A HAZARDOUS WASTE SUPPLEMENT TO PERSONAL PROTECTIVE EQUIPMENT FOR HAZARDOUS MATERIALS INCIDENTS: A SELECTION GUIDE

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INTRODUCTION

In 1985, NIOSH published, "Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide," (NIOSH 84-114) which makes specific recommendations for personal protective equipment (PPE) for hazardous materials emergencies. NIOSH realized the need for such detailed guidelines in selection of PPE for hazardous waste site cleanups. Therefore, we are offering this publication as a supplement to the previous document.

In using this supplement, reference should be made to the original document which is available from GPO (Stock Number 017-033-00-414-5) or from NTIS (Stock Number PB 85-222 230).

Part II: PPE SELECTION GUIDE

INTRODUCTION: How to Use the Selection Guide

This part presents step-by-step guides to the selection of respirators, chemical protective clothing, and ancillary equipment which comprise the PPE ensemble necessary to workers who enter uncontrolled hazardous waste sites. The decision logic employed permits the person responsible for planning a mission to make the most appropriate selection of PPE components, configurations and ensembles.

The Respirator section (R) and the Chemical Protective Clothing section (C), which includes ancillary equipment, are presented in the same manner. Each page represents a critical factor that requires a decision; i.e., a step in the logic process, and is given the letter designation for the component being selected and a number designation representing sequence (e.g., R1). The decision process is not a straight-line sequence. Rather, each specific decision affects the sequence of subsequent factors to be considered.

Each page contains the letter/number designation for the step, a title which reflects the factor under consideration, a brief discussion of that factor, the reference(s) supporting the information contained in the discussion, and "yes" or "no" statements which allow the user to choose the applicable statement. The choice determines the next step in the sequence, which is indicated by the number to the right of the statement.

The final step in all decision processes will be a full description of the appropriate respirator, protective clothing, or ancillary equipment necessary for the mission.

DISCLAIMER

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

RESPIRATORS (R)

R 1

FIRE FIGHTING & RESCUE

The operations of fire fighting and rescue are always considered to involve atmospheres immediately dangerous to life and health and thus require the most dependable and effective respiratory protection possible [177].

IF THE OPERATION INVOLVES RESCUE OR FIRE FIGHTING

GO TO R 39

IF THE OPERATION INVOLVES NO RESCUE OR FIRE FIGHTING

GO TO R 2

R 2

SUBSTANCE IDENTIFICATION

The positive identification of a substance may allow the use of effective air-purifying respirators. In the event that the substance cannot be positively identified, then only the most dependable and effective respiratory protection should be used [92].

IF THE SUBSTANCE IS IDENTIFIED

GO TO R 3

IF THE SUBSTANCE IS UNIDENTIFIED

GO TO R 43

R 3

PERMISSIBLE EXPOSURE LIMIT/THRESHOLD LIMIT VALVE®

The determination of the efficiency of the respirator is dependent upon knowledge of the permissible exposure limit or threshold limit value for the airborne contaminant [34].

IF THE PERMISSIBLE EXPOSURE LIMIT OR THRESHOLD LIMIT VALUE IS KNOWN
GO TO R 4

IF THE PERMISSIBLE EXPOSURE LIMIT OR THRESHOLD LIMIT VALUE IS UNKNOWN
GO TO R 43

R ACGIH

R 4

CONCENTRATION

Once the hazardous material is identified, the airborne concentration which has been, or which could be, generated is an important determinant of the required efficiency of required respiratory protection. If the concentration cannot be measured or estimated, then only the most dependable and effective respiratory protection should be used [178].

IF THE CONCENTRATION OF HAZARDOUS MATERIAL IS KNOWN

GO TO R 5

IF THE CONCENTRATION OF HAZARDOUS MATERIAL IS UNKNOWN

GO TO R 43

LOWER FLAMMABLE LIMIT/MINIMUM EXPLOSIVE CONCENTRATION

Contaminant concentrations above the lower flammable limit or the minimum explosive concentration can be ignited causing an explosion. Only the most dependable and effective respiratory protection should be used [34].

IF THE CONCENTRATION IS AT OR ABOVE THE LOWER FLAMMABLE LIMIT OR THE MINIMUM EXPLOSIVE CONCENTRATION

GO TO R 43

IF THE CONCENTRATION IS BELOW THE LOWER FLAMMABLE LIMIT OR THE MINIMUM EXPLOSIVE CONCENTRATION

GO TO R 6

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH)

"Immediately dangerous to life or health" means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials or carcinogens, mutagens or teratogens, which are likely to have adverse cumulative or delayed effects on health. Only the most dependable and effective respiratory protection can be used [44].

IF THE CONCENTRATION OR CONDITION IS IMMEDIATELY DANGEROUS TO LIFE OR HEALTH OR THE IDLH OR CONCENTRATION ARE UNKNOWN

GO TO R 43

IF THE CONCENTRATION OR CONDITION IS NOT IMMEDIATELY DANGEROUS TO LIFE OR HEALTH

GO TO R 7

OXYGEN DEFICIENT ATMOSPHERES

Man needs a minimum amount of oxygen to sustain life and somewhat more for effective work. Both barometric pressure and percentage of oxygen present are factors in determining if the atmosphere is oxygen deficient. Self-contained breathing apparatus are required in oxygen deficient atmospheres (See Figure I-3, page 33) [178].

IF THE ATMOSPHERE IS NOT OXYGEN DEFICIENT

GO TO R 8

IF THE ATMOSPHERE IS OXYGEN DEFICIENT OR THIS IS UNKNOWN

GO TO R 43

REQUIRED PROTECTION FACTOR (PF)

The protection factor (PF) is the ratio of the contaminant concentration outside and inside the respirator. Since the concentration inside the respirator must be less than the PEL or TLV®, the PF then determines the maximum concentration in which the respirator can be used [34].

$$RPF = \frac{\text{AMBIENT CONCENTRATION}}{\text{PEL or TLV®}}$$

IF THE REQUIRED PROTECTION FACTOR IS GREATER THAN 50 OR IS UNKNOWN
GO TO R 43

IF THE REQUIRED PROTECTION FACTOR IS EQUAL TO OR LESS THAN 50
GO TO R 9

R_{ACGIH}

R 9

AEROSOLS

Airborne materials of greater than molecular size are considered aerosols. Dusts, fumes, mists, fogs and smokes are the most commonly encountered hazardous aerosols. Aerosols can usually be readily filtered from otherwise respirable air with simple respirators having a high efficiency filter [179].

IF THE CONTAMINANT IS SOLELY AN AEROSOL

GO TO R 10

IF THE CONTAMINANT IS NOT AN AEROSOL OR IF IT IS AN AEROSOL MIXED WITH A GAS OR VAPOR

GO TO R 11

R 10

SUBLIMATION OR DECOMPOSITION OF AEROSOLS

Aerosol material trapped on a respirator filter may be inhaled if the material decomposes or sublimes into a gas or vapor since filters are ineffective against gases or vapors.

Materials having a vapor pressure in mm Hg greater than the $\frac{TLV®}{2000}$ in ppm should be considered to have a significant vapor pressure [178].

IF THE AEROSOL HAS A SIGNIFICANT VAPOR PRESSURE, SUBLIMES, DECOMPOSES OR IF THESE PROPERTIES ARE UNKNOWN

GO TO R 11

IF THE AEROSOL DOES NOT HAVE A SIGNIFICANT VAPOR PRESSURE, AND NEITHER SUBLIMES NOR DECOMPOSES

SELECT RESPIRATOR A

R 11

RADIOACTIVE GASES & VAPORS

Air-purifying respirators cannot be used for protection against any radioactive gas or vapor [180].

