/25/88
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 56-23-5

SUBSTANCE: CARBON TETRACHLORIDE

TRADE NAMES/SYNONYMS:
TETRACHLOROMETHANE; PERCHLOROMETHANE; CARBON CHLORIDE; TETRACHLOROCARBON; METHANE TETRACHLORIDE; CARBON TET; FREON 10; HALON 104; BENZINOFORM; STCC 4940320; UN 1846; C-186; C-187; C-199; C-570; C-612; RCRA U211; ACC04310

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C-CL4

MOLECULAR WEIGHT: 153.84

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CARBON TETRACHLORIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
CARBON TETRACHLORIDE:
10 PPM OSHA TWA; 25 PPM OSHA CEILING;
200 PPM/5 MINUTES IN ANY 4 HOURS OSHA PEAK
5 PPM (30 MG/M3) ACGIH TWA (SKIN)
ACGIH A2-SUSPECTED HUMAN CARCINOGEN.
2 PPM NIOSH RECOMMENDED 60 MINUTE CEILING (45 LITER SAMPLE)

5000 POUNDS CERCLA SECTION 103 REPORTABLE QUANTITY

SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY
WARNING AND RELEASE REQUIREMENTS- (OCTOBER 1, 1987)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WITH AN ETHEREAL ODOR.

BOILING POINT: 172 F (78 C) MELTING POINT: -9 F (-23 C)

SPECIFIC GRAVITY: 1.58 VAPOR PRESSURE: 91.3 MMHG @ 20 C

EVAPORATION RATE: (BUTYL ACETATE=1) 12.8 SOLUBILITY IN WATER: 0.08%

ODOR THRESHOLD: 10-50 PPM VAPOR DENSITY: 5.3

SOLVENT SOLUBILITY: ALCOHOL, ETHER, CHLOROFORM, BENZENE, CARBON DISULFIDE, OILS, PETROLEUM NAPHTHA,

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FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. FIGHT FIRE FROM MAXIMUM DISTANCE. STAY AWAY FROM STORAGE TANK ENDS. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL. DO NOT SCATTER MATERIAL (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 55).

USE SUITABLE AGENT FOR SURROUNDING FIRE. AVOID BREATHING VAPORS OR DUSTS, KEEP UPWIND.

FIRE FIGHTING PHASES: WHEN INVOLVED IN FIRE, CARBON TETRACHLORIDE EMITS HIGHLY TOXIC AND IRRITATING FUMES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.620
EXCEPTIONS: 49CFR173.505

TOXICITY

CARBON TETRACHLORIDE:
4 MG SKIN-RABBIT MILD IRRITATION; 2200 UG/30 SECONDS EYE-RABBIT MILD IRRITATION; 500 MG/24 HOURS EYE-RABBIT MILD IRRITATION; 43 MG/KG ORAL-HUMAN LDLO; 20 PPM INHALATION-HUMAN TCLO; 1800 MG/KG ORAL-WOMAN TDLO; 1700 MG/KG ORAL-MAN TDLO; 1000 PPM INHALATION-HUMAN LCLO; 45 PPM/3 DAYS INHALATION-HUMAN TCLO; 317 PPM/30 MINUTES INHALATION-HUMAN TCLO; 5 PPH/5 MINUTES INHALATION-HUMAN LCLO; 93 MG/KG UNREPORTED-MAN LDLO; 2800 MG/KG ORAL-RAT LD50; 8000 PPM/4 HOURS INHALATION-RAT LC50; 5070 MG/KG SKIN-RAT LD50; 1500 MG/KG INTRAPERITONEAL-RAT LD50; 8263 MG/KG ORAL-MOUSE LD50; 9526 PPM/8 HOURS INHALATION-MOUSE LC50; 572 MG/KG INTRAPERITONEAL-MOUSE LD50; 31 GM/KG SUBCUTANEOUS-MOUSE LDLO; 1000 MG/KG ORAL-DOG LDLO; 14,620 PPM/8 HOURS INHALATION-DOG LCLO; 1500 MG/KG INTRAPERITONEAL-DOG LD50; 125 MG/KG INTRAVENOUS-DOG LDLO; 38,110 PPM/2 HOURS INHALATION-CAT LCLO; 300 MG/KG SUBCUTANEOUS-CAT LDLO; 5760 MG/KG ORAL-RABBIT LD50; 478 MG/KG INTRAPERITONEAL-RABBIT LDLO; 3000 MG/KG SUBCUTANEOUS-RABBIT LDLO; 5840 MG/KG INTRAVENOUS-RABBIT LD50; 5760 MG/KG ORAL-GUINEA PIG LD50; 20,000 PPM/2 HOURS INHALATION-GUINEA PIG LCLO; 34,500 MG/M3 INHALATION-MAMMAL LC50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS); POSITIVE ANIMAL CARCINOGEN (IARC); SUSPECT HUMAN CARCINOGEN (IARC, NTP). THERE IS SUFFICIENT EVIDENCE THAT CARBON TETRACHLORIDE IS CARCINOGENIC IN EXPERIMENTAL ANIMALS. THERE ARE SUGGESTIVE CASE REPORTS OF LIVER CANCER IN HUMANS. IN THE ABSENCE OF ADEQUATE DATA IN HUMANS, IT IS REASONABLE, FOR PRACTICAL PURPOSES, TO REGARD CARBON TETRACHLORIDE AS IF IT PRESENTED A CARCINOGENIC RISK TO HUMANS.

CARBON TETRACHLORIDE IS A CENTRAL NERVOUS SYSTEM DEPRESSANT, NEPHROTOXIN, AND HEPATOTOXIN. CONSUMPTION OF ALCOHOL MAY INCREASE THE SYSTEMIC TOXICITY. STIMULANTS SUCH AS EPINEPHRINE OR EPHEDRINE MAY INDUCE VENTRICULAR FIBRILLATION. PERSONS WITH A HISTORY OF LIVER, KIDNEY, CENTRAL NERVOUS SYSTEM DISEASE, OR ALCOHOLISM MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.
300 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- ABOVE 10 PPM, RESPIRATORY TRACT IRRITATION MAY OCCUR. POISONING MAY CAUSE IMMEDIATE NAUSEA, VOMITING, ABDOMINAL PAIN, CYANOSIS, AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH HEADACHE, DIZZINESS, CONFUSION, DROWSINESS, UNCONSCIOUSNESS, COMA, AND DEATH FROM RESPIRATORY ARREST, CIRCULATORY COLLAPSE, OR VENTRICULAR FIBRILLATION. OTHER EFFECTS MAY INCLUDE DYSPNEA, HYPOTENSION, CONVULSIONS, SPASMS OF THE HANDS AND FEET, OPTIC NEURITIS, TOXIC AMBLYOPIA, AND OPTIC ATROPHY. IF DEATH IS NOT IMMEDIATE, AN ASYMPTOMATIC PERIOD, OR THE ABOVE SYMPTOMS MAY BE FOLLOWED IN 1-2 DAYS BY KIDNEY DAMAGE WITH ALBUMINURIA, UREMIA, OLIGURIA OR ANURIA, EDEMA, AND WEIGHT GAIN. ANOREXIA, JAUNDICE, AND HEPATOMEGALY INDICATE LIVER DAMAGE.

CHRONIC EXPOSURE- FATIGUE, ANOREXIA, WEIGHT LOSS, VOMITING, ABDOMINAL PAIN, ANEMIA, WEAKNESS, NAUSEA, BLURRED VISION, AMNESIA, PARESTHESIAS, TREMORS, AND LOSS OF PERIPHERAL COLOR VISION MAY INDICATE CHRONIC POISONING. CASE REPORTS HAVE DESCRIBED LIVER TUMORS ASSOCIATED WITH CIRRHOSIS IN CARBON TETRACHLORIDE-EXPOSED HUMANS. A MORTALITY STUDY OF LAUNDRY AND DRY CLEANING WORKERS EXPOSED TO A VARIETY OF SOLVENTS SUGGEST AN EXCESS OF

RESPIRATORY CANCERS, LIVER TUMORS, AND LEUKEMIA.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.
ACUTE EXPOSURE- CONTACT WITH THE LIQUID MAY CAUSE MILD IRRITATION. MAY BE ABSORBED, CAUSING SYMPTOMS AS IN ACUTE INHALATION POISONING, WITH COMA, OLIGURIA, AND JAUNDICE.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY DEFAT THE SKIN, CAUSING IRRITATION AND DERMATITIS. ABSORPTION MAY PRODUCE SYSTEMIC EFFECTS AS IN CHRONIC INHALATION POISONING.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CARBON TETRACHLORIDE:
ACUTE EXPOSURE- CONTACT WITH LIQUID OR VAPOR MAY CAUSE PAIN AND MINOR CONJUNCTIVAL INJURY.
CHRONIC EXPOSURE- NO DATA AVAILABLE. DIMINISHED VISUAL ACUITY AND COLOR VISION LOSS FOLLOWING INHALATION OR SKIN ABSORPTION HAS BEEN REPORTED.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CARBON TETRACHLORIDE:
NARCOTIC/NEPHROTOXIN/HEPATOTOXIN.
ACUTE EXPOSURE- TOXIC AMOUNTS WILL RESULT IN SYMPTOMS AS IN ACUTE INHALATION POISONING, WITH HEMATEMESIS AND DIARRHEA.
CHRONIC EXPOSURE- HAS NOT BEEN REPORTED IN HUMANS. TUMORS OF THE LIVER WERE REPORTED IN MICE, RATS, HAMSTERS, AND TROUT FOLLOWING REPEATED ORAL ADMINISTRATION.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GIVE OXYGEN IF THE SKIN IS BLUE OR IF THERE IS DIFFICULTY IN BREATHING.

ANTIDOTE:
NO SPECIFIC ANTIDOTE FOR CARBON TETRACHLROIDE POISONING. MAINTAIN BLOOD PRESSURE. DO NOT GIVE STIMULANTS! MAINTAIN URINE OUTPUT. DO NOT GIVE DIURETICS. TREAT ACUTE RENAL SHUTDOWN AND HEPATIC COMA. GIVE POTASSIUM CHLORIDE FOR ALKALOSIS. CONTROL BLOOD ELECTROLYTES WITH HEMODIALYSIS.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
CARBON TETRACHLORIDE:
ALLYL ALCOHOL: FORMS EXPLOSIVE DI- AND TRI-CHLOROBUTYLENE EPOXIDES.
ALUMINUM (POWDER): EXPLOSIVE ON HEATING OR IMPACT.
BARIUM (FINELY DIVIDED): VIOLENT REACTION OR POSSIBLE EXPLOSION.
BERYLLIUM (POWDER): FLASH OR SPARK ON HEAVY IMPACT.
BROMINE TRIFLUORIDE: IGNITION REACTION.
CALCIUM DISILICATE: POSSIBLE EXPLOSION ON IMPACT.
CALCIUM HYPOCHLORITE: EXPLOSIVE REACTION ON HEATING.
CHLORINE TRIFLUORIDE: PROBABLE EXPLOSION.
DECABORANE: FORMS IMPACT-SENSITIVE EXPLOSIVE COMPOUND.
DIBORANE (BURNING): VIOLENT EXPLOSION.
DIMETHYLACETAMIDE: EXOTHERMIC REACTION WITH INCREASE IN PRESSURE OR VIGOROUS REACTION IN PRESENCE OF IRON.
DIMETHYL FORMAMIDE: VIOLENT REACTION IN PRESENCE OF IRON OR AT TEMPERATURES ABOVE 65 C.
DINITROGEN TETRAOXIDE: EXPLOSION BY SHOCK OR HEATING TO 150 C.
DISILANE: PROBABLE EXPLOSION.
ETHYLENE: EXPLOSION WHEN UNDER HIGH PRESSURE IN PRESENCE OF ORGANIC PEROXIDE CATALYSTS.
ETHYLENE WITH BENZOYL PEROXIDE: EXPLOSION.
FLUORINE: VIOLENT REACTION OR POSSIBLE EXPLOSION.
HEXACHLOROCYCLOHEXANE: POSSIBLE VIOLENT REACTION IN PRESENCE OF IRON.
IRON: CORRODES WHEN IN CONTACT WITH WATER, ESPECIALLY a HIGH TEMPERATURES.
LITHIUM: VIOLENT EXPLOSIVE REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
METALS: POSSIBLE EXPLOSION ON HEATING OR IMPACT.
OXYGEN (LIQUID): VIOLENT REACTION OR MILD EXPLOSION WHEN IGNITED.
PLASTICS, RUBBER, COATINGS: MAY BE ATTACKED.
PLUTONIUM: IGNITION OR POSSIBLE EXPLOSION.
POTASSIUM AND POTASSIUM ALLOYS: FORMS EXPLOSIVE MIXTURES.
POTASSIUM TERT-BUTOXIDE: IGNITION REACTION.
SILVER PERCHLORATE: REACTS IN PRESENCE OF HYDROGEN CHLORIDE AND YIELDS TRICHLOROMETHYL PERCHLORATE WHICH DETONATES AT 40 C.
SODIUM: VIOLENT REACTION WHEN HOT OR EXPLOSION ON IMPACT.
SODIUM-POTASSIUM ALLOY: VIOLENT EXPLOSION ON LIGHT IMPACT.
TRIETHYLDIALUMINUM SESQUICHLORIDES: DARKENED AND EXPLODED AT ROOM TEMPERATURE.
TETRAETHYLENEPENTAMINE: EXPLOSIVE REACTION.
TRISILANE: EXPLODES IN AIR ON CONTACT.
TETRASILANE, OXYGEN: EXPLOSIVE REACTION.
TRICHLOROMETHYL PERCHLORATE WHICH DETONATES AT 40 C.
URANIUM (BURNING): EXPLOSIVE REACTION.
WAX (BURNING): EXPLOSIVE REACTION.
ZIRCONIUM: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITON PRODUCTS MAY INCLUDE TOXIC AND HAZARDOUS PHOSGENE, OXIDES OF CARBON, AND CORROSIVE CHLORINE AND HYDROCHLORIC ACID.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

PROTECT AGAINST PHYSICAL DAMAGE. STORE IN A COOL, DRY WELL VENTILATED LOCATION, AWAY FROM ANY AREA WEHRE THE FIRE HAZARD MAY BE ACUTE (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

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CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. CONTAINERS MAY EXPLODE IN HEAT OF FIRE.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

AIR SPILL:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER USED TO KNOCK DOWN VAPORS MAY BECOME CORROSIVE OR TOXIC AND SHOULD BE CONTAINED PROPERLY FOR LATER DISPOSAL.

MAY EMIT TOXIC PHOSGENE UNDER FIRE CONDITIONS.

WATER SPILL:
TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

IF DISSOLVED, AT A CONCENTRATION OF 10 PPM OR GREATER, APPLY ACTIVATED CARBON AT TEN TIMES THE AMOUNT THAT HAS BEEN SPILLED.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINERS AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE

AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROCESS ENCLOSURE RECOMMENDED TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

CARBON TETRACHLORIDE:
AT ANY DETECTABLE CONCENTRATION
SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.
SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/24/84 REVISION DATE: 07/08/88

-ADDITIONAL INFORMATION-

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CHLOROFORM
CHLOROFORM
CHLOROFORM

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 67-66-3

SUBSTANCE: CHLOROFORM

TRADE NAMES/SYNONYMS:
TRICHLOROMETHANE; METHANE TRICHLORIDE; R20; FREON 20; METHENYL TRICHLORIDE; METHYL TRICHLORIDE; TRICHLOROFORM; FORMYL TRICHLORIDE; U044; STCC 4940310; UN 1888; C-294; C-295; C-298; C-574; C-605; C-603; C-607; C-606; ACC04770

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C-H-CL3 MOL WT: 119.4

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: CHLOROFORM PERCENT: >99

OTHER CONTAMINANTS: <1% ETHANOL AS A STABILIZER

EXPOSURE LIMITS:
CHLOROFORM:
50 PPM OSHA CEILING
10 PPM (50 MG/M3) ACGIH TWA
ACGIH A2-SUSPECTED HUMAN CARCINOGEN.
2 PPM NIOSH RECOMMENDED 60 MINUTE CEILING

10,000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
5000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY
SUBJECT TO SARA SECTION 313 ANNUAL TOXIC CHEMICAL RELEASE REPORTING
SUBJECT TO CALIFORNIA PROPOSITION 65 CANCER AND/OR REPRODUCTIVE TOXICITY WARNING AND RELEASE REQUIREMENTS- (OCTOBER 1, 1987)

PHYSICAL DATA

DESCRIPTION: CLEAR, COLORLESS VOLATILE LIQUID WITH A SWEET PLEASANT ODOR AND SWEET TASTE BOILING POINT: 142 F (61 C)

MELTING POINT: -82 F (-63 C) SPECIFIC GRAVITY: 1.5

VAPOR PRESSURE: 160 MM HG @ 20 C EVAPORATION RATE: (BU ACETATE=1) 11.6

SOLUBILITY IN WATER: 0.8% ODOR THRESHOLD: 200-307 PPM VAPOR DENSITY: 4.1

SOLVENT SOLUBILITY: ALCOHOL, ETHER, BENZENE, SOLVENT NAPHTHA

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE HAZARD AND NEGLIGIBLE EXPLOSION HAZARD WHEN EXPOSED TO HIGH HEAT. WILL NOT SUPPORT COMBUSTION. NONFLAMMABLE, BUT WILL BURN ON PROLONGED EXPOSURE TO FLAME OR HIGH TEMPERATURE.

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. FIGHT FIRE FROM MAXIMUM DISTANCE. STAY AWAY FROM STORAGE TANK ENDS. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL. DO NOT SCATTER MATERIAL (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 55).

EXTINGUISH USING AGENTS SUITABLE FOR TYPE OF FIRE. AVOID BREATHING VAPORS OR DUSTS, KEEP UPWIND.

FIRE FIGHTING PHASES: WHEN INVOLVED IN FIRE, CHLOROFORM EMITS HIGHLY TOXIC AND IRRITATING FUMES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.630
EXCEPTIONS: 49CFR173.505

TOXICITY

CHLOROFORM:
10 MG/24 HOURS OPEN SKIN-RABBIT MILD IRRITATION; 148 MG EYE-RABBIT IRRITATION; 500 MG/24 HOURS SKIN-RABBIT MILD IRRITATION; 20 MG/24 HOURS EYE-RABBIT MODERATE IRRITATION; 10 MG/M3/1 YEAR INHALATION-HUMAN TCLO; 140 MG/KG ORAL-HUMAN LDLO; 25000 PPM/5 MINUTES INHALATION-HUMAN TCLO; 5000 MG/M3/7 MINUTES INHALATION-HUMAN TCLO; 546 MG/KG UNREPORTED ROUTE-MAN LDLO; 908 MG/KG ORAL-RAT LD50; 75 GM/M3/60 MINUTES INHALATION-RAT LCLO; 36 MG/KG ORAL-MOUSE LD50; 28 G/M3 INHALATION-MOUSE LCLO; 500 MG/KG ORAL-RABBIT LDLO; 59 G/M3 INHALATION-RABBIT LC50; 800 MG/KG SUBCUTANEOUS-RABBIT LDLO; 1000 MG/KG ORAL-DOG LDLO; 100 G/M3 INHALATION-DOG LCLO; 35000 MG/M3/4 HOURS INHALATION-CAT LCLO; 820 MG/KG ORAL-GUINEA PIG LD50; 20000 PPM/2 HOURS INHALATION-GUINEA PIG LCLO; 25000 PPM/5 MINUTES INHALATION-MAMMAL LCLO; 1000 MG/KG INTRAPERITONEAL-DOG LD50; 623 MG/KG INTRAPERITONEAL-MOUSE LD50; 704 MG/KG SUBCUTANEOUS-MOUSE LD50; 75 MG/KG INTRAVENOUS-DOG LDLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); TUMORIGENIC DATA (RTECS); POSITIVE ANIMAL CARCINOGEN (IARC); INDEFINITE HUMAN CARCINOGEN (IARC); SUSPECT HUMAN CARCINOGEN (NTP); ORAL ADMINISTRATION CAUSED LIVER AND KIDNEY TUMORS IN MICE AND KIDNEY AND THYROID TUMORS IN RATS.

CHLOROFORM IS TOXIC EYE, SKIN AND MUCOUS MEMBRANE IRRITANT, CENTRAL NERVOUS SYSTEM DEPRESSANT, HEPATOTOXIN AND NEPHROTOXIN.
ALCOHOLICS MAY BE AT INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CHLOROFORM:
NARCOTIC/HEPATOTOXIC/NEPHROTOXIC.
1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- 1024 PPM CAUSED DIZZINESS, INTRACRANIAL PRESSURE AND NAUSEA AFTER 7 MINUTES, FOLLOWED BY PERSISTENT FATIGUE AND HEADACHE. VOMITING, SENSATION OF FAINTING AND SERIOUS DISORIENTATION OCCURRED AT 4100 PPM OR LESS. 10,000-15,000 PPM PRODUCED RAPID LOSS OF CONSCIOUSNESS OR ANESTHESIA. CHLOROFORM WAS WIDELY USED AS AN ANESTHETIC AGENT, BUT HAS BEEN LARGELY ABANDONED DUE TO THE FREQUENCY OF CARDIAC ARREST DURING SURGERY AND OF DELAYED DEATH DUE TO HEPATIC INJURY. EXPOSURE TO HIGH CONCENTRATIONS HAS RESULTED IN CARDIAC SENSITIZATION TO CATECHOLAMINES. AN INCREASED INCIDENCE OF CARDIAC ARRHYTHMIAS WAS DEMONSTRATED IN PATIENTS ANESTHETIZED WITH APPROXIMATELY 22,500 PPM CHLOROFORM AS COMPARED TO OTHER ANESTHETICS. RESPONSES ASSOCIATED WITH EXPOSURE TO CONCENTRATIONS BELOW ANESTHETIC OR PREANESTHETIC LEVEL TYPICALLY INCLUDE A FEELING OF WARMTH OF THE FACE AND BODY, THEN IRRITATION OF THE MUCOUS MEMBRANES AND SKIN, FOLLOWED BY LOSS OF REFLEXES, SENSATION AND CONSCIOUSNESS. OVERDOSAGE DURING ANESTHESIA MAY CAUSE SUDDEN DILATION OF THE PUPILS (TERMINALLY THE CORNEA BECOMES DULL AND CLOUDY), SUDDEN DISAPPEARANCE OF THE PULSE, COMPLETE RESPIRATORY FAILUTE AND RAPID DEATH FROM CIRCULATORY COLLAPSE AND VENTRICULAR FIBRILLATION. TRANSIENT NYSTAGMUS MAY OCCUR DURING RECOVERY FROM NARCOSIS. AFTER TRANSIENT RECOVERY FROM HEAVY EXPOSURE, LIVER AND KIDNEY FAILURE MAY CAUSE DEATH. ELDERLY, RUNDOWN OR CACHECTIC PERSONS ARE MORE SUSCEPTIBLE TO DELAYED TOXIC REACTIONS WHICH USUALLY DEVELOP 3-5 DAYS AFTER ANESTHESIA. SIGNS INCLUDE DROWSINESS AND SLEEPINESS, NAUSEA AND VOMITING, AND CHANGES IN THE SIZE OF THE LIVER, WHICH USUALLY BECOMES ENLARGED AND PAINFUL, BUT MAY BE CONTRACTED. SIGNS OF KIDNEY IRRITATION MAY BE PRESENT AND URINE MAY CONTAIN ACETONE AND BILE PIGMENTS. DELIRIUM AND COMA MAY DEVELOP. ALTHOUGH INJURY TO THE KIDNEY IS NOT AS COMMON AS THAT TO THE LIVER, IT MAY BE OBSERVED FROM EITHER ACUTE OR CHRONIC EXPOSURE. DILATION OF THE PUPILS OF THE EYES, REDUCED REACTION TO LIGHT AND REDUCED INTRAOCULAR PRESSURE HAVE BEEN DETECTED IN ANIMALS.

CHRONIC EXPOSURE- ALTHOUGH THE INCIDENCE OF HEPATIC NECROSIS FOLLOWING SINGLE ADMINISTRATION OF HALOMETHANE IS NOT SIGNIFICANTLY DIFFERENT FROM OTHER ANESTHETICS, AFTER MULTIPLE ADMINISTRATIONS, THE INCIDENCE INCREASES 7 TIMES. HEPATIC NECROSIS AFTER HALOMETHANE ADMINISTRATION IS AN ALLERGIC OR AUTOIMMUNE RESPONSE. REPEATED ANESTHESIA INCREASES LIVER AND KIDNEY DAMAGE SOMETIMES FOLLOWED BY JAUNDICE AND CIRRHOSIS OF THE LIVER. THE ODOR THRESHOLD IS BY NO MEANS LOW ENOUGH TO BE CONSIDERED A WARNING FOR CHRONIC EXPOSURE. LIVER DAMAGE HAS BEEN REPORTED FROM REPEATED INDUSTRIAL EXPOSURE AT 10 PPM. OF 68 CHEMICAL WORKERS EXPOSED REGULARLY TO 2-205 PPM FOR 1-4 YEARS, 25% HAD HEPATOMEGALY; OF THESE 17, 4 HAD TOXIC HEPATITIS AND 14 HAD FATTY DEGENERATION OF THE LIVER. THE GROUP WAS MORE SUSCEPTIBLE TO VIRAL HEPATITIS THAN THE GENERAL POPULATION. IN ADDITION TO LIVER DAMAGE, DRUNKEN FEELING, SOMNOLENCE, IRRITABILITY, PSYCHOTIC UNBALANCE, LOSS OF APPETITE, AND DIGESTIVE DISTURBANCES, DRY MOUTH AND THIRST, FREQUENT AND PAINFUL URINATION, DEPRESSION, IRRITABILITY AND A FEELING OF BEING DAZED HAVE BEEN REPORTED FROM OCCUPATIONAL EXPOSURE. OTHERS HAVE REPORTED ANOREXIA, ANEMIA, WEAKNESS, BLURRING OF VISION, PARESTHESIA, MEMORY LOSS AND TREMORS. WORKERS IN A PHARMACEUTICAL PLANT EXPOSED TO CHLOROFORM

AND OTHER SOLVENTS COMPLAINED OF HEADACHE, NAUSEA, ERUCTATION AND LOSS OF APPETITE. A HIGHER INCIDENCE OF ENLARGEMENT OF LIVER AND SPLEEN WERE DETECTED, BUT NO REMARKABLE CHANGE IN LIVER FUNCTION WERE DETECTED. IN RATS EXPOSED TO 25, 50 OR 85 PPM CHLOROFROM IN AIR FOR 7 HOURS/DAY, 5 DAYS/WEEK FOR 6 MONTHS, HISTOPATHOLOGICAL ALTERATIONS, INCLUDING CLOUDY SWELLING OF KIDNEYS AND CENTRILOBULAR GRANULAR DEGENERATION AND NECROSIS OF THE LIVER, HIGHER MORTALITY AND CHANGES IN ORGAN WEIGHTS WERE OBSERVED. AFFECTS APPEARED REVERSIBLE AT 25 PPM AND NO EFFECTS WERE DETECTED IN RATS EXPOSED 4, 2 OR 1 HOUR/DAY. IN MICE, HEPATOTOXICITY WAS POTENTIATED BY PRIOR EXPOSURE TO ALIPHATIC ALCOHOLS. INHALATION STUDIES ON PREGNANT RATS AND MICE REPORTED EFFECTS ON THEIR FERTILITY, STUNTED FETUSES, FETAL DEATH, HOMEOSTASIS AND DEVELOPMENTAL ABNORMALITIES OF THE MUSCULOSKELETAL AND GASTROINTESTINAL SYSTEM OF THE OFFSPRING.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CHLOROFORM:
IRRITANT.

ACUTE EXPOSURE- LOCAL EFFECTS FROM LIQUID EXPOSURE MAY RANGE FROM MILD IRRITATION TO SEVERE ERYTHEMA AND PURULENT BLEBS. SOME SKIN PENETRATION MAY OCCUR. ABSORPTION THROUGH INTACT SKIN OF RABBITS WAS INDICATED BY WEIGHT LOSS AND DEGENERATIVE CHANGES OF THE KIDNEY TUBULES, BUT DOSES AS HIGH AS 3980 MG/KG WERE SURVIVED.

CHRONIC EXPOSURE- THE LIQUID HAS A DEFATTING EFFECT ON SKIN AND MAY PRODUCE CHRONIC IRRITATION WITH DRYING AND CRACKING. ONE OR TWO 24-HOUR APPLICATIONS ON SKIN OF RABBITS RESULTED IN HYPEREMIA AND MODERATE NECROSIS. HEALING OF ABRADED SKIN APPEARED TO BE DELAYED BY APPLICATION OF A COTTON PAD SOAKED IN CHLOROFORM.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CHLOROFORM:
IRRITANT.

ACUTE EXPOSURE- LIQUID SPLASHED IN THE EYES CAUSES IMMEDIATE BURNING PAIN, TEARING AND REDDENING OF THE CONJUNCTIVA. FREQUENTLY THE CORNEAL EPITHELIUM IS INJURED AND MAY BE PARTIALLY LOST; HOWEVER, REGENERATION IS PROMPT AND THE EYES RETURN TO NORMAL IN 1-3 DAYS. HIGH VAPOR CONCENTRATION MAY CAUSE MODERATE SENSATION OF STINGING AND IRRITATION WHICH USUALLY AUTOMATICALLY INDUCES PROTECTIVE CLOSURE OF LIDS. CONJUNCTIVAL IRRITATION AND BLEPHAROSPASM HAVE ALSO BEEN REPORTED FROM VAPOR EXPOSURE.

CHRONIC EXPOSURE- PROLONGED EXPOSURE OF THE CORNEA DURING GENERAL ANESTHESIA HAS CAUSED PERSISTENT INJURY.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CHLOROFORM:
NARCOTIC/HEPATOTOXIC/NEPHROTOXIC/CARCINOGENIC/TOXIC.

ACUTE EXPOSURE- THE MEAN LETHAL DOSE FOR HUMANS IS ESTIMATED AT ABOUT 1 FLUID OUNCE; HOWEVER, INGESTION OF 6 OUNCES HAS BEEN SURVIVED, BUT AS LITTLE AS 1 TEASPOON HAS CAUSED SERIOUS ILLNESS. SWALLOWING IS FOLLOWED IMMEDIATELY BY SEVERE BURNING SENSATION IN THE MOUTH, THROAT, ESOPHAGUS AND STOMACH, PAIN IN THE CHEST AND ABDOMEN WITH NAUSEA AND VOMITING. DEPENDING ON THE DOSE, COLD, CLAMMY SKIN; CYANOSIS OF THE EXTREMITIES AND FACE; GASPING, IRREGULAR RESPIRATION; EXTREME DILATION OF THE PUPILS; MUSCULAR CRAMPING, ESPECIALLY OF THE MASSETERS; AND LOSS OF CONSCIOUSNESS MAY FOLLOW. PROGRESSIVE HYPOTENSION FROM INCREASED CARDIAC WEAKNESS, PERIPHERAL VASODILATION AND RESPIRATORY FAILURE MAY OCCUR. LIVER DAMAGE MAY OCCUR AND, RARELY, THE HEARING IS AFFECTED. IN RATS, GROSS PATHOLOGICAL EXAMINATION SHOWED LIVER AND KIDNEY CHANGES AT DOSES AS LOW AS 250 MG/KG. IN RATS GIVEN LETHAL DOSES OF CHLOROFORM, CLINICAL SIGNS, INCLUDING DEPRESSION, PROFOUND SLEEP, DYSPNEA, ANOREXIA AND HEMATURIA, BEGAN WITHIN 20 MINUTES AFTER TREATMENT AND CONTINUED FOR SEVERAL DAYS. DEATH GENERALLY OCCURED IN 2-4 HOURS, BUT SOME WERE DELAYED AS LONG AS 2 WEEKS. THE ACUTE TOXICITY OF CHLOROFORM IS SPECIES-, STRAIN-, SEX- AND AGE-DEPENDENT; MALES OF MANY MOUSE STRAINS WERE SUSCEPTIBLE TO RENAL TUBULAR NECROSIS, BUT FEMALES WERE NOT AFFECTED.

CHRONIC EXPOSURE- CHLOROFORM WAS BANNED BY THE U. S. FOOD AND DRUG ADMINISTRATION FROM USE IN FOOD, DRUGS AND COSMETICS ON JUNE 29, 1976. PRIOR TO BEING BANNED, CHLOROFROM HAD BEEN APPROVED FOR USE IN COUGH PREPARATIONS, LINAMENTS, TOOTHPASTES, COSMETICS AND TOOTHACHE DROPS. IT IS STILL USED IN A PESTICIDE USED IN THE U. S. FOR FUMIGATION OF RAW, STORED, BULK GRAIN INCLUDING BARLEY, CORN, MILO, OATS, RICE, RYE, SORGHUM AND WHEAT, BUT DIETARY EXPOSURE IS BELIEVED TO BE NEGLIGIBLE FROM THE SOURCE. SMALL AMOUNTS OF CHLOROFROM HAVE BEEN FOUND IN TOMATOES, MUSCAT GRAPES, MILK, CREAM AND FRESH CODFISH. ALTHOUGH RESULTANT LEVELS ARE LOW, FEW PPB, CHLOROFORM CAN BE PRODUCED IN THE PROCESS OF CHLORINATING DRINKING WATER. CORRELATIONS WERE FOUND BETWEEN TRIHALOMETHANE LEVELS IN DRINKING-WATER SUPPLIES AND VARIOUS SITE-SPECIFIC CANCER MORTALITY RATES, ESPECIALLY BLADDER CANCER, BUT ALSO LYMPHOMA AND CANCERS OF RECTUM-INTESTINE, BRAIN AND KIDNEYS, BUT NO CAUSAL INFERENCE CAN BE MADE FROM THE DATA. RESULTS OF PREGNANT MICE AND RAT FEEDING STUDIES INCLUDE FETOTOXICITY, REDUCED WEIGHT GAIN OF THE NEWBORNS AND DEVELOPMENTAL ABNORMALITIES OF THE MUSCULOSKELETAL SYSTEM IN THE FETUSES. CHLOROFORM IS CARCINOGENIC FOLLOWING ORAL ADMINISTRATION, PRODUCING BENIGN AND MALIGNANT LIVER NEOPLASMS IN MICE AND KIDNEY AND THYROID NEOPLASMS IN RATS. NODULAR HYPERPLASIA OF THE LIVER AND CIRRHOSIS ALSO OCCURRED IN MICE THAT HAD NOT DEVELOPED CARCINOMAS.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
CHLOROFORM:
UNLESS STABILIZED WITH ETHANOL OR OTHER STABILIZER, DECOMPOSES SLOWLY ON PROLONGED EXPOSURE TO SUNLIGHT IN THE PRESENCE OR ABSENCE OF AIR AND IN THE DARK WHEN AIR IS PRESENT. DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC PHOSGENE AND OXIDES OF CARBON AND CORROSIVE HYDROGEN CHLORIDE. THE REACTION MAY BE ACCELERATED BY IRON AND WATER AT HIGH TEMPERATURES. CAN BE EXPLOSIVE WHEN CONFINED WITH WATER. POSES AN EXPLOSION HAZARD IF PRESENT IN BOILER FEED OR COOLING WATER.

INCOMPATIBILITIES:
CHLOROFORM:
- ADDITION OF SODIUM TO INADEQUATELY COOLED CHLOROFORM-METHANOL MIXTURE DURING ATTEMPTED PREPARATION OF TRIMETHYLORTHOFORMATE: VIOLENT EXPLOSION.
- A SOLUTION OF PERCHLORIC ACID IN CHLOROFORM POURED ON PHOSPHORUS PENTOXIDE: VIOLENT EXPLOSION.
- MIXED WITH ACETONE IN A RESIDUE BOTTLE POSSIBLY CONTAINING BASE: EXPLOSION.
- STRONG BASES AND ALCOHOLS: EXPLOSION HAZARD.
- METHANOL AND SODIUM HYDROXIDE OR POTASSIUM HYDROXIDE: EXPLOSIVE REACTION.
- DINITROGEN TETROXIDE: EXPLOSION ON IMPACT.
- POTASSIUM-SODIUM ALLOY: IMPACT SENSITIVE, PRODUCING A VIOLENT EXPLOSION.
- POTASSIUM: IMPACT SENSITIVE, PRODUCING A STRONG EXPLOSION.
- SODIUM: IMPACT SENSITIVE, PRODUCING A FAIRLY STRONG EXPLOSION.
- LITHIUM: IMPACT SENSITIVE, PRODUCING A WEAK EXPLOSION.
- ALUMINUM POWDER: POSSIBLE EXPLOSION.
- MAGNESIUM POWDER: POSSIBLE EXPLOSION.
- VARIOUS COMBINATIONS OF ALKALI OR ALKALINE-EARTH METALS WITH HALOCARBONS: HIGHLY HEAT OR IMPACT SENSITIVE.
- NITROMETHANE WITH HALOFORMS: DETONABLE MIXTURE.
- ACETONE OR OTHER KETONES IN PRESENCE OF POTASSIUM HYDROXIDE, CALCIUM HYDROXIDE OR OTHER STRONG ALKALI: VIGOROUS, EXOTHERMIC REACTION WITH FORMATION OF EXPLOSIVE PRODUCT.
- IN PREPARATION OF METHYLORTHOFORMATE, SOLID SODIUM METHOXIDE, METHANOL AND CHLOROFORM WERE MIXED TOGETHER: VIOLENT EXOTHERMIC REACTION FOLLOWED BY EXPLOSION.
- RAPID ADDITION OF SODIUM METHYLATE TO MIXTURE OF CHLOROFORM AND METHANOL: UNCONTROLLED EXOTHERMIC REACTION TERMINATED IN VIOLENT EXPLOSION.
- 1:1 SOLUTION WITH BIS(DIMETHYLAMINO)DIMETHYLSTANNANE: MILD EXPLOSION ON HEATING.
- CONTACT OF 1.5 GM SOLID POTASSIUM-TERT-BUTOXIDE WITH DROPS OF LIQUID CHLOROFORM: IMMEDIATE IGNITION.
- EXPOSURE OF 1.5 GM SOLID POTASSIUM-TERT-BUTOXIDE TO VAPORS OF CHLOROFORM: IGNITION AFTER 2 MINUTES.
- DISILANE: INCANDESCENT
- FLUORINE: VIOLENT OR POSSIBLE EXPLOSIVE REACTION.
- TRIISOPROPYLPHOSPHINE: INTENSE OR VIGOROUS REACTION.
- OXIDIZED BY STRONG OXIDIZING AGENTS SUCH AS CHROMIC ACID WITH FORMATION OF PHOSGENE AND CHLORINE GAS: HIGHLY TOXIC PRODUCT.
- IN CONTACT WITH WATER WILL CORRODE IRON AND CERTAIN METALS: CORROSIVE PRODUCT.
- REACTS READILY WITH HALOGENS OR HALOGENATING AGENTS: VIGOROUS REACTION.
- SOME FORMS OF PLASTIC, RUBBER AND COATINGS: ATTACKED BY LIQUID CHLOROFORM.
- LIGHT METALS: EXOTHERMIC REACTION.

DECOMPOSITION:
CHLOROFORM:
THERMAL DECOMPOSITION MAY RELEASE TOXIC OR CORROSIVE VAPORS, INCLUDING OXIDES OF CHLORINE AND CARBON, PHOSGENE, CHLORINE GAS AND HYDROGEN CHLORIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

STORE IN A COOL, DRY, WELL-VENTILATED LOCATION. SEPARATE FROM STRONG ALKALIS (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

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CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. CONTAINERS MAY EXPLODE IN HEAT OF FIRE.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

AIR SPILL:
COMBUSTION PRODUCTS INCLUDE CORROSIVE OR TOXIC VAPORS.

MAY EMIT TOXIC PHOSGENE UNDER FIRE CONDITIONS.

WATER SPILL:
TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

IF DISSOLVED, AT A CONCENTRATION OF 10 PPM OR GREATER, APPLY ACTIVATED CARBON AT TEN TIMES THE AMOUNT THAT HAS BEEN SPILLED.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR SMALL DRY SPILLS, WITH A CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINERS AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY, ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 5000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

FOR CHLOROFORM:
GREATER THAN ANY DETECTABLE CONCENTRATION:
- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE:
- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
- ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

- SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

- SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/01/84 REVISION DATE: 07/08/88

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O-DICHLOROBENZENE
O-DICHLOROBENZENE
O-DICHLOROBENZENE

MATERIAL SAFETY DATA SHEET

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EMERGENCY CONTACTS
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 95-50-1

SUBSTANCE: **O-DICHLOROBENZENE**

TRADE NAMES/SYNONYMS: 1,2-DICHLOROBENZENE; DICHLOROBENZOL; DICHLORICIDE; ORTHO-DICHLOROBENZENE; B-248; B-435; O-2231

CHEMICAL FAMILY:
HALOGEN COMPOUND, AROMATIC

MOLECULAR FORMULA: C6-H4-CL2 MOL WT: 147

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=2 REACTIVITY=0 PERSISTENCE=3
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=2 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

PERCENT: 100 COMPONENT: O-DICHLOROBENZENE

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS
50 PPM (300 MG/M3) OSHA CEILING; 50 PPM ACGIH CEILING

PHYSICAL DATA

DESCRIPTION: COLORLESS TO PALE YELLOW LIQUID WITH A DISAGREEABLE, AROMATIC ODOR. BOTH ODOR AND EYE IRRITATION ARE ADEQUATE WARNING PROPERTIES. BOILING POINT: 356 F (180 C) MELTING POINT: 1 F (-17 C)

SPECIFIC GRAVITY: 1.3 VAPOR PRESSURE: 1.2 MMHG @ 20 C

EVAPORATION RATE: (BU ACETATE=1) >1.0 SOLUBILITY IN WATER: 0.015%

SOLVENT SOLUBILITY: ALCOHOL, ETHER, OILS, FATS, BENZENE

ODOR THRESHOLD: 2 - 50 PPM VAPOR DENSITY: 5.1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME. EXPLOSIVE VAPOR-AIR MIXTURES MAY BE FORMED ABOVE THE FLASH POINT.

FLASH POINT: 151 F (66 C) UPPER EXPLOSION LIMIT: 9.2%

LOWER EXPLOSION LIMIT: 2.2% AUTOIGNITION TEMP.: 1198 F (648 C)

FLAMMABILITY CLASS(OSHA): IIIA

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

WATER MAY BE USED TO BLANKET FIRE (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERILS, EIGHTH EDITION).

FIRE FIGHTING PHASES: USE WATER SPRAY, DRY CHEMICAL, FOAM, OR CARBON DIOXIDE. USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF A LEAK HAS NOT IGNITED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROTECT THE MEN ATTEMPTING TO STOP A LEAK. WATER SPRAY MAY BE USED TO FLUSH SPILLS AWAY FROM EXPOSURES (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
ORM-A

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
NONE

TOXICITY

500 MG/KG ORAL-RAT LD50; 821 PPM/7 HR INHALATION-RAT LCLO; INDEFINITE ANIMAL CARCINOGEN (IARC); INDEFINITE HUMAN CARCINOGEN (IARC). ONE REPORT SUGGESTS AN ASSOCIATION BETWEEN LEUKEMIA AND EXPOSURE TO DICHLOROBENZENES, BUT IS CONSIDERED INSUFFICIENT EVIDENCE TO ASSESS CARCINOGENIC RISK.

O-DICHLOROBENZENE IS AN EYE, MUCOUS MEMBRANE, SKIN IRRITANT, AND SKIN SENSITIZER. POISONING AFFECTS THE BLOOD, LIVER, AND KIDNEYS. PERSONS WITH A HISTORY OF LIVER, KIDNEY, OR SKIN DISEASE MAY BE AT AN INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
MODERATELY TOXIC. 1700 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH

ACUTE EXPOSURE- CONCENTRATIONS RANGING FROM 1-44 PPM AND AVERAGING 15 PPM USUALLY DO NOT PRODUCE ADVERSE EFFECTS. HIGHER CONCENTRATIONS CAUSE COUGHING, NAUSEA, AND HEADACHE. EXTREMELY HIGH CONCENTRATIONS OF 500-1000 PPM CAUSE LIVER AND KIDNEY DAMAGE WITH JAUNDICE.

CHRONIC EXPOSURE- BY ANALOGY TO THE EFFECTS OBSERVED IN ANIMALS, REPEATED EXPOSURE CAUSES LIVER AND KIDNEY INJURY.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/TOXIC.

ACUTE EXPOSURE- LEFT ON THE SKIN, THE LIQUID MAY PRODUCE BLISTERING, AND MAY LATER BECOME PIGMENTED. IT MAY BE ABSORBED, PRODUCING SYMPTOMS AS FOR ACUTE INHALATION.

CHRONIC EXPOSURE- REPEATED EXPOSURE MAY CAUSE DERMATITIS DUE TO THE DEFATTING NATURE OF THE LIQUID.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREAS WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- IF EXPOSURES ARE FOR MORE THAN A FEW MINUTES DURATION, IRRITATION BECOMES NOTICEABLE AT VAPOR CONCENTRATIONS OF 20-30 PPM AND PAINFUL TO SOME AT 60-100 PPM. THE LIQUID, TESTED INTHE EYES OF RABBITS, PRODUCED APPARENT DISTRESS AND SLIGHT CONJUNCTIVAL IRRITATION.

CHRONIC EXPOSURE- NO KNOWN EFFECTS IN HUMANS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
MODERATELY TOXIC.

ACUTE EXPOSURE- IMMEDIATE EFFECTS ARE ABDOMINAL PAIN, NAUSEA AND VOMITING,

DIZZINESS, AND CONFUSION PROGRESSING TO UNCONSCIOUSNESS. SLOW RESPIRATION IRREGULAR PULSE, AND HYPOTENSION MAY ALSO OCCUR. LIVER AND KIDNEY DAMAGE IS POSSIBLE DEPENDING ON THE AMOUNT INGESTED. LIVER DAMAGE IS INDICATED BY JAUNDICE, AND A SWOLLEN, TENDER LIVER. KIDNEY DAMAGE IS INDICATED BY DECREASED URINE OUTPUT, FLUOD BUILD-UP AND SUDDEN WEIGHT GAIN.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
VIOLENT REACTION WITH STRONG OXIDIZERS. CONTACT WITH HOT ALUMINUM OR ALUMINUM ALLOYS MAY CAUSE FIRES AND EXPLOSIONS. INCOMPATIBLE WITH ACTIVE METALS, AND METAL POWDERS OR FILINGS.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC AND/OR CORROSIVE VAPORS OF HYDROGEN CHLORIDE, CHLORINE, AND CARBON MONOXIDE.

POLYMERIZATION:
WILL NOT OCCUR.

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CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.

WILL ATTACK SOME FORMS OF PLASTICS, RUBBER, AND COATINGS.

CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS LISTED ABOVE AND EXCESSIVE HEAT.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
PROVIDE VENTILATION. WEAR PERSONAL PROTECTIVE EQUIPMENT. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE AS CLOSE TO SPILL AS IS PRACTICAL AND EFFECTIVE, IN ORDER TO REDUCE THE AREA CONTAMINATED AND THE AMOUNT FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMITS.

RESPIRATOR:
EXPOSURE LIMIT TO 1000 PPM- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE, FULL FACEPIECE, AND A PARTICULATE FILTER.

>1000 PPM INCLUDING IDLH OF 1700 PPM- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE OR USE EQUIVALENT RESPIRATOR.

ESCAPE- ANY GAS MASK PROVIDING PROTECTION AGAINST ORGANIC VAPORS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 01/14/85 REVISION DATE: 08/13/85

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1,2-DICHLOROETHANE
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 107-06-2

SUBSTANCE: **1,2-DICHLOROETHANE**

TRADE NAMES/SYNONYMS:
ETHYLENE DICHLORIDE; GLYCOL DICHLORIDE; DICHLOROETHANE; ETHYLENE CHLORIDE; 1,2-BICHLOROETHANE; S-DICHLOROETHANE; ETHANE DICHLORIDE; ALPHA,BETA-DICHLOROETHANE; 1,2-ETHYLENE DICHLORIDE; SYM-DICHLOROETHANE; DICHLORO-1,2-ETHANE; DICHLOROETHYLENE; E-175; E-190; 13187; ACC09390

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C2-H4-CL2 MOL WT: 98.96

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=1 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: 1,2-DICHLOROETHANE PERCENT: 100.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
50 PPM (200 MG/M3) OSHA TWA; 100 PPM OSHA CEILING;
200 PPM/5 MIN OSHA PEAK; 1 PPM NIOSH RECOMMENDED TWA;
2 PPM NIOSH RECOMMENDED CEILING
10 PPM (40 MG/M3) ACGIH TWA; 15 PPM (60 MG/M3) ACGIH STEL (NOTICE OF INTENDED CHANGE 1984-1985)

PHYSICAL DATA

DESCRIPTION: CLEAR LIQUID WITH A CHLOROFORM-LIKE ODOR. THE ODOR IS

CONSIDERED TO BE AN ADEQUATE WARNING. BOILING POINT: 183 F (89 C)

MELTING POINT: -32 F (-35 C) SPECIFIC GRAVITY: 1.3

VAPOR PRESSURE: 87 MMHG @ 25 C EVAPORATION RATE: NOT AVAILABLE

SOLUBILITY IN WATER: 8690 MG/L ODOR THRESHOLD: 6 PPM VAPOR DENSITY: 3.4

SOLVENT SOLUBILITY: ALCOHOL, ETHER, ACETONE, BENZENE.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
FIRE HAZARD WHEN EXPOSED TO HEAT, FLAME, OR BY CHEMICAL REACTION WITH INCOMPATIBLE SUBSTANCES. VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 56 F (13 C) UPPER EXPLOSIVE LIMIT: 16%

LOWER EXPLOSIVE LIMIT: 6.2% AUTOIGNITION TEMP.: 775 F (413 C)

FLAMMABILITY CLASS(OSHA): IB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. STAY AWAY FROM STORAGE TANK ENDS. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 23).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

1000 PPM/4 HR INHALATION-RAT LCLO; 810 MG/KG ORAL-MAN LDLO; 670 MG/KG ORAL-RAT LD50; 5000 MG/KG/2 HR INHALATION-MOUSE LCLO; MUTAGENIC DATA (RTECS); ANIMAL CARCINOGEN (IARC); SUSPECT HUMAN CARCINOGEN (IARC, NTP). THERE IS SUFFICIENT EVIDENCE THAT 1,2-DICHLOROETHANE IS CARCINOGENIC IN RATS AND MICE, AND SHOULD BE REGARDED AS IF IT PRESENTED A CARCINOGENIC RISK TO HUMANS.
1,2-DICHLOROETHANE IS A SKIN IRRITANT, CENTRAL NERVOUS SYSTEM DEPRESSANT, AND HEPATOTOXIN. POISONING AFFECTS THE LUNGS AND CARDIOVASCULAR SYSTEM.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NARCOTIC/HEPATOXIN/CARCINOGEN. 1000 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE- VAPOR CONCENTRATIONS OF 10 TO 200 PPM MAY CAUSE DIZZINESS, NAUSEA, VOMITING, DIARRHEA, AND ANOREXIA. HIGHER CONCENTRATIONS MAY RESULT IN CYANOSIS, HYPOTENSION, DYSPNEA, CONJUNCTIVITIS, PULMONARY EDEMA, RALES, LIVER AND KIDNEY DAMAGE, CARDIOVASCULAR COLLAPSE, AND COMA.

CHRONIC EXPOSURE- WEIGHT LOSS, HYPOTENSION, JAUNDICE, OLIGURIA, OR ANEMIA MAY OCCUR AFTER REPEATED MINIMAL EXPOSURE. IMPAIREMENT OF THE CENTRAL NERVOUS SYSTEM, AND INCREASED MORBIDITY, ESPECIALLY DISEASES OF LIVER AND BILE DUCTS, WERE FOUND IN WORKERS CHRONICALLY EXPOSED TO CONCENTRATIONS BELOW 40 PPM AND AVERAGING 10 TO 15 PPM. SEE HUMAN AND ANIMAL CARCINOGENIC, HUMAN AND ANIMAL MUTAGENIC, AND TURMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/NARCOTIC/HEPATOTOXIN.

ACUTE EXPOSURE- PROLONGED SKIN CONTACT MAY CAUSE SEVERE IRRITATION, MODERATE EDEMA, AND NECROSIS. THE LIQUID IS READILY ABSORBED THROUGH THE SKIN AND SYSTEMIC EFFECTS MAY ENSUE, INCLUDING VOMITING,DIARRHEA, HYPOTENSION, CYANOSIS, PULMONARY EDEMA, AND RESPIRATORY DIFFICULTIES. LIVER AND KIDNEY DAMAGE MAY OCCUR.

CHRONIC EXPOSURE- REPEATED SKIN CONTACT MAY CAUSE ROUGH, RED, DRY SKIN DUE TO THE DEFATTING PROPERTIES OF THE LIQUID. CHRONIC ABSORPTION MAY CAUSE WEIGHT LOSS, HYPOTENSION, JAUNDICE, OLIGURIA, AND ANEMIA. SEE HUMAN AND ANIMAL CARCINOGENIC, HUMAN AND ANIMAL MUTAGENIC, AND TUMORIGENIC REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.

ACUTE EXPOSURE- EYE CONTACT WITH EITHER THE LIQUID OR WITH HIGH CONCENTRATIONS OF VAPOR MAY CAUSE IMMEDIATE DISCOMFORT, WITH CONJUNCTIVAL HYPEREMIA AND SLIGHT CORNEAL INJURY; CORNEAL BURNS FROM SPLASHES RECOVER QUICKLY WITH NO SCARRING.

CHRONIC EXPOSURE- NO EFFECTS REPORTED IN HUMANS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
NARCOTIC/HEPATOTOXIC.
ACUTE EXPOSURE- INITIAL SYMPTOMS ARE CYANOSIS, HYPOTENSION, VOMITING, DIARRHEA, CARDIOVASCULAR COLLAPSE, AND COMA. IN SEVERE POISONINGS, THESE PROGRESS RAPIDLY TO PULMONARY EDEMA AND RESPIRA TORY DIFFICULTY. IF THE EFFECTS OF POISONING ARE NOT IMMEDIATELY FATAL, THE VICTIM MAY HAVE A TEMPORARY SYMPTOM-FREE INTERVAL FOLLOWED BY JAUNDICE AND OLIGURIA OR ANURIA. THE FATAL ADULT DOSE IS APPROXIMATELY 5 ML.

FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL CONDITIONS. BECOMES SLIGHTLY ACIDIC ON EXPOSURE TO AIR, MOISTURE, OR LIGHT.

INCOMPATIBILITIES:
ALUMINUM: FORMATION OF A SHOCK-SENSITIVE COMPOUND.
AMMONIA: POSSIBLE EXPLOSION.
DIMETHYL AMINO PROPYL AMINE: POSSIBLE VIOLENT EXPLOSION.
DINITROGEN TETROXIDE: FORMATION OF A SHOCK-SENSITIVE COMPOUND.
NITRIC ACID: MIXTURES ARE EASILY DETONATED BY HEAT, IMPACT, OR FRICTION.
POTASSIUM: FORMATION OF A SHOCK-SENSITIVE COMPOUND.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE TOXIC GASES OF PHOSGENE AND CARBON MONOXIDE, AND CORROSIVE FUMES OF HYDROGEN CHLORIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****

CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUN-OFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG HOLDING AREA SUCH AS LAGOON, POND OR PIT FOR CONTAINMENT.

DIKE FLOW OF SPILLED MATERIAL USING SOIL OR SANDBAGS OR FOAMED BARRIERS SUCH AS POLYURETHANE OR CONCRETE.

USE CEMENT POWDER OR FLY ASH TO ABSORB LIQUID MASS.

IMMOBILIZE SPILL WITH UNIVERSAL GELLING AGENT.

REDUCE VAPOR AND FIRE HAZARD WITH FLUOROCARBON WATER FOAM.

AIR SPILL:
KNOCK DOWN VAPORS WITH WATER SPRAY. KEEP UPWIND.

WATER SPILL:
TRAP SPILLED MATERIAL AT BOTTOM IN DEEP WATER POCKETS, EXCAVATED HOLDING AREAS OR WITHIN SAND BAG BARRIERS.

USE ACTIVATED CARBON TO ABSORB SPILLED SUBSTANCE THAT IS DISSOLVED.

USE SUCTION HOSES TO REMOVE TRAPPED SPILL MATERIAL.

USE MECHANICAL DREDGES OR LIFTS TO EXTRACT IMMOBILIZED MASSES OF POLLUTION AND PRECIPITATES.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF THE SPILL AS IS PRACTICAL AND EFFECTIVE, IN ORDER TO REDUCE THE AREA CONTAMINATED AND THE AMOUNT OF MATERIAL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL NOT INVOLVED IN FIRE:
KEEP OPEN FLAMES, SPARKS OR OTHER IGNITION SOURCES AWAY.
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
BUILD DIKES FOR CONTAINMENT OF SPILL FLOW.
STOP LEAK IF YOU CAN DO IT WITHOUT RISK.
KNOCK DOWN VAPORS WITH WATER SPRAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION SYSTEM TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
EXPOSURE LIMIT TO 1000 PPM-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- GAS MASK WITH A CHIN-STYLE, FRONT-, OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY ESCAPE SELF-CONTAINED BREATHING APPARATUS.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND VENTED SAFETY GOGGLES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/14/85 REVISION DATE: 10/18/85

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METHYLENE CHLORIDE
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 75-09-2

SUBSTANCE: **METHYLENE CHLORIDE**

TRADE NAMES/SYNONYMS:
DICHLOROMETHANE; METHYLENE DICHLORIDE; METHYLENE BICHLORIDE; METHANE DICHLORIDE; D-150; D-143; D-142; D-123; D-35; D-37; D-37-S; D-37-SK; ACC14930

CHEMICAL FAMILY:
HALOGEN COMPOUND, ALIPHATIC

MOLECULAR FORMULA: C-H2-CL2 MOL WT: 84.93

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=0 REACTIVITY=1 PERSISTENCE=2
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: METHYLENE CHLORIDE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
500 PPM OSHA TWA; 1000 PPM OSHA CEILING; 2000 PPM/5 MIN IN 2 HOURS OSHA PEAK;
100 PPM ACGIH TWA; 500 PPM ACGIH STEL (NOTICE OF INTENDED CHANGES 1984-85)
75 PPM NIOSH RECOMMENDED TWA; 500 PPM/15 MINUTES NIOSH RECOMMENDED CEILING

PHYSICAL DATA

DESCRIPTION: CLEAR LIQUID WITH AN MILD, CHLOROFORM-LIKE ODOR. NOT CONSIDERED TO HAVE ADEQUATE WARNING PROPERTIES. BOILING POINT: 104 F (40 C)

MELTING POINT: -142 F (-95 C) SPECIFIC GRAVITY: 1.3

VAPOR PRESSURE: 380 MMHG @ 22 C EVAPORATION RATE: (BU AC=1) 0.036 TTE

SOLUBILITY IN WATER: 2% ODOR THRESHOLD: 214 PPM VAPOR DENSITY: 2.9

SOLVENT SOLUBILITY: ALCOHOL, ETHER, DIMETHYL FORMAMIDE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
FORMS FLAMMABLE VAPOR-AIR MIXTURES AT 212 F (100 C) OR HIGHER. CAN FORM FLAMMABLE MIXTURES IN ATMOSPHERE HAVING HIGH OXYGEN CONTENT.

FLASH POINT: NONE UPPER EXPLOSIVE LIMIT: 19% LOWER EXPLOSIVE LIMIT: 12%

AUTOIGNITION TEMP.: 1033 F (556 C)

FIREFIGHTING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
STAY AWAY FROM STORAGE TANK ENDS. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 74).

WEAR RESPIRATORY PROTECTIVE EQUIPMENT. EXTINGUISH USING AGENTS INDICATED; IF LARGE AMOUNTS OF COMBUSTIBLE MATERIALS ARE INVOLVED, USE WATER SPRAY OR FOG IN FLOODING AMOUNTS. USE WATER SPRAY TO KNOCK DOWN CORROSIVE VAPORS. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS; KEEP UPWIND.

TOXICITY

10 MG EYE-RABBIT MILD IRRITATION; 88,000 MG/M3/30 MINUTES INHALATION-RAT LC50; 14400 PPM/7 HOURS INHALATION-MOUSE LC50; 1900 MG/KG ORAL-RABBIT LDLO; 500 PPM/8 HOURS INHALATION-HUMAN TCLO; 2524 MG/KG ORAL-RAT LD50; MUTAGENIC DATA (RTECS); TUMORIGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTECS); INDEFINITE ANIMAL CARCINOGEN (IARC). AVAILABLE DATA DO NOT PERMIT AN EVALUATION OF THE CARCINOGENICITY OF METHYLENE CHLORIDE TO BE MADE.

METHYLENE CHLORIDE IS A SKIN IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT. EXPOSURE MAY IRRITATE THE EYES, AND MUCOUS MEMBRANES. POISONING MAY AFFECT THE LIVER AND KIDNEYS. METABOLISM OF METHYLENE CHLORIDE BY HUMANS LEADS TO AN ELEVATION OF CARBOXYHEMOGLOBIN (METHEMOGLOBINEMIA), RESULTING IN DECREASED OXYGEN CARRYING CAPACITY IN THE BLOOD. THIS MAY PRESENT AN INCREASED RISK TO PEOPLE WITH HEART PROBLEMS.

IN AN INHALATION STUDY BY THE NATIONAL TOXICOLOGY PROGRAM (NTP), METHYLENE CHLORIDE CAUSED AN INCREASE IN LUNG AND LIVER CANCER IN MICE. IN A SIMILAR STUDY IN RATS, METHYLENE CHLORIDE CAUSED AN INCREASE IN BENIGN MAMMARY TUMORS. TO DATA, THERE IS NO EVIDENCE THAT METHYLENE CHLORIDE HAS CAUSED INCREASED CANCER IN HUMANS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC. 5000 PPM IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
ACUTE EXPOSURE- BRIEF EXPOSURE TO HIGH CONCENTRATIONS RESULTS IN FATIGUE, WEAKNESS, IRRITABILITY, MENTAL CONFUSION, HEADACHE, LIGHTHEADEDNESS, GIDDINESS, SLEEPINESS, STUPOR, VOMITING, NAUSEA,CHILLS, PARESTHESIAS, DYSPNEA, INCREASED, FOLLOWED BY DECREASED RESPIRATION, AND DELAYED PULMONARY EDEMA. EXCESSIVE EXPOSURE (>25,000 PPM, HUMANS) CAUSES RAPID COMA AND DEATH. IN ANIMALS, METHYLENE CHLORIDE HAS CAUSED LIVER AND KIDNEY DAMAGE, TACHYCARDIA, AND HYPOTENSION. CAUSES METHEMOGLOBINEMIA AS EVIDENCED BY BLUE SKIN AND LIPS (SEE TOXICITY SECTION). AT HIGH LEVELS IT HAS BEEN SHOWN TO CAUSE CARDIAC ARRYTHMIA IN ANIMALS AND THIS IS POTENTIALLY FATAL.

CHRONIC EXPOSURE- REPEATED EXPOSURE TO CONCENTRATIONS FROM 500-3600 PPM FOR ONE YEAR HAS CAUSED TOXIC ENCAPHALOSIS WITH HEARING AND VISUAL DELUSIONS AND HALLUCINATIONS. LIVER DAMAGE IS POSSIBLE. SEE ANIMAL AND HUMAN MUTAGENIC, ANIMAL MUTAGENIC, ANIMAL REPRODUCTIVE EFFECTS AND TUMORIGENIC REFERENCES IN TOXICITY SECTION.
REST. GET MEDICAL ATTENTION.

FIRST AID: REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- CONTACT MAY CAUSE SEVERE PAIN, BURNS, BLISTERING AND PARESTHESIAS, AND MAY BE ABSORBED THROUGH INTACT SKIN TO CAUSE NARCOSIS CHARACTERIZED BY NAUSEA, VOMITING, HEADACHE, MENTAL CONFUSION AND STUPOR. INHALATION.

CHRONIC EXPOSURE- REPEATED CONTACT MAY CAUSE A DRY, SCALY, AND FISSURED DERMATITIS DUE TO DEFATTING ACTION OF LIQUID ON SKIN. SEE ANIMAL CARCINOGENIC, HUMAN AND ANIMAL MUTAGENIC, AND ANIMAL MUTAGENIC AND REPRODUCTIVE EFFECTS IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE PAIN AND EXTREME IRRITATION, BUT IT IS NOT LIKELY TO CAUSE SERIOUS INJURY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
NARCOTIC.
  ACUTE EXPOSURE- TOXIC AMOUNTS CAUSE RAPID UNCONSCIOUSNESS AND LACK OF RESPONSE TO PAINFUL STIMULI. RESPIRATION IS RAPID AT FIRST, THEN SLOW.

  FIRST AID- GET MEDICAL ATTENTION IMMEDIATELY. IF MEDICAL ATTENTION IS NOT IMMEDIATELY AVAILABLE, AND IF VICTIM IS CONSCIOUS, ATTEMPT TO INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GIVE OXYGEN IF THE SKIN IS BLUE OR IF THERE IS DIFFICULTY IN BREATHING.

REACTIVITY

REACTIVITY:
STABLE AT ORDINARY PRESSURES UP TO THE BOILING POINT, 40 C. SLIGHTLY REACTIVE AND PRACTICALLY NON-FLAMMABLE.

INCOMPATIBILITIES:
REACTIVE METALS INCLUDING HALOGENS AND STRONG OXIDIZERS, EXAMPLES FOLLOW:

METHYLENE CHLORIDE:
  LITHIUM: EXPLOSIVE REACTION.
  SODIUM: EXPLOSIVE REACTION.
  LIQUID OXYGEN: EXPLOSIVE REACTION.
  ZIRCONIUM: EXPLOSIVE REACTION.
  ZINC: EXPLOSIVE REACTION.
  N-METHYL-N-NITRSO UREA AND POTASSIUM HYDROXIDE: EXPLOSIVE REACTION.
  POTASSIUM/SODIUM ALLOY: EXPLOSIVE REACTION.
  POTASSIUM: EXPLOSIVE REACTION.
  MAGNESIUM (POWDER): VIOLENT REACTION.
  ALULMINUM (POWDER): VIOLENT REACTION.
  NITRIC ACID: FORMS EXPLOSIVE COMPOUND (DISSOLVES EXOTHERMICALLY).
  NITROGEN DIOXIDE: FORMS EXPLOSIVE COMPOUND.
  DINITROGEN PENTAOXIDE: FORMS EXPLOSIVE COMPOUND.
  METHANOL (<0.5 VOL.%): INCREASED FLAMMABILITY.
  STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.
  POTASSIUM TERT-BUTOXIDE: IGNITION REACTION.
  PLASTICS, RUBBER OR COATINGS: SOME FORMS MAY BE ATTACKED.

DECOMPOSITION:
NO REPORTS FOUND. (BOILS AWAY UNCHANGED AT 40 C.)

POLYMERIZATION:
WILL NOT OCCUR.

****

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.
CONTAINER MAY EXPLODE IN HEAT OF FIRE.
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3)

METHYLENE CHLORIDE WILL ATTACK SOME FORMS OF PLASTICS, RUBBER, OR COATINGS.

CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS LISTED ABOVE AND EXCESSIVE HEAT.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP HEAT AND FLAMES AWAY. PROVIDE VENTILATION. WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING AND GLOVES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL. SCOOP UP AND PLACE IN A SUITABLE CONTAINER, E.G. METAL, CLOSE AND LABEL "METHYLENE CHLORIDE - KEEP AWAY FROM FIRE ANF HEAT - DO NOT BREATHE FUMES". FOR LARGER SPILLS, DIKE AS CLOSE TO THE SOURCE OF THE SPILL AS IS PRACTICAL AND EFFECTIVE IN ORDER TO REDUCE THE AREA CONTAMINATED. PUMP INTO METAL CONTAINERS AND CLOSE TIGHTLY AND LABEL "METHYLENE CHLORIDE - KEEP AWAY FROM HEAT AND FLAMES - DO NOT BREATHE FUMES". ASSURE THAT PUMPS DO NOT OVERHEAT. NO SMOKING FLAMES, OR HEAT SOURCES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY.

PROTECTIVE EQUIPMENT

VENTILATION:
DO NOT USE THE DETECTION OF THE ODOR AS A SUBSTITUTE FOR NORMAL MONITORING METHODS. PROVIDE LOCAL EXHAUST, OR PROCESS ENCLOSURE VENTILATION SYSTEM TO MEET PERMISSIBLE EXPOSURE LIMITS.

RESPIRATOR:
EXPOSURE LIMIT TO >3000 PPM, INCLUDING THE IDLH LEVEL 5000 PPM- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE OR USE EQUIVALENT RESPIRATOR.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE. PREFFERED MATERIALS: PVA OR NBR.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-PROOF SAFETY GOGGLES TO PREVENT THIS SUBSTANCE FROM CONTACTING THE EYES. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/11/85 REVISION DATE: 02/06/86

-ADDITIONAL INFORMATION-

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3. MATERIAL SAFETY DATA SHEETS - SCINTILLATION FLUID

Crown Quad

NEF 934

NEN RESEARCH PRODUCTS

DUPONT

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

Name
AQUASOL® Universal LSC Cocktail

Synonyms
Not Applicable

CAS Name
Not Applicable

I.D. Nos./Codes
NEN Catalog # NEF-934

Manufacturer/Distributor DuPont
NEN Research Products

Address 549 Albany Street
Boston, MA 02118

Product Description Universal liquid scintillation counting solution.

Chemical Family
Mixture: Organic solvents; non-ionic surfactants; fluors; additives.

CAS Registry No.
Not Applicable

Chemical Formula Not Applicable

Product Information and Emergency Phone Weekdays:
Massachusetts and International (617)482-9595
Continental US: (800)225-1572 Evenings &
Weekends (617)667-9538

Transportation Emergency Phone
Chemtrec:(800)424-9300[If in DC (800)483-7616]

HAZARDOUS COMPONENTS

Material(s)	CAS #	CAS #	Approximate %
Mineral Spirits (Mixture), Pseudocumene (95-63-6), Paraxylene (106-42-3)			>50
Non-ionic surfactants (ethoxylated alkyl phenols)			<50

The following are not formula components: chlorinated solvents, benzene.

PHYSICAL DATA

Boiling Point 760mm Hg
Range: Starts ≈ 150°C (302°F)

Freezing Point
≈ -25°C(-13°F)

Specific Gravity (H_2O=1)
0.94

Vapor Pressure
Not determined.

Vapor Density : (Air=1)
> 1

Solubility in H_2O
Immiscible.

% Volatiles by Vol.
> 50

Evaporation Rate (Butyl Acetate = 1)
<1 (slower)

Form Liquid **Appearance** Clear

Color Colorless to slight fluorescence **Odor** Aromatic

pH Information
6% + H_2O = Approx. 5.5
50% + H_2O = Approx. 5.5

Octanol/Water Partition Coefficient
Not Determined.

FIRE AND EXPLOSION DATA

Flash Point 34°C (94°F) **Method** TCC

Autoignition Temperature
Not Determined

Flammable Limits in Air, % by Vol.

Lower Not Determined **Upper**

Fire and Explosion Hazards Flammable Liquid. Keep away from heat, sparks and open flame. Vapor heavier than air.

Extinguishing Media
Dry chemical, CO_2, foam

Special Fire Fighting Instructions Use self-contained breathing equipment to protect against the hazardous effects of the normal products of combustion, oxygen deficiency and toxic vapors.

The data in this Material Safety Data Sheet relates only to the specific material designated herein and does not relate to use in combination with any other material or in any process. The information set forth herein is furnished free of charge and is based on technical data that New England Nuclear believes to be reliable. It is intended for use by persons having technical skill and at their own discretion and risk. Since conditions of use are outside our control, we make no warranties, express or implied, and assume no liability in connection with any use of this information. Nothing herein is to be taken as a license to operate under or a recommendation to infringe any patents.

HAZARDOUS REACTIVITY

Instability Product is stable.

Incompatibility Reacts vigorously with oxidizing material.

Polymerization Not Applicable.

HEALTH HAZARD INFORMATION

Exposure Limits TLV not available.

Routes of Exposure and Effects

Inhalation	Low to medium concentrations may produce dizziness, headache, excitement. High concentrations may cause CNS depression and collapse.
Eye Contact	Irritation may result from contact with liquid or with vapor.
Skin Contact	Irritation leading to dermatitis may occur on prolonged or repeated skin contact.
Ingestion	Local irritation to mucous tissue. Ingestion may cause bronchitis, chemical pneumonia, collapse.

First Aid

Inhalation	Remove to fresh air. Call a physician.
Eye Contact	Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.
Skin Contact	Flush with plenty of water. Remove contaminated clothing. Wash skin with soap and water. Call a physician.
Ingestion	Call a physician. Do NOT induce vomiting.

PROTECTION INFORMATION

Ventilation Adequate local exhaust ventilation and/or general exhaust ventilation.

Personal Protective Equipment

Eye Protection - Chemical protective eye wear which complies with American National Standards Institute (ANSI) Standard Z87 (1972) should be worn.

Skin Protection- Chemical resistant gloves, apron/coat should be worn where handling conditions require them.

Use mechanical pipets. Do not pipet by mouth.

DISPOSAL PROCEDURES

Spill, Leak or Release Avoid inhalation of vapors and eye/skin contact. Remove sources of ignition; ventilate area. An air-supplied respirator should be worn in confined or inadequately ventilated areas. Use inert absorbent material and dispose of in a closed container.

Waste Disposal Comply with local, state and federal regulations.

SPECIAL PRECAUTIONS

Storage Conditions Flammable Liquid.

Store away from heat, sources of ignition and reactive materials in a cool, adequately ventilated area. Storage in cold is permissible. Restore container carefully to room temperature (vent cap, do not heat), and hold until any precipitate has redissolved and product is homogeneous.

Date Prepared Revised November 1985 MSDS934

SCINTIVERSE TM BIO-HP
SCINTIVERSE TM BIO-HP
SCINTIVERSE TM BIO-HP

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
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FAIR LAWN NJ 07410
(201) 796-7100

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CAT NO: SX144

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SUBSTANCE IDENTIFICATION

SUBSTANCE: SCINTIVERSE TM BIO-HP

TRADE NAMES/SYNONYMS:
SO-X-14; ACC40230

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT:	1,2,4-TRIMETHYLBENZENE CAS# 95-63-6	PERCENT: 65.0
COMPONENT:	XYLENE CAS# 1330-20-7	PERCENT: 8.8
COMPONENT:	METHYL ALCOHOL CAS# 67-56-1	PERCENT: 8.1
COMPONENT:	TRITON X-114 CAS# 9036-19-5	PERCENT: 6.7
COMPONENT:	POLYOXYETHYLENE (10) OCTYL PHENOL CAS# 9036-19-5	PERCENT: 5.5
COMPONENT:	TRITON GR 7M CAS# 577-11-7	PERCENT: 2.3
COMPONENT:	AEROSOL A-102 CAS# 39354-45-5	PERCENT: 2.3
COMPONENT:	BIS(MSB) CAS# 13280-61-0	PERCENT: <1.0
COMPONENT:	2,5-DIPHENYLOXAZOLE CAS# 92-71-7	PERCENT: <1.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
1,2,4-TRIMETHYLBENZENE:
25 PPM (125 MG/M3) ACGIH TWA; 35 PPM (170 MG/M3) ACGIH STEL
XYLENE:
100 PPM (435 MG/M3) OSHA TWA
100 PPM ACGIH TWA; 150 PPM (655 MG/M3) ACGIH STEL
100 PPM NIOSH RECOMMENDED TWA; 200 PPM NIOSH RECOMMENDED 15 MINUTE CEILING
METHYL ALCOHOL:
200 PPM OSHA TWA
200 PPM ACGIH TWA (SKIN); 250 PPM ACGIH STEL
200 PPM NIOSH RECOMMENDED TWA

PHYSICAL DATA

DESCRIPTION: FAINT BLUE FLUORESCENT-HUED LIQUID SPECIFIC GRAVITY: 0.9-0.93

SOLUBILITY IN WATER: SOLUBLE VAPOR DENSITY: > 1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME. VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE THE FLASHPOINT. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 118 F (48 C) FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND.

TOXICITY

1,2,4-TRIMETHYLBENZENE: 5000 MG/KG ORAL-RAT LDLO; 18 MG/M3/4 HOURS INHALATION-RAT LC50; CARCINOGEN STATUS: NONE; EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT, HIGHLY TOXIC BY INHALATION ROUTE AND A NARCOTIC.
XYLENE: 200 PPM INHALATION-HUMAN TCLO; 10000 PPM/6 HOURS INHALATION MAN LCLO; 4300 MG/KG ORAL-RAT LD50; 5000 PPM/4 HOURS INHALATION-RAT LD50; 1700 MG/KG SUBCUTANEOUS-RAT LD50; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA; (RTECS); IRRITATION DATA (RTECS); CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT; CENTRAL NERVOUS SYSTEM DEPRESSANT.
METHYL ALCOHOL: 340 MG/KG ORAL-HUMAN LDLO; 5628 MG/KG ORAL-RAT LD50; 64,000 PPM/ 4 HOURS INHALATION-RAT LC50; 20 GM/KG SKIN-RABBIT LD50; 86,000 MG/M3 INHALATION-HUMAN TCLO; MUTAGENIC DATA (RTECS); REPRODUCTIVE EFFECTS DATA (RTETCS); IRRITATION DATA (RTECS); CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT AND NARCOTIC.
TRITON X-114: 1800 MG/KG ORAL-RAT LD50; >3 G/KG SKIN-RABBIT LD50; CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.
POLYOXYETHYLENE (10) OCTYL PHENOL AND AEROSOL A-102: CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC.
10,000 PPM XYLENE IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
25,000 PPM METHYL ALCOHOL IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE

XYLENE: IRRITATION OF EYES, NOSE AND THROAT CAN OCCUR AT 200 PPM. THUS, THE IRRITANT EFFECTS MAY SERVE AS A WARNING TO PREVENT SERIOUS SYSTEMIC POISONING. SYSTEMIC EFFECTS AT ABOUT 200 PPM MAY INCLUDE ANOREXIA, NAUSEA, VOMITING, ABDOMINAL PAIN, HEADACHE AND SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION SUCH AS DIZZINESS, WEAKNESS, EUPHORIA, EXCITEMENT, INCOORDINATION, STAGGERING GAIT, DROWSINESS AND ANESTHESIA. HIGHER LEVELS MAY CAUSE FLUSHING AND REDDENING OF THE FACE WITH A FEELING OF INCREASED BODY HEAT DUE TO DILATION OF SUPERFICIAL BLOOD VESSELS, BLURRED VISION, TREMORS, SALIVATION, SHALLOW AND RAPID RESPIRATION, VENTRICULAR FIBRILLATION, PARALYSIS, PARESTHESIA OF THE EXTREMITIES, UNCONSCIOUSNESS AND CONVULSIONS, POSSIBLY PRECEDED BY VIOLENT EXCITEMENT OR DELIRIUM. FROM 10,000-30,000 PPM CAN PRODUCE ANESTHESIA WITHIN 1 MINUTE. EXPOSURE OF 3 PAINTERS TO APPROXIMATELY 10,000 PPM FOR 18.5 HOURS RESULTED IN 1 DEATH FROM PULMONARY EDEMA AND BRAIN HEMORRHAGES. BOTH SURVIVORS WERE UNCONSCIOUS FOR 19-24 HOURS AND DEVELOPED HEPATIC IMPAIRMENT; RENAL IMPAIRMENT, RETROGRADE AMNESIA, HYPOTHERMIA AND LUNG CONGESTION ALSO OCCURRED, BUT RECOVERY WAS COMPLETE WITHIN 2 DAYS. HIGH CONCENTRATIONS RARELY CAUSE RAPID DEATH FROM SUDDEN VENTRICULAR FIBRILLATION DUE TO SENSTIZATION OF MYOCARDIUM TO EVEN ENDOGENOUS EPINEPHRINE. MORE FREQUENTLY DEATH OCCURS FROM RESPIRATORY ARREST AND CONSEQUENT ASPHYXIA. APPROXIMATELY 60% OF XYLENE SUPPLIED TO THE LUNGS IS ABSORBED. UPTAKE BY THE BODY IS HIGHLY CORRELATED WITH THE AMOUNT OF BODY FAT. XYLENE STORED IN ADIPOSE TISSUE IS ELIMANATED SLOWLY. PSYCHOLOGICAL TESTS HAVE SHOWN IMPAIRMENT OF PERFORMANCE ABILITY, SPECIALLY WHEN UPTAKE IS INCREASED BY PHYSICAL WORK.

1,2,4-TRIMETHYLBENZENE: MAY CAUSE CHEMICAL PNEUMONITIS AT SITE OF CONTACT, MAY ALSO CAUSE SORE THROAT, COUGHING, HEADACHE, DYSPNEA, FATIGUE, NARCOSIS, AND HEMORRHAGIC INFLAMMATORY LESIONS OF MUCOUS MEMBRANES.

METHYL ALCOHOL: INTOXICATION BEGINS WITH A STATE OF INEBRIATION. WITHIN 12-18 HOURS, HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS OCCUR, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS AND OTHER SIGNS OF NARCOSIS, THEN SEVERE ABDOMINAL, BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS OCCUR RARELY. BLURRED OR DIMMED VISION HAS OCCURRED, FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN AND ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION.

TRITON X-114: MAY CAUSE COUGHING AND IRRITATION OF THE MUCOUS MEMBRANE.
POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION.
TRITON GR 7M: MAY CAUSE COUGHING AND IRRITATION OF THE MUCOUS MEMBRANES.
AEROSOL A-102: MAY CAUSE COUGHING AND IRRITATION OF THE MUCOUS MEMBRANES.

CHRONIC EXPOSURE

XYLENE: REPEATED OR PROLONGED INHALATION OF VAPORS MAY CAUSE CENTRAL NERVOUS SYSTEM EXCITATION, FOLLOWED BY DEPRESSION WITH PARESTHESIAS, TREMORS, APPREHENSION, IMPAIRED MEMORY, WEAKNESS, FATIGUE, NERVOUS IRRITABILITY, VERTIGO, HEADACHE, ANOREXIA, NAUSEA, FLATULENCE, TINNITUS, SWEETISH TASTE IN THE MOUTH, STRONG THIRST AND BLEEDING NOSE. CENTRAL NERVOUS SYSTEM DISORDERS ASSOCIATED WITH VEGETATIVE DYSTONIA,

IMPAIRED PROTEIN METABOLISM AND DECREASED IMMUNE RESPONSE ARE POSSIBLE. BLOOD CHANGES MAY INCLUDE ANEMIA, POIKILOCYTOSIS, ANISOCYTOSIS, LEUKOPENIA WITH RELATIVE LYMPHOCYTOSIS AND POSSIBLE THROMBOCYTOPENIA. WOMEN MAY DEVELOP MENSTRUAL DISORDERS SUCH AS MENORRHAGIA OR METRORRHAGIA AND PATHOLOGICAL PREGNANCY OR INFERTILITY. CASES OF SERIOUS AND FATAL POISONING AMONG PREGNANT WOMEN WITH HEMOPHILIA AND BONE MARROW APLASIA HAVE BEEN REPORTED. CLINICALLY, NO BONE MARROW APLASIA, BUT HYPERPLASIA, MODERATE LIVER ENLARGEMENT, NECROSIS AND NEPHROSIS MAY OCCUR. CHRONIC INHALATION BY PREGNANT RATS PRODUCED FETAL MUSCULOSKELETAL ABNORMALITIES. LONG TERM EXPOSURE OF GREATER THAN 10 YEARS TO AROMATIC HYDROCARBONS HAS BEEN ASSOCIATED WITH INCREASED LEVELS OF GASTROINTESTINAL CANCER IN WHITE MALE WORKERS.

1,2,4-TRIMETHYBENZENE: MAY CAUSE NERVOUSNESS, TENSION, ANXIETY, ASTHMATIC BRONCHITIS, PAIN IN THE LIMBS, PERIPHERAL NUMBNESS AND PARESTHESIA. MAY ALSO CAUSE BONE MARROW DAMAGE.

METHYL ALCOHOL: PROLONGED OR REPEATED EXPOSURE MAY CAUSE SYMPTOMS SUCH AS BLURRED VISION, CONTRACTION OF VISUAL FIELDS AND SOMETIMES, COMPLETE BLINDNESS.

TRITON X-144: NO EFFECTS REPORTED.

POLYOXYETHYLENE (10) OCTYL PHENOL: REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION.

TRITON GR 7M: NO EFFECTS REPORTED.

AEROSOL A-102: NO EFFECTS REPORTED.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE

XYLENE: LIQUID XYLENE IS A DEFATTING AGENT AND MAY CAUSE DRYING, ERYTHEMA AND POSSIBLY BLISTERING. THE LIQUID IS READILY ABSORBED THROUGH INTACT OR BROKEN SKIN AT A RATE OF APPROXIMATELY 4-10 MG/CM2/HOUR. LIQUID CONTACT MAY CAUSE VASODILATION IN SENSITIVE AREAS.

1,2,4-TRIMETHYLBENZENE: MAY CAUSE IRRITATION WITH REDNESS, EDEMA AND BLISTERS.

METHYL ALCOHOL: CONTACT WITH THE LIQUID CAN PRODUCE DEFATTING AND A MILD DERMATITIS. READILY ABSORBED THROUGH INTACT SKIN TO CAUSE NARCOSIS, OPTIC NEURITIS AND ACIDOSIS.

TRITON X-114: MAY CAUSE IRRITATION, REDNESS AND PAPULAR DERMATITIS DUE TO THE REMOVAL OF OILS FROM THE SKIN.

POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION.

TRITON GR 7M: CONTACT WITH THE LIQUID MAY CAUSE DRYING AND CRACKING.

AEROSOL A-102: CONTACT WITH THE LIQUID MAY CAUSE DRYING AND CRACKING.

CHRONIC EXPOSURE

XYLENE: REPEATED OR PROLONGED EXPOSURE MAY CAUSE ECZEMA OR DERMATITIS.

1,2,4-TRIMETHYLBENZENE: MAY CAUSE DERMATITIS, AND NERVOUSNESS, TENSION, ANXIETY, PERIPHERAL NUMBNESS AND PARESTHESEA.

METHYL ALCOHOL: PROLONGED OR REPEATED SKIN CONTACT PRODUCES ECZEMA, REDNESS AND SCALING. CHRONIC ABSORPTION MAY RESULT IN VISUAL IMPAIRMENT AND OPTIC NEURITIS.

TRITON X-114: MAY CAUSE IRRITATION, BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.

POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION. BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.

TRITON GR 7M: REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

AEROSOL A-102: REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CORROSIVE.

ACUTE EXPOSURE

XYLENE: 200 PPM MAY CAUSE CONJUNCTIVAL IRRITATION IN HUMANS. AN ACCIDENTAL SPLASH IN THE HUMAN EYE CAUSED TRANSIENT SUPERFICIAL DAMAGE WITH RAPID RECOVERY. IN RABBIT EYES, THE LIQUID CAUSED IMMEDIATE DISCOMFORT AND BLEPHAROSPASM FOLLOWED BY HYPEREMIA OF THE CONJUNCTIVA AND VERY SLIGHT TRANSIENT INJURY OF THE CORNEAL EPITHELIUM.

1,2,4-TRIMETHYLBENZENE: MAY CAUSE REDNESS, EDEMA, PAIN AND POSSIBLE CORNEAL LESIONS.

METHYL ALCOHOL: EYE CONTACT WITH METHANOL HAS CAUSED SUPERFICIAL CORNEAL LESIONS. INGESTION, INHALATION OR SKIN ABSORPTION MAY RESULT IN BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANANENT BLINDNESS, WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA.

TRITON X-114: VAPORS MAY BE IRRITATING AND MAY CAUSE PROFUSE LACRIMATION. DIRECT CONTACT MAY CAUSE IRRITATION, BURNS, AND PERMANENT CORNEAL DAMAGE.

POLYOXYETHYLENE (10) OCTYL PHENOL: DIRECT CONTACT MAY CAUSE IRRITATION, PAIN AND POSSIBLY INJURY.

TRITON GR 7M: MAY CAUSE IRRITATION WITH REDNESS.

AEROSOL A-102: MAY CAUSE IRRITATION WITH REDNESS.

CHRONIC EXPOSURE:

XYLENE: PROLONGED EXPOSURE TO HIGH VAPOR CONCENTRATION CAUSED VACUOLAR, EPITHELIAL KERATOPATHY IN WORKERS. SIMILAR LESIONS WERE PRODUCED IN CATS EXPOSED TO SUBLETHAL CONCENTRATIONS FOR SEVERAL HOURS. CORNEAL EPITHELIAL DAMAGE, BUT NO VACUOLES OCCURRED IN RABBITS.

1,2,4-TRIMETHYLBENZENE: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

METHYL ALCOHOL: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS. VISUAL IMPAIRMENT AS DESCRIBED ABOVE MAY INDICATE CHRONIC EXPOSURE BY INGESTION, INHALATION OR SKIN ABSORPTION.
TRITON X-114: REPEATED OR PROLONGED CONTACT WITH VAPORS MAY CAUSE CONJUNCTIVITIS.
POLYOXYETHYLENE (10) OXTYL PHENOL: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.
TRITON GR 7M: NO EFFECTS REPORTED.
AEROSOL A-102: NO EFFECTS REPORTED.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE
XYLENE: TOXIC EFFECTS APPEAR MORE RAPIDLY AND ARE MUCH MORE SEVERE FOLLOWING INGESTION THAN AFTER INHALATION. HUMANS MAY BE MUCH MORE SUSCEPTIBLE THAN RODENTS TO ACUTE TOXICITY OF AROMATIC HYDROCARBONS. A DOSE OF 15 TO 30 MILLILITERS, OR ABOUT 1 OUNCE, IS THE EXPECTED HUMAN LETHAL DOSE BY INGESTION. INGESTION WILL CAUSE SEVERE GASTROINTESTINAL DISTRESS. IF ASPIRATION INTO THE LUNGS OCCURS, CHEMICAL PNEUMONITIS, PULMONARY EDEMA AND HEMORRHAGE MAY OCCUR. INGESTION OF SMALL QUANTITIES PRODUCED URINARY DEXTROSE AND UROBILINOGEN EXCRETION WITH TOXIC HEPATITIS WHICH WAS REVERSIBLE IN 20 DAYS. INCREASED CARDIAC SENSITIVITY TO CATECHOLAMINES MAY OCCUR.
1,2,4-TRIMETHYLBENZENE: MAY CAUSE BURNING SENSATION IN THE MOUTH, SORE THROAT, HEADACHE, ABDOMINAL PAIN, NAUSEA, VOMITING, BLOODY SPUTUM, WEAKNESS, VERTIGO, DYSPNEA, NARCOSIS, ANEMIA, AND CONVULSIONS.
METHYL ALCOHOL: MAY CAUSE DELAYED SYMPTOMS OF HEADACHE, ANOREXIA, WEAKNESS, FATIGUE, LEG CRAMPS, VERTIGO AND RESTLESSNESS, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, DIZZINESS, AND OTHER SIGNS OF NARCOSIS. SEVERE ABDOMINAL, BACK AND LEG PAIN, MUSCULAR INCOORDINATION, SWEATING, TRACHEITIS AND BRONCHITIS MAY OCCUR. APATHY OR DELIRIUM MAY PROGRESS TO COMA. EXCITEMENT, MANIA AND CONVULSIONS HAVE OCCURED RARELY. BLURRED OR DIMMED VISION FOLLOWED BY TRANSIENT OR PERMANENT BLINDNESS WITH OPTIC NEURITIS, EYE PAIN, ATROPHY, CONCENTRIC VISUAL FIELDS AND PHOTOPHOBIA MAY OCCUR. ACIDOSIS MAY RESULT IN RAPID, SHALLOW RESPIRATION, CYANOSIS, COMA AND HYPOTENSION. MILD TACHYCARDIA, CARDIAC DEPRESSION AND PERIPHERAL NEURITIS ARE POSSIBLE, AS WELL AS LIVER AND KIDNEY DAMAGE AND CEREBRAL AND PULMONARY EDEMA. DEATH IS POSSIBLE FROM RESPIRATORY FAILURE OR CIRCULATORY COLLAPSE. PROLONGED ASTHENIA AND PARTIAL OR COMPLETE LOSS OF VISION IN 2-6 DAYS, AND PERMANENT RENAL DYSFUNCTION MAY FOLLOW NON-FATAL INTOXICATION.
TRITON X-114: MAY CAUSE GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING. LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.
POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING, LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.
TRITON GR 7M: INGESTION OF LARGE AMOUNTS OF THIS SUBSTANCE MAY CAUSE DIARRHEA, ABDOMINAL CRAMPS AND DEHYDRATION.
AEROSOL A-102: INGESTION OF LARGE AMOUNTS OF THIS SUBSTANCE MAY CAUSE DIARRHEA, ABDOMINAL CRAMPS AND DEHYDRATION.

CHRONIC EXPOSURE
XYLENE: CHRONIC INGESTION BY PREGNANT MICE RESULTED IN REPRODUCTIVE EFFECTS OF POST-IMPLANTATION MORTALITY, FETOTOXICITY AND FETAL ABNORMALITIES INVOLVING CRANIOFACIAL AND MUSCULOSKETAL DEVELOPMENT.
1,2,4-TRIMETHYLBENZENE: NO DATA REPORTED FOR HUMANS.
METHYL ALCOHOL: PROLONGED OR REPEATED INGESTION MAY CAUSE VISUAL IMPAIRMENT LEADING TO POSSIBLE BLINDNESS.
TRITON X-114: NO DATA REPORTED FOR HUMANS.
POLYOXYETHYLENE (10) OCTYL PHENOL: NO DATA REPORTED FOR HUMANS.
TRITON GR 7M: NONE REPORTED IN HUMANS. MAY INCREASE ABSORBANCE OF DRUGS GIVEN CONCURRENTLY.
AEROSOL A-102: NONE REPORTED IN HUMANS. MAY INCREASE ABSORBANCE OF DRUGS GIVEN CONCURRENTLY.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
XYLENE:
1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLID-INDIONE: POSSIBLE EXPLOSION.
NITRIC ACID UNDER PRESSURE IN THE MANUFACTURE OF TEREPHTHALLIC ACID: CREATES A POSSIBLE EXPLOSION HAZARD IN AUTOCLAVE AND CONDENSING SYSTEMS.
LIQUID PHASE OXIDATION OF P-XYLENE IN ACETIC ACID: POSSIBLE EXPLOSION.
NITRIC ACID IN THE PRESENCE OF SULFURIC ACID: INTENSE REACTION.
OXIDIZING AGENTS: POSSIBLE HAZARDOUS REACTION.

1,2,4-TRIMETHYLBENZENE:
NITRIC ACID: MAY CAUSE AN EXPLOSION WHEN MIXED AT 115 C OR ABOVE.

METHYL ALCOHOL:
CHLOROFORM AND SODUM HYDROXIDE: EXPLOSIVE REACTION.
CALCIUM CARBIDE: VIOLENT REACTION.
MAGNESIUM: VIOLENT REACTION.
CYANURIC CHLORIDE: VIOLENT REACTION.

BERYLLIUM HYDRIDE: INTENSE REACTION AT 200 C.
BROMINE: INTENSE EXOTHERMIC REACTION.
CHROMIC ANHYDRIDE: POSSIBLE EXPLOSIVE REACTION.
NICKEL: POSSIBLE IGNITION IN THE PRESENCE OF CATALYTIC AMOUNTS.
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

TRITON X-114:
STRONG OXIDIZING AGENTS: POSSIBLE VIOLENT OR EXPLOSIVE REACTION.
STRONG REDUCING AGENTS: POSSIBLE VIOLENT OR EXPLOSIVE REACTION.

POLYOXYETHYLENE (10) OCTYL PHENOL:
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

TRITON GR 7M:
NONE KNOWN.

AEROSOL A-102:
NONE KNOWN.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****
CONDITIONS TO AVOID

AVOID HEAT NITRIC ACID, AND OXIDIZERS.

****
SPILL AND LEAK PROCEDURES

WATER SPILL:
IF WATER POLLUTION OCCURS, NOTIFY APPROPRIATE AUTHORITIES.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA! KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET OR HOOD. SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE. TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
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SCINTANALIZED (TM) REAGEN
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SUBSTANCE IDENTIFICATION

SUBSTANCE: SCINTANALIZED (TM) REAGENTS

TRADE NAMES/SYNONYMS:
SCINTIVERSE TM; SCINTILENE TM; SCINTIPREP TM 1; SCINTIPREP TM 2;
SCINTIVERSE TM E; SO-X-1; SO-X-2; SO-X-6; SO-X-7; SO-X-16 OHS40206; ACC40206

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=3 REACTIVITY=0 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: XYLENE CAS# 1330-20-7	PERCENT: 60.7-99.5
COMPONENT: 2,5-DIPHENYLOXAZOLE CAS# 92-71-7	PERCENT: 0.5-11.8
COMPONENT: POLYOXYETHYLENE (10) OCTYL PHENOL CAS# 9036-19-5	PERCENT: 0.0-37.0
COMPONENT: IGEPAL (R) CO-630 CAS# 9016-45-9	PERCENT: 0.0-39.0
COMPONENT: BIS(MSB) CAS# 13280-61-0	PERCENT: <1.0
COMPONENT: DIMETHYL POPOP CAS# 3073-87-8	PERCENT: <1.0
COMPONENT: POPOP 1,4-BIS-2-(5-PHENYLOXAXOLYL)-BENZENE CAS# 1806-34-4	PERCENT: <1.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
XYLENE:
100 PPM (435 MG/M3) OSHA TWA
100 PPM ACGIH TWA; 150 PPM (655 MG/M3) ACGIH STEL
100 PPM NIOSH RECOMMENDED TWA; 200 PPM NIOSH RECOMMENDED CEILING

PHYSICAL DATA

DESCRIPTION: FAINT BLUE FLUORESCENT-HUED LIQUID SPECIFIC GRAVITY: 0.9-0.93

EVAPORATION RATE: (ETHER=1) > 1.0

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
DANGEROUS FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE FLASH POINT.

VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

DUE TO LOW ELECTROCONDUCTIVITY OF THE SUBSTANCE, FLOW OR AGITATION MAY GENERATE ELECTROSTATIC CHARGES RESULTING IN SPARKS WITH POSSIBLE IGNITION.

FLASH POINT: >86 F (>30 C) FLAMMABILITY CLASS(OSHA): IC

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 27).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND.

TOXICITY

XYLENE: 200 PPM EYE-HUMAN IRRITATION; 100% CONCENTRATION SKIN-RABBIT MODERATE IRRITATION; 87 MG EYE-RABBIT MILD IRRITATION; 5 MG/24 HOURS EYE-RABBIT SEVERE IRRITATION; 200 PPM INHALATION-HUMAN TCLO; 10000 PPM/6 HOURS INHALATION-MAN LCLO; 4300 MG/KG ORAL-RAT LD50; 5000 PPM/4 HOURS INHALATION-RAT LC50; 1700 MG/KG SUBCUTANEOUS-RAT LD50; 1570 UG/KG

INTRAPERITONEAL-MOUSE LD50; 2000 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; 2000 MG/KG INTRAPERITONEAL-MAMMAL LDLO; MUTAGENIC DATA (RTEC); REPRODUCTIVE EFFECTS DATA (RTECS); CARCINOGENS STATUS: NONE; EYE, MUCOUS MEMBRANE AND SKIN IRRITANT; CENTRAL NERVOUS SYSTEM DEPRESSANT.

2,5-DIPHENYLOXAZOLE: 750 MG/KG INTRAPERITONEAL-MOUSE LD50; CARCINOGEN STATUS: NONE.MODERATELY TOXIC BY INTRAPERITONEAL ROUTES.

IGEPAL (R) CO-630: 2590 MG/KG ORAL-RAT LD50; 2830 MG/KG SKIN-RABBIT LD50; IRRITATION DATA (RTECS); CARCINOGEN STATUS: NONE; MAY BE EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.

POLYOXYETHYLENE (10) OCTYL PHENOL: CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:

IRRITANT/NARCOTIC.

10,000 PPM XYLENE IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE

XYLENE: IRRITATION OF EYES, NOSE AND THROAT CAN OCCUR AT 200 PPM. THUS, THE IRRITANT EFFECTS MAY SERVE AS A WARNING TO PREVENT SERIOUS SYSTEMIC POISONING. SYSTEMIC EFFECTS AT ABOUT 200 PPM MAY INCLUDE ANOREXIA, NAUSEA, VOMITING, ABDOMINAL PAIN, HEADACHE AND SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION SUCH AS DIZZINESS, WEAKNESS, EUPHORIA, EXCITEMENT, INCOORDINATION, STAGGERING GAIT, DROWSINESS AND ANESTHESIA. HIGHER LEVELS MAY CAUSE FLUSHING AND REDDENING OF THE FACE WITH A FEELING OF INCREASED BODY HEAT DUE TO DILATION OF SUPERFICIAL BLOOD VESSELS, BLURRED VISION, TREMORS, SALIVATION, SHALLOW AND RAPID RESPIRATION, VENTRICULAR FIBRILLATION, PARALYSIS, PARESTHESIA OF THE EXTREMITIES, UNCONSCIOUSNESS AND CONVULSIONS, POSSIBLY PRECEDED BY VIOLENT EXCITEMENT OR DELIRIUM. FROM 10,000-30,000 PPM CAN PRODUCE ANESTHESIA WITHIN 1 MINUTE. EXPOSURE OF 3 PAINTERS TO APPROXIMATELY 10,000 PPM FOR 18.5 HOURS RESULTED IN 1 DEATH FROM PULMONARY EDEMA AND BRAIN HEMORRHAGES. BOTH SURVIVORS WERE UNCONSCIOUS FOR 19-24 HOURS AND DEVELOPED HEPATIC IMPAIRMENT; RENAL IMPAIRMENT, RETROGRADE AMNESIA, HYPOTHERMIA AND LUNG CONGESTION ALSO OCCURRED, BUT RECOVERY WAS COMPLETE WITHIN 2 DAYS. HIGH CONCENTRATIONS RARELY CAUSE RAPID DEATH FROM SUDDEN VENTRICULAR FIBRILLATION DUE TO SENSTIZATION OF MYOCARDIUM TO EVEN ENDOGENOUS EPINEPHRINE. MORE FREQUENTLY DEATH OCCURS FROM RESPIRATORY ARREST AND CONSEQUENT ASPHYXIA. APPROXIMATELY 60% OF XYLENE SUPPLIED TO THE LUNGS IS ABSORBED. UPTAKE BY THE BODY IS HIGHLY CORRELATED WITH THE AMOUNT OF BODY FAT. XYLENE STORED IN ADIPOSE TISSUE IS ELIMINATED SLOWLY PSYCHOLOGICAL TESTS HAVE SHOWN IMPAIRMENT OF PERFORMANCE ABILITY, ESPECIALLY WHEN UPTAKE IS INCREASED BY PHYSICAL WORK.

2,5-DIPHENYLOXAZOLE: NO DATA AVAILABLE.

POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION.

IGEPAL (R) CO-630: EXPOSURE TO VAPOR IS NOT LIKELY UNLESS MATERIAL IS HANDLED HOT. DIRECT CONTACT AND CONTACT WITH VAPORS MAY IRRITATE THE MUCOUS MEMBRANE.

CHRONIC EXPOSURE

XYLENE: REPEATED OR PROLONGED INHALATION OF VAPORS MAY CAUSE CENTRAL NERVOUS SYSTEM EXCITATION, FOLLOWED BY DEPRESSION WITH PARESTHESIAS, TREMORS, APPREHENSION, IMPAIRED MEMORY, WEAKNESS, FATIGUE, NERVOUS IRRITABILITY, VERTIGO, HEADACHE, ANOREXIA, NAUSEA, FLATULENCE, TINNITUS, SWEETISH TASTE IN THE MOUTH, STRONG THIRST AND BLEEDING NOSE. CENTRAL NERVOUS SYSTEM DISORDERS ASSOCIATED WITH VEGETATIVE DYSTONIA, IMPAIRED PROTEIN METABOLISM AND DECREASED IMMUNE RESPONSE ARE POSSIBLE. BLOOD

CHANGES MAY INCLUDE ANEMIA, POIKILOCYTOSIS, ANISOCYTOSIS, LEUKOPENIA WITH RELATIVE LYMPHOCYTOSIS AND POSSIBLE THROMBOCYTOPENIA. WOMEN MAY DEVELOP MENSTRUAL DISORDERS SUCH AS MENORRHAGIA OR METRORRHAGIA AND PATHOLOGICAL PREGNANCY OR INFERTILITY. CASES OF SERIOUS AND FATAL POISONING AMONG PREGNANT WOMEN WITH HEMOPHILIA AND BONE MARROW APLASIA HAVE BEEN REPROTED. CLINICALLY, NO BONE MARROW APLASIA, BUT HYPERPLASIA, MODERATE LIVER ENLARGEMENT, NECROSIS AND NEPHROSIS MAY OCCUR. CHRONIC INHALATION BY PREGNANT RATS PRODUCED FETAL MUSCULOSKELETAL ABNORMALITIES. LONG TERM EXPOSURE OF GREATER THAN 10 YEARS TO AROMATIC HYDROCARBONS HAS BEEN ASSOCIATED WITH INCREASED LEVELS OF GASTROINTESTINAL CANCER IN WHITE MALE WORKERS.

2,5-DIPHENYLOXAZOLE: NO DATA AVAILABLE.

POLYOXYETHYLENE (10) OCTYL PHENOL: REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION.

IGEPAL (R) CO-630: NO EFFECTS REPORTED. MAY CAUSE IRRITATION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:

IRRITANT.

ACUTE EXPOSURE

XYLENE: LIQUID XYLENE IS A DEFATTING AGENT AND MAY CAUSE DRYING, ERYTHEMA AND POSSIBLY BLISTERING. THE LIQUID IS READILY ABSORBED THROUGH INTACT OR BROKEN SKIN AT A RATE OF APPROXIMATELY 4-10 MG/CM2/HOUR. LIQUID CONTACT MAY CAUSE VASODILATION IN SENSITIVE AREAS.

2,5-DIPHENYLOXAZOLE: NO DATA AVAILABLE. MAY BE IRRITATING.

POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION.

IGEPAL (R) CO-630: MAY CAUSE IRRITATION AND DEFATTING OF THE SKIN. IN RABBITS, IT IS MODERATELY TOXIC BY SKIN ABSORPTION.

CHRONIC EXPOSURE

XYLENE: REPEATED OR PROLONGED EXPOSURE MAY CAUSE ECZEMA OR DERMATITIS.

2,5-DIPHENYLOXAZOLE: NO DATA AVAILABLE.

POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE IRRITATION, BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.

IGEPAL (R) CO-630: MAY CAUSE IRRITATION OR DERMATITIS. NO SYSTEMIC EFFECTS HAVE BEEN REPORTED.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:

IRRITANT.

ACUTE EXPOSURE

XYLENE: 200 PPM MAY CAUSE CONJUNCTIVAL IRRITATION IN HUMANS. AN ACCIDENTAL SPLASH IN THE HUMAN EYE CAUSED TRANSIENT SUPERFICIAL DAMAGE WITH RAPID RECOVERY. IN RABBIT EYES, THE LIQUID CAUSED IMMEDIATE DISCOMFORT AND BLEPHAROSPASM FOLLOWED BY HYPEREMIA OF THE CONJUNCTIVA AND VERY SLIGHT TRANSIENT INJURY OF THE CORNEAL EPITHELIUM.

2,5-DIPHENYLOXAZOLE: MAY CAUSE IRRITATION. NO EFFECTS REPORTED IN HUMANS.

POLYOXYETHYLENE (10) OCTYL PHENOL: DIRECT CONTACT MAY CAUSE IRRITATION,

PAIN, AND POSSIBLY INJURY.
IGEPAL (R) CO-630: CONTACT MAY CAUSE IRRITATION AND REDNESS.

CHRONIC EXPOSURE
XYLENE: PROLONGED EXPOSURE TO HIGH VAPOR CONCENTRATION CAUSED VACUOLAR, EPITHELIAL KERATOPATHY IN WORKERS. SIMILAR LESIONS WERE PRODUCED IN CATS EXPOSED TO SUBLETHAL CONCENTRATIONS FOR SEVERAL HOURS. CORNEAL EPITHELIAL DAMAGE, BUT NO VACUOLES OCCURRED IN RABBITS.
2,5 DIPHENYLOXAZOLE: NO DATA AVAILABLE.
POLYOXYETHYLENE (10) OCTYL PHENOL: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.
IGEPAL (R) CO-630: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE
XYLENE: TOXIC EFFECTS APPEAR MORE RAPIDLY AND ARE MUCH MORE SEVERE FOLLOWING INGESTION THAN AFTER INHALATION. HUMANS MAY BE MUCH MORE SUSCEPTIBLE THAN RODENTS TO ACUTE TOXICITY OF AROMATIC HYDROCARBONS. A DOSE OF 15 TO 30 MILLILITERS, OR ABOUT 1 OUNCE, IS THE EXPECTED HUMAN LETHAL DOSE BY INGESTION. INGESTION WILL CAUSE SEVERE GASTROINTESTINAL DISTRESS. IF ASPIRATION INTO THE LUNGS OCCURS, CHEMICAL PNEUMONITIS, PULMONARY EDEMA AND HEMORRHAGE MAY OCCUR. INGESTION OF SMALL QUANTITIES PRODUCED URINARY DEXTROSE AND UROBILINOGEN EXCRETION WITH TOXIC HEPATITIS WHICH WAS REVERSIBLE IN 20 DAYS. INCREASED CARDIAC SENSITIVITY TO CATECHOLAMINES MAY OCCUR.
2,5-DIPHENYLOXAZOLE: NO DATA AVAILABLE.
POLYOXYETHYLENE (10) OCTYL PHENOL: MAY CAUSE GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING. LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.
IGEPAL (R) CO-630: MAY CAUSE DIARRHEA, BLOATING, AND IRRITATION OF GASTROINTESTINAL TRACT. IT IS GENERALLY POORLY ABSORBED. HOWEVER, IN RATS, IT IS MODERATELY TOXIC ORALLY.

CHRONIC EXPOSURE
XYLENE: CHRONIC INGESTION BY PREGNANT MICE RESULTED IN REPRODUCTIVE EFFECTS OF POST-IMPLANTATION MORTALITY, FETOTOXICITY AND FETAL ABNORMALITIES INVOLVING CRANIOFACIAL AND MUSCULOSKETAL DEVELOPMENT.
2,5-DIPHENYLOXAZOLE: NO EFFECTS REPORTED.
POLYOXYETHYLENE (10) OCTYL PHENOL: NO EFFECTS REPORTED.
IGEPAL (R) CO-630: NO EFFECTS REPORTED.

FIRST AIDE- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
XYLENE:
NITRIC ACID UNDER PRESSURE IN THE MANUFACTURE OF TEREPHTHALLIC ACID: CREATES A POSSIBLE EXPLOSION HAZARD IN AUTOCLAVE AND CONDENSING SYSTEMS.
LIQUID PHASE OXIDATION OF P-XYLENE IN ACETIC ACID: POSSIBLE EXPLOSION.
NITRIC ACID IN THE PRESENCE OF SULFURIC ACID: INTENSE REACTION.
OXIDIZING AGENTS: POSSIBLE HAZARDOUS REACTION.
1,3-DICHLORO-5,5-DIMETHYL-2,4-IMIDAZOLID-INDIONE: POSSIBLE EXPLOSION.

2,5-DIPHENYLOXAZOLE: NONE KNOWN.

POLYOXYETHYLENE (10) OCTYL PHENOL:
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

IGEPAL (R) CO-630:
OXIDIZERS: MAY REACT VIOLENTLY OR VIGOROUSLY.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****
CONDITIONS TO AVOID

MAY BE IGNITED BY HEAT, SPARKS OR FLAMES. VAPORS MAY TRAVEL TO A SOURCE OF IGNITION AND FLASH BACK. CONTAINER MAY EXPLODE IN HEAT OF FIRE. VAPOR EXPLOSION HAZARD INDOORS, OUTDOORS OR IN SEWERS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND RESTRICT ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
FOR XYLENE:

XYLENE (O-, M-, AND P-ISOMERS):
1000 PPM- ANY CHEMICAL CARTRIDGE RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE(S).
ANY POWERED AIR-PURIFYING RESPIRATOR WITH ORGANIC VAPOR

CARTRIDGE(S).
ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED ORGANIC VAPOR CANISTER.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/08/85 REVISION DATE: 07/12/88

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 9036-19-5

SUBSTANCE: **SCINTILLATION SURFACTANT AND DETERGENT CUTSCUM (R)**

TRADE NAMES/SYNONYMS:
S-570; C-574; ACC40205

CHEMICAL FAMILY:
ALKYL ARYL POLYETHER ALCOHOL

MOLECULAR FORMULA: RO-(CH2-CH2-O)10-H

MOLECULAR WEIGHT: APPROX. 650

CERCLA RATINGS (SCALE 0-3): HEALTH=U FIRE=0 REACTIVITY=0 PERSISTENCE=1

COMPONENTS AND CONTAMINANTS

COMPONENT: POLYOXYETHYLENE (10) OCTYL PHENOL PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: CLEAR, YELLOWISH LIQUID WITH A BLAND ODOR

BOILING POINT: >350 F (>177 C) MELTING POINT: 45 F (7 C) POUR PT.

SPECIFIC GRAVITY: 1.07 VAPOR PRESSURE: NIL @ 20 C

EVAPORATION RATE: (ETHER = 1) >1 (TTE) SOLUBILITY IN WATER: SOLUBLE

VAPOR DENSITY: NOT DETERMINED

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: 500 F (260 C) FLAMMABILITY CLASS(OSHA): IIIB

FIREFIGHTING MEDIA:
DRY CHEMICAL OR CARBON DIOXIDE
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT.

TOXICITY

1% EYE-RABBIT SEVERE IRRITATION; 3620 MG/KG ORAL-RAT LD50; 70 MG/KG INTRAVENOUS-MOUSE LD50; 3500 MG/KG ORAL-MOUSE LD50; MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE.
ALKYL ARYL POLYETHER ALCOHOLS ARE IRRITANTS. THEY ARE OF A LOW ORDER OF ORAL TOXICITY.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION. SEE MUTAGENIC DATA REFERENCE IN TOXICITY SECTION. (APPLICABLE TO MIST IF MIST IS FORMED).

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- MAY CAUSE IRRITATION, BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- MIST OR DIRECT CONTACT MAY CAUSE IRRITATION, PAIN AND

POSSIBLY INJURY.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING. LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL PRESSURES UP TO THE BOILING POINT, (>177 C)

INCOMPATIBILITIES:
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

DECOMPOSITION:
COMBUSTION IS PREDICTED TO YIELD CARBON MONOXIDE AND POSSIBLY OTHER TOXIC PRODUCTS.

POLYMERIZATION:
WILL NOT OCCUR.

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CONDITIONS TO AVOID

AVOID HEATING TO THE BOILING POINT, WHERE HAZARDOUS VAPOR AND MIST ARE EMITTED. AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS, INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP HEAT AND FLAMES AWAY. SOAK UP WITH VERMICULITE AND PLACE IN A SUITABLE CONTAINER. KEEP OUT OF SEWERS, WATERWAYS AND OTHER WATER SOURCES.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE GENERAL DILUTION VENTILATION.

RESPIRATOR:
HIGH LEVELS-
CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE WITH A FULL FACEPIECE AND WITH A PARTICULATE FILTER.

FIREFIGHTING-
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE OR SOLUTIONS.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT REPEATED OR PROLONGED CONTACT WITH THIS SUBSTANCE OR ITS SOLUTION. PREFERRED MATERIALS: NEOPRENE RUBBER.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF SAFETY GOGGLES TO PREVENT CONTACT WITH THIS SUBSTANCE OR ITS SOLUTIONS. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE OR ITS SOLUTION, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 11/12/85 REVISION DATE: 11/07/86

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SUBSTANCE IDENTIFICATION

SUBSTANCE: **SCINTIVERSE TM II, SCINTANALIZED TM AND SCINTIVERSE TM LC**

TRADE NAMES/SYNONYMS:
SCINTIVERSE TM II; SCINTANALYZED TM; SO-X-12; SCINTIVERSE TM-LC; SO-X-20; ACC40207

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT:	1,2,4-TRIMETHYLBENZENE CAS# 95-63-6	PERCENT: 60.0-63.1
COMPONENT:	POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER CAS# 9003-11-6	PERCENT: 36.2
COMPONENT:	PLURAFAC A-46 CAS# 63704-78-9	PERCENT: 26.7
COMPONENT:	ISOPROPYL ALCOHOL CAS# 67-63-0	PERCENT: 13.0
COMPONENT:	2,5-DIPHENYLOXAZOLE CAS# 92-71-7	PERCENT: <1.0
COMPONENT:	BIS(MSB) SCINTANALYZED TM CAS# 13280-61-0	PERCENT: <1.0
COMPONENT:	POPOP (1,4-BIS-2-(5-PHENYLOXAXOLYL)-BENZENE) CAS# 1806-34-4	PERCENT: <1.0

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
1,2,4-TRIMETHYLBENZENE:
25 PPM (125 MG/M3) ACGIH TWA; 35 PPM (170 MG/M3) ACGIH STEL
ISOPROPYL ALCOHOL:
400 PPM OSHA TWA
400 PPM ACGIH TWA; 500 PPM ACGIH STEL
400 PPM NIOSH RECOMMENDED TWA; 800 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: FAINT BLUE FLUORESCENT-HUED LIQUID SPECIFIC GRAVITY: 0.9-0.93

SOLUBILITY IN WATER: SOLUBLE ODOR THRESHOLD: 1-2 PPM (ESTIMATED)

VAPOR DENSITY: > 1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE TO SEVERE FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME. VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE THE FLASHPOINT. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 118 F (48 C) FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. WEAR PERSONAL PROTECTIVE EQUIPMENT. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT.

TOXICITY

1,2,4-TRIMETHYLBENZENE: 5000 MG/KG ORAL-RAT LDLO; 18 MG/M3/4 HOURS INHALATION-RAT LC50; 2000 MG/KG INTRAPERITONEAL-RAT LDLO; 1788 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT AND A HIGHLY TOXIC NARCOTIC.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: 6900 MG/KG SUBCUTANEOUS-RAT LD50; 5500 MG/KG SUBCUTANEOUS-MOUSE LD50; 7500 MG/KG INTRAVENOUS-RAT LD50; 3000 MG/KG INTRAVENOUS-MOUSE LD50; CARCINOGEN STATUS: NONE.
PLURAFAC A-46: CARCINOGEN STATUS: NONE; MAY BE AN EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.
ISOPROPYL ALCOHOL: 20 PPM EYE-HUMAN IRRITATION; 16 MG EYE-RABBIT IRRITATION; 400 PPM INHALATION-MAN TCLO; 8600 MG/KG ORAL-MAN LDLO; 15,710 MG/KG ORAL-HUMAN TDLO; 5840 MG/KG ORAL-RAT LD50; 933 MG/KG INTRAPERITONEAL-MOUSE LD50; 16,000 PPM/8 HOURS INHALATION-RAT LC50; 6150 MG/KG ORAL-DOG LD50; 5000 MG/KG ORAL-RABBIT LDLO; 13 GM/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTECS); CARCINOGEN STATUS: NONE; SEVERE EYE IRRITANT, SKIN AND MUCOUS MEMBRANE IRRITANT AND NARCOTIC.
BIS(MSB) SCINTANALYZED TM: CARCINOGENIC STATUS: NONE.
POPOP: CARCINOGENIC STATUS: NONE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC/CARCINOGEN.
20,000 PPM ISOPROPYL ALCOHOL IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
8050 PPM 1,2,4-TRIMETHYLBENZENE IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
ACUTE EXPOSURE
1,2,4-TRIMETHYLBENZENE: CAUSES CHEMICAL PNEUMONITIS AT SITE OF CONTACT. ALSO CAUSES SORE THROAT, COUGHING, HEADACHE, DYSPNEA, FATIGUE, NARCOSIS, AND HEMORRHAGIC INFLAMMATORY LESIONS OF MUCOUS MEMBRANES.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: DUE TO ITS LOW VAPOR PRESSURE, EXPOSURE TO VAPORS OF POLYOXYETHYLENE-POLYOXYPROPLENE BLOCK POLYMER IS NOT LIKELY TO OCCUR.
PLURAFAC A-46: MAY CAUSE IRRITATION.
ISOPROPYL ALCOHOL: ISOPROPYL ALCOHOL CAUSES DIZZINESS, INCOORDINATION, HEADACHE, CONFUSION, PERSISTENT NAUSEA, HEMATEMESES, ABDOMINAL PAIN, STUPOR, HYPOTENSION, ANEMIA, REFRACTORY NARCOSIS, AREFLEXIA, DEPRESSED RESPIRATION, OLIGURIA FOLLOWED BY DIURESIS, AND UREMIA. TENDERNESS AND EDEMA OF MUSCLES MAY ALSO OCCUR. SEVERE CASES MAY CAUSE COMA.

CHRONIC EXPOSURE
1,2,4-TRIMETHYLBENZENE: CAUSES NERVOUSNESS, TENSION, ANXIETY, ASTHMATIC BRONCHITIS, PAIN IN THE LIMBS, PERIPHERAL NUMBNESS AND PARESTHESIA. MAY ALSO CAUSE BONE MARROW DAMAGE.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO DATA AVAILABLE.
PLURAFAC A-46: REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION.
SEE MUTAGENIC DATA REFERENCES IN TOXICITY SECTION.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE
1,2,4-TRIMETHYLBENZENE: CAUSES IRRITATION WITH REDNESS, EDEMA AND BLISTERS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: MAY CAUSE MILD IRRITATION IN SENSITIVE INDIVIDUALS.
PURAFAC A-46: MAY CAUSE IRRITATION.
ISOPROPYL ALCOHOL: CAUSES NARCOSIS WITH NAUSEA, VOMITING, HYPOTENSION, DEPRESSED RESPIRATION, ANEMIA, UREMIA, ANC COMA.

CHRONIC EXPOSURE
1,2,4-TRIMETHYLBENZENE: MAY CAUSE DERMATITIS AND NERVOUSNESS, TENSION, ANXIETY, PERIPHERAL NUMBNESS AND PARESTHESIA.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO EFFECTS REPORTED.
PLURAFAC A-46: MAY CAUSE IRRITATION, BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.
ISOPROPYL ALCOHOL: MAY CAUSE DERMATITIS DUE TO THE DEFATTING ACTION ON THE SKIN. SEE MUTAGENIC DATA REFERENCE IN TOXICITY SECTION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL

ATTENTION IMMEDIATELY.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE
1,2,5-TRIMETHYLBENZENE: CAUSES REDNESS, EDEMA, PAIN, AND POSSIBLE CORNEAL LESIONS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: CONTACT WITH THE EYES MAY PRODUCE MILD IRRITATION.
PLURAFAC A-46: DIRECT CONTACT CAUSES IRRITATION, PAIN, AND POSSIBLY INJURY.
ISOPROPYL ALCOHOL: VAPORS MAY BE IRRITATING AND MAY CAUSE PROFUSE LACRIMATION. DIRECT CONTACT CAUSES IRRITATION, BURNS AND PERMANENT CORNEAL DAMAGE.

CHRONIC EXPOSURE
1,2,5-TRIMETHYLBENZENE: MAY CAUSE CONJUNCTIVITIS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO EFFECTS REPORTED.
PULRAFAC A-46: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.
ISOPROPYL ALCOHOL: PROLONGED OR REPEATED EXPOSURE TO VAPORS OF ISOPROPYL ALCOHOL MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE
1,2,4-TRIMETHYLBENZENE: CAUSES BURNING SENSATION IN THE MOUTH, SORE THROAT, HEADACHE, ABDOMINAL PAIN, NAUSEA, VOMITING, BLOODY SPUTUM, WEAKNESS, VERTIGO, DYSPNEA, NARCOSIS, ANEMIA, AND CONVULSIONS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: RELATIVELY NONTOXIC. MAY CAUSE NAUSEA ON INGESTION.
PLURAVAC A-46: CAUSES GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING. LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.
ISOPROPYL ALCOHOL: CAUSES NARCOSIS WITH HEADACHE, NAUSEA, HEMATEMESIS, DIZZINESS, INCOORDINATION, ABDOMINAL PAIN, STUPOR, DEPRESSED RESPIRATION, OLIGURIA, UREMIA, DIURESIS, AND COMA. DEATH MAY OCCUR FROM RESPIRATORY PARALYSIS.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
OXIDIZERS AND OTHER MATERIALS, EXAMPLES FOLLOW:

ISOPROPYL ALCOHOL:
PHOSGENE: IN THE PRESENCE OF IRON SALTS, MAY EXPLODE.
NITROFORM (>50%): DISSOLVES LIBERATING HEAT AND POSSIBLY EXPLODING.
TRINITROMETHANE: POSSIBLE EXPLOSION.
HYDROGEN: WHEN A STREAM OF HYDROGEN ENTRAINED ISOPROPYL ALCOHOL VAPORS AND

PALLADIUM PARTICLES, THE MIXTURE CAUGHT FIRE UPON CONTACT WITH AIR.
POTASSIUM TERT-BUTOXIDE: IGNITION.
DIOXYGENYL TETRAFLUOROBORATE: IGNITION AT AMBIENT TEMPERATURES.
CHROMIUM TRIOXIDE (GRANULAR): IGNITION.
2-BUTANONE: ACCELERATES THE PEROXIDATION OF THE ALCOHOL, RESULTING IN FORMATION OF POTENTIALLY EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE: FORMATION OF A SHOCK- OR HEAT-SENSITIVE, DETONATABLE PRODUCT.
OXYGEN (GAS): AUTOXIDATION, ON EXPOSURE TO LIGHT, RESULTS IN FORMATION OF POTENTIALLY EXPLOSIVE KETONES AND HYDROGEN PEROXIDE.
OLEUM: REACTS WITH AN INCREASE IN TEMPERATURE AND PRESSURE.
ALUMINUM: DISSOLUTION IS EXOTHERMIC.

1,2,4-TRIMETHYLBENZENE:
NITRIC ACID: AN EXPLOSION MAY OCCUR WHEN MIXED TOGETHER AT 115 C OR ABOVE.

DECOMPOSITION:
COMBUSTION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

COMBUSTION MAY RELEASE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
WILL NOT OCCUR.

****
CONDITIONS TO AVOID

AVOID HEATING TO THE FLASH POINT, 118 F (TYPE II) AND <100 F FOR TYPE LC.
AVOID CONTACT WITH OR STORAGE WITH INCOMPATIBLE MATERIALS INCLUDING THOSE LISTED IN THE REACTIVITY SECTION.

****
SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. PROVIDE VENTILATION. WEAR PERSONAL PROTECTIVE EQUIPEMENT. USE WATER SPRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER INCOMBUSTIBLE ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE TIGHTLY AND LABEL FLAMMABLE OR COMBUSTIBLE. NO SMOKING, FLAMES OR FLARES IN HAZARD AREA. KEEP UNNECESSARY PEOPLE AWAY; ISOLATE AREA AND DENY ENTRY. KEEP OUT OF SEWERS, WATER WAYS AND OTHER WATER SOURCES.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION OR GENERAL DILUTION VENTILATION TO MEET PERMISSIBLE EXPOSURE LIMITS. VENTILATION EQUIPMENT MUST BE EXPLOSION-PROOF.

RESPIRATOR:
VALUES REFER TO PPM OF 1,2,4-TRIMETHYLBENZENE:
EXPOSURE LIMIT TO 500 PPM-
CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) AND A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SOLUTION.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT REPEATED OR PROLONGED CONTACT WITH THIS SOLUTION. PREFERRED MATERIALS: PVA AND VITON PLASTICS.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF SAFETY GOGGLES WHENEVER THERE IS REASONABLE PROBABILITY OF CONTACT WITH THIS SOLUTION. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SOLUTION, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 11/12/85 REVISION DATE: 03/11/86

-ADDITIONAL INFORMATION-
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ECOLUME™

The Environmentally Safe Liquid Scintillation Counting Solution

ICN Radiochemicals
Division of ICN Biomedicals, Inc.

(800) 854-0530

What's unique about ECOLUME?

ECOLUME is a **nontoxic, nonhazardous, nonflammable, biodegradable liquid scintillation counting solution.** It contains biodegradable and nontoxic medium, and is essentially odorless.

By using ECOLUME you eliminate other toxic cocktails from your laboratory. At the same time, **you make a commitment to reduce toxic waste from our environment.**

Can ECOLUME do what other cocktails do now?

Yes! ECOLUME is a **complete ready-to-use LSC** for virtually all aqueous and organic samples, e.g.: deionized water, phosphate buffered saline, PBS with gelatin or BSA, sucrose gradients, salt solutions, 0.1N HCl, 0.1N NaOH, urine, serum, alcohols, acetonitrile, steroids, lipids, polyacrylamide gels, cellulose, acetate strips, glass fiber filters, silica gels, TLC extracts, and more.

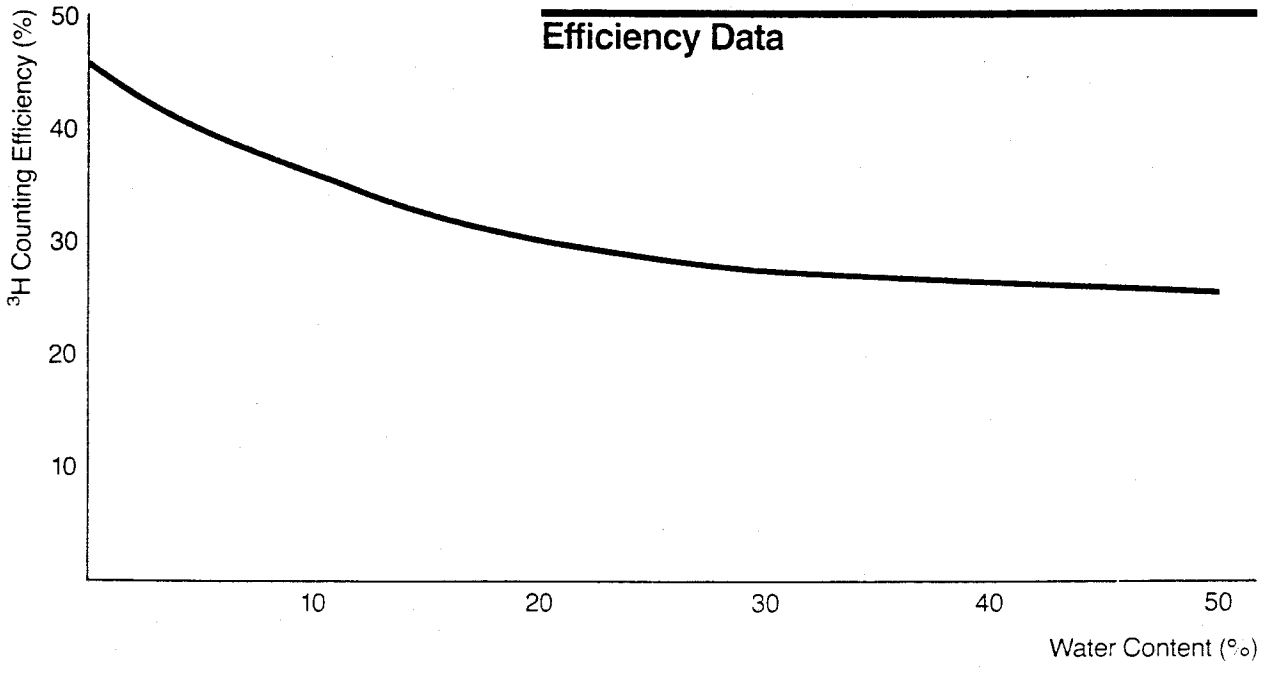
For 90% of all applications, ECOLUME will perform as well or better than your current LSC's without the hazards and toxic waste those other cocktails entail.

Is ECOLUME easy to work with?

Yes, ECOLUME has been formulated for your laboratory: it is **nontoxic, odorless and does not require any respiratory protection or ventilation.**

It forms **no gel or phasing** with addition of sample up to its maximum load capacity, even with addition of aqueous sample exceeding 25% by volume at room temperature. In addition it is chemiluminescence resistant and is **the most efficient LSC of its kind.**

Efficiency Data



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 3 1987

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

Mr. William K. Vogt
Director
WestChem
P.O. Box 19368
San Diego, CA 92119

Dear Mr. Vogt:

This letter is in response to your letter of February 4, 1987, requesting an interpretation of the regulatory status of your products EcoLite and EcoLume under the hazardous waste management regulations. Under the hazardous waste management regulations, a waste is considered hazardous if it is either listed under 40 CFR Part 261.31, 261.32, or 261.33, or exhibits one or more of the characteristics of hazardous waste (i.e., ignitability, corrosivity, reactivity, or extraction procedure (EP) toxicity).

Your products are not listed in the hazardous waste regulation; in addition, your products do not appear to exhibit any of the characteristics of hazardous waste based on our evaluation of the data enclosed with your letter. Furthermore, radioactive materials are not currently defined as hazardous under the Resource Conservation and Recovery Act. Therefore, your products do not appear to be hazardous wastes under the hazardous waste regulations. Nevertheless, each generator is still responsible for determining the hazardousness of their waste. In addition, since states and local authorities may have requirements more stringent than the federal hazardous waste rules (i.e., regarding the disposal of radioactive solutions), your customers should contact their state and local authorities to determine the regulatory status of these materials under state or local rules.

If you have any further questions regarding this matter, please call Mr. Ed Abrams at (202) 382-4787.

Sincerely,

Matthew A. Straus
Chief, Waste Characterization Branch

ECOLUME Performance Specifications

Sample Description	Load Capacity**	Appearance	^3H Efficiency
H_2O	0-50%	Clear Solution	44-28%
0.1N HCl in Normal Saline	0-30%	Clear Solution	42-27%
0.5N HCl	0-40%	Clear Solution	42-26%
1.0N HCl	0-30%	Clear Solution	42-25%
1M $CaCl_2$	0-30%	Clear Solution	40-25%
1M $MgCl_2$	0-30%	Clear Solution	42-28%
0.1N NaOH	0-40%	Clear Solution	42-28%
0.5N NaOH	0-15%*	Cloudy Solution	40-25%
0.1N NaOH in Normal Saline	0-40%	Clear Solution	42-28%
PBS, 0.1% at pH 7, with 1% Gelatin	0-30%	Clear Solution	42-30%
Methanol	0-50%	Clear Solution	42-25%
8M Urea	0-20%	Clear Solution	40-30%
Urine	0-20%	Clear Solution	42-35%
Tetrafluoro Acetic Acid	0-25%	Clear Solution	43-30%
Tetrapropyl Ammonium Hydroxide, at pH 12.3, w/EDTA	0-40%	Clear Solution	43-28%
2N CsCl	0-15%*	Clear Solution	43-30%
20% Sucrose	0-25%	Clear Solution	43-30%

*Distilled H_2O required, 1:1 to form clear solution to 30% load capacity.

**Load capacity is the volume of sample expressed as a percentage of the volume of ECOLUME into which the sample has been added.

ECOLUME is a safe, odorless and versatile liquid scintillation cocktail that does not require any respiratory protection or special ventilation. You and your laboratory will find it most convenient to work with.

Catalog Number: 882470. Available in 1 gallon and 4 × 1 gallon packages.

ECOLUME Safety Data

Ingredients (Typical Values—Not Specifications): %

Mono-alkylates proprietary mixtures	65-75
Blend of nonionic surfactants	23-35
Scintillators	<0.5

Section 1 Physical Data

Appearance and Odor:	Water-white liquid, nearly odorless
Boiling Point:	280-320°C
Specific Gravity:	0.90 at 20°C
Vapor Pressure:	<0.1 mm Hg at 20°C
Solubility in Water:	Very low
Volatility:	<0.1%/WT at 100°F

Section 2 Fire Protection Data

Flash Point:	155°C by: C.O.C.
Extinguishing Media:	Water spray, foam, dry chemical, CO_2, or any class B extinguishing agent.
Special Firefighting Procedures:	Wear goggles and special breathing apparatus.

Section 3 Reactivity Data

Materials to Avoid:	Nonoxidizing except under extreme conditions in the presence of a strong oxidizer.
Hazardous Decomposition Products:	None
Hazardous Polymerization:	Will not occur
Stability:	Stable

Section 4 Spills, Leak & Disposal Procedure

Action for Spills:	Use adsorbent material or sand, followed by water flush.
Waste Disposal:	Flush into sanitary sewer (if radioactivity level permits), incinerate, or dispose along with other radioactive liquid scintillation waste.

Section 5 Health Hazard Data

Threshold Limit Value:	None established
Respiratory Protection:	None required
Ventilation:	No special requirement
Eye Protection:	Chemical goggles
Emergency and First Aid Procedures:	In case of eye contact, immediately flush with copious amounts of water for 15 minutes, then seek medical attention if irritation persists. Remove from skin and clothing with soap and water.

Section 6 Special Handling Information

Storage Precautions:	Keep material protected from light, tightly capped and store in a cool, dry area.
Precautionary Label:	Contains a mildly irritating solvent. Avoid contact with eyes, skin and clothing. Do not pipette by mouth. Keep out of reach of children.

ICN Radiochemicals
Division of ICN Biomedicals, Inc.
P.O. Box 19536, Irvine, CA 92713

Nationwide: (800) 854-0530
(714) 545-0113

SX 18-4

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS:
GASTON L. PILLORI: (201) 796-7100
AFTER BUSINESS HOURS; HOLIDAYS:
(201) 796-7523
CHEMTREC ASSISTANCE: (800) 429-9300

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SUBSTANCE IDENTIFICATION

SUBSTANCE: SCINTIVERSE (TM) BD

TRADE NAMES/SYNONYMS:
ACC60003, SX18

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=1 REACTIVITY=0 PERSISTENCE=-
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NALKYLENE 500 DETERGENT ALKYLATE
CAS# 67774-74-7

COMPONENT: DIOCTYL SODIUM SULFOSUCCINATE
CAS# 577-11-7

COMPONENT: ETHOXYLATED NONYLPHENOL
CAS# 9016-45-9

COMPONENT: 2,5'-DIPHENYLOXAZOLE
CAS# 92-71-7

COMPONENT: PARA-BIS-(O-METHYLSTYRYL) BENZENE
CAS# 13200-61-1

COMPONENT: DISTEARYL PENTAERYTHRITOL DIPHOSPHITE
CAS# NOT ASSIGNED

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NO OCCUPATIONAL EXPOSURE LIMITS ESTABLISHED BY OSHA, ACGIH, OR NIOSH.

PHYSICAL DATA

DESCRIPTION: OILY LIQUID BOILING POINT: NOT AVAILABLE

SPECIFIC GRAVITY: NOT AVAILABLE EVAPORATION RATE: NOT AVAILABLE

SOLUBILITY IN WATER: NOT AVAILABLE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: >280 F (>138 C)

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT SCATTER SPILLED MATERIAL WITH HIGH PRESSURE WATER STREAMS. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 31).

USE AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING HAZARDOUS VAPORS, KEEP UPWIND.

TOXICITY

NALKYLENE 500 DETERGENT ALKYLATE:
21.5 GM/KG ORAL-RAT LD0 (CONOCO MSDS); 71,000 MG/M3/1 HOUR INHALATION-RAT LC0 (CONOCO MSDS); 2.0 GM/KG SKIN-RABBIT LD50 (CONOCO MSDS); CARCINOGEN STATUS: NONE.
NALKYENE 500 DETERGENT ALKYLATE IS AN EYE, SKIN AND MUCOUS MEMBRANE IRRITANT AND CENTRAL NERVOUS SYSTEM DEPRESSANT.

DIOCTYL SODIUM SULFOSUCCINATE:
10 MG/24 HOURS SKIN-RABBIT MODERATE IRRITATION; 250 UG EYE-RABBIT MILD IRRITATION; 1% EYE-RABBIT SEVERE IRRITATION; 1900 MG/KG ORAL-RAT LD50; 590 MG/KG INTRAPERITONEAL-RAT LD50; 2643 MG/KG ORAL-MOUSE LD50; 60 MG/KG INTRAVENOUS-MOUSE LD50.
CARCINOGEN STATUS: NONE.
DIOCTYL SODIUM SULFOSUCCINATE IS A SKIN AND MUCOUS MEMBRANE IRRITANT AND A SEVERE EYE IRRITANT. CONCURRENT ADMINISTRATION OF VARIOUS DRUGS WITH DIOCTYL SODIUM SULFOSUCCINATE MAY CAUSE ADVERSE EFFECTS; INCREASED RISK OF HYPOKALEMIA AND INCREASED SODIUM AND WATER RETENTION WITH CORTICOTROPIN AND CORTICOSTEROIDS; INCREASES THE SENSITIVITY OF THE MYOCARDIUM TO DIGITALIS DUE TO HYPOKALEMIA WITH DIGITALIS GLYCOSIDES; ENHANCES THE NEUROMUSCULAR BLOCKING EFFECT DUE TO HYPOKALEMIA WITH CURARIFORM DRUGS.

ETHOXYLATED NONYL PHENOL:
500 MG OPEN SKIN-RABBIT MILD IRRITATION; 5 MG EYE-RABBIT SEVERE IRRITATION;

310 MG/KG ORAL-RAT LD50; 2000 MG/KG SKIN-RABBIT LD50; CARCINOGEN STATUS:
NONE.
ETHOXYLATED NONYL PHENOL IS AN EYE IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NALKYLENE 500 DETERGENT ALKYLATE:
IRRITANT/NARCOTIC.
ACUTE EXPOSURE- DUE TO THE LOW VAPOR PRESSURE, A HEALTH HAZARD FROM INHALATION IS NOT LIKELY TO OCCUR AT NORMAL ROOM TEMPERATURES. EXPOSURE TO VAPORS FROM ELEVATED TEMPERATURES MAY CAUSE IRRITATION OF THE UPPER RESPIRATORY TRACT AND CENTRAL NERVOUS SYSTEM DEPRESSION WITH SYMPTOMS OF SLUGGISHNESS, DIZZINESS, NAUSEA AND NARCOSIS.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE SYMPTOMS DESCRIBED IN ACUTE EXPOSURE.

DIOCTYL SODIUM SULFOSUCCINATE:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

ETHOXYLATED NONYL PHENOL:
ACUTE EXPOSURE- NO DATA AVAILABLE. SINCE MOST ALKYL ARYL POLYETHER ALCOHOLS HAVE LOW VAPOR PRESSURES, NO SIGNIFICANT HEALTH HAZARD FROM INHALATION IS LIKELY TO OCCUR AT NORMAL ROOM TEMPERATURES. INHALATION OF DUST, GENERATED MIST, OR VAPORS PRODUCED FROM ELEVATED TEMPERATURES MAY CAUSE IRRITATION OF THE MUCOUS MEMBRANES.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
NALKYLENE 500 DETERGENT ALKYLATE:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- PROLONGED OR REPEATED CONTACT MAY DRY AND DEFAT THE SKIN, CAUSING IRRITATION AND DERMATITIS.

DIOCTYL SODIUM SULFOSUCCINATE:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION DUE TO THE DEFATTING ACTION ON THE SKIN.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH IRRITANTS MAY RESULT IN DERMATITIS.

ETHOXYLATED NONYL PHENOL:
ACUTE EXPOSURE- MAY CAUSE IRRITATION. THIS MATERIAL APPLIED TO THE SKIN OF RABBITS PRODUCED MILD IRRITATION AND A MODERATE DOSE WAS LETHAL BY SKIN ABSORPTION.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO CONCENTRATED ETHOXYLATED ALKYLPHENOLS DRY AND DEFAT THE SKIN CAUSING IRRITATION AND DERMATITIS.

IRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

YE CONTACT:
ALKYLENE 500 DETERGENT ALKYLATE:
RRITANT.
ACUTE EXPOSURE- LIQUID CONTACT OR EXPOSURE TO HIGH VAPOR CONCENTRATION MAY CAUSE IRRITATION.
CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

IOCTYL SODIUM SULFOSUCCINATE:
ORROSIVE.
ACUTE EXPOSURE- MAY CAUSE SEVERE IRRITATION. A 10% SOLUTION APPLIED TO RABBIT EYES RESULTED IN SEVERE DAMAGE. SOLUTIONS OF >0.1% RESULTED IN REVERSIBLE DAMAGE.
CHRONIC EXPOSURE- DEPENDING ON CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED CONTACT MAY RESULT IN SYMPTOMS SIMILAR TO THOSE SEEN IN ACUTE EXPOSURE.

THOXYLATED NONYL PHENOL:
RRITANT.
ACUTE EXPOSURE- MAY CAUSE SEVERE IRRITATION; 5 MG APPLIED TO THE EYES OF RABBITS PRODUCED SEVERE IRRITATION. ALKYL ARYL POLYETHER ALCOHOLS, IN CONCENTRATED FORM, CAUSED MODERATE TO SEVERE CORNEAL DAMAGE IN THE EYES OF RABBITS. SOME NONIONIC SURFACTANTS HAVE A LOCAL ANESTHETIC EFFECT ON THE CORNEA, THIS EFFECT MAY ELIMINATE THE WARNING DISCOMFORT AND ALLOW DAMAGE TO OCCUR TO THE EYE.
CHRONIC EXPOSURE- PROLONGED OR REPEATED CONTACT MAY CAUSE SYMPTOMS AS DISCRIBED IN ACUTE EXPOSURE.

IRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

NGESTION:
ALKYLENE 500 DETERGENT ALKYLATE:
ARCOTIC.
ACUTE EXPOSURE- MAY CAUSE NAUSEA, VOMITING, DIZZINESS, HEADACHE, AND OTHER SYMPTOMS OF CENTRAL NERVOUS SYSTEM DEPRESSION. THIS MATERIAL MAY BE ASPIRATED INTO THE LUNGS, PRODUCING PULMONARY EDEMA, PNEUMONITIS, AND HEMORRHAGING.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

IOCTYL SODIUM SULFOSUCCINATE:
ACUTE EXPOSURE- MAY CAUSE GASTROENTERITIS, DIARRHEA, VOMITING, CRAMPING PAINS, NAUSEA, BLOATING AND ANOREXIA.
CHRONIC EXPOSURE- IN CHRONIC FEEDING TESTS, FATALLY POISONED RATS SHOWED NO GROSS LESIONS OUTSIDE THE GASTROINTESTINAL TRACT. IT IS ON THE FDA LIST OF FOOD ADDITIVES PERMITTED FOR DIRECT ADDITION TO FOOD FOR HUMAN CONSUMPTION.

ETHOXYLATED NONYL PHENOL:
ACUTE EXPOSURE- IN ANIMAL STUDIES, ETHOXYLATED ALKYLPHENOLS PRODUCED DIARRHEA, BLOATING AND OTHER SYMPTOMS OF GASTROINTESTINAL IRRITATION WITH LITTLE INTESTINAL ABSORPTION OR DECOMPOSITION. A MODERATE DOSE WAS LETHAL IN RATS.

FIRST AID- TREAT SYMPTOMATICALLY AND SUPPORTIVELY. GET MEDICAL ATTENTION AND ADVICE ON WHETHER TO USE GASTRIC LAVAGE. EXTREME CARE MUST BE TAKEN TO PREVENT ASPIRATION. A CUFFED ENDOTRACHEAL TUBE USED BY QUALIFIED MEDICAL PERSONNEL MIGHT BE ADVISABLE. KEEP HEAD LOWER THAN HIPS TO PREVENT ASPIRATION SHOULD VOMITING OCCUR.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
NALKYLENE 500 DETERGENT ALKYLATE:
  STRONG OXIDIZERS: MAY CAUSE FIRE AND EXPLOSION HAZARD.

DIOCTYL SODIUM SULFOSUCCINATE:
  ACIDS (STRONG): HYDROLYZED.
  BASES (STRONG): HYDROLYZED.
  OXIDIZERS (STRONG): FIRE AND EXPLOSION HAZARD.

ETHOXYLATED NONYL PHENOL:
  OXIDIZERS: MAY REACT VIOLENTLY OR VIGOROUSLY.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****

CONDITIONS TO AVOID

NONE REPORTED.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
SWEEP UP AND PLACE IN SUITABLE CLEAN, DRY CONTAINERS FOR LATER DISPOSAL. DO NOT FLUSH WITH WATER. KEEP UNNECESSARY PEOPLE AWAY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON THE CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON THE DATA FOUND IN THE

SCINTIVERSE (TM) BD-HF
PHYSICAL DATA, HEALTH EFFECTS AND TOXICITY SECTIONS, THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION:

CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S) WITH A FULL FACEPIECE.

GAS MASK WITH ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER) WITH A FULL FACEPIECE.

TYPE 'C' SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 11/25/86 REVISION DATE: 05/10/88

-ADDITIONAL INFORMATION-

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ATTN: SAFETY DIRECTOR
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CALVIN OVERCESH

DATE: 10/12/89
CUST # 232882 P.O. #

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 29550-7 NAME: CHLOROMETHANE, 99.5+%
CAS # 74-87-3
MF: CH3CL

SYNONYMS
ARTIC * CHLOOR-METHAAN (DUTCH) * CHLOR-METHAN (GERMAN) * CHLOROMETHANE * CHLORURE DE METHYLE (FRENCH) * CLOROMETANO (ITALIAN) * CLORURO DI METILE (ITALIAN) * METHYLCHLORID (GERMAN) * METHYL CHLORIDE * METHYL CHLORIDE (ACGIH,DOT,OSHA) * METYLU CHLOREK (POLISH) * MONOCHLOROMETHANE * R 40 * RCRA WASTE NUMBER U045 * UN 1063 (DOT) *

TOXICITY HAZARDS

RTECS # PA6300000
METHANE, CHLORO-
TOXICITY DATA
IHL-HMN LCLO:20000 PPM/2H 34ZIAG -,386,69
ORL-RAT LD50:1800 MG/KG 85JCAE -,86,86
IHL-RAT LC50:5300 MG/M3/4H 85GMAT -,82,82
IHL-MUS LC50:2200 PPM/6H TXAPA9 86,93,86
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 50 PPM; STEL 100 PPM (SKIN) 85INA8 5,380,86
IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 41,161,86
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 41,161,86
IARC CANCER REVIEW:GROUP 3 IMSUDL 7,246,87
MSHA STANDARD:AIR-CL 100 PPM (210 MG/M3) DTLVS* 3,160,71
OSHA PEL:8H TWA 100 PPM;CL 200;PK 300/5M/3H FEREAC 54,2923,89
OSHA PEL FINAL:8H TWA 50 PPM (105 MG/M3);STEL 100 PPM (205 MG/M3) FEREAC 54,2923,89
NIOSH REL TO MONOHALOMETHANES-AIR:TWA REDUCE TO LOWEST LEVEL MMWR** 37(S-7),20,88
EPA GENETOX PROGRAM 1988, POSITIVE: HISTIDINE REVERSION-AMES TEST
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA 8(A) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE FEREAC 47,26992,82
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-1182-0464
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-1083-0499
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1989
NIOSH CURRENT INTELLIGENCE BULLETIN 43, 1984
NIOSH ANALYTICAL METHODS: SEE METHYL CHLORIDE, 1001
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
PATERNAL EFFECTS (SPERMATOGENESIS)
PATERNAL EFFECTS (TESTES, EPIDIDYMIS, SPERM DUCT)
EFFECTS ON EMBRYO OR FETUS (FETOTOXICITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (MUSCULOSKELETAL SYSTEM)
SPECIFIC DEVELOPMENTAL ABNORMALITIES (CARDIOVASCULAR SYSTEM)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

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MATERIAL SAFETY DATA SHEET

CATALOG # 29550-7 NAME: CHLOROMETHANE, 99.5+%

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF INHALED.
CAUSES EYE AND SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.

CHRONIC EFFECTS
DAMAGE TO THE LUNGS
DAMAGE TO THE LIVER
DAMAGE TO THE KIDNEYS
DAMAGE TO THE HEART
POSSIBLE CARCINOGEN.
MAY ALTER GENETIC MATERIAL.
OVEREXPOSURE MAY CAUSE REPRODUCTIVE DISORDER(S) BASED ON TESTS WITH LABORATORY ANIMALS.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.

ADDITIONAL INFORMATION
METHYL CHLORIDE IS RAPIDLY ABSORBED THROUGH THE LUNGS AND IS EXCRETED VERY SLOWLY FROM THE BODY. SYMPTOMS OF EXPOSURE INCLUDE: DIZZINESS, HEADACHE, WEAKNESS, UNSTEADY WALK, NAUSEA, VOMITING, ABDOMINAL PAIN, EXTREME NERVOUSNESS, MENTAL CONFUSION, TREMORS, CONVULSIONS, UNCONSCIOUSNESS AND DEATH, DAMAGE TO THE CENTRAL NERVOUS SYSTEM. APPARENT RECOVERY FROM A SEEMINGLY MINOR EXPOSURE VIA INHALATION MAY BE FOLLOWED BY SERIOUS AND PROLONGED AFTEREFFECTS WITHIN A FEW DAYS OR WEEKS WHICH CAN BE FATAL. REPEATED EXPOSURES TO METHYL CHLORIDE ARE DANGEROUS BECAUSE IT IS ELIMINATED VERY SLOWLY FROM THE BODY WHICH CONVERTS METHYL CHLORIDE INTO HYDROCHLORIC ACID AND METHYL ALCOHOL.

PHYSICAL DATA

MELTING POINT: -97 C
BOILING POINT: -24.2 C
VAPOR DENSITY: 1.74
VAPOR PRESSURE: 3796.0 MM @ 20 C
APPEARANCE: COLORLESS GAS

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 1169 F
LOWER EXPLOSION LEVEL: 7%
UPPER EXPLOSION LEVEL: 19%

EXTINGUISHING MEDIA
DO NOT EXTINGUISH BURNING GAS IF FLOW CANNOT BE SHUT OFF IMMEDIATELY. USE WATER SPRAY OR FOG NOZZLE TO KEEP CYLINDER COOL. MOVE CYLINDER AWAY FROM FIRE IF THERE IS NO RISK.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
DANGER: FLAMMABLE AND TOXIC LIQUID AND GAS UNDER PRESSURE.

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CATALOG # 29550-7 NAME: CHLOROMETHANE, 99.5+%

UNUSUAL FIRE AND EXPLOSION HAZARDS
MAY FORM EXPLOSIVE MIXTURES WITH AIR.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
GALVANIZED IRON
MAY DECOMPOSE ON EXPOSURE TO MOIST AIR OR WATER.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA AND KEEP PERSONNEL UPWIND.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SHUT OFF LEAK IF THERE IS NO RISK.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
CAUTION: NO-RETURN CYLINDER. DO NOT REUSE. EMPTY CYLINDER WILL CONTAIN HAZARDOUS RESIDUE. FOLLOW PROPER DISPOSAL TECHNIQUES.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
USE ONLY IN A CHEMICAL FUME HOOD.
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
DO NOT BREATHE GAS.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
TOXIC.
IRRITANT.
POSSIBLE CARCINOGEN.
MUTAGEN.
POSSIBLE TERATOGEN.
KEEP TIGHTLY CLOSED.
MOISTURE SENSITIVE
KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME.
CYLINDER TEMPERATURE SHOULD NOT EXCEED 125 F(52 C).
STORE AND USE WITH ADEQUATE VENTILATION.
CONTENTS UNDER PRESSURE.
REFRIGERATE BEFORE OPENING.

ADDITIONAL PRECAUTIONS AND COMMENTS

WARNING: SUCK-BACK INTO CYLINDER MAY CAUSE RUPTURE.
USE BACK-FLOW-PREVENTIVE DEVICE IN PIPING.
USE WITH EQUIPMENT RATED FOR CYLINDER PRESSURE, AND OF COMPATIBLE MATERIALS OF CONSTRUCTION. CLOSE VALVE WHEN NOT IN USE AND WHEN EMPTY.

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CATALOG # 29550-7 NAME: CHLOROMETHANE, 99.5+%

MAKE SURE CYLINDER IS PROPERLY SECURED WHEN IN USE OR STORED.

ADDITIONAL INFORMATION

IN THE PRESENCE OF CATALYTIC AMOUNTS OF ALUMINUM CHLORIDE, POWDERED ALUMINUM AND CHLOROMETHANE INTERACT TO FORM PYROPHORIC TRIMETHYLALUMINUM. CHLOROMETHANE MAY REACT EXPLOSIVELY WITH: MAGNESIUM, ZINC OR POTASSIUM, SODIUM OR THEIR ALLOYS. INCOMPATIBLE WITH NATURAL RUBBER AND MANY NEOPRENE COMPOSITES WHILE POLYVINYL ALCOHOL IS UNAFFECTED.

---------- REGULATORY INFORMATION ----------

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

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SUBSTANCE IDENTIFICATION

SUBSTANCE: SCINTIVERSE

TRADE NAMES/SYNONYMS:
SCINTIVERSE TH II; SO-X-12; SCINTIVERSE TH -LC; SO-X-20; ACC40207

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: 1,2,4-TRIMETHYLBENZENE
CAS# 95-63-6

COMPONENT: POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER
CAS# 9003-11-6

COMPONENT: PLURAFAC A-46
CAS# 63704-78-9

COMPONENT: ISOPROPYL ALCOHOL
CAS# 67-63-0

COMPONENT: 2,5-DIPHENYLOXAZOLE
CAS# 92-71-7

COMPONENT: BIS(MSB)
CAS# 13280-61-0

COMPONENT: POPOP 1,4-BIS-2-(5-PHENYLOXAXOLYL)-BENZENE
CAS# 1806-34-4

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
1,2,4-TRIMETHYLBENZENE:

SX 12 - 500
SX 12 - 4
SX 20 - 4
SX 20 - 500

25 PPM (125 MG/M3) ACGIH TWA; 35 PPM (170 MG/M3) ACGIH STEL

ISOPROPYL ALCOHOL:
400 PPM OSHA TWA
400 PPM ACGIH TWA; 500 PPM ACGIH STEL
400 PPM NIOSH RECOMMENDED TWA; 800 PPM NIOSH RECOMMENDED 15 MINUTE CEILING

PHYSICAL DATA

DESCRIPTION: FAINT BLUE FLUORESCENT-HUED LIQUID SPECIFIC GRAVITY: 0.9-0.93

SOLUBILITY IN WATER: SOLUBLE VAPOR DENSITY: > 1

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
MODERATE FIRE AND EXPLOSION HAZARD WHEN EXPOSED TO HEAT OR FLAME. VAPOR-AIR MIXTURES ARE EXPLOSIVE ABOVE THE FLASHPOINT. VAPORS ARE HEAVIER THAN AIR AND MAY TRAVEL A CONSIDERABLE DISTANCE TO A SOURCE OF IGNITION AND FLASH BACK.

