# NEW JERSEY HAZMAT EMERGENCY RESPONSE COURSE

**STUDENT GUIDE** **COURSE NUMBER: 06077**

## Hospital Operations Level 2

**Hazmat/WMD**

***PRESENTED THROUGH:***

**NEW JERSEY STATE POLICE-HOMELAND SECURITY BRANCH**
**SPECIAL OPERATIONS SECTION, TECHNCIAL RESPONSE BUREAU**
**HAZARDOUS MATERIALS RESPONSE UNIT (HMRU)**

0403 rev 0505

# FOREWORD



**Although the information set forth in this program is presented in good faith and believed to be correct, persons or agencies using this information must make their own determination as to its suitability for their purposes. In no event are the participating organizations and the developing Technical committee responsible for damages of any nature resulting from the use of this information.**

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# GEOGRAPHIC IDENTIFICATION CODE SCHEME

Incorporated Areas of New Jersey

Arranged Alphabetically by County and Municipality

All codes listed in this Manual will be four (4) digit codes

The first two (2) digits being the County Code, the second (2) being the Municipality Code

EXAMPLES:

Counties:

01—Atlantic County
02—Bergen County
03—Burlington County

Municipalities:

01—Absecon City
02—Atlantic City City
03—Brigantine City

Complete Code

0101—Atlantic County, Absecon City
0201—Bergen County, Allendale Borough
0301—Burlington County, Bass River Township

**ATLANTIC COUNTY—01**

0101 Absecon City
0102 Atlantic City
0103 Brigantine City
0104 Buena Borough
0105 Buena Vista Twsp.
0106 Corbin City
0107 Egg Harbor City
0108 Egg Harbor Twsp.
0109 Estell Manor City
0110 Folsom Borough
0111 Galloway Twsp.
0112 Hamilton Twsp.
0113 Hammonton Town
0114 Linwood City
0115 Longport Borough
0116 Margate City
0117 Mullica Twsp.
0118 Morthfield City
0119 Pleasantville City
0120 Port Republic City
0121 Somers Point City
0122 Ventnor City
0123 Weymouth Twsp.

**BERGEN COUNTY—02**

0201 Allendale Borough
0202 Alpine Borough
0203 Bergenfield Borough
0204 Bogota Borough
0205 Carlstadt Borough
0206 Cliffside Park Borough
0207 Closter Borough
0208 Cresskill Borough
0209 Demarest Borough
0210 Dumont Borough
0211 Elmwood Park Borough
0212 East Rutherford Borough
0213 Edgewater Borough
0214 Emerson Borough
0215 Englewood City
0216 Englewood Cliffs Borough
0217 Fair Lawn Borough
0218 Fairview Borough
0219 Fort Lee Borough
0220 Franklin Lakes Borough
0221 Garfield City
0222 Glen Rock Borough
0223 Hackensack City
0224 Harrington Park Borough
0225 Hasbrouck Heights Borough
0226 Haworth Borough
0227 Hillsdale Borough
0228 Hohokus Borough
0229 Leonia Borough
0230 Little Ferry Borough
0231 Lodi Borough
0232 Lyndhurst Twsp.
0233 Mahwah Twsp.
0234 Maywood Borough
0235 Midland Park Borough
0236 Montvale Borough
0237 Moonachie Borough
0238 New Milford Borough
0239 North Arlington Borough
0240 Northvale Borough
0241 Norwood Borough
0242 Oakland Borough
0243 Old Tappan Borough
0244 Oradell Borough
0245 Palisades Park Borough
0246 Paramus Borough
0247 Park Ridge Borough
0248 Ramsey Borough
0249 Ridgefield Borough
0250 Ridgefield Park Village
0251 Ridgewood Village
0252 River Edge Borough
0253 River Vale Twsp.
0254 Rochelle Park Twsp.
0255 Rockleigh Borough
0256 Rutherford Borough
0257 Saddle Brook Twsp.
0258 Saddle River Borough
0259 South Hackensack Twsp.
0260 Teaneck Twsp.
0261 Tenafly Borough
0262 Teterboro Borough
0263 Upper Saddle River Borough
0264 Waldwick Borough
0265 Wallington Borough
0266 Washington Twsp.
0267 Westwood Borough
0268 Woodcliff Lake Borough
0269 Wood-Ridge Borough
0270 Wyckoff Twsp.

**BURLINGTON COUNTY—03**

0301 Bass River Twsp.
0302 Beverly City
0303 Bordentown City
0304 Bordentown Twsp.

0305 Burlington City
0306 Burlington Twsp.
0307 Chesterfield Twsp.
0308 Cinnaminson Twsp.
0309 Delanco Twsp.
0310 Delran Twsp.
0311 Eastampton Twsp.
0312 Edgewater Park Twsp
0313 Evesham Twsp.
0314 Fieldsboro Borough
0315 Florence Twsp.
0316 Hainesport Twsp.
0318 Lumberton Twsp.
0319 Mansfield Twsp.
0320 Maple Shade Twsp
0321 Medford Twsp.
0322 Medford Lakes Borough
0323 Moorestown Twsp.
0324 Mount Holly Twsp.
0325 Mount Laurel Twsp.
0326 New Hanover Twsp
0327 North Hanover Twsp.
0328 Palmyra Borough
0329 Pemberton Borough
0330 Pemberton Twsp.
0331 Riverside Twsp.
0332 Riverton Borough
0333 Shamong Twsp.
0334 Southampton Twsp
0335 Springfield Twsp.
0336 Tabernacle Twsp.
0337 Washington Twsp.
0338 Westampton Twsp.
0317 Willingboro Twsp
0339 Woodland Twsp.
0340 Wrightstown Borough

**CAMDEN COUNTY—04**

0401 Audubon Borough
0402 Audubon Park Borough
0403 Barrington Borough
0404 Bellmawr Borough
0405 Berlin Borough
0406 Berlin Twsp.
0407 Brooklawn Borough
0408 Camden City
0412 Cherry Hill Twsp.
0409 Chesilhurst Borough
0410 Clementon Borough
0411 Collingswood Borough
0413 Gibbsboro Borough
0414 Gloucester City
0415 Gloucester Twsp.
0416 Haddon Twsp.
0417 Haddonfield Borough
0418 Haddon Heights Borough
0419 Hi-Nella Borough
0420 Laurel Springs Borough
0421 Lawnside Borough
0422 Lindenwold Borough
0423 Magnolia Borough
0424 Merchantville Borough
0425 Mount Ephraim Borough
0426 Oaklyn Borough
0427 Pennsauken Twsp.
0428 Pine Hill Borough
0429 Pine Valley Borough
0430 Runnemede Borough
0431 Somerdale Borough
0432 Stratford Borough
0433 Tavistock Borough
0434 Voorhees Twsp.
0435 Waterford Twsp.
0436 Winslow Twsp.
0437 Wood-Lynne Borough

**CAPE MAY COUNTY—06**

0501 Avalon Borough
0502 Cape May City
0503 Cape May Point Borough
0504 Dennis Twsp.
0505 Lower Twsp.
0506 Middle Twsp.
0507 North Wildwood City
0508 Ocean City
0509 Sea Isle City
0510 Stone Harbor Borough
0511 Upper Twsp.
0512 West Cape May Borough
0513 West Wildwood Borough
0514 Wildwood City
0515 Wildwood Crest Borough
0516 Woodbine Borough

**CUMBERLAND COUNTY—06**

0601 Bridgeton City
0602 Commercial Twsp.
0603 Deerfield Twsp.
0604 Downe Twsp.
0605 Fairfield Twsp.
0606 Greenwich Twsp.
0607 Hopewell Twsp.
0608 Lawrence Twsp.
0609 Maurice River Twsp
0610 Millville City
0611 Shiloh Borough
0612 Stow Creek Twsp.
0613 Upper Deerfield Twsp.
0614 Vineland City

**ESSEX COUNTY—07**

0701 Belleville Town
0702 Bloomfield Town
0703 Caldwell Borough
0705 Cedar Grove Twsp.
0706 East Orange City
0707 Essex Fells Borough
0704 Fairfield Borough
0708 Glen Ridge Borough
0709 Irvington Town
0710 Livingston Twsp.
0711 Maplewood Twsp.
0712 Millburn Twsp
0713 Montclair Town
0714 Newark City
0715 North Caldwell Borough
0716 Nutley Town
0717 Orange City
0718 Roseland Borough
0719 South Orange Village
0720 Verona Borough
0721 West Caldwell Borough
0722 West Orange Town

**GLOUCESTER COUNTY—08**

0801 Clayton Borough
0802 Deptford Twsp.
0803 East Greenwich Twsp.
0804 Elk Twsp.
0805 Franklin Twsp.
0806 Glassboro Borough
0807 Greenwich Twsp.
0808 Harrison Twsp
0809 Logan Twsp
0810 Mantua Twsp.
0811 Monroe Twsp.
0812 National Park Borough
0813 Newfield Borough
0814 Paulsboro Borough
0815 Pitman Borough
0816 South Harrison Twsp.
0817 Swedesboro Borough
0818 Washington Twsp.
0819 Wenonah Borough
0820 West Deptford Twsp.
0821 Westville Borough
0822 Woodbury City
0823 Woodbury Heights Borough
0824 Woolwich Twsp.

**HUDSON COUNTY—09**

0901 Bayonne City
0902 East Newark Borough
0903 Guttenberg Town
0904 Harrison Town
0905 Hoboken City
0906 Jersey City City
0907 Kearny Town
0908 North Bergen Twsp.
0909 Secaucus Town
0910 Union City
0911 Weehawken Twsp.
0912 West New York Town

**HUNTERDON COUNTY—10**

1001 Alexandria Twsp.
1002 Bethlehem Twsp.
1003 Bloomsbury Borough
1004 Califon Borough
1005 Clinton Town
1006 Clinton Twsp.
1007 Delaware Twsp.
1008 East Amwell Twsp.
1009 Flemington Borough
1010 Franklin Twsp.
1011 Frenchtown Borough
1012 Glen Gardner Borough
1013 Hampton Borough
1014 High Bridge Borough
1015 Holland Twsp.
1016 Kingwood Twsp.
1017 Lambertville City
1018 Lebanon Borough
1019 Lebanon Twsp.
1020 Milford Borough
1021 Raritan Twsp.
1022 Readington Twsp.
1023 Stockton Borough
1024 Tewksbury Twsp.
1025 Union Twsp.
1026 West Amwell Twsp.

**MERCER COUNTY—11**

1101 East Windsor Twsp.
1102 Ewing Twsp.
1103 Hamilton Twsp.
1104 Hightstown Borough
1105 Hopewell Borough
1106 Hopewell Twsp.

1107 Lawrence Twsp.
1108 Pennington Borough
1109 Princeton Borough
1110 Princeton Twsp.
1111 Trenton City
1112 Washington Twsp.
1113 West Windsor Twsp.

**MIDDLESEX COUNTY—12**

1201 Carteret Borough
1202 Cranbury Twsp.
1203 Dunellen Borough
1204 East Brunswick Twsp.
1205 Edison Twsp.
1206 Helmetta Borough
1207 Highland Park Borough
1208 Jamesburg Borough
1210 Metuchen Borough
1211 Middlesex Borough
1212 Milltown Borough
1213 Monroe Twsp.
1214 New Brunswick City
1215 North Brunswick Twsp.
1209 Old Bridge Twsp.
1216 Perth Amboy City
1217 Piscataway Twsp.
1218 Plainsboro Twsp.
1219 Sayreville Borough
1220 South Amboy City
1221 South Brunswick Twsp.
1222 South Plainfield Borough
1223 South River Borough
1224 Spotswood Borough
1225 Woodbridge Twsp.

**MONMOUTH COUNTY—13**

1330 Aberdeen Twsp.
1301 Allenhurst Borough
1302 Allentown Borough
1303 Asbury Park City
1305 Atlantic Highlands Borough
1306 Avon-By-The-Sea Borough
1307 Belmar Borough
1308 Bradley Beach Borough
1309 Brielle Borough
1304 Colts Neck Twsp.
1310 Deal Borough
1311 Eatontown Borough
1312 Englishtown Borough
1313 Fair Haven Borough
1314 Farmingdale Borough
1315 Freehold Borough
1316 Freehold Twsp.
1339 Hazlet Twsp.
1317 Highlands Borough
1318 Holmdel Twsp.
1319 Howell Twsp.
1320 Interlaken Borough
1321 Keansburg Borough
1322 Keyport Borough
1323 Little Silver Borough
1324 Loch Arbour Village
1325 Long Branch City
1326 Manalapan Twsp.
1327 Manasquan Borough
1328 Marlboro Twsp.
1329 Matawan Borough
1331 Middletown Twsp.
1332 Millstone Twsp.
1303 Monmouth Beach Borough
1334 Neptune Twsp.
1335 Neptune City Borough
1337 Ocean Twsp.
1338 Oceanport Borough
1340 Red Bank Borough
1341 Roosevelt Borough
1342 Rumson Borough
1343 Sea Bright Borough
1344 Sea Girt Borough
1345 Shewsbury Borough
1346 Shewsbury Twsp.
1347 South Belmar Borough
1348 Spring Lake Borough
1349 Spring Lake Heights Borough
1336 Tinton Falls Borough
1350 Union Beach Borough
1351 Upper Freehold Twsp.
1352 Wall Twsp.
1353 West Long Branch Borough

**MORRIS COUNTY—14**

1401 Boonton Town
1402 Boonton Twsp.
1403 Butler Borough
1404 Chatham Borough
1405 Chatham Twsp.
1406 Chester Borough
1407 Chester Twsp.
1408 Denville Twsp.
1409 Dover Town
1410 East Hanover Twsp.
1411 Florham Park Borough
1412 Hanover Twsp.
1413 Harding Twsp.
1414 Jefferson Twsp.
1415 Kinnelon Borough
1416 Lincoln Park Borough
1417 Madison Borough
1418 Mendham Borough
1419 Mendham Twsp.
1420 Mine Hill Twsp.
1421 Montville Twsp.
1422 Morris Twsp.
1423 Morris Plains Borough
1424 Morristown Town
1425 Mountain Lakes Borough
1426 Mount Arlington Borough
1427 Mount Olive Twsp.
1428 Netcong Borough
1429 Parsippany-Troy Hills Twsp.
1430 Long Hill Twsp.
1431 Pequannock Twsp.
1432 Randolph Twsp.
1433 Riverdale Borough
1434 Rockaway Borough
1435 Rockaway Twsp.
1436 Roxbury Twsp.
1437 Victory Gardens Borough
1438 Washington Twsp.
1439 Wharton Borough

**OCEAN COUNTY—15**

1501 Barnegat Light Borough
1533 Barnegat Twsp.
1502 Bay Head Borough
1503 Beach Haven Borough
1504 Beachwood Borough
1505 Berkeley Twsp.
1506 Brick Twsp.
1507 Dover Twsp.
1508 Eagleswood Twsp.
1509 Harvey Cedars Borough
1510 Island Heights Borough
1511 Jackson Twsp.
1512 Lacey Twsp.
1513 Lakehurst Borough
1514 Lakewood Twsp.
1515 Lavallette Borough
1516 Little Egg Harbor Twsp.
1517 Long Beach Twsp.
1518 Manchester Twsp.
1519 Mantoloking Borough
1520 Ocean Twsp.
1521 Ocean Gate Borough
1522 Pine Beach Borough
1523 Plumsted Twsp.
1524 Point Pleasant Borough
1525 Point Pleasant Beach Borough
1526 Seaside Heights Borough
1527 Seaside Park Borough
1528 Ship Bottom Borough
1529 South Toms River Borough
1530 Stafford Twsp.
1531 Surf City Borough
1532 Tuckerton Borough

**PASSAIC COUNTY—16**

1601 Bloomingdale Borough
1602 Clifton City
1603 Haledon Borough
1604 Hawthorne Borough
1605 Little Falls Twsp.
1606 North Haledon Borough
1607 Passaic City
1608 Paterson City
1609 Pompton Lakes Borough
1610 Prospect Park Borough
1611 Ringwood Borough
1612 Totowa Borough
1613 Wanaque Borough
1614 Wayne Twsp.
1615 West Milford Twsp.
1616 West Paterson Borough

**SALEM COUNTY—17**

1701 Alloway Twsp.
1713 Carney's Point Twsp.
1702 Elmer Borough
1703 Elsinboro Twsp.
1704 Lower Alloways Creek Twsp.
1705 Pennsville Twsp.
1706 Mannington Twsp.
1707 Oldmans Twsp.
1708 Penns Grove Borough
1709 Pilesgrove Twsp.
1710 Pittsgrove Twsp.
1711 Quinton Twsp.
1712 Salem City
1714 Upper Pittsgrove Twsp.
1715 Woodstown Borough

**SOMERSET COUNTY—18**

1801 Bedminster Twsp.
1802 Bernards Twsp.
1803 Bernardsville Borough
1804 Bound Brook Borough
1805 Branchburg Twsp.
1806 Bridgewater Twsp.
1807 Far Hills Borough
1808 Franklin Twsp.

1809 Green Brook Twsp.
1810 Hillsborough Twsp.
1811 Manville Borough
1812 Millstone Borough
1813 Montgomery Twsp.
1814 North Plainfield Borough
1815 Peapack-Gladstone Borough
1816 Raritan Borough
1817 Rocky Hill Borough
1818 Somerville Borough
1819 South Bound Brook Borough
1820 Warren Twsp.
1821 Watchung Borough

**SUSSEX COUNTY—19**

1901 Andover Borough
1902 Andover Twsp.
1903 Branchville Borough
1904 Byram Twsp.
1905 Frankford Twsp.
1906 Franklin Borough
1907 Fredon Twsp.
1908 Green Twsp.
1909 Hamburg Borough
1910 Hampton Twsp.
1911 Hardyston Twsp.
1912 Hopatcong Borough
1913 Lafayette Twsp.
1914 Montague Twsp.
1915 Newton Town
1916 Ogdensburg Borough
1917 Sandyston Twsp.
1918 Sparta Twsp.
1919 Stanhope Borough
1920 Stillwater Twsp.
1921 Sussex Borough
1922 Vernon Twsp.
1923 Walpack Twsp.
1924 Wantage Twsp.

**UNION COUNTY—20**

2001 Berkeley Heights Twsp.
2002 Clark Twsp.
2003 Cranford Twsp.
2004 Elizabeth City
2005 Fanwood Borough
2006 Garwood Borough
2007 Hillside Twsp.
2008 Kenilworth Borough
2009 Linden City
2010 Mountainside Borough
2011 New Providence Borough
2012 Plainfield City
2013 Rahway City
2014 Roselle Borough
2015 Roselle Park Borough
2016 Scotch Plains Twsp.
2017 Springfield Twsp.
2018 Summit City
2019 Union Twsp.
2020 Westfield Town
2021 Winfield Twsp.

**WARREN COUNTY—21**

2101 Allamuchy Twsp.
2102 Alpha Borough
2103 Belvidere Town
2104 Blairstown Twsp.
2105 Franklin Twsp.
2106 Frelinghuysen Twsp.
2107 Greenwich Twsp.
2108 Hackettstown Town
2109 Hardwick Twsp.
2110 Harmony Twsp.
2111 Hope Twsp.
2112 Independence Twsp.
2113 Knowlton Twsp.
2114 Liberty Twsp.
2115 Lopatcong Twsp.
2116 Mansfield Twsp.
2117 Oxford Twsp.
2118 Pahaquarry Twsp.
2119 Phillipsburg Town
2120 Pohatcong Twsp.
2121 Washington Borough
2122 Washington Twsp.
2123 White Twsp.

# MODULE I

# HOSPITAL PREPAREDNESS

## Outline

- **OSHA Interpretation on Hospital Decon**
- **OSHA Final Rule**
- **Communications**
- **Pre Planning**
    - **A. External vs. Internal**
- **Incident Command**

# MODULE 1
# HOSPITAL PREPAREDNESS

## Objectives

*The students will be able to:*

1. Identify recent OSHA intrepretations as they relate to Hospital Decontamination workers.

2. Understand the importance of Standard Operating Guidelines and how they relate to effective communications.

3. Understand the importance of pre planning and differentiate between internal and external planning.

4. Understand basic Incident Command terminology, and identify alternative methods of incident management.

**U.S. Department of Labor**

Occupational Safety and Health Administration
Washington, D.C. 20210

Reply to the Attention of:

State of New Jersey
Emergency Management Section
Department of Law and Public Safety
PO Box 7068
West Trenton, NJ 08628-0068

Thank you for your May 7 letter to Occupational Safety and Health Administration's (OSHA's) Directorate of Technical Services. Your letter was forwarded to the Directorate of Enforcement Programs to answer your emergency response related questions. This letter constitutes OSHA's interpretation only of the requirements discussed and may not apply to any question not delineated within your original correspondence.

You had questions concerning training and personal protective equipment (PPE) requirements under the Hazardous Waste Operations and Emergency Response (HAZWOPER) standard for hospital employees who may have to decontaminate patients exposed to biological, chemical or nuclear agents resulting from a weapon of mass destruction incident. You state that in such an incident, many ambulatory victims/patients would be self-referrals to hospitals, while decontamination and treatment of highly contaminated, non-ambulatory victims/patients would begin at the scene of the incident. Your questions and our responses are listed below.

**Question 1:** Since decontamination will occur in an open-air environment outside the hospital's emergency department, could Level C respiratory protection be used instead of Level B as described in the HAZWOPER standard?

**Response:** OSHA does not require hospital staff members who decontaminate patients to wear Level B respiratory protection (positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA). The requirement to wear positive pressure self-contained breathing apparatus in 29 CFR 1910.120(q)(3)(iv) applies to employees under an Incident Command System who are engaged in emergency response with the intent of handling or controlling the release. These employees respond to areas proximate to the point of release where exposure to inhalation hazards is anticipated.

In contrast, hospital staff members who decontaminate a patient at the hospital are removed from the site of the emergency and the point of release. Normally, these personnel do not need to be trained or equipped for the same level of control, containment, or confinement operations as required for the hazardous materials (HAZMAT) team. Potential exposures to hospital staff usually result from proximity to, or contact with a patient whose skin and/or clothing may be contaminated. The hospital staff's personal protective equipment must be sufficient for the type and exposure levels an employee can reasonably anticipate from such incidents. Anticipated exposures are likely to include airborne or absorption hazards from a patient whose skin or clothing has come in contact with hazardous liquids or contaminated with hazardous particles.

Emergency response planning therefore, includes selection of PPE based on worst-case employee exposure scenarios. PPE selection should be based on the hospital's role in community emergency response evaluation.

**Question 2:** Since a majority of the victims/patients will be self-referrals and will be going to the hospital "on their own," how badly contaminated are they? If they can travel to the hospital wearing no respiratory protection, would not a hospital employee wearing Level C respiratory protection be better protected than the victims/patients?

**Response:** Depending on the contaminant present and the type of Level C respiratory protection provided (full-face or half-mask, air purifying respirators), a hospital employee wearing an air purifying respirator (APR) may be adequately protected. APRs are appropriate when the types of airborne substances are known and the worse case exposure estimates have been calculated for such events. For example, when preparing for an *industrial chemical emergency response*, where an MSDS for a particular chemical substance is available a hospital can select APRs to protect employees from being over exposed when decontaminating patients at the hospital. However, this may not be the case for a response to unknown biological, chemical or nuclear agents resulting from a weapon of mass destruction incident.

There is no clear answer to how contaminated a victim may be if he/she is a self-referral, and OSHA certainly cannot predict the levels or severity of these types of exposures. Some types of nuclear/chemical contaminants can kill quickly. Also, biological agent contamination may not be recognized when a victim arrives at a hospital because of the delay between the incident and the onset of symptoms. As a result, we are obviously unable to provide an absolute response to this concern.

**Question 3:** Should all the competencies listed for First Responder Operations Level training be met for hospital employees or could the minimum 8-hour course concentrate on personal protective equipment and contamination? For example, must a hospital employee know basic hazard and risk assessment techniques including placard recognition?

**Response:** HAZWOPER is a performance-based regulation allowing employers flexibility in meeting the requirements of the regulation, although the level and type of training is to be based on worst-case scenarios. Generally, all the competencies listed in 29 CFR 1910.120(q)(6)(ii) should be met for hospital employees trained to the First Responder Operations Level designated to decontaminate victims. The competencies may be tailored to fit the tasks the employees are expected to perform.

For instance, placard recognition is not required as a basic hazard and risk assessment technique. The ability to identify placards is important for a HAZMAT team, but not for hospital personnel designated to perform decontamination. Employees who will decontaminate patients must be trained to identify when a hazardous substance is present. They should also receive training on identifying potential contaminates so that the correct decontamination methods are used, selection of proper PPE, how to control the spread of further contamination, and how to properly handle decontamination chemicals. Employees need to know their capabilities and limitations so they can determine when their training and equipment is not adequate to handle a situation.

**Question 4:** Are all hospitals nationwide preparing to equip and train their employees in the donning of Level B respiratory protection? It is our understanding that there are hospitals in other states that equip their employees with only Level C respiratory protection.

**Response:** We are unaware of what types of preparation hospitals are taking for emergency responses to such incidents. As previously stated, depending on the expected response by a hospital, Level C personal protective equipment may be appropriate.

**Question 5:** Does Level B respiratory protection exclude the supplied air hood?

**Response:** The personal protective equipment protection levels described in Appendix B of 29 CFR 1910.120 are guidelines that an employer may use to begin the selection of appropriate PPE. PPE must be selected which will protect employees from the specific hazards that they are likely to encounter during their work. If a hood type respirator offers sufficient protection for the task or potential emergency, then such a protective measure is acceptable.

Under 1910 Subpart I, the employer must perform a hazard assessment to select appropriate personal protective equipment for the hazards that are present, or likely to be present, including foreseeable emergencies. The hazard assessment must be in the form of a written certification as described in 29 CFR 1910.132(d)(2). In addition, the employer must include procedures for selecting respirators in the written respiratory protection program as described in 29 CFR 1910.134(c). Hospital employees who are trained to the HAZWOPER First Responder Operations Level must be trained to know how to properly select and use proper PPE that is provided to them.

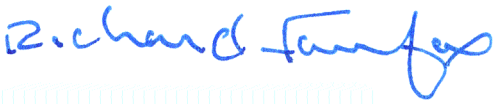
Please be aware that our reply addresses federal OSHA standards and applies to employers under federal OSHA's jurisdiction. Federal OSHA has no jurisdiction over state and local government employees, such as the public employees of a state-owned hospital. The OSHA Act does, however, encourage States to assume responsibility for their own occupational safety and health programs under plans approved by the U.S. Department of Labor. Such plans must extend coverage to State and local government employees. Twenty-three (23) States operate programs that cover both private and public sector employees. Three (3) States, including New Jersey, operate programs that are limited in scope to state and local government employees. (In New Jersey, Federal OSHA continues to cover private sector safety and health issues.) The New Jersey Department of Labor, Office of Public Employees Safety and Health (PEOSH) is the State plan agency. It covers hospital and emergency services personnel employed by State and local governments, and adopts and enforces its own occupational safety and health standards, which for the most part are identical to Federal OSHA's standards. For additional information about the requirements of the New Jersey Public Employee Only State Plan and its standards, you may contact the New Jersey Department of Labor directly at the following address:

Leonard Katz, Assistant Commissioner
New Jersey Department of Labor
P.O. Box 054
Trenton, New Jersey 08625-0054
Telephone: (609) 292-2313

Thank you for your interest in occupational safety and health. We hope you find this information helpful. OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information.

To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov. If you have any further questions, please feel free to contact the Office of Health Enforcement at (202) 693-2190.

Sincerely,



Richard E. Fairfax, Director
Directorate of Enforcement Programs

cc: Leonard Katz, Assistant Commissioner, New Jersey Department of Labor
Patricia Clark, Regional Administrator–II

# FROM OSHA'S FINAL RULE
# 29 CFR PART 1910.120(q)

## March 6, 1989

**(q) Emergency response to hazardous substance releases**

**(6) Training.** Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

**(ii) First Responder Operations Level.**

First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available within their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

**(8) Refresher training**

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

# GUIDANCE FOR PRE-PLANNING

# ADVANCE PLANNING FOR A HAZMAT/WEAPONS OF MASS DESTRUCTION (WMD) INCIDENT

## PRE-PLANNING

Pre-incident planning is that process where the hospital worker prepares for unwanted occurrences and takes those necessary actions to mitigate or abate the emergency condition. The effective use of this planning activity will serve to considerably minimize damage and injury. It is not necessarily a new *system* but just a method of dealing with new elements. It will encompass a broader area of concern. In the past fire departments have developed response protocols in pre-firing buildings; but for the most part limited this activity to large multiple-person buildings, unusual structures and extremely hazardous areas. High rise buildings, refineries, chemical manufacturing plants, and the like, were of sufficient importance to warrant the pre-incident attention of the fire service. A preliminary risk assessment process involves selection criteria which develops the class of buildings to be pre-fired. In the pre-incident plan for hazardous materials the approach shall be a system method. It is virtually impossible to "pre-fire" every building in the community as it is to "pre-plan" every hazardous material incident. However, it is possible to design a system whereby the response protocols will embrace categories of hazardous material incidents.

Where large volumes of flammable or combustible liquids are present the possibility of ignition cannot be totally eliminated; but by proper application of engineering controls the probability factor can be reduced to an infinitely negligible measurement. Risk Assessment is the process of evaluating the possibility and probability of an incident occurring.

In pre-incident planning the local fire authorities shall develop an aggressive program of recognition and identification (R&I) of those unusual hazardous materials that may exist and possibly be involved in an emergency situation. A risk assessment process of the hazard levels existing in the community will lead to the development of response protocols to be implemented in the Emergency Response Plan should an emergency take place.

Naturally a response agency must have substantial criteria for the operational activities of the HAZMAT team. The standard operational procedures for HAZMAT operations are not significantly different than those of a fire department. A fire department has an assigned mission to prevent loss and to limit the damage when an incident takes place. The HAZMAT team has an assigned task to limit injury and damage when a hazardous material incident has taken place. An increasing role for the HAZMAT team is to protect the environment. Contaminants spilled or released may have widespread effects. Just as the incident in Chernobyl has affected hundreds of square miles the potential for a similar serious incident exists in this country today. Prompt response with a planned approach will serve to significantly mitigate the impact of the incident.

A response plan will serve to detail who will do what and how they will do it. The operational phase of the plan will identify the following:

## Response protocol

- Level of personnel protection to be used prior to event participation.
- Preliminary site characterization (i.e., wind direction, data gathering, etc.)
- Communication systems—on site communications between teams

## Equipment requirements

- Personnel protective equipment
- Testing and monitoring equipment
- Items for special purposes such as dike material for oil spills, neutralizing chemicals for acid and base spills, etc.
- Communication equipment—access to data bases, CHEMTREC, and government agencies.
- Transportation for evacuations, movement of injured personnel (ambulances, etc.)

Part of the response plan must include the involvement with the community. Many incidents have a high visibility and local citizens will express a greater concern for a hazardous material incident than they would for a fire. Generally the public views a fire with curiosity and as a spectator item. Clouds of gas or vapors threaten them and emergency responders can expect calls from concerned citizens. A part of the response plan must allocate resources to the community. In some areas it might simply involve a communication link with the local emergency planning committee and in others the HAZMAT operation may require community evacuation, etc.

In resolving a hazardous materials incident, there are many resources (both people and equipment) that will have to be brought together to effectively and safely mitigate the incident. How do you contact CHEMTREC? Who is in charge at a Decon incident? Who has the authority to order an evacuation? All of these questions and many more must be answered long before a HAZMAT/Decon incident occurs.

Besides being the common sense way to effectively and safely handle HAZMAT incidents, planning is also a legal requirement. OSHA, RCRA, the Toxic Catastrophe Prevention Act, and SARA all require planning by either the private employer and/or public agencies. By law, state, county, and local governments are required to have basic emergency management plans that will cover many possible disasters. As an annex to the disaster planning process SARA requires the development of a plan that specifically addresses hazardous materials. This hazardous materials contingency plan should be the basis for the response of all expected emergency responders to a HAZMAT incident.