IF THE CONTAMINANT IS A RADIOACTIVE GAS OR VAPOR

GO TO R 45

IF THE CONTAMINANT IS NOT A RADIOACTIVE GAS OR VAPOR

GO TO R 12

WARNING PROPERTIES

Gas masks cannot be used for protection from materials which have inadequate warning of sorbent breakthrough. Materials which have an odor, irritation or taste at or below the PEL or TLV® can usually be considered to have adequate warning properties. Exceptions are materials which cause olfactory fatigue or whose odors are so pronounced at very low concentrations that they may be perceived even with a properly functioning respirator [34, 181].

IF THE MATERIAL HAS ADEQUATE WARNING PROPERTIES

GO TO R 13

IF THE MATERIAL HAS INADEQUATE WARNING PROPERTIES OR THEY ARE UNKNOWN

GO TO R 45

SORBENT EFFICIENCY

The sorbents for gases and vapors are influenced by many factors which can affect their efficiency. NIOSH has established sorbent efficiencies for only a few substances (see Table II-1 below). Other reputable sources of sorbent efficiency information can be used to determine the adequacy of respiratory protection provided by the canister. Use of gas and vapor sorbent respirators for chemicals whose sorption properties are unknown is unwarranted.[31, 182].

Table II-1

GASES/VAPORS TESTED BY NIOSH

AMMONIA	CARBON TETRACHLORIDE*
MONOMETHYLAMINE	SULFUR DIOXIDE
HYDROGEN CHLORIDE	CARBON MONOXIDE
CHLORINE	VINYL CHLORIDE
FORMALDEHYDE	

* Use of sorbent respirators not recommended

IF SORBENT EFFICIENCY IS KNOWN AND APPROPRIATE

GO TO R 14

IF SORBENT EFFICIENCY IS UNKNOWN OR INAPPROPRIATE

GO TO R 45

USE RELATIVE HUMIDITY

The relative humidity during use shows little effect below 65%. Above 65%, the canister service life may be drastically altered. This problem has not been adequately studied and therefore use of sorbent respirators at relative humidities above 65% is not recommended [31, 183].

IF USE RH IS EQUAL TO OR LESS THAN 65%

GO TO R 15

IF USE RH IS GREATER THAN 65% OR IS UNKNOWN

GO TO R 45

R 15

USE TEMPERATURE

Gas mask canisters, other than for carbon monoxide, are tested by NIOSH at a use temperature of 25 $\pm$ 2.5^{o} C (72.5 - 81.5^{o} F). The effects of varying use temperatures on sorbent efficiency have not been adequately studied. Lower temperatures may prevent adequate sorbent efficiency. Higher temperatures may cause excessive desorption and rapid breakthrough. Extrapolation of sorbent efficiency to unknown conditions is unwarranted [31, 183].

IF THE USE TEMPERATURE IS CONSIDERED TO ADVERSELY AFFECT USE

GO TO R 45

IF THE USE TEMPERATURE IS NOT CONSIDERED TO ADVERSELY AFFECT USE

GO TO R 16

HEAT OF REACTION

Sorption or catalytic reactions may produce heat which may increase the heat load of the user or, in extreme cases, cause the respirator canister to ignite. Substances listed in Table II-1, with the exception of carbon monoxide, do not produce excessive heat when tested at the concentrations and flowrates specified.

Carbon monoxide (CO) may generate excessive temperatures of more than 100 C^{o} (212 F^{o}) at challenges of 1% (10,000 ppm). Since these concentrations of CO are far above the IDLH (0.15% - 1500 ppm) they are of little practical importance for hazardous materials incidents. Phosphine, however, can ignite the canister at challenge concentrations below 1% (10,000 ppm) [32].

IF THE CHEMICAL PRODUCES A HIGH HEAT OF REACTION AT THE AMBIENT CONCENTRATION OR IT IS UNKNOWN

GO TO R 45

IF THE CHEMICAL DOES NOT PRODUCE A HIGH HEAT OF REACTION AT THE AMBIENT CONCENTRATION

GO TO R 17

SHOCK IGNITION SENSITIVITY

Some substances such as nitroglycerin, PETN, or nitromethane may be concentrated by a sorbent canister and make the canister into a low level explosive device. For this reason, sorbent respirators are not recommended for use with potentially explosive substances [184].

IF THE SUBSTANCE IS A POTENTIAL EXPLOSIVE OR IT IS UNKNOWN

GO TO R 45

IF THE SUBSTANCE IS NOT A POTENTIAL EXPLOSIVE

GO TO R 18

R 18

EMERGENCY SITUATIONS

Chemical cartridge respirators are not approved for escape from IDLH emergency situations. If emergencies may arise or escape from an IDLH atmosphere may be required then chemical cartridge respirators cannot be used.

30 CFR 11.90(a), S11.150

IF AN EMERGENCY SITUATION CAN OCCUR
GO TO R 35

IF AN EMERGENCY SITUATION CANNOT OCCUR
GO TO R 19

R 19

ENVIRONMENTAL SURVEILLANCE PROGRAM

An environmental surveillance program is an essential element in characterizing an environment in which chemical cartridge respirators are to be used. Due to the limited sorbent capacity of these respirators, excursions, or wide fluctuations in airborne concentrations may overtax their air purifying capabilities. Therefore, chemical cartridge respirators can only be used where the environment is well controlled and of relative unvarying concentration.

IF AN ENVIRONMENTAL SURVEILLANCE PROGRAM IS IMPLEMENTED
GO TO R 20

IF NO ENVIRONMENTAL SURVEILLANCE PROGRAM IS IMPLEMENTED
GO TO R 35

SAMPLING STRATEGY

A sampling strategy should be chosen so that confidence can be placed in a determination that concentrations of airborne contaminants do not exceed the maximum use concentrations (MUC) for the cartridges selected.

IF CONCENTRATIONS DO NOT EXCEED THE APPROPRIATE LIMITING CONCENTRATIONS

GO TO R 22

IF CONCENTRATIONS EXCEED THE APPROPRIATE LIMITING CONCENTRATIONS

GO TO R 35

AEROSOLS

Chemical cartridges are available either with or without high efficiency dust, fume and mist (DF&M) filters for aerosols. If aerosols, including contaminated soils, may be generated then DF&M filters are required.

IF AEROSOLS ARE PRESENT

GO TO R 29

IF AEROSOLS ARE NOT PRESENT

GO TO R 23

ORGANIC VAPORS

Chemical cartridges are available which are specifically designed for absorbance of organic vapors either singly or in combination with acid gases. Their sorbent efficiency should be verified before use for the specific vapor(s) and gas(es) encountered (see R 13).

IF ORGANIC VAPORS ARE PRESENT

GO TO R 28

IF ORGANIC VAPORS ARE NOT PRESENT

GO TO R 24

ACID GASES

Chemical cartridges are available which are specifically designed for absorbance of acid gases either singly or in combination with organic vapors. Their sorbent efficiency should be verified before use for the specific gas(es) or vapor(s) encountered (see R 13).

IF ACID GASES ARE PRESENT
GO TO R 27

IF ACID GASES ARE NOT PRESENT
GO TO R 25

ALKALINE GASES

Chemical cartridges are available which are specifically designed for absorbance of alkaline gases. Their sorbent efficiency should be verified before use for the specific gas(es) encountered (see R 13).