FLASH POINT: 118 F (48 C) FLAMMABILITY CLASS(OSHA): II

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR ALCOHOL FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL FIRE-EXPOSED CONTAINERS WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES, ELSE WITHDRAW FROM AREA AND LET FIRE BURN. WITHDRAW IMMEDIATELY IN CASE OF RISING SOUND FROM VENTING SAFETY DEVICE OR ANY DISCOLORATION OF STORAGE TANK DUE TO FIRE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 26).

EXTINGUISH ONLY IF FLOW CAN BE STOPPED; USE FLOODING AMOUNTS OF WATER AS A FOG, SOLID STREAMS MAY BE INEFFECTIVE. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING VAPORS, KEEP UPWIND.

TOXICITY

1,2,4-TRIMETHYLBENZENE: 5000 MG/KG ORAL-RAT LDLO; 18 MG/M3/4 HOURS INHALATION-RAT LC50; 2000 MG/KG INTRAPERITONEAL-RAT LDLO; 1788 MG/KG INTRAPERITONEAL-GUINEA PIG LDLO; CARCINOGEN STATUS: NONE; EYE, SKIN AND MUCOUS MEMBRANE IRRITANT AND A HIGHLY TOXIC NARCOTIC.

POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: 6900 MG/KG SUBCUTANEOUS-RAT LD50; 5500 MG/KG SUBCUTANEOUS-MOUSE LD50; 7700 MG/KG INTRAVENOUS-RAT LD50; 3000 MG/KG INTRAVENOUS-MOUSE LD50; CARCINOGEN STATUS: NONE.

PLURAFAC A-46: CARCINOGEN STATUS: NONE; MAY BE AN EYE, SKIN AND MUCOUS MEMBRANE IRRITANT.

ISOPROPYL ALCOHOL: 20 PPM EYE-HUMAN IRRITATION; 16 MG EYE-RABBIT IRRITATION; 400 PPM INHALATION-MAN TCLO; 8600 MG/KG ORAL-MAN LDLO; 15,710 MG/KG

ORAL-[illegible] [illegible]; 5840 MG/KG ORAL-RAT LD50; 933 MG/KG INTRAPERITONEAL-[illegible] LD50; 16,000 PPM/8 HOURS INHALATION-RAT LC50; 6150 MG/KG ORAL-DOG LD50; 5000 MG/KG ORAL-RABBIT LDLO; 13 GM/KG SKIN-RABBIT LD50; MUTAGENIC DATA (RTEC); POSITIVE HUMAN CARCINOGEN (NTP); SUSPECT HUMAN CARCINOGEN (IARC). WORKER INVOLVED IN THE MANUFACTURING OF ISOPROPYL ALCOHOL SHOWED AN INCREASE IN SINUS AND LARYNGEAL CANCERS. SEVERE EYE IRRITANT, SKIN AND MUCOUS MEMBRANE IRRITANT AND NARCOTIC.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT/NARCOTIC/CARCINOGEN.
20,000 PPM ISOPROPYL ALCOHOL IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.

ACUTE EXPOSURE

1,2,4-TRIMETHYLBENZENE: MAY CAUSE CHEMICAL PNEUMONITIS AT SITE OF CONTACT. MAY ALSO CAUSE SORE THROAT, COUGHING, HEADACHE, DYSPNEA, FATIGUE, NARCOSIS, AND HEMORRHAGIC INFLAMMATORY LESIONS OF MUCOUS MEMBRANES.

POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: DUE TO ITS LOW VAPOR PRESSURE, EXPOSURE TO VAPORS OF POLYOXYETHYLENE-POLYOXYPROPLENE BLOCK POLYMER IS NOT LIKELY TO OCCUR.

PLURAFAC A-46: MAY CAUSE IRRITATION.

ISOPROPYL ALCOHOL: ISOPROPYL ALCOHOL MAY CAUSE DIZZINESS, INCOORDINATION, HEADACHE, CONFUSION, PERSISTENT NAUSEA, HEMATEMESES, ABDOMINAL PAIN, STUPOR, HYPOTENSION, ANEMIA, REFRACTORY NARCOSIS, AREFLEXIA, DEPRESSED RESPIRATION, OLIGURIA FOLLOWED BY DIURESIS, AND UREMIA. TENDERNESS AND EDEMA OF MUSCLES MAY ALSO OCCUR. SEVERE CASES MAY CAUSE COMA.

CHRONIC EXPOSURE

1,2,4-TRIMETHYLBENZENE: MAY CAUSE NERVOUSNESS, TENSION, ANXIETY, ASTHMATIC BRONCHITIS, PAIN IN THE LIMBS, PERIPHERAL NUMBNESS AND PARESTHESIA. MAY ALSO CAUSE BONE MARROW DAMAGE.

POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO DATA AVAILABLE.

PLURAFAC A-46: REPEATED OR PROLONGED EXPOSURE MAY CAUSE IRRITATION.

ISOPROPYL ALCOHOL: THERE HAS BEEN AN INCREASED INCIDENCE OF CANCER OF THE PARANASAL SINUSES, AND POSSIBLY OF THE LARYNX, IN THE MANUFACTURE OF ISOPROPYL ALCOHOL BY THE STRONG ACID PROCESS, INVOLVING THE FORMATION OF ISOPROPYL OILS. IT IS NOT CLEAR WHICH SUBSTANCES ARE RESPONSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
IRRITANT.

ACUTE EXPOSURE

1,2,4-TRIMETHYLBENZENE: MAY CAUSE IRRITATION WITH REDNESS, EDEMA AND BLISTERS.

POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: MAY CAUSE MILD IRRITATION IN SENSITIVE INDIVIDUALS.

PURAFAC A-46: MAY CAUSE IRRITATION.

ISOPROPYL ALCOHOL: MAY CAUSE NARCOSIS WITH NAUSEA, VOMITING, HYPOTENSION, DEPRESSED RESPIRATION, ANEMIA, UREMIA, ANC COMA.

CHRONIC EXPOSURE

SCINTIVERSE
1,2,4-TRIMETHYLBENZENE: MAY CAUSE DERMATITIS AND NERVOUSNESS, TENSION, ANXIETY, PERIPHERAL NUMBNESS AND PARESTHESIA.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO EFFECTS REPORTED.
PLURAFAC A-46: MAY CAUSE IRRITATION, BUT SENSITIZATION AND ALLERGIC REACTIONS ARE RARE.
ISOPROPYL ALCOHOL: MAY CAUSE DERMATITIS DUE TO THE DEFATTING ACTION ON THE SKIN.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE
1,2,5-TRIMETHYLBENZENE: MAY CAUSE REDNESS, EDEMA, PAIN, AND POSSIBLE CORNEAL LESIONS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: CONTACT WITH THE EYES MAY PRODUCE MILD IRRITATION.
PULRAFAC A-46: DIRECT CONTACT MAY CAUSE IRRITATION, PAIN, AND POSSIBLY INJURY.
ISOPROPYL ALCOHOL: VAPORS MAY BE IRRITATING AND MAY CAUSE PROFUSE LACRIMATION. DIRECT CONTACT MAY CAUSE IRRITATION, BURNS AND PERMANENT CORNEAL DAMAGE.

CHRONIC EXPOSURE
1,2,5-TRIMETHYLBENZENE: MAY CAUSE CONJUNCTIVITIS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO EFFECTS REPORTED.
PULRAFAC A-46: REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.
ISOPROPYL ALCOHOL: PROLONGED OR REPEATED EXPOSURE TO VAPORS OF ISOPROPYL ALCOHOL MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NARCOTIC.
ACUTE EXPOSURE
1,2,4-TRIMETHYLBENZENE: MAY CAUSE BURNING SENSATION IN THE MOUTH, SORE THROAT, HEADACHE, ABDOMINAL PAIN, NAUSEA, VOMITING, BLOODY SPUTUM, WEAKNESS, VERTIGO, DYSPNEA, NARCOSIS, ANEMIA, AND CONVULSIONS.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: RELATIVELY NONTOXIC. MAY CAUSE NAUSEA ON INGESTION.
PLURAVAC A-46: MAY CAUSE GASTROINTESTINAL TRACT IRRITATION WITH DIARRHEA, VOMITING, AND BLOATING. LITTLE IF ANY INTESTINAL ABSORPTION OCCURS.
ISOPROPYL ALCOHOL: MAY CAUSE NARCOSIS WITH HEADACHE, NAUSEA, HEMATEMESIS, DIZZINESS, INCOORDINATION, ABDOMINAL PAIN, STUPOR, DEPRESSED RESPIRATION, OLIGURIA, UREMIA, DIURESIS, AND COMA. DEATH MAY OCCUR FROM RESPIRATORY PARALYSIS.

CHRONIC EXPOSURE
1,2,4-TRIMETHYLBENZENE: NO EFFECTS REPORTED.
POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER: NO EFFECTS REPORTED.
PLURAFAC A-46: NO EFFECTS REPORTED.
ISOPROPYL ALCOHOL: NO EFFECTS REPORTED.

FIRST AID- DO NOT INDUCE VOMITING. GET IMMEDIATE MEDICAL ATTENTION.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
ISOPROPYL ALCOHOL:
PHOSGENE: IN THE PRESENCE OF IRON SALTS, MAY EXPLODE.
NITROFORM (>50%): DISSOLVES LIBERATING HEAT AND POSSIBLY EXPLODING.
TRINITROMETHANE: POSSIBLE EXPLOSION.
HYDROGEN: WHEN A STREAM OF HYDROGEN ENTRAINED ISOPROPYL ALCOHOL VAPORS AND PALLADIUM PARTICLES, THE MIXTURE CAUGHT FIRE UPON CONTACT WITH AIR.
POTASSIUM TERT-BUTOXIDE: IGNITION.
DIOXYGENYL TETRAFLUOROBORATE: IGNITION AT AMBIENT TEMPERATURES.
CHROMIUM TRIOXIDE (GRANULAR): IGNITION.
2-BUTANONE: ACCELERATES THE PEROXIDATION OF THE ALCOHOL, RESULTING IN FORMATION OF POTENTIALLY EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE: FORMATION OF A SHOCK- OR HEAT-SENSITIVE, DETONATABLE PRODUCT.
OXYGEN (GAS): AUTOXIDATION, ON EXPOSURE TO LIGHT, RESULTS IN FORMATION OF POTENTIALLY EXPLOSIVE KETONES AND HYDROGEN PEROXIDE.
OLEUM: REACTS WITH AN INCREASE IN TEMPERATURE AND PRESSURE.
ALUMINUM: DISSOLUTION IS EXOTHERMIC.
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

1,2,4-TRIMETHYLBENZENE:
NITRIC ACID: AN EXPLOSION MAY OCCUR WHEN MIXED TOGETHER AT 115 C OR ABOVE.

PLURAFAC A-46:
STRONG OXIDIZERS: FIRE AND EXPLOSION HAZARD.

POLYOXYETHYLENE-POLYOXYPROPYLENE BLOCK POLYMER:
NONE KNOWN

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF CARBON.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****

CONDITIONS TO AVOID

AVOID HEAT, NITRIC ACID, AND OXIDIZERS.

SPILL AND LEAK PROCEDURES

:ATER SPILL:
F WATER POLLUTION OCCURS, NOTIFY APPROPRIATE AUTHORITIES.

:CCUPATIONAL SPILL:
:HUT OFF IGNITION SOURCES. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER
:PRAY TO REDUCE VAPORS. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER
.BSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER
:PILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. NO SMOKING, FLAMES OR
'LARES IN HAZARD AREA; KEEP UNNECESSARY PEOPLE AWAY; ISOLATE HAZARD AREA AND
:ENY ENTRY.

PROTECTIVE EQUIPMENT

/ENTILATION:
?ROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED
:XPOSURE LIMITS.

:ESPIRATOR:
HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET OR HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
TYPE C SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE OR WITH A FULL FACEPIECE, HELMET, OR HOOD OPERATED IN CONTINUOUS-FLOW MODE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 10/07/85 REVISION DATE: 05/27/88

-ADDITIONAL INFORMATION-

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4. MATERIAL SAFETY DATA SHEETS - CORROSIVES AND REACTIVES

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ATTN: SAFETY DIRECTOR
GLAXO INC
ACCOUNTS PAYABLE
5 MOORE DRIVE
RSCH TRI PK NC 27709

EMERGENCY PHONE 1-314-771-5765

DATE: 03/16/88

CUST#: 6-065-31571 PO#: 0000092150

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: A6283 NAME: ACETIC ACID, GLACIAL
CAS #: 64-19-7

TOXICITY HAZARDS

RTECS NO: AF1225000
ACETIC ACID
IRRITATION DATA

SKN-HMN 50 MG/24H MLD	TXAPA9 31,481,75
SKN-RBT 20 MG/24H MOD	85JCAE -,304,86
SKN-RBT 525 MG OPEN SEV	UCDS** 8/7/63
SKN-RBT 50 MG/24H MLD	TXAPA9 31,481,75
EYE-RBT 50 UG OPEN SEV	AMIHBC 4,119,51
EYE-RBT 100 MG RINSE MLD	TXCYAC 23,281,82

TOXICITY DATA

UNR-MAN LDLO:308 MG/KG	85DCAI 2,73,70
ORL-RAT LD50:3530 MG/KG	3C 4,119,51
IHL-MUS LC50:5620 PPM/1H	\0 48,559,57
IVN-MUS LD50:525 MG/KG	6 18,141,61
SKN-RBT LD50:1060 MG/KG	* 8/7/63

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 10 PPM; STEL 15 P 5931
MSHA STANDARD-AIR:TWA 10 PPM (2 '1
OSHA STANDARD-AIR:TWA 10 PPM FEI
EPA GENETOX PROGRAM 1986, NEGATI ION-AMES TEST
EPA TSCA CHEMICAL INVENTORY, 198
EPA TSCA SECTION 8(E) STATUS REP
EPA TSCA TEST SUBMISSION (TSCATS, ,87
NIOSH ANALYTICAL METHODS: SEE ACE 1003
MEETS CRITERIA FOR PROPOSED OSHA ...ICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.

CONTINUED ON NEXT PAGE

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CUST#: 6-065-31571 PO#: 0000092150

PRODUCT #: A6283 NAME : ACETIC ACID, GLACIAL

---------- HEALTH HAZARD DATA ----------

ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

---------- PHYSICAL DATA ----------

BOILING PT: 117 C TO 118 C
MELTING PT: 16 C TO 16.5 C
SPECIFIC GRAVITY: 1.049
VAPOR DENSITY: 2.07
VAPOR PRESSURE: 11.4 MM @ 20 C

---------- FIRE AND EXPLOSION HAZARD DATA ----------

FLASHPOINT: 104 F
AUTOIGNITION TEMPERATURE: 800 F
LOWER EXPLOSION LEVEL: 4%
UPPER EXPLOSION LEVEL: 16%

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIREFIGHTING PROCEDURES
COMBUSTIBLE.
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
BASES
PROTECT FROM MOISTURE.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
THIS COMBUSTIBLE MATERIAL MAY BE BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

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CUST#: 6-065-31571 PO#: 0000092150

PRODUCT #: A6283 NAME : ACETIC ACID, GLACIAL

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

WEAR APPROPRIATE NIOSH-MSHA-APPROVED RESPIRATOR, CHEMICAL RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
DO NOT BREATHE VAPOR.
READILY ABSORBED THROUGH SKIN.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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ACCTS PAYABLE
PO BOX 13358
RSCH TRI PK NC 27709

DATE: 10/12/88

CUST#: 6-065-31571 PO#: 92950071

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: A6404 NAME: ACETIC ANHYDRIDE
CAS #: 108-24-7
MF: C4H6O3

SYNONYMS
ACETANHYDRIDE * ACETIC ACID, ANHYDRIDE (9CI) * ACETIC ANHYDRIDE (ACGIH,DOT) * ACETIC OXIDE * ACETYL ANHYDRIDE * ACETYL ETHER * ACETYL OXIDE * ANHYDRIDE ACETIQUE (FRENCH) * ANHYDRID KYSELINY OCTOVE (CZECH) * ANIDRIDE ACETICA (ITALIAN) * AZIJNZUURANHYDRIDE (DUTCH) * ESSIGSAEUREANHYDRID (GERMAN) * ETHANOIC ANHYDRATE * OCTOWY BEZWODNIK (POLISH) * UN 1715 (DOT) *

TOXICITY HAZARDS

RTECS NO: AK1925000
ACETIC ANHYDRIDE
IRRITATION DATA

SKN-RBT 10 MG/24H OPEN MLD	AMIHBC 4,119,51
SKN-RBT 540 MG OPEN MLD	UCDS** 8/7/63
EYE-RBT 250 UG OPEN SEV	AMIHBC 4,119,51

TOXICITY DATA

ORL-RAT LD50:1780 MG/KG	AMIHBC 4,119,51
IHL-RAT LC50:1000 PPM/4H	34ZIAG -,607,69
SKN-RBT LD50:4000 MG/KG	UCDS** 8/7/63

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 5 PPM 85INA8 5,5,86
MSHA STANDARD:AIR-CL 5 PPM (20 MG/M3) OTLWS* 3,2,71
OSHA STANDARD-AIR:TWA 5 PPM FEREAC 39,23540,74
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, MARCH 1988
NIOSH ANALYTICAL METHODS: SEE ACETIC ANHYDRIDE, 3506
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS

CONTINUED ON NEXT PAGE

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CABLE ADDRESS: SIGMACHEM TWX: 910-761-0593

CUST#: 6-065-31571 PO#: 92950071

PRODUCT #: A6404 NAME : ACETIC ANHYDRIDE

---------- HEALTH HAZARD DATA ----------

AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED SHOES.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

---------- PHYSICAL DATA ----------

BOILING PT: 138 C TO 140 C
MELTING PT: -73 C
SPECIFIC GRAVITY: 1.080
VAPOR DENSITY: 3.5
VAPOR PRESSURE: 4 MM @ 20 C
10 MM @ 36 C

---------- FIRE AND EXPLOSION HAZARD DATA ----------

FLASHPOINT: 130 F
AUTOIGNITION TEMPERATURE: 629 F
LOWER EXPLOSION LEVEL: 2.7%
UPPER EXPLOSION LEVEL: 10.3%

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
ACIDS
BASES
MOISTURE
ALCOHOLS
OXIDIZING AGENTS
REDUCING AGENTS
FINELY POWDERED METALS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.

CONTINUED ON NEXT PAGE

CH OFFICES AT: SIGMA CHEMICAL CO. LTD.
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SIGMA CHEMIE GmbH
Grunwalder Weg 30
D-8024 Deisenhofen
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CABLE ADDRESS: SIGMACHEM TWX: 910-761-0593

CUST#: 6-065-31571 PO#: 92950071

PRODUCT #: A6404 NAME : ACETIC ANHYDRIDE

SPILL OR LEAK PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH AN ACTIVATED CARBON ADSORBENT, TAKE UP AND PLACE IN CLOSED CONTAINERS. TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD

THIS MATERIAL SHOULD BE IGNITED IN THE PRESENCE OF SODIUM CARBONATE AND SLAKED LIME (CALCIUM HYDROXIDE). THE SUBSTANCE SHOULD BE MIXED WITH VERMICULITE AND THEN WITH THE DRY CAUSTICS, WRAPPED IN PAPER AND BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH-MSHA-APPROVED RESPIRATOR, CHEMICAL RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
LACHRYMATOR.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
MOISTURE SENSITIVE
STORE IN A COOL DRY PLACE.

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
GARY GITLIN/DEPT RECEPTOR RES

DATE: 05/05/89
CUST # 232882 P.O. # 95155/1

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 22122-8 NAME: AMMONIUM HYDROXIDE, A.C.S. REAGENT
CAS # 1336-21-6
MF: H5NO

SYNONYMS
AMMONIA AQUEOUS * AMMONIA SOLUTION, CONTAINING 44% OR LESS AMMONIA (DOT) * AMMONIA WATER 29% * AMMONIUM HYDROXIDE (DOT) * AMMONIUM HYDROXIDE, CONTAINING NOT LESS THAN 12% BUT NOT MORE THAN 44% AMMONIA (DOT) * AQUA AMMONIA * AQUA AMMONIA, SOLUTION (DOT) * NA 2672 (DOT) *

TOXICITY HAZARDS

RTECS # BQ9625000
AMMONIUM HYDROXIDE
IRRITATION DATA
EYE-RBT 750 UG SEV — AJOPAA 29,1363,46
EYE-RBT 44 UG SEV — AROPAW 25,839,41
EYE-RBT 1 MG/30S RINSE SEV — TXCYAC 23,281,82
TOXICITY DATA
ORL-HMN LDLO:43 MG/KG — 34ZIAG -,95,69
IHL-HMN LCLO:5000 PPM — 34ZIAG -,95,69
ORL-RAT LD50:350 MG/KG — JIHTAB 23,259,41
REVIEWS, STANDARDS, AND REGULATIONS
NIOSH REL TO AMMONIA-AIR:CL 50 PPM MMWR** 34(1S),7S,85
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
LUNGS, THORAX OR RESPIRATION (FIBROSIS, FOCAL)
LUNGS, THORAX OR RESPIRATION (ACUTE PULMONARY EDEMA)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIC

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
CALL A PHYSICIAN.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL

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Japan: Aldrich Japan, Kyodo Bldg. Shinkanda, 10 Kanda-Mikuracho, Chiyoda-Ku, Tokyo, Telephone (03) 258-0155, FAX (03) 258-0157
United Kingdom: Aldrich Chemical Co., Ltd., The Old Brickyard, New Road, Gillingham, Dorset SP8 4JL, Telephone (07476) 2211, Telex 417238 Aldrich G, FAX (07476) 3779
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CATALOG # 22122-8 NAME: AMMONIUM HYDROXIDE, A.C.S. REAGENT

RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.

---------- PHYSICAL DATA ----------

SPECIFIC GRAVITY: 0.900
VAPOR DENSITY: 1.2
VAPOR PRESSURE: 115.0 MM @ 20 C
APPEARANCE: CLEAR COLORLESS LIQUID

---------- FIRE AND EXPLOSION HAZARD DATA ----------

AUTO IGNITION TEMP.: 1204 F
LOWER EXPLOSION LEVEL: 16%
UPPER EXPLOSION LEVEL: 27%
FLASH POINT: NONE
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
ACIDS
COPPER, COPPER ALLOYS
GALVANIZED IRON
ALUMINUM
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
AMMONIA

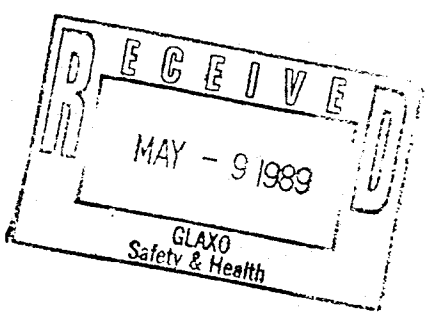
---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
SELF-CONTAINED BREATHING APPARATUS SHOULD BE WORN.
EVACUATE AREA.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.



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CATALOG # 22122-8 NAME: AMMONIUM HYDROXIDE, A.C.S. REAGENT

CORROSIVE.
TOXIC.
KEEP TIGHTLY CLOSED.
REFRIGERATE BEFORE OPENING.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
NH3 CONTENT 20-30%

---------- REGULATORY INFORMATION ----------

NOT APPLICABLE

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AMMONIUM NITRATE
AMMONIUM NITRATE
AMMONIUM NITRATE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
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FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
(201) 796-7100

DATE 03/31/88
PO NBR: 0000031813
ACCT: 311488-14
INDEX: 14880880346
CAT NO: A676500

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 6484-52-2

SUBSTANCE: **AMMONIUM NITRATE**

TRADE NAMES/SYNONYMS:
NITRAM; AMMONIUN(I) NITRATE; NITRIC ACID, AMMONIUM SALT; A-676; ACC01290

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: H4-N2-03 MOL WT: 80.06

CERCLA RATINGS (SCALE 0-3): HEALTH=0 FIRE=0 REACTIVITY=3 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: AMMONIUM NITRATE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS CRYSTALLINE SOLID.

BOILING POINT: 410 F (210 C) DECOMP MELTING POINT: 337 F (170 C)

SPECIFIC GRAVITY: 1.7 PH: 5.43 (0.1 M AQ SOLN)

SOLUBILITY IN WATER: SOLUBLE

SOLVENT SOLUBILITY: ACETONE, AMMONIA, ALCOHOL

C489

TOXICITY

CARCINOGEN STATUS: NONE. AMMONIUM NITRATE IS AN IRRITANT TO THE SKIN, EYES, AND MUCOUS MEMBRANES. MODERATELY TOXIC BY INGESTION.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE COUGHING, DYSPNEA, HEADACHE, DIZZINESS, WEAKNESS, SORE THROAT, TACHYCARDIA, FLUSHING OF THE SKIN, PULMONARY EDEMA, HEMORRHAGE, AND CONVULSIONS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY AFFECT THE CENTRAL NERVOUS SYSTEM AND CAUSE KIDNEY DAMAGE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION AS SOON AS POSSIBLE.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE IRRITATION AND PAIN.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTILNO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE REDNESS, PAIN, AND BLURRED VISION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

REACTIVITY

REACTIVITY:
STABLE AT ORDINARY PRESSURES UP TO THE DECOMPOSITION TEMPERATURE, 210 C, BUT IS SHOCK-SENSITIVE; SEE FIRE AND EXPLOSION HAZARDS.

INCOMPATIBILITIES:

ALKALI METALS: FORMS EXPLOSIVE SODIUM HYPONITRITE.
CYANOGUANIDINE: FORMS EXPLOSIVE MIXTURE.
METALLIC POWDERS (ALUMINUM, ANTIMONY, BRASS, BISMUTH, CADMIUM, CHROMIUM, COBALT, COPPER, IRON, LEAD, MAGNESIUM, MANGANESE, NICKEL, STAINLESS STEEL, STAINLESS STEEL, TIN, ZINC): VIOLENT OR EXPLOSIVE REACTION, SHOCK SENSITIVE. SHOCK SENSITIVE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT TO PROLONGED OR REPEATED CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 01/14/85 REVISION DATE: 08/13/85

-ADDITIONAL INFORMATION-

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FAX: (414) 273-4979

ATTN: SAFETY DIRECTOR
GLAXO INC
NEW PRODUCT DEVELOPMENT
5 MOORE DR
RESEARCH TRIANGLE PARK NC 27709
N MEHROTRA

DATE: 10/13/87
CUST # 926471 P.O. # 91119

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # A8847-6 NAME: P-ANISOYL CHLORIDE, 99%
CAS # 100-07-2

TOXICITY HAZARDS

RTECS # CA0270000
ANISOYL CHLORIDE
REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: 22 C
BOILING POINT: 145 C/14MM.

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 190 F
EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

6353

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ATTN: SAFETY DIRECTOR
GLAXO INC
NEW PRODUCT DEVELOPMENT
5 MOORE DR
RESEARCH TRIANGLE PARK NC 27709
N MEHROTRA

DATE: 10/13/87
CUST # 926471 P.O. # 91119

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 23024-3 NAME: M-ANISOYL CHLORIDE, 99%
CAS # 1711-05-3

TOXICITY HAZARDS

NO TOXICITY

6354

HAZARD DATA

ACUTE EFFECTS
HARMFUL IF [illegible] OR ABSORBED THROUGH SKIN.
MATERIAL IS [illegible] VE TO TISSUE OF THE MUCOUS MEMBRANES
AND UPPER RI[illegible] ES AND SKIN.
INHALATION [illegible] SULT OF SPASM, INFLAMMATION AND EDEMA
OF THE LARYI[illegible] ICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF [illegible] BURNING SENSATION, COUGHING,
WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND
VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND
TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS
AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED
CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS
WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL
RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

BOILING POINT: 123 C TO 125 C/15MM.
SPECIFIC GRAVITY: 1.214

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 198 F
EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO
PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

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GLAXO INC
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P J BROWN

DATE: 06/21/89
CUST # 232882 P.O. # 0000096408

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 24238-1 NAME: BENZOIC ACID, 99+%, A.C.S. REAGENT
CAS # 65-85-0
MF: C7H6O2

SYNONYMS
ACIDE BENZOIQUE (FRENCH) * BENZENECARBOXYLIC ACID * BENZENEFORMIC ACID * BENZENEMETHANOIC ACID * BENZOATE * BENZOESAEURE (GERMAN) * BENZOIC ACID (DOT) * CARBOXYBENZENE * DRACYLIC ACID * KYSELINA BENZOOVA (CZECH) * NA 9094 (DOT) * PHENYL CARBOXYLIC ACID * PHENYLFORMIC ACID * RETARDER BA * RETARDEX * TENN-PLAS * SALVO LIQUID * SALVO POWDER *

TOXICITY HAZARDS

RTECS # DG0875000
BENZOIC ACID
IRRITATION DATA
SKN-HMN 22 MG/3D-I MOD 85DKA8 -,127,77
SKN-RBT 500 MG/24H MLD BIOFX* 28-4/73
EYE-RBT 100 MG SEV BIOFX* 28-4/73
TOXICITY DATA
ORL-MAN LDLO:500 MG/KG FCTXAV 17,715,79
ORL-MUS LD50:1940 MG/KG IYKEDH 15,359,84
IPR-MUS LD50:1460 MG/KG CRSBAW 160,1097,66
ORL-DOG LD50:2000 MG/KG 27ZTAP 3,22,69
ORL-CAT LD50:2000 MG/KG 27ZTAP 3,22,69
REVIEWS, STANDARDS, AND REGULATIONS
EPA GENETOX PROGRAM 1988, NEGATIVE: HISTIDINE REVERSION-AMES TEST: S CEREVISIAE-HOMOZYGOSIS
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-1177-0018
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
BEHAVIORAL (SOMNOLENCE)
LUNGS, THORAX OR RESPIRATION (DYSPNAE)
LUNGS, THORAX OR RESPIRATION (RESPIRATORY DEPRESSION)
GASTROINTESTINAL (OTHER CHANGES)
SKIN AND APPENDAGES (AFTER SYSTEMIC EXPOSURE: DERMATITIS, ALLERGIC)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED.
MAY BE HARMFUL IF INHALED.
MAY BE HARMFUL IF ABSORBED THROUGH THE SKIN.
CAUSES EYE AND SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
FIRST AID

397

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CATALOG # 24238-1 NAME: BENZOIC ACID, 99+%, A.C.S. REAGENT

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

MELTING POINT: 122 C TO 123 C
BOILING POINT: 249 C
VAPOR DENSITY: 4.21
VAPOR PRESSURE: 10.0 MM @ 132 C
APPEARANCE: WHITE CRYSTALLINE POWDER

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 1061 F
FLASH POINT: 250 F
EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
NOT APPLICABLE

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG BASES
STRONG REDUCING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES.
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
DO NOT BREATHE DUST.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.

RECEIVED
JUN 27 1989

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CATALOG # 24238-1 NAME: BENZOIC ACID, 99+%, A.C.S. REAGENT

WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

NOT APPLICABLE

---------- REGULATORY INFORMATION ----------

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
LACKEY JOHN

DATE: 06/09/89
CUST # 232882 P.O. # 95325

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 24054-0 NAME: BENZOYL CHLORIDE, 99+%, GOLD LABEL
CAS # 98-88-4
MF: C7H5CLO

SYNONYMS
BENZALDEHYDE, ALPHA-CHLORO- * BENZENECARBONYL CHLORIDE * BENZOIC ACID, CHLORIDE * BENZOYL CHLORIDE (DOT) * ALPHA-CHLOROBENZALDEHYDE * UN 1736 (DOT) *

TOXICITY HAZARDS

RTECS # DM6600000
BENZOYL CHLORIDE
TOXICITY DATA
IHL-RAT LC50:1870 MG/M3/2H 85GMAT -,25,82
REVIEWS, STANDARDS, AND REGULATIONS
IARC CANCER REVIEW:ANIMAL INADEQUATE EVIDENCE IMEMDT 29,83,82
IARC CANCER REVIEW:HUMAN INADEQUATE EVIDENCE IMEMDT 29,83,82
IARC CANCER REVIEW:GROUP 3 IMSUDL 7,56,87
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: B SUBTILIS REC ASSAY
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA 8(A) PRELIMINARY ASSESSMENT INFORMATION, FINAL RULE FEREAC 47,26992,82
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0582-0444;8EHQ-0980-0360; 8EHQ-0777-0001
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0178-0041;8EHQ-0478-0138 P
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0578-0156;8EHQ-0678-0180
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (OTHER OLFACTION EFFECTS)
LUNGS, THORAX OR RESPIRATION (OTHER CHANGES)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIC

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
CHRONIC EFFECTS
POSSIBLE CARCINOGEN.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICA TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY I
FIRST AID

6996

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CATALOG # 24054-0 NAME: BENZOYL CHLORIDE, 99+%, GOLD LABEL

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: -1 C
BOILING POINT: 198 C
SPECIFIC GRAVITY: 1.211
VAPOR DENSITY: 4.88
VAPOR PRESSURE: 1.0 MM @ 32 C
APPEARANCE: COLORLESS LIQUID

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 1056 F
LOWER EXPLOSION LEVEL: 1.2%
UPPER EXPLOSION LEVEL: 4.9%
FLASH POINT: 156 F

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE LIQUID.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
WATER HYDROLYZES MATERIAL LIBERATING ACIDIC GAS WHICH IN CONTACT WITH METAL SURFACES CAN GENERATE FLAMMABLE AND/OR EXPLOSIVE HYDROGEN GAS.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG BASES
ALCOHOLS
MAY DECOMPOSE ON EXPOSURE TO MOIST AIR OR WATER.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS
PHOSGENE GAS

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

STEELY

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CATALOG # 24054-0 NAME: BENZOYL CHLORIDE, 99+%, GOLD LABEL

WASTE DISPOSAL METHOD
THIS COMBUSTIBLE MATERIAL MAY BE BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
POSSIBLE CARCINOGEN.
LACHRYMATOR.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
MOISTURE-SENSITIVE.
STORE UNDER NITROGEN.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
CAUTION: REACTS VIOLENTLY WITH DIMETHYL SULFOXIDE. AVOID PHYSICAL DAMAGE TO CONTAINERS.

---------- REGULATORY INFORMATION ----------

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
TOM WHEELER

DATE: 06/19/89
CUST # 232882 P.O. # 95325

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 32813-8 NAME: BROMINE, 99.99+%
CAS # 7726-95-6
MF: BR2
SYNONYMS
BROM (GERMAN) * BROME (FRENCH) * BROMINE (ACGIH,DOT,OSHA) * BROMINE SOLUTION (DOT) * BROMO (ITALIAN) * BROOM (DUTCH) * UN 1744 (DOT) *

TOXICITY HAZARDS

RTECS # EF9100000
BROMINE
TOXICITY DATA
ORL-HMN LDLO:14 MG/KG 34ZIAG -,645,69
IHL-HMN LCLO:1000 PPM 34ZIAG -,645,69
IHL-MUS LC50:750 PPM/9M AIHAAP 39,129,78
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 0.1 PPM; STEL 0.3 PPM 85INA8 5,65,86
MSHA STANDARD-AIR:TWA 0.1 PPM (0.7 MG/M3) DTLVS* 3,27,71
OSHAPEL:8H TWA 0.1 PPM (0.7 MG/M3) FEREAC 54,2923,89
OSHAPEL FINAL:8H TWA 0.1 PPM (0.7 MG/M3);STEL 0.3 PPM (2 MG/M3) FEREAC 54,2923,89
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
OSHA ANALYTICAL METHOD #ID-108
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
DISCARD CONTAMINATED CLOTHING AND SHOES.

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MATERIAL SAFETY DATA SHEET

CATALOG # 32813-8 NAME: BROMINE, 99.99+%

PHYSICAL DATA

MELTING POINT: -7.25 C TO C
BOILING POINT: 59.5 C
SPECIFIC GRAVITY: 3.102
VAPOR DENSITY: 7.14
VAPOR PRESSURE: 175.0 MM @ 20 C
671.0 MM @ 55 C
APPEARANCE: DARK-RED LIQUID

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
STRONG OXIDIZER.
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
REDUCING AGENTS
ALKALI METALS
FINELY POWDERED METALS
ALUMINUM
CORRODES STEEL
STAINLESS STEEL
GALVANIZED IRON
COPPER, COPPER ALLOYS
ORGANIC MATERIALS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR FULL PROTECTIVE EQUIPMENT SUCH AS, A BUTYL RUBBER CHEMICAL-PROOF AIR SUIT, WITH BREATHING AIR SUPPLIED.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
IN A RETENTION AREA, DROWN THE MATERIAL BY FLOODING WITH WATER OR BY ADDING IT TO A VERY LARGE EXCESS OF WATER AT A CONTROLLED RATE. ADJUST THE PH TO NEUTRAL AND PROCESS ANY INSOLUBLE MATERIALS AS HAZARDOUS WASTE. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE LARGE QUANTITIES OF HEAT AND FUMES. THEREFORE APPROPRIATE CARE SHOULD BE TAKEN.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.

RECEIVED
JUN 23 1989

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CATALOG # 32813-8 NAME: BROMINE, 99.99+%

FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
HIGHLY TOXIC.
LACHRYMATOR.
CORROSIVE.
HARMFUL VAPOR.
KEEP TIGHTLY CLOSED.
DO NOT STORE NEAR, NOR ALLOW CONTACT WITH, CLOTHING AND OTHER COMBUSTIBLE MATERIAL.
MAY DEVELOP PRESSURE.
STORE AWAY FROM HEAT AND DIRECT SUNLIGHT.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

NOT APPLICABLE

---------- REGULATORY INFORMATION ----------

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
GLAXO INC
ACCOUNTS PAYABLE
5 MOORE DRIVE
RSCH TRI PK NC 27709

DATE: 12/10/87

CUST#: 6-065-31571 PO#: 90467
REL# 84

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: B5887 NAME: N-BUTYRIC ACID, SODIUM
CAS #: 156-54-7

TOXICITY HAZARDS

RTECS NO: ET6400000
BUTYRIC ACID, SODIUM SALT
REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
CAUSES EYE AND SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

MELTING PT: 250 C TO 253 C

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
WATER SPRAY.
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

CONTINUED ON NEXT PAGE

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MATERIAL SAFETY DATA SHEET

CUST#: 6-065-31571 PO#: 90467

REL# 84

PRODUCT #: B5887 NAME : N-BUTYRIC ACID, SODIUM

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
AVOID CONTACT AND INHALATION.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
HARMFUL SOLID.
KEEP TIGHTLY CLOSED.
HYGROSCOPIC
STORE IN A COOL DRY PLACE.

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WILL BURKHART

DATE: 09/28/88
CUST # 232882 P.O. # 0000093668

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 25136-4 NAME: FORMIC ACID, 96%, A.C.S. REAGENT
CAS # 64-18-6
MF: CH2O2

SYNONYMS
ACIDE FORMIQUE (FRENCH) * ACIDO FORMICO (ITALIAN) * AMEISENSAEURE (GERMAN) * AMINIC ACID * FORMIC ACID (ACGIH,DOT) * FORMIC ACID, SOLUTION (DOT) * FORMYLIC ACID * HYDROGEN CARBOXYLIC ACID * KWAS METANIOWY (POLISH) * KYSELINA MRAVENCI (CZECH) * METHANOIC ACID * MIERENZUUR (DUTCH) * RCRA WASTE NUMBER U123 * UN 1779 (DOT) *

TOXICITY HAZARDS

RTECS # LQ4900000
FORMIC ACID
IRRITATION DATA

SKN-RBT 610 MG OPEN MLD	UCDS** 5/8/68
EYE-RBT 122 MG SEV	UCDS** 5/8/68

TOXICITY DATA

ORL-RAT LD50:1100 MG/KG	GTPZAB 23(12),49,79
IHL-RAT LC50:15 GM/M3/15M	GTPZAB 23(12),49,79
ORL-MUS LD50:700 MG/KG	GTPZAB 23(12),49,79
IHL-MUS LC50:6200 MG/M3/15M	GTPZAB 23(12),49,79
IPR-MUS LD50:940 MG/KG	IGIBAS 11,507,62
IVN-MUS LD50:145 MG/KG	ZERNAL 9,332,69
ORL-DOG LD50:4000 MG/KG	AMIHAB 20,517,59

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 5 PPM; STEL 10 PPM 85INA8 5,279(87),86
MSHA STANDARD-AIR:TWA 5 PPM (9 MG/M3) DTLVS* 3,119,71
OSHA STANDARD-AIR:TWA 5 PPM FEREAC 39,23540,74
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, MARCH 1988
NTP CARCINOGENESIS STUDIES;ON TEST (PRECHRONIC STUDIES), JANUARY 1988
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
BEHAVIORAL (SOMNOLENCE)
LUNGS, THORAX OR RESPIRATION (DYSPNAE)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
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CATALOG # 25136-4 NAME: FORMIC ACID, 96%, A.C.S. REAGENT

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: 8.2 C TO 8.4 C
BOILING POINT: 100 C TO 101 C
SPECIFIC GRAVITY: 1.220
VAPOR DENSITY: 1.6
VAPOR PRESSURE: 44.8 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

AUTO IGNITION TEMP.: 1004 F
LOWER EXPLOSION LEVEL: 18%
UPPER EXPLOSION LEVEL: 57%
FLASH POINT: 156 F

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE LIQUID.

UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG BASES
FINELY POWDERED METALS

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
THIS COMBUSTIBLE MATERIAL MAY BE BURNED IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

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MATERIAL SAFETY DATA SHEET

CATALOG # 25136-4 NAME: FORMIC ACID, 96%, A.C.S. REAGENT

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
READILY ABSORBED THROUGH SKIN.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
MAY DEVELOP PRESSURE.
VENT PERIODICALLY.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
INCOMPATIBILITY: REACTS VIOLENTLY WITH FURFURYL ALCOHOL, HYDROGEN PEROXIDE, HYDRATED THALLIUM NITRATE, PERMANGANATES. CONTACT WITH CONCENTRATED SULFURIC ACID RESULTS IN THE FORMATION OF TOXIC AND FLAMMABLE CARBON MONOXIDE GAS.

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
Y NUNEZ

DATE: 07/14/89
CUST # 232882 P.O. # 95325/63

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 26800-3 NAME: HYDROBROMIC ACID, 48%
CAS # 10035-10-6
MF: HBR

SYNONYMS
ACIDE BROMHYDRIQUE (FRENCH) * ACIDO BROMIDRICO (ITALIAN) * ANHYDROUS HYDROBROMIC ACID * BROMOWODOR (POLISH) * BROMWASSERSTOFF (GERMAN) * BROOMWATERSTOF (DUTCH) * HYDROBROMIC ACID, ANHYDROUS (DOT) * HYDROGEN BROMIDE * HYDROGEN BROMIDE (ACGIH,DOT,OSHA) * UN 1048 (DOT) * UN 1788 (DOT) *

TOXICITY HAZARDS

RTECS # MW3850000
HYDROBROMIC ACID
TOXICITY DATA
IHL-RAT LC50:2858 PPM/1H NTIS** PB214-270
IPR-RAT LD50:76 MG/KG GISAAA 41(1),105,76
IHL-MUS LC50:814 PPM/1H NTIS** PB214-270
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 3 PPM 85INA8 5,312,86
MSHA STANDARD-AIR:TWA 3 PPM (10 MG/M3) DTLVS* 3,128,71
OSHAPEL:8H TWA 3 PPM (10 MG/M3) FEREAC 54,2923,89
OSHAPEL FINAL:CL 3 PPM (10 MG/M3) FEREAC 54,2923,89
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
REMOVE AND WASH CONTAMINATED CLOTHING PROMPTLY.

7140

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MATERIAL SAFETY DATA SHEET

CATALOG # 26800-3 NAME: HYDROBROMIC ACID, 48%

PHYSICAL DATA

SPECIFIC GRAVITY: 1.490
VAPOR DENSITY: 2.8
VAPOR PRESSURE: 8.0 MM @ 25 C
APPEARANCE: CLEAR COLORLESS TO PALE-YELLOW LIQUID

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE DRY CHEMICAL POWDER EXTINGUISHER ON THIS MATERIAL.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
BASES
OXIDIZING AGENTS
AMMONIA
AVOID CONTACT WITH METALS.
AIR SENSITIVE
LIGHT SENSITIVE
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
AVOID CONTACT AND INHALATION.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
POISON

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RESEARCH TRIANGLE PARK NC 27709
CHEMISTRY

DATE: 01/04/89
CUST # 232882 P.O. # 92885 260

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT
CAS # 7647-01-0
MF: HCL

SYNONYMS
ACIDE CHLORHYDRIQUE (FRENCH) * ACIDO CLORIDRICO (ITALIAN) * CHLOORWATERSTOF (DUTCH) * CHLOROHYDRIC ACID * CHLOROWODOR (POLISH) * CHLORWASSERSTOFF (GERMAN) * HYDROCHLORIC ACID, ANHYDROUS (DOT) * HYDROCHLORIC ACID (DOT) * HYDROCHLORIC ACID, SOLUTION (DOT) * HYDROCHLORIC ACID, SOLUTION, INHIBITED (DOT) * HYDROCHLORIDE * HYDROGEN CHLORIDE (ACGIH,DOT) * HYDROGEN CHLORIDE, ANHYDROUS (DOT) * HYDROGEN CHLORIDE, REFRIGERATED LIQUID (DOT) * MURIATIC ACID * MURIATIC ACID (DOT) * SPIRITS OF SALT * SPIRITS OF SALT (DOT) * UN 1050 (DOT) * UN 1789 (DOT) * UN 2186 (DOT) *

TOXICITY HAZARDS

RTECS # MW4025000
HYDROCHLORIC ACID

IRRITATION DATA
EYE-RBT 5 MG/30S RINSE MLD TXCYAC 23,281,82

TOXICITY DATA

IHL-HMN LCLO:1300 PPM/30M	29ZWAE -,207,68
IHL-HMN LCLO:3000 PPM/5M	TABIA2 3,231,33
UNR-MAN LDLO:81 MG/KG	85DCAI 2,73,70
IHL-RAT LC50:3124 PPM/1H	AMRL** TR-74-78,74
IHL-MUS LC50:1108 PPM/1H	JCTDDH 3,61,76
IPR-MUS LD50:1449 MG/KG	COREAF 256,1043,63
ORL-RBT LD50:900 MG/KG	BIZEA2 134,437,23

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 5 PPM 85INA8 5,313,86
OSHA STANDARD-AIR:CL 5 PPM FEREAC 39,23540,74
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-SAT/SHE
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0578-0146
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1988
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

TARGET ORGAN DATA
SENSE ORGANS AND SPECIAL SENSES (OTHER EYE EFFECTS)
LUNGS, THORAX OR RESPIRATION (RESPIRATORY STIMULATION)
SKIN AND APPENDAGES (AFTER SYSTEMIC EXPOSURE: DERMATITIS, OTHER)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.

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CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA. SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

SPECIFIC GRAVITY: 1.200
VAPOR DENSITY: 1.3
VAPOR PRESSURE: 3.23 PSI @ 21.1 C
7.93 PSI @ 37.7 C

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE

EXTINGUISHING MEDIA

NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
USE WATER SPRAY TO COOL FIRE-EXPOSED CONTAINERS.

UNUSUAL FIRE AND EXPLOSION HAZARDS

NOT APPLICABLE

REACTIVITY DATA

INCOMPATIBILITIES

BASES
AMINES
ALKALI METALS
COPPER, COPPER ALLOYS
ALUMINUM
CORRODES STEEL
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

TOXIC FUMES OF:
HYDROGEN CHLORIDE GAS

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

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CATALOG # 25814-8 NAME: HYDROCHLORIC ACID, 37%, A.C.S. REAGENT

WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
NIOSH/MSHA-APPROVED RESPIRATOR IN NONVENTILLATED AREAS AND/OR FOR EXPOSURE ABOVE THE ACGIH TLV.
MECHANICAL EXHAUST REQUIRED.
RUBBER GLOVES.
DO NOT PIPET BY MOUTH.
AVOID BREATHING VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
POISON.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

NOT APPLICABLE

---------- REGULATORY INFORMATION ----------

37.0% HYDROCHLORIC ACID 7647-01-0
37.0% HYDROCHLORIC ACID 7647-01-0
THESE PRODUCT'S ARE SUBJECT TO SARA 313 REPORTING REQUIREMENTS.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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Glaxo / Lee

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C/O UNIV OF NORTH CAROLINA
VENABLE HALL 045A
CHEM DEPT
CHAPELL HILL NC 27514
EUN LEE

DATE: 02/17/89
CUST # 232882 P.O. # 92885/339

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 24427-9 NAME: HYDROFLUORIC ACID, 48%, A.C.S. REAGENT
CAS # 7664-39-3
MF: HF

SYNONYMS
ACIDE FLUORHYDRIQUE (FRENCH) * ACIDO FLUORIDRICO (ITALIAN) * ANHYDROUS HYDROFLUORIC ACID (DOT) * FLUOROWODOR (POLISH) * FLUORWASSERSTOFF (GERMAN) * FLUORWATERSTOF (DUTCH) * HYDROFLUORIC ACID, ANHYDROUS (DOT) * HYDROFLUORIC ACID SOLUTION (DOT) * HYDROFLUORIDE * HYDROGEN FLUORIDE * HYDROGEN FLUORIDE (ACGIH,DOT) * RCRA WASTE NUMBER U134 * RUBIGINE * UN 1052 (DOT) * UN 1790 (DOT) *

TOXICITY HAZARDS

RTECS # MW7875000
HYDROFLUORIC ACID

IRRITATION DATA
EYE-HMN 50 MG SEV — AMLTAS 37,110,57

TOXICITY DATA

IHL-HMN LCLO:50 PPM/30M	34ZIAG -,318,69
IHL-RAT LC50:1276 PPM/1H	AIHAAP 33,661,72
IHL-MUS LC50:342 PPM/1H	JCTODH 3,61,76
IHL-MKY LC50:1774 PPM/1H	AMRL** TR-70-77,70
IHL-GPG LC50:4327 PPM/15M	AIHAAP 24,253,63

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 3 PPM (F) 85INA8 5,315,86
MSHA STANDARD-AIR:TWA 3 PPM (2 MG/M3) DTLVS* 3,131,71
OSHA STANDARD-AIR:TWA 3 PPM FEREAC 39,23540,74
NIOSH REL TO HF-AIR:TWA 2.5 MG(F)/M3;CL 5.0 MG(F)/M3/15M MMWR** 34(1S),19S,85
EPA GENETOX PROGRAM 1988, POSITIVE: D MELANOGASTER SEX-LINKED LETHAL
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1988
NIOSH ANALYTICAL METHODS: SEE FLUORIDES, 7902; ACIDS, INORGANIC, 7903
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

TARGET ORGAN DATA
PERIPHERAL NERVE AND SENSATION (SPASTIC PARALYSIS WITH/WITHOUT SENSORY CHANGE)
SENSE ORGANS AND SPECIAL SENSES (CORNEAL DAMAGE)
SENSE ORGANS AND SPECIAL SENSES (OTHER EYE EFFECTS)
BEHAVIORAL (TREMOR)
LUNGS, THORAX OR RESPIRATION (DYSPNAE)
LUNGS, THORAX OR RESPIRATION (RESPIRATORY DEPRESSION)
EFFECTS ON FERTILITY (PRE-IMPLANTATION MORTALITY)
EFFECTS ON FERTILITY (POST-IMPLANTATION MORTALITY)
EFFECTS ON EMBRYO OR FETUS (FETAL DEATH)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

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MAR 29 1989
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CATALOG # 24427-9 NAME: HYDROFLUORIC ACID, 48%, A.C.S. REAGENT

HEALTH HAZARD DATA

ACUTE EFFECTS

MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

ADDITIONAL INFORMATION

BOTH THE LIQUID AND THE VAPOR CAN CAUSE SEVERE BURNS WHICH MAY NOT BE IMMEDIATELY PAINFUL OR VISIBLE. SOLUTIONS LESS THAN 2% MAY CAUSE BURNS. THE FULL EXTENT OF TISSUE DAMAGE MAY NOT EXHIBIT ITSELF FOR 12-24 HOURS AFTER EXPOSURE. HYDROGEN FLUORIDE WILL PENETRATE THE SKIN AND ATTACK THE UNDERLYING TISSUES AND BONE. PROFOUND HYPOCALCEMIA CAN OCCUR WITH SOMETIMES FATAL RESULTS. CHRONIC EFFECTS: CAUSES CHANGES IN BONES AND JOINTS IN HUMANS. REPORTED TO BE EMBRYOTOXIC IN THE RAT AT AN EXPOSURE LEVEL OF 0.47 TO 4.98MG/M3/4 HR DAILY DURING THE PERIOD OF GESTATION. FIRST AID: FOR SKIN CONTACT FLUSH WITH LARGE QUANTITIES OF COOL WATER WHILE REMOVING ANY CONTAMINATED CLOTHING. PAY ESPECIAL ATTENTION TO SKIN UNDER THE NAILS, FOLLOW BY APPLYING 0.20% BENZALKONIUM CHLORIDE SOLUTION, ICED 70% ALCOHOL OR AN ICE-COLD SATURATED SOLUTION OF MAGNESIUM SULFATE(EPSOM SALT). IF THESE SOLUTIONS ARE NOT AVAILABLE, CONTINUE WASHING UNTIL MEDICAL ATTENTION IS OBTAINED. A PHYSICIAN SHOULD BE CALLED IMMEDIATELY IN CASE OF CONTACT OR SUSPECTED CONTACT. IF SWALLOWED DO NOT GIVE EMETICS OR BAKING SODA. IF CONSCIOUS, GIVE WATER, MILK OF MAGNESIA, MILK OR WHITES OF EGGS BEATEN WITH WATER.

PHYSICAL DATA

SPECIFIC GRAVITY: 1.150
VAPOR DENSITY: 1.27
VAPOR PRESSURE: 25.0 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE

EXTINGUISHING MEDIA

DRY CHEMICAL POWDER.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

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CATALOG # 24427-9 NAME: HYDROFLUORIC ACID, 48%, A.C.S. REAGENT

UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
STRONG BASES
DO NOT STORE IN GLASS.
AVOID CONTACT WITH METALS.
LIGHT-SENSITIVE.
STORE AWAY FROM HEAT AND DIRECT SUNLIGHT.
ALKALI METALS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
HYDROGEN FLUORIDE

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
CAUTIOUSLY DISSOLVE THE MATERIAL IN WATER. NEUTRALIZE IMMEDIATELY WITH SODIUM CARBONATE, OR FIRST ADD A LITTLE HYDROCHLORIC ACID FOLLOWED BY SODIUM CARBONATE IF MATERIAL DOES NOT DISSOLVE COMPLETELY.
ADD CALCIUM CHLORIDE IN EXCESS OF THE AMOUNT NEEDED TO PRECIPITATE THE FLOURIDE AND/OR CARBONATE. SEPARATE THE INSOLUBLES AND BURY IN A LANDFILL SITE APPROVED FOR HAZARDOUS-WASTE DISPOSAL.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
POISON.
CORROSIVE.
KEEP TIGHTLY CLOSED.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ----------

ADDITIONAL INFORMATION
CONTACT WITH GLASS, CONCRETE AND OTHER SILICON-BEARING MATERIALS YIELD SILICON TETRAFLUORIDE GAS. CONTACT WITH CYANIDES AND SULFIDES PRODUCES HIGHLY TOXIC GASES OF HYDROGEN CYANIDE AND HYDROGEN SULFIDE. REACTION WITH CARBONATES PRODUCES VIGOROUS EVOLUTION OF CARBON DIOXIDE. VIOLENT REACTION WITH N-PHENYLAZOPIPERIDINE, POTASSIUM PERMANGANATE, BISMUTHIC ACID, FLUORINE, METAL OXIDES AND WATER-REACTIVE MATERIALS. CONTACT WITH COMMON METALS WILL PRODUCE HYDROGEN GAS CREATING A FIRE AND EXPLOSION HAZARD. MIXTURES (1:1) OF HYDROFLUORIC ACID AND NITRIC ACID WITH GLYCEROL, LACTIC ACID OR PROPYLENE GLYCOL BUILD UP PRESSURE IN CLOSED CONTAINERS SUFFICENT TO

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MATERIAL SAFETY DATA SHEET

CATALOG # 24427-9 NAME: HYDROFLUORIC ACID, 48%, A.C.S. REAGENT

SHATTER THE CONTAINER (TIME OF REACTION IS FROM 30 MINUTES TO 12 HRS).

REGULATORY INFORMATION

49.5% HYDROGEN FLUORIDE 7664-39-3
49.5% HYDROGEN FLUORIDE (HYDROFLUORIC ACID) 7664-39-3
THESE PRODUCT'S ARE SUBJECT TO SARA 313 REPORTING REQUIREMENTS.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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**HYDROGEN PEROXIDE, 30%*
**HYDROGEN PEROXIDE, 30%*
**HYDROGEN PEROXIDE, 30%*

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7722-84-1

SUBSTANCE: **HYDROGEN PEROXIDE, 30%**

TRADE NAMES/SYNONYMS:
HYDROGEN PEROXIDE SOLUTION, 30%; STCC 4918776; UN 2014; H-323; H-325; H-327; ACC11189

CHEMICAL FAMILY:
PEROXIDE

MOLECULAR FORMULA: H2-O2

MOLECULAR WEIGHT: 34.02

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=0 REACTIVITY=1

COMPONENTS AND CONTAMINANTS

COMPONENT: HYROGEN PEROXIDE PERCENT: 30

COMPONENT: WATER PERCENT: 70

OTHER CONTAMINANTS: MAY CONTAIN ACETANILIDE OR SODIUM STANNATE AS AN INHIBITOR

EXPOSURE LIMITS:
HYDROGEN PEROXIDE:
1 PPM (1.4 MG/M3) OSHA TWA
1 PPM (1.5 MG/M3) ACGIH TWA

(CONCENTRATIONS GREATER THAN 52%):
1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1 POUND SARA SECTION 304 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: COLORLESS, CLEAR WATER-LIKE LIQUID WITH A SLIGHTLY SHARP ODOR AND BITTER TASTE BOILING POINT: 223 F (106 C)

MELTING POINT: -13 F (-25 C) SPECIFIC GRAVITY: 1.1

VAPOR PRESSURE: 25 MMHG @ 30 C SOLUBILITY IN WATER: SOLUBLE

VAPOR DENSITY: 1.2

SOLVENT SOLUBILITY: ALCOHOL; INSOLUBLE IN PETROLEUM ETHER

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FLASH POINT: NON-COMBUSTIBLE

FIREFIGHTING MEDIA:
WATER ONLY, NO DRY CHEMICAL, CARBON DIOXIDE OR HALON (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR

NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4 GUIDE PAGE 45).

USE WATER IN FLOODING AMOUNTS AS A FOG. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING TOXIC VAPORS, KEEP UPWIND.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
OXIDIZER

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.266
EXCEPTIONS: 49CFR173.244

TOXICITY

HYDROGEN PEROXIDE, 30%:
TOXICITY DATA: TUMORIGENIC DATA (RTECS).
CARCINOGEN STATUS: ANIMAL LIMITED EVIDENCE (IARC CLASS-3). ORAL ADMINISTRATION IN MICE RESULTED IN ADENOMAS AND CARCINOMAS OF THE DUODENUM. OTHER STUDIES WERE INADEQUATE FOR EVALUATION. ONE STUDY BY SKIN APPLICATION INDICATED THAT HYDROGEN PEROXIDE HAS NO TUMOR PROMOTING ACTIVITY.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYE, INGESTION.
ACUTE TOXICITY LEVEL: NO DATA AVAILABLE.
TARGET EFFECTS: NO DATA AVAILABLE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
HYDROGEN PEROXIDE, 30%:
CORROSIVE. 75 PPM IS IMMEDIATELY DANGEROUS TO LIFE AND HEALTH.
- ACUTE EXPOSURE- MAY CAUSE IRRITATION AND INFLAMMATION OF RESPIRATORY TRACT, SORE THROAT, COUGHING, DYSPNEA, LABORED BREATHING, AND DELAYED PULMONARY EDEMA.
- CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE SNEEZING, LACRIMATION, AND BLEACHING OF HAIR.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
HYDROGEN PEROXIDE, 30%:
CORROSIVE.
- ACUTE EXPOSURE- MAY CAUSE IRRITATION, PAIN, BLEACHING OF THE SKIN AND HAIR, AND ON PROLONGED CONTACT WITH THE LIQUID, BURNS.
- CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE BLEACHING OF THE HAIR, DERMATITIS, IN SOME INDIVIDUALS, ECZEMA.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
HYDROGEN PEROXIDE, 30%:
CORROSIVE.
- ACUTE EXPOSURE- VAPORS MAY CAUSE IRRITATION, REDNESS, PAIN, AND BLURRED VISION. DIRECT CONTACT WITH LIQUID MAY CAUSE CORNEAL BURNS AND POSSIBLE BLINDNESS.
- CHRONIC EXPOSURE- MAY CAUSE CONJUNCTIVITIS AND LACRIMATION.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
HYDROGEN PEROXIDE, 30%:
CORROSIVE.
- ACUTE EXPOSURE- MAY CAUSE SORE THROAT, FOCAL AND DIFFUSE BURNS OF THE ESOPHAGUS, ABDOMINAL PAIN, CHEST PAIN, VOMITING, DIARRHEA, AND DISTENTION AND DAMAGE OF THE ESOPHAGUS, STOMACH, OR ABDOMEN DUE TO RELEASE OF OXYGEN.
- CHRONIC EXPOSURE- AS EVALUATED BY RTECS, ADMINISTRATION TO MICE BY INGESTION RESULTED IN A STATISTICALLY SIGNIFICANT INCREASE IN THE INCIDENCE OF GASTROINTESTINAL TUMORS.

FIRST AID FOR INGESTION OF HYDROGEN PEROXIDE: GIVE 2-4 GLASSES OF WATER TO DILUTE THE CHEMICAL; USE A GASTRIC TUBE TO RELIEVE THE PRESSURE CAUSED BY EVOLVED OXYGEN. MAINTAIN AIRWAY AND GET MEDICAL ATTENTION (DREISBACH, HANDBOOK OF POISONING, 11TH EDITION). TREATMENT SHOULD BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
A POWERFURL OXIDIZER; MAY CAUSE SPONTANEOUS COMBUSTION ON CONTACT WITH READILY OXIDIZABLE MATERIALS. SOMEWHAT UNSTABLE IF NOT PROPERLY INHIBITED.

INCOMPATIBILITIES:
HYDROGEN PEROXIDE, 30%:
EXPLOSION- ACETONE, DIMETHYL BENZYLCARBINOL AND SULFURIC ACID, 2-METHYL-1-PHENYL-2-PROPANOL AND SULFURIC ACID, PLATINUM, KETONES AND NITRIC ACID, ORGANIC MATTER, THIODIGLYCOL AND ACETONE ON HEATING, GLYCERIN, ACETIC ACID AND N-HETEROCYCLES, CHLOROSULFONIC ACID, FORMIC ACID AND METABORIC ACID, SULFURIC ACID ON EVAPORATION, VINYL ACETATE AND OSMIUM TETRAOXIDE.
EXPLOSIVE IGNITION: LITHIUM TETRAHYDROALUMINATE.
POSSIBLE EXPLOSION: ACETAL AND ACETIC ACID, N-BUTANOL AND SULFURIC ACID, FORMIC ACID AND ORGANIC SUBSTANCES, SILVER, POWDERED MANGANESE DIOXIDE, FERRIC SULFATE AND 2-METHYLPYRIDINE AND SULFURIC ACID, TETRAHYDROTHIOPHENE.
VIOLENT REACTION: DIPHOSPHOROUS PENTOXIDE, POTASSIUM PERMANGANATE, LEAD DIOXIDE, LEAD MONOXIDE, POTASSIUM, SODIUM, PHOSPHORUS(V) OXIDE.
VIOLENT DECOMPOSITION: BRASS, BRONZE, CARBON, CHROMIUM, COPPER, IRON, LEAD, MERCURIC OXIDE, MERCUROUS OXIDE, MAGNESIUM, MANGANESE, MANGANESE DIOXIDE, SILVER, BENZENSULPHONIC ANHYDRIDE.
DECOMPOSITION: HYDROGEN SESENIDE, SODIUM IODATE.
POSSIBLE DECOMPOSITION: NITROGENOUS BASES
INGITION AND POSSIBLE EXPLOSION: ACETIC ACID ON HEATING.
IGNITION: UNSYM-DIMETHYL HYDRAZINE, FURFURYL ALCOHOL, HYDRAZINE AND NITRIC ACID, MANGANESE, SILVER, CELLULOSE, CHARCOAL, ALUMINUM ISOPROPOXIDE AND HEAVY METAL SALTS, WOOD.
RED LUMINESCENCE: CLORINE AND POTASSIUM HYDROXIDE.
POSSIBLE IGNITION: PHOSPHORUS.
INTENSE EXOTHERMIC REACTION: STAMMOUS CHLORIDE, A-PHENYLSELENOKETONES
VIGOROUS REACTION: ANTIMONY TRISULFIDE, ARSENIC TRISULFIDE, CUPRIC SULFIDE, LEAD SULFIDE, MOLYBDENUM DISULFIDE, FERROUS SULFIDE.
FORMATION OF EXPLOSIVE COMPOUND: ALCOHOLS, ESPECIALLY ETHYL, ACETALDEHYDE AND DESSICANTS, KETONES AND NITRIC ACID, NITIRIC ACID AND THIOUREA, GADOLINIUM HYDROXIDE, 2-METHYL-2-PROPENYL TETRAHYDROPYRANYL ETHER AND SODIUM SULPHITE, KETENE, LEAD AND TRIOXANED.
FORMATION OF A POSSIBLY EXPLOSIVE COMPOUND: NITRIC ACID (>50%).

DECOMPOSITION:
THERMAL DECOMPOSITION RELEASES FLAMMABLE OXYGEN AND HEAT. REACTION BECOMES SELF-SUSTAINING AT 141 C. DECOMPOSITION IS ACCELERATED BY AGITATION, CONTACT WITH ROUGH SURFACES, ALKALIS, FINELY DIVIDED METALS, AND MANY OTHER SUBSTANCES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

****

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTION WITH FUELS MAY BE VIOLENT. FLAMMABLE POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT GET WATER INSIDE CONTAINER. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER. MOVE CONTAINERS FROM SPILL AREA. FOR SMALL LIQUID SPILLS, FLUSH AREA WITH FLOODING AMOUNTS OF WATER. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

REPORTABLE QUANTITY (RQ): 1 POUND
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS

SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST VENTILATION AND/OR GENERAL DILUTION VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

HYDROGEN PEROXIDE:

10 PPM- ANY SUPPLIED-AIR RESPIRATOR.
ANY SELF-CONTAINED BREATHING APPARATUS.

25 PPM- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS FLOW MODE.

50 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

75 PPM- ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST HYDROGEN PEROXIDE.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 02/06/85 REVISION DATE: 04/04/89

-ADDITIONAL INFORMATION-
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THE WORLD'S FOREMOST MANUFACTURER OF RESEARCH BIOCHEMICALS AND DIAGNOSTIC REAGENTS

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OR PHONE COLLECT
1-314-771-5765
FROM ANYWHERE IN THE WORLD
MAILING ADDRESS: P.O. BOX 14508, ST. LOUIS, MO. 63178, U.S.A.

CABLE ADDRESS: SIGMACHEM TWX: 910-761-0593

ATTN: SAFETY DIRECTOR
GLAXO INC
ACCOUNTS PAYABLE
PO BOX 13398
RSCH TRI PARK NC 27709

EMERGENCY PHONE 1-314-771-5765

DATE: 09/26/86

CUST#: 6-065-31571 PO#: 90000

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: L1376 NAME: **LINOLEIC ACID** FREE ACID APPROX. 99%
CAS #: 60-33-3

TOXICITY HAZARDS

RTECS NO: RF9990000
9,12-OCTADECADIENOIC ACID, (Z)-
IRRITATION DATA
SKN-HMN 75 MG/3D-I MOD 85DKA8 -,127,77
REVIEWS, STANDARDS, AND REGULATIONS
REPORTED IN EPA TSCA INVENTORY, 1983

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

BOILING PT: 229 C TO 230 C/16MM.
MELTING PT: -5 C
SPECIFIC GRAVITY: 0.902

FIRE AND EXPLOSION HAZARD DATA

FLASHPOINT: >230
EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
WATER SPRAY.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

CONTINUED ON NEXT PAGE

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CUST#: 6-065-31571 PO#: 90000

PRODUCT #: L1376 NAME : LINOLEIC ACID FREE ACID APPROX. 99%

REACTIVITY DATA

INCOMPATIBILITIES
BASES
OXIDIZING AGENTS
REDUCING AGENTS
AIR- AND MOISTURE-SENSITIVE.
HEAT-SENSITIVE.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
STE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES
OSHA/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
AVOID CONTACT AND INHALATION.
KEEP CONTAINER CLOSED.
CORROSIVE.
HANDLE AND STORE UNDER NITROGEN.
REFRIGERATE.

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JUL 19 1989
ENVIRONMENTAL SAFETY

NITRIC ACID
NITRIC ACID
NITRIC ACID

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS:
GASTON L. PILLORI: (201) 796-7100
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(201) 796-7523
CHEMTREC ASSISTANCE: (800) 424-9300

DATE: 04/27/89
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7697-37-2

SUBSTANCE: **NITRIC ACID**

TRADE NAMES/SYNONYMS:
AQUA FORTIS; WFNA; RFNA; HYDROGEN NITRATE; AZOTIC ACID; NITRYL HYDROXIDE; NITAL; STCC 4918528; UN 2031; A-200; A-200-C; A-200-S; A-202; A-206-C; A-509; A-467; HNO3; /4; ACC16550

CHEMICAL FAMILY:
INORGANIC ACID

MOLECULAR FORMULA: H-N-O3

MOLECULAR WEIGHT: 63.01

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=1 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=3 FIRE=0 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: NITRIC ACID PERCENT: 70

COMPONENT: WATER PERCENT: 30

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NITRIC ACID:
2 PPM (5 MG/M3) OSHA TWA
2 PPM ACGIH TWA; 4 PPM ACGIH STEL
2 PPM NIOSH RECOMMENDED 10 HOUR TWA

1000 POUNDS SARA SECTION 302 THRESHOLD PLANNING QUANTITY
1000 POUNDS SARA SECTION 304 REPORTABLE QUANTITY

PHYSICAL DATA

DESCRIPTION: COLORLESS TO PALE YELLOW LIQUID WITH A SUFFOCATING ODOR.

BOILING POINT: 181 F (83 C) MELTING POINT: -44 F (-42 C)

SPECIFIC GRAVITY: 1.5027 @ 25 C VAPOR PRESSURE: 47.9 MMHG @ 20 C

EVAPORATION RATE: NOT AVAILABLE SOLUBILITY IN WATER: VERY SOLUBLE

VAPOR DENSITY: 3.2

SOLVENT SOLUBILITY: SOLUBLE IN ETHER.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

OXIDIZER: OXIDIZERS DECOMPOSE, ESPECIALLY WHEN HEATED, TO YIELD OXYGEN OR OTHER GASES WHICH WILL INCREASE THE BURNING RATE OF COMBUSTIBLE MATTER. CONTACT WITH EASILY OXIDIZABLE, ORGANIC, OR OTHER COMBUSTIBLE MATERIALS MAY RESULT IN IGNITION, VIOLENT COMBUSTION OR EXPLOSION.

FIREFIGHTING MEDIA:
WATER, DRY CHEMICAL OR SODA ASH
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, FLOOD AREA WITH WATER FROM A DISTANCE
(1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. STAY AWAY FROM STORAGE TANK ENDS. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR

NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 44).

USE FLOODING AMOUNTS OF WATER AS FOG. COOL CONTAINERS WITH FLOODING AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. AVOID BREATHING CORROSIVE VAPORS, KEEP UPWIND. CONSIDER EVACUATION OF DOWNWIND AREA IF MATERIAL IS LEAKING.

TRANSPORTATION DATA

DEPARTMENT OF TRANSPORTATION HAZARD CLASSIFICATION 49CFR172.101:
OXIDIZER

DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS 49CFR172.101 AND 172.402:
OXIDIZER AND CORROSIVE

DEPARTMENT OF TRANSPORTATION PACKAGING REQUIREMENTS: 49CFR173.268
EXCEPTIONS: NONE

TOXICITY

NITRIC ACID:
TOXICITY DATA:
  ANHYDROUS: 110 MG/KG UNREPORTED-MAN LDLO; REPRODUCTIVE EFFECTS DATA (RTECS).
  MONOHYDRATE: NO DATA AVAILABLE.
  TRIHYDRATE: NO DATA AVAILABLE.
CARCINOGEN STATUS: NONE.
LOCAL EFFECTS: CORROSIVE- INHALATION, SKIN, EYES, INGESTION.
ACUTE TOXICITY LEVEL: INSUFFICIENT DATA.
TARGET EFFECTS: NO DATA AVAILABLE.
AT INCREASED RISK FROM EXPOSURE: PERSONS WITH IMPAIRED PULMONARY FUNCTION, PRE-EXISTING EYE AND SKIN DISORDERS.

HEALTH EFFECTS AND FIRST AID

INHALATION:
NITRIC ACID:
CORROSIVE. 100 PPM IMMEDIATELY DANGEROUS TO LIFE OR HEALTH.
  ACUTE EXPOSURE- INHALATION OF ACIDIC SUBSTANCES MAY CAUSE SEVERE RESPIRATORY IRRITATION WITH COUGHING, CHOKING, AND POSSIBLY YELLOWISH BURNS OF THE MUCOUS MEMBRANES. OTHER INITIAL SYMPTOMS MAY INCLUDE DIZZINESS, HEADACHE, NAUSEA, AND WEAKNESS. PULMONARY EDEMA MAY BE IMMEDIATE IN THE MOST SEVERE EXPOSURES, BUT MORE LIKELY WILL OCCUR AFTER A LATENT PERIOD OF 5-72 HOURS. THE SYMPTOMS MAY INCLUDE TIGHTNESS IN THE CHEST, DYSPNEA, DIZZINESS, FROTHY SPUTUM, AND CYANOSIS. PHYSICAL FINDINGS MAY INCLUDE HYPOTENSION, WEAK, RAPID PULSE, MOIST RALES, AND HEMOCONCENTRATION. IN NON-FATAL CASES, COMPLETE RECOVERY MAY OCCUR WITHIN A FEW DAYS OR WEEKS OR, CONVALESCENCE MAY BE PROLONGED WITH FREQUENT RELAPSES AND CONTINUED DYSPNEA AND OTHER SIGNS AND SYMPTOMS OF PULMONARY INSUFFICIENCY. IN SEVERE EXPOSURES, DEATH DUE TO ANOXIA MAY OCCUR WITHIN A FEW HOURS AFTER ONSET OF THE SYMPTOMS OF PULMONARY EDEMA OR FOLLOWING A RELAPSE.
  CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION AND DURATION OF EXPOSURE, REPEATED OR PROLONGED EXPOSURE TO AN ACIDIC SUBSTANCE MAY CAUSE EROSION OF THE TEETH, INFLAMMATORY AND ULCERATIVE CHANGES IN THE MOUTH, AND POSSIBLY JAW NECROSIS. BRONCHIAL IRRITATION WITH COUGH AND FREQUENT ATTACKS OF BRONCHIAL PNEUMONIA MAY OCCUR. GASTROINTESTINAL DISTURBANCES ARE ALSO POSSIBLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. TREAT SYMPTOMATICALLY AND SUPPORTIVELY. ADMINISTRATION OF OXYGEN SHOULD BE PERFORMED BY QUALIFIED PERSONNEL. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
NITRIC ACID:
CORROSIVE.
  ACUTE EXPOSURE- DIRECT CONTACT WITH LIQUID OR VAPOR MAY CAUSE SEVERE PAIN, BURNS AND POSSIBLY YELLOWISH STAINS. BURNS MAY BE DEEP WITH SHARP EDGES AND HEAL SLOWLY WITH SCAR TISSUE FORMATION. DILUTE SOLUTIONS OF NITRIC ACID MAY PRODUCE MILD IRRITATION AND HARDEN THE EPIDERMIS WITHOUT DESTROYING IT.
  CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED CONTACT WITH ACIDIC SUBSTANCES MAY RESULT IN DERMATITIS OR EFFECTS SIMILAR TO ACUTE EXPOSURE.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
NITRIC ACID:
CORROSIVE.
  ACUTE EXPOSURE- DIRECT CONTACT WITH ACIDIC SUBSTANCES MAY CAUSE PAIN AND LACRIMATION, PHOTOPHOBIA, AND BURNS, POSSIBLY SEVERE. THE DEGREE OF INJURY DEPENDS ON THE CONCENTRATION AND DURATION OF CONTACT. IN MILD BURNS, THE EPITHELIUM REGENERATES RAPIDLY AND THE EYE RECOVERS COMPLETELY. IN SEVERE CASES, THE EXTENT OF INJURY MAY NOT BE FULLY APPARENT FOR SEVERAL WEEKS. ULTIMATELY, THE WHOLE CORNEA MAY BECOME DEEPLY VASCULARIZED AND OPAQUE RESULTING IN BLINDNESS. IN THE WORST CASES, THE EYE MAY BE TOTALLY DESTROYED. CONCENTRATED NITRIC ACID MAY IMPART A YELLOW COLOR TO THE

EYE UPON CONTACT.
CHRONIC EXPOSURE- EFFECTS DEPEND ON THE CONCENTRATION AND DURATION OF EXPOSURE. REPEATED OR PROLONGED EXPOSURE TO ACIDIC SUBSTANCES MAY CAUSE CONJUNCTIVITIS OR EFFECTS AS IN ACUTE EXPOSURE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). CONTINUE IRRIGATING WITH NORMAL SALINE UNTIL THE PH HAS RETURNED TO NORMAL (30-60 MINUTES). COVER WITH STERILE BANDAGES. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
NITRIC ACID:
CORROSIVE.
ACUTE EXPOSURE- ACIDIC SUBSTANCES MAY CAUSE CIRCUMORAL BURNS WITH YELLOW DISCOLORATION AND CORROSION OF THE MUCOUS MEMBRANES OF THE MOUTH, THROAT AND ESOPHAGUS. THERE MAY BE IMMEDIATE PAIN AND DIFFICULTY OR INABILITY TO SWALLOW OR SPEAK. EPIGLOTTAL EDEMA MAY RESULT IN RESPIRATORY DISTRESS AND POSSIBLY ASPHYXIA. MARKED THIRST, EPIGASTRIC PAIN, NAUSEA, VOMITING AND DIARRHEA MAY OCCUR. DEPENDING ON THE DEGREE OF ESPOHAGEAL AND GASTRIC CORROSION, THE VOMITUS MAY CONTAIN FRESH OR DARK PRECIPITATED BLOOD AND LARGE SHREDS OF MUCOSA. SHOCK WITH MARKED HYPOTENSION, WEAK, RAPID PULSE, SHALLOW RESPIRATION, AND CLAMMY SKIN MAY OCCUR. CIRCULATORY COLLAPSE MAY ENSUE AND IF UNCORRECTED, LEAD TO RENAL FAILURE. IN SEVERE CASES, GASTRIC, AND TO A LESSER DEGREE, ESOPHAGEAL PERFORATION AND SUBSEQUENT PERITONITIS MAY OCCUR AND BE ACCOMPANIED BY FEVER AND ABDOMINAL RIGIDITY. ESOPHAGEAL, GASTRIC ANC PYLORIC STRICTURE MAY OCCUR WITHIN A FEW WEEKS, BUT MAY BE DELAYED FOR MONTHS OR EVEN YEARS. DEATH MAY RESULT WITHIN A SHORT TIME FROM ASPHYXIA, CIRCULATORY COLLAPSE OR ASPIRATION OF EVEN MINUTE AMOUNTS. LATER DEATH MAY BE DUE TO PERITONITIS, SEVERE NEPHRITIS OR PNEUMONIA. COMA AND CONVULSIONS SOMETIMES OCCUR TERMINALLY.
CHRONIC EXPOSURE- DEPENDING ON THE CONCENTRATION, REPEATED INGESTION OF ACIDIC SUBSTANCES MAY RESULT IN INFLAMMATORY AND ULCERATIVE CHANGES IN THE MUCOUS MEMBRANES OF THE MOUTH AND OTHER EFFECTS AS IN ACUTE INGESTION. REPRODUCTIVE EFFECTS HAVE BEEN REPORTED IN ANIMALS.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE HIM LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GIVE PATIENT 1 OUNCE (30 ML) OF MILK OF MAGNESIA. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
REACTS EXOTHERMICALLY WITH WATER.

INCOMPATIBILITIES:
NITRIC ACID:
ACETIC ACID: MAY REACT EXPLOSIVELY.
ACETIC ANHYDRIDE: EXPLOSIVE REACTION BY FRICTION OR IMPACT.
ACETONE: MAY REACT EXPLOSIVELY.
ACETONITRILE: EXPLOSIVE MIXTURE.
4-ACETOXY-3-METHOXYBENZALDEHYDE: EXOTHERMIC REACTION.
ACROLEIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ACRYLONITRILE: EXPLOSIVE REACTION AT 90 C.
ACRYLONITRILE-METHACRYLATE COPOLYMER: INCOMPATIBLE.
ALCOHOLS: POSSIBLE VIOLENT REACTION OR EXPLOSION; FORMATION OF EXPLOSIVE COMPOUND IN THE PRESENCE OF HEAVY METALS.
ALKANETHIOLS: EXOTHERMIC REACTION WITH POSSIBLE IGNITION.
2-ALKOXY-1,3-DITHIA-2-PHOSPHOLANE: IGNITION REACTION.
ALLYL ALCOHOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ALLYL CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
AMINES (ALIPHATIC OR AROMATIC): POSSIBLE IGNITION REACTION.
2-AMINOETHANOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
2-AMINOTHIAZOLE : EXPLOSIVE REACTION.
AMMONIA (GAS): BURNS IN AN ATMOSPHERE OF NITRIC ACID VAPOR.
AMMONIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
AMMONIUM NITRATE: FORMS EXPLOSIVE MIXTURE.
ANILINE: IGNITES ON CONTACT.
ANILINIUM NITRATE: FORMS EXPLOSIVE SOLUTION.
ANION EXCHANGE RESINS: POSSIBLE VIOLENT EXOTHERMIC REACTION.
ANTIMONY: VIOLENT REACTION.
ARSINE: EXPLOSIVE REACTION.
ARSINE-BORON TRIBROMIDE: VIOLENT OXIDATION.
BASES: REACTS.
BENZENE: EXPLOSIVE REACTION.
BENZIDINE: SPONTANEOUS IGNITION.
BENZONITRILE: POSSIBLE EXPLOSION.
BENZOTHIOPHENE DERIVATIVES: FORMATION OF POSSIBLY EXPLOSIVE COMPOUNDS.
N-BENZYL-N-ETHYLANILINE: VIGOROUS DECOMPOSITION.
1,4-BIS(METHOXYMETHYL)2,3,5,6-TETRAMETHYLBENZENE: GAS EVOLUTION.
BISMUTH: INTENSE EXOTHERMIC REACTION OR EXPLOSION.
1,3-BIS(TRIFLUOROMETHYL)BENZENE: POSSIBLE EXPLOSION.
BORON: VIOLENT REACTION WITH INCANDESCENCE.
BORON DECAHYDRIDE: EXPLOSIVE REACTION.
BORON PHOSPHIDE: IGNITION REACTION.
BROMINE PENTAFLUORIDE: IGNITION REACTION.
N-BUTYL MERCAPTAN: IGNITION REACTION.
N-BUTYRALDEHYDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CADMIUM PHOSPHIDE: EXPLOSIVE REACTION.
CALCIUM HYPOPHOSPHITE: IGNITION REACTION.
CARBON (PULVERIZED): VIOLENT REACTION.
CELLULOSE: FORMS EASILY COMBUSTIBLE ESTER.
CHLORATES: REACTS.
CHLORINE: INCOMPATIBLE.

CHLORINE TRIFLUORIDE: VIOLENT REACTION.
CHLOROBENZENE: POSSIBLE EXPLOSION.
4-CHLORO-2-NITROANILINE: FORMS EXPLOSIVE COMPOUND.
CHLOROSULFONIC ACID: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
COAL: EXPLOSIVE MIXTURE.
COATINGS: MAY BE ATTACKED.
CRESOL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CROTONALDEHYDE: VIOLENT DECOMPOSITION WITH IGNITION.
CUMENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
CUPRIC NITRIDE: EXPLOSIVE REACTION.
CUPROUS NITRIDE: VIOLENT REACTION.
CYANATES: POSSIBLE EXPLOSIVE REACTION.
CYCLOHEXANONE: VIOLENT REACTION.
CYCLOHEXYLAMINE: FORMS EXPLOSIVE COMPOUND.
CYCLOPENTADIENE: EXPLOSIVE REACTION.
1,2-DIAMINOETHANEBIS(TRIMETHYLGOLD): EXPLOSIVE REACTION.
DIBORANE: SPONTANEOUS IGNITION.
DI-2-BUTOXYETHYL ETHER: VIOLENT DECOMPOSITION REACTION.
2,6-DI-T-BUTYL PHENOL: FORMATION OF EXPLOSIVE COMPOUND.
DICHLOROETHANE: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
DICHLOROETHYLENE: FORMS EXPLOSIVE COMPOUND.
DICHLOROMETHANE: FORMS EXPLOSIVE SOLUTION.
DICYCLOPENTADIENE: SPONTANEOUS IGNITION.
DIENES: IGNITION REACTION.
DIETHYLAMINO ETHANOL: POSSIBLE EXPLOSION.
DIETHYL ETHER: POSSIBLE EXPLOSION.
3,6-DIHYDRO-1,2,2H-OXAZINE: EXPLOSIVE INTERACTION.
DIISOPROPYL ETHER: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
DIMETHYLAMINOMETHYLFERROCENE: VIOLENT DECOMPOSITION IF HEATED.
DIMETHYL ETHER: FORMS EXPLOSIVE COMPOUND.
DIMETHYL HYDRAZINE: IGNITES ON CONTACT.
DIMETHYL SULFOXIDE + 1,4-DIOXANE: EXPLOSION.
DIMETHYL SULFOXIDE + <14% WATER: EXPLOSIVE REACTION.
DINITROBENZENE: EXPLOSION HAZARD.
DINITROTOLUENE: EXPLOSIVE REACTION.
DIOXANE + PERCHLORIC ACID: POSSIBLE EXPLOSION.
DIPHENYL DISTIBENE: EXPLOSIVE OXIDATION.
DIPHENYL MERCURY + CARBON DISULFIDE: VIOLENT REACTION.
DIPHENYL TIN: IGNITION REACTION.
DISODIUM PHENYL ORTHOPHOSPHATE: VIOLENT EXPLOSION.
DIVINYL ETHER: POSSIBLE IGNITION REACTION.
EPICHLOROHYDRIN: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHANESULFONAMIDE: EXPLOSIVE REACTION.
ETHOXY-ETHYLENE DITHIOPHOSPHATE: IGNITION ON CONTACT.
M-ETHYL ANILINE: IGNITION REACTION.
ETHYLENE DIAMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ETHYLENE GLYCOL: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
ETHYLENEIMINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
5-ETHYL-2-METHYL PYRIDINE: EXPLOSIVE REACTION.
ETHYL PHOSPHINE: IGNITION REACTION.
5-ETHYL-2-PICOLINE: FORMS EXPLOSIVE COMPOUNDS.
FERROUS OXIDE (POWDERED): INTENSE EXOTHERMIC REACTION.
FLUORINE: POSSIBLE EXPLOSIVE REACTION.
FORMIC ACID: EXOTHERMIC REACTION WITH RELEASE OF TOXIC GASES.
2-FORMYLAMINO-1-PHENYL-1,3-PROPANEDIOL: POSSIBLE EXPLOSION.
FUEL OIL (BURNING): EXPLOSION.
FULMINATES: REACTS.
FURFURYLIDENE KETONES: IGNITES ON CONTACT.
GERMANIUM: VIOLENT REACTION.
GLYCEROL: POSSIBLE EXPLOSION.
GLYOXAL: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
HEXALITHIUM DISILICIDE: EXPLOSIVE REACTION.
HEXAMETHYLBENZENE: POSSIBLE EXPLOSION.
2,2,4,4,6,6-HEXAMETHYLTRITHIANE: EXPLOSIVE OXIDATION.
HEXENAL: EXPLODES ON HEATING.
HYDRAZINE: VIOLENT REACTION.
HYDRAZOIC ACID: ENERGETIC REACTION.
HYDROGEN IODIDE: IGNITION REACTION.
HYDROGEN PEROXIDE: FORMS UNSTABLE MIXTURE.
HYDROGEN PEROXIDE AND KETONES: FORMS EXPLOSIVE PRODUCTS.
HYDROGEN PEROXIDE AND MERCURIC OXIDE: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN PEROXIDE AND THIOUREA: FORMS EXPLOSIVE COMPOUNDS.
HYDROGEN SELENIDE: IGNITION REACTION.
HYDROGEN SULFIDE: INCANDESCENT REACTION.
HYDROGEN TELLURIDE: IGNITION AND POSSIBLE EXPLOSIVE REACTION.
INDANE AND SULFURIC ACID: EXPLOSIVE REACTION.
ISOPRENE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
KETONES (CYCLIC): VIOLENT REACTION.
LACTIC ACID + HYDROFLUORIC ACID: EXPLOSIVE REACTION.
LITHIUM: IGNITION REACTION.
LITHIUM SILICIDE: INCANDESCENT REACTION.
MAGNESIUM: EXPLOSIVE REACTION.
MAGNESIUM + 2-NITROANILINE: MAY IGNITE ON CONTACT.
MAGNESIUM PHOSPHIDE: INCANDESCENT REACTION.
MAGNESIUM SILICIDE: VIOLENT REACTION.
MAGNESIUM-TITANIUM ALLOY: FORMS SHOCK AND HEAT SENSITIVE MIXTURE.
MANGANESE (POWDERED): INCANDESCENCE AND POSSIBLE EXPLOSION.
MESITYL OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
MESITYLENE: POSSIBLE EXPLOSIVE REACTION.
METALS: VIOLENT REACTION WITH EXPLOSION OR IGNITION.
METAL ACETYLIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CARBIDES: VIOLENT OR EXPLOSIVE REACTION.
METAL CYANIDES: EXPLOSIVE REACTIONS.
METAL FERRICYANIDE OR FERROCYANIDE: VIOLENT REACTION.
METAL SALICYLATES: FORMS EXPLOSIVE COMPOUNDS.
METAL THIOCYANATES: POSSIBLE EXPLOSION.
2-METHYLBENZIMIDAZOLE + SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
4-METHYLCYCLOHEXANONE: EXPLOSIVE REACTION.

2-METHYL-5-ETHYLPYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
METHYL THIOPHENE: IGNITION REACTION.
NEODYMIUM PHOSPHIDE: VIOLENT REACTION.
NICKEL TETRAPHOSPHIDE: IGNITION REACTION.
NITRO AROMATIC HYDROCARBONS: FORMS HIGHLY EXPLOSIVE PRODUCTS.
NITROBENZENE: EXPLOSIVE REACTION, ESPECIALLY IN THE PRESENCE OF WATER.
NITROMETHANE: EXPLOSIVE REACTION.
NITRONAPHTHALENE: EXPLOSION HAZARD.
NON-METAL OXIDES : EXPLOSIVE REACTION.
OLEUM: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
ORGANIC MATERIALS: FIRE AND EXPLOSION HAZARD.
ORGANIC SUBSTANCES AND PERCHLORATES: POSSIBLE EXPLOSION.
ORGANIC SUBSTANCES AND SULFURIC ACID: POSSIBLE EXPLOSION.
PHENYL ACETYLENE + 1,1-DIMETHYLHYDRAZINE: VIOLENT REACTION.
PHENYL ORTHOPHOSPHORIC ACID DISODIUM SALT: FORMS EXPLOSIVE PRODUCTS.
PHOSPHINE + OXYGEN: SPONTANEOUS IGNITION.
PHOSPHONIUM IODIDE: IGNITION REACTION.
PHOSPHORUS (VAPOR): IGNITES WHEN HEATED.
PHOSPHOROUS HALIDES: IGNITION REACTION.
PHOSPHORUS TETRAIODIDE: VIGOROUS REACTION.
PHOSPHORUS TRICHLORIDE: EXPLOSIVE REACTION.
PHTHALIC ACID AND SULFURIC ACID: POSSIBLE EXPLOSIVE REACTION.
PHTHALIC ANHYDRIDE: EXOTHERMIC REACTION AND FORMS EXPLOSIVE PRODUCTS.
PICRATES: REACTS.
PLASTICS: MAY BE ATTACKED.
POLYALKENES: INTENSE REACTION.
POLYDIBROMOSILANES: EXPLOSIVE REACTION.
POLY(ETHYLENE OXIDE) DERIVATIVES: POSSIBLE EXPLOSION.
POLYPROPYLENE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
POLY(SILYLENE): IGNITION.
POLYURETHANE (FOAM): VIGOROUS REACTION.
POTASSIUM HYPOPHOSPHITE: EXPLOSIVE REACTION.
POTASSIUM PHOSPHINATE: EXPLODES ON EVAPORATION.
B-PROPIOLACTONE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PROPIOPHENONE + SULFURIC ACID: EXOTHERMIC REACTION ABOVE -5 C.
PROPYLENE GLYCOL + HYDROFLUORIC ACID + SILVER NITRATE: EXPLOSIVE MIXTURE.
PROPYLENE OXIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYRIDINE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
PYROCATECHOL: IGNITES ON CONTACT.
REDUCING AGENTS: POSSIBLE EXPLOSIVE OR IGNITION REACTION.
RESORCINOL: POSSIBLE EXPLOSION.
RUBBER: VIGOROUS REACTION, POSSIBLE EXPLOSION.
SELENIUM: VIGOROUS REACTION.
SELENIUM HYDRIDE: IGNITION OR INCANDESCENT REACTION.
SELENIUM IODOPHOSPHIDE: EXPLOSIVE REACTION.
SILICON: VIOLENT REACTION.
SILICONE OIL: POSSIBLE EXPLOSION.
SILVER BUTEN-3-YNIDE: EXPLOSION.
SODIUM: SPONTANEOUS IGNITION.
SODIUM AZIDE: EXOTHERMIC REACTION.
SODIUM HYDROXIDE: TEMPERATURE AND PRESSURE INCREASE IN A CLOSED CONTAINER.
STIBINE: EXPLOSIVE REACTION.
SUCROSE (SOLID): VIGOROUS REACTION.
SULFAMIC ACID: VIOLENT REACTION WITH EVOLUTION OF TOXIC NITROUS OXIDE.
SULFIDES: REACTS.
SULFUR DIOXIDE: EXPLOSIVE REACTION.
SULFUR HALIDES: VIOLENT REACTION.
SULFURIC ACID + GLYCERIDES: EXPLOSIVE REACTION.
SULFURIC ACID + TEREPHTHALIC ACID: VIOLENT REACTION.
SURFACTANTS + PHOSPHORIC ACID: EXPLOSION HAZARD.
TERPENES: SPONTANEOUS IGNITION.
TETRABORANE: EXPLOSIVE REACTION.
TETRABORANE DECAHYDRIDE: EXPLOSIVE REACTION.
TETRAPHOSPHOROUS DIIODOTRISELENIDE: EXPLOSIVE REACTION.
TETRAPHOSPHOROUS IODIDE: IGNITES ON CONTACT.
TETRAPHOSPHOROUS TETRAOXIDE TRISULFIDE: VIOLENT REACTION.
THIOALDEHYDES: VIOLENT REACTION.
THIOKETONES: VIOLENT REACTION.
THIOPHENES: EXPLOSIVE REACTION.
TITANIUM: FORMS SHOCK-SENSITIVE COMPOUND.
TITANIUM ALLOYS: POSSIBLE EXPLOSIVE REACTION.
TITANIUM-MAGNESIUM ALLOY: POSSIBLE EXPLOSION ON IMPACT.
TOLUENE: VIOLENT REACTION.
TOLUIDENE: IGNITION REACTION.
1,3,5-TRIACETYLHEXAHYDRO-1,3,5-TRIAZINE + TRIFLUOROACETIC ANHYDRIDE: EXPLOSIVE REACTION.
TRIAZINE: VIOLENTLY EXPLOSIVE REACTION.
TRICADMIUM DIPHOSPHIDE: EXPLOSIVE REACTION.
TRIETHYLGALLIUM MONOETHYL ETHER COMPLEX: IGNITION REACTION.
TRIMETHYLTRIOXANE: INTENSE REACTION.
TRIS(IODOMERCURI)PHOSPHINE: VIOLENT DECOMPOSITION.
TRITHIOACETONE: EXPLOSIVE REACTION.
TURPENTINE: EXPLOSIVE MIXTURE.
UNSYMMETRICAL DIMETHYL HYDRAZINE: SPONTANEOUS IGNITION.
URANIUM: EXPLOSIVE REACTION.
URANIUM ALLOY: VIOLENT REACTION.
URANIUM DISULFIDE: VIOLENT REACTION.
URANIUM-NEODYMIUM ALLOYS: EXPLOSIVE REACTION.
VINYL ACETATE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
VINYLIDENE CHLORIDE: TEMPERATURE AND PRESSURE INCREASE IN CLOSED CONTAINER.
WOOD: POSSIBLE IGNITION.
P-XYLENE: INTENSE REACTION IN PRESENCE OF SULFURIC ACID.
ZINC: INCANDESCENT REACTION.
ZINC ETHOXIDE: POSSIBLE EXPLOSION.
ZIRCONIUM-URANIUM ALLOYS: EXPLOSIVE REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION PRODUCTS MAY INCLUDE TOXIC OXIDES OF NITROGEN.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE. FOR ASSISTANCE, CONTACT THE DISTRICT DIRECTOR OF THE ENVIRONMENTAL PROTECTION AGENCY.

STORAGE

PROTECT AGAINST PHYSICAL DAMAGE. SEPARATE FROM METALLIC POWDERS, CARBIDES, HYDROGEN SULFIDE, TURPENTINE, ORGANIC ACIDS, AND ALL COMBUSTIBLE, ORGANIC OR OTHER READILY OXIDIZABLE MATERIALS. PROVIDE GOOD VENTILATION AND AVOID DIRECT SUNLIGHT (NFPA 49, HAZARDOUS CHEMICALS DATA, 1975).

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

THRESHOLD PLANNING QUANTITY (TPQ):
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 302 REQUIRES THAT EACH FACILITY WHERE ANY EXTREMELY HAZARDOUS SUBSTANCE IS PRESENT IN A QUANTITY EQUAL TO OR GREATER THAN THE TPQ ESTABLISHED FOR THAT SUBSTANCE NOTIFY THE STATE EMERGENCY RESPONSE COMMISSION FOR THE STATE IN WHICH IT IS LOCATED. SECTION 303 OF SARA REQUIRES THESE FACILITIES TO PARTICIPATE IN LOCAL EMERGENCY RESPONSE PLANNING (40 CFR 355.30).

DISPOSAL

DISPOSAL MUST BE IN ACCORDANCE WITH STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE, 40 CFR 262. EPA HAZARDOUS WASTE NUMBER D002.

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CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTS VIOLENTLY WITH WATER AND FUELS. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

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SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A HOLDING AREA SUCH AS A PIT, POND OR LAGOON TO CONTAIN SPILL AND DIKE SURFACE FLOW USING BARRIER OF SOIL, SANDBAGS, FOAMED POLYURETHANE OR FOAMED CONCRETE. ABSORB LIQUID MASS WITH FLY ASH OR CEMENT POWDER.

NEUTRALIZE SPILL WITH SLAKED LIME, SODIUM BICARBONATE OR CRUSHED LIMESTONE.

AIR SPILL:
APPLY WATER SPRAY TO KNOCK DOWN AND REDUCE VAPORS. KNOCK-DOWN WATER IS CORROSIVE AND TOXIC AND SHOULD BE DIKED FOR CONTAINMENT AND LATER DISPOSAL.

WATER SPILL:
ADD SUITABLE AGENT TO NEUTRALIZE SPILLED MATERIAL TO PH-7.

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC.) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. USE WATER SPRAY TO REDUCE VAPORS. DO NOT GET WATER INSIDE CONTAINER. FOR SMALL SPILLS, FLUSH AREA WITH FLOODING AMOUNTS OF WATER. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY. VENTILATE CLOSED SPACES BEFORE ENTERING.

REPORTABLE QUANTITY (RQ): 1000 POUNDS
THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA) SECTION 304 REQUIRES THAT A RELEASE EQUAL TO OR GREATER THAN THE REPORTABLE QUANTITY FOR THIS SUBSTANCE BE IMMEDIATELY REPORTED TO THE LOCAL EMERGENCY PLANNING COMMITTEE AND THE STATE EMERGENCY RESPONSE COMMISSION (40 CFR 355.40). IF THE RELEASE OF THIS SUBSTANCE IS REPORTABLE UNDER CERCLA SECTION 103, THE NATIONAL RESPONSE CENTER MUST BE NOTIFIED IMMEDIATELY AT (800) 424-8802 OR (202) 426-2675 IN THE METROPOLITAN WASHINGTON, D.C. AREA (40 CFR 302.6).

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE FOLLOWING RESPIRATORS AND MAXIMUM USE CONCENTRATIONS ARE RECOMMENDATIONS BY THE U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, NIOSH POCKET GUIDE TO CHEMICAL HAZARDS OR NIOSH CRITERIA DOCUMENTS; OR DEPARTMENT OF LABOR, 29CFR1910 SUBPART Z.
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON CONTAMINATION LEVELS FOUND IN THE WORK PLACE AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.

NITRIC ACID:

125 MG/M3- ANY SUPPLIED-AIR RESPIRATOR OPERATED IN A CONTINUOUS-FLOW MODE.

250 MG/M3- ANY SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.
ANY SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE.
ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY CHEMICAL CARTRIDGE RESPIRATOR WITH A FULL FACEPIECE AND CARTRIDGE(S) PROVIDING PROTECTION AGAINST NITRIC ACID.

ESCAPE- ANY AIR-PURIFYING FULL FACEPIECE RESPIRATOR (GAS MASK) WITH A CHIN-STYLE OR FRONT-OR BACK-MOUNTED CANISTER PROVIDING PROTECTION AGAINST NITRIC ACID.
ANY APPROPRIATE ESCAPE-TYPE SELF-CONTAINED BREATHING APPARATUS.

NOTE: ONLY NON-OXIDIZABLE SORBENTS ARE ALLOWED (NOT CHARCOAL).

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

EMERGENCY WASH FACILITIES:
WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES AND/OR SKIN MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHOULD PROVIDE AN EYE WASH FOUNTAIN AND QUICK DRENCH SHOWER WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
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-ADDITIONAL INFORMATION-

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OLEIC ACID
OLEIC ACID
OLEIC ACID

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
CHEMICAL DIVISION
1 REAGENT LANE
FAIR LAWN NJ 07410
(201) 796-7100

EMERGENCY CONTACTS
GASTON L. PILLORI
(201) 796-7100

DATE 10/19/88
PO NBR: 31731/REL 032
ACCT: 311488-14
INDEX: 14882880146
CAT NO: A195500

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 112-80-1

SUBSTANCE: OLEIC ACID

TRADE NAMES/SYNONYMS:
9-OCTADECANOIC ACID (Z)-; RED OIL; CENTURY CD FATTY ACID; EMERSOL 210; ENERSOL 213; WHITE OLEIC ACID; GLYCON RO; CIS-OCTADEC-9-ENOIC ACID; CIS-9-OCTADECENOIC; GROCO 2; A-195; A-222; (Z)-9-OCTADECANOIC ACID; CIS-OLEIC ACID; C18H3402; ACC17305

CHEMICAL FAMILY:
CARBOXYLIC ACID, ALIPHATIC

MOLECULAR FORMULA: C18-H34-02

MOLECULAR WEIGHT: 282.52

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=1 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=0 FIRE=1 REACTIVITY=0

COMPONENTS AND CONTAMINANTS

COMPONENT: OLEIC ACID PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NUISANCE DUST:
10 MG/M3 ACGIH TWA (TOTAL DUST) (NO ASBESTOS AND < 1% CRYSTALLINE SILICA)

PHYSICAL DATA

DESCRIPTION: COLORLESS LIQUID WHEN PURE; INDUSTRIAL GRADES ARE PALE RED

TO PALE BROWN, OILY LIQUIDS WHICH DARKEN ON EXPOSURE TO AIR; LARD-LIKE OR RANCID ODOR. BOILING POINT: 547 F (286 C) @ 100 MMHG

MELTING POINT: 61 F (16 C) SPECIFIC GRAVITY: 0.8935

VAPOR PRESSURE: 1 MM @ 176.5 C SOLUBILITY IN WATER: INSOLUBLE

SOLVENT SOLUBILITY: SOLUBLE IN ETHANOL, BENZENE, ETHER, CHLOROFORM, METHANOL, CARBON TETRACHLORIDE, ACETONE, FIXED AND VOLATILE OILS, MOST ORGANIC SOLVENTS

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: 372 F (189 C) (CC) AUTOIGNITION TEMP.: 685 F (363 C)

FLAMMABILITY CLASS(OSHA): IIIB

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, HALON, WATER SPRAY OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FOR LARGER FIRES, USE WATER SPRAY, FOG OR STANDARD FOAM (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4).

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT SCATTER SPILLED MATERIAL WITH HIGH PRESSURE WATER STREAMS. DIKE FIRE CONTROL WATER FOR LATER DISPOSAL (1987 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.4, GUIDE PAGE 31).

USE AGENTS SUITABLE FOR TYPE OF SURROUNDING FIRE. AVOID BREATHING HAZARDOUS VAPORS, KEEP UPWIND.

WATER OR FOAM MAY CAUSE FROTHING (NFPA FIRE PROTECTION GUIDE ON HAZARDOUS MATERIALS, EIGHTH EDITION).

TOXICITY

OLEIC ACID:
15 MG/3 DAYS INTERMITTENT SKIN-HUMAN MODERATE IRRITATION; 500 MG OPEN SKIN-RABBIT MILD IRRITATION; 74 GM/KG ORAL-RAT LD50; 230 MG/KG INTRAVENOUS-MOUSE LD50; 2400 UG/KG INTRAVENOUS-RAT LD50; MUTAGENIC DATA (RTECS); TUMORIGENIC DATA (RTECS).
CARCINOGEN STATUS: NONE.
OLEIC ACID IS A MILD EYE AND SKIN IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
OLEIC ACID:
ACUTE EXPOSURE- SUFFICIENT CONCENTRATIONS OF VAPOR OR MIST MAY INTERFERE WITH RESPIRATORY FUNCTIONS.

CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, PERFORM ARTIFICIAL RESPIRATION. KEEP PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
OLEIC ACID:
ACUTE EXPOSURE- MAY CAUSE MILD IRRITATON.
CHRONIC EXPOSURE- INTERMITTENT CONTACT WITH HUMAN SKIN FOR 3 DAYS CAUSED MODERATE IRRITATION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
OLEIC ACID:
ACUTE EXPOSURE- MAY CAUSE MILD IRRITATION.
CHRONIC EXPOSURE- NO DATA AVAILABLE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
OLEIC ACID:
ACUTE EXPOSURE- THE LETHAL DOSE IN RATS WAS 74 GM/KG. SYMPTOMS WERE NOT REPORTED. INGESTION OF LARGE AMOUNTS MAY RESULT IN GASTROINTESTINAL DISTURBANCES WITH IRRITATION TO THE MOUTH AND STOMACH.
CHRONIC EXPOSURE- OLEIC ACID DERIVED FROM TALL OIL FATTY ACIDS IS ON THE FDA LIST OF FOOD ADDITIVES PERMITTED FOR DIRECT ADDITION TO FOOD FOR HUMAN CONSUMPTION.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

ANTIDOTE:
NO SPECIFIC ANTIDOTE. TREAT SYMPTOMATICALLY AND SUPPORTIVELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL TEMPERATURES AND PRESSURES.

INCOMPATIBILITIES:
OLEIC ACID:
ALUMINUM POWDER: POSSIBLE FORMATION OF AN EXPLOSIVE PRODUCT.
PERCHLORIC ACID: FORMATION OF AN EXPLOSIVE PRODUCT BY HEATING.
PERCHLORATES: FORMATION OF AN EXPLOSIVE PRODUCT BY HEATING.
OXIDIERS (STRONG): REACTION.

DECOMPOSITION:
THERMAL DECOMPOSITION MAY RELEASE ACRID SMOKE AND IRRITATING FUMES.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

STORAGE AND DISPOSAL

OBSERVE ALL FEDERAL, STATE AND LOCAL REGULATIONS WHEN STORING OR DISPOSING OF THIS SUBSTANCE.

STORAGE

STORE AWAY FROM INCOMPATIBLE SUBSTANCES.

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CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
STOP LEAK IF YOU CAN DO IT WITHOUT RISK. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CLEAN, DRY CONTAINERS FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR PROCESS ENCLOSURE VENTILATION TO MEET PUBLISHED EXPOSURE LIMITS.

RESPIRATOR:
THE SPECIFIC RESPIRATOR SELECTED MUST BE BASED ON THE CONTAMINATION LEVELS FOUND IN THE WORK PLACE, MUST NOT EXCEED THE WORKING LIMITS OF THE RESPIRATOR AND BE JOINTLY APPROVED BY THE NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH AND THE MINE SAFETY AND HEALTH ADMINISTRATION.
THE FOLLOWING RESPIRATORS ARE RECOMMENDED BASED ON THE DATA FOUND IN THE PHYSICAL DATA, HEALTH EFFECTS AND TOXICITY SECTIONS. THEY ARE RANKED IN ORDER FROM MINIMUM TO MAXIMUM RESPIRATORY PROTECTION:

- CHEMICAL CARTRIDGE RESPIRATOR WITH AN ORGANIC VAPOR CARTRIDGE(S)
- GAS MASK WITH ORGANIC VAPOR CANISTER (CHIN-STYLE OR FRONT- OR BACK-MOUNTED CANISTER).
- TYPE 'C' SUPPLIED-AIR RESPIRATOR OPERATED IN THE PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE OR CONTINUOUS-FLOW MODE.
- SELF-CONTAINED BREATHING APPARATUS.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN PRESSURE DEMAND OR OTHER POSITIVE PRESSURE MODE.

SUPPLIED-AIR RESPIRATOR WITH FULL FACEPIECE AND OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE IN COMBINATION WITH AN AUXILIARY SELF-CONTAINED BREATHING APPARATUS OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES TO PREVENT EYE CONTACT WITH THIS SUBSTANCE. CONTACT LENSES SHOULD NOT BE WORN.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 04/03/85 REVISION DATE: 05/18/88

-ADDITIONAL INFORMATION-

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
B CHRISTOPHER

DATE: 08/24/88
CUST # 232882 P.O. # 92885/113

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 24117-2 NAME: OXALIC ACID, ANHYDROUS, 99+%, GOLD LABEL
CAS # 144-62-7
MF: C2H2O4

SYNONYMS
ACIDE OXALIQUE (FRENCH) * ACIDO OSSALICO (ITALIAN) * ETHANEDIOIC ACID * ETHANEDIONIC ACID * KYSELINA STAVELOVA (CZECH) * NCI-C55209 * OXAALZUUR (DUTCH) * OXALIC ACID (ACGIH) * OXALSAEURE (GERMAN) *

TOXICITY HAZARDS

RTECS # RO2450000
OXALIC ACID

IRRITATION DATA

SKN-RBT 500 MG/24H MLD	85JCAE -,311,86
EYE-RBT 250 UG/24H SEV	85JCAE -,311,86
EYE-RBT 100 MG/4S RINSE SEV	FCTOD7 20,573,82

TOXICITY DATA

ORL-RAT LD50:375 MG/KG	TXAPA9 42,417,77
UNR-RAT LD50:1400 MG/KG	GISAAA 50(3),57,85
SKN-RBT LD50:20 GM/KG	TXAPA9 42,417,77

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 1 MG/M3; STEL 2 MG/M3 85INA8 5,451,86
MSHA STANDARD-AIR:TWA 1 MG/M3 DTLVS* 3,193,71
OSHA STANDARD-AIR:TWA 1 MG/M3 FEREAC 39,23540,74
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
DISCARD CONTAMINATED CLOTHING AND SHOES.

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MATERIAL SAFETY DATA SHEET

CATALOG # 24117-2 NAME: OXALIC ACID, ANHYDROUS, 99+%, GOLD LABEL

PHYSICAL DATA

MELTING POINT: 190 C (DEC)
VAPOR DENSITY: 4.4
VAPOR PRESSURE: <.01 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
SPECIAL FIRE FIGHTING PROCEDURES
FOR FIRES INVOLVING THIS MATERIAL, DO NOT ENTER ANY ENCLOSED OR CONFINED FIRE SPACE WITHOUT PROPER PROTECTIVE EQUIPMENT. THIS MAY INCLUDE SELF-CONTAINED BREATHING APPARATUS TO PROTECT AGAINST THE HAZARDOUS EFFECTS OF THE NORMAL PRODUCTS OF COMBUSTION OR OXYGEN DEFICIENCY.
UNUSUAL FIRE AND EXPLOSION HAZARDS
THIS MATERIAL, LIKE MOST MATERIALS IN POWDER FORM, IS CAPABLE OF CREATING A DUST EXPLOSION.

REACTIVITY DATA

INCOMPATIBILITIES
BASES
ACID CHLORIDES
ALKALI METALS
CORRODES STEEL
PROTECT FROM MOISTURE.
AVOID CONTACT WITH METALS.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
SAFETY SHOWER AND EYE BATH.
COMPATIBLE CHEMICAL-RESISTANT GLOVES.
NIOSH/MSHA-APPROVED RESPIRATOR.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
TOXIC.
IRRITATING DUST.
KEEP TIGHTLY CLOSED.
HYGROSCOPIC.
STORE IN A COOL DRY PLACE.

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CATALOG # 24117-2 NAME: OXALIC ACID, ANHYDROUS, 99+%, GOLD LABEL

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
GLAXO INC
ACCOUNTS PAYABLE
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RSCH TRI PK NC 27709

EMERGENCY PHONE 1-314-771-5765

DATE: 03/08/88

CUST#: 6-065-31571 PO#: 90000
REL #140

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: P5917 NAME: PALMITIC ACID
CAS #: 57-10-3

TOXICITY HAZARDS

TECS NO: RT4550000
PALMITIC ACID
RRITATION DATA
SKN-HMN 75 MG/3D-I MLD 85DKA8 -,127,77
OXICITY DATA
IVN-MUS LD50:57 MG/KG APTOA6 18,141,61
EVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

CUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
CAUSES SKIN IRRITATION.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
IRST AID
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

MELTING PT: 61 C TO 64 C

FIRE AND EXPLOSION HAZARD DATA

XTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
WATER SPRAY.
PECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

CONTINUED ON NEXT PAGE

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CUST#: 6-065-31571 PO#: 90000

REL #140

PRODUCT #: P5917 NAME : PALMITIC ACID

---------- FIRE AND EXPLOSION HAZARD DATA ----------

INUSUAL FIRE AND EXPLOSIONS HAZARDS
THIS MATERIAL, LIKE MOST MATERIALS IN POWDER FORM, IS CAPABLE OF CREATING A DUST EXPLOSION.

---------- REACTIVITY DATA ----------

NCOMPATIBILITIES
BASES
OXIDIZING AGENTS
REDUCING AGENTS
AZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

---------- SPILL OR LEAK PROCEDURES ----------

TEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
ASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
AVOID CONTACT AND INHALATION.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP CONTAINER CLOSED.
STORE IN A COOL DRY PLACE.

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ATTN: SAFETY DIRECTOR
GLAXO INC
IMPERIAL CENTER
EXCHANGE PLACE
1020A SWABIA
MORRISVILLE NC 27560
AVIS LAHEY

DATE: 01/19/87
CUST # 926471 P.O. # 0000039985

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 24425-2 NAME: PERCHLORIC ACID, 70%, A.C.S. REAGENT
CAS # 7601-90-3

TOXICITY HAZARDS

RTECS # SC7500000
PERCHLORIC ACID
TOXICITY DATA
ORL-RAT LD50:1100 MG/KG GTPZAB 17(8),33,73
SCU-MUS LD50:250 MG/KG GTPZAB 17(8),33,73
ORL-DOG LD50:400 MG/KG GTPZAB 17(8),33,73
REVIEWS, STANDARDS, AND REGULATIONS
REPORTED IN EPA TSCA INVENTORY, 1983

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

SPECIFIC GRAVITY: 1.664

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: >230 F
EXTINGUISHING MEDIA
DRY CHEMICAL POWDER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
STRONG OXIDIZER.

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CATALOG # 24425-2 NAME: PERCHLORIC ACID, 70%, A.C.S. REAGENT

UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
STRONG BASES
STRONG ACIDS
AMINES
PHOSPHORUS HALIDES
ACID ANHYDRIDES
ALCOHOLS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
HYDROGEN CHLORIDE GAS

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE OSHA/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
POISON
CORROSIVE.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM COMBUSTIBLE MATERIALS, HEAT, SPARKS, AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ----------

ADDITIONAL INFORMATION
ALTHOUGH 68- 72% COLD PERCHLORIC ACID BEHAVES AS AS STRONG BUT NON-OXIDIZING ACID, IT BECOMES AN EXTREME OXIDANT AND POWERFUL DEHYDRATOR AT ELEVATED TEMPERATURES(>150 C) OR WHEN ANHYDROUS. IT MAY BE FAIRLY READILY DEHYDRATED TO THE ANHYDROUS ACID,E.G. STRONG CONCENTRATED ACIDS(SULFURIC, OLEUM, FUMING NITRIC), INORGANIC ANHYDRIDES(SULFUR TRIOXIDE AND DIOXIDE, PHOSPHOROUS PENTOXIDE, THIONYL CHLORIDE ETC.), ORGANIC ANHYDRIDES AND HALOGENS. CONTACT WITH ALCOHOLS, GLYCOLS OR POLYHYDROXY COMPOUNDS PRODUCES EXPLOSIVE COMPOUNDS. CONTACT WITH WOOD, CELLULOSE AND ITS DERIVATES (PAPER, CARDBOARD,ETC.) CAN PRODUCE VIOLENT EXPLOSIONS. ATTEMPTS TO DISSOLVE BISMUTH OR ITS ALLOYS IN HOT PERCHLORIC ACID CARRIES A VERY HIGH RISK OF AN EXPLOSION OCCURRING. CONTACT WITH SULFOXIDES OR ETHERS MAY PRODUCE EXPLOSIONS. THE CRYSTALLINE SALT OBTAINED BY THE ACTION OF PHOSPHINE ON 68% PERCHLORIC ACID AT -20 C IS DANGEROUSLY EXPLOSIVE, SENSITIVE TO MOIST

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CATALOG # 24425-2 NAME: PERCHLORIC ACID, 70%, A.C.S. REAGENT

AIR, INCREASE IN TEMPERATURE, OR FRICTION AND CANNOT BE DRIED. VIOLENT REACTIONS WITH TRICHLORETHYLENE, SODIUM PHOSPHINATE, ZINC PHOSPHIDE, ORGANOPHOSPHOROUS COMPOUNDS, UNSATURATED ORGANICS HAVE OCCURRED ON HEATED WITH PERCHLORIC ACID.

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
A SINHABABU

DATE: 06/30/89
CUST # 232882 P.O. # 31113-124

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 31027-1 NAME: PHOSPHORIC ACID, CRYSTALS, 99%
CAS # 7664-38-2
MF: H3O4P

SYNONYMS
ACIDE PHOSPHORIQUE (FRENCH) * ACIDO FOSFORICO (ITALIAN) * FOSFORZUUROPLOSSINGEN (DUTCH) * ORTHOPHOSPHORIC ACID * PHOSPHORIC ACID (ACGIH,DOT,OSHA) * PHOSPHORIC ACID, LIQUID (DOT) * PHOSPHORIC ACID, SOLID (DOT) * PHOSPHORSAEURELOESUNGEN (GERMAN) * UN 1805 (DOT) *

TOXICITY HAZARDS

RTECS # TB6300000
PHOSPHORIC ACID
IRRITATION DATA
SKN-RBT 595 MG/24H SEV BIOFX* 17-4/70
EYE-RBT 119 MG SEV BIOFX* 17-4/70
TOXICITY DATA
UNR-MAN LDLO:220 MG/KG 85DCAI 2,73,70
ORL-RAT LD50:1530 MG/KG BIOFX* 17-4/70
SKN-RBT LD50:2740 MG/KG BIOFX* 17-4/70
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 1 MG/M3; STEL 3 MG/M3 85INA8 5,483,86
MSHA STANDARD-AIR:TWA 1 MG/M3 DTLVS* 3,210,71
OSHAPEL:8H TWA 1 MG/M3 FEREAC 54,2923,89
OSHAPEL FINAL:8H TWA 1 MG/M3;STEL 3 MG/M3 FEREAC 54,2923,89
EPA GENETOX PROGRAM 1988, NEGATIVE: CELL TRANSFORM.-SA7/SHE
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JANUARY 1989
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903
OSHA ANALYTICAL METHOD #ID-111
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
MAY CAUSE CYANOSIS (BLUE-GRAY COLORING OF SKIN AND LIPS CAUSED BY LACK OF OXYGEN).
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS

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CATALOG # 31027-1 NAME: PHOSPHORIC ACID, CRYSTALS, 99%

AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: 41 C TO 44 C
VAPOR PRESSURE: .03 MM @ 20 C
5.0 MM @ 25 C
APPEARANCE: WHITE CRYSTALS

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG BASES
FINELY POWDERED METALS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.

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CATALOG # 31027-1 NAME: PHOSPHORIC ACID, CRYSTALS, 99%

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
KEEP TIGHTLY CLOSED.
HYGROSCOPIC.
HANDLE AND STORE UNDER ARGON.
REFRIGERATE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
FORMS A DETONABLE MIXTURE WITH NITROMETHANE.

---------- REGULATORY INFORMATION ----------

THIS PRODUCT IS SUBJECT TO SARA SECTION 313 REPORTING REQUIREMENTS.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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D LEVESQUNE

DATE: 07/27/89
CUST # 232882 P.O. # 31113/133

MATERIAL SAFETY DATA SHEET

PAGE:

IDENTIFICATION

PRODUCT # 15777-5 NAME: PHOSPHORUS PENTACHLORIDE, 98%
CAS # 10026-13-8
MF: CL5P

SYNONYMS
FOSFORO(PENTACLORURO DI) (ITALIAN) * FOSFORPENTACHLORIDE (DUTCH) * PIECIOCHLOREK FOSFORU (POLISH) * PHOSPHORE(PENTACHLORURE DE) (FRENCH) * PHOSPHORIC CHLORIDE * PHOSPHOROUS PENTACHLORIDE * PHOSPHORPENTACHLORID (GERMAN) * PHOSPHORUS PENTACHLORIDE * PHOSPHORUS PENTACHLORIDE (ACGIH,OSHA) * PHOSPHORUS PENTACHLORIDE, SOLID (DOT) * PHOSPHORUS PERCHLORIDE * UN 1806 (DOT) *

TOXICITY HAZARDS

RTECS # TB6125000
PHOSPHORANE, PENTACHLORO-
TOXICITY DATA
ORL-RAT LD50:660 MG/KG TNICS* 13,104,73
IHL-RAT LC50:205 MG/M3 TNICS* 13,105,73
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 0.1 PPM 85INA8 5,485,86
MSHA STANDARD-AIR:TWA 1 MG/M3 DTLVS* 3,211,71
OSHAPEL:8H TWA 1 MG/M3 FEREAC 54,2923,89
OSHAPEL FINAL:8H TWA 1 MG/M3 FEREAC 54,2923,89
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

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HEALTH HAZARD DATA

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HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
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IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

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MF: CL5P

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HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

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MATERIAL SAFETY DATA SHEET

CATALOG # 15777-5 NAME: PHOSPHORUS PENTACHLORIDE, 98%

DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: 179 C TO 181 C (SUBL)
SPECIFIC GRAVITY: 1.600
VAPOR PRESSURE: <1.0 MM @ 20 C
APPEARANCE: YELLOW POWDER

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
WATER HYDROLYZES MATERIAL LIBERATING ACIDIC GAS WHICH IN CONTACT WITH METAL SURFACES CAN GENERATE FLAMMABLE AND/OR EXPLOSIVE HYDROGEN GAS.

REACTIVITY DATA

INCOMPATIBILITIES
ALCOHOLS
REACTS VIOLENTLY WITH WATER.
AMINES
ALUMINUM
SODIUM
POTASSIUM
ACIDS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
HYDROGEN CHLORIDE GAS
THERMAL DECOMPOSITION MAY PRODUCE TOXIC FUMES OF PHOSPHORUS OXIDES AND/OR PHOSPHINE.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
PLEASE CONTACT THE TECHNICAL SERVICES DEPARTMENT. BE SURE TO MENTION THE NAME, CATALOG NUMBER, AND THE QUANTITY OF THE MATERIAL.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.

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MATERIAL SAFETY DATA SHEET

CATALOG # 15777-5 NAME: PHOSPHORUS PENTACHLORIDE, 98%

WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
TOXIC.
KEEP TIGHTLY CLOSED.
DO NOT ALLOW CONTACT WITH WATER.
STORE UNDER NITROGEN.
STORE IN A COOL DRY PLACE.

ADDITIONAL PRECAUTIONS AND COMMENTS

ADDITIONAL INFORMATION
A SOLUTION OF PHOSPHORUS PENTACHLORIDE IN NITROBENZENE IS STABLE AT 110 C BUT BEGINS TO DECOMPOSE WITH ACCELERATING VIOLENCE ABOVE 120 C WITH EVOLUTION OF NITROUS FUMES. A HEATED MIXTURE WITH MAGNESIUM OXIDE INCANDESCES BRILLIANTLY. VIOLENT REACTION WITH PHOS- PHORUS(III) OXIDE OR HYDROXYLAMINE AT AMBIENT TEMPERATURE. PHOSPHOROUS PENTACHLORIDE IGNITES ON CONTACT WITH FLUORINE AND EXPLODES ON CONTACT WITH A MIXTURE OF CHLORINE AND CHLORINE DIOXIDE. A DRY MIXTURE WITH UREA EXPLODED AFTER HEATING. PROBABLY OWING TO THE FORMATION OF NITROGEN TRICHLORIDE.

REGULATORY INFORMATION

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
MARK ROSE

DATE: 11/28/88
CUST # 232882 P.O. # 31431/24

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 29822-0 NAME: PHOSPHORUS PENTOXIDE, POWDER, 98+%, A.C.S. REAGENT

CAS # 1314-56-3
MF: O5P2

SYNONYMS
DIPHOSPHORUS PENTOXIDE * NA 1807 (DOT) * PHOSPHORIC ANHYDRIDE (DOT) * PHOSPHORUS(V) OXIDE * PHOSPHORUS PENTAOXIDE * PHOSPHORUS PENTOXIDE PHOSPHORUS PENTOXIDE (DOT) * UN 1807 (DOT) *

TOXICITY HAZARDS

RTECS # TH3945000
PHOSPHORUS OXIDE

TOXICITY DATA

IHL-RAT LC50:1217 MG/M3/1H	TOXIDG 1,140,81
IHL-MUS LC50:271 MG/M3/1H	TOXIDG 1,140,81
IHL-RBT LC50:1689 MG/M3/1H	TOXIDG 1,140,81
IHL-GPG LC50:61 MG/M3/1H	TOXIDG 1,140,81

REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1988
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

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MATERIAL SAFETY DATA SHEET

CATALOG # 29822-0 NAME: PHOSPHORUS PENTOXIDE, POWDER, 98+%, A.C.S. REAGENT

PHYSICAL DATA

VAPOR DENSITY: 4.9
VAPOR PRESSURE: 10.0 MM @ 238 C
1.0 MM @ 384 C

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
SODIUM
ALUMINUM
POTASSIUM
AMMONIA
PEROXIDES
MAGNESIUM
REACTS VIOLENTLY WITH WATER.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
TOXIC.

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CATALOG # 29822-0 NAME: PHOSPHORUS PENTOXIDE, POWDER, 98+%, A.C.S. REAGENT

KEEP TIGHTLY CLOSED.
DO NOT ALLOW CONTACT WITH WATER.
STORE UNDER NITROGEN.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
REACTION WITH 95% FORMIC ACID CAUSED RAPID EVOLUTION OF CARBON MONOXIDE. DRY MIXTURES WITH SODIUM OXIDE, CALCIUM OXIDE REACT VIOLENTLY IF WARMED OR MOISTENED. MIXTURE WITH SODIUM CARBONATE IS INITIATED BY STRONG LOCAL HEATING. THE ADDITION OF PHOSPHORUS PENTOXIDE TO 3-PROPYNOL RESULTS IN IGNITION. REACTS VIGOROUSLY WITH HYDROGEN FLUORIDE, VIOLENTLY WITH IODIDES, SULFIDES AND EXPLOSIVELY WITH CALCIUM WHEN HEATED. INCOMPATIBLE WITH: BROMINE PENTAFLUORIDE, CHLORINE TRIFLUORIDE, PERCHLORIC ACID AND OXYGEN DIFLUORIDE.

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ATTN: SAFETY DIRECTOR
GLAXO INC
NEW PRODUCT DEVELOPMENT
5 MOORE DR
RESEARCH TRIANGLE PARK NC 27709

DATE: 06/30/87
CUST # 926471 P.O. # 0000030700

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 22147-3 NAME: POTASSIUM HYDROXIDE, PELLETS, 85+%, A.C.S. REAGENT

CAS # 1310-58-3

TOXICITY HAZARDS

RTECS # TT2100000
POTASSIUM HYDROXIDE
IRRITATION DATA

SKN-HMN 50 MG/24H SEV	TXAPA9 31,481,75
SKN-RBT 50 MG/24H SEV	TXAPA9 31,481,75
EYE-RBT 1 MG/24H RINSE MOD	TXAPA9 32,239,75
SKN-GPG 50 MG/24H SEV	TXAPA9 31,481,75

TOXICITY DATA

ORL-RAT LD50:365 MG/KG	TXAPA9 32,239,75

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 2 MG/M3 85INA8 5,495,86
EPA TSCA CHEMICAL INVENTORY, 1986
NIOSH ANALYTICAL METHODS: SEE ALKALINE DUSTS, 7401
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.
DISCARD CONTAMINATED CLOTHING AND SHOES.

PHYSICAL DATA

MELTING POINT: 361 C
SPECIFIC GRAVITY: 2.044
VAPOR PRESSURE: 1.0 MM @ 719 C

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CATALOG # 22147-3 NAME: POTASSIUM HYDROXIDE, PELLETS, 85+%, A.C.S. REAGENT

---------- FIRE AND EXPLOSION HAZARD DATA ----------

EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
AVOID CONTACT WITH ACID.
ABSORBS CO2 FROM AIR.
ACID CHLORIDES
ACID ANHYDRIDES
ALUMINUM
ORGANIC MATERIALS
DO NOT HEAT ABOVE MELTING POINT.
PROTECT FROM MOISTURE.
MAGNESIUM
COPPER
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
TOXIC.
KEEP TIGHTLY CLOSED.
VERY HYGROSCOPIC
STORE IN A COOL DRY PLACE.

MATERIAL SAFETY DATA SHEET

CATALOG # 22147-3 NAME: POTASSIUM HYDROXIDE, PELLETS, 85+%, A.C.S. REAGENT

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION

DANGER: UNDER FIRE CONDITIONS MATERIAL WILL MELT AND FLOW. MOLTEN MATERIAL REACTS VIOLENTLY WITH WATER AND CAN REACT WITH ALUMINUM, TIN, ZINC AND THEIR ALLOYS TO GENERATE FLAMMABLE AND EXPLOSIVE HYDROGEN GAS. POTASSIUM HYDROXIDE REACTS WITH TRICHLOROETHYLENE TO FORM SPONTANEOUSLY FLAMMABLE DICHLOROACETYLENE.

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. ALDRICH SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

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P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
MARK ROSE

DATE: 11/28/88
CUST # 232882 P.O. # 31431/24

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 22129-5 NAME: POTASSIUM NITRATE, A.C.S. REAGENT
CAS # 7757-79-1
MF: KNO3
SYNONYMS
KALIUMNITRAT (GERMAN) * NITER * NITRE * NITRIC ACID, POTASSIUM SALT *
POTASSIUM NITRATE (DOT) * SALTPETER * UN 1486 (DOT) * VICKNITE *

TOXICITY HAZARDS

RTECS # TT3700000
POTASSIUM NITRATE
TOXICITY DATA
ORL-RAT LD50:3750 MG/KG NYKZAU 81,459,83
ORL-RBT LD50:1901 MG/KG SOVEAT 27,246,74
REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE HARMFUL BY INHALATION, INGESTION, OR SKIN ABSORPTION.
CAUSES EYE AND SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

MELTING POINT: 400 C (DEC)
SPECIFIC GRAVITY: 2.109

FIRE AND EXPLOSION HAZARD DATA

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CATALOG # 22129-5 NAME: POTASSIUM NITRATE, A.C.S. REAGENT

EXTINGUISHING MEDIA
WATER SPRAY.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
STRONG OXIDIZER.
UNUSUAL FIRE AND EXPLOSION HAZARDS
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG REDUCING AGENTS
FINELY POWDERED METALS
STRONG ACIDS
SENSITIVE TO MOISTURE
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
NITROGEN OXIDES

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
USE ONLY IN A CHEMICAL FUME HOOD.
SAFETY SHOWER AND EYE BATH.
AVOID BREATHING DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM COMBUSTIBLE MATERIALS, HEAT, SPARKS, AND OPEN FLAME.
PROTECT FROM MOISTURE.
STORE IN A COOL DRY PLACE.

ADDITIONAL PRECAUTIONS AND COMMENTS

ADDITIONAL INFORMATION
A MIXTURE WITH CALCIUM SILICIDE IS EASILY IGNITED AND BURNS AT A VERY HIGH TEMPERATURE WHICH IS CAPABLE OF INITIATING MANY HIGH TEMPERATURE REACTIONS. MIXTURES OF POTASSIUM NITRATE WITH: TITANIUM, ANTIMONY, GERMANIUM OR ZIRCONIUM POWDERS, ANTIMONY TRISULFIDE, BARIUM SULFIDE, CALCIUM SULFIDE, ARSENIC DISULFIDE, TITANIUM DISULFIDE, GERMANIUM

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CATALOG # 22129-5 NAME: POTASSIUM NITRATE, A.C.S. REAGENT

MONOSULFIDE, MOLYBDENUM DISULFIDE, POWDERED CARBON, ARSENIC, WHITE OR RED PHOSPHORUS, BORON PHOSPHIDE, COPPER PHOSPHIDES, SODIUM PHOSPHINATE, SODIUM ACETATE, SODIUM THIOSULFATE, THORIUM DICARBIDE, ALUMINUM, MAGNESIUM, SODIUM OR IRON, CHROMIUM NITRIDE MAY EXPLODE OR BE DETONABLE IF HEATED, IGNITED OR STRUCK.

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POTASSIUM PERCHLORATE
POTASSIUM PERCHLORATE
POTASSIUM PERCHLORATE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 777 . . 7

SUBSTANCE: **POTASSIUM PERCHLORATE**

TRADE NAMES/SYNONYMS: ASTRUMAL; IRENAL; IRENAT; PERIODIN; PEROIDIN
POTASSIUM HYPERCHLORIDE; PERCHLORIC ACID, POTASSIUM SALT; UN 1489; P 5

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: K-CL-O4 MOL WT 138.53

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=0 REACTIVITY=2 PERSI E=0

COMPONENTS AND CONTAMINANTS

PERCENT: 100 COMPONENT: POTASSIUM PERCHLORATE

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: COLORLESS CRYSTALS, OR WHITE CRYSTALLINE POWDER

MELTING POINT: 1130 F (400 C) DEC. SPECIFIC GRAVITY: 2.5

SOLUBILITY IN WATER: 0.75% @ 0 C SOLVENT SOLUBILITY: INSOLUBLE . OHOL

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
OXIDIZING AGENT: MAY CAUSE IGNITION, VIOLENT COMBUSTION OR EXPLOSI N EN IN CONTACT WITH EASILY OXIDIZABLE SUBSTANCES; INCREASES THE FLAMMABIL T F COM-BUSTIBLE MATERIALS.

MODAERATE EXPLOSION HAZARD WHEN SHOCKED, EXPOSED TO HEAT, OR BY CH L REACTION.

FLASH POINT: NON-FLAMMABLE

FIREFIGHTING MEDIA:
FOR LARGE FIRES, USE WATER SPRAY OR FOG
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSE . FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIR STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW F REA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

USE FLOODING QUANTITIES OF WATER AS FOG. COOL CONTAINERS WITH FLOC I AMOUNTS OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. EVACUA A RADIUS OF 2500 FEET (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF H OUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

CARCINOGEN STATUS: NONE. POTASSIUM PERCHLORATE CAUSES METHEMOGLOBI AND IS AN EYE, MUCOUS MEMBRANE, RESPIRATORY TRACT, AND SKIN IRRITANT.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.
ACUTE EXPOSURE- IRRITATED THROAT, CYANOSIS, CONFUSION, AND OTHER S TOMS AS WITH ACUTE INGESTION.

CHRONIC EXPOSURE- NOT REPORTED IN HUMANS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. I . ATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AI AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILBLE. KEE ECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION. OXYGE F BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE DERMA .

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. W FFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF NTIL

NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE IRRITATION, REDNESS, PAIN.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
IRRITANT.
ACUTE EXPOSURE- INGESTION OF CHLORATES MAY CAUSE NAUSEA, VOMITING, DIARRHEA, ABDOMINAL PAIN, GASTROINTESTINAL IRRITATION, HEMOLYSIS, CYANOSIS, CENTRAL NERVOUS SYSTEM DEPRESSION, COMA, CONVULSION, ANURIA, AND KIDNEY AND LIVER DAMAGE.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
MAY BE EXPLODED, OR CAUSE IGNITION, BY SHOCK, HEAT, OR REACTION WITH COMPATIBLES.

INCOMPATIBILITIES:
EXPLOSION: HYDRAZINE OR THE HYDRATE, HYDROXYLAMINE OR THE SALTS, POWDERED ALUMINUM AND MAGNESIUM, REDUCING AGENTS, HOT CHARCOAL, ALUMINUM AND TITANIUM DIOXIDE, BARIUM CHROMATE AND TUNGSTEN.
VIOLENT REACTION: BENZENE, CALCIUM HYDRIDE, OLEFINS, SULFURIC ACID
POSSIBLE EXPLOSION ON HEATING: ETHANOL, CARBON, COMBUSTIBLE MATERIALS, STRONTIUM HYDRIDE.
EXPLOSION BY IMPACT OR FRICTION: SULFUR, ORGANIC MATERIALS, REDUCING AGENTS, POWDERED MAGNESIUM, POWDERED NICKEL AND TITANIUM AND INFUSORIAL EARTH, METALLIC POWDERS, OXIDES, COMBUSTIBLE MATERIALS, STRONG OXIDANTS.
FORMS EXPLOSIVE MIXTURE: FLUORINE
IGNITION: ARSENIC, ANTIMONY, METAL POWDERS.
FORMS AN IGNITABLE MIXTURE: ALUMINUM AND ALUMINUM FLUORIDE.
FORMS A PYROTECHNIC MIXTURE: POTASSIUM HEXACYANOCOBALTATE, TITANIUM HYDRIDE.

DECOMPOSITION:
THERMAL DECOMPOSITION RELEASES VERY TOXIC FUMES OF POTASSIUM OXIDE AND HYDROGEN CHLORIDE.

POLYMERIZATION:
NONE KNOWN.

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). R ON WITH FUELS MAY BE VIOLENT. RUNOFF TO SEWER MAY CREATE FIRE OR EXPL HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZIN ERIALS, FOR STORAGE REQUIREMENTS.

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC) AWAY FROM SPILLED MATERI ; DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PL MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SP L AREA. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER A ENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER S, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPL Y. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROCESS ENCLOSURE, LOCAL EXHAUST, OR GENERAL DILUTION VENTILATION M.

RESPIRATOR:
HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELME , HOOD.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEP

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEP
OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE PRES MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT T VENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTAC ON THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPO D THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WI THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 02/27/85 REVISION DATE: 04/26/85

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MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 22346-8 NAME: POTASSIUM PERMANGANATE, 99%, A.C.S. REAGENT
CAS # 7722-64-7
MF: KMNO4

SYNONYMS
CAIROX * CHAMELEON MINERAL * C.I. 77755 * CONDY'S CRYSTALS * KALIUMPERMANGANAAT (DUTCH) * KALIUMPERMANGANAT (GERMAN) * PERMANGANATE DE POTASSIUM (FRENCH) * PERMANGANATE OF POTASH * PERMANGANATE OF POTASH (DOT) * POTASSIO (PERMANGANATO DI) (ITALIAN) * POTASSIUM PERMANGANATE * POTASSIUM (PERMANGANATE DE) (FRENCH) * POTASSIUM PERMANGANATE (DOT) * UN 1490 (DOT) *

TOXICITY HAZARDS

RTECS # SD6475000
PERMANGANIC ACID, POTASSIUM SALT

TOXICITY DATA
ORL-HMN LDLO:143 MG/KG 34ZIAG -,493,69
ORL-RAT LD50:1090 MG/KG AIHAAP 30,470,69
SCU-MUS LD50:500 MG/KG 27ZWAY 3.2,1346,-

REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 5 MG(MN)/M3 85INA8 5,354(86),86
MSHA STANDARD-AIR:CL 5 MG(MN)/M3 OTLVS* 3,149,71
EPA GENETOX PROGRAM 1986, NEGATIVE: IN VITRO CYTOGENETICS-NONHUMAN; N CRASSA-REVERSION
EPA GENETOX PROGRAM 1986, NEGATIVE: B SUBTILIS REC ASSAY
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

TARGET ORGAN DATA
LUNGS, THORAX OR RESPIRATION (DYSPNAE)
GASTROINTESTINAL (NAUSEA OR VOMITING)
GASTROINTESTINAL (OTHER CHANGES)
EFFECTS ON FERTILITY (MALE FERTILITY INDEX)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS

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CATALOG # 22346-8 NAME: POTASSIUM PERMANGANATE, 99%, A.C.S. REAGENT

AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

ADDITIONAL INFORMATION
OVEREXPOSURE CAN RESULT IN ANEMIA, SWELLING OF THE THROAT WITH THE POSSIBILITY OF SUFFOCATION, KIDNEY DAMAGE.

PHYSICAL DATA

SPECIFIC GRAVITY: 2.703

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
WATER SPRAY.

SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
STRONG OXIDIZER.

UNUSUAL FIRE AND EXPLOSION HAZARDS
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG REDUCING AGENTS
FINELY POWDERED METALS
PEROXIDES
ALUMINUM
ZINC
LEAD
COPPER
AND THEIR ALLOYS.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
SHUT OFF ALL SOURCES OF IGNITION.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
CAUTIOUSLY ACIDIFY A 3% SOLUTION OR A SUSPENSION OF THE MATERIAL TO PH 2 WITH SULFURIC ACID. GRADUALLY ADD A 50% EXCESS OF AQUEOUS SODIUM BISULFITE WITH STIRRING AT ROOM TEMPERATURE. AN INCREASE IN TEMPERATURE INDICATES THAT A REACTION IS TAKING PLACE. IF NO REACTION IS OBSERVED ON THE ADDITION OF ABOUT 10% OF THE SODIUM BISULFITE SOLUTION INITIATE IT BY CAUTIOUSLY ADDING MORE ACID. IF MANGANESE, CHROMIUM, OR MOLYBDENUM ARE PRESENT ADJUST THE PH OF THE SOLUTION TO 7 AND TREAT WITH SULFIDE TO PRECIPITATE FOR BURIAL AS HAZARDOUS WASTE. DESTROY

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CATALOG # 22346-8 NAME: POTASSIUM PERMANGANATE, 99%, A.C.S. REAGENT

EXCESS SULFIDE, NEUTRALIZE AND FLUSH THE SOLUTION DOWN THE DRAIN.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
AVOID BREATHING DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM COMBUSTIBLE MATERIALS, HEAT, SPARKS, AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
CONTACT OF POTASSIUM PERMANGANATE WITH: METHYL SULFOXIDE (DMSO), HYDROGEN TRISULFIDE, ACETALDEHYDE, BENZALDEHYDE, ISOBUTYRALDEHYDE, ACETYLACETONE, ACETIC ACID, OXALIC ACID, LACTIC ACID, TRIETHANOLAMINE, MANNITOL, ERYTHRITOL, ETHYLENE GLYCOL, ESTERS OF ETHYLENE GLYCOL, 1, 2-PROPANEDIOL, 3-CHLOROPROPANE-1,2 -DIOL, HYDROXYLAMINE RESULTS IN IGNITION. TRACE AMOUNTS OF POTASSIUM PERMANGANATE ADDED TO AMMONIUM NITRATE, AMMONIUM PERCHLORATE OR DICHLOROMETHYLSILANE INCREASE THE SENSITIVITY OF THESE MATERIALS TO HEAT OR FRICTION. ADDITION OF POTASSIUM PERMANGANATE TO SULFURIC OR NITRIC ACIDS FOLLOWED BY ALCOHOLS RESULTS IN VIOLENT REACTIONS. AN EXPLOSION HAS BEEN REPORTED DURING THE GENERATION OF CHLORINE BY ADDING POTASSIUM PERMANGANATE TO CONCENTRATED HYDROCHLORIC ACID. ANTIMONY IGNITES ON GRINDING WITH POTASSIUM PERMANGANATE WHILE ARSENIC EXPLODES WHEN GROUND. WHEN MIXED WITH POTASSIUM PERMANGANATE, PHOSPHOROUS EXPLODES ON GRINDING WHILE SULFUR AND POWDERED TITANIUM EXPLODE ON HEATING. MIXTURES OF ORGANIC NITRO COMPOUNDS IGNITE EASILY ON HEATING, SHOCK OR CONTACT WITH SULFURIC ACID. MIXTURES OF CARBON OR ALUMINUM CARBIDE WITH POTASSIUM PERMANGANATE IGNITE ON HEATING. DECOMPOSES SPONTANEOUSLY ABOVE 150 C. INCOMPATIBLE WITH IRON(II) OR MERCURY(I) SALTS, HYPOPHOSPHITES, ARSENITES, OR IODODES. DISTILLATION OF TRIFLUORACETIC ANHYDRIDE FROM POTASSIUM PERMANGANATE RESULTED IN AN EXPLOSION OF THE APPARATUS A FEW HOURS AFTER THE DISTILLATION WAS STOPPED. (CHEM. ENG. NEWS, P.2, MARCH 30, 1987)

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EMERGENCY PHONE 1-314-771-5765

ATTN: SAFETY DIRECTOR
GLAXO INC
ACCOUNTS PAYABLE
5 MOORE DRIVE
RSCH TRI PK NC 27709

DATE: 07/27/87

CUST#: 6-065-31571 PO#: 90467

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: P1386 NAME: PROPIONIC ACID
CAS #: 79-09-4

TOXICITY HAZARDS

RTECS NO: UE5950000
PROPIONIC ACID
IRRITATION DATA
SKN-RBT 495 MG OPEN SEV UCDS** 3/24/70
EYE-RBT 990 UG SEV UCDS** 3/24/70
TOXICITY DATA
ORL-RAT LD50:3500 MG/KG FMCHA2 -,C193,83
IPR-RAT LD50:200 MG/KG FMCHA2 -,C230,83
IVN-MUS LD50:625 MG/KG APTOA6 18,141,61
SKN-RBT LD50:500 MG/KG AIHAAP 23,95,62
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 10 PPM 85INA8 5,493,86
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, DECEMBER 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

BOILING PT: 141 C
MELTING PT: -23 C

CONTINUED ON NEXT PAGE

SIGMA® chemical company

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PHONE TOLL FREE
CONTINENTAL U.S.A. (EXCL. MO.)
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OR PHONE COLLECT
1-314-771-5765
FROM ANYWHERE IN THE WORLD
MAILING ADDRESS: P.O. BOX 14508, ST. LOUIS, MO. 63178, U.S.A.

CABLE ADDRESS: SIGMACHEM TWX 910-761-0593

CUST#: 6-065-31571 PO#: 90467

PRODUCT #: P1386 NAME : PROPIONIC ACID

---------- PHYSICAL DATA ----------

SPECIFIC GRAVITY: 0.993
VAPOR DENSITY: 2.55
VAPOR PRESSURE: 2.4 MM @ 20 C

---------- FIRE AND EXPLOSION HAZARD DATA ----------

FLASHPOINT: 125 F
LOWER EXPLOSION LEVEL: 2.9% @ 0 C
UPPER EXPLOSION LEVEL: 12.1% @ 0 C
EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
WATER SPRAY.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
COMBUSTIBLE.

---------- REACTIVITY DATA ----------

INCOMPATIBILITIES
BASES
OXIDIZING AGENTS
REDUCING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

---------- SPILL OR LEAK PROCEDURES ----------

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.

CONTINUED ON NEXT PAGE

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CUST#: 6-065-31571 PO#: 90467

PRODUCT #: P1386 NAME : PROPIONIC ACID

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

CORROSIVE.
TOXIC.
KEEP TIGHTLY CLOSED.
KEEP AWAY FROM HEAT AND OPEN FLAME.
STORE IN A COOL DRY PLACE.

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SODIUM
SODIUM
SODIUM

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7440-23-5

SUBSTANCE: **SODIUM**

TRADE NAMES/SYNONYMS: NATRIUM; SODIUM METAL; S-135; S-206

CHEMICAL FAMILY:
INORGANIC METAL

MOLECULAR FORMULA: NA MOL WT: 22.99

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=1 REACTIVITY=2 PERSISTENCE=3

COMPONENTS AND CONTAMINANTS

PERCENT: 100 COMPONENT: SODIUM

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED.

PHYSICAL DATA

DESCRIPTION: ODORLESS, LIGHT, SILVER METAL, MALLEABLE.

BOILING POINT: 1621 F (883 C) MELTING POINT: 208 F (98 C)

SPECIFIC GRAVITY: 1.0 VAPOR PRESSURE: 1.23 MMHG @ 400 C

PH: SOLUTION IS ALKALINE SOLUBILITY IN WATER: REACTS

SOLVENT SOLUBILITY: DECOMPOSES IN ALCOHOL, INSOLUBLE IN ETHER, BENZENE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
EXTREMELY DANGEROUS IN CONTACT WITH MOISTURE OR WATER, RELEASING HYDROGEN WITH SUFFICIENT HEAT TO CAUSE IGNITION OR EXPLOSION. IGNITES SPONTANEOUSLY IN AIR OR OXYGEN. BURNS VIOLENTLY ACCOMPANIED BY EXPLOSIONS WHICH CAUSE SPATTERING OF THE MATERIAL.

FLASH POINT: COMBUSTIBLE AUTOIGNITION TEMP.: 250 F (121 C)

FIREFIGHTING MEDIA:
SEE PROCEDURES BELOW.

FIREFIGHTING:
MOVE CONTAINER FROM FIRE AREA IF POSSIBLE. DO NOT USE WATER OR FOAM! (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

DO NOT USE WATER OR CARBON DIOXIDE. USE GRAPHITE, SODA ASH, POWDERED SODIUM CHLORIDE, OR SUITABLE DRY POWDER. AVOID BREATHING FUMES (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

CARCINOGEN STATUS: NONE.
SODIUM REACTS WITH WATER OR MOISTURE FORMING SODIUM HYDROXIDE, WHICH IS A SEVERE EYE, SKIN, AND MUCOUS MEMBRANE IRRITANT. IT MAY CAUSE PERMANENT EYE AND SKIN DAMAGE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CORROSIVE.
ACUTE EXPOSURE- INHALATION OF DUST OR FUMES MAY CAUSE SEVERE IRRITATION OF NOSE AND RESPIRATORY TRACT, COUGH, DYSPNEA, AND PNEUMONITIS.

CHONIC EXPOSURE- REPEATED OR PROLONGED INHALATION MAY CAUSE SEVERE MUCOUS MEMBRANE IRRITATION, AND PNEUMONITIS.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION IMMEDIATELY.

SKIN CONTACT:
CORROSIVE.
ACUTE EXPOSURE- ALKALIES PENETRATE SKIN SLOWLY, THEREFORE THE EXTENT OF DAMAGE DEPENDS ON THE DURATION OF CONTACT. SOLID MAY CAUSE SEVERE BURNS, ULCERATION, AND NECROSIS. FUMES ARE HIGHLY IRRITATING.

CHRONIC EXPOSURE- MAY CAUSE CHRONIC DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF CHEMICAL

BURNS, COVER AREA WITH STERILE, DRY DRESSING. BANDAGE SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION IMMEDIATELY.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT WITH ALKALIES MAY CAUSE SEVERE BURNS, CONJUNCTIVAL EDEMA, CORNEAL DESTRUCTION, AND PERMANENT CORNEAL OPACIFICATION. FUMES ARE HIGHLY IRRITATING AND MAY CAUSE BLURRED VISION AND CORNEAL DAMAGE.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT WITH VAPORS MAY CAUSE CONJUNCTIVITIS, BLURRED VISION, AND CORNEAL DAMAGE.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (AT LEAST 15-20 MINUTES). IN CASE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION IMMEDIATELY.

INGESTION:
CORROSIVE.
ACUTE EXPOSURE- MAY CAUSE SEVERE PAIN, VOMITING, DIARRHEA, AND COLLAPSE. THE VOMITUS CONTAINS BLOOD AND SHREDS OF MUCOUS. IF DEATH DOES NOT OCCUR IN THE FIRST 24 HOURS, THE PATIENT MAY IMPROVE FOR 2-4 DAYS AND THEN HAVE A SUDDEN ONSET OF ABDOMINAL PAIN, BOARDLIKE ABDOMINAL RIGIDITY, AND HYPOTENSION INDICATING DELAYED GASTRIC OR ESOPHAGEAL PERFORATION. MAY CAUSE CORROSIVE DAMAGE TO THE ESOPHAGUS AND UPPER GASTROINTESTINAL TRACT.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
NORMALLY UNSTABLE AND MAY READILY UNDERGO VIOLENT CHEMICAL CHANGE WITHOUT DETONATION. MAY REACT VIOLENTLY OR EXPLOSIVELY WITH WATER.

MAY REACT SPONTANEOUSLY IN AIR.

INCOMPATIBILITIES:
MAY REACT VIGOROUSLY OR EXPLOSIVELY WITH OXIDIZING MATERIALS.
ACIDS- MAY CAUSE AN EXPLOSIVE REACTION.
AIR- MAY CAUSE IGNITION.
ALUMINUM HALIDES- MAY CAUSE A STRONG EXPLOSION ON IMPACT.
AMMONIUM NITRATE- FORMS EXPLOSIVE SODIUM NITRATE.
BISMUTH TRIOXIDE- INCANDESCENT REACTION.
BROMINE- MAY CAUSE AN EXPLOSIVE REACTION.
CARBON (POWDER) AND AIR- POSSIBLE EXPLOSION.
CARBON TETRACHLORIDE- MAY CAUSE AN EXPLOSION BY HEAT OR UPON IMPACT.
CHLORINATED HYDROCARBONS- MAY CAUSE AN EXPLOSIVE REACTION.
CHLORINE- MAY CAUSE IGNITION.
CHLOROFORM- MAY CAUSE AN EXPLOSIVE REACTION.
CHROMIC ANHYDRIDE- INCANDESCENT REACTION.
CUPRIC OXIDE OR STANNIC OXIDE- INCANDESCENT REACTION.
DIAZOMETHANE- POSSIBLE EXPLOSION.

DICHLOROMETHANE- FORMATION OF EXPLOSIVE MIXTURE.
1,2-DICHLOROETHYLENE- FORMATION OF COMBUSTIBLE MIXTURE.
FLUORINE- MAY CAUSE IGNITION.
HYDROCHLORIC ACID- MAY CAUSE AN EXPLOSIVE REACTION.
HYDRAZINE HYDRIDE- HIGHLY EXOTHERMIC REACTION.
HYDROGEN FLUORIDE- MAY CAUSE AN EXPLOSIVE REACTION.
HYDROXYLAMINE- FORMATION OF SELF-COMBUSTIBLE SALT.
IODINE MONOIODE- MAY CAUSE IGNITION.
IODINE PENTAFLUORIDE- POSSIBLE EXPLOSION.
LEAD OXIDE- MAY CAUSE IGNITION.
MALEIC ANHYDRIDE- MAY UNDERGO EXPLOSIVE DECOMPOSITION.
MERCUROUS OXIDE- INCANDESCENT REACTION.
MERCURY- HIGHLY EXOTHERMIC REACTION.
METAL HALIDES- EXOTHERMIC REACTION.
METHYL CHLORIDE- FORMATION OF EXPLOSIVE MIXTURE.
MOLYBDENUM TRIOXIDE- INCANDESCENT REACTION.
NICKEL CARBONYL AND OXYGEN- POSSIBLE EXPLOSION.
NITRIC ACID (FUMING)- MAY CAUSE IGNITION.
N,N-DIMETHYTL FORMAMIDE- MAY CAUSE A VIOLENT REACTION UPON HEATING.
NON-METAL HALIDES- MAY CAUSE A VIOLENT REACTION, IGNITION, OR EXPLOSION.
PERFLUOROHEXYL IODIDE- POSSIBLE EXPLOSION.
PHOSPHOROUS TRIBROMIDE- MAY CAUSE AN EXPLOSION UPON IMPACT.
SELENIUM- INCANDESCENT REACTION UPON HEATING.
SILVER HALIDES- FORMATION OF EXPLOSIVE COMPOUNDS.
SODIUM PEROXIDE- VIOLENT REACTION AT 500 C.
SULFUR- MAY CAUSE AN EXPLOSION BY FRICTION.
SULFUR DIOXIDE- MAY CAUSE A VIOLENT REACTION.
TELLURIUM- MAY CAUSE A VIOLENT REACTION.
2,2,3,3-TETRAFLUOROPROPANOL- MAY CAUSE VIOLENT IGNITION.
THIONYL CHLORIDE- IGNITION AT 300 C.
THIOPHOSPHONYL FLUORIDE- FORMATION OF SELF-COMBUSTIBLE PHOSPHINE.
WATER- MAY CAUSE AN IGNITION.