These plans should have been developed by a planning committee that included representation from many different agencies as well as the public and are as site specific as possible to take into account local conditions. The process of preparing for a HAZMAT incident does not end with the development of the plan. In order for any plan to work it must be known to the people expected to use it and they must have practiced with it. Even the best appearing plan will not be effective if the responders have not tried it out to see if it is realistic. As part of the process of being an emergency responder, you must know the local plan, your role in it, and what is expected of you. Just as this hazardous materials technician course will help prepare you to respond to HAZMAT incidents, so will the local emergency response plan.

## Hazardous Materials Annex (Emergency Response Plan)

A hazardous materials annex should contain the following information:

- Identity of hazards within the jurisdiction & facility.
- Assumption of what would happen if an incident occurred at one of the hazardous materials locations, or in the facility.
- A policy statement that identifies the expected operations and defines roles and authority, as well as notification of other agencies.
- Phases of emergency management including mitigation, preparedness, response, and recovery.
- Direction and control including alerting of the public, emergency operations center (EOC) activation, and cleanup oversite.
- Organization and assignment with responsibilities assigned to specific department heads.
- Administration and logistics for support of the operations envisioned in the contingency plan.
- Appendices that provide for mutual aid, emergency response reference guides, telephone numbers of people, industries, and agencies that might be called upon for assistance. These appendices should also include contractor response procedures (this is where you get your bulldozer), evacuation and traffic routing information, and any other needed information that supports the HAZMAT plan.

Know what major businesses and industries in your community use, store or transport hazardous materials. If possible, meet with them to discuss their emergency plan in case of an accident.

- Contacts, including names and phone numbers
- Do plants have internal hazardous materials teams?
- Location of decontamination showers in the plants
- Availability of support agencies

Know who is available to provide a HAZMAT Emergency Response Team in your community, and an alternate if they are not available. If possible, meet with them to discuss how you can best work together at an emergency in your community.

Provide means for having the necessary equipment available for personal protection of the workers—consider disposable items to minimize the need for decontamination.

The items available for use must accommodate incidents involving a variety of hazardous materials. The following list is a starting point which your unit should refine and alter to suit the conditions of your most common incidents.

## Communications

Establish or review communication procedures for information collection and dissemination, as well as for operations. Will the necessary information be collected?

Establish or review communication procedures for operations.

- Do the emergency service organizations in your community follow an Incident Command System (ICS)?
- Does your facility use ICS?

Maintain a list of radio frequencies used by local fire, police, EMS and Hazardous Materials units. Is there a common frequency that you are capable of using?

An ED representative should respond to the Command Post, or minimally a second portable radio should be provided to the Incident Commander or Command Post.

Provide First Call Prompting Forms with Access Supplies to record information transmitted about a hazardous materials incident.

Communications should be in plain language. They should be simple and concise. All communications should be acknowledged.

# INCIDENT COMMAND SYSTEM (ICS)

Although many systems exist throughout the nation for the command and control of resources at emergency incidents, the National Fire Academy has adopted the Incident Command System (ICS) as its base for teaching the concepts of incident command. The ICS is recognized by the Academy as a system that is documented and has been successfully used in managing available resources at emergency operations.

The system consists of procedures for controlling personnel, facilities, equipment, and communications.

It is designed to begin developing from the time an incident occurs until the requirement for management and operations no longer exists. The "Incident Commander" is a title which can apply equally to an charge nurse, or the CEO, depending upon the situation. The structure of the ICS can be established and expanded depending upon the changing conditions of the incident. It is intended to be staffed and operated by qualified personnel from any Hospital Department and may involve personnel from a variety of disciplines.

As such, the system can be utilized for any type or size of emergency, ranging from a minor incident involving a single unit, to major emergency involving several agencies. The ICS allows agencies to communicate using common terminology and operating procedures. It also allows for the timely combining of resources during an emergency.

## H.E.I.C.S.

**The Hospital Emergency Incident Command System (HEICS)** is an emergency management system which employs a logical management structure, defined responsibilities, clear reporting channels, and a common nomenclature to help unify hospitals with other emergency responders. While there are many parallels between HEICS and "traditional" Incident Command methods HEICS is specifically structured to take advantage of the unique environment found in hospitals. For more information on this management tool go to http://www.emsa.cahwnet.gov/Dms2/heics3.htm.

## Primary Features of the Incident Command System

- Adaptability
- Flexibility
- Span of Control
- Unity of Command
- Modular Organizational Structure

## Organization and Operation

The ICS has five major functional areas:

| | |
|---|---|
| Command: | Command function manages the incident including establishing strategic goals, and ordering and releasing resources (personnel and equipment). Note: Command also has responsibility for any of the other four functions until and if they are delegated. |
| Operations: | Operations function directs all incident tactical resources to accomplish the goals and objectives developed by command. Operations assures that the personnel and equipment at the scene are used to perform effective mitigation. |
| Planning: | Planning is responsible for the collection and evaluation of information important to the incident. This then leads to the development of action plan. Planning is ongoing. |
| Logistics: | The logistics function provides the services and supplies needed to support the tactical operations. |
| Finance/ Admin: | Purchasing, renting equipment deemed necessary on-site, keeping records on overtime on more complex larger operations. |

## External Pre-planning

External pre-planning should involve coordination which local agencies such as fire, EMS, and HAZMAT teams, along with local chemical or industrial sites. It will be important to establish an integrated plan that outlines a common response philosophy AND the roles and responsibilities that should be taken in the event of a HAZMAT/WMD case.

For example, it will be important to know the following types of information in the preparation for a HAZMAT/WMD incident:

1. What are the sources of Hazardous Material accidents in the community?
2. Where is the nearest HAZMAT team located?
3. Which local EMS organization and fire departments are trained and equipped to respond to a HAZMAT incident?
4. Do any of the local industrial sites have HAZMAT teams that can be called upon for assistance in response to a HAZMAT incident?
5. How will victims from a HAZMAT/WMD incident be handled?
6. Will **all** contaminated/injured patients be decontaminated prior to transport to the hospital? Does this include trauma patients? Are there any exceptions? Who will perform field decontamination?
7. To what extent will patients be decontaminated? (i.e. gross or definitive decontamination)
8. Which other local hospitals are trained and equipped to handle hazardous material accident victims?
9. How will a hazardous material incident involving mass casualties be handled? How will the patient load be dispersed in this type of incident?

## Internal Pre-planning

A formal written HAZMAT/WMD Response Plan should be developed as part of the overall Hospital Disaster Plan. It should be developed in conjunction with the local OEM or LEPC, local EMS organization, fire department, HAZMAT team and local industry. It should be comprehensive in addressing all possible situations involving hazardous material accident patients:

- Walk in patient(s)
- Announced pre-hospital delivered patients
- Unannounced pre-hospital delivered patients
- Stable vs. unstable patient
- Mass casualty incident

The formal plan should address the following types of issues:

A. Determine the responsibilities of the departments ranging from emergency medicine, administration and security to clinical specialties such as toxicology, laboratory medicine and occupational medicine.

B. Determine the responsibilities of all hospital personnel who will be involved in the handling of a hazardous material accident patient.

C. Selection and set-up of an outside or external decontamination area.

D. Selection and set-up of an inside or internal decontamination area.

E. Selection of decontamination equipment and supplies.

F. Selection of proper personal protective clothing.

G. Establish a pre-hospital notification procedure.

H. Development and maintenance of a list of resource organizations that can be contacted in the event of a HAZMAT incident.

**REMEMBER:** Coordinate your planning efforts with JCAHO Guidelines and Office of Emergency Management Standards.

# MODULE 2

# CHEMICAL TERMINOLOGY FOR HOSPITAL PERSONNEL

## Outline

- **Basic classes of hazardous substances:**
    - **A. Functional classification of hazardous materials**
- **Physical properties**
- **Radioactivity**

# MODULE 2
# CHEMICAL TERMINOLOGY FOR HOSPITAL PERSONNEL

## Objectives

*The students will be able to:*

1. Define the following eight basic chemical and physical properties:
    —boiling point
    —flash point
    —flammable (explosive) limits
    —ignition (autoignition) temperature
    —specific gravity
    —vapor density
    —vapor pressure
    —water solubility

2. Understand the hazard class system.

3. Differentiate among alpha, beta, and gamma particles and rays on the basis of their penetration and the protection required to deal with them.

## Physical Properties of Hazardous Substances

Information about the physical properties of a hazardous materials give the responder an indication of how the substance will act on the environment and people. This information can help determine the defensive measures which need to be taken to mitigate an incident. These properties include:

**STUDENT NOTES:**

- Density _____
- Specific Gravity _____
- Vapor Density _____
- Vapor Density _____
- Boiling Point _____
- Flammable (explosive) limits _____
- Flash Point _____
- Ignition Temperature _____
- Water Solubility _____

For detailed definitions of the physical properties, see the glossary.

## EXAMPLES OF PHYSICAL PROPERTIES OF CHEMICALS

**FLASH POINT**

KEROSENE 100 DEGREES F. GASOLINE –45 DEGREES F. ACETONE 0 DEGREES F. DIESEL FUEL 125 DEGREES F.

**FLAMMABLE RANGE**

GASOLINE 1.3-7.6 FR = 6.3% CARBON DISULFIDE 1.3-50.0 FR = 38.7%
METHANE 5.0-15.0 FR = 10% HYDROGEN 4.0-75.0 FR = 71%

**AUTOIGNITION TEMPERATURE**

GASOLINE 536 DEGREES F. CARBON DISULFIDE 194 DEGREES F. ISOPROPYL ALCOHOL 750 DEG F.

**VAPOR PRESSURE**

AT 68 DEGREESF. BUTYL ACETATE—10 ACETONE—220 PENTANE—426 CHLORINE—4,800

PRESSURE INCREASES AS TEMPERATURE RISES
WATER AT 52 DEGREES IS 10; AT 93 DEGREES IS 40, AT 176 DEGREES; AT 212 DEGREES IS 760

**BOILING POINT**

WATER = 212 DEG F. TRICHLOROETHANE = 170 DEG F. LEAD = 3,183 DEG F.

**VAPOR DENSITY**—TEMPERATURE AND HUMIDITY INFLUENCE VAPOR DENSITY

LOW TEMPERATURE = INCREASE VAPOR DENSITY HIGH TEMPERATURE = DECREASE VAPOR DENSITY
LOW HUMIDITY = DECREASE VAPOR DENSITY HIGH HUMIDITY = INCREASE DENSITY

GREATER THAN 1 = SETTLE IN LOWEST AVAILABLE SPACE
LESS THAN 1 = MATERIAL WILL RISE
IF CLOSE TO SURROUNDING AIR DENSITY = WILL DISPERSE IN ATMOSPHERE

GASOLINE = 3.0-4.0 CHLORINE = 2.5 ETHYLENE = 1.0 METHANE = .55 HYDROGEN = 0.1

**SPECIFIC GRAVITY**

**SOLUBILITY**—DEGREE IN WHICH A SUBSTANCE IS CAPABLE OF MIXING WITH WEAR WITH NO OBSERVABLE PHASE SEPARATION, TENDENCY FOR A CHEMICAL TO DISSOLVE EVENLY IN A LIQUID.

MISCIBLE = MATERIALS WHICH READILY DISSOLVE
IMMISCIBLE = MATERIALS THAT DO NOT DISSOLVE

| CHEMICAL | SOLUBLE IN WATER | SPECIFIC GRAVITY | BEHAVIOR IN WATER |
|---|---|---|---|
| GASOLINE | NO | 0.7 | FLOATS |
| TRICHLOROETHANE | NO | 1.3 | SINKS |
| SULFURIC ACID | YES | 1.8 | DISSOLVES |

pH REPRESENTS A TENFOLD INCREASE IN ACID OR BASE CONCENTRATION RELATIVE TO PURE WATER.

NEUTRALIZING IS A CHEMICAL REACTION IN WHICH WATER IS FORMED BY MUTUAL DESTRUCTION OF IONS.
NEUTRALIZING DOES NOT MEAN ATTAINING A pH of 7.0

**TOXICOLOGY**

$LD_{50}$ DOSE THAT KILLS HALF OF THE TEST ANIMALS IN 14 DAYS (LETHAL DOSE)
$LC_{50}$ LETHAL CONCENTRATION

EXAMPLE:

| GROUP | # TESTED | ORAL DOSE (mg/kg) (1 kg = 2.2 lbs.) | # OF DEATHS |
|---|---|---|---|
| A | 100 | 12 | 83 |
| B | 100 | 8 | 50 |
| C | 100 | 4 | 12 |
| D | 100 | 0 | 0 |

$LD_{50}$ FOR THIS MATERIAL WOULD BE 8

CONCENTRATION DOSE WILL BE SHOWN IN units of ppm/time

AN EXAMPLE OF A $LC_{50}$ WOULD READ AS 800 ppm/4 hrs

$LD_{50}$ AND $LC_{50}$ ARE THE LOWEST CONCENTRATIONS EXPECTED TO BE LETHAL

ESTIMATING IDLH FROM $LC_{50} \times 0.01$ $LD_{50} \times 0.1$

PELs = PERMISSIBLE EXPOSURE LIMITS (OSHA)
TLVs = THRESHOLD LIMIT VALUES (ACGIH)
IDLHs = IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (NIOSH)

TWA = TIME WEIGHTED AVERAGE (8 hour day, 40 hour week)
STEL = SHORT TERM EXPOSURE LIMIT 9four 15 minute periods, 1 hour interval)
CEILING = CONCENTRATION THAT SHOULD NEVER BE EXCEEDED
ALARA = AS LOW AS REASONABLY ACHIEVABLE

## pH OF SOME COMMON SUBSTANCES

| | | |
|---|---|---|
| | 14 | |
| lye ..... | | |
| | 13 | |
| household ammonia ..... | 12 | |
| | 11 | **BASIC** |
| lime water ..... | | |
| | 10 | |
| borax ..... | | |
| | 9 | |
| baking soda ..... | | |
| | 8 | |
| blood ..... | | |
| milk ..... | 7 | **NEUTRAL** |
| rain ..... | 6 | |
| black coffee ..... | 5 | |
| tomatoes ..... | 4 | |
| soda ..... | | |
| | 3 | **ACIDIC** |
| lemon juice ..... | 2 | |
| gastric fluid ..... | 1 | |
| | 0 | |

* scale is logarithmic

**Hazard Classes**

**U.S. DEPARTMENT OF TRANSPORTATION CLASSIFICATION SYSTEM**

| CLASS NO. | DIVISION NO. | NAME OF CLASS |
|---|---|---|
| 1 | 1.1 | EXPLOSIVES (MASS EXPLOSION) |
| 1 | 1.2 | EXPLOSIVES (PROJECTION HAZARD) |
| 1 | 1.3 | EXPLOSIVES (FIRE HAZARD) |
| 1 | 1.4 | EXPLOSIVES (NO SIGNIFICANT BLAST) |
| 1 | 1.5 | VERY INSENSITIVE EXPLOSIVES (BLASTING AGENTS) |
| 1 | 1.6 | EXTREMELY INSENSITIVE DETONATING SUBSTANCE |
| 2 | 2.1 | FLAMMABLE GAS |
| 2 | 2.2 | NON-FLAMMABLE COMPRESSED GAS |
| 2 | 2.3 | POISONOUS GAS |
| 2 | 2.4 | CORROSIVE GAS (CANADIAN) |
| 3 | 3 | FLAMMABLE AND COMBUSTIBLE LIQUID<br>FLAMMABLE (0-141°F FLASHPOINT)<br>COMBUSTIBLE (141-200°F) |
| 4 | 4.1 | FLAMMABLE SOLID |
| 4 | 4.2 | SPONTANEOUSLY COMBUSTIBLE |
| 4 | 4.3 | DANGEROUS WHEN WET MATERIAL |
| 5 | 5.1 | OXIDIZER |
| 5 | 5.2 | ORGANIC PEROXIDE |
| 6 | 6.1 | POISONOUS MATERIALS |
| 7 | 7 | RADIOACTIVE MATERIAL |
| 8 | 8 | CORROSIVE MATERIAL |
| 9 | 9 | MISCELLANEOUS HAZARDOUS MATERIAL |
| ORM D | | CONSUMER COMMODITIES |


Many hazardous substances present multiple dangers. The following is a brief description with examples of major classes of hazards.

### 1) Explosives: Class 1

Any mixture, compound, chemical or mechanical device designed to function by explosion, thus generating the instantaneous release of heat and gas.

Explosives are divided into six divisions. These are:

1. Division 1.1, which is the most dangerous and is very sensitive to heat, impact, and shock. Examples include dynamite and nitroglycerin.
2. Division 1.2, which includes very fast burning materials such as flares and solid rocket motors.
3. Division 1.3, materials in which the major hazard is the release of radiant heat, violent burning or both, but there is no projection or blast hazard.

4. Division 1.4, contains small amounts of Class A and/or Class B explosives such as fireworks and ammunition.
5. Division 1.5, this material is used for blasting and is the most insensitive of the explosive class to shock and offer minimal threat of accidental detonation.
6. Division 1.6, these materials are found to be extremely insensitive detonating substances.

**2) Gases: Class 2**

1. Division 2.1, **Flammable Gases** are any compressed gas which meets the technical requirements so as low flammability limits and flame projection and often ignite immediately when leaks or punctures occur. i.e. LPG, propane, hydrogen.
2. Division 2.2, **Non Flammable Gases** are those which do not fall under the flammable gas limits. i.e. oxygen, compressed nitrogen, anhydrous ammonia.
3. Division 2.3, **Poisonous Gases** are materials known to be so toxic to humans as to pose a hazard to health during transportation.

**3) Flammable Liquids: Class 3**

This hazard category deals with liquids which produce vapors which can be easily ignited. They are broken into two groups.

1. Flammable Liquids are any liquid which have a flash point of 141 F or below.
   Examples: gasoline, acetone, toluene.
2. Combustible Liquids are those that have a flash point between 141 F and 200 F.
   Examples: fuel oil, kerosene, asphalt, creosote.

**4) Flammable Solids: Class 4**

These are solids (other than explosives) which are likely to cause fire through spontaneous chemical changes, friction, absorption of moisture or exposure to moisture. This group also includes material that is water reactive or spontaneously combustible. Once these materials start burning they often generate toxic vapors and are sometimes difficult to extinguish. Class 4 materials are further divided into three subcategories:

1. Division 4.1, Flammable Solids
2. Division 4.2, Spontaneously Combustible
3. Division 4.3, Dangerous When Wet

**5) Oxidizers and Organic Peroxide: Class 5**

Are materials which readily produce or yield oxygen to stimulate the combustion of other mate-

rial. Should this class of material be allowed to mix with flammable liquids or other combustibles rapid burning could result.

**6) Poisons or Infectious Substances: Class 6**

1. Division 6.1, are those very toxic substances in which a very small amount of the gas or vapor of the liquid are dangerous to life and can cause immediate illness or death.
   Examples: hydrogen cyanide, chlorine, aniline.
2. Division 6.2, are live microorganisms or toxins from organisms, which can cause or transmit disease.
   Examples: anthrax, botulism, rabies.

**7) Radioactive Material: Class 7**

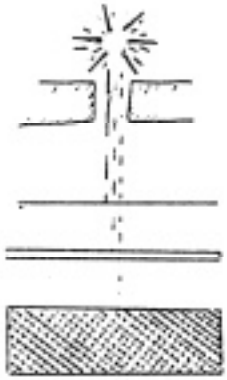
Are those products which spontaneously emit ionizing radiation, which could be capable or damaging living tissue.

## Radioactivity

**Radioactive exposure** usually comes in the form of exposure to particles or rays from a **radioactive source**. Particles and rays are, generally, emitted in three forms during radioactive decay; **alpha and beta particles**, or **gamma rays**.

**Alpha particles** are, essentially, helium nuclei (two protons and two neutrons) that have been stripped of their electrons. They are massive and travel only three of four inches from a radioactive source. Very little shielding is required to stop alpha particles; several sheets of paper are enough. Sources of alpha radiation can adhere to dust particles and be inhaled which causes lung exposure and possible cancer risks.

**Beta particles** are more energetic and less massive than alpha particles. They can be either electrons, carrying a negative electrical charge, or positrons, carrying a positive charge. Beta particles can travel up to one hundred feet from their source and can penetrate firefighter's turnout gear. They can be stopped by one millimeter of aluminum.




**Gamma rays** or **photons** are not particles but are a form of pure energy. They are like X-rays and can travel great dis-

tances from their source. Gamma rays can only be attenuated by massive shielding; three inches of lead. We measure the amount of these particles and rays in terms of roentgens, rads, and rems.

**8) Corrosives: Class 8**

Materials that cause the visible destruction or irreversible damage to human tissue or that has a severe rate of corrosion on steel.

**9) Miscellaneous Hazardous Materials: Class 9**

May include any hazardous material that does not meet the criteria of another hazard class.

# MODULE 3

# BASIC HAZARD AND RISK ASSESSMENT TECHNIQUES

## Outline

- **Introduction**
- **Assessing the Hazards & Risks**
- **Identifying Hazardous Materials**
- **The DECIDE Process**

# MODULE 3
# HAZARD AND RISK ASSESSMENT

## Objectives

*The student will be able to:*

1. Describe the purpose of Hazard Risk Assessment.
2. List and describe the four factors effecting behavior of hazardous materials.
3. Discuss the meaning of each letter listed in the D.E.C.I.D.E. process.

# I. HAZARD AND RISK ASSESSMENT

This module will help you to understand the hazards and risks associated with hazardous materials and assist you in determining what actions will help you "do something" without creating additional problems.

*Definition:* The process of: detecting and identifying the presence of contaminated people, obtaining information of the properties of a material(s) to predict and visualize a likely outcome from the exposure and using this information to formulate an initial decon action plan.

Hazard and risk assessment consists of five basic items:

1. Obtaining information on the hazardous materials, populations that might be exposed to the release, and environmentally sensitive areas.
2. Recording the collected data to be able to view the possible effects.
3. Determining the types of hazards present based on the information you have obtained and recorded.
4. Identifying vulnerable areas presented by the situation.
5. Calculating the risks associated with the situation based on the information that you have gathered.

## Information Gathering

1. You must ask for the information you need. Do not wait for outsiders to contact you. You realize the need for the information long before anyone else does. You need to know where to get the needed information.
2. You must get some information yourself before you can use other sources for more information. You will need to make an accurate identification before you can unlock other sources for additional information.

# COMMON LOCATIONS FOR HAZARDOUS MATERIALS

| TYPE OF FACILITY | HAZARDOUS MATERIALS COMMONLY FOUND AT FACILITY |
|---|---|
| AIRPORT AND MARINE FUEL DEPOTS | GASOLINES AND FUEL OILS |
| BREWERIES AND DISTILLERIES | ALCOHOLS |
| COMPRESSED GAS SUPPLIERS | MEDICAL AND INDUSTRIAL GASES |
| CONSTRUCTION FIRMS AND SITES | EXPLOSIVES, COMPRESSED GASES, FUELS |
| DRY CLEANERS | CLEANING SOLVENTS, PERCHLOROETHYLENE |
| ELECTRONIC CIRCUIT MAKERS | ACIDS |
| ENBALMING SUPPLY HOUSES | FORMALDEHYDE |
| FARM/GARDEN SUPPLY SHOPS | PESTICIDES, FERTILIZERS, (OXIDERS) HERBICIDES |
| FIREWORKS MANUFACTURERS | EXPLOSIVES, PYROTECHNICS |
| FOOD STORES OR WAREHOUSES | AMMONIA (REFRIGERATION SYSTEMS), COMBUSTIBLE DUSTS |
| FOUNDRIES | RESINS, OTHER CHEMICALS |
| FUEL OIL COMPANIES | FUEL OILS |
| FURNITURE STRIPPING OPERATIONS | SOLVENTS |
| GASOLINE STATIONS | GASOLINE, AUTOMOTIVE OILS, SOLVENTS |
| GUN AND AMMO SHOPS | AMMUNITION, EXPLOSIVES |
| HAZARDOUS WASTE DISPOSAL FACILITIES | VIRTUALLY ANYTHING |
| HOSPITALS | COMPRESSED GASES, CRYOGENICS, MEDICINES, RADIOACTIVE MATERIALS, ETIOLOGIC AGENTS |
| LABORATORIES, CHEMICAL AND BIOLOGICAL | VARIOUS CHEMICALS, ETIOLOGIC AGENTS |
| LAWN FERTILIZER COMPANIES | PESTICIDES, HERBICIDES, FERTILIZERS |
| LEATHER TANNERS | VARIOUS CHEMICALS |
| LP GAS OR PROPANE SUPPLIERS | LIQUEFIED FLAMMABLE GASES |
| PAINT, VARNISH AND LAQUER MAKERS | RESINS, SOLVENTS, CHEMICAL PIGMENTS AND ADDITIVES |
| PEST CONTROL COMPANIES | PESTICIDES, POISONS |
| PLASTIC AND RUBBER MAKERS | SOLVENTS, ADDITIVES, BULK CHEMICALS |
| PLATING SHOPS | ACIDS, CYANIDES |
| PULP AND PAPER MILLS | BLEACHES, CAUSTICS, ACIDS, SULFER COMPOUNDS, AND OTHERS |
| SCHOOL/UNIVERSITY CHEMICAL LABORATORIES | VARIOUS CHEMICALS |
| SWIMMING POOLS (PUBLIC) | LIQUEFIED CHLORINE |
| SWIMMING POOL SUPPLY HOUSES | OXIDIZERS (CALCIUM HYPOCHLORITE), HYDROCHLORIC ACID, ALGAECIDES |
| STEEL MILLS | ACIDS, DEGREASERS |
| TEXTILE AND FIBER MANUFACTURERS | SOLVENTS, DYES, RESINS, VARIOUS OTHER BULK CHEMICALS |
| WATER TREATMENT FACILITIES | LIQUEFIED CHLORINE, ACIDS |
| WELDING SHOPS | COMPRESSED GASES, DISSOLVED ACETYLENE |

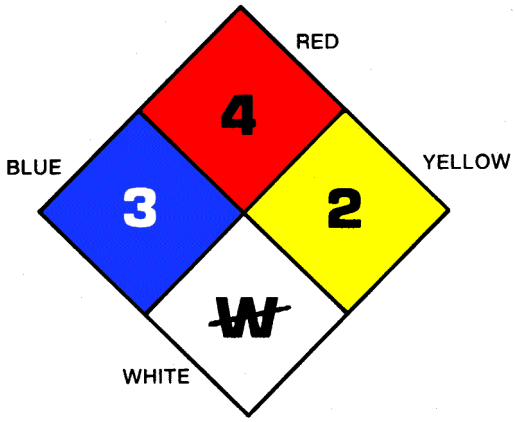
# SOURCES OF INFORMATION

## **The NFPA 704 System** (used at industrial facilities)

This system uses a diamond shaped diagram divided into four quadrants to identify the "health," "flammability" and "reactivity" of a chemical. Severity is indicated by numbers 0 to 4, with 4 being the most severe.

The bottom space is primarily used to identify unusual reactivity with water. A "W" with a line through it alerts personnel to the possible hazard in use of water. This space may also be used to identify radiation hazard by displaying the Tri-Blade symbol or oxidizing material by displaying OXY.

**NFPA 704 System**




### Health (Blue)

In general, health hazard in fire fighting or HAZMAT response is that of a single exposure which may vary from a few seconds up to an hour. The physical exertion demanded in fire fighting or other emergency conditions may be expected to intensify the effects of any exposure. Only hazards arising out of an inherent property of the material are considered.

The following explanation is based upon protective equipment normally used by fire fighters.

**4** Materials too dangerous to health to expose fire fighters. A few whiffs of the vapor could cause death or the vapor or liquid could be fatal on penetrating the fire fighter's normal full protective clothing. The normal full protective clothing and breathing apparatus available to the average fire department will not provide adequate protection against inhalation or skin contact with these materials.

**3** Materials extremely hazardous to health but areas may be entered with extreme care. Full protective clothing, including self-contained breathing apparatus, coat, pants, gloves, boots, and bands around legs, arms and waist should be provided. No skin surface should be exposed.

**2** Materials hazardous to health, but areas may be entered freely with full-faced mask self-contained breathing apparatus which provides eye protection.

**1** Materials only slightly hazardous to health. It may be desirable to wear self-contained breathing apparatus.

**0** Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.

**Flammability (Red)**

Susceptibility to burning is the basis for assigning degrees within this category. The method of attacking the fire is influenced by this susceptibility factor.

**4** Very flammable gases or very volatile flammable liquids. Shut off flow and keep cooling water streams on exposed tanks or containers.

**3** Materials which can be ignited under almost all normal temperature conditions. Water may be ineffective because of the low flash point.

**2** Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

**1** Materials that must be preheated before ignition can occur. Water may cause frothing if it gets below the surface of the liquid and turns to steam. However, water fog gently applied to the surface will cause a frothing which will extinguish the fire.

**0** Materials that will not burn.

**Reactivity (Stability) (Yellow)**

The assignment of degrees in the reactivity category is based upon the susceptibility of materials to release energy either by themselves or in combination with water. Fire exposure was one of the factors considered along with conditions of shock and pressure.

**4** Materials which (in themselves) are readily capable of detonation or of explosive decomposition or explosive reaction at normal temperatures and pressures. Includes materials which are sensitive to mechanical or localized thermal shock. If a chemical with this hazard rating is in an advanced or massive fire, the area should be evacuated.

**3** Materials which (in themselves) are capable of detonation or of explosive decomposition or of explosive reaction but which require a strong initiating source or which must be heated under confinement before initiation. Includes materials which are sensitive to thermal or mechanical shock at elevated temperatures and pressures or which react explosively with water without requiring heat or confinement. Fire fighting should be done from an explosive resistant location.

**2** Materials which (in themselves) are normally unstable and readily undergo violent chemical change but do not detonate. Includes materials which can undergo chemical change with rapid release of energy at normal temperatures and pressures or which can undergo violent chemical change at elevated temperatures and pressures. Also includes those materials which may react violently with water or which may form potentially explosive mixtures with water. In advance or massive fires, fire fighting should be done from a safe distance or from a protected location

**1** Materials which (in themselves) are normally stable but which may become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently. Caution must be used in approaching the fire and applying water.

**0** Materials which (in themselves) are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

## Shipping Papers

In an incident involving the transport of hazardous materials shipping papers can provide information to Hospital Personnel that might otherwise take an inordinate amount of time to "filter down". All shipping papers will have the following information:

1. The quantity of material (number of pieces i.e., number of drums)
2. Proper shipping name
3. Hazard Classification
4. Identification number

**AN EXAMPLE OF SHIPPING PAPERS**

**CHEMTREC 1-800-424-9300**

EXAMPLE OF EMERGENCY CONTACT NUMBER

| NO. PACKAGES | DESCRIPTION OF ARTICLES AND SPECIFICATIONS | WEIGHT |
|---|---|---|
| 2 drums | ALLYL ALCOHOL, 6.1, UN 1098, PG I, | |
| | POISON-INHALATION HAZARD, ZONE B | 714 lbs |
| | | |
| 25 pkg | SODIUM PHOSPHIDE, 4.3, UN 1432, PG I, | |
| | DANGEROUS WHEN WET | 2,000 lbs |
| 20 pkg | SULFURIC ACID, 8, UN 1830, PG II | 304 lbs. |
| | | |
| | | |
| | | |
| | | |

SHIPPING NAME

DIVISION NO.

ID NO.

PACKING GROUP NO.

## Material Safety Data Sheets

**Material Safety Data Sheets (MSDS)** are required by OSHA 29 CFR 1910.1200 as the primary communications link between chemical manufacturers and chemical users or handlers. The Material Safety Data Sheet is a source of information supplied by manufacturers on the materials that they produce. The MSDS deals with products (which may be mixtures of several chemicals) as they come from the shelf. An MSDS is written in nine sections and may be a single or multi page document. The sections of the document (not necessarily in this order) are:

1. Identity (material and manufacturer)
2. Physical data
3. Hazardous ingredients
4. Fire and explosion hazard data
5. Health hazard data
6. Reactivity data
7. Spill or leak procedures
8. Special protection required
9. Special precautions and comments

**Warning: not all MSDS's are created equally!** While MSDS's are required to contain certain information, not all of the suppliers of MSDS's pay close attention to the accuracy of information on the sheet. Look on the sheet for a telephone number to call in emergencies.