IF ALKALINE GASES ARE PRESENT
GO TO R 26

IF ALKALINE GASES ARE NOT PRESENT
GO TO R 35

CONCENTRATION

The maximum use concentration (MUC) for alkaline gas chemical cartridges is as low as 100 ppm.

IF THE CONCENTRATION CAN EXCEED 100 ppm
GO TO R 35

IF THE CONCENTRATION CANNOT EXCEED 100 ppm
SELECT RESPIRATOR L

CONCENTRATION

The maximum use concentration (MUC) for acid gas chemical cartridges is as low as 10 ppm.

IF THE CONCENTRATION CAN EXCEED 10 ppm
GO TO R 35

IF THE CONCENTRATION CANNOT EXCEED 10 ppm
SELECT RESPIRATOR K

CONCENTRATION

The maximum use concentration (MUC) for organic vapor chemical cartridges is 1000 ppm.

IF THE CONCENTRATION CAN EXCEED 1000 ppm
SELECT RESPIRATOR R

IF THE CONCENTRATION CANNOT EXCEED 1000 ppm
SELECT RESPIRATOR J

ORGANIC VAPORS/AEROSOLS

Chemical cartridges are available which are specifically designed for absorbance of organic vapors either singly or in combination with acid gases and for filtration of aerosols. Their sorbent efficiency should be verified before use for the specific vapor(s) or gas(es) encountered (see R 13).

IF ORGANIC VAPORS AND AEROSOLS ARE PRESENT
GO TO R 34

IF ORGANIC VAPORS AND AEROSOLS ARE NOT PRESENT
GO TO R 30

ACID GASES/AEROSOLS

Chemical cartridges are available which are specifically designed for absorbance of acid gases either singly or in combination with organic vapors and for filtration of aerosols. Their sorbent efficiency should be verified before use for the specific gas(es) or vapor(s) encountered (see R 13).

IF ACID GASES AND AEROSOLS ARE PRESENT
GO TO R 33

IF ACID GASES AND AEROSOLS ARE NOT PRESENT
GO TO R 31

ALKALINE GASES/AEROSOLS

Chemical cartridges are available which are specifically designed for absorbance of alkaline gases and for the filtration of aerosols. Their sorbent efficiency should be verified before use for the specific gases encountered (see R 13).

IF ALKALINE GASES AND AEROSOLS ARE PRESENT
GO TO R 32

IF ALKALINE GASES AND AEROSOLS ARE NOT PRESENT
GO TO R 35

R 32

CONCENTRATION

The maximum use concentration (MUC) for alkaline gas chemical cartridges is as low as 100 ppm.

IF THE CONCENTRATION CAN EXCEED 100 ppm.
GO TO R 35

IF THE CONCENTRATION CANNOT EXCEED 100 ppm.
SELECT RESPIRATOR 0

CONCENTRATION

The maximum use concentration (MUC) for acid gas chemical cartridges is as low as 10 ppm.

IF THE CONCENTRATION CAN EXCEED 10 ppm.
GO TO R 35

IF THE CONCENTRATION CANNOT EXCEED 10 ppm.
SELECT RESPIRATOR N

CONCENTRATION

The maximum use concentration (MUC) for organic vapor chemical cartridges is 1000 ppm.

IF THE CONCENTRATION CAN EXCEED 1000 ppm.
GO TO 350

IF THE CONCENTRATION CANNOT EXCEED 1000 ppm.
SELECT RESPIRATOR M

CHIN STYLE GAS MASKS

The maximum test concentration of chin style gas masks is 0.5% (5000 ppm). Use at concentrations above this value may dramatically reduce service life and is therefore not recommended [185].

IF THE USE CONCENTRATION IS MORE THAN 5000 ppm

GO TO R 36

IF THE USE CONCENTRATION IS 5000 ppm OR LESS

SELECT RESPIRATOR B

MAXIMUM TEST CONCENTRATION

Gas mask canisters are tested to a maximum concentration of 2% (20,000 ppm) (ammonia 3% (30,000 ppm)) and are expected to give service times of from 6-12 minutes. Since these service times are so short, use of canisters at higher concentrations may reduce service times to unreasonably short periods and is, therefore, not recommended [182].

IF THE CONCENTRATION IS OR IS LESS THAN 2%

GO TO R 42

IF THE CONCENTRATION EXCEEDS 2%

GO TO R 37

R 37

MOBILITY

The prime distinguishing characteristic between a supplied air respirator (SAR) and the self-contained breathing apparatus (SCBA) is the restriction to mobility produced by the trailing air line of the SAR [38].

IF MOBILITY IS REQUIRED

GO TO R 39

IF MOBILITY IS NOT REQUIRED

GO TO R 38

REQUIRED AIRFLOW

Supplied air respirators of Type C pressure demand mode are tested to maintain a facepiece pressure which is not negative at flowrates up to 115 lpm. This corresponds to a minute volume (V_e) of about 40 liters. A V_e in excess of 40 liters can result in a degradation of the protection factor by X100 (from 10,000 to 50) [42].

IF ANTICIPATED V_e IS EQUAL TO OR MORE THAN 40 LITERS OR IS UNKNOWN
GO TO R 39

IF ANTICIPATED V_e IS LESS THAN 40 LITERS

SELECT RESPIRATOR E

REQUIRED AIRFLOW

Self-contained breathing apparatus of the open circuit pressure demand mode are tested to maintain a facepiece pressure which is not negative at flowrates up to 200 lpm. This corresponds to a minute volume (V_e) of about 67 liters. A V_e in excess of 67 liters can result in a degradation of the protection factor by X200 (from 10,000 to 50) [106].

IF ANTICIPATED V_e IS EQUAL TO OR MORE THAN 67 LITERS OR IS UNKNOWN
GO TO F

IF ANTICIPATED V_e IS LESS THAN 67 LITERS

GO TO R 40

R 40

SERVICE LIFE (POSITIVE PRESSURE SCBA)

The maximum rated service life for a current positive pressure self-contained breathing apparatus (SCBA) at a V_e of 40 liters is 2 hours [33].

IF THE REQUIRED SERVICE LIFE AT A V_e OF 40 LITERS IS EQUAL TO OR GREATER THAN 2 HOURS

GO TO F

IF THE REQUIRED SERVICE LIFE AT A V_e OF 40 LITERS IS LESS THAN 2 HOURS

GO TO R 41

SERVICE LIFE (POSITIVE PRESSURE SCBA)

The maximum rated service life for a current open circuit positive pressure self-contained breathing apparatus (SCBA) at a V_e of 40 liters is 1 hour [33].

IF THE REQUIRED SERVICE LIFE AT A V_e OF 40 LITERS IS EQUAL TO OR GREATER THAN 1 HOUR

SELECT RESPIRATOR H

IF THE REQUIRED SERVICE LIFE AT A V_e OF 40 LITERS IS LESS THAN 1 HOUR

SELECT RESPIRATOR I

FRONT EXPOSURE

Full size canister gas masks are made to be front mounted (canister worn on the chest) or back mounted (canister worn on the back). Some repetitive uses of a gas mask, such as drum sampling, barrel crushing, or lab benchwork, may enable the placement of the canister in the position of lower exposure to extend its service life [186].

IF THE EXPOSURE IS PRIMARILY IN THE FRONT

SELECT RESPIRATOR D

IF THE EXPOSURE IS PRIMARILY IN THE BACK OR IF NO DIFFERENCE IN EXPOSURE IS NOTED

SELECT RESPIRATOR C

MOBILITY

The prime distinguishing characteristic between a supplied air respirator (SAR) and the self-contained breathing apparatus (SCBA) is the restriction to mobility produced by the trailing air line of the SAR [38].