DECOMPOSITION:
MAY RELEASE TOXIC FUMES OF SODIUM OXIDE, WHICH CAN REACT WITH WATER OR STEAM TO PRODUCE HEAT AND FLAMMABLE HYDROGEN VAPORS.

POLYMERIZATION:
NONE KNOWN.

****

CONDITIONS TO AVOID

MAY IGNITE ITSELF IF EXPOSED TO AIR OR IN PRESENCE OF MOISTURE. MAY RE-IGNITE AFTER FIRE IS EXTINGUISHED. VIOLENT REACTION WITH WATER PRODUCES FLAMMABLE GAS. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

****

SPILL AND LEAK PROCEDURES

SOIL SPILL:
DIG A PIT, POND, OR LAGOON TO HOLD MATERIAL.
COVER WITH OIL.

WATER SPILL:
NEUTRALIZE WITH VINEGAR OR OTHER DILUTE ACID.

OCCUPATIONAL SPILL:
SHUT OFF IGNITION SOURCES. DO NOT TOUCH SPILLED MATERIAL. STOP LEAK IF YOU CAN DO IT WITHOUT RISK. DO NOT GET WATER ON SPILLED MATERIAL OR INSIDE THE CONTAINER. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE SPILL FOR LATER DISPOSAL. COVER POWDER SPILLS WITH PLASTIC SHEET OR TARP TO MINIMIZE SPREADING. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
HIGH LEVELS- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE CLOTHING AND EQUIPMENT TO PREVENT ANY POSSIBILITY OF SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - ALLIED FISHER SCIENTIFIC
CREATION DATE: 02/14/85 REVISION DATE: 04/23/85

-ADDITIONAL INFORMATION-

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SODIUM CHLORATE
SODIUM CHLORATE
SODIUM CHLORATE

MATERIAL SAFETY DATA SHEET

FISHER SCIENTIFIC
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SUBSTANCE IDENTIFICATION

CAS-NUMBER 7775-09-9

SUBSTANCE: **SODIUM CHLORATE**

TRADE NAMES/SYNONYMS:
CHLORATE OF SODA; CHLORAX; CHLORIC ACID, SODIUM SATL; ATLACIDE; KLOREX; SHED-A-LEAF; VAL-DROP; ASEX; ATRATOL; B-HERBATOX; DE-FOL-ATE; DESOLET; DREXEL DEFOL; DROP LEAF; GRANEX O; SODA CHLORATE; OXYCIL; TUMBLEAF; CHLORATE SALT OF SODIUM; S-268; ACC21100

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: NA-CL-03 MOL WT: 106.44

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=0 REACTIVITY=2 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM CHLORATE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS CRYSTALS OR WHITE GRANULES.

BOILING POINT: DECOMPOSES MELTING POINT: 478 F (248 C)

SPECIFIC GRAVITY: 2.5 @ 15 C PH: NEUTRAL IN SOLUTION

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- CONTACT MAY CAUSE REDNESS, PAIN, AND IRRITATION.
CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE CONJUNCTIVITIS.

FIRST AID: WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING THE UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 10-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
CORROSIVE.
ACUTE EXPOSURE- INGESTION OF TOXIC AMOUNTS CAUSES NAUSEA, VOMITING, DIARRHEA, ABDOMINAL PAIN, HEMOLYSIS, METHEMOGLOBINEMIA, CYANOSIS, NEPHRITIS, ANURIA, CONFUSION, AND CONVULSIONS.

FIRST AID- IF VICTIM IS CONSCIOUS, GIVE LARGE QUANTITIES OF WATER IMMEDIATELY TO DILUTE THE ACID. DO NOT INDUCE VOMITING. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
FORMS EXPOLSIVE MIXTURES WITH COMBUSTIBLE, ORGANIC, OR EASILY OXIDIZABLE MATERIALS, WHICH ARE EASILY IGNITED BY HEAT OR FRICTION. A POWERFUL OXIDIZER.

INCOMPATIBILITIES:
MAY REACT VIOLENTLY WITH COMBUSTIBLE, AND REDUCING MATERIALS.
ALUMINUM (POWDER), ARSENIC (POWDER), CARBON (POWDER), COPPER (POWDER): MAY CAUSE AN EXPLOSION BY HEAT, IMPACT, OR FRICTION.
DIARSENIC TRIOXIDE- FORMATION OF SELF-COMBUSTIBLE MIXTURE.
MANGANESE DIOXIDE- MAY CAUSE AN EXPLOSION BY HEAT, IMPACT, OR FRICTION.
NITROBENZENE- POSSIBLE EXPLOSIVE REACTION.
ORGANIC SUBSTANCES (SUGAR, WHEAT, SHELLAC, WOOD DUST, ETC.)- POSSIBLE IGNITION OR EXPLOSION.
PHOSPHORUS- MAY CAUSE A VIOLENT EXPLOSION.
POTASSIUM CYANIDE- MAY CAUSE AN EXPLOSIVE REACTION.
SILICON- MAY IGNITE OR EXPLODE.
SODIUM HYPOPHOSPHITE- MAY EXPLODE UPON HEATING.
SULFUR OR SULFIDES- POSSIBLE EXPLOSIVE REACTION.
SULFURIC ACID- MAY CAUSE IGNITION OR EXPLOSION.
THIOCYANATES- MAY FORM AN EXPLOSIVE MIXTURE.

DECOMPOSITION:
THERMAL DECOMPOSITON MAY RELEASE HAZARDOUS FUMES OF SODIUM OXIDES AND HYDROGEN CHLORIDE.

POLYMERIZATION:
NONE KNOWN.

chemists helping chemists in research & industry

aldrich chemical co.

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RESEARCH TRIANGLE PARK NC 27709
ADRIENNE LAWLER

DATE: 08/24/88
CUST # 232882 P.O. # 0000032570

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 22146-5 NAME: SODIUM HYDROXIDE, PELLETS, 97+%, A.C.S. REAGENT

CAS # 1310-73-2
MF: HNAO

SYNONYMS

CAUSTIC SODA * CAUSTIC SODA, BEAD (DOT) * CAUSTIC SODA, DRY (DOT) * CAUSTIC SODA, FLAKE (DOT) * CAUSTIC SODA, GRANULAR (DOT) * CAUSTIC SODA, LIQUID (DOT) * CAUSTIC SODA, SOLID (DOT) * CAUSTIC SODA, SOLUTION (DOT) * HYDROXYDE DE SODIUM (FRENCH) * LEWIS-RED DEVIL LYE * LYE * LYE (DOT) * NATRIUMHYDROXID (GERMAN) * NATRIUMHYDROXYDE (DUTCH) * SODA LYE * SODIO(IDROSSIDO DI) (ITALIAN) * SODIUM HYDRATE * SODIUM HYDRATE (DOT) * SODIUM HYDROXIDE (ACGIH) * SODIUM HYDROXIDE, BEAD (DOT) * SODIUM HYDROXIDE, DRY (DOT) * SODIUM HYDROXIDE, FLAKE (DOT) * SODIUM HYDROXIDE, GRANULAR (DOT) * SODIUM HYDROXIDE, LIQUID (DOT) * SODIUM HYDROXIDE, SOLID (DOT) * SODIUM HYDROXIDE, SOLUTION (DOT) * SODIUM(HYDROXYDE DE) (FRENCH) * UN 1823 (DOT) * UN 1824 (DOT) * WHITE CAUSTIC *

TOXICITY HAZARDS

RTECS # WB4900000
SODIUM HYDROXIDE

IRRITATION DATA

EYE-MKY 1%/24H SEV	TXAPA9 6,701,64
SKN-RBT 500 MG/24H SEV	28ZPAK -,7,72
EYE-RBT 400 UG MLD	OYYAA2 26,627,83
EYE-RBT 1% SEV	AJOPAA 29,1363,46
EYE-RBT 50 UG/24H SEV	28ZPAK -,7,72
EYE-RBT 1 MG/24H SEV	TXAPA9 6,701,64
EYE-RBT 1 MG/30S RINSE SEV	TXCYAC 23,281,82

TOXICITY DATA

IPR-MUS LD50:40 MG/KG	COREAF 257,791,63

REVIEWS, STANDARDS, AND REGULATIONS

ACGIH TLV-CL 2 MG/M3 85INA8 5,535,86
MSHA STANDARD:AIR-CL 2 MG/M3 DTLVS* 3,233,71
OSHA STANDARD-AIR:TWA 2 MG/M3 FEREAC 39,23540,74
NIOSH REL TO SODIUM HYDROXIDE-AIR:CL 2 MG/M3/15M MMWR** 34(1S),26S,85
EPA GENETOX PROGRAM 1986, NEGATIVE: CELL TRANSFORM.-SA7/SHE
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0485-0552
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, MARCH 1988
NIOSH ANALYTICAL METHODS: SEE ALKALINE DUSTS, 7401

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS

HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
CAUSES SEVERE BURNS.

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CATALOG # 22146-5 NAME: SODIUM HYDROXIDE, PELLETS, 97+%, A.C.S. REAGENT

INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA. SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID

IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

MELTING POINT: 318 C
SPECIFIC GRAVITY: 2.130
VAPOR DENSITY: <1
VAPOR PRESSURE: <18.0 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA

USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE WATER.

SPECIAL FIRE FIGHTING PROCEDURES

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS

EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES

STRONG OXIDIZING AGENTS
STRONG ACIDS
ORGANIC MATERIALS
CHLORINATED SOLVENTS
ABSORBS CO2 FROM AIR.
ORGANIC PEROXIDE.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS

NATURE OF DECOMPOSITION PRODUCTS NOT KNOWN.

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

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CATALOG # 22146-5 NAME: SODIUM HYDROXIDE, PELLETS, 97+%, A.C.S. REAGENT

WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ----

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
READILY ABSORBED THROUGH SKIN.
WASH THOROUGHLY AFTER HANDLING.
TOXIC.
CORROSIVE.
KEEP TIGHTLY CLOSED.
EXTREMELY HYGROSCOPIC.
AIR-SENSITIVE.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
CONTACT WITH ALUMINUM, TIN, AND ZINC LIBERATES HYDROGEN GAS. CONTACT WITH NITROMETHANE AND OTHER SIMILAR NITRO COMPOUNDS CAUSES FORMATION OF SHOCK-SENSITIVE SALTS.

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SODIUM PERCHLORATE
SODIUM PERCHLORATE
SODIUM PERCHLORATE

MATERIAL SAFETY DATA SHEET

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SUBSTANCE IDENTIFICATION

SUBSTANCE: **SODIUM PERCHLORATE** CAS-NUMBER 7791-07-3

TRADE NAMES/SYNONYMS:
SODIUM PERCHLORATE, MONOHYDRATE; PERCHLORIC ACID, SODIUM SALT; S-360; S-490; ACC21490

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: NA-CL-04.H2-0 MOL WT: 140.46

CERCLA RATINGS (SCALE 0-3): HEALTH=2 FIRE=0 REACTIVITY=2 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM PERCHLORATE PERCENT: 100

OTHER CONTAMINANTS: NONE

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: WHITE, DELIQUESCENT CRYSTALS BOILING POINT: 900 F (482 C)

MELTING POINT: 266 F (130 C) SPECIFIC GRAVITY: 2.0

SOLUBILITY IN WATER: 209G @ 15 C

SOLVENT SOLUBILITY: ALCOHOL

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NEGLIGIBLE FIRE AND EXPLOSION HAZARD UNDER NORMAL CONDITIONS. DANGEROUS FIRE AND EXPLOSION RISK WITH ORGANIC MATERIAL OR SULFURIC ACID.

FLASH POINT: NON-FLAMMABLE

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE OR WATER SPRAY
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE WATER SPRAY OR FOG
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 35)

FLOOD WITH WATER. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. EVACUATE TO A RADIUS OF 2500 FEET FOR UNCONTROLLABLE FIRES (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

CARCINOGEN STATUS: NONE.
SODIUM CHLORATE IS A SKIN, EYE, AND RESPIRATORY TRACT IRRITANT. SEVERE EXPOSURE MAY CAUSE BLOOD, LIVER, AND KIDNEY DAMAGE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CORROSIVE/METHEMOGLOBIN FORMER.
ACUTE EXPOSURE- INHALATION OF THE DUST MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- HAS NOT BEEN REPORTED IN HUMANS.

FIRST AID- REMOVE FROM EXPOSURE. IF VICTIM HAS STOPPED BREATHING, PERFORM ARTIFICIAL RESPIRATION. GET MEDICAL ATTENTION.

SKIN CONTACT:
CORROSIVE.
ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE BURNS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED DUST CONTACT MAY CAUSE IRRITATION.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND WASH AFFECTED AREAS WITH LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CONTAMINATION REMAINS. TREAT FOR SKIN BURNS. GET MEDICAL ATTENTION.

EYE CONTACT:
CORROSIVE.

ACUTE EXPOSURE- DIRECT CONTACT MAY CAUSE BURNS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED DUST CONTACT MAY PRODUCE IRRITATION.

FIRST AID- WASH EYES WITH WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CONTAMINATION REMAINS (APPROXIMATELY 15-20 MINUTES). TREAT FOR CORNEAL BURNS. GET MEDICAL ATTENTION.

INGESTION:
CORROSIVE.
ACUTE EXPOSURE- INGESTION OF TOXIC AMOUNTS CAUSES NAUSEA, VOMITING, DIARRHEA, ABDOMINAL PAIN, HEMOLYSIS, METHEMOGLOBINEMIA, CYANOSIS, NEPHRITIS, ANURIA, CONFUSION, AND CONVULSIONS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
FORMS EXPLOSIVE MIXTURES WITH COMBUSTIBLE, ORGANIC, OR OTHER EASILY OXIDIZABLE MATERIALS.

INCOMPATIBILITIES:
EXPLOSIVE WITH AMMONIUM NITRATE, CHARCOAL, MAGNESIUM, REDUCING AGENTS, AND STRONTIUM HYDRIDE. FORMS EXPLOSIVE MIXTURES WITH COMBUSTIBLE, ORGANIC, OR OTHER EASILY OXIDIZABLE MATERIALS.

DECOMPOSITION:
WHEN HEATED TO THERMAL DECOMPOSITION, IT EMITS TOXIC FUMES OF HYDROGEN CHLORIDE AND SODIUM OXIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

****

CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTION WITH FUELS MAY BE VIOLENT. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

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SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY.

ISOLATE HAZARD AREA AND DENY ENTRY.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
HIGH- DUST MASK.
SUPPLIED-AIR RESPIRATOR WITH A FULL FACE-PIECE.
SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE.

FIREFIGHTNG- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 02/10/85 REVISION DATE: 05/16/85

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SODIUM NITRATE
SODIUM NITRATE
SODIUM NITRATE

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SUBSTANCE IDENTIFICATION

SUBSTANCE: **SODIUM NITRATE**

CAS-NUMBER 7631-99-4

TRADE NAMES/SYNONYMS:
NITRATINE; SODIUM NITER; CHILE SALTPETER; CUBIC NITER; SODIUM(I) NITRATE; SODIUM(+1) NITRATE; NITRIC ACID, SODIUM SALT; S-343; S-342; ACC21400

CHEMICAL FAMILY:
INORGANIC SALT

MOLECULAR FORMULA: NA-N-03 MOL WT: 84.99

CERCLA RATINGS (SCALE 0-3): HEALTH=1 FIRE=0 REACTIVITY=0 PERSISTENCE=0

COMPONENTS AND CONTAMINANTS

COMPONENT: SODIUM NITRATE PERCENT: 99.5

OTHER CONTAMINANTS: SILICATES

EXPOSURE LIMITS:
NONE ESTABLISHED

PHYSICAL DATA

DESCRIPTION: ODORLESS, COLORLESS CRYSTALS WITH A SLIGHTLY BITTER TASTE.

BOILING POINT: 716 F (380 C) DECOMP MELTING POINT: 584 F (307 C)

SPECIFIC GRAVITY: 2.3 PH: NEUTRAL IN SOLUTION

SOLUBILITY IN WATER: 92.1% @ 25 C

SOLVENT SOLUBILITY: ALCOHOL, METHANOL, AMMONIA, GLYCERINE

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
NON-COMBUSTIBLE UNDER NORMAL CONDITIONS. MAY IGNITE WITH ORGANIC MATERIAL, AND EXPLODE WHEN SHOCKED OR HEATED TO 1000 F.

FLASH POINT: NON-COMBUSTIBLE

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE OR WATER SPRAY
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FOR LARGE FIRES, USE WATER SPRAY OR FOG
(1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3).

FIREFIGHTING:
MOVE CONTAINERS FROM FIRE AREA IF POSSIBLE. COOL CONTAINERS EXPOSED TO FLAMES WITH WATER FROM SIDE UNTIL WELL AFTER FIRE IS OUT. FOR MASSIVE FIRE IN STORAGE AREA, USE UNMANNED HOSE HOLDER OR MONITOR NOZZLES; ELSE WITHDRAW FROM AREA AND LET FIRE BURN (1984 EMERGENCY RESPONSE GUIDEBOOK, DOT P 5800.3, GUIDE PAGE 35)

FLOOD WITH WATER. COOL CONTAINERS WITH FLOODING QUANTITIES OF WATER, APPLY FROM AS FAR A DISTANCE AS POSSIBLE. EVACUATE TO A RADIUS OF 2500 FEET FOR FOR UNCONTROLLABLE FIRES (BUREAU OF EXPLOSIVES, EMERGENCY HANDLING OF HAZARDOUS MATERIALS IN SURFACE TRANSPORTATION, 1981).

TOXICITY

2680 MG/KG ORAL-RABBIT LD50; MUTAGENIC DATA (RTECS); TUMORIGNEIC DATA (RTECS);
CARCINOGEN STATUS: NONE.
SODIUM NITRATE IS A TOXIC EYE, SKIN AND RESPIRATORY TRACT IRRITANT.
POISONING AFFECTS THE BLOOD.

HEALTH EFFECTS AND FIRST AID

INHALATION:
IRRITANT.
ACUTE EXPOSOURE- MAY CAUSE COUGHING, SHORTNESS OF BREATH, OR RESPIRATORY TRACT IRRITATION. SEVERE EXPOSURE MAY CAUSE EXCITATION, CONVULSIONS, AND METHEMOGLOBINEMIA.

CHRONIC EXPOSURE- MAY CAUSE RESPIRATORY TRACT IRRITATION, SHORTNESS OF BREATH, AND COUGHING.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST (DRIESBACH, HANDBOOK OF POISONING, 11TH ED.).

SKIN CONTACT:
IRRITANT.
ACUTE EXPOSURE- CONTACT MAY CAUSE IRRITATION.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING AND SHOES IMMEDIATELY. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

EYE CONTACT:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE MILD IRRITATION AND REDNESS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED EXPOSURE TO VAPORS MAY CAUSE CONJUNCTIVITIS.

FIRST AID: WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALYY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). GET MEDICAL ATTENTION.

INGESTION:
IRRITANT.
ACUTE EXPOSURE- MAY CAUSE ABDOMINAL SPASM, MUSCLE SPASM, FAINTNESS, VOMITING, AND CYANOSIS. SEVERE EXPOSURE MAY CAUSE METHEMOGLOBINEMIA AND CONVULSIONS.

FIRST AID- IF VICTIM IS CONSCIOUS, IMMEDIATELY GIVE 2 TO 4 GLASSES OF WATER, AND INDUCE VOMITING BY TOUCHING FINGER TO BACK OF THROAT. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UNDER NORMAL CONDITIONS. MAY INCREASE BURNING RATE OF COMBUSTIBLE MATERIALS.

INCOMPATIBILITIES:
EXPLODES WHEN MIXED WITH BARIUM RHODANIDE, CYANIDES, SODIUM HYPOPHOSPHITE, POWDERED METAL OR OXIDE, BARIUM THIOCYANATE, CALCIUM-SILICON ALLOY, ACETIC ANHYDRIDE, METAL AMIDOSULFATE; POWDERED CHARCOAL, PEROXYFORMIC ACID, SODIUM, SODIUM PHOSPHINATE, SODIUM THIOSULFATE, BORON PHOSPHIDE, OR CYANATES. EXPLODES WHEN HEATED WITH ANTIMONY. REACTS VIOLENTLY WITH COMBUSTIBLE AND REDUCING MATERIAL, METAL CYANIDES, AND PHENOL. IGNITES WITH SULFUR + CHARCOAL, DIARSENIC TRIOXIDE, FIBROUS MATERIAL, JUTE, MAGNESIUM, OR WOOD.

DECOMPOSITION:
THERMAL-OXIDATIVE DEGRADATION OR REACTION WITH ACIDS PRODUCES TOXIC NITROGEN OXIDES AND SODIUM OXIDE.

POLYMERIZATION:
HAZARDOUS POLYMERIZATION HAS NOT BEEN REPORTED TO OCCUR UNDER NORMAL TEMPERATURES AND PRESSURES.

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CONDITIONS TO AVOID

MAY IGNITE OTHER COMBUSTIBLE MATERIALS (WOOD, PAPER, OIL, ETC.). REACTION WITH FUELS MAY BE VIOLENT. RUNOFF TO SEWER MAY CREATE FIRE OR EXPLOSION

HAZARD.

CONSULT NFPA PUBLICATION 43A, STORAGE OF LIQUID AND SOLID OXIDIZING MATERIALS, FOR STORAGE REQUIREMENTS.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
KEEP COMBUSTIBLES (WOOD, PAPER, OIL, ETC) AWAY FROM SPILLED MATERIAL. DO NOT TOUCH SPILLED MATERIAL. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER; MOVE CONTAINERS FROM SPILL AREA. FOR SMALL LIQUID SPILLS, TAKE UP WITH SAND, EARTH OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. FOR LARGER SPILLS, DIKE FAR AHEAD OF SPILL FOR LATER DISPOSAL. KEEP UNNECESSARY PEOPLE AWAY. ISOLATE HAZARD AREA AND DENY ENTRY.

WHEN MATERIAL NOT INVOLVED IN FIRE:
KEEP OPEN FLAMES, SPARKS AND OTHER IGNITION SOURCES AWAY FROM MATERIAL.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
HIGH LEVELS- DUST MASK.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACE-PIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE (IMPERVIOUS) CLOTHING AND EQUIPMENT TO PREVENT REPEATED OR PROLONGED SKIN CONTACT WITH THIS SUBSTANCE.

GLOVES:
EMPLOYEE MUST WEAR APPROPRIATE PROTECTIVE GLOVES TO PREVENT CONTACT WITH THIS SUBSTANCE.

EYE PROTECTION:
EMPLOYEE MUST WEAR SPLASH-PROOF OR DUST-RESISTANT SAFETY GOGGLES AND A FACESHIELD TO PREVENT CONTACT WITH THIS SUBSTANCE.

WHERE THERE IS ANY POSSIBILITY THAT AN EMPLOYEE'S EYES MAY BE EXPOSED TO THIS SUBSTANCE, THE EMPLOYER SHALL PROVIDE AN EYE-WASH FOUNTAIN WITHIN THE IMMEDIATE WORK AREA FOR EMERGENCY USE.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 02/12/85 REVISION DATE: 01/22/86

-ADDITIONAL INFORMATION-

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ACCOUNTS PAYABLE
5 MOORE DRIVE
RSCH TRI PK NC 27709

DATE: 03/08/88

CUST#: 6-065-31571 PO#: 90000
REL 139

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: S4751 NAME: STEARIC ACID FREE ACID GRADE I
CAS #: 57-11-4

TOXICITY HAZARDS

RTECS NO: WI2800000
STEARIC ACID
IRRITATION DATA
SKN-HMN 75 MG/3D-I MLD — 85DKA8 -,127,77
SKN-RBT 500 MG/24H MOD — FCTXAV 17,383,79
TOXICITY DATA
IVN-RAT LD50:21500 UG/KG — FCTXAV 17,383,79
IVN-MUS LD50:23 MG/KG — FCTXAV 17,383,79
REVIEWS, STANDARDS, AND REGULATIONS
EPA GENETOX PROGRAM 1986, NEGATIVE: E COLI POLA WITHOUT S9
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1987
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF INHALED OR SWALLOWED.
CAUSES EYE AND SKIN IRRITATION.
MATERIAL IS IRRITATING TO MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.
FIRST AID
CONTAMINATION OF THE EYES SHOULD BE TREATED BY IMMEDIATE AND PROLONGED IRRIGATION WITH COPIOUS AMOUNTS OF WATER.
IN CASE OF CONTACT, IMMEDIATELY WASH SKIN WITH SOAP AND COPIOUS AMOUNTS OF WATER.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

PHYSICAL DATA

BOILING PT: 183 C TO 184 C/1MM.
MELTING PT: 67 C TO 69 C

CONTINUED ON NEXT PAGE

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MATERIAL SAFETY DATA SHEET

CUST#: 6-065-31571 PO#: 90000

REL 139

PRODUCT #: S4751 NAME : STEARIC ACID FREE ACID GRADE I

FIRE AND EXPLOSION HAZARD DATA

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.
WATER SPRAY.
SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSIONS HAZARDS
THIS MATERIAL, LIKE MOST MATERIALS IN POWDER FORM, IS CAPABLE OF CREATING A DUST EXPLOSION.

REACTIVITY DATA

INCOMPATIBILITIES
BASES
OXIDIZING AGENTS
REDUCING AGENTS
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE AND CARBON DIOXIDE

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
WEAR RESPIRATOR, CHEMICAL SAFETY GOGGLES, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
SWEEP UP, PLACE IN A BAG AND HOLD FOR WASTE DISPOSAL.
AVOID RAISING DUST.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

CHEMICAL SAFETY GOGGLES.
RUBBER GLOVES
NIOSH/MSHA-APPROVED RESPIRATOR.
SAFETY SHOWER AND EYE BATH.
MECHANICAL EXHAUST REQUIRED.
AVOID CONTACT AND INHALATION.
WASH THOROUGHLY AFTER HANDLING.
IRRITANT.
KEEP CONTAINER CLOSED.
STORE IN A COOL DRY PLACE.

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ATTN: SAFETY DIRECTOR
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ACCOUNTS PAYABLE DEPT
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RESEARCH TRIANGLE PARK NC 27709

DATE: 05/10/88
CUST # 926471 P.O. # 0000032010

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 32050-1 NAME: SULFURIC ACID, A.C.S. REAGENT
CAS # 7664-93-9

TOXICITY HAZARDS

RTECS # WS5600000
SULFURIC ACID
IRRITATION DATA
EYE-RBT 1380 UG SEV — AJOPAA 29,1363,46
EYE-RBT 5 MG/30S RINSE SEV — TXCYAC 23,281,82
TOXICITY DATA
UNR-MAN LDLO:135 MG/KG — 85DCAI 2,73,70
ORL-RAT LD50:2140 MG/KG — AIHAAP 30,470,69
IHL-RAT LC50:510 MG/M3/2H — 85GMAT -,107,82
IHL-MUS LC50:320 MG/M3/2H — 85GMAT -,107,82
IHL-GPG LC50:18 MG/M3 — MELAAD 45,590,54
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 1 MG/M3 85INA8 5,544,86
MSHA STANDARD-AIR:TWA 1 MG/M3 DTLVS* 3,239,71
OSHA STANDARD-AIR:TWA 1 MG/M3 FEREAC 39,23540,74
NIOSH REL TO SULFURIC ACID-AIR:TWA 1 MG/M3 MMWR** 34(1S),27S,85
EPA TSCA CHEMICAL INVENTORY, 1986
EPA TSCA SECTION 8(E) STATUS REPORT 8EHQ-0985-0566
EPA TSCA TEST SUBMISSION (TSCATS) DATA BASE, JUNE 1987
NIOSH ANALYTICAL METHODS: SEE ACIDS, INORGANIC, 7903
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF SWALLOWED.
HARMFUL IF INHALED OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.

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CATALOG # 32050-1 NAME: SULFURIC ACID, A.C.S. REAGENT

WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

SPECIFIC GRAVITY: 1.840
VAPOR DENSITY: <.3 @ 25 C
VAPOR PRESSURE: 1.0 MM @ 145.8 C

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
NONCOMBUSTIBLE.
USE EXTINGUISHING MEDIA APPROPRIATE TO SURROUNDING FIRE CONDITIONS.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
STRONG OXIDIZER.
CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.
UNUSUAL FIRE AND EXPLOSION HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
BASES
HALIDES
AVOID CONTACT WITH METALS.
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
SULFUR OXIDES

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY-LIME, SAND, OR SODA ASH. PLACE IN COVERED CONTAINERS USING NON-SPARKING TOOLS AND TRANSPORT OUTDOORS.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
MECHANICAL EXHAUST REQUIRED.
SAFETY SHOWER AND EYE BATH.
FACESHIELD (8-INCH MINIMUM).
AVOID BREATHING VAPOR.
AVOID CONTACT WITH EYES, SKIN AND CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.

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CATALOG # 32050-1 NAME: SULFURIC ACID, A.C.S. REAGENT

WASH THOROUGHLY AFTER HANDLING.
POISON.
CORROSIVE.
KEEP TIGHTLY CLOSED.
REACTS VIOLENTLY WITH WATER.
DO NOT STORE NEAR, NOR ALLOW CONTACT WITH, CLOTHING AND OTHER COMBUSTIBLE MATERIAL.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
INCOMPATIBLE WITH CARBIDES, CHLORATES FULMINATES, NITRATES, PICRATES, CYANIDES, ALKALI HALIDES, NITRITES, ZINC IODIDE, PERMANGANATES, HYDROGEN PEROXIDE, AZIDES, PERCHLORATES, NITROMETHANE, PHOSPHOROUS. VIOLENT REACTION WITH: CYCLOPENTADIENE, CYCLOPENTANONE OXIME, NITROARYL AMINES, HEXALITHIUM DISILICIDE, PHOSPHOROUS(III) OXIDE.

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P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
ROBERT MOOK/V 354

DATE: 07/31/89
CUST # 232882 P.O. # 9532573

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 32052-8 NAME: SULFURYL CHLORIDE, 97%
CAS # 7791-25-5
MF: CL2O2S

SYNONYMS
SULFONYL CHLORIDE * SULFURIC OXYCHLORIDE * SULFURYL CHLORIDE (DOT) *
UN 1834 (DOT) *

TOXICITY HAZARDS

RTECS # WT4870000
SULFURYL CHLORIDE

REVIEWS, STANDARDS, AND REGULATIONS
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION

ADDITIONAL INFORMATION
IHL-RAT (MALE) LC50: 131 PPM, IHL-RAT (FEMALE) LC50: 242 PPM.

HEALTH HAZARD DATA

ACUTE EFFECTS
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

PHYSICAL DATA

MELTING POINT: -54 C TO C
BOILING POINT: 68 C TO 70 C
SPECIFIC GRAVITY: 1.680
VAPOR DENSITY: 4.65
VAPOR PRESSURE: 100.0 MM @ 17.8 C

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MATERIAL SAFETY DATA SHEET

CATALOG # 32052-8 NAME: SULFURYL CHLORIDE, 97%

APPEARANCE: COLORLESS TO PALE YELLOW LIQUID

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
DRY CHEMICAL POWDER.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
WATER HYDROLYZES MATERIAL LIBERATING ACIDIC GAS WHICH IN CONTACT WITH METAL SURFACES CAN GENERATE FLAMMABLE AND/OR EXPLOSIVE HYDROGEN GAS.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
ACIDS
BASES
ALCOHOLS
AVOID CONTACT WITH METALS.
AMINES
READILY HYDROLYZED.
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
HYDROGEN CHLORIDE GAS
SULFUR OXIDES

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.

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FAX: (414) 273-4979

CATALOG # 32052-8 NAME: SULFURYL CHLORIDE, 97%

HIGHLY TOXIC.
LACHRYMATOR.
KEEP TIGHTLY CLOSED.
UNPLEASANT ODOR.
REACTS VIOLENTLY WITH WATER.
STORE UNDER NITROGEN.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
INCOMPATIBLE WITH: METHYL SULFOXIDE (DMSO), DIMETHYLFORMAMIDE (DMF), LEAD DIOXIDE, PHOSPHOROUS, DINITROGEN PENTOXIDE, ETHER ESPECIALLY IF PEROXIDES ARE PRESENT.

---------- REGULATORY INFORMATION ----------

NOT APPLICABLE

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ATTN: SAFETY DIRECTOR
GLAXO INC
FIVE MOORE DRIVE
P O BOX 13358
RESEARCH TRIANGLE PARK NC 27709
STEVE YUNGER

DATE: 09/12/88
CUST # 232882 P.O. # 0000032697

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT # 23046-4 NAME: THIONYL CHLORIDE, 99+%
CAS # 7719-09-7
MF: CL2OS

SYNONYMS
SULFINYL CHLORIDE * SULFUR CHLORIDE OXIDE * SULFUROUS DICHLORIDE * SULFUROUS OXYCHLORIDE * THIONYL CHLORIDE (ACGIH,DOT) * THIONYL DICHLORIDE * UN 1836 (DOT) *

TOXICITY HAZARDS

RTECS # XM5150000
THIONYL CHLORIDE
TOXICITY DATA
IHL-RAT LC50:500 PPM/1H NTIS** AD-A148-952
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-CL 1 PPM 85INA8 5,572,86
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATIO

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, NAUSEA AND VOMITING.
TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.

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FAX: (414) 273-4979

CATALOG # 23046-4 NAME: THIONYL CHLORIDE, 99+%

PHYSICAL DATA

MELTING POINT: -105 C
BOILING POINT: 79 C
SPECIFIC GRAVITY: 1.631
VAPOR PRESSURE: 97.0 MM @ 20 C

FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: NONE
EXTINGUISHING MEDIA
DRY CHEMICAL POWDER.
DO NOT USE WATER.
SPECIAL FIRE FIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.
UNUSUAL FIRE AND EXPLOSION HAZARDS
WATER HYDROLYZES MATERIAL LIBERATING ACIDIC GAS WHICH IN CONTACT WITH METAL SURFACES CAN GENERATE FLAMMABLE AND/OR EXPLOSIVE HYDROGEN GAS.
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.
CONTAINER EXPLOSION MAY OCCUR UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
ACIDS
BASES
ALCOHOLS
AVOID CONTACT WITH METALS.
AMINES
READILY HYDROLYZED.
DO NOT ALLOW WATER TO ENTER CONTAINER BECAUSE OF VIOLENT REACTION.
HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
HYDROGEN CHLORIDE GAS
SULFUR OXIDES

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.
WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.
WASTE DISPOSAL METHOD
FOR SMALL QUANTITIES: CAUTIOUSLY ADD TO A LARGE STIRRED EXCESS OF WATER. ADJUST THE PH TO NEUTRAL, SEPARATE ANY INSOLUBLE SOLIDS OR LIQUIDS AND PACKAGE THEM FOR HAZARDOUS-WASTE DISPOSAL. FLUSH THE AQUEOUS SOLUTION DOWN THE DRAIN WITH PLENTY OF WATER. THE HYDROLYSIS AND NEUTRALIZATION REACTIONS MAY GENERATE HEAT AND FUMES WHICH CAN BE CONTROLLED BY THE RATE OF ADDITION.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.

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CATALOG # 23046-4 NAME: THIONYL CHLORIDE, 99+%

DO NOT BREATHE VAPOR.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
WASH THOROUGHLY AFTER HANDLING.
CORROSIVE.
LACHRYMATOR.
TOXIC.
KEEP TIGHTLY CLOSED.
UNPLEASANT ODOR.
REACTS VIOLENTLY WITH WATER.
STORE UNDER NITROGEN.
STORE IN A COOL DRY PLACE.

---------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

ADDITIONAL INFORMATION
THIONYL CHLORIDE HAS BEEN REPORTED TO REACT VIOLENTLY WITH DIMETHYL FORMAMIDE AND WITH METHYL SULFOXIDE (DMSO). CONTAINERS MAY EXPLODE IF EXPOSED TO TEMPERATURES ABOVE 140 CENTIGRADE.

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**P-TOLUENESULFONIC ACID*
**P-TOLUENESULFONIC ACID*
**P-TOLUENESULFONIC ACID*

MATERIAL SAFETY DATA SHEET

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CHEMICAL DIVISION
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CAT NO: A320500

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SUBSTANCE IDENTIFICATION

CAS-NUMBER 104-15-4

SUBSTANCE: **P-TOLUENESULFONIC ACID**

TRADE NAMES/SYNONYMS:
4-METHYLBENZENE SULFONIC ACID; 4-TOLUENESULFONIC ACID;
P-METHYLPHENYLSULFONIC ACID; ACC67915

CHEMICAL FAMILY:
SULFONIC ACID

MOLECULAR FORMULA: C7-H8-S-O3 MOL WT: 156.20

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=1 REACTIVITY=1 PERSISTENCE=1

COMPONENTS AND CONTAMINANTS

COMPONENT: P-TOLUENESULFONIC ACID PERCENT: >98

OTHER CONTAMINANTS: NONE.

EXPOSURE LIMITS:
NONE ESTABLISHED.

PHYSICAL DATA

DESCRIPTION: COLORLESS, HYGROSCOPIC CRYSTALS. BOILING POINT: 295 F (140 C)

MELTING POINT: 220 F (105 C) SPECIFIC GRAVITY: 1.2

SOLUBILITY IN WATER: SOLUBLE VAPOR DENSITY: 6.0

SOLVENT SOLUBILITY: ALCOHOL, ETHER.

FIRE AND EXPLOSION DATA

FIRE AND EXPLOSION HAZARD:
SLIGHT FIRE HAZARD WHEN EXPOSED TO HEAT OR FLAME.

FLASH POINT: 363 F (184 C) (CC)

FIREFIGHTING MEDIA:
DRY CHEMICAL, CARBON DIOXIDE, WATER SPRAY

FIREFIGHTING:
CORROSIVE SOLID- WEAR PERSONAL PROTECTIVE EQUIPMENT. EXTINGUISH USING AGENT SUITABLE FOR TYPE OF SURROUNDING FIRE. MATERIAL ITSELF DOES NOT BURN READILY. USE FLOODING QUANTITIES OF WATER AS A FOG.

TOXICITY

2480 MG/KG ORAL-RAT LD50, 400 MG/KG ORAL-MOUSE LD50.
CARCINOGEN STATUS: NONE.
P-TOLUENESULFONIC ACID IS CORROSIVE. CONTACT WITH THE SKIN AND MUCOUS MEMBRANES MAY CAUSE SEVERE BURNS. PERSONS WITH PRE-EXISTING SKIN OR CHRONIC RESPIRATORY DISEASE MAY BE AT INCREASED RISK FROM EXPOSURE.

HEALTH EFFECTS AND FIRST AID

INHALATION:
CORROSIVE.

ACUTE EXPOSURE- LOW CONCENTRATIONS CAUSES SEVERE MUCOUS MEMBRANE IRRITATION, COUGHING, CHOKING, DYSPNEA, HEADACHE, DIZZINESS AND WEAKNESS. DELAYED SYMPTOMS MAY INCLUDE PULMONARY EDEMA, CHEST TIGHTNESS, FROTHY SPUTUM, CYANOSIS, RALES, AND HYPOTENSION. EXPOSURE TO 50 PPM IS INTOLERABLE TO MOST PERSONS AND RESULTS IN SEVERE IRRITATION AND CORROSION.

CHRONIC EXPOSURE- PROLONGED EXPOSURE TO ACID FUMES MAY CAUSE DENTAL EROSION, NECROSIS OF THE JAW, NASAL ULCERATION, BRONCHIAL IRRITATION, COUGHING, BRONCHIAL PNEUMONIA, AND GASTROINTESTINAL DISTURBANCES.

FIRST AID- REMOVE FROM EXPOSURE AREA TO FRESH AIR IMMEDIATELY. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. MAINTAIN AIRWAY AND BLOOD PRESSURE AND ADMINISTER OXYGEN IF AVAILABLE. KEEP AFFECTED PERSON WARM AND AT REST. GET MEDICAL ATTENTION. OXYGEN MUST BE ADMINISTERED BY QUALIFIED MEDICAL PERSONNEL.

SKIN CONTACT:
CORROSIVE.

ACUTE EXPOSURE- CONTACT MAY CAUSE SEVERE IRRITATION AND PAIN, WITH BURNS, VESICULATION, AND BROWNISH OR YELLOWISH STAINS.

CHRONIC EXPOSURE- REPEATED OR PROLONGED CONTACT MAY CAUSE DERMATITIS.

FIRST AID- REMOVE CONTAMINATED CLOTHING WHILE RUNNING STREAMS OF WATER UNDER CLOTHING. WASH AFFECTED AREA WITH SOAP OR MILD DETERGENT AND LARGE AMOUNTS OF WATER UNTIL NO EVIDENCE OF CHEMICAL REMAINS (APPROXIMATELY 15-20 MINUTES). FOR CHEMICAL BURNS, APPLY STERILE BANDAGES SECURELY, BUT NOT TOO TIGHTLY. GET MEDICAL ATTENTION.

EYE CONTACT:
CORROSIVE.
ACUTE EXPOSURE- LOW VAPOR CONCENTRATIONS OR DIRECT CONTACT MAY CAUSE CORNEAL AND CONJUNCTIVAL EDEMA, IRITIS, CORNEAL EROSION AND OPACITY, PAIN, LACRIMATION, PHOTOPHOBIA, AND BLURRED VISION.

CHRONIC EXPOSURE- PROLONGED OR REPEATED EXPOSURE TO VAPOR MAY CAUSE CONJUNCTIVITIS.

FIRST AID- WASH EYES IMMEDIATELY WITH LARGE AMOUNTS OF WATER, OCCASIONALLY LIFTING UPPER AND LOWER LIDS, UNTIL NO EVIDENCE OF CHEMICAL REMAINS, (APPROXIMATELY 15-20 MINUTES). IN PRESENCE OF BURNS, APPLY STERILE BANDAGES LOOSELY WITHOUT MEDICATION. GET MEDICAL ATTENTION.

INGESTION:
CORROSIVE/TOXIC.
ACUTE EXPOSURE- SEVERE BURNING PAIN IN THE MOUTH, THROAT AND ABDOMEN, FOLLOWED BY NAUSEA, VOMITING, DIARRHEA, BLOODY STOOLS, HEMATEMESIS, HEMATURIA, ALBUMINURIA AND POSSIBLY ASPHYXIA. PERFORATION OF THE ESOPHAGUS AND STOMACH MAY OCCUR. NEPHROSIS IS ALSO POSSIBLE. DEATH MAY OCCUR FROM CARDIOVASCULAR COLLAPSE.

FIRST AID- IF VICTIM IS CONSCIOUS GIVE HIM LARGE QUANTITIES OF WATER TO DILUTE THE ACID. DO NOT INDUCE VOMITING. THEN GIVE 1 OUNCE (30 ML) OF MILK OF MAGNESIA. IF BREATHING HAS STOPPED, GIVE ARTIFICIAL RESPIRATION. GET MEDICAL ATTENTION IMMEDIATELY.

REACTIVITY

REACTIVITY:
STABLE UP TO THE BOILING POINT, 140 C AT ORDINARY PRESSURES. IT IS SAID TO DECOMPOSE.

INCOMPATIBILITIES:
STRONG OXIDANTS, STRONG ALKALIS AND OTHER MATERIALS, EXAMPLES FOLLOW:
ACETIC ACID, WATER: POSSIBLE EXPLOSION.
M-THIOCRESOL: POSSIBLE EXPLOSION.
CARBONATES, SULFIDES, CYANIDES, AND CARBIDES: REACTS WITH COMMON METALS TO EMIT FLAMMABLE HYDROGEN GAS.

DECOMPOSITION:
COMBUSTION PRODUCTS INCLUDE HIGHLY TOXIC FUMES OF SULFUR OXIDES.

POLYMERIZATION:
WILL NOT OCCUR.

****

CONDITIONS TO AVOID

MAY BURN BUT DOES NOT IGNITE READILY. FLAMMABLE, POISONOUS GASES MAY ACCUMULATE IN TANKS AND HOPPER CARS. AVOID HEATING TO THE MELTING POINT, WHERE TOXIC FUMES ARE EMITTED.

****

SPILL AND LEAK PROCEDURES

OCCUPATIONAL SPILL:
DO NOT TOUCH SPILLED MATERIAL. PROVIDE VENTILATION. WEAR PERSONAL PROTECTIVE EQUIPMENT. FOR SMALL SPILLS, TAKE UP WITH SAND OR OTHER ABSORBENT MATERIAL AND PLACE INTO CONTAINERS FOR LATER DISPOSAL. CLOSE TIGHTLY AND LABEL CORROSIVE. FOR SMALL DRY SPILLS, WITH CLEAN SHOVEL PLACE MATERIAL INTO CLEAN, DRY CONTAINER AND COVER AND LABEL CORROSIVE. MOVE CONTAINERS FROM SPILL AREA.
WHEN MATERIAL IS INVOLVED IN FIRE:
EXTINGUISH USING AGENT SUITABLE FOR TYPE F SURROUNDING FIRE. MATERIAL ITSELF DOES NOT BURN READILY.
USE FLOODING QUANTITIES OF WATER AS A FOG.
USE FLOODING QUANTITIES OF WATER TO COOL ALL CONTAINERS INVOLVED IN FIRE.
APPLY WATER TO MATERIAL FROM AS FAR A DISTANCE AS POSSIBLE.
WHEN MATERIAL IS NOT ON FIRE OR INVOLVED IN FIRE:
DO NOT ALLOW MATERIAL TO CONTAMINATE SEWERS OR WATER SOURCES.
USE CRUSHED LIMESTONE, SODA ASH, OR LIME TO NEUTRALIZE SPILL.

PROTECTIVE EQUIPMENT

VENTILATION:
PROVIDE LOCAL EXHAUST OR GENERAL DILUTION VENTILATION SYSTEM.

RESPIRATOR:
HIGH LEVELS- SUPPLIED-AIR RESPIRATOR WITH A FULL FACEPIECE, HELMET, OR HOOD. SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE.

FIREFIGHTING- SELF-CONTAINED BREATHING APPARATUS WITH A FULL FACEPIECE OPERATED IN PRESSURE-DEMAND OR OTHER POSITIVE-PRESSURE MODE.

CLOTHING:
PROTECTIVE CLOTHING NOT REQUIRED. AVOID REPEATED OR PROLONGED CONTACT WITH THIS SOLUTION.

GLOVES:
WEAR PROTECTIVE GLOVES AS NECESSARY TO AVOID ANY CONTACT WITH SUBSTANCE, SOLUTION OR MIST. SPECIFIC TYPE OF GLOVE MAY BE TESTED AND RECOMMENDED BY MANUFACTURER FOR CERTAIN SUBSTANCES.

EYE PROTECTION:
WEAR FACESHIELD (8 INCH MINIMUM) AND/OR DUST-PROOF SAFETY GOGGLES TO PREVENT ANY POSSIBILITY OF CONTACT WITH SUBSTANCE, SOLUTION OR MIST. DO NOT WEAR CONTACT LENSES WHEN WORKING WITH CHEMICALS.

AUTHORIZED - FISHER SCIENTIFIC GROUP, INC.
CREATION DATE: 11/13/85 REVISION DATE: 03/19/86

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DATE: 07/12/89

CUST#: 6-065-31571 PO#: 96769

324734837

MATERIAL SAFETY DATA SHEET

IDENTIFICATION

PRODUCT #: T4385 NAME: TRICHLOROACETIC ACID CRYSTALLINE
CAS #: 76-03-9
MF: C2HCL3O2

SYNONYMS
ACETO-CAUSTIN * ACIDE TRICHLORACETIQUE (FRENCH) * ACIDO TRICLOROACETICO (ITALIAN) * AMCHEM GRASS KILLER * DOW SODIUM TCA INHIBITED * KONESTA * KYSELINA TRICHLOROCTOVA (CZECH) * NA TA * SODIUM TCA SOLUTION * TCA * TRICHLOORAZIJNZUUR (DUTCH) * TRICHLORACETIC ACID * TRICHLORESSIGSAEURE (GERMAN) * TRICHLOROACETIC ACID * TRICHLOROACETIC ACID (ACGIH,OSHA) * TRICHLOROACETIC ACID, SOLID (DOT) * TRICHLOROACETIC ACID SOLUTION (DOT) * TRICHLOROETHANOIC ACID * UN 1839 (DOT) * UN 2564 (DOT) * VARITOX *

TOXICITY HAZARDS

RTECS NO: AJ7875000
ACETIC ACID, TRICHLORO-
IRRITATION DATA
SKN-RBT 210 UG MLD — XEURAQ MDDC-1715
EYE-RBT 3500 UG/5S SEV — XEURAQ MDDC-1715
TOXICITY DATA
ORL-RAT LD50:400 MG/KG — PEMNDP 8,765,87
SCU-MUS LD50:270 MG/KG — NIIRDN 6,879,82
REVIEWS, STANDARDS, AND REGULATIONS
ACGIH TLV-TWA 1 PPM 85INAB 5,592,86
OSHAPEL FINAL:3H TWA 1 PPM (7 MG/M3) FEREAC 54,2923,89
EPA GENETOX PROGRAM 1988, INCONCLUSIVE: HISTIDINE REVERSION-AMES TEST
EPA TSCA CHEMICAL INVENTORY, 1986
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAC 47,30420, 82
TARGET ORGAN DATA
PATERNAL EFFECTS (SPERMATOGENESIS)

ONLY SELECTED REGISTRY OF TOXIC EFFECTS OF CHEMICAL SUBSTANCES (RTECS) DATA IS PRESENTED HERE. SEE ACTUAL ENTRY IN RTECS FOR COMPLETE INFORMATION.

HEALTH HAZARD DATA

ACUTE EFFECTS
HARMFUL IF SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.
MATERIAL IS EXTREMELY DESTRUCTIVE TO TISSUE OF THE MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT, EYES AND SKIN.
INHALATION MAY BE FATAL AS A RESULT OF SPASM, INFLAMMATION AND EDEMA OF THE LARYNX AND BRONCHI, CHEMICAL PNEUMONITIS AND PULMONARY EDEMA.
SYMPTOMS OF EXPOSURE MAY INCLUDE BURNING SENSATION, COUGHING, WHEEZING, LARYNGITIS, SHORTNESS OF BREATH, HEADACHE, N/ VOMITING.
CAUSES BLISTERS ON CONTACT WITH SKIN.
CHRONIC EFFECTS
GASTROINTESTINAL DISTURBANCES

1355

CONTINUED ON NEXT PAGE

BRANCH OFFICES AT: SIGMA CHEMICAL CO. LTD. Fancy Road, Poole, Dorset BH17 7NH England
SIGMA CHEMIE GmbH Grünwalder Weg 30 D-8024 Deisenhofen West Germany

SIGMA® chemical company
THE WORLD'S FOREMOST MANUFACTURER OF RESEARCH BIOCHEMICALS AND DIAGNOSTIC REAGENTS

PHONE TOLL FREE
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1-800-325-8070
OR PHONE COLLECT
1-314-771-5765
FROM ANYWHERE IN THE WORLD
MAILING ADDRESS: P.O. BOX 14508, ST. LOUIS, MO. 63178, U.S.A.
CABLE ADDRESS: SIGMACHEM TWX: 910-761-0593

MATERIAL SAFETY DATA SHEET

CUST#: 6-065-31571 PO#: 96769

324734837

PRODUCT #: T4885 NAME : TRICHLOROACETIC ACID CRYSTALLINE

HEALTH HAZARD DATA

TO THE BEST OF OUR KNOWLEDGE, THE CHEMICAL, PHYSICAL, AND TOXICOLOGICAL PROPERTIES HAVE NOT BEEN THOROUGHLY INVESTIGATED.

FIRST AID
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH COPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
WASH CONTAMINATED CLOTHING BEFORE REUSE.
DISCARD CONTAMINATED SHOES.

PHYSICAL DATA

BOILING PT: 196 C
MELTING PT: 54 C TO 58 C
SPECIFIC GRAVITY: 1.620
VAPOR DENSITY: <1
VAPOR PRESSURE: 1 MM @ 51 C

APPEARANCE AND ODOR
WHITE CRYSTALLINE POWDER

FIRE AND EXPLOSION HAZARD DATA

FLASHPOINT: >230

EXTINGUISHING MEDIA
CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

SPECIAL FIREFIGHTING PROCEDURES
WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSIONS HAZARDS
EMITS TOXIC FUMES UNDER FIRE CONDITIONS.

REACTIVITY DATA

INCOMPATIBILITIES
STRONG OXIDIZING AGENTS
STRONG BASES
PROTECT FROM MOISTURE.

HAZARDOUS COMBUSTION OR DECOMPOSITION PRODUCTS
TOXIC FUMES OF:
CARBON MONOXIDE, CARBON DIOXIDE
HYDROGEN CHLORIDE GAS

SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED
EVACUATE AREA.

CONTINUED ON NEXT PAGE

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CABLE ADDRESS SIGMACHEM TWX 910-761-0593

CUST#: 6-065-31571 PO#: 96769

324734837

PRODUCT #: T4885 NAME : TRICHLOROACETIC ACID CRYSTALLINE

---------- SPILL OR LEAK PROCEDURES ----------

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.
COVER WITH DRY LIME OR SODA ASH, PICK UP, KEEP IN A CLOSED CONTAINER AND HOLD FOR WASTE DISPOSAL.
VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL METHOD
DISSOLVE OR MIX THE MATERIAL WITH A COMBUSTIBLE SOLVENT AND BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER.
OBSERVE ALL FEDERAL, STATE, AND LOCAL LAWS.

--- PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE ---

WEAR APPROPRIATE NIOSH/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.
SAFETY SHOWER AND EYE BATH.
USE ONLY IN A CHEMICAL FUME HOOD.
FACESHIELD (8-INCH MINIMUM).
DO NOT BREATHE DUST.
DO NOT GET IN EYES, ON SKIN, ON CLOTHING.
AVOID PROLONGED OR REPEATED EXPOSURE.
WASH THOROUGHLY AFTER HANDLING.
TOXIC.
VESICANT.
CORROSIVE.
KEEP TIGHTLY CLOSED.
VERY HYGROSCOPIC
STORE IN A COOL DRY PLACE.

--------- ADDITIONAL PRECAUTIONS AND COMMENTS ---------

SECTION 9 FOOTNOTES
A VIOLENT REACTION HAS BEEN REPORTED ON MIXING TRICHLOROACETIC ACID AND COPPER WOOL IN DIMETHYL SULFOXIDE. (CHEM.ENG.NEWS, P.4, JULY 13, 1981)

THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT TO BE ALL INCLUSIVE AND SHALL BE USED ONLY AS A GUIDE. SIGMA SHALL NOT BE HELD LIABLE FOR ANY DAMAGE RESULTING FROM HANDLING OR FROM CONTACT WITH THE ABOVE PRODUCT. SEE REVERSE SIDE OF INVOICE OR PACKING SLIP FOR ADDITIONAL TERMS AND CONDITIONS OF SALE.

BRANCH OFFICES AT: SIGMA CHEMICAL CO. LTD.
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England.

SIGMA CHEMIE GmbH
Grünwalder Weg 30
D-8024 Deisenhofen
West Germany.

5. LIST OF P AND U WASTE CONSTITUENTS

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical Abstracts No.	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro- sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
P070	116-06-3	Aldicarb
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P119	7803-55-6	Ammonium vanadate
P099	506-61-6	Argentate(1-),bis(cyano-C)-,potassium
P010	7778-39-4	Arsenic acid H_3AsO_4
P012	1327-53-3	Arsenic oxide As_2O_3
P011	1303-28-2	Arsenic oxide As_2O_5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2 methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P046	122-09-8	Benzeneethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P001	81-81-2[1]	2H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P045	39196-18-4	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[methylamino)carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide $Ca(CN)_2$
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
P030	.....	Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P033	506-77-4	Cyanogen chloride(CN)Cl
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate

[1] CAS Number given for parent compound only.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical abstracts No.	Substance
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta, 5alpha,8alpha,8abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10-10-hexachloro-1,4,4a,5,8,8a-hexahydro-,(1alpha,4alpha,4abeta,5beta, 8beta,8abeta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha, 3beta,6beta,6aalpha,7beta,7aalpha)-
P051	[1]72-20-8	2,7:3,6-Dimethanonaphth[2,3b]cxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha, 2beta,2abeta,3alpha,6alpha,6abeta,7beta,7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	[1]22-09-8	alpha,alpha-Dimethylphenethylamine
P047	[1]534-52-1	4,6-Dinitro-o-cresol and salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P111	107-49-3	Diphosphoric acid, tetraethyl ester-
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P066	16752-77-5	Ethanimidothioic acid, N-[[(methylamino)carbonyl]oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyltetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P092	62-38-4	Mercury, (acetato-O)phenyl-
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis(chloro-
P118	75-70-7	Methanethiol, trichloro-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-,3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a, 4,7,7a-tetrahydro-
P066	16752-77-5	Methomyl

[1]CAS Number given for parent compound only.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical abstracts No.	Substance
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl, $Ni(CO)_4$,(T-4)-
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide, $Ni(CN)_2$
P075	[1]54-11-5	Nicotine and salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P078	10102-44-0	Nitrogen oxide NO_2
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO_4,(T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	[1]51-28-5	Phenol, 2,4-dinitro-
P047	[1]534-52-1	Phenol, 2-methyl-4,6-dinitro- and salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl,S-[(ethylthio)methyl] ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S[2-(methylamino)-2-oxoethyl]ester
P043	55-91-4	Phosphorofluoric acid bis(1-methylethyl)-ester
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino)sulfonyl) phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O-dimethyl O-(4-nitrophenyl) ester
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-,O-[(methylamino) carbonyl]oxime
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P017	598-31-2	2-Propanone, 1-bromo-
P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine

[1]CAS Number given for parent compound only.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical abstracts No.	Substance
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P075	[1]54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S), & salts
P114	12039-52-0	Selenious acid, dithalium(1+) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P107	1314-96-1	Strontium sulfide SrS
P108	[1]57-24-9	Strychnidin-10-one, and salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	[1]57-24-9	Strychnine and salts
P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl_2O_3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide $[(H_2N)C(S)]_2NH$
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P123	8001-35-2	Toxaphene
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V_2O_5
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-.
P001	[1]81-81-2	Warfarin & salts, when present at concentrations greater than 0.3%
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide $Zn(CN)_2$

(f) The commercial chemical products, manufacturing chemical intermediates, or off-specification commercial chemical products referred to in paragraphs (a) through (d) of this section, are identified as toxic wastes [T], unless otherwise designated and are subject to the small quantity generator exclusion defined in Section 261.5(a) and (g).

[Comment: For the convenience of the regulated community, the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), R (Reactivity), I (Ignitability) and C (Corrosivity). Absence of a letter indicates that the compound is only listed for toxicity.]

[1] CAS Number given for parent compound only.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical abstracts No.	Substance
U001	75-07-0	Acetaldehyde (I)
U034	75-87-6	Acetaldehyde, trichloro-
U187	62-44-2	Acetamide, N-(4-ethoxyphenyl)-
U005	53-96-3	Acetamide, N-9H-fluoren-2-yl
U240	94-75-7[1]	Acetic acid, (2,4-dichlorophenoxy), salts & esters
U112	141-78-6	Acetic acid, ethyl ester (I)
U144	301-04-2	Acetic acid, lead(2+) salt
U214	563-68-8	Acetic acid, thallium (1+) salt
see F027	93-76-5	Acetic acid, (2,4,5-trichlorophenoxy)-
U002	67-64-1	Acetone (I)
U003	75-05-8	Acetonitrile (I,T)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U007	79-06-1	Acrylamide
U008	79-10-7	Acrylic acid (I)
U009	107-13-1	Acrylonitrile
U011	61-82-5	Amitrole
U012	62-53-3	Aniline (I,T)
U136	70-60-5	Arsinic acid, dimethyl-
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U010	50-07-7	Azirino[2',3':3,4]pyrrolo[1,2-a]indole-4,7-dione, 6-amino-8-[[(aminocarbonyl)oxy]methyl]-1,1a,2,8, 8a,8b-hexahydro-8a-methoxy-5-methyl- [1aS-(1aalpha, 8beta,8aalpha,8balpha)]-
U157	56-49-5	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U192	23950-58-5	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	56-55-3	Benz[a]anthracene
U094	57-97-6	Benz[a]anthracene, 7,12-dimethyl-
U012	62-53-3	Benzenamine (I,T)
U014	492-80-8	Benzenamine, 4,4'-carbonimidoylbis(N,N-dimethyl-
U049	3165-93-3	Benzenamine, 4-chloro-2-methyl-,hydrochloride
U093	60-11-7	Benzenamine, N-N'-dimethyl-4-phenylazo-
U328	95-53-4	Benzenamine, 2-methyl-
U353	106-49-0	Benzenamine, 4-methyl-
U158	101-14-4	Benzenamine, 4,4'-methylenebis[2-chloro-
U222	636-21-5	Benzenamine, 2-methyl-, hydrochloride
U181	99-55-8	Benzenamine, 2-methyl-5-nitro-
U019	71-43-2	Benzene (I,T)
U038	510-15-6	Benzeneacetic acid, 4-chloro-alpha-(4-chlorophenyl)- alpha-hydroxy, ethyl ester
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U035	305-03-3	Benzenebutanoic acid, 4-[bis(2-chloroethyl)amino]-
U037	108-90-7	Benzene, chloro-
U221	25376-45-8	Benzenenediamine, ar-methyl-
U028	117-81-7	1,2-Benzenedicarboxylic acid, [bis(2-ethylhexy)] ester
U069	84-74-2	1,2-Benzenedicarboxylic acid, dibutyl ester
U088	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
U102	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
U107	117-84-0	1,2-Benzenedicarboxylic acid, dioctyl ester
U070	95-50-1	Benzene, 1,2-dichloro-
U071	541-73-1	Benzene, 1,3-dichloro-
U072	106-46-7	Benzene, 1,4-dichloro-
U060	72-54-8	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-

[1] CAS Number given for parent compound only.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Hazardous waste no.	Chemical abstracts No.	Substance
U017	98-87-3	Benzene, (dichloromethyl)-
U239	1330-20-7	Benzene, dimethyl-(I,T)
U201	108-46-3	1,3-Benzenediol
U127	118-74-1	Benzene, hexachloro-
U056	110-82-7	Benzene, hexahydro- (I)
U220	108-88-3	Benzene, methyl-
U105	121-14-2	Benzene, 1-methyl-2,4-dinitro-
U106	606-20-2	Benzene, 2-methyl-1,3-dinitro-
U055	98-82-8	Benzene, (1-methylethyl)- (I)
U169	98-95-3	Benzene, nitro-
U183	608-93-5	Benzene, pentachloro-
U185	82-68-8	Benzene, pentachloronitro-
U207	95-94-3	Benzene, 1,2,4,5-tetrachloro-
U061	50-29-3	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-
U247	72-43-5	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-
U023	98-07-7	Benzene, (trichloromethyl)-
U234	99-35-4	Benzene, 1,3,5-trinitro-
U202	81-07-2	1,2-Benzisothiazol-3-(2H)-one, 1,1-dioxide and salts
U203	94-59-7	1,3-Benzodioxole, 5-(2-propenyl)-
U141	120-58-1	1,3-Benzodioxole, 5-(1-propenyl)-
U090	94-58-6	1,3-Benzodioxole, 5-propyl-
U064	189-55-9	Benzo[rst]pentaphene
U248	181-81-2	2H-1-Benzopyran-2-one, 4-hydroxy-3(3-oxo-1-phenylbutyl)-& & salts, when present at concentrations of 0.3% or less
U022	50-32-8	Benzo[a]pyrene
U197	106-51-4	p-Benzoquinone
U085	1464-53-5	2,2'-Bioxirane
U021	92-87-5	(1,1'-Biphenyl)-4,4'diamine
U073	91-94-1	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dichloro-
U091	119-90-4	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethoxy-
U095	119-93-7	(1,1'-Biphenyl)-4,4'-diamine, 3,3'-dimethyl-
U225	75-25-2	Bromoform
U030	101-55-3	4-Bromophenyl phenyl ether
U128	87-68-3	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	924-16-3	1-Butanamine, N-butyl-N-nitroso-
U031	71-36-3	1-Butanol (I)
U159	78-93-3	2-Butanone (I,T)
U053	4170-30-3	2-Butenal
U074	764-41-0	2-Butene, 1,4-dichloro- (I,T)
U143	303-34-4	2-Butenoic acid, 2-methyl-, 7-[(2,3-dihydroxy-2-(1-methoxyethyl)-3-methyl-1-oxobutoxy)methyl]-2,3,5,7a-tetrahydro-1H-pyrrolizin-1-yl ester, [1S-[1alpha(Z),7(2S*,3R*), 7aalpha]]-
U031	71-36-3	n-Butyl alcohol (I)
U136	75-60-5	Cacodylic acid
U032	13765-19-0	Calcium chromate
U238	59-79-6	Carbamic acid, ethyl ester
U178	615-53-2	Carbamic acid, methylnitroso-, ethyl ester
U097	79-44-7	Carbamic chloride, dimethyl-
U114	1111-54-6	Carbamodithioic acid, 1,2-ethanediylbis-, salts & esters
U062	2303-16-4	Carbamothioc acid, bis(1-methylethyl)-S-(2,3-dichloro-2-propenyl) ester

Hazardous waste no.	Chemical abstracts No.	Substance
U215	6533-73-9	Carbonic acid, dithallium (I+) salt
U033	353-50-4	Carbonic difluoride
U156	79-22-1	Carbonochloridic acid. methyl ester (I,T)
U211	56-23-5	Carbon tetrachloride
U034	75-87-6	Chloral
U035	305-03-3	Chlorambucil
U036	57-74-9	Chlordane, alpha & gamma isomers
U026	494-03-1	Chlornaphazin
U037	108-90-7	Chlorobenzene
U038	510-15-6	Chlorobenzilate
U039	59-50-7	p-Chloro-m-cresol
U042	110-75-8	2-Chloroethyl vinyl ether
U044	67-66-3	Chloroform
U046	107-30-2	Chloromethyl methyl ether
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	o-Chlorophenol
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U032	13765-19-0	Chromic acid H_2CrO_4, calcium salt
U050	218-01-9	Chrysene
U051	.....	Creosote
U052	1319-77-3	Cresols (Cresylic acid)
U053	4170-30-3	Crotonaldehyde
U055	98-82-8	Cumene (I)
U246	506-68-3	Cyanogen bromide (CN)Br
U197	106-51-4	2,5-Cyclohexadiene-1,4-dione
U056	110-82-7	Cyclohexane (I)
U129	58-89-9	Cyclohexane, 1,2,3,4,5,6-hexachloro-, (1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	108-94-1	Cyclohexanone (I)
U130	77-47-4	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro-
U058	.50-18-0	Cyclophosphamide
U059	20830-81-3	Daunomycin
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene
U064	189-55-9	Dibenzo[a,i]pyrene
U066	96-12-8	1,2-Dibromo-3-chloropropane
U069	84-74-2	Dibutyl phthalate
U070	95-50-1	o-Dichlorobenzene
U071	541-73-1	m-Dichlorobenzene
U072	106-46-7	p-Dichlorobenzene
U073	91-94-1	3,3'-Dichlorobenzidine
U074	764-41-0	1.4-Dichloro-2-butene (I,T)
U078	75-35-4	1,1-Dichloroethylene
U079	156-60-5	1,2-Dichloroethylene
U025	111-44-4	Dichloroethyl ether
U027	108-60-1	Dichloroisopropyl ether
U024	111-91-1	Dichloromethoxy ethane
U081	120-83-2	2,4-Dichlorophenol
U082	87-65-0	2,6-Dichlorophenol
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	1,2:3,4-Diepoxybutane (I,T)
U108	123-91-1	1,4-Diethyleneoxide
U028	117-81-7	Diethylhexyl phthalate
U086	1615--80-1	N,N-Diethylhydrazine

[1] CAS Number given for parent compound only.

Hazardous waste no.	Chemical abstracts No.	Substance
U087	3288-58-2	O,O-Diethyl-S-methyl-Dithiophosphate
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstilbestrol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3'-Dimethoxybenzidine
U092	124-40-3	Dimethylamine (I)
U093	60-11-7	p-Dimethylaminoazobenzene
U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U095	119-93-7	3.3'-Dimethylbenzidine
U097	79-44-7	Dimethylcarbamoyl chloride
U098	57-14-7	1,1-Dimethylhydrazine
U099	540-73-8	1,2-Dimethylhydrazine
U101	105-67-9	2,4-Dimethylphenol
U102	131-11-3	Dimethyl phthalate
U103	77-78-1	Dimethyl sulfate
U105	121-14-2	2,4-Dinitrotoluene
U106	606-20-2	2,6-Dinitrotoluene
U107	117-84-0	Di-n-octyl phthalate
U108	123-91-1	1,4-Dioxane
U109	122-66-7	1,2-Diphenylhydrazine
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n-propylnitrosamine
U041	106-89-8	Epichlorohydrin
U001	75-07-0	Ethanal (I)
U174	55-18-5	Ethanamine, N-ethyl-N-nitroso-
U155	91-80-5	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U067	106-93-4	Ethane, 1,2-dibromo-
U076	75-34-3	Ethane, 1,1-dichloro-
U077	107-06-2	Ethane, 1,2-dichloro-
U131	67-72-1	Ethane, hexachloro-
U024	111-91-1	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	60-29-7	Ethane, 1,1'-oxybis- (I)
U025	111-44-4	Ethane 1,1'-oxybis[2-chloro-
U184	76-01-7	Ethane, pentachloro-
U208	630-20-6	Ethane, 1,1,1,2-tetrachloro-
U209	79-34-5	Ethane, 1,1,2,2-tetrachloro-
U218	62-55-5	Ethanethioamide
U226	71-55-6	Ethane, 1,1,1-trichloro-
U227	79-00-5	Ethane, 1,1,2-trichloro
U359	110-80-5	Ethanol, 2-ethoxy-
U173	1116-54-7	Ethanol, 2,2'-(nitrosoimino)bis-
U004	98-86-2	Ethanone, 1-phenyl-
U043	75-01-4	Ethene, chloro-
U042	110-75-8	Ethene, 2-chloroethoxy-
U078	75-35-4	Ethene, 1,1-dichloro-
U079	156-60-5	Ethene, 1,2-dichloro-, (E)-
U210	127-18-4	Ethene, tetrachloro-
U228	79-01-6	Ethene, trichloro-
U112	141-78-6	Ethyl acetate (I)
U113	140-88-5	Ethyl acrylate (I)
U238	51-79-6	Ethyl carbamate (urethane)
U117	[1] 60-29-7	Ethyl (ether (I)
U114	111-54-6	Ethylenebisdithiocarbamic acid, salts and esters
U067	106-93-4	Ethylene dibromide
U077	107-06-2	Ethylene dichloride
U359	110-80-5	Ethylene glycol monoethyl ether
U115	75-21-8	Ethylene oxide (I,T)
U116	96-45-7	Ethylenethiourea

[1] CAS Number given for parent compound only.

Hazardous waste no.	Chemical abstracts No.	Substance
U076	75-34-3	Ethylidene dichloride
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethylmethanesulfonate
U120	206-44-0	Fluoranthene
U122	50-00-0	Formaldehyde
U124	110-00-9	Furan (I)
U125	98-01-1	2-Furancarboxaldehyde (I)
U147	108-31-6	Furandione
U213	109-99-9	Furan, tetrahydro- (I)
U125	98-01-1	Furfural (I)
U124	110-00-9	Furfuran (I)
U206	18883-66-4	Glucopyranose, 2-deoxy-2(3-methyl-3-nitrosoureido)- D-
U206	18883-66-4	D-Glucose, 2-deoxy-2-[[(methylnitrosoamino)-carbonyl]amino]-
U126	765-34-4	Glycidylaldehyde
U163	70-25-7	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U130	77-47-4	Hexachlorocyclopentadiene
U131	67-72-1	Hexachloroethane
U132	70-30-4	Hexachlorophene
U243	1888-71-7	Hexachloropropene
U086	1615-80-1	Hydrazine, 1,2-diethyl-
U098	57-14-7	Hydrazine, 1,1-dimethyl-
U099	540-73-8	Hydrazine 1,2-dimethyl-
U109	122-66-7	Hydrazine, 1,2-diphenyl-
U135	7783-06-4	Hydrogen sulfide
U135	7783-06-4	Hydrogen sulfide H_2S
U116	96-45-7	2-Imidazolidinethione
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U190	85-44-9	1,3-Isobenzofurandione
U140	78-83-1	Isobutyl alcohol (I,T)
U141	120-58-1	Isosafrole
U142	143-50-0	Kepone
U143	303-34-4	Lasiocarpine
U144	301-04-2	Lead acetate
U146	1335-32-6	Lead, bis(acetato-O)tetrahydroxytri-
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lead subacetate
U129	58-89-9	Lindane
U163	70-25-7	MNNG
U147	108-31-6	Maleic anhydride
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile
U150	148-82-3	Melphalan
U152	126-98-7	Methacrylonitrile (I,T)
U092	124-40-3	Methanamine, N-methyl- (I)
U029	74-83-9	Methane, bromo-
U045	74-87-3	Methane, chloro- (I,T)
U046	107-30-2	Methane, chloromethoxy-
U068	74-95-3	Methane, dibromo-

Hazardous waste no.	Chemical abstracts No.	Substance
U080	75-09-2	Methane, dichloro-
U075	75-71-8	Methane, dichlorodifluoro-
U138	74-88-4	Methane, iodo-
U119	62-50-0	Methanesulfonic acid, ethyl ester
U211	56-23-5	Methane, tetrachloro-
U153	74-93-1	Methanethiol (I,T)
U044	67-66-3	Methane, trichloro-
U121	75-69-4	Methane, trichlorofluoro-
U036	57-74-9	4,7-Methano-1H-indene, 1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-
U154	67-56-1	Methanol (I)
U155	91-80-5	Methapyrilene
U142	143-50-0	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one,1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
U247	72-43-5	Methoxychlor
U154	67-56-1	Methyl alcohol (I)
U029	74-83-9	Methyl bromide
U186	504-60-9	1-Methylbutadiene (I)
U045	74-87-3	Methyl chloride (I,T)
U156	79-22-1	Methyl chlorocarbonate (I,T)
U226	71-55-6	Methyl chloroform
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4'-Methylenebis(2-chloroaniline)
U068	74-95-3	Methylene bromide
U080	75-09-2	Methylene chloride
U159	78-93-3	Methyl ethyl ketone (MEK) (I,T)
U138	74-88-4	Methyl iodide
U161	108-10-1	Methyl isobutyl ketone (I)
U162	80-62-6	Methyl methacrylate (I,T)
U161	108-10-1	4-Methyl-2-pentanone (I)
U164	56-04-2	Methylthiouracil
U010	50-07-7	Mitomycin C
U059	20830-81-3	5,12-Naphthacenedione, 8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxyl-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-, (8S-cis)-
U167	134-32-7	1-Naphthalenamine
U168	91-59-8	2-Naphthalenamine
U026	494-03-1	Naphthalenamine,N,N-bis(2-chloroethyl)-
U165	91-20-3	Naphthalene
U047	91-58-7	Naphthalene, 2-chloro-
U166	130-15-4	1,4-Naphthalenedione
U236	72-57-1	2,7-Naphthalenedisulfonic acid, 3,3'-[(3,3'-dimethyl-[1,1'-biphenyl]-4,4'diyl)-bis(azo)bis[5-amino-4-hydroxy]-tetrasodium salt
U166	130-15-4	1,4,Naphthoquinone
U167	134-32-7	alpha-Naphthylamine
U168	91-59-8	beta-Naphthylamine
U217	10102-45-1	Nitric acid, thallium(1+) salt
U169	98-95-3	Nitrobenzene (I,T)
U170	100-02-7	p-Nitrophenol
U171	79-46-9	2-Nitropropane (I,T)
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine

Hazardous waste no.	Chemical abstracts No.	Substance
U176	759-73-9	N-Nitroso-N-ethylurea
U177	684-93-5	N-Nitroso-N-methylurea
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U180	930-55-2	N-Nitrosopyrrolidine
U181	99-55-8	5-Nitro-o-toluidine
U193	1120-71-4	1,2-Oxathiolane, 2,2-dioxide
U058	50-18-0	2H-1,3,2-Oxazaphosphorin-2-amine N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	75-21-8	Oxirane (I,T)
U126	765-34-4	Oxiranecarboxyaldehyde
U041	106-89-8	Oxirane, (chloromethyl)-
U182	123-63-7	Paraldehyde
U183	608-93-5	Pentachlorobenzene
U184	76-01-7	Pentachloroethane
U185	82-68-8	Pentachloronitrobenzene (PCNB)
See F027	87-86-5	Pentachlorophenol
U161	108-10-1	Pentanol, 4-methyl-
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Phenacetin
U188	108-95-2	Phenol
U048	95-57-8	Phenol, 2-chloro-
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U089	56-53-1	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediyl)bis-, (E)-
U101	105-67-9	Phenol, 2,4-dimethyl-
U052	1319-77-3	Phenol, methyl-
U132	70-30-4	Phenol, 2,2'-Methylenebis[3,4,6-trichloro-
U170	100-02-7	Phenol, 4-nitro-
See F027	87-86-5	Phenol, pentachloro-
See F027	58-90-2	Phenol, 2,3,4,6-tetrachloro-
See F027	95-95-4	Phenol, 2,4,5-trichloro-
See F027	88-06-2	Phenol, 2,4,6-trichloro-
U150	148-82-3	L-Phenylalanine, 4-[bis(chloroethyl)amino]-
U145	7446-27-7	Phosphoric acid, lead(2+)salt(2-3)
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl- S-methyl ester
U190	85-44-9	Phthalic anhydride
U191	109-06-8	2-Picoline
U179	100-75-4	Picoline,1-nitroso-
U192	23950-58-5	Pronamide
U194	107-10-8	1-Propanamine (I,T)
U111	621-64-7	1-Propanamine, N-Nitroso-N-propyl-
U110	142-84-7	1-Propanamine, N-propyl- (I)
U066	96-12-8	Propane, 1,2-dibromo-3-chloro-
U083	78-87-5	Propane, 1,2-dichloro-
U149	109-77-3	Propanedinitrile
U171	79-46-9	Propane, 2-nitro- (I,T)
U027	108-60-1	Propane, 2,2'oxybis[2-chloro-
U193	1120-71-4	1,3-Propane sultone
See F027	93-72-1	Propanoic acid, 2-(2,4,5-trichlorophenoxyl)-
U235	126-72-7	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	78-83-1	1-Propanol, 2-methyl- (I,T)

Hazardous waste no.	Chemical abstracts No.	Substance
U002	67-64-1	2-Propanone (I)
U007	79-06-1	2-Propenamide
U084	542-75-6	1-Propene, 1,3-dichloro-
U243	1888-71-7	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	107-13-1	2-Propenenitrile
U152	126-98-7	2-Propanenitrile, 2-methyl- (I,T)
U008	79-10-7	2-Propenoic acid (I)
U113	140-88-5	2-Propenoic acid, ethyl ester (I)
U118	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester
U162	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester (I,T)
U194	107-10-8	n-Propylamine (I,T)
U083	78-87-5	Propylene dichloride
U148	123-33-1	3,6-Pyridazinedione, 1,2-dihydro-
U196	110-86-1	Pyridine
U191	109-06-8	Pyridine, 2-methyl-
U237	66-75-1	2,4(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	56-04-2	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	930-55-2	Pyrrolidine, 1-nitroso-
U200	50-55-5	Reserpine
U201	108-46-3	Resorcinol
U202	81-07-2	Saccharin and salts
U203	94-59-7	Safrole
U204	7783-00-8	Selenious acid
U204	7783-00-8	Selenium dioxide
U205	7488-56-4	Selenium sulfide
U015	115-02-6	L-Serine, diazoacetate (ester)
See F027	93-72-1	Silvex (2,4,5-TP)
U206	18883-66-4	Streptozotocin
U103	77-78-1	Sulfuric acid, dimethyl ester
See F027	93-76-5	2,4,5-T
U207	95-94-3	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	1,1,1,2-Tetrachloroethane
U209	79-34-5	1,1,2,2-Tetrachloroethane
U210	127-18-4	Tetrachloroethylene
See F027	58-90-2	2,2,4,6-Tetrachlorophenol
U213	109-99-9	Tetrahydrofuran (I)
U214	563-68-8	Thallium(I) acetate
U215	6533-73-9	Thallium(I) carbonate
U216	7791-12-0	Thallium(I) chloride
U216	7791-12-0	Thallium chloride Tlcl
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Thioacetamide
U153	74-93-1	Thiomethanol(I,T)
U244	137-26-8	Thioperoxydicarbonic diamide, $[(H_2N)C(S)]_2S_2$, tetra-methyl-
U219	62-56-6	Thiourea
U244	137-26-8	Thiram
U220	108-88-3	Toluene
U221	25376-45-8	Toluenediamine
U328	95-53-4	o-Toluidine
U353	106-49-0	p-Toluidine
U222	636-21-5	o-Toluidine hydrochloride
U011	61-82-5	1H-1,2,4,-Triazol-3-amine
U227	79-00-5	1,1,2-Trichloroethane
U228	79-01-6	Trichloroethylene

Hazardous waste no.	Chemical abstracts No.	Substance
See F027	95-95-4	2,4,5-Trichlorophenol
See F027	88-06-2	2,4,6-Trichlorophenol
U182	123-63-7	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	126-72-7	Tris(2,3-dibromopropyl) phosphate
U236	72-57-1	Trypan blue
U237	66-75-1	Uracil mustard
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U043	[1]75-01-4	Vinyl chloride
U248	[1]81-81-2	Warfarin, when present at concentrations of 0.3% or less
U239	1330-20-7	Xylene (I)

[1] CAS Number given for parent compound only.

6. SOMAT SYSTEM DESCRIPTION

Animal bedding and waste disposal systems

somat® CORPORATION

RICHARD J. JENDRASIAK
SALES MANAGER

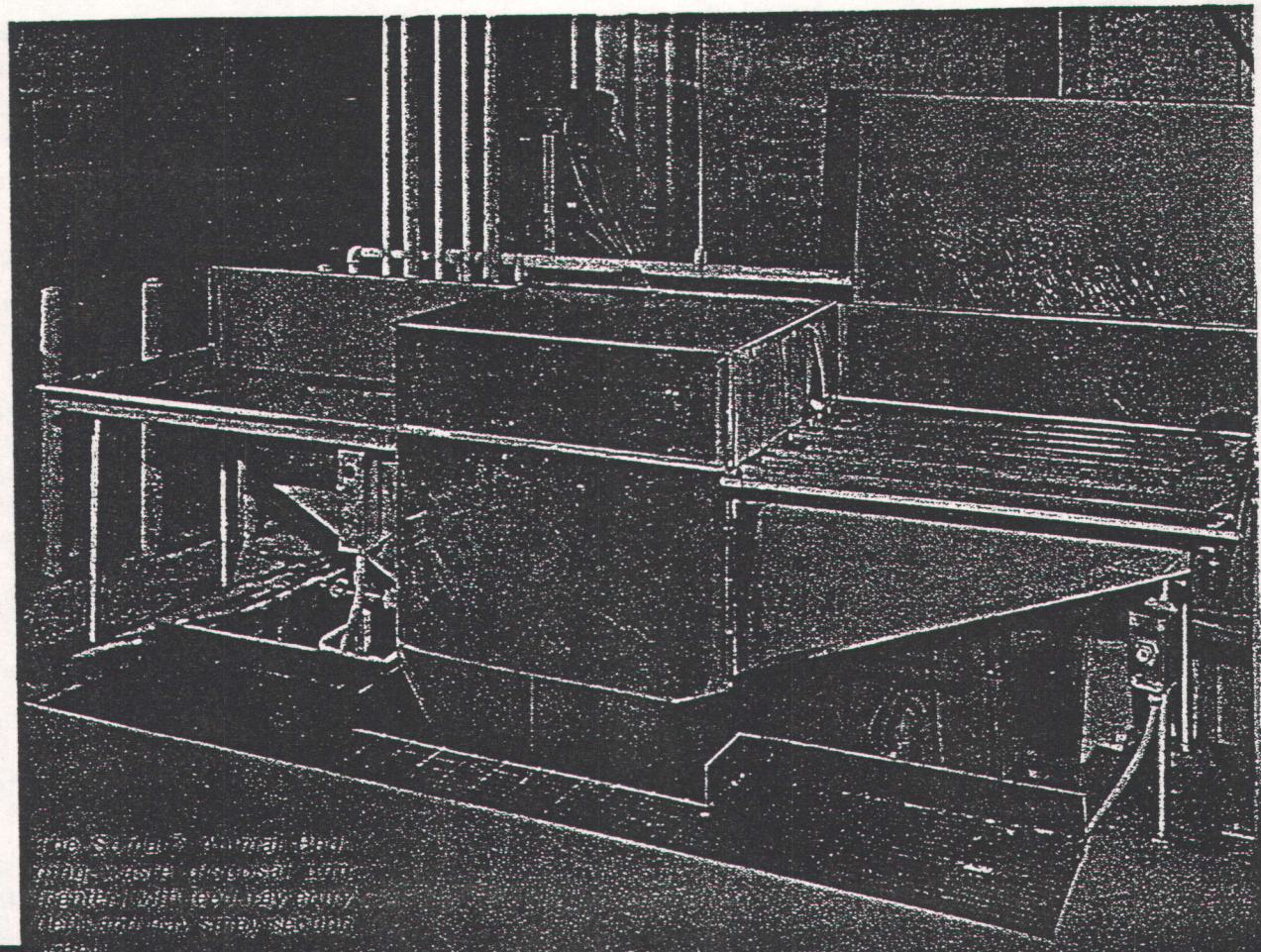
somat® CORPORATION

POMEROY, PENNSYLVANIA 19367
TELEPHONE (215) 384-7000 TELEX 835332
FAX (215) 857-2165

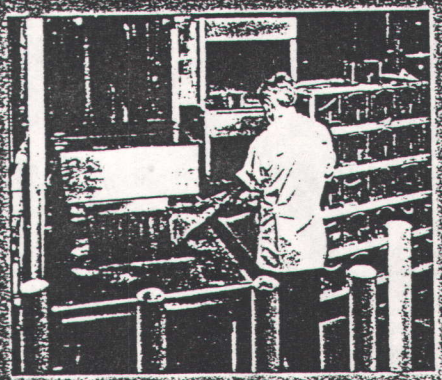
The Practical Answer to Sanitary Animal B

The SOMAT System

Isolates Biological Waste Away From Animals and Personnel
Handles Biological Waste On The Spot
Reduces Contamination Potential To the Absolute Minimum



Typical animal bedding and waste which will be ground to a slurry and transported directly to the loading dock.



Dipple board is fed directly into the Somat. Note the proximity to the tunnel washer (background).

Large waterproof bag of waste being fed into the Somat, illustrating the unit's tremendous capacity.

Fecal trays are wheeled directly to the Somat.

dding Waste Disposal

The Somat Animal Bedding waste disposal system offers today's most efficient, sanitary and economical method for disposing of animal bedding and waste. It is the ideal system for the pharmaceutical industry, government and university research facilities and hospitals. . .actually anywhere biological waste must be isolated from animals and employees.

The Somat System offers both isolation from potential contamination and economic benefits derived from automatic waste handling. The system is composed of three basic elements:

Pulping Unit - Grinds all animal bedding and waste into a slurry.

Pipeline Transport - Pipes the slurry to any location desired. . .usually to the trash disposal area.

Hydra-Extractor® - Extracts solids and recirculates water to the pulping unit. Automatically discharges semi-dry animal bedding and waste pulp into a haul-away container or a live-bottom bin feeding an incinerator.

CRUCIAL BENEFITS

- Open air movement of potentially contaminated waste is eliminated by the pipeline transportation. Experiments are protected since all potential contaminants are isolated within a specified area and disposed of on the spot. There is no transport of waste through "clean" areas.
- The pulp that is discharged directly to the haul-away container is self-compacted, requiring only 15-20% of the space needed for typical animal bedding waste which has not been otherwise compacted. In addition, the pulp waste will not "blow-away" and subject surrounding areas to potential contamination.
- The system is fully automatic and it reduces operating costs, including manpower requirements, maintenance, and hauling and landfill costs.
- The need for special transport corridors for moving waste to disposal areas is eliminated.
- The homogeneous nature of the pulped material allows for easy incineration or acceptance as compact landfill. This material is an ideal fuel for an incinerator or heat recovery system.
- The system's pre-wash eliminates all solids from trays, reducing tunnel washer problems such as clogged jets.
- The pipeline transport will not clog, because the specially designed system utilizes extra long radius sweep elbows and smooth bore pipes to eliminate the types of problems encountered with vacuum systems.

In addition, construction is extremely rugged and designed for continuous or intermittent use with minimum maintenance. But by far, its biggest advantage is that it takes animal bedding and waste and makes it disappear.

Keeps Clean Areas Clean

The Somat Pulper is normally located in the cage-wash area. All bedding and other disposable waste is fed into the pulping unit and is ***never handled again.*** It is automatically pumped in slurry form to the extractor area without contaminating clean areas. Chemicals can be introduced at the extractor, to sanitize both the pulp before it is discharged into a haul-away container, and the water as it is recirculated to the pulping unit.

An additional Somat pulping unit for handling bulk materials can be conveniently located anywhere for on-the-spot waste disposal. Bulk material can include full-size carts and bags, and pulper capacity ranges as high as 360 single-size animal shipping crates per hour.

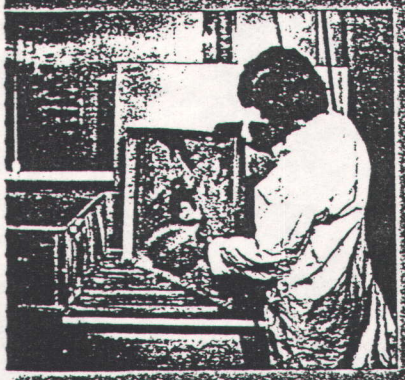
Handles All Types of Animal Bedding and Waste

The Somat Pulping Tank is constructed of heavy duty stainless steel and features a rugged cutting mechanism capable of making slurry out of all commonly used animal bedding material such as hardwood chips, pinewood and alfalfa shavings, dipple board and the like. In addition, heavy duty waterproof bags, cardboard receiving cartons, animal shipping crates, fecal matter and urine can also be processed easily through the system. To facilitate slurry transport and the recirculation of return water, most single-unit systems utilize a standard 2-in. diameter pipeline that can be run horizontally or vertically over any distance, wherever convenient.

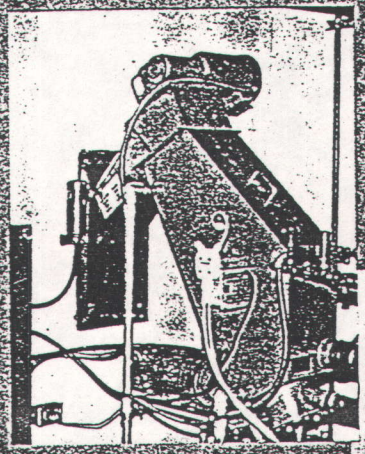
Fits New or Existing Facilities

It is quite easy to fit a Somat System into a newly designed or planned facility. It is also practical to install a system in an existing facility. Main considerations are space, utility connections (power, drain and water) and installation of piping. The extractor is easily accommodated at the waste disposal loading area. For large or specialized installations, several pulpers can pump slurry to one extractor.

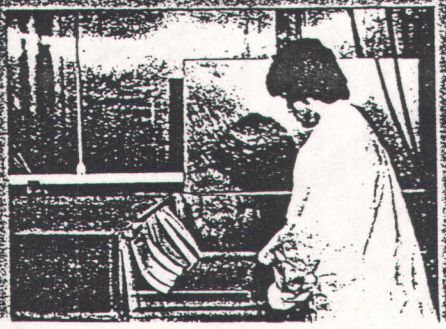
Units for the system come in capacities to fit the busiest facilities, and service is available from the Somat Corporation. For complete details on equipment and systems operation, a factory representative is available for consultation. A facility survey is recommended.



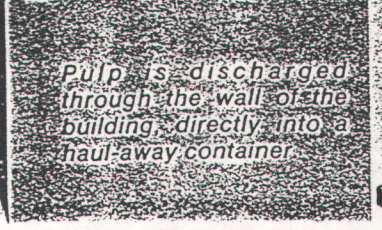
Animal waste and chips are dumped, then hand sprayed prior to being sanitized in the tunnel washer. This enhances tunnel wash operation.



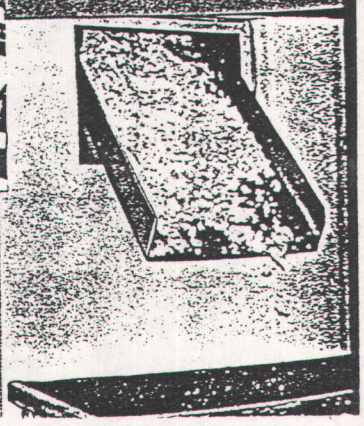
The Hydra-Extractor® receives the piped slurry and turns it into semi-dry pulp. In this application the pulp and return water are chemically treated in the Hydra-Extractor.



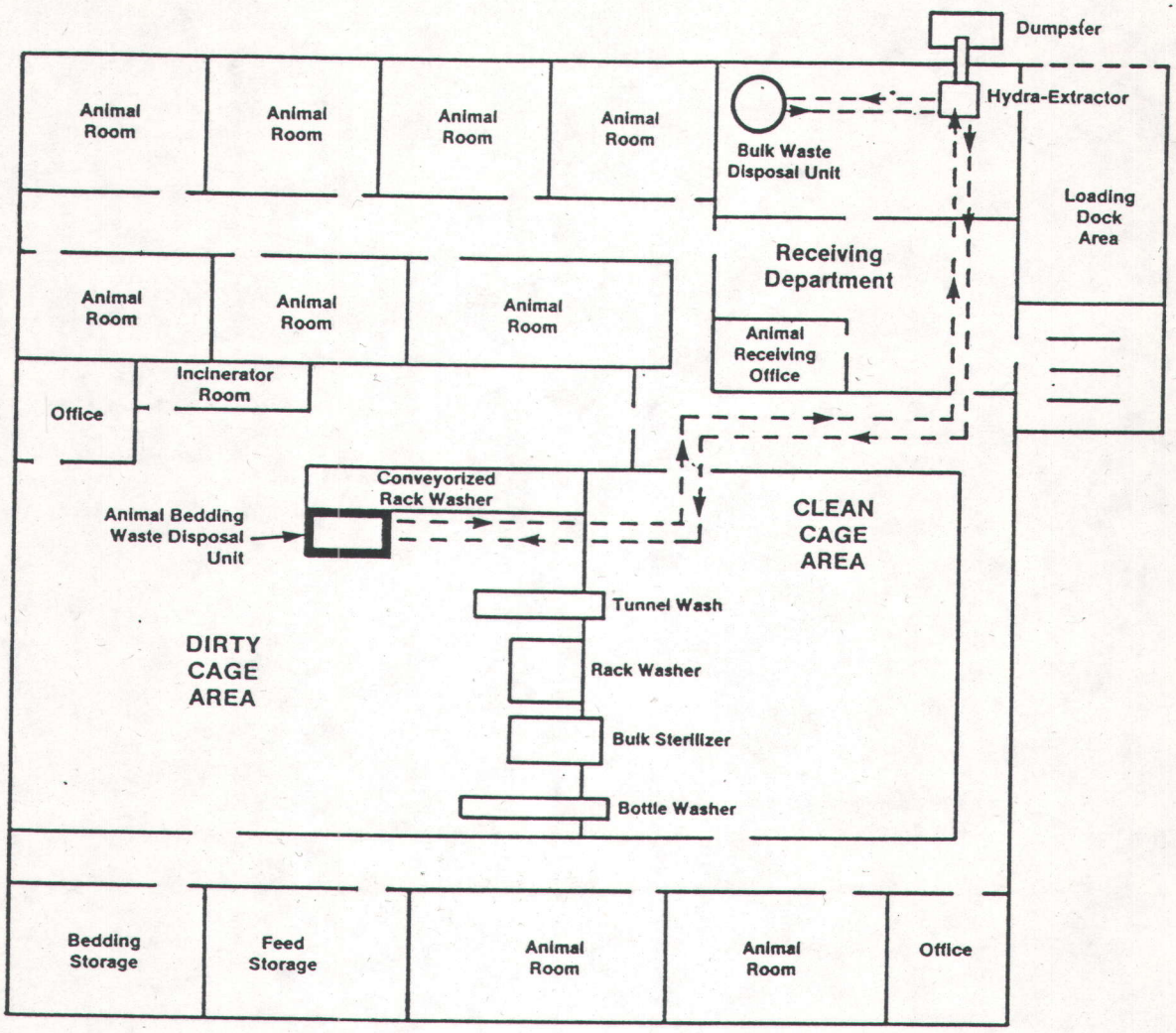
Somat's optional automatic rinse device completely removes all solid material from trays and shoeboxes.



Pulp is discharged through the wall of the building, directly into a haul-away container.



TYPICAL somat® INSTALLATION



The floor plan of a typical medical research facility shows a SOMAT Animal Bedding Waste Disposal System at work.

Waste, brought to the dirty cage area, is scraped or dumped into the animal bedding waste disposal unit where it is mixed with water and ground up to form a slurry. The slurry then travels via pipeline to the Hydra-Extractor, normally located near the loading dock. The Hydra-Extractor removes excess water, and the semi-dry pulp discharges directly into a compactor or haul-away container. The excess water is recirculated to the pulper. The entire process is automatic.

The above facility also contains a Bulk Waste Disposal Unit connected to the Hydra-Extractor. The Bulk Unit handles full-size carts and bags, and has a capacity ranging as high as 360 single-size disposable animal shipping crates per hour.

The system utilizes small diameter pipelines that can be run through both clean and dirty areas without danger of contamination.

NOTE: Systems can be designed to fit virtually any facility and handle virtually any waste disposal needs.

NOTE: Through the use of a chemical additive device, all system water can be automatically treated as it is being recirculated.

SOMAT EQUIPMENT CHARTS

Pulpers

Model Number(1)	Pulper Tank Diameter (Inches)	Motor Drive (HP)	Capacity(2) (lbs. per hr.)
SP-50AS	23	5	750
SP-75S	30	7½	1000
SP-150S	36	15	1250
SP-250S(3)	42	25	2000
SP-400S(3)	48	40	3000

Hydra-Extractors

Model Number	Screw/Screen Diameter (Inches)	Motor Drive (HP)	Capacity(2) (lbs. per hr.)
HE-6S	6	1½	1250
HE-6S-3	6	3	1500
HE-9S	9	5	2000
HE-9TS	9(2)	5(2)	4000

Package Units—Pulpers/Hydra-Extractors

Model Number	Pulper Tank Dia. (Inches)	Hydra-Extractor Screw/Screen Dia. (Inches)	Pulper Motor (HP)	HE Motor (HP)	Capacity(2) (lbs. per hr.)
SPC-50AS	23	6	5	1½	750
SPC-75S	30	6	7½	1½	1000
SPC-150S	36	6	15	3	1250
SPC-250S(3)	42	9	25	5	2000

NOTES:

(1) SOMAT Corporation supplies larger size units to accommodate customer specification where required, such as larger diameters, higher capacities, etc. Consult factory for complete specifications.

(2) Capacity ratings listed are nominal. They will vary depending upon the bedding material (waste, type and density) fed to the system. Additional considerations such as operating procedures and feed requirements may also affect capacity.

(3) Larger units are capable of being bulk fed either by conveyor or by manual operation. Pulpers are sized to accept dumping of ½ cubic yard tilt-type containers, and continuous processing of single use shipping containers.

Combinations of pulpers and Hydra-Extractors are available, based on application and installation requirements. Modular design affords optimum flexibility and facilitates attainment of low-cost operating objectives.

PATENT NOTICE: SOMAT Equipment and Process are covered under one or more of the following U.S. Patents: 3,164,329, 3,188,942, 3,310,241, 3,319,897, 3,584,800, 3,620,460, 3,885,745, 4,150,617, 4,155,299, and/or pending U.S. Patent Applications; and under various patents and pending patent applications in principal foreign countries.

SOMAT reserves the right to make changes in specifications without notice.

somat®
CORPORATION
Pomeroy, PA 19367 • 215/384-7000
Telex: 835332

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PAM, Inc.
51 North Second Street
Souderton, Pa 18964
(215) 723-0976

7. SITE-SPECIFIC MODELING AND RISK ANALYSIS FOR HCl AND METALS

SITE-SPECIFIC MODELING AND RISK ANALYSIS FOR HCl AND METALS

In response to the North Carolina Hazardous Waste Section's request for additional information regarding the maximum ambient air quality impact and associated health risks related to the operation of the proposed incinerator, Worksheet 2 and supporting materials are provided. The results presented on Worksheet 2 are based on modeling completed earlier this year in support of the Air Quality Permit for the incinerator. A copy of the model protocol as well as the model output as submitted by Sirrine Environmental Consultants, dated October 31, 1989, is included.

As discussed in the modeling protocol, a "generic" emission rate of one gram per second (1 g/s) is assumed in the modeling. Concentrations for all of the pollutants of concern are then estimated by multiplying the modeled concentration by the appropriate emission rate to determine the maximum expected ambient concentration for each pollutant of concern. The one-hour average concentration for the receptor 200 meters from the source is used in the calculations because the proposed stack is 200 meters from the nearest property boundary. The one-hour average concentration is then multiplied by 0.038 as recommended by the Air Quality Section of the North Carolina Department of Environment, Health and Natural Resources (Guidelines for Evaluating the Air Quality Impacts of Toxic Pollutants in North Carolina, July 1990) to estimate a maximum annual average concentration. (The 0.038 factor was used in lieu of the 0.045 factor which was proposed in the modeling protocol dated October 30, 1989.) Also in accordance with the modeling guidelines, concentrations with averaging periods less than one hour are estimated by assuming the maximum short term emission rate and the calculated one hour average concentration.

Table 1 presents the assumptions and results of the analysis of the maximum expected concentrations associated with the operation of the proposed incinerator.

In response to the second notice of deficiency, the emission rates and maximum feed rates were calculated from annual concentrations using a factor of 0.025 for simple terrain. (In accordance with NC Division of Environmental Management policy, all of Durham County, North Carolina is typically considered to be simple terrain for air modeling purposes.) As stated in the second NOD the US EPA requests that this factor be used rather than the 0.038 factor recommended in the "Guidelines for Evaluating the Air Quality Impacts of Toxic Pollutants in North Carolina, July 1990." Table 2 reports results based on using the 0.025 factor. Use of the 0.025 factor yields increased maximum feed rates without increased annual concentrations or risk. Therefore results based on the 0.038 factor are more conservative.

The control efficiencies stated for metals are in accordance with Table III-8 of the EPA "Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators", August, 1990.

The system is expected to remove 99% of the HCl that is produced in the combustion process. However, the manufacturer's guarantee is that the air pollution control system will remove 90% of the HCl produced if the HCl emissions in the flue gas are less than or equal to 40 lb/hr. Therefore, a 90% HCl control efficiency is used for the risk analysis calculations.

As shown in Worksheet 2, the estimated maximum concentrations are expected to comply both with the risk analysis required for carcinogens and each of the RAC limits for non-carcinogens.

Also enclosed is a site layout (Figure 1) showing the location of the source and the locations and dimensions of adjacent structures. As documented in the protocol, the

modeling incorporates the effects of aerodynamic downwash because the stack is within the area of influence of some of the buildings on-site. The proposed stack is in the side zone of building number 6 which has the highest wake effect height of any of the surrounding buildings and thus, building number 6 will control downwash from the proposed stack.

The following materials provide the results and supporting documentation required for the site-specific Modeling and Risk Analysis requested.

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

October 31, 1989

Mr. Kevin Eldridge
NC Division of Environmental Management
P.O. Box 27687
Raleigh, NC 27611-7687

Re: Glaxo Incinerator Permitting Project
SEC Project No. R-8279
Screening Modeling Protocol

Dear Mr. Eldridge:

We are forwarding to you the protocol developed by Sirrine Environmental Consultants (SEC) to perform the screening dispersion modeling to support an air permit application to the NCDEM for a hazardous waste incinerator at Glaxo Inc.'s Research Triangle Park, North Carolina facility. This protocol was developed from verbal discussions between you and SEC personnel.

Please review this protocol for consistency with your modeling policy, procedures, and guidance. In order that we can begin our modeling activities as soon as practicable, we would appreciate your comments or formal concurrence with this protocol by November 14, 1989. If you have any questions regarding this submittal, please contact me at (919) 881-0777.

Sincerely,

SIRRINE ENVIRONMENTAL CONSULTANTS

George W. Siple

George W. Siple
GWS/cc

Enclosure

cc: Mr. Terry Bradham, w/o encl.
Mr. Bob Midgette, w/o encl.
Project File, w/encl.
Mr. Robert Wojtas, w/enc.
Mr. Bill Hamner, w/enc.

MODELING PROTOCOL FOR NAAQS ATTAINMENT DEMONSTRATION AND AIR TOXICS ANALYSIS

Glaxo Inc.
Research Triangle Park, Durham County, North Carolina

I. New Glaxo Source Under Review

A. Process: hazardous waste incinerator to dispose the following classes of research wastes generated on-site

(1) Hazardous Wastes
(2) Solid Wastes
(3) Radioactive Hazardous Wastes
(4) Radioactive Solid Wastes

B. Location

(1) Rural southern Durham County, North Carolina
(2) Plant property is east of County Road 1945, west of Durham Freeway (State Road 147), south of Ellis Road, and north of Alexander Drive, approximately 7 miles west, northwest of Raleigh-Durham airport (see map attached)
(3) Relatively flat terrain, elevation 300 to 380 feet above mean sea level

II. Emissions Inventory

A. Criteria Pollutants

(1) Particulate Matter
(2) Sulfur Dioxide
(3) Nitrogen Dioxide
(4) Carbon Monoxide

B. Air toxics - any compounds listed for control in the latest proposed revision of 15 NCAC 2D .0505 which are present in the waste stream input to the incinerator or may reasonably to expected to be formed during combustion in the incinerator and emitted.

III. Good Engineering Practice (GEP) Stack Height Analysis - to be consistent with current EPA policy.

IV. Modeling Approach

A. Use SCREEN model following guidance in "Guidelines for Air Quality Maintenance Planning and Analysis Volume 10 (Second Edition)", April 1988: A generic emission rate of 1.0 gram per second will be used in the model, then concentrations of each contaminant will be proportioned by each specific contaminant's emission rate.

(1) Model generates 1-hour concentrations.
(2) 3-hour concentrations to be generated by converting 1-hour modeled concentrations using factor of 0.9.
(3) 24-hour concentrations to be generated by converting 1-hour modeled concentration using factor of 0.4.
(4) Annual concentrations to be generated by converting 1-hour modeled concentrations using factor of 0.045.
(5) 15-minute concentrations to be modeled using a maximum 15-minute emission rate and using the model output as is.

B. Receptors to be modeled at distance from proposed incinerator to nearest property line.

C. Terrain will be assumed flat unless nearby terrain rises to greater that 0.5 times the proposed stack height; in which case, receptor elevation will be included.

D. Building dimensions for worst-case downwash will be included if the stack is below GEP height.

E. Rural dispersion will be assumed.

F. Cavity analysis will be conducted.

V. Background Concentrations - for criteria pollutants will be based on most recent one-year of NCDEM monitoring data nearest the source or other quality-assured, NCDEM-approved data; values to be approved by NCDEM prior to submittal of report.

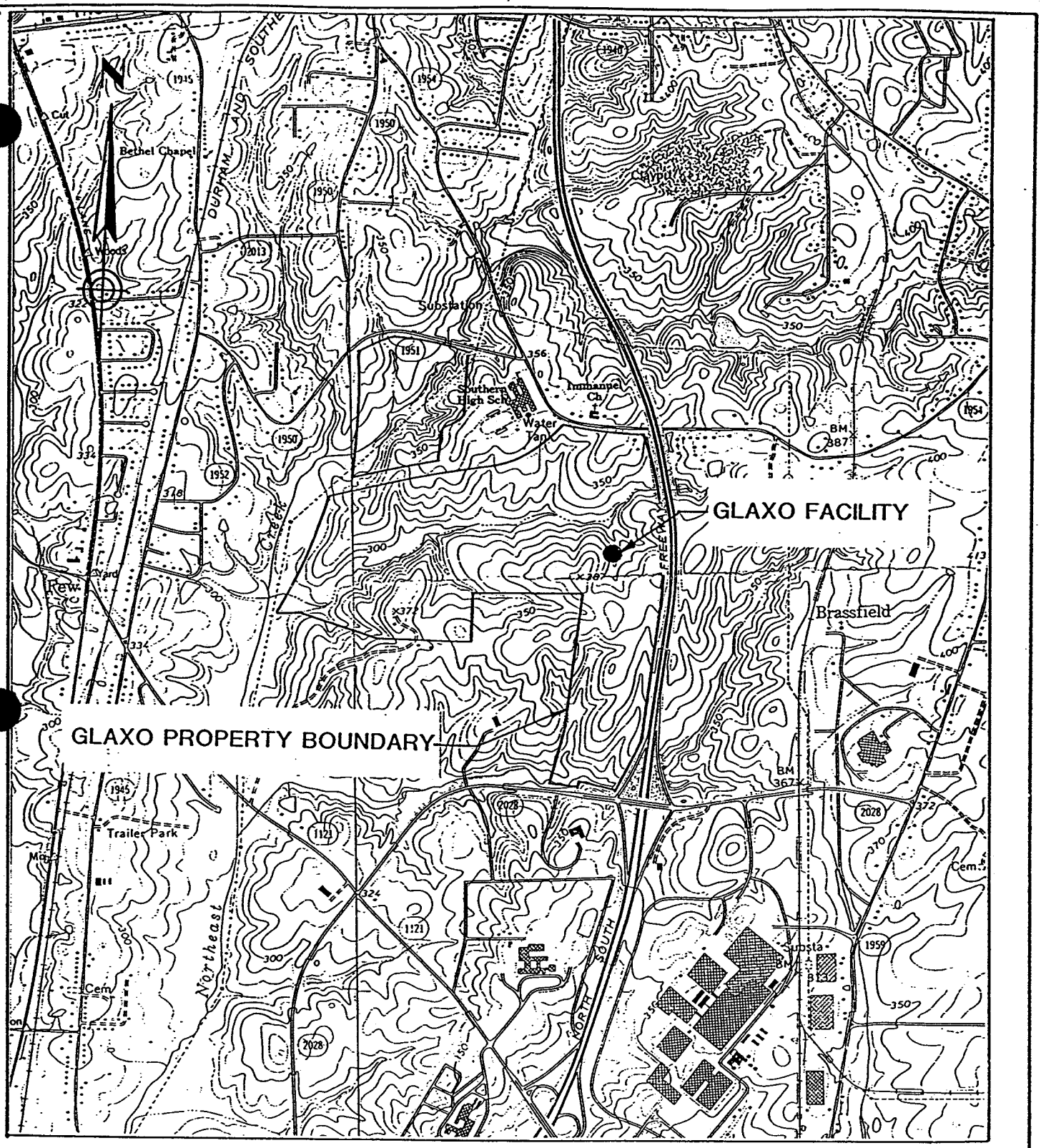
VI. Analysis

A. Criteria pollutants - if the modeled maximum concentration for each applicable averaging time plus the background concentration are less than the ambient air quality standard, the standard is met.

B. Air toxics - if the modeled maximum concentration for each applicable averaging time is less than the acceptable ambient level in the proposed revision to 15 NCAC 2D .0505, the standard is met.

C. If a standard is not met for any contaminant, guidance will be sought from NCDEM for further analysis.

VII. Report - a brief report will be prepared to document the analysis and results, including a listing of the modeling input and output.



REFERENCE :USGS SW , SE DURHAM QUADRANGLES

SCALE 1:24,000

SIRRINE ENVIRONMENTAL CONSULTANTS
Raleigh, North Carolina

FACILITY KEY PLAN

GLAXO INC. ,
RESEARCH TRIANGLE PARK , N.C.
DRAWING NO. R-8279-B1

DUNCAN-PARNELL, INC., CHARLOTTE 366 800-432-6022

State of North Carolina
Department of Environment, Health, and Natural Resources
Division of Environmental Management
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
William W. Cobey, Jr., Secretary

AIR QUALITY SECTION

R. Paul Wilms
Director

November 6, 1989

Mr. George Siple
Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, North Carolina 27612

RECEIVED
NOV 1989
SIRRINE ENVIRONMENTAL
CONSULTANTS

Subject: Modeling Protocol Glaxo Incinerator,
Durham County

Dear George:

The Division of Environmental Management (DEM) has reviewed the modeling plan for the the Glaxo Incinerator to be located in Durham County. Receptors should be placed at the nearest property line and beyond.

With the above change the modeling plan is acceptable. This modeling plan approval is valid for only 90 days. Additionally, this letter approves only the modeling plan and not any data submitted. These data will be reviewed upon receipt of the final application.

If you have any questions, please contact me at (919)733-3340.

Sincerely,

Kevin Eldridge

Kevin Eldridge, Meteorologist
Air Permits Branch

GLAXPLAN.LET

cc: Ken Schuster

11-30-89
14:11:54

*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED 88300 ***

GLAXO INCINERATOR

SIMPLE TERRAIN INPUTS:

SOURCE TYPE	=	POINT
EMISSION RATE (G/S)	=	1.000
STACK HEIGHT (M)	=	29.26
STK INSIDE DIAM (M)	=	.76
STK EXIT VELOCITY (M/S)	=	6.21
STK GAS EXIT TEMP (K)	=	394.26
AMBIENT AIR TEMP (K)	=	293.00
RECEPTOR HEIGHT (M)	=	.00
IOPT (1=URB,2=RUR)	=	2
BUILDING HEIGHT (M)	=	27.13
MIN HORIZ BLDG DIM (M)	=	20.27
MAX HORIZ BLDG DIM (M)	=	53.65

BUOY. FLUX = 2.26 M**4/S**3; MOM. FLUX = 4.14 M**4/S**2.

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
10.	.0000	0	.0	.0	.0	.0	.0	.0	NA
100.	368.4	6	1.0	1.8	5000.0	32.9	4.1	16.6	SS
200.	333.6	6	1.0	1.8	5000.0	33.2	7.7	22.1	SS
300.	272.0	6	1.0	1.8	5000.0	33.2	11.2	26.8	SS
400.	210.3	6	1.0	1.8	5000.0	33.2	14.6	27.2	SS
500.	172.5	6	1.0	1.8	5000.0	33.2	18.0	27.7	SS
600.	146.9	6	1.0	1.8	5000.0	33.2	21.2	28.1	SS
700.	128.2	6	1.0	1.8	5000.0	33.2	24.5	28.5	SS
800.	114.0	6	1.0	1.8	5000.0	33.2	27.6	28.8	SS
900.	102.8	6	1.0	1.8	5000.0	33.2	30.8	29.2	SS
1000.	93.68	6	1.0	1.8	5000.0	33.2	33.9	29.6	SS
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 10. M:									
82.	422.1	6	1.0	1.8	5000.0	31.8	3.4	15.7	SS

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
* SUMMARY OF TERRAIN HEIGHTS ENTERED FOR *

****

TERRAIN HT (M)	DISTANCE RANGE (M) MINIMUM	MAXIMUM
0.	10.	1000.

*** CAVITY CALCULATION - 1 ***			*** CAVITY CALCULATION - 2 ***		
CONC (UG/M**3)	=	458.0	CONC (UG/M**3)	=	371.3
CRIT WS @10M (M/S)	=	1.00	CRIT WS @10M (M/S)	=	5.27
CRIT WS @ HS (M/S)	=	1.24	CRIT WS @ HS (M/S)	=	6.53
DILUTION WS (M/S)	=	1.00	DILUTION WS (M/S)	=	3.26
CAVITY HT (M)	=	43.56	CAVITY HT (M)	=	30.45
CAVITY LENGTH (M)	=	81.47	CAVITY LENGTH (M)	=	17.96
ALONGWIND DIM (M)	=	20.27	ALONGWIND DIM (M)	=	53.65

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)	
SIMPLE TERRAIN	422.1	82.	0.	
BUILDING CAVITY-1	458.0	81.	--	(DIST = CAVITY LENGTH)
BUILDING CAVITY-2	371.3	18.	--	(DIST = CAVITY LENGTH)

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

TABLE 1

MAXIMUM CONCENTRATIONS AT NEAREST PROPERTY BOUNDARY

Pollutant	Maximum Feed Rate lb/hr	Control Efficiency (%)	Emission Rate (g/s)	Annual Concentration (ug/m^3)
As	$7.1\text{-}10^{-3}$	98	1.8×10^{-5}	2.33×10^{-4}
Be	3.9×10^{-2}	98	9.8×10^{-5}	1.25×10^{-3}
Cd	5.2×10^{-2}	98	1.3×10^{-4}	1.67×10^{-3}
Cr	7.8×10^{-3}	98	2.0×10^{-5}	2.5×10^{-4}
Ag	9.4	98	2.4×10^{-2}	0.3
Ba	1565	98	3.9	50
Pb	2.8	98	7.1×10^{-3}	0.09
Hg	3.8×10^{-1}	50	2.4×10^{-2}	0.3
Sb	93.9	98	2.4×10^{-1}	3
Tl	9.4	98	2.4×10^{-2}	0.3
HCl	35	90	0.44	147 (3 min)* 5.6 (annual)

*3 minute concentration assumed to be equal to the modelled one hour maximum.

TABLE 2

ANNUAL CONCENTRATIONS AND MAXIMUM FEED RATES
(Calculated Using Annual Concentration Multiplying Factor of 0.025)

Pollutant	Maximum Feed Rate lb/hr	Control Efficiency (%)	Emission Rate (g/s)	Annual Concentration (ug/m^3)
As	1.1×10^{-2}	98	2.8×10^{-5}	2.33×10^{-4}
Be	5.9×10^{-2}	98	1.5×10^{-4}	1.25×10^{-3}
Cd	7.9×10^{-2}	98	2.0×10^{-4}	1.67×10^{-3}
Cr	1.2×10^{-2}	98	3.0×10^{-5}	2.5×10^{-4}
Ag	14.3	98	3.6×10^{-2}	0.3
Ba	2379	98	6.0	50
Pb	4.3	98	1.1×10^{-2}	0.09
Hg	5.7	50	3.6×10^{-2}	0.3
Sb	143	98	3.6×10^{-1}	3
Tl	14.3	98	3.6×10^{-2}	0.3
HCl	35	90	0.44	147 (3 min)* 3.7 (annual)

*3 minute concentration assumed to be equal to the modelled one hour maximum.

WORKSHEET 2

Checklist of Required Results
for Site-Specific Modeling and Risk Analysis
(if facility has more than five units, attach additional sheets)

Facility Name: Glaxo Inc.
Address: Five Moore Drive, Research Triangle Park, NC 27709
Telephone Number: (919) 549-7438
Date: September 24, 1990

MODELING

General Considerations

For the in-depth modeling exercise, the following guidelines must be followed:

1. Must be consistent with the EPA "Guideline on Air Quality Models"

2. Special receptors should be specified for these model runs; these receptors are at the closest distance to the fenceline for each wind direction sector

WORKSHEET 2

Checklist of Required Results for Site-Specific Modeling and Risk Analysis
(if facility has more than five units, attach additional sheets)

Information to be Presented

The following items must be presented to the Permit Writer after completion of the in-depth modeling.

EPA guideline model used

Terrain type

Receptor grid assumptions

Maximum offsite annual average concentration
(or maximum annual average concentration if people reside on-site)

The selected special receptors

For multiple sources, the predicted concentration for each source separately and combined

The full input file (either in the model output or appended to the results)

The rationale for selection of the meteorological monitoring station including a map showing alternative stations

A site layout map showing the location of all sources and structures*

Building dimensions for structures adjacent to each source

*The following criteria should be applied: if the distance from a stack to the nearest portion of a building is within 5 x height of building or 5 x maximum projected width, the building dimensions should be provided.

WORKSHEET 2

Checklist of Required Results
for Site-Specific Modeling and Risk Analysis
(if facility has more than five units, attach additional sheets)

RISK ANALYSIS

Considerations:

Theoretical MEI risk should be calculated (not population-weighted risk or cancer incidence)

The aggregate risk from the carcinogens must be less than or equal to 1E-5

The MEI concentration for each noncarcinogen must be less than or equal to the RAC

For Carcinogens: MEI Risk = Unit Risk X Ambient MEI Concentration

For Noncarcinogens: MEI Risk = Ambient MEI Concentration/RAC

Information To Be Presented:
MEI risk due to each carcinogen and aggregate risk

Pollutant	Unit Risk	Source 1 MEI		Source 2 MEI		Source 3 MEI		Source 4 MEI		Source 5 MEI		MEI Risk Estimates for Combined Sources
		Conc	Risk	Conc	Risk	Conc	Risk	Conc	Risk	Conc	Risk	
Arsenic	4.3E-03	2.33E-4	1E-6									
Beryllium	2.4E-03	1.25E-3	3E-6									
Cadmium	1.8E-03	1.67E-3	3E-6									
Chromium	1.2E-02	2.5E-4	3E-6									
Aggregate MEI cancer risk:	—		1E-5									

WORKSHEET 2

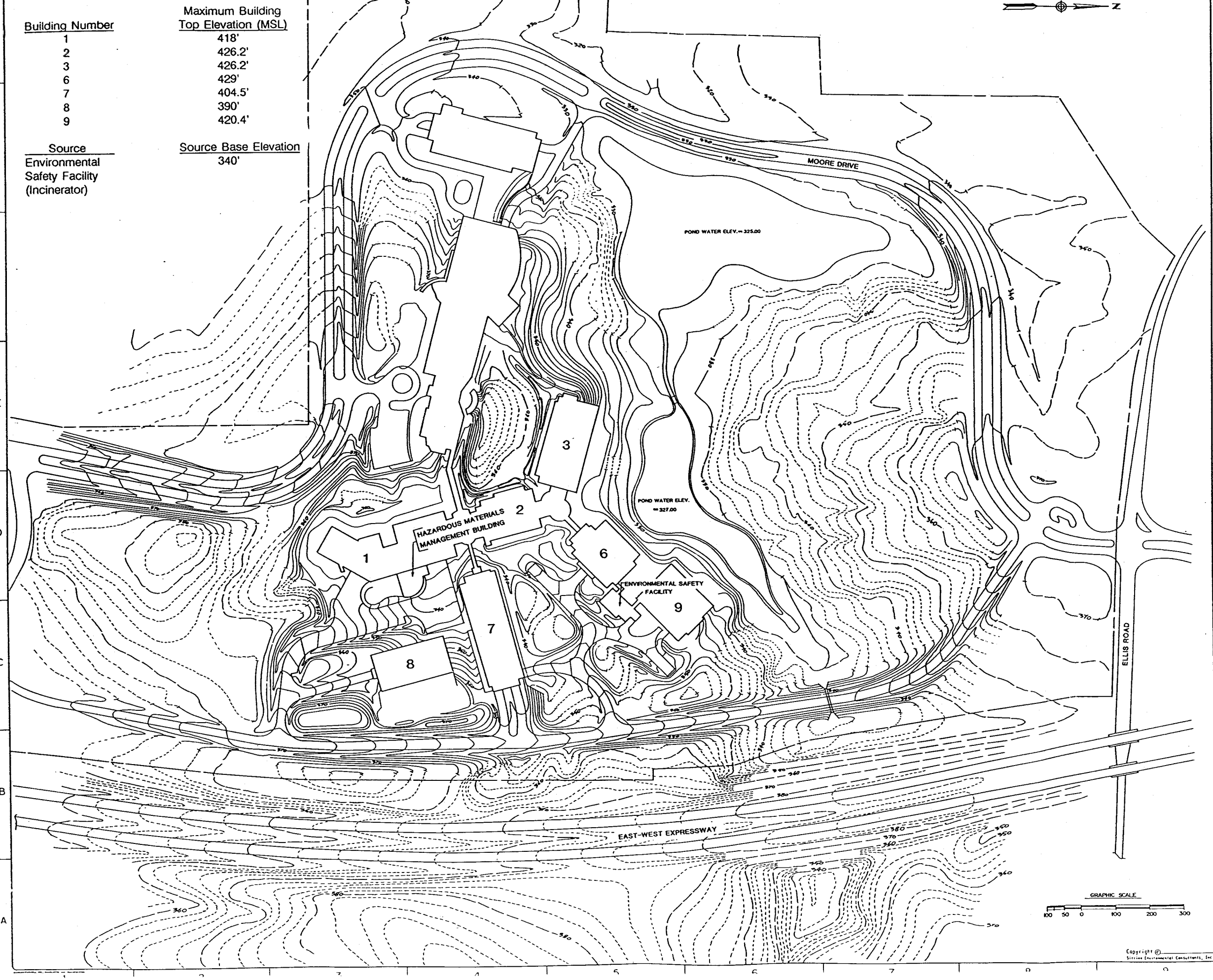
Checklist of Required Results for Site-Specific Modeling and Risk Analysis
(if facility has more than five units, attach additional sheets)

MEI concentration of each non-carcinogen and the ratio of the MEI concentration to the RAC

Pollutant	RAC (µg/m3)	Source 1 MEI		Source 2 MEI		Source 3 MEI		Source 4 MEI		Source 5 MEI	
		Conc	Risk	Conc	Risk	Conc	Risk	Conc	Risk	Conc	Risk
Antimony	0.3	0.3	1								
Barium	50	50	1								
Lead	0.09	0.09	1								
Mercury	0.3	0.3	1								
Silver	3	3	1								
Thallium (Oxide)	0.3	0.03	1								
HCl	150 (3 min)	147	0.98								
	7 (annual)	5.6	0.8								

Building Number	Maximum Building Top Elevation (MSL)
1	418'
2	426.2'
3	426.2'
6	429'
7	404.5'
8	390'
9	420.4'

Source	Source Base Elevation
Environmental Safety Facility (Incinerator)	340'



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LEGEND

EXISTING CONTOURS

PROPOSED CONTOURS

REV. NO.	CODE	CIRCLES	DATE	DESCRIPTION	SEC APPROVED
0	G		9	ISSUED FOR RCRA	
	RWM		19	PERMIT APPLICATION	
			90		

REV. BY

NOTE: CIRCLE ALL REVISIONS. IDENTIFY WITH DIAMOND, NUMBER AND ARROW. REMOVE ONLY CIRCLE AND ARROW BEFORE NEXT REVISION.

ISSUE CODE					
A	PRELIMINARY	C	MAT'L T.O.	F	CONST'N
B	DESIGN	D	MAT'L PURC.	G	PERMIT
		E	BIDS	H	

SEAL

SIGNATURE

DATE

DR.	MC	DATE	
DSGN.		SEC FILE NUMBER	
CK.	RWM		
DPE		JOB NO.	R-8279
CAD FILE NO.			

SIRRINE ENVIRONMENTAL CONSULTANTS

Raleigh, North Carolina

GLAXO INC.,

RESEARCH TRIANGLE PARK

NORTH CAROLINA

DRAWING TITLE

FIGURE 1

CLIENT DRAWING NUMBER

SEC DRAWING NUMBER

8. ORGANIC AIR EMISSION STANDARDS FOR PROCESS VENTS AND EQUIPMENT LEAKS

ORGANIC AIR EMISSION STANDARDS FOR PROCESS VENTS AND EQUIPMENT LEAKS

The following information is submitted in accordance with:

- 40 CFR 264, Subpart AA - Air Emission Standards for Process Vents
- 40 CFR 264, Subpart BB - Air Emission Standards for Equipment Leaks
- 40 CFR 270.24, Specific Part B Information Requirements for Process Vents
- 40 CFR 270.25, Specific Part B Information Requirements for Equipment

These standards and information requirements became effective on December 21, 1990.

Subpart AA - Air Emission Standards for Process Vents

The requirements of this subpart and 40 CFR 270.24 are not applicable to the Glaxo facility per 40 CFR 264.1030(b). Glaxo does not currently plan to operate any of the following equipment that processes hazardous waste with time weighted annual average total organics concentration of 10 parts per million by weight: distillation columns, fractionation units, thin film evaporators, solvent extractors, and air or steam strippers.

Subpart BB - Air Emission Standard for Equipment Leaks

The requirements of this subpart apply to the following types of equipment that contain or contract hazardous wastes with organic concentrations of at least 10 percent by weight: pumps, compressors, pressure relief devices, sampling connecting systems, open-ended valves or lines, and valves.

As required in 40 CFR 264.1050(d), each piece of equipment to which this subpart applies will be marked in such a manner that it can be distinguished readily from other pieces of equipment.

40 CFR 270.25, SPECIFIC PART B INFORMATION REQUIREMENTS FOR EQUIPMENT

Each piece of equipment to which subpart BB applies is listed and identified by number on Drawing No. 9-60812. This equipment is located in the Liquid Waste Storage room of the Environmental Safety Facility (ESF). The percent by weight total organics in the hazardous waste stream (i.e., liquid waste) will be greater than ten percent. Also, for the purposes of these regulations, it will be assumed that the percent by weight total organics in the nitrogen blanket will be greater than ten percent. The hazardous waste at all equipment will be in a liquid state except for the gas/vapor state associated with the nitrogen blanketing system equipment. The method of compliance with the standards will be as specified in the following sections for specific equipment.

- 40 CFR 264.1052 Standards: Pumps in Light Liquid Service

  The liquid waste metering pumps (reference 24 on drawing 9-60812) and drum pumps (reference 3 on drawing 9-60812) will be monitored monthly to detect leaks by the methods specified in Section 264.1063(b). Also, each pump will be checked by visual inspection each week for indications of liquids dripping from the pump seal. Alternatively, Glaxo may select for use a pump which meets the requirements of 264.1052(d)(e) or (f). Pumps which meet these requirements are subject to different testing and/or monitoring requirements.

An instrument reading of 10,000 ppm or greater or an indication of liquids dripping from a pump seal will be considered a leak. When a leak is detected it will be repaired no later than 15 days after it is detected except as provided in section 264.1059. Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1053 Standards: Compressors

Glaxo will not operate a compressor that contains or contacts hazardous wastes.

- 40 CFR 264.1054 Standards: Pressure Relief Devices in Gas/Vapor Service

A pressure relief device in gas/vapor service is provided for each of the low pressure storage tanks (reference 59 on drawing 9-60812). Except during pressure releases, each pressure relief device in gas/vapor service will be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the methods specified in section 264.1063(c).

After any pressure release, the device will be returned to a condition of no detectable emissions within five days after the release. Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1055 Standards: Sampling Connecting Systems

Sample valves will be provided as depicted on drawing 9-60812 (references 18, 31, 60). Each sampling connection will be provided with a closed-purge system or alternatively a closed-vent system.

Each closed-purge system or closed-vent system will:

(1) Return the purged hazardous waste stream directly to the hazardous waste process line with no detectable emissions to the atmosphere, or

(2) Collect and recycle the purged hazardous waste stream with no detectable emissions to the atmosphere, or

(3) Be designed and operated to capture and transport all the purged hazardous waste stream to a control device that complies with the requirements of 264.1060.

Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1056 Standards: Open-Ended Valves or Lines

Open-ended valves or lines will be provided as depicted on drawing 9-60812 (references 5, 6, 28). Each quick disconnect coupling will be equipped with a check valve and a second manual shut off valve. The purpose of the drain valves for the liquid waste pumps (reference 28) is to allow for the removal and containment of liquid before a pump is taken out of a service. Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1057 Standards: Valves in Gas/Vapor Service or Light Liquid Service

The subject valves associated with the liquid waste storage and feed system in gas/vapor service or light liquid service are depicted on drawing 9-60812 (references 5, 6, 7, 8, 9, 17, 19, 20, 21, 23, 27, 30, 31, 32, 33, 34, 52, 53, 54, 55,

61, 62). Each valve will be monitored monthly to detect leaks by the methods specified in section 264.1063(b) and will comply with 264.1057(b) through (e) except as provided in 264.1057(f) and (g) and 264.1061 and 264.1062.

A leak is detected if an instrument reading of 10,000 ppm or greater is measured.

Any valve for which a leak is not detected for two successive months may be monitored the first month of every succeeding quarter, beginning with the next quarter, until a leak is detected. If a leak is detected, the valve shall be monitored monthly until a leak is not detected for two successive months.

When a leak is detected it will be repaired no later than 15 days after the leak is detected, except as provided in 264.1059. Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1058 Standards: Pumps and Valves in Heavy Liquid Service, Pressure Relief Devices in Light Liquid or Heavy Liquid Service, and Flanges and Other Connectors.

The Glaxo facility will not have any pumps or valves in heavy liquid service.

Pressure relief valves for the liquid waste pumps will be provided as depicted on drawing 9-60812 (reference 26).

Flanges and other connectors for the liquid waste storage and feed system will be identified on detailed piping design drawings.

The pressure relief valves for the liquid waste pumps as well as flanges and other connectors will be monitored by a method specified in 264.1063(b) within 5 days

if evidence of a potential leak is found by visual, audible, olfactory or other detection method.

If an instrument reading of 10,000 ppm or greater is measured, a leak is detected. A detected leak will be repaired not later than 15 days after it is detected, except as provided in 264.1059. The first attempt at repair will be made no later than 5 days after a leak is detected. Records as required by section 264.1064 will be maintained in the facility operating record.

- 40 CFR 264.1059 Standards: Delay of Repair

Delay in repair of equipment for which leaks have been detected will be allowed only in accordance with conditions specified in this section.

- 40 CFR 264.1060 Standards: Closed Vent Systems and Control Devices

As described in specification G-8279-4 (see Appendix C), an Activated Carbon Adsorber System will be used to control organics emissions due to vapors generated when the contents of 55 gallon drums are transferred to storage tanks in the Environmental Safety Facility (ESF). Two carbon canisters piped in series will be used for each tank system.

- Glaxo will monitor the concentration level of organic compounds in the exhaust vent stream from the carbon adsorption systems on a daily basis. When breakthrough is detected on the first canister, the second canister will be rotated to first in series and a new canister will be installed downstream.

These closed vent systems will be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background and

by visual inspections as determined by the methods specified in 264.1034(b). The systems will be monitored to determine compliance with these requirements during the initial leak detection monitoring and annually thereafter. Records of these tests will be maintained in the facility operating records.

Detectable emissions will be controlled as soon as practicable, but not later than 15 days after the emission is detected. A first attempt at repair shall be made no later than 5 days after the emission is detected. Records as required by section 264.1064 will be maintained in the facility operating record.

The certification statement required by 40 CFR 270.25(e) to document compliance with 40 CFR 264.1060 follows this page.

OWNER OR OPERATOR CERTIFICATION STATEMENT
PER 40 CFR 270.25(e)

I certify, to the best of my knowledge and belief, the operating parameters used in the design analysis for the Activated Carbon Adsorber Systems reasonably represent the conditions that will exist when the contents of a 55 gallon drum is transferred to a hazardous waste storage tank in the Environmental Safety Facility (ESF).

The Activated Carbon Adsorber systems are designed to operate at an efficiency of 95 weight percent or greater.

Signature: _____ Date: 2/8/91

Title: DIRECTOR, SAFETY & ENVIRONMENTAL AFFAIRS

APPENDIX B

TRIAL BURN PLAN

INCINERATOR TRIAL BURN PLAN

GLAXO INCORPORATED

RESEARCH TRIANGLE PARK, NORTH CAROLINA

Prepared By

FOUR NINES, INC.
400 Stenton Avenue
Plymouth Meeting, PA 19462

AND

ENTROPY ENVIRONMENTALISTS, INC.
9001 Glenwood Avenue
Raleigh, NC 27612

AND

SIRRINE ENVIRONMENTAL CONSULTANTS
3733 National Drive
Suite 120
Raleigh, NC 27612

December 15, 1989

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SECTION 1 - INTRODUCTION

1.1 GENERAL INFORMATION

This Trial Burn Plan is for a new incinerator for burning hazardous, non-hazardous, infectious and radioactive waste material from the Glaxo Inc. facilities at Research Triangle Park, NC. The test conditions in this plan are designed to verify the compliance of the incinerator performance as described in 40 CFR Part 264.343 and the North Carolina Department of Human Resources Hazardous Waste Regulations .0032 and all applicable State and local regulations for incinerators burning hazardous, infectious and radioactive waste.

These tests will determine the following:

1. That the Destruction and Removal Efficiency (DRE) for the selected Principal Organic Hazardous Components (POHCs) is equal to or greater than 99.99%.

2. That the removal of hydrochloric acid (HCl) created in the combustion reaction is equal to or greater than 99% or that emissions of HCl will be less than 4 lb/hr.

3. That the particulate content of the stack gas is equal to or less than 0.08 grains/dry standard cubic foot (DSCF) of flue gas corrected to 7% oxygen in the flue gas.

4. That the carbon monoxide (CO) in the flue gas will not exceed 100 ppm on the basis of a 60 minute rolling average corrected to 7% oxygen.

5. That the metal emissions from the incinerator will conform to the new Hazardous Waste Guidelines.

The Trial Burn will be conducted jointly by Sirrine Environmental Consultants, Inc., Four Nines, Inc., and Entropy Environmentalists, Inc. in conjunction with Glaxo Inc. Entropy will provide the personnel for sampling all waste streams and all emission monitoring and will be responsible for the analysis of these samples. QA/QC and chain-of-custody functions for sampling and analysis will be provided by Entropy.

1.2 INCINERATOR FACILITY DESCRIPTION

The incinerator to be tested is a Kennedy Van Saun Model HR-75 two chamber controlled air type incinerator which has been modified by the addition of a liquid waste feed nozzle.

In the Trial Burn the incinerator will be operated on all of the generic waste categories specified in Section 2 of this Trial Burn Plan. The incinerator will be run at maximum waste rates during four replicate sampling runs at each condition. Details of the Trial Burn operation are described in Section 4.

1.3 PERMIT LIMITATIONS ANTICIPATED BY TRIAL BURN

Through the results of the Trial Burn, Glaxo proposes to establish permitted operating conditions which will include the following:

* Maximum Heat Release - 5.75 MM BTU/hr

* Maximum Organically Bound Chlorine in the waste shall not exceed 40 lb/hr.

* Temperature - The temperature of the primary incinerator chamber shall not be less than 1000°F or more than 2000°F. The temperature of the secondary chamber shall not be less than 1700°F or more than 2200°F.

* The carbon monoxide content in the flue gas, measured in the stack shall not exceed 100 ppm rolling average over 60 minutes when corrected to 7% oxygen on a dry basis.

* The Total Particulate Emission Rate shall not exceed 0.08 grains per dry standard cubic foot of flue gas, corrected to 7% oxygen.

SECTION 2 - WASTE CHARACTERISTICS

The incinerator receives both solid and liquid waste feeds. Liquids may be fed to the incinerator in small containerized amounts through the solid feed mechanism or fed in bulk through a nozzle in the primary chamber. Solids are fed only through the solid feed system.

Section C of the Part B Application provides a detailed list and description of all of the waste materials which will be burned in the incinerator. The major classifications of these waste types follow. Each waste type will be burned during the Trial Burn.

2.1 HAZARDOUS WASTES

2.1.1 Solvent Waste:

The solvent waste consists of a wide variety of solvent compounds and mixtures mainly under the EPA Hazard numbers F002, F003, F005 and D001. These wastes will also contain other solvents under the "P" and "U" hazard categories. Other "P" and "U" wastes may be contained in the solvents at concentrations less than 5%. These wastes will be liquid and have viscosities less than 100 centipoises.

2.2.2 Discarded Chemical Products:

These are discarded commercial chemical products whose shelf life has expired or are no longer needed. They will fit the "P" or "U" hazard classifications.

2.2 SOLID WASTES

2.2.1 Somat Waste:

This is a combination of animal waste and animal bedding which has been processed in a Somat Corporation processor. It is a semi-dry pulp and will be packaged in plastic bags. Each bag of somat waste will weigh approximately 50 pounds.

2.2.2 Animal Carcasses:

These will be fed in 1.5 cubic foot boxes or plastic bags at weights of about 68 lb. each.

2.2.3 Disposable laboratory Equipment & Supplies:

Plastic laboratory ware, lab coats, gloves, glassware etc. will be packaged in plastic lined cardboard boxes having a volume of about 2 cubic feet.

2.2.4 Infectious/Medical Wastes:

This material consists of infectious animal bedding, disposable laboratory items generated during experiments with infectious agents and "sharps". The bedding will be in plastic bags contained in 1.5 cubic foot cardboard safety boxes with a total weight of 25 lbs. The disposable lab equipment will be in 2.25 cubic foot plastic lined cardboard boxes with a weight of 40 lbs. each. The sharps will be in plastic lined safety boxes of about 0.075 cubic feet and weighing 5 lbs.

2.3 RADIOACTIVE HAZARDOUS WASTE

2.3.1 Radioactive Solvent waste:

This waste stream is identical to the non-radioactive solvent waste stream except that it will contain one or more of the radioactive elements listed in Section C of the Part B application and the water content will be higher. This waste will be collected in 55 gallon drums, transferred to storage tanks and fed to the incinerator through the liquid feed system.

2.3.2 Scintillation Vials:

These vials contain hazardous solvents and radioactive isotopes. They are glass or polyethylene and contain 4 to 14 ml of liquid. The vials are packaged in cardboard trays of 100 to 150 vials. These trays are packaged in one cubic foot cardboard boxes which weigh approximately 16 lbs. each.

2.4 RADIOACTIVE SOLID WASTE

2.4.1 Animal Carcasses:

These animal carcasses have been exposed to radioactive tracers. They will be packaged in 1.5 cubic foot plastic lined boxes of about 68 lbs. each.

2.4.2 Animal Bedding

This waste will be collected in plastic lined cardboard boxes of 1.5 cubic foot volume at a weight of 25 lbs. each.

2.4.3 Disposable Lab Supplies

Radioactive disposable lab material will be identical to the non-radioactive material. It will be received in 2.25 cubic foot plastic lined cardboard boxes of about 40 lbs. each.

SECTION 3 - ENGINEERING DESCRIPTION

3.1 GENERAL DESCRIPTION OF THE SYSTEM

The incinerator system consists of a two chamber, controlled air modular incinerator which has provisions for burning both liquid and solid waste. The liquid is fed to the primary chamber from tanks by a pump through a single pipe. All of the solid waste is fed through a solids feed ram. All of the solid waste is containerized before it is fed to the incinerator. The proposed incinerator is a Kennedy Van Saun Model No. HR-75 and has a rated capacity of 900 lbs./hr based upon 6000 Btu/lb waste.

The incinerator will be followed by an Interel "dry scrubber" for the removal of particulate and acid gas components in the flue gas. The Interel system involves the cooling of the flue gases by dilution with recycled cooled flue gas and then with ambient air in an indirect heat exchanger. Cooling in the recirculation tower is followed by the addition of dry lime to the flue gases for neutralization. The lime, both reacted and unreacted, and any particulates from the incinerator are collected in a fabric filter. The flue gases subsequently pass through a HEPA filter and a carbon adsorber to remove any radioactive particulate remaining. A portion of the solids removed from the fabric filter is recycled through a conditioner and back into the flue gas stream.

The incinerator is of the fixed hearth, controlled air design with the waste fed into the primary (lower) chamber, ignited and burned under controlled air input conditions. The flue gases from the primary chamber at 1400°F to 1800°F pass into the secondary chamber where they are mixed with additional air and further heated by a natural gas burner to 2000°F before passing into the stack. Velocities in the primary chamber are kept low so that the entrainment of particulate in the flue gas stream is minimal. The incinerator is equipped with a CO gas analyzer and an oxygen analyzer to measure the CO and oxygen in the stack gas.

3.2 SOLID WASTE FEEDING SYSTEM

The solid waste is delivered to the incinerator in plastic bags, cardboard cartons or small fiber containers. The volume of the solid waste feed loader is 36 cubic feet. This is measured, in the normal position, from the face of the loader ram (retracted) to the face of the charging gate (closed) and using the cross section inside of the loader housing. Solid wastes may or may not constitute hazardous waste. The top of the feed chamber is hinged along one side. The feed hopper may be manually loaded or fed by an hydraulic cart dumper from 27 cubic foot carts. When the feeder is completely loaded with the waste bags or boxes, the top of the feed chamber is closed. If the temperature in the primary chamber is above 1000°F the hydraulic ram feeder is then actuated and begins to move through the feed chamber towards the incinerator. (The ram cannot feed the incinerator if the temperature in the primary chamber is below 1000°F or above 2000°F or if the temperature in the secondary chamber is below 1700°F or above 2200°F.) At this time the guillotine door on the front of the incinerator opens and the ram continues to move forward until the entire waste charge is deposited in the primary chamber. The ram then begins to retract, the guillotine door closes and the ram returns to its initial position behind the feeder chamber. The feed chamber closure, ram and guillotine door are hydraulically operated either by manual control or through automatic sequential timers which may be set at variable charging rates. These functions are also interlocked so that none of the operations can occur out of sequence even when manually controlled.

3.3 PRIMARY COMBUSTION CHAMBER

The primary combustion chamber is circular in cross section and has flat heads at either end. The charging system enters through the center of one head and the ash is removed at the bottom of the other. The shell is constructed of carbon steel plate lined with refractory.

The chamber is fired by four (4) gas burners each with a capacity of 1.2 MM Btu/Hr. capable of maintaining the primary chamber at temperatures up to 1800°F.

A separate injection pipe is installed in the top of the primary chamber to supply the bulk liquid waste to the primary hearth.

Figure D-1 (see Section D) provides a cross section drawing of the incinerator. A charging ram, a transfer ram, and an ash ram move the solid waste through the incinerator. The charging ram feeds solids into the primary chamber. The transfer ram moves material from the upper hearth to the lower hearth level. The ash ram discharges ash from the primary chamber.

The primary chamber has the following dimensions:

Length:	16' - 5"
Inside Diameter:	6' - 5"
Inside Area:	32.3 ft^2
Refractory Thickness:	6 1/2"
Refractory Type:	Insulating Castable Chrome Silica
Chamber Volume:	400 ft^3
Normal Operating Temperature:	1600°F

Combustion air is supplied to the primary chamber by a 1 HP combustion air blower which delivers air to five (5) ports on each side of the chamber at each of three (3) hearth levels. A total of thirty (30) air ports (see Figure D-1).

In addition, this blower also delivers air to four (4) underfire air ports on each of the two (2) bottom hearths. A total of eight (8) underfire air ports.

The total combustion air is controlled by one (1) modulating control damper. As total combustion air is varied, the underfire air will also vary. Distribution of the air to the various locations will be adjusted by manual balancing dampers at start-up.

The minimum waste heating value is zero. Some of the liquid waste may be contaminated water with zero heating value. If low heating value or no heating value material is fed, the natural gas burners will maintain the required operating temperatures. If too much low BTU material is fed, and the burners are not able to maintain the required minimum operating temperatures, the temperature controls will prevent feeding additional waste until the temperatures return to the recommended limits.

The liquid injection nozzle is not intended as an atomizing burner with variable turndown. The actual turndown ratio will depend on the metering pumps which have an operating range of 10 to 50 GPH. Compressed air to the injection nozzle will remain at 10 CFM at all times. The compressed air pressure at the nozzle is expected to be in the range of 3-5 inches water gage.

3.4 SECONDARY COMBUSTION CHAMBER

The secondary chamber is also a horizontal cylindrical vessel located above the primary chamber. Hot flue gases from the primary chamber pass upward through a refractory lined breeching tangentially into the bottom of the secondary chamber where they are mixed with additional air and further heated to 2000°F by a single gas burner. The secondary burner has a capacity of four 4.0 MM Btu/Hr.

The secondary chamber has the following dimensions:

Length:	14' - 3 1/2"
Inside Diameter:	6' - 5"
Inside Area:	32.3 ft^2
Refractory Thickness:	6 1/2"
Refractory Type:	Insulating Castable Chrome Silica
Chamber Volume:	426 ft^3
Operating Temperature:	2000°F
Flue Gas Residence Time:	2.0 seconds minimum

Combustion air is supplied to the secondary chamber by a 5 HP combustion air blower which delivers air to three (3) groups of five (5) ports, (a total of fifteen (15) air ports in the secondary chamber). The distribution of the air to the three (3) groups of ports will be adjusted by manual balancing dampers at start-up.

3.5 LIQUID WASTE BURNER/INJECTOR DESIGN

The liquid (solvent) waste will be atomized into the incinerator. The liquid injection nozzle will be North American No. 5642-01 or equivalent. This nozzle is rated at 55 gallons per hour of liquid waste and requires 10 SCFM of compressed air. The liquid waste flow will be measured by rotameters. The incinerator will be fed from only one waste solvent tank at a time. The liquid injection nozzle is capable of handling up to 64 GPH of liquid waste and 50 CFM of compressed air with a viscosity range from 0 to 100 centipoise (cp) and a design maximum of 150 cp. The maximum particle size of the liquid waste will not exceed 1/16 inch and the solids content will not exceed 15 percent by weight.

The liquid injection nozzle is slightly oversized for the application since the metering pumps are designed to handle 50 GPH. By using an oversized nozzle, potential plugging problems due to a small tip opening are avoided. The expected compressed air usage is 10 CFM for maintaining a reasonable tip velocity and to cool the tip when liquid waste is not being injected.

Drawing R-8279-D6A provides a process and instrumentation diagram of the incinerator burner system.

3.6 AUXILIARY FUEL FIRING SYSTEM

There are four auxiliary gas burners in the primary chamber each with a maximum capacity of 1.2 MM BTU/hr. The burner output will be controlled to provide the desired temperature at the outlet of the primary chamber. Each burner shall have its own pilot for ignition.

The secondary or reheat burner has a capacity 4.0 MM BTU/Hr. It is used to heat the flue gases from the primary chamber to between 2000°F and 2100°F. This burner output will be controlled to provide a constant temperature of 2000°F at the outlet of the secondary chamber. The burner will be ignited by an electric/gas pilot.

3.7 COMBUSTION AIR SYSTEM

The Primary Chamber Fan will be sized for approximately 810 SCFM and the Secondary Chamber Fan will be sized for approximately 1,900 SCFM. Both of these fans will be provided with dampers for volume control. In addition, each of the four (4) Primary Chamber Burners and the one (1) Secondary Chamber Burner will have their own fans to supply the required air for combustion of the natural gas.

3.8 ASH REMOVAL

Ash is removed from the primary chamber on a periodic basis by a special dry ash conveyor system through the ash removal drop at the end of the incinerator. The ash will be deposited in a 55 gallon steel drum. Ash samples will be taken from the collecting drum at specified intervals during the Trial Burn and composited.

3.9 RECIRCULATION TOWER

Hot flue gases from the secondary chamber at 2000°F will be mixed with cooled 250°F flue gases from the baghouse in a refractory lined recirculation tower. The resulting mixture will be controlled at 900°F. The recirculation tower will have the following dimensions:

Height:	12' - 0"
Diameter:	8' - 0"
Refractory thickness:	4"
Refractory Type:	Insulating Castable Chrome Silica
Volume of Tower:	269 ft^3

The hot flue gas inlet and recirculation gas inlet are located at the side of the tower near the top. Within the tank there is cylindrical core section with 3 or 4 openings near the bottom. The separate gases are tangentially swirled around the inside of the tower and turbulently mixed before entering the cylindrical core openings. The mixed gases exit at the top of the tank into round duct leading to the heat exchanger.

3.10 AIR TO FLUE GAS HEAT EXCHANGER

The mixed flue gases at 900°F will be cooled in a special heat exchanger by indirect cooling with ambient air. The air will be supplied by a forced draft fan. The cooled flue gases will exit the heat exchanger at a controlled temperature of 250°F. The Interel flat-tube heat exchanger lowers the temperature of the incoming flue gases (from the gas mixer) from 900°F to 250°F by indirect heat exchange with ambient cooling air. The amount of cooling air in controlled by fans having variable frequency drives in order to maintain a set temperature on the cooling tubes. Cooling air is passed within the tubes and the dirty flue gas is passed over the tubes. Fouling of the tube outside surfaces (with lime dust) is mechanically removed by chains that are automatically run up and down the outside of the flat tubes on a periodic basis.

For long term reliability of the heat exchanger against cold and corrosion and condensation during the daily start-up periods and periods of down time, a separate gas recirculation loop has been added to preheat the system above the dewpoint temperature. Just before cooldown of the incinerator and off-gas treatment system, a fresh lime dosing of the system would be injected to provide enough active lime to neutralize any HCl that would try to condense.

The overall dimensions of the heat exchanger are shown on the permit drawings and depending on the exact location of measurement the approximate dimensions are:

Length	16 feet
Width	9 feet
Height	9 feet

The heat exchanger will have the following specifications:

Heat Transfer Area:	8,611 sq. ft.
Tube Side Material:	SA 252 Mild Steel

Shell Side Material:	A-36 Mild Steel
Tube Side Flow In:	14,984 ACFM
Shell Side Flow In:	103,842 ACFM
Tube Side Pressure Drop:	2 IWG
Outlet Air Temperature:	250°F

Lime will be injected in two (2) locations at the top of the Heat Exchanger. One (1) in the top center of the first heat exchanger module and one (1) in the top center of the third heat exchanger module

The lime feed system can be switched on or off at the control panel. With the system on, the transport fan, metering screw weigh scale controlled and chart recorder are running. The discharge slide gate and feed screw operate on demand from the weigh scale controller. A reagent flow alarm is provided to detect loss of reagent flow in the transport piping after the reagent injection point. The weigh scale controller has a remote set point dial which is mounted on the air quality control system panel. Manually adjusting this dial either feeds more or less lime into the system. The HCl emissions in the flue gas are projected to be 31.9 lbs/hour, however, the air quality control system is sized to handle up to 40 lbs/hr. The lime feed metering will be set for neutralization of 40 lbs/hour to avoid any batch size adjustments during hazardous waste feeding.

3.11 DRY REACTOR

The cooled flue gases will pass into the dry reactor where the lime which has been injected into the flue gas completes its reaction with the acid gas components of the flue gas. Lime dust and ash discharged from the heat exchanger and the fabric filter are fed back to the dust conditioning drum in the bottom of the reactor to promote further reaction of the lime. The dry reactor is fabricated of carbon steel and has the following specifications:

Chamber Volume:	160 ft^3
Inside Dimensions -	
Down Pass:	2' x 3.25' x 11'
Up Pass:	1.25' x 3.25' x 19'

The dry scrubber or reaction tower is a vertical two-pass design which incorporates external recirculation. In this arrangement, the dust conditioning drum is positioned at the base of the tower and is located upstream of the fabric filter. The recirculation of dust from the fabric filter to the dust conditioning drum of the reaction tower greatly increases the efficiency of the dry additives chemisorption of gas components.

The dust conditioning drum is a simple device consisting of a rotating perforated cylinder, partially filter with ceramic balls. Process gases travel radially through the drum, where previously filtered, aged dust is retained and used to precondition the fresh dust entrained in the gas stream. The ceramic balls are free to roll within the rotating drum and act to grind the accumulated material and prevent caking and dust accumulation.

3.12 FABRIC FILTER

The flue gases from the dry reactor contain particulate in the form of ash from the incinerator, acid salts caused by the reaction of lime with acid gases and excess unreacted lime. These solids build up on the fabric surfaces of the filter and are periodically removed by on line pulsed jet cleaning. Specifications for the fabric filter are as follows:

Filter Cloth Material:	Felted Polyacryl
Square Ft. Filter Area:	3875
Flue Gas Flow:	8975 ACFM (normal)
	13,984 ACFM (design)
Air to Cloth Ratio:	3.6/1
Cleaning:	Pulsed Jet
Compressed Air Required:	90 psig

The fabric filter or baghouse has horizontally mounted bags that allow access to the clean air side from the walkway platform, for inspection or bag replacement. Cleaning of the bags is accomplished by compressed air pulsing on the interior of the filter bags. Cleaning is initiated by high differential pressure across the bags, as sensed by a differential pressure transmitter/control loop; expiration of a control timer; placing the cleaning control HOA selector in the "Hand" position and manually activating the cleaning sequence; and pressing the shutdown button on the control panel.

The fly ash/lime dust residue from the baghouse will be discharged via a screw-conveyor to an enclosed loadout cubicle of approximate dimensions 4 feet square x 6 feet high.

3.13 HEPA FILTERS AND CARBON ADSORBER

The HEPA filter system will consist of a Flanders (or equivalent) 3x2 filter with bio-hazard and nuclear grade adsorbent charcoal. The unit will consist of six prefilter elements, six HEPA elements, twelve charcoal elements and six HEPA elements in series. All elements are replaceable.

3.14 INDUCED DRAFT FAN (Prime Mover)

The I.D. Fan will be V-belt driven and sized to operate at approximately 3982 ACFM at 250°F while developing a negative pressure of 24 inches water gage. It shall be manufactured by Chicago Blower or New York Blower.

3.15 STACK

The stack will be provided by Susquehanna Concrete Products Inc. (SUSCON), Van-Packer, or another manufacturer of the same caliber. Refractory will be acid resistant, rated for continuous duty at 2,000°F with intermittent operation to a temperature of 2,200°F. The inside diameter of the stack will be 30 inches. The stack height above the ground elevation is 96 feet. The top elevation of the stack will be 439 ft. MSL.