**For more information on Material Safety Data Sheets, see the Appendix**

# REFERENCE PUBLICATIONS

Earlier in this module we discussed sources of information. Printed reference material should be used by hospital workers to identify a possible hazardous material. These publications should be readily available. The following list of publications will provide hospital personnel with information pertaining to the identification and suggested actions/treatments for HAZMAT:

1. DOT North American Emergency Response Guide Book
2. Emergency Medical Response to Hazardous Materials Incidents
3. Emergency Care for Hazardous Materials Exposure
4. Goldfranks Toxicologic Emergencies
5. NIOSH Pocket Guide to Chemical Hazards

# The D.E.C.I.D.E. PROCESS

The D.E.C.I.D.E. process is a guide to your intervention during an emergency. It is meant to minimize personal risk and in order to do so certain basic decisions must be made.

## To use the process you will:

**D**etect the presence of hazardous materials and/or contaminated patients.
**E**stimate the likely harm without intervention.
**C**hoose the response objectives.
**I**dentify the action options.
**D**o the best option.
**E**valuate your progress.

**Detect** and identify the hazardous materials present. Know the size of your problem!

**Estimate** the likely harm without intervention.

**Choose** objectives based on your knowledge of the problem. What is the overall goal—the harm you want to prevent? This is a most critical step.

**Identify** your action options, with your objectives in mind. Take the time to consider all practical options before you act. You are defining your tactics in this step.

**Do** the best possible option, the one with the most gain and the least loss.

**Evaluate** your progress to see if what you expected to happen is happening. You may have to change your actions based on your evaluation.

# MODULE 4

# PERSONAL PROTECTIVE EQUIPMENT (PPE) AVAILABLE TO THE HOSPITAL WORKER

## Outline

- **Introduction**
- **The Hospital Worker and Hazardous Materials Incidents**
- **The Difference Between Structural Fire Fighting PPE And Hazardous Materials PPE**
- **Recognized Personal Protective Equipment Operating Limitations**
- **Personal Protective Equipment For The Hospital Worker**
- **Routes Of Entry Of Hazardous Materials Into The Human Body**
- **The Means By Which Personal Protective Equipment Performance May Become Compromised**
- **When To Remove Personal Protective Equipment**

# MODULE 4
# PERSONAL PROTECTIVE EQUIPMENT AVAILABLE TO THE HOSPITAL WORKER

## Objectives

*The student will be able to:*

1. Identify two limitations of the standard response uniforms worn by police, firefighters, and emergency medical/hospital personnel.

2. Identify the EPA/OSHA four levels of chemical protective clothing.

3. List the four routes of entry by which hazardous materials may enter the body.

4. List three chemical means by which personal protective equipment's performance may be compromised.

5. List when and where personal protective clothing can be removed, following a HAZMAT/Decon incident.

6. Demonstrate proficiency in ppe donning/doffing procedures for Level B & Level C ensembles.

# I. INTRODUCTION

Greater care should be given to personal protection of the hospital personnel with more detail given to approach and operational procedures. The availability of proper protective equipment, or the lack of it, has a direct bearing on how and if an approach is made; what the incident mitigation objectives can be; how work area assignments are made and defined; and how the establishment of working limits (operating time, work zones, and personal protection) are determined.

The most critical factor here is the life threat to hospital personnel. Without knowledge of exactly what personal protection equipment is necessary for the materials involved in the incident and the protective limits of the equipment, the incident response team can get into serious trouble. The first concern should be the proper protection of the hospital worker.

## FEDERAL REGULATIONS PERTAINING TO THE USE OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

The term Personal Protective Equipment (PPE) is used in this document to refer to both personal protective clothing and equipment. The purpose of PPE is to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered at a hazardous material Decon incident.

OSHA standards mandate specific training requirements (8 hours of initial training to demonstrate competency) for employees engaged in emergency response to hazardous substances incidents at the First Responder Operations level. Additionally, each employer must develop a safety and health program and provide for emergency response. These standards also are intended to provide additional protection for those who respond to hazardous materials incidents, such as firefighters, police officers, and EMS personnel. One such regulation is OSHA's March 6, 1989, 29 CFR [1910.120] final rule as it applies to emergency medical personnel states that: "Training shall be based on the duties and functions to be performed by each responder of an emergency response organization (p. 9329).

## TRAINING IS ESSENTIAL BEFORE ANY INDIVIDUAL ATTEMPTS TO USE PPE

No single combination of protective equipment and clothing is capable of protecting against all hazards. Thus, PPE should be used in conjunction with other protective methods. The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. In general, the greater the level of PPE protection, the greater are the associated risks. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. Over-protection can be as hazardous as under-protection and should be avoided. Personnel should not be expected to use PPE without adequate training. The two basic objectives of any PPE program should be to protect the wearer from safety and health hazard and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include: hazard identification; medical monitoring; environmental surveillance; selection, use, maintenance, and decontamination of PPE; and training.

## PROTECTIVE EQUIPMENT FOR HOSPITAL PERSONNEL

The first consideration of all hospital personnel must be their own safety. That thought sounds simple enough. You would think that if you're in the hospital, some distance from the incident in fresh air, that you're okay. This may not necessarily be true! The products involved in hazardous materials incidents can be colorless, odorless, tasteless, and, you may not feel their presence as they envelop you in a cloud whose effects may not be noticed until years later. The question of hospital personnel safety is dependent upon three factors:

1. What products are involved in the incident?
2. What are their associated risks under the incident conditions?
3. What level of protection should operating personnel have to deal with the incident?

The first and second factors can only be answered through discovery of what products are involved. **If, and as long as, the products remain unknown,** then a worse case probability should be assumed. Once the product or products are known and the risks have been evaluated accordingly, **then** the level of personal protection can be set to match the needs of the operational objectives.

**All** personnel **must** therefore understand what constitutes personal protection or personal protective equipment. This includes all personnel who work in or near the incident site, regardless of whether they be the nurses, physicians, emergency medical services personnel, x-ray, lab, respiratory services, maintenance, security or food service.

**Unless the product exposure risk is known and determined to be no risk at all, or of little risk to personnel, unprotected people should be denied access to the incident site, and their proximity to the operational area should be clearly defined and closely monitored.**

The psychological feeling of invulnerability is a significant factor when dealing with emergency services personnel. The danger must always be in the mind of the incident commander as a concern during operations.

Everyone is vulnerable unless they:

1. Are properly protected before they enter the incident site
2. Are aware of the risks present at the site
3. Know what objectives can be realistically attained

## PROTECTIVE CLOTHING SELECTION FACTORS

A. **CLOTHING DESIGN.** Manufacturers sell clothing in a variety of styles and configurations.

1. **Design Considerations.**
   - Clothing configuration
   - Components and options
   - Sizes
   - Ease of donning and doffing
   - Clothing construction
   - Accommodation of other selected ensemble equipment
   - Comfort
   - Restriction of mobility

## B. **MATERIAL CHEMICAL RESISTANCE.**

**Permeation** is the process by which a chemical dissolves in or moves through a material on a molecular basis. In most cases, there will be no visible evidence of chemicals permeating a material.

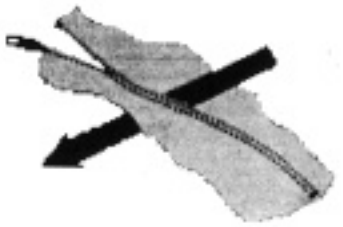
Permeation breakthrough time is the most common result used to assess material chemical compatibility. The rate of permeation is a function of several factors such as chemical concentration, material thickness, humidity, temperature, and pressure. Most material testing is done with 100% chemical over an extended exposure period. The time it takes chemical to permeate through the material is the breakthrough time. An acceptable material is one where the breakthrough time exceeds the expected period of garment use. However, temperature and pressure effects may enhance permeation and reduce the magnitude of this safety factor. For example, small increases in ambient temperature can significantly reduce breakthrough time and the protective barrier properties of a protective clothing material.

**Chemical resistance** is represented by charts and tables distributed by the manufacturers of the protective clothing or their testing agencies which have performed these tests. They typically show their resistance or relative effectiveness against generic classes of chemicals. The majority of these tables or charts show the ability of a material to resist by **degradation**. The test performed simply determines if the material once exposed degrades. If the material does not degrade then it may be listed as excellent resistance capability to a specific chemical.

The remainder of the charts or tables show resistance ratings on data collected by **permeation**. If permeation does occur, the time it takes after exposure and the rate it occurs is usually listed on this type of chart.

It is important to note that presently not all protective clothing materials are being tested for each specific chemical. In addition, tests are subject to variation due to the test method performed. Since these tests are performed under controlled environments, exposure in the field may differ from those in the laboratory tests. Results may actually be longer or shorter. Some other factors that may influence the outcome may be the time the chemical is in contact with the material, the concentration of the chemical, and what level or how strong the chemical is. Temperature and humidity are all factors that are not calculated with regard to field activities.

**Degradation** involves physical changes in a material as the result of a chemical exposure, use, or ambient conditions (e.g. sunlight). The most common observations of material degradation are discoloration, swelling, loss of physical strength, or deterioration.



**Penetration** is the movement of chemicals through zippers, seams, or imperfections in a protective clothing material.

*It is important to note that no material protects against all chemicals and combinations of chemicals, and that no currently available material is an effective barrier to any prolonged chemical exposure.*

Sources of information include:

- ***Guidelines for the Selection of Chemical Protective Clothing***, 3rd Edition. This reference provides a matrix of clothing material recommendations for approximately 500 chemicals based on an evaluation of chemical resistance test data, vendor literature, and raw material suppliers. The major limitation for these guidelines are their presentation of recommendations by generic material class. Numerous test results have shown that similar materials from different manufacturers may give widely different performance. That is to say manufacturer A's butyl rubber glove may protect against chemical X, but a butyl glove made by manufacturer B may not.
- ***Quick Selection Guide to Chemical Protective Clothing.*** Pocket size guide that provides chemical resistance data and recommendations for 11 generic materials against over 400 chemicals. The guide is color-coded by material-chemical recommendation. As with the "Guidelines . . ." above, the major limitation of this reference is its dependence on generic data.
- ***Vendor data or recommendations.*** The best source of current information on material compatibility should be available from the manufacturer of the selected clothing. Many vendors supply charts which show actual test data or their own recommendations for specific chemicals. However, *unless vendor data or the recommendations are well documented, end users must approach this information with caution.* Material recommendations must be based on data obtained from tests performed to standard ASTM methods. Simple ratings of "poor," "good," or "excellent" give no indication of how the material may perform against various chemicals.

Mixtures of chemicals can be significantly more aggressive towards protective clothing materials than any single chemical alone. One permeating chemical may pull another with it through the material. Very little data is available for chemical mixtures. Other situations may involve unidentified substances. In both the case of mixtures and unknowns, serious consideration must be given to deciding which protective clothing is selected. If clothing must be used without test data, garments with materials having the broadest chemical resistance should be worn, i.e. materials which demonstrate the best chemical resistance against the widest range of chemicals.

## DOES ONE SIZE FIT ALL?

It should also be noted here that **no one type of personal protection will satisfy every condition encountered** at hazardous materials incidents. Obviously, selecting the appropriate level of personal protective equipment necessary for the incident and properly wearing it, is the key to a safe and effective operation.
Clothing which is specifically designed for hazardous materials incidents, and for use with specific types of chemicals, falls into four categories: Level A, Level B, Level C, and Level D. The predominant physical, chemical, and toxic properties of a chemical, or chemicals, involved in a hazardous materials incident will dictate the specific type of chemical protection required. The guidelines for the use of these various levels of protection are as follows:

### Level A: MAXIMUM PROTECTION

**Should be worn when the highest level of respiratory, skin, and eye protection is required.**

Level A Conditions:

- Unknown gas concentrations.
- Known extremely toxic or corrosive gases.
- Possible or expected skin exposure to toxic or corrosive liquids, gases or solids.
- IDLH Atmospheres


Level A Configuration:

- Fully-encapsulating chemical resistant suit completely encloses user and SCBA.

**Level B: HIGH RESPIRATORY PROTECTION**

**Should be worn when the highest level of respiratory protection is needed but a lesser level of skin protection is required. (SPLASH PROTECTION)**

Level B Conditions:

- Known contaminant levels below IDLH concentrations.
- Atmosphere with less than 19.5% oxygen.
- Chemical concentrations which are above the TLV level.

Level B Configuration:

- Chemical resistant clothing including boots and gloves, that generally do not fully enclose user and SCBA.

**Level C: LIMITED RESPIRATORY PROTECTION**

**Should be worn when the criteria for using air-purifying/respirators has been met.**

Level C Conditions:

- Greater than 19.5% oxygen.
- Contaminant level below IDLH and above TLV.
- Skin contact hazards are minimal or do not exist.

Level C Configuration:

- Level B and Level C differ only in type of respiratory protection required. The chemical protective clothing requirements are the same.

**Level D:** **MINIMUM PROTECTION**

**Should be worn only as a work uniform and not on any site with a respiratory or skin hazard.**

Level D Conditions:

- No possibility of respiratory exposure.
- No possibility of skin exposure.
- No contaminant levels below TWA.

Level D Configuration:

- Standard Work Uniform, including structural firefighter protective equipment.

# CHEMICAL PROTECTION OF CLOTHING MATERIALS BY GENERIC CLASS

| Genric Class | Butyl Rubber | Polyvinyl Chloride | Neoprene | Natural Rubber |
|---|---|---|---|---|
| ALCOHOL | E | E | E | E |
| ALDEHYDES | E-G | G-F | E-G | E-F |
| AMINES | E-F | G-F | E-G | G-F |
| ESTERS | G-F | P | G | F-G |
| ETHERS | G-F | G | E-G | G-F |
| FUELS | F-P | G-P | E-G | F-P |
| HALOGENATED HYDROCARBONS | G-P | G-P | G-F | F-P |
| HYDROCARBONS | F-P | F | G-F | F-G |
| INORGANIC ACIDS | G-F | E | E-G | F-P |
| INORGANIC BASES | E | E | E | E |
| KETONES | E | P | G-F | E-F |
| NATURAL FATS & OILS | G-F | G | E-G | G-F |
| ORGANIC ACIDS | E | E | E | E |

KEY: E = EXCELLENT G = GOOD Source US DOT/USCG September 1974
F = FAIR P = POOR

# PERMEATION RATE FOR TYVEK FABRICS 1994

| | | Tyvek QC | | Tyvek Sarenex 23-P | | Tychem 7500 | | Barricade | | Tychem 9400 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Normal Break Thur Time | Perm Rate | Normal Break Thur Time | Perm Rate | Normal Break Thur Time | Perm Rate | Normal Break Thur Time | Perm Rate | Normal Break Thur Time | Perm Rate |
| **Chemical Name** | **Physical Phase** | **minutes** | **ug/cm2 /min** | **minutes** | **ug/cm2 /min** | **minutes** | **ug/cm2 /min** | **minutes** | **ug/cm2 /min** | **minutes** | **ug/cm2 /min** |
| Acetone | L | immed. | 10 | 24 | 1.6 | 338 | 0.16 | >480 | ND | >480 | ND |
| Acetonirile | L | immed. | 16 | 13 | 2.8 | 14 | 180 | <480 | ND | >480 | ND |
| Ammonia (anhydrous) | G | immed. | 3.1 | 32 | 0.15 | 125 | 0.5 | 47 | 0.4 | 47 | 0.4 |
| 1,3Butadiene | G | 8 | 12 | >480 | ND | >480 | ND | >480 | ND | >480 | ND |
| Carbon Disulfide | L | immed. | high | 8 | >50 | >480 | ND | >480 | ND | >480 | ND |
| Chlorine Gas | G | immed. | >50 | >480 | ND | >480 | ND | >480 | ND | >480 | ND |
| Dichloromethane | L | immed. | >50 | >480 | ND | >480 | ND | >480 | ND | >480 | ND |
| Diethylamine | L | immed. | 64 | 12 | >50 | >480 | ND | >480 | ND | >480 | ND |
| Hydrogen chloride | L | immed. | 9.3 | >480 | ND | 180 | 0.54 | >480 | ND | >480 | ND |
| Sulfurin Acid concen. | L | >480 | ND | >480 | ND | >480 | ND | >480 | ND | >480 | ND |

Copied from the Dupont Chemical And Fibers Div.
Permeation Guide for DuPont Tychem Fabrics 1994.

# CHEMICAL RESISTANCE AND PERMEATION CHART
## Playtex Industrial Gloves—Styles #834, #835, #4153

Permeability— Expressed as the amount of vapor diffusing through the rubber film per unit time (mg/cm2 hrs.)

Chemical—Resistance Expressed as the deterioration of the film to the resistance solvent/chemical.

| Chemical | Permeation Rating | Chemical Resistance Rating | Chemical | Permeation Rating | Chemical Resistance Rating |
|---|---|---|---|---|---|
| Acetone | S | S | Isobutyl Alcohol | E | E |
| Acetonitrile | VG | E | Isopropyl Alcohol | VG | E |
| Acetic Acid, Glacial | VG | VG | Kerosene | VG | VG |
| Ammonium Fluoride (4%) | E | VG | Methyl Alcohol | VG | E |
| Ammonium Hydroxide Concentrated | VG | E | Methyl Ethyl Ketone | S | S |
| Amyl Acetate | VG | VG | Methyl Isobutyl Ketone | S | S |
| Aniline | VG | E | Methylene Chloride | P | P |
| Benzene | P | P | Mineral Spirits | S | VG |
| Carbon Tetrachloride | P | P | Muriatic Acids | E | VG |
| Castor Oil | E | E | Naphtha | P | S |
| Cellosolve | VG | E | Nitric Acid (25%) | VG | E |
| Chromatic Acid (5.9%) | S | VG | Nitric Acid (69%) | P | S |
| Cleaning Solution | S | S | Nitrobenzene | P | P |
| Chlorobenzene | P | P | Nitroethane | VG | E |
| Cyclohexanone | S | S | Octane | S | VG |
| Diethanolamine | VG | E | Oleic Acid | E | VG |
| Diethyl Ether | P | P | Perchloroethylene | P | P |
| Dimethylacetamide | VG | S | Phenol | VG | E |
| Diethylformamide (DMF) | VG | S | Pine Oil | S | S |
| Doctyl Phthalate | VG | E | Phosphoric Acid | VG | VG |
| Ethyl Acetate | S | VG | Potassium Hydroxide (50%) | E | E |
| Ethyl Alcohol | VG | E | Sodium Hydroxide (25%) | E | E |
| Ethylene Glycol | VG | E | Sulfuric Acid (5%) | E | E |
| Formamide | VG | VG | Sulfuric Acid (25%) | E | VG |
| Formaldehyde (30%) | VG | S | Tetrahydrofuran (THF) | P | S |
| Formic Acid | VG | VG | Toluene | P | S |
| Hydrochloric Acid (10%) | E | E | Trichloroethane | P | P |
| Hydrochloric Acid (Concentrated) | E | E | Trichloroethylene | P | P |
| Hydroflouric Aicd (50%) | VG | VG | Triethylamine | VG | E |
| Hydrogen Peroxide | VG | E | Xylene | P | S |

Key to Chart: **E** = no permeation/no chemical attack
**VG** = trace permeation/mild chemical attack
**S** some permeation/moderate chemical attack
**P** significant permeation/significant chemical attack

This is a partial list of chemicals in which Playtex gloves have been tested. Method of testing is available upon request. If recommendations are required for specific concentrations, or operating conditions on chemical listed above, or on chemicals not listed, please contact:

Industrial Glove Division, International Playtex Inc.
700 Fairfield Avenue
Stamford, CT 06902

## Types

Some of the most common materials used in the manufacture of protective clothing:

- Poly Vinyl Chloride (PVC)
- Poly Vinyl Alcohol (PVA)
- Butyl Rubber
- Viton—(fluroelastomer)
- Chlorinated polyethylene (CPE)
- Neoprene
- Nitrile
- Natural Rubber (Latex)
- Tyvek (Spun Bonded Olefin)
- Teflon or combination of other materials with teflon.

## Selection by Levels of Protection

The level of protection selected should be based on:

- The type and measured concentration of the chemical substances in the ambient atmosphere and its toxicity.
- Potential for exposure to substances in air, splashes of liquids, or other direct or indirect contact with materials or substances due to work being performed.

**In dealing with unknown concentrations or levels of exposure, the maximum level of protection should be selected.**

**PHYSICAL PROPERTIES.**

1. As with chemical resistance, manufacturer materials offer wide ranges of physical qualities in terms of strength, resistance to physical hazards, and operation in extreme environmental conditions. Comprehensive manufacturing standards such as the NFPA Standards set specific limits on these material properties, but only for limited applications, i.e. emergency response.
2. End users in other applications may assess material physical properties by posing the following questions:
   - Does the material have sufficient strength to withstand the physical strength of the tasks at hand?
   - Will the material resist tears, punctures, cuts, and abrasions?
   - Will the material withstand repeated use after contamination and decontamination?
   - Is the material flexible or pliable enough to allow end users to perform needed tasks?
   - Will the material maintain its protective integrity and flexibility under hot and cold extremes?
   - Is the material flame-resistant or self-extinguishing (if these hazards are present)?
   - Are garment seams in the clothing constructed so they provide the same physical integrity as the garment material?

**EASE OF CONTAMINATION.** The degree of difficulty in decontaminating protective clothing may dictate whether disposable or reusable clothing is used, or a combination of both.

**COST.** Protective clothing end users must endeavor to obtain the broadest protective equipment they can buy with available resources to meet their specific application.

**CHEMICAL PROTECTIVE CLOTHING STANDARDS.** Protective clothing buyers may wish to specify clothing that meets specific standards, such as 1910.120 or the NFPA Standards. The NFPA Standards do not apply to all forms of protective clothing and applications.

Other types of protection that must be considered, but are not specifically listed as chemical protective equipment, and are incorporated into the levels of protection that are standard issue to all those working in the field include the following:

- Head protection (hard hat, helmets, etc.)
- Foot protection (boots & shoes)
- Hand protection (gloves)
- Ear protection (ear plugs or muffs to protect against damage to the ear).

**Some other factors to be considered dealing with chemical protective clothing and its use in hazardous material response are:**

**STRENGTH:** The materials ability to resist tears, punctures, and abrasions as well as tensile strength.

**FLEXIBILITY:** The ability of a material to remain soft and pliable, easy to move about and work. Stretchability.

**THERMAL LIMITS:** The ability of a material to maintain its protective capability in temperature extremes. Thermal limits would include cold weather and hot weather. Examples would be that of how lower temperatures effect mobility and how during high temperatures the ability of the material to insulate the wearer.

**LIFE EXPECTANCY:** The ability to resist aging due to exposure to sunlight, general use, repeated washing using cleaning agents and its ability to be decontaminated.

Additionally, specialized equipment that may be utilized for specific applications are, but not limited to:

- Approach Suit
- Flash Suit
- Proximity Suit
- Entry Suit

These specific types of protective clothing may be used to provide the wearer with additional protection depending on the specific hazard presented.

As each response organization evaluates the hazard confronting them, many are now and have been requiring the use of **FLASH SUIT** protection. While little to no protection is afforded with respect to chemical resistance, its use can go a long way to improving survivability in the field where volatile materials are present.

**APPROACH SUIT**

These specific types of protective clothing may be used to provide the wearer with additional protection depending on the specific hazard presented.

An example may be that an entry team may wish to use an aluminized suit or approach type suit in dealing with a hazard that has a high potential to ignite or is flammable in nature (i.e.—Propane). While this equipment is not specifically chemically resistant, it provides an added level of protection to the wearer.

**FIRE ENTRY**

## Limited Use Garments (Disposals)

Similarly, tyvek garments which have specific protective properties in as far as chemical resistance, have been used over top of standard chemical protective clothing and firefighting turnout gear to provide the wearer with chemical protection when dealing with materials that are flammable and/or possess a high potential for ignition.

Variations of protective clothing ensembles are encouraged; however, it should be noted that variations should only be used after careful consideration of the potential hazard involved. Part of the risk assessment phase is to determine the risk, assess the hazard and potential, and develop your tactical plan. While variations of protective clothing may be classified as EPA Level B protection, users should always check with the manufacturer of the material or garment and be guided by their recommendation prior to the actual use in the field.

## Flash Suit Protection

Basically a coverall type design that completely covers the wearer and his Level A protective garment. Typical materials used are aluminized outer covering with either Nomex III™ substrate material or PBI® Kevlar™ fabric.

The basic design is to provide the wearer exposure to up to 2000 degrees Fahrenheit for not longer than 5 seconds. (momentary flash)

Intended and designed for those entries that have or have had the potential for the materials to volatilize and ignite.

## NFPA Chemical Protective Clothing Standards

The National Fire Protection Association has completed the development and publishing of four (4) national standards regarding chemical protective clothing for use during hazardous chemical emergencies.

**NFPA 1991 Standard:**

This standard is for specifying the design and performance criteria for a chemical protective garment that is intended to be used in a gaseous or vapor atmosphere of chemicals. This garment must be totally encapsulating.

**NFPA 1992 Standard:**

This standard is for the design and manufacture of a garment that did not have to meet the rigid permeation resistance requirements found in the 1991 standard. In the 1992 standard, Standard on Liquid Splash-protective Suits for Hazardous Chemical Emergencies, the emphasis was basically on two things:

1. single to multi-piece garments
2. suitable chemical test that reflected resistance to liquids.

Its use is for liquid splash environments only.

**NFPA 1993 Standard:**

This standard deals with support functions and is described as hazardous chemical operations involving controlled chemical uses or exposures in non-flammable atmospheres with minimum threats to loss of life, personnel injury, or damage to property or to the environment. Functions include, but are not limited to, decontamination, remedial cleanup, and training.

**NFPA 1994**

This standard specifies minimum design, performance and documentation requirements, and test methods for protective ensembles for personnel responding to incidents involving the release of dual-use industrial chemicals, chemical warfare agents or biological warfare agents.

## Protection From Chemical Warfare Agents

Military-issued equipment to protect against these agents varies widely based on the level of anticipated exposure. Civilian activities in the presence of these materials are regulated by HAZWOPER, which is more stringent than military standards. As in any chemical emergency, *use the highest level of protection available until the chemical is identified*. Modify that level of protection as appropriate after determining what chemicals are present. For example, nerve and blister agents require SCBA with Level A protection. Other toxic chemicals may require a lower level of protection.

## WHEN TO REMOVE PERSONAL PROTECTIVE EQUIPMENT (PPE) IF IT HAS BEEN CONTAMINATED

There is always the possibility that circumstances will cause PPE to become contaminated despite all precautions. Personnel should continually check each other to detect any contamination. The question of exactly when it is safe to remove contaminated PPE is dependent on several factors which can become quite complicated. The scope of the incident and the probability that multiple chemicals are involved must be considered. The dilemma goes beyond "when" to include where can protective equipment be removed; why should it always be removed when you leave the incident area; what should be removed based on the conditions; and who should do the removal of the equipment. Who, what, when, where, why and how are all critical questions which must be answered when dealing with the removal of personal protective equipment.

The removal of personal protective equipment should never be done within the incident "hot zone" or in any contaminated area until recognized professionals have determined, through the use of appropriate equipment, that the hazard risk has been removed. The incident commander is responsible for insuring that incident operations in the work area, the decontamination area, and any other areas used during the incident are safe.

If personal protective clothing and equipment is removed within the incident site, even where it has been declared safe, incident commanders must continue to monitor personnel, who should also be checking each other, to insure that symptoms of exposure are not becoming apparent. There is always the chance that something was missed. A test may have been performed incorrectly or a testing device may fail. The final responsibility again lies with the incident commander.

Regardless of the type of contaminated protective clothing, the removal of the protective envelope should be a closely monitored and planned exercise. It should only be done when it has been declared safe to do so, and only in an area which has been specifically designated and designed for the purpose. Where the risks to health are unknown or found to be serious—great care must be taken in removal supervision and personnel safety. Personnel are not safe until they have removed their protective clothing an equipment, and are returned to a safe and clean environment.

# RESPIRATORY PROTECTION

The use of respiratory protection at a hazardous materials incident or Decon is mandatory. The level (degree) of respiratory protection must be in compliance with both OSHA regulations, NIOSH guidance documents, standard operating procedures, and, most of all, be suited for the hazard and the wearer. Air purifying respirators (APR's) and self-contained breathing apparatus (SCBA) are the only two forms of respiratory protection that are addressed.

## Respiratory Protection Need

One of the most common routes of entry of chemical exposure is by inhalation. Entry of a chemical by inhalation is also one of the easiest to control. While the respiratory tract or system has some very good protection, most often during chemical exposures, this protection is not sufficient to handle the chemical exposure. Health and Safety professionals must consider one of the three (3) means of controlling respiratory hazards from these chemical exposures.

- Engineering Controls
- Administrative Controls
- Personal Protective Equipment

NOTE: Personal Protective Equipment is last on the list.

The OSHA HAZWOPER standard (29 CFR 1910.120) does not permit the use of administrative controls as a means of reducing worker exposure to chemical hazards. If engineering controls are not utilized, the effects of chemical exposure on the human body may be:

- Asphyxiation
- Allergic reaction
- Anesthetic effect
- Irritations
- Systemic poisoning
- Cancer causing

If engineering controls are inadequate or not practical, personal protective equipment (respiratory) must be used.

The OSHA respiratory protection standard, 29 CFR 1910.134 requires employers to supply suitable respiratory protection for all employees and personnel who may be exposed to unknown levels of toxins, IDLH atmospheres and/or above permissible exposure levels (PEL) OSHA and PEOSHA address a written respiratory program.

**Respiratory protection program shall include:**

1. Standard Operating Procedures/Guidelines (SOP/SOG) for the selection and use.
2. Proper selection of respirators based on the hazard.
3. Training of personnel in the use, care and maintenance of respiratory equipment.
4. Regular cleaning and maintenance.
5. Routine inspections before & after use with appropriate documentation.
6. Constant monitoring of work area for changing conditions and worker stress.
7. Continual evaluation of respiratory compliance program.
8. Determination of medical fitness of users.
9. Use of approved equipment (typically NIOSH and MSHA).
10. Proper fit testing.

Also included in the program is the use of the buddy system, emergency alerting, evacuation and accountability.

## Types of Respiratory Protection

There are two major classifications for respiratory protection:

1. Air Purifying Respirators (APR)
2. Atmosphere Supplying Respirators (SAR, SCBA)

### Air Purifying Respirators

Air purifying respirators allow the wearer to use atmospheric air by filtering out, absorbing or neutralizing the airborne contaminants.

Use of air purifying respirators are limited and only appropriate when:

1. Atmospheric oxygen levels are above 19.5%
2. Chemical substance is known
3. Chemical substance can be filtered, absorbed or neutralized
4. Chemical substance has a detectable odor below IDLH
5. Airborne concentration of chemical substance is known
6. Airborne concentration of chemical substance does exceed .1% or 1000 ppm
7. Airborne concentration of chemical substance does not exceed established IDLH

## Canister Selection

The canisters or cartridges used in an air purifying respirator are selected according to the chemical in the air and the physical state of the chemical. These cartridges are color coded:

| Atmospheric Contaminants to be Protected Against | Colors Assigned |
|---|---|
| Acid Gas | White |
| Hydrocyanic Acid Gas | White with 1/2 inch green stripe completely around the canister near the bottom |
| Chlorine Gas | White with 1/2 inch yellow stripe completely around the canister near the bottom |
| Organic Vapors | Black |
| Ammonia Gas | Green |
| Acid Gas & Ammonia Gas | Green with 1/2 inch White stripe completely around the canister near the bottom |
| Carbon Monoxide | Blue |
| Acid Gases, organic vapors & Ammonia gases | Brown |
| Radioactive materials, excepting tritium and noble gases | Purple (Magenta) |
| Particulates (dusts, fumes, mists, fogs, or smoke) in combination with any of the above gases or vapors | Canisters color for contaminants, as designated above, with 1/2 inch Gray stripe completely around the canister near the TOP |
| All of the above atmospheric contaminants | Red with 1/2 inch Gray stripe completely around the canister near the TOP |

*Gray shall not be assigned as the main color for a canister designed to remove acids or vapors.