IF MOBILITY IS REQUIRED

GO TO R 44

IF MOBILITY IS NOT REQUIRED

GO TO R 39

REQUIRED AIRFLOW

Supplied air respirators of Type C pressure demand mode are tested to maintain a facepiece pressure which is not negative at flowrates up to 115 lpm. This corresponds to a minute volume (V_e) of about 40 liters. A V_e in excess of 40 liters can result in a degradation of the protection factor by X200 (from 10,000 to 50) [42].

IF ANTICIPATED V_e IS EQUAL TO OR MORE THAN 40 LITERS OR IS UNKNOWN
GO TO R 39

IF ANTICIPATED V_e IS LESS THAN 40 LITERS

SELECT RESPIRATOR G

R 45

MOBILITY

The prime distinguishing characteristic between a supplied air respirator (SAR) and the self-contained breathing apparatus (SCBA) is the restriction to mobility produced by the trailing air line of the SAR [38].

IF MOBILITY IS REQUIRED

GO TO R 39

IF MOBILITY IS NOT REQUIRED

GO TO R 46

REQUIRED AIRFLOW

Supplied air respirators of Type C pressure demand mode are tested to maintain a facepiece pressure which is not negative at flowrates up to 115 lpm. This corresponds to a minute volume (V_e) of about 40 liters. A V_e in excess of 40 liters can result in a degradation of the protection factor by X200 (from 10,000 to 50) [42].

IF ANTICIPATED V_e IS EQUAL TO OR MORE THAN 40 LITERS OR IS UNKNOWN
GO TO R 39

IF ANTICIPATED V_e IS LESS THAN 40 LITERS

SELECT RESPIRATOR E

HiEPF
or
PAPHiE*

A

TITLE: HIGH EFFICIENCY DUST, FUME & MIST RESPIRATOR WITH FULL FACEPIECE.

DESCRIPTION: A POWERED OR NON POWERED AEROSOL FILTERING RESPIRATOR WITH REPLACEABLE FILTERS.

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o FILTER 99.97% EFFICIENT AGAINST 0.3 μm DOP
- o PF = 50
- o PROVIDES EYE PROTECTION

STANDARDS: NIOSH 30 CFR Part 11 Subpart K
(TC 21 C XXX)
See 30 CFR 11.130 (d) [187]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

GMScHiE*

B

TITLE: CHIN STYLE GAS MASK WITH GAS/VAPOR CANISTER EQUIPPED WITH A HIGH EFFICIENCY DUST, FUME & MIST FILTER.

DESCRIPTION: A NON POWERED FULL FACEPIECE GAS MASK WITH THE CANISTER DIRECTLY ATTACHED TO THE FACEPIECE.

CANISTER IS SELECTED BASED ON THE GAS OR VAPOR PRESENT.

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o PF = 50
- o MAXIMUM TEST CONCENTRATION = 5000 ppm (0.5% v/v)
- o FILTER 99.97% EFFICIENT AGAINST 0.3 μm DOP
- o PROVIDES EYE PROTECTION

STANDARDS: NIOSH 30 CFR PART 11 SUBPART I
(TC 14G XXX)
SEE 30 CFR 11.90 (a)(3) [188]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

GMScHiE*

C

TITLE: FRONT MOUNTED GAS MASK WITH GAS/VAPOR CANISTER EQUIPPED WITH A HIGH EFFICIENCY DUST, FUME & MIST FILTER.

DESCRIPTION: A NON POWERED FULL FACEPIECE GAS MASK WITH THE CANISTER MOUNTED ON THE WEARER'S CHEST AND ATTACHED TO THE FACEPIECE BY A BREATHING TUBE.

CANISTER IS SELECTED BASED ON THE GAS OR VAPOR PRESENT.

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o PF = 50
- o MAXIMUM TEST CONCENTRATION = 20,000 ppm (2% v/v)(AMMONIA 3% v/v)
- o FILTER 99.97% EFFICIENT AGAINST 0.3 μm DOP
- o PROVIDES EYE PROTECTION

STANDARDS: NIOSH 30 CFR PART 11 SUBPART I
(TC 14G XXX)
SEE 30 CFR 11.90 (a)(1) OR (2) [189]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

D

TITLE: BACK MOUNTED GAS MASK WITH GAS/VAPOR CANISTER EQUIPPED WITH A HIGH EFFICIENCY DUST, FUME & MIST FILTER.

DESCRIPTION: A NON POWERED FULL FACEPIECE GAS MASK WITH THE CANISTER MOUNTED ON THE WEARER'S BACK AND ATTACHED TO THE FACEPIECE BY A BREATHING TUBE.

CANISTER IS SELECTED BASED ON THE SINGLE GAS OR VAPOR PRESENT.

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o PF = 50
- o MAXIMUM TEST CONCENTRATION = 20,000 ppm (2% v/v)(AMMONIA 3% v/v)
- o FILTER 99.97% EFFICIENT AGAINST 0.3 µm DOP
- o PROVIDES EYE PROTECTION

STANDARDS: NIOSH 30 CFR PART 11 SUBPART I
(TC 14G XXX)
SEE 30 CFR 11.90 (a)(1) OR (2) [189]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

E

TITLE: TYPE "C" SUPPLIED AIR RESPIRATOR WITH FULL FACEPIECE OPERATED IN THE PRESSURE DEMAND MODE.

DESCRIPTION: A POSITIVE PRESSURE RESPIRATOR SUPPLIED WITH BREATHING AIR FROM CYLINDER(S) CONNECTED TO THE RESPIRATOR BY NOT MORE THAN 300 FEET OF HOSE.

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o PF = 10,000 (V_e < 40 Liters)
- o 300 FOOT MAXIMUM HOSE LENGTH
- o NO ESCAPE CAPABILITY

STANDARDS: NIOSH 30 CFR PART 11 SUBPART J
(TC 19C XXX)
SEE 30 CFR 11.110(a)(5) [38]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

TITLE: NONE AVAILABLE

DESCRIPTION: NIOSH HAS NOT EVALUATED THESE CHARACTERISTICS IN AVAILABLE RESPIRATORS SINCE THEY EXCEED THE MINIMUM PERFORMANCE LEVELS SET BY 30 CFR PART 11. [190]

PERFORMANCE SHOULD BE VERIFIED BEFORE USE.

ATTRIBUTES:

STANDARDS:

G

TITLE: COMBINATION COMPRESSED AIR OPEN CIRCUIT SELF-CONTAINED BREATHING APPARATUS AND SUPPLIED AIR RESPIRATOR WITH FULL FACEPIECE OPERATING IN THE PRESSURE DEMAND MODE.

DESCRIPTION: SUPPLIED AIR RESPIRATOR WITH AUXILIARY SELF-CONTAINED AIR SUPPLY WHICH CAN BE USED FOR ESCAPE OR EGRESS.

UNITS WITH AN AUXILIARY AIR SUPPLY RATED FOR 15 MINUTES OR LONGER DURATION MAY BE USED FOR EMERGENCY ENTRY IF NOT MORE THAN 20% OF THE RATED CAPACITY IS USED FOR ENTRY.