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SECTION 4 - MONITORING

4.1 GENERAL INFORMATION

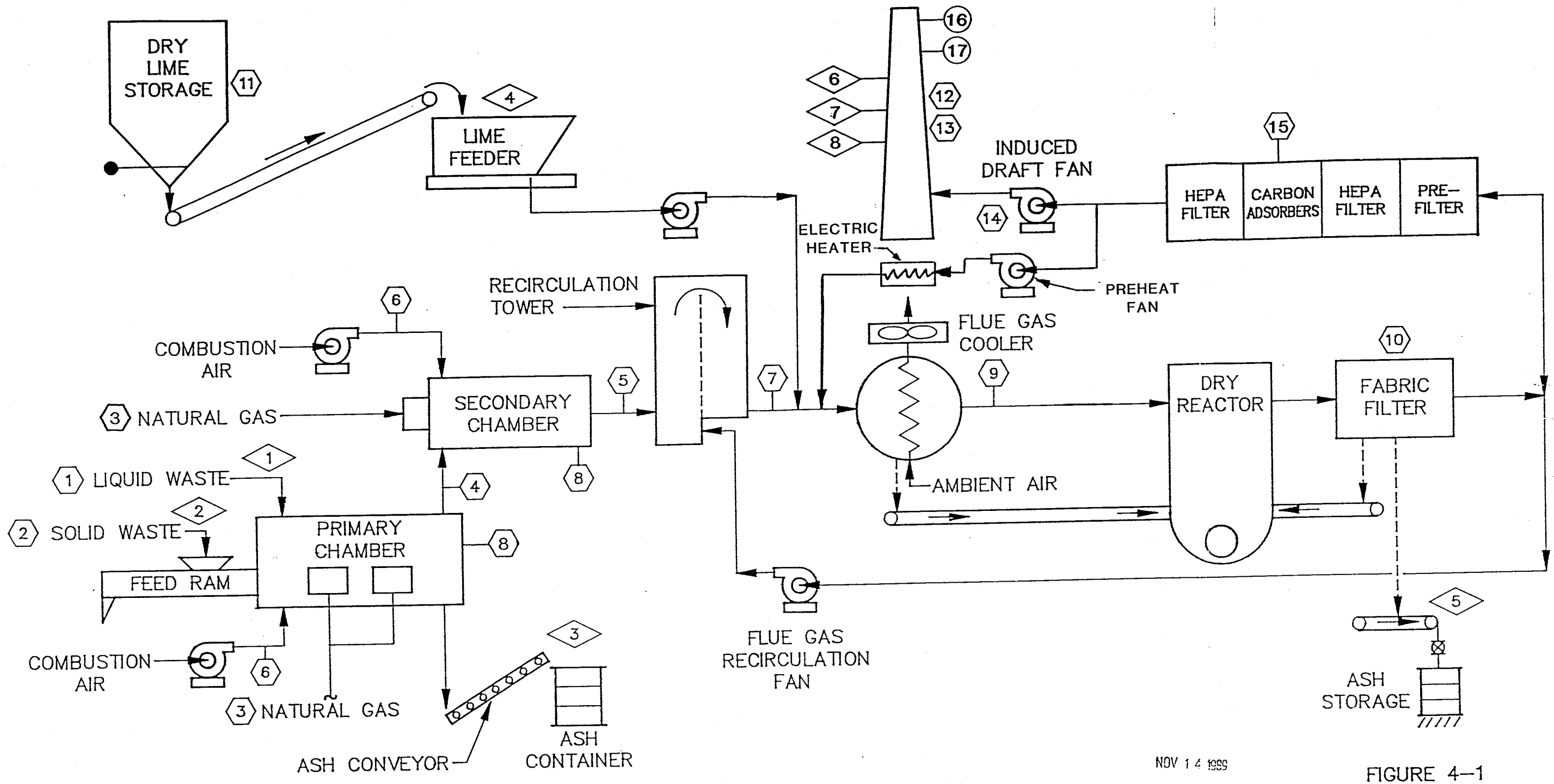
The schematic diagram Figure 4-1 shows the location of the system monitors.

4.2 PROCESS MONITORS

The primary control of the incinerator is temperature. The primary chamber temperature is controlled at 1600°F through a thermocouple located in the breeching between the primary and secondary chambers. The natural gas flow to the four gas burners is modulated to maintain the desired operating temperature. The secondary chamber temperature is similarly controlled through a thermocouple located at the exit of the secondary chamber. Natural gas to the secondary chamber gas burner is modulated to maintain 2000°F. Combustion air for the natural gas burners will be proportioned to the gas flow by a mechanical linkage at each burner. Combustion air to the primary and secondary chambers is supplied by a separate blower. The flow to the primary chamber is manually set and a motorized damper adds air to the secondary chamber to maintain the operating temperature if it cannot be controlled by modulating the burner alone.

Solid feed rates are manually programmed, or can be automatically set on a programmable timer. Liquid waste feed rates are manually set and the incinerator runs at a fixed flow condition.

The temperature of the flue gases from the recirculation tower is controlled to 900° F by modulating the flue gas flow to the flue gas recirculation blowers. The temperature from the air/flue gas cooler is controlled to 250°F by varying the cold air flow in the heat exchanger.



(3) PROCESS MONITORS – SEE SECTION 4, TABLE 4-1

(10) FLUE GAS MONITORS – SEE SECTION 4, TABLE 4-2

<1> TRIAL BURN SAMPLING POINTS – SEE SECTION 4, TABLE 4-3

NOV 14 1989

FIGURE 4-1

REV.	DATE	BY	DESCRIPTION
A	11-14-89	J.E.K.	ENGINEERING CHANGE

DRN:	J.E.K.	9-13-89
CHKD:		
APPD:		
SCALE:		
JOB NO.	8906-08	
CUSTOMER:		
DWG. NO.		

FOUR NINES, INC.
CONSHOHOCKEN, PENNSYLVANIA

GLAXO, INC.
INCINERATOR SYSTEM

REV. | DWG. NO. BX-72-0-082 | REV. A

The flow of dry lime into the flue gas stream is manually set based upon the expected acid gas concentration in the flue gas. Similarly the rate of ash removal is set by manually adjusting the ash conveyor speed and ash transfer ram cycle timers.

Pressure control in the system is through pressure transmitters located in the flue gas outlets from the primary and secondary chambers. The fan damper on the inlet to the induced draft fan will modulate to maintain the proper draft on the system.

Pressure drop across the baghouse will control the cleaning frequency of the bags. Pressure drop across the HEPA filters and charcoal adsorbers will indicate the necessity for changing these units.

The location of the process monitors are shown schematically on Figure 4-1 and listed in Table 4-1.

TABLE 4-1

PROCESS MONITORS

ITEM	FUNCTION	DEVICE
1. LIQUID WASTE	FLOW	FLOWMETER
2. SOLID WASTE	WEIGHT/TIME	AUTOMATIC FEEDER
3. NATURAL GAS	FLOW	FLOWMETER
4. FLUE GAS/PRIMARY	TEMPERATURE	THERMOCOUPLE
5. FLUE GAS/SECONDARY	TEMPERATURE	THERMOCOUPLE
6. COMBUSTION AIR	FLOW	FLOWMETER
7. RECIRC. TOWER EXIT	TEMPERATURE	THERMOCOUPLE
8. INCINERATOR	PRESSURE	PRESS. TRANS.
9. HX OUTLET	TEMPERATURE	THERMOCOUPLE
10. FABRIC FILTER	PRESSURE DROP	D/P TRANSMITTER
11. LIME USAGE	WEIGHT	WEIGHT TRANS.
12. STACK GAS	FLOW	FLOWMETER
13. STACK GAS	TEMPERATURE	THERMOCOUPLE
14. I.D. FAN	AMPERAGE	AMMETER
15. HEPA FILTER	PRESSURE DROP	D/P TRANSMITTER

NOTE: The final design for the incinerator system will specify the appropriate type of process monitoring device. For example, the specific types of thermocouples (i.e., J, E, K, S, R, or B) will be selected based on temperature range, location and the specific environmental effects.

4.3 FLUE GAS MONITORS

Continuous stack monitoring for carbon monoxide will be achieved through extractive monitoring systems as described in Table 4-2. The sampling points for these monitors will be located as shown on Figure 4-1.

A visual and audible alarm will be activated at 100 ppm CO concentration levels in the stack. The waste feed will automatically be cut off if the rolling 60 minute average CO concentration exceeds 100 ppm on a dry basis, corrected to 7% oxygen.

A single point mass flowmeter is installed in the stack to continuously monitor the flue gas flow. The purpose of this measurement is to assure a residence time of at least two seconds in the secondary combustion chamber. Since it is impractical to measure the hot gases exiting from the secondary chamber, the stack gases will relate to the residence time. The stack gas flow is limited to 5,774 ACFM. Flows above this will cause automatic waste feed cutoff. The stack gas flow meter is a Kurz Model No. 455-16-4-N4W-D-132-111 or equivalent.

The intent of the single point mass flowmeter is to establish a stack flow which can be directly related to the flow in the secondary combustion chamber, and therefore preclude a combustion gas residence time in the SCC which is less than 2 seconds.

The measurement of flow in particulate laden, high temperature lines is difficult; therefore, flow measurement at the outlet of the SCC is not desireable. In the Glaxo incinerator system, dry lime is added beyond the SCC making flow measurement in the downstream piping unadvisable until the particulate is removed.

The use of stack gas flow to determine SCC residence time (an automatic feed cutoff parameter) is an accepted method. The stack flow cutoff point (5,774 acfm) is based upon its relationship to SCC residence time of 2.0 seconds. Inasmuch as the trial burn protocol, Tables 6-1 and 6-2 show ample margin over the normally prescribed 2 second residence time, stack gas (i.e., residence time) should not be a critical operating parameter.

TABLE 4-2

FLUE GAS MONITORS

ITEM	DESCRIPTION
16. CONTINUOUS OXYGEN ANALYZER	Teledyne Model 326RB-I-20-2x or equivalent. Range 0-25%. Utilizes an electrical transducer for signal generation in proportion to oxygen content.
17. CONTINUOUS CO ANALYZER	Non-dispersive/infrared analyzer w/extractive system. Beckman #880 or equivalent. Range 0-200 ppm. Calibration with standard gas. 4-20 mA output is received by the programmable logic controller (PLC).

4.4 AUTOMATIC WASTE FEED CUTOFF

The waste feed to the incinerator will automatically be shut off (in the case of the bulk liquid waste) and the waste feed mechanism automatically taken out of service for the solid waste if any of the following conditions occur:

1. CO concentration in the flue gas of > 100 ppm dry basis on a sixty minute rolling average, corrected to 7% oxygen.

2. Electric power failure.

3. The temperature in the primary chamber exceeds 2000°F or the temperature in the secondary chamber exceeds 2200°F.

4. The temperature in the primary chamber drops below 1000°F or the temperature in the secondary chamber drops below 1700°F.

5. If the natural gas pressure is less than 1" W.C.

6. Failure of any of the combustion air blowers as measured by a discharge pressure below 0.5" W.C.

7. Stack Gas Flow above 5774 ACFM.

8. Flame failure in primary and/or secondary burners.

9. There are visible fugitive emissions from the incinerator. (In this event, the waste feed will be shut off manually.)

10. Failure of the ash conveyor system.

11. Failure of the lime system.

12. Temperatures over 1000°F into the heat exchanger.

13. Temperatures above 260°F to the fabric filter.

14. Secondary combustion chamber pressure greater than -0.05 inches water gage.

4.5 TRIAL BURN SAMPLING POINTS

The Trial Burn sampling points are shown on Figure 4-1 and Table 4-3.

TABLE 4-3

TRIAL BURN SAMPLING POINTS

SAMPLING POINT NO.	DESCRIPTION
1.	LIQUID WASTE
2.	SOLID WASTE
3.	INCINERATOR ASH
4.	LIME
5.	ASH FROM FABRIC FILTER
6.	HCl
7.	POHCs BY VOST & MM-5
8.	PARTICULATE/O_2/CO/METALS

4.6 CALIBRATION

The analyzers for oxygen and carbon monoxide will be calibrated according to the manufacturer's procedures.

All temperature sensing thermocouples will be calibrated at three conditions. These conditions include an ice bath, boiling water, and hot oil (corrected for barometric pressure). These conditions will be measured using an ASTM mercury-in-glass thermometer as a reference. During the calibration, the data obtained from the thermocouples must agree within approximately 1.5% of the reference thermometer. If the calibration data is not within this range then corrective action will be taken. This corrective action will determine a correction factor for each thermocouple.

SECTION 5 - TRIAL BURN

5.1 SELECTION OF PRINCIPAL ORGANIC HAZARDOUS CONSTITUENTS (POHCs)

As provided for in 40CFR 270.62 (b) (4), POHCs must be designated for a Trial Burn and the DRE of the incinerator calculated for these compounds. Because the bulked liquid waste may contain many different Appendix VIII compounds and other listed wastes in small quantities and because the solid waste can also contain these materials in trace amounts, it seems reasonable to suggest surrogate waste materials as POHCs which will be added to the bulk liquid and solid wastes for the Trial Burn.

One of the criteria for the selection of these POHCs is that they be more difficult to burn than existing waste materials. The USEPA IERL Incinerability List has been the primary basis for this determination until recently.

A more recently developed criteria for POHC selection is a Thermal Stability Index provided in the USEPA publication EPA/625/6-89/019 "GUIDANCE ON SETTING PERMIT CONDITIONS AND REPORTING TRIAL BURN RESULTS, VOLUME II OF THE HAZARDOUS WASTE INCINERATION GUIDANCE SERIES". This document lists the relative thermal stability of 320 compounds, with those at the top of the list (lowest number) being the most stable and therefore the hardest to break down thermally.

Another implied criterion is that the POHC be capable of VOST sampling, if possible, although the North Carolina Hazardous Waste Section generally prefers that a solid POHC be used with solid waste.

In order for a reasonable material balance to be made on the system, the selected POHC must be present in a sufficient known quantity. While the Glaxo waste profile shows many compounds, none are either constant or guaranteed to be present.

Of the compounds present in the waste which could be considered POHCs, the one with the lowest heating value is Carbon Tetrachloride, which is ranked #4 on the Incinerability List and #136-140 on the Thermal Stability List.

Other POHC selection considerations are:

- Physical State: POHCs should be limited to liquids or solids at ambient temperatures and pressures. This facilitates handling and containment.
- Stability: Compounds selected as POHCs must be stable enough to allow for conventional VOST or Modified Method 5 sampling techniques.
- Availability and Cost: The compounds selected as POHCs should be readily available at reasonable cost and in common use and be reasonably expected to appear in the waste.
- If VOST sampling is to be used, the compounds cannot be water soluble and should have a boiling point of less than 140°C and preferably closer to 100°C.

Carbon Tetrachloride is a stable compound, readily available at reasonable cost and has a boiling point of 170.24°F (76.8°C) and a heat of combustion of 432 BTU/lb. None of the three more highly ranked compounds on the Incinerability List will be in the waste. Also each of the more highly ranked compounds are difficult to use as a POHC because of physical state, stability and availability. Carbon Tetrachloride is recommended as a POHC.

1,2-Dichlorobenzene is also a stable liquid compound which is readily available at reasonable cost. It has a boiling point of 356.7°F (180.4°C) and a heat of combustion of 8226 Btu/lb. It is ranked #122 on the Incinerability List and #23-24 on the Thermal Stability List. 1,2-Dichlorobenzene is recommended as a POHC. While it is not truly a volatile organic it can be measured by VOST and also by EPA MM-5.

The incinerator will burn both solid and liquid hazardous wastes. Two POHCs are desirable and EPA Region IV and the North Carolina Hazardous Section generally prefer that solid hazardous waste incinerators employ at least one solid POHC. A solid material which is both high on the Incinerability List (# 28) and also high on

the Thermal Stability List (# 31-33) is Hexachlorobenzene. It has a heating value of 3222 BTU/lb. and is solid at ambient temperatures. It is available at reasonable cost, is a stable compound and is also present in the waste. It is not however, suitable for VOST sampling but can be sampled using Modified EPA Method 5. Hexachlorobenzene is recommended as a POHC.

POHC selection criteria never agree entirely. For this reason POHCs have been selected using various methods. The selected POHCs should provide confidence that the incinerator can destroy all organic compounds which might be present in the Glaxo waste streams.

5.2 TRIAL BURN WASTE DESCRIPTION

There will be two generic types of waste burned during the Trial Burn, liquid wastes and solid wastes. These wastes will consist of hazardous waste, non-hazardous waste and radioactive waste. Glaxo intends to use the incinerator for all of these wastes in a random fashion, i.e. any of these waste categories or types may be burned in the incinerator at the same time or in any sequence. The most probable operating scenario will be to burn the wastes at a rate proportional to their generation. For this reason Stage #1 of the Trial Burn will be run on this basis. This will provide the best evidence that the incinerator can perform as required with the widest variety of feed materials.

Glaxo, however, desires to obtain a hazardous waste incineration permit which will not limit their operation in terms of the amount of liquid hazardous waste burned per hour in the event they should wish to increase the amount of liquid waste in the composite wastestream for a short time period. For this reason, Test Stage #2 is proposed, where liquid wastes will be burned up to the design capacity of the liquid waste feed system and the incinerator.

Trial Burn Stage # 1 will use the waste materials outlined in Section C of the Part B Application in approximate proportions to their generation rate at the Glaxo facility. These waste rates and approximate heating values are shown in Table 5-1.

Trial Burn Stage #2 will increase the hazardous waste content of the mixture to a maximum while reducing the solid waste proportionately, consistent with the capacity of the incinerator system. The waste rates for Test Stage #2 are shown in Table 5-2.

TABLE 5-1

TRIAL BURN WASTES - TEST STAGE # 1

WASTE DESCRIPTION	UNITS/HR	LB/HR	BTU/LB	MM BTU/HR
1. HAZARDOUS				
(a) Solvents		192	11125	
(b) Chemicals *		8	11125	
Total				2.23
2. SOLID WASTE				
(a) Somat	3	150	5800	0.87
(b) Carcasses	4	272	1000	0.272
(c) Disposables	1	40	6000	0.240
(d) Infectious	2	50	6000	0.300
3. RADIOACTIVE/HAZARDOUS				
(a) Solvents *		15	11125	0.167
(b) Scintillation	3	48	18000	0.864
4. RADIOACTIVE/SOLID				
(a) Carcasses	1	68	1000	0.068
(b) Bedding	1	25	5800	0.145
(c) Disposables	1	40	6000	0.240
TOTALS	16	908		5.328

* These waste rates will be added to waste 1a.

TABLE 5-2

TRIAL BURN WASTES - TEST STAGE # 2

WASTE DESCRIPTION	UNITS/HR	LB/HR	BTU/LB	MM BTU/HR
1. Solvents		350	11125	3.89
2. Carcasses	5	340	1000	0.340
3. Somat Waste	5	250	5800	1.450
TOTALS	10	940		5.68

5.3 PREPARATION OF WASTE MIXTURES

In Test Stage # 1 the incinerator system will be operated in a manner similar to the normal operation. Only solvent wastes, as described on Table 5-1, are fed through the liquid nozzle. The liquid injector will be fed from only one tank at a time. Because waste 1b and waste 3a are expected in such small quantities they will not actually be included in the Trial Burn, but their quantities will be represented by increasing waste 1a to a total of 215 lb/hr. The remainder of the waste, 693 lb/hr, will be fed as solid waste through the ram feeder. This quantity represents 16 boxes or containers/hr of solid waste.

Glaxo segregates halogenated waste from non-halogenated waste. Because Carbon Tetrachloride and Dichlorobenzene are POHCs it is desireable to use all non-halogenated liquid solvent as the liquid waste and add the POHCs to it. For the Trial Burn the tare weight of each 55-gallon drum will be determined and then it will be filled with 320.7 lb of waste solvent to which 13.02 lb of virgin Carbon Tetrachloride and 16.28 lb of Dichlorobenzene will be added and thoroughly mixed. Each drum of feed material shall be prepared before the Trial Burn, sampled and stored. On the day of the Trial Burn, the feed material will be placed in a 500 gallon tank from which the waste will be fed to the incinerator.

The solid waste will be "spiked" with both Hexachlorobenzene and Dichlorobenzene. The weight of solid feed to the incinerator is 648 lb/hr in 16 containers, or 40.5 lb per container. 30 lb/hr of Hexachlorobenzene and 15 lb/hr of Dichlorobenzene will be the POHC feed rate. Therefore 1.875 lb of Hexachlorobenzene and 0.9375 lb of Dichlorobenzene will be weighed, placed in compatible glass or plastic containers, sealed and placed into each of the 16 containers of solid waste. Glaxo shall try to eliminate all three POHCs from the normal waste streams, but every waste will be sampled and analyzed so that background concentrations of Carbon Tetrachloride, Dichlorobenzene and Hexachlorobenzene will be accounted for.

Test stage #2 wastes will be prepared in the same manner but with the following quantities:

LIQUID WASTE:

Solvent	318 lb.
Carbon Tetrachloride	12 lb.
Dichlorobenzene	20 lb.

SOLID WASTE:

Solid Waste	568 lb =	35.5 lb/box
Hexachlorobenzene	12 lb =	1.875 lb/box
Dichlorobenzene	10 lb =	0.9375 lb/box

5.4 WASTE QUANTITIES

The quantity of each waste and each POHC required for the Trial Burn is shown in Table 5.3. A Trial Burn sampling run can be as long as 3 hours. Three runs are recommended for each condition. Therefore the Trial Burn waste quantities should provide for at least 16 hours per Test Condition or Stage in order to provide for unforseen mistrials. The waste and POHC quantities are based on 16 hours per Stage.

TABLE 5-3

TRIAL BURN MATERIAL QUANTITIES

	WASTE	TOTAL WEIGHT, LB
TEST STAGE # 1		
1.	SOLVENT WASTE	3440
2.	SOMAT	2440
	CARCASSES	4352
	DISPOSABLES	640
	INFECTIOUS	800
3.	SCINTILLATION	768
4.	RADIOACTIVE	
	CARCASSES	1088
	BEDDING	400
	DISPOSABLES	640
5.	CARBON TETRACHLORIDE	128
6.	HEXACHLOROBENZENE	480
7.	DICHLOROBENZENE	400
TEST STAGE # 2		
1.	SOLVENT WASTE	5600
2.	CARCASSES	5440
3.	SOMAT	4000
4.	CARBON TETRACHLORIDE	192
5.	HEXACHLOROBENZENE	192
6.	DICHLOROBENZENE	480

6.0 TEST CONDITIONS

The waste fed to the Glaxo incinerator is highly variable in its heating value, water content and chemical content. It is therefore difficult to present anything more than an approximation of the actual Trial Burn test conditions in terms of the incinerator output. Tables 6-1 and 6-2 represent the best estimate of the output conditions from Test Stage # 1 and #2 respectively, based upon the input conditions described in Tables 5-1 and 5-2 plus the POHCs.

During the Trial Burn the air pollution control equipment will be operated in accordance with the manufacturer's operating requirements. Drawing R-8279-D7, Off-Gas Treatment System, Process Flow Diagram lists the design and normal operating conditions at various points in the system.

As discussed in Section D-5 of the application the HCl emissions in the flue gas during normal operation is projected to be 31.9 lbs/hr, however the air pollution control equipment was designed based on 40 lbs/hr. In order to demonstrate the system's capability during worst case conditions, Test Stage #1 has been developed to demonstrate compliance with an organically bound chlorine feed rate of approximately 41.8 lbs/hr.

TABLE 6-1

INCINERATOR OPERATING CONDITIONS - TEST STAGE # 1

Temperature- Primary Chamber °F	1,600
Temperature- Secondary Chamber °F	2,000
Liquid Waste Feed, lb/hr (Total)	215
Carbon Tetrachloride Feed, lb/hr	8.0
Dichlorobenzene Feed, lb/hr	10.0
Approximate Heating Value, BTU/lb	11,125
Solid Waste Feed, lb/hr (Total)	693
Hexachlorobenzene Feed, lb/hr	30
Dichlorobenzene Feed, lb/hr	15
Approximate Heating Value, BTU/lb	4,329
Batch Size, lb	25-68
Natural Gas Rate,lb/hr	26.0
Total Combustion Air,	
lb/hr	8,008
ACFM @ 80 °F	1,842
Total Heat Release, MM BTU/hr	5.51
Total Combustion Products	
lb/hr	8,796
ACFM @ 2000 °F	9,098
Velocity in Secondary Chamber, fps	4.7
Residence Time, sec	3.0
Stack Gas Flowrate, ACFM	2,615
Stack Gas Velocity fps	8.9
Maximum CO in Flue Gas, ppm	
Continuous	100

TABLE 6-2

INCINERATOR OPERATING CONDITIONS - TEST STAGE #2

Temperature- Primary Chamber °F	1,600
Temperature- Secondary Chamber °F	1,900
Liquid Waste Feed, lb/hr (Total)	350
Carbon Tetrachloride Feed, lb/hr	12
Dichlorobenzene Feed, lb/hr	20
Approximate Heating Value, BTU/lb	11,125
Solid Waste Feed, lb/hr (Total)	590
Hexaclorobenzene Feed, lb/hr	12
Dichlorobenzene Feed, lb/hr	10
Batch Size, lb	50-68
Approximate Heating Value, BTU/hr	3,034
Natural Gas Rate, lb/hr	26
Total Combustion Air	
lb/hr	8,847
ACFM @ 80 °F	2,033
Total Heat Release, MM BTU/hr	5.75
Total Combustion Products	
lb/hr	9,684
ACFM @ 1900 °F	9,634
Velocity in Secondary Chamber, fps	5.0
Residence Time, sec	2.9
Stack Gas Flowrate, ACFM	2,890
Stack Gas Velocity, fps	9.8
Maximum CO in Flue Gas, ppm	
Continuous	100

SECTION 7 - TRIAL BURN TEST SCHEDULE AND REPORT

7.1 TRIAL BURN TEST SCHEDULE

The Trial Burn is expected to take six days of testing. Several days will be required to set up and calibrate all sampling and monitoring equipment prior to the Trial Burn. One day will be required to remove the sampling equipment.

The proposed daily schedule for the Trial Burn is shown in Table 7-1.

TABLE 7-1

TRIAL BURN - DAILY SCHEDULE

FIRST DAY

TIME	ACTIVITY	INCINERATOR CONDITION
0700	BRING INCINERATOR TO OPERATING TEMP.	NATURAL GAS OPERATION
0800	FINAL QA/QC CHECKS	STEADY STATE AT TEST TEMPERATURE
0900	BEGIN WASTE FEED	STEADY STATE
1000	BEGIN SAMPLING RUN # 1	STEADY STATE
1300	END SAMPLING RUN # 1	STEADY STATE
1400	QA/QC CHECKS CHECK TEST EQUIPMENT	STEADY STATE

SECOND DAY	REPEAT ABOVE SCHEDULE FOR STAGE # 1, RUN #2
THIRD DAY	REPEAT ABOVE SCHEDULE FOR STAGE # 1, RUN #3
FOURTH DAY	REPEAT ABOVE SCHEDULE FOR STAGE #2, RUN #1
FIFTH DAY	REPEAT ABOVE SCHEDULE FOR STAGE #2, RUN #2
SIXTH DAY	REPEAT ABOVE SCHEDULE FOR STAGE #2, RUN #3

7.2 TRIAL BURN REPORT

Process data which is not recorded by continuous monitors will be recorded every fifteen minutes during each sampling run of the Trial Burn. There will be three sampling runs for each of two Trial Burn Stages (test conditions).

Table 7-2 represents the process data collection requirements for one sample run.

A final Trial Burn Report will be prepared containing all of the raw data collected during the Trial Burn. This report will condense the data and provide calculations as well as a heat and material balance for the system.

Included in the Trial Burn Report will be:

- A quantitative analysis of the trial POHCs in the waste feed to the incinerator
- A quantitative analysis of the exhaust gas for the concentration and mass emissions of the trial POHCs, oxygen (O_2) and hydrogen chloride (HCl).
- A quantitative analysis of ash residues, ash from the fabric filters, and lime for the purpose of estimating the fate of the trial POHCs.
- A computation of destruction removal efficiency (DRE), in accordance with the DRE formula specified in 40 CFR 264.343(a).
- A quantitative analysis of the HCl emission rate. If the HCl emission rate exceeds four (4) pounds per hour, a computation of the HCl removal efficiency in accordance with 40 CFR 264.343(b) will be provided.
- A computation of particulate emissions in accordance with 40 CFR 264.343(c).
- An identification of sources of fugitive emissions and their means of control.

- o A measurement of average, maximum, and minimum temperatures an d combustion gas velocity.
- o A continuous measurement of carbon monoxide (CO) in the exhaust gas.

Glaxo will include in the Trial Burn Report, a certification that the trial burn was carried out in accordance with the approved trial burn plan.

Glaxo will submit the Trial Burn Report within 90 days of completion of the trial burn, or later if approved by the NC Hazardous Waste Section.

TABLE 7-2

PROCESS DATA SHEET

SAMPLING RUN NO:

DATE:

TIME:

---

1. Liquid waste feed rate, lb/hr
2. Solid waste feed rate:

   lb/container.

   Containers/hr.
3. Primary combustion chamber temperature.
4. Secondary combustion chamber temperature.
5. Total natural gas flow, lb/hr.
6. Ash collected from incinerator, lb/Test Stage.
7. Ash collected from APC equipment, lb/Test Stage.
8. Lime added to APC system, lb/hr.
9. Heat exchanger inlet temperature.
10. Heat exchanger outlet temperature.
11. Stack temperature.
12. Stack gas flow, ACFM.
13. Stack gas oxygen %.
14. Stack Gas CO %.

SECTION 8.0
SAMPLING PROCEDURES

Table 8-1 summarizes all sampling and analytical procedures to be used during the program. Following are descriptions of the sampling methods to be performed at the stack.

8.1 SAMPLING POINT DETERMINATION - EPA METHOD 1

The number and location of the sampling or traverse points will be determined according to the procedures outlined in EPA Method 1. The location of traverse points will be in strict compliance with EPA Method 1.

8.2 FLUE GAS VELOCITY AND VOLUMETRIC FLOW RATE - EPA METHOD 2

The flue gas velocity and volumetric flow rate will be determined according to the procedures outlined in EPA Method 2. Velocity measurements will be made using type S pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Accordingly, each has been assigned a coefficient of 0.84. Differential pressures will be measured with Magnehelic gauges of appropriate range or with fluid manometers. Effluent gas temperatures will be measured with chromel-alumel thermocouples equipped with hand-held digital readouts.

8.3 FLUE GAS COMPOSITION AND MOLECULAR WEIGHT - EPA METHOD 3

Flue gas analysis for carbon dioxide and oxygen and the calculation of percent excess air and flue gas dry molecular weight will be performed in accordance with EPA Method 3. Multi-point, integrated sampling will be used to obtain a constant rate sample of flue gas concurrent with the particulate testing. A stainless steel probe will be affixed to the particulate sampling probe for this purpose. A peristaltic pump, delivering 500 to 750 ml/min of flue gas, will be used to fill a Tedlar bag. Moisture will be removed from the sample gas by means of a knockout jar located

TABLE 8-1
SAMPLES AND ANALYTICAL PROCEDURES

SAMPLES TO BE TAKEN	SAMPLE FREQUENCY FOR EACH RUN	METHOD[a]	SAMPLING PARAMETER	ANALYSIS[b] METHOD	ANALYTICAL[c] LABORATORY
Waste feed liquid	1 per 15 min.	SOO4	Carbon Tetrachloride	SW-846 8010	OLI
			Dichlorobenzene	SW-846 8120	OLI
			Chlorine	AOAC 11ED. 6.187	OLI
			Ash	AOO1(b)	OLI
			% H_2O	AOO1(b)	OLI
			Heating Value	AOO6	OLI
			Viscosity	AOO5	OLI
			Flashpoint	COO1	OLI
			Metals	SW-846 7000s	OLI
Waste feed solid	1 per 15 min.	SOO7	Dichlorobenzene	SW-846 8120	OLI
			Hexachlorobenzene	SW-846 8120	OLI
			Chlorine	AOAC 11ED. 6.187	OLI
			Ash	AOO1(b)	OLI
			% H_2O	AOO1(b)	OLI
			Heating Value	AOO6	OLI
			Metals	SW-846 7000s	OLI
Incinerator Ash	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			EP Tox	SW-846 1310	OLI
Lime Feed	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			Chlorine	AOAC 11 ED. 6.187	OLI
Baghouse Ash	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			Chlorine	AOAC 11 ED. 6.187	OLI
			EP Tox	SW-846 1310	OLI
Stack Gas	2 hr. run	EPA M2	Velocity	EPA M2	EEI
	2 hr. run	EPA M3	O_2 + CO_2	EPA M3	EEI
	2 hr. run	EPA M4	Moisture	EPA M4	EEI
	2 hr. run	EPA M5	Particulate	EPA M5	EEI
		MMTL	Metals	SW-846 7000s	OLI
	2 hr. run	EPA MM5	Hexachlorobenzene	SW-846 8270	TLI
			Dichlorobenzene	SW-846 8270	TLI
	2 hr. 40 min. run	VOST	CCl_4	SW-846 5040	TLI
	2 hr. run	EPA Draft	HCl	Ion chromatography	EEI
	2 hr. run	EPA M10	CO	EPA M10	EEI

(a) SOO- and AOO- Sampling and analytical methods from "Sampling and Analysis Methods for Hazardous Waste Incinerators, "First Edition, EPA, 1982.

(b) SW-846 Analytical methods from "Test Methods for Evaluating Solid Wastes," September, 1986.

(c) OLI - Oxford Laboratories, Inc.
EEI - Entropy Environmentalists, Inc.
TLI - Triangle Laboratories, Inc.

prior to the pump. Sampling will be of the same duration (except purges following port changes) as the particulate runs.

Analysis will be performed by Orsat apparatus. Prior to each series of analyses, the Orsat will be leak checked to confirm that there is less than 0.2 ml change in five minutes. Analyses for a given sample must agree within 0.3% by volume.

8.4 FLUE GAS MOISTURE CONTENT - EPA METHOD 4

The flue gas moisture content will be determined in conjunction with each EPA Method 5 type train and according to the sampling and analytical procedures outlined in EPA Method 4. The impingers will be connected in series and will contain reagents as described in the respective method. The impingers will be contained in an ice bath in order to assure condensation of the moisture in the flue gas stream. Any moisture that is not condensed in the impingers is captured in the silica gel, therefore all moisture can be weighed and entered into moisture content calculations.

8.5 PARTICULATE AND TRACE METALS -
EPA METHOD 5/MULTI-METAL SAMPLING TRAIN

A combined EPA Method 5 and an EPA Draft Multi-Metal Sampling Train will be used to collect particulate, inorganic lead, and the metals of interest (Sb, As, Ba, Be, Cd, total Cr, Pb, Hg, Ag, and Tl). This train is operated in the same manner as a regular EPA Method 5 sampling train. Pretest preparations, preliminary determinations, and leak check procedures will be those outlined in EPA Method 5. The average sampling rate for each run will be within ± 10% of 100% isokinetic conditions. Each test run will be a minimum of two (2) hours in duration and will sample a minimum of 60 dry standard cubic feet. Borosilicate glass probe liners and nozzles will be used to avoid possible contamination. All materials and equipment used in testing by Entropy meet or exceed USEPA

requirements. Figure 8-1 presents a schematic of the EPA Method 5/MMTL sampling train.

The reagents placed in the impingers will be as follows: 100 ml of 0.1N HNO_3/10% H_2O_2 in each of the first two impingers, the third will remain empty, the fourth will contain 100 ml of acidic $KMnO_4$, and 200 grams of silica gel in the fifth impinger. In addition an ultra pure low metals filter which meets EPA Method 5 specifications will be used instead of the normal EPA Method 5 filter for QA purposes. The low metals filter is a Pallflex 2500QAT-UP quartz filter. The filter will be placed between the probe exit and the first impinger.

The amount of condensate collected will be determined as required by EPA Method 5. The front half of the sampling train will be first rinsed with acetone to recover particulate matter then with 0.1N nitric acid to recover the metals. After impinger adsorbing solution recovery, all sample exposed components will be rinsed into appropriate containers with 0.1N nitric acid. SW-846 Methods (atomic absorption (AA)) will be used to determine the concentration of the metals. The filter, impinger catches, and the rinse will be analyzed for the metals. Filter makeup and recovery will be performed using a Teflon spatula and Teflon coated tweezers. A Teflon brush will be used for rinsing the probe.

For the metals analyses, the HNO_3 front half rinse will be evaporated to near dryness in a Teflon beaker. The filter, loose particulate, 3 mL of concentrated HNO_3, and 5 mL of concentrated HF will be added to the beaker. The sample will be digested on a hotplate until brown fumes are evident, indicating the destruction of organic matter. After the addition of concentrated HNO_3, the reagent and impinger's rinse will be evaporated to dryness in a Teflon beaker on a hotplate. After cooling, 3 mL of concentrated HNO_3 and 5 mL of concentrated HF will be added to the beaker and the sample will be fumed on a hotplate to destroy organic residue. The prepared

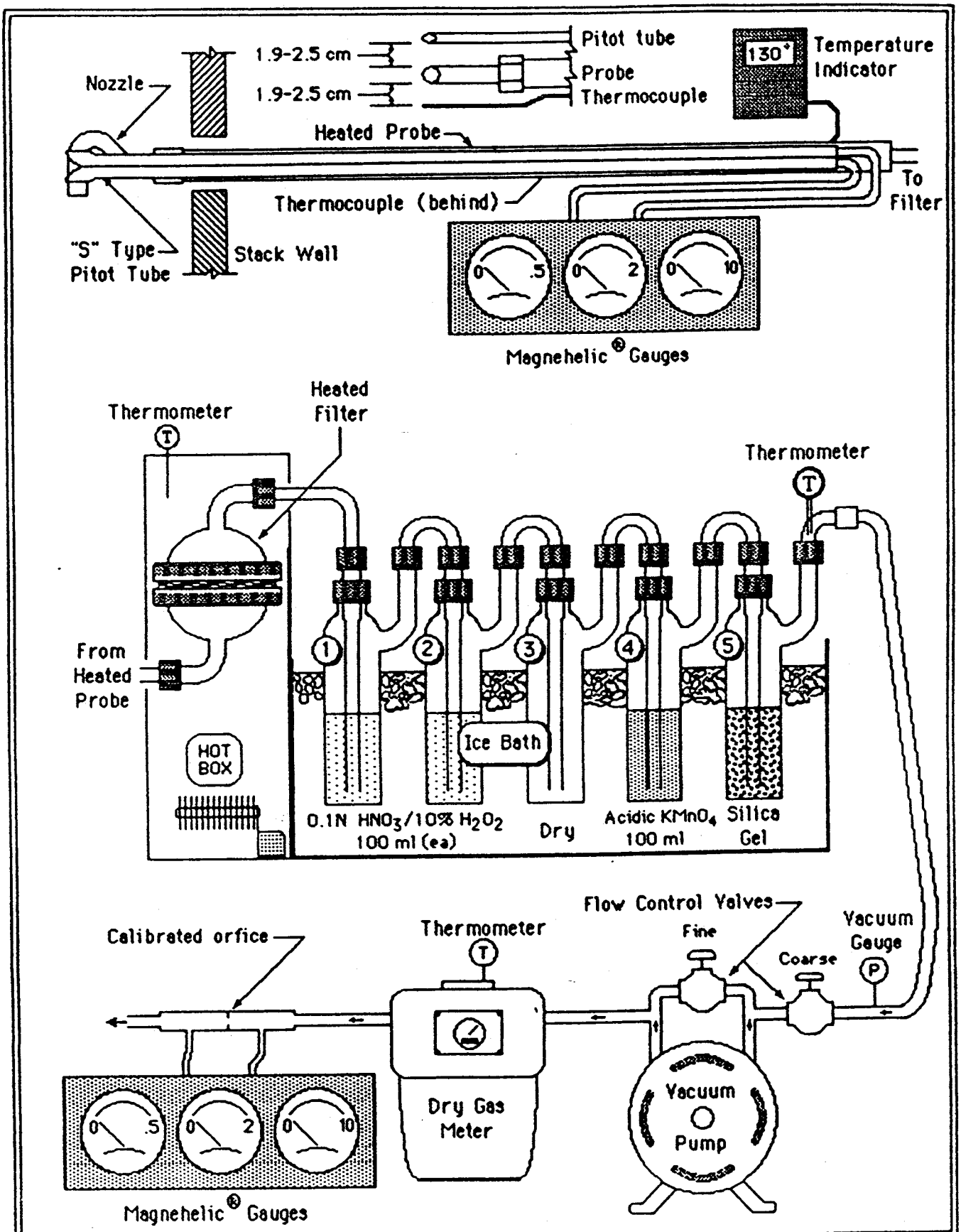


FIGURE 8-1. METHOD 5/MMTL SAMPLING TRAIN.

filter and water samples will be combined and brought to a final volume of 100 mL with 10% HNO_3. After preparation, the samples will be analyzed with a Perkin Elmer 3030 atomic absorption analyzer.

An acetone blank will be checked for residue prior to field use for the EPA Method 5 train. The filters will be checked for background metals contamination and duplicate analyses will be performed for MMTL samples. In addition a field blank, a reagent blank, and a filter blank will be analyzed for the metals. During analysis, spikes will be added to determine recovery efficiencies for the metals.

8.6 HYDROGEN CHLORIDE - EPA DRAFT METHOD 26

The sampling and analytical procedures outlined in the EPA Draft Method will be followed to determine hydrogen chloride (HCl) emissions. The sampling train impinger system will contain 15 mL of 0.1N sulfuric acid in the first two impingers, the third impinger will remain empty and 15 mL of 0.1N sodium hydroxide in the fourth impinger, and 30 grams of silica gel in the fourth impinger. The end of the probe will be directed away from the flue gas flow, and a teflon wool plug will be inserted into the probe to remove particulate matter. The sampling train will be operated at a single point at a constant sampling rate of two liters per minute for 120 minutes. The sampling probe will be purged for five minutes prior to isolating the sample.

The sulfuric acid solution will be analyzed using ion chromatography techniques for HCl. Duplicate analyses will be performed on the samples and a reagent blank.

8.7 VOLATILE ORGANIC SAMPLING TRAIN - SW-846 METHOD 0030

Volatile Organic Sampling Train (VOST) will be used to measure emissions of carbon tetrachloride. The VOST system is designed to draw effluent flue gas through a series of sorbent traps. The first trap will contain Tenax resin, and the second will contain a section of Tenax followed by a section of activated charcoal. The Tenax trap will be preceded by a water-cooled condenser arranged so that condensate will drain vertically through the Tenax. The temperature is monitored at the exit of the first trap and is kept below 68°F. Saturation at 68°F is less than 2.5%. The VOST system is depicted schematically in Figure 8-2.

The Tenax resin will be soxhlet extracted with toluene for 16 hours, dried in an oven at 100°C, and then packed in sampling tubes. The tubes will be placed in a Nutech VOST tube conditioner and conditioned with Nitrogen at 180°C for twelve hours. A contamination check will be performed on the VOST tubes as described in SW-846 Method 0030 Section 4.4. The conditioned tubes, accompanied by charcoal tubes will be placed in Ziploc bags and then stored in a freezer.

Sampling will take place for 2 hours and 40 minutes per run; three runs will be performed during the trial burn. Each pair of traps will be replaced every 40 minutes so that four pairs of traps will be collected per run, twelve pairs during the trial burn. Three of the four pair of VOST tubes will be analyzed for each run to represent a two hour test run. The fourth will be held for backup and analyzed if one of the first three cannot be analyzed. The VOST will be operated at a sampling rate of 0.5 liter per minute (20 liters per sample) instead of the normal 1.0 liter per minute. VOST sampling procedures will strictly adhere to SW-846 Method 0030.

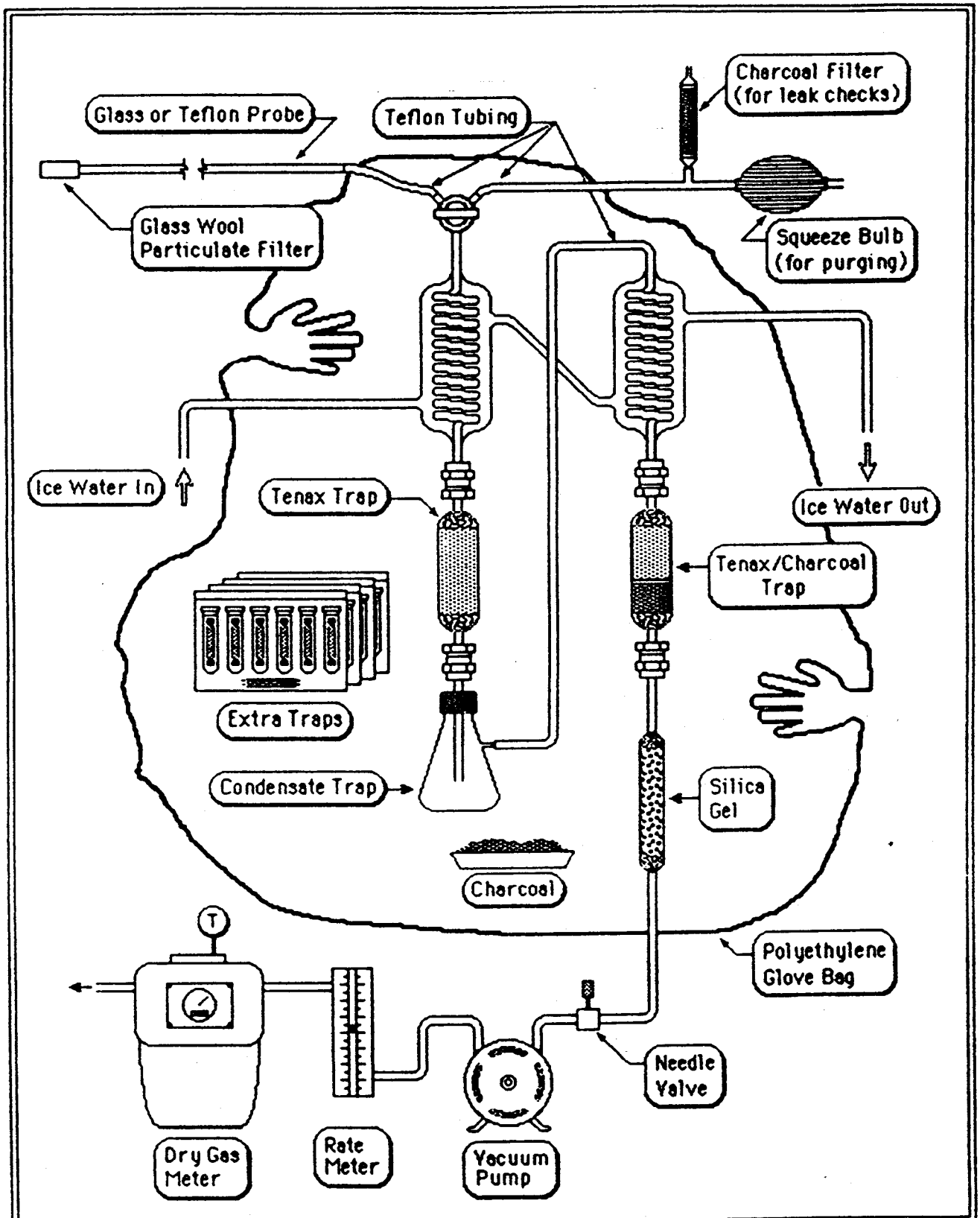


Figure 8-2. Volatile Organic Sampling Train (VOST).

Analysis for the POHCs will follow the guidelines of SW846 Method 5040, a method that has been proposed for volatile organic compounds that are amenable to the purge-trap-desorb (P-T-D) technique. Each pair of traps will be analyzed separately and the total of the three pairs reported for each test run. The organic contents of one pair of Tenax and Tenax/charcoal traps will be thermally desorbed into water using a carrier gas. The desorbed compounds will then be purged from the water and collected on an analytical trap containing Tenax and charcoal. The compounds are then back-purged off the trap into the GC/MS. Helium will be the carrier gas in all cases.

VOST Breakthrough

According to the EPA, breakthrough is present if the catch of the second tube exceeds 30% of the first tube and concentrations on the second tube are above 75 ng. If breakthrough is found on the first pair of tubes, then the remaining VOST tubes for that run are analyzed separately. Otherwise, the VOST tubes are analyzed as pairs. Entropy will follow the guidelines and procedures specified in EPA's SW-846 Method 0030 (VOST).

VOST Sorbent Cartridge Blanks

Extra sorbent cartridges will be taken to the sampling site to serve as field and trip blanks. One pair of VOST tubes, designated as a field blank, will be uncapped and inserted into the train and leak checked during each day of the testing series. The field blank will be capped and stored for transport in the same manner as the sample-exposed cartridges. The field blanks will be analyzed by the same method as the actual samples. An additional pair of tubes, designated as a trip blank, will be transported to and from the field and otherwise treated as the other cartridges, except that the caps will not be removed. The trip blank will not be analyzed unless the field blanks suggest possible contamination.

Preventing contamination of the sorbent during transport or in the environment surrounding the hazardous waste facility is an important Quality Assurance consideration. Entropy has developed procedures for sample collection and transport which go beyond the requirements of the VOST sampling method. Entropy's system isolates the VOST from the surrounding atmosphere during sampling, effectively preventing sorbent contamination and preserving sample integrity. Blank analyses are consistently below detectable limits, confirming the effectiveness of this procedure. A VOST audit will be performed on-site one day prior to the beginning of the trial burn if requested by the regulatory agencies.

8.8 MODIFIED METHOD 5 SAMPLING TRAIN - SW-846 METHOD 0010

A Modified Method 5 (MM5) sampling train will be used to measure emissions of dichlorobenzene and hexachlorobenzene. The MM5 sampling train includes a cartridge of XAD-2 resin to capture hydrocarbons that pass through the particulate filter. The sample gas is cooled by a water-cooled condenser prior to encountering the XAD cartridge. The following sections describe each component in the MM5 sampling train.

Sampling Train Description. A schematic of a typical MM5 sampling train is shown in Figure 8-3. Flue gas is pulled from the stack through a stainless steel nozzle and a borosilicate glass probe. Particulate matter is removed from the gas stream by means of a glass fiber filter housed in a glass filter holder maintained at 248 ± 25°F. All glass components will be thoroughly cleaned with a 1:1 volume ratio mixture of methanol and methylene chloride (methanol/methylene chloride) prior to use. The sample gas passes through a water-cooled condenser and into the XAD sorbent trap for removal of the organic constituents. The condenser and XAD trap are arranged in a manner that allows the condensate to drain vertically through the XAD trap. A chilled impinger train will be used to remove water from the flue gas and a dry gas meter will be used to measure the sample gas flow. Sealing grease will not be used on the sample train.

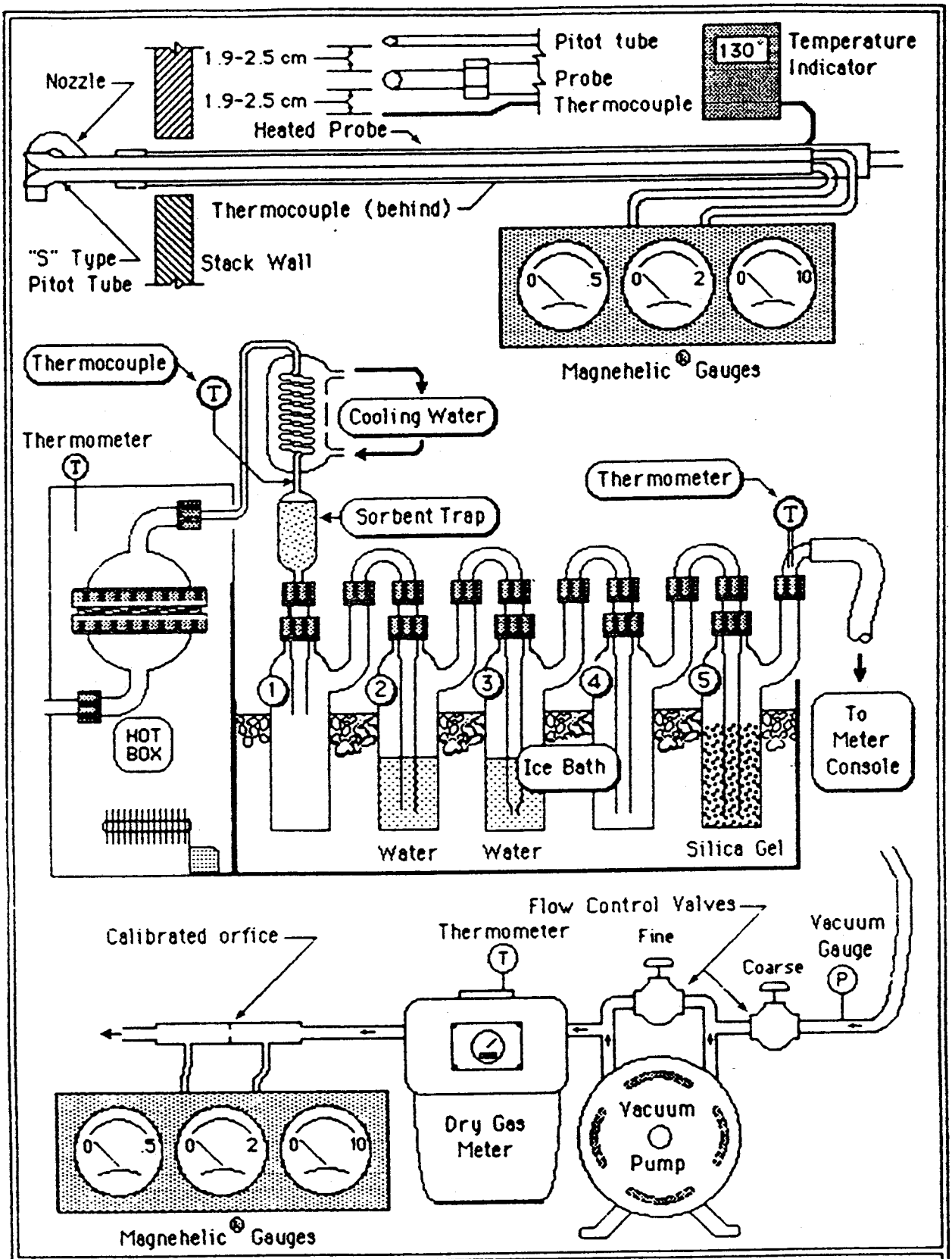


FIGURE 8-3. MODIFIED METHOD 5 (MM5) SAMPLING TRAIN

XAD Preparation. All XAD material is purchased pre-cleaned from Supelco. The XAD meets USEPA recommended criteria for purity, as outlined in the EPA's Level 1 Environmental Assessment Procedures Manual. Care will be taken to ensure that the resin is kept at temperatures below 120°F before and after sample collection to prevent resin decomposition. The sorbent trap will be charged with 20 to 30 grams of the precleaned resin. The period of time between resin precleaning and use in the field will be minimized and will not be allowed to exceed 14 days.

Glassware Preparation. All glass parts of the MM5 sample train including the sorbent trap glassware, will be precleaned prior to sampling according to the procedure listed in Table 8-3. Clean glassware will be capped with precleaned foil or glass plugs until sample train assembly. Following sample recovery, the glassware will be reused at the same sampling location.

Sample Train Operation. The sample train will be operated according to SW-846 Method 0010. Special attention will be given to the following Quality Control checks:

1. The entire sample train will be leak tested to ensure that leakage does not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm.
2. The probe exit temperature will be maintained above 248°F, and the filter compartment will be maintained at 248 ±25°F during sampling.
3. Gas entering the sorbent module will be maintained at or below 68°F.
4. Isokinetic sampling will be maintained within ±10 percent of 100.
5. Stored resin will be kept below 120°F at all times.

If a sample train leak is found after testing has begun, the sampling train with the leak will be aborted and that run of the sampling method will be repeated.

Sample Recovery. Recovery of the MM5 samples and assembly of the sample trains will be conducted in an environment free from uncontrolled dust, such as a lab or vehicle if a lab is not available. Access to this area will be limited to only those individuals involved in the recovery process.

Sample containers from a typical MM5 test run will include those shown in Table 8-4. All sample containers containing water will be extracted for analysis by the designated lab within 7 to 14 days after sample collection. It should be noted that depending on the particulate loading and/or the flue gas moisture content, the actual number of containers from each sample run may vary.

The solvent to be used for rinsing the nozzle, probe, and filter holder will be methanol/methylene chloride.

Sample Train Blanks. A field blank will be recovered during each operating condition of the testing program. A field blank consists of a complete MM5 sampling train (probe, filter, transfer line, condenser, XAD trap, and impinger set) which is assembled as though to collect a sample, but flue gas is not pulled through the train. The field blank train will be leak checked the same number of times as a sampling train used during a test run. The train will be placed at the sampling location for the duration of one test run. The train is then returned to the laboratory and disassembled for recovery using the same procedure used to recover actual samples. The field blank will be obtained using a train that has previously been used to collect at least one actual sample from the test site.

A proof blank can be obtained from a complete set of MM5 sample train glassware that has been cleaned according to the procedure presented in Table 8-3. The pre-cleaned glassware which consists of a probe liner, condenser coil, and impinger set,

is rinsed with the methanol/methylene chloride mixture three times. Potential analysis of the rinse is used to check the effectiveness of the glassware pre-cleaning procedure. Glassware used during a previous run will be cleaned with methanol/methylene chloride rinses before use during a subsequent operating condition. Blanks of each solvent lot used at the test site will also be saved for potential analysis.

Modified Method 5 Analysis. The XAD traps, filters, and impinger solutions to be analyzed for the designated semi-volatile organics will be extracted with methylene chloride for 16 hours according to EPA Method 3540. All extracts from one (1) test run will be combined and reduced to one (1) 1mL extract per test run. Analysis of the final extract will be according to SW-846 Method 8270.

TABLE 8-3. GLASSWARE PRECLEANING PROCEDURE

1. Soak all glassware in hot soapy water (Alconox) at 50°C or higher.
2. H_2O rinse, three (3) times.
3. Distilled/deionized H_2O rinse, three (3) times.
4. Pesticide grade methanol/methylene chloride rinse, three (3) times.
5. Bake at 450°F for 2 hours.
6. Cap glassware with clean glass plugs or methylene chloride rinsed aluminum foil.

Note: Use disposable gloves and adequate ventilation.

TABLE 8-4. TYPICAL MODIFIED METHOD 5 SAMPLING TRAIN COMPONENTS TO BE SHIPPED TO ANALYTICAL LABORATORY

Container Number 1	Filter(s)
Container Number 2	Rinses of nozzle, probe, and front half filter holder
Container Number 3	XAD cartridge and resin
Container Number 4	Knockout impinger contents
Container Number 5	First, second, and third impinger contents
Container Number 6	Rinses of back half of filter holder, transfer line, condenser, and knockout impinger
Container Number 7	Rinses of first, second, and third impingers
Container Number 8	Silica Gel

Note: The rinse solution will be a 1:1 volume ratio of methanol and methylene chloride.

8.9 CONTINUOUS EMISSIONS MONITORING - EPA METHOD 10

Concentrations of CO will be quantified by a gas analyzer. The sample gas is drawn through a heated probe with a glass wool filter and through heated sample line to an ice bath condenser where the moisture is removed continuously. From the condenser, the sample gas flows through a coalescing filter to the sample gas manifold which controls the flow of effluent sample and calibration standards to the analyzers. From the manifold the gas is directed into the appropriate analyzers for measuring the concentrations of the gaseous components of interest. The configuration of the sampling system allows for the injection of calibration gases either directly to the analyzers or through the sampling system. The motive force for the effluent sample is a Thomas Model 2107CA 18-TFE sampling pump. All components in the sampling system which contact the sample are constructed of Type 316 stainless steel, Teflon, or borosilicate glass. The operation of the gas analyzer is described below.

ACS FuJi 3300 CO Analyzer

The ACS Model 3300 non-dispersive infrared (NDIR) analyzer automatically and continuously monitors the CO (carbon monoxide) concentration of a flowing gas mixture. The theory of operation for this analyzer is based on the principle that the gas has a unique absorption line spectrum in the infrared region. The instrument consists of an infrared light source, chopper, measuring cell, and detector, with the only difference being the length of the measuring cell.

The infrared light beam emitted by the source passes through the measuring cell filled with a continuously flowing gas sample. The light beam is partially absorbed or attenuated by the gas species of interest in this cell before reaching the front chamber of the detector. Both the front and rear chambers of the sealed detector are filled with a reference gas. Additional absorption is sustained in the front and

rear chambers at ever decreasing rates. The difference in the amount of light absorbed between the front and rear chambers is dependent on the concentration of the gas species of interest within the sample measuring cell and creates a pressure differential between the two chambers. This pressure difference is then observed as gas flow by the micro-flow sensor located in a channel communicating the two chambers. The resulting AC signal from the micro-flow sensor is amplified, rectified, and linearized into a DC voltage signal for output. The instrument is equipped with ranges of 0 to 500 ppm CO.

Data Acquisition and Reduction

Data from the analyzer can be recorded by Entropy's data acquisition system (DAS). The DAS is an IBM compatible PC-based computer with analog-to-digital conversion hardware. The signals from the gas analyzer will be recorded on strip charts. Data from the gas analyzers are displayed on the screen and can be averaged and printed in tabular form. The DAS can also be used to calculate emission rates and to record the calibration data. The data and results are stored on hard disk. Because the DAS software was written by Entropy, it can be easily altered to print values almost instantaneously or to save peak values. Data files can be loaded onto spreadsheets where additional calculations and graphics can be provided at any time.

TCEMS Sampling/Calibration Procedures

Concentrations of the gas of interest in the effluent stream are continuously monitored through the use of the extractive monitoring system. The IBM portable personal computer mentioned above is used as the primary data recording device. The analyzer response is also displayed on a strip chart recorder, which serves as a back-up to the computer system.

The transportable continuous emissions monitoring system (TCEMS) is calibrated with a series of certified calibration gases. Calibration gas injection points are located both at the inlet of the primary condenser and immediately upstream of the analyzer. This arrangement provides both ease in checking the analyzer performance and a means of evaluating the entire monitoring system. The analyzer calibrations are conducted by flowing the calibration gases through a Teflon transport line to the inlet of the condenser; thus, the calibration gases pass through all system components which come in contact with the effluent sample. This calibration procedure eliminates the effects of any potential biases within the sampling system. The calibration of the TCEMS is frequently checked by flowing the calibration gases through the entire sampling system in order to quantify any calibration drift.

Quality control of the TCEMS is based on the utilization of certified calibration gases. The CO gases are certified NBS-traceable by the gas vendor following EPA Protocol No. 1.

8.10 PROCESS SAMPLE COLLECTION PROCEDURES

Liquid Waste Feed

Grab samples of the liquid waste feed will be collected every 15 minutes during each test run in accordance with Method S004. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500 ml aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Solid Waste Feed

Grab samples of the solid waste feed will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500 ml aliqouts will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Ash and Lime

Grab samples of the ash or lime will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500 ml aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

SECTION 9.0
QUALITY ASSURANCE PROGRAM
ORGANIZATION AND RESPONSIBILITY

Entropy assumes responsibility for all measurements made in connection with this project, and therefore responsibility for the implementation of an adequate quality assurance (QA) program. This section discusses Entropy's approach to management of the QA aspects of the subject test program. Provisions and procedures which are incorporated in the overall management structure to promote implementation of QA procedures and adherence to QA guidelines are described.

The management structure and organization employed by Entropy facilitates the development and performance of quality assurance/quality control (QA/QC) functions by accurately defining the QA/QC direct lines of communication and authority between different levels of project management and the QA management structure. Entropy's QA program is designed in a way that facilitates interaction between QA program personnel and the project team. QA program personnel interface independently with project team members at all levels, monitoring data representativeness, accuracy, precision, and completeness. QA program personnel are free to interact directly with project team members at any time QA considerations in one of these areas need to be addressed.

The organization of the Entropy project team, including QA functions, is shown in Figure 9-1. Note that the QA structure is independent of the organizational groups which will generate environmental measurement data during this project.

The focus of the Entropy QA program is the quality assurance manager. He is responsible for the day-to-day oversight of QA activities. The quality assurance manager reports to the quality assurance coordinator. The quality assurance coordinator occupies a level higher than the project manager, and reports directly to the project director.

9.1 PROJECT MANAGEMENT DIRECTOR

The Project Management Director (PMD) oversees the Project Managers' test program planning, organization, and performance. He also assists in technical supervision and oversees protocol development and review, data interpretation, and report preparation. The PMD for this sampling project will be Mr. Tony Wong. Mr. Wong serves as the PMD for all testing projects including hazardous waste, Municipal Solid Waste/Refuse Derival Fuel (MSW/RDF) incinerators. He has been PMD for over 25 RCRA/TSCA trial burns and over 15 MSW/RDF testing projects. Some of the complex projects include high temperature, moisture, and pressure locations, dioxins/furans, emissions inventories, and ambient air. He is often involved in site surveys, method design, and method evaluation. Prior to becoming PMD, he served as Project Manager for 20 RCRA/TSCA trial burns, which involved developing sections of the trial burn plan, negotiating with regulatory agencies, supervising field operations, evaluating data, and preparing the final report. He also spent numerous hours performing volatile organic compound (VOC) and indoor air pollution monitoring.

9.2 PROJECT MANAGER

The Project Manager (PM) assists the PMD in the planning, oversight and review functions associated with the various elements of the test program. In practice, the PMD has responsibility for several ongoing projects at any given time. The PM's responsibilities are more narrowly focused; he usually has responsibility for one test project at a time. The PM for this sampling project will be David Brintle. To obtain a complete working knowledge of field work, Mr. Brintle spent numerous hours serving as a technician and team leader for RCRA/TSCA and VOC testing. He has been project manager for over 10 RCRA trial burns which involved developing the trial burn plan, negotiating with regulatory agencies, supervising the trial burn testing, and preparing the final report.

9.3 QUALITY ASSURANCE COORDINATOR

The Quality Assurance Coordinator (QAC) has the primary responsibility for ensuring that all reported data meet the QA objectives associated with the measurement project. The QAC is independent of project management, reporting directly to upper corporate management.

Walter S. Smith, P.E. (B.S., Chemical Engineering) co-founded Entropy in 1972 with Mr. D. James Grove, and serves as President and QAC of the company. Prior to 1972, Mr. Smith served with the U.S. Public Health Service and, later, the U.S. EPA. His duties at both organizations included the development of sampling methods and emissions factors for numerous source categories. He headed the team which developed EPA Methods 1 through 8.

Mr. Smith will provide supervision of all technical aspects of the work effort, which includes but is not limited to, method development, sample analysis, interpretation of test results, and preparation of the final report. We anticipate that the level of Mr.

Smith's participation in the proposed work effort will be more extensive than for Entropy's more routine testing projects.

9.4 QUALITY ASSURANCE MANAGER

Entropy's Quality Assurance Manager (QAM) is Mr. Emil Stewart. His responsibilities include (1) the review of QA project plans, (2) oversight of QA consideration of field testing projects, (3) oversight of QA aspects of major EPA contracts, and (4) recommendation and implementation of QA activities within Entropy's internal systems to enhance the overall quality of the product.

If problems arise which have the potential to adversely affect data, he will make recommendations to the project manager, and higher management levels as necessary, to ensure that appropriate corrective actions are taken.

9.5 LABORATORY QUALITY CONTROL COORDINATOR

Bruce G. Hawks is Entropy's Quality Control Coordinator (QCC). This role involves working with project managers and coordinators to ensure that project goals and objectives are recognized, and efforts necessary for their attainment are implemented. At the inception of the sampling project, Mr. Hawks will meet with the Project Manager and the Associate Project Manager to discuss the goals of the project, the strategy of project implementation, and necessary QA/QC. A major function of the interaction at this management level is the selection of personnel to manage, perform, or assist in the performance of project activities. In this area, the QCC assists the Project Manager in evaluating the qualifications and experience of the candidate personnel, providing input on the suitability of individuals with reference to their ability to carry out the intended activities.

In his capacity as QCC, Mr. Hawks also will oversee preparatory operations that occur prior to conducting environmental measurements using the VOST or MM5

protocols. Some of the activities which Mr. Hawks will bear responsibility for during this test project are:

- Observing calibration techniques to ensure that operators follow prescribed procedures;
- Checking calibration records to ensure that record keeping practices are adequate, prescribed calibration frequencies are observed, and QC criteria are attained and maintained;
- Performing system audits of facilities and equipment to ensure that the status of these reflect the effective operation of the QA program;
- Conducting performance audits on measurement systems to assess the adequacy of QC systems; and
- Periodic reporting to the project director, quality assurance coordinator, project manager, and other involved personnel with regard to the QA status of on-going projects.

Most of the items listed for Mr. Hawks are routine activities, and reflect the lines of authority which are present when the team leaders and technical staff are at the home office/laboratory. In the field, many of these routine QA activities become the responsibility of the Project Manager and/or Project Supervisor and pertinent task managers, who oversee QA practices and procedures in the field.

9.6 CONTRACT LABORATORY QUALITY CONTROL OFFICER

The Entropy contract laboratory Quality Control Officer for this project will be Rik Tebeau. Mr. Tebeau will oversee the efforts of Bruce Babson, Task Manager for Oxford Laboratories, Inc., and Dr. J.R. Hass of Triangle Laboratories, Inc., as well as any other outside labs whose services may be required.

Mr. Tebeau's responsibilities are to insure that proper QA/QC protocols are followed by all outside labs, and to review raw data before it is processed. He also sees that

the samples are properly shipped and received by the respective labs in good shape, that the correct analytical method is performed on the samples, and the results are sent to him in a timely fashion.

9.8 ENTROPY LABORATORY TASK MANAGER

The Entropy Laboratory Task Manager for this project will be Mary Ellen Jackson. Ms. Jackson has ten years of experience in the analysis of air pollution samples. She serves as supervisor for Entropy's Reference Methods Laboratory, directing the efforts of the laboratory staff in all analyses. She also is responsible for purchasing and maintenance of inventories of all laboratory equipment and supplies. She oversees preparation of reagents for all field stack testing efforts undertaken by Entropy's Stack Sampling Division. Ms. Jackson directs Entropy's participation in both state and federal laboratory QA programs.

The laboratory staff, under the direction of Ms. Jackson, performs a high volume of gravimetric and volumetric analyses, titrations, colorimetry, HPLC, spectrophotometry, gas chromatography, and wet chemistry. Ms. Jackson supervises all analyses required by EPA Methods 4, 5 (front and back half), 6, 7, 8, and 17. She also handles particle size analyses, both microscopy and cascade impactor.

9.9 FIELD SAMPLING TASK MANAGER

Entropy's Field Sampling Task Manager is Chris Wrenn. Mr. Wrenn's responsibilities include scheduling, coordination of sampling tasks, and support for the sampling teams while they are in the field.

The Sampling Task Manager works together with project managers, equipment and laboratory managers in an effort to identify and eliminate potential problems that could occur during the test program. Mr. Wrenn also coordinates changes in the scope of work that develop while in the field. He serves as support should any

questions, problems, or situations arise which would require the assistance of the home office in the form of equipment, personnel, or technical information.

9.10 DATA REDUCTION AND REPORTING TASK MANAGER

Data reduction and report preparation will be under the direction of John Nash. Mr. Nash and the staff of technical writers design appropriate data forms for the collection of field data, debrief test team members on their return from the field, apply appropriate laboratory results and data gathered in the field to generate test results using computerized data reduction programs, design and implement programs for data reduction, prepare the test reports, and submit the final product to the client. An average of 15 to 20 test reports are in process at any given time, and an average of eight to ten reports per week are completed and submitted.

Entropy designs its own computerized data reduction programs. Entropy has developed appropriate programs for virtually all types of testing; each of these programs are designed to print out the final test results in a manner appropriate for direct inclusion in the test report. Mr. Nash's responsibilities demand that he possess a thorough understanding of EPA test methods as applied at different source categories and of the relationship between field activities and test results data.

Entropy developed the reporting format recommended in Volume III of the EPA Division of Stationary Source Enforcement's Quality Assurance Handbook, and prepares all reports accordingly.

9.11 TRIANGLE LABORATORIES, INC. PROJECT MANAGER

The Triangle Laboratories, Inc. (TLI) Project Manager for this project will be Dr. J. Ronald Hass. He is the President of TLI and has been actively involved in the development and application of methods for the measurement of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) for 10 years. In addition to the application of existing methods to specific problems, his laboratory was the first to use negative chemical ionization for the gas chromatography/mass spectrometry analysis of PCDD in environmental samples. His group also pioneered the use of the tandem mass spectrometry (more popularly known as MS/MS) to determine TCDD in environmental matrices. Specific matrices with which he is experienced include various tissues, soil, water, fly of bottom ash, oil (hydrocarbon or polychlorinated biphenyls) and commodity chemicals.

9.12 OXFORD LABORATORIES, INC. PROJECT MANAGER

Bruce A. Babson will be the Project Manager for Oxford Laboratories, Inc. (OLI) if their services are required. OLI was assembled in April, 1983 as a branch of Grainger Laboratories of Raleigh, North Carolina. In March, 1985 Roger Oxford, laboratory manager, bought the assets of Grainger Laboratories and built the new OLI facility in Wilmington, North Carolina. Current staff members have performed Entropy's hazardous waste incineration analyses for over five years. These analyses include all waste feed, ash, and scrubber makeup and discharge samples. The years of association with OLI personnel has enabled Entropy to develop an interlaboratory QA/QC program.

The analytical methods and results from previous testing projects performed with the aforementioned labs have been thoroughly examined and approved by appropriate governing regulatory agencies. All sampling and analytical results are guaranteed to be acceptable to the governing regulatory agencies.

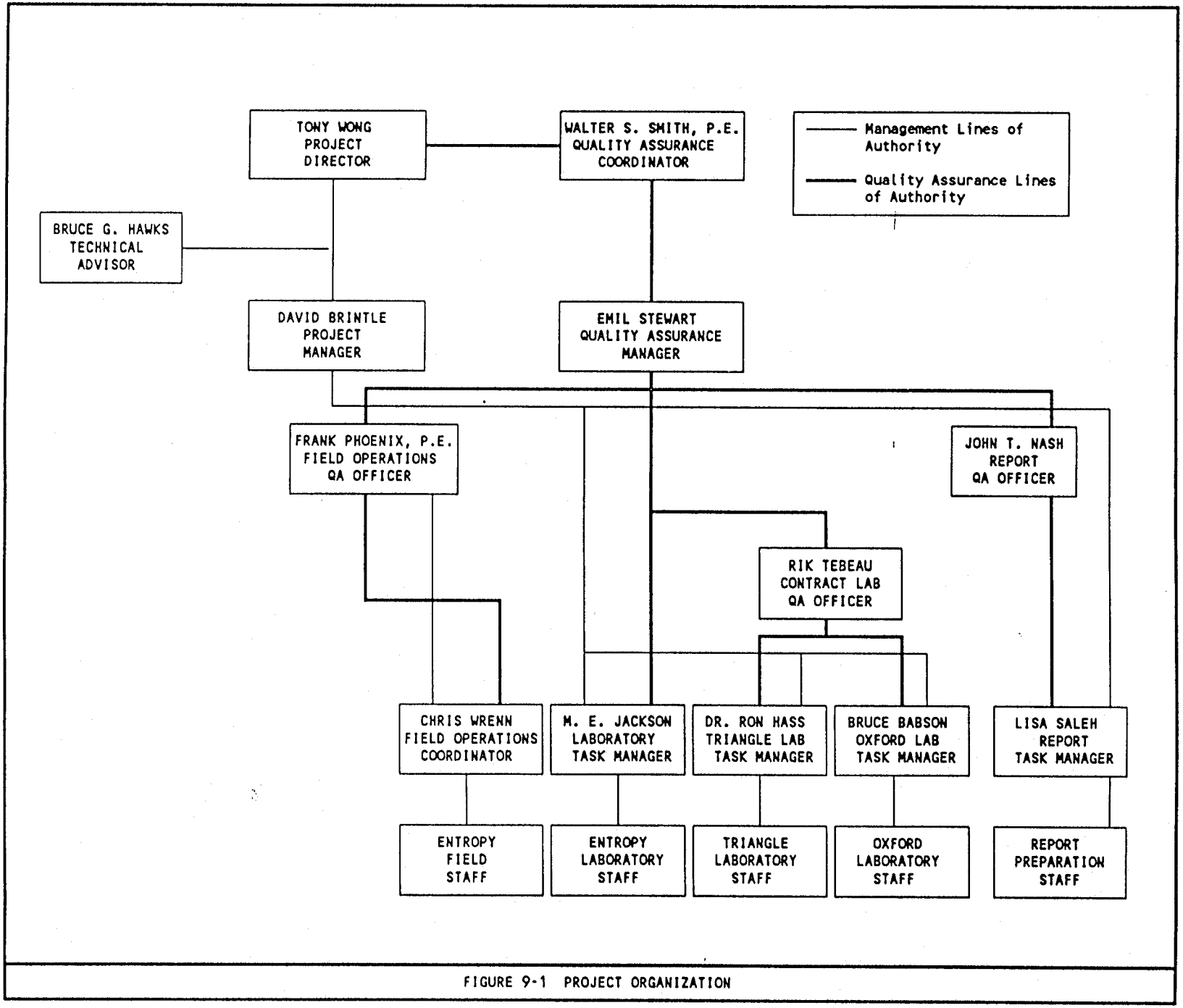


FIGURE 9-1 PROJECT ORGANIZATION

SECTION 10.0
SAMPLE CUSTODY

Sample custody procedures for this program are based on EPA recommended procedures (Quality Assurance Handbook for Air Pollution Measurement Systems: Volume 3, Stationary Source-Specific Methods (1977)). Since samples will be analyzed by one or more laboratories as well as in the field, the custody procedures emphasize careful documentation of sample collection and field analytical data and the use of chain of custody records for samples being transported. The procedures which will be used are discussed below.

10.1 FIELD SAMPLING OPERATIONS

The project supervisor will be responsible for ensuring that proper custody and documentation procedures are followed for the field sampling and field analytical efforts. He will be assisted in this effort by key sampling personnel involved in sample recovery.

Samples are collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix such as glass jars. Only containers which allow air tight seals are used. Amber glass jars are employed when containers are needed which inhibit photochemical reactions.

All sampling data, including information regarding sampling times, locations, and any specific considerations associated with sample acquisition will be recorded on preformatted data sheets. The field sampling data form for the Modified Method 5 sampling train is shown in Figure 10-1. The analytical data form for the Method 5 sampling train is shown in Figure 10-2.

PARTICULATE FIELD DATA

COMPANY NAME_____ RUN NUMBER_____
ADDRESS_____ TIME START_____
SAMPLING LOCATION _____ TIME FINISH_____
DATE_____TEAM LEADER_____TECHNICIANS_____
BAROMETRIC PRESSURE. IN. HG____STATIC PRESSURE IN. H_2O_____
SAMPLING TRAIN LEAK VACUUM IN. HG ___ ___ ___ ___ ___ ___
SAMPLING TRAIN LEAK RATE,CU.FT/MIN___ ___ ___ ___ ___ ___

EQUIPMENT CHECKS	IDENTIFICATION NUMBERS	LK.TEST READING
___PITOTS, PRE-TEST	REAGENT BOX____NOZZLE_____DIAMETER____	
___PITOTS, POST-TEST	METER BOX_____T/C READOUT_____	
___ORSAT SAMPL. SYS.	UMBILICAL_____T/C PROBE_____	
___TEDLAR BAG	SAMPLE BOX_____ORSAT PUMP_____	
___THERMOCOUPLE @_____ °F	PROBE_____TEDLAR BAG_____	
FILTER # TARE		
_____ _____	DELTA H@ _____ C FACTOR _____	
_____ _____	METER TEMP_____ STACK TEMP _____	
_____ _____	% MOISTURE _____ REF. DELTA P_____	

SAMPLE POINT	CLOCK TIME MIN.	DRY GAS METER READING CU. FT.	PITOT READING IN. H_2O	ORIFICE SETTING IN. H_2O IDEAL	ORIFICE SETTING IN. H_2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMP. OF °F FILTER BOX	GAS TEMP. OF °F CONDEN. EXIT	GAS TEMP. OF °F IMPIN. EXIT	STACK TEMP.	*

Figure 10-1 Modified Method 5 Data Sheet

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name _____ EEI Ref. #_____
Sampling Location _____
Date Received _____ Date Analyzed _____ Reagent Box(es)____

Run Number			
Run Date			

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.			
Total Filter Tare mg.			
Blank Residue, mg.	(____mL)	(____mL)	(____mL)
TOTAL PARTICULATE CATCH, mg.			

ANALYSIS OF MOISTURE CATCH

Reagent 1 (_____):			
Final Weight, g.			
Tared Weight, g.			
Water Catch, g.			
Reagent 2 (_____):			
Final Weight, g.			
Tared Weight, g.			
Water Catch, g.			
CONDENSED WATER, g.			
Silica Gel:			
Final Weight, g.			
Tared Weight, g.			
ABSORBED WATER, g.			
TOTAL WATER COLLECTED, g.			

Blank Beaker #____	--- Legend ---	Notes and Comments
Final wt. mg. _____	= Final Weight	
Tare wt. mg. _____	L = Loose Particulate	
Residue, mg. _____	F = Filter D = Dish	
	R = Rinse P = Pan	
Concen., mg/mL		

Figure 10-2 Moisture Impinger Catch Data Sheet Performed in Lab

DRAFT

Following sample collection, all samples will be given a unique alphanumeric sample identification code as shown in Figure 10-3. Actual sample code could vary slightly depending upon sample location and type. Figure 10-4 is the chain of custody sheet which will accompany all Modified Method 5 reagent boxes used during the testing program.

Process samples (feed, scrubber, ash, etc.) that are collected during testing will be packed for shipment to the appropriate laboratories and process sample chain of custody forms (Figure 10-5) will be completed for each shipment box. The chain of custody forms and a letter specifying the treatment of each sample will also be enclosed in the sample shipment container. Samples to be combined and analyzed immediately, extracted and stored for later analysis, or simply stored as is, will be clearly stated in this letter. The purpose of the letter will be to ensure that the correct samples are combined, that samples containing moisture will be analyzed on an as-received basis, and that samples with a limited shelf life (those containing water) are extracted within the allowable time of 7 to 14 days after collection.

Samples are stored for transport from the lab to the field to the lab in storage boxes constructed in a fashion which minimizes movement and thus prevents breakage of containers. For example, boxes used for transporting glass containers have foam inserts with form-fitting cutouts. Sample transport boxes are always locked except when in use. Vans containing equipment and samples are locked whenever they are left unattended.

VOST traps are placed in culture tubes which also contain activated charcoal. These tubes are then placed in Ziploc bags which also hold open charcoal tubes. VOST traps will be kept cold during transportation and storage.

I	-	M5/MMTL	-	1	-	a

Condition Number	Sample Type	Run Number	Multiple Samples Collected at Same Time (if applicable)
I, II, ...	Manual Methods M5/MMTL MM5 VOST M10 M26	1,2,3,4...	a,b,c...

Process Samples
WFL - Waste Feed Liquid
WFS - Waste Feed Solid
IA - Incinerator Ash
LF - Lime Feed
BA - Baghouse Ash

FIGURE 10-3 ALPHANUMERIC SAMPLE IDENTIFICATION NUMBER

CUSTODY SHEET FOR REAGENT BOX #

Date of Makeup _____ Initials _____ Locked? _____

Individual Tare of Reagent: _____ mls. of _____

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight _____ gms.

PLANT NAME _____

SAMPLING LOCATION _____

Run Number	Date Used	Initials	Locked?	Date Cleanup	%S. Gel Spent	Initials	Locked?

Received in Lab Date _____ Initials _____ Locked? _____

Zero & Span Balance Initials _____

Sampling Method: _____

Filter #	Tare Weight (mgms)	Used on Test

Remarks:

Figure 10-4 Custody Sheet for Reagent Box

ENTROPY

PROCESS SAMPLE CHAIN OF CUSTODY

PLANT NAME _____

PLANT LOCATION _____

DESCRIBE PROCESS _____

_____

DESCRIBE SAMPLE _____

_____

DESCRIBE SAMPLING PROCEDURES (i.e. Grab or Intergrated sample; single or composite, etc.) _____

_____

SAMPLING LOG				
SAMPLE ID	DATE	TIME	TAKEN BY	SAMPLING LOCATION

SAMPLES RECEIVED FROM THE PLANT BY _____ ON _____

SAMPLES RECEIVED IN THE LAB BY _____ ON _____

Figure 10-5 Process Sample Chain of Custody Form

A daily activity log will be maintained by the project supervisor. This will be an informal log used to record various types of information, such as minor problems which arise, sketches of sampling locations, names and phone numbers of plant contacts, daily activity summaries, etc.

10.2 ANALYTICAL OPERATIONS

Analytical operations will be performed on-site in the laboratory as well as in the Entropy laboratories. The analytical data form to be used for on-site fixed gas (molecular weight) determinations using Orsat analyzer is shown in Figure 10-6. Samples analyzed by outside laboratories are transported with a Request-For-Analysis form as shown in Figure 10-7. This form will list sample identifications, analytical parameters, sample matrices, anticipated date of results, and other relevant information necessary to ensure the appropriate analyses are performed and to document the progress of the samples.

ORSAT FIELD DATA

Plant Name_____

Sampling Location_____Fuel Type_____

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.			Avg.			

Figure 10-6 Orsat Analytical Data Sheet

PATRON

ENTROPY ENVIRONMENTALISTS INC.
POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919/781-3550

REQUEST FOR ANALYSIS

PURCHASE ORDER #_____ JOB NAME:_____

LABORATORY:_____

DATE SAMPLES WERE TRANSMITTED:_____ EXPECTED DATE OF RESULTS:_____

SAMPLE MATRIX:_____

TYPE OF ANALYSIS REQUESTED:_____

SUBMITTED BY:_____

FIGURE 10-7 REQUEST FOR ANALYSIS FORM

SECTION 11.0
INTERNAL QUALITY CONTROL CHECKS

Specific quality control (QC) procedures will be followed to ensure the continuous production of useful and valid data throughout the course of this test program. The QC checks and procedures described in this section represent an integral part of the overall sampling and analytical scheme. Strict adherence to prescribed procedures is quite often the most applicable QC check. A discussion of both the sampling and analytical QC checks that will be utilized during this program is presented below.

11.1 EQUIPMENT INSPECTION AND MAINTENANCE

Each item of field test equipment purchased by Entropy is assigned a unique, permanent identification number. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program is inspected again before being packed to detect equipment problems which may originate during periods of storage. This minimizes lost time on the job site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, Entropy routinely transports to the job site replacement equipment for all critical sampling train components.

11.2 EQUIPMENT CALIBRATION

New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or the time is inspected in the field before testing begins and again upon return from each field use. When an item of equipment is found to be out of calibration, it is repaired and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner, and at a frequency, which meets or exceeds U. S. EPA specifications. Entropy follows the calibration procedures outlined in the EPA Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When these methods are inapplicable, Entropy uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the quality assurance director or the quality assurance manager. Data reduction and subsequent calculations are performed using Entropy's own computer facilities. Calculations are checked at least twice for accuracy. Copies of calibration forms are included in the test or project reports.

Emissions sampling equipment requiring calibration includes pitot tubes, pressure gauges, thermometers, dry gas meters, and barometers. The following sections elaborate on the calibration procedures followed by Entropy for these items of equipment.

A: Pitot Tubes. All Type S pitot tubes used by Entropy, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each new pitot is calibrated in accordance with the geometry standards contained in EPA Method 2. A Type S pitot tube, constructed and

positioned according to these standards, will have a coefficient of 0.84 ± 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually upon return from the field. If a cursory inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube is refurbished as needed and recalibrated.

B: Differential Pressure Gauges. Some meter consoles used by Entropy are equipped with 10-in. water column (W.C.) inclined-vertical manometers. Fluid manometers do not require calibration other than leak checks. Manometers are leak checked in the field prior to each test series, and again upon return from the field.

Most of Entropy's meter consoles are equipped with Magnehelic differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within ± 5 percent, the calibration is acceptable.

C: Impinger Thermometer. Prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared with a mercury-in-glass thermometer which meets ASTM E-1 No. 63F specifications. The impinger thermometer is adjusted if necessary until it agrees within 2°F of the reference thermometer. If the thermometer is not adjustable, it is labeled with a correction factor.

D: Dry Gas Meter Thermometer. The thermometer used to measure the temperature of the metered gas sample is checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4°F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

E: Flue Gas Temperature Sensor. All thermocouples employed by Entropy for the measurement of flue gas temperatures are calibrated upon receipt. Initial calibrations are performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer is used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

On-site, prior to the start of testing, the reading from the flue gas thermocouple-potentiometer combination is compared with an ASTM mercury-in-glass reference thermometer. If the two agree within ± 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is compared with an ASTM mercury-in-glass reference thermometer at a temperature within ± 10 percent of the average absolute flue gas temperature. If the absolute temperatures agree within ± 1.5 percent, the temperature data are considered valid.

F: Dry Gas Meter and Orifice. Two procedures are used to calibrate the dry gas meter and orifice simultaneously. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter. Full calibrations are performed over a wide range of orifice settings. A simpler procedure, the post-test calibration, is designed to check whether the calibration factor has changed. Post-test calibrations are performed after each field test series at an intermediate orifice setting (based on the test data) and at the maximum vacuum reached during the test.

Entropy uses, as a transfer standard, a dry gas meter that is calibrated annually against a spirometer. During the annual calibration, triplicate calibration runs are performed at seven flow rates ranging from 0.25 to 1.40 cfm.

G: Dry Gas Meter. Each metering system receives a full calibration at the time of purchase and a post-test calibration after each field use. If the calibration factor, Y, deviates by less than five percent from the initial value, the test data are acceptable. If Y deviates by more than 5 percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Method 5 requires another full calibration anytime the post-test calibration check indicates that Y has changed by more than 5 percent. Standard practice at Entropy is to recalibrate the dry gas meter anytime Y is found to be outside the range of 0.97 to 1.03.

H: Orifice. An orifice calibration factor is calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.15 in. H_2O over the range of 0.4 to 4.0 in. H_2O, the arithmetic average of the values obtained during the calibration is used.

I: Barometer. Each field barometer is adjusted before each test series to agree within ± 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham airport, approximately 2.5 miles from Entropy's location.

11.3 SAMPLING QUALITY CONTROL PROCEDURES

The following pretest QC checks will be conducted:

- All sampling equipment will be thoroughly checked to ensure clean and operable components.
- Equipment will be inspected for possible damage from shipment.
- The oil manometer or Magnehelic gauge used to measure pressure across the Type S pitot tube will be leveled and zeroed.
- The number and location of the sampling traverse points will be checked before taking measurements.
- The temperature measurement system will be visually checked for damage and operability by measuring the ambient temperature prior to each traverse.

In addition to the general QC procedures listed above, QC procedures specific to each sampling method will also be incorporated into the sampling scheme. These method specific procedures are discussed below.

A: Sampling Train QC Checks. The following QC procedures will be emphasized:

Prior to Start of Tests

- Keep all cleaned glassware and sample train components sealed until train assembly.
- Assemble the sampling trains in an environment free from uncontrolled dust.
- Visually inspect each sampling train for proper assembly.
- Perform pretest calculations to determine the proper sampling nozzle size.

Prior to Testing Each Day

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.

During Testing Each Day

- Readings of temperature and differential pressure will be taken at each traverse point.
- All sampling data and calculations will be recorded on preformatted data sheets.
- All calibration data forms will be reviewed for completeness and accuracy.
- Any unusual occurrences will be noted during each run on the appropriate data form.
- The project supervisor will review sampling data sheets daily during testing.
- Properly maintain the roll and pitch axis of the Type S pitot tube and the sampling nozzle.
- Leak check the train before and after any move from one sampling port to another during a run or if a filter change takes place.
- Conduct additional leak checks if the sampling time exceeds 4 hours.
- Maintain the probe, filter, and impingers at the proper temperature.
- Maintain ice in the ice bath at all times.
- Make proper readings of the dry gas meter, delta P and delta H, temperature, and pump vacuum during sampling at each traverse point.
- Maintain isokinetic sampling within ± 10% of 100%.

After Testing Each Day

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.

11.4 QC FOR VOLUMETRIC AIR FLOW RATE DETERMINATIONS

A: Flue Gas Velocity. Data required to determine the flue gas velocity will be collected using the methodology specified in EPA Method 2. Quality control procedures are as follows:

- Visually inspect the Type S pitot tube before and after sampling.

- Leak check both legs of the pitot tube before and after sampling.
- Check the number and location of the sampling traverse points before taking measurements.

B: Flue Gas Molecular Weight. Samples to be used for determination of flue gas molecular weight will be collected using the integrated sampling technique specified in EPA Method 3. Quality control will focus on the following procedures:

- The sampling train will be leak checked before and after each run.
- A constant sampling rate will be used in withdrawing a sample.
- The sampling train will be purged prior to sample collection.
- The sampling port will be properly sealed to prevent air inleakage.

C: Moisture Content. The moisture content of the gas stream will be determined using the technique specified in EPA Method 5. The following QC checks will be performed:

- The sampling train will be leak checked before and after each run.
- Ice will be maintained in the ice bath throughout each run.

11.5 ANALYTICAL QUALITY CONTROL PROCEDURES

All analyses for this program will be performed using accepted laboratory procedures in accordance with the specified analytical protocols. Adherence to prescribed QC procedures will ensure data of consistent and measurable quality. Table 11-1 presents the minimum QA measurements to be performed. Analytical QC will focus upon the use of control standards to provide a measure of analytical precision and accuracy. Also, specific acceptance criteria are defined for various analytical operations including calibrations, control standard analyses, drift checks, blanks, etc. The following general QC procedures will be incorporated into the analytical effort:

TABLE 11-1
MINIMUM QUALITY ASSURANCE MEASUREMENTS

SAMPLE	PARAMETER	BLANKS*	DUPLICATES	SURROGATE SPIKES
Waste Feed liquid	Carbon Tet	-	10%	-
	Dichlorobenzene	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	$\%H_20$	-	10%	-
	Heating Value	-	10%	-
	Viscosity	-	10%	-
	Flashpoint	-	10%	-
	Metals	-	10%	-
Waste Feed solid	Dichlorobenzene	-	10%	-
	Hexachlorobenzene	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	$\%H_20$	-	10%	-
	Heating Value	-	10%	-
	Metals	-	10%	-
Incinerator Ash	POHCs	1MB	10%	100%
	Metals	-	10%	-
	EP Tox	-	10%	-
Lime Feed	POHCs	1MB	10%	100%
	Metals	-	10%	-
	Chlorine	-	10%	-
Baghouse Ash	POHCs	1MB	10%	100%
	Metals	-	10%	-
	Chlorine	-	10%	-
	EP Tox	-	10%	-
Stack Gas	Particulate	Acetone	-	-
	Metals	1 FB, reagents	10%	-
	HCl	1MB	100%	-
	Carbon Tet.	1FB, 1MB, 1TB	-	100%
	Hexachlorobenzene	1FB, 1MB, 1TB	-	100%
	Dichlorobenzene	1FB, 1MB, 1TB	-	100%
	Carbon Monoxide	-	-	-

* MB - Method Blank
FB - Field Blank
TB - Trip Blank

TABLE 11-1
MINIMUM QUALITY ASSURANCE MEASUREMENTS

SAMPLE	PARAMETER	BLANKS*	DUPLICATES	SURROGATE SPIKES
Waste Feed liquid	Carbon Tet	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	%H_2O	-	10%	-
	Heating Value	-	10%	-
	Viscosity	-	10%	-
	Flashpoint	-	10%	-
	Metals	-	10%	-
Waste Feed solid	Hexachlorobenzene	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	%H_2O	-	10%	-
	Heating Value	-	10%	-
	Metals	-	10%	-
Ash	POHCs	1MB	10%	100%
	Metals	-	10%	-
	EP Tox	-	10%	-
Scrubber Makeup and Discharge	POHCs	1MB	10%	100%
	Chlorine	-	10%	-
	Metals	-	10%	-
Stack Gas	Particulate	Acetone	-	-
	HCl	1MB	100%	-
	Carbon Tet.	1FB, 1MB, 1TB	-	100%
	Hexachlorobenzene	1FB, 1MB, 1TB	-	100%
	Carbon Monoxide	-	-	-

* MB - Method Blank
FB - Field Blank
TB - Trip Blank

- The on-site project supervisor will review all analytical data and QC data on a daily basis for completeness and acceptability.
- Analytical QC data will be tabulated using the appropriate charts and forms on a daily basis.
- Copies of the QC data tabulation will be submitted to the quality assurance manager following the completion of the test program.
- All hardcopy raw data (i.e., chromatograms, computer printouts, etc.) will be maintained in organized files.

Specific analytical QC procedures for the Orsat analyzer are listed below.

- The analyzer will be leveled and the fluid levels zeroed prior to use.
- The analyzer will be leak checked prior to use.
- The analyzer will be thoroughly purged with sample prior to analysis.
- The analyzer will be checked by analyzing an ambient air sample.
- All hardcopy raw data (i.e., chromatograms. computer printouts, etc.) will be maintained in organized files.

Specific analytical QC procedures for the Orsat analyzer are listed below.

- The analyzer will be leveled and the fluid levels zeroed prior to use.
- The analyzer will be leak checked prior to use.
- The analyzer will be thoroughly purged with sample prior to analysis.
- The analyzer will be checked by analyzing an ambient air sample.

Hydrogen Chloride Analytical QC Check are listed below.

- Lab (reagent) blanks will be analyzed for every 10 samples or at least one per matrix.
- Duplicates are analyzed for each sample and should agrees within 10%.

All measurements methods employed by TLI have associated quality control checks. The extent of the activities depends upon the control status of a particulate method at the time of its use. In this respect, a method is either on control or out of control.

Routine quality control activities are applied to methods in control: these routine activities generally include quality control measures recommended within published methods. For EPA methods, these are the minimum activities followed.

For methods not designated as Reference Methods, minimum quality control efforts include the following, as applicable.

1) Initial tuning, mass and response calibration of the mass spectrometer.
2) Measurement of analytical blanks, processed in the same manner as the samples.
3) Analysis of quality control samples, including matrix spikes and duplicate determinations.

For methods out of control (which includes method under development, since these are by definition, of undetermined quality), quality control activities in addition to this described as routine are applied. While the course for establishing (or re-establishing) control of the analysis is generally approached on a case-by-case basis, TLI has employed the following quality control activities when criteria associated with routine activities were not met, and when methods are being evaluated.

1) Replicate determination to establish the consistency of analytical behavior.
2) Split samples to assess either the quality of the sample preparation phase or to acquire an independent check of the measurement result.
3) Spiked samples to assess the influence of matrix effects.
4) Assessment of reagent quality.
5) Evaluation of reagent quality.

Data from initial and continuing calibrations are incorporated into the final report for each projects, as are results from other quality control activities including the results from the analysis of blanks and spiked samples.

APPENDIX C

1. INSPECTION LOG SHEETS
2. LIQUID WASTE FEED SYSTEM DATA
3. SPILL CONTAINMENT TANK DATA
4. TANK SYSTEM ASSESSMENT

1. INSPECTION LOG SHEETS

HMMB SAFETY AND EMERGENCY EQUIPMENT
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____/_____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Standard Industrial Absorbents				
55-Gallon Drums				
Overpack Drum				
Portable Sump Pump & Hoses				
Emergency Shower & Eyewash				
Shovels, Brooms, & Dust Pans				
SCBA Equipment				
Full Face Respirators				
Fire Extinguishers				
Fire Blankets				
Protective Clothing				
Alarm System				
Emergency Lighting and Power				

HMMB SAFETY AND EMERGENCY EQUIPMENT (Continued)
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
First Aid Equipment				
Communication System (PA)				

ESF SAFETY AND EMERGENCY EQUIPMENT
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Standard Industrial Absorbents				
55-Gallon Drums				
Overpack Drum				
Portable Sump Pump & Hoses				
Emergency Shower & Eyewash				
Shovels, Brooms, & Dust Pans				
SCBA Equipment				
Full Face Respirators				
Fire Extinguishers				
Fire Blankets				
Protective Clothing				
Alarm System				
Emergency Lighting and Power				

ESF SAFETY AND EMERGENCY EQUIPMENT (Continued)
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____/_____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
First Aid Equipment				
Communication System				

HMMB CONTAINER STORAGE
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Container Placement				
Sealing of Container				
Condition of Containers				
Containment Systems				
Loading Area				
Labeling of Containers				
Pallets				
Floors, Dikes, Ramps				
Warning Signs				

ESF CONTAINER STORAGE
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Container Placement				
Sealing of Container				
Condition of Containers				
Containment Systems				
Loading Area				
Labeling of Containers				
Pallets				
Floors, Dikes, Ramps				
Warning Signs				

ESF TANK AREA
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Monitoring Instruments				
Monitoring Equipment				
Tank Structure				
Containment System				
Liquid Level				
Tank Corrosion				
Ancillary Equipment				

ESF INCINERATOR CONTROLS
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____/_____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Emergency Feed Cut-Off Sensors & Alarms				
Low Secondary Combustion Chamber (SCC) Temperature				
Excessive SCC Temperature				
Combustion Gas Velocity				
Incinerator Operating Interlocks				
Combustion Air Fans				
Hydraulic Ram Feed System				
Waste Feed Cut-Off Valves				
Control Instruments				
Control Valves				
Monitoring and Recording Devices				

ESF INCINERATOR SYSTEM
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____

INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Incinerator Feed Piping				
Refractory Visual Check (Daily)				
Refractory Comprehensive Inspection (Quarterly)				
Primary Combustion Chamber Visual Check (Daily)				
Primary Combustion Chamber Comprehensive Check (Quarterly)				
Secondary Combustion Chamber Visual Check (Daily)				
Secondary Combustion Chamber Comprehensive Check (Quarterly)				
Ash Hopper				

ESF INCINERATOR SYSTEM (Continued)
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____/_____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
Air Quality Control System (AQCS) Recirculation Tower & Appurtenances (Daily Check)				
AQCS Recirculation Tower & Appurtenances (Quarterly Inspection)				
AQCS Heat Exchanger & Appurtenances (Daily Check)				
AQCS Heat Exchanger & Appurtenances (Quarterly Inspection)				
AQCS Dry Reactor & Appurtenances (Daily Check)				
AQCS Dry Reactor & Appurtenances (Quarterly Inspection)				

ESF INCINERATOR SYSTEM (Continued)
INSPECTION LOG SHEET

INSPECTOR'S NAME/TITLE _____ / _____

INSPECTION DATE _____
INSPECTION TIME _____

Item	Status ( )		Observations	Date and nature of Repairs/remedial action
	Acceptable	Unacceptable		
AQCS Fabric Filter (Baghouse) and Appurtenances (Daily Check)				
AQCS Fabric Filter (Baghouse) and Appurtenances (Quarterly Inspection)				
AQCS Fly Ash/Residual Overflow Container				
Stack				
Building HVAC Equipment				
Weighing Scales				

2. LIQUID WASTE FEED SYSTEM DATA

SPECIFICATIONS

FOR

LOW PRESSURE/STAINLESS STEEL

TANKS

FOR

GLAXO, INC.

ENVIRONMENTAL SAFETY FACILITY

RESEARCH TRIANGLE PARK, NC

SPECIFICATION NO. R-8279-1

EQUIPMENT NO. T-101, 102, 103

SEC JOB NO. R-8279

NOVEMBER 3, 1989

SIRRINE ENVIRONMENTAL CONSULTANTS

RALEIGH, NORTH CAROLINA

SIRRINE ENVIRONMENTAL CONSULTANTS

SHOP FABRICATED

LOW PRESSURE/STAINLESS STEEL TANKS

PART 1 GENERAL

This specification and the accompanying data sheet(s) are intended to provide bidders with a basis for the preparation of a lump sum quotation. The format is based upon the recommendations of the Construction Specifications Institute (CSI).

1.1 WORK INCLUDED

1.1.1 This specification covers material, design, and construction requirements for low pressure, stainless steel, shop fabricated production vessels where the internal pressure does not exceed 15 psig.

1.1.2 These specifications do not cover vessels designed and fabricated under Section VIII, Unfired Pressure Vessels, of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

1.1.3 The Vendor shall furnish all tools, materials, labor, and appurtenances necessary for the complete fabrication, testing, and shipment of the vessels to the job site.

1.1.4 Specific information and requirements of individual tanks are provided on separate Data Sheets, which shall be considered an integral part of this Specification. In the event of a conflict between the Data Sheets and this Specification, the Data Sheets shall take precedence.

1.1.5 Any conflicts between this Specification of the Data Sheets with any Code or Authority shall immediately be brought to the attention of Sirrine Environmental Consultants (SEC) for resolution.

1.1.6 Consideration will not be given to proposals wherein the Vendor cannot supply tank(s) for efficient operation or where, in SEC's judgement, the selection is not applicable.

1.2 RELATED WORK

1.2.1 Furnished by Owner

1.2.1.1 Foundation.

1.2.1.2 External piping

1.2.1.3 Vacuum or Pressure Relief Valves

1.2.1.4 Instrumentation

1.2.2 Furnished by Vendor

1.2.2.1 Agitator supports

1.2.2.2 Legs

1.2.2.3 Baffles

1.3 SYSTEM DESCRIPTION

1.3.1 Tanks shall be suitable for installations inside in a chemical plant environment.

1.4 QUALITY ASSURANCE

1.4.1 The inspection and testing of vessels shall be performed in compliance with Part 5 of the API Standard 620.

1.4.2 The Purchaser's representative is to have free access to all applicable manufacturing areas of the Vendor's Facilities concerned with this work and shall be notified in advance when tanks will be ready for inspection and test.

1.4.3 Mill chemical and physical test reports on plates shall be furnished to the Owner, if requested.

1.4.4 When completed and before painting, each tank shall be tested and satisfactorily pass the following hydrostatic and pneumatic tests.

1.4.4.1 Test preliminaries in accordance with Articles 5.23 of API Standard 620, latest edition.

1.4.4.2 Hydrostatic test in accordance with Articles 5.23.4 and 5.23.7 of API Standard 620, latest edition. Test condition shall be full tank plus full riser pipe of height to develop test pressure as notes on drawing.

1.4.4.3 A suitable pneumatic test shall be made on all pipe columns or other box members to ensure are hermetically tight. Included as parts to be tested in Article 5.23.2 (b) of API Standard 620, are reinforcing plates attached to the tank shell and pipe columns or other members.

1.4.5 All leaks must be welded tight. Foreign materials shall not be used to stop leaks.

1.4.6 The Purchaser's representative may be present during fabrication and testing of the tanks, but failure of the representative to be present or to note and call for corrections of deviation from specifications and drawings shall not release the Vendor form full responsibility to comply with them. Any deviation form the specifications, without written approval from the Purchaser, or any indication of inferior workmanship shall constitute cause for rejection.

1.5 REFERENCES

1.5.1 All reference shall be taken as the latest editions, including appendices addenda, errata, revisions, etc.

1.5.2 All aspects of the work shall comply with all applicable local, state and federal requirements, including, but not limited to, the publications of the following associations:

1.5.2.1 OSHA - Occupational Safety and Health Administration.

1.5.2.2 ASTM - American Society for Testing Materials.

1.5.2.3 ANSI - American National Standards Institute.

1.5.2.4 AWS - American Welding Society.

1.5.2.5 API - American Petroleum Institute.

1.5.2.6 SSPC - Steel Structures Painting Council.

1.6 SUBMITTALS

1.6.1 The Vendor shall supply the information requested in the instructions to Bidders, Vendor Data Requirements, and Bid Tabulation sheets that are part of this package.

1.6.2 Shop drawings, giving complete information necessary for the fabrication and erection of all component parts of the vessel, supporting structures, or attaching structures, including the location, type and size of all bolts and weld, shall be prepared and submitted to SEC for approval prior to commencing fabrication.

1.6.3 The following load information shall be submitted by the Vendor:

Tank Shipping Weight
Tank Flooded Weight
Total Roof Live Load

1.6.4 For vessels supported on legs, the load data submitted shall be tabulated in load per leg.

1.6.5 If requested, the Vendor shall submit calculations for the design of the vessel prior to commencing fabrication.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Tanks shall have the following information stamped on Type 316 stainless steel nameplates:

Name of Manufacturer
Year Built
Equipment Number of Tank
Nominal Capacity
Material of Construction
Design Pressure and Temperature
Design Code

1.7.2 The nameplates shall be mounted on Type 316 stainless steel standoff that will raise it form the tank wall a minimum of 2 inches.

1.7.3 Before shipment, flanged connections shall be covered with wood or other suitable material and fastened securely to prevent foreign matter from entering. Threaded connections shall be fitted with nipples and caps of the same material as the pump and properly identified.

1.8 ALTERNATES

1.8.1 Vendor's standard equipment differing from this specification in certain design features of materials, will be considered under the following conditions.

1.8.1.1 Price is reduced or delivery is improved without a sacrifice in quality or serviceability is improved.

1.8.1.2 All deviations form this specification are listed as such in the proposal.

1.8.2 Vendor shall indicate the amount his bid will be altered for each proposed substitution.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 The materials of construction shall be new and free of defect. The vendor shall be responsible for testing the materials to determine their suitability.

2.1.2 All material in contact with the contained liquid shall be of the same type stainless steel as the shell unless otherwise notes on the drawings.

2.2 EQUIPMENT

2.2.1 The Vendor shall assume and acknowledge full and complete responsibility for the suitability, adequacy, and safety of design, construction, and performance of equipment designed or furnished by the Vendor, including the Vendor and subcontractors.

2.2.2 Tanks

2.2.2.1 Plate thickness for roof, shell, and bottom cone shall not be less than 1/4 inch minimum.

2.2.2.2 Unless otherwise detailed, top angles shall be outside the shell and have continuous weld at the top of the angle, stitch weld at the bottom of the angle. Top angle shall not be smaller that required by API Standard 620 and shall be larger where detailed on drawings.

2.2.2.3 Tanks shall be all welded construction, unless otherwise noted. Plates 1/4 inch to 7/16 inch shall have single "v" butt vertical joints and single bevel butt horizontal joints. Plates over 7/16 inch shall have double "V" butt vertical joints and double bevel butt horizontal joints. Lap welds shall not be permitted. Butt welds shall be full penetration.

2.2.2.4 Bottom seams shall be full penetration butt welds with back-up strips.

2.2.2.5 When back-up strips must be used, they shall be stainless steel of the same quality as adjacent plates.

2.2.2.6 Shell to bottom connections shall be by tee joint with full fillet welds on both sides of the shell plate, unless otherwise indicated on the drawings.

2.2.2.7 Tank roofs shall be dome shaped or cone shaped, except where drawings require a specific shape. Roofs shall be self-supporting, except where drawings specifically permit structural supports. Roof support contact line shall be within the neutral axis dimension of the rim angle, unless otherwise shown. Roof joints shall be butt welded.

2.2.2.8 Welds in the necks of stub ends shall be far enough from the lap to allow ample room for inspection and cleaning when the flange is pushed back.

2.2.2.9 Manholes, opening reinforcement, and other details shall agree with API Standard 620.

2.2.2 Tanks Designed by Vendor

2.2.2.1 When the tanks purchased are to be designed by the Vendor, the following provisions shall apply, in addition to the other requirements of these specifications for field erected tanks.

2.2.2.2 Tanks shall be designed in accordance with the API Specification for Low Pressure Storage Tanks, API Standard 620, latest edition. Loading conditions shall comply with Article 3.4 API Standard 620, with the following exceptions and additions:

2.2.2.2.1 In all cases, the specific gravity used for design shall be considered not less than 1.8.

2.2.2.2.2 Thermal stresses and localized stresses at supports shall be provided for in the design of the vessel.

2.2.2.2.3 Roof live load shall be not less than 50 pounds per square foot, unless otherwise noted on drawings.

2.2.2.3 The maximum allowable stress in the tank shell or other parts subject to pressure-imposed stresses shall not exceed 15,000 pounds per square inch before applying reduction due to weld efficiency, unless noted on the drawings. The maximum weld efficiency shall be assumed as 85 percent, unless otherwise noted on the drawings.

2.2.2.4 The design metal temperature to be used for plate specification requirements in Article 2.02 of API Standard 620 shall be that indicated on drawings.

2.2.2.5 Tank supports shall be designed and fabricated in accordance with the AISC Specifications for Design, Fabrication, and Erection of Structural Steel for Buildings, latest edition.

2.2.2.6 Minimum anchor bolt size shall be 3/4 inches diameter. Tank Vendor shall specify number and size of anchor bolts. Bolts shall be designed to withstand internal pressure as shown on drawings at not over 20,000 pounds per square inch stress or internal pressure plus wind on empty tank at 26,000 pounds per square inch. All tanks shall have a minimum of 4 anchor bolts; but in no case shall the maximum anchor bolt spacing exceed 15 feet.

2.2.3 Gaskets

2.2.3.1 Gasket type, dimensions, and material shall be specified in the contract documents and approved drawings.

2.2.3.2 Gaskets for raised face flanges shall extend to the edge of the bolts to center the gasket.

2.2.3.3 At least two sets of identical gaskets shall be furnished for all tank openings which have flanged fittings, covers, or blind flanges attached. One set shall be installed for hydrostatic testing and, where practical, shall remain in place following a successful test. The second set, new and unused and adequately protected, shall be delivered to the Purchaser.

2.3 FABRICATION

2.3.1 The fabrication and workmanship of the tanks are to be in accordance with the API Specification for Low Pressure Storage Tanks, API Standard 620, latest edition, except where drawings or these specifications require otherwise.

2.3.2 The Vendor shall guarantee that all butt welds will develop a joint efficiency of at least 85 percent of the pate strength.

2.3.3 The finished tanks shall be guaranteed to pass any inspection requirements of local and state codes of the locality in which the tanks are to be used.

2.3.4 All notes and dimensions on the drawings are part of the specifications and shall be adhered to. There will be a permissible variation of 1/2 percent, plus or minus, in the nominal height unless the drawings show closer limits.

2.3.5 Stainless steel tanks to be formed by rolling. The joints, where practical, to be continuously weld using fusion methods and in conformance with the following standard practice.

2.3.5.1 The welding process selected shall provide a reasonably smooth, corrosion resistant welded joint. In addition to being both physically and chemically compatible with the base metal, the filler metal electrode shall contain no more than 0.03 percent carbon composition.

2.3.5.2 All welds are to be cleaned, pickled, and passivated prior to shipment to job site.

2.3.6 Care shall be exercised when welding stainless steel to structural steel members to minimize contamination of the stainless steel. No carbon steel shall be welded directly to the shell of the tank or to any appurtenance in contact with the fluid contained therein.

2.3.7 Where carbon steel supporting members are welded to the tanks, austenitic stainless steel reinforcing pads of like carbon quantity as the tanks shall be used. These pads shall be at least as thick as the shell plate to which they are welder. In every case, the pads shall be welded to the supporting members before being welded to the shell.

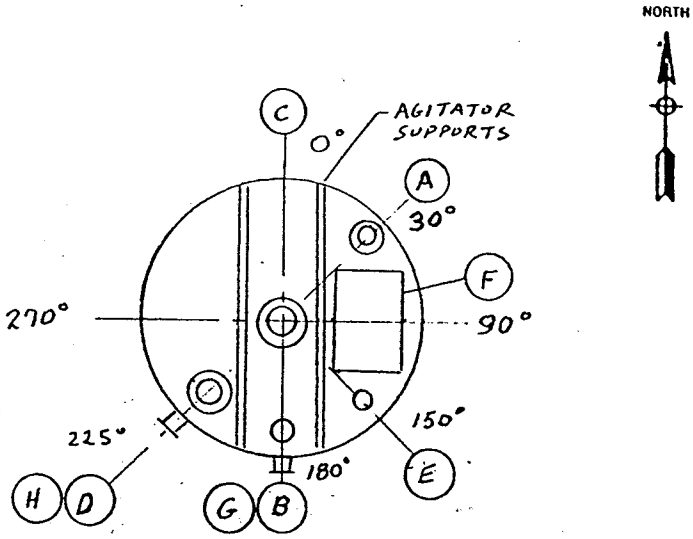
2.3.8 Telltale holes shall be provided in reinforcing plates in compliance with Article 3.16.9 of SPI Standard 620.

2.3.9 Qualifications of welding procedure and testing of welding operators shall be at lest equal to Part 3 of the API Specification for Welded Low Pressure Storage Tanks, API Standard 620. The Vendor shall certify that the welder and welding operator qualification test required by API Standard 620 were made.

2.3.10 For shop fabricated tanks, the Vendor shall state when the equipment will be ready for shipment. Also, the Vendor shall indicate the required time to make delivery to the destination. The Vendor shall also be responsible for being aware of and providing for any restriction on shipping the equipment.

2.3.11 Edge preparation of joints to be welded shall be dimensioned and detailed; shop and field welds shall be distinguished. Note shall be made on the shop drawing of those joints, or group of joints, for which it is important that the welding sequence and technique of welding be carefully controlled to minimize locked-up stresses and distortion.

2.3.12 Carbon steel support members and appurtenance shall be cleaned and coated with a universal primer, a high solids catalyzed epoxy coating with a topcoat of high build epoxy-polyamide coating.



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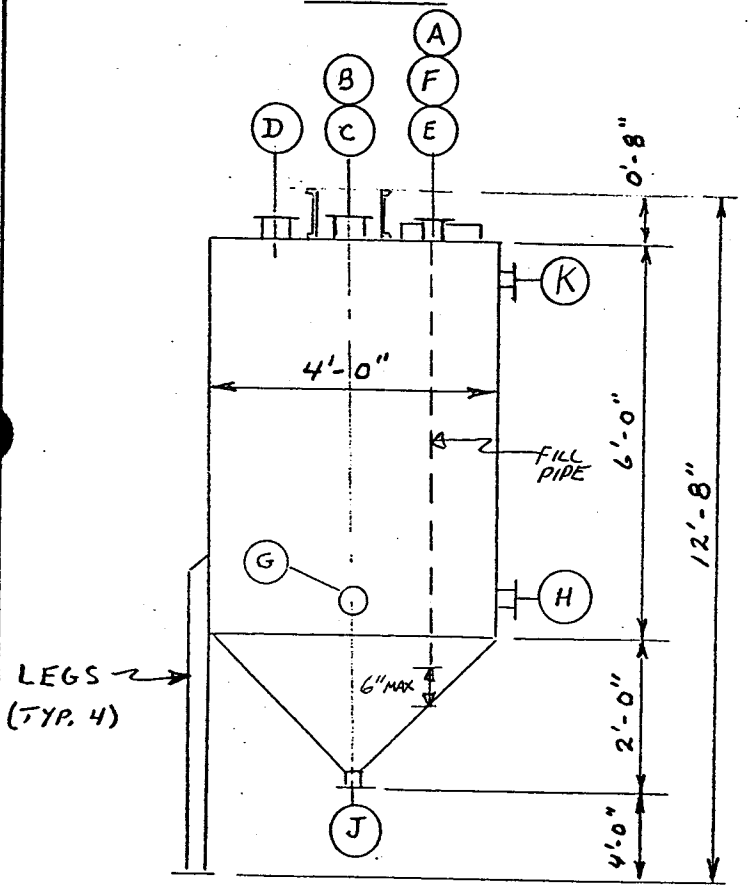


ELEVATION

DESIGN DATA

FLUID	AQ SOLN AND SOLVENTS
SPECIFIC GRAVITY	0.8 - 1.8
OPERATING PRESSURE	5 IN W.G.
DESIGN PRESSURE	5 FT W.G.
TEST PRESSURE	10 FT W.G.
DESIGN TEMPERATURE	200 °F
CODE/STAMP REQUIRED	NA
CORROSION ALLOWANCE-HEAD	1/8"
CORROSION ALLOWANCE-SHELL	1/8"
CORROSION ALLOWANCE-BOTTOM	1/8"
CORROSION ALLOWANCE-INTERNALS	1/8"
MATERIAL	316 L STN. STL.
ALLOWABLE WORKING STRESS	
WELD EFFICIENCY	85 %
WIND LOAD-BELOW FT.	NA
WIND LOAD- FT.- FT.	NA
WIND LOAD- FT.- FT.	NA
WIND LOAD-ABOVE FT.	NA
SEISMIC ZONE & CODE	
ROOF LIVE LOAD	50 LB/SQ FT
GASKET MATERIAL	TEFLON
PROTECTIVE COATING	
EMPTY WEIGHT	
FLOODED WEIGHT	

NOZZLE DATA

NOZ	SERVICE	SIZE	LOC	ELEV	DETAIL
A	PROCESS INLET	2	30°		
B	NITROGEN	1	180°		
C	AGITATOR	6	CTR.		
D	RELIEF VALVE	4	225°		
E	VAPOR VENT	2	150°		
F	MAN WAY	12x18	90°		
G	SAMPLE VALVE	1	180°	2'6"	
H	LEVEL TRANSMITTER	3	225°	2'6"	
J	OUTLET	2	CTR.		
K	PRESSURE GAUGE	1/4 NPT	90°	7'6"	
L					
M					

APPURTENANCES

ANCHOR BOLTS	NO. 4	SIZE 3/4"	DETAIL		
EQUALLY SPACED STARTING AT LEGS					
LADDER NONE					

notes

1. PROVIDE LIFTING LUGS ON TOP AT 60°, 180° AND 300°.
2. WORKING VOLUME 500 GALLONS.
3. FLAT TOP
4. AGITATOR SUPPORTS 2"x8" CARBON STEEL CHANNEL.
5. PROVIDE 4 BAFFLES, 1/4" x 6", SPACED 1" FROM WALL
6. PROVIDE HINGED, GASKETED COVER ON MANWAY WITH TWO SWING BOLTS

SIRRINE ENVIRONMENTAL CONSULTANTS

Greenville, South Carolina

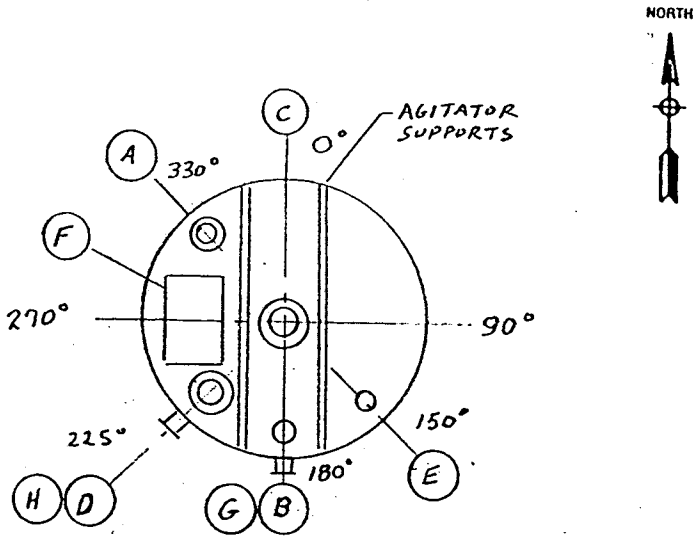
DESIGN	HWH	DWG. BY		CK.	RLF	DATE	10/19/89

TANK DESIGN SHEET

NAME LIQUID WASTE FEED TANK

EQ. NO. T-101, T-102

DWG. NO. | SH. OF



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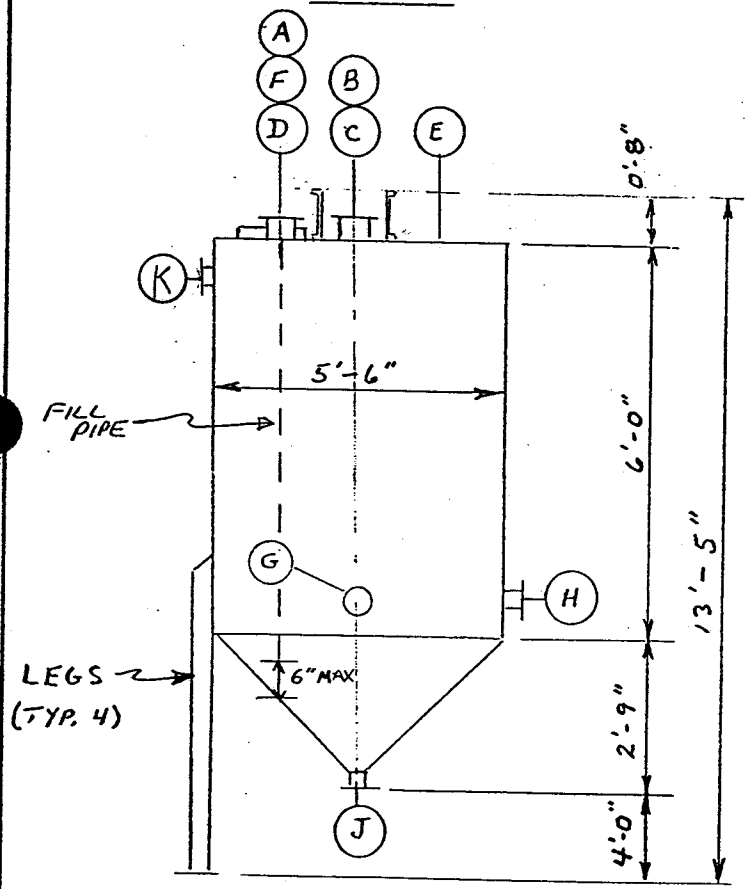


ELEVATION

DESIGN DATA

FLUID	AG SOLN AND SOLVENTS
SPECIFIC GRAVITY	0.8 - 1.8
OPERATING PRESSURE	5 IN W.G.
DESIGN PRESSURE	5 FT W.G.
TEST PRESSURE	10 FT W.G.
DESIGN TEMPERATURE	200 °F
CODE/STAMP REQUIRED	NA
CORROSION ALLOWANCE-HEAD	1/8"
CORROSION ALLOWANCE-SHELL	1/8"
CORROSION ALLOWANCE-BOTTOM	1/8"
CORROSION ALLOWANCE-INTERNALS	1/8"
MATERIAL	316 L STN. STL.
ALLOWABLE WORKING STRESS	
WELD EFFICIENCY	85 %
WIND LOAD-BELOW FT.	NA
WIND LOAD- FT.- FT.	NA
WIND LOAD- FT.- FT.	NA
WIND LOAD-ABOVE FT.	NA
SEISMIC ZONE & CODE	
ROOF LIVE LOAD	50 LB/SQ FT
GASKET MATERIAL	TEFLON
PROTECTIVE COATING	
EMPTY WEIGHT	
FLOODED WEIGHT	

NOZZLE DATA

NOZ	SERVICE	SIZE	LOC	ELEV	DETAIL
A	PROCESS INLET	2	330°		
B	NITROGEN	1	180°		
C	AGITATOR	8	CTR.		
D	RELIEF VALVE	4	225°		
E	VAPOR VENT	2	150°		
F	MAN WAY	12x18	270°		
G	SAMPLE VALVE	1	180°		
H	LEVEL TRANSMITTER	3	225°		
J	OUTLET	2	CTR.		
K	PRESSURE GAUGE	1/4 NPT	270°	8'3"	
L					
M					

APPURTENANCES

ANCHOR BOLTS	NO. 4	SIZE 3/4"	DETAIL		
EQUALLY SPACED STARTING AT LEGS					
LADDER NONE					

notes

1. PROVIDE LIFTING LUGS ON TOP AT 60°, 180° AND 300°.
2. WORKING VOLUME 1000 GALLONS.
3. FLAT TOP
4. AGITATOR SUPPORTS 2 3/8" x 8" CARBON STEEL CHANNEL.
5. PROVIDE 4 BAFFLES, 1/4" x 6", SPACED 1" FROM WALL
6. PROVIDE HINGED, GASKETED COVER ON MANWAY WITH TWO SWING BOLTS.

SIRRINE ENVIRONMENTAL CONSULTANTS

Greenville, South Carolina

DESIGN	HWH	DWG. BY		CK.	RLF	DATE	10/19/89

TANK DESIGN SHEET

NAME LIQUID WASTE FEED TANK

EQ. NO. T-103

DWG. NO. | SH. OF

END OF SECTION

SPECIFICATIONS

FOR

AGITATORS

FOR

GLAXO, INC.
ENVIRONMENTAL SAFETY FACILITY
RESEARCH TRIANGLE PARK, NC

SPECIFICATION NO. R-8279-2

EQUIPMENT NO. A-101, A-102, A-103

SEC JOB NO. R-8279

NOVEMBER 3, 1989

SIRRINE ENVIRONMENTAL CONSULTANTS
RALEIGH, NORTH CAROLINA

SIRRINE ENVIRONMENTAL CONSULTANTS

AGITATORS

PART 1 GENERAL

1.1 WORK INCLUDED

1.1.1 This specification defines the requirements for the design, performance, material, and delivery of an agitator. It establishes the minimum quality and performance requirements for agitators. The equipment shall be standard Vendor-supplied equipment modified if required.

1.1.2 The Vendor shall furnish all tools, materials, labor, and appurtenances necessary for the complete fabrication, testing, and shipment of the agitator.

1.1.3 Specific information and requirements of individual agitators are provided on separate Data Sheets, which shall be considered an integral part of this Specification. In the event of a conflict between the Data Sheets and this Specification, the Data Sheet shall take precedence.

1.1.4 Any conflicts between this Specification or the Data Sheets with any Code or Authority or referenced Specification shall immediately be brought to the attention of the Owner.

1.1.5 Consideration will not be given to proposals wherein the Vendor cannot supply an agitator for efficient operation or where, in SEC's judgment, the selection is not applicable.

1.2 RELATED WORK

1.2.1 Furnished by Owner

1.2.1.1 Motor starters (except on variable speed units) controls, and external wiring connections.

1.2.1.2 Supports not integral to the agitator.

1.2.1.3 Installation.

1.2.2 Furnished by Vendor

1.2.2.1 Motor, coupling, and guards.

1.2.2.2 Gear reducers, baseplates, and slide rails/plates.

1.3 SYSTEM DESCRIPTION

1.3.1 The equipment for which this standard is being established shall be suitable for continuous 24 hours or intermittent operation in a heavy duty, minimum maintenance service under varying operating conditions.

1.4 QUALITY ASSURANCE

1.4.1 The Owner's Representative shall have access to all applicable manufacturing areas of the Vendor's facilities during construction of the equipment specified herein.

1.4.2 The Owner's Representative may be present during fabrication and testing of the agitator(s), but failure of the Representative to be present or to note and call for correction of deviations from specification and drawings shall not release the Vendor from full responsibility to comply with them. Any deviations from the specifications, without written approval from the Owner, or any indication of inferior workmanship shall constitute cause for rejection.

1.5 REFERENCES

1.5.1 All references shall be taken as the latest editions, including appendices, addenda, errata, revisions, etc.

1.5.2 All aspects of the work shall comply with all applicable local, state, and federal requirements, including but not limited to the publications of the following associations:

1.5.2.1 OSHA - Occupational Safety and Health Administration.

1.5.2.2 ASMA - American Gear Manufacturer's Association

1.5.2.3 ASTM - American Society for Testing Materials

1.5.2.4 ANSI - American National Standards Institute

1.5.2.5 NEMA - National Electrical Manufacturers Association

1.6 SUBMITTALS

1.6.1 The Vendor is to complete the attached Data Sheets.

1.6.2 The Vendor shall include standard Data Sheets and descriptive literature adequately describing the design details of each agitator.

1.6.3 The Vendor shall enclose dimensional drawings, baffle configuration, mounting patterns, and turbine/impeller dimensions with configuration. The Vendor shall be required to guarantee the performance indicated on these submittals as part of the Purchase Order/Procurement Contract.

1.6.4 The Vendor shall include literature adequately describing auxiliary equipment available which would provide improved system operation. Vendor shall provide prices for this equipment.

1.6.5 The Vendor shall submit four sets of preliminary drawings containing:

1.6.5.1 Complete outlined dimension drawings, including front view, side view, and mounting details (physical arrangement).

1.6.5.2 Weight of equipment, including motor, coupling, base plate, gear reducer, shaft, turbine/impeller, etc.

1.6.6 The Vendor shall furnish a list of all parts associated with the equipment including:

1.6.6.1 Spare parts furnished with equipment.

1.6.6.2 Spare parts recommended to be purchased by Owner for stock.

1.6.6.3 Current prices of replacement parts and nearest stocking warehouse.

1.6.6.4 Special storage or handling requirements.

1.6.7 The Vendor shall include the expected delivery dates and the estimated shipping cost to the job site.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Each assembly shall be skidded, crated, boxed, or otherwise suitably protected against damage or loss during shipment and to facilitate field handling.

1.7.2 For shipping, the various components shall be identified by the Owner's equipment numbers and purchase order number, which are to be clearly shown on all drawings, shipping packages, and orders pertaining to the equipment.

1.7.3 All agitators shall have a stainless steel nameplate attached with stainless steel fasteners to the agitators casing or bearing housing.

1.7.4 The nameplate shall be of the embossed type and shall contain the following information:

1.7.4.1 Manufacturer, model number, and size.

1.7.4.2 Serial Number.

1.7.4.3 Impeller diameter, horsepower, and RPM.

1.7.4.4 Additional information per Vendor's standard practice.

1.8 ALTERNATES

1.8.1 The Vendor shall quote the equipment as specified herein. Additionally, the Vendor is invited to submit suggestions for equipment or materials other than those set forth in this Specification, provided that the performance, quality, and value of the proposed alternates are the equivalent, or better, than those specified.

1.8.2 The Vendor shall indicate the amount his bid will be altered for each proposed substitution.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 The materials of construction shall be new and free of defect. The Vendor shall be responsible for testing of materials to determine their suitability.

2.1.2 The materials of construction are specified on the Data Sheets. Standard materials, selected for compatibility with the particular application involved, shall be used for materials not specified on the Data Sheets.

2.2 EQUIPMENT

2.2.1 The Vendor shall assume and acknowledge full and complete responsibility for the suitability, adequacy, and safety of design, construction, and performance of equipment designed or furnished by the Vendor, including the Vendor and subcontractors.

2.2.2 BEARINGS

2.2.2.1 The output shaft bearings shall be grease lubricated. All others shall be oil lubricated by the gearbox splash lubrication.

2.2.3 COUPLINGS

2.2.3.1 Unless otherwise specified, all direct driven units shall be fitted with spacer type couplings on the input shaft.

2.2.3.2 The input couplings shall be sized with a 1.5 service factor for the installed driver horsepower.

2.2.4 GUARDS

2.2.4.1 All agitators, whether direct or V-belt driven, shall be provided with guards meeting OSHA requirements and all other applicable state and local codes.

2.2.5 SHAFT SEALING

2.2.5.1 The Data Sheets specify the need, type, and materials for any packing, lip seals, or mechanical seals and the acceptable seal or packing manufacturer(s). Lip seals shall be Vendor's standard.

2.2.5.2 The shaft sealing shall be designed for in-place changes.

2.2.6 GEAR REDUCERS

2.2.6.1 All gears shall be splash lubricated with oil.

2.2.6.2 The design shall incorporate positive means of preventing oil leakage at the output shaft.

2.2.6.3 A "change-gear" feature shall be incorporated for changing output speeds.

2.2.6.4 A magnetic drain plug, oil sight level, and vented filler cap shall be provided.

2.2.6.5 Only AGMA standard output speed shall be used.

2.2.6.6 A minimum overall service factor of 1.5 shall be used unless otherwise specified.

2.2.6.7 The rotation direction shall be permanently marked on the gearbox.

2.2.7 SHAFTS

2.2.7.1 Shafts shall be solid and of one piece construction except for low speed couplings.

2.2.7.2 If the shaft diameter is stepped, a radius shall be used to relieve stress concentrations.

2.2.7.3 Shafts shall be machined true to a maximum static runout of 0.003 inches per foot. Where multiple lengths are coupled, machining shall be on the coupled assembly.

2.2.8 IMPELLERS

2.2.8.1 Unless otherwise specified, impellers shall be standard flat or pitched blade turbines. Special "airfoil" designs, etc., are not desired unless Vendor provide sufficient process sizing information for independent verification of the process performance.

2.2.8.2 All impellers regardless of design shall be statically balanced.

2.2.8.3 Turbine impellers blades shall be attached to the hub by bolting and double nuttings.

2.2.8.4 Turbine hubs shall be attached to the shafts by pinned keys and lock screws.

2.2.8.5 Impeller operating speeds shall be limited to 65 percent of the first critical speed for turbines without stabilizers, and to 80 percent of the first critical speed for turbines with stabilizers. Propellers shall operate above the first critical speed at Vendor's recommended speed ratio.

2.2.9 ELECTRIC MOTORS

2.2.9.1 This Specification covers the requirements for general purpose induction motors 1/4 to 200 HP, which will be furnished with equipment.

2.2.9.2 All motors shall be in accordance with NEMA Standard MG-1 (latest revision) and with the applicable portions of the National Electrical Code.

2.2.9.3 Motors shall be rated 460 volts, 3-phase, 60 Hertz, Explosion Proof, Class I, Group D, TEFC, NEMA Design B, Class F insulation, 1.15 service factor, 40°C ambient, continuous duty, constant speed, ball bearing, with F-1 conduit box arrangement, unless otherwise noted.

2.2.9.4 Motors shall be designed for severe duty chemical service in moist, corrosive and contaminated industrial environments. Frame and end shields shall be cast iron. Rolled steel frames shall be acceptable for frames below 180. Double-shielded ball bearings shall have provisions for regressing. The insulation system, rotor surface, and stator surface shall be epoxy enameled.

2.2.9.5 The Vendor shall provide the following motor data as part of his proposal.

1. Equipment No. _____

2. Motor Manufacturer and Type/Model No.

3. H.P. _____ RPM _____ Frame _____

4. Full Load Amps at 460 Volts _____

5. NEMA Efficiency Code Index per IEEE 112, Method B _____

6. Weight (lbs.) _____

2.3 DESIGN CONSIDERATIONS

2.3.1 The design shall incorporate provisions to eliminate or minimize the adverse effects of vibration on the performance of the agitators as well as on tanks, mounting platforms, and other adjacent equipment.

2.3.2 The design of the impeller and baffles shall be selected for efficient operation. The need for multiple impellers on a single shaft shall be determined by the Vendor, unless noted otherwise.

2.3.3 All tank data other than the tank dimensions are estimates only. Vendor shall confirm or recommend changes as necessary for baffling and mounting nozzle size, as well as any other specific items influencing size, as well as any other specific items influencing the agitator design or performance. Tank design sheets are included, and shall be considered an integral part of this specification.

SIRRINE ENVIRONMENTAL CONSULTANTS

AGITATOR

Job No.:	R-8279
Equipment No.:	A-101, A-102, A-103
Equipment Name:	Feed Tank Agitator(s)
Quantity:	3
Client:	Glaxo, Inc.
Location:	Research Triangle Park, NC
Issued By:	HWH
Issue Date:	October 31, 1989
Rev. No. ____ Rev. By:	
Rev. Date:	
Reference Dwg. No.:	
Environment:	Indoors, Flammable vapors
Remarks:	Must be capable of resuspending settled solids when level is one foot below top. Must be able to keep solids in suspension when level is in the cone.

PERFORMANCE CHARACTERISTICS

Batch:

Volume	gal	2 @ 500, 1 @ 1,000
Weight	lbs	Approximately 2 @ 4,600, 1 @ 9,200

Continuous:

Volume	GPM	
Weight	lbs/	
Specify Gravity		0.8 to 1.8
Viscosity	cP	0.8 to 1,000
Temperature	•F	60 to 120
Specific Heat	BTU/lb•F	Approximately 1
% Solids	By Weight	0 to 10

Solids Type:

[X] Soluble
[X] Insoluble
[ ] Abrasive
[ ] Crystalline
[ ] Sticky or gummy
[ ] Light or fluffy

Particle Size: 1/16" maximum

Foaming Tendency of Mixture:

[ ] Low
[X] Medium
[ ] High

PERFORMANCE CHARACTERISTICS (cont.)

Class of Mixing:

[X] Blend
[X] Dissolve
[ ] Disperse gas
[X] Suspend Solids
[ ] Heat transfer
[ ] Emulsify

Mixer Operation:

[X] During filling
[X] During draw-off

Agitator Entry:

[X] Top entering
[ ] Side entering
[ ] in-line

Liquid type:

[ ] A-101: Radioactive Solvents
[ ] A-102: Halogenated Solvents
[ ] A-103: Nonhalogenated Solvents

MATERIALS OF CONSTRUCTION

Impeller: 316 L STN.STL

Shaft: 316 L STN.STL.

Shaft Coupling (if any): 316L STN.STL

Steady Bearings (if any): NONE

All Wetted Parts: 316 STN.STL

MATERIALS OF CONSTRUCTION (cont.)

Mechanical Seal:	Manufacturer:	
	Type:	
	Mfr's Code:	
	Rotating Face:	
	Body:	
	Stationary Face:	
	O-Rings:	
Packing:	Manufacturer:	
	Type:	
	Mfr's Code:	
Agitator:	Manufacturer:	
	Type:	
	Model No.:	
Mounting:	Support Beam Dimensions:	2" x 8" Carbon Steel Channels
	Flange and Bracket Mounted:	
	Clamp Mounted:	No
	Bung Hole Adaptor:	No
	Minimum Opening to Install:	
	Entry Position:	No

MATERIALS OF CONSTRUCTION (cont.)

Coupling:	Manufacturer:		_____
	Type:		_____
	Model No.:		_____
	Spacer Blocks Included:		_____
Drive:	Manufacturer:		_____
	Type:		_____
	Model No.:		_____
Motor:	Manufacturer:		_____
	Type:		_____
	RPM:		_____
Break HP:			_____
Motor HP:			_____
Shaft:	Overall Length:	in	_____
	Bearing to Propeller:	in	_____
	Critical RPM:		_____
	Operating RPM:		_____
	Sectional Lengths:	in	_____

MATERIALS OF CONSTRUCTION (cont.)

Impeller:	Number:		_____
	Number of Blades Per Impeller:		_____
	Type:		_____
	Diameter:	in	_____
	Stabilizer (Blades/Ring):		_____
Baffles:	Number:		_____
	Size (LXW):	in	_____
	Distance from Wall:	in	_____

END OF SECTION

SPECIFICATIONS

FOR

METERING PUMP

FOR

GLAXO, INC.
ENVIRONMENTAL SAFETY FACILITY
RESEARCH TRIANGLE PARK

SPECIFICATION NO. 8279-3

EQUIPMENT NO. P-101, 102, 103

SEC JOB NO. R-8279

NOVEMBER 3, 1989

SIRRINE ENVIRONMENTAL CONSULTANTS
RALEIGH, NORTH CAROLINA

SIRRINE ENVIRONMENTAL CONSULTANTS

METERING PUMP

PART 1 GENERAL

1.1 WORK INCLUDED

1.1.1 This specification defines the requirements for the design, performance, material, and delivery of a metering pump. It establishes the minimum quality and performance requirements. The pump shall be standard Vendor-supplied equipment, modified if required.

1.1.2 The Vendor shall furnish all necessary tools, materials, labor, and appurtenances necessary for the complete fabrication, testing, and shipment of the pump.

1.1.3 Specific information and requirements of individual pumps are provided on separate Data Sheets, which shall be considered an integral part of this Specification. In the event of a conflict between the Data Sheets and this Specification, the Data Sheets shall take precedence.

1.1.4 Any conflicts between this Specification or the Data Sheets with any Code or Authority shall immediately be brought to the attention of the Owner for resolution.

1.1.5 Consideration will not be given to proposals wherein the Vendor cannot supply a metering pump for efficient operation or where, in SEC's judgement, the selection is not applicable.

1.2 RELATED WORK

1.2.1 Furnished by Owner

1.2.1.1 External piping.

1.2.1.2 Motor starters, controls, external wiring.

1.2.1.3 Foundations, supports, anchor bolts.

1.2.1.4 Installation.

1.2.2 Furnished by Vendor

1.2.2.1 Motor, coupling, coupling guard, and base plate.

1.2.2.2 Pulsation dampener.

1.3 SYSTEM DESCRIPTION

1.3.1 The equipment for which this standard is being established shall be suitable for continuous 24 hours or intermittent operation in a heavy duty, minimum maintenance service under varying operation conditions.

1.4 QUALITY ASSURANCE

1.4.1 The Owner's Representative shall have access to all applicable manufacturing areas of the Vendor's facilities during construction of the equipment specified herein.

1.4.2 The Owner's Representative may be present during fabrication and testing of the metering pump, but failure of the Representative to be present or to note and call for correction of deviations from specification and drawings shall not release the Vendor from full responsibility to comply with them. Any deviations from the specifications, without written approval from the Owner, or any indication of inferior workmanship shall constitute cause for rejection.

1.5 REFERENCES

1.5.1 All references shall be taken as the latest editions, including appendices, addenda, errata, revisions, etc.

1.5.2 All aspects of the work shall comply with all applicable local, state, and federal requirements, including, but not limited to, the publications of the following associations:

1.5.2.1 OSHA - Occupational Safety and Health Administration.

1.5.2.2 Standards of the Hydraulic Institute.

1.5.2.3 ASTM - American Society for Testing Materials.

1.5.2.4 ANSI - American National Standards Institute.

1.5.2.5 AGMA - American Gear Manufacturer's Association.

1.5.2.6 AFBMA - Anti-Friction Bearing Manufacturer's Association.

1.5.2.7 NEMA - National Electrical Manufacturer's Association.

1.6 SUBMITTALS

1.6.1 The Vendor is to complete the attached data sheets.

1.6.2 The Vendor shall include standard data sheets and descriptive literature adequately describing the design details of each pump.

1.6.3 The Vendor shall enclose performance curves for each pump clearly annotated with operating conditions (head, flow, power, efficiency, strokes per minute, max piston volume) stated on each pump data sheet. The Vendor shall be required to guarantee the performance indicated on these Submittals as part of the Purchase Order/Procurement Contract.

1.6.4 The Vendor shall include literature adequately describing auxiliary equipment available which would provide improved system operation, such as seal flushing systems, etc. Vendor shall provide prices for this equipment.

1.6.5 The Vendor shall submit four sets of preliminary drawings containing:

1.6.5.1 Complete outlined dimension drawings, including front view, side view, and mounting details (physical arrangement).

1.6.5.2 Weight of equipment, including pump, motor, coupling, base plate, etc.

1.6.6 The Vendor shall furnish a list of all parts associated with the equipment including:

1.6.6.1 Spare parts furnished with equipment.

1.6.6.2 Spare parts recommended to be purchased by Owner for stock.

1.6.6.3 Current prices of replacements parts and nearest stocking warehouse.

1.6.6.4 Special storage or handling requirements.

1.6.7 The Vendor shall include the expected delivery dates and the estimated shipping cost to the job site.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Each assembly shall be skidded, crated, boxed, or otherwise suitably protected against damage or loss during shipment and to facilitate field handling.

1.7.2 Before shipment, flanged connections shall be covered with wood or other suitable material and fastened securely to prevent foreign matter from entering. Threaded connections shall be fitted with nipples and caps of the same material as the pump and properly identified.

1.7.3 For shipping, the various components shall be identified by the Owners's equipment numbers and purchase order number, which are to be clearly shown on all drawings, shipping packages, and orders pertaining to the equipment.

1.7.4 All pumps shall have a stainless steel nameplate attached with stainless steel fasteners to the pump casing or bearing housing.

1.7.5 The nameplate shall be of the embossed type and shall contain the following information:

1.7.5.1 Manufacturer, model number, and size.

1.7.5.2 Serial number.

1.7.5.3 Design flow in GPM or GPH and discharge head in feet or PSIG.

1.7.5.4 Additional information per Vendor's standard practice.

1.8 ALTERNATES

1.8.1 The Vendor shall quote the equipment as specified herein. Additionally, the Vendor is invited to submit suggestions for equipment or materials other than those set forth in this Specification, provided that the performance, quality, and value of the proposed alternates are the equivalent, or better, than those specified.

1.8.2 The Vendor shall indicate the amount his bid will be altered for each proposed substitution.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 The materials of construction shall be new and free of defect. The Vendor shall be responsible for testing of materials to determine their suitability.

2.1.2 The materials of construction, unless otherwise specified on the Data Sheets, shall be Vendor's standard materials selected for compatibility with the particular application involved.

2.2 EQUIPMENT

2.2.1 The Vendor shall assume and acknowledge full and complete responsibility for the suitability, adequacy, and safety of design, construction, and performance of equipment designed or furnished by the Vendor, including the Vendor and subcontractors.

2.2.2 Pumps

2.2.2.1 The metering pumps shall be (piston/piston with diaphragm type) with electronic stroke control. Stroke must be adjustable while pump is running.

2.2.2.2 Pump selection shall be made by equipment manufacturer based on conditions and Specifications on the attached Data Sheets.

2.2.3 Controls

2.2.3.1 Flow adjustment for each head shall be over the full range of 0 percent to 100 percent of capacity in smooth increments.

2.2.3.2 For any given setting of capacity within the range of 10 percent to 100 percent maximum capacity, the actual delivery shall remain within plus/minus 1 percent of the average flow for that setting.

2.2.3.3 For the conditions stated in Paragraph 2.2.3.2 when the pump is restarted after shutdown and the control setting remains unchanged, the subsequent average flow shall be within plus/minus 1 percent of the previous flow.

2.2.3.4 The Vendor shall supply a calibration curve relating the control setting to the average discharge. Vendor shall specify the accuracy of such a curve. Linearity of the calibration curve is not required.

2.2.4 The pump assembly shall be constructed to facilitate ease of disassembly, inspection, parts replacement, and reassembly.

2.2.5 Casing

2.2.5.1 The Vendor shall provide the maximum working pressure of the casing based on the actual thickness less the corrosion allowance.

2.2.5.2 The pumping chamber shall be provide with an automatic built-in hydraulic relief valve.

2.2.5.3 All pump casings having flanged suctions and discharges shall conform to applicable ANSI Standards. Size and facing shall be per the Data Sheets.

2.2.5.4 All screwed connections shall have American Standard Taper Pipe Threads and shall not be smaller than ½ inch N.P.S.

2.2.5.5 Drain plugs in the casing shall have a contained gasket at the bottom of the threads.

2.2.6 Bearings

2.2.6.1 All bearings shall have an L10 life of 30,000 hours in accordance with AFBMA Standards.

2.2.6.2 Where sleeve bearings are used, they shall be the horizontally split type. All other bearings shall be the anti-friction type.

2.2.6.3 Bearings shall be mounted in water- and dust-tight housings. Housing shall be of the same material as the pump casing, unless completely isolated in all respects from the fluid pumped.

2.2.6.4 Bearings shall be oil lubricated with oil reservoirs equipped with level indicators and drains.

2.2.7 Couplings

2.2.7.1 All pumps shall be fitted with spacer type couplings.

2.2.7.2 The couplings shall be sized with a 1.25 service factor for the installed driver horsepower.

2.2.7.3 The couplings shall be Wood's Sure-Flex Type SC, Dodge, Falk, or Rexnord of the same type and quality. Other types may be acceptable subject to the approval of the Owner's Representative.

2.2.8 Guards

2.2.8.1 All pumps shall be provided with guards meeting OSHA Specifications.

2.2.9 Baseplates

2.2.9.1 All pumps shall have a single baseplate for the pump, drive, and motor.

2.2.9.2 The baseplates shall be steel, either cast or fabricated, and shall be provided with grouting holes. Unless otherwise specified on the Data Sheets, a tapped drain connection shall be provided for each baseplate.

2.2.10 Painting

2.2.10.1 All unmachined carbon steel exterior surfaces shall be suitably prepared, prime coated, and finish coated with Vendor's recommended paint system. Preparation and application shall be in accordance with the paint manufacturer's instructions. The paint system selected shall be compatible with the environmental conditions and the materials handled.

2.3 ELECTRIC MOTORS

2.3.1 This Specification covers the requirements for general purpose induction motors 1/4 to 200 HP, which will be furnished with equipment.

2.3.2 All motors shall be in accordance with NEMA Standard MG-1 (latest revision) and with the applicable portions of the National Electrical Code.

2.3.3 Motors shall be rated 460 volts, 3-phase, 60 Hertz, TEFC, NEMA Design B, Class F insulation, 1.15 service factor, 40·C ambient, continuous duty, constant speed, ball bearing, with F-1 conduit box arrangement, unless otherwise noted.

2.3.4 Motors shall be designed for severe duty chemical service in moist, corrosive and contaminated industrial environments. Frame and end shields shall be cast iron. Rolled steel frames shall be acceptable for frames below 180. Double-shielded ball bearings shall have provisions for regressing. The insulation system, rotor surface, and stator surface shall be epoxy enameled.

2.3.5 Motors shall be Reliance, Louis-Allis or approved equal.

2.3.6 The Vendor shall provide the following motor data as part of his proposal.

1. Equipment No. _____

2. Motor Manufacturer and Type/Model No. _____

3. H.P. _____ RPM _____ Frame _____

4. Full Load Amps at 460 Volts _____

5. NEMA Efficiency Code Index per IEEE 112, Method B ____

6. Weight (lbs.) _____

PART 3 EXECUTION

Not used.

SIRRINE ENVIRONMENTAL CONSULTANTS

METERING PUMP

Job No.:	R-8279
Equipment No.:	P-101, P-102, P-103
Equipment Name:	Incinerator Feed Pump(s)
Quantity:	3
Function:	Feed liquid waste to incinerator
Client:	Glaxo, Inc.
Location:	Research Triangle Park, NC
Issued By:	HWH
Issue Date:	October 31, 1989
Rev. No.____ Rev. By:	
Reference Drawing No.:	R-8279-D2
Environment:	Indoors, Flammable Vapors
Remarks:	
Flow Required: Maximum GPH	50
Normal GPH	27
Minimum GPH	10
Pumping Temperature: °F	60 to 120
Liquid Handled:	Aq. solns. and organic solvents
pH:	5 to 9
Specific Gravity:	0.85 to 1.1

PERFORMANCE CHARACTERISTICS

Viscosity:	cP	0 to 100
Vapor Pressure:	PSIA	
Total Solids:	%	0 to 10
Suspended Solids:	%	0 to 10
Solids Maximum Size:	in	1/16
NPSH Available:	ft	4 to 10
Suction Pressure:	ft	4 to 10
Discharge Pressure:	ft	120
Driver Type:		Electric Motor
Pump Duty:Continuous/Intermittent		Continuous
Pump Accuracy:	%	1
Turn-Down Ratio:		10:1
Hydrostatic Test Pressure:	PSIG	100
Performance Tst Required:Yes/No		No
Witnessed:Yes/No		No
Pulsation Dampener Required: Yes/No		Yes
Remarks:		See attached list of materials that could be in the feed stream.

MATERIALS OF CONSTRUCTION*

Body: _____

Cylinder: _____

Liner: _____

Plunger: _____

Diaphragm: _____

Valves: _____

Seats: _____

Plunger Packing: _____

Stuffing Box: _____

Gland: _____

Gaskets: _____

MISCELLANEOUS*

Connections: Type: _____

Rating: _____

Base: _____

Coupling: _____

Coupling Guard: _____

Relief Valves: Internal/External _____

Relief Valve Setting: PSIG _____

Pulsation Dampener
Furnished: Yes/No _____

DATA SUPPLIED BY VENDOR*

Manufacturer: _____

Model No.: _____

Size: _____

Serial No.: _____

Pump Type: _____

Plunger: _____

Diaphragm: _____

Minimum Flow: GPH _____

Maximum Flow: GPH _____

Volumetric Displacement:
gal/stroke _____

Capacity Control:

Manual/Automatic: _____

Pneumatic/Electric/Hydraulic: _____

Capacity Change:

Variable Speed/Stroke _____

While: Running/Stopped _____

Stalling Pressure: PSI _____

Brake HP: HP _____

Motor HP: HP _____

DATA SUPPLIED BY VENDOR*

Drive Type: direct/gear reducer _____

Gear Reducer: Mfr: _____

Model No.: _____

Reduction Ratio: _____

DATA SUPPLIED BY VENDOR*

Pump Accuracy: % _____

Turn-Down Ratio: _____

Lubrication Requirements: _____

Weight of Pump, Base, Motor, Gear Reducer, Coupling, and Coupling Guard: lbs _____

Remarks: _____

_____

_____

* Data marked by asterisks must be furnished by Vendor unless specified by Purchaser.

THE MATERIALS LISTED ARE EXPECTED TO BE IN VARYING CONCENTRATIONS IN THE SOLVENT WASTE FEED TO THE INCINERATOR

WASTE

1. Non-Halogenated Solvents

Acetonitrile
Methanol
Ethyl alcohol (Ethanol)
Isopropyl alcohol
Dimethyl Formamide
Cyclohexane
Hexane
Acetone
Toluene
Ethyl Acetate
Ethyl Ether
Petroleum Ether
Methyl Ether
1, 4 Dioxane
Tetrahydrofuran
Pyridine
Phenol
Xylene
Isooctane
Pentane
Benzene
N-Butanol
Propylene Glycol
(monoethylether)
Formaldehyde
Isoamyl Alcohol

2. Halogenated Solvents

Methylene Chloride
Chloroform
Methyl Chloride
Dichloroethane
Dichlorobenzene
Carbon Tetrachloride

END OF SECTION

SPECIFICATIONS

FOR

ACTIVATED CARBON ADSORBER SYSTEM

FOR

GLAXO, INC.
ENVIRONMENTAL SAFETY FACILITY
RESEARCH TRIANGLE PARK

SPECIFICATION NO. G-8279-4

EQUIPMENT NO. C-101A, C102-A, C-103A
C-101B, C-102B, C-103B

SEC JOB NO. R-8279

NOVEMBER 3, 1989

SIRRINE ENVIRONMENTAL CONSULTANTS
RALEIGH, NORTH CAROLINA

SIRRINE ENVIRONMENTAL CONSULTANTS

ACTIVATED CARBON ADSORBER SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

1.1.1 This specification defines the requirements for the design, performance, material, and delivery of an activated carbon adsorber system. It establishes the minimum quality and performance requirements for the adsorber system. The equipment shall be standard Vendor-supplied equipment, modified if required.

1.1.2 The Vendor shall furnish all necessary tools, materials, labor, and appurtenances necessary for the complete fabrication, testing, and shipment.

1.1.3 Specific information and requirements of individual adsorber systems are provided on separate data sheets, which shall be considered an integral part of this specification. In the event of a conflict between data sheets and this specification, the data sheets shall take precedence.

1.1.4 Any conflicts between this specification or the data sheets with any code or authority shall immediately be brought to the attention of the Owner for resolution.

1.1.5 Consideration will not be given to proposals wherein the Vendor cannot supply an activated carbon adsorber system for efficient operation or where, in SEC's judgement, the selection is not applicable.