NOTE: Orange shall be used as a complete body, or stripe color represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

## The Use of Air Purifying Respirators (APR's)

The use of APR's is limited to the available approved cartridges or canisters. Both cartridges and canisters have very limited use, if used at all, during a hazardous materials incident. This is due to several very critical factors:

1. APR's are negative system, thus allowing for infiltration of contaminated air into the mask,
2. APR's have limited use times.
3. APR's require individual fit testing prior to actual use and wearing.
4. APR's do not protect the wearer from unknown air contaminants.
5. APR's ARE NOT APPROVED FOR USE BY EMERGENCY RESPONDERS AT A HAZARDOUS MATERIALS INCIDENT UNLESS THE AGENT AND ITS CONCENTRATION IS KNOWN AND IS BELOW IDLH.
6. You can be sure that the contaminants at the emergency will not elevate nor control the oxygen content of the atmosphere.

As stated in Item 4, in order for APR's to provide the safe and proper level of protection necessary for the wearer to be protected, the wearer must know both the contaminant type and concentration. This may not be the case for the emergency worker or hazardous materials responder.

As such, this form of respiratory protection is usually reserved for use by those workers that are outside both the hot and warm zone, and who have been properly fit tested as well as supplied with the appropriate canister or cartridge, based upon verifiable air monitoring. ONLY UNDER THE DIRECT SUPERVISION OF THE ON SCENE COORDINATOR OR OTHER HEALTH OR SAFETY OFFICER CAN THESE DEVICES BE USED AT A HAZARDOUS MATERIALS INCIDENT.

## Powered Air Purifying Respirators (PAPR's)

An alternative to the traditional air-purifying respirator (APR) is the PAPR, in which a motor-blower draws surrounding air through particulate filters and/or chemical cartridges that capture any contaminants. Purified air then passes through a breathing tube to a face piece (full or half) or hood. The air pressure in the face piece or hood is higher than the surrounding air, creating a positive pressure environment (unlike an APR which functions under negative pressure). This means that if a small leak occurs in the face piece or hood air will flow from the inside to the outside hopefully keeping any contaminant from entering the face piece. Because of the positive pressure created by the motor-blower PAPR's are generally more comfortable to wear. However, many of the indications/contradictions for use are the same as for an APR.

PAPR with a full face mask.

PAPR with hood.

## Self-Contained Breathing Apparatus (SCBA)

The SCBA affords the wearer the best, and highest, level of respiratory protection (Level B and Level A). It provides the wearer with his or her personal air supply, totally segregated from the environmental air.

Although there exist various makes, models, styles, and manufacturers, the important thing to remember is that there exists only three types:

1. Re-breathers
2. Demand
3. Pressure Demand

RE-BREATHERS are basically air generators. The wearer is supplied with a closed, recirculating system, whereby exhaled air is sent through a carbon dioxide scrubber, and returned, after a small "injection" of oxygen. The wearer also carries a small canister of oxygen in the unit. THESE UNITS ARE NOT TOTALLY POSITIVE PRESSURE AND ARE NOT APPROVED FOR HAZARDOUS MATERIAL RESPONDERS.

The DEMAND type, NOT APPROVED FOR USE AT HAZARDOUS MATERIAL INCIDENTS, only provides positive pressure to the user upon exhalation. As such, the possibility exists that the wearer may breathe contaminated air.

The PRESSURE DEMAND type is the ONLY TYPE APPROVED FOR USE AT HAZARDOUS MATERIAL INCIDENTS, since positive pressure is always present in the system, thus preventing the wearer from inhaling environmental air.

## Supplied Air Respirators (S.A.R.)

Similar in use and function to the SCBA is the **S**upplied **A**ir **R**espirator (SAR) or air-line system. This system consists of a mask and regulator connected by an umbilical hose to a large air reservoir or tank manifold system. The SAR is frequently used in confined space entry and in tasks that require the operator to remain on air for long periods of time. There are however drawbacks in the use of an SAR system: they are limited to a maximum hose length of 300 feet, mobility restrictions, and multiple operators can easily become entangled in each others hoses. **Whenever an SAR system is used the operator must be outfitted with a 10-15 minute escape bottle.**

Hospital personnel conducting Decon in SAR's

## The Hazardous Materials Involved

The form of hazardous material involved will have a direct bearing on the choice of personal protective equipment, or the decision to withdraw from the area. These are three broad categories of hazardous material to consider: chemical materials, biological (etiologic) materials, and radioactive materials.

These categories can be defined as follows:

1. **Chemical Materials:** Are materials which are hazardous because of their chemical and physical properties.
2. **Biological Materials:** Are organisms which can have a dangerous effect on life or the environment, and they can exist in normal ambient environments.
3. **Radioactive Materials:** These are materials which emit ionizing radiation.

Each of these categories and the risks associated with that particular category of hazardous material will influence the choice of personal protective equipment. In addition, the type of material, as referenced to these categories, can have far reaching effects on how personal protective equipment is used (operationally), how and whether it can be decontaminated, and whether it can be reused during the operation. An incident involving radioactive material, for example, can lead to the disposal of all personal protective equipment utilized during the incident—**and it can never be used again**. This can certainly be an expensive proposition for many communities.

The physical state of the hazardous material involved is also a factor of concern in choosing protective equipment. Materials, or elements, can be classified into three basic states of matter: gases, liquids, and solids. Each of these states can affect your choice of equipment and how you wear it. As an example, large solids are not as much of a problem as liquids, gases or fine dusts (solid particles) and vapors, which can permeate or penetrate protective clothing as well as contaminate it.

## PPE DONNING AND DOFFING

The procedures listed below are given for liquid splash protective suit ensembles and should be included as part of the written Decon plan.

### Donning the Ensemble

A routine should be established and practiced on a regular basis for donning (putting on) the various ensemble configurations that the Decon Team may use. Assistance should always be provided during donning and doffing (taking off) as these procedures are difficult to perform alone, and solo efforts may increase the possible of ensemble damage.

The procedure below lists sample procedures for donning chemical protective clothing. These procedures should be modified depending on the suit and accessory equipment used. These procedures assume that the wear has previous training in respirator use and decontamination procedures.

#### Suit Inspection

Prior to Donning and **periodically** during the use of the suit it should be closely inspected, some sample inspection guidelines are:

Determine that the clothing material is correct for the specified task at hand.

*Visually inspect for:*

- Imperfect seams
- Nonuniform coatings
- Tears
- Malfunctioning closures
- Hold up to light and check for pinholes

*Flex the suit material:*

- Observe for cracks
- Observe for other signs or shelf deterioration.

If the product has been used previously, inspect inside and out for signs of chemical attack:

- Discoloration
- Swelling
- Stiffness

Once the equipment has been donned, its fit should be evaluated. If the clothing is too small, it will restrict movement, increase the likelihood of tearing the suit material, and accelerate the wearer fatigue. If the suit is too large, the possibility of snagging the material is increased, and the dexterity and coordination of the wearer may be compromised. In either case, the wearer should be recalled and better fitting clothing provided.

**Sample Donning Procedure**

1. Inspect clothing and respiratory equipment before donning.
2. Adjust hard hat (if worn).
3. Standing or sitting, step into the legs of the suit; ensure proper placement of the feet within the suit; then gather the suit around the waist.
4. Put chemical resistant boots over the feet of the suit. Seal the boot and suit cuff interface with duct tape.
5. Put on inner medical type gloves.
6. Pull upper half of suit up and put arms through sleeves.
7. Put on outer gloves and seal the glove and cuff interface with duct tape.
8. Secure front closure on suit and seal with duct tape.
9. Put on harness and tank assembly of the SCBA. Don face piece and adjust it for security.
10. Perform negative and positive respirator face piece seal test procedure, if using an APR.
11. Pull hood over head, being careful not to disturb face piece deal.
12. Seal mask and hood interface with duct tape.
13. Open air valve on tank.
14. Have assistant check all interfaces and closures.
15. Place regulator in mask.
16. Report to work area.

## Checking the APR Face Piece

Prior to donning the user should always inspect the respirator, make sure both inhalation and exhalation valves are inside the mask. Check for any signs of wear or deterioration. After donning and before entry into the work area the users should aways check for leaks by performing both **positive- and negative-pressure checks**:

***Positive-Pressure Check***—Block the exhaust port(s) with the heel of your hand and exhale with enough force to cause a slight positive pressure inside the face piece. If the face piece bulges slightly and no air leaks between the face and face piece are detected, a proper fit has been obtained.

***Negative-Pressure Check***—Block the intake port(s) with your palms and inhale for five to ten seconds. If the face piece collapses slightly and no air leakage is detected between your face and the face piece, a proper fit has been obtained.

Performing a negative pressure test.

## Doffing an Ensemble

Exact procedures for removing chemical protective clothing must be established and followed in order to prevent contaminate migration from the work area and transfer of contaminates to the wearers body, the assistant and others.

The procedures listed below should be performed only after decontamination of the person wearing the suit.

**Sample Doffing Procedure**

1. Remove any extraneous or disposable clothing, boot covers, and tape.
2. Loosen SCBA straps and remove pack while remaining on air.
3. Sit on chair with SCBA pack positioned next to chair.
4. Have assistant remove outer gloves, be careful to leave inner gloves on.
5. Stand up to remove upper portion of suit, one sleeve at a time, using caution to not allow outer surface of suit to contact wearer.
6. Sit down, have assistant remove boots.
7. Partially stand and have assistant remove lower half of suit, using caution to not allow outer surface of suit to contact wearer.
8. Remove mask and regulator assembly.
9. Remove inner gloves by rolling them off the hand turning them inside out.
10. Report for medical monitoring, followed by shower.

For more information on respiratory protection see Appendix G.

# PROTECTIVE CLOTHING AND DEVICE FOR HAZARDOUS MATERIALS/WMD WORKER SURVEY

| EPA LEVEL | DEGREE OF EXPOSURE | NATURE OF EXPOSURE | RESPIRATORY PROTECTION | PROTECTIVE CLOTHING | EXAMPLES OF WORK ENVIRONMENTS |
|---|---|---|---|---|---|
| **A** | HIGHEST LEVEL OF EYE, SKIN AND RESPIRATORY PROTECTION NEEDED | IDLH IN AIR AND SKIN IS MET. ABSORPTION THROUGH SKIN & CONTACT CAUSES SEVERE INJURY OR DEATH. | S.C.B.A. OR AIR LINE WITH ESCAPE BOTTLE | FULLY ENCAPSULATED SUIT (CHEMICAL SPECIFIC RESISTANT)<br>GLOVES } (CHEMICAL RESISTANT)<br>BOOTS }<br>2 WAY INTRINSICALLY SAFE RADIO | CONFINED SPACES AND OXYGEN DEFICIENT ATMOSPHERE. HIGH EXPOSURE POTENTIAL. EXPLOSIVE OR HIGH VISIBLE OR SUSPECTED TOXIC OR CORROSIVE VAPORS AND GASES. USED WHEN EXCAVATING LEAKING DRUMS (CYANIDE POISONS, ARSENICS AND PESTICIDES) EMERGENCIES WITH KNOWN TOXIC ENVIRONMENTS. |
| **B** | HIGHEST LEVEL OR RESPIRATORY PROTECTION BUT LESSER SKIN PROTECTION | AIR CONCENTRATIONS REQUIRE HIGH PROTECTION (IDLH IN AIR), 19.5% OXYGEN OR LESS.<br>NO SEVERE SKIN HAZARD (SPLASH) | S.C.B.A. OR AIR LINE WITH ESCAPE BOTTLE | CHEMICAL RESISTANT COVERALL (SPLASH SUIT) DISPOSAL CHEMICAL SUITS COVERALLS AND LONG UNDERWEAR 2 PR. CHEMICAL RESISTANT GLOVES BOOTS AND COVERS HARD HAT ESCAPE MASK 2 WAY INTRINSICALLY SAFE RADIO | TOXIC SUBSTANCES HAVE BEEN IDENTIFIED. RESPIRATORY PROTECTION IS A PROBLEM. NO SEVERE SKIN DAMAGE. USED WHEN HANDLING DRUMS, TEMPORARY STORAGE FACILITY WHERE HIGHER LEVEL OF PROTECTION IS NOT REQUIRED. POSSIBLE POTENTIAL OF TOXIC VAPORS OR OXYGEN DEFICIENCY. |
| **C** | WHEN AIR PURIFYING RESPIRATOR IS NEEDED | OXYGEN IS GREATER THAN 19.5% IN AIR. UP TO TLV VALUE IS MET. | FULL FACE AIR PURIFYING RESPIRATOR | CHEMICAL RESISTANT COVERALL (SPLASH SUIT) DISPOSAL CHEMICAL SUITS COVERALLS AND LONG UNDERWEAR 2 PR. CHEMICAL RESISTANT GLOVES BOOTS AND GLOVES HARD HAT ESCAPE MASK 2 WAY INTRINSICALLY SAFE RADIO | S.C.B.A. NOT NEEDED BUT RESPIRATOR IS REQUIRED. NO ADVERSE AFFECTS TO SKIN IF SPLASHED. DIRECT READING INSTRUMENTS SHOW SLIGHTLY ABOVE BACKGROUND OR TLV VALUES. PARTICLES OR DUST IN AIR. |
| **D** | NO PROTECTION NEEDED AGAINST HAZARDS | LESS THAN TLV LEVEL | NOT NECESSARY TO BE WORN | NORMAL WORK ATTIRE | ADMINISTRATION AREA OF WORK SITE. NO CONTAMINATION. LOW THREAT OF HAZARD IMPACT. |

## MEDICAL CONSIDERATIONS FOR WEARING CPC

The most common cause of injury to workers involved in hazardous materials mitigation is heat stress—induced by the wearing of chemical protective clothing. With the availability of higher capacity SCBAs and supplied air or cascade systems, the restricting factor on work periods has become the health, and wisdom, of the individual. We must adequately assess the health threats to all workers in CPC and properly implement the necessary safeguards to ensure well-being. Stress management techniques and medical monitoring of emergency response personnel are the principal points in accomplishing this goal.

Both physiological and psychological stress can severely affect response personnel. Under certain conditions, stress can contribute significantly to accidents or harm workers in other ways. This chapter will provide information about the physiologic and psychological stress encountered by personnel who operate in CPC.

### Stress Programs

Any complete program that attempts to reduce the potential for abnormal physical stress or mental anxiety should incorporate pre-incident, on-site and post-incident components:

- Workers must be periodically examined by medical authorities to determine if they are physically, and if possible, psychologically fit to perform their duties.
- Continual practice and training must be provided in using PPE, especially Self-Contained Breathing Apparatus and Chemical Protective Clothing.
- An effective safety program must be implemented, and concerted efforts made, to protect the worker. These actions help to ensure personnel that their health and safety will be protected now, and in the future.

### Stresses of Encapsulating Garments

Many hazardous materials responders and team managers tend to underestimate the risks to personnel working in chemical protective clothing because they focus on the environment and the chemicals, and fail to adequately recognize the health risks associated with wearing CPC.

Technological advances in chemical protective clothing, SCBA and supplied (compressor, cascade) air systems make it possible to work in hazardous environments for much longer periods than was ever permitted before. This presents a significant increase in the health risk to personnel as they become limited more by their own physical conditions than by the limitations of their protective equipment. Yet, this very same protective equipment can become a *"hostile interior environment"* as personnel are subjected to 100% humidity and elevated temperatures within 7 minutes of donning the suit.

Response personnel must also recognize situations where there is a potential for protective clothing to become breached or otherwise damaged. Protective ensembles, by their very design and function, are intended to prevent a hostile exterior environment from entering the suit and reaching the individual. This infers that the suit will also keep hostile substances *inside* the suit, next to the individual, once they have entered. It can create a situation where the substance concentration is higher in the *interior* of the suit than on the exterior.

## Incident Stressors

Personnel operating in chemical protective clothing are typically subjected to four types of stressors: environmental, mechanical, psychological and physiological.

- **Environmental stresses** include temperature and humidity both outside and inside the suit, wind conditions, terrain, confined spaces, etc. These factors can affect both the physical and mental state of personnel wearing CPC. These factors must be taken into account during mission planning activities.
- **Mechanical stresses** are caused by faults or defects in the protective equipment; limitations inherent in the CPC (mobility, dexterity, visibility, etc.); or objects that come into contact with the garments creating punctures, tears, rips or abrasions. Close inspection of the suits, careful planning at the incident, and attention to detail in the task, are the best preventative techniques for mechanical stress.
- **Physiologic stresses** are created by the physical characteristics of the individual: age, fitness, health and personal habits.
- **Psychological stresses** are manifested by anxiety and/or claustrophobic reactions to operating in adverse environments, with dangerous materials, or under unfamiliar conditions. These may be due to the incident, the individual, or the chemical protective equipment itself. Often these psychological stresses have lingering effects that must be dealt with during Incident Stress Debriefings and/or individual counseling conducted by trained professionals.

## Physiological Factors

Just wearing an encapsulating garment puts personnel at considerable risk for injuries ranging from heat-related illnesses to various physical traumas, chemical toxicity, or psychological harm. Conditions related to the incident (the environment, the CPC itself, difficulty and duration of the work performed, etc.) are part of the problem. Individual physical and emotional characteristics of the personnel themselves are also significant contributing factors. Some of the factors that predispose individuals to injuries include lack of physical fitness, lack of familiarity, anxiety, age, dehydration, obesity, personal habits, illness, sunburn, diarrhea and disease. Each are discussed below.

- **Lack of physical fitness** is an avoidable condition that should not be tolerated by employers or employees. Hospitals should develop doctrines that encourage fitness in the members of the decon team. Personnel who have low work capacities are more susceptible to heat-related injuries.
- **Lack of familiarity** is another inexcusable factor in injuries. Team members should practice and drill with various CPC until they are as comfortable with them as they are with any other duty they need to perform.
- **Anxiety** may be overcome with time and training, claustrophobia is too serious of a condition to risk an employee's health on. No one with this condition should be allowed to work in chemical protective clothing, particularly the encapsulating kinds.
- **Age** affects personnel in numerous ways; general health, reaction time, stamina, and dexterity are a few. Younger individuals are often preferred for assignments that require working in CPC. However, older individuals who are physically fit and experienced in dealing with hazardous materials are a valuable resource, and should not be overlooked merely because of age.
- **Dehydration** caused by sweating, diarrhea or other conditions is one of the principal causes of heat-related injuries. Therefore, anyone who exhibits symptoms of dehydration (unusual thirst, etc.), or signs of other maladies for that matter, should not be assigned to duties that require the use of CPC.
- **Obesity** causes excessive stress on the body, especially to the cardiovascular system, under normal conditions. Wearing CPC will put additional stress on the body. Obese individuals ideally should not be chosen for tasks requiring the use of CPC.
- **Personal habits** can greatly affect an individual's health. Alcohol, smoking and drug use can result in diminished lung capacity and mental alertness. Even an individual who is experiencing the effects of a "rough night on the town" should be barred from wearing CPC. Over the counter medications, especially decongestants and antihistamines, may increase the risk of heat stress.
- **Infections or other illnesses** preclude personnel from operating at "peak efficiency." Strenuous physical activity will further deplete their already overtaxed energy and immune systems.

- A **sunburn** can cause extreme discomfort when it's irritated. The body is already coping with one injury. Aggravating that injury may cause further harm to the individual.
- **Diarrhea** depletes large amounts of body fluids. Expecting an already dehydrated individual to operate in an environment where fluid loss is the greatest hazard is tantamount to gross negligence. Diarrhea may also be difficult to manage while confined in an encapsulating suit.
- **Chronic diseases**, such as emphysema, heart disease or significant obesity, can severely limit the physical capabilities of personnel. Emergency response personnel who manifest signs of chronic illnesses should be prohibited from participating on Decon teams.

## Work Tolerance

Chemical protective clothing directly influences work tolerance. Heavy, bulky suits are much more difficult to work in than lighter suits. Level A suits have been known to reduce work tolerance by as much as 50%. The slight margin of comfort created by multi-piece suits helps to explain their popularity over the encapsulating type.

Heat stress and work tolerance are interrelated. As the work duration increases, heat tolerance decreases. Chemical protective clothing adds weight, bulk and heat to the wearer. It also severely reduces the effectiveness of normal heat exchange mechanisms such as evaporation of sweat, convection from cooling currents and radiation of body heat. The interior of the suit begins to behave much as a sauna does with temperatures rising to well over 100 degrees F. The temperature inside the suit can be more than 25% higher than the external ambient temperature. At the same time, interior suit humidity rises until it is near 100%. This not only severely represses the body's cooling mechanisms, it acts to reflect heat back towards the body, elevating core temperatures even further. The result can quickly become catastrophic if the metabolic processes are not managed properly.

As an example, FEMA studies have shown that personnel wearing Level A chemical protective clothing, working hard in a typical California summer climate, lost approximately 5% of their body weight within the duration of just one air bottle (about 45 minutes). This completely disrupts normal blood chemistry and can be a very dangerous medical condition.

## Effects of Cold Exposure

Personnel working in extreme cold, even for a short time, may experience severe injury to the surface of the body (frostbite) or profound generalized cooling (hypothermia). The result may include permanent injury or death. Personnel exhibiting signs of hypothermia should be immediately removed from the environment, placed in a warm location, covered with blankets and provided with warm liquids to drink.

Two factors influence the development of a cold injury: ambient air temperature and wind velocity. "Wind chill" is used to describe the chilling effect of moving air in combination with low temperatures. For instance, 10 degrees F with a wind of 15 miles per hour is equivalent in chilling effect to still air at –18 degrees F. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. This simple doubling in wind speed can quadruple the wind chill factor. The effects are far worse when the skin is wet. Water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical protective equipment is removed and the clothing beneath is soaked with perspiration.

Local injury resulting from cold is included in the generic term *"frostbite."* Areas of the body which have high surface-to-volume ratios, such as fingers, toes and ears, are the most susceptible to frostbite. Frostbite of the extremities can fall into three categories:

- Frost Nip or Incipient Frostbite: Characterized by sudden blanching or whitening of the skin.
- Superficial Frostbite: Characterized by skin with a waxy or white appearance that is firm to the touch, but the tissue beneath is resilient.
- Deep Frostbite: Characterized by cold, pale skin that is solid to the touch. This is an extremely serious injury.

Systemic *hypothermia* is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

- Shivering: the body's automatic mechanism to generate heat through muscle contractions.
- Apathy, listlessness, sleepiness, and sometimes rapid cooling of the body to less than 95 degrees F.
- Unconsciousness, glassy stare, slow pulse and respiratory rates.
- Freezing of the extremities.
- Death.

Always consult available standard reference books or higher medical authority any time signs and symptoms of hypothermia become visible.

## Work Mission Duration

Work mission duration is an important factor in safeguarding the health and well-being of decon personnel. Work mission duration is dependent upon a number of factors including travel and decontamination times, environmental conditions, work load, CPC, and the limitations of the personnel themselves. It must also include a safety factor to protect against problems that may arise during the operation.

A "Work Mission Duration" form, such as the sample on the following page, can be used to provide a relatively subjective analysis of safe operating times. The form provides recommended work times based on environmental conditions. Actual operating times can be adjusted based on available air supplies. However, there are two important points to remember when adjusting work times. First, the person with the lowest remaining air supply dictates the time remaining for all team members. Second, return travel time, decontamination time and the safety margin must all be deducted from the total time remaining in order to determine the safe operating work time.

**One other word of caution: supplied air systems are almost limitless. It's even more critical to follow the recommended work times when using supplied air systems to prevent over-exertion injuries to personnel.**

## Rest Periods

Providing adequate rest periods between work missions is just as important as limiting work mission duration. The Environmental Protection Agency has established guidelines for responder rehabilitation times based on research of endurance rates. This is one tool which is available to response teams. Drills and training exercises should be used as an avenue to measure and test rest period durations in given environments. However, regardless of how an agency determines adequate rest periods, the time frames must be predicated upon measurable factors such as the anticipated work levels, environmental conditions, type of protective garments, individual workers' characteristics and fitness, and medical monitoring results.

## Work Mission Duration

Incident Name_____ Date:_____ Location:_____

| Air Supply | 30 Minutes | 45 Minutes | 60 Minutes | Umbilical Air |
|---|---|---|---|---|
| Safety Factor | | | | |
| Travel Time (times 2) | | | | |
| Environmental Conditions (L-0, M-5, H-10) | | | | |
| Work Load (L-0, M-5, H-10) | | | | |
| Decontamination (maximum) | | | | |
| Other | | | | |
| Operating Work Time (To be amended during incident as dictated by actual air supply) | | | | |

Recommended Work Time (Between Rest Periods)
When wearing Chemical Protective Clothing

| Air Temperature (Maximum) | Sunshine (Radiant Heat Exposure) | | |
|---|---|---|---|
| | Full Sun No shadows | Partly Sunny Shadows 50% | Full Shade |
| 70 F | 60 Min. | 90 Min. | 120 Min. |
| 75 F | 30 Min. | 60 Min | 90 Min |
| 80 F | 20 Min. | 30 Min. | 60 Min. |
| 85 F | 15 Min. | 20 Min. | 30 Min |
| 90 F | 10 Min. | 15 Min. | 20 Min. |
| 95 F | Danger | Danger | 15 Min |

Reference: Occupational Safety and Health (OSHA) Guidance Manual for HAZwaste Site Activity

## WORK MISSION DURATION FORM INSTRUCTIONS

Each part of the Work Mission Duration Form which needs to be completed is explained below:

1. **Air Supply:** Across the top of the form are standard air supplies (30/45/60 minute air bottles and umbilical air). When completing the form, enter information into the column that corresponds to the air supply being used by the Decon Team.
2. **Safety Factor:** A standard rule of thumb is that personnel should be able to perform the task, exit the zone, complete decontamination, and begin doffing before the low-air alarm sounds. On most SCBAs the alarm will sound with approximately a 5 minute reserve. Therefore, 5 minutes is an acceptable standard entry in this portion of the form.
3. **Travel Time:** This should be a close estimation of the travel time to and from the site.
4. **Environmental Conditions:** Environmental conditions impact emergency response personnel before they don PPE, while they are working, and after they doff the garments. Temperature and humidity are the primary factors to be concerned about. The recommended entries are as follows:

| Entry | Environmental Condition |
|---|---|
| 0 | Cool and Dry |
| 5 | Warm and Moist |
| 10 | Hot and Wet |

5. **Work Load:** The type of work is another measurable factor. The greater the work load, the greater the impact. The recommended entries are as follows:

| Entry | Work Load |
|---|---|
| 0 | Light |
| 5 | Moderate |
| 10 | Heavy |

6. **Decontamination:** Decon takes time to accomplish. The more people who need decontamination, the more time will be required. The number entered into this row should account for the time it takes to decontaminate *all* team members.
7. **Other:** This row provides a place to account for other factors which impact air supply such as age, obesity or personal habits. Again, it is not recommended that these individuals participate in these types of activities, but sometimes there is no other choice.
8. **Operating Work Time:** The estimated operating work time is entered at the bottom of the form. To determine the operating work time, add the entries from all the previous rows, then subtract that number from the total air supply available.

## Field Meteorology

Field monitoring must include conditions relating to the health and well-being of emergency response personnel. Temperature, relative humidity and wind speed are the minimum components necessary to define the environmental parameters for personnel at the site.

Ambient air temperature and relative humidity are combined to determine the "heat index." This index is a measure of the body's ability to cool itself. As already mentioned, the most important cooling process of the body is evaporation. The amount of moisture that air can hold is a function of the ambient air temperature. The higher the temperature, the more moisture that it can hold. When the air is already high in moisture content, less moisture can be removed from our bodies. In other words, humidity decreases the effectiveness of evaporation and general cooling.

The lungs are an important source of evaporation in the human body. While the following is an oversimplification of the physiology involved, it is important for responders to understand the impact of humidity. As the moisture content in the air increases, the exhaled air in the lungs begins to approximate the same moisture level and no evaporation occurs. When the moisture content in the lungs is high, the amount of oxygen in the lungs is diminished. Additionally, the lungs serve to expel wastes dissolved in water, much as urine does. When the moisture in the lungs cannot evaporate, these wastes begin to build up. This is one reason why people tend to feel such discomfort in high humidity.

As already indicated, the wind speed (or "wind chill factor") is another important condition. It can be beneficial in warm climates, and dangerous in cold ones. Wind chill charts should be a standard reference for emergency response teams as they monitor the well-being of personnel at the scene.

## Heat Related Illnesses

Heat related illnesses are the most common stress situation encountered by workers in CPC. However, the potential for these life-threatening injuries is not limited to emergency situations. Records exist to document that personnel are just as susceptible to these stresses during drills and training sessions.

Most of the systematic studies that apply to heat stress and protective clothing are adaptations of military tests conducted from the 1940's to the 1960's. However, in 1990 the Biotherm Company conducted stress testing for FEMA. 20 firefighters were tested for psychological responses to each of three suits. The climactic conditions used during this study were:

| Climactic Conditions | Degrees Celsius | Degrees Fahrenheit |
|---|---|---|
| Hot/dry | 38.9-42.2 | 102-108 |
| Hot/wet | 30.0-33.8 | 86-93 |
| Comfortable | 21.1-27.2 | 70-81 |
| Cold | 5.7-7.2 | 42-45 |

Each firefighter wore one suit per day. The individuals' rectal temperature, heart rate, blood pressure, recovery rate and body weight were recorded. The inside garment temperature was determined and environmental parameters were measured. The test lasted 55 total minutes, with 45 minutes of exercise time—equivalent to 5.5-6.5 METs. Results showed that increases in all parameters were greatest during the hot/dry and hot/wet phases. Rectal temperatures exceeded NIOSH regulations in all cases (100.5 degrees F). Some heart rates exceeded maximum treadmill test values.

Human beings are homiotherms. This means that they self-regulate their internal temperatures. This "body core" temperature—not the temperature at the skin surface—is what we have come to recognize as 98.6 degrees F (37 ± degrees C). This is an average temperature and very few individuals actually register 98.6 degrees F on a regular basis.

Body core temperature is maintained by a portion of the brain known as the hypothalamus, through what is known as the "set point." When core temperatures deviate too many degrees on either side of the set point the brain sets into motion certain physical reactions to counter the temperature change:

- Shunting blood to the core, along with muscle contractions (shivering) to raise internal temperatures, or
- Shunting blood to the surface, along with sweating (evaporation) to lower internal temperatures.

These physical reactions are based upon standard thermodynamic laws: conduction, convection and radiation.

This heat balance equation is expressed as:

$$DT = \text{Met Heat} \pm \text{convection} \pm \text{- radiation} \pm \text{conduction} - \text{evaporation}$$

(where DT = Deep Temperature and Met Heat = Metabolic Heat)

## Heat Dissipation Modes

**Conduction** is the transfer of heat between two solids, or a solid and a liquid, that are in contact with one another. The dissipation of heat through conduction is minimal for emergency response personnel. This would typically only occur where the responder's body came into direct contact with the PPE suit material, when sitting, or holding onto an object that is cooler than the body.

**Radiation** is the transfer of heat between two bodies that are not in direct contact with each other. This transfer occurs as infrared waves that carry energy from an emitter (radiator), outward in all directions, to a receiver. An example of this is the heat radiated from asphalt on a hot day. Objects that emit electromagnetic energy greater than 39 degrees C (95 degrees F) are heat radiators to the human body. Color is another heat variable. Lighter colored objects or materials tend to reflect the majority of the electromagnetic energy that strikes them, while dark objects tend to absorb most of that energy. This means that while light colored PPE suits will absorb some radiated heat, they will absorb far less than the darker suits will.