ATTRIBUTES:
- o FOR LIMITED EMERGENCY USE
- o AUTOMATIC CHANGEOVER REQUIRED
- o PF = 10,000 (Ve < 40 liters SAR; V_e < 67 liters SCBA MODE)
- o UP TO 60' RATED DURATION SCBA

STANDARDS: NIOSH 30 CFR PART 11 SUBPARTS H & J
(TC 13F XXX)
SEE 30 CFR 11.70 (b) [45]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

H

TITLE: **COMPRESSED OXYGEN CLOSED CIRCUIT SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN A POSITIVE PRESSURE MODE**

DESCRIPTION: CLOSED OR PARTIALLY CLOSED CIRCUIT APPARATUS WITH CARBON DIOXIDE SCRUBBER AND OXYGEN SOURCE.

ALARM WARNS OF 20-25% REMAINING OXYGEN SUPPLY.

ATTRIBUTES:
- o **FOR EMERGENCY USE**
- o PF = 10,000 (V_e < 40 liters)
- o 30', 60' & 2 HOUR RATED DURATION UNITS

STANDARDS: NIOSH 30 CFR PART 11 SUBPART H
(TC 13F XXX)
SEE 30 CFR 11.70 (a) (1) [53]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

I

TITLE: COMPRESSED AIR OPEN CIRCUIT SELF-CONTAINED BREATHING APPARATUS WITH FULL FACEPIECE OPERATED IN THE PRESSURE DEMAND MODE

DESCRIPTION: CYLINDER OF COMPRESSED AIR USUALLY CARRIED ON THE WEARERS BACK. FLOW REGULATED ON DEMAND (INHALATION) OF THE WEARER WITH THE FACEPIECE PRESSURE REMAINING ABOVE AMBIENT AT LOW TO MODERATE FLOWS.

ALARM WARNS OF 20-25% REMAINING AIR SUPPLY

ATTRIBUTES:
- o FOR EMERGENCY USE
- o PF = 10,000 (V_e < 67 liters)
- o 30' & 60' RATED DURATION UNITS
- o 2216 psig & 4500 psig RATED CYLINDERS
- o 45 ft^3 to 90 ft^3 CAPACITY

STANDARDS NIOSH 30 CFR PART 11 SUBPART H
(TC 13F XXX)
SEE 30 CFR 11.70 (a) (2) (ii) [191]

* Classification in NIOSH/OSHA Pocket Guide to Chemical Hazards

J

TITLE: FULL FACEPIECE ORGANIC VAPOR CHEMICAL CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ORGANIC VAPOR SORBENT CARTRIDGE(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 1000 ppm

STANDARDS: NIOSH 30 CFR PART 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS

K

TITLE: FULL FACEPIECE ACID GAS CHEMICAL CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ACID GAS SORBENT CARTRIDGE(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 10 ppm.

STANDARDS: NIOSH 30 CFR Part 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS

L

TITLE: FULL FACEPIECE ALKALINE GAS CHEMICAL CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ALKALINE GAS SORBENT CARTRIDGE(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 100 ppm

STANDARDS: NIOSH 30 CFR PART 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS

M

TITLE: FULL FACEPIECE ORGANIC VAPOR/DUST FUME AND MIST CHEMICAL CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ORGANIC VAPOR SORBENT CARTRIDGE(S) AND HIGH EFFICIENCY DUST, FUME AND MIST FILTER(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 1000 ppm

STANDARDS: NIOSH 30 CFR PART 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS

CCRAGFHiEP*

N

TITLE: FULL FACEPIECE ACID GAS/DUST, FUME AND MIST CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ACID GAS SORBENT CARTRIDGE(S) AND HIGH EFFICIENCY DUST, FUME AND MIST FILTER(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 10 ppm

STANDARDS: NIOSH 30 CFR PART 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARDS

o

TITLE: FULL FACEPIECE ALKALINE GAS/DUST, FUME AND MIST CARTRIDGE RESPIRATOR

DESCRIPTION: AIR PURIFYING RESPIRATOR WITH LIMITED SERVICE LIFE ALKALINE GAS SORBENT CARTRIDGE(S) AND HIGH EFFICIENCY DUST, FUME AND MIST FILTER(S)

ATTRIBUTES:
- o NOT FOR EMERGENCY USE
- o NOT FOR ESCAPE FROM IDLH ATMOSPHERE
- o MAXIMUM USE CONCENTRATION 100 ppm

STANDARDS: NIOSH 30 CFR PART 11 SUBPART L
(TC 23 C XXX)
SEE 30 CFR 11.150

* CLASSIFICATION IN NIOSH/OSHA POCKET GUIDE TO CHEMICAL HAZARD

Chemical Protective Clothing (C)

SPECIAL PROBLEMS

There are several special problem areas which may require ancillary equipment to supplement or replace the normal chemical protective clothing. These would include fire, whether structural fire fighting or flammable or combustible liquid fire fighting; the potential blast and fragmentation effects of explosives; and work over water.

IF THE POTENTIAL FOR FIRE OR BLAST OR FRAGMENTATION EXISTS, OR WORK OVER WATER WILL BE CONDUCTED

GO TO C 2

IF THE POTENTIAL FOR FIRE OR BLAST OR FRAGMENTATION DOES NOT EXIST, OR IF WORK OVER WATER IS NOT INVOLVED

GO TO C 12

FIRE

Operations which potentially involve fire or exposure to flame or radiant heat are special cases since chemical protective clothing offers little, if any, resistance to flame or heat.

Consideration should be given to the possible effects of contamination of clothing with flammable or combustible materials. If either condition exists then additional protective clothing may be required.

IF SUBSTANCE IS FLAMMABLE OR INVOLVED IN FIRE

GO TO C 9

IF SUBSTANCE IS NOT FLAMMABLE OR NOT INVOLVED IN FIRE

GO TO C 3

FLOTATION

No chemical protective garment offers adequate and dependable flotation in the event the wearer falls into water. Work over water usually will require a U.S. Coast Guard approved flotation device such as a work vest or life jacket. If such a device is worn, it must be protected from contamination but it normally can only be worn under a fully encapsulating suit. Other users should consider enclosing the device in a plastic bag [69].

IF WORK OVER WATER IS ANTICIPATED

SELECT SPECIAL PROTECTION J
GO TO 12

IF NO WORK OVER WATER IS ANTICIPATED

GO TO C 4

C 4

RADIATION

Ionizing radiation may require specialized protective ensembles.

IF THE EXPOSURE INVALUES IONIZING RADIATION

GO TO C 8

IF THE EXPOSURE DOES NOT INVOLVE IONIZING RADIATION

GO TO C 5

BLAST AND FRAGMENTATION

Protection against blast and fragmentation is not particularly effective. If only very small quantities of a substance are involved (a couple of ounces) or distances are great (more than 10') then protection can be effective. With larger quantities, closer distances or inside or with a nearby reflective surface, the user of the protective equipment will be injured but his injuries may be lessened by the ensemble [71].

IF THE SUBSTANCE MAY DETONATE OR PRODUCE FRAGMENTATION

GO TO C 6

IF THE SUBSTANCE MAY NOT DETONATE OR PRODUCE FRAGMENTATION

GO TO C 12

EXPLOSIVE EFFECTS

Protective equipment for blast and fragmentation effects of explosives is suitable only for quite limited quantities of substance. More than a couple of ounces of explosive may be sufficient to cause severe or even lethal injuries despite the use of protective equipment. As a rule of thumb, any quantity of explosives greater than 1/4# TNT equivalent should require reevaluation of the mission which makes PPE a necessity (i.e. Don't do it!) [71].