1.2 RELATED WORK

1.2.1 FURNISHED BY OWNER

1.2.1.1 External piping.

1.2.1.2 Foundations, supports, and anchor bolts.

1.2.1.3 All control equipment.

1.2.1.4 Installation.

1.2.2 PROVIDED BY VENDOR

1.2.2.1 Activated Carbon Canisters.

1.2.2.2. Carbon Charge.

1.3 SYSTEM DESCRIPTION

1.3.1 The equipment for which this standard is being established shall be suitable for continuous or intermittent operation in a heavy duty, minimum maintenance service at a hazardous waste incinerator under varying operating conditions. Organic emissions are due to vapors generated when the contents of 55 gallon drums are transferred to bulking tanks. Two canisters shall be piped in series for this application. When breakthrough is detected on the first canister, the second canister shall be rotated to first in series and a new canister will be installed downstream.

1.4 QUALITY ASSURANCE

1.4.1 The Owner's Representative shall have access to all applicable manufacturing areas of the Vendor's facilities during construction of the equipment specified herein.

1.5 REFERENCES

1.5.1 All references shall be taken as the latest editions, including appendices, addenda, errata, revisions, etc.

1.5.2 All aspects of work shall comply with all applicable local, state, and federal requirements, including, but not limited to, the following associations:

1.5.2.1 OSHA - Occupational Safety and Health Administration

1.5.2.2 ASTM - American Society for Testing Materials

1.5.2.3 ANSI - American National Standards Institute

1.5.2.4 AWS - American Welding Society

1.5.2.5 DOT - Department of Transportation

1.6 SUBMITTALS

1.6.1 The Vendor is to complete the attached data sheets.

1.6.2 The Vendor shall include standard data sheets and descriptive literature adequately describing the design details of each adsorber.

1.6.3 The Vendor shall enclose isotherms for each chemical.

1.6.4 The Vendor shall include information detailing suggested piping arrangements and controls.

1.6.5 The Vendor shall state operating and maintenance procedures for successful operation.

1.6.6 The Vendor shall include literature adequately describing auxiliary equipment available which would provide improved system operation. Vendor shall provide prices for this equipment.

1.6.7 The Vendor shall submit four sets of preliminary drawings containing:

1.6.7.1 Complete outlined dimension drawings, including front view, side view, and mounting details (physical arrangement).

1.6.7.2 Weight of canisters, empty, filled with carbon, and flooded with water.

1.6.8 The Vendor shall furnish a list of all parts associated with the equipment including:

1.6.8.1 Spare parts furnished with equipment.

1.6.8.2 Spare parts recommended to be purchased by Owner for stock.

1.6.8.3 Discounted prices of replacement parts and nearest stocking warehouse.

1.6.8.4 Special storage or handling requirements.

1.6.9 The Vendor shall include the expected delivery dates and the established shipping cost to the job site.

1.6.10 The Vendor shall estimate the expected life of each canister, the removal efficiency and the uptake capacity for each compound on the data sheets, assuming only one compound present at a time in nitrogen and saturated at 55°F.

1.6.11 The Vendor shall recommend a method of detecting breakthrough on the carbon canisters.

1.6.12 The Vendor shall submit a statement of all warranties including all limitations in scope and time. Minimum warranty against defects in material or workmanship shall be one year from start of normal operations.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 All canisters shall be shipped on pallets and suitably protected against damage during shipment to facilitate field handling. All openings (nozzles) shall be covered for protection during shipment.

1.7.2 The Owner reserves the right to inspect any or all parts prior to shipping.

1.7.3 All canisters shall be clearly labeled and shall contain the following information:

1.7.3.1 Manufacturer, model number, and size.

1.7.3.2 Type of carbon, net weight of carbon, and maximum operating pressure.

1.7.3.3 Additional information per Vendor's standard practice.

1.8 ALTERNATES

1.8.1 The Vendor shall quote the equipment as specified herein. Additionally, the Vendor is invited to submit suggestions for equipment or materials other than those set forth in this Specification, provided that the performance, quality, and value of the proposed alternates are the equivalent, or better, than those specified.

1.8.2 The Vendor shall indicate the amount his bid will be altered for each proposed substitution.

1.8.3 The Vendor shall provide information and prices or credits on services available for regeneration and shipment of the spent carbon canisters.

PART 2 PRODUCTS

2.1 The materials of construction shall meet all D.O.T. shipping requirements.

2.2 The materials of construction are to be recommended by the vendor. Standard materials, selected for compatibility with the particular application involved, shall be used for materials not specified on the Data Sheets.

2.3 The Vendor shall assume and acknowledge full and complete responsibility for the suitability, adequacy, and safety of design, construction, and performance of equipment designed or furnished by the Vendor, and the Vendor's suppliers and subcontractors.

2.4 The selected vendor shall submit four sets of maintenance, installation, and operating manuals on all equipment during the approval process.

2.5 The selected vendor shall submit certified reproducible dimensioned drawings of all equipment.

SIRRINE ENVIRONMENTAL CONSULTANTS

ACTIVATED CARBON ADSORBER SYSTEM

Job No.	R-8279
Equipment No.	C-101A, C-101B, C-102A, C-102B, C-103A, C-103B
Equipment Name	Activated Carbon Canisters
Quantity	Estimated 7 per week
Client	Glaxo, Inc.
Location	Research Triangle Park, NC
Issued By	HWH
Issue Date	October 31, 1989
Rev. No. ___ Rev. By	
Reference Dwg. No.	R-8279-D2
Environment	Indoors

PERFORMANCE CHARACTERISTICS

Exhaust Flow Rate: Maximum	CFM	6
Average	CFM	3
Inlet Gas Temperature		60 to 100
Removal Efficiency	%	Per Vendor Based on Two Canister in Series
Pressure Drop Across Unit	IWG	Per Vendor
Pressure	PSIA	14.7
Chemicals to be scrubbed		see P. 10

DATA SUPPLIED BY VENDOR

Adsorber:

Manufacturer _____

Type _____

Model No. _____

Size (Dia.× H) In. _____

Recommended Shipping Quantity _____

Vapor Inlet Nozzle Type & Size _____

Vapor Outlet Nozzle Type & Size _____

Liquid Drain Nozzle In. _____

Weight of Carbon per Unit Lbs _____

Type of Carbon

Adsorber Weight: New Lbs _____

Saturated Lbs _____

Water Filled Lbs _____

Canister Cost per unit _____

Regeneration Cost _____

Quantity required for Regeneration _____

Normal Shipping Time _____

Nearest Stocking Warehouse _____

MATERIALS OF CONSTRUCTION

Adsorber _____

Carbon/Adsorbent _____

Vapor Distributor _____

CHEMICAL VAPORS EXPECTED TO BE PRESENT IN THE VENT GAS FROM THE INCINERATOR FEED TANKS

1. Non-Halogenated Solvents

Acetonitrile
Methanol
Ethyl alcohol (Ethanol)
Isopropyl alcohol
Dimethyl Formamide
Cyclohexane
Hexane
Acetone
Toluene
Ethyl Acetate
Ethyl Ether
Petroleum Ether
Methyl Ether
1, 4 Dioxane
Tetrahydrofuran
Pyridine
Phenol
Xylene
Isooctane
Pentane
Benzene
N-Butanol
Propylene Glycol
(monoethylether)
Formaldehyde
Isoamyl Alcohol

2. Halogenated Solvents

Methylene Chloride
Chloroform
Methyl Chloride
Dichloroethane
Dichlorobenzene
Carbon Tetrachloride

END OF SECTION

FORM 13300 - 10F

TRANSMITTING ROTAMETERS

1. GENERAL SPECIFICATIONS

A. Case material and window frame shall be 300 series stainless steel.

B. Windows shall be of safety glass.

C. Meter tube shall be borosilicate glass.

D. Float shall be made of 300 series stainless steel and corrosion-resistant material.

E. Connections shall be horizontal NPT connections.

F. Rotameter shall be designed to permit easy removal of metering tube for cleaning or replacement.

G. Rotameter shall include a transmitting extension providing an output compatible with programmable logic controller.

H. Pressure Rating: 150 psi

I. Accuracy: $\pm$ 2% of Maximum Flow Rate.

J. Rangeability: From 8% to 100%

K. All electrical compounds shall be NEMA 4 rated.

2. EQUIPMENT DATA

Tag Number	Service	Fluid	Maximum Flow Rate (gph)	Line Size (inches)
	Incinerator Feed	Radioactive Solvents	50	2
	Incinerator Feed	Nonhalogenated Solvent	50	2
	Incinerator Feed	Halogenated Solvents	50	2

FORM 13300 - 23F

TANK LEVEL TRANSMITTER

1. GENERAL SPECIFICATION

A. Two-wire, 4-20 MADC output signal.

B. All electrical components shall be NEMA 4 rated.

C. Transmitter shall be pressure type calibrated to provide output of tank level in feet with local indication.

D. ± 2% of full scale accuracy

E. All wetted parts shall be 300 series stainless steel and corrosion resistant material compatible with tanks contents.

2. EQUIPMENT DATA

Tag Number	Service	Fluid	Operating Range	Indicator Scale	Tank Connection
	Incinerator Feed	Radioactive Solvents	0-6 ft.	0-6 ft.	3"
	Incinerator Feed	Halogenated Solvents	0-6 ft.	0-6 ft.	3"
	Incinerator Feed	Nonhalogenated Solvents	0-6 ft.	0-6 ft.	3"

3. SPILL CONTAINMENT TANK DATA

SECTION 15179

UNDERGROUND DOUBLE-WALL FIBERGLASS SPILL CONTAINMENT TANKS

PART 1 GENERAL

1.01 DESCRIPTION OF WORK - Provide fiberglass-reinforced polyester underground double-wall spill containment tanks, including fittings and accessories, with sizes and materials as shown on the contract drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Structure Excavation - Section 02220.

B. Utility Excavation - Section 02221.

C. Fill, Backfill and Compaction - Section 02225.01.

D. Cast-in-Place Concrete - Section 03300.01.

E. Specialty Drainage Systems - Section 15407.

1.03 SUBMITTALS - Submit the following to the Owner for record:

A. Product Data - Show tank dimensions, fitting sizes and locations, and accessories. Include details and locations of hold-down straps, manways, and ladders. Submit copy of manufacturer's latest installation instructions.

B. Manufacturer's Warranty - See Paragraph 1.05.

C. Field Test Report - See Paragraph 3.02.

D. Record Drawings - At acceptance, submit three (3) sets of "as-built" drawings.

1.04 QUALITY ASSURANCE

A. Reference Codes and Standards - Comply with the following:

1. Governing Standards; Primary (Internal) Tank

a. ASTM D 3299-81: Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks.

2. Governing Standards; Secondary (External) Tank

a. ASTM D 4097-82: Specification for Contact Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.

b. National Fire Protection Association (NFPA) Standards:

1) NFPA 30-1987: Flammable and Combustible Liquids Code.

2) NFPA 31-1987: Installation of Oil Burning Equipment.

3. North Carolina State Mechanical Code.

4. County of Durham Fire Code.

5. North Carolina State Building Code.

6. North Carolina Department of Natural Resources and Community Development regulations.

7. United States Environmental Protection Agency, Office of Underground Storage Tanks: Publication Number 26A, April 1987.

1.05 SPECIAL WARRANTY - Submit tank manufacturer's 30-year warranty against external and internal corrosion.

PART 2 PRODUCTS

2.01 TANK CONSTRUCTION

A. Tank shall be of fiberglass-reinforced plastic (FRP) construction with Durakane 470 resin, and shall be post-cured. Tank shall have a full 360° double-wall provided over the entire tank shell wall and endcaps. Construct and test tank in accordance with manufacturer's specifications and local ordinances.

B. Tank and annular space shall withstand 5 psig internal air pressure test with a safety factor of 10 to 1.

C. Tank shall be mercury vacuum tested by the tank manufacturer at the factory to ensure structural integrity. Primary tanks shall be tested to 11.5 inches mercury vacuum and secondary tanks shall be tested to 9.5 inches mercury vacuum.

D. Tank shall have high-strength fiberglass internal ribs (sandwich construction) between the inner and outer walls. Tank shall withstand H-20 axle surface loads (32,000 pounds per axle) when properly installed in accordance with tank manufacturer's installation instructions.

E. Buried tank shall withstand 13 feet of cover with the excavation hole fully flooded with a safety factor of 5 to 1 against buckling.

F. Tank shall be designed to support accessory equipment, such as drop tubes and ladders, when installed in accordance with tank manufacturer's recommendations and limitations.

G. Tank shall be designed for a maximum temperature of 150°F at tank interior surface.

H. Tank shall have a space between the primary and secondary shell walls to allow for the free flow and containment of all leaked product from the primary tank. Space shall also allow for the insertion of a leak monitoring device through NPT monitoring fitting located at each end of the tank. Tank shall be factory shipped with a continuous vacuum on the space and shall remain intact until the tank is air tested at the job site.

2.02 TANK ACCESSORIES

A. Provide a 20-inch manway with a bolted cover and a 40-inch manway extension as shown on the contract drawings. Manway shall be constructed of the same material as the tank.

B. Ladder shall be provided for access to tank.

C. Provide standard NPT fittings on tank for drain and vent connections as shown on the contract drawings.

D. Provide all penetrations through side wall as shown on the contract drawings.

E. Provide lifting lug(s) capable of sustaining tank weight (empty) with a safety factor of 3 to 1.

F. Fiberglass-reinforced plastic anchor straps will be used to anchor the tank to the concrete holding pad. The number and location of straps shall be as specified by the manufacturer. Provide the necessary anchor bolts and hold-down hardware. The straps, anchor bolts and hold-down hardware shall be capable of withstanding the buoyant upward force of an empty tank in a flooded condition. All hold-down hardware shall be rigid steel material. Steel cables are not acceptable. All hold-down hardware shall receive two coats of protective epoxy paint or asphalt sealant.

G. Leak Detectors, Level Indicators, and Monitoring Panel

* 1. Provide a leak detector and alarm system to detect the presence of hydrocarbon-based solvents between the inner and outer shells of each tank. Furnish and install all wiring in tank and manway extension as shown on the contract drawings and in accordance with manufacturer's recommendations. Approved Manufacturers - Raychem TraceTek TT500.

2. Provide a level indicator to indicate a high level and a high-level alarm. Material of indicator shall be compatible with solvent solutions. Furnish and install all wiring in tank and manway extension as shown on contract drawings and in accordance with manufacturer's recommendations. Approved Manufacturer - BW Controls, Unifloat 7000 Series or approved equal.

3. The monitoring and control panel shall provide the following:

   a. Visual Indicator - High level reached in tank.

   b. Audible Alarm - High level alarm.

   c. Audible Alarm - Vapor and/or liquid leaks between tank walls.

   One panel shall be provided for all three tanks, with the name and number of each tank identified for each indicator and alarm. See contract drawings for tank names and numbers.

4. Furnish and install all necessary lengths of sensing cable and wiring. Conduit and fittings will be provided under Division 16.

2.03 APPROVED MANUFACTURERS - The following tank manufacturers are approved to provide tank and tank accessories. No substitutions.

A. Warner Fiberglass Products.

B. Palmer Manufacturing and Tank, Inc.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install tanks in accordance with manufacturer's installation instructions, and in compliance with all local ordinances, building codes and fire codes, and as shown on the contract drawings.

B. Tank installer shall be approved by the tank manufacturer.

C. Perform excavation work in accordance with Section 02220. Perform fill, backfill and compaction work in accordance with Section 02225.01, except as specified otherwise, and in accordance with manufacturer's instructions. Excavate to a minimum of 24 inches beyond tank ends and sides.

D. Support tank bottom over its full length on a 12-inch layer of 1/4 inch pea gravel. Prior to backfilling, test tank in accordance with Paragraph 3.02 of this specification.

E. For backfill, use material specified in Paragraph 3.01.C above. Bring backfill up to 24 inches above the top of the tank.

3.02 TESTING

A. Prior to backfilling, test primary and secondary tanks as follows:

1. Inner Tank

   a. Cap off all openings.

b. Pressurize to 5 psi maximum air pressure.

c. Let stand for 2 to 4 hours and check for pressure drop.

2. Secondary Containment Area

a. Install threaded plug complete with suitable airline fitting, valve, and pressure gauge to leak detector mount coupling.

b. Pressurize to 3 psi maximum air pressure.

c. Let stand for 2 to 4 hours and check for pressure drop.

d. If pressure drops, check for leaks with soapy water solution both inside and outside.

e. Consult factory immediately if a leak is found.

B. Submit testing schedule at least one week in advance of the test to the Owner's Representative.

C. The Owner's Representative shall witness test equipment calibration and testing.

D. Repair leaks by replacing defective fittings and defective tanks, and retest.

E. Repair damage caused by leak testing at no additional cost to the Owner.

F. Submit field test report to the Owner certifying that the tank is tight, leak-free, and as specified.

3.03 TANK SCHEDULE - See contract drawings.

- END -

COUNTY OF DURHAM

OFFICE OF THE FIRE MARSHAL

RICHARD J. SAUER
FIRE MARSHAL

September 15, 1989

Mr. Robert G. Wojtas
Project Manger
Glaxo Inc.
Five Moore Drive
Research Triangle Park, NC 27709

Dear Mr. Wojtas:

In response to our meeting on September 14, 1989 concerning the use of Palmer Mfg. Co., underground fiberglass reinforced plastic tanks, I have reviewed the plans and submittal information once again. It appears these tanks will meet the specified standards. Please find this letter, to be documented approval for the use of all three tanks at the Glaxo project, providing of course that all recognized installation standards are met.

If there are any additional questions or concerns feel free to call this office.

Sincerely,

E. Charles Ottaway

E. Charles Ottaway
Assistant Fire Marshal

ECO:prr

CC: Richard J. Sauer
Durham County Fire Marshal

4. TANK SYSTEM ASSESSMENT

ASSESSMENT OF THE INTEGRITY OF THE HAZARDOUS LIQUID WASTE TANK STORAGE SYSTEM AT THE GLAXO FACILITY IN RESEARCH TRIANGLE PARK, NORTH CAROLINA

I, H. William Hauser, Registered Professional Engineer, do hereby certify in accordance with 40 CFR Parts 264.192 and 270.16(a) that I am familiar with said provisions of the Environmental Protection Agency, that I am familiar with the hazardous characteristics of the waste to be handled in the liquid hazardous waste feed and storage system and that I have reviewed the following design standards which include:

- Specifications for Low Pressure/Stainless Steel Tanks
- Specifications for Agitators
- Specifications for Metering Pumps
- Specifications for Activated Carbon Adsorber System
- Specification for Transmitting Rotameters
- Specifications for Tank Level Transmitter
- Drawing R-8279-D4, Liquid Waste Feed System Process and Instrumentation Diagram

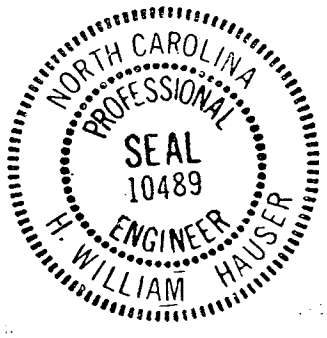
Based upon said familiarity, examination, and review, it is my assessment that the proposed tank system has sufficient structural integrity (with the exception of the foundations, which were not reviewed), that the waste is compatible with the materials of construction specified, that the tank system is acceptable for the storing of hazardous waste, and that the tank system has been designed in accordance with good engineering practices.

I certify under penalty of law that this document and the above listed design standards were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIRRINE ENVIRONMENTAL CONSULTANTS

By: H. William Hauser
Registered Professional Engineer

Date: December 18, 1990



ASSESSMENT OF THE INTEGRITY OF THE FOUNDATION SUPPORTING THE HAZARDOUS LIQUID WASTE TANK STORAGE SYSTEM AT THE GLAXO FACILITY IN RESEARCH TRIANGLE PARK, NORTH CAROLINA

I, William Douglas Henderson, Jr., Registered Professional Engineer, do hereby certify in accordance with 40 CFR Part 264.192 and 270.16(a) that I am familiar with said provisions of the Environmental Protection Agency, that I have reviewed the design specifications for the Liquid Hazardous Waste feed and storage system located in Glaxo Inc.'s Environmental Safety Facility located in Research Triangle Park, North Carolina which includes "Specifications for Low Pressure/Stainless Steel Tank" prepared by Sirrine Environmental Consultants (Spec. No. R-8279-1), and that I have reviewed the following documents associated with the foundation to support this system:

1) 6S-111 Building 11 - Foundation & Slab-On-Grade Plans Level 1

2) 6S-401 Building 11 - Sections I

3) 6S-403 Building 11 - Sections III

4) 6S-404 Building 11 - Typical Concrete Details

5) Specification Section 03200.01 (CP-2) - Concrete Reinforcement

6) Specification Section 03300.01 (CP-2) - Cast-In-Place Concrete

7) Foundation Structural Integrity Assessment Calculations

Based upon said familiarity, examination, and review, it is my assessment that the foundation has sufficient structural integrity to support the tank storage system and that the foundation has been designed in accordance with good engineering practices.

I certify under penalty of law that this document and the above listed documents associated with the foundation to support the tank storage system were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

THE KLING-LINDQUIST PARTNERSHIP, INC.

By: William D. Henderson, Jr. William Douglas Henderson, Jr.
Registered Professional Engineer

Date: 12/17/90

SECTION 03200.01

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Portland Cement Concrete Paving - Section 02511.

B. Caissons (Drilled Piers) - Section 02380.

C. Subdrainage System - Section 02710.

D. Concrete Formwork - Section 03100.01.

E. Concrete Accessories - Section 03250.01.

* F. Cast-In-Place Concrete - Section 03300. †

G. Unit Masonry - Section 04200.

* † For actual suffix number see specifications list.

1.02 SUBMITTALS

A. Shop Drawings - Show reinforcement so that bars can be cut, bent and placed from information shown on shop drawings. Provide schedules and details showing placing, bending and length of reinforcement. Draw elevations of concrete walls showing reinforcement, top and bottom levels, openings, ledges, and beam pockets. Top and bottom flat slab reinforcing shall be shown on separate drawings. Show dowels on drawings for work into which the dowels are first placed. Detail "Opposite Hand" reinforcement on separate drawings. Show walls in elevation at a minimum scale of 1/4 inch = 1 foot.

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

ACI 315-80 Details and Detailing of Concrete Reinforcement.

ACI 318-83 Building Code Requirements for Reinforced Concrete.

B. American Society for Testing and Materials (ASTM)

A615-84a Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

C. American Welding Society (AWS)

AWS D1.79 - Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction.

D. Concrete Reinforcing Steel Institute (CRSI)

CRSI P1-83 - Placing Reinforcing Bars.

1.04 QUALITY ASSURANCE

A. Perform concrete reinforcing work in accordance with CRSI P1-83 unless specified otherwise in this Section.

1.05 SPECIAL STORAGE/HANDLING - Store reinforcing steel in a neat and orderly manner in suitable racks and off the ground. Before placing, clean off ice, rust scale or other bond reducing coatings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars - ASTM A 615 Grade 60.

1. Bend test requirements for bars shall be based on A.C.I. 318.

2. Bars shall be free from excessive rust and coatings which shall reduce bond.

3. Bars which are to be welded shall comply with ASTM A 706.

B. ACCESSORIES

1. Reinforcing supports, chairs, and metal elements in contact with concrete surfaces shall be stainless steel C.R.S.I. Type E or completely encased with hard durable preformed plastic tips for length of 3/4 inch minimum measured perpendicular to plane of surface, or this element may be entirely of plastic. Use only stainless steel supports for concrete surfaces to be sandblasted or bush hammered. Accessories shall not mar, discolor or be visible on hardened concrete surfaces nor create any planes of weakness in the concrete.

2. Bar supports shall be able to support a static load of 250 pounds at any point without permanent deformation.

3. Tie wire shall be annealed

4. Support reinforcement in slabs on grade on concrete brick to avoid damage to vapor retarder.

5. Support reinforcement in concrete slabs on metal deck using steel supports designed for this purpose. Other types of supports shall not be permitted.

2.02 FABRICATION

A. Cut and bend reinforcing steel cold to exact lengths and shapes in accordance with approved shop drawings.

B. Steel shall be free of paint, oil, dirt, scale, ice, frost, loose rust or any coating that might reduce the bond with concrete.

C. Reinforcing bar embedments and lap splice length shall be in accordance with ACI 318.

D. Splice continuous top reinforcing bars in beams at the center of the clear span.

E. Splice continuous bottom reinforcing bars in beams at the center of the supporting element.

F. Where continuous bars are shown, run bars continuously around corners. Lap at splices and hook at discontinuous ends.

G. Where dowels extend up from footings, provide the same size, number and spacing as the main vertical bars above. Extend the bars the required splice length above the top of footings unless noted otherwise.

PART 3 EXECUTION

3.01 GENERAL

A. Be responsible to insure that reinforcement is in compliance with the Contract Documents and within the tolerances specified. Check reinforcement before and during placing of concrete.

B. Provide approved bar supports, spacers and other placing accessories, whether or not shown, so that reinforcing is not displaced during construction or casting of concrete beyond tolerances specified.

3.02 PLACING OF REINFORCEMENT BARS

A. Place, securely tie and support reinforcement to prevent displacement by construction traffic prior to or during casting of concrete. Do not allow top bars to sag below tolerances specified. Wire the dowels securely in place before embedding in concrete. Concrete cover as specified by ACI or shown shall be uniformly maintained and special care taken at concrete surfaces exposed to weathering. Immediately correct displacement of reinforcing, and provide additional supports to prevent recurrence. Tolerances for position of reinforcing shall be:

1. Plus or minus 1/4 inch for concrete members having an effective depth of 24 inches or less.

2. Plus or minus 1/2 inch for concrete members having an effective depth of more than 24 inches.

B. Lapped ends of bars may be placed in contact and securely wired or may be separated sufficiently to permit the embedment of the entire surface of each bar in concrete. Stagger splices in adjacent bars.

C. Tie reinforcing with wire and bend wire back beyond general plane of reinforcing.

D. Avoid exposure of reinforcement to the weather for any considerable length of time before placing of concrete. Where this is unavoidable, paint reinforcement with a heavy coat of cement grout. Protect exposed concrete and other material against staining from exposed concrete reinforcement.

- END -

SECTION 03300.01

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

* A. Testing Laboratory and Inspection Services - Section 01410. †

B. Portland Cement Concrete Paving - Section 02511.

C. Concrete Curbs - Section 02525.01.

D. Concrete Formwork - Section 03100.01.

E. Concrete Reinforcement - Section 03200.01.

* F. Concrete Accessories - Section 03250. †

* G. Concrete Finishing - Section 03345. †

* † For actual suffix number see specifications list.

1.02 SUBMITTALS

A. Shop Drawings - Show sequence of concrete placement for walls and floors; and, locations and details of construction and control joints, elevations of walls, ledges, openings and other significant features. Coordinate with shop drawings of equipment pads and curbs specified in Divisions 15 and 16. Coordinate with existing structures (based on field check of actual conditions and dimensions).

B. Product Data - Submit data for aggregates, cement (including chemical composition), curing compounds, and admixtures.

C. Samples - Furnish samples of all materials as specified.

D. Certifications - Furnish certifications from each manufacturer (or supplier) of each material, that materials supplied comply with applicable Reference Standards and are applicable to conditions of this Project.

E. Delivery Tickets - For ready-mixed concrete, furnish batch ticket information in accordance with ASTM C94; and, the actual strength of concrete furnished clearly listed thereon.

F. Miscellaneous - Submit the following:

1. Aggregate test reports.

2. Concrete design mix and preliminary test reports.

3. Proposed method of curing and protection during cold weather.

1.03 QUALITY ASSURANCE

A. Testing/Inspection Agency - The services of a qualified testing laboratory and inspection service shall be used for formwork, reinforcing and cast-in-place concrete work.

B. Perform cast-in-place concrete work in accordance with ACI 318, unless specified otherwise in this Section.

C. Contractor Responsibilities

1. The Contractor shall be responsible for methods of construction, and for strength, slump, consistency, finish and general quality of the concrete. Statements in this Section relative to methods, quality, preliminary approval, and testing and inspection by the Testing Laboratory shall be construed as the minimum acceptable, and shall not relieve the Contractor of his responsibility.

2. Facilitate the work of, and cooperate with the testing laboratory at the site and at the concrete plant and supply concrete required for test cylinders and for slump tests and other field tests required.

3. Provide suitable wood or metal boxes to store newly made cylinders. Provide space for storage and maintain the boxes in temperature between 60° F. and 80° F during the first 24 hours after cylinders are made.

4. Notify the Design Professional and testing agency not less than 24 hours in advance of any concrete operation involving more than 2 cubic yards.

5. If the Contractor elects to use concrete from more than one source of supply simultaneously additional inspection personnel shall be required. The Contractor shall bear all costs of this additional personnel.

D. Approval of Work - Concrete shall be considered approved if the 28-day test cylinder strength meets or exceeds the specified requirements. The average results for two cylinders of concrete at a given age shall constitute a test and the average of three consecutive tests of the laboratory-cured specimens representing each class of concrete shall equal or exceed the specified 28-day compressive strength. No individual test result may be more than 500 psi below the specified strength.

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1.04 CORRECTIVE ACTIONS

A. If the strength of test cylinders at 7 days is less than 65% of the required 28 day strength (unless a lower percentage has been established as being satisfactory), provide reshoring and additional moist curing of the concrete in question, and change the mix to achieve concrete of specified quality.

B. If the laboratory tests indicate that concrete does not meet the specified 28 day strength, the Design Professional may order additional tests (load tests in accordance with ACI 318, beams tests in accordance with ASTM C42, etc.) on the portion(s) of the structure affected, to determine whether such portion(s) can sustain the designed load. Any concrete found deficient shall, as directed by the Design Professional, be repaired or removed and renewed, at the Contractor's expense. The Contractor shall reimburse the Owner for direct salary costs multiplied by a factor of 2.5 incurred by the Design Professional for any calculation or drawing work required to investigate or correct construction that contains concrete questionable in strength, as indicated in ACI-318. The Contractor shall also pay all additional inspection and testing costs incurred by the testing laboratory relative to investigating, testing and correcting non-complying construction.

C. Those portions of the structure that do not meet the contract requirements based on appearance or for any other aesthetic reason shall be corrected or removed and replaced as directed by the Design Professional. Cost of corrections, removal and replacement, shall be borne by the Contractor.

D. If any difficulties occur in achieving concrete of the required workability and strength with the materials being used, the Design Professional may order such changes in proportions, materials, or both, as may be necessary to achieve the desired properties, subject to the limiting requirements specified herein. Any changes so ordered shall be made at the Contractor's expense.

1.05 REGULATORY AGENCIES AND CODES - Cast-in-place concrete work shall comply with applicable requirements of the building code of the local jurisdiction.

1.06 TESTING AGENCY

* A. Inspection and testing shall be performed by firm in accordance with Section 01410. †

B. Contractor shall provide free access to work and cooperate with appointed firm.

C. Contractor shall submit proposed mix design of each Class of concrete to inspection and testing firm for review prior to commencement of work.

D. Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.

* † For actual suffix number see specifications list.

E. Four (4) concrete test cylinders shall be taken for each 100 cubic yards or fraction thereof of each class of concrete placed in any one day. This is a minimum requirement. If more test cylinders are required to verify Contractor's work, the Contractor shall pay for this added testing by having it deducted from contract amount still owed. Test one cylinder at seven days, two at 28 days and the fourth cylinder shall be tested, if required, at 56 days.

F. During cold weather concreting, cure one set of test cylinders on job site under same conditions as concrete it represents.

G. One (1) slump test shall be taken for each set of test cylinders taken.

1.07 REFERENCE STANDARDS - Except as modified by code or this specification, comply with the applicable provisions of the latest edition of the following:

A. American Society for Testing and Materials (ASTM)

Standard	Title
C 31-84	Making and Curing Concrete Test Specimens in the Field
C 33-85	Specification for Concrete Aggregates
C 39-84	Test for Compressive Strength of Cylindrical Concrete Specimens
C 40-84	Test for Organic Impurities in Fine Aggregates for Concrete
C 42-84a	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 88-83	Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 94-84	Specification for Ready-Mixed Concrete
C 117-84	Test for Material Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
C 123-83	Test for Lightweight Pieces in Aggregate
C 127-84	Test for Specific Gravity and Absorption of Coarse Aggregate
C 128-84	Test for Specific Gravity and Absorption of Fine Aggregate

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C 138-81	Test for Unit Weight, Yield, and Air Content of Concrete
C 142-78	Test for Clay Lumps and Friable Particles in Aggregates
C 143-78	Test for Slump of Portland Cement Concrete
C 150-85	Specification for Portland Cement
C 172-82	Fresh Concrete, Sampling
C 173-78	Test for Air Content of Freshly Mixed Concrete by the Volumetric Method
C 192-81	Making and Curing Concrete Test Specimens in the Laboratory
C 227-81	Test for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
C 231-82	Test for Air Content of Freshly Mixed Concrete by the Pressure Method
C 260-77	Specification for Air-Entraining Admixtures for Concrete
C 289-81	Test for Potential Reactivity of Aggregates (Chemical Method)
C 330-85	Specification for Lightweight Aggregates for Structural Concrete
C 494-82	Specification for Chemical Admixtures for Concrete
C 496-85	Test for Splitting Tensile Strength of Cylindrical Concrete Specimens
C 567-85	Test for Unit Weight of Structural Lightweight Concrete

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B. American Concrete Institute (ACI)

Standard	Title
ACI 211.1-81 (Rev.84)	Recommended Practice for Selecting Proportions for Normal Heavyweight, and mass concrete.
ACI 211.2-81	Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.

ACI 214-77	Recommended Practice for Evaluation of Strength Test Results of Concrete.
ACI 301-84	Specifications for Structural Concrete for Buildings.
ACI 304-73	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
ACI 304.2R-71 (Rev. 82)	Placing Concrete By Pumping Methods
ACI 305R-77 (Rev. 82)	Hot Weather Concreting.
ACI 306R-78 (Rev. 83)	Cold Weather Concreting.
ACI 309-72	Standard Practice for Consolidation of Concrete.
ACI 315-80	Details and Detailing of Concrete Reinforcement.
ACI 318-83	Building Code Requirements for Reinforced Concrete.

C. American Welding Society (AWS)

AWS D1.4-79 Welding Code.

D. National Ready Mixed Concrete Association (NRMCA)

Concrete Plant Standards

Truck Mixer and Agitator Standards

1.08 DESIGN AND PERFORMANCE CRITERIA

A. The specifications of The American Society for Testing and Materials (ASTM), latest edition, shall apply to any material for which an ASTM standard has been established.

B. The standards of the American Concrete Institute, American Welding Society, and National Ready Mixed Concrete Association, as listed in Reference Standards in Part 1 of this Section, are other sources of design and performance criteria.

C. Concrete shall be of homogeneous structure, with the strength, appearance, durability, and imperviousness to water required for the various parts of the work, and shall have the minimum possible residual shrinkage upon drying. Achieve these results, in addition to meeting the particular minimum requirements specified.

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D. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water-reducing admixtures, water, and air-entraining admixture where required, and shall be so proportioned and mixed as to produce controlled concrete having the following minimum compressive strength in pounds per square inch at age 28 days:

1. Slab on Grade, Structural slabs, beams, girders, columns, equipment foundations, concrete pads, basement walls and footings for buildings No. 6 and 9 - 4000 psi.

2. All Other, Fill for Metal Pan Stairs - 3000 psi.

3. Lightweight Concrete - 3000 psi.

4. Lean Concrete - 2000 psi. For buildings No. 2, 3, 6, 9 and R&D Node.

E. The slump of concrete, as determined in accordance with ASTM C 143, shall be as listed below. (Exception: For pumped concrete, take samples at point of final placement, not at truck discharge.) DO NOT USE concrete with slump greater than that specified. Concrete with greater slump shall be removed and replaced at no additional cost (unless super-plasticizer is used for higher slump).

SLUMP	* AREA OF WORK
2 Inches (± 1 inch)	Slab-on-grade, piers, footings placed on grade, lightweight concrete, (unless specified otherwise)
3 Inches (± 1 inch)	Suspended slabs, beams, walls, columns, thin or heavily reinforced sections, footings placed on grade, and lightweight concrete when air temperatures exceed 85°F.

F. If a HRWR admixture (Super Plasticizer) is approved and used, the maximum slump shall be as approved by the Design Professional by and may be as much as 8 inches, rather than the value specified previously. Slump of concrete before addition of the admixture shall be no more than 3 inches.

G. Structural Lightweight Concrete - Concrete shall have air-dry weight of 113 ± 3 pounds per cubic foot. The air-dry and wet weights shall be determined in accordance with ASTM C 567 and ASTM C 138 respectively. Maximum air content shall not exceed 7.0 percent. Add lightweight fine aggregate if necessary.

PART 2 PRODUCTS

2.01 PORTLAND CEMENT - ASTM C 150, Type I, II, or III, of approved manufacturer. Avoid use of Type III cement for concrete-mat foundations, footings or massive sections. Cement shall be of a type that will not cause efflorescence on concrete surfaces when tested as per ASTM C 67. Do not use air entraining cement.

A. Special Cement - For use in constructing neutralization pits, use Type V sulfate resisting portland cement.

2.02 AGGREGATES

A. General - ASTM C 33. Fine and coarse aggregates shall have hard, angular, uncoated, durable particles and shall be free of all deleterious substances and free of injurious amounts of thin elongated pieces, mica, clay and organic matter. Where sharp corners are required in finished concrete work, use smaller aggregate, (3/4 inch maximum). For concrete encasement of structural steel use aggregate size No. 7 (1/2 inch to No. 4).

B. Fine Aggregate - Natural sand or stone screenings. Maximum silt content shall be 2%, organic impurities Plate No. 2 maximum when tested as per ASTM C 40. Fineness Modulus shall be 2.85 $\pm$ 0.20.

C. Coarse Aggregate - Crushed stone or gravel, meeting gradation requirements for size No. 57 (1 inch to No. 4) generally. Size No. 467 (1 1/2 inches to No. 4) shall be used in concrete for slab-on-grade, footings, mats, and piers. Maximum silt content 1%, organic impurities plate 1 maximum when tested as per ASTM C 40.

D. Pea Gravel - Clean, washed, hard rounded gravel, conforming to ASTM C 33, except that it shall be graded to 90% passing a 3/8 inch screen and 90% retained on a 1/4 inch screen. Use pea gravel in sections 3 inches or less in thickness.

E. Lightweight Aggregate - Expanded shale or slate of 3/4 inch maximum size, manufactured by the rotary kiln method, conforming to ASTM C 330. Aggregate must be free of impurities that will damage finish or cause aggregate to separate at the surface of the concrete. The aggregate shall be such that the approved lightweight concrete shall have a minimum splitting tensile strength (fct) of 365 psi for 3000 psi concrete and 400 psi for 4000 psi concrete, when determined as per ASTM C 192, ASTM C 496 and ASTM C 39. Handle, store and predampen lightweight aggregate as per manufacturer's recommendations before it is mixed with cement.

F. Testing - Submit Test Reports made in compliance with ASTM C 33 for aggregates which will be subject to wetting or extended exposure.

1. Deleterious substances including tests for material that could react harmfully with alkalis in the cement. Submit tests as per ASTM C 40, C 117, C 123, and C 142 - ASTM C 227 or ASTM C 289.

2. Soundness - Submit tests as per ASTM C 88. Loss shall not exceed 8% if tested with sodium sulfate, and 10% if tested with magnesium sulfate.

3. Absorption test as per ASTM C 127, C 28. Absorption of aggregates shall not exceed 1-1/2% unless approved otherwise.

2.03 ADMIXTURES

A. General - The use of any admixture is subject to the approval of Design Professional. Where more than one admixture is used, admixtures shall be compatible. Admixtures shall not contain calcium chloride . The following products are approved:

1. Air-Entraining Admixtures - ASTM C 260 except that relative durability factor shall be 95.

a. "Daravair" - W.R. Grace & Company.

b. "Sika AER" - Sika Chemical Corporation.

c. "MB-VR" - Master Builders.

d. "Euco-Air-Mix" - The Euclid Chemical Company.

2. Accelerating Admixtures - ASTM C 494, Type C or E.

The admixture shall be non-corrosive and non-chloride, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accellerated corrosion test method such as that using electrical potential measures.

a. "Accelguard 80" - The Euclid Chemical Company.

b. "Pozzolith 555" - Master Builders.

3. Water-Reducing Admixtures - ASTM C 494, Type A.

a. "Eucon WR-75" - The Euclid Chemical Company.

b. "Pozzolith 200-N" - Master Builders.

c. "Plastocrete 160" - Sika Chemical Corporation.

d. "WRDA-W/Hycal" - W.R. Grace & Company.

4. Water Reducing - Retarding Admixtures - ASTM C 494, Type D.

a. "Eucon Retarder 75" - The Euclid Chemical Company.

b. "Pozzolith" 122-N - Master Builders.

c. "Plastoment" - Sika Chemical Corporation.

d. "Daratard H-C" - W.R. Grace and Company.

5. High-Range Water-Reducing Admixtures (Super Plasticizer) - ASTM C 494, Type F or G.

a. "Eucon 37" - The Euclid Chemical Company.

b. "Daracem 100" - W.R. Grace.

c. "Sikament" - Sika Chemical Corporation.

2.04 CURING AND SEALING COMPOUND

A. The compound shall be a clear styrene acrylate type, 30% solids content minimum, and have test data from an independent testing laboratory indicating a maximum moisture loss of 0.030 grams per sq cm when applied at a coverage rate of 300 sq ft per gallon. Manufacturer's certification required.

1. "Super Rez Seal" or "Super Pliocure" by the Euclid Chemical Co.

2. "Masterseal 66" by Master Builders.

B. Dissipating Resin Curing Compound: The compound shall be a dissipating resin type compound, conforming to ASTM C 309, Type 1, "Kurez DR" by the Euclid Chemical Company or approved equal. The film must chemically break down in a two-to-four week period.

2.05 MOIST CURING MATERIALS - Water and cotton mats, quilted covers, insulating blankets, reinforced waterproof kraft paper, or other approved material which shall keep the concrete continuously moist and is suitable for prevailing weather conditions.

2.06 WATER - Water for mixing and curing concrete shall be clean, potable, free of oils, acids, alkali, chlorides, fluorides, nitrates, organic materials or other substances, in amounts deleterious to concrete.

2.07 BONDING AND REPAIR MATERIALS

A. Bonding Materials - The compound shall be a polyvinyl acetate, rewettable type, "Euco Weld" by the Euclid Chemical Co. or "Weldcrete" by the Larsen Company.

B. Epoxy Adhesive - The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces, "Euco Epoxy #460 or #620 by the Euclid Chemical Company or "Sikadur Hi-Mod" by the Sika Chemical Corporation.

C. Patching Mortar - Free-flowing, polymer-modified cementitious coating, "Euco Thin Coat" by the Euclid Chemical Company or "Sikadur Hi-Mod" by the Sika Chemical Corporation.

2.08 NON-SHRINK GROUT

The grout shall conform to CRD-C-621-80, "Corps of Engineers Specification for Non-Shrink Grout.

1. "Firmfix" (metallic) or "Euco NS" (non-metallic) by the Euclid Chemical Company.

2. "Embeco 153" (metallic) or "Masterflow 713" (non-metallic) by Master Builders.

* 2.09 ARCHITECTURAL CONCRETE AT LOBBY FOUNTAIN

A. Poured in place concrete where shown on drawings as "Architectural Concrete" or "Concrete" to match P.C. Finish No. 1" shall match color and texture of Architectural precast panels with Finish No. 1. Coordinate with the Construction Manager to obtain aggregate and concrete mix and source from the Architectural precast supplier. Submit design mix for review and after approval submit 1 ft. X 1 ft. X 2 in. thick concrete sample with finish for approval by the Design Professional before starting work. Allow for a minimum of two submittals before final approval is given.

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PART 3 EXECUTION

3.01 GENERAL

A. Coordinate the work with other trades affected. See Part 1067 for responsibilities regarding chases, openings and inserts.

B. Do not place horizontal joints in walls, except as shown, without specific approval by Design Professional.

C. Concrete thicknesses shown on metal decks are the measured minimum. The maximum deflection at the center of the panel is estimated at 1.5 inch. Provide additional concrete to make up for the deflection such that finished top surfaces meet Class A, ACI finish requirements.

D. Provide concrete work specified under Divisions 15 and 16.

E. Concrete thicknesses and coverages shown of fire-rated slabs, columns, beams, joists, etc. are absolute measured minimums. Tolerance variations shall not result in thicknesses less than that shown.

3.02 PROPORTIONING

A. At least five weeks before the first scheduled concrete placement, submit to the Design Professional and the testing agency, proposed design mixes for each type of concrete with complete standard deviation analysis or trial mixture results. Include water/cement/strength curves and all other supporting data. With the design mixes, submit to the testing agency samples of all concrete materials and mixtures for acceptance testing of the materials.

B. Deliver to the Design Professional for future reference, small samples of each cement shipment used in the work, in sealed containers plainly and neatly marked with source, where proposed to be used, date and name of collector.

C. Proportion concrete mixes in accordance with Section 4.3 (Field Experience and/or Trial Mixtures) or Section 4.4 (Proportioning by Water-Cement Ratio) of ACI 318. With trial batches, the mix shall achieve a compressive strength 1200 psi higher than the specified strength. This over-design shall be increased to 1400 psi when concrete strengths over 5000 psi are used.

D. Design concrete mixes that will consistently produce concrete strengths required. Test and check concrete throughout the work.

E. If the basic design mixes fail in any way to comply with the specified requirements, revise and resubmit until they prove satisfactory. No concrete may be placed until the design mix has been approved.

F. The concrete shall be of such consistency and composition that it can be worked into the corners and angles of the forms and around the reinforcement without permitting the materials to segregate or free water to collect on the surface.

G. For lightweight concrete consult with the manufacturers of the aggregate to establish the proportions of the mix, including cement content, to produce the required strength and weight.

H. Sources of supply of cement and aggregate shall not be changed during the course of the work without prior approval. Material from any new source shall be subject to a complete new set of preliminary tests, with all expenses borne by the Contractor.

I. Measure water by weight or volume. Measure cement and aggregrate (each type and size separately) by weight; cement used directly from full 94-pound bags need not be weighed. Cement and water quantities shall be accurate within 1%, aggregate within 2%, and dispensed admixtures within 3%.

J. Control the moisture content as much as possible by protecting it from the weather and draining as necessary. Before adding to the mixture, measure the moisture content (with a moisture meter), and adjust the batch weights as necessary to compensate for variations in the moisture content of the aggregate. Maintain a uniform stable moisture content in the fine aggregate not in excess of 6%.

3.03 MIXING CONCRETE

A. General - Provide mixing equipment capable of combining the aggregates, cement and water into a uniform mass that can be conveyed and placed without segregation of the components. The size of each batch shall not exceed the rated capacity of the equipment.

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B. Water-Cement Ratio - Maximum water-cement ratio shall be:

1. Concrete subjected to deicers, salt spray, brackish water - sidewalk, pavement — 0.40

2. Watertank, retaining walls, and other exterior concrete except in "1." above — 0.45

3. For all other concrete — 0.48

C. Ready-Mixed Concrete - Mix and transport in accordance with "Specifications for Ready-Mixed Concrete", C94 except as modified herein. The use of nonagitating equipment to transport concrete shall not be approved.

D. Batch Mixing at Site - Use mixers conforming to the requirements of the "Mixer Manufacturer's Bureau of The Associated General Contractors of America".

E. Lightweight Concrete Mixing - Use one of the following procedures involving predampened aggregate:

1. Add all the aggregate predampened (plus the air-entraining agent) to about 2/3 of the mixing water, and premix for about 30 seconds (5-10 revolutions of the typical truck mixer). Then add the cement, other admixtures (if required), and the rest of the water. Mix for the specified length of time.

2. Predampen the lightweight aggregate by premixing the aggregate and about 2/3 of the water for about 90 seconds (15-30 revolutions of the mixer). Add the air-entraining admixture and continue the premix for 30 seconds (5-10 revolutions). Add the cement, other admixtures (if required), and the rest of the water. Mix for the specified length of time.

F. Admixtures

1. Air Entraining Admixtures - All concrete shall have an approved air-entraining admixture added to the concrete at the mixer. The following percentages of total air content by volume shall be consistent throughout the work.

a. Lightweight Concrete - 4.5% to 7.5%

b. Normal Weight Concrete - 5% to 7%

Nominal Aggregate Size (Inches)	Percent Air Content
3/8	6 to 9
1/2	5.5 to 8.5
3/4	5 to 7
1	4.5 to 7.5
1 1/2	2.5 to 5.5

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c. Concrete receiving Dry Shake Finish - 3%.

2. Accelerating Admixtures - When the mean temperature falls below 50° F., use Design Professional approved noncorrosive non-chloride accelerator to accelerate the setting of the concrete and its early strength.

3. Water-reducing - Concrete shall contain only the specified water-reducing admixture or high-range water-reducing (HRWR) admixture, which is specified when increased workability, pumpability, lower water-cement ratio, or higher ultimate or early strength is required.

* 4. High-range Water-reducing Admixture - All pumped concrete, except concrete on metal deck and special conditions, shall contain the specified high-range water-reducing admixture (superplasticizer). Concrete on metal deck may be pumped without superplasticizer, provided specified slump limits are observed. The use of pumped concrete without superplasticizer for special conditions shall be submitted to the Design Professional for approval.

5. Retarding Admixtures - When the mean temperature exceeds 80°F, use a Design Professional approved water reducing and retarding admixture.

3.04 PREPARATION FOR CONVEYING AND PLACING

A. Before placing concrete, remove soil, foreign matter, hardened concrete, debris, ice, frost, snow and free water from forms and from all conveying and placing equipment. Moisten subgrades sufficiently to avoid drawing cement grout from concrete placed thereon.

B. Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

C. Use conveying and placing equipment of the proper type and size to provide concrete of the specified consistency and capable of being handled and conveyed from the mixer to the place of final deposit without delay, segregation or intrusion of foreign matter.

D. Do not pump concrete without specific approval. When pumping is approved, do not allow concrete to come in contact with aluminum in mixing, conveying or handling. If concrete is to be pumped, provide sufficient standby equipment to insure continuous placement up to a properly located construction joint. Check the design mix with the manufacturer or supplier of pumping equipment, to insure its suitability.

E. Use belt conveyers and chutes of such length that there will be no significant change in slump between the mixer and the place of deposit. No chute shall be longer than 30 feet unless approved otherwise.

F. Chutes shall have a maximum slope of two vertical to three hori ntal. For slopes steeper than one vertical to two horizontal discharge concrete into closed, tapered down-pipes at least 24 inches long.

3.05 PLACING CONCRETE

A. Place concrete within 1-1/2 hours after the introduction of water to the mix or after the introduction of the cement to the aggregates. In hot weather, shorten this time, or use approved retarding admixtures so that stiffening of the concrete will occur only after placement. Retempering of concrete that has partially hardened shall not be approved or allowed. Remove such concrete from the site.

B. Wherever possible, place concrete in between planned construction joints continuously in layers no thicker than 16 inches. Rate of placement shall be such that it will insure that previously-placed concrete being integrated with fresh concrete is still plastic, thus avoiding seams or planes of weakness. If a section cannot be placed continuously, provide a field joint and additional reinforcement, to preserve structural continuity in such cases, obtain Design Professional approval before placing.

C. Deposit concrete into the "face" of in-place concrete to prevent segregation. Avoid formation of "rock pockets" by keeping horizontal flow of concrete to a minimum.

D. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and water stops are not disturbed during concrete placement.

E. Free fall shall not exceed 10 feet for concrete with high-range water-reducing admixture and 5 feet for other concrete so as to avoid segregation.

F. Provide side access in forms where required. Set hoppers and chutes at intervals of 5 feet or less, to minimize horizontal flow of concrete after deposition.

G. Delay placing of concrete in elements supported on columns, deep girders or walls until the concrete previously placed in these supports is no longer plastic.

H. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's recommendations.

I. If fiberglass or steel forms are exposed to the sun, spray them with water prior to placing concrete, to prevent excessive transmission of heat to the concrete.

J. Protect concrete to prevent rain water, snow or ice from increasing the amount of mixing water in the concrete.

K. Do not place concrete on frosted or frozen ground.

L. Provide control joints in wall at a maximum spacing of 30 feet unless control joints are shown at shorter spacing.

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M. Slabs on Grade

1. Begin work for slabs on grade only after the sub-grade (virgin or controlled fill) has been compacted and tested, and underslab utilities have been placed and tested. Do not place concrete on frozen or partially frozen sub-grade. Thaw the sub-grade, and recompact before placing any concrete. Provide protection against frost heave.

2. Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches and seal. Do not disturb or damage vapor retarder while placing concrete reinforcing. If damage does occur, repair areas before placing concrete. Use vapor retarder material, lapped over damaged areas minimum 6 inches and seal.

3. Provide control and expansion joints as shown. Do not make changes in details or location without prior approval.

4. Place slab in strips, and form panels with control joints, allowing at least 48 hours between placement of adjacent strips.

5. Support reinforcement with approved accessories to insure that it remains in place throughout placement of the concrete.

N. Vibrate concrete, screed to level, and prepare for finishes specified in Section 03345. Screed floors and slabs-on-grade, concrete base for toppings, level, maintaining surface flatness of maximum 1/4 inch in 10 ft.

O. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solidly with non-shrink grout.

3.06 VIBRATING

A. Consolidate the concrete thoroughly with mechanical vibrators of the internal type that have a frequency of 8,000 to 10,000 revolutions per minute. For difficult placements (e.g. heavily-reinforced sections), provide supplemental external form vibration.

B. Vibrate each layer of concrete, except the upper portion of the topmost layer. Extend the vibrator into the preceding layer to insure thorough bonding.

C. Insert vibrators into the concrete at regular intervals of 12-30 inches, and operate for 5-15 seconds at each insertion.

D. Where air bubbles must be expelled, use longer periods of vibration at each location.

E. Do not use vibrators to transport concrete horizontally.

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F. For all placements except concealed massive foundations, provide one vibrator for every 10 cubic yards of concrete placed per hour, plus one spare. Make sure that all vibrators are on-site and operable before starting placement.

G. Avoid cold joints wherever possible. If they occur, follow the instructions of the Design Professional for removal of concrete. As a minimum, treat the cold joint as a bonded construction joint.

H. Do not allow any internal-type vibrator to contact a form for a surface that is to be sandblasted or bush-hammered.

I. Use and type of vibrators shall conform to ACI 309.

3.07 PROTECTION

A. Throughout construction, protect the concrete against excessive loading, other construction activities, ice, rain, snow, excessive heat, and freezing temperatures.

B. After concrete is placed, and the temperature falls below 40°F, do the following: (If temperature is below 40°F during mixing operations, see "Cold Weather Work".)

C. Provide enclosures, covers, insulation, and/or heat so that the temperature of the concrete is maintained at 70°-80°F for at least 66 hours with Type I and II cements, and for at least 42 hours with Type III cement or with Type I cement and non-corrosive accelerator; such times being measured from the first placement of the concrete involved.

D. Allow the concrete to cool gradually at a rate not to exceed 5°F in any hour, nor more than 40°F in 24 hours.

E. Use only the specified non-corrosive non-chloride accelerator. Calcium chloride, triacynates, antifreeze or other chemicals containing more than 0.05% chloride ions are not permitted for frost protection.

F. Provide temporary protection against frost heave for slab-on-grade and for footings where backfill is not yet completed.

G. Where framed slabs, walls or slabs-on-grade are exposed to the elements pending completion of the work, brace and protect the concrete against wind forces, frost and other weathering. Provide polyethylene enclosures or covering, temporary heat, or insulated mats.

3.08 COMPOUND CURING

A. Compound curing will not be allowed for flat surfaces except when the temperature falls below 35°F. At temperatures below 35°F, the Contractor shall use a dissipating resin curing compound. The Testing and Inspection Agency shall inspect and certify that the curing compound has been applied per specification. Any residual curing compound shall

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be removed by sand or shot blasting before applying floor finishes in areas identified in attached Table No. 1. Cure vertical surfaces with compound curing.

B. The curing compounds must be applied immediately after final finishing.

3.09 MOIST CURING

A. Moist cure all flat surfaces including interior and exterior concrete slabs, sidewalks, paving ramps and steps when temperature is above 35°F.

B. Guard against early drying-out of concrete (i.e. during the first 24 hours after placing), especially in dry, windy weather or when thin sections have been cast. Commence moist curing (by a fine fog spray of water) as soon as finishes would not be marred thereby. Do not postpone curing until the next morning. Control the amount of water used so the curing water does not intermingle with concrete.

C. Keep all concrete continuously moist for at least seven days after placement. When weather permits, the concrete may be ponded or continuously sprayed by means of soaker hoses. The concrete may be periodically sprayed, provided that it is covered by materials hereinbefore specified. After temporary heat is removed, (in cold weather), cover the concrete with insulating blankets or other material that will retain moisture and protect against frost.

3.10 COLD-WEATHER CONCRETE WORK - Whenever the air temperature falls below 40°F., the temperature of concrete as placed shall be 60° to 75°F. To accomplish this, heat the mixing water, forms, and, when necessary, the aggregate. When either the water or the aggregate is heated to temperatures above 100°F bring the water and aggregate together first and add the cement and admixtures only when the temperature of water plus aggregate is not above 80°F.

3.11 HOT-WEATHER CONCRETE WORK - Except as modified herein, follow procedures as outlined in ACI 305. Wet the forms just before placing of concrete, and keep exposed surfaces damp. Take special precautions for slabs in unshaded locations. Provide a continuous fog spray of water immediately after screeding, maintain in moist condition, and take other protective measures as required to prevent damage from flash setting of concrete. Do not use retardant admixtures (other than the specified waterreducing agent) without specific prior approval. The contractor may use evaporation retardant, Euco Bar by the Euclid Chemical Company or Confirm by Master Builders one or more times during the finished operation to prevent plastic cracking.

3.12 CONCRETE PADS, CURBS AND EQUIPMENT FOUNDATIONS - Provide concrete equipment foundations, pads and curbs required for Mechanical and Electrical work in accordance with shop drawings prepared by those trades. The 28-day compressive strength of this concrete shall be at least 4,000 psi.

3.13 TEMPERATURE RECORDS - Keep a permanent record of outside air and concrete temperatures for all concreting operations (including curing).

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Take thermometer readings at the start of work each day, at noon, and late in the afternoon. Record the locations of all concrete placed and cured. Records shall be kept in such manner as to show any effect the temperature may have had on the construction.

3.14 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details and elevations.

B. Repair or replace concrete not properly placed resulting in excessive honeycombing and other defects. Do not patch, fill, touch-up, repair, or replace exposed architectural concrete except upon express approval of Design Professional for each individual area. When approved, make repairs using the following procedures:

1. Where concrete is to be exposed to view in the finished work, exercise care to avoid damaging virgin skin of surrounding parent concrete.

2. Cut out defective concrete to a minimum depth of 1 inch leaving neat square cut edges.

3. Where reinforcement is practically or fully exposed, cut around reinforcement to provide a clear space not less than 3/8 inch wide.

4. For patching of areas larger than 1 square foot, provide 2 inch X 2 inch stainless steel mesh reinforcement securely attached to existing reinforcement with stainless steel wire.

5. Thoroughly saturate concrete surface to receive patch and keep the patch area damp with wet burlap one day prior to application of patching materials. Remove excess water by blowing compressed air. Apply bonding compound as instructed by manufacturer.

6. Prepare pre-mixed non-shrink patching mortar using water only. Compressive strength of patching mortar shall not be less than the compressive strength of the surrounding concrete.

7. Do not mix more mortar than can be placed in twenty minutes. Apply mortar in layers not exceeding 3/8 inch thick. All layers except the final layer shall be left rough to receive the succeeding layer.

8. As soon as each layer has taken its initial set, coat the surface with bonding compound and apply another layer of mortar.

9. Where this work will be exposed in the finished construction, finish the final layer to match the existing concrete surface in color and texture. Use aggregate or white cement as required to provide a mixture which will exactly match the color of the parent concrete after hardening and curing.

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a. If necessary, rub the surface slightly with a fine carborundum stone at one to five days age.

b. Cure patches as soon as possible to avoid early drying. Place wet burlap against the patch or use other method of positive retention of water of hydration in the patch. Continuously moist cure all patches for seven days minimum.

10. Remove and replace patches which become crazed, cracked, sound hollow upon tapping, or do not exactly match the existing concrete surfaces.

TABLE 1

SUMMARY OF FLOOR FINISH COMPATIBILITY WITH COMPOUND CURED CONCRETE.

FINISH	ABBREVIATION	COMPATIBLE WITH COMPOUND CURE
Rubber Tile	RT	NO
Carpet	CPT	YES
Concrete Sealer	CS	NO
Vinyl Composition Tile	VCT	YES
Vinyl Seamless	VS	NO
Ceramic Tile	CT	YES
Poly Vinyl Chloride	PVC	NO
Polymer Aggregate Tile	PAT	YES
Rubber Stud Tile	RST	NO
Epoxy Quartz	EQ	NO
Liquid Waterproofing (Merflex)	—	NO

NOTES:

1. Compatibility determined through phone conversations with finish manufacturers representatives. Manufacturers contacted were those listed as approved in the Specification. Since others may eventually become successful bidders, for those applications listed as being compatible, the floor finish supplier should be informed of the use of the compound curing agent so that a suitable adhesive is used.

- END -

CN-051, 12/30/88
CN-082, 2/27/89

Job 2345-00 CP-2
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TKLP The Kling-Lindquist Partnership, Inc.

Job Name & Number				Sheet
GLAXO - BLDG. #11 (E.S.F.) 01-2345-00				1 of 1
Description	**Calc. By**	**Date**	**Approved By**	**Date**
FOUNDATION STRUCTURAL INTEGRITY ASSESS. CALCS.	D.H.	12/17/90	[illegible]	12/17/90

CHECK CAPACITY OF SLAB @ TANK STORAGE AREA -

WORST CASE CONDITION ; ASSUME ALLOWABLE SOIL BEARING CAPACITY = 4 KSF

FOR 1000 gal. TANK,

$$\text{LIQUID WT.} = 1000 \text{ gal.} \times \frac{0.1337 \text{ C.F.}}{1 \text{ gal}} \times \frac{62.4 \#}{\text{C.F.}} = 8343 \#$$

DRY TANK WT.	= 3050 #
MIXER	= 550 #
TOTAL	= 11,943 #

THIS LOAD IS DISTRIBUTED OVER AN AREA APPROXIMATELY 4'-2 x 4'-2

$$\therefore \text{SOIL PRESSURE} = \frac{11.94^{K}}{(4.17)^2} = 0.7 \text{ KSF} < 4 \text{ KSF} \quad \text{O.K.}$$

FOR 500 gal. TANK,

$$\text{LIQUID WT.} = 500 \text{ gal} \times \frac{0.1337 \text{ C.F.}}{1 \text{ gal.}} \times \frac{62.4 \#}{\text{C.F.}} = 4171 \#$$

DRY TANK WT.	= 2050 #
MIXER	= 500 #
TOTAL =	6721 #

THIS LOAD IS DISTRIBUTED OVER AN AREA APPROXIMATELY 3'-1 x 3'-1

$$\therefore \text{SOIL PRESSURE} = \frac{6.72}{(3.08)^2} = 0.7 \text{ KSF} < 4 \text{ KSF} \quad \text{O.K.}$$

CHECK PUNCHING SHEAR -

@ WORST CASE : $P = \frac{11.9}{4} = 3.0^{K}$

$\therefore d \approx 3''$

$\therefore b_o = 60''$

$$V_c = 4\sqrt{4000}\,(60)(3) \cdot \frac{1}{1000} = 45.5^{K}$$

$$P_u = 1.4(3.0) = 4.2^{K} << 0.85(45.5) = 38.7^{K} \quad \text{O.K.}$$

APPENDIX D

1. COORDINATION AGREEMENTS

2. CLOSURE ASSURANCE AND LIABILITY COVERAGE DOCUMENTS

1. COORDINATION AGREEMENTS

Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

Mr. William Colley
Durham City/Durham County Emergency
Management Agency
P.O. Box 1086
Durham, NC 27702

Dear Mr. Colley:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed is a copy of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please review this Plan and advise if you will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

Durham - Durham County
Emergency Management Agency

314 N. Mangum St.
PO Box 1086
Durham, NC 27702

(919) 683-4517

William L. Colley
Director/Coordinator

November 27, 1990

Mr. Calvin Overcash
Environmental Safety
Glaxo Inc.
5 Moore Drive
P. O. Box 13358
Research Triangle Park, NC 27709

Dear Mr. Overcash:

We are in receipt of your Emergency Response Contingency Plan dated December 11, 1989 and we see no problems with the Plan.

Durham County will respond to an emergency at the Glaxo facility with equipment and personnel necessary to handle the situation from all necessary emergency response units including Fire, Hazardous Materials Team, Law Enforcement and etc.

If we can be of further assistance, please do not hesitate to call.

Respectfully yours,

William L. Colley, Sr.
Director, Emergency Management

WLC/bw

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Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

Mr. John Robinette
Assistant Administrative Director
Box 3933
Duke University Medical Center
Durham, NC 27710

Dear Mr. Robinette:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed is a copy of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please review this Plan and advise if you will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

DUKE UNIVERSITY MEDICAL CENTER
DUKE UNIVERSITY HOSPITAL

December 3, 1990

Mr. Calvin Overcash
Supervisor, Environmental Safety
Glaxo, Inc.
Five Moore Drive
Post Office Box 13358
Research Triangle Park, North Carolina 27709

Dear Mr. Overcash,

I have reviewed the Glaxo Hazardous Waste Contingency Plan and have forwarded the copy you sent me to our Emergency Department.

Duke University Medical Center would certainly be willing to provide appropriate medical care in response to a fire, explosion or contaminant exposure situation at the Glaxo, Inc. facility.

Sincerely,

George M. Richards
Assistant Administrator

GMR/cm

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Box 3869 • Durham, North Carolina 27710 • Telephone (919) 681-3420

Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

Mr. Larry Suitt
Senior Vice President
Durham County Hospital Corporation
3643 North Roxboro Street
Durham, NC 27704

Dear Mr. Suitt:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed is a copy of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please review this Plan and advise if you will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

DURHAM COUNTY HOSPITAL CORPORATION
DURHAM COUNTY GENERAL HOSPITAL • OAKLEIGH AT DURHAM • EMERGENCY MEDICAL SERVICES
HEALTH CAMPUS AT WESTGATE • LINCOLN COMMUNITY HEALTH CENTER • FAMILY MEDICINE CENTER
HOME TREATMENT & LIFE CARE • HEALTH PROFESSIONAL EDUCATION • WATTS SCHOOL OF NURSING
919-470-4000 ☐ 3643 N. ROXBORO STREET, DURHAM, NORTH CAROLINA 27704

January 2, 1990

Mr. Thomas F. Cecich
Director, Safety, Health & Environmental Affairs
GLAXO, Inc.
Post Office Box 13358
Research Triangle Park, N. C. 27709

Dear Mr. Cecich:

Representatives from our Corporate Offices and Emergency Medical Services Division have reviewed Glaxo's Contingency Plan for the planned hazardous waste incinerator. We believe we can provide the appropriate type of emergency response per your plan.

We do request, however, that you list our data for the Medical Emergency Services Division on page G-6. That data is:

Emergency Medical Services (Ambulance response) Durham County Hospital Corporation 470-7351 Dispatch via 911)

Thank you for the opportunity to review and respond to your plan.

Sincerely,

DURHAM COUNTY HOSPITAL CORPORATION

Earl D. Powell

Earl D. Powell
Vice-President, Management Services

cc: J. Mickey Tezai

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Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

Lieutenant C. W. Crabtree
Durham County Sheriff's Department
P.O. Box 170
Durham, NC 27702

Dear Lieutenant Crabtree:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed is a copy of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please review this Plan and advise if you will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

Five Moore Drive, P.O. Box 13358 Research Triangle Park, NC 27709 • Telex 802813 • Telephone (919) 248-2100

COUNTY OF DURHAM
SHERIFF'S DEPARTMENT

ROLAND W. LEARY
SHERIFF

November 27, 1990

Glaxco Inc.
Calvin Overcash
5 Moore Dr.
P.O. Box 13358
RTP, NC 27709

Dear Mr. Overcash,

The Durham County Sheriff's Department is the Primary Law Enforcement Agency in the Research Triangle Park. Glaxco Inc. is located in RTP and has provided an Emergency Contingency Plan from December 1989. The Sheriff's Department will respond to all Emergencies and calls for service at Glaxco as notified.

Major G. R. Naylor
George R. Naylor
Durham County Sheriff's Dept.

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Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

Mr. Richard J. Sauer
Durham County Fire Marshall
2515 Apex Highway, Suite D
Durham, NC 27713

Dear Mr. Sauer:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed are two (2) copies of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please forward one (1) copy to the Bethesda Volunteer Fire Department. Please review this Plan and advise if you or the Bethesda Volunteer Fire Department will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

COUNTY OF DURHAM
OFFICE OF THE FIRE MARSHAL

RICHARD J. SAUER
FIRE MARSHAL

December 3, 1990

Mr. Calvin Overcash
Glaxo, Inc.
Five Moore Drive
Research Triangle Park, NC 27709

Dear Mr. Overcash:

This is in reference to our telephone conversation concerning the construction of a hazardous waste incinerator at the Glaxo R & D Facility. The contingency plan dated December, 1989 has been reviewed by this office once again along with Bethesda Fire Department personnel. Per your request this letter will serve as acknowledgement to providing emergency response to your facility as stated in Section G., Contingency Plan and Emergency Procedure.

If you have any other questions in this matter feel free to contact this office.

Sincerely,

E. Charles Ottaway

E. Charles Ottaway
Assistant Fire Marshal
Durham County

ECO:prr

CC: R. J. Sauer
Durham County Fire Marshal

RECEIVED
DEC 5 1990
ENVIRONMENTAL SAFETY

Glaxo

Glaxo Inc.

Thomas F. Cecich
Director
Safety, Health & Environmental Affairs

December 11, 1989

First Sergeant R. W. Isley
North Carolina Highway Patrol
P.O. Box 11098
Durham, NC 27703

Dear First Sergeant Isley:

Glaxo Inc., located in Research Triangle Park, is proposing the construction of a hazardous waste incinerator to destroy waste by-products generated by our pharmaceutical research and development facility. Enclosed is a copy of Glaxo's Contingency Plan which we are submitting as part of our hazardous waste permit application. Please review this Plan and advise if you will not be able to provide the appropriate type of emergency response in the event of a fire or spill involving hazardous wastes.

We anticipate the incinerator to be permitted and in operation in approximately one year. If you have any further questions regarding this project please contact me at (919) 248-2655.

We appreciate your cooperation with the development and implementation of this plan.

Sincerely,

Thomas F. Cecich

Attachment

cc: Calvin Overcash, Glaxo Inc.
Robert Midgette, Sirrine Environmental Consultants
Robert Wojtas, Glaxo Inc.

North Carolina Department of Crime Control and Public Safety
Division of State Highway Patrol

James G. Martin, Governor
Joseph W. Dean, Secretary

W. D. Teem, Colonel

Troop "C", District VII
Durham, North Carolina
6 December 1990

Mr. Calvin Overcash
Glaxco, Inc
Post Office Box 13358
Research Triangle Park, North Carolina 27709

Dear Mr. Overcash:

This is to confirm that the State Highway Patrol would be willing to provide the necessary emergency response in the event of a fire, explosion, or release involving hazardous waste at Glaxco Inc., in Research Triangle Park.

Please contact me at my office, telephone number (560-6868), if you have any further questions.

Sincerely,

1/Sgt Raymond W. Isley/so

Raymond W. Isley
First Sergeant

RWI/so

RECEIVED
DEC 11 1990
"ENVIRONMENTAL SAFETY"

2. CLOSURE ASSURANCE AND LIABILITY COVERAGE DOCUMENT

APPENDIX E

NORTH CAROLINA AMENDMENTS

1. SURFACE WATER DATA
2. SOIL SURVEY DATA
3. CLIMATOLOGICAL DATA
4. CORRESPONDENCE WITH STATE AGENCIES
5. TEST BORING RECORDS
6. PUBLIC MEETING DATA
7. GROUNDWATER VELOCITY CALCULATION
8. GROUNDWATER MONITORING INSTALLATION DETAIL
9. DEMONSTRATION OF SUBSTANTIAL COMPLIANCE PER 10 NCAC .0034(h)

1. SURFACE WATER DATA

CAPE FEAR RIVER BASIN

0209741955 NORTHEAST CREEK AT SECONDARY ROAD 1100 NEAR GENLEE, NC

LOCATION.--Lat 35°52'20", long 78°54'49", Durham County, Hydrologic Unit 03030002, on left bank at downstream side of bridge on Secondary Road 1100, 1.3 mi west of Genlee, and 1.6 mi downstream from Burdens Creek.

DRAINAGE AREA.--21.1 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1982 to current year.

GAGE.--Water-stage recorder. Datum of gage is 235 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--No estimated daily discharges. Records fair. Slight diurnal fluctuation at low flow. The city of Durham diverted from Neuse River basin an average of 34.7 ft^3/s for municipal water supply and returned an average of 16.7 ft^3/s as treated effluent into the Cape Fear River basin, of which 4.3 ft^3/s entered upstream from station. About 12.4 ft^3/s, was returned to Neuse River basin.

AVERAGE DISCHARGE.--5 years, 28.4 ft^3/s, 18.28 in/yr.

COOPERATION.--Chemical and biological data shown in the last table were provided by the North Carolina Department of Natural Resources and Community Development.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,220 ft^3/s Aug. 20, 1986, gage height, 11.07 ft; minimum 0.76 cfs Oct. 7, 1985, minimum gage height, 3.50 ft Sept. 5, 1983.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 400 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Jan. 2	0400	458	9.12	Mar. 1	0700	925	9.94
Jan. 19	2030	626	9.46	Apr. 16	0930	*1,020	*10.06
Jan. 22	1930	889	9.89	Sep. 13	0300	682	9.56
Feb. 23	1030	499	9.21				

Minimum discharge, 1.2 ft^3/s June 20, Sept. 26; minimum gage height, 3.63 ft, May 19.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.5	3.6	11	88	12	806	44	7.3	5.9	5.2	4.1	23
2	4.3	3.3	34	338	13	204	20	5.7	6.5	5.6	5.4	4.8
3	4.2	3.7	30	43	18	39	14	5.1	5.8	5.4	4.0	3.5
4	3.5	3.7	10	16	13	23	40	6.3	6.1	4.7	4.4	3.1
5	3.4	3.2	6.2	12	10	16	19	6.5	6.3	4.4	4.9	3.3
6	4.1	2.9	4.9	9.5	8.8	15	13	6.9	4.3	6.4	4.4	15
7	4.4	3.0	4.2	8.3	7.2	12	11	7.5	3.4	6.7	4.4	13
8	4.3	3.1	4.6	7.6	6.7	12	10	7.9	4.0	6.4	2.5	168
9	4.0	2.5	4.7	7.0	7.7	21	8.6	7.4	4.2	6.1	3.0	44
10	4.9	2.9	9.6	8.1	6.9	39	7.6	6.2	3.5	6.1	4.5	6.8
11	3.9	2.3	32	11	7.8	21	6.6	7.1	2.9	5.2	5.2	15
12	3.3	24	23	8.4	8.0	15	6.1	7.2	3.7	5.4	4.7	38
13	4.1	12	12	7.4	7.6	12	18	6.9	3.3	6.5	4.6	348
14	4.9	6.0	7.6	6.7	6.7	9.9	10	9.8	3.2	5.2	4.4	21
15	4.3	16	6.2	6.4	6.8	8.7	236	8.4	3.7	5.0	5.0	6.6
16	4.1	13	5.7	6.4	8.0	8.4	826	20	3.8	5.3	4.5	4.1
17	3.8	6.4	5.3	8.5	13	9.4	202	8.2	4.0	5.1	4.7	3.4
18	3.1	5.5	5.5	98	26	9.0	89	7.2	4.3	4.1	4.6	3.1
19	3.5	5.5	5.3	420	35	43	52	4.9	3.0	3.7	7.2	2.3
20	4.1	7.0	4.2	314	58	45	27	58	2.3	4.7	7.9	1.9
21	4.3	13	3.5	40	85	19	18	14	3.1	4.9	9.2	20
22	4.3	6.4	3.8	398	113	12	14	6.8	2.8	4.9	6.2	5.8
23	4.0	4.4	4.0	411	422	10	12	4.1	6.0	4.8	3.8	3.0
24	4.3	4.9	110	44	234	9.3	41	3.2	14	4.9	5.2	2.3
25	3.8	6.1	235	29	81	8.1	107	4.0	3.6	4.1	5.9	2.2
26	7.6	5.9	25	58	55	7.9	34	5.2	4.3	3.9	6.2	1.8
27	4.5	5.2	12	26	78	8.4	17	4.7	5.2	4.4	6.4	2.0
28	3.7	4.5	8.2	20	556	73	13	4.9	3.5	4.4	6.6	3.2
29	3.8	4.2	7.0	17	---	23	9.9	5.1	4.9	5.2	5.3	4.6
30	3.7	4.4	6.1	17	---	28	8.2	3.9	4.9	4.9	4.6	11
31	3.5	---	5.7	16	---	92	---	5.3	---	4.4	34	---
TOTAL	128.2	188.6	646.3	2500.4	1904.2	1659.1	1934.0	265.7	136.5	158.0	187.8	783.8
MEAN	4.14	6.29	20.8	80.7	68.0	53.5	64.5	8.57	4.55	5.10	6.06	26.1
MAX	7.6	24	235	420	556	806	826	58	14	6.7	34	348
MIN	3.1	2.3	3.5	6.4	6.7	7.9	6.1	3.2	2.3	3.7	2.5	1.8
CFSM	.20	.30	.99	3.82	3.22	2.54	3.06	.41	.22	.24	.29	1.24
IN.	.23	.33	1.14	4.41	3.36	2.93	3.41	.47	.24	.28	.33	1.38

CAL YR 1986 TOTAL 6763.5 MEAN 18.5 MAX 911 MIN 1.7 CFSM .88 IN. 11.9
WTR YR 1987 TOTAL 10492.5 MEAN 28.7 MAX 826 MIN 1.8 CFSM 1.36 IN. 18.5

CAPE FEAR RIVER BASIN

0209741955 NORTHEAST CREEK AT SECONDARY ROAD 1100 NEAR GENLEE, NC--Continued

WATER QUALITY DATA PROVIDED BY NORTH CAROLINA DEPARTMENT OF NATURAL RESOURCES AND COMMUNITY DEVELOPMENT

WATER QUALITY DATA, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987

DATE FROM TO	TIME OF DAY	MEDIUM	OR DEPTH (M)	STREAM STAGE FEET	STREAM FLOW, INST-CFS	CNDUCTVY FIELD MICROMHO	PH SU	WATER TEMP CENT	TURB TRBIDMTR HACH FTU	DO MG/L	FEC COLI MFM-FCBR /100ML
86/10/17	0850	WATER	0.1			405	6.70	12.0		6.2	2900
86/11/12	1015	WATER	0.1			301	6.50	11.0		5.9	
86/12/04	0945	WATER	0.1			138	6.80	8.0		7.6	
87/01/14	1020	WATER	0.1			275	6.80	6.0		9.1	
87/02/20	1000	WATER	0.1			135	7.00	2.0	38.0	10.8	
87/03/11	1420	WATER	0.1			136		7.0		11.6	
87/04/08	1330	WATER	0.1	4.57	12	225	6.00	15.0		9.9	
87/06/02	1300	WATER	0.1	4.45	6	488		24.0	19.0	6.8	
87/06/25	0930	WATER	0.1	4.20	3	430		22.0		6.0	
87/08/27	1110	WATER	0.1	4.58	5						

DATE FROM TO	TIME OF DAY	MEDIUM	OR DEPTH (M)	T ALK FIELD MG/L	RESIDUE TOT NFLT MG/L	RESIDUE TOTAL MG/L	NO2&NO3 N-TOTAL MG/L	NH3+NH4- N TOTAL MG/L	TOT KJEL N MG/L	PHOS-TOT MG/L P	PHOS-T ORTHO MG/L P
86/10/17	0850	WATER	0.1	40	16	410	14.00	.150	1.100	7.200	5.700
86/11/12	1015	WATER	0.1	31			13.00	.110	1.000	5.100	4.600
86/12/04	0945	WATER	0.1	37			3.10	.800	1.200	1.200	1.100
87/01/14	1020	WATER	0.1	57			8.80	.120	.800	2.700	2.700
87/02/20	1000	WATER	0.1		37	220	1.10	.120	.400	.390	.310
87/03/11	1420	WATER	0.1				3.30	.040	.300	.950	.860
87/04/08	1330	WATER	0.1	11			5.20	.040	.500	1.700	1.500
87/06/02	1300	WATER	0.1		34	360	14.00	.120	.800	5.800	5.700
87/06/25	0930	WATER	0.1				12.00	.530	2.500	5.200	

DATE FROM TO	TIME OF DAY	MEDIUM	OR DEPTH (M)	ARSENIC AS,TOT UG/L	CADMIUM CD,TOT UG/L	CHROMIUM CR,TOT UG/L	COPPER CU,TOT UG/L	LEAD PB,TOT UG/L	MERCURY HG,TOTAL UG/L	NICKEL NI,TOTAL UG/L	ZINC ZN,TOT UG/L
86/10/17	0850	WATER	0.1	10K	10K	25K	10K	50K	.2K	50K	130
87/02/20	1000	WATER	0.1	10K	10K	25K	14	50K	.2K	50K	41
87/06/02	1300	WATER	0.1	10K	10K	25K	16	50K	.2K	50K	86

2. SOIL SURVEY DATA

A2—3 to 9 inches, light yellowish-brown (10YR 6/4) sandy loam; weak, medium, granular structure; very friable; common medium roots; strongly acid; abrupt, wavy boundary.

B1—9 to 12 inches, reddish-yellow (7.5YR 6/6) sandy clay loam; moderate, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; few fine roots; common medium pores; very strongly acid; clear, wavy boundary.

B2t—12 to 30 inches, strong-brown (7.5YR 5/8) clay; moderate, medium, subangular blocky structure; firm, sticky, plastic; few fine roots; common fine pores; few discontinuous clay films on faces of peds; strongly acid; gradual, wavy boundary.

B3—30 to 36 inches, mottled strong-brown (7.5YR 5/6) and very pale brown (10YR 7/4) clay loam; weak, medium, subangular blocky structure; firm, slightly sticky, slightly plastic; few, fine, hard, white silty fragments; strongly acid; gradual, wavy boundary.

C—36 to 60 inches, mottled strong-brown (7.5YR 5/6), very pale brown, (10YR 7/4) and white (10YR 8/2) saprolite that crushes to silt loam; massive; friable; very strongly acid.

Depth to bedrock is more than 4 feet. The B horizon is very strongly acid or strongly acid.

The Ap horizon, if present, is yellowish brown, and the A1 horizon is dark brown or dark grayish brown. The A2 horizon is commonly yellow, light yellowish brown, or brown. The B1 horizon, if present, is reddish-yellow or brownish-yellow sandy clay loam or loam. The B2t horizon is strong-brown or brownish-yellow clay or sandy clay. The B3 horizon is strong-brown and very pale brown clay loam, sandy clay loam, or loam. The B horizon commonly has very pale brown mottles. The C horizon is mottled strong-brown, brown, very pale brown, yellow, red, or white saprolite that crushes to silt loam or loam.

Wedowee sandy loam, 10 to 15 percent slopes (WmD).—This well-drained soil is on side slopes adjacent to major drainageways in the uplands. It has the profile described as representative of the series. Areas occur as long, narrow bands that are roughly rectangular in shape and range from 2 to 8 acres in size.

Included with this soil in mapping are areas where stones are on the surface and spots where the soil is eroded. Also included are areas of Nason soils.

This Wedowee soil is easy to keep in good tilth, and it can be worked throughout a wide range of moisture content. Infiltration is moderate, and runoff is rapid.

This soil is well suited to tobacco, corn, soybeans, small grain, hay, and pasture. Slope and the erosion resulting from runoff are the major concerns in management. Capability unit IVe-1; woodland suitability group 3o7.

Wedowee sandy loam, 15 to 25 percent slopes (WmE).—This well-drained soil is on side slopes adjacent to major drainageways in the uplands. It has a surface layer of yellowish-brown or dark-brown sandy loam. Its subsoil is reddish-yellow to strong-brown, firm clay loam to sandy clay loam. Areas occur as long, narrow bands that are roughly rectangular in shape and range from 2 to 15 acres in size.

Included with this soil in mapping are places where slopes are more than 25 percent. Also included are areas of Nason soils.

Infiltration is moderate, and runoff is rapid.

This soil is well suited to pine and hardwood forest and to pasture. Slope and the erosion resulting from runoff are the major concerns in management. Capability unit VIe-1; woodland suitability group 3r8.

Wehadkee Series

The Wehadkee series consists of nearly level, poorly drained soils on flood plains. These soils formed in fine loamy alluvium washed from soils on uplands.

In a representative profile the surface layer is brown silt loam about 7 inches thick. The subsoil to a depth of about 46 inches is mottled light-gray, friable silty clay loam. Below this to a depth of 60 inches is mottled dark-brown and light-gray, friable clay loam.

Wehadkee soils are flooded very frequently for very brief periods. They are low in natural fertility and medium in organic-matter content. Permeability is moderate, and available water capacity is high. The root zone is deep. Shrink-swell potential is low. The seasonal high water table is generally at or near the surface late in winter and early in spring.

Most of the acreage is now forested with mixed hardwoods. If adequately drained, these soils are fairly well suited to some row crops, including corn. The major limitations are wetness and flooding.

Representative profile of Wehadkee silt loam in a hardwood forest 5.7 miles southwest from Durham on U.S. 15-501; 100 feet south of road, and 100 feet west of New Hope Creek:

A1—0 to 7 inches, brown (10YR 5/3) silt loam; weak, coarse, granular structure; friable, slightly sticky, slightly plastic; many fine roots; few brittle concretions; medium acid; abrupt, smooth boundary.

B1—7 to 12 inches, light-gray (10YR 7/2) silty clay loam; many, coarse, distinct, dark-brown (10YR 4/3) mottles; weak, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; common fine roots; common medium pores; common, small, soft, dark-brown concretions; medium acid; clear, wavy boundary.

B2g—12 to 46 inches, light-gray (10YR 7/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) and dark-brown (10YR 4/3) mottles; weak, coarse, subangular blocky structure; friable, slightly sticky, slightly plastic; few fine roots to a depth of about 24 inches; common medium pores; common small concretions; medium acid; gradual, irregular boundary.

B3—46 to 60 inches, mottled dark-brown (10YR 4/3) and light-gray (10 YR 7/1) clay loam; weak, medium, subangular blocky structure; friable, slightly sticky, slightly plastic; common, small, soft, dark-brown concretions; medium acid.

Depth to bedrock is more than 5 feet. The B horizon is medium acid or slightly acid.

The Ap horizon, if present, is grayish brown, and the A1 horizon is brown, grayish brown, or gray. The B1 horizon is light-gray or gray silty clay loam or loam. The B2 horizon is light-gray or gray silty clay loam or clay loam mottled with yellowish brown and dark brown. The B3 horizon is mottled dark brown or brown and light gray. The C horizon, if present, is commonly gray or light-gray sandy loam or gray stratified sand and gravel.

Wehadkee silt loam (Wn).—This poorly drained soil is on narrow flood plains. Areas generally occur as narrow bands parallel to small streams and are 3 to 50 acres in size. Slopes range from 0 to 2 percent.

Included with this soil in mapping are areas of Congaree and Chewacla soils.

This Wehadkee soil is easy to keep in good tilth, and it can be worked throughout a wide range of moisture. Infiltration is moderate, and runoff is slow.

This soil is fairly well suited to corn and pasture. Flooding and wetness are the major concerns in management. Capability unit IVw-1; woodland suitability group 1w9.

White Store Series

The White Store series consists of nearly level to moderately steep, moderately well drained soils on uplands. The landscape is one of rounded divides and steep side slopes. These soils formed under forest vegetation, in material weathered from Triassic Mudstone.

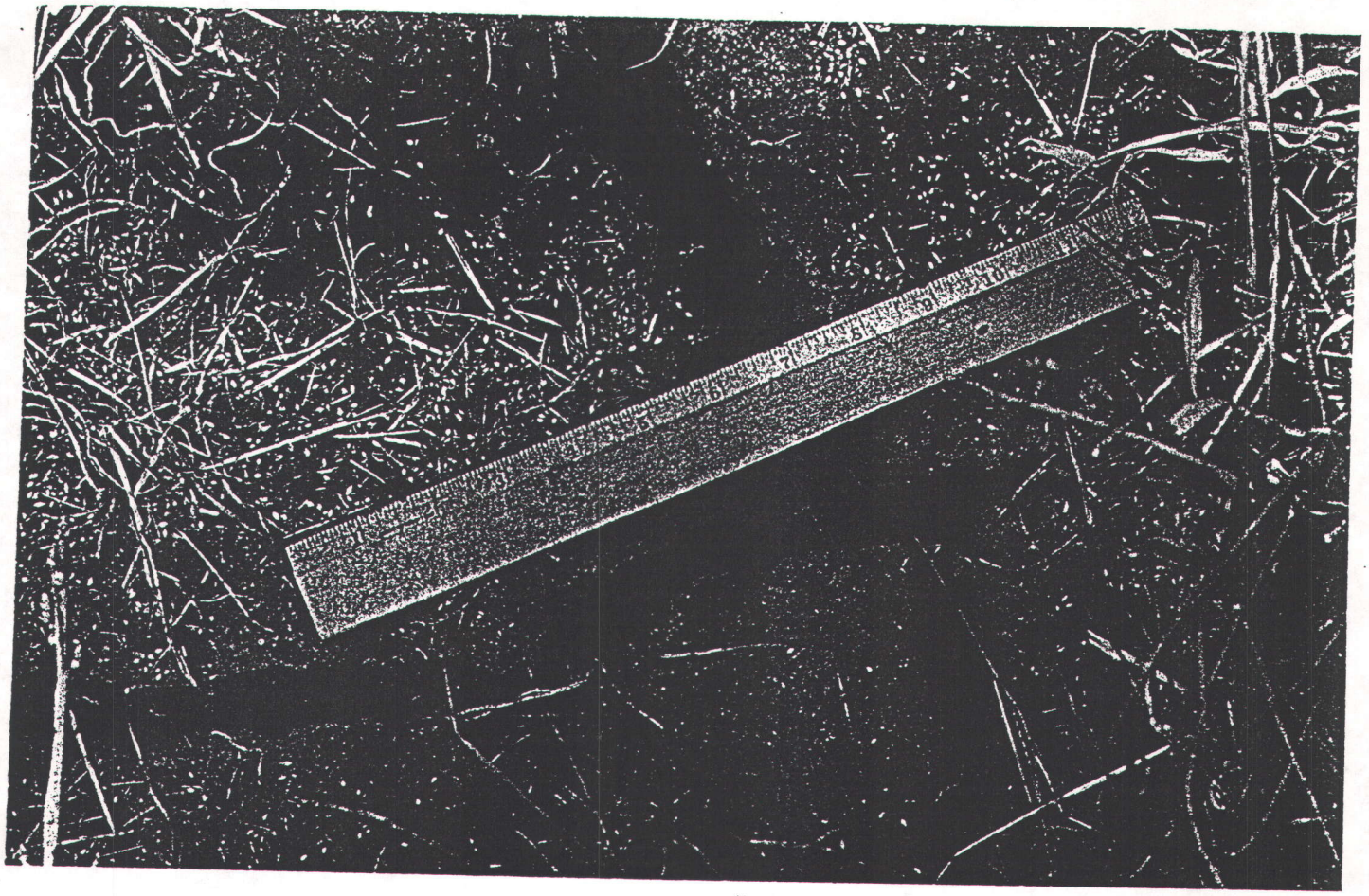


Figure 8.—**Cracks 1¾ inches wide and 10 inches deep in a White Store soil.**

In a representative profile the surface layer is brown sandy loam about 6 inches thick. The subsoil is about 29 inches thick. The upper part is strong-brown, firm clay loam. The lower part is mottled yellowish-red, very firm clay. The underlying material to a depth of 60 inches is dark reddish-brown, highly weathered sandstone and shale and mottled red and pink, partly weathered, fine-grained sandstone that crushes to fine sandy loam.

White Store soils are low in natural fertility and organic-matter content. Permeability is very slow, and available water capacity is medium. The root zone is deep. Shrink-swell potential is high; the soil shrinks when dry and swells when wet (fig. 8). Depth to the seasonal high water table is about 1½ feet.

Most of the acreage is forested with loblolly pine and low-quality hardwoods. The rest is chiefly in pasture or under cultivation. The soils are well suited to most crops commonly grown in the county, including tobacco, corn, and small grain. The major limitations are the erosion hazard resulting from runoff, the very slow permeability, the steep slopes, the high shrink-swell potential, and a perched water table.

Representative profile of White Store sandy loam, 2 to 6 percent slopes, in a young pine forest 1 mile north of Nelson on State Road 1959 at the intersection with State Road 1969; 25 feet west of road:

Ap—0 to 6 inches, brown (10YR 5/3) sandy loam; weak, medium, granular structure; very friable; common fine roots; few quartz pebbles; medium acid; abrupt, wavy boundary.

B1t—6 to 10 inches, strong-brown (7.5YR 5/6) clay loam; weak, medium, subangular blocky structure; firm, sticky, plastic; few fine roots; few discontinuous clay films; few quartz pebbles; strongly acid; clear, wavy boundary.

B21t—10 to 22 inches, yellowish-red (5YR 5/6) clay; common, medium, distinct, reddish-brown (5YR 4/4) and yellowish-brown (10YR 5/6) mottles; prismatic structure parting to moderate, fine and medium, blocky structure; very firm, very sticky, very plastic; few fine roots; common continuous clay films on faces of peds; very strongly acid; gradual, wavy boundary.

B22t—22 to 28 inches, yellowish-red (5YR 4/6) clay; many, medium, distinct, reddish-brown (5YR 4/4) and light brownish-gray (10YR 6/2) mottles; moderate, medium, blocky structure; very firm, very plastic, very sticky; few discontinuous clay films on faces of peds; very strongly acid; gradual, wavy boundary.

B3t—28 to 35 inches, yellowish-red (5YR 5/6) clay; many, coarse, distinct mottles and streaks of reddish brown (2.5YR 4/4) and gray (10YR 5/1); weak, medium, blocky structure; very firm, sticky, plastic; few discontinuous clay films on faces of peds; few small flakes of mica; common soft shale fragments; very strongly acid; gradual, wavy boundary.

C1—35 to 38 inches, dark reddish-brown (2.5YR 3/4), highly weathered sandstone and shale containing pockets of

clay; many, coarse, distinct, gray (10YR 6/1) and yellowish-brown (10YR 5/4) mottles; massive; friable; few small flakes of mica; strongly acid; clear boundary.
C2—38 to 60 inches, mottled red and pink, partly weathered, fine-grained sandstone that crushes to fine sandy loam; massive; medium acid.

Depth to bedrock is more than 4 feet. The B horizon is very strongly acid or strongly acid.

The Ap horizon is brown or yellowish brown, and the A1 horizon, if present, is grayish brown, brown, or yellowish brown. The A horizon is sandy loam or clay loam. The B1t horizon, if present, is strong-brown or brown clay, clay loam, or sandy clay loam. The B2t horizon is yellowish-red or reddish-brown clay to silty clay. The B3 horizon, if present, is reddish-yellow, yellowish-red, dark reddish-brown, or dusky red clay to silty clay loam. The B horizon has many red, brownish-yellow, or gray mottles. The upper part of the C horizon is commonly dark reddish-brown, weathered sandstone or siltstone that has gray mottles. The lower part of the C horizon is gray, red, and light-red, partly weathered sandstone.

White Store sandy loam, 2 to 6 percent slopes (WsB).—This moderately well drained soil is on broad ridges on uplands. It has the profile described as representative of the series. Areas are generally elliptical in shape and 2 to 10 acres in size.

Included with this soil in mapping are areas of similar soils that have a surface layer of fine sandy loam or silt loam and a few small areas where the soil is eroded. Also included are a few areas of Creedmoor and Mayodan soils.

This White Store soil is easy to keep in good tilth. Because the subsoil is very slowly permeable, however, tillage is restricted after heavy rain. Infiltration is moderate, and runoff is medium.

This soil is well suited to tobacco, corn, small grain, hay, and pasture. Erosion resulting from runoff, high shrink-swell potential, and very slow permeability are the major concerns in management. Capability unit IIe-3; woodland suitability group 4c2.

White Store sandy loam, 6 to 10 percent slopes (WsC).—This moderately well drained soil is on narrow side slopes on uplands. It has a surface layer of brown or yellowish-brown sandy loam. Its subsoil is yellowish-red, very firm clay or silty clay that in most places is mottled with red and gray. Areas occur as narrow bands that are roughly rectangular in shape and range from 3 to 15 acres in size.

Included with this soil in mapping are areas of soils that have a surface layer of fine sandy loam and a few areas where the soil is eroded. Also included are a few acres of Creedmoor and Pinkston soils.

This White Store soil is easy to keep in good tilth, and it can be worked throughout a wide range of moisture content. Infiltration is moderate, and runoff is rapid.

The soil is well suited to pine and hardwood forests and to corn, tobacco, small grain, and pasture. The slope, the erosion resulting from runoff, the high shrink-swell potential, and the very slow permeability are the major concerns in management. Capability unit IIIe-3; woodland suitability group 4c2.

White Store sandy loam, 10 to 25 percent slopes (WsE).—This moderately well drained soil is on side slopes adjacent to major drainageways in uplands. It has a surface layer of yellowish-brown or grayish-brown sandy loam. Its subsoil is yellowish-red, very firm clay. Areas occur as long, narrow bands that are roughly rectangular in shape and 3 to 20 acres in size.

Included with this soil in mapping are areas of soils that have a surface layer of fine sandy loam or loam and spots where the soil is eroded. Also included are areas of Mayodan and Pinkston soils.

Infiltration is moderate, and runoff is rapid.

This soil is well suited to pine and hardwood forests and to pasture. The slope, the erosion resulting from runoff, the high shrink-swell potential, and the very slow permeability are the major concerns in management. Capability unit VIe-1; woodland suitability group 4c2.

White Store clay loam, 2 to 10 percent slopes, eroded (WvC2).—This moderately well drained soil is on ridges and narrow side slopes on uplands. It has a surface layer of yellowish-brown clay loam. Its subsoil is reddish-brown, very firm clay that in most places is mottled with red and gray. Areas occur as narrow bands that are roughly rectangular in shape and 2 to 25 acres in size.

Included with this soil in mapping are a few spots where the surface layer is fine sandy loam and a few acres where shallow gullies have formed. Also included are a few acres of Pinkston and Wilkes soils.

This White Store soil is easy to keep in good tilth, but it can be worked within only a narrow range of moisture content because the surface layer has a high content of clay. Infiltration is slow, and runoff is rapid.

This soil is well suited to pine and hardwood forest and to pasture. The slope, the erosion resulting from runoff, the high shrink-swell potential, and the very slow permeability are the major concerns in management. Capability unit VIe-2; woodland suitability group 4c2.

White Store clay loam, 10 to 25 percent slopes, eroded (WvE2).—This moderately well drained soil is on side slopes adjacent to major drainageways on uplands. It has a surface layer of yellowish-brown clay loam. Its subsoil is yellowish-red, very firm clay or silty clay. Areas occur as long, narrow bands that are roughly rectangular in shape and 2 to 20 acres in size.

Included with this soil in mapping are a few spots where the surface layer is fine sandy loam and a few places where deep gullies have formed. Also included are areas of Pinkston soils.

Infiltration is slow, and runoff is rapid.

This soil is suited to pine and hardwood forests and to pasture. The slope, the erosion resulting from runoff, the high shrink-swell potential, and the very slow permeability are the major concerns in management. Capability unit VIIe-2; woodland suitability group 4c2.

White Store-Urban land complex, 0 to 10 percent slopes (WwC).—This complex consists of White Store soil and Urban land, which is mainly White Store soil material. As much as 30 percent of each mapped area is covered by streets, houses, and other structures. About 30 percent is an undisturbed White Store soil. About 25 percent is a White Store soil that in places has been covered with as much as 18 inches of fill material and in other places has had as much as two-thirds of the original soil material removed. The rest is fill, 18 inches or more thick, or places where the original soil material has been cut away. The fill material is commonly a mixture of sandy loam and clay.

Included with this complex in mapping are areas of Creedmoor and Mayodan soils. Capability unit unassigned; woodland suitability group unassigned.

White Store-Urban land complex, 10 to 25 percent slopes (WwE).—This complex consists of White Store soil and Urban land, which is mainly White Store soil material.

About 25 percent of each mapped area is covered by houses, streets, driveways, and sidewalks. About 40 percent is an undisturbed White Store soil. About 30 percent is a White Store soil that has been graded or terraced. In these graded or terraced areas, as much as two-thirds of the original soil material has been cut away or as much as 18 inches of fill material has been added. The rest of each mapped area is fill, 18 inches or more thick, or places where the original soil material has been cut away. The fill material is a mixture of sand and very plastic clay.

Included with this complex in mapping are areas of Mayodan soils. Capability unit unassigned; woodland suitability group unassigned.

Wilkes Series

The Wilkes series consists of strongly sloping and moderately steep, well-drained soils on uplands. The landscape is one of rounded divides and steep side slopes. These soils formed under forest vegetation, in residuum from mixed acidic and basic rock.

In a representative profile the surface layer is grayish-brown sandy loam about 3 inches thick. It is underlain by a 3-inch layer of light brownish-gray sandy loam. The subsoil is yellowish-brown, firm clay and clay loam about 7 inches thick. The underlying material to a depth of about 40 inches is mottled yellowish-brown, green, black, and gray saprolite that crushes to silt loam. Hard bedrock is at a depth of 40 inches.

Wilkes soils are medium in natural fertility and low in organic-matter content. Permeability is moderately slow, and available water capacity is low. The root zone is moderately deep. Shrink-swell potential is moderate. Depth to the seasonal high water table is more than 6 feet.

Most of the acreage is forested with loblolly pine and low-quality hardwoods. The rest is chiefly in pasture. The soils are fairly well suited to most row crops grown in the county, including tobacco and corn. The major limitations are the erosion hazard resulting from runoff, the steep slopes, the depth to bedrock, and the seasonal high water table.

Representative profile of Wilkes sandy loam, 10 to 25 percent slopes, in a wooded area 10.4 miles southeast of Durham on State Road 1901; 100 feet north or road:

O1—3 inches to 1 inch, undecomposed mixed hardwood and pine forest litter.

O2—1 inch to 0, partly decomposed forest litter.

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) sandy loam; moderate, medium, granular structure; very friable; common fine and medium roots; common quartz pebbles ¼ inch to 2 inches in diameter; strongly acid; abrupt, smooth boundary.

A2—3 to 6 inches, light brownish-gray (2.5Y 6/2) sandy loam; moderate, medium and coarse, granular structure; very friable; common fine and medium roots; common small strong-brown fragments of weathered rocks; common quartz pebbles ¼ inch to 2 inches in diameter; strongly acid; abrupt, smooth boundary.

B2t—6 to 10 inches, yellowish-brown (10YR 5/6) clay; common, fine, prominent black and green mottles and common, fine, faint, strong-brown mottles which are assumed to be partly weathered primary materials; massive parting to coarse, angular blocky structure; firm, sticky, plastic; few fine roots; few small pores; few, discontinuous clay films on faces of peds and on walls of cracks; few medium pebbles; material from A horizon in old root channels; slightly acid; clear, wavy boundary.

B3t—10 to 13 inches, yellowish-brown (10YR 5/6) clay loam; weak, coarse, subangular blocky and platy structure; firm, sticky, plastic; common, fine, partly weathered black, gray, and green primary minerals; few fine roots; few discontinuous clay films on faces of peds; common hard schist fragments; slightly acid; abrupt, wavy boundary.

C—13 to 40 inches, mottled yellowish-brown, green, black, and gray saprolite which crushes to silt loam; massive (platy rock structure); friable; few fine roots; thin discontinuous clay films line vertical cracks; common, small and medium, hard schist fragments; neutral; abrupt, wavy boundary.

R—40 inches, hard bedrock.

Depth to bedrock is more than 2 feet. The B horizon is medium acid to neutral.

The Ap horizon, if present, is brown, and the A1 horizon is grayish brown or yellowish brown. The A2 horizon is light brownish gray or yellowish brown. The B horizon is mottled with black, green, and brown. The B2t horizon is yellowish-brown or brown clay or clay loam. The B3t horizon, if present, is yellowish-brown or brown clay loam, loam, or silt loam and in places has partly weathered rock fragments. The C horizon is commonly mottled yellowish-brown, green, black, and gray saprolite that crushes to silt loam or loam.

Wilkes sandy loam, 10 to 25 percent slopes (WxE).—This well-drained soil is on side slopes adjacent to major drainageways in the uplands. Areas occur as narrow bands that are roughly rectangular in shape and range from 2 to 10 acres in size.

Included with this soil in mapping are places where slopes are less than 10 percent and areas where many stones are on the surface.

Infiltration is moderate, and runoff is rapid.

This soil is well suited to pine and hardwood forest and to pasture. The slope, the erosion resulting from runoff, the depth to bedrock, and the seasonal high water table are the major concerns in management. Capability unit VIe-1; woodland suitability group 4r2.

Use and Management of the Soils

This section describes use and management of the soils for crops and pasture, woodland, wildlife, recreation, and engineering. It does not give detailed information about management of individual soils. For specific suggestions, consult a representative of the local office of the Soil Conservation Service, the Extension Service, or the Agricultural Experiment Station.

Crops and Pasture[3]

The pages that follow explain the system of capability grouping and suggest management of the soils of Durham County by capability units. Estimated yields for specific crops under superior management are listed in table 2.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the

[3] J. E. Pollock, conservation agronomist, and R. S. Tennant, district conservationist, Soil Conservation Service, helped prepare this section.

TABLE 6.—*Estimates of soil properties*

Soil name and map symbols	Flood hazard	Depth to seasonal high water table	Depth to bedrock	Depth from surface of representative profile	USDA texture	Classification	
						Unified	AASHO
		Feet	*Feet*	*Inches*			
White Store: WsB, WsC, WsE, WvC2, WvE2, WwC, WwE. Urban land part of WwC and WwE too variable to estimate.	None	>1½	>4	0–6 6–35 35–60	Sandy loam Clay loam Weathered sandstone and shale.	SM, SM–SC CH, CL	A–4, A–2 A–7
Wilkes: WxE	None	>6	>2	0–6 6–13 13–40 40	Sandy loam Clay, clay loam Silt loam Bedrock.	SM, SM–SC CH, CL ML, CL–ML	A–2, A–4 A–7 A–4

[1] Rating applies to all layers of soil.
[2] NP is nonplastic.
[3] Coarse fraction more than 3 inches in diameter is 30 percent.

difficulty of layout and construction and also the hazard of erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Sewage lagoons are shallow ponds constructed to hold sewage within a depth of 2 to 5 feet long enough for bacteria to decompose the solids. A lagoon has a nearly level floor and sides, or embankments, of compacted soil material. The assumption is made that the embankment is compacted to medium density and the pond is protected from flooding. Properties are considered that affect the pond floor and the embankment. Those that affect the pond floor are permeability, organic-matter content, and slope; and if the floor needs to be leveled, depth to bedrock becomes important. The soil properties that affect embankments are the engineering properties of the embankment material as interpreted from the Unified Soil Classification and the amounts of stones, if any, that influence the ease of excavation and compaction of the embankment material.

Shallow excavations are those that require digging or trenching to a depth of less than 6 feet, as for example, excavations for pipelines, sewer lines, phone and power transmission lines, basements, open ditches, and cemeteries. Desirable soil properties are good workability, moderate resistance to sloughing, gentle slopes, absence of rock outcrops or big stones, and freedom from flooding or a high water table.

Dwellings, as rated in table 7, are not more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to capacity to support load and resist settlement under load and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Sanitary landfills are areas of dug trenches for disposing of refuse. The waste is spread in thin layers, compacted, and covered with soil throughout the disposal period. Landfill areas are subject to heavy vehicular traffic. Some soil properties that affect suitability for landfill are ease of excavation, hazard of polluting ground water, and trafficability. The best soils have moderately slow permeability, withstand heavy traffic, and are friable and easy to excavate. Unless otherwise stated, the ratings in table 7 apply only to a depth of about 6 feet, and therefore limitation ratings of *slight* or *moderate* may not be valid if trenches are much deeper than that. For some soils, reliable predictions can be made to a depth of 10 or 15 feet, but every site should be investigated before it is selected.

Local roads and streets, as rated in table 7, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base consisting of gravel, crushed rock, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep. Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material and also the shrink-swell potential indicate load-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Ratings for light industry are for the undisturbed soils that are used to support building foundations. Emphasis is on foundations, ease of excavation for underground utilities, and corrosion potential of uncoated steel pipe. The undisturbed soil is rated for spread footing foundations for buildings less than three stories high or foundation loads not in excess of that weight. Properties affecting load-supporting capacity and settlement under load are wetness, flooding, texture, plasticity, density, and shrink-swell behavior. Properties affecting excavation are wetness, flooding, slope,

significant in engineering—Continued

Percentage less than 3 inches in diameter passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Shrink-swell potential	Probability of corrosion on—[1]	
No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							Uncoated steel	Concrete
				Percent		*Inches per hour*	*Inches per inch of soil*	*pH*			
95–100	90–100	60–95	30–50	<25	NP–5	2.0–6.0	0.11–0.13	4.5–6.0	Low	High: drainage and texture.	Moderate: texture and reaction.
95–100	90–100	75–100	70–95	45–90	25–65	<0.06	0.10–0.15	4.5–6.0	High		
95–100	90–100	60–80	30–50	<25	NP–4	2.0–6.0	0.11–0.13	5.1–7.3	Low	High: texture.	Low.
95–100	90–100	75–100	70–90	45–90	25–65	0.2–0.6	0.05–0.10	5.6–7.3	Moderate		
95–100	95–100	80–100	60–90	<25	NP–7	0.6–2.0	0.11–0.13	5.6–7.3	Moderate		

[4] Water table is at or near the surface.
[5] Coarse fraction more than 3 inches in diameter is 15 to 25 percent.

and depth to bedrock. Properties affecting corrosion of buried uncoated steel pipe are wetness, texture, total acidity, and electrical resistivity.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material (fig. 14).

Pond embankments are raised structures of soil material constructed across drainageways in order to impound water. These embankments are generally less than 20 feet high, are constructed of homogeneous soil material, and are compacted to medium density. Embankments of core and shell type construction are not rated in this table. Embankment foundation, reservoir area, and slope are assumed to be suitable for pond construction. Soil properties are considered that affect the embankment and the availability of borrow material. The best soils have good slope stability, low permeability, slight compressibility under load, and good resistance to piping and erosion. The best borrow material is free of stones or rocks and thick enough for easy excavation.

Aquifer-fed excavated ponds are bodies of water created by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds fed by runoff and also embankment-type ponds where the depth of water impounded against the embankment exceeds three feet. The assumption is that the pond is properly designed, located, and constructed and that the water is of good quality. Soil properties affecting aquifer-fed ponds are the existence of a permanent water table, permeability of the aquifer, and properties that interfere with excavation (stoniness and rockiness).

Road fill is soil material used in embankments for roads. The suitability ratings reflect the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and the relative ease of excavating the material at borrow areas.

Topsoil is used for topdressing an area where vegetation is is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or the response of plants when fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that will result at the area from which topsoil is taken.

Agricultural drainage is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or soil blowing; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and fragipans or other layers that restrict movement of water; available water capacity; and need for drainage or depth to water table or bedrock.

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures provides outlets for runoff and is not difficult to vegetate.

Soil test data

Table 8 contains engineering test data for some of the major soil series in Durham County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analyses and by tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

3. CLIMATOLOGICAL DATA

TABLE 14.—*Temperature and precipitation*

[All data recorded at Durham, or estimated as indicated]

Month	Temperature					Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have at least four days with—		Soil temperature 4 inch depth, bare, level ground (estimated)	Average monthly total	1 year in 10 will have		Days with snow cover 1 inch or more	Average depth of snow on days with snow cover
			Maximums equal to or higher than—	Minimums equal to or lower than—			Less than—	More than—		
	°F	°F	°F	°F	°F	Inches	Inches	Inches	Number	Inches
January	53	31	69	13	40	3.3	1.5	5.8	3	2
February	55	31	72	18	42	3.4	1.2	5.5	2	2
March	63	37	76	23	48	3.6	1.6	5.6	2	3
April	73	46	86	32	59	3.4	1.6	5.4	(1)	(1)
May	81	55	91	42	67	3.2	.8	4.8	0	----------
June	88	64	97	53	76	3.7	1.8	6.0	0	----------
July	89	67	98	60	79	5.4	2.5	7.5	0	----------
August	88	66	97	58	79	4.7	1.7	7.8	0	----------
September	83	60	92	45	73	3.4	.7	7.6	0	----------
October	74	48	86	32	63	2.7	.6	5.4	0	----------
November	62	37	77	24	52	2.9	.5	6.3	(1)	(1)
December	53	31	67	13	43	3.0	1.2	4.9	1	1
Year	72	48	[2] 99	[3] 10	60	42.7	27.8	51.3	8	2

[1] Less than one-half.
[2] Average annual highest temperature.
[3] Average annual lowest temperature.

The county is served by four railroads. Interstate Highway 85 and United States Highways 70, 15, and 501 traverse the county. A good county road system provides access to schools and local markets.

A major commercial airport is located midway between Raleigh and Durham.

Information about physiography, relief, and drainage, the water supply, and the climate of Durham County follows.

Physiography, Relief, and Drainage

About two-thirds of Durham County lies in a basin or lowland that is underlain by Triassic rocks of the Newark Group. This basin is characterized by mature, U-shaped valleys and fairly wide flood plains. Distinct escarpments of resistant metavolcanic rocks border this basin on the northwest and southeast. An undulating surface dissected by many drainageways has formed on these resistant metavolcanic rocks. There are some Granodiorite intrusions in these volcanic rocks. The Triassic rocks and some areas of volcanic rocks have intrusions of diabasic materials.

Many young, V-shaped valleys that have short, steep sides formed near streams where differences in elevation range from 50 to 100 feet. The topography generally slopes in a southeasterly direction.

Elevation ranges from 450 to 600 feet above sea level in the northern section of the county and from 275 to 400 feet in the southern part. The highest elevation, 700 feet, is in the northwest part of the county, south of Mt. Lebanon Church. The lowest elevation, 234 feet, is south of the city of Durham near the intersection of Farrington and Stagecoach roads.

A thick layer of soil material and soft weathered rock overlies the bedrock throughout most of the county. In some places where roadbanks are deep, this soft weathered material is exposed to a depth of more than 15 feet.

The county is drained by the New Hope and Neuse River systems. The confluence of the Eno and Flat Rivers east of Fairntosh marks the beginning of the Neuse River. Major streams, including New Hope, Ellerbe, Morgan, Little, Burden Northeast, Third Fork, Sandy, Buffalo, Dial, Camp, Deep, and Panther Creeks and the Little River, are tributaries to the major rivers (*3*).

Natural surface drainage is generally medium to rapid. It is slow, however, on nearly level interstream divides and the flood plains.

Water Supply

Water for most of the industry, research facilities, educational institutions, and more than 75 percent of the people in Durham County comes from the surface water impounded in Lake Michie, located near Bahama. The rest of the water supply comes from wells.

Drilled wells, rather than dug wells, are the most dependable source of ground water. Wells drilled in the volcanic rocks yield nearly twice the amount of water per foot of uncased well as wells in the Triassic rocks. A yield of approximately 12 gallons per minute can be obtained from wells that penetrate the metavolcanic rocks to an average depth of 108 feet.

Ground water in Durham County is principally a calcium bicarbonate type suitable for most domestic, municipal, and industrial purposes (*3*).

TABLE 15.—*Probabilities of last freezing temperatures in spring and first in fall*

[From data recorded at Durham, modified for a rural environment]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 10	March 24	April 4	April 18	April 26
2 years in 10 later than	February 28	March 15	March 28	April 12	April 20
5 years in 10 later than	February 10	February 25	March 10	March 30	April 11
Fall:					
1 year in 10 earlier than	November 25	November 15	November 5	October 26	October 14
2 years in 10 earlier than	December 3	November 21	November 10	October 30	October 19
5 years in 10 earlier than	December 12	December 2	November 20	November 11	October 28

Climate[6]

Durham County is mostly rolling country, but the variation in elevation is not large. In the northern part of the county the higher ground is around 600 feet above mean sea level, and the lower streambeds are near 300 feet. The southern part of the county is lower. Some streambeds are at elevations of about 200 feet, and the higher elevations are about 500 feet. The Blue Ridge Mountains, about 100 miles to the northwest, form a northeast-southwest barrier at elevations of 3,000 to 5,000 feet; in the opposite direction the topography slopes gradually down to the Atlantic Ocean about 135 miles away. These features and the latitude and position are the principal factors influencing the climate. Data on temperature and precipitation are given in tables 14 and 15.

TEMPERATURE

The average length of the growing season is about 200 days. It lasts from the second week in April until the last week in October. Table 15 shows the probabilities of freezes of various intensities in spring and fall. The temperature falls below freezing at Durham on more than half the days in winter, but rarely remains that low for 24 hours. It drops to 0° F. less than once in 10 years. On the average, it rises about 100° perhaps once every 3 years. Temperatures of 90° are possible from late in March well into October and average about 50 occurrences in a summer.

PRECIPITATION

Much of the rain in the growing season comes from summer thunderstorms and varies widely from place to place and from one season to the next. Hail occasionally occurs during a thunderstorm, but in most cases only a small area is affected. A given locality can be without significant rain for 1 to 3 weeks. Irrigation is used in these areas to increase crop production. In winter rain results mainly from low-pressure storms moving through or near the area, and it is less variable than in summer. There are no distinct wet and dry seasons, however, and measurable rain falls on an average of 1 to 3 days per week.

Some snow falls in Durham County every winter, but total amounts vary from 1 inch to 1½ feet. The average total amount in winter is about 6 inches. Generally only a few inches accumulate at one time, and such accumulations generally melt within a few days. Once in several years, however, 8 or 10 inches fall at one time. About as often, snow covers the ground for a week or more. In 1960, the total amount of snow for February and March was 27 inches. Snow accumulated on the ground to a depth of 13 inches at Durham, and remained on the ground in varying amounts continuously from March 2 to March 18.

CLOUDINESS, STORMS, AND WINDINESS

On the average slightly more than half the sky is covered with clouds during daylight hours. The greatest amount of cloudiness occurs in winter and the least in autumn. The sun shines during about half of the daylight hours in winter and nearly two-thirds in other seasons. The average relative humidity is near 85 percent at sunrise, dropping off to around 50 percent by midafternoon.

Tropical storms from the Atlantic Ocean and Gulf of Mexico are greatly weakened if they move inland as far as Durham County. Highest winds most often result from summer thunderstorms. Such winds affect limited areas and are of short duration. A little hail occurs in the county every few years, but does not generally cause damage to more than 1 or 2 square miles of area. No destructive tornadoes have occurred in the county.

Surface wind directions are variable in all seasons. Winds from the southwest and northeast are dominant, and come from the two opposite directions with almost equal frequency. Northeasterlies are more prevalent late in summer and in autumn and southwesterlies at other seasons. Highest winds

[6] Prepared by A. V. HARDY, climatologist for North Carolina, National Oceanic and Atmospheric Administration, National Weather Service, U. S. Department of Commerce.

quite often come from the northwest quadrant. The average speed of the wind near the earth's surface is about 8 miles per hour.

Literature Cited

(1) American Association of State Highway Officials. 1961. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 v., illus.
(2) McCracken, R. J., Weed, S. B., and Goldston, E. F. 1964. Planosolic piedmont soils of North Carolina: I. morphology and composition. Reprinted from Soil Sci., v. 98, No. 1.
(3) North Carolina Department of Water Resources. 1966. Geology and ground water in the Durham area, North Carolina. Bul. No. 7, 143 pp.
(4) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dept. Agr. Handbook No. 18, 503 pp., illus.
(5) ——— 1967. Soil survey laboratory methods and procedures for collecting soil samples. Soil Survey Invest. Rpt. No. 1, 50 pp. Revised April 1972.
(6) ——— 1969. Soil survey interpretations for woodlands in the Southern Piedmont area of Alabama, Georgia, North Carolina, and South Carolina. Prog. Rpt. W-13, U.S. Dept. Agr., Soil Conserv. Serv., 20 pp.
(7) United States Department of Defense. 1968. Unified soil classification system for roads, airfields, embankments and foundations. MIL-STD-619B, 30 pp., illus.

Glossary

Acidity, soil. See Reaction, soil.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Cation exchange capacity. The sum total of exchangeable cations absorbed by a soil, expressed in milliequivalents per 100 grams of soil.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Horizon, soil. A layer of soil, approximately parallel to the surface that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow*, *slow*, *moderately slow*, *moderate*, *moderately rapid*, *rapid*, and *very rapid*.

Plinthite. The sesquioxide-rich, humus-poor, highly weathered mixture of clay with quartz and other diluents that commonly shows as red mottles, usually in platy, polygonal, or reticulate patterns. Plinthite changes irreversibly to hardpan or to irregular aggregates upon repeated wetting and drying. It is a form of laterite.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that

4. CORRESPONDENCE WITH STATE AGENCIES

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

December 28, 1988

Mr. David Brook
North Carolina Department of Cultural Resources
Division of Archives and History
Archaeology and Historic Preservation Section
507 Blount Street
Raleigh, NC 27611

Subject: Glaxo Inc., Research Triangle Park, NC
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Brook:

Glaxo Inc. in Research Triangle Park, NC will be applying for a Resource Conservation and Recovery Act (RCRA) Part B Permit for a hazardous waste incinerator. The January 30, 1985 revisions to the NC Hazardous Waste Management Rules require that factors in addition to the federal requirements be considered by the North Carolina Solid and Hazardous Waste Management Branch before issuing a permit.

Glaxo's proposed incinerator will be located at their facility in Research Triangle Park, NC as identified on the attached Facility Key Plan. The wastes to be incinerated will be wastes generated during research and development activities at the Glaxo facility.

To help us meet the regulatory requirements, please provide a description of the facility's proximity to and potential impact on historical sites. Please provide this information no later than February 1, 1989. Your assistance will be greatly appreciated.

If you have any questions, please call me at 919-881-0777.

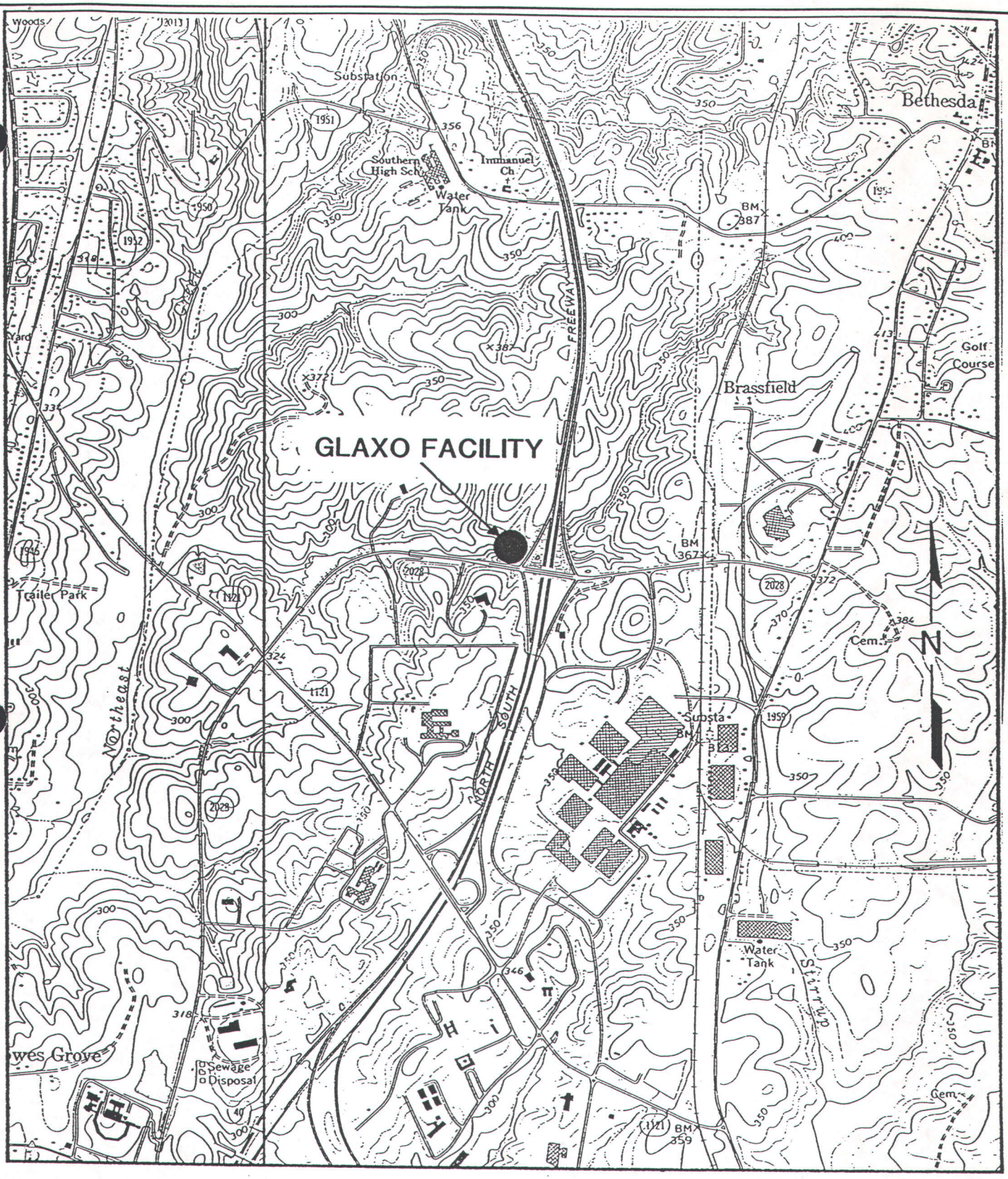
Very truly yours,

SIRRINE ENVIRONMENTAL CONSULTANTS

Robert W. Midgette /SKR
Robert W. Midgette

RWM:mal

Attachment
cc: Mr. Robert G. Wojtas, w/att
Mr. Calvin W. Overcash, w/att
Project File, w/att



REFERENCE :USGS SW , SE DURHAM QUADRANGLES

SIRRINE ENVIRONMENTAL CONSULTANTS

Raleigh, North Carolina

SCALE 1:24,000

FACILITY KEY PLAN

GLAXO INC. ,

RESEARCH TRIANGLE PARK , N.C.

DRAWING NO. R-8279-01

DUNCAN-PARNELL, INC., CHARLOTTE 388 800-432-6022

RECEIVED
FEB - 3 1989
SIRRINE ENVIRONMENTAL
CONSULTANTS

North Carolina Department of Cultural Resources

James G. Martin, Governor
Patric Dorsey, Secretary

Division of Archives and History
William S. Price, Jr., Director

February 2, 1989

Mr. Robert W. Midgette
Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, N.C. 27612

Re: Glaxo, Inc., Research Triangle Park, RCRA Permit Application, SEC Project No. R-8279, Durham County, ER 89-7796

Dear Mr. Midgette:

Thank you for your letter of December 28, 1988, concerning the above project.

We have determined that the project as proposed will not have an effect on any property of architectural, historical, or archaeological significance.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, please contact Ms. Renee Gledhill-Earley, environmental review coordinator, at 919/733-4763.

Sincerely,

David Brook

David Brook, Deputy State
Historic Preservation Officer

DB:slw

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

December 28, 1988

Mr. Frank Morris, Regional Engineer
North Carolina Division of Health Services
Environmental Health Section
Public Water Supply Branch
South Central Regional Office
225 Green Street, Suite 606
Fayetteville, NC 28301

Subject: Glaxo Inc., Research Triangle Park, NC
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Morris:

Glaxo Inc. in Research Triangle Park, NC will be applying for a Resource Conservation and Recovery Act (RCRA) Part B Permit for a hazardous waste incinerator. The January 30, 1985 revisions to the NC Hazardous Waste Management Rules require that factors in addition to the federal requirements be considered by the North Carolina Solid and Hazardous Waste Management Branch before issuing a permit.

Glaxo's proposed incinerator will be located at their facility in Research Triangle Park, NC as identified on the attached Facility Key Plan. The wastes to be incinerated will be wastes generated during research and development activities at the Glaxo facility.

To help us meet the regulatory requirements, please provide a description of the facility's proximity to and potential impact on public water supply water sheds in the area. Also, please provide any available information on the location and withdrawal rates of surface water users within the immediate drainage basin and well water users within a one-mile radius of the facility. Please provide this information no later than February, 1, 1989. Your assistance will be greatly appreciated.

If you have any questions, please call me at 919-881-0777.

Very truly yours,

SIRRINE ENVIRONMENTAL CONSULTANTS

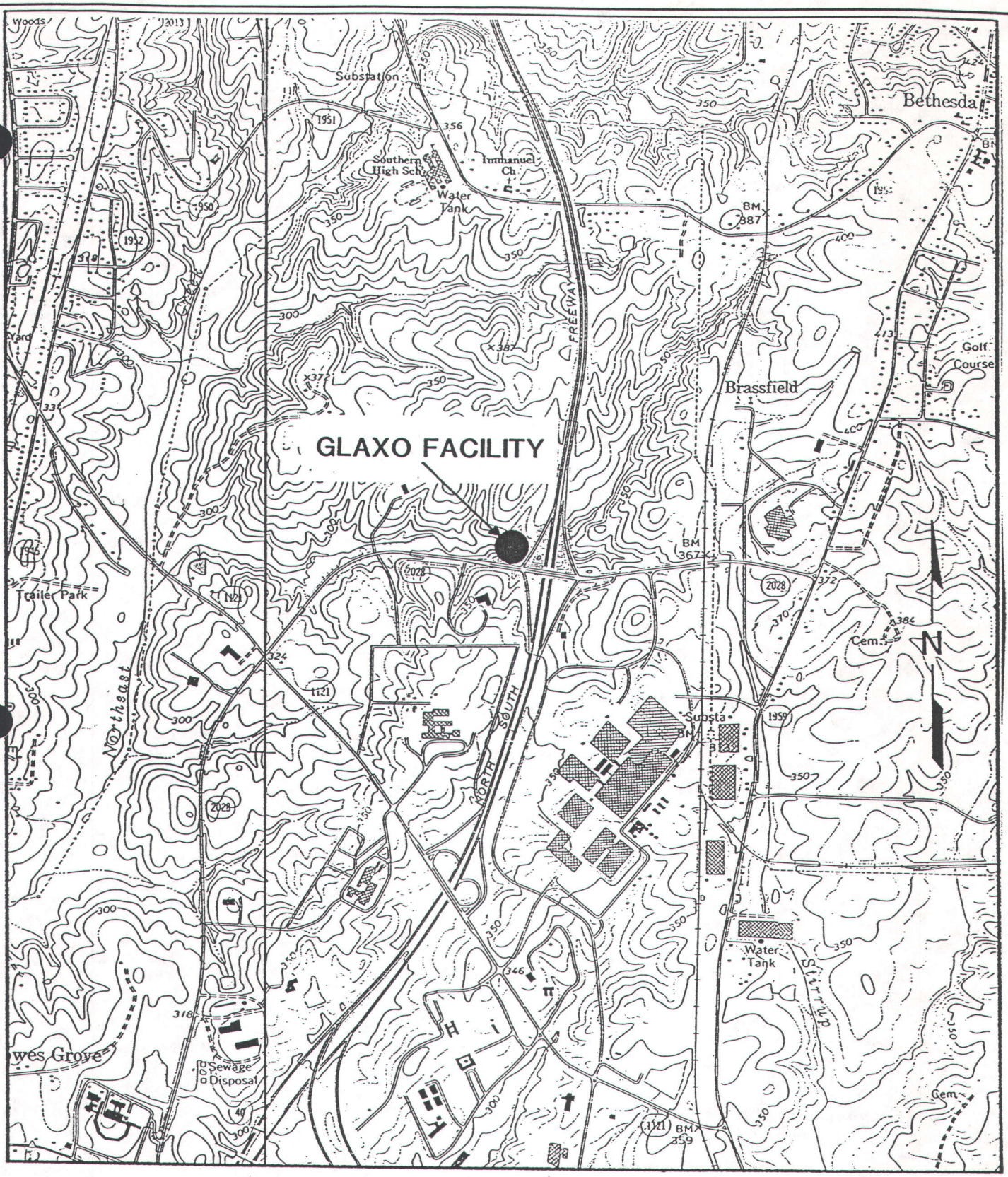
Robert W. Midgette /SWR

Robert W. Midgette

RWM:rw

Attachment

cc: Mr. Robert G. Wojtas, w/att
Mr. Calvin W. Overcash, w/att
Project File, w/att



REFERENCE :USGS SW , SE DURHAM QUADRANGLES

SIRRINE ENVIRONMENTAL CONSULTANTS

Raleigh, North Carolina

SCALE 1:24,000

FACILITY KEY PLAN

GLAXO INC. ,

RESEARCH TRIANGLE PARK , N.C.

DRAWING NO. R-8279-01

DUNCAN-PARNELL, INC., CHARLOTTE 388 800-432-6022

Division of Health Services
225 Green Street, Suite 606
Fayetteville, North Carolina 28301
(919) 486-1191

RECEIVED
JAN 25 1989
CONSULTANTS

North Carolina Department of Human Resources

South Central Regional Office • Wachovia Building • 225 Green Street • Fayetteville, North Carolina 28301

James G. Martin, Governor

David T. Flaherty, Secretary

January 24, 1989

Mr. Robert W. Midgette
Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, North Carolina 27612

Dear Mr. Midgette:

Re: Glaxo Inc., Research Triangle Park, Inc.
RCRA Permit Application
SEC Project No. R-8279
Durham County

At your request, we made investigations of any public water supplies that may be affected by this project. There are no public water systems using groundwater within a one-mile radius of this project. The surface water drainage is to Jordan Lake, and the first downstream user of surface water is the city of Sanford.

If we can assist you at any time, please feel free to contact this office.

Sincerely,

Frank O. Morris

Frank O. Morris, P.E.
Regional Engineer
Public Water Supply Branch
Environmental Health Section

FOM/ps

cc: Mr. W. E. Venrick
Durham County Health Department

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

December 28, 1988

Mr. Charles Roe
North Carolina Parks and Recreation Division
National Heritage Program
P.O. Box 27687
Raleigh, NC 27611

Subject: Glaxo Inc., Research Triangle Park, NC
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Roe:

Glaxo Inc. in Research Triangle Park, NC will be applying for a Resource Conservation and Recovery Act (RCRA) Part B Permit for a hazardous waste incinerator. The January 30, 1985 revisions to the NC Hazardous Waste Management Rules require that factors in addition to the federal requirements be considered by the North Carolina Solid and Hazardous Waste Management Branch before issuing a permit.

Glaxo's proposed incinerator will be located at their facility in Research Triangle Park, NC as identified on the attached Facility Key Plan. The wastes to be incinerated will be wastes generated during research and development activities at the Glaxo facility.

To help us meet the regulatory requirements, please provide a description of the facility's proximity to and potential impact on wetlands, endangered species' habitats, parks, forests, and wilderness areas. Please provide this information no later than February 1, 1989. Your assistance will be greatly appreciated.

If you have any questions, please call me at 919-881-0777.

Very truly yours,

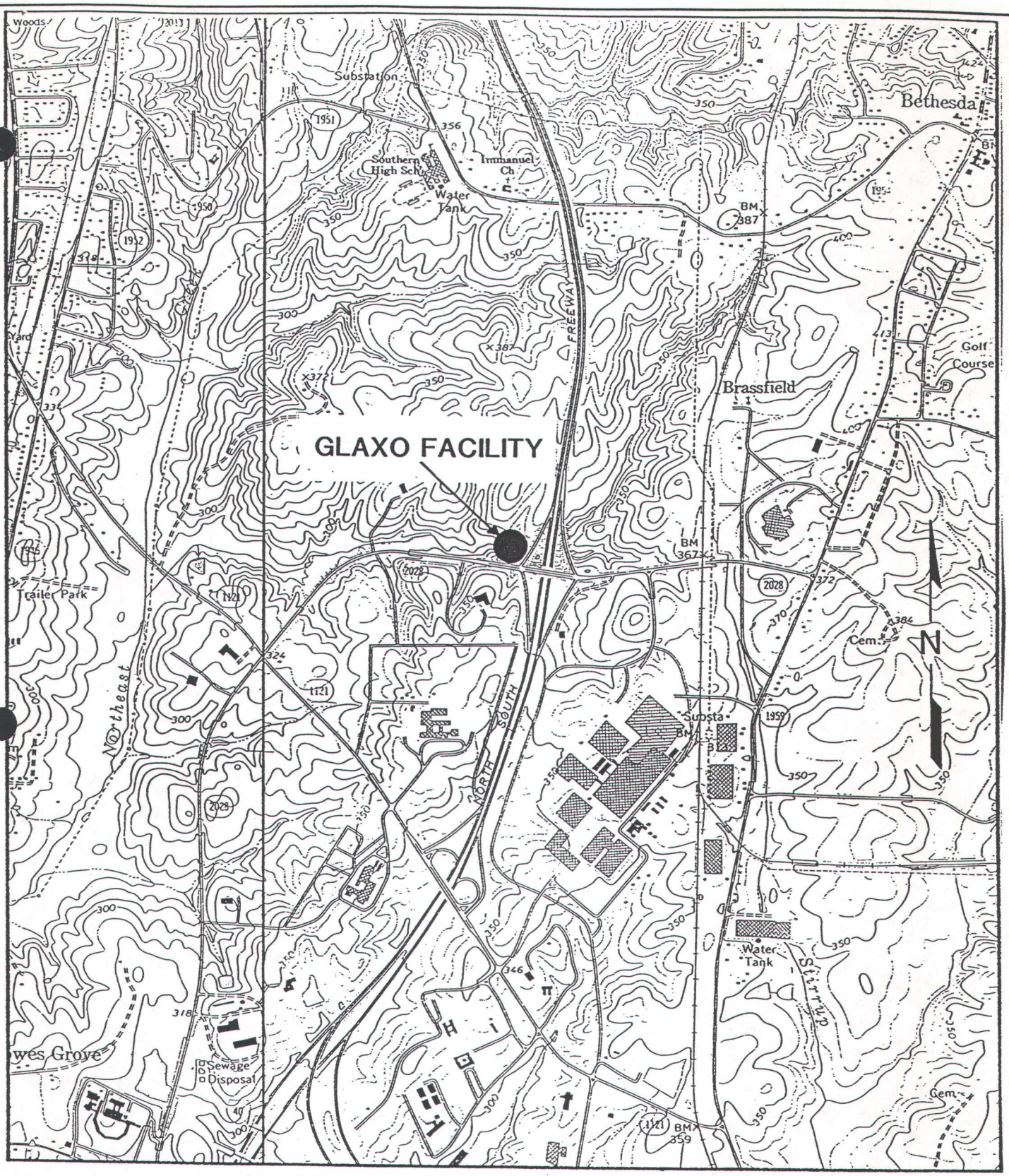
SIRRINE ENVIRONMENTAL CONSULTANTS

Robert W. Midgette/RWM

Robert W. Midgette

RWM:rw

Attachment
cc: Mr. Robert G. Wojtas, w/att
Mr. Calvin W. Overcash, w/att
Project File, w/att



REFERENCE :USGS SW , SE DURHAM QUADRANGLES

SIRRINE ENVIRONMENTAL CONSULTANTS
Raleigh, North Carolina

SCALE 1:24,000

FACILITY KEY PLAN

GLAXO INC .,
RESEARCH TRIANGLE PARK , N.C.

DRAWING NO. R-8279-01

DUNCAN-PARNELL, INC., CHARLOTTE 366 800-432-6022

RECEIVED
JAN 24 1989
SIRRINE ENVIRONMENTAL CONSULTANTS

State of North Carolina
Department of Natural Resources and Community Development
Division of Parks and Recreation
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
William W. Cobey, Jr., Secretary

Dr. William W. Davis
Director

January 18, 1989

Mr. Robert W. Midgette
Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, NC 27612

Subject: Glaxo Inc., Research Triangle Park, NC
RCRA Permit Application

Dear Mr. Midgette:

We have no records of federal or state listed endangered species that may occur within the general project area. This site may not have been included in the natural area inventory for Durham County.

A population of veined skullcap (Scutellaria nervosa - plant sp.) occurs approximately 2.0 miles southwest of the proposed project site. A sharp-shinned hawk was observed approximately 2.5 miles southeast of the project site. Both species are listed as "significantly rare" in North Carolina.

If you need more information about these species, please contact us. A brochure of the NC Natural Heritage Program's data management services has been enclosed, in the event that you have further questions.

Sincerely,

Jo Anne Tippett

Jo Anne Tippett
Natural Heritage Program

JAT/des

Enclosure

N/1

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

December 28, 1988

Mr. Charles Gardner
North Carolina Division of Land Resources
Land Quality Section
P.O. Box 27687
Raleigh, NC 27611

Subject: Glaxo Inc., Research Triangle Park, NC
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Gardner:

Glaxo Inc. in Research Triangle Park, NC will be applying for a Resource Conservation and Recovery Act (RCRA) Part B Permit for a hazardous waste incinerator. The January 30, 1985 revisions to the NC Hazardous Waste Management Rules require that factors in addition to the federal requirements be considered by the North Carolina Solid and Hazardous Waste Management Branch before issuing a permit.

Glaxo's proposed incinerator will be located at their facility in Research Triangle Park, NC as identified on the attached Facility Key Plan. The wastes to be incinerated will be wastes generated during research and development activities at the Glaxo facility.

To help us meet the regulatory requirements, please provide a description of the facility's proximity to and potential impact on any mines in the area. Please provide this information no later than February 1, 1989. Your assistance will be greatly appreciated.

If you have any questions, please call me at 919-881-0777.

Very truly yours,

SIRRINE ENVIRONMENTAL CONSULTANTS

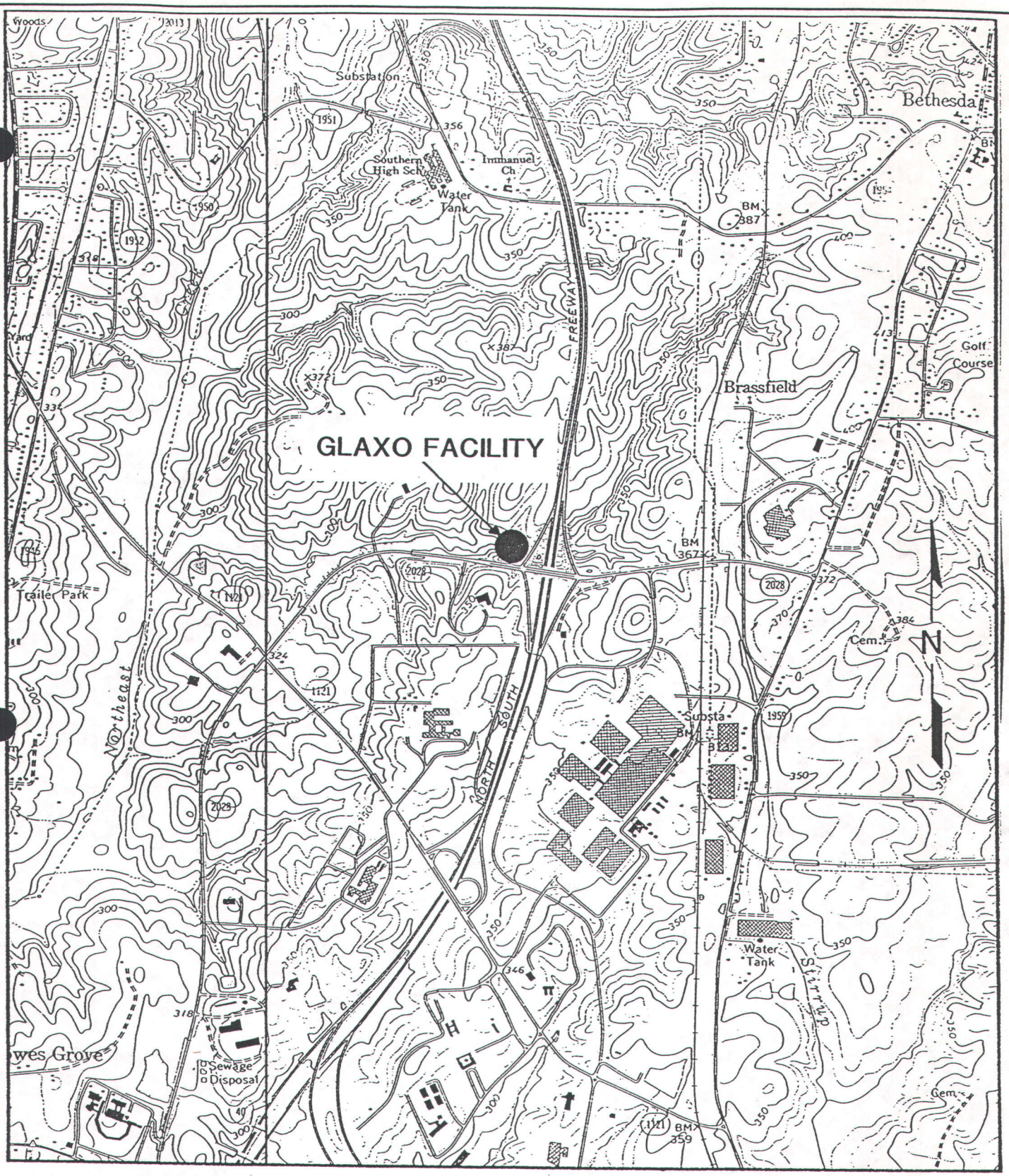
Robert W. Midgette

Robert W. Midgette

RWM:mal

Attachment

cc: Mr. Robert G. Wojtas, w/att
Mr. Calvin W. Overcash, w/att
Project File, w/att



REFERENCE :USGS SW , SE DURHAM QUADRANGLES

SCALE 1:24,000

SIRRINE ENVIRONMENTAL CONSULTANTS

Raleigh, North Carolina

FACILITY KEY PLAN

GLAXO INC.,

RESEARCH TRIANGLE PARK , N.C.

DRAWING NO. R-8279-01

DUNCAN-PARNELL, INC., CHARLOTTE 366 800-432-6022

RECEIVED
JAN 6 1989
SIRRINE ENVIRONMENTAL CONSULTANTS

State of North Carolina
Department of Natural Resources and Community Development
Division of Land Resources
512 North Salisbury Street • Raleigh, North Carolina 27611

James G. Martin, Governor
S. Thomas Rhodes, Secretary

Stephen G. Conrad
Director

January 3, 1989

Mr. Robert W. Midgette
Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, NC 27612

RE: Request for Information
SEC Project No. R-8279

Dear Mr. Midgette:

Your letter of December 28, 1988 to Mr. Charles Gardner has been referred to me for action. From review of our files it appears that there are three (3) permitted mining operations within a five (5) mile radius of the above referenced project site. The numbers on the attached map correspond to the following mining operations:

No. 2	Triangle Brick Co. 6523 Apex Road Durham, NC 27713 (919) 544-1796	Durham Mine
No. 3	Borden Brick & Tile Co. P. O. Box 11558 Durham, NC 27703 (919) 596-8241	Stone Road Mine
No. 4	Borden Brick & Tile Co. (as above)	Cook Mine

All three are relatively shallow, clay mining operations. I do not envision that your proposed incinerator would have an adverse impact on these three operations but I strongly suggest that you contact each operator to confirm this.

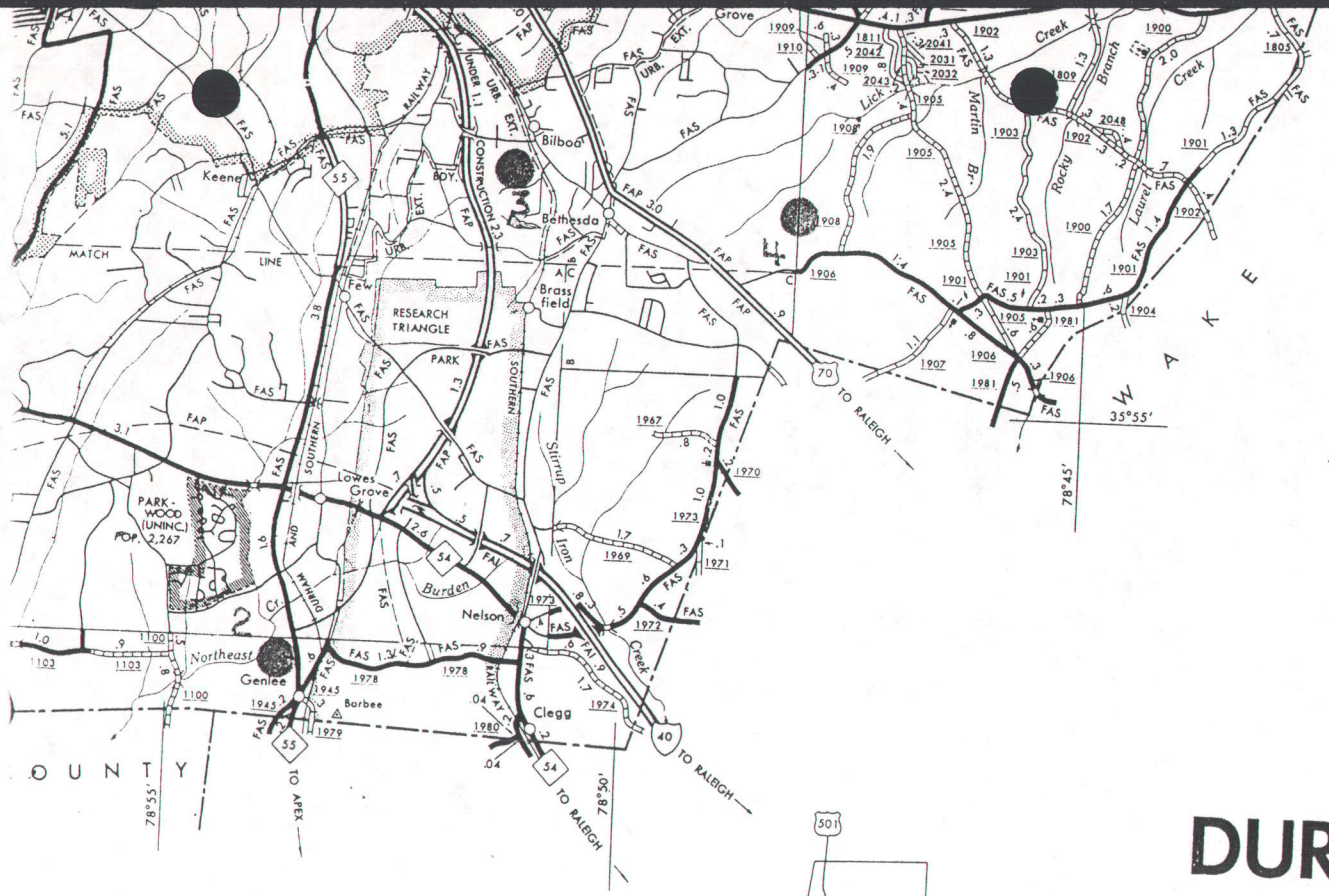
Should you need additional information please advise at (919) 733-4574.

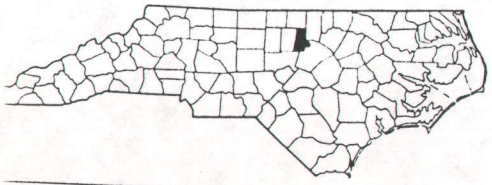
Sincerely,

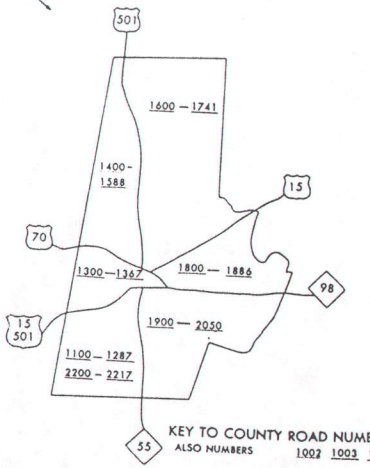
Thomas E. Carroll, P.G.
Mining Specialist
Land Quality Section

TEC:se

Attachment







KEY TO COUNTY ROAD NUMBERS
ALSO NUMBERS 1002 1003 1004

NOTE: MAP INCLUDES ONLY STATE MAINTAINED ROADS OR IMPORTANT NON-SYSTEM ROADS. MILEAGE NOT SHOWN ON FRONTAGE ROADS. ROADS SHOWN AS OF JAN. 1, 1972.

DURHAM COUNTY

NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA STATE HIGHWAY COMMISSION
PLANNING AND RESEARCH DEPARTMENT
IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

1 0 1 2 3 4 MILES
0 0.5 MILE
SCALE FOR ENLARGEMENTS

POLYCONIC PROJECTION

SHEET 1 OF 2

MAINTENANCE MAP DURHAM COUNTY NORTH CAROL

SIRRINE
ENVIRONMENTAL
CONSULTANTS

3733 National Drive
Suite 120
Raleigh, North Carolina 27612
(919) 881-0777

November 2, 1989

North Carolina Department of Transportation
Division of Highways
P.O. Box 15580
Durham, NC 27704

ATTENTION: Mr. Butch Ferguson
Fleet Safety Coordinator

SUBJECT: Glaxo Inc.
Research Triangle Park, North Carolina
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Ferguson:

Glaxo Inc. in Research Triangle Park, North Carolina is currently applying for a Resource Conservation and Recovery Act (RCRA) permit. Rule .0034(b)(13) of the North Carolina Hazardous Waste Management Rules requires that Glaxo provide "the comments of the local community and state transportation authority on the proposed route and route safety" which will be used for waste transportation. It is our understanding, based on conversations with representatives of the Durham County Managers Office, that your office is the only transportation authority for Durham County.

Attached is a written description of the facility (Section B of the RCRA permit application) which includes a key plan showing the facility's location, access points to the facility, traffic patterns, and the estimated volume of traffic.

The hazardous wastes to be transported include waste solvents and discarded commercial chemical products which are listed or characteristic hazardous wastes as defined in 40 CFR 261.

To assist us in meeting regulatory requirements and deadlines, please review the enclosed information and provide your comments on the proposed traffic routes by November 16, 1989. Your assistance is greatly appreciated.

If you have any questions, please call me.

Sincerely,

SIRRINE ENVIRONMENTAL CONSULTANTS

Robert W Midgette

Robert W. Midgette

RWM/cc

Enclosure

cc: Mr. Robert Wojtas
Mr. Calvin Overcash
Mr. Terry Bradham
Project File

STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

P. O. Box 15580
Durham, North Carolina 27704

JAMES G. MARTIN
GOVERNOR

JAMES E. HARRINGTON
SECRETARY

November 9, 1989

DIVISION OF HIGHWAYS

GEORGE E. WELLS, P.E.
STATE HIGHWAY ADMINISTRATOR

Sirrine Environmental Consultants
3733 National Drive
Suite 120
Raleigh, N. C. 27612

Attention: Mr. Robert W. Midgette
Project Engineer

RECEIVED
NOV 13 1989
SIRRINE ENVIRONMENTAL
CONSULTANTS

Subject: Glaxo, Inc.
Research Triangle Park
RCRA Permit Application
SEC Project No. R-8279

Dear Mr. Midgette:

After reviewing the proposed waste transportation routes to and from Glaxo, Inc., the Department of Transportation concurs that the routes proposed are acceptable, provided that all Federal and DOT Rules and Regulations for transporting hazardous waste are adhered to and that all transporting vehicles meet DOT and Federal Motor Carriers Safety Regulations.

However, in the event there is a change in the Regulations For Transporting Hazardous Waste, Glaxo may be required to submit a new proposal.

If we can be of further assistance please advise.