**Convection** is the transfer of heat that does not involve a phase change. Simply stated, convection utilizes liquid or gaseous mediums, or masses, to transport heat energy to other objects. These liquid or gaseous masses pick up the heat and carry them on rising columns to other objects where they can be absorbed. An example of this would be cool air blowing against dry skin. This form of heat exchange is also of little use to responders wearing PPE because of the insulating properties of the suit. As responders exhale air into the suit, the suit expands, creating an air void that limits the transfer of heat (or cooling).

**Evaporation** is the transfer of heat using a phase change. This phase change utilizes heat carried by a liquid such as sweat. As air travels over this liquid, heat energy is absorbed by the air from the liquid and carried away from the body. Evaporation is the major process, set off by the brain "set point," for body cooling. PPE is utilized by responders because it is impermeable to the transfer of vapors. This same quality renders the garments totally ineffective to the transfer of heat away from the body by evaporation.

## Physical Heat Responses

The combination of physical exertion and lack of cooling begins to raise the body's core temperature. As the internal temperature rises, the body starts various control functions to moderate this heat. Increasing amounts of blood are shunted from the core to the cutaneous layers of skin. Greater amounts of sweat are produced for evaporative cooling. The heart begins to pump faster and harder to move more volumes of heat to the surface.

The body begins to lose ground when the heat cannot be dissipated quickly enough. The internal heating process continues, building more heat that still cannot be dissipated by normal body mechanisms. Eventually, the thermal regulatory system is overwhelmed. The brain now exacerbates the cooling problem by greatly increasing the "set point," which severely diminishes any further amounts of sweat production. This condition marks total failure of thermoregulation by the body.

One dysfunction that occurs is the build-up of lactic acid in the muscle tissues. Lactic acid is a by-product of muscular activity which can only be removed through oxidation. However, the metabolic processes of muscle activity preferentially use available oxygen to assist the muscles in work. Since there is insufficient oxygen during activity to oxidize both the acid and the muscle tissues, the acid begins to accumulate. The results are muscle cramps and physical pain, and can lead to significant acidosis.

Additionally, all humans are exercise-limited by the cardiovascular system. When energy is no longer available from the ready nutrient sources; blood sugars and stored fats, the body will begin to go after other sources—muscles, then nerves, and then other tissues. The brain is in even worse shape since it cannot store oxygen or nutrients, and must have immediately available supplies of both.

The body's initial response to exercise is to increase the heart's stroke volume (SV). This is the amount of blood ejected by one beat of the heart. The second body response to exercise is to increase the heart rate (HR)—the number of beats/min. The identified safe maximum number of beats-per-minute for an individual is computed by the equation:

$$\text{Max. HR} = 220 - \text{age}$$

This increased stroke volume and heart rate can result in a cardiac output (CO) of 20-25 liters per minute:

$$\text{CO} = \text{HR} \times \text{SV}$$

Typically, the average adult blood volume is about 3.2 liters. This blood is primarily composed of plasma and red blood cells. Blood also provides the fluid used in the production of sweat. Therefore, sweating begins to deplete the available blood volume as some of the fluid is converted for the sweating process.

Physical exertion provides another impact. Exercise begins a process in the body that leads to the dilation of the blood vessels. As the walls of the vessels begin to expand, the normal blood volume can no longer fill the intervening space. The normal plasma volume is insufficient to circulate oxygen and nutrients to the various body areas that are in need. A simple rapid increase of only 5 or 10% dilation in the vascular system is sufficient to produce relative hypovolemia. When massive vasodilation occurs, such as often accompanies shock, blood volume resuscitation may require 10 liters, or more.

## Heat Related Injuries

If the body's physiological processes fail to maintain a normal body temperature, and excessive heat is allowed to build up, a number of physical reactions can occur. These may range from mild (fatigue, irritability, anxiety, decreased concentration and dexterity) to fatal. Heat related injuries are the result of certain thermal disorders:

**Heat Rash:** Caused by continuous exposure to heat and humid air, and aggravated by chafing clothes. Heat rash decreases the ability to tolerate heat, as well as being a general nuisance.

**Heat Cramps:** Caused by profuse perspiration with inadequate fluid intake and chemical replacement (especially salts). Signs of heat cramps include muscle spasms, and pain in the extremities and abdomen.

**Heat Exhaustion:** Heat exhaustion is caused by increased stress on various organs to meet increased demands to cool the body. While the body is still capable of producing sweat, a condition known as cardiovascular insufficiency is developing. This condition exists when the total available blood volume is no longer capable of fulfilling the vascular system's needs. Typical signs and symptoms include rapid breathing; flushed, cool, moist skin; profuse sweating; dizziness and lassitude. The body temperature is between 37.5-38.5 degrees C (99.5-101.3 degrees F).

**Heat Stroke (Sunstroke):** The most serious heat related injury is heatstroke—sometimes referred to as "sunstroke." This is the catastrophic failure of the body's thermoregulatory system and is a true medical emergency that can rapidly result in the patient's death. The body must be cooled immediately to prevent severe injury and/or death. Signs and symptoms include red and hot skin; nausea; dizziness and confusion; strong, rapid pulse; hypotension; coma. The body temperature is over 40 degrees C (104 degrees F). Although victims are classically described as having dry skin and no perspiration, since these victims will be coming out of CPC with a 100% humidity level, the clothing and skin will be moist. The major differences between heat exhaustion and heat stroke clinically are elevated temperature and altered mental status.

## Treatment of Heat Illnesses

Anyone who exhibits the signs or symptoms of a heat related illness requires immediate medical attention. These individuals should be removed to a shaded area and cooled by evaporative or active cooling methods. Intravenous therapy should be considered anytime that cardiovascular insufficiency is a factor or the victim is unable to drink fluids.

# Heat Stress Index

HUMIDITY%

| | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% |
|---|---|---|---|---|---|---|---|---|---|
| 104 | 98 | 104 | 110 | 120 | 132 | | | | |
| 102 | 97 | 101 | 108 | 117 | 125 | | | | |
| 100 | 95 | 99 | 105 | 110 | 120 | 132 | | | |
| 98 | 93 | 97 | 101 | 106 | 110 | 125 | | | |
| 96 | 91 | 95 | 98 | 104 | 108 | 120 | 128 | | |
| 94 | 89 | 93 | 95 | 100 | 105 | 111 | 122 | | |
| 92 | 87 | 90 | 92 | 96 | 100 | 106 | 114 | 122 | |
| 90 | 85 | 88 | 90 | 92 | 96 | 100 | 106 | 114 | 122 |
| 88 | 92 | 86 | 87 | 89 | 93 | 95 | 100 | 106 | 115 |
| 86 | 80 | 84 | 85 | 87 | 90 | 92 | 96 | 100 | 109 |
| 84 | 78 | 81 | 83 | 85 | 86 | 89 | 91 | 95 | 99 |
| 82 | 77 | 79 | 80 | 81 | 84 | 86 | 89 | 91 | 95 |
| 80 | 75 | 77 | 78 | 79 | 81 | 83 | 85 | 86 | 89 |
| 78 | 72 | 75 | 77 | 78 | 79 | 90 | 81 | 83 | 85 |
| 76 | 70 | 72 | 75 | 76 | 77 | 77 | 77 | 78 | 79 |
| 74 | 68 | 10 | 73 | 74 | 75 | 75 | 75 | 76 | 77 |

**Add 10°F when wearing protective clothing and 10°F when in direct sunlight**

| HUMITURE °F | DANGER CATEGORY | INJURY THREAT |
|---|---|---|
| BELOW 80° | **NONE** | LITTLE OR NO DANGER UNDER NORMAL CIRCUMSTANCES |
| 80° to 90° | **CAUTION** | FATIGUE POSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY |
| 90° to 105° | **EXTREME CAUTION** | HEAT CRAMPS AND HEAT EXHAUSTION POSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY |
| 105° to 130° | **DANGER** | HEAT CRAMPS OR EXHAUSTION LIKELY, HEAT STROKE POSSIBLE IF EXPOSURE IS PROLONGED AND THERE IS PHYSICAL ACTIVITY |
| ABOVE 130° | **EXTREME DANGER** | HEAT STROKE IMMINENT! |

# Medical Monitoring

The need for medical monitoring guidelines is heightened by the pressures placed on emergency responders by their supervisors, peers, and their own individual motivations, to continue working even when it is no longer safe for them to do so. Fortunately, OSHA requirements specify medical monitoring as a component of the Site Safety Plan. This reduces the chances that individuals may exceed their physical limitations due to inappropriate motivations. However, we must also recognize that medical monitoring has certain implications. It may shorten the work time for each individual, which requires that additional trained responders be available to mitigate the same incident. Medical monitoring may also increase the time between entries, and increase the times needed for rehydration, rest periods and temperature recovery—again increasing the number of trained responders required. These two factors illustrate the need to better prioritize the objectives for personnel working in the various zones.

## Pre-Entry and Post-Entry Assessments

Medical support and assessment is an important element of safe Decon operation when wearing CPC. Medical monitoring should be initiated both before donning, and after completion of the work rotation.

More important than the legal requirements for medical monitoring is the personal impact of monitoring on the individual. We already know that heat related illnesses (heat exhaustion and heat stroke) are the number one health risk to emergency responders. Heat related illnesses are most prevalent during warm or hot weather. Monitoring vital signs provides the best method to prevent or identify these conditions. Obviously, the backbone of this program rests with assigning critical values that identify these symptoms before they become serious.

Monitoring programs are not limited to field locations. 29 CFR 1910.120 designates two types of programs: baseline medical exams and field monitoring programs. Medical monitoring is a multifaceted program that is predicated on the status of the individual:

- Employees who have hazardous materials incident response functions as a regular, expected function of their employment.
- Employees who *do not* have hazardous materials incident response functions as a regular, expected function of their employment.

Employees in the first category fall into the group of those who must have baseline medical examinations, as well as pre-entry and post-entry monitoring. Employees in the second group require pre-entry and post-entry monitoring only. Hospital personnel are in the second category.

Baseline medical evaluations are conducted under the guidance of a physician and are done biennially, annually, or prior to response. Pre-entry assessments are routinely conducted by medical personnel; however, or other person familiar with the collection of vital signs. Post-entry screening applies the monitoring guidelines, as suggested in this chapter, to assess physical status at the scene.

Emergency decon personnel must establish a medical monitoring station at each incident. The medical monitoring site should be located near the "dress out" area for the Entry or Decontamination Team personnel. If possible, this should be in a cool, shaded location away from noise and other distractions.

All pre-entry and post-entry vitals that are taken must be documented. Therefore, agencies should establish some sort of record keeping system to document these vitals.

## Elements of an Effective Medical Monitoring Program

Advances in medical science have altered our understanding of what constitutes heat illnesses and what their more accurate indicators are. Previously, we held the belief that the best indicators for measuring heat distress were accomplished by assessing the patient's temperature, heart rate and blood pressure. We now accept that a more accurate assessment is gained by measuring the patient's body core temperature, heart rate and water weight loss. Therefore, an effective medical monitoring program should include assessments of these essential factors.

**Body weight:** It is possible for individuals to have a sweat rate as high as 3.5 liters per hour when they are wearing chemical protective clothing. Fluid loss is an element of heat stress management that cannot be made up quickly. Fluid metabolism is a slow process that must occur throughout the day to be truly effective. A good rule of thumb for fluid replacement is to administer 1-1.5 x the amount of fluid weight as was lost through the incident activity. When considering the administration of fluids, do not rely on the patient's thirst level alone. This is a deceptive indicator. Another indicator of dehydration is deeply yellow colored urine, however false indicators from certain vitamins and various foods can also create this condition. Don't guess. Rely on measurable indices: body weight loss using a scale accurate to within 1/4 of a pound.

Suggested water weight loss parameters are:

- Body weight loss should not be allowed to exceed 1.5% of total body weight.
- A 3% loss of body weight should require that the individual be immediately removed from all duties pending a thorough assessment by a qualified medical authority.
- A 5% loss of body weight should require that the individual be immediately removed and have a thorough assessment performed. This person will likely require lengthy rehydration.

Be cautious when taking the post-entry body weights. Post-entry assessment is intended to weigh the amount of fluid remaining in the body tissues. Weighing individuals who have rehydrated or are still in sweat soaked garments defeats the purpose of the measurement. Pools of liquid in the stomach or hanging on the body serve no immediate value and may mask a serious condition. Make sure the post-entry weight is a "dry" one.

**Body temperature:** The most common of body temperature assessment is the oral thermometer, but oral temperatures are not accurate enough to rely on for determining patient well-being. The second option is hardly practical in the field. Even though rectal temperatures are the most representative deep core temperature indicator, few responders would consider them to be practical at a hazardous materials incident. The third option provides the best solution. Tympanic temperature readings (taken through the ear drum) are a good indicator of body core temperatures and are relatively easy to acquire.

The best method of accurately determining an individual's temperature rise is by establishing a baseline prior to the event. This is accomplished by measuring the temperature every day over a two week period. However, this is not always an easy task to accomplish. Again, some guidelines can be utilized.

- A maximum rise in temperature should not exceed 1.5 degrees Fahrenheit upon post-entry examination.
- No personnel should be permitted to continue working until their temperatures return to within 0.5 degrees of normal.
- To be valid, the temperature must be acquired as quickly as possible after the individual has exited the work zones.
- Temperature must be $<$100.4 F.

**Pulse or heart rate:** The pulse is the best indicator of the overall stress being applied to the body. It is a direct measurement of how fast the body is attempting to cool itself, and it indicates the aerobic exercise recently generated by the individual. The most widely accepted pulse measurement is known as the *"Age Adjusted Maximum Heart Rate*. This figure represents the limit to which an individual can maintain aerobic exercise for extended periods without damaging the heart muscles. However, this number should never be exceeded by personnel. To figure the Age Adjusted Heart Rate, subtract the individual's age from the number 220.

$$220 - \text{age} = \text{Adjusted Heart Rate}$$

**Blood pressure:** This is a health component that is not believed to be affected by heat stress, and does not require constant monitoring. However, it is a measurement of the "quality" of rest by the heart muscle between each stroke and is worth tracking.

**General health:** Is an overall indicator of the responders' fitness for stressful working environments. This includes general physical appearance and identification of personnel who haven't

been feeling well lately. Underlying medical problems such as diabetes may present a problem under stressful conditions.

**Neurological status:** Can be an early indicator of stress and/or exposure.

**Electrocardiograph strip:** Sometimes provides a good, qualitative baseline if available.

## Pre-Entry Procedures

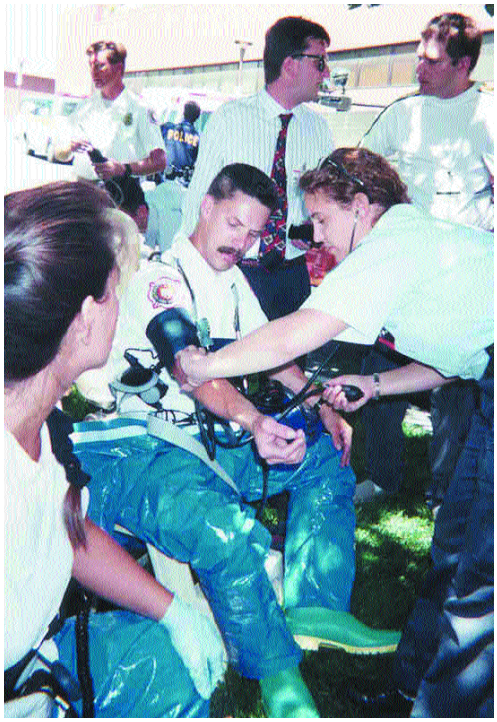
Pre-entry vital signs and weights shall be taken prior to performing any strenuous activities or donning any chemical protective equipment. Baseline vital signs should include:

- Blood Pressure
- Pulse
- Respirations
- Weight
- Temperature

The Medical Monitor shall calculate the following values for each Team member: (Refer to Chart)

- Maximum Heart Rate (220 – Age)
- 85% of Maximum Heart Rate
- 60% of Maximum Heart Rate
- 5% Body Weight
- 3% Body Weight

All information shall be entered on the medical monitoring forms.



Any personnel required to wear CPC/PPE should be medically monitored.

Any team member with any of the following conditions shall not be allowed to don PPE.

| | |
|---|---|
| Temperature | >100.4 degrees F. |
| Blood Pressure | >150/90* |
| Heart Rate | >60% of Maximum Heart Rate, or |
| Respirations | >25 |

*Less conservative values up to 180/100 are probably acceptable but should be decided on by the team's medical authority.

## Post-Entry Procedures

After team members doff PPE they shall immediately proceed to the medical monitoring station. The medical monitors will obtain the following:

- Pulse—first minute
- Pulse—3 minutes after first pulse (recovery rate)
- Temperature
- Weight (Dry)
- Blood Pressure
- Respirations

Determinations will then be made for capabilities to perform further entry operations.

If any of the following criteria are met the team member shall not be allowed to perform duties requiring the use of PPE for 24 Hours:

| | |
|---|---|
| Pulse | >85% of Maximum Heart Rate |
| Temperature | >100.4 degrees F |
| Recovery Heart Rate | <10 BPM (1 minute pulse—3 minute pulse) |
| Blood Pressure | >160/100 |
| Weight Loss | $\geq$3% |

No team member shall be allowed to re-don PPE if they cannot meet the pre-entry requirements previously described.

Any team member exhibiting signs or symptoms of heat exhaustion, or heat stroke, or who has had a weight loss $\geq$5% shall be evaluated by a physician in the emergency department or comparable area. Intravenous fluid resuscitation may be required for these personnel.

While at the medical monitoring station, Team members should drink at least 16 fluid ounces of water or other suitable substance for rehydration, i.e. Gatorade. Team members should be encouraged to drink more than this if they still feel thirsty. Soda, or other liquids containing caffeine, carbonation, or alcohol will not be allowed. Remember, thirst is not an adequate indicator of heat exposure. Consult fluid resuscitation charts when appropriate.

After all operations are terminated, the Medical Monitoring Leader shall collect all Medical Monitoring Forms and give them to the Documentation Unit Leader or Safety Officer.

## Fluid Replacement, Rest and Recuperation Guidelines

The Medical Monitoring plan must address every factor pertinent to the full recovery and return-to-work of all personnel. These factors include: fluid replacement, rest, and heart recovery.

Alcohol and caffeinated drinks should never be permitted because they actually promote dehydration, as do salt tablets. Additionally, drinks that are cooled to 40-50°F better facilitate the absorption of water by the body. Sports drinks such as Gatorade® are bettter rehydrating solutions than plain water alone and the flavor encourages greater intake. Serving drinks in large cups also will encourage greater intake.

The medical monitoring plan may use a variety of methods to determine rest and recuperation periods. As an example, aerobically fit personnel, working under normal conditions for twenty minutes should rest as per the following:

| Ambient Air Temperature | Rest Period |
|---|---|
| <70 degrees F | 30 minutes |
| 70-85 degrees F | 45 minutes |
| >85 degrees F | 60 minutes |

Recommended work durations, between rest periods, for personnel wearing CPC is covered by the Occupational Safety and Health Guidance manual for Hazardous Waste Site activity in Table 8-10. However, minimum recovery guidelines must be utilized to determine when personnel have returned to a condition where they may wear CPC and return to a work zone again. The minimum suggested health guidelines are:

| Vital Sign | Minimum Guideline |
|---|---|
| Temperature | A return to within .5 degrees of baseline |
| Body Weight | A return to within 1.5% of baseline |
| Pulse | A return to within 5% of baseline |
| | <90 beats per minute |
| Blood Pressure | <150/90 |

These guidelines may be amended, deleted, or added to based upon the guidance of your Team physician.

**NJSP**
**Emergency Management Section**

| DP/HMERP Unit Medical Monitoring Form | | | | Page____of____ | | | Critical Values | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Heart Rate | | | | Body Weight | | |
| Name / Age | Date | Time | Pulse | B/P | Temp | Weight | Age | MHR | 85% | 60% | Wgt | 3% | 5% |
| | | | | | | | **25** | 195 | 166 | 117 | **150** | 146 | 143 |
| | | | | | | | **26** | 194 | 165 | 116 | **155** | 150 | 147 |
| | | | | | | | **27** | 193 | 164 | 116 | **160** | 155 | 152 |
| | | | | | | | **28** | 192 | 163 | 115 | **165** | 160 | 157 |
| | | | | | | | **29** | 191 | 162 | 115 | **170** | 165 | 162 |
| | | | | | | | **30** | 190 | 162 | 114 | **175** | 170 | 166 |
| | | | | | | | **31** | 189 | 161 | 113 | **180** | 175 | 171 |
| | | | | | | | **32** | 188 | 160 | 113 | **185** | 179 | 176 |
| | | | | | | | **33** | 187 | 159 | 112 | **190** | 184 | 181 |
| | | | | | | | **34** | 186 | 158 | 112 | **195** | 189 | 185 |
| | | | | | | | **35** | 185 | 157 | 111 | **200** | 194 | 190 |
| | | | | | | | **36** | 184 | 156 | 110 | **205** | 199 | 195 |
| | | | | | | | **37** | 183 | 156 | 110 | **210** | 204 | 200 |
| | | | | | | | **38** | 182 | 155 | 109 | **215** | 209 | 204 |
| | | | | | | | **39** | 181 | 154 | 109 | **220** | 213 | 209 |
| | | | | | | | **40** | 180 | 153 | 108 | **225** | 218 | 214 |
| | | | | | | | **41** | 179 | 152 | 107 | **230** | 223 | 219 |
| | | | | | | | **42** | 178 | 151 | 107 | **235** | 228 | 223 |
| | | | | | | | **43** | 177 | 150 | 106 | **240** | 233 | 228 |
| | | | | | | | **44** | 176 | 150 | 106 | **245** | 238 | 233 |
| | | | | | | | **45** | 175 | 149 | 105 | **250** | 243 | 238 |
| | | | | | | | **46** | 174 | 148 | 104 | **255** | 247 | 242 |
| | | | | | | | **47** | 173 | 147 | 103 | **260** | 252 | 247 |
| | | | | | | | **48** | 172 | 146 | 103 | **265** | 257 | 252 |
| | | | | | | | **49** | 171 | 145 | 102 | **270** | 262 | 257 |
| | | | | | | | **50** | 170 | 145 | 101 | **275** | 267 | 261 |
| | | | | | | | **51** | 169 | 144 | 101 | **280** | 272 | 266 |

# _____ Hospital Decon Team

MEDICAL HISTORY_____ NAME _____

A. Current Medications
   1. _____
   2. _____
   3. _____

B. Known Allergies Drug & Environmental; (Food)
   1. _____
   2. _____
   3. _____

C. Cardio Respiratory Symptoms
   1. Cough yes _____ no _____
   2. Sore Throat yes _____ no _____
   3. Chest Pain yes _____ no _____
   4. Short of Breath yes _____ no _____
   5. Nasal Symptoms yes _____ no _____

D. Abdominal Symptoms
   1. Nausea/Vomiting yes _____ no _____
   2. Pain yes _____ no _____
   3. Diarrhea yes _____ no _____

E. Skin Problems
   1. Rash yes _____ no _____
   2. Sores yes _____ no _____
   3. Wounds/Cuts yes _____ no _____

F. CNS Symptoms
   1. Headache yes _____ no _____
   2. Dizzy yes _____ no _____
   3. Weak yes _____ no _____

COMMENTS:

_____

_____

_____

_____

Examiner _____

## Personal Exposure Records

29 CFR 1910.120 requires personal exposure records for all personnel working at a hazardous waste site. By definition, a hazardous materials incident is a hazardous waste site. This requirement covers all employees who were exposed to, or were potentially exposed to, hazardous materials. This regulation requires the employer to document exposures in the employee's records and maintain those files for thirty years beyond the last day of the individual's employment. However, records do get lost or accidentally destroyed. **Therefore, it is essential that the employees maintain their own copies of the file. Otherwise, it may be very difficult to prove occupational exposures in the future.**

# MODULE 5

# DECONTAMINATION PROCEDURES

# MODULE 5

# DECONTAMINATION PROCEDURES

## Outline

- **Definition/purpose**
- **The Law**
- **Concerns of the Incident Commander**
- **Decontamination Location**
- **Decontamination Officer**
- **Decontamination Methods**
- **Decontamination Solutions**
- **Victim Decon**
- **Field Exercise**

# MODULE 5
# DECONTAMINATION PROCEDURES

## Objectives

*The student will be able to:*

1. Explain the definition or purpose of decontamination.
2. List two reasons why it is important to decontaminate.
3. List five considerations associated with the placement, location, size, and establishment of the Decon site.
4. Name three responsibilities of the Decon officer.
5. Name the two types of Decon.
6. List three factors that affect permeation.
7. List five methods of Decon.
8. List stages of victim Decon.
9. List the victim categories.

# DECONTAMINATION

## DECONTAMINATION DEFINED

It is important to address the steps necessary to prevent the unknowing spread of potential contaminants.

It is necessary to assure that all personnel, equipment, and vehicles used at the site are deconned to a point of safety, with respect to the off-site spread of contaminants. In other words, it would be the cleaning of vehicles, equipment, and personnel used or contaminated in an area or effort in order to sample, contain, or treat the contaminant, and to eliminate the spread of hazardous materials, chemicals, products, or substances to the environment.

For our purposes, the **definition or purpose of Decon** is as follows:

1) Contaminated Victim Isolation/Exclusion

To help achieve this goal, make sure all personnel meet four criteria prior to dealing with contaminated patients. They are:

A) Training
B) Personal Protective Equipment
C) Task to Perform
D) Supervisor/Safety Officer/Incident Commander is Aware of Work Assigned

2) Reduce the Spread of Contaminant

3) Removal

As the definition implies, decontamination is to prevent or mitigate the transport of residual materials, be it to people, property, or equipment, outside of the contaminated area. This transport may be to our families, adjacent property, or vehicles.

If hospital personnel become intimately involved with the runoff or other debris at the incident site, then in all probability they will have accumulated a certain amount of dust, dirt or liquid on their clothing. If equipment was brought into the Decon site, they too would have become "dirty." The purpose of decontamination is to remove, as best as possible, those contaminants encountered.

Unfortunately, 100 percent removal may not be realistic. Therefore, what is conducted is the best practical approach to neutralize or remove the "dirt" from the impacted material, fabric, or person.

## DECON: IT'S THE LAW

Because the obvious reasons of why we perform Decon, we must remember that we are required to perform decontamination procedures according to regulations and standards. At the Operations level, the standard states that you will "know how to implement basic decontamination procedures."

Also addressed in OSHA 1910.120(q) is the Emergency Response Plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, decontamination. Finally, OSHA discusses decontamination in Appendix C—Compliance Guidelines and Appendix E—Training Guidelines, both found in the back of the standard.

Appendix C states "decontamination should be tailored to the specific hazards of the site, and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by re-using PPE."

In addition to the OSHA standard, the National Fire Protection Association addresses decontamination in its 472 standard.

## INCIDENT COMMANDER/EMERGENCY COORDINATOR CONCERNS

Many knowledgeable people in the field of hazardous materials response consider decontamination to be the most critical step in the whole response process. You may think about this and disagree, thinking that other aspects of response such as choosing chemical protective clothing or air monitoring is more important. Granted that all areas of response must be properly addressed, just remember that you were "clean" prior to your arrival at the incident. You want to make sure you leave the scene just as clean.

One of the most important but often overlooked aspects in preparing to deal with hazardous materials incidents is planning to perform effective decontamination. **Decon must be part of the initial size up of the incident.** Included with the concerns of Decon, initial size up would include:

A) **Proper assessment of site**
B) **Appropriate levels of protective clothing**
C) **Establishing control zones**
D) **Limiting access to the scene**

Decontamination will place an additional strain on equipment, manpower and resources, which may already be stretched to their limit. On the other hand, should decontamination be ignored, the prevention of spread of contaminants off-site, as well as the health and safety of the responders and their families, may be compromised.

## DECON LOCATION

A primary means of maintaining site control in order to ensure safety and to prevent the spread of hazardous materials into uncontaminated areas is by establishing work zones. The work zones serve to limit site access (isolation), contain contamination (reduce spread), provide site security, and place real estate between the incident and the response community. There are several considerations one should keep in mind, such as the extent of contamination and the probability of airborne contamination, when establishing these work zones.

From prior hazardous materials training, we have become familiar with three work zones: commonly referred to as the hot zone, warm zone and the cold zone.

| Common Terminology | EPA Terminology | Slang Terminology |
|---|---|---|
| Hot zone | Exclusionary zone | Dirty zone |
| Warm zone | Contamination reduction corridor | Decon zone |
| Cold zone | Support zone | Clean zone |


Be sure to pick a site for your Decon area that will not impact the continued operations of the facility.

## DECON OFFICER

The Decon officer is responsible for the overall operation and safety of the Decon process. This person must define the types of contamination the response personnel may encounter at the scene. Consideration must be given to the factors that may influence the extent of contamination, and the methods for preventing or reducing contamination.

### Four Types of Decon

While planning the incident response, methods (SOPs) should be developed to prevent the contamination of personnel and equipment. For example, limiting contact with ambulatory patients by encouraging them to thoroughly decontaminate themselves reduces the probability of the hospital Decon Worker getting "dirty".

Your team, prior to performing any Decon procedure, should be familiar with a minimum decontamination set-up based on the number of personnel you would have on site, as well as, the type and amount of equipment you have available. Then, based on the specific conditions, the decontamination process may be reduced, altered, expanded or eliminated based upon the best known information. Depending on severity, a simple brushing to a full maximum decontamination layout may prove necessary. Specific conditions at the site include:

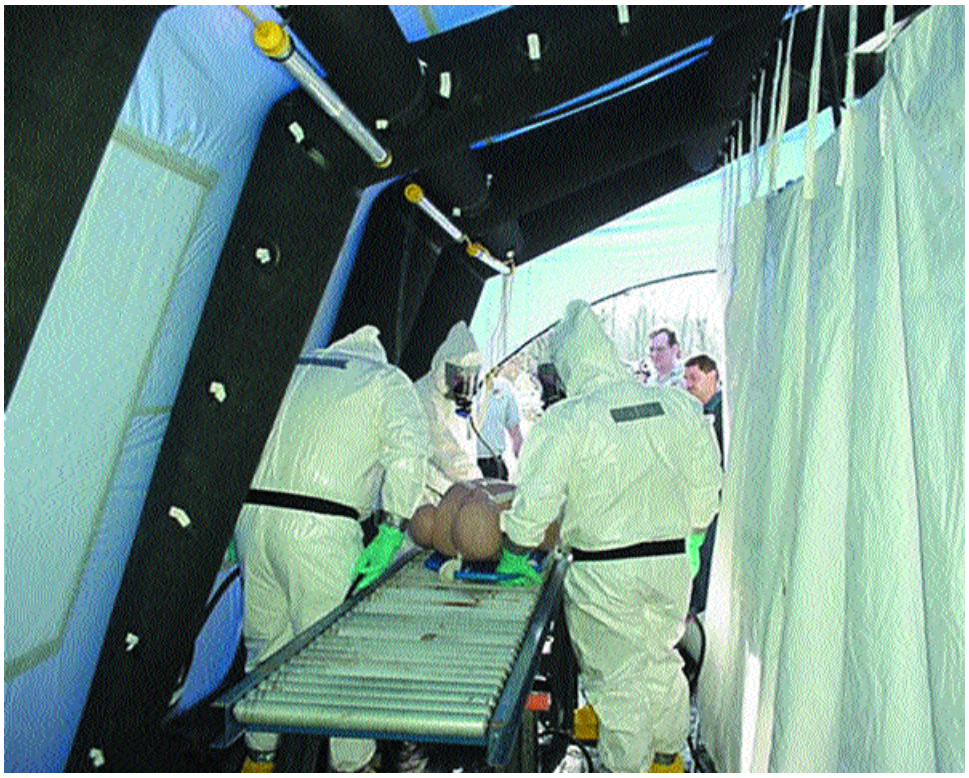
A) **Type of contaminant**
B) **Amount of contamination**
C) **Type and amount of clothing worn**

Since the number one goal of the Decon officer is to make sure that all personnel and equipment leaving the hot zone are cleaned, then it is the responsibility of this individual to choose the type of Decon needed for that specific incident. There are **four types of decontamination**. They are:

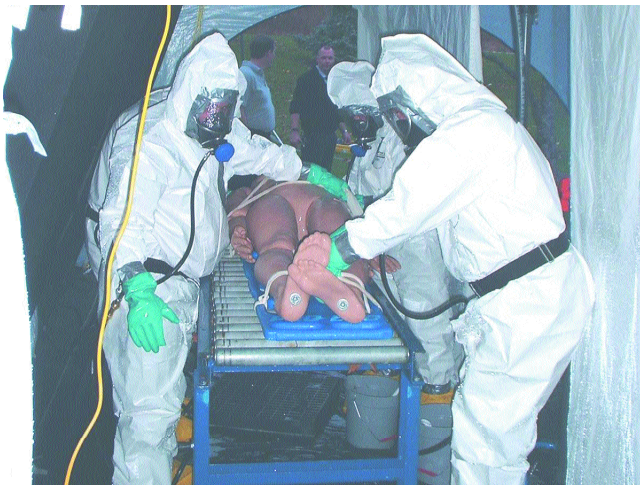
1) **Technical**—Removal of contamination from personnel and equipment through physical or chemical means. Used primarily by hazmat teams through a stage or step by step process.
2) **Emergency**—Immediate removal of contaminant usually from response personnel.