IF EXPLOSIVE IS LESS THAT 4 oz. TNT_e

SELECT SPECIAL PROTECTION I
GO TO C 12

IF EXPLOSIVE IS 4 oz. OR MORE TNT_e

GO TO C 7

DISTANCE TO EXPLOSIVES

With the limitations on quantity of explosive to 1/4#, consideration should then be given to the distance of the explosive to the wearer of the PPE. Distances greater than 10 feet are recommended, or 20 feet if the wearer and explosive are indoors or the wearer is interposed between the explosive and a reflective surface such as a wall [71].

IF THE DISTANCE TO THE EXPLOSIVE IS EQUAL TO OR GREATER THAN 10 FEET UNREFLECTED OR EQUAL TO OR GREATER THAN 20 FEET REFLECTED

SELECT SPECIAL PROTECTION I
GO TO C 12

IF THE DISTANCE TO THE EXPLOSIVE IS LESS THAN 10 FEET UNREFLECTED OR LESS THAN 20 FEET REFLECTED

SEE NOTE K
GO TO C 12

IONIZING RADIATION AND CONTAMINATION PROTECTION ONLY

If the substance involved is radioactive then two different problems exist. One, protection against the direct effects of the ionizing radiation (shielding) cannot usually be provided by protective clothing. Secondly, protection against contamination can usually be provided by the appropriate selection of a material for protection against the non radioactive form of the substance.

If protection from a radioactive substance is directed solely to avoiding body contamination then use of appropriate chemical protective clothing will suffice.

If protection is required against the direct effects of ionizing radiation (shielding) or against tritium (3H) then consultation with a knowledgeable health physicist is recommended before selection [73].

IF ONLY CONTAMINATION PROTECTION IS REQUIRED

GO TO C 12

IF PROTECTION AGAINST IONIZING RADIATION OR AGAINST TRITIUM (3H) IS REQUIRED

SEE NOTE L
GO TO C 12

STRUCTURAL FIRE FIGHTING

Chemical protective clothing is not suitable for operations involving structural type fire fighting. Conversely, fire fighters turnout gear offers little chemical protection. Limited exposures of one hazard to the inappropriate equipment can be tolerated for short periods but any operation which envisions both heavy chemical exposure and significant fire fighting exposure must be redefined [62].

IF INVOLVED IN STRUCTURAL FIRE FIGHTING

SELECT CLOTHING F
GO TO C 12

IF NOT INVOLVED IN STRUCTURAL FIRE FIGHTING

GO TO C 10

RADIANT HEAT

Chemical protective clothing (CPC) offers little protection from radiant heating. Such protection, in the form of proximity (fire) suits are available to wear over the CPC and can provide good protection, up to 90% reflectance, for a limited time period. They do not offer protection for fire or flame entry. In many instances, use of protective water sprays may be necessary to allow approach to a fire [64].

IF EXPOSED TO RADIANT HEAT

SELECT CLOTHING G
GO TO C 12

IF NOT EXPOSED TO RADIANT HEAT

GO TO C 11

FLASH FIRE

Users of chemical protective clothing (CPC) who may be exposed to a flash fire may be required to wear flame or fire retardant coveralls (such as Nomex (TM)) under the CPC. If the CPC is combustible or becomes contaminated with a flammable or combustible material, then exposure to a flash fire situation should be avoided [64].

IF POTENTIAL FOR EXPOSURE TO FLASH FIRE EXISTS

SELECT CLOTHING H
GO TO C 12

IF NO POTENTIAL FOR FLASH FIRE EXISTS

GO TO C 12

SUBSTANCE IDENTIFICATION

Substance identification is one of the most important factors in selection of personal protection equipment. Chemical resistance (permeation and degradation), fastener and material leakage and the necessity for precautions against fire and explosion are all substance dependent. If a positive identification can be made then specific protective materials may usually be selected. In the absence of positive identification, classification by chemical properties may be attempted. If classification is impractical, then an arbitrary selection is made and the presence of specific substances or classes of substances for which this choice is inappropriate must be ruled out.

IF THE SUBSTANCE CAN BE IDENTIFIED

GO TO C 13

IF THE SUBSTANCE CANNOT BE IDENTIFIED

GO TO C 22

C 13

KNOWN PERMEATION CHARACTERISTICS

The permeation of a substance through a suit material is a major factor in the protection the suit will provide from the substance. If this information is known, then it may be applied to the field situation. If the permeation data is not known, then recourse to classification or to preselection must be made. Permeation may occur even in the absence of degradation so both factors must be considered [192].

IF THE PERMEATION RATE AND BREAKTHROUGH TIME ARE KNOWN

GO TO C 14

IF THE PERMEATION RATE AND BREAKTHROUGH TIME ARE UNKNOWN

GO TO C 22

PERMEATION DATA

The permeation data should be specific as to test conditions and results. General guidelines such as good, fair or poor are not that helpful but they may be used if nothing else is available. The dose permeating the suit is proportional to the time duration of exposure (MD - BT), the permeation rate (PR), and the exposed surface area (BSA) [90].

Permeation Dose = (MD - BT) (PR) (BSA)

where: MD = mission duration; PR = permeation rate

BT = breakthrough time; BSA = suit surface area.

IF THE PERMEATION DOSE IS LESS THAN THE TOXIC DOSE

GO TO C 15

IF THE PERMEATION DOSE IS EITHER EQUAL TO OR GREATER THAN THE TOXIC DOSE OR IS UNKNOWN

GO TO C 13

C 15

KNOWN DEGRADATION CHARACTERISTICS

If degradation is known to occur with a specific substance or group of substances, then it's a relative contra-indication to the use of the suit material.

Swelling, weight gain, change in physical properties or cracking are all indications of unacceptable degradation [193].

IF DEGRADATION DATA IS KNOWN

GO TO C 16

IF DEGRADATION DATA IS UNKNOWN

GO TO C 13

DEGRADATION DATA

If degradation does not occur during the anticipated mission duration then the suit material is acceptable. If degradation does occur then mission duration or exposure should be modified to prevent degradation. Reuse of a suit suggests that no degradation or weight gain is acceptable. Single use suits may have to be evaluated in terms of acceptable degradation without unacceptable employee exposure.

Relative rankings of good, fair, poor, etc. are of limited use [193].

IF DEGRADED BY SUBSTANCE — GO TO C 13

IF NOT DEGRADED BY SUBSTANCE — GO TO C 17

C 17

AIRBORNE

Airborne substances include those generated by operations which due to particle size have very rapid settling times. This is to allow for protection against large particles which may penetrate suit openings from sprays, splashes, or "dust" clouds.

IF THE SUBSTANCE IS AIRBORNE

GO TO C 18

IF THE SUBSTANCE IS NOT AIRBORNE

GO TO C 20

SKIN EFFECTS

Skin effects include not only acute irritation but chronic effects and the hazards associated with skin contamination and subsequent ingestion or inhalation. Permissible skin exposure data are not available so that prevention of any exposure may be the goal of skin protection [194].

IF THE SUBSTANCE HAS SKIN EFFECTS OR IS UNKNOWN

SELECT CLOTHING M

IF THE SUBSTANCE HAS NO SKIN EFFECTS

GO TO C 19

C 19

PHYSICAL STATE

The physical state of the substance is of importance in determining the infiltration rate or ease of infiltration through fasteners or interfaces of personal protective equipment. Additionally, the need for and extent of decontamination must be considered.

IF THE SUBSTANCE IS A GAS OR VAPOR

SELECT CLOTHING D

IF THE SUBSTANCE IS AN AEROSOL

SELECT CLOTHING C

C 20

PHYSICAL STATE

The physical state of the substance is of importance in determining the infiltration rate or ease of infiltration through fasteners or interfaces of personal protective equipment. Additionally the need for and extent of decontamination must be considered.