Sincerely,

C. W. Ferguson, Jr.

C. W. Ferguson, Jr.
Fleet Safety Coordinator
Division Five

CWF:ad

5. TEST BORING RECORDS

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.
0.0	Brown-Gray Fine Sandy Silty Clay (Topsoil)	347.0		2-2-3
0.5	Soft to Very Stiff Orange-Tan Very Sandy Clay to Fine Sandy Silt			
4.0	Soft Weathered Rock Sampled as Brown Sli. Fine Sandy Silt	342.0		24-50/0.4'
		337.0		50/0.5'
15.5	Rock Coring Hard Tan Sandstone with occ. Thin Clay Layers REC. = 96.7% RQD = 70.8%	332.0		50/0.3'
20.5	Rock Coring Terminated Grid Coordinates: 350N 650W	327.0		
		322.0		

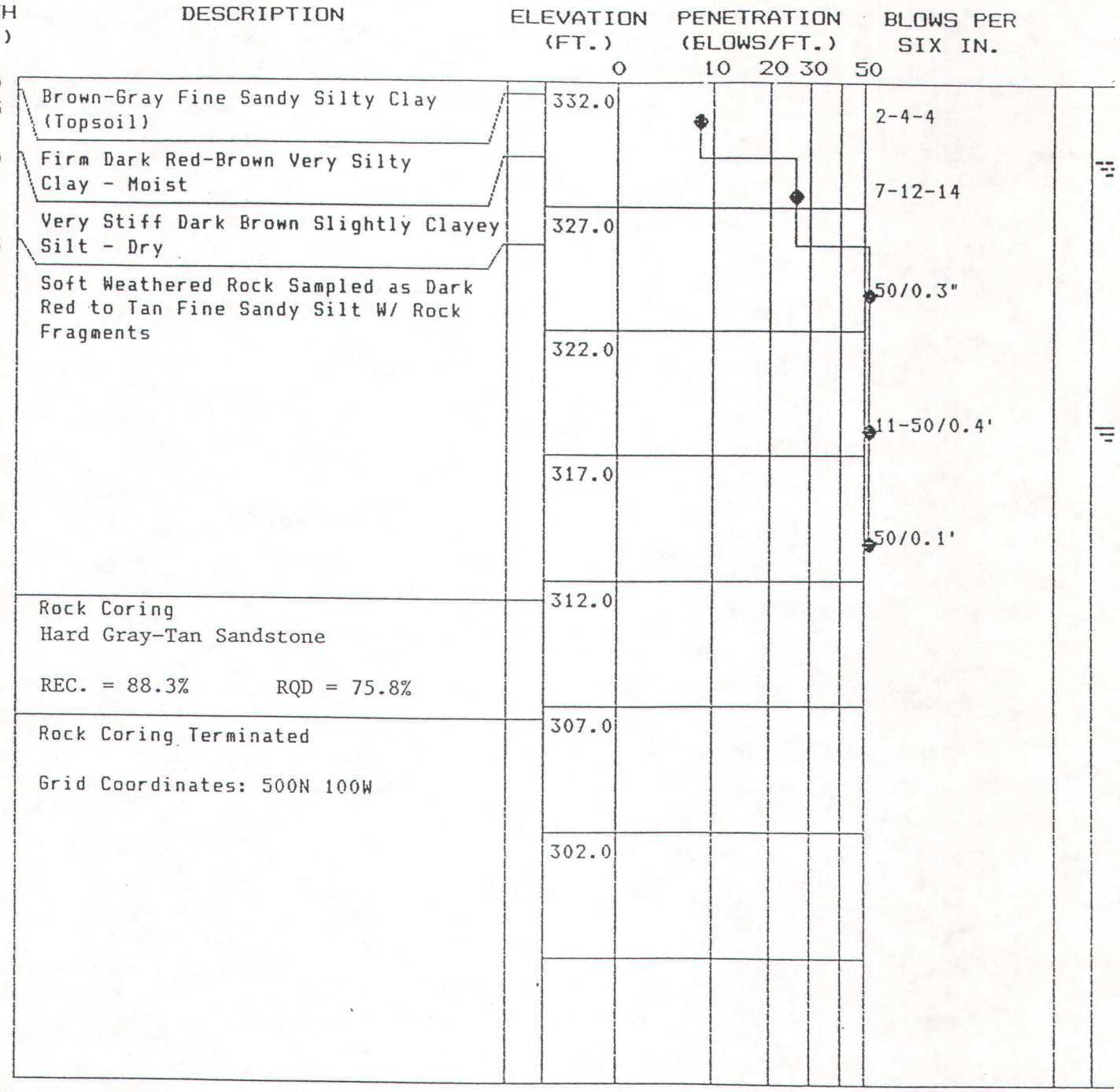
REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 051-87-158
BORING NUMBER TB-3
DATE 4/01/87

PAGE 1 OF 1

SOIL & MATERIAL ENGINEERS, INC.

TEST BORING RECORD



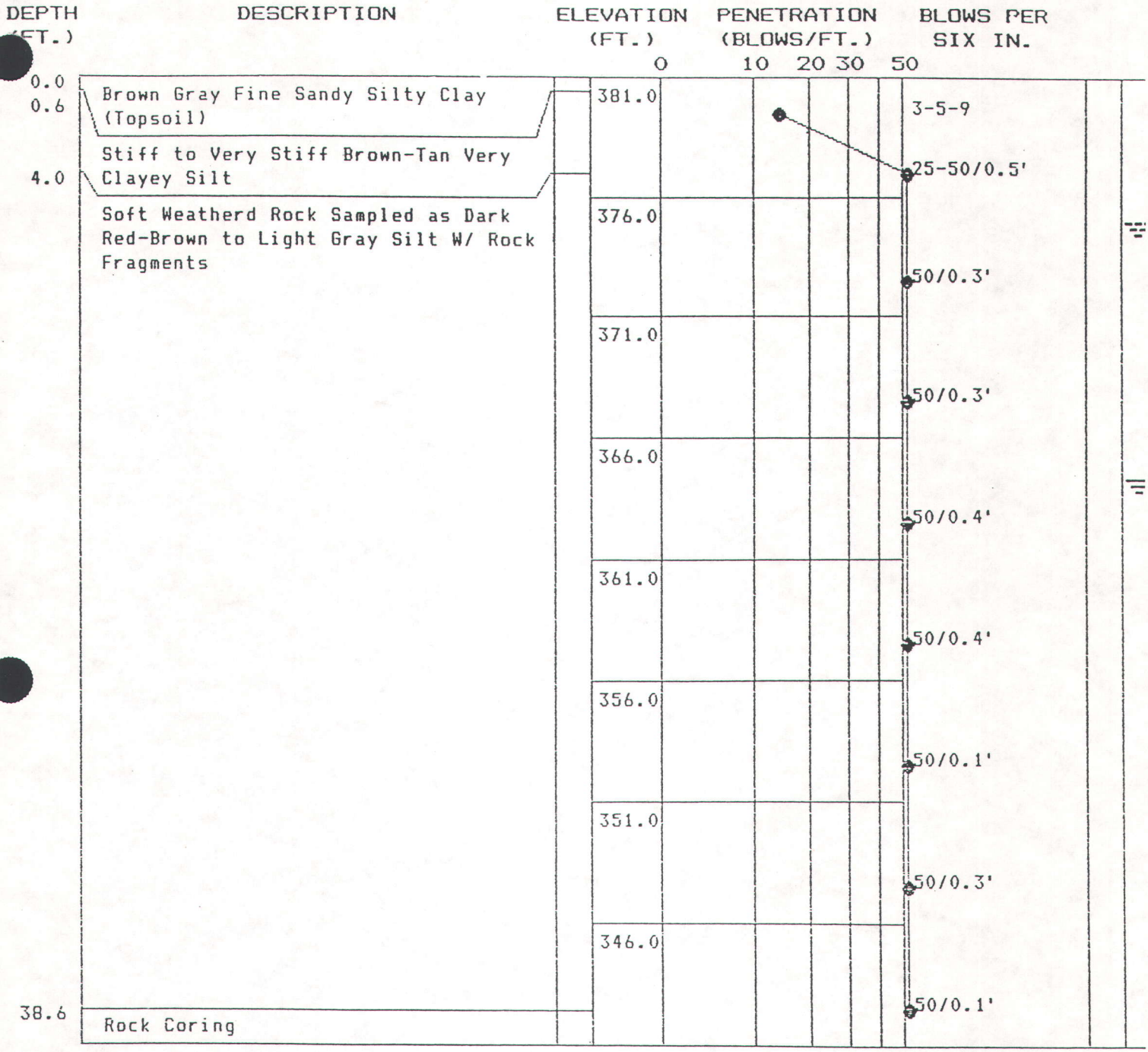
REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 051-87-158
BORING NUMBER TB-16
DATE 4/03/87

PAGE 1 OF 1

SOIL & MATERIAL ENGINEERS, INC.

TEST BORING RECORD

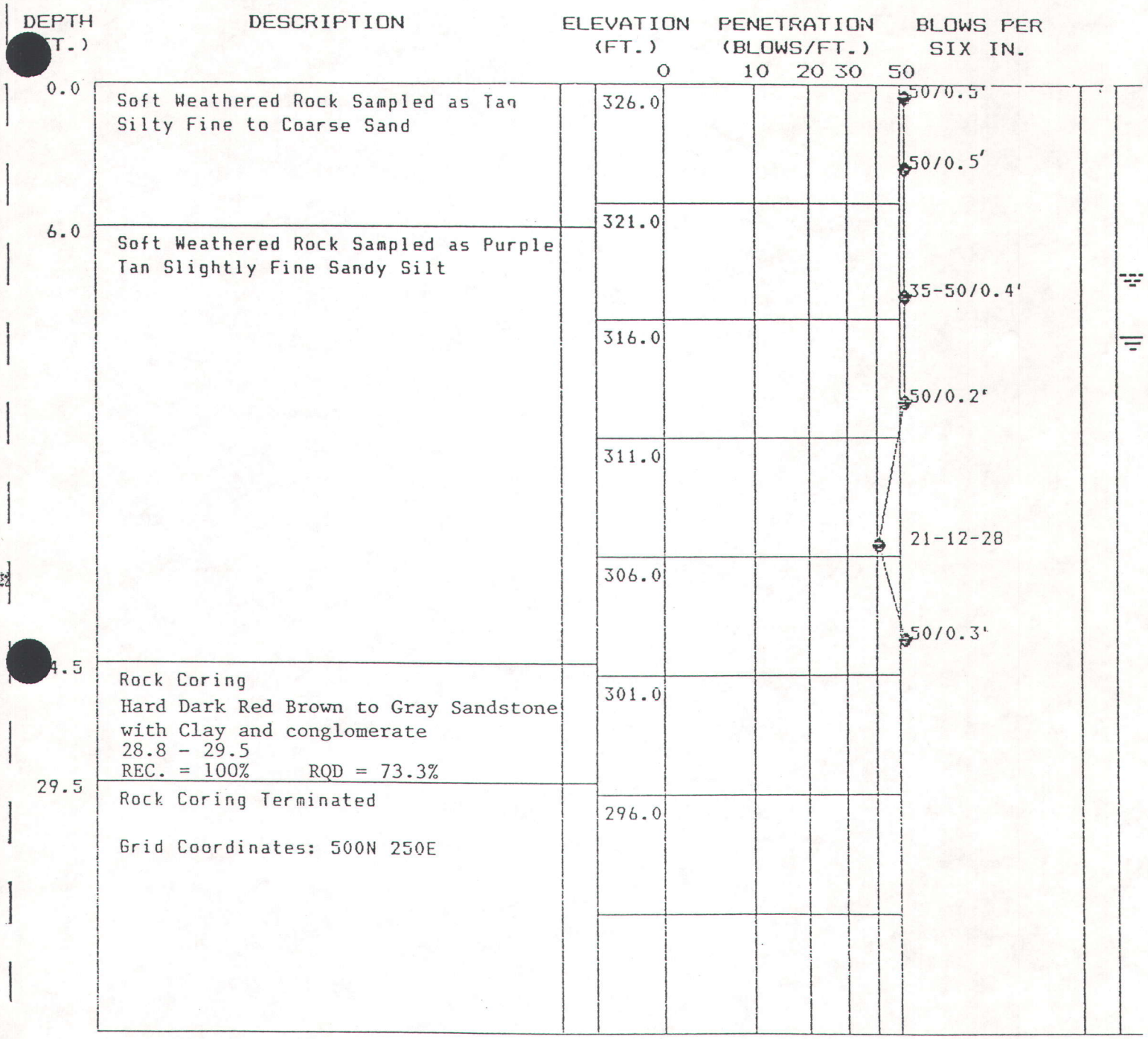


REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 051-87-158
BORING NUMBER TB-17
DATE 4/01/87

SOIL & MATERIAL ENGINEERS, INC.

TEST BORING RECORD



REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 051-87-158
BORING NUMBER TB-26
DATE 4/06/87

SOIL & MATERIAL ENGINEERS, INC.

TEST BORING RECORD

DEPTH (FT.)	DESCRIPTION	ELEVATION (FT.)	PENETRATION (BLOWS/FT.) 0 10 20 30 50	BLOWS PER SIX IN.
		296.0		
43.5				50/0.2"
44.5	Clean Out			
	Rock Coring Medium Hard Dark Red-Brown Sandy Siltstone REC. = 100% RQD = 70.8%	291.0		
49.5	Rock Coring Terminated	286.0		
	No Groundwater Encountered at TOB No Groundwater Encountered at 24-Hour Grid Coordinates: 50N 300E			

REFER TO ATTACHED SHEET FOR EXPLANATIONS AND SYMBOLS

JOB NUMBER 051-87-158
BORING NUMBER TB-29
DATE 4/03/87

SOIL & MATERIAL ENGINEERS, INC.

6. PUBLIC MEETING DATA

Glaxo

Glaxo Inc.

November 13, 1989

Ms. Ann Green
Durham Herald-Sun Newspapers
ATTN: Newsroom
P.O. Box 2092
Durham, NC 27702

Dear Ms. Green:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

To satisfy the requirements of the State of North Carolina related to the permitting process, we must provide 30 days notice prior to the public meetings to be held as described in the attached notice. We request publication of this information on November 15, 1989.

Sincerely,

Stephen R. Conafay
Sr. V.P., Corporate Affairs

Five Moore Drive, P.O. Box 13358 Research Triangle Park, NC 27709 • Telex 802813 • Telephone (919) 248-2100

NOTICE OF PUBLIC MEETING ON

REQUEST FOR HAZARDOUS WASTE PERMIT

Glaxo Inc., a company engaged in the research and development of prescription drug products and headquartered in Research Triangle Park, North Carolina, will conduct a public meeting on December 15, 1989, at 7 p.m. in the Dreyfus Auditorium at Research Triangle Institute, 3040 Cornwallis Road, Research Triangle Park, North Carolina.

Glaxo Inc. intends to request a Resource Conservation and Recovery Act ("RCRA") permit for the storage and incineration of hazardous waste. The purpose of this meeting is to inform the public of hazardous waste management activities to be conducted at the site, including, but not limited to, the types, quantities, and sources of the wastes to be stored and incinerated.

A follow-up meeting will be held on January 24, 1990 at the same time and location to present answers to questions and issues raised at the December 15 meeting.

Glaxo

Glaxo Inc.

November 13, 1989

Mr. Scott Picken
WPTF-TV
P.O. Box 29521
Raleigh, NC 27626

Dear Mr. Picken:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

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Glaxo

Glaxo Inc.

November 13, 1989

WDNC Radio
P.O. Box 2126
Durham, NC 27702

ATTN: PSA

To Whom It May Concern:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

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Glaxo

Glaxo Inc.

November 14, 1989

Mr. Earl D. Thompson, Chairman
Chatham County Board of Commissioners
P.O. Box 87
Pittsboro, NC 27312

Dear Mr. Thompson:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

To satisfy the requirements of the State of North Carolina related to the permitting process, we have enclosed a copy of the notice of the public meeting on our permit request.

If you have any questions, please call me at 248-2100.

Sincerely,

Stephen R. Conafay
Sr. V.P., Corporate Affairs

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Glaxo

Glaxo Inc.

November 14, 1989

Mr. Moses Carey, Chairman
Orange County Board of Commissioners
106 E. Margaret Lane
Hillsborough, NC 27278

Dear Mr. Carey:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

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If you have any questions, please call me at 248-2100.

Sincerely,

Stephen R. Conafay
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Glaxo

Glaxo Inc.

November 14, 1989

Mr. Michael S. Wilkins, Chairman
Person County Board of Commissioners
Courthouse
Roxboro, NC 27573

Dear Mr. Wilkins:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

To satisfy the requirements of the State of North Carolina related to the permitting process, we have enclosed a copy of the notice of the public meeting on our permit request.

If you have any questions, please call me at 248-2100.

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Glaxo

Glaxo Inc.

November 14, 1989

Mr. Edmund Aycock, Chairman
Wake County Board of Commissioners
P.O. Box 550
Raleigh, NC 27602

Dear Mr. Aycock:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

To satisfy the requirements of the State of North Carolina related to the permitting process, we have enclosed a copy of the notice of the public meeting on our permit request.

If you have any questions, please call me at 248-2100.

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Glaxo

Glaxo Inc.

November 14, 1989

Mr. William Bell, Chairman
Durham County Board of Commissioners
6th Floor
Durham County Judicial Building
201 E. Main Street
Durham, NC 27701

Dear Bill:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

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Glaxo

Glaxo Inc.

November 14, 1989

Mr. J. David Brooke, Chairman
Granville County Board of Commissioners
P.O. Box 906
Oxford, NC 27565

Dear Mr. Brooke:

As part of its research and development complex in Research Triangle Park, Glaxo Inc. is seeking a permit that will allow us to build a hazardous waste incinerator.

To satisfy the requirements of the State of North Carolina related to the permitting process, we have enclosed a copy of the notice of the public meeting on our permit request.

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H & S: November 15, 1989

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N&O/TIMES: November 15, 1989.

7. GROUNDWATER VELOCITY CALCULATION

ESTIMATE OF AVERAGE LINEAR GROUNDWATER VELOCITY AT GLAXO

Based on field observations of grain size
and water level measurements, it is estimated that:

Hydraulic Conductivity (K) = 10^{-5}cm/s or .00864 m/day
Hydraulic Gradient (dh/dl) = -0.05 m/m
Effective Porosity (n) = 35 percent

For average linear velocity (v):

$$v = - K(dh/dl)/n$$
$$= (-.00864 \text{ m/day})(-0.05)/.35$$
$$= 0.00123 \text{ m/day} \quad \text{or} \quad 1.23 \times 10^{-3} \text{ m/day}$$

8. GROUNDWATER MONITORING INSTALLATION DETAIL

SIRRINE
ENVIRONMENTAL
CONSULTANTS

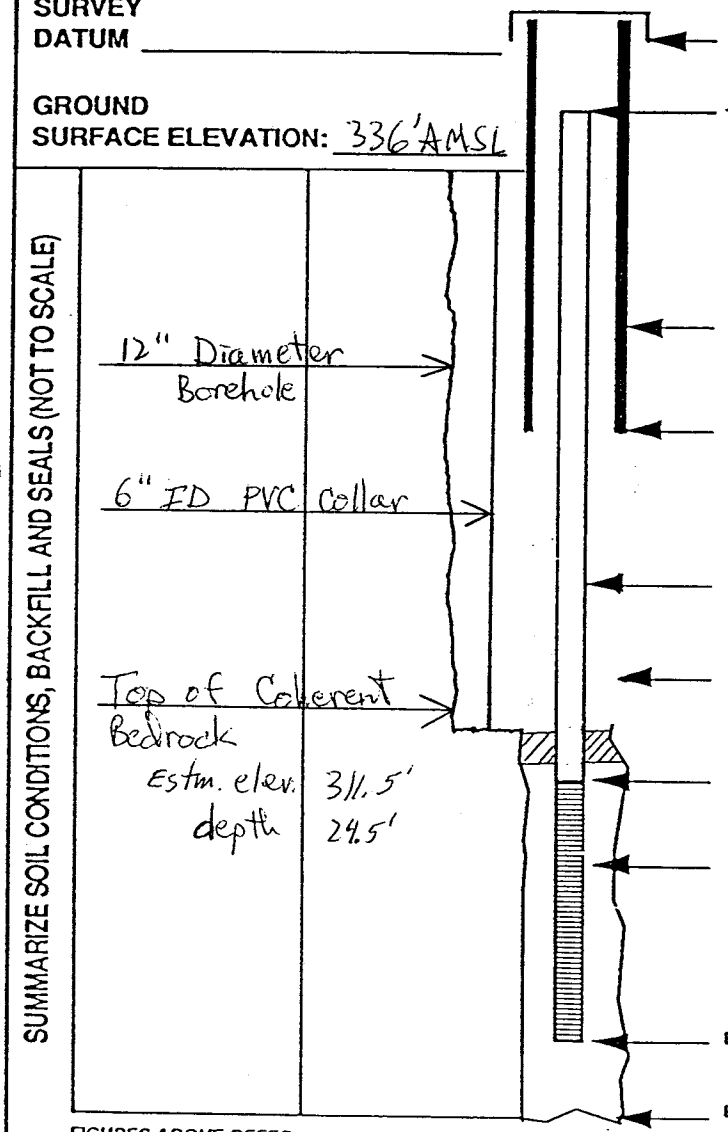
GROUND WATER MONITORING INSTALLATION DETAIL

PROJECT: RCRA Permit - NC Siting Requirement
LOCATION: Research Triangle Park
CLIENT:
CONTRACTOR:
DRILLER: CERTIFICATION NO:
SEC FIELD REPRESENTATIVE:

JOB NO R-8279-10-1
INSTALLATION NO A
TYPE OF INSTALLATION
BORING NO. A
LOCATION Downgradient
INSTALLATION DATE

SURVEY DATUM

GROUND SURFACE ELEVATION: 336' AMSL



TOP OF PROTECTIVE CASING (CAP OPEN) EL 338.5 STICKUP 2.5'
TOP OF WELL CASING OR RISER PIPE EL 338 STICKUP 2.0'
TYPE OF SURFACE SEAL: Cement Grout
THICKNESS OF SURFACE SEAL: 20'
TYPE OF PROTECTIVE CASING: Sch 40 Steel
INSIDE DIAMETER: 4.0"
TOTAL LENGTH: 40'
BOTTOM OF PROTECTIVE CASING EL 334.5' DEPTH 1.5'
TYPE OF WELL CASING OR RISER PIPE: Sch 40 PVC
INSIDE DIAMETER: 2.067"
APPROXIMATE DIAMETER OF BOREHOLE: 4.8"
TOP OF WELL POINT EL 306.5 DEPTH 28'
TYPE OF WELLPOINT: PVC
SCREEN GAUGE OR SIZE OF OPENINGS: 10-slot
INSIDE DIAMETER: 1.875"
TYPE OF BACKFILL AROUND POINT: Clean Sand
BOTTOM OF WELL POINT EL 296.5 DEPTH 38'
BOTTOM OF BOREHOLE EL 295.5 DEPTH 39'

- FIGURES ABOVE REFER TO DEPTH IN FEET
- ALL DEPTHS ARE REFERENCED TO GROUND SURFACE

30'	+	10'	=	40'
LENGTH OF RISER PIPE		LENGTH OF POINT		TOTAL

BENTONITE SEALS

SIRRINE
ENVIRONMENTAL
CONSULTANTS

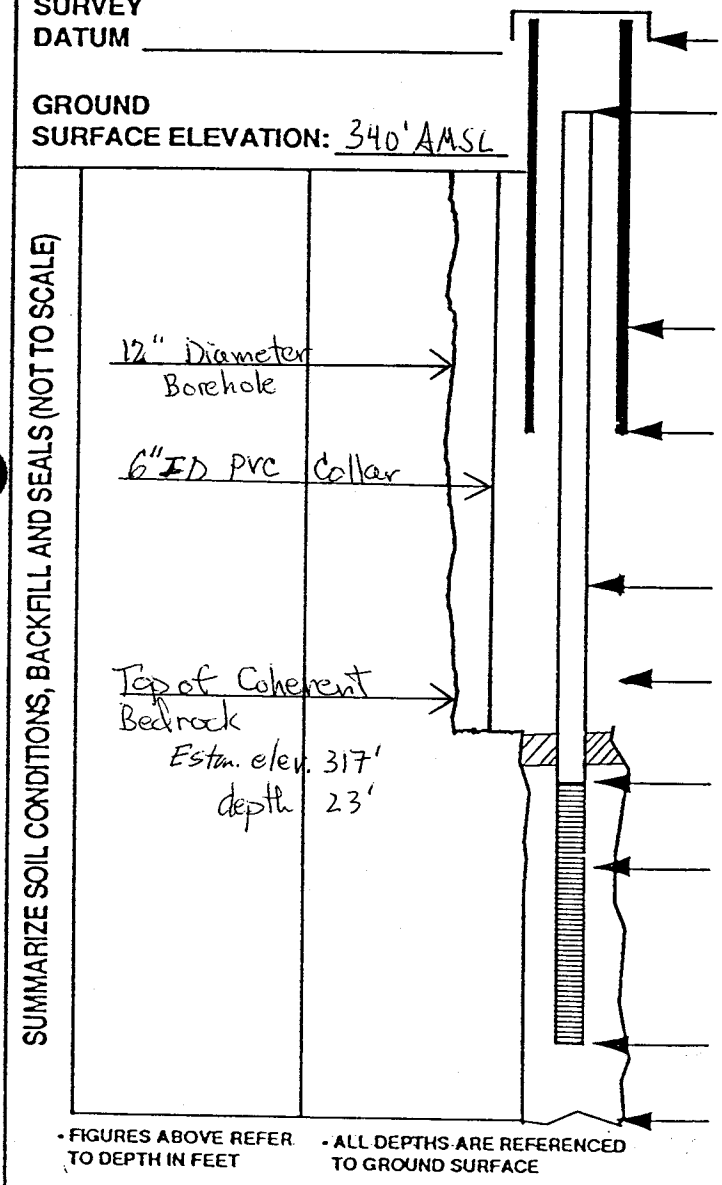
GROUND WATER MONITORING INSTALLATION DETAIL

PROJECT: RCRA Permit - NC Siting Requirement
LOCATION: Research Triangle Park
CLIENT:
CONTRACTOR:
DRILLER: CERTIFICATION NO:
SEC FIELD REPRESENTATIVE:

JOB NO R-8279-10-1
INSTALLATION NO B
TYPE OF INSTALLATION
BORING NO. B
LOCATION Down gradient
INSTALLATION DATE

SURVEY DATUM

GROUND SURFACE ELEVATION: 340' AMSL



SUMMARIZE SOIL CONDITIONS, BACKFILL AND SEALS (NOT TO SCALE)

TOP OF PROTECTIVE CASING (CAP OPEN)
EL. 342.5 STICKUP 2.5'

TOP OF WELL CASING OR RISER PIPE
EL. 342 STICKUP 2.0'

TYPE OF SURFACE SEAL: Cement Grout
THICKNESS OF SURFACE SEAL: 25'

TYPE OF PROTECTIVE CASING: Sch 40 Steel
INSIDE DIAMETER: 4.0"
TOTAL LENGTH: 4.0'

BOTTOM OF PROTECTIVE CASING
EL. 338.5 DEPTH 1.5'

TYPE OF WELL CASING OR RISER PIPE: Sch 40 PVC
INSIDE DIAMETER: 2.067"

APPROXIMATE DIAMETER OF BOREHOLE: 4.8"

TOP OF WELL POINT
EL. 304 DEPTH 36'

TYPE OF WELLPOINT: PVC
SCREEN GAUGE OR SIZE OF OPENINGS: 10-Slot
INSIDE DIAMETER: 1.875"
TYPE OF BACKFILL AROUND POINT: Clean Sand

BOTTOM OF WELL POINT
EL. 294 DEPTH 46'

BOTTOM OF BOREHOLE
EL. 293' DEPTH 47'

- FIGURES ABOVE REFER TO DEPTH IN FEET
- ALL DEPTHS ARE REFERENCED TO GROUND SURFACE

38'	+	10'	=	48'
LENGTH OF RISER PIPE		LENGTH OF POINT		TOTAL

BENTONITE SEALS

CRRINE
NVIRONMENTAL
ONSULTANTS

OK

GROUNDWATER MONITORING INSTALLATION DETAIL

PROJECT: RCRA PERMIT - NO SITING REQUIREMENT
JOB NO. R-8279-10-1

LOCATION: RESEARCH TRIANGLE PARK
INSTALLATION NO. C

CLIENT:
TYPE OF INSTALLATION

CONTRACTOR:

DRILLER: CERTIFICATION NO:
BORING NO. C

CRSS FIELD REPRESENTATIVE:
LOCATION UPGRADIENT - WEST

P.E.:
INSTALLATION DATE

SURVEY DATUM

GROUND SURFACE ELEVATION: 371' AMSL

SUMMARIZE SOIL CONDITIONS, BACKFILL AND SEALS (NOT TO SCALE)

12" BOREHOLE DIAMETER

SDR 21 PVC 6" COLLAR INSIDE DIAMETER

TOP OF COHERENT BEDROCK
ESTM-DEPTH 40'
ELEV. 331'

TOP OF PROTECTIVE CASING
EL. 373.5 STICKUP 2.5'

TOP OF WELL CASING OR RISER PIPE
EL. 373 STICKUP 2.0'

TYPE OF SURFACE SEAL: CEMENT GROUT
THICKNESS OF SURFACE SEAL: 58'

TYPE OF PROTECTIVE CASING: SCH 40 STEEL
INSIDE DIAMETER: 4.0"
TOTAL LENGTH: 4.0'

BOTTOM OF PROTECTIVE CASING
EL. 369.5 DEPTH 1.5'

TYPE OF WELL CASING OR RISER PIPE: SCH 40 PVC
INSIDE DIAMETER: 2.067"

APPROXIMATE DIAMETER OF BOREHOLE

TOP OF WELLPOINT
EL. 318 DEPTH 53

TYPE OF WELLPOINT: PVC
SCREEN GAUGE OR SIZE OF OPENINGS: 10-SLOT
INSIDE DIAMETER: 1.875"
TYPE OF BACKFILL AROUND POINT: CLEAN SAND

BOTTOM OF WELL POINT
EL. 308 DEPTH 63

BOTTOM OF BOREHOLE
EL. 307 DEPTH 64

- FIGURES ABOVE REFER TO DEPTH IN FEET
- ALL DEPTHS ARE REFERENCED TO GROUND SURFACE

55	+	10	=	65
LENGTH OF RISER PIPE		LENGTH OF POINT		TOTAL

BENTONITE SEALS

CRSS FORM 106 9-2-86

9. DEMONSTRATION OF SUBSTANTIAL COMPLIANCE PER 10 NCAC 10F .0034 (h)

State of North Carolina

County of Wake

I, Thomas W. D'Alonzo, President of Glaxo Inc., a North Carolina Corporation, do hereby affirm that to the best of my knowledge and belief, the information provided hereunder in accordance with 10 NCAC 10F .0034(h), regarding the permitting requirements concerning operating records of other facilities, is complete, true and accurate.

Signed Thomas W. D'Alonzo

Subscribed and sworn to before me this 24th day of August, 1990.

Vicki R Everhart

Notary Public in and for
the State of
North Carolina

10/22/94
Com. Exp.

North Carolina Hazardous Waste Section
Compliance History for
Applicant and In-State Parent and Subsidiary Corporations

Applicant Name: Glaxo Inc.
Facility Name: RTP
EPA ID Number: See attached page
Location: 5 Moore Drive
Research Triangle Park, NC 27709

Environmental Program: Hazardous Waste
If permitted, Permit Type and Number: Not Permitted
(Relevant environmental federal and state permits/licenses)

Use a separate sheet for each facility and each type of permit.

Date of Violation	Description of Violation - Include violation class (ie, Class I, II or III)	Amount of Penalty Assessed	Amount of Penalty Paid	Court Docket Number

Total Number of Inspections: 0
Total Number of Violations: 0

Total Amount of Penalties Assessed: 0
Total Amount of Penalties Paid: 0

Has this facility ever been denied an environmental permit? If yes, explain. No

Is there a pending enforcement action against this facility that is not descibed above? No

The following is listing of EPA ID numbers assigned to Glaxo Inc. facilities in Research Triangle Park.

EPA ID#	LOCATION	STATUS
NCD065655599	5 Moore Drive	Small Quantity
NCD981920762	Imperial Center	Small Quantity
NCD982094997	Quadrangle	Small Quantity
NCD982117384	Swabia Court	Generator

North Carolina Hazardous Waste Section
Compliance History for
Applicant and In-State Parent and Subsidiary Corporations

Applicant Name: Glaxo Inc.
Facility Name: Zebulon, NC
EPA ID Number: NCD 101 740 215
Location: P. O. Box 1217
Zebulon, NC 27597

Environmental Program: Hazardous Waste Generator
If permitted, Permit Type and Number: Not permitted
(Relevant environmental federal and state permits/licenses)

Use a separate sheet for each facility and each type of permit.

Date of Violation	Description of Violation - Include violation class (ie, Class I, II or III)	Amount of Penalty Assessed	Amount of Penalty Paid	Court Docket Number
6/26/89	Inoperative overfill warning device (class II)	0	0	- - -
6/26/89	No hazardous waste label on container (class II)	0	0	- - -
6/26/89	Need for revision to contingency plan (class II)	0	0	- - -
7/18/90	Certification/demonstration were not submitted for "soft hammer waste" (class II)	0	0	- - -

Total Number of Inspections: 7
Total Number of Violations: 4

Total Amount of Penalties Assessed: 0
Total Amount of Penalties Paid: 0

Has this facility ever been denied an environmental permit? If yes, explain. No

Is there a pending enforcement action against this facility that is not descibed above?
No

OFFICERS OF GLAXO INC.
As of March 21, 1990

Ernest Mario	-	Chairman
Charles A. Sanders	-	Chief Executive Officer
Thomas W. D'Alonzo	-	President and Chief Operating Officer
Robert A. Ingram	-	Executive Vice President Administrative and Regulatory Affairs
Alan A. Steigrod	-	Executive Vice President Sales and Marketing
Thomas R. Haber	-	Senior Vice President Finance and Administration
Peter J. Wise	-	Senior Vice President Medical Marketing
Clifford H. Disbrow	-	Senior Vice President Technical Operations
Stephen Conafay	-	Senior Vice President Corporate Affairs
Fred Eshelman	-	Senior Vice President Development
Santo J. Costa	-	Vice President, General Counsel and Secretary
Michael A. Gallucci, Jr.		Vice President and Treasurer
James R. Butler	-	Vice President and General Manager, Glaxo Pharmaceuticals
Richard A. Franco	-	Vice President Commercial Development
Robert H. Zeiger	-	Vice President and General Manager, Allen & Hanburys
Ronald J. McCord	-	Vice President Human Resources
David M. Winer	-	Assistant Secretary
Salvatore R. Conte	-	Assistant Secretary
Gary Freedman	-	Assistant Secretary

BOARD OF DIRECTORS OF GLAXO INC.
(as of September 28, 1989)

Ernest Mario, Chairman
Charles A. Sanders, Chief Executive Officer
Joseph J. Ruvane, Jr., Vice Chairman
Thomas W. D'Alonzo
Alan A. Steigrod
Thomas R. Haber
Peter J. Wise
Fred Eshelman
Stephen Conafay
Clifford Disbrow

Santo J. Costa, Secretary

(delete Eshelman as of May 1, 1990)
(add Ingram as of June 7, 1990)

GLAXO CARIBBEAN INC.

DIRECTORS

Arthur M. Pappas, Chairman
Javier Alvarez
Santo J. Costa
David MacLennan
Peter F. Young

Timothy J. Williams, Secretary

OFFICERS

Arthur M. Pappas	- Chairman and Chief Executive Officer
Peter F. Young	- President
Santo J. Costa	- Vice President and Assistant Secretary
Timothy J. Williams	- Secretary
Javier Alvarez	- Treasurer
David MacLennan	- General Manager

GLAXO SPECIALTIES INC.

Directors

Charles Sanders, Chairman
Thomas W. D'Alonzo
Thomas R. Haber

Officers

Charles Sanders - President
Thomas W. D'Alonzo - Vice President
Santo J. Costa - Secretary
Thomas R. Haber - Treasurer
Michael A. Gallucci - Asst. Treasurer
Timothy J. Williams - Asst. Secretary

GLAXO SUPPLY INC.

Directors

Charles Sanders, Chairman
Thomas W. D'Alonzo
Thomas R. Haber

Officers

Charles Sanders - President
Thomas W. D'Alonzo - Vice President
Santo J. Costa - Secretary
Thomas R. Haber - Treasurer
Michael A. Gallucci - Asst. Treasurer
Timothy J. Williams - Asst. Secretary

Rev. 1/18/90

GLAXO SERVICES INC.

Directors

Charles Sanders, Chairman
Thomas W. D'Alonzo
Thomas R. Haber

Officers

Charles Sanders - President
Thomas W. D'Alonzo - Vice President
Santo J. Costa - Secretary
Thomas R. Haber - Treasurer
Michael A. Gallucci - Asst. Treasurer
Timothy J. Williams - Asst. Secretary

Glaxo Holdings p.l.c.

Interim Report
Six months to 31st December 1989

Financial Year to 30th June 1990

Financial Facts

	Unaudited 6 months to 31.12.89 £m	Unaudited 6 months to 31.12.88 £m	Change %
Turnover	**1,472**	1,120	+31
Trading profit	**521**	421	+24
Investment income less interest payable	**64**	39	+64
Profit on ordinary activities before taxation	**585**	460	+27
Profit attributable to shareholders	**406**	317	+28
Research and development expenditure	**192**	132	+45
Capital expenditure	**248**	141	+76
Earnings per Ordinary Share	**27.2p**	21.4p	+27
Interim dividend per Ordinary Share	**7.0p**	5.0p	+40

Board of Directors

Chairman
Sir Paul Girolami

Chief Executive
Dr. E. Mario

Executive Directors
Dr. M. Fertonani
Mr. J. M. Hignett
Dr. F. B. Humer
Mr. H. Konishi
Dr. H. McCorquodale
Dr. C. A. Sanders
Dr. R. B. Sykes

Non-Executive Directors
Sir Ronald Arculus, K.C.M.G., K.C.V.O.
Sir John Cuckney
Sir Ralf Dahrendorf, K.B.E., F.B.A.
Mr. J. L. Ferguson
Mr. J. M. Raisman, C.B.E.

Registered Office

Clarges House, 6–12 Clarges Street,
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Telephone: 01-493 4060
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Cables: Glaxogroup, London W1

Transfer Office

National Westminster Bank PLC,
Registrar's Department,
P.O. Box 82,
Caxton House, Redcliffe Way,
Bristol BS99 7NH
Telephone: 0272-306600

Chairman's Statement

I am very pleased to report on another period of outstanding progress for your Group. In the six months covered by this Interim Report, sales reached £1,472 million, 31% higher than those in the same period last year, and trading profit increased by 24% to £521 million. Movements in exchange rates had a favourable effect and were this to be excluded then the figures would have been lower, with a growth in sales of 20% and in trading profit of 14%. Our net income from investments benefited from high interest rates, particularly in the United Kingdom, and amounted in the period to £64 million.

The trading profit and the net income from investments combine to produce a profit before tax of £585 million, an increase of 27% and the earnings per share at 27.2p show a similar increase. These results serve to confirm Glaxo's position as one of the world's leading pharmaceutical companies.

The Board announces an interim dividend of 7p per share, 40% higher than last year, and now offers shareholders the option of taking a scrip dividend instead of cash or, in the case of holders of American Depositary Receipts, a dividend re-investment plan, further details of which can be found on page 16. The dividend will be paid on the 8th of June (18th of June to holders of ADRs) to shareholders on the register on the 5th of April.

Once again, your management and staff throughout the world have produced an impressive trading performance through their efforts to realise the potential of our excellent products. Sales of Zantac, our anti-peptic ulcerant, grew by 35% compared with the same period last year, and this proven and safe product remains, justifiably, the world's best selling medicine. We maintained our world leadership in respiratory medicines with an increase in sales of 31%, and the vigorous growth of our latest oral antibiotic Zinnat, particularly in the United States and France, made a significant contribution to an outstanding increase of 44% in the sales of our systemic antibiotics.

Chairman's Statement *continued*

Turning to the markets in which we trade, Glaxo Inc., our company in the USA, maintained its extraordinary record of growth, and accounted for 41% of our total Group turnover during the six months. Our companies in France, Australia, the Netherlands, Belgium and Spain also did particularly well. In East Europe we have, for some years, been establishing a presence and recent events have found your Group well positioned to take advantage of opportunities there.

Looking beyond immediate trading activities to the years ahead, I am very glad to say that these last six months have witnessed excellent progress in the plans to bring our new generation of products to the market. Already this year we have received marketing approval in the United Kingdom, France and Belgium for Zofran, one of our new products used to prevent the nausea and vomiting which are associated with the chemotherapy and radiotherapy for cancer, and it is now on sale in the first two of these markets. Flixonase, a product used for the treatment of seasonal rhinitis, has also been approved for sale in the United Kingdom. We have, moreover, made our first marketing submissions for a new oral product for the treatment of hypertension, and in the course of 1990 we plan to make further submissions for at least four other important new medicines: one, a product which represents a breakthrough in the treatment of migraine; another, for the treatment of perennial rhinitis and two new products for the treatment of asthma.

We are therefore well on the way to realising the extremely ambitious programme that I outlined some years ago for bringing our several major discoveries to market. With Zofran we have bridged the gap between existing product growth and new product introduction; and it is a remarkable achievement that all these development activities, which are by their nature so uncertain in timing, are proceeding in accordance with that early programme.

During this six month period we spent £192 million on international research and development activities, and this amount is in line with our plans to spend a little over £400 million in the financial year as a whole. I am also glad to report continuing progress on the expansion of our research and development laboratories throughout the world. In particular, work on the new facilities in the United Kingdom is continuing satisfactorily; in the United States, a new complex covering over one million square feet is to be opened in October; in Italy, the new building is almost complete; and, in Japan, work has now started on the new centre at Tsukuba Science City.

We run a global business and, as such, our results are sensitive to the vagaries of foreign exchange rates. For this reason, if no other, we cannot be sure that the figures for this first half will be representative of those for the full financial year. Nevertheless, you will see from this brief report that your company is successfully implementing its policies for growth and, while growing, is laying the foundations for future expansion. Your management, therefore, faces the second half of this financial year, and the future, with confidence.

Sir Paul Girolami
Chairman
15th March 1990

Consolidated Profit and Loss Account

	Notes	Unaudited 6 months to 31.12.89 £m	Unaudited 6 months to 31.12.88 £m	Audited 12 months to 30.6.89 £m
TURNOVER	3/4	**1,472**	1,120	2,570
Operating costs less other income	5	**951**	699	1,694
TRADING PROFIT		**521**	421	876
Investment income less interest payable	6	**64**	39	130
PROFIT ON ORDINARY ACTIVITIES BEFORE TAXATION		**585**	460	1,006
Taxation	7	**175**	142	316
PROFIT ON ORDINARY ACTIVITIES AFTER TAXATION		**410**	318	690
Minority interests		**4**	1	2
PROFIT ATTRIBUTABLE TO SHAREHOLDERS		**406**	317	688
Dividends		**104**	74	260
PROFIT RETAINED		**302**	243	428
EARNINGS PER SHARE	8/9	**27.2p**	21.4p	46.2p
DIVIDENDS PER SHARE	9	**7.0p**	5.0p	17.5p

Consolidated Balance Sheet

	Notes	Unaudited as at 31.12.89 £m	Unaudited as at 31.12.88 £m	Audited as at 30.6.89 £m
FIXED ASSETS				
Tangible assets	10	**1,316**	910	1,124
Investments in associated companies		**63**	59	63
		1,379	969	1,187
CURRENT ASSETS				
Stocks		**359**	302	351
Debtors		**749**	610	637
Investments	11	**1,379**	1,162	1,256
Cash at bank	11	**21**	28	38
		2,508	2,102	2,282
CREDITORS:				
Amounts falling due within one year	11	**997**	883	863
NET CURRENT ASSETS		**1,511**	1,219	1,419
TOTAL ASSETS LESS CURRENT LIABILITIES		**2,890**	2,188	2,606
CREDITORS:				
Amounts falling due after more than one year	11	**132**	129	192
PROVISIONS FOR LIABILITIES AND CHARGES		**117**	82	101
		249	211	293
		2,641	1,977	2,313
CAPITAL AND RESERVES	12	**2,615**	1,958	2,291
Minority interests		**26**	19	22
		2,641	1,977	2,313

Consolidated Source and Application of Funds

	Unaudited 6 months to 31.12.89 £m	Unaudited 6 months to 31.12.88 £m	Audited 12 months to 30.6.89 £m
SOURCES			
Profit on ordinary activities before taxation	**585**	460	1,006
Depreciation	**56**	42	93
Increase in pension and other provisions	**10**	–	2
Share of profits of associated companies	**(11)**	(14)	(26)
	640	488	1,075
Exchange translation adjustments	**10**	(54)	18
Dividends from associated companies	**3**	3	9
Shares issued under share option scheme	**13**	–	38
	666	437	1,140
APPLICATIONS			
Tangible fixed assets:			
Purchases	**248**	141	373
Disposals	**(2)**	(3)	(9)
Investments in associated companies	**–**	1	4
Increase/(decrease) in working capital:			
Stocks	**8**	(8)	41
Debtors	**128**	75	117
Creditors	**(15)**	48	(53)
Tax paid	**145**	95	248
Dividends paid to ordinary shareholders	**186**	–	207
	698	349	928
(DECREASE)/INCREASE IN NET LIQUID FUNDS (note 11)	**(32)**	88	212

Notes on the Interim Report

For the six months to 31st December 1989

1 Subject to the restatement referred to in note 9 below, the Profit and Loss Account for the year ended, and the Balance Sheet at, 30th June 1989 are an abridged statement of the full Group accounts for that year which have been delivered to the Registrar of Companies and on which the auditors made an unqualified report.

2 Foreign currency assets, liabilities and results of overseas subsidiaries and associated companies have been converted into sterling at rates of exchange ruling on the last day of each period.

3 Geographical analysis of turnover:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
U.K.	**165**	152	305
Europe (excluding U.K.)	**471**	340	776
North America	**657**	480	1,163
Central and South America	**28**	22	38
Africa and Middle East	**27**	26	59
South East Asia and Far East	**79**	65	156
Australasia	**45**	35	73
	1,472	1,120	2,570

4 Therapeutic analysis of turnover:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Anti-ulcerants	**749**	556	1,291
Respiratory	**345**	264	585
Systemic antibiotics	**239**	166	396
Cardiovascular	**23**	21	46
Dermatologicals	**53**	46	101
Other	**63**	67	151
	1,472	1,120	2,570

Notes on the Interim Report *continued*

5 Operating costs include research and development expenditure:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Charge in the period	**192**	132	323

6 Investment income less interest payable:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Income from investments:			
Interest income	**84**	54	128
Realised (losses)/gains and market value provisions	**(3)**	(2)	28
	81	52	156
Interest payable	**17**	13	26
	64	39	130

7 Taxation on profits:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
United Kingdom	**70**	59	143
Overseas	**105**	83	173
	175	142	316
Attributable to:			
Holding company and subsidiaries	**168**	135	301
Associated companies	**7**	7	15

8 The earnings per share at 27.2p have been calculated by dividing the profit for the period attributable to shareholders of £406m by 1,492,613,551, the number of shares in issue at 31st December 1989.

9 Comparative figures for earnings per share and dividends per share have been adjusted to reflect the bonus issue on 23rd November 1989.

10 Tangible fixed assets:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Net book value at the beginning of the period	**1,124**	829	829
Capital expenditure	**248**	141	373
Depreciation	**(56)**	(42)	(93)
Exchange adjustments	**2**	(15)	24
Disposals	**(2)**	(3)	(9)
Net book value at the end of the period	**1,316**	910	1,124

11 Net liquid funds:

	As at 31.12.89 £m	As at 31.12.88 £m	As at 30.6.89 £m
Investments	**1,379**	1,162	1,256
Cash at bank	**21**	28	38
	1,400	1,190	1,294
Loans and overdrafts*	**308**	190	170
	1,092	1,000	1,124

*Included in creditors falling due within one year and creditors falling due after more than one year.

Notes on the Interim Report *continued*

12 Capital and reserves:

	6 months to 31.12.89 £m	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Balance at the beginning of the period	**2,291**	1,784	1,784
Exchange adjustments relating to net assets of subsidiary and associated companies:			
– tangible fixed assets (note 10)	**2**	(15)	24
– stocks and work in progress	**(3)**	(17)	2
– net liquid funds (note 11)	**3**	(47)	18
– other assets and liabilities	**7**	10	(3)
Shares issued under share option scheme:			
– nominal value	**1**	–	2
– share premium	**12**	–	36
Profit retained	**302**	243	428
Balance at the end of the period	**2,615**	1,958	2,291

Financial Calendar

Announcements

Preliminary announcement of full year results and final dividend: September 1990

Annual General Meeting: October 1990

Dividends and Interest

Ordinary Shares

Interim dividend payable: June 1990

Final dividend payable: November 1990

6¾% Unsecured Loan Stock of Glaxo Group Limited

Payable: 1st April 1990

1st October 1990

7¾% Unsecured Loan Stock of Glaxo Group Limited

Payable: 1st May 1990

1st November 1990

Reconciliation to U.S. Accounting Principles

The following is a summary of the estimated material adjustments to profit and ordinary shareholders' equity which would be required if U.S. Generally Accepted Accounting Principles (GAAP) had been applied instead of U.K. GAAP.

PROFIT AVAILABLE FOR APPROPRIATION	**6 months to 31.12.89 £m**	6 months to 31.12.88 £m	12 months to 30.6.89 £m
Net income under U.K. GAAP	**406**	317	688
U.S. GAAP adjustments:			
Foreign currency translation	**(4)**	3	(44)
Goodwill amortisation	**(2)**	(2)	(3)
Deferred taxation	**(23)**	(3)	(6)
Pensions charges (net of tax)	**–**	–	(1)
	(29)	(2)	(54)
Net income under U.S. GAAP	**377**	315	634
Income per Ordinary Share of 50p under U.S. GAAP	**25.3p**	21.3p	42.6p

ORDINARY SHAREHOLDERS' EQUITY	**As at 31.12.89 £m**	As at 31.12.88 £m	As at 30.6.89 £m
Ordinary shareholders' equity under U.K. GAAP	**2,615**	1,958	2,291
U.S. GAAP adjustments:			
Goodwill	**8**	11	10
Deferred taxation	**(149)**	(123)	(126)
Pensions charges	**4**	5	4
Proposed dividend	**104**	74	186
	(33)	(33)	74
Ordinary shareholders' equity under U.S. GAAP	**2,582**	1,925	2,365

Summary of differences between U.K. and U.S. Generally Accepted Accounting Principles

Foreign currency translation

As permitted under U.K. GAAP, income statements of subsidiary and associated companies which are denominated in foreign currencies are translated into sterling at rates of exchange prevailing at the balance sheet date for consolidation purposes. Under U.S. GAAP such income statements are translated at average rates of exchange for the period.

Goodwill

The Group writes off goodwill arising on consolidation directly against retained earnings. Under U.S. GAAP, goodwill arising on consolidation is amortised over its useful life. For the purposes of determining the differences between U.K. GAAP and U.S. GAAP, the expected useful life of goodwill has been taken to be ten years.

Deferred taxation

There are two principal differences between U.K. GAAP and U.S. GAAP in respect of deferred taxation. First, under U.K. GAAP deferred taxation is only accounted for to the extent that it is probable that tax liabilities or benefits will crystallise; U.S. GAAP requires that full provision is made for all deferred taxation liabilities. Second, U.K. GAAP requires that deferred taxation is provided using the liability method whereby tax is provided at the same rates at which timing differences are expected to reverse; under U.S. GAAP, the deferral method is used whereby deferred taxation is provided at the rates applicable to the period when provision is made.

Pensions charges

Under U.K. GAAP, prior to 1st July 1988 the accounting policy of the Group was to account for exceptional pension contributions when they became payable. Under U.S. GAAP, such charges are deferred and amortised over a future period. For the purposes of determining the differences between U.K. GAAP and U.S. GAAP, the amortisation period has been taken as ten years. With the introduction of SSAP 24 (Accounting for pension costs), any exceptional pension contributions made on or after 1st July 1988 are also required to be amortised under U.K. GAAP.

Ordinary dividends

Under U.K. GAAP, ordinary dividends are provided for in the period in respect of which they are recommended by the Board of Directors. Under U.S. GAAP, such dividends are not provided for until declared by the Board of Directors.

Shareholder Information

Information relating to the Scrip Dividend Alternative to be offered to holders of Ordinary Shares

The Board of Glaxo Holdings p.l.c. has decided to exercise the authority originally granted to it by shareholders at the Annual General Meeting of 1988 to offer a scrip dividend alternative. This will allow all shareholders on the register on 5th April 1990 except for shareholders in the USA or Canada, and all holders of American Depositary Receipts (see below), to elect, if they so wish, to receive new shares instead of a cash dividend. Shareholders may elect either for full or partial reinvestment of their dividend, or to receive cash. Full details will be sent to shareholders on 18th April 1990. If anyone has any queries relating to this documentation they should write to:

National Westminster Bank PLC
Registrar's Department
P O Box No. 82
Caxton House
Redcliffe Way
Bristol BS99 7NH
Telephone: 0272-306514/5

Information relating to a Dividend Reinvestment Plan to be offered to holders of American Depositary Receipts (ADRs)

Following the bonus issue which took place in November 1989, each American Depositary Share (which is evidenced by an ADR), now represents two Ordinary Shares in the Company.

The Board of Glaxo Holdings p.l.c. has authorized The Bank of New York, as depositary for holders of ADRs, to establish a Dividend Reinvestment Plan in which all ADR holders having a registered address in the USA or Canada will be entitled to participate. The plan will allow for full or partial reinvestment of dividends in additional American Depositary Shares and will permit monthly optional investments in additional American Depositary Shares as well. Full details of the plan will be sent to ADR holders on or about 18th April 1990. If anyone has any queries relating to this documentation they should write to:

The Bank of New York
Shareholder Relations Department
90 Washington Street
New York, NY 10015
Telephone: 212–495 3584

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APPENDIX F

DRAWINGS AND MAPS

Drawing No.	Title
R-8279-B2	Site Plan
R-8279-B3	Topographic Map
R-8279-B7	Traffic Flow Diagram
R-8279-D1	HMMB General Arrangement
R-8279-D2	ESF General Arrangement
R-8279-D3	Liquid Waste Storage Room, General Arrangement
R-8279-D4	Liquid Waste Feed System, P&ID
R-8279-D6	Incinerator, P&ID
R-8279-D6a	Incinerator Burner System, P&ID
R-8279-D7	Off-Gas Treatment System, Process Flow Diagram
R-8279-D9	Off-Gas Treatment System, P&ID
R-8279-N1	Well Location Map

USGS Quadrangle Maps

- Southeast Durham, North Carolina
- Southwest Durham, North Carolina

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ENTROPY
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PREPARED FOR:
SIRRINE ENVIRONMENTAL CONSULTANTS
RALEIGH, NORTH CAROLINA

SUBMITTED BY:
ENTROPY ENVIRONMENTALISTS, INC.
P.O. BOX 12291
RESEARCH TRIANGLE PARK, N.C. 27709
AUGUST 7, 1990

QUALITY ASSURANCE PROJECT PLAN FOR RCRA TRIAL BURN HAZARDOUS WASTE INCINERATOR TESTING AT THE GLAXO FACILITY IN RESEARCH TRIANGLE PARK, NORTH CAROLINA

REFERENCE #6395

Revision 1.0, December 5, 1991
Revision 2.0, June 7, 1991

QUALITY ASSURANCE PROJECT PLAN APPROVAL FORM

Testing Initiation Date: _____

Task Title: SIRRINE ENVIRONMENTAL CONSULTANTS, TRIAL BURN

Approval Signatures:

Tony Wong Contractor Project Director	_____ Signature	_____ Date
David G. Brintle Contractor Project Manager	_____ Signature.	_____ Date
Walter S. Smith Contractor QA Coordinator	_____ Signature	_____ Date
_____ Sirrine, Project Manager	_____ Signature	_____ Date
_____ Sirrine, QA Officer	_____ Signature	_____ Date

2. TABLE OF CONTENTS

Section		Pages	Revision	Date
1	Title page	1	0.0	08/07/90
2	Table of Contents	1	2.0	06/07/91
3	Project Description	1	1.0	12/05/90
4	Quality Assurance Program Organization and Responsibility	6	0.0	08/07/90
5	Quality Assurance Objectives	2	1.0	12/05/90
6	Sampling Procedures	13	1.0	12/05/90
7	Sample Custody	9	1.0	12/05/90
8	Calibration Procedures and Frequency	3	2.0	06/07/91
9	Analytical Procedures	1	1.0	12/05/90
10	Data Reduction, Validation and Reporting	2	0.0	08/07/90
11	Internal Quality Control Checks	8	2.0	06/07/91
12	Performance and System Audits	2	0.0	08/07/90
13	Preventative Maintenance	2	0.0	08/07/90
14	Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness	1	0.0	08/07/90
15	Corrective Action	2	0.0	08/07/90
16	Quality Assurance Reports to Management	1	0.0	08/07/90
17	Appendix A - DRE Calculations	2	0.0	08/07/90
18	Appendix B - Sampling and analytical Procedures	141	0.0	08/07/90
19	Appendix C - Sample Table of Contents	6	0.0	08/07/90
20	Appendix D - Example Calculations	6	0.0	08/07/90

3. PROJECT DESCRIPTION

Glaxo, Inc., located in Research Triangle Park, North Carolina, will operate an incinerator for the destruction of hazardous wastes. Glaxo is required to conduct a trial burn to demonstrate compliance with RCRA performance standards. The standards are as follows:

1) Particulate emissions below 0.08 grains/dscf at 7% O_2,
2) Hydrogen chloride (HCl) removal efficiency of greater than 99% if emission levels are greater than 4 pounds per hour, and
3) Destruction and Removal Efficiency (DRE) of greater than 99.99% for the Principal Organic Hazardous Constituents (POHCs).

Two test conditions are proposed for the trial burn. The designated POHCs for the trail burn are carbon tetrachloride (CCl_4), dichlorobenzene (DCB) and hexachlorobenzene (HCB). The each test condition will, therefore, consist of four VOST runs for carbon tetrachloride, four Modified Method 5 (MM5) runs for dichlorobenzene and hexachlorobenzene, four EPA Method 5/Multi-Metal runs for particulate and the metals of interest (Sb, As, Ba, Be, Cd, total Cr, Pb, Hg, Ag and Tl), four EPA Draft Method runs for hydrogen chloride (HCl), and four EPA Method 10 runs for carbon monoxide. Control equipment and operational parameters will be maintained at set conditions for all four runs for each test condition of the trial burn. Sampling performed during the trial burn will include waste feed, ash, scrubber makeup, scrubber discharge, and stack gas. Stack gas sample collection will be performed by Entropy Environmentalists, Inc. Process sample collection will be performed by Glaxo personnel under the direct supervision of Entropy. Oxford Laboratories, Inc. and Triangle Laboratories, Inc. have been subcontracted by Entropy to perform process and stack gas sample analyses. Table 6-1 lists the sampling and analytical methods.

4. QUALITY ASSURANCE PROGRAM ORGANIZATION AND RESPONSIBILITY

Entropy assumes responsibility for all measurements made in connection with this project, and therefore responsibility for the implementation of an adequate quality assurance (QA) program. This section discusses Entropy's approach to management of the QA aspects of the subject test program. Provisions and procedures which are incorporated in the overall management structure to promote implementation of QA procedures and adherence to QA guidelines are described.

The management structure and organization employed by Entropy facilitates the development and performance of quality assurance/quality control (QA/QC) functions by accurately defining the QA/QC direct lines of communication and authority between different levels of project management and the QA management structure. Entropy's QA program is designed in a way that facilitates interaction between QA program personnel and the project team. QA program personnel interface independently with project team members at all levels, monitoring data representativeness, accuracy, precision, and completeness. QA program personnel are free to interact directly with project team members at any time QA considerations in one of these areas need to be addressed.

The organization of the Entropy project team, including QA functions, is shown in the project organization chart (see Figure 4-1). Note that the QA structure is independent of the organizational groups who will generate environmental measurement data during this project.

The focus of the Entropy QA program is the quality assurance manager. He is responsible for the day-to-day oversight of QA activities. The quality assurance manager reports to the quality assurance coordinator. The quality assurance coordinator occupies a level higher than the project manager, and reports directly to the project director.

4.1 Project Management Director

The Project Management Director (PMD) oversees the Project Managers' test program planning, organization, and performance. He also assists in technical supervision and oversees protocol development and review, data interpretation, and report preparation. The PMD for this sampling project will be Mr. Tony Wong. Mr. Wong serves as the PMD for all testing projects including hazardous waste, Municipal Solid Waste/Refuse Derived Fuel (MSW/RDF) incinerators. He has been PMD for over 25 RCRA/TSCA trial burns and over 15 MSW/RDF testing projects. Some of the complex projects include high temperature, moisture, and pressure locations, dioxins/furans, emissions inventories, and ambient air. He is often involved in site surveys, method design, and method evaluation. Prior to becoming PMD, he served as Project Manager for over 20 RCRA/TSCA trial burns, which involved developing sections of the trial burn plan, negotiating with regulatory agencies, supervising field operations, evaluating data, and preparing the final report. He also spent numerous hours performing volatile organic compound (VOC) and indoor air pollution monitoring.

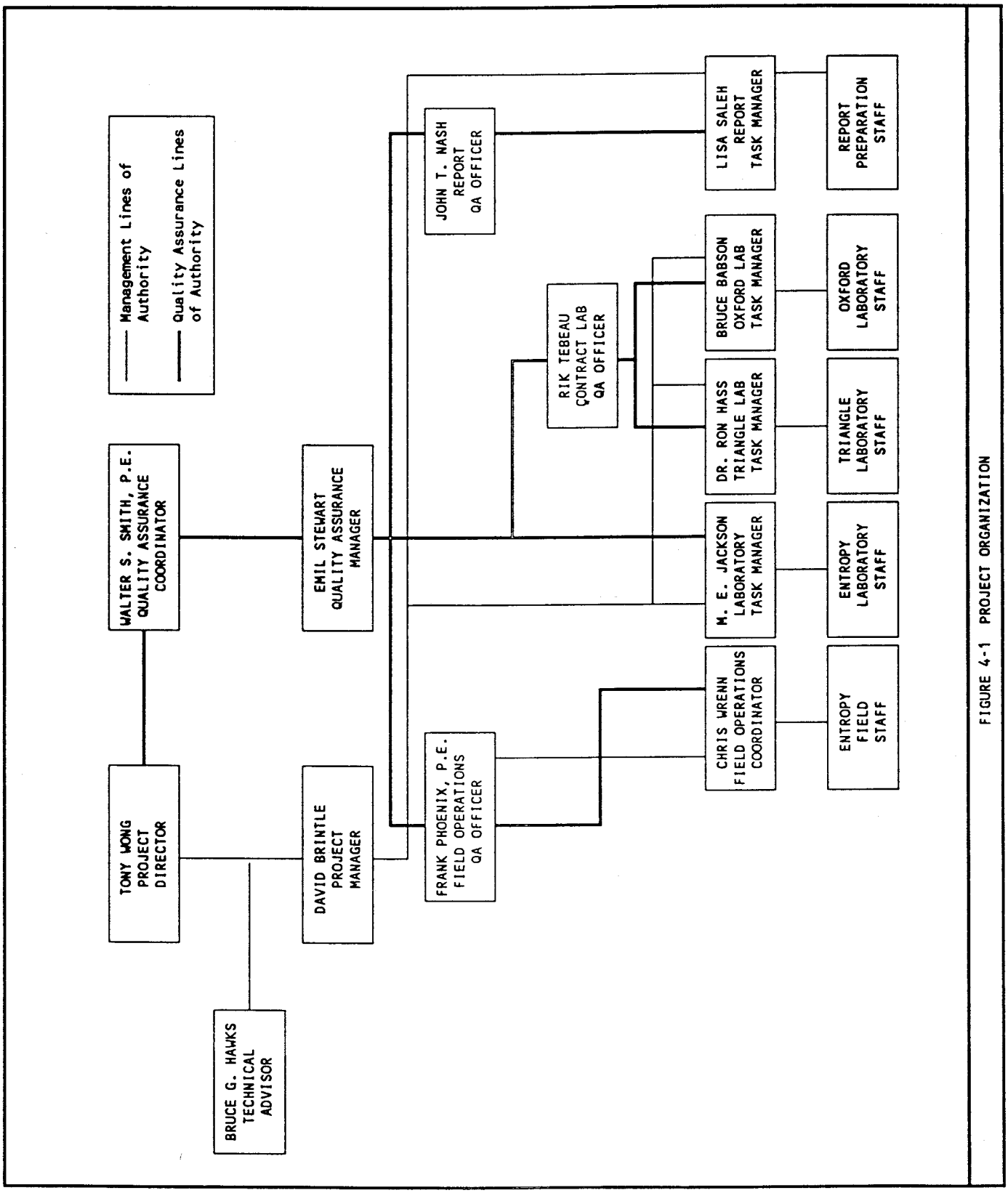

FIGURE 4-1 PROJECT ORGANIZATION

4.2 Project Manager

The Project Manager (PM) assists the PMD in the planning, oversight and review functions associated with the various elements of the test program. In practice, the PMD has responsibility for several ongoing projects at any given time. The PM's responsibilities are more narrowly focused; he usually has responsibility for one test project at a time. The PM for this sampling project will be David Brintle. To obtain a complete working knowledge of field work, Mr. Brintle spent numerous hours serving as a technician and team leader for RCRA/TSCA and indoor air pollution testing. He has been project supervisor for over 15 RCRA trial burns which involved developing the trial burn plan, negotiating with regulatory agencies, supervising the trial burn testing, and preparing the final report.

4.3 Quality Assurance Coordinator

The Quality Assurance Coordinator (QAC) has the primary responsibility for ensuring that all reported data meet the QA objectives associated with the measurement project. The QAC is independent of project management, reporting directly to upper corporate management.

Walter S. Smith, P.E. (B.S., Chemical Engineering) President and co-founder of Entropy, serves as the Quality Assurance Coordinator of the company. Prior to 1972, Mr. Smith served with the U.S. Public Health Service and, later, the U.S. EPA. His duties at both organizations included the development of sampling methods and emissions factors for numerous source categories. He headed the team which developed EPA Methods 1 through 8.

Mr. Smith will provide supervision of all technical aspects of the work effort, which includes but is not limited to, method development, sample analysis, interpretation of test results, and preparation of the final report. We anticipate that the level of Mr. Smith's participation in the proposed work effort will be more extensive than for Entropy's more routine testing projects.

4.4 Quality Assurance Manager

Entropy's Quality Assurance Manager (QAM) is Mr. Emil Stewart. His responsibilities include (1) the review of QA project plans, (2) oversight of QA consideration of field testing projects, (3) oversight of QA aspects of major EPA contracts, and (4) recommendation and implementation of QA activities within Entropy's internal systems to enhance the overall quality of the product.

If problems arise which have the potential to adversely affect data, he will make recommendations to the project manager, and higher management levels as necessary, to ensure that appropriate corrective actions are taken.

4.5 Technical Advisor

Bruce G. Hawks is Entropy's Technical Advisor. This role involves working with project managers and coordinators to ensure that project goals and objectives are recognized, and efforts necessary for their attainment are implemented. At the inception of the sampling project, Mr. Hawks will meet with the Project Management Director and the Project Manager to discuss the goals of the project, the strategy of project

implementation, and necessary QA/QC. A major function of the interaction at this management level is the selection of personnel to manage, perform, or assist in the performance of project activities. In this area, the Technical Advisor assists the Project Manager in evaluating the qualifications and experience of the candidate personnel, providing input on the suitability of individuals with reference to their ability to carry out the intended activities.

In his capacity as Technical Advisor, Mr. Hawks also will oversee preparatory operations that occur prior to conducting environmental measurements using the VOST or MM5 protocols. Some of the activities which Mr. Hawks will bear responsibility for during this test project are:

1. observing calibration techniques to ensure that operators follow prescribed procedures;
2. checking calibration records to ensure that record keeping practices are adequate, prescribed calibration frequencies are observed, and QC criteria are attained and maintained;
3. performing system audits of facilities and equipment to ensure that the status of these reflect the effective operation of the QA program;
4. conducting performance audits on measurement systems to assess the adequacy of QC systems; and
5. periodic reporting to the project director, quality assurance coordinator, project manager, and other involved personnel with regard to the QA status of on-going projects.

Most of the items listed for Mr. Hawks are routine activities, and reflect the lines of authority which are present when the team leaders and technical staff are at the home office/laboratory. In the field, many of these routine QA activities become the responsibility of the Project Manager and/or Project Supervisor and pertinent task managers, who oversee QA practices and procedures in the field.

4.6 Contract Lab Quality Assurance Officer

The Entropy contract laboratory Quality Assurance Officer for this project will be Rik Tebeau. Mr. Tebeau will oversee the efforts of Bruce Babson, Task Manager for Oxford Laboratories, Inc., and Dr. J.R. Hass of Triangle Laboratories, Inc., as well as any other outside labs whose services may be required.

Mr. Tebeau's responsibilities are to insure that proper QA/QC protocols are followed by all outside labs, and to review raw data before it is processed. He also sees that the samples are properly shipped and received by the respective labs in good shape, that the correct analytical method is performed on the samples, and the results are sent to him in a timely fashion.

4.7 Entropy Laboratory Task Manager

The Entropy Laboratory Task Manager for this project will be Mary Ellen Jackson. Ms. Jackson has ten years of experience in the analysis of air pollution samples. She serves as supervisor for Entropy's Reference Methods Laboratory, directing the efforts of the laboratory staff in all analyses. She also is responsible for purchasing and maintenance of inventories of all laboratory equipment and supplies. She oversees preparation of reagents for all field stack testing efforts undertaken by Entropy's Stack Sampling Division. Ms. Jackson directs Entropy's participation in both state and federal laboratory QA programs.

The laboratory staff, under the direction of Ms. Jackson, performs a high volume of gravimetric and volumetric analyses, titrations, colorimetry, HPLC, spectrophotometry, gas chromatography, and wet chemistry. Ms. Jackson supervises all analyses required by EPA Methods 4, 5 (front and back half), 6, 7, 8, and 17. She also handles particle size analyses, both microscopy and cascade impactor.

4.8 Operations Quality Assurance Officer

The Entropy Operations Quality Assurance Officer is Frank Phoenix. Mr. Phoenix is responsible for directing 32 engineers and technicians on six to eight weekly emissions measurement projects. Mr. Phoenix is responsible for all the manual method and VOC testing performed by Entropy. In this capacity he oversees training, equipment maintenance and calibration, project scheduling, project planning and preparation, test protocol design and standardization, and test program implementation. He has over 13 years of experience in point source, area and fugitive emissions studies, and has managed hundreds of emissions characterization projects. He has been involved with every aspect of this process including personnel management and training, methodology development, and data validation and quality assurance.

4.9 Field Operations Coordination

Entropy's Field Operations Coordinator is Chris Wrenn. Mr. Wrenn's responsibilities include scheduling, coordination of sampling tasks, and support for the sampling teams while they are in the field.

The Field Operations Coordinator works together with project managers, equipment and laboratory managers in an effort to identify and eliminate potential problems that could occur during the test program. Mr. Wrenn also coordinates changes in the scope of work that develop while in the field. He serves as support should any questions, problems, or situations arise which would require the assistance of the home office in the form of equipment, personnel, or technical information.

4.10 Report Quality Assurance Officer

Data reduction and report preparation will be under the direction of John Nash. Mr. Nash and the staff of technical writers design appropriate data forms for the collection of field data, debrief test team members on their return from the field, apply appropriate laboratory results and data gathered in the field to generate test results using computerized data reduction programs, design and implement programs for data reduction, prepare the test reports, and submit the final product to the client. An average of 15 to 20 test reports are in process at any given time, and an average of eight to ten reports per week are completed and submitted.

Entropy designs its own computerized data reduction programs. Entropy has developed appropriate programs for virtually all types of testing; each of these programs are designed to print out the final test results in a manner appropriate for direct inclusion in the test report. Mr. Nash's responsibilities demand that he possess a thorough understanding of EPA test methods as applied at different source categories and of the relationship between field activities and test results data.

Entropy developed the reporting format recommended in Volume III of the EPA Division of

Stationary Source Enforcement's Quality Assurance Handbook, and prepares all reports accordingly. All compliance test reports prepared by Entropy carry a guarantee that they will be acceptable to the control agencies to whom they are submitted, provided Entropy is allowed to participate in protocol negotiations with the agencies prior to testing. Entropy will provide any interpretations or clarifications that may be requested. In the unlikely event that testing or analytical errors compromise the data to the extent that a control agency will not accept the results of the test, Entropy will repeat the test at its own expense.

4.11 Data Report Task Manager

Data reduction and report preparation will be performed by Lisa Saleh. Ms. Saleh is responsible for the management of the report progress. After the field data has been reduced and analytical results have been evaluated, Ms. Saleh will calculate the pollutant concentrations and emission rates and present them in a report that meets guidelines established by the EPA and state agency.

4.12 Triangle Laboratories, Inc. Task Manager

The Triangle Laboratories, Inc. (TLI) Task Manager for this project will be Dr. J. Ronald Hass. He is the President of TLI and has been actively involved in the development and application of methods for the measurement of polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) for 12 years. In addition to the application of existing methods to specific problems, his laboratory was the first to use negative chemical ionization for the gas chromatography/mass spectrometry analysis of PCDD in environmental samples. His group also pioneered the use of the tandem mass spectrometry (more popularly known as MS/MS) to determine TCDD in environmental matrices. Specific matrices with which he is experienced include various tissues, soil, water, fly of bottom ash, oil (hydrocarbon or polychlorinated biphenyls) and commodity chemicals.

4.13 Oxford Laboratories, Inc. Task Manager

Bruce A. Babson will be the Task Manager for Oxford Laboratories, Inc. (OLI) if their services are required. OLI was assembled in April, 1983 as a branch of Grainger Laboratories of Raleigh, North Carolina. In March, 1985 Roger Oxford, laboratory manager, bought the assets of Grainger Laboratories and built the new OLI facility in Wilmington, North Carolina. Current staff members have performed Entropy's hazardous waste incineration analyses for over five years. These analyses include all waste feed, ash, and scrubber makeup and discharge samples. The years of association with OLI personnel has enabled Entropy to develop an interlaboratory QA/QC program.

The analytical methods and results from previous testing projects performed with the aforementioned labs have been thoroughly examined and approved by appropriate governing regulatory agencies. All sampling and analytical results are guaranteed to be acceptable to the governing regulatory agencies.

5. QUALITY ASSURANCE OBJECTIVES

The overall measurement objective is to determine the effectiveness of the incineration system in achieving thermal destruction of the hazardous constituents in the test burn wastes. Numerical QA objectives for accuracy and precision of the sampling system calibration, sample preparation, and analysis procedures can be established based on previous experience in applying comparable procedures to a variety of complex sample matrices.

The QA objectives for analytical accuracy and precision for this test burn sampling and analysis program are consistent with general laboratory practices. The quality assurance objective for completeness is to obtain analytical results for at least 75% of the samples collected during each incinerator test burn.

The representativeness of gas samples collected by EPA Method 5 will be ensured by their collection at ± 10% isokinetic sampling conditions. VOST collection (single point sampling) will consist of four 40-minute samples collected during a 160 minute test period for each test run. Each 40-minute sample will be operated at a constant sampling rate (approximately 1/2 liter per minute). Initial calibration-check compounds during VOST analysis should be within 30% of the relative standard deviation. During a systems performance check, volatile compounds should have response factors greater than 0.3. Bag samples collected for EPA Method 3 analysis are multi-point and constant rate. Each of these samples, therefore, represents the average composition of the stack gas during each test run that the sample is collected.

Waste feed, baghouse dust, and scrubber water samples will be collected in strict accordance with the methods described in Sampling and Analysis Methods for Hazardous Waste Incineration (First Edition), a guideline document prepared for the EPA by Arthur D. Little, Inc. Each sample container will be rinsed thoroughly with waste prior to isolating the sample.

All data will be reported in terms of mass analyte per unit volume of sample matrix. Results from the analyses of all samples for a given matrix will be reported in the same units. Rates of POHCs input to each incinerator and exhausted from the stack will be stated in common units (e.g., pounds per hour) to enable calculation of DREs.

Surrogate recovery information determined during the analysis phase will be supplied in the final report. The MM5 surrogate recovery objectives are established by the Upper and Lower Control Limits specified in Section 8.9.3 of SW-846 Method 8270. Concentration data will be corrected for recovery of internal standards.

A list of QA objectives for all measurements, field and laboratory, are presented in Table 5-1. The accuracy objectives will only be quantitatively determined for the volatile POHCs in the stack gas. This will be achieved by performance of a VOST audit if required by the regulatory agencies. Accuracy objectives for the other parameters can be quantitatively determined if supplied with performance (check) samples by the regulatory agencies. The analytical approach used to demonstrate that the data will be suitable in obtaining at least four nines DRE is shown in Appendix A.

TABLE 5-1
QUALITY ASSURANCE OBJECTIVES

SAMPLE	PARAMETER	PRECISION	ACCURACY	COMPLETENESS
Waste feed liquid	Carbon Tetrachloride	≤10% RPD	±25% RE	>90%
	Dichlorobenzene	≤10% RPD	±25% RE	>90%
	Chlorine	≤10% RPD	±10% RE	>90%
	Ash	≤20% RPD	±10% RE	>90%
	% H_2O	≤10% RPD	±10% RE	>90%
	Heating Value	≤15% RPD	± 5% RE	≥90%
	Viscosity	≤10% RPD	±10% RE	>90%
	Flashpoint	≤10% RPD	±10% RE	>90%
	Metals	≤10% RPD	±10% RE	>90%
Waste feed solid	Dichlorobenzene	≤10% RPD	±25% RE	>90%
	Hexachlorobenzene	≤10% RPD	±25% RE	>90%
	Chlorine	≤10% RPD	±10% RE	>90%
	Ash	≤20% RPD	±10% RE	>90%
	% H_2O	≤10% RPD	±10% RE	>90%
	Heating Value	≤15% RPD	± 5% RE	≥90%
	Metals	≤10% RPD	±10% RE	>90%
Incinerator Ash	POHCs	≤10% RPD	±10% RE	>90%
	Metals	≤10% RPD	±10% RE	>90%
	EP Toxicity	≤10% RPD	±10% RE	>90%
Lime Feed	POHCs	≤10% RPD	±10% RE	>90%
	Metals	≤10% RPD	±10% RE	>90%
	Chlorine	≤10% RPD	±10% RE	>90%
Baghouse Ash	POHCs	≤10% RPD	±10% RE	>90%
	Metals	≤10% RPD	±10% RE	>90%
	Chlorine	≤10% RPD	±10% RE	>90%
	EP Toxicity	≤10% RPD	±10% RE	>90%
Stack Gas	Particulate	-	-	>90%
	HCl	≤10% RPD	-	>90%
	Carbon Tetrachloride	-	±50% RE	75%**
	Dichlorobenzene	-	±25% RE	90%
	Hexachlorobenzene	-	±25% RE	90%
	Metals	≤10% RPD	±10% RE-	≥90%
	Carbon Monoxide	-	± 5% RE	≥90%

* Three out of the four samples collected for each test run will be analyzed.

6. SAMPLING PROCEDURES

Table 6-1 summarizes all sampling and analytical procedures to be used during the program. Following are descriptions of the sampling methods to be performed at the stack. The actual methods are contained in Appendix B.

6.1 Sampling Point Determination - EPA Method 1

The number and location of the sampling or traverse points will be determined according to the procedures outlined in EPA Method 1. The location of traverse points will be in strict compliance with EPA Method 1.

6.2 Flue Gas Velocity and Volumetric Flow Rate - EPA Method 2

The flue gas velocity and volumetric flow rate will be determined according to the procedures outlined in EPA Method 2. Velocity measurements will be made using type S pitot tubes conforming to the geometric specifications outlined in EPA Method 2. Accordingly, each has been assigned a coefficient of 0.84. Differential pressures will be measured with Magnehelic gauges of appropriate range or with fluid manometers. Effluent gas temperatures will be measured with chromel-alumel thermocouples equipped with hand-held digital readouts.

6.3 Flue Gas Composition and Molecular Weight - EPA Method 3

Flue gas analysis for carbon dioxide and oxygen and the calculation of percent excess air and flue gas dry molecular weight will be performed in accordance with EPA Method 3. Multi-point, integrated sampling will be used to obtain a constant rate sample of flue gas concurrent with the particulate testing. A stainless steel probe will be affixed to the particulate sampling probe for this purpose. A peristaltic pump, delivering 500 to 750 mL/min of flue gas, will be used to fill a Tedlar bag. Moisture will be removed from the sample gas by means of a knockout jar located prior to the pump. Sampling will be of the same duration (except purges following port changes) as the particulate runs.

Analysis will be performed by Orsat apparatus. Prior to each series of analyses, the Orsat will be leak checked to confirm that there is less than 0.2 mL change in five minutes. Analyses for a given sample must agree within 0.3% by volume.

6.4 Flue Gas Moisture Content - EPA Method 4

The flue gas moisture content will be determined in conjunction with each EPA Method 5 type train and according to the sampling and analytical procedures outlined in EPA Method 4. The impingers will be connected in series and will contain reagents as described below. The impingers will be contained in an ice bath in order to assure condensation of the moisture in the flue gas stream. Any moisture that is not condensed in

TABLE 6-1
SAMPLES AND ANALYTICAL PROCEDURES

SAMPLES TO BE TAKEN	SAMPLE FREQUENCY FOR EACH RUN	METHOD[a]	SAMPLING PARAMETER	ANALYSIS[b] METHOD	ANALYTICAL[c] LABORATORY
Waste feed liquid	1 per 15 min.	SOO4	Carbon Tetrachloride	SW-846 8010	OLI
			Dichlorobenzene	SW-846 8120	OLI
			Chlorine	AOAC 11ED. 6.187	OLI
			Ash	AOO1(b)	OLI
			% H_2O	AOO1(b)	OLI
			Heating Value	AOO6	OLI
			Viscosity	AOO5	OLI
			Flashpoint	COO1	OLI
			Metals	SW-846 7000s	OLI
Waste feed solid	1 per 15 min.	SOO7	Dichlorobenzene	SW-846 8120	OLI
			Hexachlorobenzene	SW-846 8120	OLI
			Chlorine	AOAC 11ED. 6.187	OLI
			Ash	AOO1(b)	OLI
			% H_2O	AOO1(b)	OLI
			Heating Value	AOO6	OLI
			Metals	SW-846 7000s	OLI
Incinerator Ash	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			EP Tox	SW-846 1310	OLI
Lime Feed	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			Chlorine	AOAC 11 ED. 6.187	OLI
Baghouse Ash	1 per 15 min.	SOO7	POHCs	SW-846 8010, 8120	OLI
			Metals	SW-846 7000s	OLI
			Chlorine	AOAC 11 ED. 6.187	OLI
			EP Tox	SW-846 1310	OLI
Stack Gas	2 hr. run	EPA M2	Velocity	EPA M2	EEI
	2 hr. run	EPA M3	O_2 + CO_2	EPA M3	EEI
	2 hr. run	EPA M4	Moisture	EPA M4	EEI
	2 hr. run	EPA M5	Particulate	EPA M5	EEI
		MMTL	Metals	SW-846 7000s	OLI
	2 hr. run	EPA MM5	Hexachlorobenzene	SW-846 8270	TLI
			Dichlorobenzene	SW-846 8270	TLI
	2 hr. 40 min. run	VOST	CCl_4	SW-846 5040	TLI
	2 hr. run	EPA Draft	HCl	Ion chromatography	EEI
	2 hr. run	EPA M10	CO	EPA M10	EEI

(a) SOO- and AOO- Sampling and analytical methods from "Sampling and Analysis Methods for Hazardous Waste Incinerators, "First Edition, EPA, 1982.

(b) SW-846 Analytical methods from "Test Methods for Evaluating Solid Wastes," September, 1986.

(c) OLI - Oxford Laboratories, Inc.
EEI - Entropy Environmentalists, Inc.
TLI - Triangle Laboratories, Inc.

the impingers is captured in the silica gel, therefore all moisture can be weighed and entered into moisture content calculations.

6.5 Particulate and Trace Metals - EPA Method 5/Multi-Metal Sampling Train

A combined EPA Method 5 and an EPA Draft Multi-Metal Sampling Train will be used to collect particulate, and the metals of interest (Sb, As, Ba, Be, Cd, total Cr, Pb, Hg, Ag, and Tl). This train is operated in the same manner as a regular EPA Method 5 sampling train. Pretest preparations, preliminary determinations, and leak check procedures will be those outlined in EPA Method 5. The average sampling rate for each run will be within ± 10% of 100% isokinetic conditions. Each test run will be a minimum of two (2) hours in duration and will sample a minimum of 60 dry standard cubic feet. Borosilicate glass probe liners and nozzles will be used to avoid possible contamination. All materials and equipment used in testing by Entropy meet or exceed USEPA requirements. Figure 6-1 presents a schematic of the EPA Method 5/MMTL sampling train.

The reagents placed in the impingers will be as follows: 100 ml of 0.1N HNO_3/10% H_2O_2 in each of the first two impingers, the third will remain empty, the fourth will contain 100 ml of acidic KMnO4, and 200 grams of silica gel in the fifth impinger. In addition, an ultrapure low metals filter which meets EPA Method 5 specifications will be used instead of the normal EPA Method 5 filter for QA purposes. The low metals filter is a Pallflex 2500QAT-UP quartz filter. The filter will be placed between the probe exit and the first impinger.

The amount of condensate collected will be determined as required by EPA Method 5. The fronthalf of the sampling train will be first rinsed with acetone to recover particulate matter then with O.1N nitric acid to recover the metals. After impinger adsorbing solution recovery, all sample exposed components will be rinsed into appropriate containers with O.1N nitric acid. SW-846 Methods (atomic absorption (AA)) will be used to determine the concentration of the metals. The filter, impinger catches, and the rinse will be analyzed for the metals. Filter makeup and recovery will be performed using a Teflon spatula and Teflon coated tweezers. A Teflon brush will be used for rinsing the probe.

For the metals analyses, the HNO_3 fronthalf rinse will be evaporated to near dryness in a Teflon beaker. The filter, loose particulate, 3 mL of concentrated HNO_3, and 5 mL of concentrated HF will be added to the beaker. The sample will be digested on a hotplate until brown fumes are evident, indicating the destruction of organic matter. After the addition of concentrated HNO_3, the reagent and impinger's rinse will be evaporated to dryness in a Teflon beaker on a hotplate. After cooling, 3 mL of concentrated HNO_3 and 5 mL of concentrated HF will be added to the beaker and the sample will be fumed on a hotplate to destroy organic residue. The prepared filter and water samples will be combined and brought to a final volume of 100 mL with 10% HNO_3. After preparation, the samples will be analyzed with a Perkin Elmer 3030 atomic absorption analyzer.

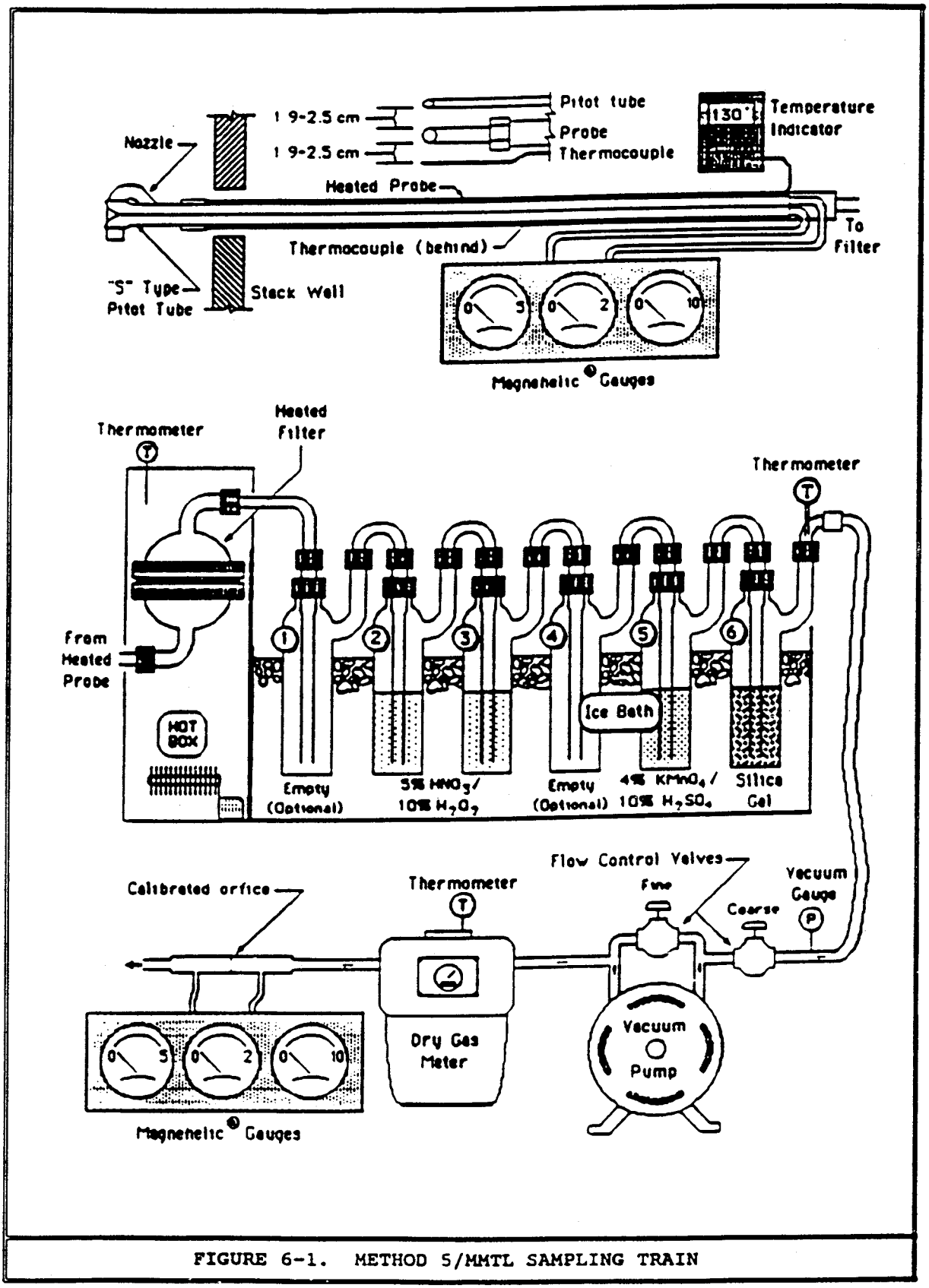

FIGURE 6-1. METHOD 5/MMTL SAMPLING TRAIN

An acetone blank will be checked for residue prior to field use for the EPA Method 5 train. The filters will be checked for background metals contamination and duplicate analyses will be performed for MMTL samples. In addition a field blank, a reagent blank, and a filter blank will be analyzed for the metals. During analysis, spikes will be added to determine recovery efficiencies for the metals.

6.6 Hydrogen Chloride - EPA Draft Method 26

The sampling and analytical procedures outlined in the EPA Draft Method will be followed to determine hydrogen chloride (HCl) emissions. The sampling train impinger system will contain 15 mL of 0.1N sulfuric acid in the first two impingers, the third impinger will remain empty and 15 mL of 0.1N sodium hydroxide in the fourth impinger. The end of the probe will be directed away from the flue gas flow, and a teflon wool plug will be inserted into the probe to remove particulate matter. The sampling train will be operated at a single point at a constant sampling rate of two liters per minute for 120 minutes. The sampling probe will be purged for five minutes prior to isolating the sample.

The sulfuric acid solution will be analyzed using ion chromatography techniques for HCl. Duplicate analyses will be performed on the samples and a reagent blank.

6.7 Volatile Organic Sampling Train - SW-846 Method 0030

Volatile Organic Sampling Train (VOST) will be used to measure emissions of carbon tetrachloride. The VOST system is designed to draw effluent flue gas through a series of sorbent traps. The first trap will contain Tenax resin, and the second will contain a section of Tenax followed by a section of activated charcoal. The Tenax trap will be preceded by a water-cooled condenser arranged so that condensate will drain vertically through the Tenax. The temperature is monitored at the exit of the first trap and is kept below 68° F. Saturation at 68° F is less than 2.5%. The VOST system is depicted schematically in Figure 6-2.

The tenax resin will be soxhlet extracted with toluene for 16 hours, dried in an oven at 100° C, and then packed in sampling tubes. The tubes will be placed in a Nutech VOST tube conditioner and conditioned with Nitrogen at 180° C for twelve hours. A contamination check will be performed on the VOST tubes as described in SW-846 Method 0030 Section 4.4. The conditioned tubes, accompanied by charcoal tubes will be placed in Ziploc bags and then stored in a freezer.

Sampling will take place for 2 hours and 40 minutes per run; four runs will be performed during each trial burn condition. Each pair of traps will be replaced every 40 minutes so that four pairs of traps will be collected per run, twelve pairs during the trial burn. Three of the four pair of VOST tubes will be analyzed for each run to represent a two hour test run. The fourth will be held for backup and analyzed if one of the first three cannot be analyzed. The VOST will be operated at a sampling rate of 0.5 liter per minute (20 liters per sample) instead of the normal 1.0 liter per minute. VOST sampling procedures will strictly adhere to SW-846 Method 0030.

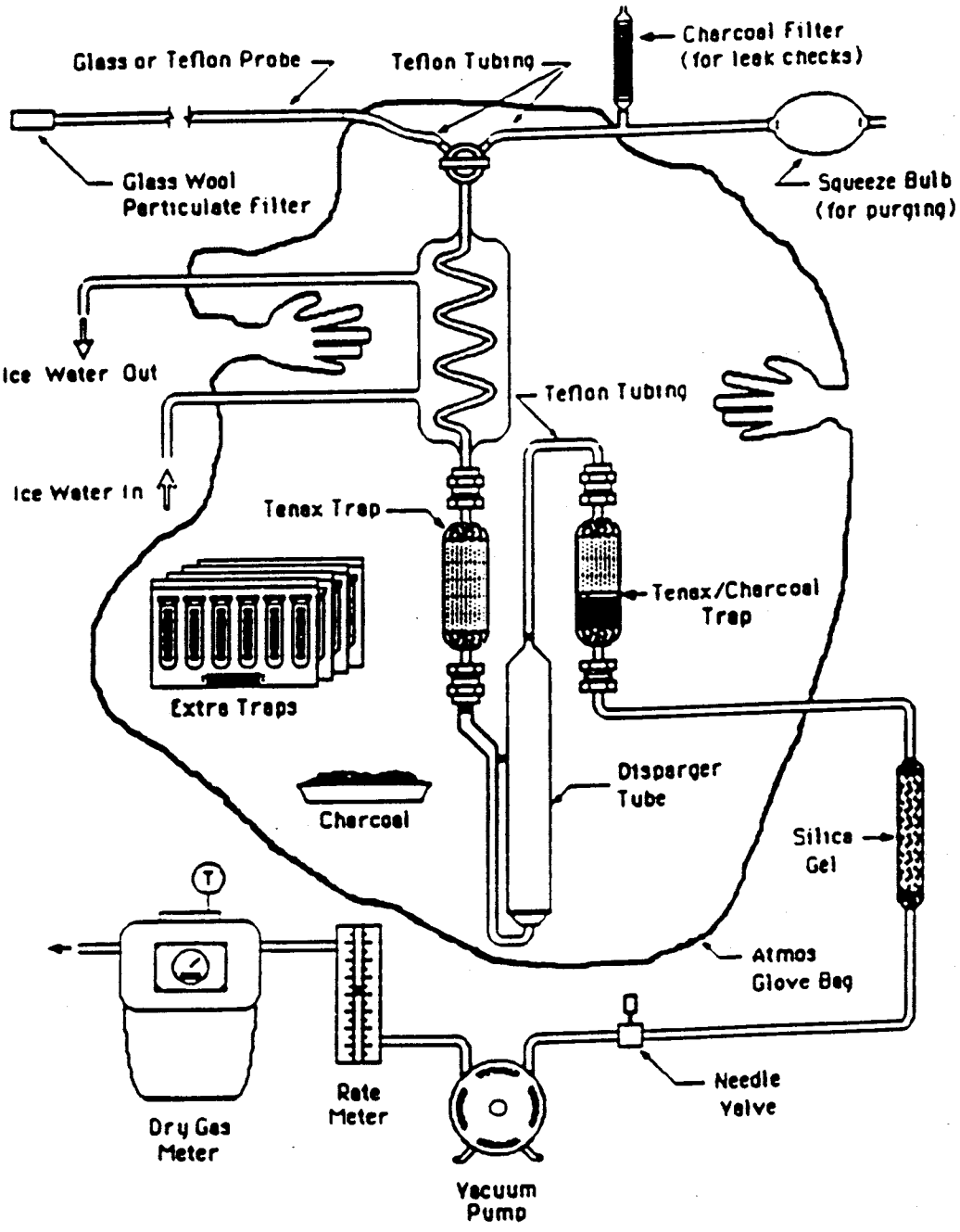

FIGURE 6-2 VOLATILE ORGANIC SAMPLING TRAIN (VOST)

Analysis for the POHCs will follow the guidelines of SW846 Method 5040, a method that has been proposed for volatile organic compounds that are amenable to the purge-trap-desorb (P-T-D) technique. Each pair of traps and each condensate catch will be analyzed separately and the total of the three pairs reported for each test run. The organic contents of one pair of Tenax and Tenax/charcoal traps will be thermally desorbed into water using a carrier gas. The desorbed compounds will then be purged from the water and collected on an analytical trap containing Tenax and charcoal. The compounds are then back-purged off the trap into the GC/MS. Helium will be the carrier gas in all cases.

VOST Breakthrough

According to the EPA, breakthrough is present if the catch of the second tube exceeds 30% of the first tube and concentrations on the second tube are above 75 ng. If breakthrough is found on the first pair of tubes, then the remaining VOST tubes for that run are analyzed separately. Otherwise, the VOST tubes are analyzed as pairs. It should be stated that Entropy will follow the guidelines and procedures specified in EPA's SW-846 Method 0030 (VOST). However, Entropy cannot accept responsbility should EPA invalidate results collected according to EPA's suggested guidelines and procedures.

VOST Sorbent Cartridge Blanks

Extra sorbent cartridges will be taken to the sampling site to serve as field and trip blanks. One pair of VOST tubes, designated as a field blank, will be uncapped and inserted into the train and leak checked during each day of the testing series. The field blank will be capped and stored for transport in the same manner as the sample-exposed cartridges. The field blanks will be analyzed by the same method as the actual samples. An additional pair of tubes, designated as a trip blank, will be transported to and from the field and otherwise treated as the other cartridges, except that the caps will not be removed. The trip blank will not be analyzed unless the field blanks suggest possible contamination.

Preventing contamination of the sorbent during transport or in the environment surrounding the hazardous waste facility is an important Quality Assurance consideration. Entropy has developed procedures for sample collection and transport which go beyond the requirements of the VOST sampling method. Entropy's system isolates the VOST from the surrounding atmosphere during sampling, effectively preventing sorbent contamination and preserving sample integrity. Blank analyses are consistently below detectable limits, confirming the effectiveness of this procedure. A VOST audit will be performed on-site one day prior to the beginning of the trial burn if requested by the regulatory agencies.

6.8 Modified Method 5 Sampling Train - SW-846 Method 0010

A Modified Method 5 (MM5) sampling train will be used to measure emissions of dichlorobenzene and hexachlorobenzene. The MM5 sampling train includes a cartridge of XAD-2 resin to capture hydrocarbons that pass through the particulate filter. The sample gas is cooled by a water-cooled condenser prior to encountering the XAD cartridge. The following sections describe each component in the MM5 sampling train.

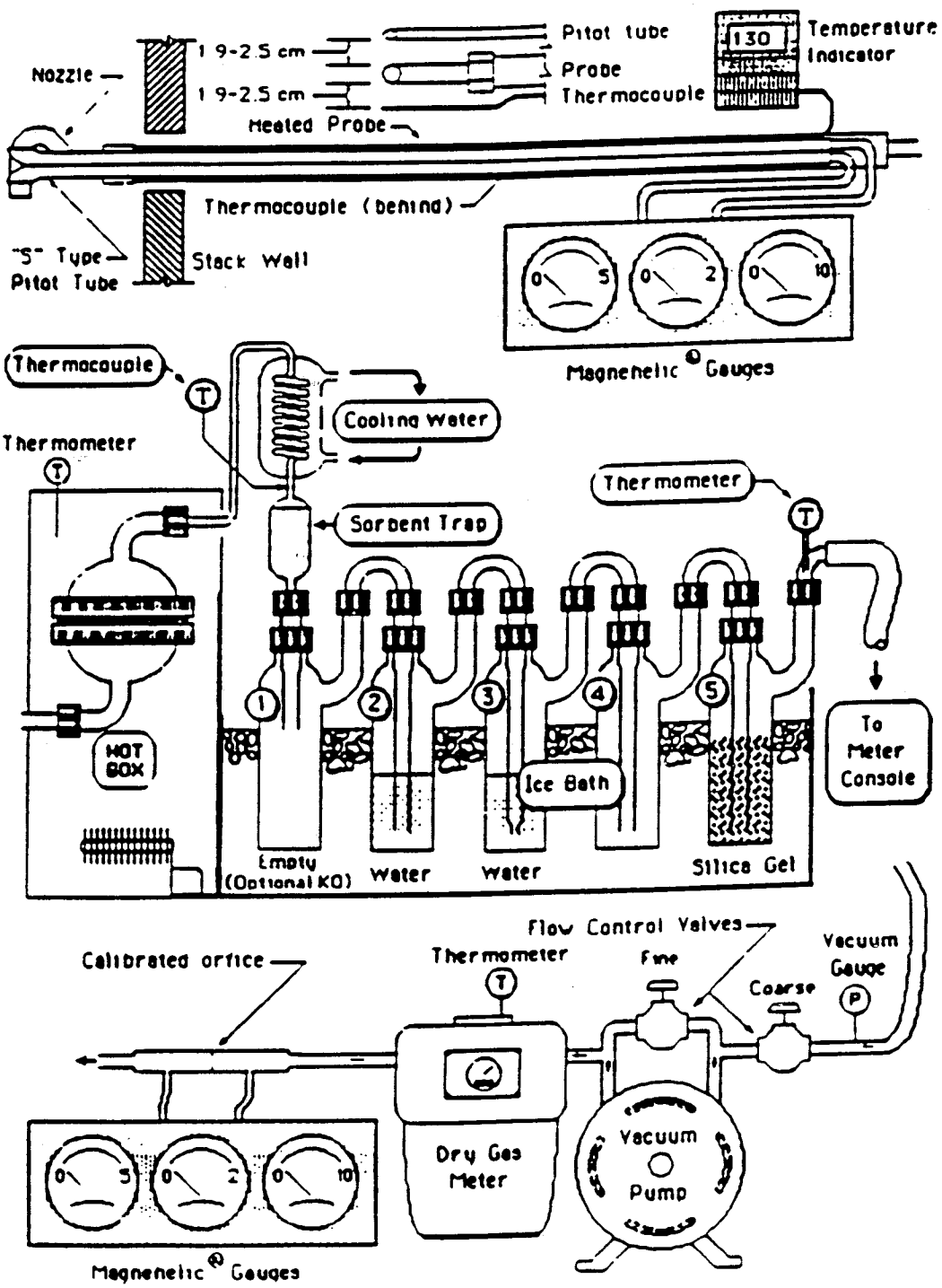

FIGURE 6-3. MODIFIED METHOD 5 SAMPLING TRAIN

Sampling Train Description. A schematic of a typical MM5 sampling train is shown in Figure 6-3. Flue gas is pulled from the stack through a stainless steel nozzle and a borosilicate glass probe. Particulate matter is removed from the gas stream by means of a glass fiber filter housed in a glass filter holder maintained at 248 ± 25° F. All glass components will be thoroughly cleaned with a 1:1 volume ratio mixture of methanol and methylene chloride (methanol/methylene chloride) prior to use. The sample gas passes through a water-cooled condenser and into the XAD sorbent trap for removal of the organic constituents. The condenser and XAD trap are arranged in a manner that allows the condensate to drain vertically through the XAD trap. A chilled impinger train will be used to remove water from the flue gas and a dry gas meter will be used to measure the sample gas flow. Sealing grease will not be used on the sample train.

XAD Preparation. All XAD material is purchased pre-cleaned from Supelco. The XAD meets USEPA recommended criteria for purity, as outlined in the EPA's Level 1 Environmental Assessment Procedures Manual. Care will be taken to ensure that the resin is kept at temperatures below 120° F before and after sample collection to prevent resin decomposition. The sorbent trap will be charged with 20 to 30 grams of the precleaned resin. The period of time between resin precleaning and use in the field will be minimized and will not be allowed to exceed 14 days.

Glassware Preparation. All glass parts of the MM5 sample train including the sorbent trap glassware, will be precleaned prior to sampling according to the procedure listed in Table 6-3. Clean glassware will be capped with precleaned foil or glass plugs until sample train assembly. Following sample recovery, the glassware will be reused at the same sampling location.

Sample Train Operation. The sample train will be operated according to SW-846 Method 0010. Special attention will be given to the following Quality Control checks:

1. The entire sample train will be leak tested to ensure that leakage does not exceed the lesser of a) 4 percent of the average sampling rate, or b) 0.02 cfm.
2. The probe exit temperature will be maintained above 248° F, and the filter compartment will be maintained at 248 ± 25° F during sampling.
3. Gas entering the sorbent module will be maintained at or below 68° F.
4. Isokinetic sampling will be maintained within ± 10 percent of 100.
5. Stored resin will be kept below 120° F at all times.

If a sample train leak is found after testing has begun, the sampling train with the leak will be aborted and that run of the sampling method will be repeated.

Sample Recovery. Recovery of the MM5 samples and assembly of the sample trains will be conducted in an environment free from uncontrolled dust, such as a lab or vehicle if a lab is not available. Access to this area will be limited to only those individuals involved in the recovery process.

Sample containers from a typical MM5 test run will include those shown in Table 6-4. All sample containers containing water will be extracted for analysis by the designated lab within 7 to 14 days after sample

collection. It should be noted that depending on the particulate loading and/or the flue gas moisture content, the actual number of containers from each sample run may vary.

The solvent to be used for rinsing the nozzle, probe, and filter holder will be methanol/methylene chloride.

Sample Train Blanks. A field blank will be recovered during each operating condition of the testing program. A field blank consists of a complete MM5 sampling train (probe, filter, transfer line, condenser, XAD trap, and impinger set) which is assembled as though to collect a sample, but flue gas is not pulled through the train. The field blank train will be leak checked the same number of times as a sampling train used during a test run. The train will be placed at the sampling location for the duration of one test run. The train is then returned to the laboratory and disassembled for recovery using the same procedure used to recover actual samples. The field blank will be obtained using a train that has previously been used to collect at least one actual sample from the test site.

A proof blank can be obtained from a complete set of MM5 sample train glassware that has been cleaned according to the procedure presented in Table 6-3. The pre-cleaned glassware which consists of a probe liner, condenser coil, and impinger set, is rinsed with the methanol/methylene chloride mixture three times. Potential analysis of the rinse is used to check the effectiveness of the glassware pre-cleaning procedure. Glassware used during a previous run will be cleaned with methanol/methylene chloride rinses before use during a subsequent operating condition. Blanks of each solvent lot used at the test site will also be saved for potential analysis.

Modified Method 5 Analysis. The XAD traps, filters, and impinger solutions to be analyzed for the designated semi-volatile organics will be extracted with methylene chloride for 16 hours according to EPA Method 3540. All extracts from one (1) test run will be combined and reduced to one (1) 1mL extract per test run. Analysis of the final extract will be according to SW-846 Method 8270.

TABLE 6-3. GLASSWARE PRECLEANING PROCEDURE

1. Soak all glassware in hot soapy water (Alconox) at 50° C or higher
2. H_2O rinse, three (3) times
3. Distilled/deionized H_2O rinse, three (3) times
4. Pesticide grade methanol/methylene chloride rinse, three (3) times
5. Bake at 450° F for 2 hours.
6. Cap glassware with clean glass plugs or methylene chloride rinsed aluminum foil.

Note: Use disposable gloves and adequate ventilation.

TABLE 6-4. TYPICAL MODIFIED METHOD 5 SAMPLING TRAIN COMPONENTS TO BE SHIPPED TO ANALYTICAL LABORATORY

Container Number 1	Filter(s)
Container Number 2	Rinses of nozzle, probe, and front half filter holder
Container Number 3	XAD cartridge and resin
Container Number 4	Knockout impinger contents
Container Number 5	First, second, and third impinger contents
Container Number 6	Rinses of back half of filter holder, transfer line, condenser, and knockout impinger
Container Number 7	Rinses of first, second, and third impingers
Container Number 8	Silica Gel

Note: The rinse solution will be a 1:1 volume ratio of methanol and methylene chloride.

6.9 Continuous Emissions Monitoring - EPA Method 10

Concentrations of CO will be quantified by a gas analyzer. The sample gas is drawn through a heated probe with a glass wool filter and through heated sample line to an ice bath condenser where the moisture is removed continuously. From the condenser, the sample gas flows through a coalescing filter to the sample gas manifold which controls the flow of effluent sample and calibration standards to the analyzers. From the manifold the gas is directed into the appropriate analyzers for measuring the concentrations of the gaseous components of interest. The configuration of the sampling system allows for the injection of calibration gases either directly to the analyzers or through the sampling system. The motive force for the effluent sample is a Thomas Model 2107CA 18-TFE sampling pump. All components in the sampling system which contact the sample are constructed of Type 316 stainless steel, Teflon, or borosilicate glass. The operation of the gas analyzer is described below.

ACS FuJi 3300 CO Analyzer

The ACS Model 3300 non-dispersive infrared (NDIR) analyzer automatically and continuously monitors the CO (carbon monoxide) concentration of a flowing gas mixture. The theory of operation for this analyzer is based on the principle that the gas has a unique absorption line spectrum in the infrared region. The instrument consists of an infrared light source, chopper, measuring cell, and detector, with the only difference being the length of the measuring cell.

The infrared light beam emitted by the source passes through the measuring cell filled with a continuously flowing gas sample. The light beam is partially absorbed or attenuated by the gas species of interest in this cell before reaching the front chamber of the detector. Both the front and rear chambers of the sealed detector are filled with a reference gas. Additional absorption is sustained in the front and rear chambers at ever decreasing rates. The difference in the amount of light absorbed between the front and rear

chambers is dependent on the concentration of the gas species of interest within the sample measuring cell and creates a pressure differential between the two chambers. This pressure difference is then observed as gas flow by the micro-flow sensor located in a channel communicating the two chambers. The resulting AC signal from the micro-flow sensor is amplified, rectified, and linearized into a DC voltage signal for output. The instrument is equipped with ranges of 0 to 500 ppm CO.

Data Acquisition and Reduction

Data from the analyzer can be recorded by Entropy's data acquisition system (DAS). The DAS is an IBM compatible PC-based computer with analog-to-digital conversion hardware. The signals from the gas analyzer will be recorded on strip charts. Data from the gas analyzers are displayed on the screen and can be averaged and printed in tabular form. The DAS can also be used to calculate emission rates and to record the calibration data. The data and results are stored on hard disk. Because the DAS software was written by Entropy, it can be easily altered to print values almost instantaneously or to save peak values. Data files can be loaded onto spreadsheets where additional calculations and graphics can be provided at any time.

TCEMS Sampling/Calibration Procedures

Concentrations of the gas of interest in the effluent stream are continuously monitored through the use of the extractive monitoring system. The IBM portable personal computer mentioned above is used as the primary data recording device. The analyzer response is also displayed on a strip chart recorder, which serves as a back-up to the computer system.

The transportable continuous emissions monitoring system (TCEMS) is calibrated with a series of certified calibration gases. Calibration gas injection points are located both at the inlet of the primary condenser and immediately upstream of the analyzer. This arrangement provides both ease in checking the analyzer performance and a means of evaluating the entire monitoring system. The analyzer calibrations are conducted by flowing the calibration gases through a Teflon transport line to the inlet of the condenser; thus, the calibration gases pass through all system components which come in contact with the effluent sample. This calibration procedure eliminates the effects of any potential biases within the sampling system. The calibration of the TCEMS is frequently checked by flowing the calibration gases through the entire sampling system in order to quantify any calibration drift.

Quality control of the TCEMS is based on the utilization of certified calibration gases. The CO gases are certified NBS-traceable by the gas vendor following EPA Protocol No. 1.

6.10 Process Sample Collection Procedures

Liquid Waste Feed. Grab samples of the liquid waste feed will be collected every 15 minutes during each test run in accordance with Method S004. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500mL aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Solid Waste Feed. Grab samples of the solid waste feed will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500mL aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Incinerator Ash. Grab samples of the incinerator ash will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500mL aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Lime Feed. Grab samples of the lime feed will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500mL aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

Baghouse Ash. Grab samples of the baghouse ash will be collected every 15 minutes during each test run in accordance with Method S007. All grab samples from a test run will be composited during the run into a gallon jar. At the conclusion of the run, the sample will be mixed and two 500mL aliquots will be taken into amber glass jars. One sample will be used for analysis and the other will be held as backup and archived.

7. SAMPLE CUSTODY

Sample custody procedures for this program are based on EPA recommended procedures (Quality Assurance Handbook for Air Pollution Measurement Systems: Volume 3, Stationary Source-Specific Methods (1977)). Since samples will be analyzed by one or more laboratories as well as in the field, the custody procedures emphasize careful documentation of sample collection and field analytical data and the use of chain of custody records for samples being transported. The procedures which will be used are discussed below.

7.1 Field Sampling Operations

The project supervisor will be responsible for ensuring that proper custody and documentation procedures are followed for the field sampling and field analytical efforts. He will be assisted in this effort by key sampling personnel involved in sample recovery.

Samples are collected, transported, and stored in clean containers which are constructed of materials inert to the analytical matrix such as glass jars. Only containers which allow air tight seals are used. Amber glass jars are employed when containers are needed which inhibit photochemical reactions.

All sampling data, including information regarding sampling times, locations, and any specific considerations associated with sample acquisition will be recorded on preformatted data sheets. The field sampling data form for the Modified Method 5 sampling train is shown in Figure 7-1. The analytical data form for the Method 5 sampling train is shown in Figure 7-2.

Following sample collection, all samples will be given a unique alphanumeric sample identification code as shown in Figure 7-3. Actual sample code could vary slightly depending upon sample location and type. Figure 7-4 is the chain of custody sheet which will accompany all Modified Method 5 reagent boxes used during the testing program.

Process samples (feed, scrubber, ash, etc.) that are collected during testing will be packed for shipment to the appropriate laboratories and process sample chain of custody forms (Figure 7-5) will be completed for each shipment box. The chain of custody forms and a letter specifying the treatment of each sample will also be enclosed in the sample shipment container. Samples to be combined and analyzed immediately, extracted and stored for later analysis, or simply stored as is, will be clearly stated in this letter. The purpose of the letter will be to ensure that the correct samples are combined, that samples containing moisture will be analyzed on an as-received basis, and that samples with a limited shelf life (those containing water) are extracted within the allowable time of 7 to 14 days after collection.

Samples are stored for transport from the lab to the field to the lab in storage boxes constructed in a fashion which minimizes movement and thus prevents breakage of containers. For example, boxes used for transporting glass containers have foam inserts with form-fitting cutouts. Sample transport boxes are always locked except when in use. Vans containing equipment and samples are locked whenever they are left unattended.

VOST traps are placed in culture tubes which also contain activated charcoal. These tubes are then placed in Ziploc bags which also hold open charcoal tubes. VOST traps will be kept cold during transportation and storage.

A daily activity log will be maintained by the project supervisor. This will be an informal log used to record various types of information, such as minor problems which arise, sketches of sampling locations, names and phone numbers of plant contacts, daily activity summaries, etc.

7.2 Analytical Operations

Analytical operations will be performed on-site in the laboratory as well as in the Entropy laboratories. The analytical data form to be used for on-site fixed gas (molecular weight) determinations using Orsat analyzer is shown in Figure 7-6. Samples analyzed by outside laboratories are transported with a Request-For-Analysis form as shown in Figure 7-7. This form will list sample identifications, analytical parameters, sample matrices, anticipated date of results, and other relevant information necessary to ensure the appropriate analyses are performed and to document the progress of the samples.

PARTICULATE FIELD DATA

COMPANY NAME_____ RUN NUMBER_____
ADDRESS_____ TIME START_____
SAMPLING LOCATION _____ TIME FINISH_____
DATE_____TEAM LEADER_____TECHNICIANS_____
BAROMETRIC PRESSURE. IN. HG____STATIC PRESSURE IN. H_2O_____
SAMPLING TRAIN LEAK VACUUM IN. HG ___ ___ ___ ___ ___ ___
SAMPLING TRAIN LEAK RATE,CU.FT/MIN___ ___ ___ ___ ___ ___

EQUIPMENT CHECKS	IDENTIFICATION NUMBERS	LK.TEST READING
___PITOTS, PRE-TEST	REAGENT BOX____NOZZLE_____DIAMETER____	
___PITOTS, POST-TEST	METERBOX_____T/C READOUT_____	
___ORSAT SAMPL. SYS.	UMBILICAL_____T/C PROBE_____	
___TEDLAR BAG	SAMPLE BOX_____ORSAT PUMP_____	
___THERMOCOUPLE @_____ °F	PROBE_____TEDLAR BAG_____	
FILTER # TARE		
_____ _____	DELTA H@ _____ C FACTOR _____	
_____ _____	METER TEMP_____ STACK TEMP _____	
_____ _____	% MOISTURE_____ REF. DELTA P_____	

SAMPLE POINT	CLOCK TIME MIN.	DRY GAS METER READING CU. FT.	PITOT READING IN. H_2O	ORIFICE SETTING IN. H_2O IDEAL	ORIFICE SETTING IN. H_2O ACTUAL	GAS METER TEMP. °F	VACUUM IN. HG GAUGE	GAS TEMP. OF °F FILTER BOX	GAS TEMP. OF °F CONDEN. EXIT	GAS TEMP. OF °F IMPIN. EXIT	STACK TEMP.	*

FIGURE 7-1 MODIFIED METHOD 5 DATA SHEET

PARTICULATE SAMPLING LABORATORY RESULTS

Plant Name _____ EEI Ref. #_____
Sampling Location
Date Received _____ Date Analyzed _____ Reagent Box(es)____

Run Number			
Run Date			

SUMMARY OF PARTICULATE ANALYSES

Sum of Particulate, mg.			
Total Filter Tare mg.			
Blank Residue, mg.	(____mL)	(____mL)	(____mL)
TOTAL PARTICULATE CATCH, mg.			

ANALYSIS OF MOISTURE CATCH

Reagent 1 (_____):			
Final Weight, g.			
Tared Weight, g.			
Water Catch, g.			
Reagent 2 (_____):			
Final Weight, g.			
Tared Weight, g.			
Water Catch, g.			
CONDENSED WATER, g.			
Silica Gel:			
Final Weight, g.			
Tared Weight, g.			
ABSORBED WATER, g.			
TOTAL WATER COLLECTED, g.			

Blank Beaker #____	--- Legend ---	Notes and Comments
Final wt. mg. _____	= Final Weight	
Tare wt. mg. _____	L = Loose Particulate	
Residue, mg. _____	F = Filter D = Dish	
Concen., mg/mL	R = Rinse P = Pan	

FIGURE 7-2 MOISTURE IMPINGER CATCH DATA SHEET PERFORMED IN LAB

I	-	M5/MMTL	-	1	-	a

Condition Number	Sample Type	Run Number	Multiple Samples Collected at Same Time (if applicable)
I, II, ...	Manual Methods M5/MMTL MM5 VOST M10 M26	1,2,3,4...	a,b,c...

Process Samples
WFL - Waste Feed Liquid
WFS - Waste Feed Solid
IA - Incinerator Ash
LF - Lime Feed
BA - Baghouse Ash

FIGURE 7-3 ALPHANUMERIC SAMPLE IDENTIFICATION NUMBER

CUSTODY SHEET FOR REAGENT BOX # _____

Date of Makeup _____ Initials _____ Locked? _____

Individual Tare of Reagent: _____ mls. of _____

Individual Tare of Reagent: _____ mls. of _____

Individual Silica Gel Tare Weight _____ gms.

PLANT NAME

SAMPLING LOCATION

Run Number	Date Used	Initials	Locked?	Date Cleanup	%S. Gel Spent	Initials	Locked?

Received in Lab Date _____ Initials _____ Locked? _____

Zero & Span Balance Initials

Sampling Method: _____

Filter #	Tare Weight (mgms)	Used on Test

Remarks:

FIGURE 7-4 CUSTODY SHEET FOR REAGENT BOX

PROCESS SAMPLE CHAIN OF CUSTODY

PLANT NAME _____
PLANT LOCATION _____

DESCRIBE PROCESS _____
_____

DESCRIBE SAMPLE _____
_____

DESCRIBE SAMPLING PROCEDURES (i.e. Grab or Integrated sample; single or composite, etc.) _____
_____

SAMPLING LOG				
SAMPLE ID	DATE	TIME	TAKEN BY	SAMPLING LOCATION

SAMPLES RECEIVED FROM THE PLANT BY _____ ON _____

SAMPLES RECEIVED IN THE LAB BY _____ ON _____

FIGURE 7-5 PROCESS SAMPLE CHAIN OF CUSTODY FORM

ORSAT FIELD DATA

Plant Name_____

Sampling Location_____Fuel Type_____

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.				Avg.		

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.				Avg.		

Run and/or Sample No. _____Leak Test?_____Date_____Operator_____

Time of Sample Collection	Time of Analysis	CO_2 Reading A	O_2 Reading B	CO Reading C	$\%O_2$ B-A	%CO C-B	$\%N_2$ 100-C
	Avg.				Avg.		

FIGURE 7-6 ORSAT ANALYTICAL DATA SHEET

ENTROPY ENVIRONMENTALISTS INC.
POST OFFICE BOX 12291
RESEARCH TRIANGLE PARK
NORTH CAROLINA 27709-2291
919/781-3550

REQUEST FOR ANALYSIS

PURCHASE
ORDER #_____ JOB NAME:

LABORATORY:_____

DATE SAMPLES WERE TRANSMITTED:_____ EXPECTED DATE OF RESULTS:_____

SAMPLE MATRIX:_____

TYPE OF ANALYSIS REQUESTED:_____

SUBMITTED BY:_____

FIGURE 7-7 REQUEST FOR ANALYSIS FORM

CALIBRATION PROCEDURES AND FREQUENCY

8.1 Sampling Equipment

Entropy's sampling equipment is calibrated according to the criteria specified in the reference method being employed. In addition, Entropy follows the guidelines set forth in the "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods". Dry gas meters, orifices, nozzles, and pitot tubes are calibrated in accordance with this document.

The range of the calibration is specified for all environmental measurements to encompass the range of probable experimental values. This approach ensures that all results are based upon interpolative analyses rather than extrapolative analyses. Calibrations are designed to include, where practical, at least four measurement points evenly spaced over the range. This practice minimizes the probability that false assumptions of calibration linearity will be made. In addition, it is common practice to select, when practical, at least one calibration value which approximates the levels anticipated in the actual measurement.

Typically, calibration frequency is dictated by the need to demonstrate the stability of the calibration value over the course of measurements. Dry gas meters undergo a pretest calibration check on site.

Following the test program, calibrations are checked on all relevant items of sampling equipment to ensure the validity of data collected in the field according to the procedures outlined in Section 11. The calibration performance criteria for the sampling equipment are presented in Table 8-1. Sampling equipment calibration forms are presented in Figures 8-1 through 8-7.

8.2 Analytical Instruments

Calibration materials are employed which ensure calibration accuracy. Materials are prepared according to prescribed procedures. For example, depending on the end use of the data, gaseous calibration standards reflect either traceability to National Institute of Standards and Technology Standard Reference Materials (NIST SRMs) or traceability to in-house primary standards (prepared as part of an established methodology).

To ensure that all calibration standards prepared in-house have quality levels that in turn ensure meeting the data quality goals of all measurement programs, Entropy uses high quality reagents, volumetric devices, balances, etc. When adequate calibration materials cannot be prepared in-house, necessary materials (either NIST SRMs or materials possessing NIST SRM traceability) are acquired from outside sources.

The analytical balance used for gravimetric determination is checked each day of use with Class S weights. The procedure is described in "Quality Assurance Handbook for Air Pollution Measurement Systems," Volume III.

8.2.1 GC/MS Tuning Conditions and Mass Calibration - The mass calibration of a quadrupole mass spectrometer is checked daily through the use of FC-43. The initial tune of the instrument if also adjusted to give specific peak ratios for this compound, consistent with the type of analysis to be performed. For Volatile Organic Compound (VOA) or Volatile Organic Sample Train (VOST) analyses 50 ng of Bromofluorobenzene (BFB) is analyzed by GC/MS and the peak ratio criteria specified in Method 624 and/or the current EPA Contract Laboratory IFB are demonstrated.

The high resolution mass spectrometer is tuned to give the required static resolving power, which is checked by using PFK. Mass calibration is adjusted automatically to within ñ 5 parts-per-million approximately once per second during the course of all quantitative analyses.

8.2.2 GC/MS Calibration Curves - All instruments are subjected to initial calibration procedures, the details of which are specified in each method and/or the Project QA Plan. Curves have a minimum of three and typically five points and include a response factor for each analyte.

Continuing calibration is demonstrated on a daily basis. The maximum time between demonstrations of continuing calibration is 12 hours. The exact specifications for continuing calibration are as specified in the relevant EPA Method and typically require response factors to agree within 30% of the initial calibration value. In the event that continuing calibration cannot be demonstrated after corrective action (such as re-tuning instruments, maintenance of chromatographic columns, etc.) a new initial calibration curve will be generated.

All standards and samples will have internal standards added at a level approximating the mid point of the calibration curve. The response factor will be calculated from:

$$RF = A_S C_{IS} / A_{IS} C_S$$

Where

A_{IS} = area of the internal standard

A_S = area of the target compound

C_{IS} = amount of internal standard

C_S = amount of the target compound

The response factor is used to demonstrate linearity in initial calibrations, continuing calibration and the concentration of analytes.

TABLE 8-1
IN-HOUSE EQUIPMENT CALIBRATION

APPARATUS	CALIBRATION METHOD AND FREQUENCY	CORRECTIVE SPECIFICATIONS	ACTION
Type S Pitot Tubes	Standards contained in EPA Method 2	Coefficient of 0.84 ± 0.02	Refurbish or recalibrate
	Visual inspection prior to shipment to test site and again prior to each day of testing.		
Manometers	Leak check before and after each field use.		Repair or replace
Magnehelic Gauges	initially calibrated over full range.	0-10" water	
	After each field use, checked against inclined manometer at average settings encountered during testing.		
Thermometers - Impinger - Dry Gas Meter - Filter Box	After purchase and prior to each field use, using ASTM mercury-in-glass thermometer.	Imp = ñ 2° F ₒ DGM = ± 5.4 F FB = ± 5.4 F	Adjust, determine correction factor, or reject
Thermocouple/ Potentiometer	After purchase. 3-point (ice bath, boiling water, and hot oil) using ASTM mercury-in-glass thermometer	± 1.5% of absolute temperature or reject	Adjust, determine correction factor,
	Before and after each field use compared to ASTM mercury-in-glass thermometer at ambient conditions.		
Dry Gas Meter and Orifice	Full Calibration (every 6 months) over wide range of orifice settings to obtain calibration factor	DGM = ± 2% of avg. factor for each calib. run. Ori. = ± 0.15" H_2O over delta H range of 0.4" to 4.0".	Adjust, determine correction factor, or reject
	10-minute quick calibration before sending to test site and again prior to each day of field use.	± 3% of full. ± 5% of full	Use if no backup. Do not use.
	Posttest (at average delta H and highest vacuum) to determine if meter gamma has changed.	± 5% of full calibration. Factor (initial or recalibration) that yields the lowest sample volume for the testing is used.	Meter calibration, meter coefficient
Dry Gas Meter Transfer Standard	Annual calibrations conducted in triplicate using EPA wet test meter. Calibrations conducted at 7 flow rates from 0.25 to 1.40 cfm.	± 2% of average factor for each calibration run.	Adjust and recalibrate.
Barometer	Before and after each field use against an ASTM mercury-in-glass barometer.	± 0.1" mercury	Adjust to agree
	Referenced barometer adjusted for elevation differences.		
Probe Nozzle	Average of 5 I.D. measurements using a micrometer. Visual inspection before and after each field use	Difference between high and low measurement < 0.004"	Repair and recalibrate

ISOKINETIC METERBOX FULLTEST CALIBRATION

Meterbox No. _____ Calibrated By _____

Date _____ Barometric Pressure (P_b) _____ (In. Hg)

Date _____ * Barometric Pressure (P_b) _____ (In. Hg)*

Standard Meter No. _____ Standard Meter Coefficient (Yds)_____

STANDARD METER			METERBOX METERING SYSTEM				
Gas Volume (V_{ds}) cf	Temperature (t_{ds}) °F	Time (θ) Minutes	Orifice Setting (ΔH) Inches H_2O	Gas Volume (V_d) cf	Temperature (t_d) °F	Coefficient (Y_d)	$\Delta H@$ Inches H_2O
			0.5				
			0.5				
			2.0				
			2.0				
			4.8				
			4.8				
					Average		

1. Coefficient range: 0.97-1.03.
2. Coefficient tolerance: for individual runs, ± 0.02 from average.
3. H@ range: 1.6-2.0.
4. H@ tolerance: ≤ 0.15 In. H_2O over ΔH range of 0.4 In.-4.0 In.

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + (\Delta H / 13.6))}$$

$$\Delta H@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

Figure 8-1 Meterbox Calibration Form

ISOKINETIC METERBOX POSTTEST CALIBRATION

METERBOX NO. _____

Date _____ Calibrated By _____ Job Number _____

Barometric Pressure (P_b) ___(In. Hg) Meterbox Vacuum _____ (In. Hg)

Standard Meter No. _____ Standard Meter Coefficient (Yds) _____

STANDARD METER			METER BOXMETERING SYSTEM				
Gas Volume (V_{ds}) cf	Temperature (t_{ds}) °F	Time (θ) Minutes	Orifice Setting (ΔH) Inches H_2O	Gas Volume (V_d) cf	Temperature (t_d) °F	Coefficient (Y_d)	ΔH@ Inches H_2O
					Average		

Fulltest Y_d _____ Date _____ % Dev. _____ Allowed Dev.: ± 5%

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460) * P_b}{V_d * (t_{ds} + 460) * (P_b + (\Delta H / 13.6))}$$

$$\Delta H@ = \frac{0.0317 * \Delta H}{P_b * (t_d + 460)} * \left[\frac{(t_{ds} + 460) * \theta}{Y_{ds} * V_{ds}}\right]^2$$

Figure 8-2 Post Test Meterbox Calibration Form

Calibration By: _____ Meterbox Number: _____

Date:_____ Barometric Pressure (P_b):_____ in. Hg

*Date:_____ *Barometric Pressure (P_b):_____ in. Hg

Standard Meter Number:_____ Coefficient (Y_{ds}):_____

Standard Dry Gas Meter			Meterbox Metering System				
Gas Volume (V_{ds}) ft^3	Temp. (T_{ds}) °F	Time (Θ) min.	Rotameter Setting CFH	Gas Volume (V_d) ft^3	Temp. (T_d) °F	Flow Rate (Q_d) CFM	Coeff. (Y_d)
					Average		

$$Y_d = \frac{Y_{ds} * V_{ds} * (t_d + 460)}{V_d * (t_{ds} + 460)}$$

$$Q_d = \frac{17.64 * V_d * V_m * P_b}{\Theta * (t + 460)}$$

Figure 8-3 Vost Meterbox Calibration Form

NOZZLE NUMBER:

DATE	Initials	Dia. 1	Dia. 2	Dia. 3	Dia. 4	Dia. 5	Average

NOTE: All diameters measured in inches.

Figure 8-4 Nozzle Calibration Form

SAMPLING EQUIPMENT CHECKLIST

Plant Name/Address _____ Job No. _____

Sampling Location _____ Team Leader _____

BAROMETER CHECK

Date	Entropy In-House Reference Barometer	Field Barometer	Check OK?*

* ± 0.1" Mercury

THERMOMETERS AND THERMOCOUPLE CHECK

Date _____ Reference Thermometer Ambient Temperature, °F _____

	Ambient Temperature, °F	Acceptance Range, °F	Check OK?
Thermometers			
Impinger Exit	_____	± 2.0	_____
Filter Box	_____	± 5.4	_____
Dry Gas Meter	_____	± 5.4	_____
_____	_____	_____	_____

Adjust thermometer until acceptable. If it cannot be adjusted, use as back-up. If no backup, record ambient temperature indicated by unadjusted thermometer.

Thermocouples	_____	± 8.0* (± 2.0)**	_____
	_____		_____

* ± 1.5% of Absolute Temperature.
** Acceptance range is ± 2.0°F if used in saturated or water droplet-laden gas stream.

PITOT AND NOZZLE CHECK

Pitot No.	Visual Check	Nozzle No.	Visual Check
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Figure 8-5 Sampling Equipment Calibration Checklist

ON-SITE DRY GAS METER AUDIT

Plant Name _____ Job Number _____

Date _____ Meter Box Identification Number _____

Time _____ Fulltest Gamma (Y) _____ $\Delta H@$ _____

Auditor _____ Barometric Pressure (P_{bar}) _____ In. Hg

As Applicable:

Zero Magnehelics? (check) ____

Zero/Level Manometer? (check) ____

Dry Gas Meter Reading (ft^3)	Meter Temperature (°F)	Upper and Lower Limits for Audit Gamma
Initial _____	Initial _____	0.96 * Y = _____
Final _____	Final _____	1.04 * Y = _____

Dry Gas Volume Metered (ft^3)	Average Meter Temperature (°F)	Run Time (Base = 10)	
		(Min.)	(Sec.)
Vm = _____	Tm = _____	_____	_____

$$Y_c = \frac{[\text{Min.} + (\text{Sec.} / 60)]}{Vm} * \left[\frac{0.0319\ (Tm + 460)}{P_{bar}}\right]^{0.5}$$

$$Y_c = \frac{[\_\_\_\_ + (\_\_\_\_ / 60)]}{\_\_\_\_} * \left[\frac{0.0319\ (\_\_\_\_ + 460)}{\_\_\_\_}\right]^{0.5} = \underline{\text{Calculated Audit Y}}$$

Audit Gamma Within Acceptable Limits? Yes ____ No ____

Figure 8-6 On-site Dry Gas Meter Audit

TEMPERATURE SENSING EQUIPMENT CALIBRATION DATA

BAROMETRIC PRESSURE:_____ DATE:_____ CALIBRATED BY:

MERCURY-IN-GLASS REFERENCE NUMBER:_____ AMBIENT TEMP:

CALIBRATION SYSTEM USED	POTENTIOMETER I.D. NUMBER	THERMOCOUPLE/ THERMOMETER I.D. NUMBER	REFERENCE THERMOMETER TEMPERATURE T_o (°F)	T_c (°f)	MEAN THERMOMETER OF Hg COLUMN T_m (°F)	THERMOCOUPLE/ THERMOMETER TEMPERATURE T_t (°F)	delta T^E ≤1.5%

CORRECTED TEMPERATURE = $T_c = T_o + .00009\ (T_o-20)\ (T_o-T_m)$

TEMPERATURE DIFFERENCE + Delta T = $\dfrac{[(T_c, {}^\circ F + 460) - (T_t, {}^\circ F + 460)] \times 100 \leq 1.5\%}{T_c, {}^\circ F + 460}$

Figure 8-7 Thermocouple Calibration Form

9. ANALYTICAL PROCEDURES

Table 6-1 summarizes all sampling and analytical procedures to be used during the program. Table 9-1 lists the sample matrix, analytical parameter, analytical method, expected detection limits, and the recommended holding times.

TABLE 9-1
SAMPLES AND ANALYTICAL PROCEDURES

Matrix	Parameter	Analytical Method	Detection Limits	Holding Time
Waste feed	Carbon Tet	SW-846 8010	0.12 ug/l	14 days
liquid	Dichlorobenzene	SW-846 8120	0.12 ug/l	14 days
	Chlorine	AOAC 11ED. 6.187	0.1% by wt.	21-28 days
	Ash	AOO1(b)	0.001% by wt.	21-28 days
	% H_2O	AOO1(b)	0.001% by wt.	21-28 days
	Heating Value	AOO6	N/A	21-28 days
	Viscosity	AOO5	0.002-3.0 stk	21-28 days
	Flashpoint	COO1	N/A	21-28 days
	Metals	SW-846 7000s	0.1% by wt.	21-28 days
Waste feed	Dichlorobenzene	SW-846 8120	0.12 ug/l	14 days
solid	Hexachlorobenzene	SW-846 8120	0.12 ug/l	14 days
	Chlorine	AOAC 11ED. 6.187	0.1% by wt.	21-28 days
	Ash	AOO1(b)	0.001% by wt.	21-28 days
	% H_2O	AOO1(b)	0.001% by wt.	21-28 days
	Heating Value	AOO6	N/A	21-28 days
	Metals	SW-846 7000s	0.1% by wt.	21-28 days
Incinerator Ash	POHCs	SW-846 8010, 8120	0.02-0.6 ug/g	14 days
	Metals	SW-846 7000s	0.1% by wt.	21-28 days
	EP Tox	SW-846 1310	0.1% by wt.	21-28 days
Lime Feed	POHCs	SW-846 8010, 8120	0.02-0.6 ug/g	14 days
	Metals	SW-846 7000s	0.0002-0.2 mg/ml	21-28 days
	Chlorine	AOAC 11 ED. 6.187	0.1% by wt.	21-28 days
Baghouse Ash	POHCs	SW-846 8010, 8120	0.02-0.6 ug/g	14 days
	Metals	SW-846 7000s	0.0002-0.2 mg/ml	21-28 days
	Chlorine	AOAC 11 ED. 6.187	0.1% by wt.	21-28 days
	EP Tox	SW-846 1310	0.1% by wt.	21-28 days
Method 5/MMTL	Particulate	EPA M5	0.1 mg	14 days
	Metals	SW-846 7000s	0.0002-0.2 mg/ml	21-28 days
EPA Draft Method	Hydrogen Chloride	Ion Chromatography	1 ug/l	21 days
Modified	Hexachlorobenzene	SW-846 8270	10 ug	14-28 days
Method 5	Dichlorobenzene			(extractions)
VOST	Carbon Tetrachloride	SW-846 5040	0.025 ug	14 days
Method 10	Carbon Monoxide	EPA M10	N/A	N/A

10. DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Reduction

Prior to any statistical treatment, reported data will be checked to ensure that it is complete. Extreme care will be exercised to ensure hand recorded data is written accurately and legibly. Values will be reviewed to ensure that they are reasonable by comparing them with previously recorded data from the same location or with other previous experience. Additionally, the use of prepared data recording forms, conveniently formatted, is an important aid to ensure that all necessary items of data are recorded. The collected field data will be reviewed by the analyst and the Project Manager. Laboratory data will be reviewed by the analyst and the Project Manager. All data will be reviewed at the earliest opportunity so that corrective action, if needed can be taken quickly.

Entropy will reduce and validate all of the sampling and analytical data that is collected. The sampling data will include orsats, flow measurements, calibration, etc. The analytical data will be used to determine concentrations and emission rates of the compounds of interest. Quality Assurance officers of each laboratory will validate all analytical results prior to their submission to Entropy. Following reduction of the data, Entropy will review and validate the results.

Data reduction follows guidelines published in EPA Reference Methods, where applicable, and by guidance documents where EPA Reference Methods are not available. Validated computer programs will be used to calculate all reported values.

10.2 Data Validation

This test involves collection of data by various individuals from field sampling activities and laboratory analyses. For this reason data validation and coordination are very important. The data from field sampling activities and from laboratory analyses are reviewed for completeness and comparability. Data from field sampling are collected on prepared forms. A cursory review of the completed data sheets would indicate missing data necessary for accomplishing the objectives of the test. The Project Supervisor will review field data forms for completeness and procure missing items. The laboratory quality assurance officer will perform the same function for analytical data. A measure of the degree (precision) among results can be ascertained by analyzing a given sample repeatedly under conditions controlled as closely as practical. The range of these replicate results provides a measure of the indeterminate variations.

Indeterminate errors can be estimated by calculation of the standard deviation after determinate errors have been removed. When indeterminate or experimental errors occur in a random fashion, the observed results will be distributed at random around the average of arithmetic mean.

Another useful technique to aid in data validation is the analysis of duplicate samples. Duplicate analyses are employed for the determination and control precision within the laboratory and between laboratories.

10.3 Data Reporting

Entropy has prepared more than 8000 technical reports detailing source testing programs conducted for industrial clients. These reports cover compliance testing, continuous monitoring performance testing, guarantee testing and a variety of engineering studies. Entropy developed the reporting format recommended in Volume III of the Quality Assurance Handbook, and prepares all reports accordingly. Entropy will present DRE's as well as the concentration and emission rates for the compounds of interest. DRE's will be reported as percentages, concentrations as ppm, and emission rates as pounds per hour. Particulate results will be reported in grains/DSCF, corrected to 7% oxygen. An example Table of Contents is presented in Appendix C. Example calculations are presented in Appendix D.

10.4 Report Contents

Copies of the test report will be submitted after the test series has been completed. Results reported will include, but not be limited to, emission rates and concentrations of particulates and gaseous pollutants, and ash or residue determinations, any liquid stream constituents determinations, and particle size distribution determinations, and any other type of data requested by the client. This report will also include a list of all personnel present during testing, summary of results, descriptions of test procedures used, a description of the source and its operation during testing, test locations, example calculations, raw field data, copies of the EPA Methods used during the test series, and equipment calibrations.

11. INTERNAL QUALITY CONTROL CHECKS

Specific quality control (QC) procedures will be followed to ensure the continuous production of useful and valid data throughout the course of this test program. The QC checks and procedures described in this section represent an integral part of the overall sampling and analytical scheme. Strict adherence to prescribed procedures is quite often the most applicable QC check. A discussion of both the sampling and analytical QC checks that will be utilized during this program is presented below.

11.1 Equipment Inspection and Maintenance

Each item of field test equipment purchased by Entropy is assigned a unique, permanent identification number. An effective preventive maintenance program is necessary to ensure data quality. Each item of equipment returning from the field is inspected before it is returned to storage. During the course of these inspections, items are cleaned, repaired, reconditioned, and recalibrated where necessary.

Each item of equipment transported to the field for this test program is inspected again before being packed to detect equipment problems which may originate during periods of storage. This minimizes lost time on the job site due to equipment failure.

Occasional equipment failure in the field is unavoidable despite the most rigorous inspection and maintenance procedures. For this reason, Entropy routinely transports to the job site replacement equipment for all critical sampling train components.

11.2 Equipment Calibration

New items for which calibration is required are calibrated before initial field use. Equipment whose calibration status may change with use or the time is inspected in the field before testing begins and again upon return from each field use. When an item of equipment is found to be out of calibration, it is repaired and recalibrated or retired from service. All equipment is periodically recalibrated in full, regardless of the outcome of these regular inspections.

Calibrations are conducted in a manner, and at a frequency, which meets or exceeds U. S. EPA specifications. Entropy follows the calibration procedures outlined in the EPA Methods, and those recommended within the Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III (EPA-600/4-77-027b, August, 1977). When these methods are inapplicable, Entropy uses methods such as those prescribed by the American Society for Testing and Materials (ASTM).

Data obtained during calibrations are recorded on standardized forms, which are checked for completeness and accuracy by the quality assurance director or the quality assurance manager. Data reduction and subsequent calculations are performed using Entropy's own computer facilities. Calculations are checked at least twice for accuracy. Copies of calibration forms are included in the test or project reports.

Emissions sampling equipment requiring calibration includes pitot tubes, pressure gauges, thermometers, dry gas meters, and barometers. The following sections elaborate on the calibration procedures

followed by Entropy for these items of equipment.

A: Pitot Tubes. All Type S pitot tubes used by Entropy, whether separate or attached to a sampling probe, are constructed in-house or by Nutech Corporation. Each new pitot is calibrated in accordance with the geometry standards contained in EPA Method 2. A Type S pitot tube, constructed and positioned according to these standards, will have a coefficient of 0.84 ± 0.02. This coefficient should not change as long as the pitot tube is not damaged.

Each pitot tube is inspected visually upon return from the field. If a cursory inspection indicates damage or raises doubt that the pitot remains in accordance with the EPA geometry standards, the pitot tube is refurbished as needed and recalibrated.

B: Differential Pressure Gauges. Some meter consoles used by Entropy are equipped with 10-in. water column (W.C.) inclined-vertical manometers. Fluid manometers do not require calibration other than leak checks. Manometers are leak checked in the field prior to each test series, and again upon return from the field.

Most of Entropy's meter consoles are equipped with Magnehelic differential pressure gauges. Each set of gauges is calibrated initially over its full range, 0-10 inches W.C. After each field use, the calibration of the gauge set is checked against an inclined manometer at the average delta p encountered during the test. If the agreement is within ± 5 percent, the calibration is acceptable.

C: Impinger Thermometer. Prior to the start of testing, the thermometer used to monitor the temperature of the gas leaving the last impinger is compared with a mercury-in-glass thermometer which meets ASTM E-1 No. 63F specifications. The impinger thermometer is adjusted if necessary until it agrees within 2° F of the reference thermometer. If the thermometer is not adjustable, it is labeled with a correction factor.

D: Dry Gas Meter Thermometer. The thermometer used to measure the temperature of the metered gas sample is checked prior to each field trip against an ASTM mercury-in-glass thermometer. The dry gas meter thermometer is acceptable if the values agree within ± 5.4° F. Thermometers not meeting this requirement are adjusted or labeled with a correction factor.

E: Flue Gas Temperature Sensor. All thermocouples employed by Entropy for the measurement of flue gas temperatures are calibrated upon receipt. Initial calibrations are performed at three points (ice bath, boiling water, and hot oil). An ASTM mercury-in-glass thermometer is used as a reference. The thermocouple is acceptable if the agreement is within 1.5 percent (absolute) at each of the three calibration points.

On-site, prior to the start of testing, the reading from the flue gas thermocouple-potentiometer combination is compared with an ASTM mercury-in-glass reference thermometer. If the two agree within ± 1.5 percent (absolute), the thermocouple and potentiometer are considered to be in proper working order for the test series.

After each field use, the thermocouple-potentiometer system is compared with an ASTM mercury-in-glass reference thermometer at ambient temperature. If the absolute temperatures agree within ± 1.5 percent, the temperature data are considered valid.

F: Dry Gas Meter and Orifice. Two procedures are used to calibrate the dry gas meter and orifice simultaneously. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter. Full calibrations are performed over a wide range

F: Dry Gas Meter and Orifice. Two procedures are used to calibrate the dry gas meter and orifice simultaneously. The full calibration is a complete laboratory procedure used to obtain the calibration factor of the dry gas meter. Full calibrations are performed over a wide range of orifice settings. A simpler procedure, the posttest calibration, is designed to check whether the calibration factor has changed. Posttest calibrations are performed after each field test series at an intermediate orifice setting (based on the test data) and at the maximum vacuum reached during the test.

Entropy uses, as a transfer standard, a dry gas meter that is calibrated annually against a spirometer. During the annual calibration, triplicate calibration runs are performed at seven flow rates ranging from 0.25 to 1.40 cfm.

G: Dry Gas Meter. Each metering system receives a full calibration at the time of purchase and a posttest calibration after each field use. If the calibration factor, Y, deviates by less than five percent from the initial value, the test data are acceptable. If Y deviates by more than 5 percent, the meter is recalibrated and the meter coefficient (initial or recalibrated) that yields the lowest sample volume for the test runs is used.

EPA Method 5 requires another full calibration anytime the posttest calibration check indicates that Y has changed by more than 5 percent. Standard practice at Entropy is to recalibrate the dry gas meter anytime Y is found to be outside the range of 0.97 to 1.03.

H: Orifice. An orifice calibration factor is calculated for each flow setting during a full calibration. If the range of values does not vary by more than 0.15 in. H_2O over the range of 0.4 to 4.0 in. H_2O, the arithmetic average of the values obtained during the calibration is used.

I: Barometer. Each field barometer is adjusted before each test series to agree within ± 0.1 inches of a reference aneroid barometer. The reference barometer is checked weekly against the station pressure value (corrected for elevation difference) reported by the National Weather Service station at the Raleigh-Durham airport, approximately 2.5 miles from Entropy's location.

11.3 Sampling Quality Control Procedures

The following pretest QC checks will be conducted:

- All sampling equipment will be thoroughly checked to ensure clean and operable components.
- Equipment will be inspected for possible damage from shipment.
- The oil manometer or Magnehelic gauge used to measure pressure across the Type S pitot tube will be leveled and zeroed.
- The number and location of the sampling traverse points will be checked before taking measurements.
- The temperature measurement system will be visually checked for damage and operability by measuring the ambient temperature prior to each traverse.

In addition to the general QC procedures listed above, QC procedures specific to each sampling method will also be incorporated into the sampling scheme. These method specific procedures are discussed below.

A: Sampling Train QC Checks. The following QC procedures will be emphasized:

Prior to Testing Each Day

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.
- Keep all cleaned glassware and sample train components sealed until train assembly.
- Assemble the sampling trains in an environment free from uncontrolled dust.
- Visually inspect each sampling train for proper assembly.
- Perform pretest calculations to determine the proper sampling nozzle size.

During Testing Each Day

- Readings of temperature and differential pressure will be taken at each traverse point.
- All sampling data and calculations will be recorded on preformatted data sheets.
- All calibration data forms will be reviewed for completeness and accuracy.
- Any unusual occurrences will be noted during each run on the appropriate data form.
- The project supervisor will review sampling data sheets daily during testing.
- Properly maintain the roll and pitch axis of the Type S pitot tube and the sampling nozzle.
- Leak check the train before and after any move from one sampling port to another during a run or if a filter change takes place.
- Conduct additional leak checks if the sampling time exceeds 4 hours.
- Maintain the probe, filter, and impingers at the proper temperature.
- Maintain ice in the ice bath at all times.
- Make proper readings of the dry gas meter, delta P and delta H, temperature, and pump vacuum during sampling at each traverse point.
- Maintain isokinetic sampling within ± 10% of 100%.

After Testing Each Day

- Visually inspect the sampling nozzle.
- Visually inspect the Type S pitot tube.
- Leak check each leg of the Type S pitot tube.
- Leak check the entire sampling train.

11.4 QC For Volumetric Air Flow Rate Determinations

A: Flue Gas Velocity. Data required to determine the flue gas velocity will be collected using the methodology specified in EPA Method 2. Quality control procedures are as follows:

- Visually inspect the Type S pitot tube before and after sampling.
- Leak check both legs of the pitot tube before and after sampling.
- Check the number and location of the sampling traverse points before taking measurements.

B: Flue Gas Molecular Weight. Samples to be used for determination of flue gas molecular weight will be collected using the integrated sampling technique specified in EPA Method 3. Quality control will focus on the following procedures:

- The sampling train will be leak checked before and after each run.
- A constant sampling rate will be used in withdrawing a sample.
- The sampling train will be purged prior to sample collection.
- The sampling port will be properly sealed to prevent air inleakage.

C: Moisture Content. The moisture content of the gas stream will be determined using the technique specified in EPA Method 5. The following QC checks will be performed:

- The sampling train will be leak checked before and after each run.
- Ice will be maintained in the ice bath throughout each run.

11.5 Analytical Quality Control Procedures

All analyses for this program will be performed using accepted laboratory procedures in accordance with the specified analytical protocols. Adherence to prescribed QC procedures will ensure data of consistent and measurable quality. Table 11-1 presents the minimum QA measurements to be performed. Analytical QC will focus upon the use of control standards to provide a measure of analytical precision and accuracy. Also, specific acceptance criteria are defined for various analytical operations including calibrations, control standard analyses, drift checks, blanks, etc. The following general QC procedures will be incorporated into the analytical effort:

- The on-site project supervisor will review all analytical data and QC data on a daily basis for completeness and acceptability.
- Analytical QC data will be tabulated using the appropriate charts and forms on a daily basis.
- Copies of the QC data tabulation will be submitted to the quality assurance manager following the completion of the test program.
- All hardcopy raw data (i.e., chromatograms, computer printouts, etc.) will be maintained in organized files.

Specific analytical QC procedures for the Orsat analyzer are listed below.

- The analyzer will be leveled and the fluid levels zeroed prior to use.

TABLE 11-1
MINIMUM QUALITY ASSURANCE MEASUREMENTS

SAMPLE	PARAMETER	BLANKS*	DUPLICATES	SURROGATE SPIKES
Waste Feed liquid	Carbon Tet	-	10%	-
	Dichlorobenzne	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	$\%H_20$	-	10%	-
	Heating Value	-	10%	-
	Viscosity	-	10%	-
	Flashpoint	-	10%	-
	Metals	-	10%	-
Waste Feed solid	Dichlorobenzene	-	10%	-
	Hexachlorobenzene	-	10%	-
	Chlorine	-	10%	-
	Ash	-	10%	-
	$\%H_20$	-	10%	-
	Heating Value	-	10%	-
	Metals	-	10%	-
Incinerator Ash	POHCs	1MB	10%	100%
	Metals	-	10%	-
	EP Tox	-	10%	-
Lime Feed	POHCs	1MB	10%	100%
	Metals	-	10%	-
	Chlorine	-	10%	-
Baghouse Ash	POHCs	1MB	10%	100%
	Metals	-	10%	-
	Chlorine	-	10%	-
	EP Tox	-	10%	-
Stack Gas	Particulate	Acetone	-	-
	Metals	1 FB, reagents	10%	-
	HCl	1MB	100%	-
	Carbon Tet.	1FB, 1MB, 1TB	-	100%
	Dichlorobenzene	1 FB, 1MB, 1TB	-	100%
	Hexachlorobenzene	1FB, 1MB, 1TB	-	100%
	Carbon Monoxide	-	-	-

* MB - Method Blank
FB - Field Blank
TB - Trip Blank

- The analyzer will be leak checked prior to use.
- The analyzer will be thoroughly purged with sample prior to analysis.
- The analyzer will be checked by analyzing an ambient air sample.
- All hardcopy raw data (i.e., chromatograms. computer printouts, etc.) will be maintained in organized files.

Specific analytical QC procedures for the Orsat analyzer are listed below.

- The analyzer will be leveled and the fluid levels zeroed prior to use.
- The analyzer will be leak checked prior to use.
- The analyzer will be thoroughly purged with sample prior to analysis.
- The analyzer will be checked by analyzing an ambient air sample.

Hydrogen Chloride Analytical QC Check are listed below.

- Lab (reagent) blanks will be analyzed for every 10 samples or at least one per matrix.
- Duplicates are analyzed for each sample and should agrees within 10%.

All measurements methods employed by TLI have associated quality control checks. The extent of the activities depends upon the control status of a particulate method at the time of its use. In this respect, a method is either in control or out of control.

Routine quality control activities are applied to methods in control: these routine activities generally include quality control measures recommended within published methods. For EPA methods, these are the minimum activities followed.

For methods not designated as Reference Methods, minimum quality control efforts include the following, as applicable.

1) Initial tuning, mass and response calibration of the mass spectrometer.
2) Measurement of analytical blanks, processed in the same manner as the samples.
3) Analysis of quality control samples, including matrix spikes and duplicate determinations.

For methods out of control (which includes method under development, since these are by definition, of undetermined quality), quality control activities in addition to this described as routine are applied. While the course for establishing (or re-establishing) control of the analysis is generally approached on a case-by-case basis, TLI has employed the following quality control activities when criteria associated with routine activities were not met, and when methods are being evaluated.

1) Replicate determination to establish the consistency of analytical behavior.
2) Split samples to assess either the quality of the sample preparation phase or to acquire an independent check of the measurement result.
3) Spiked samples to assess the influence of matrix effects.
4) Assessment of reagent quality.

5) Evaluation of reagent quality.

Data from initial and continuing calibrations are incorporated into the final report for each project, as are results from other quality control activities including the results from the analysis of blanks and spiked samples.

12. PERFORMANCE AND SYSTEMS AUDITS

12.1 Entropy Environmentalists

Performance and systems audits are routine elements of all Entropy QA/QC programs. System audits are always conducted by teat team leaders prior to departure for the sampling site. These audits entail the use of equipment check lists, previously completed by the Project Manger and Project Supervisor, to assure the inclusion of all materials and equipment necessary for the sampling task.

The laboratory staff conducts system audits of the laboratory on a regular basis and reports to the Quality Assurance Manager as conditions require. In addition to these system audits, performance audits of the laboratory are conducted prior to the processing of any samples for analysis. Audit materials typically include materials available form the EPA of material especially prepared by the QAC. Performance audits figure prominently in long-term projects under Entropy's direction. In particular, performance audits are scheduled at the beginning, at intermediate points, and at the end of these projects to assess the quality of continuous emissions monitoring system data and to assess the adequacy and effectiveness of the project's QA/QC programs.

Relative to the VOST sampling associated with this project, a total system audit technique is not presently available. However, an on-site qualitative inspection and review of each sampling system will be performed by the Project Supervisor. This systems audit will include observation and recording of the following activities:

1) Sample train assembly and leak checks
2) Posttest leak checks and sample train assembly
3) Sample recovery, labeling, and storage for shipment

Entropy will perform a VOST and/or CEM audit if requested by the regulatory agencies. At present there are no applicable performance audits for the other sampling and analytical methods to be performed by Entropy.

12.2 Oxford Laboratories

12.2.1 External Audits

Oxford Laboratories participates in several certification programs administered by the USEPA, State of North Carolina, and USDA. Though the specific parameters requested in the scope of this work may not be covered by a formal certification program, these certifications are cited as general evidence of proficiency in a diversity of analytical techniques. Certification and recognitions of the laboratory are as follows:

Agency	Laboratory Code	Parameters
USEPA	37721	Safe Drinking Water Act (all parameters excluding microbiology).

NC Dept. of Natural Resources	75	NPDES Monitoring (all parameters excluding microbiology).
USDA	3781	Moisture, fat, protein, salt, Polychlorinated Byphenyls, Chlorinated Hydrogen Pesticide
Defense Logistics	14123	Parameters 1, 10, 16, and C

The details of the maintenance of each of these certifications are too numerous to fully describe here, but do consist of on site inspections and generating acceptable data on "known" and "round-robin" samples.

12.2.2 Internal Audits

In a sense, a constant audit of systems is in progress each working day. The laboratory manager is continually moving about the laboratory and monitoring the quality of the data being generated through hands on inspection. Certain features of our quality assurance program facilitate self-scrutiny by the analyst. For, example, notebooks used to record data for routine procedures conveniently display historical norms for standard responses. Data which falls outside of these norms is immediately suspect.

In a more formal auditing procedure, known samples of EPA quality assurance materials are periodically submitted for analysis.

12.3 Triangle Laboratories

Performance and system audits are routine elements of all TLI QA/QC programs. System audits are always conducted by Program Managers before the beginning of any project. These include verification that the instruments are in proper operating conditions, that adequate supplies and spare parts are on-hand for the samples to be analyzed and that sufficient qualified personnel are available to perform the work in the specified schedule.

Laboratory performance audits are conducted prior to the implementation of any new protocol and periodically during the performance of analyses. When available, audit samples from outside sources, such as EPA, are used to measure system performance. Otherwise, in-house audit samples are prepared and analyzed.

13. PREVENTIVE MAINTENANCE

Well maintained equipment is a very important factor in assuring the quality and completeness of measurement data. Measurements conducted in the field are more sensitive to the degree of equipment maintenance than are measurements conducted within a laboratory setting, because the former are performed in an uncontrolled and often hostile environment. All glassware will be cleaned according to SW-846 methods.