   Examples: protective suit is damaged
   responder or emergency worker is contaminated
   firefighter is injured

3) **Gross**—The removal of surface contamination. Often used for mass decon (i.e., water deluge).
4) **Definitive**—Often used by emergency medical personnel or hospital employees for victim decon.



Hospital Decon workers conducting definitive decontamination.



Remember, contaminants do not exhibit the same degree of hazard. At some incidents, a minor chlorine leak at the local swimming pool for instance, gross Decon would be sufficient. Providing that there are provisions to catch run-off, a simple rinsing of protective clothing is all that's necessary to accomplish gross Decon.

Exposure to some hazardous materials, such as poisons, warrants definitive Decon system implementation. These are substances that can incur serious short-term health effects if complete decontamination is not carried out quickly and efficiently. The definitive Decon system, therefore, merits our serious attention. The more toxic a substance is, the more detailed or thorough decontamination must be.

## DECONTAMINATION METHODS

We know by now that all personnel, clothing, equipment and samples leaving the hot zone must be decontaminated to remove any harmful chemicals or infectious organisms that may be adhered to them. Generally speaking, we can breakdown Decon into three methods. The **three Decon methods** are:

1) Physical
2) Chemical
3) Both/Combination

### Victim Decontamination

Heightened awareness of the increased possibility of terrorist use of a WMD agent or criminal employment of a toxic industrial chemical/toxic industrial material (TIC/TIM) has placed greater emphasis on the ability of HAZMAT Teams and hospital personnel to perform decontamination procedures on unprotected members of the population.

Decontamination can be defined as the process of removing or neutralizing a hazard from the environment, property or life form (people). The purpose of this process is to prevent further harm and enhance the potential for a full clinical recovery.

While victim decontamination utilizes some of the same basic theories of Technical Decon, there are differences that must be kept in mind.

1. We are cleaning people, not suits or equipment.
2. While Technical Decon can be a deliberate and sometimes slow process victim Decon relies upon speed and accuracy to effectively reduce the harm done to the victim and to limit the risk of **secondary contamination**.

## Secondary Contamination

The most important reason for conducting efficient and effective victim Decon is to prevent secondary contamination. Secondary contamination is defined as the transfer of contaminates to personnel outside the hot zone (NFPA 473). Thus by conducting effective victim Decon, we protect those who may have contact with the victim "further down the road."

### Substances with a High Risk for Secondary Contamination

Examples:

- Acids, alkali, and corrosives (if concentrated)
- Asbestos (large amounts, crumbling)
- Cyanide salts and related compounds
- Hydrofluoric acid solutions
- Nitrogen containing and other oxidizers which may produce methemoglobinemia (Aniline, aryl amines, aromatic nitro-compounds, chlorates, etc.)
- Pesticides (organophosphates)
- PCBs (polychlorinated biphenyls)
- Many other oily or adherent toxic dusts and liquids
- Radioactive material

### Substances with a Low Risk for Secondary Contamination

Examples:

- Most gases and vapors unless they condense in significant amounts on the clothing, skin or hair
- Weak acids, weak alkali, and weak corrosives in low concentrations (excluding hydrofluoric acid)
- Weak acid or weak alkali vapors (unless clothing soaked and excluding hydrofluoric acid)
- Arsine gas
- Carbon monoxide gas
- Gasoline, kerosene, and related hydrocarbons
- Smoke/combustions products (excluding chemical fires)
- Small quantities of common hydrocarbon solvents (e.g., toluene, xylene, paint thinner, ketones, chlorinated degreasers)

## Victim Categories

Victims of chemical exposure whether it is of terrorist nature or accidental release can be fitted into one of four categories:

**Exposed.** Victim was in the area of a release but has not had contact with the substance.

**Injured.** Victim was not exposed but has been injured in a secondary event.

**Contaminated.** Victim has had contact with substance.

**Injured and Contaminated.** Victim has not only been in contact with substance, but has also suffered and primary or secondary injury during the event.

## Decon Triage

In situation requiring the decontamination of more than two victims at scene methods for prioritizing the order they are decontaminated in must be devised. A process similar to the prioritization of victims at a conventional incident should be used.

## Best Practices

- In Victim Decon personnel should always try to do the following:
- Use warm water
- Use mild non-abrasive detergents
- Use low-pressure water
- Take steps to address victim modesty

What best practices are being followed here?

## Stages of Decontamination

Victim Decon can be broken down into two distinct stages **gross** (primary) and **definitive** (secondary). These terms are sometimes interchanged and juxtaposed; all nomenclature in reference to HAZMAT and Decon should be clearly defined in your facilities Emergency Operations Plan and this information shared with any assisting agencies.

## Gross Decon

Is often the initial stage of victim decontamination and in some situations may be completely effective in removing a majority of the chemical hazard. It can be accomplished by:

1. Removal of the victim from the high risk area.
2. Removal of the victims clothing. This can remove as much as 85% of the contaminate from the victim.
3. Perform a three minute head to toe rinse with warm water. Ensuring the victim changes positions to maximize exposure to the shower.

## Ambulatory Definitive Decon

Is the process of removing as much contaminate as possible from the victim and getting them as clean as possible. It can be accomplished in the following steps:

1. Direct patient to Decon area.
2. Children should be kept with parents if at all possible; if no parent is available, a Decon team member should provide needed assistance to a child.
3. The patient should be given a Personal Decon Kit (see inset) as soon as it is available and be given rapid clear instructions on its use—utilize written or tape recorded instructions if available.
4. Patient should quickly remove all clothing, putting valuables into a clear plastic bag and clothing into a larger plastic bag, then placing both bags into a third bag which should be sealed and put in a secure area (not inside the ED).
5. If staff is available, the patient's name and possibly tag number should be recorded on a Patient Decon Record.
6. The patient should then proceed to forward into the Decon area with the remainder of the Personal decon kit.
7. Patient should then quickly rinse themselves from head to toe with water using either a handheld sprayer, garden hose, or shower head.
8. Patient should next wash with soap and wash cloth or brush from the kit in a systematic fashion cleaning any open wounds first and then in head to toe order for five minutes if the agent is nonpersistent and 8 minutes when the agent is persistent or is an unknown.
9. The Decon team should closely observe each victim to ensure that they are thorough in washing themselves; particular attention should be paid to make sure they wash the axilla, creases, folds, and hair.
10. Once the washing is completed then the patient should be directed to rinse themselves thoroughly (this should take at least 1 minute).

**Self Decon Kits**

In dealing with large numbers of ambulatory patients who require Decon, the establishment of prepacked kits reduces confusion, speeds the process and reduces staffing needs.

An example of a Self Decon Kit:

- Contaminated clothing bag
- Clear plastic bag for valuables
- Overbag for clothing and valuables bags
- Disposable washcloth or brush
- Small bar of soap
- Germicidal wipe
- Redress garment

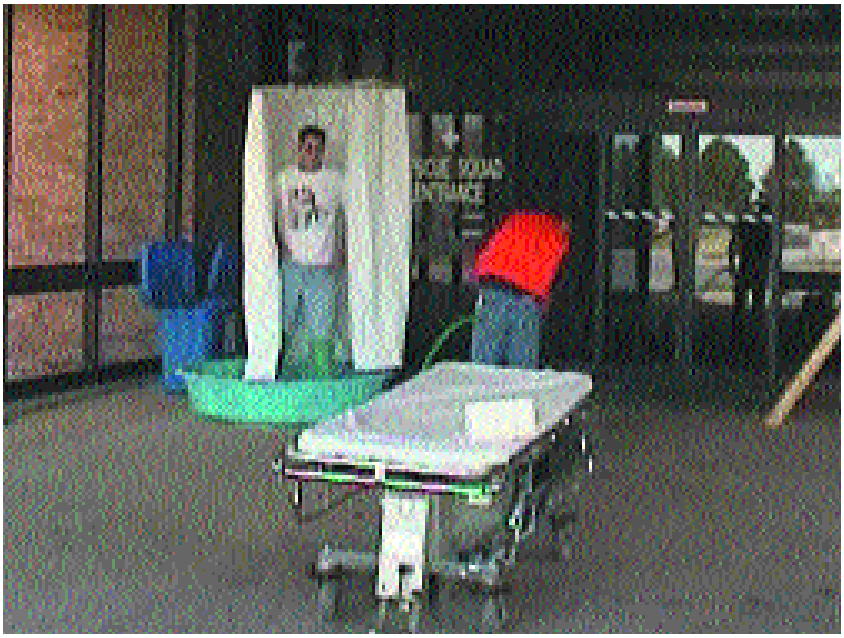
Nonambulatory decon is labor intensive.

11. Any materials used by the patient during this process should be left in a lined trash can located in the Decon area, and not carried by the patient to the Cold Zone.
12. The patient should then proceed to the towel off area and complete drying off, any towels used should be placed in a lined trash can and left in the towel off area.
13. After drying as completely as possible the patient should be reclothed in either a gown, paper scrubs or tyvek jumpsuit.
14. The patient should then proceed to the Triage area for classification and Treatment area assignment.
15. Decon team members should be alert to the possibility that an ambulatory patient may clinically deteriorate and require immediate removal to a nonambulatory Decon area.

## Ambulatory Vs. Non Ambulatory Definitive Decon

The performance of Definitive Decon in the ambulatory victim is actually nothing more than supervising them taking a rather thorough shower; the Decon team must always try to protect a patient's modesty (accomplished by establishing segregated Decon areas) and also try to ensure that a Decon team member of the same sex performs the supervision.

While the provision of Decon to the ambulatory patient is not labor intensive, the performance of Decon to the non-ambulatory patient is quite the opposite. Under ideal circumstances as many as four or as few as two Decon personnel per victim will be needed to adequately accomplish this task.



Ambulatory decon requires less labor but victims still need supervision.

One of the most prominent challenges in performing Decon of the non-ambulatory victim is patient movement. Moving patients from station to station by traditional carry method may be dangerous for the patient and physically taxing for the Decon team member. This can often be mitigated by using a roller or conveyer type system to move the patient through the process (rinse, soap/scrub, rinse).

If ambulatory Definitive Decon is a well-supervised shower, than non-ambulatory Decon can be best described as an intensive bed bath. While the results are hopefully the same, the process is slightly different:

## Nonambulatory Definitive Decon

1. Patient should be brought to the Decon area, and tended by a minimum of 4 Decon Team members.
2. If not already, the patient should be placed on backboard or other nonpermeable carrying device.
3. Carefully clean the area around the mouth and nose with a wet sponge.
4. Protect the patients airway by placing them on a non-rebreather mask and high flow oxygen.
5. All patient clothing should be removed and placed in a large plastic bag, all valuables placed in a smaller clear plastic bag, both bags should then be placed in an even larger, sealed securely, and placed in a secure area (not inside the ED).
6. Clothing should be cut away when necessary.
7. Attempt to minimize the aerosolization of particulate matter by folding clothing inside out as removal is being done and dabbing the skin with sticky tape or vacuuming.
8. If staff is available, the patient's name and tag number should be recorded on a Patient Decon Record.
9. While resting the backboard or carrying device on sawhorses or patient roller system, the patient should be rinsed from head to toe with water.
10. Attempt to simultaneously begin eye irrigation procedures.

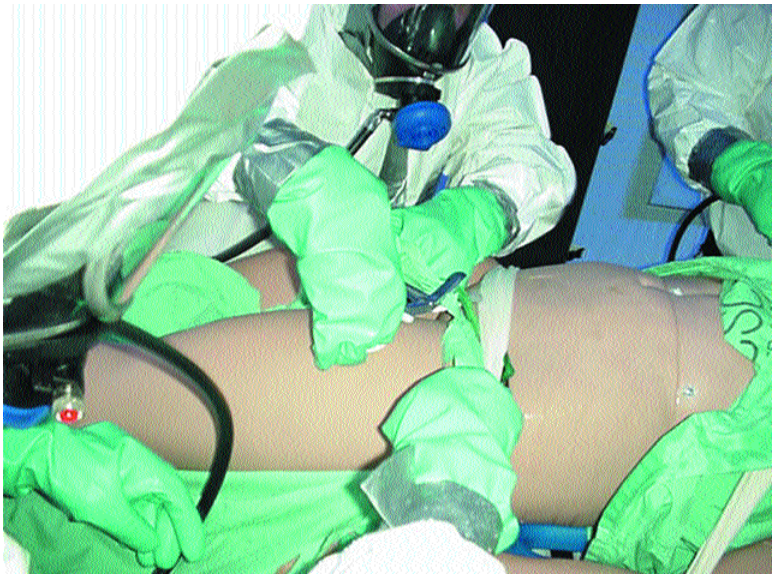
**Cut Out Procedures**

Caution should always be exercised during victim cut out procedures. The danger to both the patient and Decon personnel is significant enough to have a standardized procedure for this practice. Some points to address might be:

- Use only blunt tip scissors or seat belt cutter type devices.
- No more than one person should conduct the cut out.
- Always start at the head/chest area and work towards the feet.
- Fold the exterior of the clothing away from the patient to minimize exposure to the contaminate.
- Thoroughly rinse the scissors or other device between patients or any time they are obviously contaminated.

11. Next the patient should be washed with soap and either a brush or wash cloth in a systemic fashion starting at the head/hair and working towards the feet for five minutes when the agent is nonpersistent and eight minutes if the agent is persistent or unknown; avoid vigorous scrubbing.
12. After completing the front surfaces, the patient should be carefully rolled onto their side for washing of the posterior head, neck, back, buttocks, and lower extremities, by 2-4 personnel.
13. Careful attention should be given to washing the voids and creases such as the ears, axilla, groin, etc.
14. The patient should then be rinsed in a head to toe fashion for at least one minute.
15. Decon Team members should be alert to the possibility that the nonambulatory patient may require ABC's support (airway positioning, suctioning, spinal stabilization, etc.)
16. The patient should then be dried and put into a hospital gown and transferred to a clean backboard (or clean and dry off the board they are on).
17. Any materials used for the patient during this process should be placed in a lined trash can located in the Decon Area, and not carried with the patient to the Cold Zone.
18. The patient should then be taken to the Triage area for classification and Treatment Area assignment.

In the nonambulatory Decon scenario, care should be taken to ensure the patients physical security during movement (log roll & station to station) and steps taken to drain and contain any runoff from the patient. Also, removed property such as jewelry, clothing, shoes, etc. must be doubled bagged and remain in the Decon area.



Caution should always be used during "cut out" procedures

# PATIENTS WITH SPECIAL NEEDS

## Glasses/Contact Lenses

1. Patients with glasses should keep them if they cannot see without them. They must be washed and rinsed thoroughly during the Decon process before being worn. Otherwise, the glasses should be placed in the valuables portion of the clothing bag.
2. Contact lenses should be removed and placed in the valuables portion of the clothing bag.

## Canes/Walkers

1. Patients who use walking assist devices may retain them, but the devices must be washed with soap and water during the Decon process before being allowed into the Treatment Area.
2. Patients who are unsteady standing and/or walking should be given a walker upon entry into the Decon Area. The walker should be used to assist with ambulation until they get to the end of the line, where it should be retrieved and returned to the front of the Decon line for the next patient who needs it.

## PIC Lines/Saline Locks

1. Unless contaminated, PIC lines and saline locks should be covered with an occlusive dressing before the area is decontaminated.
2. Contaminated PIC lines or saline locks should be removed before being decontaminated. After the area is cleaned a dressing should be applied until it can be replaced in the Treatment Area.

## Hearing Aids

1. Hearing aids cannot be immersed or otherwise soaked with water. Thus, they should be either removed and placed in the valuables portion of the patients clothing bag, or, if they must be used by the patient because there is no hearing without them, they should be carefully wiped off with a saline moistened 4x4, dried off, put into a clear plastic bag and handed to the patient. The cleaned hearing aid is not to be worn until the patient has completed the Decon process.

## Dentures

1. Unless the oral cavity is contaminated, dentures should remain in place and no Decon is necessary.
2. If the oral cavity is contaminated, then the dentures should be removed, placed into a clear plastic bag with the patient's name written on it. The dentures should later then be decontaminated in accordance with instructions received from the Poison Control Center and/or dentist. The patient's mouth should be decontaminated with mouth wash or saline that is gargled and safely spit out into a biohazard bag.

## Mass Decon

In the current volatile geopolitical climate, the ability to provide Decon to large numbers of victims cannot be overlooked or under addressed. The capability of providing rapid and effective Decon to substantial numbers of victims can decrease the risk faced by members of the public safety and health care communities. However the efficacy of mass Decon is dependent upon the speed of deployment and the ability to direct large numbers of victims. Many ambulatory victims at the site of a release will "self rescue" and leave the scene prior to the arrival of public safety. Our major concern in the provision of mass Decon is that these "self rescuers" become "self referrals" at health care facilities increasing the risk of secondary contamination. One solution to this problem is the pre deployment of mass Decon assets during high threat/high profile events. Another solution is the development of mass Decon capabilities in local fire departments using low tech and readily available material(s).

**Mass Decon Methods**

Many fire departments are aptly equipped for delivery of effective mass Decon services. As previously mentioned these procedures can be structured using existing technology. A common practice is the deployment of two engines parked parallel and 20 feet apart with several ground ladders spanning the pace in between them. A forth ladder can be placed atop the other ladders at mid span, this girder supports a salvage tarp which effectively creates two corridors. Additional tarps are placed over the lattice created by the ladders making a ceiling for the structure. This is now effectively a two-lane Decon line. Hand lines or discharge gates can be used to create a low-pressure spray/fog. Use of this method is advantageous because it uses existing materials, can be built fairly rapidly, and requires a minimum of manpower to deploy.

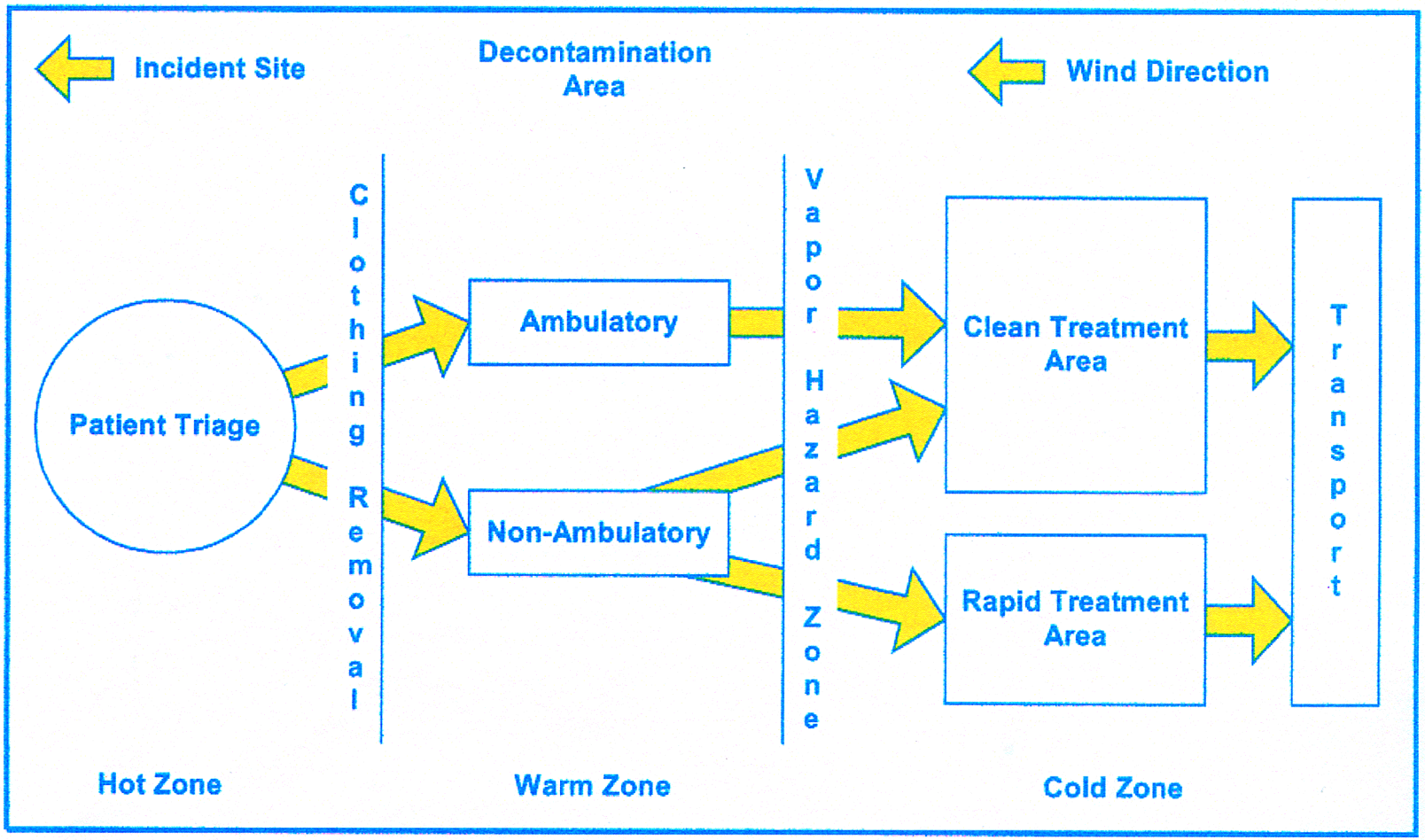
Another method utilized for mass Decon is the use of shelters or trailers; these can either be traditional tent type structures, inflatable, or prefabricated corrugated buildings. There are many advantages to the use of Decon shelters in mass Decon (pre piped water, victim rollers, segregated lanes, heated water, climate control, etc.), however their efficacy can be reduced by the speed at which they can be effectively deployed and put into service. Despite these limitations, they are enormously valuable when either pre deployed or used as a force protection asset.

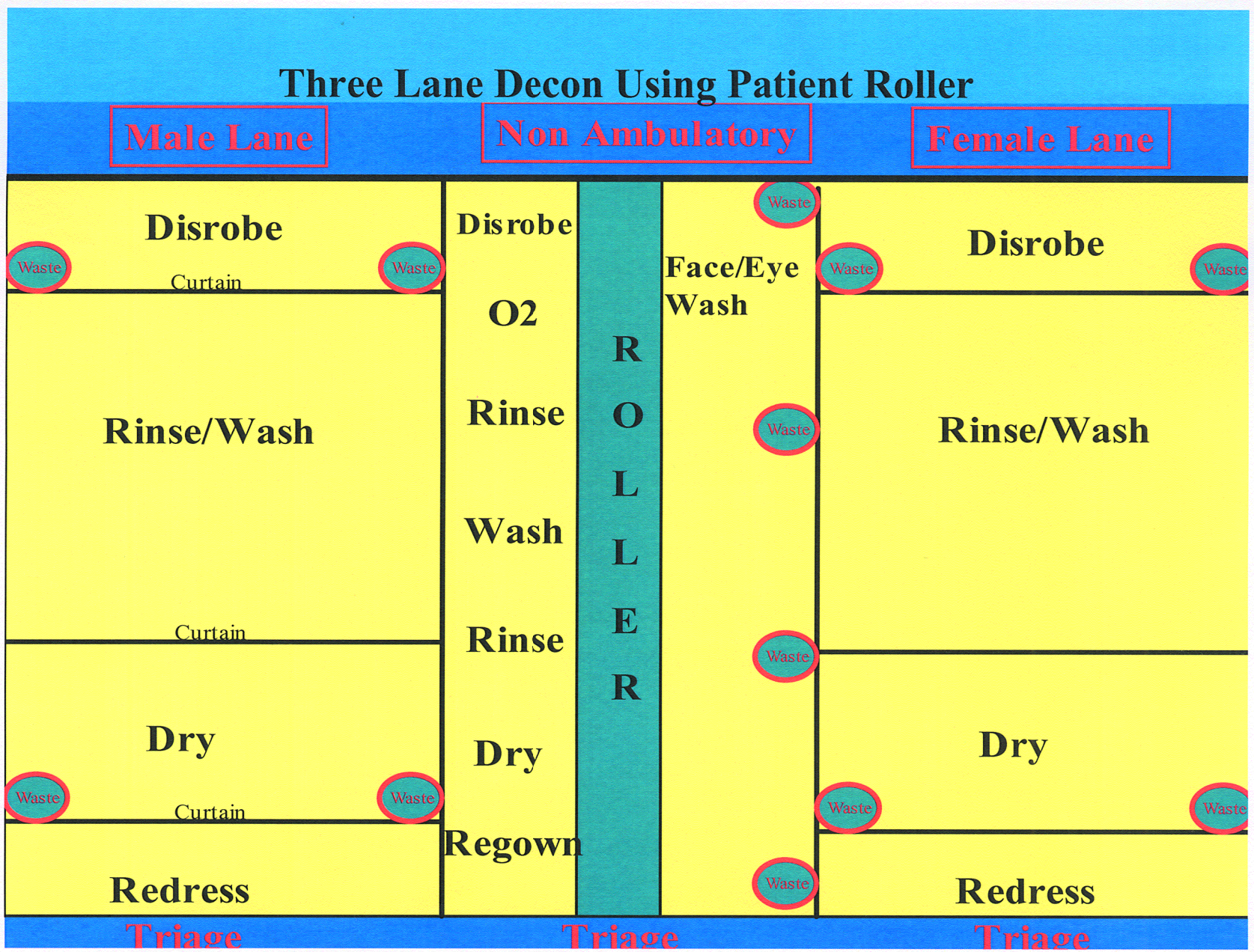
Using fire apparatus for mass decon.

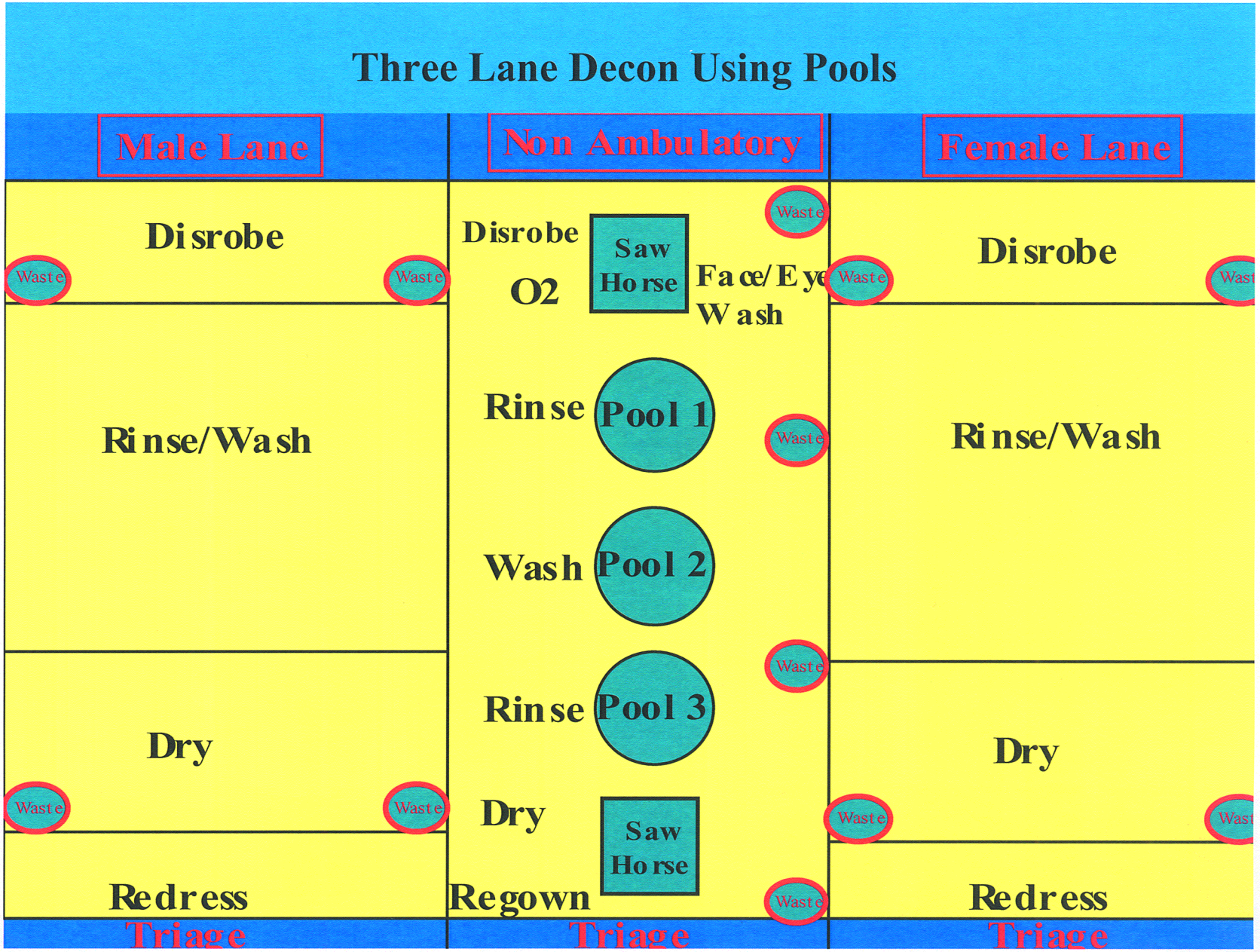
## Decon Area Configuration

There are multitudes of ways to build the physical structure needed for Decon. There is no single correct answer to how to structure the area. The needs of your facility, the physical structure of the area used for Decon, and the equipment available to conduct Decon are all factors that will influence just how you will build your Decon area. The following illustrations are examples of how Decon areas can be established/structured.