IF THE SUBSTANCE IS A LIQUID

SELECT CLOTHING C 21

IF THE SUBSTANCE IS A SOLID

SELECT CLOTHING C

C 21

SKIN

Skin effects include not only acute irritation but chronic effects and the hazards associated with skin contamination, skin absorption and subsequent ingestion or inhalation. Permissible skin exposure data are not usually available so that prevention of any exposure may be the goal of skin protection [194].

IF THE SUBSTANCE HAS SKIN EFFECTS OR IF IT IS UNKNOWN

SELECT CLOTHING E

IF THE SUBSTANCE HAS NO SKIN EFFECTS

SELECT CLOTHING C

SUBSTANCE CLASSIFICATION

If the substance cannot be identified but chemical classification is possible, then use of a look up table based upon the recommendations of manufacturers can be used for a tentative material selection [90].

IF SUBSTANCE CAN BE CLASSIFIED

GO TO C 23

IF SUBSTANCE CANNOT BE CLASSIFIED

GO TO C 25

C 23

PERMEATION

Permeation data listed by a class of substances may be used to determine the acceptability of protection afforded by a suit material. Ranking (1 of 6) or relative rankings (excellent) may imply maximal protection. Your judgement must be used to determine if the consequences of exposure due to suit permeation are acceptable in light of the mission goals to be obtained.

IF THE PERMEATION ACCEPTABLE

GO TO C 24

IF THE PERMEATION IS NOT ACCEPTABLE

GO TO C 22

DEGRADATION

Degradation data listed by a class of substances may be used to determine the acceptability of protection afforded by a suit material. Ranking (1 of 6) or relative rankings (excellent) may imply maximal protection. Your judgement must be used to determine if the consequences of exposure due to suit degradation are acceptable in light of the mission goals to be obtained.

IF THE DEGRADATION IS ACCEPTABLE

GO TO C 17

IF THE DEGRADATION IS NOT ACCEPTABLE

GO TO C 22

DETECTOR TUBE "RULE-OUT" GUIDE

If classification cannot be made, detector tubes (or other similar methods) may be used to "rule-out" the use of certain materials used in chemical protective clothing [195].

IF YOU USE DETECTOR TUBES OR A SIMILAR METHOD

GO TO C 26

IF YOU DO NOT USE "RULE-OUT"

SELECT CLOTHING A

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
NITROUS FUMES	64-24001	REDDISH-BROWN	2
		NONE	4

GO TO C 27

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
EPICHLORHDORIN	67-28111	PALE YELLOWISH-ORANGE	2
		NONE	4

GO TO C 28

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
FORMIC ACID	67-22701	YELLOW	1
		NONE	4

GO TO C 29

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. the following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
METHYL BROMIDE	67-28211	BROWN	1
		NONE	4

GO TO C 30

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
ETHYL ACETATE	CH 20201	PALE GREEN	GO TO 32
		BROWNISH-GREEN	GO TO 31
		NONE	4 GO TO C 33

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
HYDROCARBON	CH 25401	YELLOW	4
		BROWN-REDDISH BROWN	1
		NONE	4

GO TO C 33

Detector tubes may be used to rule out the use of certain materials used in chemical protective clothing. The following suggestion uses a Draeger detector tube. Use of other manufacturer's tubes has not been evaluated [17].

TUBE	PART NO.	REACTION	RESULTS CODE
ACETONE	CH 22901	YELLOW	2
		NONE	4

RESULTS CODE

Circle every number which is a result of testing. Select clothing indicated by intersection of rows and columns. Where more than one letter is indicated, select clothing N.

	1	2	4
1	B	N	B
2	N	A	A
4	B	A	A, or B or M

TITLE: FULLY ENCAPSULATING SUIT OF BUTYL RUBBER IN "A" CONFIGURATION

DESCRIPTION: ONE PIECE GARMENT FULLY COVERING HEAD, TORSO, AND EXTREMITIES. USED WITH SCBA WHICH IS WORN UNDERNEATH THE SUIT ("A" CONFIGURATION). MAY HAVE INTEGRAL BOOTS AND/OR GLOVES. HELMET, IF REQUIRED, IS ADDITIONAL IN MOST SUITS. BOOT COVERS USUALLY USED.

ATTRIBUTES:
- o FULLY ENCAPSULATING
- o "GAS TIGHT"

STANDARDS:
PERMEATION: ASTM F739-81 [196]
SWELLING AND SOLUBILITY: ASTM D471-79 [197]
STRENGTH DEGRADATION: ASTM D543-67(1978) [198]
BOOT TOE CAP: ANSI Z41-1981 [91]
HELMET: ANSI Z89.1-1981 [114]

DISCUSSION: SEE SECTION R40 IF USE OF A CLOSED CIRCUIT SCBA IS REQUIRED WITH THIS SUIT.

TITLE: FULLY ENCAPSULATING SUIT OF VITON IN "A" CONFIGURATION

DESCRIPTION: ONE PIECE GARMENT FULLY COVERING HEAD, TORSO, AND EXTREMITIES. USED WITH SCBA WHICH IS WORN UNDERNEATH THE SUIT ("A" CONFIGURATION). MAY HAVE INTEGRAL BOOTS AND/OR GLOVES. HELMET, IF REQUIRED, IS ADDITIONAL IN MOST SUITS. BOOT COVERS USUALLY USED.

ATTRIBUTES:
- o FULLY ENCAPSULATING
- o "GAS TIGHT"

STANDARDS:
PERMEATION: ASTM F739-81 [196]
SWELLING AND SOLUBILITY: ASTM D471-79 [197]
STRENGTH DEGRADATION: ASTM D543-67(1978) [198]
BOOT TOE CAP: ANSI Z41-1981 [91]
HELMET: ANSI Z89.1-1981 [114]

DISCUSSION: SEE SECTION R40 IF USE OF A CLOSED CIRCUIT SCBA IS REQUIRED WITH THIS SUIT.

TITLE: "DISPOSABLE" COVERALLS OF NONWOVEN FABRIC. MAY BE COATED WITH PLASTIC

DESCRIPTION: ONE PIECE GARMENT FULLY COVERING TORSO AND EXTREMITIES. USED WITH ANY APPROPRIATE RESPIRATOR, BOOTS, BOOT COVERS, AND GLOVES. HELMET AND/OR HOOD MAY BE REQUIRED AS ADDITIONAL ITEMS.

ATTRIBUTES:
- o DISPOSABLE
- o LIMITED DUST AND/OR LIQUID TIGHTNESS

STANDARDS:
PERMEATION: ASTM F739-81 [196]
SWELLING AND SOLUBILITY: ASTM D471-79 [197]
STRENGTH DEGRADATION: ASTM D543-67(1978) [198]
BOOT TOE CAP: ANSI Z41-1981 [91]
HELMET: ANSI Z89.1-1981 [114]

TITLE: NONENCAPSULATING SUIT. USUALLY OF PLASTIC IMPREGNATED CLOTH, RUBBER, OR SOLID PLASTIC SHEET

DESCRIPTION: USUALLY TWO PIECE GARMENT FULLY COVERING HEAD, TORSO, AND EXTREMITIES. CONSISTS OF JACKET WITH HOOD AND BIB PANTS. USED WITH ANY APPROPRIATE RESPIRATOR, BOOTS, BOOT COVERS, AND GLOVES. HELMET MAY BE REQUIRED AS ADDITIONAL ITEM. GLOVES AND BOOTS TAPED.