13.1 Entropy Environmentalists

Entropy minimizes the potential impact of equipment malfunction on data completeness through two complementary approaches. First, an in-house equipment maintenance program is part of routine operations. The maintenance program's strengths include: (a) the ready availability of technicians experienced in the details of equipment maintenance and fabrication, (b) maintenance of an adequate spare parts inventory, and (c) the availability of tools and specialized equipment.

The second approach is based upon equipment redundancy. Backup equipment, spare parts, and tools are included on the materials transported to the field for each sampling task. This approach allows the sampling team to respond to equipment breakage or malfunction in a timely fashion, minimizing the quantity of lost data.

For field equipment, preventive maintenance schedules are based on the results of routine inspections and on accumulated experience. Maintenance schedules for major analytical instruments (e.g., balances, gas chromatographs) follow manufacturer's recommendations. Maintenance performed on these items is documented in maintenance logbooks kept with each instrument.

13.2 Oxford Laboratories

13.2.1 Schedules Preventive Maintenance

Some highlights of our preventive maintenance procedures that are pertinent to this project are as follows:

a) Analytical balances are serviced yearly by the manufacturer's service technician.

b) Deionized water is generated using two mixed bed cannister in series. A 5 uhm indicating light indicates exhaustion of the resin. The exhausted cannister is immediately replaced and the "fresh unit" is placed in the downstream position. The charcoal filter for organics removal is replaced each time a cannister is replaced. These processes provide for a constant supply of quality reagent water.

c) Maintenance schedules for all major equipment follow the manufacturer's guidelines.

13.2.2 Inventory

A sufficient inventory is on hand at all times for all reagents and glassware required by the project.

13.3 Triangle Laboratories

Well maintained equipment is an essential in assuring the quality, completeness, and timeliness of analytical data. TLI minimizes the risk of data incompleteness through the performance of regular maintenance on all equipment, redundancy in equipment, provision of an ample stock of spare parts, and inventory of specialized test equipment to support rapid repair, in the event unscheduled maintenance is required. Perhaps the most important feature of our equipment maintenance/repair plan is the availability on out staff of personnel capable of providing instrument service without reliance on off site service technicians.

14. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The experimental design allows data to be grouped into sets that can be analyzed to evaluate data precision and accuracy. The general tendency and dispersion of data is assessed by reviewing the following parameters. These assessments are performed on all sets of 10 or more data points.

14.1 Arithmetic Mean

The mean of a series of replicate measurements offers an average value for the measurement. The mean is calculated as:

$$\bar{x} = \sum_{i=1}^{n} x_i/n$$

where:

n = number of replicate measurements, and

X_i value of each individual measurement.

14.2 Relative Standard Deviation

The relative standard deviation (RSD) of a series of measurements offers and assessment of the degree of dispersion of the measurements as a percentage of the mean value. RSD is calculated as:

$$\% \text{ RSD} = (s/X) \times 100$$

where:

s = standard deviation

$$s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n - 1}}$$

15. CORRECTIVE ACTION

Any samples not collected according to the methods will be considered for voiding. Any equipment found to be out or calibration or not operating properly will be repaired or replaced before additional measurements are made.

Normally, each analytical method employed and each type of sample matrix generating 10 or more data points will require mean recovery data to be generated for analysis of surrogates and percent deviation data generated for replicate samples. If surrogate recoveries exceed the performance goals established for this trial burn project, corrective action will be taken to improve performance prior to the analysis of the rest of the samples.

If weakness or problems become apparent during system performance audits, corrective action will be initiated immediately. Examples of corrective actions which might be taken are recalibration of instruments using freshly prepared calibration standards, and replacement of reagents that give unacceptable blank values.

Should performance audits indicate that any methods are out of control, the Quality Assurance Coordinator and Project Manger will review the audit data and determine the appropriate action to be taken. Independent calibration checks will be used if necessary to resolve problems with an analytical system.

In all cases where standard procedures cannot resolve the problem, the QAC and the Project Manager (and/or the GC/MS operator) will determine the appropriate action. The Project Manager and the GC/MS operator have daily contact with the procedures, and offer detailed familiarity with them. The QAC offers a broader background and more detached viewpoint. This combination helps in formulating quick and reliable solutions to various problems. The Project Manager and/or the GC/MS operator will be responsible for initiating the action, and the QAC will be responsible for determining if this action has resolved the problem.

Entropy's handling procedures for sorbent traps during all phases of handling, for blank checking, to sample collection and analysis, are designed to eliminate contamination in field blank sorbent traps by limiting their exposure to contaminants in the ambient air. If high levels of contamination are present in the field blanks, trip blanks will be analyzed. Corrective action will be taken if the field blanks are significantly different from the trip blanks. This comparison will indicate whether high levels in the field blank are due to contamination from exposure to ambient air or from degradation of the Tenax.

QC activities when criteria associated with routine activities were not met, and when methods were being evaluated:

1. replicate determination, to enable estimates of the precision of sampling and analysis phases;
2. split samples, in order to assess the quality of the sample preparation phase or to acquire an independent check of the measurement result;
3. spiked samples, in order to assess the influence of matrix effects;
4. checks of reagent quality; and

5. checks of the adequacy of calibration standards.

If a sample train leak is found after testing has begun, the sampling train that the leak is on will be aborted and that run of the sampling method will be repeated.

16. QUALITY ASSURANCE REPORTS TO MANAGEMENT

Quality assurance reporting and documentation are important elements of final project reports. Reports provided to agency and industrial clients contain sections which (a) describer QA/QC activities and criteria relevant to the measurements reported, (b) provide results from the application of these activities, and (c) address the impact of these results on the measurements reported.

The QA procedures used in this test program generate sufficient documentation to indicate quality. QA results will be included in the final report. At a minimum the following will be addressed in the final report:

(a) Precision
(b) Recovery (accuracy)
(c) Blanks
(d) Sampling and analysis equipment calibration
(e) Cylinder gas audits and on-site equipment audits
(f) Spike composition verification and recovery checks
(g) GC/MS recovery checks
(h) Internal standard response tracking

All evidence of the execution of the QA guidelines is reviewed by management. In addition, during regular meetings of Entropy's task managers and project managers, all aspects of the project are discussed, including the QA of each task. No written report results from this meeting because all interested parties are apprised of the situation during each meeting.

Two other reports are made to management which are not task related. Entropy's emission test and laboratory groups participate in all national audits by EPA's Quality Assurance Division, and Entropy's QA coordinator makes several independent checks for management.

APPENDIX A

DRE CALCULATIONS

VOST Sample Catch

Carbon Tetrachloride (CCl_4) Feed Rate	= 21 lbs/hr
Assumed DRE	= 99.99%
Stack Volumetric Flow Rate	= 2,830 DSCFM
Sample Volume per Pair of Tubes	= 20 Liters
Detection Limits	= 25 - 10,000 ng

Emission Rate of CCl_4:

21 lbs/hr in x (1-(99.99/100)) = 0.0021 lbs/hr out

CCl_4 Concentration in Stack Gas:

0.0021 lbs/hr + 60 min/hr x 453.592×10^6 µg/lb + 2,830 DSCFM + 28.317 L/CF = 0.198 µg/L

Total CCl_4 Catch per Pair of Tubes:

0.198 µg/L x 20 L = 3.96 µg

If 99.999% DRE is achieved, the CCl_4 catch would be approximately 0.4 µg.

MM5 Sample Catch

Hexachlorobenzene (HCB) Feed Rate	=> 20 lbs/hr
Assumed DRE	=> 99.99%
Stack Volumetric Flow Rate	=> 2,830 DSCFM
Sample Volume per Test Run	=> 30 DSCF
Minimum Detection Limit	=> 10 µg

Emission Rate of HCB:

20 lbs/hr in x (1-(99.99/100)) = 0.002 lbs/hr out

HCB Concentration in Stack Gas:

0.002 lbs/hr + 60 min/hr x 453.592×10^6 µg/lb + 2,830 DSCFM = 5.34 µg/DSCF

Total HCB Catch per Test Run:

5.34 µg/DSCF x 30 DSCF = 160 µg

If 99.999% DRE is achieved, the HCB catch would be approximately 16.0 µg.

APPENDIX B

SAMPLING AND ANALYTICAL METHODS

APPENDIX C

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APPENDIX D

EXAMPLE CALCULATIONS

Volume Of Dry Gas Sampled At Standard Conditions

$$Vm(std) = 17.64 * Y * Vm * \frac{(Pbar + Delta\ H/13.6)}{(460 + tm)}$$

Volume Of Water Vapor At Standard Conditions

$$Vw(std) = 0.04707 * Vlc$$

Percent Moisture, By Volume, As Measured In Flue Gas

$$\%H2O = 100 * Vw(std) / (Vw(std) + Vm(std))$$

Dry Mole Fraction Of Flue Gas

$$Mfd = 1 - (\%H_2O / 100)$$

Dry Molecular Weight Of Flue Gas

$$Md = (\%CO_2 * 0.44) + (\%O_2 * 0.32) + (\%CO + N_2 * 0.28)$$

Wet Molecular Weight Of Flue Gas

$$Ms = (Md * Mfd) + (0.18 * \%H_2O)$$

Absolute Gas Pressure

$$Ps = Pbar + (Pg / 13.6)$$

Average Flue Gas Velocity - Note: (Delta p) avg. is square of avg. sq. root

$$vs = 85.49 * Cp * SQRT\left[\frac{(Delta\ p)avg * (460 + ts))}{Ps * Ms}\right]$$

Dry Volumetric Flue Gas Flow Rate At Standard Conditions

$$Qsd = \frac{60}{144} * Mfd * vs * A * \frac{Tstd}{ts + 460} * \frac{Ps}{Pstd}$$

Wet Volumetric Flue Gas Flow Rate At Stack Conditions

$$Qaw = 60 / 144 * vs * A$$

Percent Isokinetic Of Sampling Rate

$$\%I = \frac{Pstd}{Tstd} * \frac{100}{60} * \frac{(ts + 460) * Vm(std)}{Ps * vs * Mfd * Theta * Area\text{-}nozzle,\ sq.ft.}$$

Percent Excess Air

$$\%EA = \frac{\%O_2 - (0.5 * \%CO)}{(0.264 * \%N_2) - (\%O_2 - (0.5 * \%CO))} * 100$$

Grains Per Dry Standard Cubic Foot

$$gr/DSCF = \frac{7{,}000}{453{,}592} * \frac{mgs}{Vm(std)}$$

$$gr/DSCF = \frac{7000 * ppm * Mol.\ Wt.}{385.3 * 10^6}$$

Grains Per DSCF Corrected To 7% CO2

$$gr@7\% = \frac{21.0 - 7.0}{21.0 - \%\ O_2} * gr/DSCF$$

Pounds Per Hour

$$Lb/Hr = \frac{60 * mg * Qsd}{453{,}592 * Vm(std)}$$

$$Lb/Hr = \frac{60 * micg * Qsd * 0.001}{453{,}592 * Vm(std)}$$

Parts Per Million By Volume Dry, HCl

$$ppmd = \frac{385.3 * 10^6 * mg}{453,592 * Mol.\ Wt. * Vm(std)}$$

Pounds Per Hour, HCl

$$Lb/Hr = \frac{60 * mg * Qsd}{453,592 * Vm(std)}$$

EXAMPLE CALCULATIONS, DESTRUCTION REMOVAL EFFICIENCY

Destruction Removal Efficiency, Percent

$$DRE = \frac{\text{Inlet Feed Rate (lbs/hr)} - \text{Emission Rate (lbs/hr)}}{\text{Inlet Feed Rate (lbs/hr)}} * 100$$

Parts Per Million By Volume Dry, POHC

$$ppmd = \frac{385.3 * 10^6 * micg * 0.001}{453.592 * Mol.\ Wt. * Vm(std)}$$

Pounds Per Hour, POHC

$$Lb/Hr = \frac{60 * ppmd * Mol.\ Wt. * Qsd}{385.3 * 10^6}$$

METHOD 0030

VOLATILE ORGANIC SAMPLING TRAIN

1.0 PRINCIPLE AND APPLICATION

1.1 Principle

1.1.1 This method describes the collection of volatile principal organic hazardous constituents (POHCs) from the stack gas effluents of hazardous waste incinerators. For the purpose of definition, volatile POHCs are those POHCs with boiling points less than 100°C. If the boiling point of a POHC of interest is less than 30°C, the POHC may break through the sorbent under the conditions of the sample collection procedure.

1.1.2 Field application for POHCs of this type should be supported by laboratory data which demonstrate the efficiency of a volatile organic sampling train (VOST) to collect POHCs with boiling points less than 30°C. This may require using reduced sample volumes collected at flow rates between 250 and 500 mL/min. Many compounds which boil above 100°C (e.g., chlorobenzene) may also be efficiently collected and analyzed using this method. VOST collection efficiency for these compounds should be demonstrated, where necessary, by laboratory data of the type described above.

1.1.3 This method employs a 20-liter sample of effluent gas containing volatile POHCs which is withdrawn from a gaseous effluent source at a flow rate of 1 L/min, using a glass-lined probe and a volatile organic sampling train (VOST). (Operation of the VOST under these conditions has been called FAST-VOST.) The gas stream is cooled to 20°C by passage through a water-cooled condenser and volatile POHCs are collected on a pair of sorbent resin traps. Liquid condensate is collected in an impinger placed between the two resin traps. The first resin trap (front trap) contains approximately 1.6 g Tenax and the second trap (back trap) contains approximately 1 g each of Tenax and petroleum-based charcoal (SKC Lot 104 or equivalent), 3:1 by volume. A total of six pairs of sorbent traps may be used to collect volatile POHCs from the effluent gas stream.

1.1.4 An alternative set of conditions for sample collection has been used. This method involves collecting sample volume of 20 liters or less at reduced flow rate. (Operation of the VOST under these conditions has been referred to as SLO-VOST.) This method has been used to collect 5 liters of sample (0.25 L/min for 20 min) or 20 liters of sample (0.5 L/min for 40 min) on each pair of sorbent cartridges. Smaller sample volumes collected at lower flow rates should be considered when the boiling points of the POHCs of interest are below 35°C. A total of six pairs of sorbent traps may be used to collect volatile POHCs from the effluent gas stream.

1.1.5 Analysis of the traps is carried out by thermal desorption purge-and-trap by gas chromatography/mass spectrometry (see Method 5040). The VOST is designed to be operated at 1 L/min with traps being replaced every 20 min for a total sampling time of 2 hr. Traps may be analyzed separately or combined onto one trap to improve detection limit. However, additional flow rates and sampling times are acceptable. Recent experience has shown that when less than maximum detection ability is required, it is acceptable and probably preferable to operate the VOST at 0.5 L/min for a total of three 40-min periods. This preserves the 2-hr sampling period, but reduces the number of cartridge changes in the field as well as the number of analyses required.

1.2 Application

1.2.1 This method is applicable to the determination of volatile POHCs in the stack gas effluent of hazardous waste incinerators. This method is designed for use in calculating destruction and removal efficiency (DRE) for the volatile POHCs and to enable a determination that DRE values for removal of the volatile POHCs are equal to or greater than 99.99%.

1.2.2 The sensitivity of this method is dependent upon the level of interferences in the sample and the presence of detectable levels of volatile POHCs in blanks. The target detection limit of this method is 0.1 ug/m^3 (ng/L) of flue gas, to permit calculation of a DRE equal to or greater than 99.99% for volatile POHCs which may be present in the waste stream at 100 ppm. The upper end of the range of applicability of this method is limited by breakthrough of the volatile POHCs on the sorbent traps used to collect the sample. Laboratory development data have demonstrated a range of 0.1 to 100 ug/m^3 (ng/L) for selected volatile POHCs collected on a pair of sorbent traps using a total sample volume of 20 liters or less (see Paragraph 1.1.4).

1.2.3 This method is recommended for use only by experienced sampling personnel and analytical chemists or under close supervision by such qualified persons.

1.2.4 Interferences arise primarily from background contamination of sorbent traps prior to or after use in sample collection. Many potential interferences can be due to exposure of the sorbent materials to solvent vapors prior to assembly and exposure to significant concentrations of volatile POHCs in the ambient air at hazardous waste incinerator sites.

1.2.5 To avoid or minimize the low-level contamination of train components with volatile POHCs, care should be taken to avoid contact of all interior surface or train components with synthetic organic materials (e.g., organic solvents, lubricating and sealing greases), and train components should be carefully cleaned and conditioned according to the procedures described in this protocol.

2.0 APPARATUS

2.1 Volatile Organic Sampling Train: A schematic diagram of the principal components of the VOST is shown in Figure 1 and a diagram of one acceptable version of the VOST is shown in Figure 2. The VOST consists of a glass-lined probe followed by an isolation valve, a water-cooled glass condenser, a sorbent cartridge containing Tenax (1.6 g), an empty impinger for condensate removal, a second water-cooled glass condenser, a second sorbent cartridge containing Tenax and petroleum-based charcoal (3:1 by volume; approximately 1 g of each), a silica gel drying tube, a calibrated rotameter, a sampling pump, and a dry gas meter. The gas pressure during sampling and for leak-checking is monitored by pressure gauges which are in line and downstream of the silica gel drying tube. The components of the sampling train are described below.

2.1.1 **Probe:** The probe should be made of stainless steel with a borosilicate or quartz glass liner. The temperature of the probe is to be maintained above 130°C but low enough to ensure a resin temperature of 20°C. A water-cooled probe may be required at elevated stack temperatures to protect the probe and meet the above requirements. Isokinetic sample collection is not a requirement for the use of VOST since the compounds of interest are in the vapor phase at the point of sample collection.

2.1.2 **Isolation valve:** The isolation valve should be a greaseless stopcock with a glass bore and sliding Teflon plug with Teflon wipers (Ace 8193 or equivalent).

2.1.3 **Condensers:** The condensers (Ace 5979-14 or equivalent) should be of sufficient capacity to cool the gas stream to 20°C or less prior to passage through the first sorbent cartridge. The top connection of the condenser should be able to form a leak-free, vacuum-tight seal without using sealing greases.

2.1.4 Sorbent cartridges:

2.1.4.1 The sorbent cartridges used for the VOST may be used in either of two configurations: the inside-outside (I/O) configuration in which the cartridge is held within an outer glass tube and in a metal carrier, and the inside-inside (I/I) configuration in which only a single glass tube is used, with or without a metal carrier. In either case, the sorbent packing will be the same.

2.1.4.1.1 The first of a pair of sorbent cartridges shall be packed with approximately 1.6 g Tenax GC resin and the second cartridge of a pair shall be packed with Tenax GC and petroleum-based charcoal (3:1 by volume; approximately 1 g of each).

2.1.4.1.2 The second sorbent cartridge shall be packed so that the sample gas stream passes through the Tenax layer first and then through the charcoal layer.

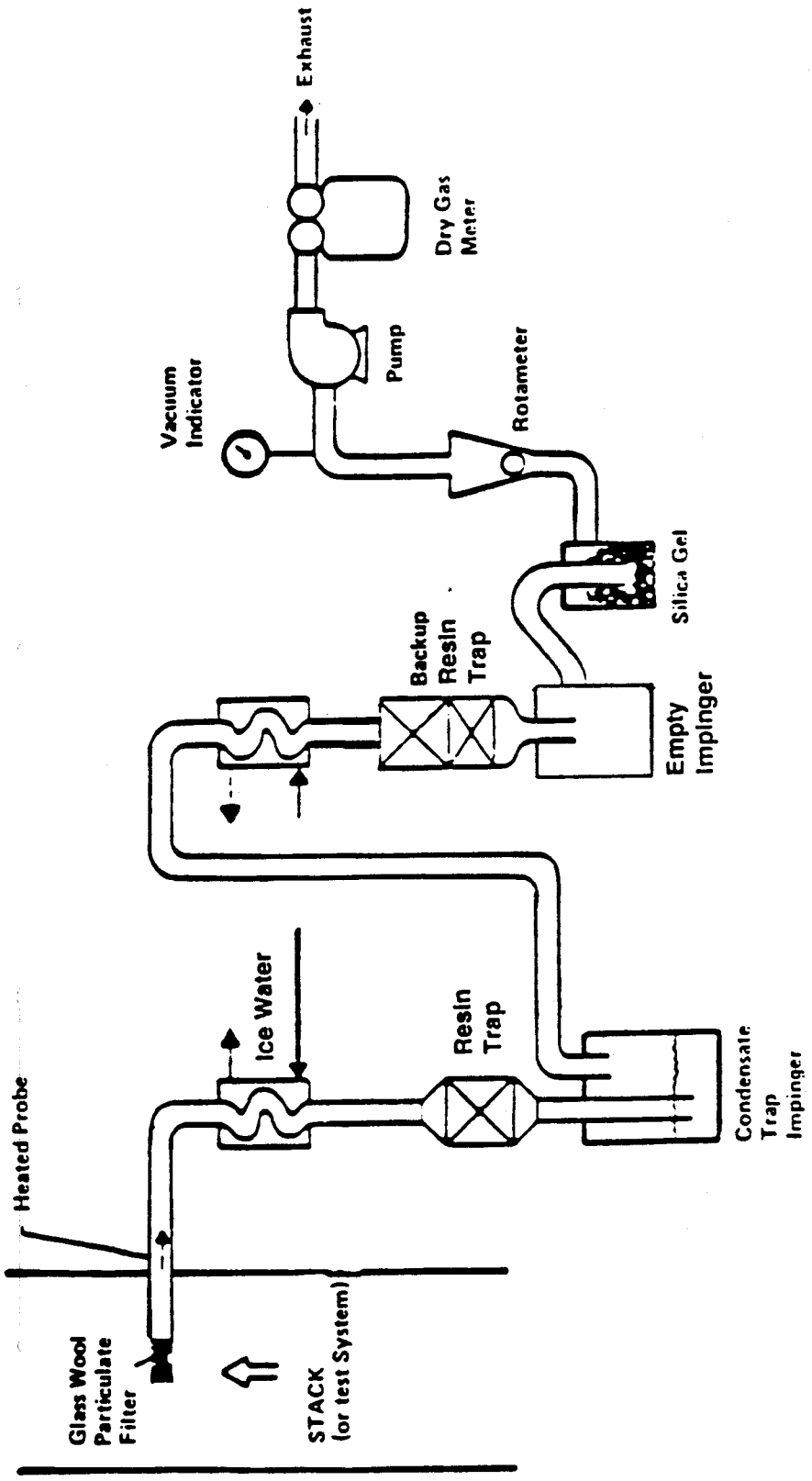


Figure 1. Schematic of Volatile Organic Sampling Train (VOST).

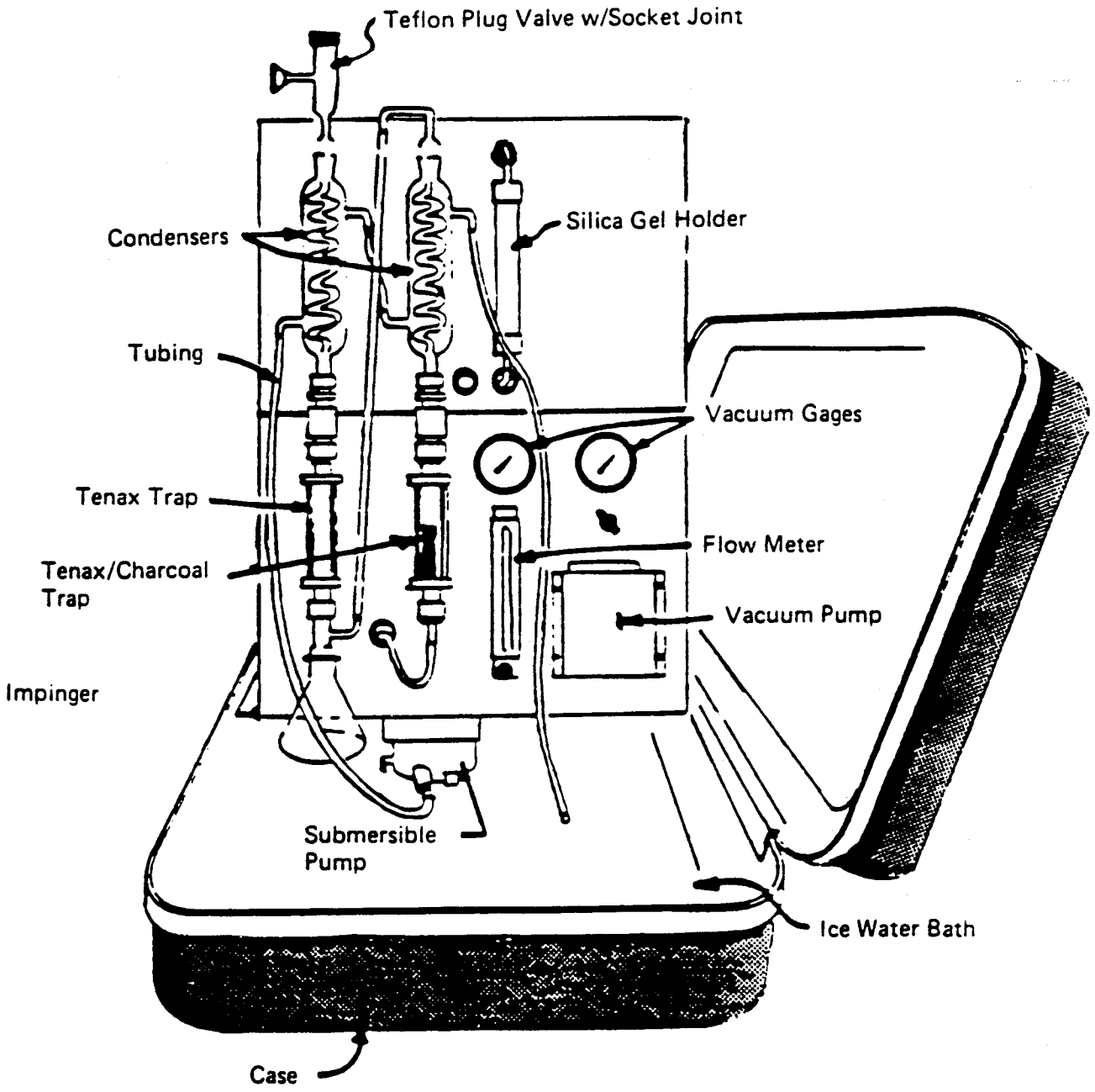


Figure 2. Volatile Organic Sampling Train (VOST).

2.1.4.2 The sorbent cartridges shall be glass tubes with approximate dimensions of 10 cm by 1.6 cm I.D. The two acceptable designs (I/O, I/I) for the sorbent cartridge are described in further detail below.

2.1.4.2.1 **Inside/Inside sorbent cartridge:** A diagram of an I/I sorbent cartridge is shown in Figure 3. This cartridge is a single glass tube (10 cm by 1.6 cm I.D.) which has the ends reduced in size to accommodate a 1/4- or 3/8-in. Swagelok or Cajon gas fitting. The resin is held in place by glass wool at each end of the resin layer. The amounts of each type of sorbent material used in the I/I design are the same as for the I/O design. Threaded end caps are placed on the sorbent cartridge after packing with sorbent to protect the sorbent from contamination during storage and transport.

2.1.4.2.2 **Inside/Outside type sorbent cartridge:** A diagram of an I/O sorbent cartridge is shown in Figure 4. In this design the sorbent materials are held in the glass tube with a fine mesh stainless steel screen and a C-clip. The glass tube is then placed within a larger diameter glass tube and held in place using Viton O-rings. The purpose of the outer glass tube is to protect the exterior of the resin-containing tube from contamination. The two glass tubes are held in a stainless steel cartridge holder, where the ends of the glass tubes are held in place by Viton O-rings placed in machine grooves in each metal end piece. The three cylindrical rods are secured in one of the metal end pieces and fastened to the other end piece using knurled nuts, thus sealing the glass tubes into the cartridge holder. The end pieces are fitted with a threaded nut onto which a threaded end cap is fitted with a Viton O-ring seal, to protect the resin from contamination during transport and storage.

2.1.5 **Metering system:** The metering system for VOST shall consist of vacuum gauges, a leak-free pump (Thomas Model 107 or equivalent, Thomas Industries, Sheboygan, Wisconsin), a calibrated rotameter (Linde Model 150, Linde Division of Union Carbide, Keasbey, New Jersey) for monitoring the gas flow rate, a dry gas meter with 2% accuracy at the required sampling rate, and related valves and equipment. Provisions should be made for monitoring the temperature of the sample gas stream between the first condenser and first sorbent cartridge. This can be done by placing a thermocouple on the exterior glass surface of the outlet from the first condenser. The temperature at that point should be less than 20°C. If it is not, an alternative condenser providing the required cooling capacity must be used.

2.1.6 **Sample transfer lines:** All sample transfer lines to connect the probe to the VOST shall be less than 5 ft in length, and shall be heat-traced Teflon with connecting fittings which are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

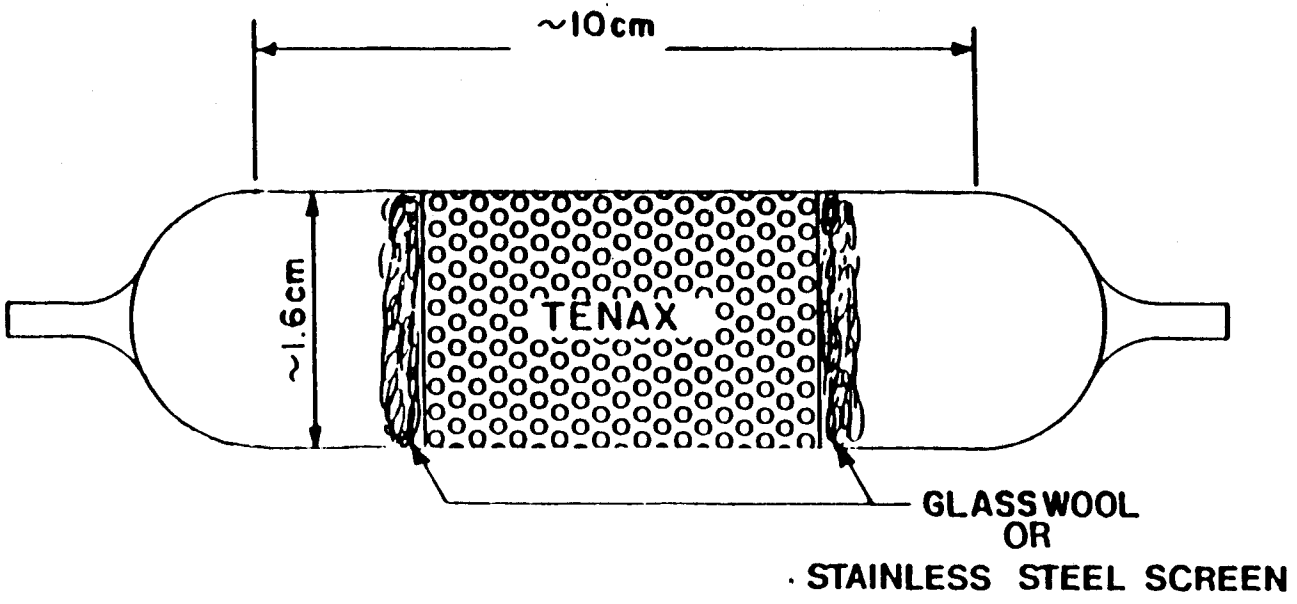
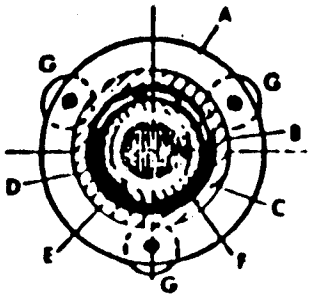


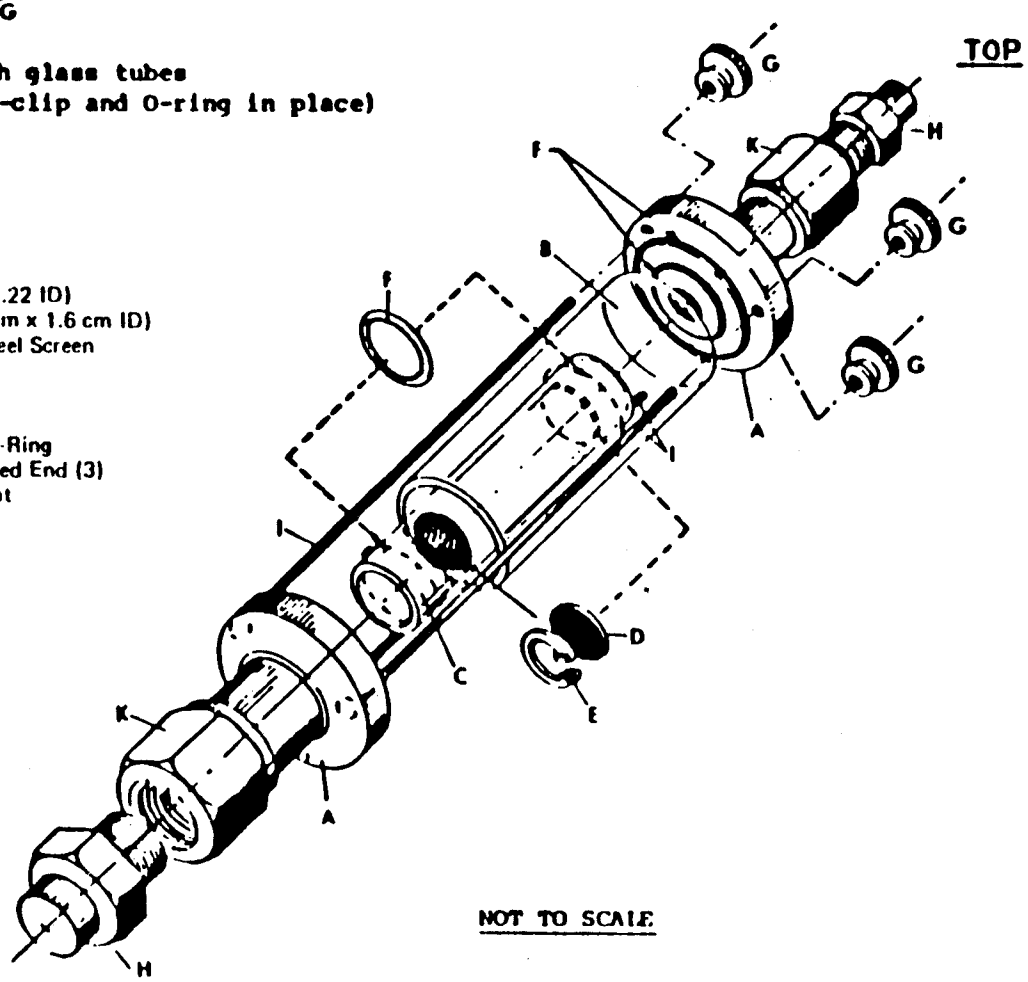
Figure 3. Inside-inside vost cartridge

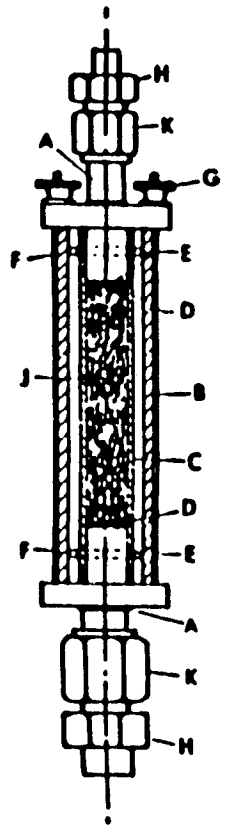


Section cut through glass tubes (showing screen, C-clip and O-ring in place)

LEGEND

A - Stainless Steel Carrier
B - Glass Tube (9.84 L x 2.22 ID)
C - Small Glass Tube (10 cm x 1.6 cm ID)
D - Fine Mesh Stainless Steel Screen
E - Stainless Steel C-Clip
F - O Ring (Viton)
G - Nuts (4)
H - End Cap with Viton O-Ring
I - Metal Rod with Threaded End (3)
J - Tenax/Charcoal Sorbent
K - Cajon Fitting





Assembled Trap
NTS

Figure 4. Sorbent Trap Assembly (I/O)
Volatile Organic Sampling Train (VOST)

Revision 0
Date September 1986

All other sample transfer lines used with the VOST shall be Teflon with connecting fittings that are capable of forming leak-free, vacuum-tight connections without the use of sealing grease.

3.0 REAGENTS AND MATERIALS

3.1 2,6-Diphenylene oxide polymer (Tenax, 35/60 mesh):

3.1.1 The new Tenax is Soxhlet extracted for 24 hr with methanol (Burdick & Jackson, pesticide grade or equivalent). The Tenax is dried for 6 hr in a vacuum oven at 50°C before use. Users of I/O and I/I sorbent cartridges have used slightly different thermal conditioning procedures. I/O sorbent cartridges packed with Tenax are thermally conditioned by flowing organic-free nitrogen (30 mL/min) through the resin while heating to 190°C. Some users have extracted new Tenax and charcoal with pentane to remove nonpolar impurities. However, these users have experienced problems with residual pentane in the sorbents during analysis.

3.1.2 If very high concentrations of volatile POHCs have been collected on the resin (e.g., micrograms of analytes), the sorbent may require Soxhlet extraction as described above. Previously used Tenax cartridges are thermally reconditioned by the method described above.

3.2 Charcoal (SKC petroleum-base or equivalent): New charcoal is prepared and charcoal is reconditioned as described in Paragraph 4.4. New charcoal does not require treatment prior to assembly into sorbent cartridges. Users of VOST have restricted the types of charcoal used in sorbent cartridges to only petroleum-based types. Criteria for other types of charcoal are acceptable if recovery of POHC in laboratory evaluations meet the criteria of 50 to 150%.

3.3 Viton-O-Ring: All O-rings used in VOST shall be Viton. Prior to use, these O-rings should be thermally conditioned at 200°C for 48 hr. O-rings should be stored in clean, screw-capped glass containers prior to use.

3.4 Glass tubes/Condensers: The glass resin tubes and condensers should be cleaned with a nonionic detergent in an ultrasonic bath, rinsed well with organic-free water, and dried at 110°C. Resin tubes of the I/O design should be assembled prior to storage as described in Paragraph 4.1. Resin tubes of the I/I design can be stored in glass culture tube containers with cotton cushioning and Teflon-lined screw caps. Condensers can be capped with appropriate end caps prior to use.

3.5 Metal parts: The stainless steel carriers, C-clips, end plugs, and screens used in the I/O VOST design are cleaned by ultrasonication in a warm nonionic detergent solution, rinsed with distilled water, air-dried, and heated in a muffle furnace for 2 hr at 400°C. Resin tubes of the I/I design require Swagelok or equivalent end caps with Supelco M-1 ferrules. These should be heated at 190°C along with the assembled cartridges.

3.6 Silica gel (Indicating type, 6-16 mesh): New silica gel may be used as received. Silica gel which has been previously used should be dried for 2 hr at 175°C (350°F).

3.7 Cold packs: Any commercially available reusable liquids or gels that can be repeatedly frozen are acceptable. They are typically sold in plastic containers as "Blue Ice" or "Ice-Packs." Enough should be used to keep cartridges at or near 4°C.

3.8 Water: Water used for cooling train components in the field may be tap water; and water used for rinsing glassware should be organic-free.

3.9 Glass wool: Glass wool should be Soxhlet extracted for 8 to 16 hr, using methanol, and oven dried at 110°C before use.

4.0 SAMPLE HANDLING AND PROCEDURE

4.1 Assembly:

4.1.1 The assembly and packing of the sorbent cartridges should be carried out in an area free of volatile organic material, preferably a laboratory in which no organic solvents are handled or stored and in which the laboratory air is charcoal . filtered. Alternatively, the assembly procedures can be conducted in a glove box which can be purged with organic-free nitrogen.

4.2 Tenax cartridges:

4.2.1 The Tenax, glass tubes, and metal cartridge parts are cleaned and stored (see Section 3.0). Approximately 1.6 g of Tenax is weighed and packed into the sorbent tube which has a stainless steel screen and C-clip (I/O design) or glass wool (I/I design) in the downstream end. The Tenax is held in place by inserting a stainless steel screen and C-clips in the upstream end (I/O design) or glass wool (I/I design). Each cartridge should be marked, using an engraving tool, with an arrow to indicate the direction of sample flow, and a serial number.

4.2.2 Conditioned resin tubes of the I/O design are then assembled into the metal carriers according to the previously described inside/inside or inside/outside procedures (with end caps) and are placed on cold packs for storage and transport. Conditioned resin tubes of the I/I design are capped and placed on cold packs for storage and transport.

4.3 Tenax/Charcoal tubes

4.3.1 The Tenax, charcoal, and metal cartridge parts are cleaned and stored as previously described (see Section 3.0). The tubes are packed with approximately a 3:1 volume ratio of Tenax and charcoal (approximately 1 g each). The Tenax and charcoal are held in place by the stainless steel screens and C-clips (I/O design) or by glass wool (I/I design). The glass tubes containing the Tenax and charcoal are then

conditioned as described below (see Paragraph 4.4). Place the I/O glass tubes in the metal carriers (see Paragraph 2.1.4.2.2), put end caps on the assembled cartridges, mark direction of sample flow and serial number, and place the assembled cartridges on cold packs for storage and transport.

4.3.2 Glass tubes of the I/I design are conditioned, and stored in the same manner as the I/O tubes.

4.4 Trap Conditioning - QC

4.4.1 Following assembly and leak-checking, the traps are connected in reverse direction to sampling to a source of organic-free nitrogen, and nitrogen is passed through each trap at a flow rate of 40 mL/min, while the traps are heated to 190°C for 12-28 hr. The actual conditioning period may be determined based on adequacy of the resulting blank checks.

4.4.2 The following procedure is used to blank check each set of sampling cartridges prior to sampling to ensure cleanliness. The procedure provides semi-quantitative data for organic compounds with boiling points below 110°C on Tenax and Tenax/Charcoal cartridges. It is not intended as a substitute for Method 5040.

4.4.2.1 The procedure is based on thermal desorption of each set of two cartridges, cryofocusing with liquid nitrogen onto a trap packed with glass beads, followed by thermal desorption from the trap and analysis by GC/FID.

4.4.2.2 The detection limit is based on the analysis of Tenax cartridges spiked with benzene and toluene and is around 2 ng for each compound.

4.4.2.3 The results of analyzing spiked cartridges on a daily basis should not vary by more than 20 percent. If the results are outside this range, the analytical system must be evaluated for the probable cause and a second spiked cartridge analyzed.

4.4.2.4 The GC operating conditions are as follows:

GC Operating Conditions

Column: Packed column 6 ft x 1/8" stainless steel 1.0 percent SP-1000 on Carbopack B 60/80, or equivalent.
Temperature program: 50°C for 5 min, 20°C/min increase to 190°C, hold 13 min.
Injector: 200°C.
Detector: F.I.D. 250°C.
Carrier Gas: Helium at 25 mL/min.
Sample valve: Valco 6-port with 40" x 1/16" stainless steel trap packed with 60/80 mesh glass beads.
Cryogen: Liquid nitrogen.
Trap heater: Boiling water, hot oil, or electrically heated.

Desorption heater: Supelco "clam shell" (high capacity carrier gas purifier) heater and Variac, adjusted to 180°C to 200°C.

4.4.2.5 Calibration is accomplished by preparing a spiked Tenax cartridge with benzene and toluene and analyzing according to the standard operating procedure. A standard of benzene, toluene and bromofluorobenzene (BFB) is prepared by injecting 2.0 uL of benzene and toluene and 1.0 uL of BFB into 10 mL of methanol. The concentration of this stock is 175 ng/uL of benzene and toluene, and 150 ng/uL BFB. One microliter of the stock standard is injected onto a Tenax cartridge through a heated injection port set at 150°C. A GC oven can be used for this with the oven at room temperature. Helium carrier gas is set at 50 mL/min. The solvent flush technique should be used. After two min, remove the Tenax cartridge and place in the desorption heater for analysis. BFB is also used as an internal standard spike for GC/MS analysis which provides a good comparison between GC/FID and GC/MS. The results of this spike analysis should not vary more than 20 percent day to day. Initially and then periodically this spiked Tenax should be reanalyzed a second time to verify that the 10 min desorption time and 180-200°C temperature are adequate to remove all of the spiked components. It should be noted that only one spiked Tenax cartridge need be prepared and analyzed daily unless otherwise needed to ensure proper instrument operation.

An acceptable blank level is left to the discretion of the method analyst. An acceptable level is one that allows adequate determination of expected components emitted from the waste being burned.

4.4.3 After conditioning, traps are sealed and placed on cold packs until sampling is accomplished. Conditioned traps should be held for a minimum amount of time to prevent the possibility of contamination.

4.4.4 It may be useful to spike the Tenax and Tenax/charcoal traps with the compounds of interest to ensure that they can be thermally desorbed under laboratory conditions. After spiked traps are analyzed they may be reconditioned and packed for sampling.

4.5 Pretest preparation:

4.5.1 All train components shall be cleaned and assembled as previously described. A dry gas meter shall have been calibrated within 30 days prior to use, using an EPA-supplied standard orifice.

4.5.2 The VOST is assembled according to the schematic diagram in Figure 1. The cartridges should be positioned so that sample flow is

through the Tenax first and then the Tenax/charcoal. Cooling water should be circulated to the condensers and the temperature of the cooling water should be maintained near 0°C. The end caps of the sorbent cartridges should be placed in a clean screw-capped glass container during sample collection.

4.6 Leak-checking:

4.6.1 The train is leak-checked by closing the valve at the inlet to the first condenser and pulling a vacuum of 250 mm (10 in. Hg) above the normal operating pressure. The traps and condensers are isolated from the pump and the leak rate noted. The leak rate should be less than 2.5 mm Hg after 1 min. The train is then returned to atmospheric pressure by attaching a charcoal-filled tube to the train inlet and admitting ambient air filtered through the charcoal. This procedure will minimize contamination of the VOST components by excessive exposure to the fugitive emissions at hazardous waste incinerator sites.

4.7 Sample Collection

4.7.1 After leak-checking, sample collection is accomplished by opening the valve at the inlet to the first condenser, turning on the pump, and sampling at a rate of 1 liter/min for 20 min. The volume of sample for any pair of traps should not exceed 20 liters.

4.7.2 Following collection of 20 liters of sample, the train is leak-checked a second time at the highest pressure drop encountered during the run to minimize the chance of vacuum desorption of organics from the Tenax. The train is returned to atmospheric pressure, using the method discussed in Paragraph 4.1 and the two sorbent cartridges are removed. The end caps are replaced and the cartridges shall be placed in a suitable environment for storage and transport until analysis. The sample is considered invalid if the leak test does not meet specification.

4.7.3 A new pair of cartridges is placed in the VOST, the VOST leak-checked, and the sample collection process repeated as described above. Sample collection continues until six pairs of traps have been used.

4.7.4 All sample cartridges should be kept on cold packs until they are ready for analysis.

4.8 Blanks

4.8.1 **Field blanks/trip blanks:** Blank Tenax and Tenax/charcoal cartridges are taken to the sampling site and the end caps removed for the period of time required to exchange two pairs of traps on VOST. After the two VOST traps have been exchanged, the end caps are replaced on the blank Tenax and Tenax/charcoal tubes and these are returned to the cold packs and analyzed with the sample traps. At least one pair of field blanks (one Tenax, one Tenax/charcoal) shall be included with each

six pairs of sample cartridges collected (or for each field trial using VOST to collect volatile POHCs).

4.8.2 **Trip blanks:** At least one pair of blank cartridges (one Tenax, one Tenax/charcoal) shall be included with shipment of cartridges to a hazardous waste incinerator site. These "field blanks" will be treated like any other cartridges except that the end caps will not be removed during storage at the site. This pair of traps will be analyzed to monitor potential contamination which may occur during storage and shipment.

4.8.3 **Laboratory blanks:** One pair of blank cartridges (one Tenax, one Tenax/charcoal) will remain in the laboratory using the method of storage which is used for field samples. If the field and trip blanks contain high concentrations of contaminants (e.g., greater than 2 ng of a particular POHC), the laboratory blank shall be analyzed in order to identify the source of contamination.

5.0 CALCULATIONS (for sample volume)

5.1 The following nomenclature are used in the calculation of sample volume:

P_{bar} = Barometric pressure at the exit orifice of the dry gas meter, mm (in.) Hg.

P_{std} = Standard absolute pressure, 760 mm (29.92 in.) Hg.

T_m = Dry gas meter average absolute temperature, K (°R).

T_{std} = Standard absolute temperature, 293K (528°R).

V_m = Dry gas volume measured by dry gas meter, dcm (dcf).

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, dscm (dscf).

γ = Dry gas meter calibration factor.

5.2 The volume of gas sampled is calculated as follows:

$$V_{m(std)} = V_m \gamma \frac{T_{std}\ P_{bar}}{T_m\ P_{std}} = K_1 \gamma \frac{V_m\ P_{bar}}{T_m}$$

where:

K_1 = 0.3858 K/mm Hg for metric units, or

K_1 = 17.64 °R/in. Hg for English units.

6.0 ANALYTICAL PROCEDURE

See Method 5040.

7.0 PRECISION AND ACCURACY REQUIREMENTS

7.1 Method Performance Check

Prior to field operation of the VOST at a hazardous waste incinerator, a method performance check should be conducted using either selected volatile POHCs of interest or two or more of the volatile POHCs for which data are available. This check may be conducted on the entire system (VOST/GC/MS) by analysis of a gas cylinder containing POHCs of interest or on only the analytical system by spiking of the POHCs onto the traps. The results of this check for replicate pairs of traps should demonstrate that recovery of the analytes fall within 50% to 150% of the expected values.

7.2 Performance Audit

During a trial burn a performance audit must be completed. The audit results should agree within 50% to 150% of the expected value for each specific target compound. This audit consists of collecting a gas sample containing one or more POHCs in the VOST from an EPA ppb gas cylinder. Collection of the audit sample in the VOST may be conducted either in the laboratory or at the trial burn site. Anaysis of the VOST audit sample must be by the same person, at the same time, and with the same analytical procedure as used for the regular VOST trail burn samples. EPA ppb gas cylinders currently available for VOST Audit are shown in Table 1 below.

The audit procedure, audit equipment and audit cylinder may be obtained by writing:

Audit Cylinder Gas Coordinator (MD-77B)
Quality Assurance Division
Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

or by calling the Audit Cylinder Gas Coordinator at (919) 541-4531.

The request for the audit must be made at least 30 days prior to the scheduled trial burn. If a POHC is selected for which EPA does not have an audit cylinder, this audit is not required.

8.1.3 **Impinger:** Spike the sample with the surrogate standards; measure and record the volume and transfer to a separatory funnel. Proceed as described in Paragraph 8.1.2.

8.1.4 **XAD-2:** Spike the resin directly with the surrogate standards. Transfer the resin to the all-glass thimbles by the following procedure (care should be taken so as not to contaminate the thimble by touching it with anything other than tweezers or other solvent-rinsed mechanical holding devices). Suspend the XAD-2 module directly over the thimble. The glass frit of the module (see Figure 2) should be in the up position. The thimble is contained in a clean beaker, which will serve to catch the solvent rinses. Using a Teflon squeeze bottle, flush the XAD-2 into the thimble. Thoroughly rinse the glass module with solvent into the beaker containing the thimble. Add the XAD-2 glass-wool plug to the thimble. Cover the XAD-2 in the thimble with a precleaned glass-wool plug sufficient to prevent the resin from floating into the solvent reservoir of the extractor. If the resin is wet, effective extraction can be accomplished by loosely packing the resin in the thimble. If a question arises concerning the completeness of the extraction, a second extraction, without a spike, is advised. The thimble is placed in the extractor and the rinse solvent contained in the beaker is added to the solvent reservoir. Additional solvent is added to make the reservoir approximately two-thirds full. Add Teflon boiling chips and assemble the apparatus. Adjust the heat source to cause the extractor to cycle 5-6 times per hr. Extract the resin for 16 hr. Transfer the solvent and three 10-mL rinses of the reservoir to a K-D and concentrate as described in Paragraph 8.1.2.

8.1.5 **Particulate filter (and cyclone catch):** If particulate loading is to be determined, weigh the filter (and cyclone catch, if applicable). The particulate filter (and cyclone catch, if applicable) is transferred to the glass thimble and extracted simultaneously with the XAD-2 resin.

8.1.6 **Train solvent rinses:** All train rinses (i.e., probe, impinger, filter housing) using the extraction solvent and methanol are returned to the laboratory as a single sample. If the rinses are contained in more than one container, the intended spike is divided equally among the containers proportioned from a single syringe volume. Transfer the rinse to a separatory funnel and add a sufficient amount of organic-free water so that the methylene chloride becomes immiscible and its volume no longer increases with the addition of more water. The extraction and concentration steps are then performed as described in Paragraph 8.1.2.

8.2 Sample analysis:

8.2.1 The primary analytical tool for the measurement of emissions from hazardous waste incinerators is GC/MS using fused-silica capillary GC columns, as described in Method 8270 in Chapter Four of this manual. Because of the nature of GC/MS instrumentation and the cost associated

8.0 REFERENCES

1. Protocol for the Collection and Analysis of Volatile POHCs Using VOST. EPA/600/8-84/007, March 1984.

2. Sykes, A.L., Standard Operating Procedure for Blanking Tenax and Tenax/Charcoal Sampling Cartridges for Volatile Organic Sampling Train (VOST), Radion Corporation, P.O. Box 13000, Research Triangle Park, NC 27709.

3. Validation of the Volatile Organic Sampling Train (VOST) Protocol, Vols. I and II, EPA/600/4-86/014a, January 1986.

TABLE 1: Organic Gases in the ppb Audit Repository

Group I	Ranges of cylinders currently available:
5 Organics in N_2:	7 - 90 ppb
Carbon tetrachloride	90 - 430 ppb
Chloroform	430 - 10,000 ppb
Perchloroethylene	
Vinyl chloride	
Benzene	

Group II	Ranges of cylinders currently available:
9 Organics in N_2	7 - 90 ppb
Trichloroethylene	90 - 430 ppb
1,2-Dichloroethane	
1,2-Dibromoethane	
F-12	
F-11	
Bromomethane	
Methyl ethyl ketone	
1,1,1-Trichloroethane	
Acetronitrile	

TABLE 1: Organic Gases in the ppb Audit Repository (Continued)

Group III	Ranges of cylinders currently available:
7 Organics in N_2:	7 - 90 ppb
Vinylidene chloride	90 - 430 ppb
F-113	
F-114	
Acetone	
1,4-Dioxane	
Toluene	
Chlorobenzene	

Group IV	Ranges of cylinders currently available:
6 Organics in N_2:	7 - 90 ppb
Acrylonitrile	430 - 10,000
1,3-Butadiene	
Ethylene oxide	
Methylene chloride	
Propylene oxide	
Ortho-xylene	

METHOD 5040

PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES FROM VOLATILE ORGANIC SAMPLING TRAIN

1.0 SCOPE AND APPLICATION

1.1 Method 5040 was formerly Method 3720 in the Second Edition of this manual.

1.2 This method covers the determination of volatile principal organic hazardous constituents (POHCs), collected on Tenax and Tenax/charcoal sorbent cartridges using a volatile organic sampling train, VOST (1). Much of the description for purge-and-trap GC/MS analysis is described in Method 8240 of this chapter. Because the majority of gas streams sampled using VOST will contain a high concentration of water, the analytical method is based on the quantitative thermal desorption of volatile POHCs from the Tenax and Tenax/charcoal traps and analysis by purge-and-trap GC/MS. For the purposes of definition, volatile POHCs are those POHCs with boiling points less than 100°C.

1.3 This method is applicable to the analysis of Tenax and Tenax/charcoal cartridges used to collect volatile POHCs from wet stack gas effluents from hazardous waste incinerators.

1.4 The sensitivity of the analytical method for a particular volatile POHC depends on the level of interferences and the presence of detectable levels of volatile POHCs in blanks. The desired target detection limit of the analytical method is 0.1 ng/L (20 ng on a single pair of traps) for a particular volatile POHC desorbed from either a single pair of Tenax and Tenax/charcoal cartridges or by thermal desorption of up to six pairs of traps onto a single pair of Tenax and Tenax/charcoal traps. The resulting single pair of traps is then thermally desorbed and analyzed by purge-and-trap GC/MS.

1.5 This method is recommended for use only by experienced mass spectroscopists or under the close supervision of such qualified persons.

2.0 SUMMARY OF METHOD

2.1 A schematic diagram of the analytical system is shown in Figure 1. The contents of the sorbent cartridges are spiked with an internal standard and thermally desorbed for 10 min at 180°C with organic-free nitrogen or helium gas (at a flow rate of 40 mL/min), bubbled through 5 mL of organic-free water, and trapped on an analytical adsorbent trap. After the 10-min desorption, the analytical adsorbent trap is rapidly heated to 180°C, with the carrier gas flow reversed so that the effluent flow from the analytical trap is directed into the GC/MS. The volatile POHCs are separated by temperature-programmed gas chromatography and detected by low-resolution mass spectrometry. The concentrations of volatile POHCs are calculated using the internal standard technique.

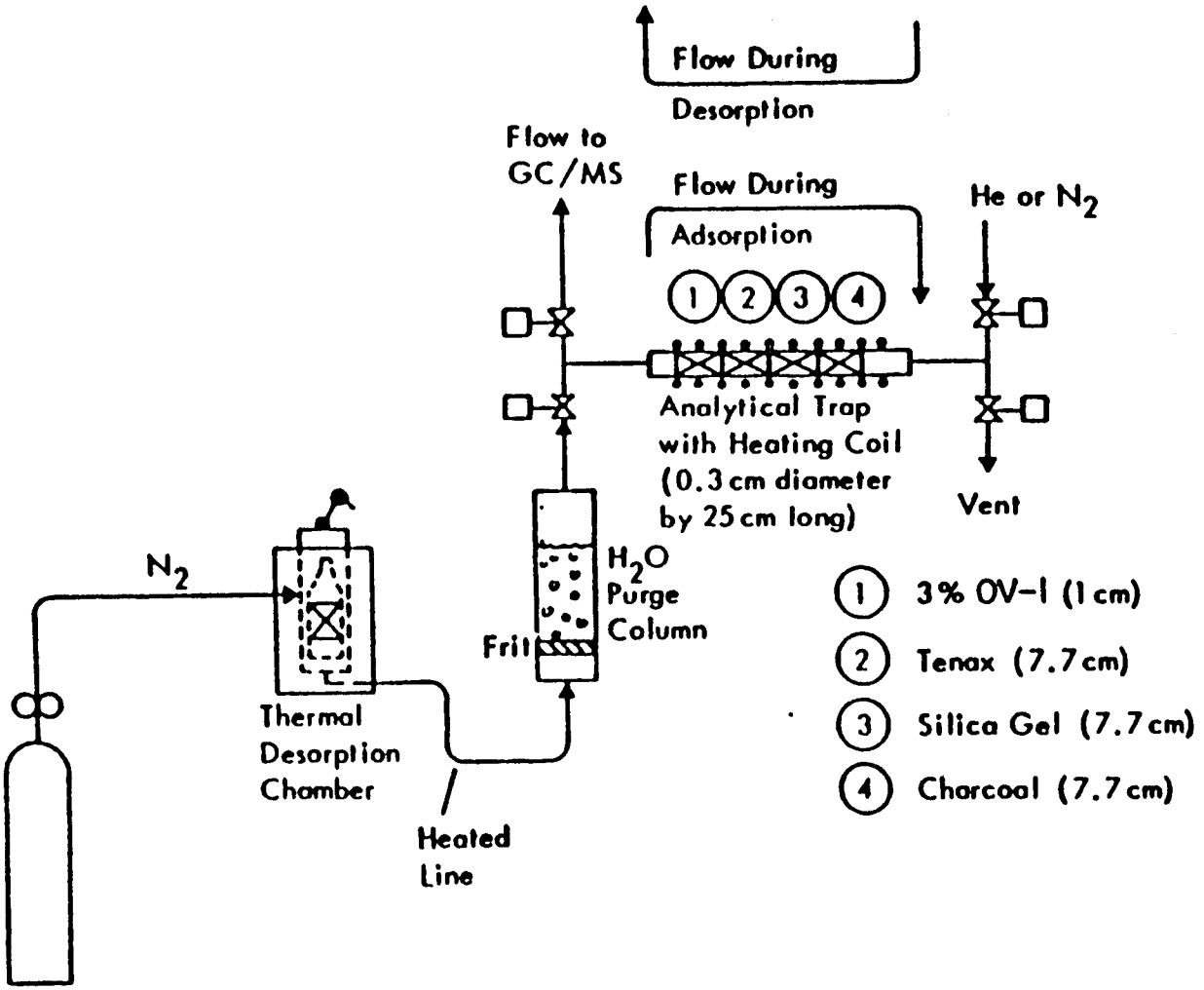


Figure 1. Schematic diagram of trap desorption/analysis system.

3.0 INTERFERENCES

3.1 Refer to Methods 3500 and 8240.

4.0 APPARATUS AND MATERIALS

4.1 Thermal desorption unit:

4.1.1 The thermal desorption unit (for Inside/Inside VOST cartridges, use Supelco "clamshell" heater; for Inside/Outside VOST cartridges, user fabricated unit is required) should be capable of thermally desorbing the sorbent resin tubes. It should also be capable of heating the tubes to 180 ± 10°C with flow of organic-free nitrogen or helium through the tubes.

4.2 Purge-and-trap unit:

4.2.1 The purge-and-trap unit consists of three separate pieces of equipment: the sample purger, trap, and the desorber. It should be capable of meeting all requirements of Method 5030 for analysis of purgeable organic compounds from water.

4.3 GC/MS system: As described in Method 8240.

5.0 REAGENTS

5.1 Reagent water: Reagent water is defined as water in which an interferent is not observed at the method detection limit of the parameters of interest.

5.1.1 Reagent water may be generated by passing tap water through a carbon filter bed containing about 450 g of activated carbon (Calgon Corporation, Filtrasorb-300, or equivalent).

5.1.2 A water purification system (Millipore Super-Q or equivalent) may be used to generate reagent water.

5.1.3 Reagent water may also be prepared by boiling distilled water for 15 min. Subsequently, while maintaining the temperature at 90°C, bubble a contaminant-free inert gas through the water for 1 hr. Allow the water to cool to room temperature while continuing to bubble the inert gas through the water. This water should be transferred directly to the purge-and-trap apparatus for use.

5.1.4 Other methods that can be shown to produce organic-free water can be used.

5.2 Analytical trap reagents:

5.2.1 **2,6-Diphenylene oxide polymer:** Tenax (60/80 mesh), chromatographic grade or equivalent.

5.2.2 **Methyl silicone packing:** 3% OV-1 on Chromosorb W (60/80 mesh) or equivalent.

5.2.3 **Silica gel:** Davison Chemical (35/00 mesh), Grade 15, or equivalent.

5.2.4 **Charcoal:** Petroleum-based (SKC Lot 104 or equivalent).

5.3 Stock standard solution:

5.3.1 Stock standard solutions will be prepared from pure standard materials or purchased as certified solutions. The stock standards should be prepared in methanol using assayed liquids or gases, as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials should be prepared in a hood. A NIOSH/MESA-approved toxic gas respirator should be used when the analyst handles high concentrations of such materials.

5.3.2 Fresh stock standards should be prepared weekly for volatile POHCs with boiling points of <35°C. All other standards must be replaced monthly, or sooner if comparison with check standards indicates a problem.

5.4 Secondary dilution standards:

5.4.1 Using stock standard solutions, prepare in methanol secondary dilution standards that contain the compounds of interest, either singly or mixed together. The secondary dilution standards should be prepared at concentrations such that the desorbed calibration standards will bracket the working range of the analytical system.

5.5 4-Bromofluorobenzene (BFB) standard:

5.5.1 Prepare a 25 ng/uL solution of BFB in methanol.

5.6 Deuterated benzene:

5.6.1 Prepare a 25 ng/uL solution of benzene-d_6 in methanol.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Refer to Method 0030, Chapter Ten.

6.2 Sample trains obtained from the VOST should be analyzed within 2-6 weeks of sample collection.

7.0 PROCEDURE

7.1 Assembly of PTD device:

7.1.1 Assemble a purge-and-trap desorption device (PTD) that meets all the requirements of Method 5030 (refer to Figure 1).

7.1.2 Connect the thermal desorption device to the PTD device. Calibrate the PTD-GC/MS system using the internal standard technique.

7.2 Internal standard calibration procedure:

7.2.1 This approach requires the use of deuterated benzene as the internal standard for these analyses. Other internal standards may be proposed for use in certain situations. The important criteria for choosing a particular compound as an internal standard are that it be similar in analytical behavior to the compounds of interest and that it can be demonstrated that the measurement of the internal standard be unaffected by method or matrix interferences. Other internal standards that have been used are d_{10}-ethylbenzene and d_4-1,2-dichloroethane. One adds 50 ng of BFB to all sorbent cartridges (in addition to one or more internal standards) to provide continuous monitoring of the GC/MS performance relative to BFB.

7.2.2 Prepare calibration standards at a minimum of three concentration levels for each analyte of interest.

7.2.3 The calibration standards are prepared by spiking a blank Tenax or Tenax/charcoal trap with a methanolic solution of the calibration standards (including 50 ng of the internal standard, such as deuterated benzene), using the flash evaporation technique. The flash evaporation technique requires filling the needle of a 5.0-uL syringe with clean methanol and drawing air into the syringe to the 1.0-uL mark. This is followed by drawing a methanolic solution of the calibration standards (containing 25 ug/uL of the internal standard) to the 2.0-uL mark. The glass traps should be attached to the injection port of a gas chromatograph while maintaining the injector temperature at 160°C. The carrier gas flow through the traps should be maintained at about 50 mL/min.

7.2.4 After directing the gas flow through the trap, the contents of the syringe should be slowly expelled through the gas chromatograph injection port over about 15 sec. After 25 sec have elapsed, the gas flow through the trap should be shut off, the syringe removed, and the trap analyzed by the PTD-GC/MS procedure outlined in Method 8240. The total flow of gas through the traps during addition of calibration standards to blank cartridges, or internal standards to sample cartridges, should be 25 mL or less.

7.2.5 Analyze each calibration standard for both Tenax and Tenax/charcoal cartridges according to Section 7.3. Tabulate the area response

of the characteristic ions of each analyte against the concentration of the internal standard and calculate response factor (RF) for each compound, using Equation 1.

$$RF = A_S C_{IS} / A_{IS} C_S \quad (1)$$

where:

A_S = Area of the characteristic ion for the analyte to be measured.

A_{IS} = Area of the characteristic ion for the internal standard.

C_{IS} = Amount (ng) of the internal standard.

C_S = Amount (ng) of the volatile POHC in calibration standard.

If the RF value over the working range is a constant (<10% RSD), the RF can be assumed to be invariant, and the average RF can be used for calculations. Alternatively, the results can be used to plot a calibration curve of response ratios, A_S/A_{IS} versus RF.

7.2.6 The working calibration curve or RF must be verified on each working day by the measurement of one or more of the calibration standards. If the response varies by more than ±25% for any analyte, a new calibration standard must be prepared and analyzed, for that analyte.

7.3 The schematic of the PTD-GC/MS system is shown in Figure 1. The sample cartridge is placed in the thermal desorption apparatus (for Inside/Inside VOST cartridges, use Supelco "clamshell" heater; for Inside/Outside VOST cartridges, user fabricated unit is required) and desorbed in the purge-and-trap system by heating to 180°C for 10 min at a flow rate of 40 mL/min. The desorbed components pass into the bottom of the water column, are purged from the water, and collected on the analytical adsorbent trap. After the 10-min desorption period, the compounds are desorbed from the analytical adsorbent trap into the GC/MS system according to the procedures described in Method 8240.

7.4 Qualitative identification:

7.4.1 The procedure for qualitative identification of volatile POHCs using this protocol is described in Method 8240.

7.5 Calculations:

7.5.1 When an analyte has been qualitatively identified, quantification should be based on the integrated abundance from the EICP of the primary characteristic ion chosen for that analyte. If the sample produces an interference for the primary characteristic ion, a secondary characteristic ion should be used.

7.5.1.1 Using the internal standard calibration procedure, the amount of analyte in the sample cartridge is calculated using the response factor (RF) determined in Paragraph 7.2.5 and Equation 2.

$$\text{Amount of POHC} = A_s C_{is} / A_{is} RF \quad (2)$$

where:

A_s = Area of the characteristic ion for the analyte to be measured.

A_{is} = Area for the characteristic ion of the internal standard.

C_{is} = Amount (ng) of internal standard.

7.5.1.2 The choice of methods for evaluating data collected using VOST for incinerator trial burns is a regulatory decision. The procedures used extensively by one user are outlined below.

7.5.1.3 The total amount of the POHCs of interest collected on a pair of traps should be summed. These values should then be blank corrected. Guidelines for blank correction of sample cartridges are outlined below.

7.5.1.3.1 After all blanks (field and trip) are analyzed, a paired t-test should be used to determine whether trip blanks are significantly different from field blanks. If no difference is found, then the mean and standard deviation of the combined field and trip blanks for each POHC of interest is calculated.

7.5.1.3.2 If, when using the paired t-test, the field and trip blanks are determined to be different, then the field blank (or the mean of multiple field blanks) associated with a particular run should be used as the blank value for that particular run.

7.5.1.4 Next, for each sample/POHC combination, a determination must be made as to whether a particular sample is significantly different from the associated blank. If the mean of the trip and field blanks is used, then a sample is different from the blank if:

$$\text{(measured sample value)} - \text{(mean blank value)} > (3 \times \text{blank standard deviation})$$

(If an individual field blank is used as the blank value, the above criteria do not apply.) If the sample is determined to be different from the blank according to the above criteria, then the emission value of a particular POHC is blank-corrected by subtracting the mean blank value from the measured sample value.

7.5.1.5 If, according to the above procedures, the sample cannot be distinguished from the blank (i.e., for a given POHC there is a high sample value and high blank value or there is a low sample value and low blank value), the measured sample value is not blank-corrected. In this case, the measured sample value is used to calculate a maximum emission value (and therefore a minimum DRE value) for that particular run.

7.5.1.6 The observation of high concentrations of POHCs of interest in blank cartridges indicates possible residual contamination of the sorbent cartridges prior to shipment to and use at the site. Data that fall in this category (especially data indicating high concentrations of POHCs in blank sorbent cartridges) should be qualified with regard to validity, and blank data should be reported separately. The applicability of data of this type to the determination of DRE is a regulatory decision. Continued observation of high concentrations of POHCs in blank sorbent cartridges indicates that procedures for cleanup, monitoring, shipment, and storage of sorbent cartridges by a particular user be investigated to eliminate this problem.

7.5.1.7 If any internal standard recoveries fall outside the control limits established in Section 8.4, data for all analytes determined for that cartridge(s) must be qualified with the observation.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One for specific quality control procedures and Method 3500 for sample preparation procedures.

8.2 Each laboratory that uses this method is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and the analysis of blank Tenax and Tenax/charcoal cartridges spiked with the analytes of interest. The laboratory is required to maintain performance records to define the quality of data that are generated. Ongoing performance checks must be compared with established performance criteria to determine if results are within the expected precision and accuracy limits of the method.

8.2.1 Before performing any analyses, the analyst must demonstrate the ability to generate acceptable precision and accuracy with this method. This ability is established as described in Paragraph 7.2.

8.2.2 The laboratory must spike all Tenax and Tenax/charcoal cartridges with the internal standard(s) to monitor continuing laboratory performance. This procedure is described in Paragraph 7.2.

8.3 To establish the ability to generate acceptable accuracy and precision, the analyst must spike blank Tenax and Tenax/charcoal cartridges with the analytes of interest at two concentrations in the working range.

8.3.1 The average response factor (R) and the standard deviation (S) for each must be calculated.

8.3.2 The average recovery and standard deviation must fall within the expected range for determination of volatile POHCs using this method. The expected range for recovery of volatile POHCs using this method is 50-150%.

8.4 The analyst must calculate method performance criteria for the internal standard(s).

8.4.1 Calculate upper and lower control limits for method performances using the average area response (A) and standard deviation(s) for internal standard:

Upper Control Limit (UCL) = A + 3S.
Lower Control Limit (LCL) = A - 3S.

The UCL and LCL can be used to construct control charts that are useful in observing trends in performance. The control limits must be replaced by method performance criteria as they become available from the U.S. EPA.

8.5 The laboratory is required to spike all sample cartridges (Tenax and Tenax/charcoal) with internal standard.

8.6 Each day, the analyst must demonstrate through analysis of blank Tenax and Tenax/charcoal cartridges and reagent water that interferences from the analytical system are under control.

8.7 The daily GC/MS performance tests required for this method are described in Method 8240.

9.0 METHOD PERFORMANCE

9.1 Refer to the determinative methods for performance data.

10.0 REFERENCES

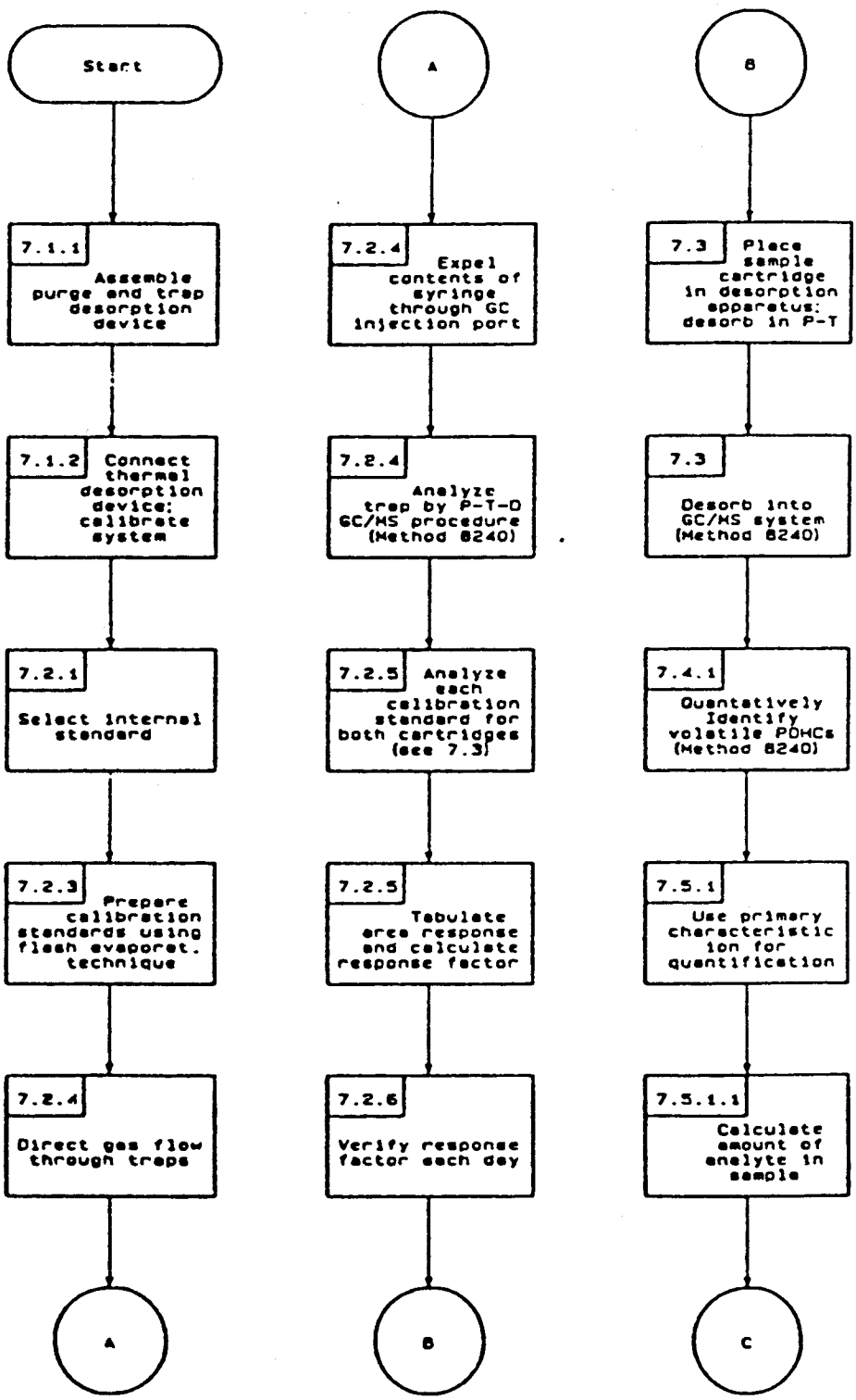
1. Protocol for Collection and Analysis of Volatile POHC's Using VOST. EPA/600/8-84-007, March 1984.

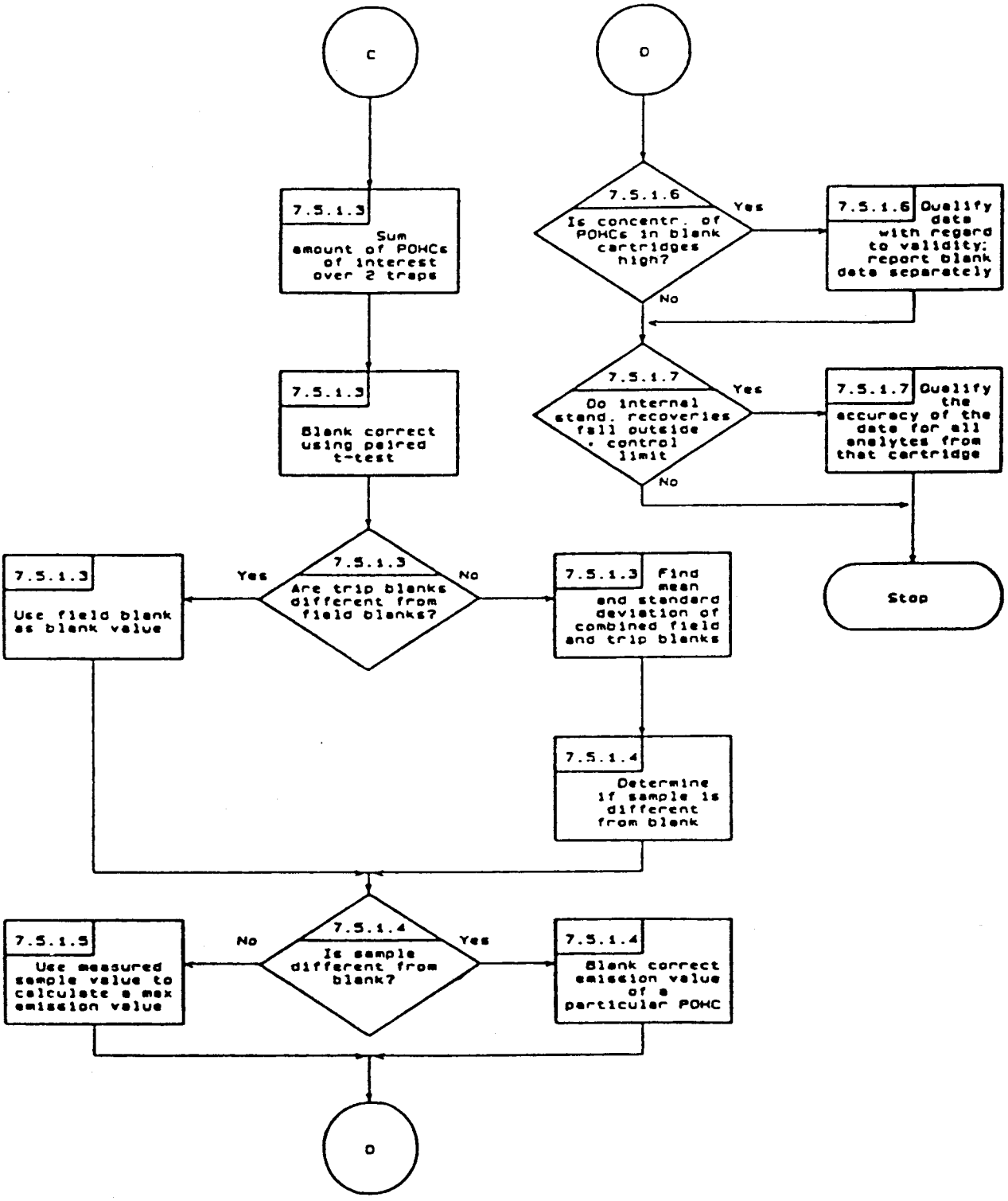
2. Validation of the Volatile Organic Sampling Train (VOST) Protocol. Volumes I and II. EPA/600/4-86-014a, January 1986.

METHOD 5040

PROTOCOL FOR ANALYSIS OF SORBENT CARTRIDGES

FROM VOLATILE ORGANIC SAMPLING TRAIN




C
D
7.5.1.3
Sum amount of POHCs of interest over 2 traps
7.5.1.6
Is concentr. of POHCs in blank cartridges high?
Yes
7.5.1.6 Qualify data with regard to validity; report blank data separately
No
7.5.1.7
Do internal stand. recoveries fall outside ± control limit
Yes
7.5.1.7 Qualify the accuracy of the data for all analytes from that cartridge
No
7.5.1.3
Blank correct using paired t-test
7.5.1.3
Are trip blanks different from field blanks?
Yes
No
7.5.1.3
Use field blank as blank value
7.5.1.3 Find mean and standard deviation of combined field and trip blanks
Stop
7.5.1.4
Determine if sample is different from blank
7.5.1.4
Is sample different from blank?
No
Yes
7.5.1.5
Use measured sample value to calculate a max emission value
7.5.1.4
Blank correct emission value of a particular POHC
D

METHOD 0010

MODIFIED METHOD 5 SAMPLING TRAIN

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the determination of Destruction and Removal Efficiency (DRE) of semivolatile Principal Organic Hazardous Compounds (POHCs) from incineration systems (PHS, 1967). This method also may be used to determine particulate emission rates from stationary sources as per EPA Method 5 (see References at end of this method).

2.0 SUMMARY OF METHOD

2.1 Gaseous and particulate pollutants are withdrawn from an emission source at an isokinetic sampling rate and are collected in a multicomponent sampling train. Principal components of the train include a high-efficiency glass- or quartz-fiber filter and a packed bed of porous polymeric adsorbent resin. The filter is used to collect organic-laden particulate materials and the porous polymeric resin to adsorb semivolatile organic species. Semivolatile species are defined as compounds with boiling points >100°C.

2.2 Comprehensive chemical analyses of the collected sample are conducted to determine the concentration and identity of the organic materials.

3.0 INTERFERENCES

3.1 Oxides of nitrogen (NO_x) are possible interferents in the determination of certain water-soluble compounds such as dioxane, phenol, and urethane; reaction of these compounds with NO_x in the presence of moisture will reduce their concentration. Other possibilities that could result in positive or negative bias are (1) stability of the compounds in methylene chloride, (2) the formation of water-soluble organic salts on the resin in the presence of moisture, and (3) the solvent extraction efficiency of water-soluble compounds from aqueous media. Use of two or more ions per compound for qualitative and quantitative analysis can overcome interference at one mass. These concerns should be addressed on a compound-by-compound basis before using this method.

4.0 APPARATUS AND MATERIALS

4.1 Sampling train:

4.1.1 A schematic of the sampling train used in this method is shown in Figure 1. This sampling train configuration is adapted from EPA Method 5 procedures, and, as such, the majority of the required equipment

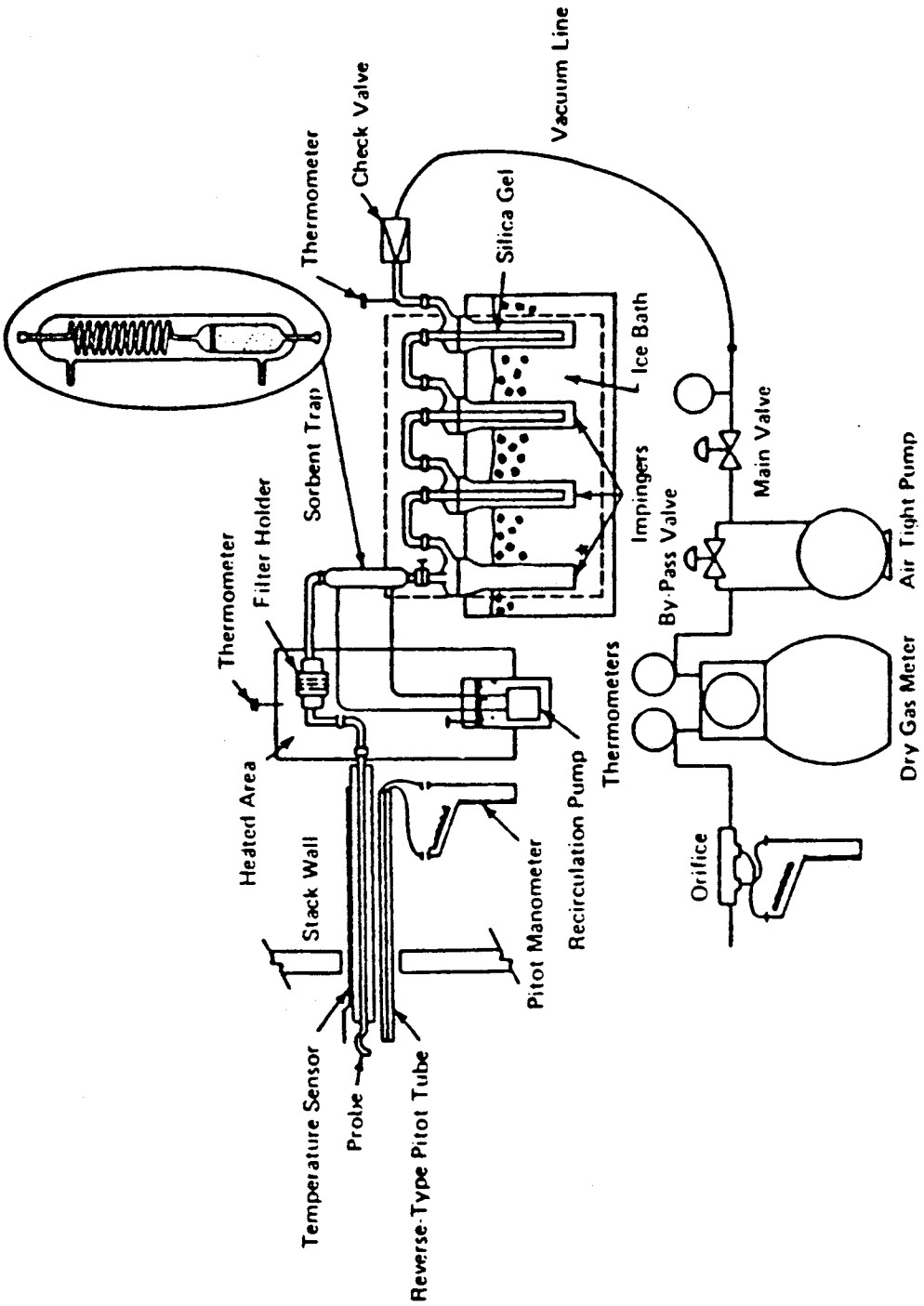


Figure 1. Modified Method 5 Sampling Train.

is identical to that used in EPA Method 5 determinations. The new components required are a condenser coil and a sorbent module, which are used to collect semivolatile organic materials that pass through the glass- or quartz-fiber filter in the gas phase.

4.1.2 Construction details for the basic train components are given in APTD-0581 (see Martin, 1971, in Section 13.0, References); commercial models of this equipment are also available. Specifications for the sorbent module are provided in the following subsections. Additionally, the following subsections list changes to APTD-0581 and identify allowable train configuration modifications.

4.1.3 Basic operating and maintenance procedures for the sampling train are described in APTD-0576 (see Rom, 1972, in Section 13.0, References). As correct usage is important in obtaining valid results, all users should refer to APTD-0576 and adopt the operating and maintenance procedures outlined therein unless otherwise specified. The sampling train consists of the components detailed below.

4.1.3.1 Probe nozzle: Stainless steel (316) or glass with sharp, tapered (30° angle) leading edge. The taper shall be on the outside to preserve a constant I.D. The nozzle shall be buttonhook or elbow design and constructed from seamless tubing (if made of stainless steel). Other construction materials may be considered for particular applications. A range of nozzle sizes suitable for isokinetic sampling should be available in increments of 0.16 cm (1/16 in.), e.g., 0.32-1.27 cm (1/8-1/2 in.), or larger if higher volume sampling trains are used. Each nozzle shall be calibrated according to the procedures outlined in Paragraph 9.1.

4.1.3.2 Probe liner: Borosilicate or quartz-glass tubing with a heating system capable of maintaining a gas temperature of 120 ± 14°C (248 ± 25°F) at the exit end during sampling. (The tester may opt to operate the equipment at a temperature lower than that specified.) Because the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) are considered acceptable. Either borosilicate or quartz-glass probe liners may be used for stack temperatures up to about 480°C (900°F). Quartz liners shall be used for temperatures between 480 and 900°C (900 and 1650°F). (The softening temperature for borosilicate is 820°C (1508°F), and for quartz 1500°C (2732°F).) Water-cooling of the stainless steel sheath will be necessary at temperatures approaching and exceeding 500°C.

4.1.3.3 Pitot tube: Type S, as described in Section 2.1 of EPA Method 2, or other appropriate devices (Vollaro, 1976). The pitot tube shall be attached to the probe to allow constant monitoring of the stack-gas velocity. The impact (high-pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see EPA Method 2, Figure 2-6b) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 4 of EPA Method 2.

4.1.3.4 Differential pressure gauge: Inclined manometer or equivalent device as described in Section 2.2 of EPA Method 2. One manometer shall be used for velocity-head (ΔP) readings and the other for orifice differential pressure (ΔH) readings.

4.1.3.5 Filter holder: Borosilicate glass, with a glass frit filter support and a sealing gasket. The sealing gasket should be made of materials that will not introduce organic material into the gas stream at the temperature at which the filter holder will be maintained. The gasket shall be constructed of Teflon or materials of equal or better characteristics. The holder design shall provide a positive seal against leakage at any point along the filter circumference. The holder shall be attached immediately to the outlet of the cyclone or cyclone bypass.

4.1.3.6 Filter heating system: Any heating system capable of maintaining a temperature of 120 $\pm$ 14°C (248 $\pm$ 25°F) around the filter holder during sampling. Other temperatures may be appropriate for particular applications. Alternatively, the tester may opt to operate the equipment at temperatures other than that specified. A temperature gauge capable of measuring temperature to within 3°C (5.4°F) shall be installed so that the temperature around the filter holder can be regulated and monitored during sampling. Heating systems other than the one shown in APTD-0581 may be used.

4.1.3.7 Organic sampling module: This unit consists of three sections, including a gas-conditioning section, a sorbent trap, and a condensate knockout trap. The gas-conditioning system shall be capable of conditioning the gas leaving the back half of the filter holder to a temperature not exceeding 20°C (68°F). The sorbent trap shall be sized to contain approximately 20 g of porous polymeric resin (Rohm and Haas XAD-2 or equivalent) and shall be jacketed to maintain the internal gas temperature at 17 $\pm$ 3°C (62.5 $\pm$ 5.4°F). The most commonly used coolant is ice water from the impinger ice-water bath, constantly circulated through the outer jacket, using rubber or plastic tubing and a peristaltic pump. The sorbent trap should be outfitted with a glass well or depression, appropriately sized to accommodate a small thermocouple in the trap for monitoring the gas entry temperature. The condensate knockout trap shall be of sufficient size to collect the condensate following gas conditioning. The organic module components shall be oriented to direct the flow of condensate formed vertically downward from the conditioning section, through the adsorbent media, and into the condensate knockout trap. The knockout trap is usually similar in appearance to an empty impinger directly underneath the sorbent module; it may be oversized but should have a shortened center stem (at a minimum, one-half the length of the normal impinger stems) to collect a large volume of condensate without bubbling and overflowing into the impinger train. All surfaces of the organic module wetted by the gas sample shall be fabricated of borosilicate glass, Teflon, or other inert materials. Commercial versions of the

complete organic module are not currently available, but may be assembled from commercially available laboratory glassware and a custom-fabricated sorbent trap. Details of two acceptable designs are shown in Figures 2 and 3 (the thermocouple well is shown in Figure 2).

4.1.3.8 Impinger train: To determine the stack-gas moisture content, four 500-mL impingers, connected in series with leak-free ground-glass joints, follow the knockout trap. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3-cm (1/2-in.) I.D. glass tube extending about 1.3 cm (1/2 in.) from the bottom of the outer cylinder. The second impinger shall be of the Greenburg-Smith design with the standard tip. The first and second impingers shall contain known quantities of water or appropriate trapping solution. The third shall be empty or charged with a caustic solution, should the stack gas contain hydrochloric acid (HCl). The fourth shall contain a known weight of silica gel or equivalent desiccant.

4.1.3.9 Metering system: The necessary components are a vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry-gas meter capable of measuring volume to within 1%, and related equipment, as shown in Figure 1. At a minimum, the pump should be capable of 4 cfm free flow, and the dry-gas meter should have a recording capacity of 0-999.9 cu ft with a resolution of 0.005 cu ft. Other metering systems capable of maintaining sampling rates within 10% of isokineticity and of determining sample volumes to within 2% may be used. The metering system must be used in conjunction with a pitot tube to enable checks of isokinetic sampling rates. Sampling trains using metering systems designed for flow rates higher than those described in APTD-0581 and APTD-0576 may be used, provided that the specifications of this method are met.

4.1.3.10 Barometer: Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). In many cases the barometric reading may be obtained from a nearby National Weather Service station, in which case the station value (which is the absolute barometric pressure) is requested and an adjustment for elevation differences between the weather station and sampling point is applied at a rate of minus 2.5 mm Hg (0.1 in. Hg) per 30-m (100 ft) elevation increase (vice versa for elevation decrease).

4.1.3.11 Gas density determination equipment: Temperature sensor and pressure gauge (as described in Sections 2.3 and 2.4 of EPA Method 2), and gas analyzer, if necessary (as described in EPA Method 3). The temperature sensor ideally should be permanently attached to the pitot tube or sampling probe in a fixed configuration such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal.

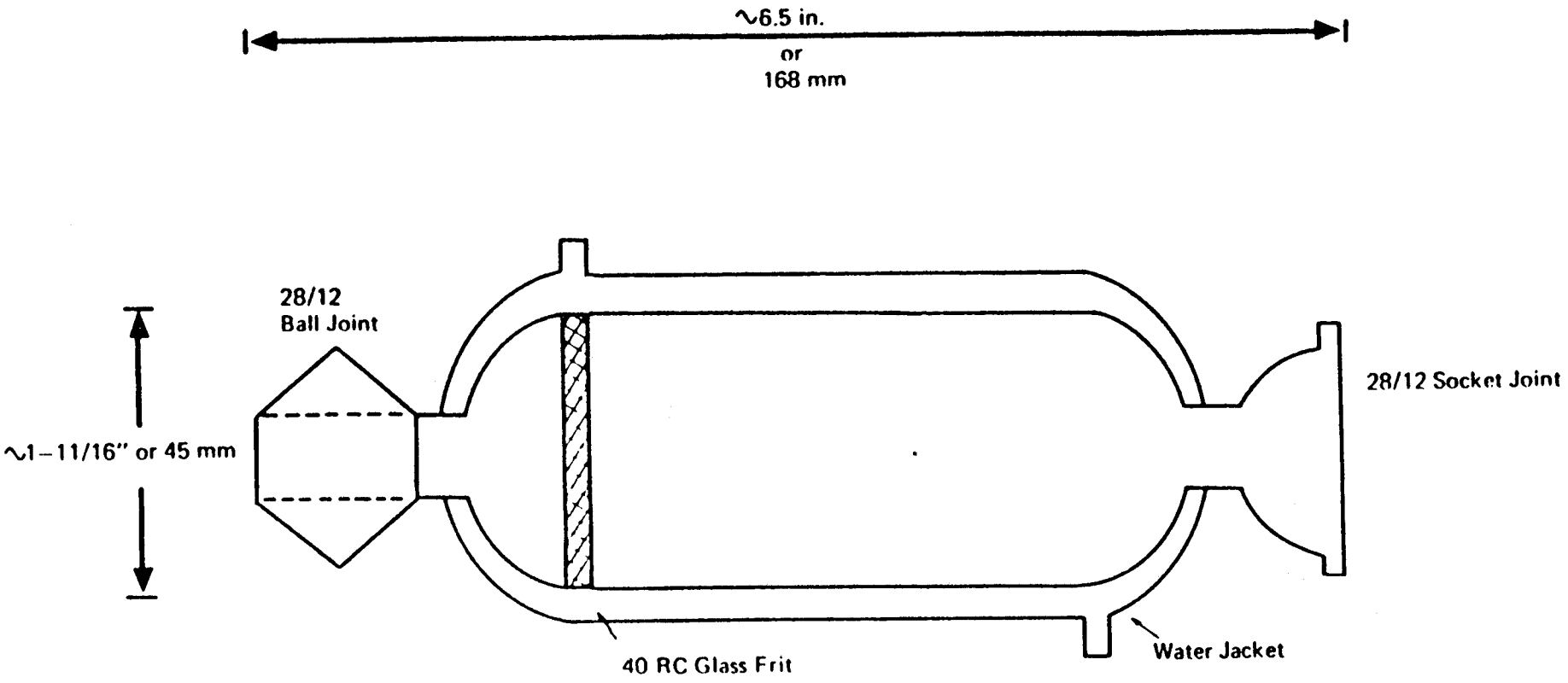


Figure 2. Adsorbent Sampling System.

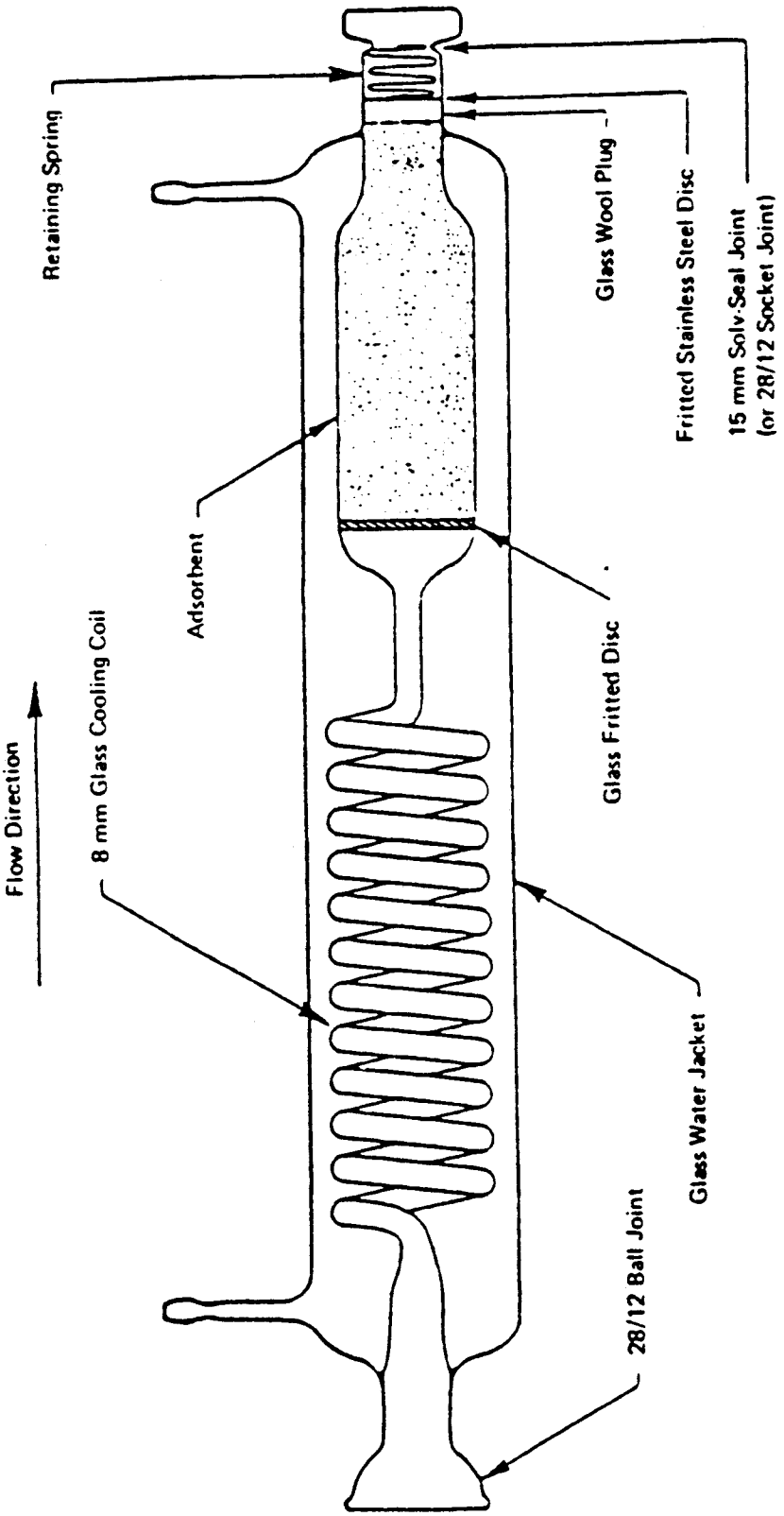


Figure 3. Adsorbent Sampling System.

Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see EPA Method 2, Figure 2-7). As a second alternative, if a difference of no more than 1% in the average velocity measurement is to be introduced, the temperature gauge need not be attached to the probe or pitot tube.

4.1.3.12 Calibration/field-preparation record: A permanently bound laboratory notebook, in which duplicate copies of data may be made as they are being recorded, is required for documenting and recording calibrations and preparation procedures (i.e., filter and silica gel tare weights, clean XAD-2, quality assurance/quality control check results, dry-gas meter, and thermocouple calibrations, etc.). The duplicate copies should be detachable and should be stored separately in the test program archives.

4.2 Sample Recovery:

4.2.1 **Probe liner:** Probe nozzle and organic module conditioning section brushes; nylon bristle brushes with stainless steel wire handles are required. The probe brush shall have extensions of stainless steel, Teflon, or inert material at least as long as the probe. The brushes shall be properly sized and shaped to brush out the probe liner, the probe nozzle, and the organic module conditioning section.

4.2.2 **Wash bottles:** Three. Teflon or glass wash bottles are recommended; polyethylene wash bottles should not be used because organic contaminants may be extracted by exposure to organic solvents used for sample recovery.

4.2.3 **Glass sample storage containers:** Chemically resistant, borosilicate amber and clear glass bottles, 500-mL or 1,000-mL. Bottles should be tinted to prevent action of light on sample. Screw-cap liners shall be either Teflon or constructed so as to be leak-free and resistant to chemical attack by organic recovery solvents. Narrow-mouth glass bottles have been found to exhibit less tendency toward leakage.

4.2.4 **Petri dishes:** Glass, sealed around the circumference with wide (1-in.) Teflon tape, for storage and transport of filter samples.

4.2.5 **Graduated cylinder and/or balances:** To measure condensed water to the nearest 1 mL or 1 g. Graduated cylinders shall have subdivisions not >2 mL. Laboratory triple-beam balances capable of weighing to ± 0.5 g or better are required.

4.2.6 **Plastic storage containers:** Screw-cap polypropylene or polyethylene containers to store silica gel.

4.2.7 **Funnel and rubber policeman:** To aid in transfer of silica gel to container (not necessary if silica gel is weighed in field).

4.2.8 **Funnels:** Glass, to aid in sample recovery.

4.3 Filters: Glass- or quartz-fiber filters, without organic binder, exhibiting at least 99.95% efficiency (<0.05% penetration) on 0.3-um dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM standard method D2986-71. Test data from the supplier's quality control program are sufficient for this purpose. In sources containing SO_2 or SO_3, the filter material must be of a type that is unreactive to SO_2 or SO_3. Reeve Angel 934 AH or Schleicher and Schwell #3 filters work well under these conditions.

4.4 Crushed ice: Quantities ranging from 10-50 lb may be necessary during a sampling run, depending on ambient air temperature.

4.5 Stopcock grease: Solvent-insoluble, heat-stable silicone grease. Use of silicone grease upstream of the module is not permitted, and amounts used on components located downstream of the organic module shall be minimized. Silicone grease usage is not necessary if screw-on connectors and Teflon sleeves or ground-glass joints are used.

4.6 Glass wool: Used to plug the unfritted end of the sorbent module. The glass-wool fiber should be solvent-extracted with methylene chloride in a Soxhlet extractor for 12 hr and air-dried prior to use.

5.0 REAGENTS

5.1 Adsorbent resin: Porous polymeric resin (XAD-2 or equivalent) is recommended. These resins shall be cleaned prior to their use for sample collection. Appendix A of this method should be consulted to determine appropriate precleaning procedure. For best results, resin used should not exhibit a blank of higher than 4 mg/kg of total chromatographable organics (TCO) (see Appendix B) prior to use. Once cleaned, resin should be stored in an airtight, wide-mouth amber glass container with a Teflon-lined cap or placed in one of the glass sorbent modules tightly sealed with Teflon film and elastic bands. The resin should be used within 4 wk of the preparation.

5.2 Silica gel: Indicating type, 6-16 mesh. If previously used, dry at 175°C (350°F) for 2 hr before using. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

5.3 Impinger solutions: Distilled organic-free water (Type II) shall be used, unless sampling is intended to quantify a particular inorganic gaseous species. If sampling is intended to quantify the concentration of additional species, the impinger solution of choice shall be subject to Administrator approval. This water should be prescreened for any compounds of interest. One hundred mL will be added to the specified impinger; the third impinger in the train may be charged with a basic solution (1 N sodium hydroxide or sodium acetate) to protect the sampling pump from acidic gases. Sodium acetate should be used when large sample volumes are anticipated because sodium hydroxide will react with carbon dioxide in aqueous media to form sodium carbonate, which may possibly plug the impinger.

5.4 Sample recovery reagents:

5.4.1 **Methylene chloride:** Distilled-in-glass grade is required for sample recovery and cleanup (see Note to 5.4.2 below).

5.4.2 **Methyl alcohol:** Distilled-in-glass grade is required for sample recovery and cleanup.

NOTE: Organic solvents from metal containers may have a high residue blank and should not be used. Sometimes suppliers transfer solvents from metal to glass bottles; thus blanks shall be run prior to field use and only solvents with low blank value (<0.001%) shall be used.

5.4.3 **Water:** Water (Type II) shall be used for rinsing the organic module and condenser component.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 Because of complexity of this method, field personnel should be trained in and experienced with the test procedures in order to obtain reliable results.

6.2 Laboratory preparation:

6.2.1 All the components shall be maintained and calibrated according to the procedure described in APTD-0576, unless otherwise specified.

6.2.2 Weigh several 200- to 300-g portions of silica gel in airtight containers to the nearest 0.5 g. Record on each container the total weight of the silica gel plus containers. As an alternative to preweighing the silica gel, it may instead be weighed directly in the impinger or sampling holder just prior to train assembly.

6.2.3 Check filters visually against light for irregularities and flaws or pinhole leaks. Label the shipping containers (glass Petri dishes) and keep the filters in these containers at all times except during sampling and weighing.

6.2.4 Desiccate the filters at 20 ± 5.6°C (68 ± 10°F) and ambient pressure for at least 24 hr, and weigh at intervals of at least 6 hr to a constant weight (i.e., <0.5-mg change from previous weighing), recording results to the nearest 0.1 mg. During each weighing the filter must not be exposed for more than a 2-min period to the laboratory atmosphere and relative humidity above 50%. Alternatively (unless otherwise specified by the Administrator), the filters may be oven-dried at 105°C (220°F) for 2-3 hr, desiccated for 2 hr, and weighed.

6.3 Preliminary field determinations:

6.3.1 Select the sampling site and the minimum number of sampling points according to EPA Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and range of velocity heads using EPA Method 2. It is recommended that a leak-check of the pitot lines (see EPA Method 2, Section 3.1) be performed. Determine the stack-gas moisture content using EPA Approximation Method 4 or its alternatives to establish estimates of isokinetic sampling-rate settings. Determine the stack-gas dry molecular weight, as described in EPA Method 2, Section 3.6. If integrated EPA Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the sample run.

6.3.2 Select a nozzle size based on the range of velocity heads so that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 2.2 of EPA Method 2).

6.3.3 Select a suitable probe liner and probe length so that all traverse points can be sampled. For large stacks, to reduce the length of the probe, consider sampling from opposite sides of the stack.

6.3.4 A minimum of 3 dscm (105.9 dscf) of sample volume is required for the determination of the Destruction and Removal Efficiency (DRE) of POHCs from incineration systems. Additional sample volume shall be collected as necessitated by analytical detection limit constraints. To determine the minimum sample volume required, refer to sample calculations in Section 10.0.

6.3.5 Determine the total length of sampling time needed to obtain the identified minimum volume by comparing the anticipated average sampling rate with the volume requirement. Allocate the same time to all traverse points defined by EPA Method 1. To avoid timekeeping errors, the length of time sampled at each traverse point should be an integer or an integer plus one-half min.

6.3.6 In some circumstances (e.g., batch cycles) it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas-sample volumes. In these cases, the Administrator's approval must first be obtained.

6.4 Preparation of collection train:

6.4.1 During preparation and assembly of the sampling train, keep all openings where contamination can occur covered with Teflon film or aluminum foil until just prior to assembly or until sampling is about to begin.

6.4.2 Fill the sorbent trap section of the organic module with approximately 20 g of clean adsorbent resin. While filling, ensure that the trap packs uniformly, to eliminate the possibility of channeling. When freshly cleaned, many adsorbent resins carry a static charge, which will cause clinging to trap walls. This may be minimized by filling the trap in the presence of an antistatic device. Commercial antistatic devices include Model-204 and Model-210 manufactured by the 3M Company, St. Paul, Minnesota.

6.4.3 If an impinger train is used to collect moisture, place 100 mL of water in each of the first two impingers, leave the third impinger empty (or charge with caustic solution, as necessary), and transfer approximately 200-300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

6.4.4 Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

6.4.5 When glass liners are used, install the selected nozzle using a Viton-A O-ring when stack temperatures are <260°C (500°F) and a woven glass-fiber gasket when temperatures are higher. See APTD-0576 (Rom, 1972) for details. Other connecting systems utilizing either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as above, or by a leak-free direct mechanical connection. Mark the probe with heat-resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

6.4.6 Set up the train as in Figure 1. During assembly, do not use any silicone grease on ground-glass joints that are located upstream of the organic module. A very light coating of silicone grease may be used on all ground-glass joints that are located downstream of the organic module, but it should be limited to the outer portion (see APTD-0576) of the ground-glass joints to minimize silicone-grease contamination. Subject to the approval of the Administrator, a glass cyclone may be used between the probe and the filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack. The organic module condenser must be maintained at a temperature of 17 $\pm$ 3°C. Connect all temperature sensors to an appropriate potentiometer/display unit. Check all temperature sensors at ambient temperature.

6.4.7 Place crushed ice around the impingers and the organic module condensate knockout.

6.4.8 Turn on the sorbent module and condenser coil coolant recirculating pump and begin monitoring the sorbent module gas entry temperature. Ensure proper sorbent module gas entry temperature before proceeding and again before any sampling is initiated. It is extremely important that the XAD-2 resin temperature never exceed 50°C (122°F), because thermal decomposition will occur. During testing, the XAD-2 temperature must not exceed 20°C (68°F) for efficient capture of the semivolatile species of interest.

6.4.9 Turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize.

6.5 Leak-check procedures

6.5.1 Pre-test leak-check:

6.5.1.1 Because the number of additional intercomponent connections in the Semi-VOST train (over the M5 Train) increases the possibility of leakage, a pre-test leak-check is required.

6.5.1.2 After the sampling train has been assembled, turn on and set the filter and probe heating systems at the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 381-mm Hg (15-in. Hg) vacuum.
(NOTE: A lower vacuum may be used, provided that it is not exceeded during the test.)

6.5.1.3 If an asbestos string is used, do not connect the probe to the train during the leak-check. Instead, leak-check the train by first attaching a carbon-filled leak-check impinger (shown in Figure 4) to the inlet of the filter holder (cyclone, if applicable) and then plugging the inlet and pulling a 381-mm Hg (15-in. Hg) vacuum. (Again, a lower vacuum may be used, provided that it is not exceeded during the test.) Then, connect the probe to the train and leak-check at about 25-mm Hg (1-in. Hg) vacuum; alternatively, leak-check the probe with the rest of the sampling train in one step at 381-mm Hg (15-in. Hg) vacuum. Leakage rates in excess of 4% of the average sampling rate or >0.00057 m^3/min (0.02 cfm), whichever is less, are unacceptable.

6.5.1.4 The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with fine-adjust valve fully open and coarse-adjust valve completely closed. Partially open the coarse-adjust valve and slowly close the fine-adjust valve until the desired vacuum is reached. Do not reverse direction of the fine-adjust valve; this will cause water to back up into the organic module. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check, as shown below, and start over.

CROSS SECTIONAL VIEW

Leak Testing Apparatus

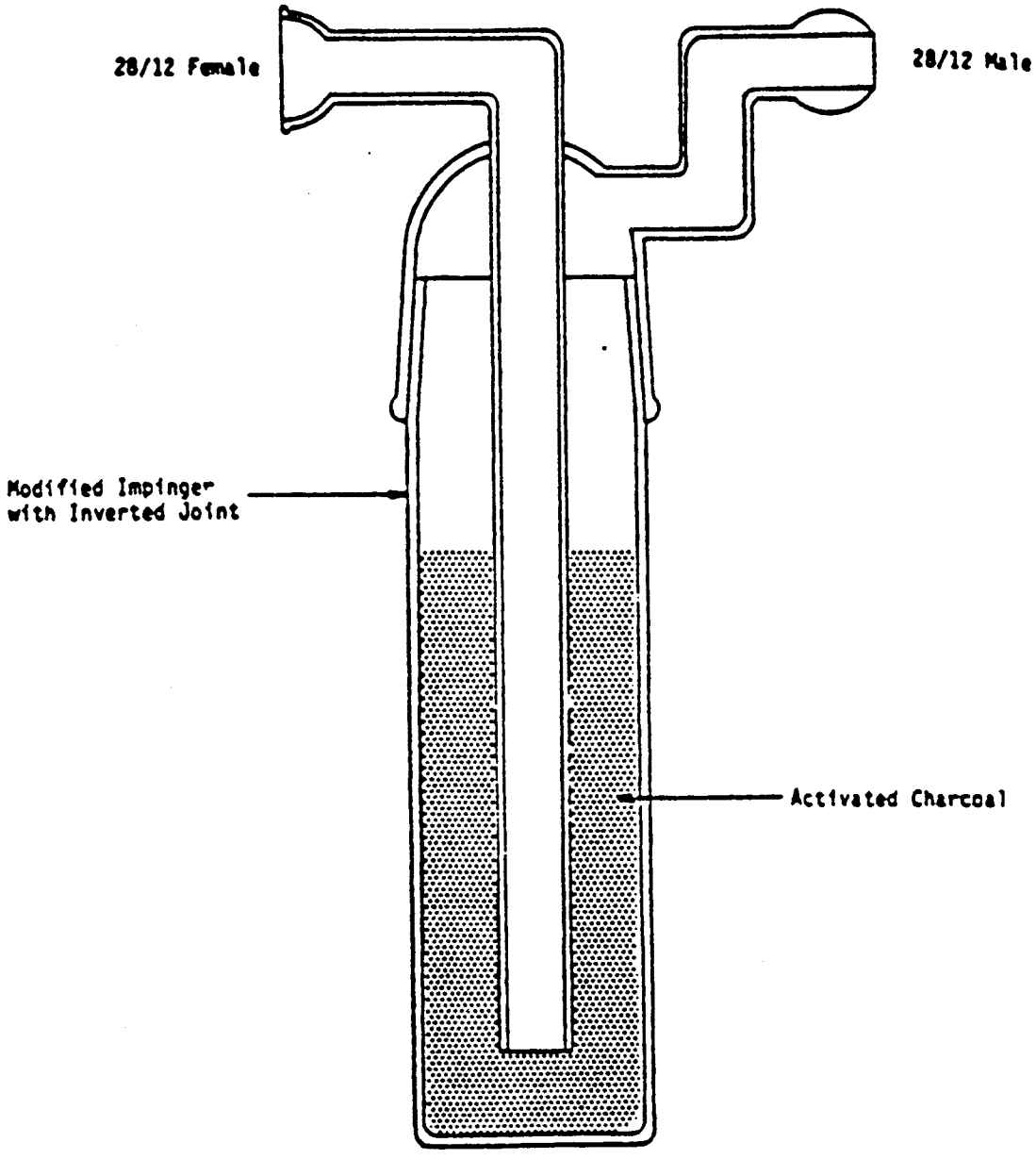


Figure 4. Leak-check impinger.

6.5.1.5 When the leak-check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable). When the vacuum drops to 127 mm (5 in.) Hg or less, immediately close the coarse-adjust valve. Switch off the pumping system and reopen the fine-adjust valve. Do not reopen the fine-adjust valve until the coarse-adjust valve has been closed. This prevents the water in the impingers from being forced backward into the organic module and silica gel from being entrained backward into the third impinger.

6.5.2 Leak-checks during sampling run:

6.5.2.1 If, during the sampling run, a component (e.g., filter assembly, impinger, or sorbent trap) change becomes necessary, a leak-check shall be conducted immediately after the interruption of sampling and before the change is made. The leak-check shall be done according to the procedure outlined in Paragraph 6.5.1, except that it shall be done at a vacuum greater than or equal to the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered. If a higher leakage rate is obtained, the tester shall void the sampling run. (It should be noted that any "correction" of the sample volume by calculation by calculation reduces the integrity of the pollutant concentrations data generated and must be avoided.)

6.5.2.2 Immediately after a component change, and before sampling is reinitiated, a leak-check similar to a pre-test leak-check must also be conducted.

6.5.3 Post-test leak-check:

6.5.3.1 A leak-check is mandatory at the conclusion of each sampling run. The leak-check shall be done with the same procedures as those with the pre-test leak-check, except that it shall be conducted at a vacuum greater than or equal to the maximum value reached during the sampling run. If the leakage rate is found to be no greater than 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, the tester shall either record the leakage rate, correct the sample volume (as shown in the calculation section of this method), and consider the data obtained of questionable reliability, or void the sampling run.

6.6 Sampling-train operation:

6.6.1 During the sampling run, maintain an isokinetic sampling rate to within 10% of true isokinetic, unless otherwise specified by the Administrator. Maintain a temperature around the filter of 120 ± 14°C (248 ± 25°F) and a gas temperature entering the sorbent trap at a maximum of 20°C (68°F).

6.6.2 For each run, record the data required on a data sheet such as the one shown in Figure 5. Be sure to record the initial dry-gas meter reading. Record the dry-gas meter readings at the beginning and end of each sampling time increment, when changes in flow rates are made before and after each leak-check, and when sampling is halted. Take other readings required by Figure 5 at least once at each sample point during each time increment and additional readings when significant changes (20% variation in velocity-head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

6.6.3 Clean the stack access ports prior to the test run to eliminate the chance of sampling deposited material. To begin sampling, remove the nozzle cap, verify that the filter and probe heating systems are at the specified temperature, and verify that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point, with the tip pointing directly into the gas stream. Immediately start the pump and adjust the flow to isokinetic conditions. Nomographs, which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations, are available. These nomographs are designed for use when the Type S pitot-tube coefficient is 0.84 $\pm$ 0.02 and the stack-gas equivalent density (dry molecular weight) is equal to 29 $\pm$ 4. APTD-0576 details the procedure for using the nomographs. If the stack-gas molecular weight and the pitot-tube coefficient are outside the above ranges, do not use the nomographs unless appropriate steps (Shigehara, 1974) are taken to compensate for the deviations.

6.6.4 When the stack is under significant negative pressure (equivalent to the height of the impinger stem), take care to close the coarse-adjust valve before inserting the probe into the stack, to prevent water from backing into the organic module. If necessary, the pump may be turned on with the coarse-adjust valve closed.

6.6.5 When the probe is in position, block off the openings around the probe and stack access port to prevent unrepresentative dilution of the gas stream.

6.6.6 Traverse the stack cross section, as required by EPA Method 1 or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the access port, in order to minimize the chance of extracting deposited material.

6.6.7 During the test run, make periodic adjustments to keep the temperature around the filter holder and the organic module at the proper levels; add more ice and, if necessary, salt to maintain a temperature of <20°C (68°F) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

Plant _____
Location _____
Operator _____
Date _____
Run No. _____
Sample Box No. _____
Meter Box No. _____
Meter ΔH@ _____
C Factor _____
Pitot Tube Coefficient C_p _____

Schematic of Stack Cross Section

Ambient Temperature _____
Barometric Pressure _____
Assumed Moisture % _____
Probe Length, m (ft) _____
Nozzle Identification No. _____
Average Calibrated Nozzle Diameter, cm (in) _____
Probe Heater Setting _____
Leak Rate, m^3/min, (cfm) _____
Probe Liner Material _____
Static Pressure, mm Hg (in. Hg) _____
Filter No. _____

Traverse Point Number	Sampling Time (θ) min.	Vacuum mm Hg (in. Hg)	Stack Temperature (T_s) °C(°F)	Velocity Head ($\sqrt{P_s}$) mm (in) H_2O	Pressure Differential Across Orifice Meter mm (H_2O) (in H_2O)	Gas Sample Volume m_3 (ft_3)	Gas Sample Temp. at Dry Gas Meter Inlet °C(°F)	Gas Sample Temp. at Dry Gas Meter Outlet °C(F°)	Filter Holder Temperature °C(F°)	Temperature of Gas Entering Sorbet Trap °C(F°)	Temperature of Gas Leaving Condenser or Last Impinger
Total							Avg.	Avg.			
Average											

Figure 5. Particulate field data.

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6.6.8 If the pressure drop across the filter or sorbent trap becomes too high, making isokinetic sampling difficult to maintain, the filter/sorbent trap may be replaced in the midst of a sample run. Using another complete filter holder/sorbent trap assembly is recommended, rather than attempting to change the filter and resin themselves. After a new filter/sorbent trap assembly is installed, conduct a leak-check. The total particulate weight shall include the summation of all filter assembly catches.

6.6.9 A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Administrator.

6.6.10 Note that when two or more trains are used, separate analysis of the front-half (if applicable) organic-module and impinger (if applicable) catches from each train shall be performed, unless identical nozzle sizes were used on all trains. In that case, the front-half catches from the individual trains may be combined (as may the impinger catches), and one analysis of front-half catch and one analysis of impinger catch may be performed.

6.6.11 At the end of the sample run, turn off the coarse-adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final dry-gas meter reading, and conduct a post-test leak-check. Also, leak-check the pitot lines as described in EPA Method 2. The lines must pass this leak-check in order to validate the velocity-head data.

6.6.12 Calculate percent isokineticity (see Section 10.8) to determine whether the run was valid or another test run should be made.

7.0 SAMPLE RECOVERY

7.1 Preparation:

7.1.1 Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool. When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over the tip to prevent losing or gaining particulate matter. Do not cap the probe tip tightly while the sampling train is cooling down because this will create a vacuum in the filter holder, drawing water from the impingers into the sorbent module.

7.1.2 Before moving the sample train to the cleanup site, remove the probe from the sample train and cap the open outlet, being careful not to lose any condensate that might be present. Cap the filter inlet.

Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the organic module and the filter holder, disconnect the line at the filter holder and let any condensed water or liquid drain into the organic module.

7.1.3 Cap the filter-holder outlet and the inlet to the organic module. Separate the sorbent trap section of the organic module from the condensate knockout trap and the gas-conditioning section. Cap all organic module openings. Disconnect the organic-module knockout trap from the impinger train inlet and cap both of these openings. Ground-glass stoppers, Teflon caps, or caps of other inert materials may be used to seal all openings.

7.1.4 Transfer the probe, the filter, the organic-module components, and the impinger/condenser assembly to the cleanup area. This area should be clean and protected from the weather to minimize sample contamination or loss.

7.1.5 Save a portion of all washing solutions (methanol/methylene chloride, Type II water) used for cleanup as a blank. Transfer 200 mL of each solution directly from the wash bottle being used and place each in a separate, prelabeled glass sample container.

7.1.6 Inspect the train prior to and during disassembly and note any abnormal conditions.

7.2 Sample containers:

7.2.1 **Container no. 1:** Carefully remove the filter from the filter holder and place it in its identified Petri dish container. Use a pair or pairs of tweezers to handle the filter. If it is necessary to fold the filter, ensure that the particulate cake is inside the fold. Carefully transfer to the Petri dish any particulate matter or filter fibers that adhere to the filter-holder gasket, using a dry nylon bristle brush or sharp-edged blade, or both. Label the container and seal with 1-in.-wide Teflon tape around the circumference of the lid.

7.2.2 **Container no. 2:** Taking care that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover particulate matter or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components first with methanol/methylene chloride (1:1 v/v) into a glass container. Distilled water may also be used. Retain a water and solvent blank and analyze in the same manner as with the samples. Perform rinses as follows:

7.2.2.1 Carefully remove the probe nozzle and clean the inside surface by rinsing with the solvent mixture (1:1 v/v methanol/-methylene chloride) from a wash bottle and brushing with a nylon bristle brush. Brush until the rinse shows no visible particles; then make a final rinse of the inside surface with the solvent mix. Brush and rinse the inside parts of the Swagelok fitting with the solvent mix in a similar way until no visible particles remain.

7.2.2.2 Have two people rinse the probe liner with the solvent mix by tilting and rotating the probe while squirting solvent into its upper end so that all inside surfaces will be wetted with solvent. Let the solvent drain from the lower end into the sample container. A glass funnel may be used to aid in transferring liquid washes to the container.

7.2.2.3 Follow the solvent rinse with a probe brush. Hold the probe in an inclined position and squirt solvent into the upper end while pushing the probe brush through the probe with a twisting action; place a sample container underneath the lower end of the probe and catch any solvent and particulate matter that is brushed from the probe. Run the brush through the probe three times or more until no visible particulate matter is carried out with the solvent or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above-prescribed manner at least six times (metal probes have small crevices in which particulate matter can be entrapped). Rinse the brush with solvent and quantitatively collect these washings in the sample container. After the brushing, make a final solvent rinse of the probe as described above.

7.2.2.4 It is recommended that two people work together to clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

7.2.2.5 Clean the inside of the front half of the filter holder and cyclone/cyclone flask, if used, by rubbing the surfaces with a nylon bristle brush and rinsing with methanol/methylene chloride (1:1 v/v) mixture. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone and cyclone flask (if applicable). Brush and rinse any particulate material adhering to the inner surfaces of these components into the front-half rinse sample. After all solvent washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that solvent will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to determine whether leakage occurs during transport. Label the container to identify its contents.

7.2.3 **Container no. 3:** The sorbent trap section of the organic module may be used as a sample transport container, or the spent resin may be transferred to a separate glass bottle for shipment. If the sorbent trap itself is used as the transport container, both ends should be sealed with tightly fitting caps or plugs. Ground-glass stoppers or Teflon caps may be used. The sorbent trap should then be labeled, covered with aluminum foil, and packaged on ice for transport to the laboratory. If a separate bottle is used, the spent resin should be quantitatively transferred from the trap into the clean bottle. Resin that adheres to the walls of the trap should be recovered using a rubber policeman or spatula and added to this bottle.

7.2.4 **Container no. 4:** Measure the volume of condensate collected in the condensate knockout section of the organic module to within +1 mL by using a graduated cylinder or by weighing to within +0.5 g using a triple-beam balance. Record the volume or weight of liquid present and note any discoloration or film in the liquid catch. Transfer this liquid to a prelabeled glass sample container. Inspect the back half of the filter housing and the gas-conditioning section of the organic module. If condensate is observed, transfer it to a graduated or weighing bottle and measure the volume, as described above. Add this material to the condensate knockout-trap catch.

7.2.5 **Container no. 5:** All sampling train components located between the high-efficiency glass- or quartz-fiber filter and the first wet impinger or the final condenser system (including the heated Teflon line connecting the filter outlet to the condenser) should be thoroughly rinsed with methanol/methylene chloride (1:1 v/v) and the rinsings combined. This rinse shall be separated from the condensate. If the spent resin is transferred from the sorbent trap to a separate sample container for transport, the sorbent trap shall be thoroughly rinsed until all sample-wetted surfaces appear clean. Visible films should be removed by brushing. Whenever train components are brushed, the brush should be subsequently rinsed with solvent mixture and the rinsings added to this container.

7.2.6 **Container no. 6:** Note the color of the indicating silica gel to determine if it has been completely spent and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere strongly to the impinger wall. Because the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, weigh the container and its contents to 0.5 g or better.

7.3 Impinger water:

7.3.1 Make a notation of any color or film in the liquid catch. Measure the liquid in the first three impingers to within +1 mL by using a graduated cylinder or by weighing it to within +0.5 g by using a balance (if one is available). Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas.

7.3.2 Discard the liquid after measuring and recording the volume or weight, unless analysis of the impinger catch is required (see Paragraph 4.1.3.7). Amber glass containers should be used for storage of impinger catch, if required.

7.3.3 If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

7.4 Sample preparation for shipment: Prior to shipment, recheck all sample containers to ensure that the caps are well secured. Seal the lids of all containers around the circumference with Teflon tape. Ship all liquid samples upright on ice and all particulate filters with the particulate catch facing upward. The particulate filters should be shipped unrefrigerated.

8.0 ANALYSIS

8.1 Sample preparation:

8.1.1 General: The preparation steps for all samples will result in a finite volume of concentrated solvent. The final sample volume (usually in the 1- to 10-mL range) is then subjected to analysis by GC/MS. All samples should be inspected and the appearance documented. All samples are to be spiked with surrogate standards as received from the field prior to any sample manipulations. The spike should be at a level equivalent to 10 times the MDL when the solvent is reduced in volume to the desired level (i.e., 10 mL). The spiking compounds should be the stable isotopically labeled analog of the compounds of interest or a compound that would exhibit properties similar to the compounds of interest, be easily chromatographed, and not interfere with the analysis of the compounds of interest. Suggested surrogate spiking compounds are: deuterated naphthalene, chrysene, phenol, nitrobenzene, chlorobenzene, toluene, and carbon-13-labeled pentachlorophenol.

8.1.2 Condensate: The "condensate" is the moisture collected in the first impinger following the XAD-2 module. Spike the condensate with the surrogate standards. The volume is measured and recorded and then transferred to a separatory funnel. The pH is to be adjusted to pH 2 with 6 N sulfuric acid, if necessary. The sample container and graduated cylinder are sequentially rinsed with three successive 10-mL aliquots of the extraction solvent and added to the separatory funnel. The ratio of solvent to aqueous sample should be maintained at 1:3. Extract the sample by vigorously shaking the separatory funnel for 5 min. After complete separation of the phases, remove the solvent and transfer to a Kuderna-Danish concentrator (K-D), filtering through a bed of precleaned, dry sodium sulfate. Repeat the extraction step two additional times. Adjust the pH to 11 with 6 N sodium hydroxide and reextract combining the acid and base extracts. Rinse the sodium sulfate into the K-D with fresh solvent and discard the desiccant. Add Teflon boiling chips and concentrate to 10 mL by reducing the volume to slightly less than 10 mL and then bringing to volume with fresh solvent. In order to achieve the necessary detection limit, the sample volume can be further reduced to 1 mL by using a micro column K-D or nitrogen blow-down. Should the sample start to exhibit precipitation, the concentration step should be stopped and the sample redissolved with fresh solvent taking the volume to some finite amount. After adding a standard (for the purpose of quantitation by GC/MS), the sample is ready for analysis, as discussed in Paragraph 8.2.

8.1.3 **Impinger:** Spike the sample with the surrogate standards; measure and record the volume and transfer to a separatory funnel. Proceed as described in Paragraph 8.1.2.

8.1.4 **XAD-2:** Spike the resin directly with the surrogate standards. Transfer the resin to the all-glass thimbles by the following procedure (care should be taken so as not to contaminate the thimble by touching it with anything other than tweezers or other solvent-rinsed mechanical holding devices). Suspend the XAD-2 module directly over the thimble. The glass frit of the module (see Figure 2) should be in the up position. The thimble is contained in a clean beaker, which will serve to catch the solvent rinses. Using a Teflon squeeze bottle, flush the XAD-2 into the thimble. Thoroughly rinse the glass module with solvent into the beaker containing the thimble. Add the XAD-2 glass-wool plug to the thimble. Cover the XAD-2 in the thimble with a precleaned glass-wool plug sufficient to prevent the resin from floating into the solvent reservoir of the extractor. If the resin is wet, effective extraction can be accomplished by loosely packing the resin in the thimble. If a question arises concerning the completeness of the extraction, a second extraction, without a spike, is advised. The thimble is placed in the extractor and the rinse solvent contained in the beaker is added to the solvent reservoir. Additional solvent is added to make the reservoir approximately two-thirds full. Add Teflon boiling chips and assemble the apparatus. Adjust the heat source to cause the extractor to cycle 5-6 times per hr. Extract the resin for 16 hr. Transfer the solvent and three 10-mL rinses of the reservoir to a K-D and concentrate as described in Paragraph 8.1.2.

8.1.5 **Particulate filter (and cyclone catch):** If particulate loading is to be determined, weigh the filter (and cyclone catch, if applicable). The particulate filter (and cyclone catch, if applicable) is transferred to the glass thimble and extracted simultaneously with the XAD-2 resin.

8.1.6 **Train solvent rinses:** All train rinses (i.e., probe, impinger, filter housing) using the extraction solvent and methanol are returned to the laboratory as a single sample. If the rinses are contained in more than one container, the intended spike is divided equally among the containers proportioned from a single syringe volume. Transfer the rinse to a separatory funnel and add a sufficient amount of organic-free water so that the methylene chloride becomes immiscible and its volume no longer increases with the addition of more water. The extraction and concentration steps are then performed as described in Paragraph 8.1.2.

8.2 Sample analysis:

8.2.1 The primary analytical tool for the measurement of emissions from hazardous waste incinerators is GC/MS using fused-silica capillary GC columns, as described in Method 8270 in Chapter Four of this manual. Because of the nature of GC/MS instrumentation and the cost associated

with sample analysis, prescreening of the sample extracts by gas chromatography/flame ionization detection (GC/FID) or with electron capture (GC/ECD) is encouraged. Information regarding the complexity and concentration level of a sample prior to GC/MS analysis can be of enormous help. This information can be obtained by using either capillary columns or less expensive packed columns. However, the FID screen should be performed with a column similar to that used with the GC/MS. Keep in mind that GC/FID has a slightly lower detection limit than GC/MS and, therefore, that the concentration of the sample can be adjusted either up or down prior to analysis by GC/MS.

8.2.2 The mass spectrometer will be operated in a full scan (40-450) mode for most of the analyses. The range for which data are acquired in a GC/MS run will be sufficiently broad to encompass the major ions, as listed in Chapter Four, Method 8270, for each of the designated POHCs in an incinerator effluent analysis.

8.2.3 For most purposes, electron ionization (EI) spectra will be collected because a majority of the POHCs give reasonable EI spectra. Also, EI spectra are compatible with the NBS Library of Mass Spectra and other mass spectral references, which aid in the identification process for other components in the incinerator process streams.

8.2.4 To clarify some identifications, chemical ionization (CI) spectra using either positive ions or negative ions will be used to elucidate molecular-weight information and simplify the fragmentation patterns of some compounds. In no case, however, should CI spectra alone be used for compound identification. Refer to Chapter Four, Method 8270, for complete descriptions of GC conditions, MS conditions, and quantitative and quantitative identification.

9.0 CALIBRATION

9.1 Probe nozzle: Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.025 mm (0.001 in.). Make measurements at three separate places across the diameter and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

9.2 Pitot tube: The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 4 of EPA Method 2, or assigned a nominal coefficient of 0.84 if it is not visibly nicked, dented, or corroded and if it meets design and intercomponent spacing specifications.

9.3 Metering system:

9.3.1 Before its initial use in the field, the metering system shall be calibrated according to the procedure outlined in APTD-0576. Instead of physically adjusting the dry-gas meter dial readings to correspond to the wet-test meter readings, calibration factors may be used to correct the gas meter dial readings mathematically to the proper values. Before calibrating the metering system, it is suggested that a leak-check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: Make a 10-min calibration run at 0.00057 m^3/min (0.02 cfm); at the end of the run, take the difference of the measured wet-test and dry-gas meter volumes and divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m^3/min (0.02 cfm).

9.3.2 After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single intermediate orifice setting (based on the previous field test). The vacuum shall be set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet-test meter and the inlet of the metering system. Calculate the average value of the calibration factor. If the calibration has changed by more than 5%, recalibrate the meter over the full range of orifice settings, as outlined in APTD-0576.

9.3.3 Leak-check of metering system: That portion of the sampling train from the pump to the orifice meter (see Figure 1) should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 6): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13-18 cm (5-7 in.) water column by blowing into the rubber tubing. Pinch off the tubing and observe the manometer for 1 min. A loss of pressure on the manometer indicates a leak in the meter box. Leaks, if present, must be corrected.

NOTE: If the dry-gas-meter coefficient values obtained before and after a test series differ by >5%, either the test series shall be voided or calculations for test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

9.4 Probe heater: The probe-heating system shall be calibrated before its initial use in the field according to the procedure outlined in APTD-0576. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used.

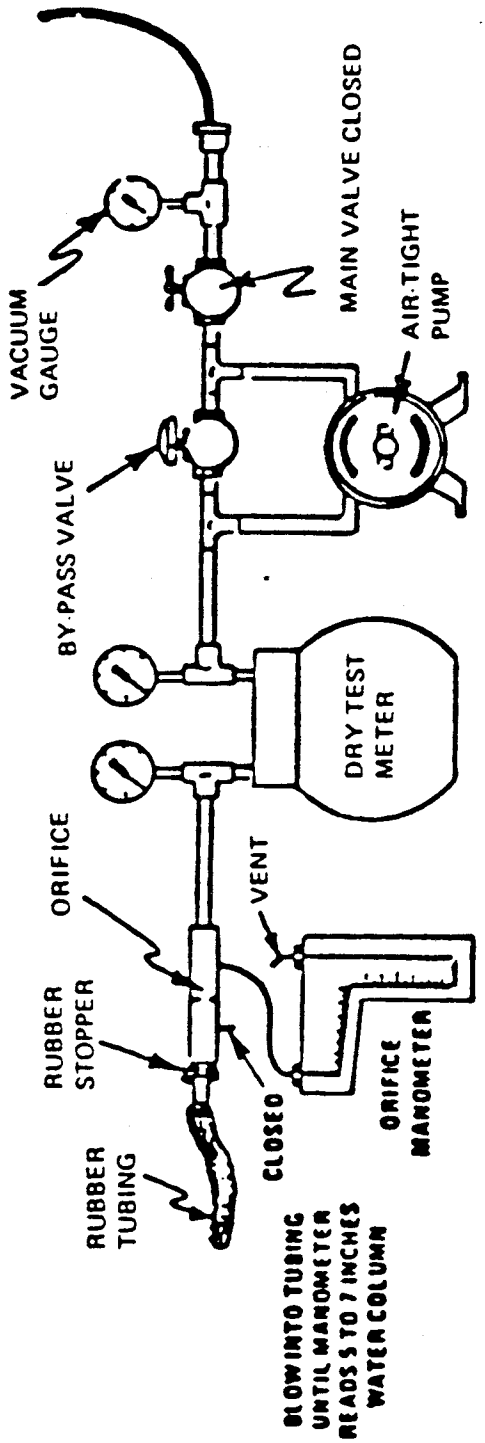


Figure 6. Leak-check of meter box.

9.5 Temperature gauges: Each thermocouple must be permanently and uniquely marked on the casting; all mercury-in-glass reference thermometers must conform to ASTM E-1 63C or 63F specifications. Thermocouples should be calibrated in the laboratory with and without the use of extension leads. If extension leads are used in the field, the thermocouple readings at ambient air temperatures, with and without the extension lead, must be noted and recorded. Correction is necessary if the use of an extension lead produces a change >1.5%.

9.5.1 Impinger, organic module, and dry-gas meter thermocouples: For the thermocouples used to measure the temperature of the gas leaving the impinger train and the XAD-2 resin bed, three-point calibration at ice-water, room-air, and boiling-water temperatures is necessary. Accept the thermocouples only if the readings at all three temperatures agree to ±2°C (3.6°F) with those of the absolute value of the reference thermometer.

9.5.2 Probe and stack thermocouple: For the thermocouples used to indicate the probe and stack temperatures, a three-point calibration at ice-water, boiling-water, and hot-oil-bath temperatures must be performed; it is recommended that room-air temperature be added, and that the thermometer and the thermocouple agree to within 1.5% at each of the calibration points. A calibration curve (equation) may be constructed (calculated) and the data extrapolated to cover the entire temperature range suggested by the manufacturer.

9.6 Barometer: Adjust the barometer initially and before each test series to agree to within ±25 mm Hg (0.1 in. Hg) of the mercury barometer or the corrected barometric pressure value reported by a nearby National Weather Service Station (same altitude above sea level).

9.7 Triple-beam balance: Calibrate the triple-beam balance before each test series, using Class-S standard weights; the weights must be within ±0.5% of the standards, or the balance must be adjusted to meet these limits.

10.0 CALCULATIONS

10.1 Carry out calculations. Round off figures after the final calculation to the correct number of significant figures.

10.2 Nomenclature:

A_n = Cross-sectional area of nozzle, m^2 (ft^2).

B_{ws} = Water vapor in the gas stream, proportion by volume.

C_d = Type S pitot tube coefficient (nominally 0.84 ± 0.02), dimensionless.

I = Percent of isokinetic sampling.

L_a = Maximum acceptable leakage rate for a leak-check, either pre-test or following a component change; equal to 0.00057 m^3/min (0.02 cfm) or 4% of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak-check conducted prior to the "i^{th}" component change (i = 1, 2, 3...n) m^3/min (cfm).

L_p = Leakage rate observed during the post-test leak-check, m^3/min (cfm).

M_d = Stack-gas dry molecular weight, g/g-mole (lb/lb-mole).

M_w = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).

P_s = Absolute stack-gas pressure, mm Hg (in. Hg).

P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

R = Ideal gas constant, 0.06236 mm Hg-m^3/K-g-mole (21.85 in. Hg-ft^3/°R-lb-mole).

T_m = Absolute average dry-gas meter temperature (see Figure 6), K (°R).

T_s = Absolute average stack-gas temperature (see Figure 6), K (°R).

T_{std} = Standard absolute temperature, 293K (528°R).

V_{lc} = Total volume of liquid collected in the organic module condensate knockout trap, the impingers, and silica gel, mL.

V_m = Volume of gas sample as measured by dry-gas meter, dscm (dscf).

$V_{m(std)}$ = Volume of gas sample measured by the dry-gas meter, corrected to standard conditions, dscm (dscf).

$V_{w(std)}$ = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

V_s = Stack-gas velocity, calculated by Method 2, Equation 2-9, using data obtained from Method 5, m/sec (ft/sec).

W_a = Weight of residue in acetone wash, mg.

γ = Dry-gas-meter calibration factor, dimensionless.

ΔH = Average pressure differential across the orifice meter (see Figure 2), mm H_2O (in. H_2O).

ρ_w = Density of water, 0.9982 g/mL (0.002201 lb/mL).

θ = Total sampling time, min.

θ_1 = Sampling time interval from the beginning of a run until the first component change, min.

θ_i = Sampling time interval between two successive component changes, beginning with the interval between the first and second changes, min.

θ_p = Sampling time interval from the final (n^{th}) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = sec/min.

100 = Conversion to percent.

10.3 Average dry-gas-meter temperature and average orifice pressure drop: See data sheet (Figure 5, above).

10.4 Dry-gas volume: Correct the sample measured by the dry-gas meter to standard conditions (20°C, 760 mm Hg [68°F, 29.92 in. Hg]) by using Equation 1:

$$V_{m(std)} = V_m \gamma \frac{T_{std}}{T_m} \frac{P_{bar} + \Delta H/13.6}{P_{std}} = K_1 V_m \gamma \frac{P_{bar} + \Delta H/13.6}{T_m} \qquad (1)$$

where:

K_1 = 0.3858 K/mm Hg for metric units, or
K_1 = 17.64°R/in. Hg for English units.

It should be noted that Equation 1 can be used as written, unless the leakage rate observed during any of the mandatory leak-checks (i.e., the post-test leak-check or leak-checks conducted prior to component changes) exceeds L_a. If L_p or L_i exceeds L_a, Equation 1 must be modified as follows:

a. Case I (no component changes made during sampling run): Replace V_m in Equation 1 with the expression:

$$V_m - (L_p - L_a)$$

b. Case II (one or more component changes made during the sampling run): Replace V_m in Equation 1 by the expression:

$$V_m - (L_1 - L_a)\theta_1 - \sum_{i=2}^{n} (L_i - L_a)\theta_1 - (L_p - L_a)\theta_p$$

and substitute only for those leakage rates (L_1 or L_p) that exceed L_a.

10.5 Volume of water vapor:

$$V_{w(std)} = V_{lc} \frac{P_w}{M_w} \frac{RT_{std}}{P_{std}} = K_2 V_{lc} \quad (2)$$

where:

$K_2 = 0.001333$ m^3/mL for metric units, or
$K_2 = 0.04707$ ft^3/mL for English units.

10.6 Moisture content:

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \quad (3)$$

NOTE: In saturated or water-droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 3) and a second from the assumption of saturated conditions. The lower of the two values of B_w shall be considered correct. The procedure for determining the moisture content based upon assumption of saturated conditions is given in the Note to Section 1.2 of Method 4. For the purposes of this method, the average stack-gas temperature from Figure 6 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is ±1°C (2°F).

10.7 Conversion factors:

From	To	Multiply by
scf	m^3	0.02832
g/ft^3	gr/ft^3	15.43
g/ft^3	lb/ft^3	2.205×10^{-3}
g/ft^3	g/m^3	35.31

10.8 Isokinetic variation:

10.8.1 Calculation from raw data:

$$I = \frac{100\ T_s[K_3 F_{1c} + (V_m/T_m)\ (P_{bar} + \Delta H/13.6)]}{60\theta V_s P_s A_n} \qquad (4)$$

where:

K_3 = 0.003454 mm Hg-m^3/mL-K for metric units, or
K_3 = 0.002669 in. Hg-ft^3/mL-°R for English units.

10.8.2 Calculation for intermediate values:

$$I = \frac{T_s V_{m(std)} P_{std} 100}{T_{std} V_s \theta A_n P_s 60(1-B_{ws})} \qquad (5)$$

$$= K_4 \frac{T_s V_{m(std)}}{P_s V_s A_n \theta (1-B_{ws})}$$

where:

K_4 = 4.320 for metric units, or
K_4 = 0.09450 for English units.

10.8.3 Acceptable results: If 90% $\leq$ I $\leq$ 110%, the results are acceptable. If the results are low in comparison with the standard and I is beyond the acceptable range, or if I is less than 90%, the Administrator may opt to accept the results.

10.9 To determine the minimum sample volume that shall be collected, the following sequence of calculations shall be used.

10.9.1 From prior analysis of the waste feed, the concentration of POHCs introduced into the combustion system can be calculated. The degree of destruction and removal efficiency that is required is used to determine the maximum amount of POHC allowed to be present in the effluent. This may be expressed as:

$$\frac{(WF)\ (POHC_i\ conc)}{100} \quad \frac{(100-\%DRE)}{100} = \text{Max } POHC_i \text{ Mass} \qquad (6)$$

where:

WF = mass flow rate of waste feed per hr, g/hr (lb/hr).

$POHC_i$ = concentration of Principal Organic Hazardous Compound (wt %) introduced into the combustion process.

DRE = percent Destruction and Removal Efficiency required.

Max POHC = mass flow rate (g/hr [lb/hr]) of POHC emitted from the combustion source.

10.9.2 The average discharge concentration of the POHC in the effluent gas is determined by comparing the Max POHC with the volumetric flow rate being exhausted from the source. Volumetric flow rate data are available as a result of preliminary Method 1-4 determinations:

$$\frac{\text{Max POHC}_i \text{ Mass}}{DV_{eff(std)}} = \text{Max POHC}_i \text{ conc} \qquad (7)$$

where:

$DV_{eff(std)}$ = volumetric flow rate of exhaust gas, dscm (dscf).

$POHC_i$ conc = anticipated concentration of the POHC in the exhaust gas stream, g/dscm (lb/dscf).

10.9.3 In making this calculation, it is recommended that a safety margin of at least ten be included:

$$\frac{LDL_{POHC} \times 10}{POHC_i \text{ conc}} = V_{TBC} \qquad (8)$$

where:

LDL_{POHC} = detectable amount of POHC in entire sampling train.
NOTE: The whole extract from an XAD-2 cartridge is seldom if ever, injected at once. Therefore, if aliquoting factors are involved, the LDL_{POHC} is not the same as the analytical (or column) detection limit.

V_{TBC} = minimum dry standard volume to be collected at dry-gas meter.

10.10 Concentration of any given POHC in the gaseous emissions of a combustion process:

1) Multiply the concentration of the POHC as determined in Method 8270 by the final concentration volume, typically 10 mL.

C_{POHC} (ug/mL) x sample volume (mL) = amount (ug) of POHC in sample (9)

where:

C_{POHC} = concentration of POHC as analyzed by Method 8270.

2) Sum the amount of POHC found in all samples associated with a single train.

Total (ug) = XAD-2 (ug) + condensate (ug) + rinses (ug) + impinger (ug) (10)

3) Divide the total ug found by the volume of stack gas sampled (m^3).

(Total ug)/(train sample volume) = concentration of POHC (ug/m^3) (11)

11.0 QUALITY CONTROL

11.1 Sampling: See EPA Manual 600/4-77-027b for Method 5 quality control.

11.2 Analysis: The quality assurance program required for this study includes the analysis of field and method blanks, procedure validations, incorporation of stable labeled surrogate compounds, quantitation versus stable labeled internal standards, capillary column performance checks, and external performance tests. The surrogate spiking compounds selected for a particular analysis are used as primary indicators of the quality of the analytical data for a wide range of compounds and a variety of sample matrices. The assessment of combustion data, positive identification, and quantitation of the selected compounds are dependent on the integrity of the samples received and the precision and accuracy of the analytical methods employed. The quality assurance procedures for this method are designed to monitor the performance of the analytical method and to provide the required information to take corrective action if problems are observed in laboratory operations or in field sampling activities.

11.2.1 **Field Blanks:** Field blanks must be submitted with the samples collected at each sampling site. The field blanks include the sample bottles containing aliquots of sample recovery solvents, unused filters, and resin cartridges. At a minimum, one complete sampling train will be assembled in the field staging area, taken to the sampling area, and leak-checked at the beginning and end of the testing (or for the same total number of times as the actual test train). The filter housing and probe of the blank train will be heated during the sample test. The train will be recovered as if it were an actual test sample. No gaseous sample will be passed through the sampling train.

11.2.2 **Method blanks:** A method blank must be prepared for each set of analytical operations, to evaluate contamination and artifacts that can be derived from glassware, reagents, and sample handling in the laboratory.

11.2.3 Refer to Method 8270 for additional quality control considerations.

12.0 METHOD PERFORMANCE

12.1 Method performance evaluation: Evaluation of analytical procedures for a selected series of compounds must include the sample-preparation procedures and each associated analytical determination. The analytical procedures should be challenged by the test compounds spiked at appropriate levels and carried through the procedures.

12.2 Method detection limit: The overall method detection limits (lower and upper) must be determined on a compound-by-compound basis because different compounds may exhibit different collection, retention, and extraction efficiencies as well as instrumental minimum detection limit (MDL). The method detection limit must be quoted relative to a given sample volume. The upper limits for the method must be determined relative to compound retention volumes (breakthrough).

12.3 Method precision and bias: The overall method precision and bias must be determined on a compound-by-compound basis at a given concentration level. The method precision value would include a combined variability due to sampling, sample preparation, and instrumental analysis. The method bias would be dependent upon the collection, retention, and extraction efficiency of the train components. From evaluation studies to date using a dynamic spiking system, method biases of -13% and -16% have been determined for toluene and 1,1,2,2-tetrachloroethane, respectively. A precision of 19.9% was calculated from a field test data set representing seven degrees of freedom which resulted from a series of paired, unspiked Semivolatile Organic Sampling trains (Semi-VOST) sampling emissions from a hazardous waste incinerator.

13.0 REFERENCES

1. Addendum to Specifications for Incinerator Testing at Federal Facilities, PHS, NCAPC, December 6, 1967.

2. Bursey, J., Homolya, J., McAllister, R., and McGangley, J., Laboratory and Field Evaluation of the Semi-VOST Method, Vols. 1 and 2, U.S. Environmental Protection Agency, EPA/600/4-851/075A, 075B (1985).

3. Martin, R.M., Construction Details of Isokinetic Source-Sampling Equipment, Research Triangle Park, NC, U.S. Environmental Protection Agency, April 1971, PB-203 060/BE, APTD-0581, 35 pp.

4. Rom, J.J., Maintenance, Calibration, and Operation of Isokinetic Source-Sampling Equipment, Research Triangle Park, NC, U.S. Environmental Protection Agency, March 1972, PB-209 022/BE, APTD-0576, 39 pp.

5. Schlickenrieder, L.M., Adams, J.W., and Thrun, K.E., Modified Method 5 Train and Source Assessment Sampling System: Operator's Manual, U.S. Environmental Protection Agency, EPA/600/8-85/003, (1985).

6. Shigehara, R.T., Adjustments in the EPA Nomography for Different Pitot Tube Coefficients and Dry Molecular Weights, Stack Sampling News, 2:4-11 (October 1974).

7. U.S. Environmental Protection Agency, CFR 40 Part 60, Appendix A, Methods 1-5.

8. Vollaro, R.F., A Survey of Commercially Available Instrumentation for the Measurement of Low-Range Gas Velocities, Research Triangle Park, NC, U.S. Environmental Protection Agency, Emissions Measurement Branch, November 1976 (unpublished paper).

PREPARATION OF XAD-2 SORBENT RESIN

1.0 SCOPE AND APPLICATION

1.1 XAD-2 resin as supplied by the manufacturer is impregnated with a bicarbonate solution to inhibit microbial growth during storage. Both the salt solution and any residual extractable monomer and polymer species must be removed before use. The resin is prepared by a series of water and organic extractions, followed by careful drying.

2.0 EXTRACTION

2.1 Method 1: The procedure may be carried out in a giant Soxhlet extractor. An all-glass thimble containing an extra-coarse frit is used for extraction of XAD-2. The frit is recessed 10-15 mm above a crenellated ring at the bottom of the thimble to facilitate drainage. The resin must be carefully retained in the extractor cup with a glass-wool plug and stainless steel screen because it floats on methylene chloride. This process involves sequential extraction in the following order.

Solvent	Procedure
Water	Initial rinse: Place resin in a beaker, rinse once with Type II water, and discard. Fill with water a second time, let stand overnight, and discard.
Water	Extract with H_2O for 8 hr.
Methyl alcohol	Extract for 22 hr.
Methylene chloride	Extract for 22 hr.
Methylene chloride (fresh)	Extract for 22 hr.

2.2 Method 2:

2.2.1 As an alternative to Soxhlet extraction, a continuous extractor has been fabricated for the extraction sequence. This extractor has been found to be acceptable. The particular canister used for the apparatus shown in Figure A-1 contains about 500 g of finished XAD-2. Any size may be constructed; the choice is dependent on the needs of the sampling programs. The XAD-2 is held under light spring tension between a pair of coarse and fine screens. Spacers under the bottom screen allow for even distribution of clean solvent. The three-necked flask should be of sufficient size (3-liter in this case) to hold solvent

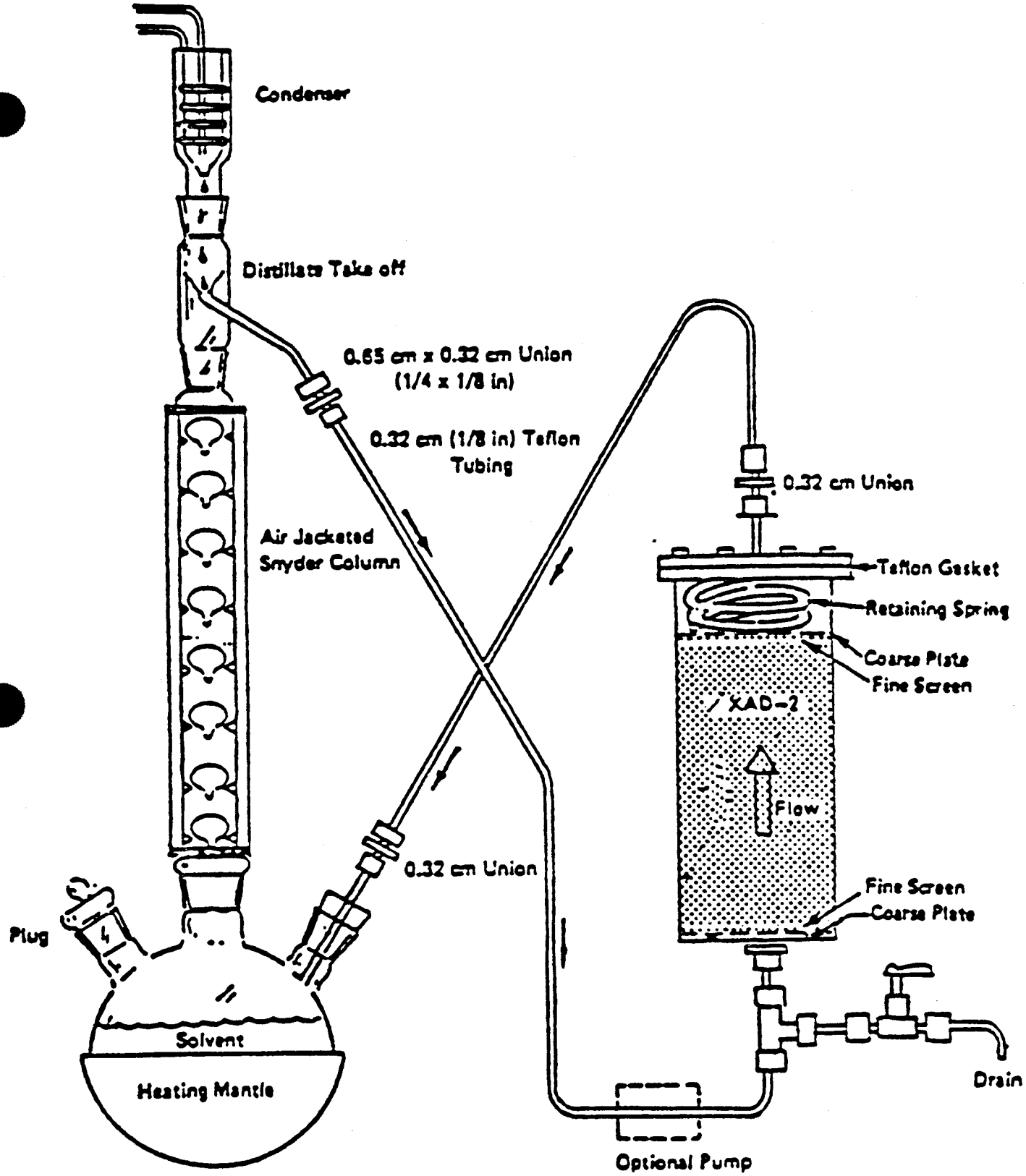


Figure A-1. XAD-2 cleanup extraction apparatus.

equal to twice the dead volume of the XAD-2 canister. Solvent is refluxed through the Snyder column, and the distillate is continuously cycled up through the XAD-2 for extraction and returned to the flask. The flow is maintained upward through the XAD-2 to allow maximum solvent contact and prevent channeling. A valve at the bottom of the canister allows removal of solvent from the canister between changes.