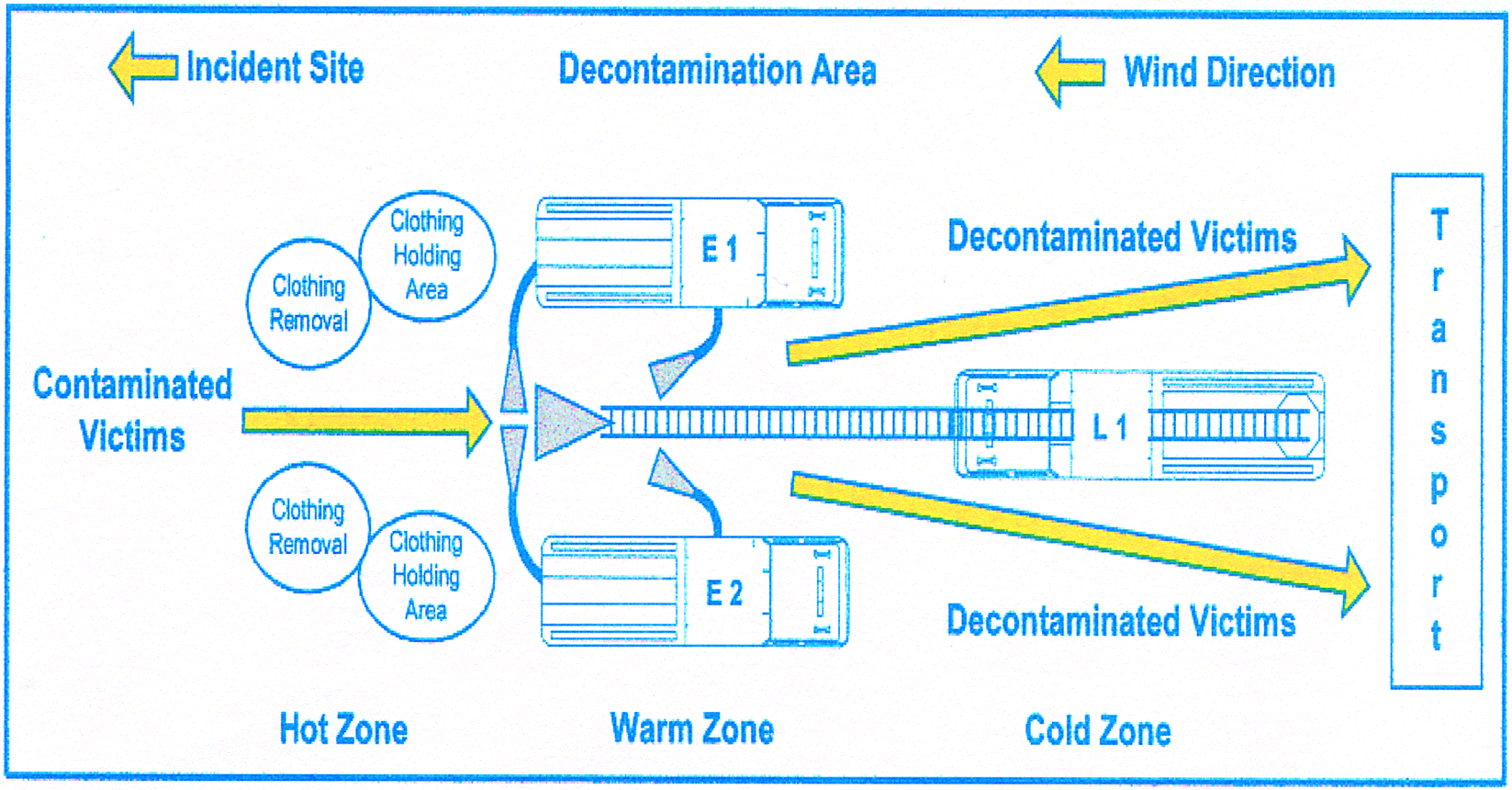
# Dry Mass Decon



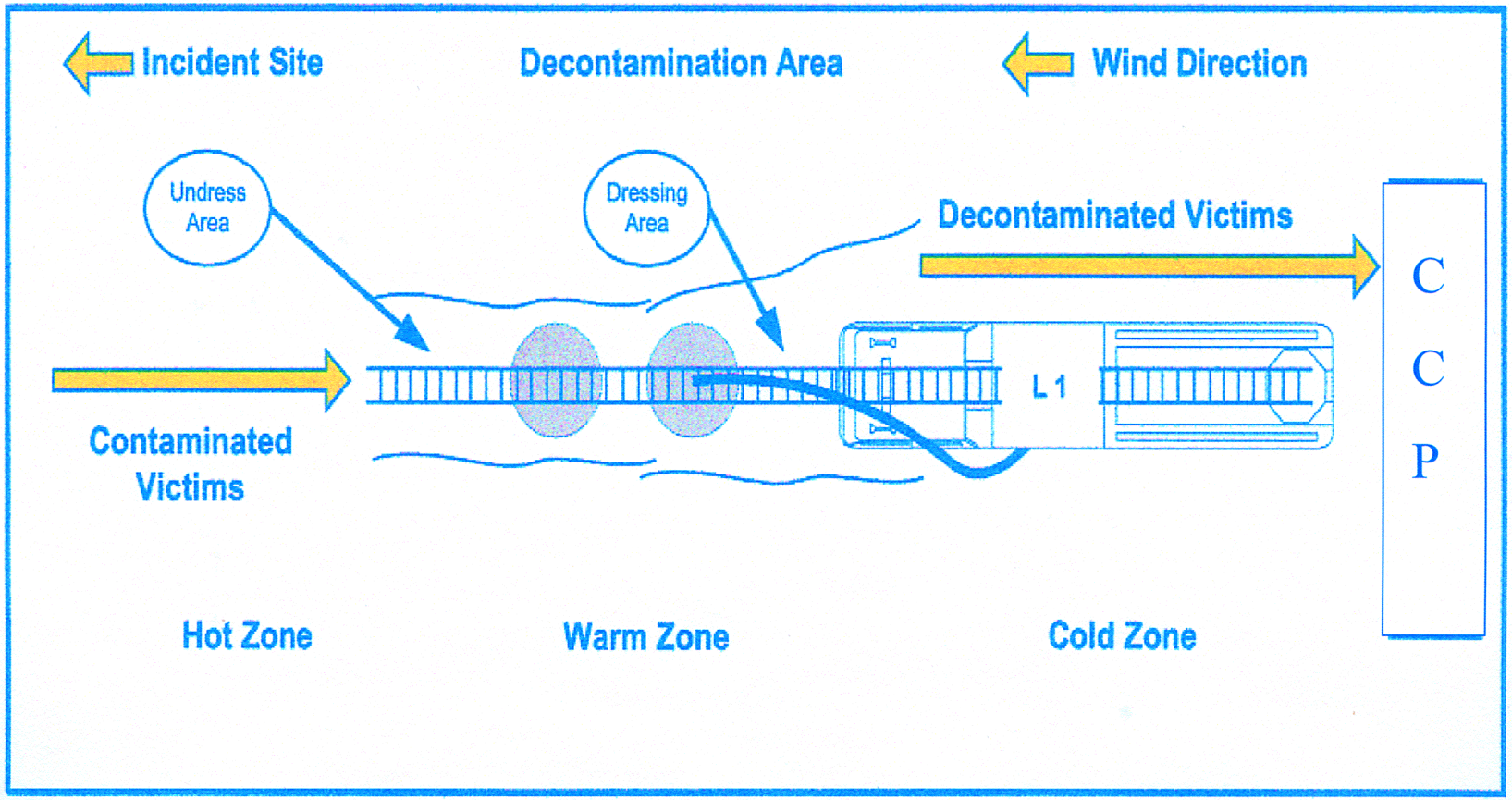

Three Lane Decon Using Patient Roller
Male Lane
Non Ambulatory
Female Lane
Disrobe
Curtain
Rinse/Wash
Curtain
Dry
Curtain
Redress
Triage
Disrobe
O2
Rinse
Wash
Rinse
Dry
Regown
Triage
ROLLER
Face/Eye Wash
Triage
Disrobe
Rinse/Wash
Dry
Redress
Triage
Waste


Three Lane Decon Using Pools
Male Lane
Non Ambulatory
Female Lane
Disrobe
Waste
Waste
Rinse/Wash
Dry
Waste
Waste
Redress
Triage
Disrobe
O2
Saw Horse
Face/Eye Wash
Waste
Rinse
Pool 1
Waste
Wash
Pool 2
Rinse
Pool 3
Waste
Dry
Saw Horse
Regown
Waste
Triage
Disrobe
Waste
Rinse/Wash
Dry
Waste
Redress
Triage

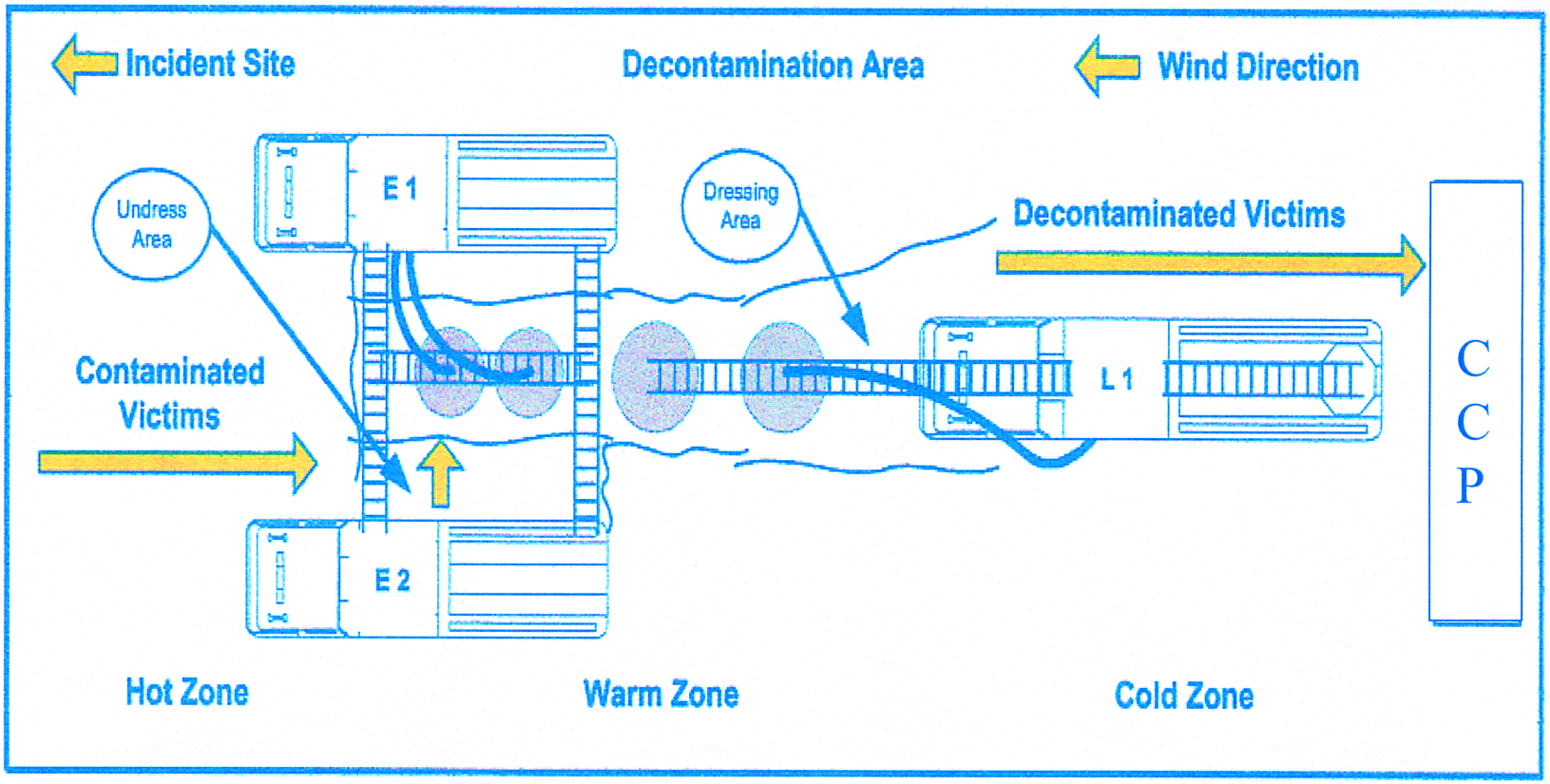
# Mass Decon
# 2 Engines/1 Ladder



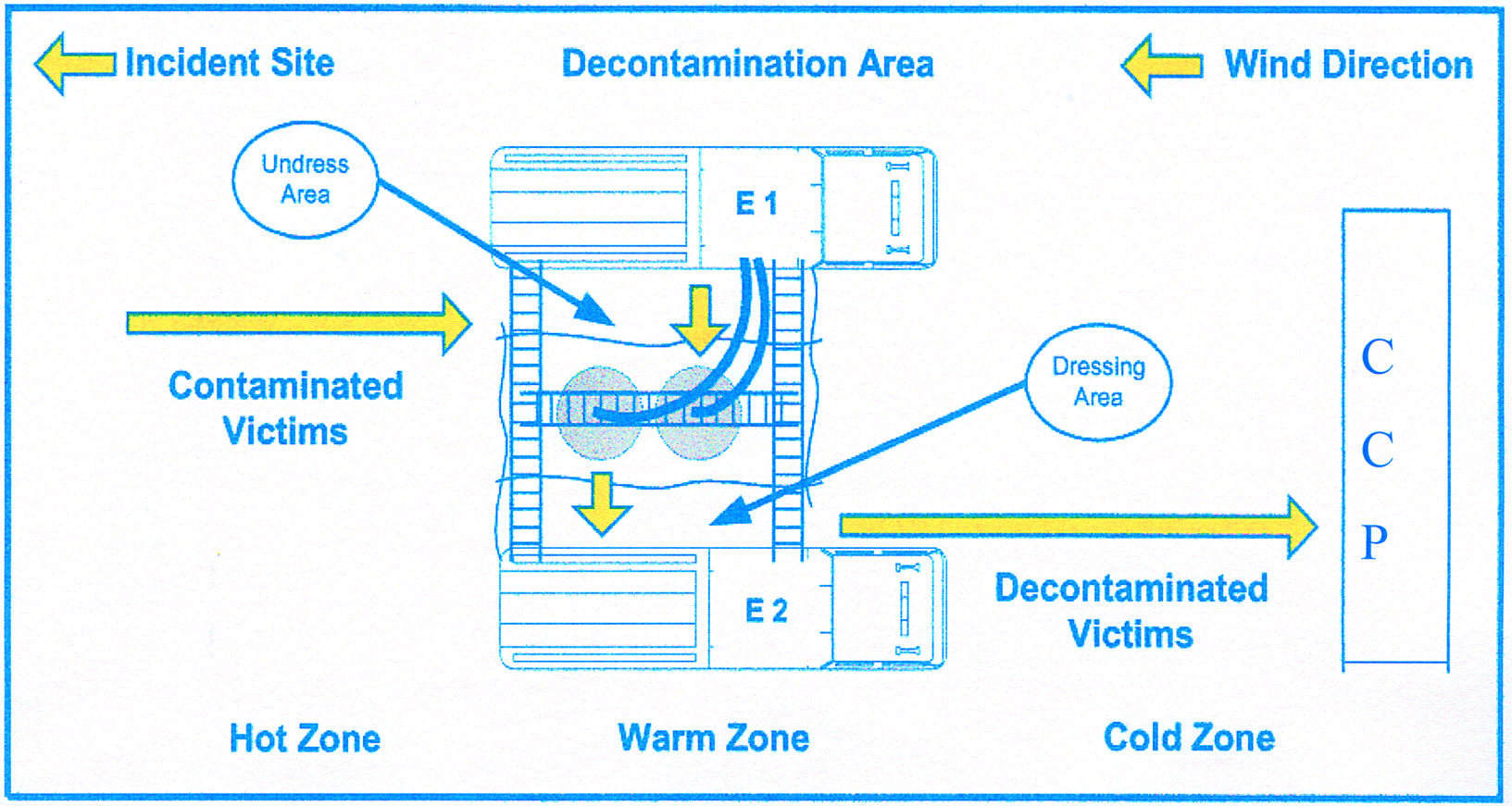
# Mass Decon
# 1 Ladder



# Mass Decon
# 2 Engines/1 Ladder

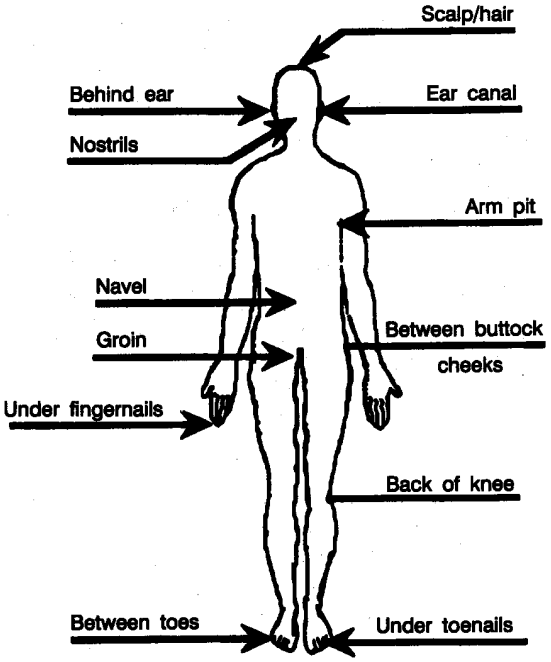


# Mass Decon
# 2 Engines



## Frequently Missed Body Zones

Despite our best efforts there are several areas of the body that frequently escape complete decontamination.




**Frequently missed body zones during decontamination**

## Victim Decon Solutions

Whenever possible mild soaps should be used in victim Decon. Tincture of Green Soap is an ideal solution for this purpose as it has a PH very close to that of human skin. Using a compound of this nature will not increase skin permeability and hasten the absorption of product through the skin. In the absence of Tincture of Green soap, a mild dishwashing soap or baby shampoo are acceptable substitutes.

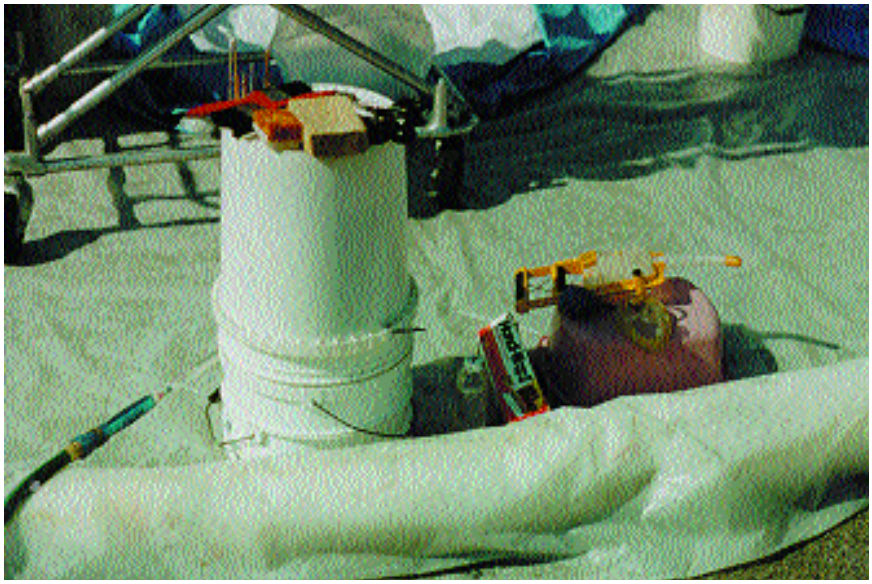
It is not an acceptable practice to use chemical neutralizers on victims. This means that we would not seek to counteract an acid by washing the victim with a weak base or vice versa. **The application of neutralizer may indeed cause an exothermic reaction and worsen the victim's condition exponentially.**

## Brushes

Just as we do not want to increase skin permeability with harsh detergents we also do not want to break down the victims skin with rough scrub brushes. The ideal tools for victim Decon are surgical scrub brushes or small dish sponges. These sponges or brushes should be disposed of properly and replaced after each patient or any time they become obviously contaminated.

## Victim Decon Supplies

The establishment of a victim Decon kit will streamline efforts in the event that victims are encountered. Some recommended supplies for this cache would be:



Keeping decon supplies together simplifies the process.

- Sheets (disposable)
- Surgical Scrub Brushes
- Cotton Tip applicators
- Sterile water
- Occlusive dressings
- Wash cloths (disposable)
- Spray Containers
- Soap
- EMT Shears
- Bulb syringes
- Towels
- Scrub suits (disposable) for redress of ambulatory victims
- Hospitals gowns—for redress of non-ambulatory victims


Permanent signage can help prevent ED contamination.

# DECONTAMINATION AREA PREPARATION

Any victim of a hazardous materials incident must be considered to be contaminated until proven otherwise.

Security personnel should be stationed at the main entrance of the emergency department close to the decontamination area to prevent unauthorized entry, and to direct the vehicle transporting the patient to the appropriate area. A reception area should be set up just outside the emergency department entrance, where arriving contaminated patients can be screened for adequate decontamination.

A decontamination area should be large enough to facilitate decontamination of more than one patient and accommodate the many personnel involved in patient treatment and contamination reduction. The ventilation system should either be separate from the rest of the hospital or turned off in order to prevent spread of airborne contaminants throughout the facility. The best place (weather permitting) to evaluate and initially treat contaminated patients is outside where ambient ventilation will keep cross-exposure low. Some hospitals have internal decontamination facilities that can be used. An outside or portable decontamination system is a viable substitute and would aid in preventing contamination of the emergency department and other patients. A practical alternative for facilities with limited resources is to have a warm shower nozzle, soap, a wading pool, and plastic garbage bags in a predesignated area outside the emergency department back door. The patient may be able to remove his or her own contaminated clothing, place it in a double bag, and do his or her own soap and water decontamination. A partial tent or curtain can provide privacy for the patients.

To prevent unnecessary contamination, all nonessential and nondisposable equipment should be removed from the decontamination area. A "clean" member of the staff should stand on the clean side of the decontamination area to hand in supplies and receive medical specimens.

# TECHNICAL DECONTAMINATION PROCEDURES

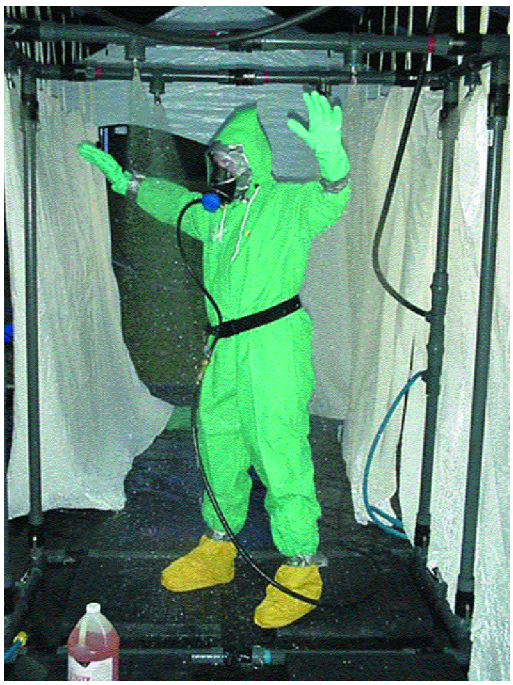
Decon incidents involve numerous on-site problems and operational concerns. The most common is the threat of contamination. Technical decontamination must be considered an essential part of any hospital HAZMAT Decon operation.
Personnel may become contaminated in a number of ways including:

- contacting vapors, gases, mists or particles in the air
- being splashed by materials during rescue or containment operations
- walking through puddles of liquids or on contaminated soil
- treating contaminated patients
- using contaminated instruments or equipment

Equipment must be thoroughly cleaned so that its subsequent use will not lead to a spread of contamination.

Different chemical threats require varying levels of technical Decon. In cases of extremely hazardous or unknown substances, the following minimum decon procedures should be complied with:

1. **Establishment of an entry/exit point:** This point will be used by all personnel to enter and exit the area of contamination. The use of one entrance will reduce the chance of contamination leaving the area. An emergency exit should also be established. This will allow for a secondary exit should conditions deteriorate and demand immediate evacuation.
2. **Definitive Decontamination:** This step may actually entail many intermediate steps. The personnel should undergo water rinsing and soap or solution washes to remove as much contaminant as possible. The number of washes will depend on the nature of the contaminant.
3. **Removal and isolation of protective clothing:** Outer protective clothing should be removed at this station. Outer gloves and overboots should be removed first. The protective clothing can then be removed with special care taken to reduce the risk of contaminating the worker. Inner gloves are the last piece of protective equipment to be removed.



A hospital Decon worker undergoes technical decontamination.

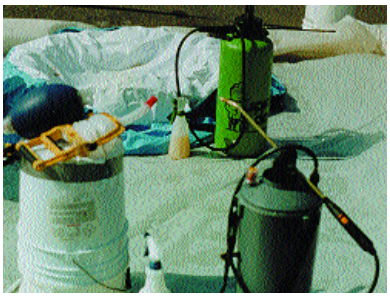
4. **Removal of personal clothing:** With extreme hazardous substances, the removal and isolation of the worker's personal clothing is necessary. All clothing should be isolated for future cleaning or disposal.
5. **Personnel shower:** In order to ensure complete decontamination, all personnel should shower. Liquid soaps work best. Special attention should be directed to the hair, fingernails and areas such as the underarms and groin. With known exposure, all run-off should be contained if possible.
6. **Drying off and redressing:** Disposable towels should be used for drying. Clean clothes can then be worn. Many teams use disposable coveralls or hospital scrubs.
7. **Medical evaluation:** All personnel with potential exposure must undergo a medical evaluation. Entry personnel should have received a pre-entry exam as a baseline. Vital signs, indications of exposure and signs of heat stress should all be evaluated. Personnel should be transported to a hospital for further evaluation if necessary.

The extent of this process will depend on the nature of the contaminant and the level of exposure. Steps 4 through 7 may not necessarily take place in this order. For example, the medical exam can follow primary decon and protective clothing removal. Or, if contaminants are not extremely hazardous, personnel may shower at an off-site location.


It might be necessary to pump off and contain Decon runoff.

Decon usually requires the use of soaps or solutions. Usually a mild detergent and water may be sufficient. In special cases, a specific decon solution will be required. Depending on the contaminant, a special base, acid, solvent or bleach solution may be used. **These solutions are only used with equipment and should never be applied to skin.**

## Water With Contaminant



Water from decon procedures needs to be contained and may need to be disposed of as hazardous waste. Numerous devices are available to contain run-off water; children's wading pools, fire department drafting tanks, hose lines covered by visquene, containment areas fashioned from ladders and salvage covers, and commercially available portable decontamination tanks are all possible alternatives. The decision of which option to choose should be governed by how easy it is to assemble and use. Remember that there is a chance that any runoff containment device may need to be disposed of.

### Technical Decon Effectiveness

Two methods of measuring the effectiveness of decon procedures are swipe and permeation testing. Cloth or paper patches (swipes) are wiped over decontaminated surfaces and sent to a laboratory for analysis. Swipe tests can be done on protective clothing, equipment and skin. Permeation tests require that a piece of protective clothing be sent for analysis. However, both swipe and permeation testing provides after-the-fact confirmation. Along with visual observations, the test results can help evaluate the effectiveness of the completed decon procedures.

## Decontamination Area Set Up

The decontamination area may be set up by both security and members of the decon team.

**Security:**

Marks off restricted area with barrier cones and warning tape to designated restricted area depending on hospital.

All personnel not associated with decontamination of the patients are to be restricted from the area by security.

Security directs all ambulances, rescue units, other transportation vehicles with CONTAMINATED PATIENTS to the decon area.

**Decon Team:**

Assists in setting up the decon containment pool and shower setup.

Prepares decontamination supplies, wash solutions, attaches hose to water supply.

Tests water quantity and quality before the patient arrives.

Determines if any additional supplies or materials are needed.

Decon team suits up and waits for patients.

Once patients are in the area, only properly protected decon workers or medical staff, if in PPE, are permitted in the area.

# Hazardous Materials/WMD Incident
# Decontamination Equipment and Supplies

Many of these items are available in the hospital. It would be advisable to set up an area where these supplies can be stored so that they are readily available when an incident occurs.

### DECON AREA EQUIPMENT

The following supplies will be needed to set up the decontamination area:

- Long handled scrub brushes (for decontamination of suits)
- Warning tape
- Warning signs
- Cones
- Containment pools
- Decontamination table
- Plastic floor covering
- Hazardous Material labels for waste containers
- Garden hose
- Nozzle
- Hazardous Materials Bags/Garbage bags
- Markers
- Buckets
- Waste containers

**Recommended Decontamination Supplies**

1. **Patient Decontamination System** that provides for the medical treatment and decontamination of a patient. This system should include a means of collecting waste water.
2. **Protective Floor Covering** constructed of a non-skid chemically resistant material.
3. **Waste Container** with a dolly, lid and liner. All contaminated articles such as the patient's clothes, dressing and medical supplies should be placed in this container for proper disposal.
4. **Sample Collection Kit** that contains all the instructions and necessary supplies for collecting samples. Should be done by qualified individuals.
5. **Decontamination Kit** that contains the necessary procedures, as well as fluids and materials, for patient decontamination.
6. **Antidotes** for use in specific cases.
7. **Contamination Control Measures** used to control access to contaminated area thereby minimizing the spread of the contamination.
    - warning rope
    - warning signs
    - boundary cones
    - step-off pad

**Additional Supplies**

- hose with splash reducing spray nozzle
- tincture of green soap
- waterproof drapes (i.e., Chucks)
- adhesive tape
- towels
- soft scrub brushes
- 5 gallon buckets

An example of a hospital HAZMAT entrance.

# WATCH OUT FOR YOURSELF AND EVERYONE ELSE!

**Emergency Department ignition sources:**

A. Most of the electrical/equipment switches.

B. Radios.

C. Electrical clocks.

D. Cigarettes, pipes, cigars, lighters, matches, etc.

E. Flashlights (including penlights) that are not intrinsically safe.

F. Portable radios that are not intrinsically safe.

G. Pagers that are not intrinsically safe.

H. Telemetry equipment that is not intrinsically safe.

I. Use of striking tools causing sparks.

J. Static electricity sparks.

K. Battery operated hearing aids, watches, etc.

L. Defibrillators.

## Decon Termination Procedures

At the conclusion of the Decon process, it is important that the Decon area itself be decontaminated to prevent the spread of any contaminated material.

1. Clean up is usually done by **Decon Team** in **PPE**. However, local HAZMAT team could handle the clean up.

2. All solid waste that is contaminated is to be collected and placed in a "Contamination Bag." (Double lined plastic garbage bags will work.)

   If it is determined to be a hazard, it will be disposed of by a hazardous waste company. For WMD events, be careful to protect and secure evidence.

3. Waste water is to be held as follows:

   a. if it is determined not to be hazardous, it can be disposed of in the sanitary sewer system.

   b. if hazardous, the waste water must be sealed in drums and arrangements made for pick up by a hazardous waste disposal company.

   c. the **Chemical Safety Officer** will make these determinations and arrangements.

4. The entire decon area is to be straightened up and cleaned down.

5. All supplies and decon equipment is to be properly put away. Inventory is to be taken as to what is to be needed.

6. HAZMAT supplies are to be relocated to storage area.

# MODULE 6

# HEALTH AND SAFETY

## Outline

- **Health and Safety Hazards**
- **Exposure vs. Dose**
- **Guidelines for Assessment**

# MODULE 6

## Objectives

*The student will be able to:*

1. Define exposure, doses and warning properties.

2. Identify (5) five common symptoms of chemical exposure.

3. Differentiate between chronic and acute effects of chemical exposure and give an example of each.

4. Identify (6) six safety and health hazards other than chemical contamination that may be encountered at a hazardous materials incident.

5. List (4) four precautions to be taken when attempting a rescue of a HAZMAT victim.

# I. EXPOSURE TO TOXIC CHEMICALS

Exposure to toxic chemicals is frequently the primary concern at HAZMAT incidents. Many scenes contain a variety of chemicals in solid, liquid or gaseous form.

Contaminants can enter the body through the four pathways consisting of inhalation, injection, ingestion and absorption. Inhalation and absorption are considered to be the most common routes of entry and protective equipment is available to minimize the risk. Remember, that the first responder with Operations training will be limited in both operation and types of protective equipment.

We must always be aware of the ingestion route and how contaminants enter the body in this manner. The act of smoking, drinking, eating or rubbing ones face with the hands may introduce contaminants to the body through ingestion. For this reason, one must always be aware of the presence of contaminants at a scene and the need for safety proper protection, and decontamination.

## Exposure and Dose

**Exposure** is the act of coming in contact with a contaminant or product.

**Dose** is the amount of a substance taken into the body.

**Warning Properties** are the physical characteristics of a chemical identified by the senses, such as an odor.

A contaminant could cause damage at the point of contact or at another point in the body. Effects may be immediate (acute), in the case of a large concentrated dose, or more commonly, delayed (chronic) and will not be detected for over a period of time. These are known as acute and chronic doses.