ATTRIBUTES:
- o DUST AND LIQUID TIGHT

STANDARDS: NONE

TITLE: SPLASH SUIT. USUALLY OF PLASTIC IMPREGNATED CLOTH OR PLASTIC.

DESCRIPTION: USUALLY TWO PIECE GARMENT COVERING TORSO AND EXTREMITIES. CONSISTS OF JACKET AND PANTS. USED WITH ANY APPROPRIATE RESPIRATOR, BOOTS, BOOT COVERS AND GLOVES. HELMET, HOOD APRON, GLOVED APRON, OR GLOVED SLEEVES MAY BE USED.

ATTRIBUTES: o LIQUID RESISTANT

STANDARDS: NONE

TITLE: FIRE FIGHTER'S TURNOUT GEAR, USUALLY OF HIGH TEMPERATURE RESISTANT NYLON

DESCRIPTION: TWO PIECE GARMENT CONSISTING OF PANTS AND COAT, USED WITH HOOD, HELMET, GLOVES, BOOTS, AND SCBA

ATTRIBUTES:
- o LIMITED HEAT RESISTANCE
- o VERY LIMITED CHEMICAL RESISTANCE
- o USED PRIMARILY FOR STRUCTURAL TYPE FIRE FIGHTING

STANDARDS:
COAT AND PANTS: NFPA 1971-1981 [62]
HELMET: NFPA 1972-1985 [61]
GLOVES: NFPA 1973-1983 [199]
BOOT TOE CAP: ANSI Z41-1981 [91]

TITLE: PROXIMITY SUIT (FIRE). ALUMINIZED HIGH TEMPERATURE RESISTANT NYLON OR RAYON.

DESCRIPTION: ONE, TWO, OR THREE PIECE GARMENT CONSISTING OF COAT, PANTS, AND HOOD OF ALUMINIZED (REFLECTIVE) MATERIAL. ALUMINIZED GLOVES AND BOOT COVERS MAY BE PROVIDED. USED WITH SCBA.

ATTRIBUTES:
- o VERY LIMITED CHEMICAL RESISTANCE
- o LIMITED HEAT RESISTANCE
- o UP TO 90% REFLECTIVITY
- o ASBESTOS UNACCEPTABLE

STANDARDS: NONE COMMERCIAL
COAT: MIL-C-29145A [200]
PANTS: MIL-T-29146A [201]
GLOVES MIL-C-87077 [202]
HOOD MIL-H-29144A [203]

TITLE: FLAME/FIRE RETARDANT COVERALLS

DESCRIPTION: COVERALLS WORN AS AN UNDERGARMENT WHERE FLASH FIRES MAY OCCUR.

ATTRIBUTES: o FLAME/FIRE RETARDANT

STANDARDS: NONE COMMERCIAL

DISCUSSION: NOMEX WILL BURN WITH SLIGHT OXYGEN ENRICHMENT SUCH AS MIGHT OCCUR WITH A CLOSED CIRCUIT SCBA AND AN "A" CONFIGURATION FULLY ENCAPSULATING SUIT.

TITLE: BLAST/FRAGMENTATION SUIT

DESCRIPTION: HEAD AND TORSO PROTECTION WORN WITH OTHER PROTECTIVE CLOTHING. HEARING PROTECTION (PREFERABLY MUFF TYPE) MUST BE WORN.

ATTRIBUTES:
- o LIMITED BLAST AND FRAGMENTATION ATTENUATION AND MITIGATION
- o PERSONAL INJURY WILL PROBABLY OCCUR IN THE EVENT OF AN EXPLOSION.

STANDARDS: NONE COMMERCIAL

TITLE: FLOATATION GEAR

DESCRIPTION: LIFE JACKETS OR WORK VESTS OF UNICELLULAR PLASTIC FOAM, FIBERGLASS, KAPOK, OR SIMILAR APPROVED MATERIAL.

ATTRIBUTES: o PROVIDE w17 1/2 TO 25# FLOATATION.

STANDARDS: WORK VEST, LIFE JACKET: USCG 46 CFR Part 160 [69]
(VARIOUS TYPES ARE AVAILABLE)

TITLE: NONE AVAILABLE

DESCRIPTION: NO PROTECTIVE EQUIPMENT MEETING THESE PERFORMANCE CRITERIA ARE KNOWN.

TITLE: REQUIRE HEALTH PHYSICS CONSULTATION

DESCRIPTION: RUBBER PROTECTIVE APRON AND GLOVES ARE AVAILABLE WITH DIFFERING ATTENUATIONS FOR IONIZING RADIATION. THIS ATTENUATION IS USUALLY GIVEN AS A LEAD EQUIVALENT IN mm. AND WOULD PROVIDE THE SAME PROTECTION AS THE STATED THICKNESS OF LEAD. THEIR SELECTION AND USE REQUIRES SPECIALIZED CALCULATION WHICH CAN BEST BE PERFORMED BY A HEALTH PHYSICIST.

TITLE: FULLY ENCAPSULATING SUIT IN "A" CONFIGURATION

DESCRIPTION: ONE PIECE GARMENT FULLY COVERING HEAD, TORSO, AND EXTREMITIES. USED WITH SCBA WHICH IS WORN UNDERNEATH THE SUIT ("A" CONFIGURATION). MAY HAVE INTEGRAL BOOTS AND/OR GLOVES. HELMET, IF REQUIRED, IS ADDITIONAL IN MOST SUITS. BOOT COVERS USUALLY USED. MATERIAL SHOULD BE SELECTED BASED UPON THE PERMEATION AND DEGRADATION DATA OBTAINED FOR THIS MATERIAL/CHEMICAL COMBINATION. YOU CAN USE EITHER VITON OR BUTYL.

ATTRIBUTES:
- o FULLY ENCAPSULATING
- o "GAS TIGHT"

STANDARDS:
PERMEATION: ASTM F739-81 [196]
SWELLING AND SOLUBILITY: ASTM D471-79 [197]
STRENGTH DEGRADATION: ASTM D543-67(1978) [198]
BOOT TOE CAP: ANSI Z41-1981 [91]
HELMET: ANSI Z89.1-1981 [114]

TITLE: FULLY ENCAPSULATING SUIT IN "A" CONFIGURATION

DESCRIPTION: ONE PIECE GARMENT FULLY COVERING HEAD, TORSO, AND EXTREMITIES. USED WITH SCBA WHICH IS WORN UNDERNEATH THE SUIT ("A" CONFIGURATION). MAY HAVE INTEGRAL BOOTS AND/OR GLOVES. HELMET, IF REQUIRED, IS ADDITIONAL IN MOST SUITS. BOOT COVERS USUALLY USED. MATERIAL SHOULD BE SELECTED BASED UPON THE PERMEATION AND DEGRADATION DATA OBTAINED FOR THIS MATERIAL/CHEMICAL COMBINATION.

SINCE SUBSTANCES TO WHICH THE SUIT IS EXPOSED PERMEATE BOTH VITON AND BUTYL COMPOSITE, BUTYL OVER VITON SUITS WITH AN OVERGARMENT MAY BE REQUIRED. EXPOSURE MUST BE MAINTAINED AT A MINIMUM!

ATTRIBUTES:
- o FULLY ENCAPSULATING
- o "GAS TIGHT"

STANDARDS:
PERMEATION: ASTM F739-81 [196]
SWELLING AND SOLUBILITY: ASTM D471-79 [197]
STRENGTH DEGRADATION: ASTM D543-67(1978) [198]
BOOT TOE CAP: ANSI Z41-1981 [91]
HELMET: ANSI Z89.1-1981 [114]