2.2.2 Experience has shown that it is very difficult to cycle sufficient water in this mode. Therefore the aqueous rinse is accomplished by simply flushing the canister with about 20 liters of distilled water. A small pump may be useful for pumping the water through the canister. The water extraction should be carried out at the rate of about 20-40 mL/min.

2.2.3 After draining the water, subsequent methyl alcohol and methylene chloride extractions are carried out using the refluxing apparatus. An overnight or 10- to 20-hr period is normally sufficient for each extraction.

2.2.4 All materials of construction are glass, Teflon, or stainless steel. Pumps, if used, should not contain extractable materials. Pumps are not used with methanol and methylene chloride.

3.0 DRYING

3.1 After evaluation of several methods of removing residual solvent, a fluidized-bed technique has proved to be the fastest and most reliable drying method.

3.2 A simple column with suitable retainers, as shown in Figure A-2, will serve as a satisfactory column. A 10.2-cm (4-in.) Pyrex pipe 0.6 m (2 ft) long will hold all of the XAD-2 from the extractor shown in Figure A-1 or the Soxhlet extractor, with sufficient space for fluidizing the bed while generating a minimum resin load at the exit of the column.

3.3 Method 1: The gas used to remove the solvent is the key to preserving the cleanliness of the XAD-2. Liquid nitrogen from a standard commercial liquid nitrogen cylinder has routinely proved to be a reliable source of large volumes of gas free from organic contaminants. The liquid nitrogen cylinder is connected to the column by a length of precleaned 0.95-cm (3/8-in.) copper tubing, coiled to pass through a heat source. As nitrogen is bled from the cylinder, it is vaporized in the heat source and passes through the column. A convenient heat source is a water bath heated from a steam line. The final nitrogen temperature should only be warm to the touch and not over 40°C. Experience has shown that about 500 g of XAD-2 may be dried overnight by consuming a full 160-liter cylinder of liquid nitrogen.

3.4 Method 2: As a second choice, high-purity tank nitrogen may be used to dry the XAD-2. The high-purity nitrogen must first be passed through a bed

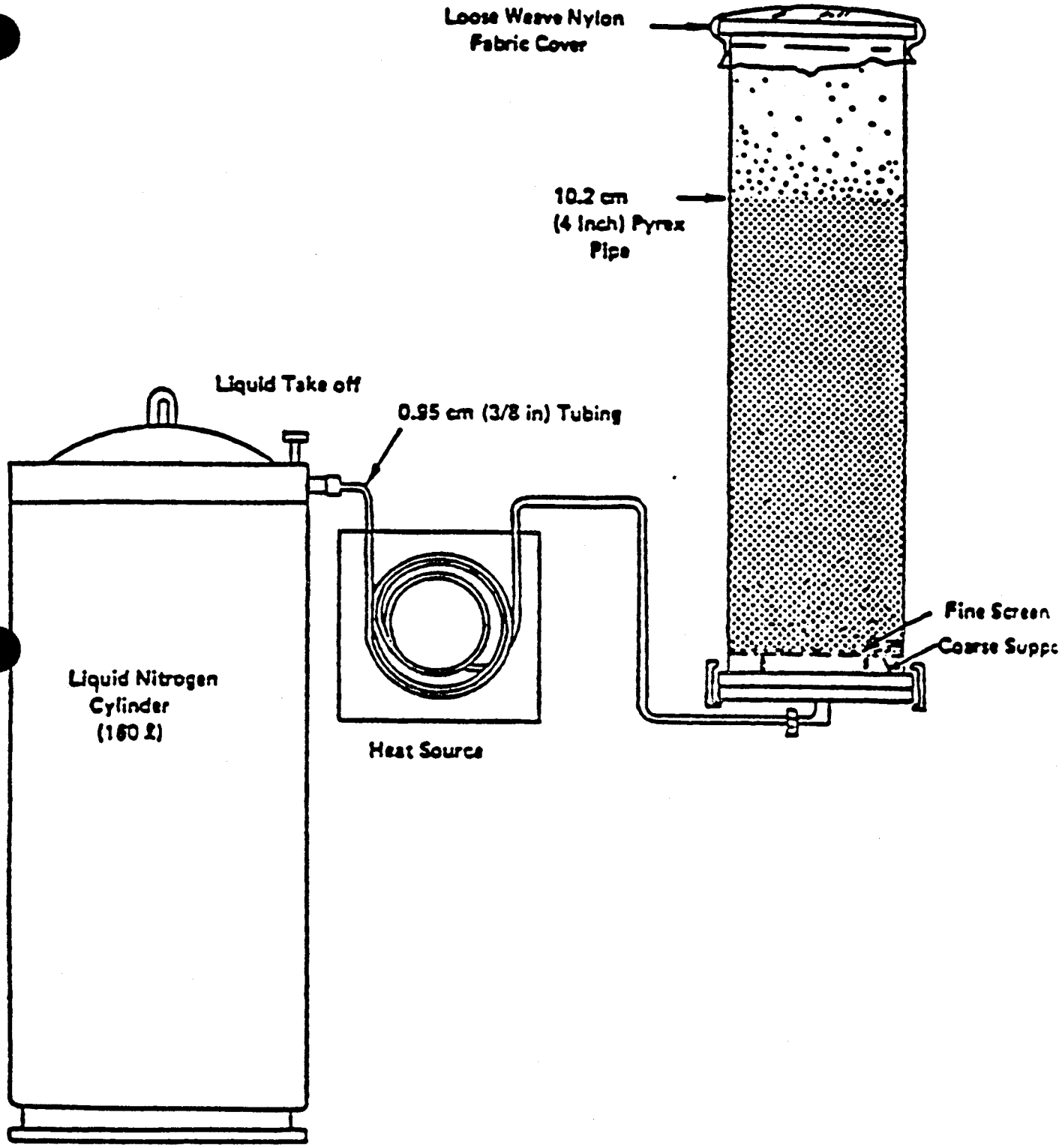


Figure A-2. XAD-2 fluidized-bed drying apparatus.

of activated charcoal approximately 150 mL in volume. With either type of drying method, the rate of flow should gently agitate the bed. Excessive fluidization may cause the particles to break up.

4.0 QUALITY CONTROL PROCEDURES

4.1 For both Methods 1 and 2, the quality control results must be reported for the batch. The batch must be reextracted if the residual extractable organics are >20 ug/mL by TCO analysis or the gravimetric residue is >0.5 mg/20 g XAD-2 extracted. (See also section 5.1, Method 0010.)

4.2 Four control procedures are used with the final XAD-2 to check for (1) residual methylene chloride, (2) extractable organics (TCO), (3) specific compounds of interest as determined by GC/MS, as described in Section 4.5 below, and (4) residue (GRAV).

4.3 Procedure for residual methylene chloride:

4.3.1 **Description:** A 1±0.1-g sample of dried resin is weighed into a small vial, 3 mL of toluene are added, and the vial is capped and well shaken. Five uL of toluene (now containing extracted methylene chloride) are injected into a gas chromatograph, and the resulting integrated area is compared with a reference standard. The reference solution consists of 2.5 uL of methylene chloride in 100 mL of toluene, simulating 100 ug of residual methylene chloride on the resin. The acceptable maximum content is 1,000 ug/g resin.

4.3.2 **Experimental:** The gas chromatograph conditions are as follows:

6-ft x 1/8-in. stainless steel column containing 10% OV-101 on 100/120 Supelcoport;

Helium carrier at 30 mL/min;

FID operated on 4 x 10^{-11} A/mV;

Injection port temperature: 250°C;

Detector temperature: 305°C;

Program: 30°C(4 min) 40°C/min 250°C (hold); and

Program terminated at 1,000 sec.

4.4 Procedure for residual extractable organics:

4.4.1 **Description:** A 20±0.1-g sample of cleaned, dried resin is weighed into a precleaned alundum or cellulose thimble which is plugged with cleaned glass wool. (Note that 20 g of resin will fill a thimble, and the

resin will float out unless well plugged.) The thimble containing the resin is extracted for 24 hr with 200-mL of pesticide- grade methylene chloride (Burdick and Jackson pesticide-grade or equivalent purity). The 200-mL extract is reduced in volume to 10-mL using a Kuderna-Danish concentrator and/or a nitrogen evaporation stream. Five uL of that solution are analyzed by gas chromatography using the TCO analysis procedure. The concentrated solution should not contain >20 ug/mL of TCO extracted from the XAD-2. This is equivalent to 10 ug/g of TCO in the XAD-2 and would correspond to 1.3 mg of TCO in the extract of the 130-g XAD-2 module. Care should be taken to correct the TCO data for a solvent blank prepared (200 mL reduced to 10 mL) in a similar manner.

4.4.2 **Experimental:** Use the TCO analysis conditions described in the revised Level 1 manual (EPA 600/7-78-201).

4.5 GC/MS Screen: The extract, as prepared in paragraph 4.4.1, is subjected to GC/MS analysis for each of the individual compounds of interest. The GC/MS procedure is described in Chapter Four, Method 8270. The extract is screened at the MDL of each compound. The presence of any compound at a concentration >25 ug/mL in the concentrated extract will require the XAD-2 to be recleaned by repeating the methylene chloride step.

4.6 Methodology for residual gravimetric determination: After the TCO value and GC/MS data are obtained for the resin batch by the above procedures, dry the remainder of the extract in a tared vessel. There must be <0.5 mg residue registered or the batch of resin will have to be extracted with fresh methylene chloride again until it meets this criterion. This level corresponds to 25 ug/g in the XAD-2, or about 3.25 mg in a resin charge of 130 g.

METHOD 0010, APPENDIX B

TOTAL CHROMATOGRAPHABLE ORGANIC MATERIAL ANALYSIS

1.0 SCOPE AND APPLICATION

1.1 In this procedure, gas chromatography is used to determine the quantity of lower boiling hydrocarbons (boiling points between 90° and 300°C) in the concentrates of all organic solvent rinses, XAD-2 resin and LC fractions - when Method 1 is used (see References, Method 0010) - encountered in Level 1 environmental sample analyses. Data obtained using this procedure serve a twofold purpose. First, the total quantity of the lower boiling hydrocarbons in the sample is determined. Then whenever the hydrocarbon concentrations in the original concentrates exceed 75 ug/m^3, the chromatography results are reexamined to determine the amounts of individual species.

The extent of compound identification is limited to representing all materials as normal alkanes based upon comparison of boiling points. Thus the method is not qualitative. In a similar manner, the analysis is semiquantitative; calibrations are prepared using only one hydrocarbon. They are replicated but samples routinely are not.

1.2 Application: This procedure applies solely to the Level 1 C7-C16 gas chromatographic analysis of concentrates of organic extracts, neat liquids, and of LC fractions. Throughout the procedure, it is assumed the analyst has been given a properly prepared sample.

1.3 Sensitivity: The sensitivity of this procedure, defined as the slope of a plot of response versus concentration, is dependent on the instrument and must be verified regularly. TRW experience indicates the nominal range is of the order of 77 uV·V·sec·uL/ng of n-heptane and 79 uV·sec·ul/ng of n-hexadecane. The instrument is capable of perhaps one hundredfold greater sensitivity. The level specified here is sufficient for Level 1 analysis.

1.4 Detection limit: The detection limit of this procedure as written is 1.3 ng/uL for a 1 uL injection of n-decane. This limit is arbitrarily based on defining the minimum detectable response as 100 uv·sec. This is an easier operational definition than defining the minimum detection limit to be that amount of material which yields a signal twice the noise level.

1.5 Range: The range of the procedure will be concentrations of 1.3 ng/uL and greater.

1.6 Limitations

1.6.1 Reporting limitations: It should be noted that a typical environmental sample will contain compounds which: (a) will not elute in the specified boiling ranges and thus will not be reported, and/or (b)

will not elute from the column at all and thus will not be reported. Consequently, the organic content of the sample as reported is a lower bound and should be regarded as such.

1.6.2 **Calibration limitations:** Quantitation is based on calibration with n-decane. Data should therefore be reported as, e.g., mg C8/m^3 as n-decane. Since response varies linearly with carbon number (over a wide range the assumption may involve a 20% error), it is clear that heptane (C7) detected in a sample and quantitated as decane will be overestimated. Likewise, hexadecane (C16) quantitated as decane will be underestimated. From previous data, it is estimated the error involved is on the order of 6-7%.

1.6.3 **Detection limitations:** The sensitivity of the flame ionization detector varies from compound to compound. However, n-alkanes have a greater response than other classes. Consequently, using an n-alkane as a calibrant and assuming equal responses of all other compounds tends to give low reported values.

2.0 SUMMARY OF METHOD

2.1 A mL aliquot of all 10-mL concentrates is disbursed for GC-TCO analysis. With boiling point-retention time and response-amount calibration curves, the data (peak retention times and peak areas) are interpreted by first summing peak areas in the ranges obtained from the boiling point-retention time calibration. Then, with the response-amount calibration curve, the area sums are converted to amounts of material in the reported boiling point ranges.

2.2 After the instrument is set up, the boiling point-retention time calibration is effected by injecting a mixture of n-C7 through n-C16 hydrocarbons and operating the standard temperature program. Response-quantity calibrations are accomplished by injecting n-decane in n-pentane standards and performing the standard temperature program.

2.3 Definitions

2.3.1 **GC:** Gas chromatography or gas chromatograph.

2.3.2 **C7-C16 n-alkanes:** Heptane through hexadecane.

2.3.3 **GCA temperature program:** 4 min isothermal at 60°C, 10°C/min from 60° to 220°C.

2.3.4 **TRW temperature program:** 5 min isothermal at room temperature, then program from 30°C to 250°C at 15°C/min.

3.0 INTERFERENCES

Not applicable.

4.0 APPARATUS AND MATERIALS

4.1 Gas chromatograph: This procedure is intended for use on a Varian 1860 gas chromatograph, equipped with dual flame ionization detectors and a linear temperature programmer. Any equivalent instrument can be used provided that electrometer settings, etc., be changed appropriately.

4.2 Gases:

4.2.1 Helium: Minimum quality is reactor grade. A 4A or 13X molecular sieve drying tube is required. A filter must be placed between the trap and the instrument. The trap should be recharged after every third tank of helium.

4.2.2 Air: Zero grade is satisfactory.

4.2.3 Hydrogen: Zero grade.

4.3 Syringe: Syringes are Hamilton 701N, 10 uL, or equivalent.

4.4 Septa: Septa will be of such quality as to produce very low bleed during the temperature program. An appropriate septum is Supelco Microsep 138, which is Teflon-backed. If septum bleed cannot be reduced to a negligible level, it will be necessary to install septum swingers on the instrument.

4.5 Recorder: The recorder of this procedure must be capable of not less than 1 mV full-scale display, a 1-sec time constant and 0.5 in. per min chart rate.

4.6 Integrator: An integrator is required. Peak area measurement by hand is satisfactory but too time-consuming. If manual integration is required, the method of "height times width at half height" is used.

4.7 Columns:

4.7.1 Preferred column: 6 ft x 1/8 in. O.D. stainless steel column of 10% OV-101 on 100/120 mesh Supelcoport.

4.7.2 Alternate column: 6 ft x 1/8 in. O.D. stainless steel column of 10% OV-1 (or other silicon phase) on 100/120 mesh Supelcoport.

4.8 Syringe cleaner: Hamilton syringe cleaner or equivalent connected to a suitable vacuum source.

5.0 REAGENTS

5.1 Pentane: "Distilled-in-Glass" (reg. trademark) or "Nanograde" (reg. trademark) for standards and for syringe cleaning.

5.2 Methylene chloride: "Distilled-in-Glass" (reg. trademark) or "Nanograde" (reg. trademark) for syringe cleaning.

6.0 SAMPLING HANDLING AND PRESERVATION

6.1 The extracts are concentrated in a Kuderna-Danish evaporator to a volume less than 10 mL. The concentrate is then quantitatively transferred to a 10-mL volumetric flask and diluted to volume. A 1-mL aliquot is taken for both this analysis and possible subsequent GC/MS analysis and set aside in the sample bank. For each GC-TCO analysis, obtain the sample sufficiently in advance to allow it to warm to room temperature. For example, after one analysis is started, return that sample to the sample bank and take the next sample.

7.0 PROCEDURES

7.1 Setup and checkout: Each day, the operator will verify the following:

7.1.1 That supplies of carrier gas, air and hydrogen are sufficient, i.e., that each tank contains $>$ 100 psig.

7.1.2 That, after replacement of any gas cylinder, all connections leading to the chromatograph have been leak-checked.

7.1.3 That the carrier gas flow rate is 30 $\pm$ 2 mL/min, the hydrogen flow rate is 30 $\pm$ 2 mL/min, and the air flow rate is 300 $\pm$ 20 mL/min.

7.1.4 That the electrometer is functioning properly.

7.1.5 That the recorder and integrator are functioning properly.

7.1.6 That the septa have been leak-checked (leak-checking is effected by placing the soap bubble flow meter inlet tube over the injection port adaptors), and that no septum will be used for more than 20 injections.

7.1.7 That the list of samples to be run is ready.

7.2 Retention time calibration:

7.2.1 To obtain the temperature ranges for reporting the results of the analyses, the chromatograph is given a normal boiling point-retention time calibration. The n-alkanes, their boiling points, and data reporting ranges are given in the table below:

	NBP, °C	Reporting Range, °C	Report As
n-heptane	98	90-110	C7
n-octane	126	110-140	C8
n-nonane	151	140-160	C9
n-decane	174	160-180	C10
n-undecane	194	180-200	C11
n-dodecane	214	200-220	C12
n-tridecane	234	220-240	C13
n-tetradecane	252	240-260	C14
n-pentadecane	270	260-280	C15
n-hexadecane	288	280-300	C16

7.2.2 **Preparation of standards:** Preparing a mixture of the C7-C16 alkanes is required. There are two approaches: (1) use of a standards kit (e.g., Polyscience Kit) containing bottles of mixtures of selected n-alkanes which may be combined to produce a C7-C16 standard; or (2) use of bottles of the individual C7-C16 alkanes from which accurately known volumes may be taken and combined to give a C7-C16 mixture.

7.2.3 **Procedure for retention time calibration:** This calibration is performed at the start of an analytical program; the mixture is chromatographed at the start of each day. To attain the required retention time precision, both the carrier gas flow rate and the temperature program specifications must be observed. Details of the procedure depend on the instrument being used. The general procedure is as follows:

7.2.3.1 Set the programmer upper limit at 250°C. If this setting does not produce a column temperature of 250°C, find the correct setting.

7.2.3.2 Set the programmer lower limit at 30°C.

7.2.3.3 Verify that the instrument and samples are at room temperature.

7.2.3.4 Inject 1 uL of the n-alkane mixture.

7.2.3.5 Start the integrator and recorder.

7.2.3.6 Allow the instrument to run isothermally at room temperature for five min.

7.2.3.7 Shut the oven door.

7.2.3.8 Change the mode to Automatic and start the temperature program.

7.2.3.9 Repeat Steps 1-9 a sufficient number of times so that the relative standard deviation of the retention times for each peak is <5%.

7.3 Response calibration:

7.3.1 For the purposes of a Level 1 analysis, response-quantity calibration with n-decane is adequate. A 10-uL volume of n-decane is injected into a tared 10 mL volumetric flask. The weight injected is obtained and the flask is diluted to the mark with n-pentane. This standard contains about 730 ng n-decane per uL n-pentane. The exact concentration depends on temperature, so that a weight is required. Two serial tenfold dilutions are made from this standard, giving standards at about 730, 73, and 7.3 ng n-decane per uL n-pentane, respectively.

7.3.2 Procedure for response calibration: This calibration is performed at the start of an analytical program and monthly thereafter. The most concentrated standard is injected once each day. Any change in calibration necessitates a full calibration with new standards. Standards are stored in the refrigerator locker and are made up monthly.

7.3.2.1 Verify that the instrument is set up properly.

7.3.2.2 Set electrometer at 1×10^{-10} A/mV.

7.3.2.3 Inject 1 uL of the highest concentration standard.

7.3.2.4 Run standard temperature program as specified above.

7.3.2.5 Clean syringe.

7.3.2.6 Make repeated injections of all three standards until the relative standard deviations of the areas of each standard are ≤5%.

7.4 Sample analysis procedure:

7.4.1 The following apparatus is required:

7.4.1.1 Gas chromatograph set up and working.

7.4.1.2 Recorder, integrator working.

7.4.1.3 Syringe and syringe cleaning apparatus.

7.4.1.4 Parameters: Electrometer setting is 1×10^{-10} A/mV; recorder is set at 0.5 in./min and 1 mV full-scale.

7.4.2 Steps in the procedure are:

7.4.2.1 Label chromatogram with the data, sample number, etc.

7.4.2.2 Inject sample.

7.4.2.3 Start integrator and recorder.

7.4.2.4 After isothermal operation for 5 min, begin temperature program.

7.4.2.5 Clean syringe.

7.4.2.6 Return sample; obtain new sample.

7.4.2.7 When analysis is finished, allow instrument to cool. Turn chromatogram and integrator output and data sheet over to data analyst.

7.5 Syringe cleaning procedure:

7.5.1 Remove plunger from syringe.

7.5.2 Insert syringe into cleaner; turn on aspirator.

7.5.3 Fill pipet with pentane; run pentane through syringe.

7.5.4 Repeat with methylene chloride from a separate pipet.

7.5.5 Flush plunger with pentane followed by methylene chloride.

7.5.6 Repeat with methylene chloride.

7.6 Sample analysis decision criterion: The data from the TCO analyses of organic extract and rinse concentrates are first used to calculate the total concentration of C7-C16 hydrocarbon-equivalents (Paragraph 7.7.3) in the sample with respect to the volume of air actually sampled, i.e., ug/m^3. On this basis, a decision is made both on whether to calculate the quantity of each n-alkane equivalent present and on which analytical procedural pathway will be followed. If the total organic content is great enough to warrant continuing the analysis -- >500 ug/m^3 -- a TCO of less than 75 ug/m^3 will require only LC fractionation and gravimetric determinations and IR spectra to be obtained on each fraction. If the TCO is greater than 75 ug/m^3, then the first seven LC fractions of each sample will be reanalyzed using this same gas chromatographic technique.

7.7 Calculations:

7.7.1 **Boiling Point - Retention Time Calibration:** The required data for this calibration are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.1.1 Average the retention times and calculate relative standard deviations for each n-hydrocarbon.

7.7.1.2 Plot average retention times as abscissae versus normal boiling points as ordinates.

7.7.1.3 Draw in calibration curve.

7.7.1.4 Locate and record retention times corresonding to boiling ranges 90-100, 110-140, 140-160, 160-180, 180-200, 200-220, 220-240, 240-260, 260-280, 280-300°C.

7.7.2 **Response-amount calibration:** The required data for this calibration are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.2.1 Average the area responses of each standard and calculate relative standard deviations.

7.7.2.2 Plot response (uv·sec) as ordinate versus ng/uL as abscissa.

7.7.2.3 Draw in the curve. Perform least squares regression and obtain slope (uV·sec·uL/ng).

7.7.3 **Total C7-C16 hydrocarbons analysis:** The required data for this calculation are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.3.1 Sum the areas of all peaks within the retention time range of interest.

7.7.3.2 Convert this area (uV·sec) to ng/uL by dividing by the weight response for n-decane (uV·sec.uL/ng).

7.7.3.3 Multiply this weight by the total concentrate volume (10 mL) to get the weight of the C7-C16 hydrocarbons in the sample.

7.7.3.4 Using the volume of gas sampled or the total weight of sample acquired, convert the result of Step 7.7.3.3 above to ug/m^3.

7.7.3.5 If the value of total C7-C16 hydrocarbons from Step 7.7.3.4 above exceeds 75 ug/m^3, calculate individual hydrocarbon concentrations in accordance with the instructions in Paragraph 7.7.5.5 below.

7.7.4 **Individual C7-C16 n-Alkane Equivalent Analysis:** The required data from the analyses are on the chromatogram and on the data sheet. The data reduction is performed as follows:

7.7.4.1 Sum the areas of peaks in the proper retention time ranges.

7.7.4.2 Convert areas (uV·sec) to ng/uL by dividing by the proper weight response (uV·sec·uL/ng).

7.7.4.3 Multiply each weight by total concentrate volume (10 mL) to get weight of species in each range of the sample.

7.7.4.4 Using the volume of gas sampled on the total weight of sample acquired, convert the result of Step 7.7.4.3 above to ug/m^3.

8.0 QUALITY CONTROL

8.1 Appropriate QC is found in the pertinent procedures throughout the method.

9.0 METHOD PERFORMANCE

9.1 Even relatively comprehensive error propagation analysis is beyond the scope of this procedure. With reasonable care, peak area reproducibility of a standard should be of the order of 1% RSD. The relative standard deviation of the sum of all peaks in a fairly complex waste might be of the order of 5-10%. Accuracy is more difficult to assess. With good analytical technique, accuracy and precision should be of the order of 10-20%.

10.0 REFERENCES

1. Emissions Assessment of Conventional Stationary Combustion Systems: Methods and Procedure Manual for Sampling and Analysis, Interagency Energy/Environmental R&D Program, Industrial Environmental Research Laboratory, Research Triangle Park, NC 27711, EPA-600/7-79-029a, January 1979.

METHOD 8270

GAS CHROMATOGRAPHY/MASS SPECTROMETRY FOR SEMIVOLATILE ORGANICS: CAPILLARY COLUMN TECHNIQUE

1.0 SCOPE AND APPLICATION

1.1 Method 8270 is used to determine the concentration of semivolatile organic compounds in extracts prepared from all types of solid waste matrices, soils, and ground water. Direct injection of a sample may be used in limited applications.

1.2 Method 8270 can be used to quantify most neutral, acidic, and basic organic compounds that are soluble in methylene chloride and capable of being eluted without derivatization as sharp peaks from a gas chromatographic fused-silica capillary column coated with a slightly polar silicone. Such compounds include polynuclear aromatic hydrocarbons, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, and phenols, including nitrophenols. See Table 1 for a list of compounds and their characteristic ions that have been evaluated on the specified GC/MS system.

1.3 The following compounds may require special treatment when being determined by this method. Benzidine can be subject to oxidative losses during solvent concentration. Also, chromatography is poor. Under the alkaline conditions of the extraction step, α-BHC, γ-BHC, endosulfan I and II, and endrin are subject to decomposition. Neutral extraction should be performed if these compounds are expected. Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reaction in acetone solution, and photochemical decomposition. N-nitrosodimethylamine is difficult to separate from the solvent under the chromatographic conditions described. N-nitrosodiphenylamine decomposes in the gas chromatographic inlet and cannot be separated from diphenylamine. Pentachlorophenol, 2,4-dinitrophenol, 4-nitrophenol, 4,6-dinitro-2-methylphenol, 4-chloro-3-methylphenol, benzoic acid, 2-nitroaniline, 3-nitroaniline, 4-chloroaniline, and benzyl alcohol are subject to erratic chromatographic behavior, especially if the GC system is contaminated with high boiling material.

1.4 The practical quantitation limit (PQL) of Method 8270 for determining an individual compound is approximately 1 mg/kg (wet weight) for soil/sediment samples, 1-200 mg/kg for wastes (dependent on matrix and method of preparation), and 10 ug/L for ground water samples (see Table 2). PQLs will be proportionately higher for sample extracts that require dilution to avoid saturation of the detector.

1.5 This method is restricted to use by or under the supervision of analysts experienced in the use of gas chromatograph/mass spectrometers and skilled in the interpretation of mass spectra. Each analyst must demonstrate the ability to generate acceptable results with this method.

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS

Compound	Retention Time (min)	Primary Ion	Secondary Ion(s)
Acenaphthene	15.13	154	153, 152
Acenaphthene-d_{10} (I.S.)	15.05	164	162, 160
Acenaphthylene	14.57	152	151, 153
Acetophenone	7.96[a]	105	77, 51
Aldrin	--	66	263, 220
Aniline	5.68	93	66, 65
Anthracene	19.77	178	176, 179
4-Aminobiphenyl	19.18[a]	169	168, 170
Aroclor-1016	--	222	260, 292
Aroclor-1221	--	190	224, 260
Aroclor-1232	--	190	224, 260
Aroclor-1242	--	222	256, 292
Aroclor-1248	--	292	362, 326
Aroclor-1254	--	292	362, 326
Aroclor-1260	--	360	362, 394
Benzidine	23.87	184	92, 185
Benzoic acid	9.38	122	105, 77
Benzo(a)anthracene	27.83	228	229, 226
Benzo(b)fluoranthene	31.45	252	253, 125
Benzo(k)fluoranthene	31.55	252	253, 125
Benzo(g,h,i)perylene	41.43	276	138, 277
Benzo(a)pyrene	32.80	252	253, 125
Benzyl alcohol	6.78	108	79, 77
α-BHC	--	183	181, 109
β-BHC	--	181	183, 109
δ-BHC	--	183	181, 109
γ-BHC (Lindane)	--	183	181, 109
Bis(2-chloroethoxy)methane	9.23	93	95, 123
Bis(2-chloroethyl)ether	5.82	93	63, 95
Bis(2-chloroisopropyl)ether	7.22	45	77, 121
Bis(2-ethylhexyl)phthalate	28.47	149	167, 279
4-Bromophenyl phenyl ether	18.27	248	250, 141
Butyl benzyl phthalate	26.43	149	91, 206
Chlordane	--	373	375, 377
4-Chloroaniline	10.08	127	129
1-Chloronaphthalene	13.65[a]	162	127, 164
2-Chloronaphthalene	13.30	162	127, 164
4-Chloro-3-methylphenol	11.68	107	144, 142
2-Chlorophenol	5.97	128	64, 130
4-Chlorophenyl phenyl ether	16.78	204	206, 141
Chrysene	27.97	228	226, 229
Chrysene-d_{12} (I.S.)	27.88	240	120, 236
4,4'-DDD	--	235	237, 165
4,4'-DDE	--	246	248, 176

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS (Continued)

Compound	Retention Time (min)	Primary Ion	Secondary Ion(s)
4,4'-DDT	--	235	237, 165
Dibenz(a,j)acridine	32.55[a]	279	280, 277
Dibenz(a,h)anthracene	39.82	278	139, 279
Dibenzofuran	15.63	168	139
Di-n-butylphthalate	21.78	149	150, 104
1,3-Dichlorobenzene	6.27	146	148, 111
1,4-Dichlorobenzene	6.40	146	148, 111
1,4-Dichlorobenzene-d_4 (I.S.)	6.35	152	150, 115
1,2-Dichlorobenzene	6.85	146	148, 111
3,3'-Dichlorobenzidine	27.88	252	254, 126
2,4-Dichlorophenol	9.48	162	164, 98
2,6-Dichlorophenol	10.05[a]	162	164, 98
Dieldrin	--	79	263, 279
Diethylphthalate	16.70	149	177, 150
p-Dimethylaminoazobenzene	24.48[a]	120	225, 77
7,12-Dimethylbenz(a)anthracene	29.54[a]	256	241, 257
α-,α-Dimethylphenethylamine	9.51[a]	58	91, 42
2,4-Dimethylphenol	9.03	122	107, 121
Dimethylphthalate	14.48	163	194, 164
4,6-Dinitro-2-methylphenol	17.05	198	51, 105
2,4-Dinitrophenol	15.35	184	63, 154
2,4-Dinitrotoluene	15.80	165	63, 89
2,6-Dinitrotoluene	14.62	165	63, 89
Diphenylamine	17.54[a]	169	168, 167
1,2-Diphenylhydrazine	--	77	105, 182
Di-n-octylphthalate	30.48	149	167, 43
Endosulfan I	--	195	339, 341
Endosulfan II	--	337	339, 341
Endosulfan sulfate	--	272	387, 422
Endrin	--	263	82, 81
Endrin aldehyde	--	67	345, 250
Endrin ketone	--	317	67, 319
Ethyl methanesulfonate	5.33[a]	79	109, 97
Fluoranthene	23.33	202	101, 203
Fluorene	16.70	166	165, 167
2-Fluorobiphenyl (surr.)	--	172	171
2-Fluorophenol (surr.)	--	112	64
Heptachlor	--	100	272, 274
Heptachlor epoxide	--	353	355, 351
Hexachlorobenzene	18.65	284	142, 249
Hexachlorobutadiene	10.43	225	223, 227
Hexachlorocyclopentadiene	12.60	237	235, 272
Hexachloroethane	7.65	117	201, 199
Indeno(1,2,3-cd)pyrene	39.52	276	138, 227

TABLE 1. CHARACTERISTIC IONS FOR SEMIVOLATILE COMPOUNDS (Continued)

Compound	Retention Time (min)	Primary Ion	Secondary Ion(s)
Isophorone	8.53	82	95, 138
Methoxychlor	--	227	228
3-Methylcholanthrene	31.14[a]	268	253, 267
Methyl methanesulfonate	4.32[a]	80	79, 65
2-Methylnaphthalene	11.87	142	141
2-Methylphenol (o-cresol)	7.22	108	107, 79
4-Methylphenol (p-cresol)	7.60	108	107, 79
Naphthalene	9.82	128	129, 127
Naphthalene-d_8 (I.S.)	9.75	136	68
1-Naphthylamine	15.80[a]	143	115, 116
2-Naphthylamine	16.00[a]	143	115, 116
2-Nitroaniline	13.75	65	92, 138
3-Nitroaniline	15.02	138	108, 92
4-Nitroaniline	16.90	138	108, 92
Nitrobenzene	7.87	77	123, 65
Nitrobenzene-d_5 (surr.)	--	82	128, 54
2-Nitrophenol	8.75	139	109, 65
4-Nitrophenol	15.80	139	109, 65
N-Nitroso-di-n-butylamine	10.99[a]	84	57, 41
N-Nitrosodimethylamine	--	42	74, 44
N-Nitrosodiphenylamine	17.17	169	168, 167
N-Nitrosodipropylamine	7.55	70	42, 101, 130
N-Nitrosopiperidine	--	42	114, 55
Pentachlorobenzene	15.64[a]	250	252, 248
Pentachloronitrobenzene	19.47[a]	295	237, 142
Pentachlorophenol	19.25	266	264, 268
Perylene-d_{12} (I.S.)	33.05	264	260, 265
Phenacetin	18.59[a]	108	109, 179
Phenanthrene	19.62	178	179, 176
Phenanthrene-d_{10} (I.S.)	19.55	188	94, 80
Phenol	5.77	94	65, 66
Phenol-d_6 (surr.)	--	99	42, 71
2-Picoline	3.75[a]	93	66, 92
Pronamide	19.61[a]	173	175, 145
Pyrene	24.02	202	200, 203
Terphenyl-d_{14} (surr.)	--	244	122, 212
1,2,4,5-Tetrachlorobenzene	13.62[a]	216	214, 218
2,3,4,6-Tetrachlorophenol	16.09[a]	232	230, 131
2,4,6-Tribromophenol (surr.)	--	330	332, 141
1,2,4-Trichlorobenzene	9.67	180	182, 145
2,4,5-Trichlorophenol	13.00	196	198, 200
2,4,6-Trichlorophenol	12.85	196	198, 200
Toxaphene	--	159	231, 233

I.S. = internal standard
surr. = surrogate

[a]Estimated retention times.

TABLE 2. PRACTICAL QUANTITATION LIMITS (PQL) FOR SEMIVOLATILE ORGANICS**

Semivolatiles	CAS Number	Practical Quantitation Limits*	
		Ground Water	Low Soil/Sediment[1]
		ug/L	ug/Kg
Phenol	108-95-2	10	660
bis(2-Chloroethyl) ether	111-44-4	10	660
2-Chlorophenol	95-57-8	10	660
1,3-Dichlorobenzene	541-73-1	10	660
1,4-Dichlorobenzene	106-46-7	10	660
Benzyl Alcohol	100-51-6	20	1300
1,2-Dichlorobenzene	95-50-1	10	660
2-Methylphenol	95-48-7	10	660
bis(2-Chloroisopropyl) ether	39638-32-9	10	660
4-Methylphenol	106-44-5	10	660
N-Nitroso-Di-N-propylamine	621-64-7	10	660
Hexachloroethane	67-72-1	10	660
Nitrobenzene	98-95-3	10	660
Isophorone	78-59-1	10	660
2-Nitrophenol	88-75-5	10	660
2,4-Dimethylphenol	105-67-9	10	660
Benzoic Acid	65-85-0	50	3300
bis(2-Chloroethoxy) methane	111-91-1	10	660
2,4-Dichlorophenol	120-83-2	10	660
1,2,4-Trichlorobenzene	120-82-1	10	660
Naphthalene	91-20-3	10	660
4-Chloroaniline	106-47-8	20	1300
Hexachlorobutadiene	87-68-3	10	660
4-Chloro-3-methylphenol	59-50-7	20	1300
2-Methylnaphthalene	91-57-6	10	660
Hexachlorocyclopentadiene	77-47-4	10	660
2,4,6-Trichlorophenol	88-06-2	10	660
2,4,5-Trichlorophenol	95-95-4	10	660

TABLE 2. PRACTICAL QUANTITATION LIMITS (PQL) FOR SEMIVOLATILE ORGANICS** (Continued)

Semivolatiles	CAS Number	Practical Quantitation Limits*	
		Ground Water	Low Soil/Sediment[1]
		ug/L	ug/Kg
2-Chloronaphthalene	91-58-7	10	660
2-Nitroaniline	88-74-4	50	3300
Dimethyl phthalate	131-11-3	10	660
Acenaphthylene	208-96-8	10	660
3-Nitroaniline	99-09-2	50	3300
Acenaphthene	83-32-9	10	660
2,4-Dinitrophenol	51-28-5	50	3300
4-Nitrophenol	100-02-7	50	3300
Dibenzofuran	132-64-9	10	660
2,4-Dinitrotoluene	121-14-2	10	660
2,6-Dinitrotoluene	606-20-2	10	660
Diethylphthalate	84-66-2	10	660
4-Chlorophenyl phenyl ether	7005-72-3	10	660
Fluorene	86-73-7	10	660
4-Nitroaniline	100-01-6	50	3300
4,6-Dinitro-2-methylphenol	534-52-1	50	3300
N-Nitrosodiphenylamine	86-30-6	10	660
4-Bromophenyl phenyl ether	101-55-3	10	660
Hexachlorobenzene	118-74-1	10	660
Pentachlorophenol	87-86-5	50	3300
Phenanthrene	85-01-8	10	660
Anthracene	120-12-7	10	660
Di-n-butylphthalate	84-74-2	10	660
Fluoranthene	206-44-0	10	660
Pyrene	129-00-0	10	660
Butyl benzyl phthalate	85-68-7	10	660
3,3'-Dichlorobenzidine	91-94-1	20	1300
Benzo(a)anthracene	56-55-3	10	660
bis(2-ethylhexyl)phthalate	117-81-7	10	660

TABLE 2. PRACTICAL QUANTITATION LIMITS (PQL) FOR SEMIVOLATILE ORGANICS** (Continued)

Semi-Volatiles	CAS Number	Practical Quantitation Limits*	
		Ground Water	Low Soil/Sediment[1]
		ug/L	ug/Kg
Chrysene	218-01-9	10	660
Di-n-octyl phthalate	117-84-0	10	660
Benzo(b)fluoranthene	205-99-2	10	660
Benzo(k)fluoranthene	207-08-9	10	660
Benzo(a)pyrene	50-32-8	10	660
Indeno(1,2,3-cd)pyrene	193-39-5	10	660
Dibenz(a,h)anthracene	53-70-3	10	660
Benzo(g,h,i)perylene	191-24-2	10	660

*PQLs listed for soil/sediment are based on wet weight. Normally data is reported on a dry weight basis, therefore, PQLs will be higher based on the % moisture in each sample. This is based on a 30-g sample and gel permeation chromatography cleanup.

**Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achieveable.

Other Matrices	Factor[1]
Medium-level soil and sludges by sonicator	7.5
Non-water-miscible waste	75

[1]PQL = [PQL for Ground Water (Table 2)] X [Factor].

2.0 SUMMARY OF METHOD

2.1 Prior to using this method, the samples should be prepared for chromatography using the appropriate sample preparation and cleanup methods. This method describes chromatographic conditions that will allow for the separation of the compounds in the extract.

3.0 INTERFERENCES

3.1 Raw GC/MS data from all blanks, samples, and spikes must be evaluated for interferences. Determine if the source of interference is in the preparation and/or cleanup of the samples and take corrective action to eliminate the problem.

3.2 Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. To reduce carryover, the sample syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross contamination.

4.0 APPARATUS AND MATERIALS

4.1 Gas chromatograph/mass spectrometer system:

4.1.1 **Gas chromatograph:** An analytical system complete with a temperature-programmable gas chromatograph suitable for splitless injection and all required accessories, including syringes, analytical columns, and gases. The capillary column should be directly coupled to the source.

4.1.2 **Column:** 30-m x 0.25-mm I.D. (or 0.32-mm I.D.) 1-um film thickness silicon-coated fused-silica capillary column (J&W Scientific DB-5 or equivalent).

4.1.3 **Mass spectrometer:** Capable of scanning from 35 to 500 amu every 1 sec or less, using 70 volts (nominal) electron energy in the electron impact ionization mode. The mass spectrometer must be capable of producing a mass spectrum for decafluorotriphenylphosphine (DFTPP) which meets all of the criteria in Table 3 when 1 uL of the GC/MS tuning standard is injected through the GC (50 ng of DFTPP).

4.1.4 **GC/MS interface:** Any GC-to-MS interface that gives acceptable calibration points at 50 ng per injection for each compound of interest and achieves acceptable tuning performance criteria may be used.

4.1.5 **Data system:** A computer system must be interfaced to the mass spectrometer. The system must allow the continuous acquisition and storage on machine-readable media of all mass spectra obtained throughout the duration of the chromatographic program. The computer must have

TABLE 3. DFTPP KEY IONS AND ION ABUNDANCE CRITERIA[a]

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	>1% of mass 198
441	Present but less than mass 443
442	>40% of mass 198
443	17-23% of mass 442

[a]J.W. Eichelberger, L.E. Harris, and W.L. Budde. "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry", Analytical Chemistry, 47, 995 (1975).

software that can search any GC/MS data file for ions of a specific mass and that can plot such ion abundances versus time or scan number. This type of plot is defined as an Extracted Ion Current Profile (EICP). Software must also be available that allows integrating the abundances in any EICP between specified time or scan-number limits. The most recent version of the EPA/NIH Mass Spectral Library should also be available.

4.2 Syringe: 10-uL.

5.0 REAGENTS

5.1 Stock standard solutions (1.00 ug/uL): Standard solutions can be prepared from pure standard materials or purchased as certified solutions.

5.1.1 Prepare stock standard solutions by accurately weighing about 0.0100 g of pure material. Dissolve the material in pesticide quality acetone or other suitable solvent and dilute to volume in a 10-mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

5.1.2 Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at 4°C and protect from light. Stock standard solutions should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

5.1.3 Stock standard solutions must be replaced after 1 yr or sooner if comparison with quality control check samples indicates a problem.

5.2 Internal standard solutions: The internal standards recommended are 1,4-dichlorobenzene-d_4, naphthalene-d_8, acenaphthene-d_{10}, phenanthrene-d_{10}, chrysene-d_{12}, and perylene-d_{12}. Other compounds may be used as internal standards as long as the requirements given in Paragraph 7.3.2 are met. Dissolve 200 mg of each compound with a small volume of carbon disulfide. Transfer to a 50-mL volumetric flask and dilute to volume with methylene chloride so that the final solvent is approximately 20% carbon disulfide. Most of the compounds are also soluble in small volumes of methanol, acetone, or toluene, except for perylene-d_{12}. The resulting solution will contain each standard at a concentration of 4,000 ng/uL. Each 1-mL sample extract undergoing analysis should be spiked with 10 uL of the internal standard solution, resulting in a concentration of 40 ng/uL of each internal standard. Store at 4°C or less when not being used.

5.3 GC/MS tuning standard: A methylene chloride solution containing 50 ng/uL of decafluorotriphenylphosphine (DFTPP) should be prepared. The

standard should also contain 50 ng/uL each of 4,4'-DDT, pentachlorophenol, and benzidine to verify injection port inertness and GC column performance. Store at 4°C or less when not being used.

5.4 Calibration standards: Calibration standards at a minimum of five concentration levels should be prepared. One of the calibration standards should be at a concentration near, but above, the method detection limit; the others should correspond to the range of concentrations found in real samples but should not exceed the working range of the GC/MS system. Each standard should contain each analyte for detection by this method (e.g., some or all of the compounds listed in Table 1 may be included). Each 1-mL aliquot of calibration standard should be spiked with 10 uL of the internal standard solution prior to analysis. All standards should be stored at -10°C to -20°C and should be freshly prepared once a year, or sooner if check standards indicate a problem. The daily calibration standard should be prepared weekly and stored at 4°C.

5.5 Surrogate standards: The recommended surrogate standards are phenol-d_6, 2-fluorophenol, 2,4,6-tribromophenol, nitrobenzene-d_5, 2-fluorobiphenyl, and p-terphenyl-d_{14}. See Method 3500 for the instructions on preparing the surrogate standards. Determine what concentration should be in the blank extracts after all extraction, cleanup, and concentration steps. Inject this concentration into the GC/MS to determine recovery of surrogate standards in all blanks, spikes, and sample extracts. Take into account all dilutions of sample extracts.

5.6 Matrix spike standards: See Method 3500 for instructions on preparing the matrix spike standard. Determine what concentration should be in the blank extracts after all extraction, cleanup, and concentration steps. Inject this concentration into the GC/MS to determine recovery of surrogate standards in all blanks, spikes, and sample extracts. Take into account all dilutions of sample extracts.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1.

7.0 PROCEDURE

7.1 Sample preparation: Samples must be prepared by one of the following methods prior to GC/MS analysis.

Matrix	Methods
Water	3510, 3520
Soil/sediment	3540, 3550
Waste	3540, 3550, 3580

7.1.1 **Direct injection:** In very limited applications direct injection of the sample into the GC/MS system with a 10 uL syringe may be appropriate. The detection limit is very high (approximately 10,000 ug/L); therefore, it is only permitted where concentrations in excess of 10,000 ug/L are expected. The system must be calibrated by direct injection.

7.2 Extract cleanup: Extracts may be cleaned up by any of the following methods prior to GC/MS analysis.

Compounds	Methods
Phenols	3630, 3640, 8040[a]
Phthalate esters	3610, 3620, 3640
Nitrosamines	3610, 3620, 3640
Organochlorine pesticides & PCBs	3620, 3640, 3660
Nitroaromatics and cyclic ketones	3620, 3640
Polynuclear aromatic hydrocarbons	3611, 3630, 3640
Haloethers	3620, 3640
Chlorinated hydrocarbons	3620, 3640
Organophosphorous pesticides	3620, 3640
Petroleum waste	3611, 3650
All priority pollutant base, neutral, and acids	3640

[a]Method 8040 includes a derivatization technique followed by GC/ECD analysis, if interferences are encountered on GC/FID.

7.3 Initial calibration: The recommended GC/MS operating conditions:

Mass range: 35-500 amu
Scan time: 1 sec/scan
Initial column temperature and hold time: 40°C for 4 min
Column temperature program: 40-270°C at 10°C/min
Final column temperature hold: 270°C (until benzo[g,h,i]perylene has eluted)
Injector temperature: 250-300°C
Transfer line temperature: 250-300°C
Source temperature: According to manufacturer's specifications
Injector: Grob-type, splitless
Sample volume: 1-2 uL
Carrier gas: Hydrogen at 50 cm/sec or helium at 30 cm/sec.

7.3.1 Each GC/MS system must be hardware-tuned to meet the criteria in Table 3 for a 50-ng injection of DFTPP. Analyses should not begin until all these criteria are met. Background subtraction should be straightforward and designed only to eliminate column bleed or instrument background ions. The GC/MS tuning standard should also be used to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD should not exceed 20%. Benzidine and pentachlorophenol should be present at their normal responses, and no peak tailing should be visible. If degradation is excessive and/or poor chromatography is noted, the injection port may require cleaning. It may also be necessary to break off the first 6-12 in. of the capillary column.

7.3.2 The internal standards selected in Paragraph 5.1 should permit most of the components of interest in a chromatogram to have retention times of 0.80-1.20 relative to one of the internal standards. Use the base peak ion from the specific internal standard as the primary ion for quantitation (see Table 1). If interferences are noted, use the next most intense ion as the quantitation ion, i.e., for 1,4-dichlorobenzene-d_4 use m/z 152 for quantitation.

7.3.3 Analyze 1 uL of each calibration standard (containing internal standards) and tabulate the area of the primary characteristic ion against concentration for each compound (as indicated in Table 1). Figure 1 shows a chromatogram of a calibration standard containing base/neutral and acid analytes. Calculate response factors (RFs) for each compound as follows:

$$RF = (A_x C_{is})/(A_{is} C_x)$$

where:

A_x = Area of the characteristic ion for the compound being measured.

A_{is} = Area of the characteristic ion for the specific internal standard.

C_x = Concentration of the compound being measured (ng/uL).

C_{is} = Concentration of the specific internal standard (ng/uL).

7.3.4 The average RF should be calculated for each compound. The percent relative standard deviation (%RSD = 100[SD/$\overline{RF}$]) should also be calculated for each compound. The %RSD should be less than 30% for each compound. However, the %RSD for each individual Calibration Check Compound (CCC) (see Table 4) must be less than 30%. The relative retention times of each compound in each calibration run should agree within 0.06 relative retention time units. Late-eluting compounds usually have much better agreement.

7.3.5 A system performance check must be performed to ensure that minimum average RFs are met before the calibration curve is used. For semivolatiles, the System Performance Check Compounds (SPCCs) are: N-nitroso-di-n-propylamine; hexachlorocyclopentadiene; 2,4-dinitrophenol; and 4-nitrophenol. The minimum acceptable average $\overline{RF}$ for these compounds SPCCs is 0.050. These SPCCs typically have very low RFs (0.1-0.2) and tend to decrease in response as the chromatographic system begins to deteriorate or the standard material begins to deteriorate. They are usually the first to show poor performance. Therefore, they must meet the minimum requirement when the system is calibrated.

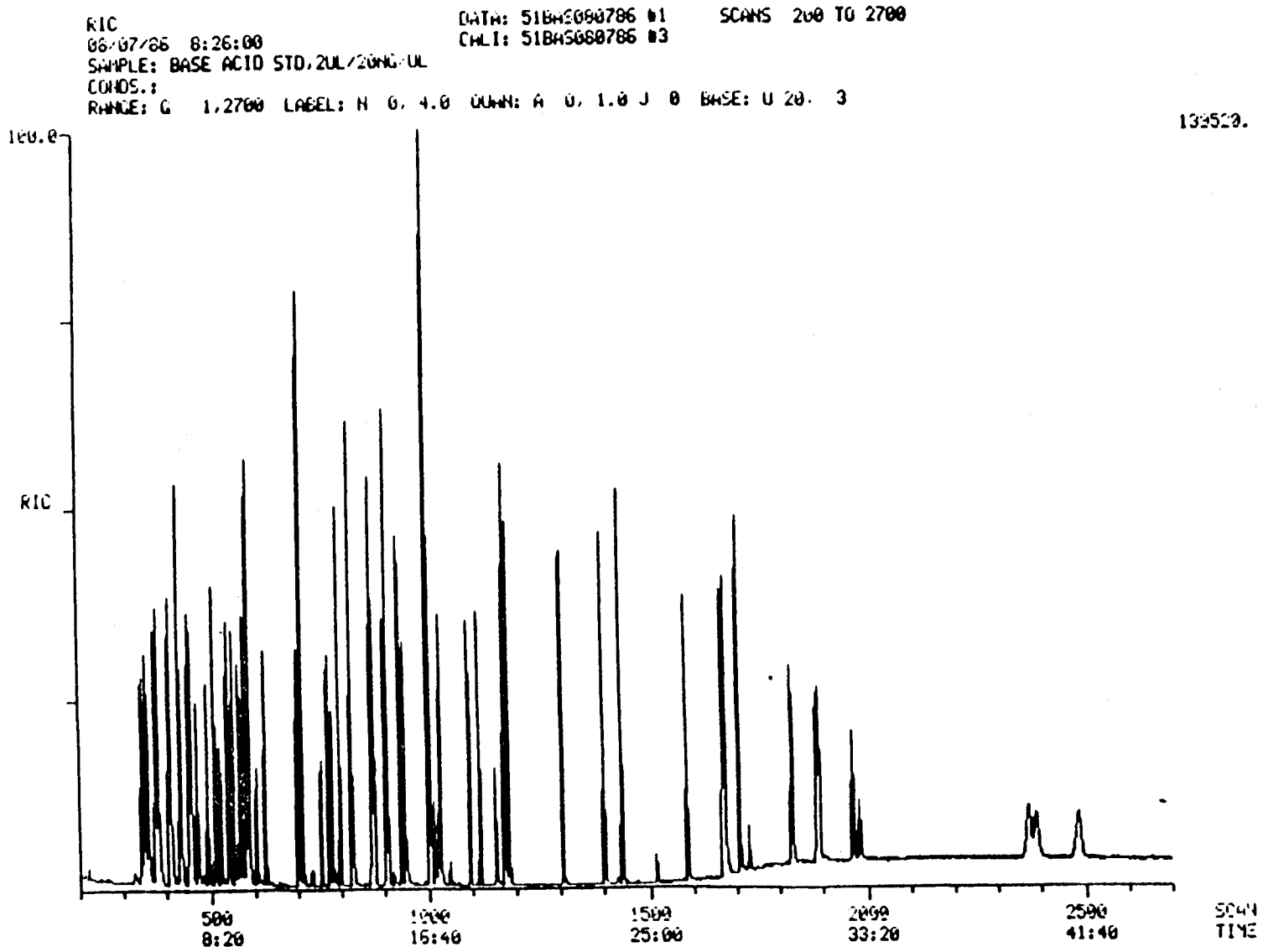


Figure 1. Gas chromatogram of base/neutral and acid calibration standard.

TABLE 4. CALIBRATION CHECK COMPOUNDS

Base/Neutral Fraction	Acid Fraction
Acenaphthene	4-Chloro-3-methylphenol
1,4-Dichlorobenzene	2,4-Dichlorophenol
Hexachlorobutadiene	2-Nitrophenol
N-Nitroso-di-n-phenylamine	Phenol
Di-n-octylphthalate	Pentachlorophenol
Fluoranthene	2,4,6-Trichlorophenol
Benzo(a)pyrene	

7.4 Daily GC/MS calibration:

7.4.1 Prior to analysis of samples, the GC/MS tuning standard must be analyzed. A 50-ng injection of DFTPP must result in a mass spectrum for DFTPP which meets the criteria given in Table 3. These criteria must be demonstrated during each 12-hr shift.

7.4.2 A calibration standard(s) at mid-level concentration containing all semivolatile analytes, including all required surrogates, must be performed every 12-hr during analysis. Compare the response factor data from the standards every 12-hr with the average response factor from the initial calibration for a specific instrument as per the SPCC (Paragraph 7.4.3) and CCC (Paragraph 7.4.4) criteria.

7.4.3 System Performance Check Compounds (SPCCs): A system performance check must be made during every 12 hr shift. If the SPCC criteria are met, a comparison of response factors is made for all compounds. This is the same check that is applied during the initial calibration. If the minimum response factors are not met, the system must be evaluated, and corrective action must be taken before sample analysis begins. The minimum RF for semivolatile SPCCs is 0.050. Some possible problems are standard mixture degradation, injection port inlet contamination, contamination at the front end of the analytical column, and active sites in the column or chromatographic system. This check must be met before analysis begins.

7.4.4 Calibration Check Compounds (CCCs): After the system performance check is met, CCCs listed in Table 4 are used to check the validity of the initial calibration. Calculate the percent difference using:

$$\% \text{ Difference} = \frac{\overline{RF}_I - RF_C}{\overline{RF}_I} \times 100$$

where:

$\overline{RF}_I$ = average response factor from initial calibration.

RF_C = response factor from current verification check standard.

If the percent difference for any compound is greater than 20, the laboratory should consider this a warning limit. If the percent difference for each CCC is less than 30%, the initial calibration is assumed to be valid. If the criterion is not met (>30% difference) for any one CCC, corrective action MUST be taken. Problems similar to those listed under SPCCs could affect this criterion. If no source of the problem can be determined after corrective action has been taken, a new five-point calibration MUST be generated. This criterion MUST be met before sample analysis begins.

7.4.5 The internal standard responses and retention times in the calibration check standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 sec from the last check calibration (12 hr), the chromatographic system must be inspected for malfunctions and corrections must be made, as required. If the EICP area for any of the internal standards changes by a factor of two (-50% to +100%) from the last daily calibration standard check, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate.

7.5 GC/MS analysis:

7.5.1 It is highly recommended that the extract be screened on a GC/FID or GC/PID using the same type of capillary column. This will minimize contamination of the GC/MS system from unexpectedly high concentrations of organic compounds.

7.5.2 Spike the 1-mL extract obtained from sample preparation with 10 uL of the internal standard solution just prior to analysis.

7.5.3 Analyze the 1-mL extract by GC/MS using a 30-m x 0.25-mm (or 0.32-mm) silicone-coated fused-silica capillary column. The volume to be injected should ideally contain 100 ng of base/neutral and 200 ng of acid surrogates (for a 1 uL injection). The recommended GC/MS operating conditions to be used are specified in Paragraph 7.3.

7.5.4 If the response for any quantitation ion exceeds the initial calibration curve range of the GC/MS system, extract dilution must take place. Additional internal standard must be added to the diluted extract to maintain the required 40 ng/uL of each internal standard in the extracted volume. The diluted extract must be reanalyzed.

7.5.5 Perform all qualitative and quantitative measurements as described in Paragraph 7.6. Store the extracts at 4°C, protected from light in screw-cap vials equipped with unpierced Teflon-lined septa.

7.6 Data interpretation:

7.6.1 Qualitative analysis:

7.6.1.1 An analyte (e.g., those listed in Table 1) is identified by comparison of the sample mass spectrum with the mass spectrum of a standard of the suspected compound (standard reference spectrum). Mass spectra for standard reference should be obtained on the user's GC/MS within the same 12 hours as the sample analysis. These standard reference spectra may be obtained through analysis of the calibration standards. Two criteria must be satisfied to verify identification: (1) elution of sample component at the same GC relative retention time (RRT) as the standard component; and (2) correspondence of the sample component and the standard component mass spectrum.

7.6.1.1.1 The sample component RRT must compare within ± 0.06 RRT units of the RRT of the standard component. For reference, the standard must be run within the same 12 hrs as the sample. If coelution of interfering components prohibits accurate assignment of the sample component RRT from the total ion chromatogram, the RRT should be assigned by using extracted ion current profiles for ions unique to the component of interest.

7.6.1.1.2 All ions present in the standard mass spectra at a relative intensity greater than 10% (most abundant ion in the spectrum equals 100% must be present in the sample spectrum.

7.6.1.1.3 The relative intensities of ions specified in Paragraph 7.6.1.1.2 must agree within plus or minus 20% between the standard and sample spectra. (Example: For an ion with an abundance of 50% in the standard spectra, the corresponding sample abundance must be between 30 and 70 percent.

7.6.1.2 For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the type of analyses being conducted. Computer generated library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Only after visual comparison of sample spectra with the nearest library searches will the mass spectral interpretation specialist assign a tentative identification. Guidelines for making tentative identification are:

(1) Relative intensities of major ions in the reference spectrum (ions >10% of the most abundant ion) should be present in the sample spectrum.

(2) The relative intensities of the major ions should agree within ±20%. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must be between 30 and 70%).

(3) Molecular ions present in the reference spectrum should be present in sample the spectrum.

(4) Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

(5) Ions present in the reference spectrum but not in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or coeluting peaks. Data system library reduction programs can sometimes create these discrepancies.

7.6.2 **Quantitative analysis:**

7.6.2.1 When a compound has been identified, the quantitation of that compound will be based on the integrated abundance from the EICP of the primary characteristic ion. Quantitation will take place using the internal standard technique. The internal standard used shall be the one nearest the retention time of that of a given analyte (e.g., see Table 5).

7.6.2.2 Calculate the concentration of each identified analyte in the sample as follows:

Water:

$$\text{concentration (ug/L)} = \frac{(A_x)(I_s)(V_t)}{(A_{is})(RF)(V_o)(V_i)}$$

where:

A_x = Area of characteristic ion for compound being measured.

I_s = Amount of internal standard injected (ng).

V_t = Volume of total extract, taking into account dilutions (i.e., a 1-to-10 dilution of a 1-mL extract will mean V_t = 10,000 uL. If half the base/neutral extract and half the acid extract are combined, V_t = 2,000.

A_{is} = Area of characteristic ion for the internal standard.

RF = Response factor for compound being measured (Paragraph 7.3.3).

V_o = Volume of water extracted (mL).

V_i = Volume of extract injected (uL).

Sediment/Soil Sludge (on a dry-weight basis) and Waste (normally on a wet-weight basis):

$$\text{concentration (ug/kg)} = \frac{(A_x)(I_s)(V_t)}{(A_{is})(RF)(V_i)(W_s)(D)}$$

where:

A_x, I_s, V_t, A_{is}, RF, V_i = same as for water.

W_s = weight of sample extracted or diluted in grams.

D = (100 - % moisture in sample)/100, or 1 for a wet-weight basis.

TABLE 5. SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION

1,4-Dichlorobenzene-d_4	Naphthalene-d_8	Acenaphthene-d_{10}
Aniline	Acetophenone	Acenaphthene
Benzyl alcohol	Benzoic acid	Acenaphthylene
Bis(2-chloroethyl)ether	Bis(2-chloroethoxy)methane	1-Chloronaphthalene
Bis(2-chloroisopropyl)ether	4-Chloroaniline	2-Chloronaphthalene
2-Chlorophenol	4-Chloro-3-methylphenol	4-Chlorophenyl phenyl ether
1,3-Dichlorobenzene	2,4-Dichlorophenol	Dibenzofuran
1,4-Dichlorobenzene	2,6-Dichlorophenol	Diethyl phthalate
1,2-Dichlorobenzene	α,α-Dimethyl-phenethylamine	Dimethyl phthalate
Ethyl methanesulfonate	2,4-Dimethylphenol	2,4-Dinitrophenol
2-Fluorophenol (surr.)	Hexachlorobutadiene	2,4-Dinitrotoluene
Hexachloroethane	Isophorone	2,6-Dinitrotoluene
Methyl methanesulfonate	2-Methylnaphthalene	Fluorene
2-Methylphenol	Naphthalene	2-Fluorobiphenyl (surr.)
4-Methylphenol	Nitrobenzene	Hexachlorocyclo-pentadiene
N-Nitrosodimethylamine	Nitrobenzene-d_8 (surr.)	1-Naphthylamine
N-Nitroso-di-n-propylamine	2-Nitrophenol	2-Naphthylamine
Phenol	N-Nitroso-di-n-butylamine	2-Nitroaniline
Phenol-d_6 (surr.)	N-Nitrosopiperidine	3-Nitroaniline
2-Picoline	1,2,4-Trichlorobenzene	4-Nitroaniline
		4-Nitrophenol
		Pentachlorobenzene
		1,2,4,5-Tetra-chlorobenzene
		2,3,4,6-Tetra-chlorophenol
		2,4,6-Tribromo-phenol (surr.)
		2,4,6-Trichloro-phenol
		2,4,5-Trichloro-phenol

(surr.) = surrogate

TABLE 5. SEMIVOLATILE INTERNAL STANDARDS WITH CORRESPONDING ANALYTES ASSIGNED FOR QUANTITATION (Continued)

Phenanthrene-d_{10}	Chrysene-d_{12}	Perylene-d_{12}
4-Aminobiphenyl	Benzidine	Benzo(b)fluoranthene
Anthracene	Benzo(a)anthracene	Benzo(k)fluoranthene
4-Bromophenyl phenyl ether	Bis(2-ethylhexyl)phthalate	Benzo(g,h,i)perylene
Di-n-butyl phthalate	Butylbenzylphthalate	Benzo(a)pyrene
4,6-Dinitro-2-methylphenol	Chrysene	Dibenz(a,j)acridine
Diphenylamine	3,3'-Dichlorobenzidine	Dibenz(a,h)anthracene
1,2-Diphenylhydrazine	p-Dimethylaminoazobenzene	7,12-Dimethylbenz-(a)anthracene
Fluoranthene	Pyrene	Di-n-octylphthalate
Hexachlorobenzene	Terphenyl-d_{14} (surr.)	Indeno(1,2,3-cd)pyrene
N-Nitrosodiphenylamine		3-Methylcholanthrene
Pentachlorophenol		
Pentachloronitrobenzene		
Phenacetin		
Phenanthrene		
Pronamide		

(surr.) = surrogate

7.6.2.3 Where applicable, an estimate of concentration for noncalibrated components in the sample should be made. The formulas given above should be used with the following modifications: The areas A_x and A_{is} should be from the total ion chromatograms and the RF for the compound should be assumed to be 1. The concentration obtained should be reported indicating (1) that the value is an estimate and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

7.6.2.4 Report results without correction for recovery data. When duplicates and spiked samples are analyzed, report all data obtained with the sample results.

7.6.2.5 Quantitation of multicomponent compounds (e.g., Aroclors) is beyond the scope of Method 8270. Normally, quantitation is performed using a GC/ECD by Method 8080.

8.0 QUALITY CONTROL

8.1 Each laboratory that uses these methods is required to operate a formal quality control program. The minimum requirements of this program consist of an initial demonstration of laboratory capability and an ongoing analysis of spiked samples to evaluate and document quality data. The laboratory must maintain records to document the quality of the data generated. Ongoing data quality checks are compared with established performance criteria to determine if the results of analyses meet the performance characteristics of the method. When results of sample spikes indicate atypical method performance, a quality control check standard must be analyzed to confirm that the measurements were performed in an in-control mode of operation.

8.2 Before processing any samples, the analyst should demonstrate, through the analysis of a reagent water blank, that interferences from the analytical system, glassware, and reagents are under control. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

8.3 The experience of the analyst performing GC/MS analyses is invaluable to the success of the methods. Each day that analysis is performed, the daily calibration standard should be evaluated to determine if the chromatographic system is operating properly. Questions that should be asked are: Do the peaks look normal?; Is the response obtained comparable to the response from previous calibrations? Careful examination of the standard chromatogram can indicate whether the column is still good, the injector is leaking, the injector septum needs replacing, etc. If any changes are made to the system (e.g, column changed), recalibration of the system must take place.

8.4 Required instrument QC is found in the following sections:

8.4.1 The GC/MS system must be tuned to meet the DFTPP specifications in Section 7.3.1 and 7.4.1.

8.4.2 There must be an initial calibration of the GC/MS system as specified in 7.3.

8.4.3 The GC/MS system must meet the SPCC criteria specified in 7.4.3 and the CCC criteria in 7.4.4, each 12 hr.

8.5 To establish the ability to generate acceptable accuracy and precision, the analyst must perform the following operations.

8.5.1 A quality (QC) check sample concentrate is required containing each analyte at a concentration of 100 ug/mL in acetone. The QC check sample concentrate may be prepared from pure standard materials or purchased as certified solutions. If prepared by the laboratory, the QC check sample concentrate must be made using stock standards prepared independently from those used for calibration.

8.5.2 Using a pipet, prepare QC check samples at a concentration of 100 ug/L by adding 1.00 mL of QC check sample concentrate to each of four 1-L aliquots of reagent water.

8.5.3 Analyze the well-mixed QC check samples according to the method beginning in Section 7.1 with extraction of the samples.

8.5.4 Calculate the average recovery ($\bar{X}$) in ug/L, and the standard deviation of the recovery (s) in ug/L, for each analyte of interest using the four results.

8.5.5 For each analyte compare s and $\bar{X}$ with the corresponding acceptance criteria for precision and accuracy, respectively, found in Table 6. If s and $\bar{X}$ for all analytes meet the acceptance criteria, the system performance is acceptable and analysis of actual samples can begin. If any individual s exceeds the precision limit or any individual $\bar{X}$ falls outside the range for accuracy, then the system performance is unacceptable for that analyte.

NOTE: The large number of analytes in Table 6 present a substantial probability that one or more will fail at least one of the acceptance criteria when all analytes of a given method are analyzed.

8.5.6 When one or more of the analytes tested fail at least one of the acceptance criteria, the analyst must proceed according to Section 8.5.6.1 or 8.5.6.2.

8.5.6.1 Locate and correct the source of the problem and repeat the test for all analytes of interest beginning with Section 8.5.2.

TABLE 6. QC ACCEPTANCE CRITERIA[a]

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Acenaphthene	100	27.6	60.1-132.3	47-145
Acenaphthylene	100	40.2	53.5-126.0	33-145
Aldrin	100	39.0	7.2-152.2	D-166
Anthracene	100	32.0	43.4-118.0	27.133
Benzo(a)anthracene	100	27.6	41.8-133.0	33-143
Benzo(b)fluoranthene	100	38.8	42.0-140.4	24-159
Benzo(k)fluoranthene	100	32.3	25.2-145.7	11-162
Benzo(a)pyrene	100	39.0	31.7-148.0	17-163
Benzo(ghi)perylene	100	58.9	D-195.0	D-219
Benzyl butyl phthalate	100	23.4	D-139.9	D-152
β-BHC	100	31.5	41.5-130.6	24-149
δ-BHC	100	21.6	D-100.0	D-110
Bis(2-chloroethyl)ether	100	55.0	42.9-126.0	12-158
Bis(2-chloroethoxy)methane	100	34.5	49.2-164.7	33-184
Bis(2-chloroisopropyl)ether	100	46.3	62.8-138.6	36-166
Bis(2-ethylhexyl)phthalate	100	41.1	28.9-136.8	8-158
4-Bromophenyl phenyl ether	100	23.0	64.9-114.4	53-127
2-Chloronaphthalene	100	13.0	64.5-113.5	60-118
4-Chlorophenyl phenyl ether	100	33.4	38.4-144.7	25-158
Chrysene	100	48.3	44.1-139.9	17-168
4,4'-DDD	100	31.0	D-134.5	D-145
4,4'-DDE	100	32.0	19.2-119.7	4-136
4,4'-DDT	100	61.6	D-170.6	D-203
Dibenzo(a,h)anthracene	100	70.0	D-199.7	D-227
Di-n-butyl phthalate	100	16.7	8.4-111.0	1-118
1,2-Dichlorobenzene	100	30.9	48.6-112.0	32-129
1,3-Dichlorobenzene	100	41.7	16.7-153.9	D-172
1,4-Dichlorobenzene	100	32.1	37.3-105.7	20-124
3,3'-Dichlorobenzidine	100	71.4	8.2-212.5	D-262
Dieldrin	100	30.7	44.3-119.3	29-136
Diethyl phthalate	100	26.5	D-100.0	D-114
Dimethyl phthalate	100	23.2	D-100.0	D-112
2,4-Dinitrotoluene	100	21.8	47.5-126.9	39-139
2,6-Dinitrotoluene	100	29.6	68.1-136.7	50-158
Di-n-octylphthalate	100	31.4	18.6-131.8	4-146
Endosulfan sulfate	100	16.7	D-103.5	D-107
Endrin aldehyde	100	32.5	D-188.8	D-209
Fluoranthene	100	32.8	42.9-121.3	26-137
Fluorene	100	20.7	71.6-108.4	59-121
Heptachlor	100	37.2	D-172.2	D-192
Heptachlor epoxide	100	54.7	70.9-109.4	26.155
Hexachlorobenzene	100	24.9	7.8-141.5	D-152
Hexachlorobutadiene	100	26.3	37.8-102.2	24-116
Hexachloroethane	100	24.5	55.2-100.0	40-113

TABLE 6. QC ACCEPTANCE CRITERIA[a] - Continued

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range p, p_s (%)
Indeno(1,2,3-cd)pyrene	100	44.6	D-150.9	D-171
Isophorone	100	63.3	46.6-180.2	21-196
Naphthalene	100	30.1	35.6-119.6	21-133
Nitrobenzene	100	39.3	54.3-157.6	35-180
N-Nitrosodi-n-propylamine	100	55.4	13.6-197.9	D-230
PCB-1260	100	54.2	19.3-121.0	D-164
Phenanthrene	100	20.6	65.2-108.7	54-120
Pyrene	100	25.2	69.6-100.0	52-115
1,2,4-Trichlorobenzene	100	28.1	57.3-129.2	44-142
4-Chloro-3-methylphenol	100	37.2	40.8-127.9	22-147
2-Chlorophenol	100	28.7	36.2-120.4	23-134
2,4-Chlorophenol	100	26.4	52.5-121.7	39-135
2,4-Dimethylphenol	100	26.1	41.8-109.0	32-119
2,4-Dinitrophenol	100	49.8	D-172.9	D-191
2-Methyl-4,6-dinitrophenol	100	93.2	53.0-100.0	D-181
2-Nitrophenol	100	35.2	45.0-166.7	29-182
4-Nitrophenol	100	47.2	13.0-106.5	D-132
Pentachlorophenol	100	48.9	38.1-151.8	14-176
Phenol	100	22.6	16.6-100.0	5-112
2,4,6-Trichlorophenol	100	31.7	52.4-129.2	37-144

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

p, p_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 625. These criteria are based directly on the method performance data in Table 7. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 7.

8.5.6.2 Beginning with Section 8.5.2, repeat the test only for those analytes that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with Section 8.5.2.

8.6 The laboratory must, on an ongoing basis, analyze a reagent blank, a matrix spike, and a matrix spike duplicate/duplicate for each analytical batch (up to a maximum of 20 samples/batch) to assess accuracy. For laboratories analyzing one to ten samples per month, at least one spiked sample per month is required.

8.6.1 The concentration of the spike in the sample should be determined as follows:

8.6.1.1 If, as in compliance monitoring, the concentration of a specific analyte in the sample is being checked against a regulatory concentration limit, the spike should be at that limit or 1 to 5 times higher than the background concentration determined in Section 8.6.2, whichever concentration would be larger.

8.6.1.2 If the concentration of a specific analyte in the sample is not being checked against a limit specific to that analyte, the spike should be at 100 ug/L or 1 to 5 times higher than the background concentration determined in Section 8.6.2, whichever concentration would be larger.

8.6.1.3 If it is impractical to determine background levels before spiking (e.g., maximum holding times will be exceeded), the spike concentration should be at (1) the regulatory concentration limit, if any; or, if none (2) the larger of either 5 times higher than the expected background concentration or 100 ug/L.

8.6.2 Analyze one sample aliquot to determine the background concentration (B) of each analyte. If necessary, prepare a new QC check sample concentrate (Section 8.5.1) appropriate for the background concentration in the sample. Spike a second sample aliquot with 1.00 mL of the QC check sample concentrate and analyze it to determine the concentration after spiking (A) of each analyte. Calculate each percent recovery (p) as 100(A-B)%/T, where T is the known true value of the spike.

8.6.3 Compare the percent recovery (p) for each analyte with the corresponding QC acceptance criteria found in Table 6. These acceptance criteria were calculated to include an allowance for error in measurement of both the background and spike concentrations, assuming a spike to background ratio of 5:1. This error will be accounted for to the extent that the analyst's spike to background ratio approaches 5:1. If spiking was performed at a concentration lower than 100 ug/L, the analyst must use either the QC acceptance criteria presented in Table 6, or optional QC acceptance criteria calculated for the specific spike concentration. To calculate optional acceptance criteria for the recovery of an analyte:

(1) Calculate accuracy (x') using the equation found in Table 7, substituting the spike concentration (T) for C; (2) calculate overall precision (S') using the equation in Table 7, substituting x' for $\bar{X}$; (3) calculate the range for recovery at the spike concentration as (100x'/T) $\pm$ 2.44(100S'/T)%.

8.6.4 If any individual p falls outside the designated range for recovery, that analyte has failed the acceptance criteria. A check standard containing each analyte that failed the criteria must be analyzed as described in Section 8.7.

8.7 If any analyte fails the acceptance criteria for recovery in Section 8.6, a QC check standard containing each analyte that failed must be prepared and analyzed.

NOTE: The frequency for the required analysis of a QC check standard will depend upon the number of analytes being simultaneously tested, the complexity of the sample matrix, and the performance of the laboratory. If the entire list of analytes in Table 6 must be measured in the sample in Section 8.6, the probability that the analysis of a QC check standard will be required is high. In this case the QC check standard should be routinely analyzed with the spiked sample.

8.7.1 Prepare the QC check standard by adding 1.0 mL of the QC check sample concentrate (Section 8.5.1 or 8.6.2) to 1 L of reagent water. The QC check standard needs only to contain the analytes that failed criteria in the test in Section 8.6.

8.7.2 Analyzed the QC check standard to determine the concentration measured (A) of each analyte. Calculate each percent recovery (p_s) as 100 (A/T)%, where T is the true value of the standard concentration.

8.7.3 Compare the percent recovery (p_s) for each analyte with the corresponding QC acceptance criteria found in Table 6. Only analytes that failed the test in Section 8.6 need to be compared with these criteria. If the recovery of any such analyte falls outside the designated range, the laboratory performance for that analyte is judged to be out of control, and the problem must be immediately identified and corrected. The analytical result for that analyte in the unspiked sample is suspect and may not be reported for regulatory compliance purposes.

8.8 As part of the QC program for the laboratory, method accuracy for each matrix studied must be assessed and records must be maintained. After the analysis of five spiked samples (of the same matrix) as in Section 8.6, calculate the average percent recovery ($\bar{p}$) and the standard deviation of the percent recovery (s_p). Express the accuracy assessment as a percent recovery interval from $\bar{p} - 2s_p$ to $\bar{p} + 2s_p$. If $\bar{p}$ = 90% and s_p = 10%, for example, the accuracy interval is expressed as 70-110%. Update the accuracy assessment for each analyte on a regular basis (e.g. after each five to ten new accuracy measurements).

8.9 To determine acceptable accuracy and precision limits for surrogate standards the following procedure should be performed.

TABLE 7. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION[a]

Parameter	Accuracy, as recovery, x' (ug/L)	Single analyst precision, s_r' (ug/L)	Overall precision, S' (ug/L)
Acenaphthene	0.96C+0.19	0.15X-0.12	0.21X-0.67
Acenaphthylene	0.89C+0.74	0.24X-1.06	0.26X-0.54
Aldrin	0.78C+1.66	0.27X-1.28	0.43X+1.13
Anthracene	0.80C+0.68	0.21X-0.32	0.27X-0.64
Benzo(a)anthracene	0.88C-0.60	0.15X+0.93	0.26X-0.21
Chloroethane	0.99C-1.53	0.14X-0.13	0.17X-0.28
Benzo(b)fluoranthene	0.93C-1.80	0.22X+0.43	0.29X+0.96
Benzo(k)fluoranthene	0.87C-1.56	0.19X+1.03	0.35X+0.40
Benzo(a)pyrene	0.90C-0.13	0.22X+0.48	0.32X+1.35
Benzo(ghi)perylene	0.98C-0.86	0.29X+2.40	0.51X-0.44
Benzyl butyl phthalate	0.66C-1.68	0.18X+0.94	0.53X+0.92
β-BHC	0.87C-0.94	0.20X-0.58	0.30X+1.94
δ-BHC	0.29C-1.09	0.34X+0.86	0.93X-0.17
Bis(2-chloroethyl)ether	0.86C-1.54	0.35X-0.99	0.35X+0.10
Bis(2-chloroethoxy)methane	1.12C-5.04	0.16X+1.34	0.26X+2.01
Bis(2-chloroisopropyl)ether	1.03C-2.31	0.24X+0.28	0.25X+1.04
Bis(2-ethylhexyl)phthalate	0.84C-1.18	0.26X+0.73	0.36X+0.67
4-Bromophenyl phenyl ether	0.91C-1.34	0.13X+0.66	0.16X+0.66
2-Chloronaphthalene	0.89C+0.01	0.07X+0.52	0.13X+0.34
4-Chlorophenyl phenyl ether	0.91C+0.53	0.20X-0.94	0.30X-0.46
Chrysene	0.93C-1.00	0.28X+0.13	0.33X-0.09
4,4'-DDD	0.56C-0.40	0.29X-0.32	0.66X-0.96
4,4'-DDE	0.70C-0.54	0.26X-1.17	0.39X-1.04
4,4'-DDT	0.79C-3.28	0.42X+0.19	0.65X-0.58
Dibenzo(a,h)anthracene	0.88C+4.72	0.30X+8.51	0.59X+0.25
Di-n-butyl phthalate	0.59C+0.71	0.13X+1.16	0.39X+0.60
1,2-Dichlorobenzene	0.80C+0.28	0.20X+0.47	0.24X+0.39
1,3-Dichlorobenzene	0.86C-0.70	0.25X+0.68	0.41X+0.11
1,4-Dichlorobenzene	0.73C-1.47	0.24X+0.23	0.29X+0.36
3,3'-Dichlorobenzidine	1.23C-12.65	0.28X+7.33	0.47X+3.45
Dieldrin	0.82C-0.16	0.20X-0.16	0.26X-0.07
Diethyl phthalate	0.43C+1.00	0.28X+1.44	0.52X+0.22
Dimethyl phthalate	0.20C+1.03	0.54X+0.19	1.05X-0.92
2,4-Dinitrotoluene	0.92C-4.81	0.12X+1.06	0.21X+1.50
2,6-Dinitrotoluene	1.06C-3.60	0.14X+1.26	0.19X+0.35
Di-n-octylphthalate	0.76C-0.79	0.21X+1.19	0.37X+1.19
Endosulfan sulfate	0.39C+0.41	0.12X+2.47	0.63X-1.03
Endrin aldehyde	0.76C-3.86	0.18X+3.91	0.73X-0.62
Fluoranthene	0.81C+1.10	0.22X-0.73	0.28X-0.60
Fluorene	0.90C-0.00	0.12X+0.26	0.13X+0.61
Heptachlor	0.87C-2.97	0.24X-0.56	0.50X-0.23
Heptachlor epoxide	0.92C-1.87	0.33X-0.46	0.28X+0.64
Hexachlorobenzene	0.74C+0.66	0.18X-0.10	0.43X-0.52
Hexachlorobutadiene	0.71C-1.01	0.19X+0.92	0.26X+0.49
Hexachloroethane	0.73C-0.83	0.17X+0.67	0.17X+0.80

TABLE 7. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION[a] - Continued

Parameter	Accuracy, as recovery, x' (ug/L)	Single analyst precision, s_r' (ug/L)	Overall precision, S' (ug/L)
Indeno(1,2,3-cd)pyrene	0.78C-3.10	0.29$\bar{X}$+1.46	0.50$\bar{X}$-0.44
Isophorone	1.12C+1.41	0.27$\bar{X}$+0.77	0.33$\bar{X}$+0.26
Naphthalene	0.76C+1.58	0.21$\bar{X}$-0.41	0.30$\bar{X}$-0.68
Nitrobenzene	1.09C-3.05	0.19$\bar{X}$+0.92	0.27$\bar{X}$+0.21
N-Nitrosodi-n-propylamine	1.12C-6.22	0.27$\bar{X}$+0.68	0.44$\bar{X}$+0.47
PCB-1260	0.81C-10.86	0.35$\bar{X}$+3.61	0.43$\bar{X}$+1.82
Phenanthrene	0.87C+0.06	0.12$\bar{X}$+0.57	0.15$\bar{X}$+0.25
Pyrene	0.84C-0.16	0.16$\bar{X}$+0.06	0.15$\bar{X}$+0.31
1,2,4-Trichlorobenzene	0.94C-0.79	0.15$\bar{X}$+0.85	0.21$\bar{X}$+0.39
4-Chloro-3-methylphenol	0.84C+0.35	0.23$\bar{X}$+0.75	0.29$\bar{X}$+1.31
2-Chlorophenol	0.78C+0.29	0.18$\bar{X}$+1.46	0.28$\bar{X}$+0.97
2,4-Dichlorophenol	0.87C-0.13	0.15$\bar{X}$+1.25	0.21$\bar{X}$+1.28
2,4-Dimethylphenol	0.71C+4.41	0.16$\bar{X}$+1.21	0.22$\bar{X}$+1.31
2,4-Dinitrophenol	0.81C-18.04	0.38$\bar{X}$+2.36	0.42$\bar{X}$+26.29
2-Methyl-4,6-dinitrophenol	1.04C-28.04	0.10$\bar{X}$+42.29	0.26$\bar{X}$+23.10
2-Nitrophenol	0.07C-1.15	0.16$\bar{X}$+1.94	0.27$\bar{X}$+2.60
4-Nitrophenol	0.61C-1.22	0.38$\bar{X}$+2.57	0.44$\bar{X}$+3.24
Pentachlorophenol	0.93C+1.99	0.24$\bar{X}$+3.03	0.30$\bar{X}$+4.33
Phenol	0.43C+1.26	0.26$\bar{X}$+0.73	0.35$\bar{X}$+0.58
2,4,6-Trichlorophenol	0.91C-0.18	0.16$\bar{X}$+2.22	0.22$\bar{X}$+1.81

x' = Expected recovery for one or more measurements of a sample containing a concentration of C, in ug/L.

s_r' = Expected single analyst standard deviation of measurements at an average concentration of $\bar{X}$, in ug/L.

S' = Expected interlaboratory standard deviation of measurements at an average concentration found of $\bar{X}$, in ug/L.

C = True value for the concentration, in ug/L.

$\bar{X}$ = Average recovery found for measurements of samples containing a concentration of C, in ug/L.

8.9.1 For each sample analyzed, calculate the percent recovery of each surrogate in the sample.

8.9.2 Once a minimum of thirty samples of the same matrix have been analyzed, calculate the average percent recovery (P) and standard deviation of the percent recovery (s) for each of the surrogates.

8.9.3 For a given matrix, calculate the upper and lower control limit for method performance for each surrogate standard. This should be done as follows:

$$\text{Upper Control Limit (UCL)} = p + 3s$$
$$\text{Lower Control Limit (LCL)} = p - 3s$$

8.9.4 For aqueous and soil matrices, these laboratory established surrogate control limits should, if applicable, be compared with the control limits listed in Table 8. The limits given in Table 8 are multi-laboratory performance based limits for soil and aqueous samples, and therefore, the single-laboratory limits established in Paragraph 8.9.3 must fall within those given in Table 8 for these matrices.

8.9.5 If recovery is not within limits, the following procedures are required.

- Check to be sure there are no errors in calculations, surrogate solutions and internal standards. Also, check instrument performance.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.
- Reextract and reanalyze the sample if none of the above are a problem or flag the data as "estimated concentration."

8.9.6 At a minimum, each laboratory should update surrogate recovery limits on a matrix-by-matrix basis, annually.

8.10 It is recommended that the laboratory adopt additional quality assurance practices for use with this method. The specific practices that are most productive depend upon the needs of the laboratory and the nature of the samples. Field duplicates may be analyzed to assess the precision of the environmental measurements. When doubt exists over the identification of a peak on the chromatogram, confirmatory techniques such as gas chromatography with a dissimilar column, specific element detector, or mass spectrometer must be used. Whenever possible, the laboratory should analyze standard reference materials and participate in relevant performance evaluation studies.

TABLE 8. SURROGATE SPIKE RECOVERY LIMITS FOR WATER AND SOIL/SEDIMENT SAMPLES

Surrogate Compound	Low/Medium Water	Low/Medium Soil/Sediment
Nitrobenzene-d_5	35-114	23-120
2-Fluorobiphenyl	43-116	30-115
p-Terphenyl-d_{14}	33-141	18-137
Phenol-d_6	10-94	24-113
2-Fluorophenol	21-100	25-121
2,4,6-Tribromophenol	10-123	19-122

9.0 METHOD PERFORMANCE

9.1 Method 8250 was tested by 15 laboratories using reagent water, drinking water, surface water, and industrial wastewaters spiked at six concentrations over the range 5-1,300 ug/L. Single operator accuracy and precision, and method accuracy were found to be directly related to the concentration of the analyte and essentially independent of the sample matrix. Linear equations to describe these relationships are presented in Table 7.

10.0 REFERENCES

1. U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, Method 625," October 26, 1984.

2. U.S. EPA Contract Laboratory Program, Statement of Work for Organic Analysis, July 1985, Revision.

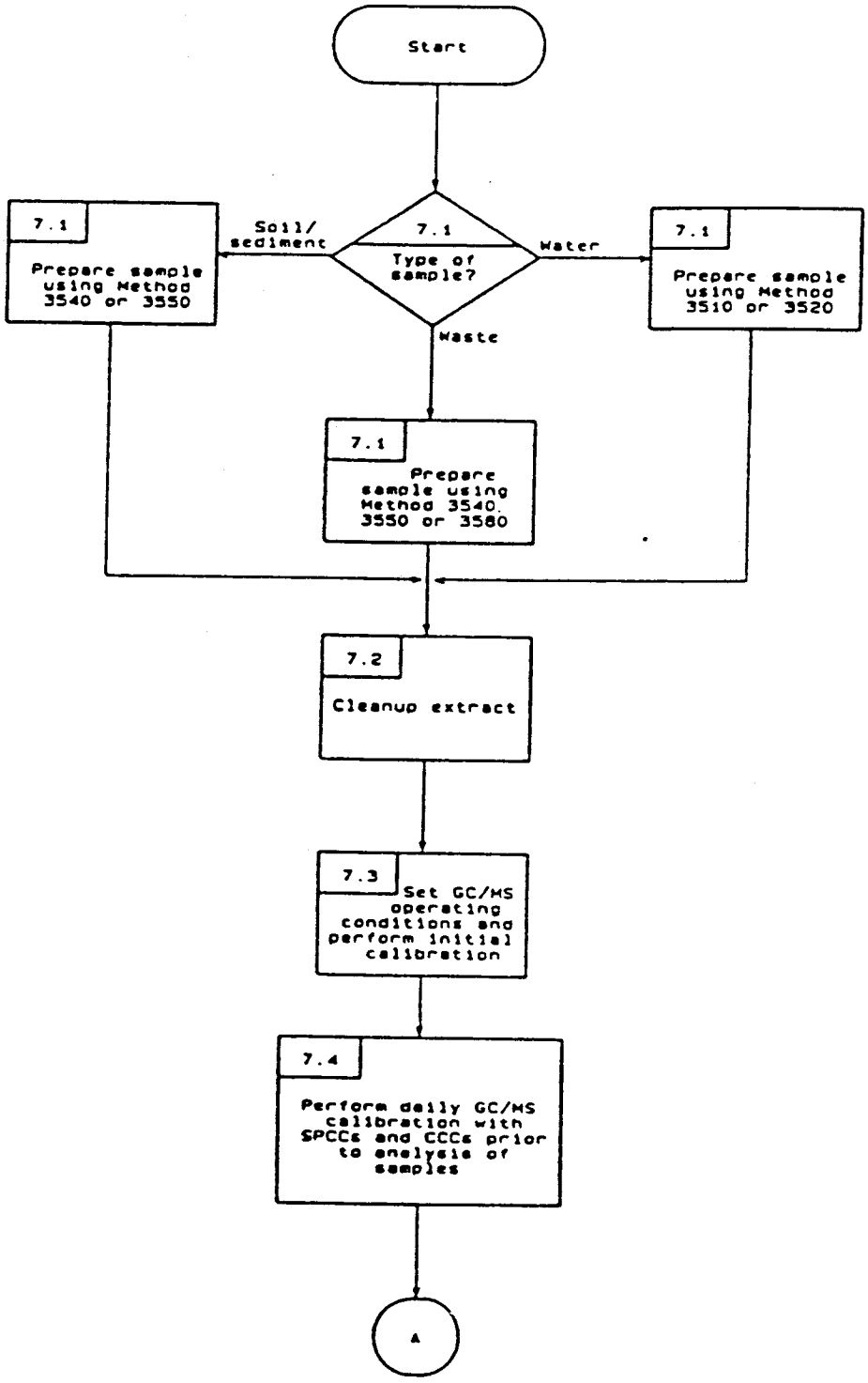
3. Provost, L.P. and R.S. Elder, "Interpretation of Percent Recovery Data," American Laboratory, 15, 58-63, 1983.

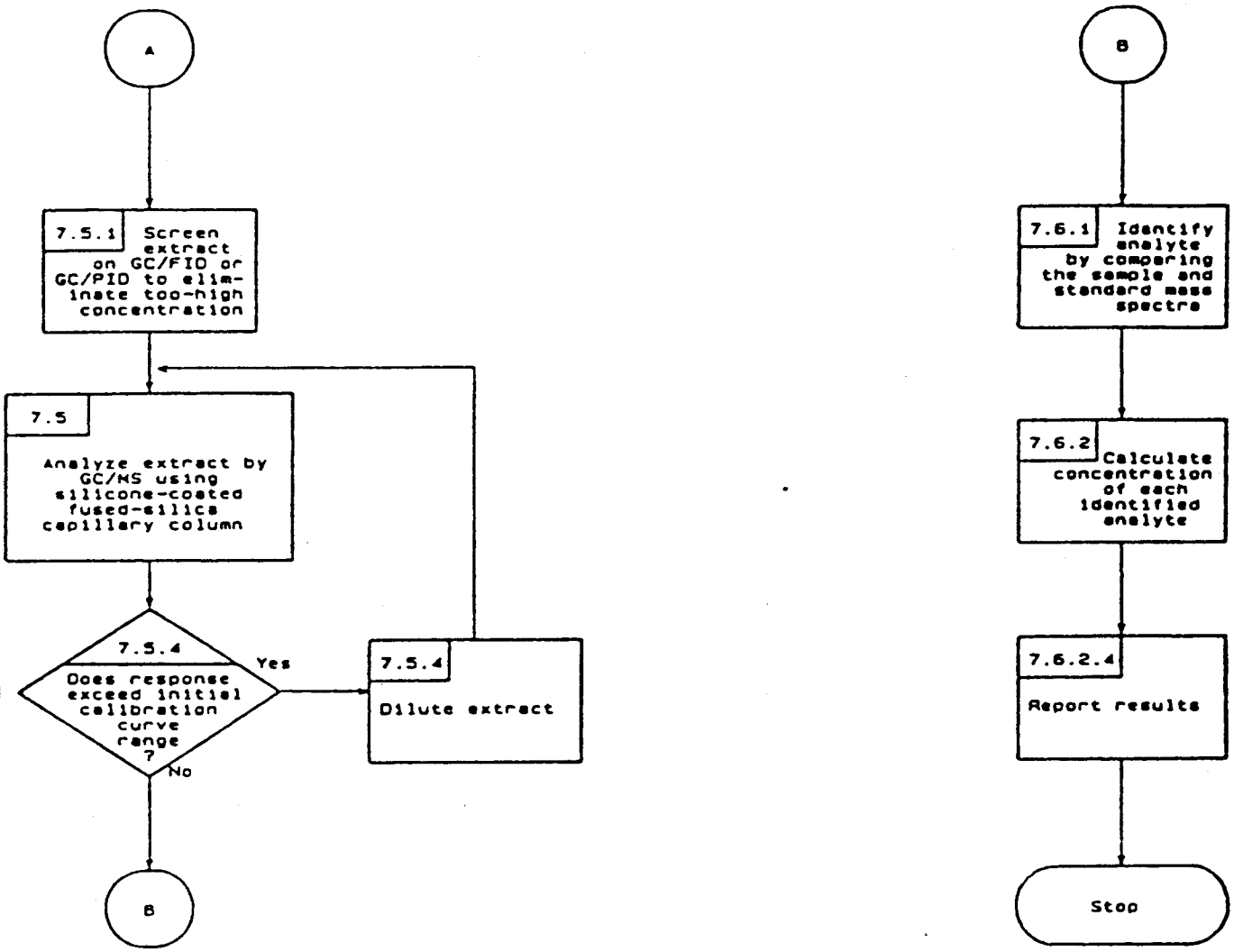
4. Eichelberger, J.W., L.E. Harris, and W.L. Budde, "Reference Compound to Calibrate Ion Abundance Measurement in Gas Chromatography-Mass Spectrometry Systems," Analytical Chemistry, 47, 995-1000, 1975.

5. "Method Detection Limit for Methods 624 and 625," Olynyk, P., W.L. Budde, and J.W. Eichelberger, Unpublished report, October 1980.

6. "Interlaboratory Method Study for EPA Method 625-Base/Neutrals, Acids, and Pesticides," Final Report for EPA Contract 68-03-3102 (in preparation).

7. Burke, J.A. "Gas Chromatography for Pesticide Residue Analysis; Some Practical Aspects," Journal of the Association of Official Analytical Chemists, 48, 1037, 1965.


Start
7.1
Type of sample?
Soil/ sediment
Water
Waste
7.1
Prepare sample using Method 3540 or 3550
7.1
Prepare sample using Method 3510 or 3520
7.1
Prepare sample using Method 3540, 3550 or 3580
7.2
Cleanup extract
7.3
Set GC/MS operating conditions and perform initial calibration
7.4
Perform daily GC/MS calibration with SPCCs and CCCs prior to analysis of samples
A


A
7.5.1 Screen extract on GC/FID or GC/PID to eliminate too-high concentration
7.5 Analyze extract by GC/MS using silicone-coated fused-silica capillary column
7.5.4 Does response exceed initial calibration curve range ?
Yes
No
7.5.4 Dilute extract
B
B
7.6.1 Identify analyte by comparing the sample and standard mass spectra
7.6.2 Calculate concentration of each identified analyte
7.6.2.4 Report results
Stop

METHOD 8010

HALOGENATED VOLATILE ORGANICS

1.0 SCOPE AND APPLICATION

1.1 Method 8010 is used to determine the concentration of various volatile halogenated organic compounds. Table 1 indicates compounds that may be analyzed by this method and lists the method detection limit for each compound in reagent water. Table 2 lists the practical quantitation limit for other matrices.

2.0 SUMMARY OF METHOD

2.1 Method 8010 provides gas chromatographic conditions for the detection of halogenated volatile organic compounds. Samples can be analyzed using direct injection or purge-and-trap (Method 5030). Ground water samples must be analyzed using Method 5030. A temperature program is used in the gas chromatograph to separate the organic compounds. Detection is achieved by a halogen-specific detector (HSD).

2.2 The method provides an optional gas chromatographic column that may be helpful in resolving the analytes from interferences that may occur and for analyte confirmation.

3.0 INTERFERENCES

3.1 Refer to Methods 5030 and 8000.

3.2 Samples can be contaminated by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through the sample container septum during shipment and storage. A field sample blank prepared from reagent water and carried through sampling and subsequent storage and handling can serve as a check on such contamination.

4.0 APPARATUS AND MATERIALS

4.1 Gas chromatograph:

4.1.1 **Gas Chromatograph:** analytical system complete with gas chromatograph suitable for on-column injections or purge-and-trap sample introduction and all required accessories, including detector, analytical columns, recorder, gases, and syringes. A data system for measuring peak heights and/or peak areas is recommended.

TABLE 1. CHROMATOGRAPHIC CONDITIONS AND METHOD DETECTION LIMITS FOR HALOGENATED VOLATILE ORGANICS

Compound	Retention time (min) Col. 1	Retention time (min) Col. 2	Method detection limit[a] (ug/L)
Benzyl chloride			
Bis(2-chloroethoxy)methane			
Bis(2-chloroisopropyl)ether			
Bromobenzene			
Bromodichloromethane	13.7	14.6	0.10
Bromoform	19.2	19.2	0.20
Bromomethane			
Carbon tetrachloride	13.0	14.4	0.12
Chloroacetaldehyde			
Chlorobenzene	24.2	18.8	0.25
Chloroethane	3.33	8.68	0.52
Chloroform	10.7	12.1	0.05
1-Chlorohexane			
2-Chloroethyl vinyl ether	18.0		0.13
Chloromethane	1.50	5.28	0.08
Chloromethylmethyl ether			
Chlorotoluene			
Dibromochloromethane	16.5	16.6	0.09
Dibromomethane			
1,2-Dichlorobenzene	34.9	23.5	0.15
1,3-Dichlorobenzene	34.0	22.4	0.32
1,4-Dichlorobenzene	35.4	22.3	0.24
Dichlorodifluoromethane			
1,1-Dichloroethane	9.30	12.6	0.07
1,2-Dichloroethane	11.4	15.4	0.03
1,1-Dichloroethylene	8.0	7.72	0.13
trans-1,2-Dichloroethylene	10.1	9.38	0.10
Dichloromethane			
1,2-Dichloropropane	14.9	16.6	0.04
trans-1,3-Dichloropropylene	15.2	16.6	0.34
1,1,2,2-Tetrachloroethane	21.6		0.03
1,1,1,2-Tetrachloroethane			
Tetrachloroethylene	21.7	15.0	0.03
1,1,1-Trichloroethane	12.6	13.1	0.03
1,1,2-Trichloroethane	16.5	18.1	0.02
Trichloroethylene	15.8	13.1	0.12
Trichlorofluoromethane	7.18		
Trichloropropane			
Vinyl chloride	2.67	5.28	0.18

[a] Using purge-and-trap method (Method 5030).

TABLE 2. DETERMINATION OF PRACTICAL QUANTITATION LIMITS (PQL) FOR VARIOUS MATRICES[a]

Matrix	Factor[b]
Ground water	10
Low-level soil	10
Water miscible liquid waste	500
High-level soil and sludge	1250
Non-water miscible waste	1250

[a]Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable.

[b]PQL = [Method detection limit (Table 1)] X [Factor (Table 2)]. For non-aqueous samples, the factor is on a wet-weight basis.

4.1.2 **Columns:**

4.1.2.1 Column 1: 8-ft x 0.1-in I.D. stainless steel or glass column packed with 1% SP-1000 on Carbopack-B 60/80 mesh or equivalent.

4.1.2.2 Column 2: 6-ft x 0.1-in I.D. stainless steel or glass column packed with chemically bonded n-octane on Porasil-C 100/120 mesh (Durapak) or equivalent.

4.1.3 **Detector:** Electrolytic conductivity (HSD).

4.2 Sample introduction apparatus: Refer to Method 5030 for the appropriate equipment for sample introduction purposes.

4.3 Syringes: 5-mL Luerlok glass hypodermic and a 5-mL, gas-tight with shutoff valve.

4.4 Volumetric flask: 10-, 50-, 100-, 500-, and 1,000-mL with a ground-glass stopper.

4.5 Microsyringe: 10-, 25-uL with a 0.006-in I.D. needle (Hamilton 702N or equivalent) and a 100-uL.

5.0 REAGENTS

5.1 Reagent water: Reagent water is defined as a water in which an interferent is not observed at the method detection limit (MDL) of the parameters of interest.

5.2 Stock standards: Stock solutions may be prepared from pure standard materials or purchased as certified solutions. Prepare stock standards in methanol using assayed liquids or gases, as appropriate. Because of the toxicity of some of the organohalides, primary dilutions of these materials of the toxicity of these materials should be prepared in a hood.

5.2.1 Place about 9.8 mL of methanol in a 10-mL tared ground-glass-stoppered volumetric flask. Allow the flask to stand, unstoppered, for about 10 min or until all alcohol-wetted surfaces have dried. Weigh the flask to the nearest 0.1 mg.

5.2.2 Add the assayed reference material, as described below.

5.2.2.1 **Liquids:** Using a 100-uL syringe, immediately add two or more drops of assayed reference material to the flask; then reweigh. The liquid must fall directly into the alcohol without contacting the neck of the flask.

5.2.2.2 **Gases:** To prepare standards for any compounds that boil below 30°C (e.g., bromomethane, chloroethane, chloromethane, dichlorodifluoromethane, trichlorofluoromethane, vinyl chloride), fill a 5-mL valved gas-tight syringe with the reference standard to the 5.0-mL mark. Lower the needle to 5 mm above the methanol

meniscus. Slowly introduce the reference standard above the surface of the liquid. The heavy gas rapidly dissolves in the methanol. This may also be accomplished by using a lecture bottle equipped with a Hamilton Lecture Bottle Septum (#86600). Attach Teflon tubing to the side-arm relief valve and direct a gentle stream of gas into the methanol meniscus.

5.2.3 Reweigh, dilute to volume, stopper, and then mix by inverting the flask several times. Calculate the concentration in micrograms per microliter (ug/uL) from the net gain in weight. When compound purity is assayed to be 96% or greater, the weight may be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards may be used at any concentration if they are certified by the manufacturer or by an independent source.

5.2.4 Transfer the stock standard solution into a Teflon-sealed screw-cap bottle. Store, with minimal headspace, at -10°C to -20°C and protect from light.

5.2.5 Prepare fresh standards every 2 months for gases or for reactive compounds such as 2-chloroethylvinyl ether. All other standards must be replaced after 6 months, or sooner if comparison with check standards indicates a problem.

5.3 Secondary dilution standards: Using stock standard solutions, prepare in methanol secondary dilution standards, as needed, that contain the compounds of interest, either singly or mixed together. The secondary dilution standards should be prepared at concentrations such that the aqueous calibration standards prepared in Section 5.4 will bracket the working range of the analytical system. Secondary dilution standards should be stored with minimal headspace for volatiles and should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

5.4 Calibration standards: Calibration standards at a minimum of five concentration levels are prepared in reagent water from the secondary dilution of the stock standards. One of the concentration levels should be at a concentration near, but above, the method detection limit. The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC. Each standard should contain each analyte for detection by this method (e.g., some or all of the compounds listed in Table 1 may be included). In order to prepare accurate aqueous standard solutions, the following precautions must be observed.

5.4.1 Do not inject more than 20 uL of alcoholic standards into 100 mL of reagent water.

5.4.2 Use a 25-uL Hamilton 702N microsyringe or equivalent (variations in needle geometry will adversely affect the ability to deliver reproducible volumes of methanolic standards into water).

5.4.3 Rapidly inject the alcoholic standard into the filled volumetric flask. Remove the needle as fast as possible after injection.

5.4.4 Mix aqueous standards by inverting the flask three times only.

5.4.5 Fill the sample syringe from the standard solution contained in the expanded area of the flask (do not use any solution contained in the neck of the flask).

5.4.6 Never use pipets to dilute or transfer samples or aqueous standards.

5.4.7 Aqueous standards are not stable and should be discarded after 1 hr, unless properly sealed and stored. The aqueous standards can be stored up to 24 hr, if held in sealed vials with zero headspace.

5.5 Internal standards (if internal standard calibration is used): To use this approach, the analyst must select one or more internal standards that are similar in analytical behavior to the compounds of interest. The analyst must further demonstrate that the measurement of the internal standard is not affected by method or matrix interferences. Because of these limitations, no internal standard can be suggested that is applicable to all samples. The compounds recommended for use as surrogate spikes (Paragraph 5.6) have been used successfully as internal standards, because of their generally unique retention times.

5.5.1 Prepare calibration standards at a minimum of five concentration levels for each parameter of interest as described in Section 5.4.

5.5.2 Prepare a spiking solution containing each of the internal standards using the procedures described in Sections 5.2 and 5.3. It is recommended that the secondary dilution standard be prepared at a concentration of 15 ug/mL of each internal standard compound. The addition of 10 uL of this standard to 5.0 mL of sample or calibration standard would be equivalent to 30 ug/L.

5.5.3 Analyze each calibration standard according to Section 7.0, adding 10 uL of internal standard spiking solution directly to the syringe.

5.6 Surrogate standards: The analyst should monitor both the performance of the analytical system and the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard, and reagent water blank with surrogate halocarbons. A combination of bromochloromethane, 2-bromo-1-chloropropane, and 1,4-dichlorobutane is recommended to encompass the range of the temperature program used in this method. From stock standard solutions prepared as in Section 5.2, add a volume to give 750 ug of each surrogate to 45 mL of reagent water contained in a 50-mL volumetric flask, mix, and dilute to volume for a concentration of 15 ng/uL. Add 10 uL of this surrogate spiking solution directly into the 5-mL syringe with every sample and reference standard analyzed. If the internal standard calibration procedure is used, the surrogate compounds may be added directly to the internal standard spiking solution (Paragraph 5.5.2).

5.7 Methanol: pesticide quality or equivalent. Store away from other solvents.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1.

7.0 PROCEDURE

7.1 Volatile compounds are introduced into the gas chromatograph either by direct injection or purge-and-trap (Method 5030). Method 5030 may be used directly on ground water samples or low-level contaminated soils and sediments. For medium-level soils or sediments, methanolic extraction, as described in Method 5030, may be necessary prior to purge-and-trap analysis.

7.2 Gas chromatography conditions (Recommended):

7.2.1 **Column 1:** Set helium gas flow at 40 mL/min flow rate. Set column temperature at 45°C for 3 min; then program an 8°C/min temperature rise to 220°C and hold for 15 min.

7.2.2 **Column 2:** Set helium gas flow at 40 mL/min flow rate. Set column temperature at 50°C for 3 min; then program a 6°C/min temperature rise to 170°C and hold for 4 min.

7.3 Calibration: Refer to Method 8000 for proper calibration techniques. Use Table 1 and especially Table 2 for guidance on selecting the lowest point on the calibration curve.

7.3.1 Calibration must take place using the same sample introduction method that will be used to analyze actual samples (see Paragraph 7.4.1).

7.3.2 The procedure for internal or external calibration may be used. Refer to Method 8000 for a description of each of these procedures.

7.4 Gas chromatographic analysis:

7.4.1 Introduce volatile compounds into the gas chromatograph using either Method 5030 (purge-and-trap method) or the direct injection method (see Paragraph 7.4.1.1). If the internal standard calibration technique is used, add 10 uL of internal standard to the sample prior to purging.

7.4.1.1 Direct injection: In very limited applications (e.g., aqueous process wastes) direct injection of the sample into the GC system with a 10-uL syringe may be appropriate. The detection limit is very high (approximately 10,000 ug/L) therefore, it is only

permitted where concentrations in excess of 10,000 ug/L are expected or for water-soluble compounds that do not purge. The system must be calibrated by direct injection (bypassing the purge-and-trap device).

7.4.2 Follow Section 7.6 in Method 8000 for instructions on the analysis sequence, appropriate dilutions, establishing daily retention time windows, and identification criteria. Include a mid-level standard after each group of 10 samples in the analysis sequence.

7.4.3 Table 1 summarizes the estimated retention times on the two columns for a number of organic compounds analyzable using this method. An example of the separation achieved by Column 1 is shown in Figure 1.

7.4.4 Record the sample volume purged or injected and the resulting peak sizes (in area units or peak heights).

7.4.5 Calculation of concentration is covered in Section 7.8 of Method 8000.

7.4.6 If analytical interferences are suspected, or for the purpose of confirmation, analysis using the second GC column is recommended.

7.4.7 If the response for a peak is off-scale, prepare a dilution of the sample with reagent water. The dilution must be performed on a second aliquot of the sample which has been properly sealed and stored prior to use.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One for specific quality control procedures and Method 8000 for gas chromatographic procedures. Quality control to ensure the proper operation of the purge-and-trap device is covered in Method 5030.

8.2 Mandatory quality control to validate the GC system operation is found in Method 8000, Section 8.6.

8.2.1 The quality control check sample concentrate (Method 8000, Section 8.6) should contain each parameter of interest at a concentration of 10 ug/mL in methanol.

8.2.2 Table 3 indicates the calibration and QC acceptance criteria for this method. Table 4 gives method accuracy and precision as functions of concentration for the analytes of interest. The contents of both Tables should be used to evaluate a laboratory's ability to perform and generate acceptable data by this method.

8.3 Calculate surrogate standard recovery on all samples, blanks, and spikes. Determine if recovery is within limits (limits established by performing QC procedure outlined in Method 8000, Section 8.10).

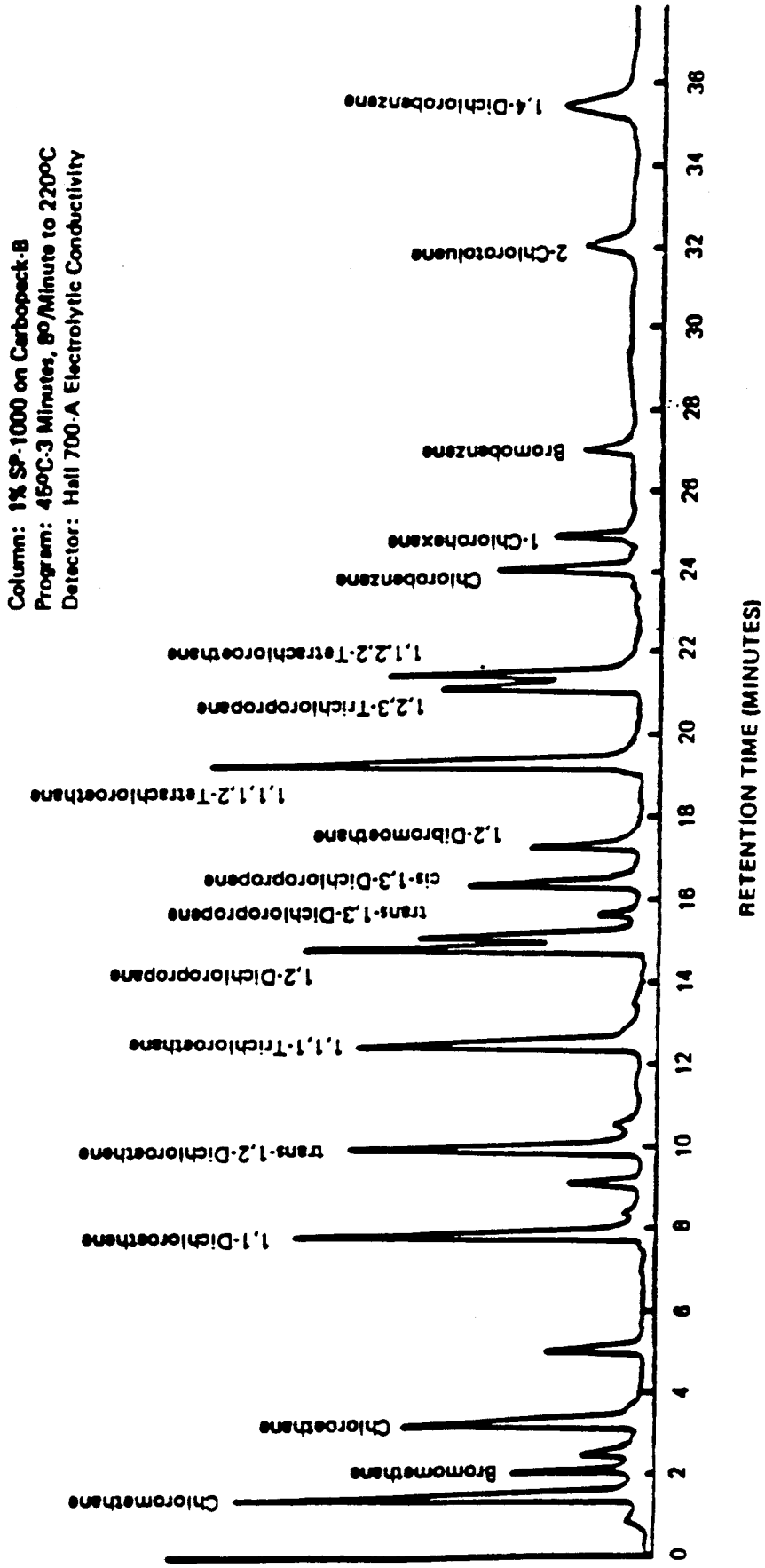


Figure 1. Gas Chromatogram of halogenated volatile organics.

8.3.1 If recovery is not within limits, the following is required.

- Check to be sure there are no errors in calculations, surrogate solutions and internal standards. Also, check instrument performance.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.
- Reextract and reanalyze the sample if none of the above are a problem or flag the data as "estimated concentration."

9.0 METHOD PERFORMANCE

9.1 This method was tested by 20 laboratories using reagent water, drinking water, surface water, and three industrial wastewaters spiked at six concentrations over the range 8.0-500 ug/L. Single operator precision, overall precision, and method accuracy were found to be directly related to the concentration of the parameter and essentially independent of the sample matrix. Linear equations to describe these relationships are presented in Table 4.

9.2 The accuracy and precision obtained will be determined by the sample matrix, sample introduction technique, and by the calibration procedure used.

10.0 REFERENCES

1. Bellar, T.A., and J.J. Lichtenberg, J. Amer. Water Works Assoc., 66(12), pp. 739-744, 1974.

2. Bellar, T.A., and J.J. Lichtenberg, "Semi-Automated Headspace Analysis of Drinking Waters and Industrial Waters for Purgeable Volatile Organic Compounds," in Van Hall, ed., Measurement of Organic Pollutants in Water and Wastewater, ASTM STP 686, pp. 108-129, 1979.

3. Development and Application of Test Procedures for Specific Organic Toxic Substances in Wastewaters: Category 11 - Purgeables and Category 12 - Acrolein, Acrylonitrile, and Dichlorodifluoromethane, Report for EPA Contract 68-03-2635 (in preparation).

4. U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," October 26, 1984.

5. Provost, L.P. and R.S. Elder, "Interpretation of Percent Recovery Data," American Laboratory, 15, pp. 58-63, 1983.

6. "EPA Method Validation Study 23, Method 601 (Purgeable Halocarbons)," Report for EPA Contract 68-03-2856 (in preparation).

TABLE 3. CALIBRATION AND QC ACCEPTANCE CRITERIA[a]

Parameter	Range for Q (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
Bromodichloromethane	15.2-24.8	4.3	10.7-32.0	42-172
Bromoform	14.7-25.3	4.7	5.0-29.3	13-159
Bromomethane	11.7-28.3	7.6	3.4-24.5	D-144
Carbon tetrachloride	13.7-26.3	5.6	11.8-25.3	43-143
Chlorobenzene	14.4-25.6	5.0	10.2-27.4	38-150
Chloroethane	15.4-24.6	4.4	11.3-25.2	46-137
2-Chloroethylvinyl ether	12.0-28.0	8.3	4.5-35.5	14-186
Chloroform	15.0-25.0	4.5	12.4-24.0	49-133
Chloromethane	11.9-28.1	7.4	D-34.9	D-193
Dibromochloromethane	13.1-26.9	6.3	7.9-35.1	24-191
1,2-Dichlorobenzene	14.0-26.0	5.5	1.7-38.9	D-208
1,3-Dichlorobenzene	9.9-30.1	9.1	6.2-32.6	7-187
1,4-Dichlorobenzene	13.9-26.1	5.5	11.5-25.5	42-143
1,1-Dichloroethane	16.8-23.2	3.2	11.2-24.6	47-132
1,2-Dichloroethane	14.3-25.7	5.2	13.0-26.5	51-147
1,1-Dichloroethene	12.6-27.4	6.6	10.2-27.3	28-167
trans-1,2-Dichloroethene	12.8-27.2	6.4	11.4-27.1	38-155
1,2-Dichloropropane	14.8-25.2	5.2	10.1-29.9	44-156
cis-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
trans-1,3-Dichloropropene	12.8-27.2	7.3	6.2-33.8	22-178
Methylene chloride	15.5-24.5	4.0	7.0-27.6	25-162
1,1,2,2-Tetrachloroethane	9.8-30.2	9.2	6.6-31.8	8-184
Tetrachloroethene	14.0-26.0	5.4	8.1-29.6	26-162
1,1,1-Trichloroethane	14.2-25.8	4.9	10.8-24.8	41-138
1,1,2-Trichloroethane	15.7-24.3	3.9	9.6-25.4	39-136
Trichloroethene	15.4-24.6	4.2	9.2-26.6	35-146
Trichlorofluoromethane	13.3-26.7	6.0	7.4-28.1	21-156
Vinyl chloride	13.7-26.3	5.7	8.2-29.9	28-163

Q = Concentration measured in QC check sample, in ug/L.

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 601 and were calculated assuming a QC check sample concentration of 20 ug/L.

TABLE 4. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION[a]

Parameter	Accuracy, as recovery, x' (ug/L)	Single analyst precision, s_r' (ug/L)	Overall precision, S' (ug/L)
Bromodichloromethane	1.12C-1.02	0.11$\bar{X}$+0.04	0.20$\bar{X}$+1.00
Bromoform	0.96C-2.05	0.12$\bar{X}$+0.58	0.21$\bar{X}$+2.41
Bromomethane	0.76C-1.27	0.28$\bar{X}$+0.27	0.36$\bar{X}$+0.94
Carbon tetrachloride	0.98C-1.04	0.15$\bar{X}$+0.38	0.20$\bar{X}$+0.39
Chlorobenzene	1.00C-1.23	0.15$\bar{X}$-0.02	0.18$\bar{X}$+1.21
Chloroethane	0.99C-1.53	0.14$\bar{X}$-0.13	0.17$\bar{X}$+0.63
2-Chloroethyl vinyl ether[b]	1.00C	0.20$\bar{X}$	0.35$\bar{X}$
Chloroform	0.93C-0.39	0.13$\bar{X}$+0.15	0.19$\bar{X}$-0.02
Chloromethane	0.77C+0.18	0.28$\bar{X}$-0.31	0.52$\bar{X}$+1.31
Dibromochloromethane	0.94C+2.72	0.11$\bar{X}$+1.10	0.24$\bar{X}$+1.68
1,2-Dichlorobenzene	0.93C+1.70	0.20$\bar{X}$+0.97	0.13$\bar{X}$+6.13
1,3-Dichlorobenzene	0.95C+0.43	0.14$\bar{X}$+2.33	0.26$\bar{X}$+2.34
1,4-Dichlorobenzene	0.93C-0.09	0.15$\bar{X}$+0.29	0.20$\bar{X}$+0.41
1,1-Dichloroethane	0.95C-1.08	0.08$\bar{X}$+0.17	0.14$\bar{X}$+0.94
1,2-Dichloroethane	1.04C-1.06	0.11$\bar{X}$+0.70	0.15$\bar{X}$+0.94
1,1-Dichloroethene	0.98C-0.87	0.21$\bar{X}$-0.23	0.29$\bar{X}$-0.04
trans-1,2-Dichloroethene	0.97C-0.16	0.11$\bar{X}$+1.46	0.17$\bar{X}$+1.46
1,2-Dichloropropane[b]	1.00C	0.13$\bar{X}$	0.23$\bar{X}$
cis-1,3-Dichloropropene[b]	1.00C	0.18$\bar{X}$	0.32$\bar{X}$
trans-1,3-Dichloropropene[b]	1.00C	0.18$\bar{X}$	0.32$\bar{X}$
Methylene chloride	0.91C-0.93	0.11$\bar{X}$+0.33	0.21$\bar{X}$+1.43
1,1,2,2-Tetrachloroethene	0.95C+0.19	0.14$\bar{X}$+2.41	0.23$\bar{X}$+2.79
Tetrachloroethene	0.94C+0.06	0.14$\bar{X}$+0.38	0.18$\bar{X}$+2.21
1,1,1-Trichloroethane	0.90C-0.16	0.15$\bar{X}$+0.04	0.20$\bar{X}$+0.37
1,1,2-Trichloroethane	0.86C+0.30	0.13$\bar{X}$-0.14	0.19$\bar{X}$+0.67
Trichloroethene	0.87C+0.48	0.13$\bar{X}$-0.03	0.23$\bar{X}$+0.30
Trichlorofluoromethane	0.89C-0.07	0.15$\bar{X}$+0.67	0.26$\bar{X}$+0.91
Vinyl chloride	0.97C-0.36	0.13$\bar{X}$+0.65	0.27$\bar{X}$+0.40

x' = Expected recovery for one or more measurements of a sample containing a concentration of C, in ug/L.

s_r' = Expected single analyst standard deviation of measurements at an average concentration of $\bar{X}$, in ug/L.

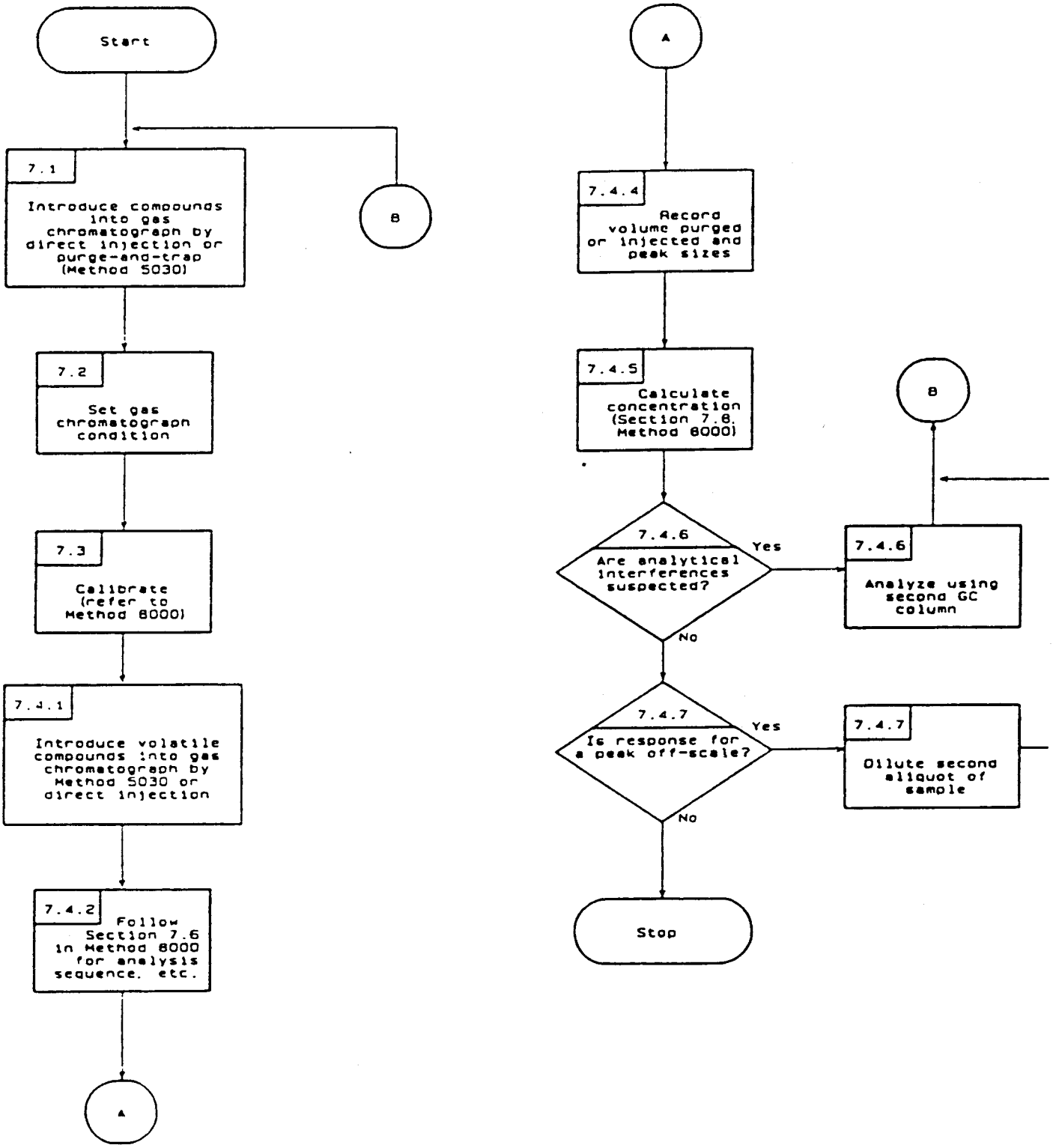
S' = Expected interlaboratory standard deviation of measurements at an average concentration found of $\bar{X}$, in ug/L.

C = True value for the concentration, in ug/L.

$\bar{X}$ = Average recovery found for measurements of samples containing a concentration of C, in ug/L.

[a]From 40 CFR Part 136 for Method 601.

[b]Estimates based upon the performance in a single laboratory.


Start
7.1
Introduce compounds into gas chromatograph by direct injection or purge-and-trap (Method 5030)
B
7.2
Set gas chromatograph condition
7.3
Calibrate (refer to Method 8000)
7.4.1
Introduce volatile compounds into gas chromatograph by Method 5030 or direct injection
7.4.2
Follow Section 7.6 in Method 8000 for analysis sequence, etc.
A
A
7.4.4
Record volume purged or injected and peak sizes
7.4.5
Calculate concentration (Section 7.8, Method 8000)
B
7.4.6
Are analytical interferences suspected?
Yes
7.4.6
Analyze using second GC column
No
7.4.7
Is response for a peak off-scale?
Yes
7.4.7
Dilute second aliquot of sample
No
Stop

METHOD 8120

CHLORINATED HYDROCARBONS

1.0 SCOPE AND APPLICATION

1.1 Method 8120 is used to determine the concentration of certain chlorinated hydrocarbons. Table 1 indicates compounds that may be determined by this method and lists the method detection limit for each compound in reagent water. Table 2 lists the practical quantitation limit (PQL) for other matrices.

2.0 SUMMARY OF METHOD

2.1 Method 8120 provides gas chromatographic conditions for the detection of ppb levels of certain chlorinated hydrocarbons. Prior to use of this method, appropriate sample extraction techniques must be used. Both neat and diluted organic liquids (Method 3580, Waste Dilution) may be analyzed by direct injection. A 2- to 5-uL aliquot of the extract is injected into a gas chromatograph (GC) using the solvent flush technique, and compounds in the GC effluent are detected by an electron capture detector (ECD).

2.2 If interferences are encountered in the analysis, Method 8120 may also be performed on extracts that have undergone cleanup using Method 3620.

3.0 INTERFERENCES

3.1 Refer to Methods 3500, 3600, and 8000.

3.2 Solvents, reagents, glassware, and other sample processing hardware may yield discrete artifacts and/or elevated baselines causing misinterpretation of gas chromatograms. All of these materials must be demonstrated to be free from interferences, under the conditions of the analysis, by analyzing method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be required.

3.3 Interferences coextracted from samples will vary considerably from source to source, depending upon the waste being sampled. Although general cleanup techniques are recommended as part of this method, unique samples may require additional cleanup.

4.0 APPARATUS AND MATERIALS

4.1 Gas chromatograph:

4.1.1 **Gas chromatograph:** Analytical system complete with gas chromatograph suitable for on-column injections and all required

TABLE 1. GAS CHROMATOGRAPHY OF CHLORINATED HYDROCARBONS

Compound	Retention time (min) Col. 1	Retention time (min) Col. 2	$	Method Detection limit (ug/L)
Benzal chloride				
Benzotrichloride				
Benzyl chloride				
2-Chloronaphthalene	2.7[a]	3.6[b]		0.94
1,2-Dichlorobenzene	6.6	9.3		1.14
1,3-Dichlorobenzene	4.5	6.8		1.19
1,4-Dichlorobenzene	5.2	7.6		1.34
Hexachlorobenzene	5.6[a]	10.1[b]		0.05
Hexachlorobutadiene	7.7	20.0		0.34
Hexachlorocyclohexane				
Hexachlorocyclopentadiene	nd	16.5[c]		0.40
Hexachloroethane	4.9	8.3		0.03
Tetrachlorobenzenes				
1,2,4-Trichlorobenzene	15.5	22.3		0.05
Pentachlorohexane				

nd = not determined.

[a]150°C column temperature.

[b]165°C column temperature.

[c]100°C column temperature.

TABLE 2. DETERMINATION OF PRACTICAL QUANTITATION LIMITS (PQL) FOR VARIOUS MATRICES[a]

Matrix	Factor[b]
Ground water	10
Low-level soil by sonication with GPC cleanup	670
High-level soil and sludges by sonication	10,000
Non-water miscible waste	100,000

[a]Sample PQLs are highly matrix-dependent. The PQLs listed herein are provided for guidance and may not always be achievable.

[b]PQL = [Method detection limit (Table 1)] X [Factor (Table 2)]. For non-aqueous samples, the factor is on a wet-weight basis.

accessories, including detectors, column supplies, recorder, gases, and syringes. A data system for measuring peak areas and/or peak heights is recommended.

4.1.2 **Columns:**

4.1.2.1 Column 1: 1.8-m x 2-mm I.D. glass column packed with 1% SP-1000 on Supelcoport (100/120 mesh) or equivalent.

4.1.2.2 Column 2: 1.8-m x 2-mm I.D. glass column packed with 1.5% OV-1/2.4% OV-225 on Supelcoport (80/100 mesh) or equivalent.

4.1.3 **Detector:** Electron capture (ECD).

4.2 Kuderna-Danish (K-D) apparatus:

4.2.1 **Concentrator tube:** 10-mL, graduated (Kontes K-570050-1025 or equivalent). Ground-glass stopper is used to prevent evaporation of extracts

4.2.2 **Evaporation flask:** 500-mL (Kontes K-570001-500 or equivalent). Attach to concentrator tube with springs.

4.2.3 **Snyder column:** Three-ball .macro (Kontes K-503000-0121 or equivalent).

4.2.4 **Snyder column:** Two-ball micro (Kontes K-569001-0219 or equivalent).

4.3 Boiling chips: Solvent extracted, approximately 10/40 mesh (silicon carbide or equivalent).

4.4 Water bath: Heated, with concentric ring cover, capable of temperature control (±5°C). The bath should be used in a hood.

4.5 Volumetric flasks: 10-, 50-, and 100-mL, ground-glass stopper.

4.6 Microsyringe: 10-uL.

4.7 Syringe: 5-mL.

4.8 Vials: Glass, 2-, 10-, and 20-mL capacity with Teflon-lined screw cap.

5.0 REAGENTS

5.1 Solvents: hexane, isooctane, acetone (pesticide quality or equivalent).

5.2 Stock standard solutions:

5.2.1 Prepare stock standard solutions at a concentration of 1.00 ug/uL by dissolving 0.0100 g of assayed reference material in isooctane and diluting to volume in a 10-mL volumetric flask. Larger volumes can be used at the convenience of the analyst. When compound purity is assayed to be 96% or greater, the weight can be used without correction to calculate the concentration of the stock standard. Commercially prepared stock standards can be used at any concentration if they are certified by the manufacturer or by an independent source.

5.2.2 Transfer the stock standard solutions into Teflon-sealed screw-cap bottles. Store at 4°C and protect from light. Stock standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards from them.

5.2.3 Stock standard solutions must be replaced after one year, or sooner if comparison with check standards indicates a problem.

5.3 Calibration standards: Calibration standards at a minimum of five concentration levels should be prepared through dilution of the stock standards with isooctane. One of the concentration levels should be at a concentration near, but above, the method detection limit. The remaining concentration levels should correspond to the expected range of concentrations found in real samples or should define the working range of the GC. Calibration solutions must be replaced after six months, or sooner if comparison with check standards indicates a problem.

5.4 Internal standards (if internal standard calibration is used): To use this approach, the analyst must select one or more internal standards that are similar in analytical behavior to the compounds of interest. The analyst must further demonstrate that the measurement of the internal standard is not affected by method or matrix interferences. Because of these limitations, no internal standard can be suggested that is applicable to all samples.

5.4.1 Prepare calibration standards at a minimum of five concentration levels for each analyte of interest as described in Paragraph 5.3.

5.4.2 To each calibration standard, add a known constant amount of one or more internal standards, and dilute to volume with isooctane.

5.4.3 Analyze each calibration standard according to Section 7.0.

5.5 Surrogate standards: The analyst should monitor the performance of the extraction, cleanup (when used), and analytical system and the effectiveness of the method in dealing with each sample matrix by spiking each sample, standard, and reagent water blank with one or two surrogates (e.g., chlorinated hydrocarbons that are not expected to be in the sample) recommended to encompass the range of the temperature program used in this method. Method 3500, Section 5.3.1.1, details instructions on the preparation of base/neutral surrogates. Deuterated analogs of analytes should not be used as surrogates for gas chromatographic analysis due to coelution problems.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1. Extracts must be stored under refrigeration and analyzed within 40 days of extraction.

7.0 PROCEDURE

7.1 Extraction:

7.1.1 Refer to Chapter Two for guidance on choosing the appropriate extraction procedure. In general, water samples are extracted at a neutral, or as is, pH with methylene chloride, using either Method 3510 or 3520. Solid samples are extracted using either Method 3540 or 3550.

7.1.2 Prior to gas chromatographic analysis, the extraction solvent must be exchanged to hexane. The exchange is performed during the K-D procedures listed in all of the extraction methods. The exchange is performed as follows.

7.1.2.1 Following K-D of the methylene chloride extract to 1-mL using the macro-Snyder column, allow the apparatus to cool and drain for at least 10 min.

7.1.2.2 Momentarily remove the Snyder column, add 50 mL of hexane, a new boiling chip, and reattach the macro-Snyder column. Concentrate the extract using 1 mL of hexane to prewet the Snyder column. Place the K-D apparatus on the water bath so that the concentrator tube is partially immersed in the hot water. Adjust the vertical position of the apparatus and the water temperature, as required, to complete concentration in 5-10 min. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume of liquid reaches 1 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 min. The extract will be handled differently at this point, depending on whether or not cleanup is needed. If cleanup is not required, proceed to Paragraph 7.1.2.3. If cleanup is needed, proceed to Paragraph 7.1.2.4.

7.1.2.3 If cleanup of the extract is not required, remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with 1-2 mL of hexane. A 5-mL syringe is recommended for this operation. Adjust the extract volume to 10.0 mL. Stopper the concentrator tube and store refrigerated at 4°C if further processing will not be performed immediately. If the extract will be stored longer than two days, it should be transferred to a Teflon-sealed screw-cap vial. Proceed with gas chromatographic analysis.

7.1.2.4 If cleanup of the extract is required, remove the Snyder column and rinse the flask and its lower joint into the concentrator tube with a minimum amount of hexane. A 5-mL syringe is recommended for this operation. Add a clean boiling chip to the concentrator tube and attach a two-ball micro-Snyder column. Prewet the column by adding about 0.5 mL of hexane to the top. Place the micro-K-D apparatus on the water bath (80°C) so that the concentrator tube is partially immersed in the hot water. Adjust the vertical position of the apparatus and the water temperature, as required, to complete concentration in 5-10 min. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood. When the apparent volume of liquid reaches 0.5 mL, remove the K-D apparatus and allow it to drain and cool for at least 10 min.

7.1.2.5 Remove the micro-Snyder column and rinse the flask and its lower joint into the concentrator tube with 0.2 mL of hexane. Adjust the extract volume to 2.0 mL and proceed with Method 3620.

7.2 Gas chromatography conditions (Recommended):

7.2.1 **Column 1:** Set 5% methane/95% argon carrier gas flow at 25 mL/min flow rate. Set column temperature at 65°C isothermal, unless otherwise specified (see Table 1).

7.2.2 **Column 2:** Set 5% methane/95% argon carrier gas flow at 25 mL/min flow rate. Set column temperature at 75°C isothermal, unless otherwise specified (see Table 1).

7.3 Calibration: Refer to Method 8000 for proper calibration techniques. Use Table 1 and especially Table 2 for guidance on selecting the lowest point on the calibration curve.

7.3.1 The procedure for internal or external calibration may be used. Refer to Method 8000 for a description of each of these procedures.

7.3.2 If cleanup is performed on the samples, the analyst should process a series of standards through the cleanup procedure and then analyze the samples by GC. This will validate elution patterns and the absence of interferents from the reagents.

7.4 Gas chromatographic analysis:

7.4.1 Refer to Method 8000. If the internal standard calibration technique is used, add 10 uL of internal standard to the sample prior to injecting.

7.4.2 Follow Section 7.6 in Method 8000 for instructions on the analysis sequence, appropriate dilutions, establishing daily retention time windows, and identification criteria. Include a mid-level standard after each group of 10 samples in the analysis sequence.

7.4.3 Examples of GC/ECD chromatograms for certain chlorinated hydrocarbons are shown in Figures 1 and 2.

7.4.4 Record the sample volume injected and the resulting peak sizes (in area units or peak heights).

7.4.4 Using either the internal or external calibration procedure (Method 8000), determine the identity and quantity of each component peak in the sample chromatogram which corresponds to the compounds used for calibration purposes. See Section 7.8 of Method 8000 for calculation equations.

7.4.5 If peak detection and identification are prevented due to interferences, the hexane extract may undergo cleanup using Method 3620.

7.5 Cleanup:

7.5.1 Proceed with Method 3620 using the 2-mL hexane extracts obtained from Paragraph 7.1.2.5.

7.5.2 Following cleanup, the extracts should be analyzed by GC, as described in the previous paragraphs and in Method 8000.

8.0 QUALITY CONTROL

8.1 Refer to Chapter One for specific quality control procedures. Quality control to validate sample extraction is covered in Method 3500 and in the extraction method utilized. If extract cleanup was performed, follow the QC in Method 3600 and in the specific cleanup method.

8.2 Procedures to check the GC system operation are found in Method 8000, Section 8.6.

8.2.1 The quality control check sample concentrate (Method 8000, Section 8.6) should contain each parameter of interest at the following concentrations in acetone: hexachloro-substituted hydrocarbon, 10 ug/mL; and any other chlorinated hydrocarbon, 100 ug/mL.

8.2.2 Table 3 indicates the calibration and QC acceptance criteria for this method. Table 4 gives method accuracy and precision as functions of concentration for the analytes of interest. The contents of both Tables should be used to evaluate a laboratory's ability to perform and generate acceptable data by this method.

8.3 Calculate surrogate standard recovery on all samples, blanks, and spikes. Determine if the recovery is within limits (limits established by performing QC procedures outlined in Method 8000, Section 8.10).

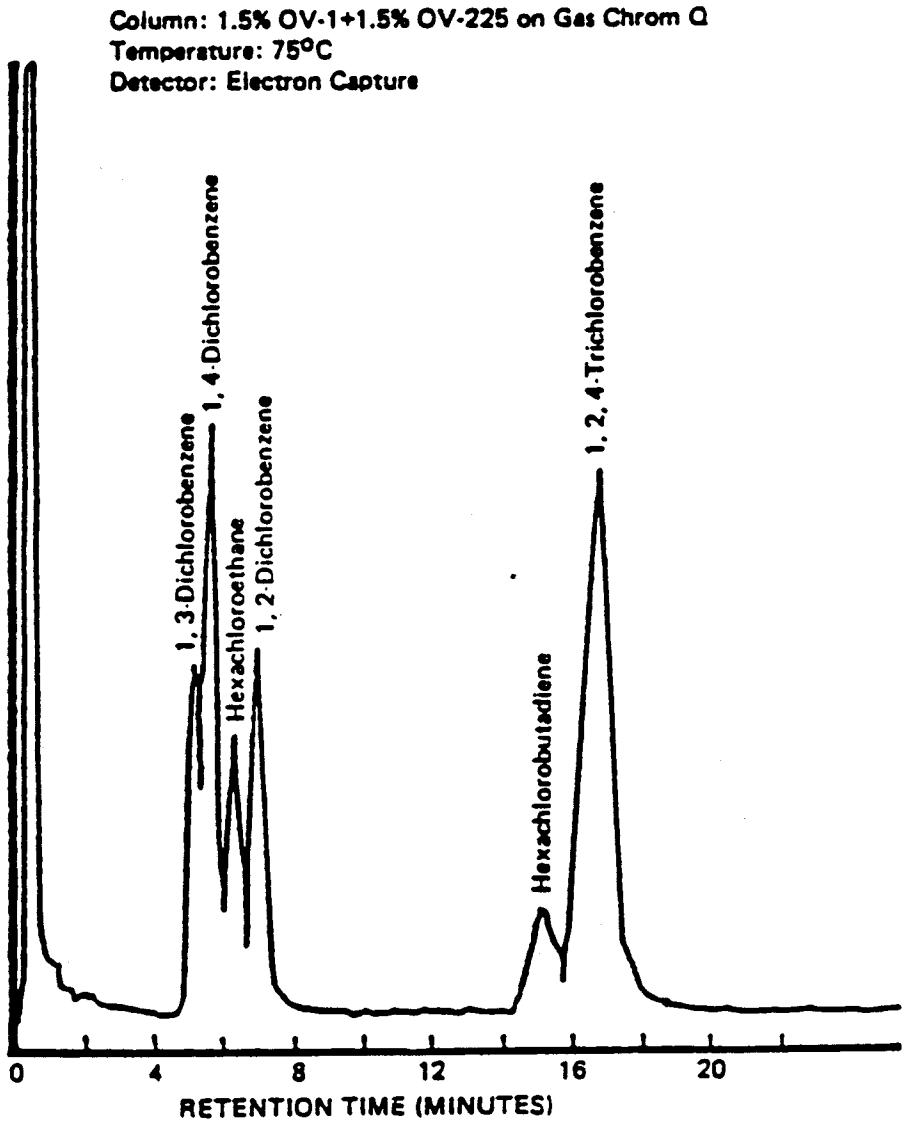


Figure 1. Gas chromatogram of chlorinated hydrocarbons (low molecular weight compounds).

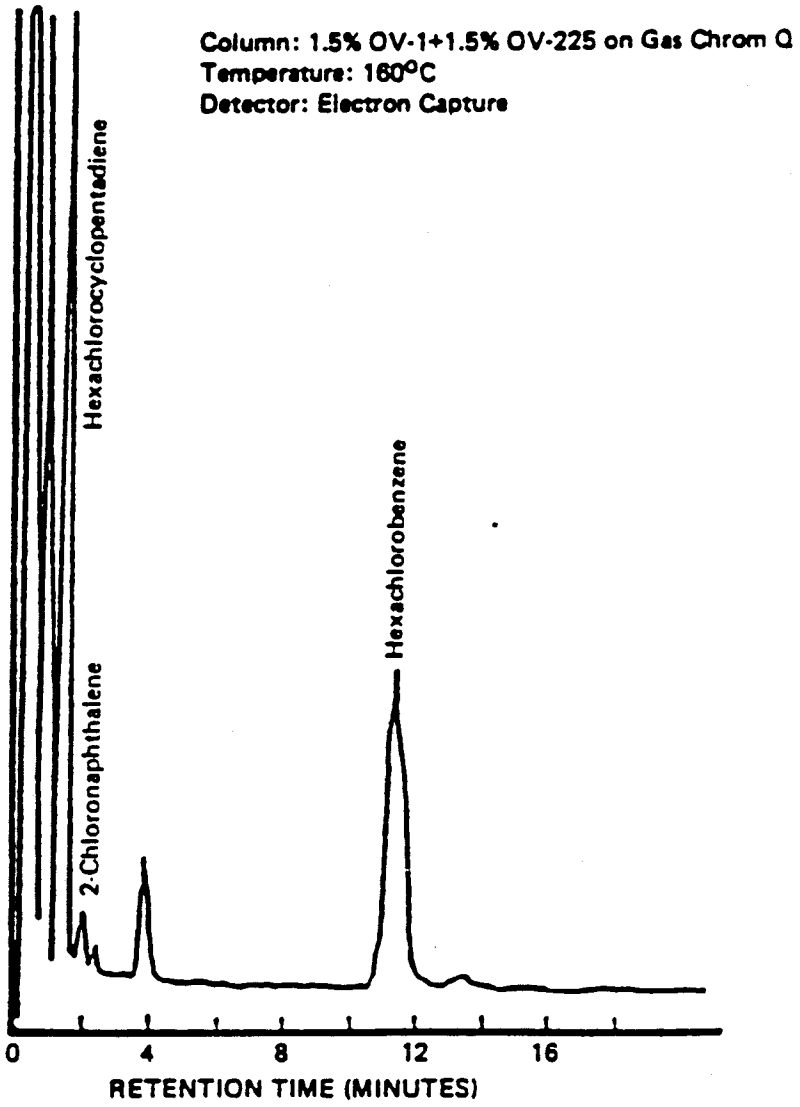


Figure 2. Gas chromatogram of chlorinated hydrocarbons (high molecular weight compounds).

8.3.1 If recovery is not within limits, the following procedures are required.

- Check to be sure there are no errors in calculations, surrogate solutions and internal standards. Also, check instrument performance.
- Recalculate the data and/or reanalyze the extract if any of the above checks reveal a problem.
- Reextract and reanalyze the sample if none of the above are a problem or flag the data as "estimated concentration."

9.0 METHOD PERFORMANCE

9.1 The method was tested by 20 laboratories using reagent water, drinking water, surface water, and three industrial wastewaters spiked at six concentrations over the range 1.0 to 356 ug/L. Single operator precision, overall precision, and method accuracy were found to be directly related to the concentration of the parameter and essentially independent of the sample matrix. Linear equations to describe these relationships for a flame ionization detector are presented in Table 4.

9.2 The accuracy and precision obtained will be determined by the sample matrix, sample-preparation technique, and calibration procedures used.

10.0 REFERENCES

1. "Development and Application of Test Procedures for Specific Organic Toxic Substances in Wastewaters. Category 3 - Chlorinated Hydrocarbons, and Category 8 - Phenols," Report for EPA Contract 68-03-2625 (in preparation).

2. Burke, J.A. "Gas Chromatography for Pesticide Residue Analysis; Some Practical Aspects," Journal of the Association of Official Analytical Chemists, 48, 1037, 1965.

3. "EPA Method Validation Study 22, Method 612 (Chlorinated Hydrocarbons)," Report for EPA Contract 68-03-2625 (in preparation).

4. "Method Performance for Hexachlorocyclopentadiene by Method 612," Memorandum from R. Slater, U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio 45268, December 7, 1983.

5. U.S. EPA 40 CFR Part 136, "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final Rule and Interim Final Rule and Proposed Rule," October 26, 1984.

6. Provost, L.P. and R.S. Elder, "Interpretation of Percent Recovery Data," American Laboratory, 15, pp. 58-63, 1983.

7. "Determination of Chlorinated Hydrocarbons in Industrial and Municipal Wastewaters," Report for EPA Contract 68-03-2625 (in preparation).

TABLE 3. QC ACCEPTANCE CRITERIA[a]

Parameter	Test conc. (ug/L)	Limit for s (ug/L)	Range for $\bar{X}$ (ug/L)	Range P, P_s (%)
2-Chloronaphthalene	100	37.3	29.5-126.9	9-148
1,2-Dichlorobenzene	100	28.3	23.5-145.1	9-160
1,3-Dichlorobenzene	100	26.4	7.2-138.6	D-150
1,4-Dichlorobenzene	100	20.8	22.7-126.9	13-137
Hexachlorobenzene	10	2.4	2.6-14.8	15-159
Hexachlorobutadiene	10	2.2	D-12.7	D-139
Hexachlorocyclopentadiene	10	2.5	D-10.4	D-111
Hexachloroethane	10	3.3	2.4-12.3	8-139
1,2,4-Trichlorobenzene	100	31.6	20.2-133.7	5-149

s = Standard deviation of four recovery measurements, in ug/L.

$\bar{X}$ = Average recovery for four recovery measurements, in ug/L.

P, P_s = Percent recovery measured.

D = Detected; result must be greater than zero.

[a]Criteria from 40 CFR Part 136 for Method 612. These criteria are based directly upon the method performance data in Table 4. Where necessary, the limits for recovery have been broadened to assure applicability of the limits to concentrations below those used to develop Table 4.

Table 4. METHOD ACCURACY AND PRECISION AS FUNCTIONS OF CONCENTRATION[a]

Parameter	Accuracy, as recovery, x' (ug/L)	Single analyst precision, s_r' (ug/L)	Overall precision, S' (ug/L)
Chloronaphthalene	0.75C+3.21	0.28$\bar{X}$-1.17	0.38$\bar{X}$-1.39
1,2-Dichlorobenzene	0.85C-0.70	0.22$\bar{X}$-2.95	0.41$\bar{X}$-3.92
1,3-Dichlorobenzene	0.72C+0.87	0.21$\bar{X}$-1.03	0.49$\bar{X}$-3.98
1,4-Dichlorobenzene	0.72C+2.80	0.16$\bar{X}$-0.48	0.35$\bar{X}$-0.57
Hexachlorobenzene	0.87C-0.02	0.14$\bar{X}$+0.07	0.36$\bar{X}$-0.19
Hexachlorobutadiene	0.61C+0.03	0.18$\bar{X}$+0.08	0.53$\bar{X}$-0.12
Hexachlorocyclopentadiene[a]	0.47C	0.24$\bar{X}$	0.50$\bar{X}$
Hexachloroethane	0.74C-0.02	0.23$\bar{X}$+0.07	0.36$\bar{X}$-0.00
1,2,4-Trichlorobenzene	0.76C+0.98	0.23$\bar{X}$-0.44	0.40$\bar{X}$-1.37

x' = Expected recovery for one or more measurements of a sample containing a concentration of C, in ug/L.

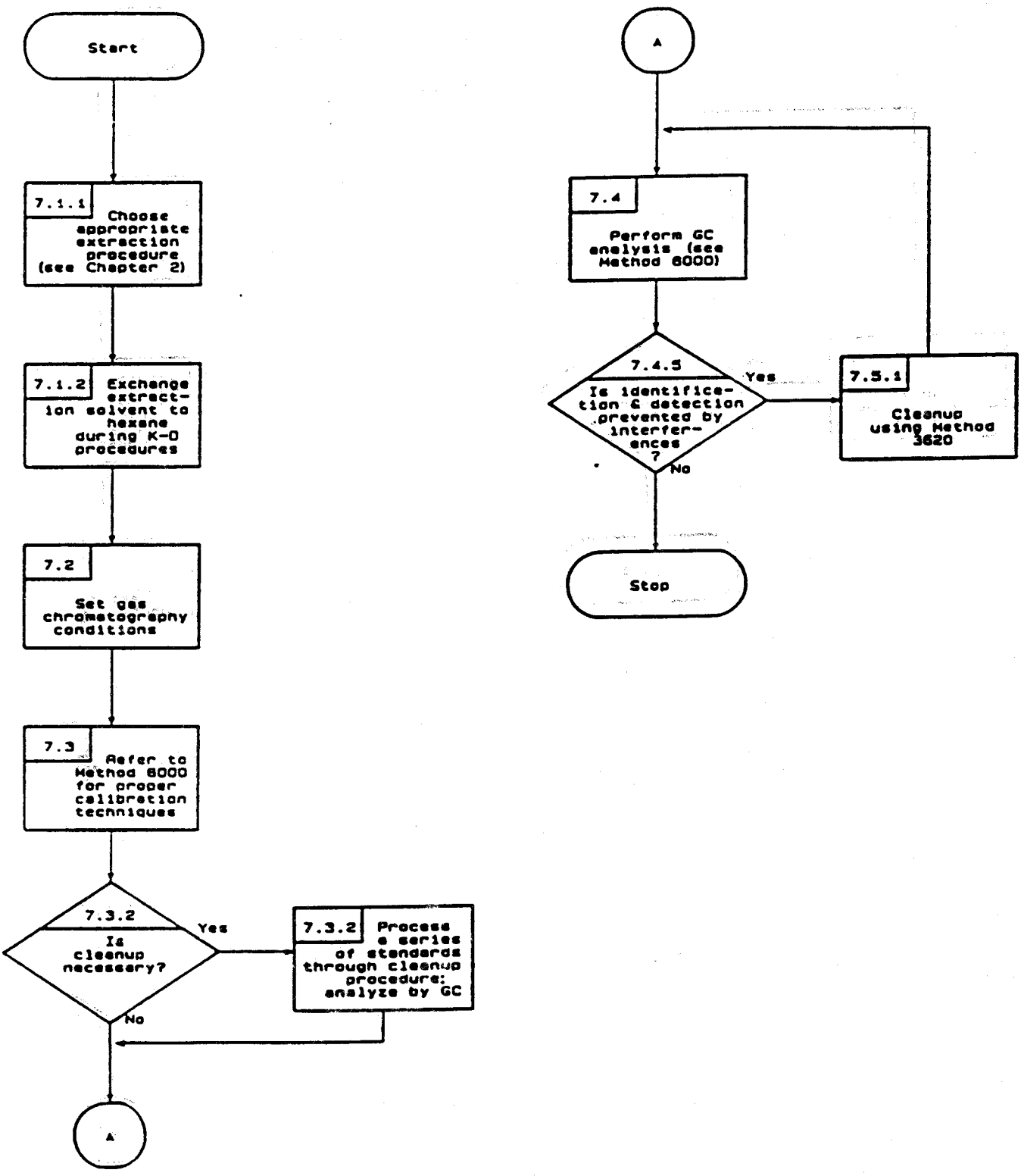
s_r' = Expected single analyst standard deviation of measurements at an average concentration of $\bar{X}$, in ug/L.

S' = Expected interlaboratory standard deviation of measurements at an average concentration found of $\bar{X}$, in ug/L.

C = True value for the concentration, in ug/L.

$\bar{X}$ = Average recovery found for measurements of samples containing a concentration of C, in ug/L.

[a]Estimates based upon the performance in a single laboratory.


Start
7.1.1 Choose appropriate extraction procedure (see Chapter 2)
7.1.2 Exchange extraction solvent to hexane during K-D procedures
7.2 Set gas chromatography conditions
7.3 Refer to Method 8000 for proper calibration techniques
7.3.2 Is cleanup necessary?
Yes
No
7.3.2 Process a series of standards through cleanup procedure; analyze by GC
A
A
7.4 Perform GC analysis (see Method 8000)
7.4.5 Is identification & detection prevented by interferences ?
Yes
No
7.5.1 Cleanup using Method 3620
Stop