## Signs and Symptoms

Symptoms from a chemical dose are not usually immediate except when the dose is very highly concentrated or the substance is highly potent. In most cases, however, effects are from small chronic doses or a single large dose with delayed effects. Unless the contaminant has "warning properties" the victim may not even be aware of his exposure and dose. Dermatitis is an inflammation of the skin which becomes red and swollen and appears as a rash, this is the most common symptom of exposure to chemicals.

***MANY SUBSTANCES PRESENT HAZARDS TO SAFETY; MANY PRESENT HAZARDS TO HEALTH. THE FOLLOWING INFORMATION FOCUSES ON HEALTH EFFECTS.**

| Type of Hazard | Signs and Symptoms |
|---|---|
| **General Chemical Hazards** | Behavioral changes<br>Breathing difficulties<br>Changes in complexion or skin color<br>Coordination difficulties<br>Coughing<br>Dizziness<br>Drooling<br>Diarrhea<br>Fatigue and/or weakness<br>Irritability<br>Irritation of eyes, nose, respiratory tract, skin or throat<br>Headache<br>Lightheadedness<br>Nausea<br>Sneezing<br>Sweating<br>Tearing<br>Tightness in the chest. |
| **Explosives and Blasting Agents:** | • Many explosives contain nitrates that can cause:<br>Dilation of blood vessels resulting in headache, nausea, cramping, low blood pressure, and eye and skin irritation<br>Severe exposures can cause dysrhythmia, shortness of breath, and formation of methemoglobin<br>• Explosives can cause toxic fumes that cause lung injury |

**Poison Gases and Poisons:**

- Most poison gases and poisons are *extremely* toxic
- The **primary** route of exposure is inhalation, although solids and liquids can be ingested and absorbed
- Poisons (which are liquids) are considered less dangerous than poison gases because they are not inhaled as readily
- Fire can liberate poison gas from liquid and solid poisons
- Some, like cyanides, can cause rapid death by asphyxiation

**Flammable Gases:**

- Methane is a simple asphyxiant
- Acetylene is a simple asphyxiant and a narcotic in high concentrations
- Ethylene oxide causes cancer and possible birth defects, and is irritating to skin, eyes, and mucous membranes

**Non-Flammable Gases, Oxygen, and Chlorine:**

- Oxygen-rich environments are non-toxic but are extremely hazardous in cases of fire
- Carbon dioxide and inert gases are simple asphyxiants
- Ammonia is extremely irritating
- Halogens and their acids, such as hydrogen fluoride and hydrogen chloride, are highly irritating to skin and mucous membranes
- Halogens react with water and can easily react with water in body tissues
- Halogenated hydrocarbons can be toxic to the liver and kidneys and may be carcinogenic
- Hydrocarbons can increase absorption of other hydrocarbons

**Flammable/Water Reactive Solids:**

- Lithium compounds are irritating to skin, eyes, mucous membranes, and lungs
- When burned, some nitro compounds liberate oxides of nitrogen which may affect the liver, kidney, heart, or CNS

**Oxidizers and Organic Peroxides:**

- Oxidizers may include nitrate compounds or ammonium compounds that create possible carcinogenic toxic fumes when they decompose
- Halogens are irritating to eyes and mucous membranes; fluorine and chlorine are especially powerful caustic irritants
- Peroxides can cause skin or mucous membrane irritation or pulmonary or laryngeal edema

**Radioactive Materials:**

- Radioactive exposure usually causes long-term, or chronic, problems

  Acute exposure to high radiation may cause neurologic problems, nausea, skin and mucous membrane irritation

  Long-term effects include cancer and birth defects

**Corrosives:**

- Corrosives include acids and bases that cause severe injury to skin and mucous membranes, lung damage (if inhaled), or gastrointestinal damage (if ingested)

**Chemical Warfare Agents:**

Chemical warfare agents are defined as compounds which through their chemical properties produce lethal or damaging effects in man, animal, plants or materials. They exist as solids, liquids or gas and are classified by their physiological effects: nerve, blood, choking or pulmonary, or blister agents.

**Nerve agents** are the most lethal. They are comparable to pesticides (organophosphates), but are much more toxic than pesticides and other standard industrial chemicals. These agents interfere with the central nervous system by disrupting nerve impulse transmissions. Nerve agents can be fatal in very small quantities. The most well-known nerve agents are tabun (also referred to by its military designation, "GA"), sarin (GB), soman (GD), and VX. Although they are liquids at room temperature, they evaporate quickly enough to create toxic vapor. Sarin is the most volatile, evaporating at about the same rate as water while VX is the least volatile.

Exposure occurs when the liquid form of the agent comes in contact with skin or eyes or the vapor is inhaled. Symptoms include pinpoint pupils, severe headache, and extreme tightness in the chest.

**Nerve agents,** such as Tabun, Sarin or VX, may be absorbed through the skin, respiratory or gastrointestinal tract. Exposure to nerve agents causes a disruption of nerve impulse transmissions and in sufficient quantities may cause almost instant death. Therefore, full protective clothing and a protective breathing mask are required to ensure safety. The substances are stored as liquids and are usually disseminated as aerosols by means of an explosive charge. They also may be circulated by aerosol dispensers.

**Blister agents,** such as mustard (HD) and lewisite (L), cause severe burns to the skin and respiratory tissues. Exposure occurs when the liquid form of the agent comes in contact with skin or eyes or the vapor is inhaled. Symptoms may be delayed for hours, making detection and response more difficult.

Although much less lethal than nerve agents, blister agents easily penetrate clothing and are readily absorbed through the skin. These agents are also systemic poisons and potent carcinogens.

**Blood agents** interfere with the blood's ability to transfer oxygen to the cells. High concentrations can cause rapid death by asphyxiation. Lower concentrations cause breathing problems, gastrointestinal distress, dizziness, and headaches.

Most of these agents are derivatives of cyanide compounds and are liquids under pressure. Examples include the common industrial chemicals hydrogen cyanide (AC) and cyanogen chloride (CK).

**Choking agents** injure the respiratory system, causing the lungs to fill with fluid (noncardiogenic pulmonary edema). High concentrations result in death by asphyxiation. Lower concentrations of these agents cause severe coughing.

Examples of choking agents include chlorine and phosgene, which are common industrial chemicals. These agents are liquids under pressure, but injury occurs when the vapor is inhaled.

**Irritants** fall into two categories: vomiting agents and riot gases. *Vomiting* agents such as DM can cause nausea, vomiting & coughing. They have been used in tandem with other chemical warfare agents—soldiers would be overcome by the vomiting agent, remove their masks, and be exposed to the second (and more lethal) agent. Riot gases, such as tear gas (CS), cause copious tearing and coughing. They are non-lethal chemicals that cause short-term incapacitation. High doses can be lethal, however.

**Biological Warfare Agents:**

**Biological agents** are generally divided into infectious agents and toxins. Infectious agents are pathogenic bacteria, viruses or fungi. Toxins are a poisonous substance produced by a living organism, but in some cases can also be man-made.

**Biological weapons** are regarded as infectious agents or toxins which are pathogenetic to man. These may include numerous naturally occurring viruses, bacteria or fungi previously known to science as well as genetically engineered organisms previously unknown to man. These substances possess the common ability to kill or incapacitate large numbers of people. Biological weapons are defined as any micro-organism, virus, infectious substance or toxin, capable of causing death, disease or other biological malfunction in a human, animal, plant or other living organism.

The danger of biological weapons is amplified by the fact that exposure to the agents would probably not be diagnosed until symptoms appeared. Comprehensive quick field detection and identification methods do not currently exist for these agents. Not only may an accurate diagnosis be difficult to quickly accomplish, but the value of medical treatment for some agents may be diminished once symptoms have developed. Personal protection generally consists of immunization or the institution of some other post-incident medical treatment, such as the use of antibiotics. A chemical protective mask also protects personnel from biological agents.

**Viruses** primarily cause diseases in man. Transmission of these viruses in a weapon system would most likely be accomplished by aerosol dissemination, or the use of a vector (a living organism capable of delivering a biological weapon to a victim). Symptoms may include fever, headache, nausea and vomiting, following an incubation period of a matter of days. These illnesses can be fatal or incapacitating.

**Bacterial agents** can be produced in the laboratory or purchased from a number of medical research firms. Dissemination would probably be accomplished by aerosol but could occur from the addition or contamination of foods. An incubation period may last from one day to several weeks and the fatality rate for untreated cases may exceed 80 percent.

**Fungal infections** usually are induced through the respiratory system by breathing infected spores. Fungal infections can be spread through the civilian or agricultural population, and would be

extremely difficult to detect prior to the first casualty. At this time, there are no known applications of fungal infections which would lend themselves to being used as a biological agent for a weapon, however there are fungal toxins that can be weaponized.

**Toxins** are defined as poisonous substances made by living organisms, and can cause incapacitation or death quickly. Toxins can now be reproduced through new advances in biotechnology and pose a new problem for new generations of C/B weapons. They can be inhaled, injected or ingested.

**Biological warfare agents** are living organisms (or their derivatives) that cause disease in humans. Examples include anthrax, plague, and smallpox. These agents can cause more damage than chemical agents because they are contagious diseases that can spread far past the incident site, infecting unlimited numbers of people.

The presence of a biological warfare agent can be difficult to recognize, identify, and treat. Many of the initial symptoms of these diseases are common to other diseases. There may be a delay between the time of exposure and the appearance of symptoms. The symptoms may also be mistaken for a naturally occurring outbreak of a disease.

Responding to a biological warfare incident includes identifying the event as a biological warfare incident, controlling access to and from the site, and imposing quarantines.

Personnel experiencing any of the above symptoms should stop working and seek immediate medical attention.

### Initial Treatment of Overexposure

This discussion of initial treatment is not intended to be a medical management course. It will point out ways of preventing further injury when overexposure occurs. In any case of overexposure, medical care should be obtained as soon as possible.

### Chemical Overexposure

Initial treatment of chemical overexposure depends on the route of exposure and the particular hazardous material.

Prior to the initiation of medical treatment, as much information as possible should be obtained about the contaminant so **proper** treatment can begin.

If material is on the skin, washing with large quantities of water is the most common method of removing the substance. Cool water should be used to minimize opening the pores of the skin preventing further absorption, but not so cold as to preclude comfort.

If there is irritation of the eyes, large amounts of water should be used for flushing. This procedure should continue for a minimum of 15 minutes.

When inhalation of toxic material has occurred, oxygen should be administered if available.

If toxic substances have entered the body by injection, the wound should be washed thoroughly. A sterile dressing or covering should then be applied.

When exposure is by ingestion and medical help is unavailable, a poison control agency should be notified for information and guidance. Treatment may vary considerably depending upon the type of chemical ingested.

## Toxicology:

- The toxicity of a substance is its ability to cause harmful effects. These effects can strike a single cell, a group of cells, an organ system, or the entire body. A toxic effect may be visible damage, or a decrease in performance or function measurable only by a test. All chemicals can cause harm, it's just a matter of the dose. When only a very large amount of the chemical can cause damage, the chemical is considered to be relatively non-toxic. When a small amount can be harmful, the chemical is considered toxic.

- The toxicity of a substance depends on three factors:
  (1) its chemical structure,
  (2) the extent to which the substance is absorbed by the body,
  (3) and the body's ability to detoxify the substance (change it into less toxic substances) and eliminate it from the body.

- The toxicity of a substance is the potential of that substance to cause harm, and is only one factoring determining whether a hazard exists. The hazard of a chemical is the practical likelihood that the chemical will cause harm. A chemical is determined to be a hazard depending on the following factors:
    (1) Toxicity: how much of the substance is required to cause harm,
    (2) Route of exposure: how the substance enters your body,
    (3) Dose: how much enters your body,
    (4) Duration: the length of time you are exposed,
    (5) Reaction and interaction: other substances you are exposed to,
    (6) Sensitivity: how your body reacts to the substance compared to others.
- Some chemicals are hazardous because of the risk of fire or explosion. These are important dangers, but are considered to be safety rather than toxic hazards. The factors of a toxic hazard are more fully explained below.
- The longer you are exposed to a chemical, the more likely you are to be affected by it. The dose is still important-at very low levels you may not experience any effects no matter how long you are exposed. At higher concentrations you may not be affected following a short-term exposure, but repeated exposure over time may cause harm. Chemical exposure which continues over a long period of time is often particularly hazardous because some chemicals can accumulate in the body or because the damage does not have a chance to be repaired. The combination of dose and duration is called the rate of exposure.
- The body has several systems, most importantly the liver, kidneys and lungs, that change chemicals to a less toxic form (detoxify) and eliminate them. If your rate of exposure to a chemical exceeds the rate at which you can eliminate it some of the chemical will accumulate in your body. For example, if you work with a chemical for eight hours each day, you have the rest of the day (16 hours) to eliminate it from your body before you are exposed again the next day. If your body can't eliminate all the chemical in 16 hours and you continue to be exposed, the amount in the body will accumulate each day you are exposed. Illness that affects the organs for detoxification and elimination, such as hepatitis (inflammation of the liver), can also decrease their ability to eliminate chemicals from the body.
- Accumulation does not continue indefinitely. There is a point where the amount in the body reaches a maximum and remains the same as long as your exposure remains the same. This point will be different for each chemical. Some chemicals, such as ammonia and formaldehyde, leave the body quickly and do not accumulate at all. Other chemicals are stored in the body for long periods. For instance, lead is stored in the bone, calcium is stored in the liver and kidneys. There are a few substances, such as asbestos fibers, that, once deposited, remain in the body forever.
- The effects of toxic substances may appear immediately or soon after exposure, or they may take many years to appear. Acute exposure is a single exposure or a few exposures. Acute effects are those which occur following acute exposures. Acute effects can occur immediately, or be delayed and occur days or weeks after exposure.

## Prevention & Control

- Prevention and control measures include, but are not limited to, the following:
  (1) Elimination/substitution and process modification;
  (2) Engineering controls;
  (3) Administrative controls; and
  (4) Use of personal protective equipment.
- In certain circumstances, personal protection of the individual employee is necessary. Personal protective devices should be regarded as being supplementary to substitution and engineering control and should not be used in preference to the latter because they do nothing to eliminate the hazard.
- Personal protective equipment must be appropriately selected, individually fitted and workers trained in their correct use and maintenance. The equipment must be regularly checked and maintained to ensure that the worker is being protected.
- Monitoring may be used for the evaluation of a hazard and for assessing the effectiveness of control measures. The design and implementation of a monitoring program should be carried out by, or in consultation with, a properly qualified person. Monitoring of the work environment involves the measurement of atmospheric contaminants at selected locations in the workplace (static, positional monitoring).
- Biological monitoring involves measurement of the concentration of a contaminant, its metabolites or other indicators in the tissues or body fluids of the worker. In some cases, biological monitoring may be required to supplement static or personal monitoring.

  In the control of health hazards due to a specific contaminant, where it has been demonstrated that the exposure of the employee to the contaminant is approaching the relevant exposure standard, or where biological monitoring indicates that an unacceptable exposure is occurring, immediate action must be taken to reduce the health hazard and intensive monitoring should continue.

## Routes of Entry

- Injury can be caused by chemicals only if they reach sensitive parts of a person or other living organism at a sufficiently high concentration and for a sufficient length of time. Thus, injury depends upon the physicochemical properties of the potentially toxic substances, the exact nature of the exposure circumstances, and the health and developmental state of the person or organism at risk.

- Major routes of exposure are through the skin (topical), through the lungs (inhalation), or through the gastrointestinal tract (ingestion). In general, for exposure to any given concentration of a substance for a given time, inhalation is likely to cause more harm than ingestion which, in turn, will be more harmful than topical exposure faster.

**a. Inhalation Route**

Inhalation is the most significant route of entry by which harmful substances enter the human body at work. Toxic atmospheric contaminants may have local or systematic effects. Local effects harm only the part of the body they come in contact with, for example, inhalation of silica dust causing pneumoconiosis. Systemic effects, cause changes to the function of other organs, as in the case of inhaled particles that are soluble in the fluid of the tissues that line the lung, for example, lead and mercury fumes. Inhalation results in the introduction of toxic compounds into the respiratory system. Most of the compounds that are commonly inhaled are gases or vapors of volatile liquids; however, solids and liquids can be inhaled as dusts or aerosols. Inhalation of toxic agents generally results in a rapid and effective absorption of the compound.

When you inhale a toxic chemical, the dose you receive depends on four factors:

(1) The level (concentration) of chemical in the air;

(2) How hard (fast and deep) you are breathing, which depends on your degree of physical exertion;

(3) How much of the chemical that is inhaled stays in your lungs and is absorbed into your bloodstream; and

(4) How long the exposure lasts.

**b. Absorption Route**

Some atmospheric contaminants may be absorbed through the skin without any noticeable change to the skin, while others may cause serious damage to the skin itself. Ingestion is of relatively minor significance in occupational exposure to toxic materials.

(1) Skin contact exposure does not typically result in as rapid systemic dosage as Inhalation, although some chemicals are readily absorbed through the skin. Many organic compounds are lipid (fat) soluble and can therefore be rapidly absorbed through the skin. Some materials that come in contact with the eyes can also be absorbed. Ingestion is a less common route of exposure for emergency personnel. However, incidental hand-to-mouth contact, smoking, and swallowing of saliva and mucus containing trapped airborne contaminants can cause exposure by this route. In addition, emergency medical personnel in both hospital or prehospital settings will see chemical exposures in patients who have ingested toxic substances as a result of accidental poisonings or suicide attempts.

(2) Many people do not realize that some chemicals can penetrate healthy intact skin and so this fact should be emphasized.

**c. Ingestion**

Airborne particles breathed through the mouth or cleared by the cilia of the lungs will be ingested. Otherwise, ingestion of potentially toxic substances in the work, domestic, or natural environment is likely to be accidental and commonsense precautions should minimize this. The nature of the absorption processes following ingestion is discussed elsewhere. The importance of concentration and time of exposure has already been pointed out. It should be remembered that exposure may be continuous or repeated at intervals over a period of time; the consequences of different patterns of exposure to the same amount of a potentially toxic substance may vary considerably in their seriousness.

**d. Injection**

The injection of hazardous materials into the body can occur by stepping on a sharp object, or being cut by a sharp object while working at an incident site. The best precaution is to have protective clothing on, including steel shank and toed foot protection, and by strictly instituting and observing safe work habits.

## Exposure Limit

These limits are established by health and safety authorities to control exposure to hazardous substances. Exposure limits usually represent the maximum amount (concentration) of a chemical which can be present in the air without presenting a health hazard. However, exposure limits may not always be completely protective, for the following reasons:

- Although exposure limits are usually based on the best available information, this information, particularly for chronic (long-term) health effects, may be incomplete. Often we learn about chronic health effects only after workers have been exposed to a chemical for many years, and then as new information is learned, the exposure limits are changed.
- Exposure limits are set to protect most workers. However, there may be a few workers who will be affected by a chemical at levels below these limits (see "Sensitivity"). Employees performing extremely heavy physical exertion breathe in more air and more of a chemical, and so may absorb an excessive amount.
- Exposure limits do not take into account chemical interactions. When two or more chemicals in the workplace have the same health effects, industrial hygienists use a mathematical formula to adjust the exposure limits for those substances in that workplace.

- When toxic chemicals are present in the workplace, your exposure can be estimated by measuring the concentration of a given chemical in the air and the duration of exposure. This measurement is called air or environmental monitoring or sampling and is usually done by industrial hygienists, using various types of instruments. The air is collected from your breathing zone (the air around your nose and mouth) so that the concentrations measured will accurately reflect the concentration you are inhaling. The exposure levels calculated from this monitoring can then be compared to the Permissible Exposure Level for that chemical.
- Environmental monitoring is the most accurate way to determine your exposure to most chemicals. However, for chemicals that are absorbed by routes other than inhalation, such as through the skin and by ingestion, air monitoring may underestimate the amount of chemical you absorb. For these and some other chemicals, the levels of the chemical (or its breakdown products) in the body can sometimes be measured in the blood, urine or exhaled air. Such testing is called biological monitoring, and the results may give an estimate of the actual dose absorbed into the body. For one substance, lead, biological monitoring is required by law when air monitoring results are above a certain level. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended the exposure limits for biological monitoring for a small number of chemicals. These are called Biological Exposure Indices (BEIs) and are published together with TLVs.
- If you smell a chemical, you are inhaling it. However, some chemicals can be smelled at levels well below those that are harmful, so that detecting an odor does not mean that you are inhaling harmful amounts. On the other hand, if you cannot smell a chemical, it may still be present. Some chemicals cannot be smelled even at levels that are harmful. The odor threshold is the lowest level of a chemical that can be smelled by most people. If a chemical's odor threshold is lower than the amount that is hazardous, the chemical is said to have good warning properties.
- If you or your co-workers experience symptoms known to be caused by a chemical during or its use, you may have been overexposed. Symptoms might include tears in your eyes; a burning sensation of skin, nose, or throat; a cough; dizziness or a headache.

## Occupational Exposure Limits

Occupational exposure limits exist to serve one main purpose: protect workers from excessive exposure to toxic chemicals in the workplace. They were designed for healthy adults, usually for an exposure duration of a day's workshift (8 hours). They were not meant to be used for protection of the public, since the general public includes:

- Sensitive groups such as the very young and very old, people with respiratory diseases and other illnesses, and people who are hypersensitive to some chemicals. Occupational exposure limits were also not designed to compare toxicity of chemicals, or to be the fine line between "safe" and "unsafe."
- The current definition has no exposure duration associated with it. Workers should not be in an IDLH environment for any length of time unless they are equipped and protected to be in that environment. They may be found in the NIOSH Pocket Guide to Chemical Hazards.

## Exposure Limits

The various occupational exposure limits found in the literature or in an MSDS are based primarily on time-weighted average limits, ceiling values, or ceiling concentration limits to which the worker can be exposed to without adverse effects. Examples of these are listed. These values were established to provide worker protection in occupational settings. Because the settings in which these values are appropriate are quite different than an uncontrolled spill site, it is difficult to interpret how these values should be used by emergency medical personnel dealing with a hazardous materials incident. At best, TLV, PEL, IDLH, and REL.

### a. Lethal Concentration 50 ($LC_{50}$)

Is the concentration of a material in air that on the basis of respiratory exposure in laboratory tests is expected to kill 50% of test animals when administered as a single exposure (usually 1 hour).

### b. Lethal Dose 50 ($LD_{50}$)

One dose-response term that is commonly used is the lethal dose of 50 ($LD_{50}$), the dose which is lethal to 50% of an animal population from exposure by any route other than inhalation when given all in one dose.

**c. Immediately Dangerous to Life and Health (IDLH)**

The Immediately Dangerous to Life and Health (IDLH) guidelines are not occupational exposure limits similar to the TLV or PEL. They were developed in the 1970s by NIOSH to guide respirator selection. A recent revision in 1994 updated many of the IDLH concentrations, and changed the IDLH definition. The current (1994) definition of the IDLH is a condition "that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an enviroment." For concentrations above the IDLH, a self-contained breathing apparatus (SCBA) is required. Below that level, air-purifying respirators may be used, if appropriate.

**How Much (Or How Little) is 1 Part Per Million**

To give you an example of how small an amount we are talking about: 1 drop of liquid from an eye dropper is 1 millionth of a tank of gas in an average compact car (13 gallon tank), or 1/8 inch is 1 millionth of a mile.

- Notice that unlike the previous definition of the IDLH, which incorporated a 30-minute time period, the new definition does not have an exposure duration associated with it. If you are in an IDLH condition, you need to get out of there immediately! IDLHs are based on analysis of human and animal studies and were developed for fewer than 100 substances. The rationale for each standard is not clearly stated. Unlike the TLVs, no formal updating mechanism exists for IDLH.

**d. Ceiling**

A concentration that should not be exceeded at any time. Note that both TWA and STEL permit limited excursion if, in the end, the average is below the exposure limit. The ceiling value, however, may not be exceeded.

**e. TLV-STEL**

(1) Some substances in the TLV booklet have a short-term exposure limit (STEL). The STEL is a 15-minute exposure limit that should not be exceeded even if the 8-hour TLV remains within the limit. Such limits were assigned to substances exerting toxic effects even over a short period of time. Where a STEL limit is not available (but is believed to be justified), the TLV committee recommends using a limit three times as high as the TLV for a 15-minute exposure.

(2) These values can be used as a benchmark for determining relative toxicity, and perhaps assist in selecting appropriate levels of Personal Protective Equipment (PPE). Furthermore, these occupational exposure limits are only useful if the appropriate instrumentation is available for measuring the levels of toxic chemicals in the air at the chemical spill site. Of the above occupational exposure limit values, only the OSHA values are regulatory limits.

(3) Of the above occupational exposure limit values, only OSHA values are regulatory limits. The ACGIH values are for guidance only and are not regulatory limits. In addition, the ACGIH limits have certain caveats that may or may not affect the usefulness of the values. Some of these conditions are individual susceptibility or aggravation of a preexisting condition. Nevertheless, all emergency medical personnel responsible for the management of chemically contaminated patients should be familiar with these concepts because they will be encountered in various documents dealing with patient care or the selection of PPE.

**f. TWA (Time-Weighted Average)**

Unless otherwise mentioned, it is the concentration of contaminants over an 8-hour period. It is determined by sampling the breathing zone of the worker for 8 hours.

**g. Permissible Exposure Limits**

PELs are values set by OSHA. These limits are a legal requirement for occupational exposures, and exceeding them is a violation of the law, for which fines may be imposed. Most of the PELs are based on older TLVs, and some have STELs as well. OSHA's PELs are published yearly in the Code of Federal Regulations (CFR). A recent PEL update was invalidated by a judge in the summer of 1993. Therefore, many of the currently valid PELs date back to 1968. Many states, however, have established their own occupational standards. These are as strict or stricter than OSHA's, were not affected by the recent ruling, and are enforced as before.

**h. Threshold Limit values**

1. Threshold Limit Values-Time Weighted Average (TLV-TWA) are exposure limits recommended by a committee of the American Conference of Governmental Industrial Hygienists (ACGIH), and are published yearly in a little booklet. All the substances in the TLV booklet have an 8-hour Time-Weighted Average (TWA) exposure which is the level to which workers may be exposed for an 8-hour work shift without suffering an adverse effect. The rationale for setting the limits is explained in a separate publication, "Documentation of the Threshold Limit Values and Biological Exposure Indices" (ACGIH, Cincinnati, Ohio). The TLVs are derived from human studies including epidemiological research and exposure studies with volunteers, occupational accidents, animal studies, and "similar structure analysis" (based on the assumption that compounds similar in structure are similar in toxicity). The TLV committee meets several times every year, and the TLVs are updated regularly.

2. TLV-TWA is meant to regulate exposure over an 8-hour period. Don't extrapolate to shorter periods of time. Don't assume that if a certain limit applies for 8 hours, then eight times that limit may be applied if the exposure lasts for only 1 hour. It simply doesn't work that way. Therefore, the 8-hour limits may not be very useful for spill response, where exposure durations are usually much shorter than 8 hours.

**i. Recommended Exposure Limits (RELs)**

The Recommended Exposure Limits (RELs) were developed by the National Institute of Occupational Safety and Health (NIOSH). Those standards are similar to TLVs in the way that they were derived, but are often stricter. The RELs are published in the *NIOSH Pocket Guide to Chemical Hazards*, which is updated every few years, and in other NIOSH publications.

## Occupational Exposure Limits

| Value | Abbreviation | Definition |
|---|---|---|
| Threshold Limit Value (3 Types) (ACGIH)* | TLV | Refers to airborne concentrations of substances and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. |
| 1) Threshold Limit Value—Time-Weighted Average (ACGIH)* | TLV-TWA | The time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all wokers may be repeatedly exposed, day after day, without adverse effect. |
| 2) Threshold Limit Value—Short-Term Exposure Limit (ACGIH)* | TLV-STEL | The concentration to which workers can be exposed continuously for a short period of time without suffering from: 1) irritation, 2) chronic or irreversible tissue damage, or 3) narcosis of sufficient degree to increase the likeihood of accidental injury, impair self-rescue or materially reduce work efficiency, and provided that the daily TLV-TWA is not exceeded. |
| 3) Threshold Limit Value—Ceiling (ACGIH)* | TLV-C | The concentration that should not be exceeded during any part of the working exposure. |
| Permissible Exposure Limit (OSHA)** | PEL | Same as TLV-TWA. |
| Immediately Dangerous To Life and Health (OSHA)** | IDLH | A maximum concentration (in air) from which one could escape within 30 minutes without any escape-impairing symptoms or any irreversible health effects. |
| Recommended Exposure Limit (NIOSH)*** | REL | Highest allowable airborne concentration is not expected to injure a worker; expressed as a ceiling limit or time-weighted average for an 8- or 10-hour work day. |

*American Conference of Governmental Industrial Hygienists

**Occupational Safety and Health Administration

***National Institute for Occupational Safety and Health

# MODULE 7

# HOSPITAL RESPONSE TO A HAZMAT INCIDENT

## Outline

- **Equipment Storage and Predeployment**
- **Decon Location and Physical Plant Issues**
- **Hospital Staff Utilization**
- **Organizational Structure**
- **Triage**
- **Incident Termination**

# MODULE 7

## Objectives

*The student will be able to:*

1. Understand the prevalence of contaminated patient self-referral.
2. Understand the importance of equipment centralization and predeployment.
3. Discuss proper Decon area placement.
4. Understand basic concepts for staff utilization.
5. Be able to construct a basic organizational chart for Decon activities.
6. Understand basic triage methods and tagging methods.
7. Be familiar with various methods for construction of Mass Decon areas.
8. Be familiar with post event considerations and incident termination procedures.

Statistically 85% of all patients contaminated with a hazardous material arrive at the Emergency Department with no public safety intervention. Consequently this means that the ED will have no "early warning" and may have to take a reactive posture to the situation. Frequently, the first indication that a contaminated patient has arrived at the facility is when they present at the triage desk. While mitigating this type of event might seem insurmountable, with good preparatory efforts and a sustainable training regimen these events can be dealt with in a manner that is safe for both staff and the patient.

While increased awareness of the employment of Weapons of Mass Destruction has brought the need for Mass Decon at hospitals into focus, the reality of the situation is that it is far more likely to encounter a "walk in" patient contaminated with a hazardous material. If ED's can develop the ability to respond to smaller incidents, it makes preparing for the large ones all that much easier.

## Equipment Storage

The ability to protect the hospital from secondary contamination is proportional to the speed in which the contaminated patient can be recognized, isolated and decontaminated. HAZMAT equipment for the hospital should ideally be stored in close proximity to where it will be utilized. The equipment is of no use if personnel have to "go downstairs" to get components of the equipment or if it is stored piecemeal in different locations. Your Decon supplies should be stored in their entirety, completely ready to be deployed, close to the area that your facility predetermines for Decon. All equipment should be periodically checked for presence and serviceability, maintenance and inspection records should be continually updated. Any reference literature, such as suit breakthrough charts, NAERGs, etc. should be kept with the Decon equipment.

## Equipment Predeployment

Your facility's Emergency Operations Plan (EOP) should address under what circumstances your facility will predeploy its Decon capabilities. Having all of your Decon assets in place prior to the first patient arriving greatly reduces the overall response time and increases the level of protection for the facility. The decision to predeploy assets can be based on threat level, proximity to high profile events, etc. . .

## Decon Location and Physical Plant Issues

Careful consideration to the physical area in which the Decon area is going to be set up is one of the most important factors in retaining the continued serviceability of the facility. The predetermined area has to be carefully selected keeping the following factors in mind:

- Patient Modesty
  - —The first question that should be asked when determining the area your facility will use for Decon is "can we protect the patient's modesty in this area?"
  - —If steps are taken early enough to protect modesty it makes convincing the patient of the need for Decon exponentially easier.
  - —Modesty protection reduces the liability for the institution.
- Availability of a warm water source
  - —This should be an exterior (or close to it) source, with back up.
  - —Ensure that all connections are compatible with the Decon equipment
- Proximity to HVAC intake.
  - —If patients/victims are off gassing vapors prior to Decon, it is prudent to keep them away from the air intake for the facility.
  - —Distance to ED itself (patient transport distance)
  - —Decon should be far enough away from the ED entrance to keep the ED from becoming contaminated but close enough that it is not a hardship to get nonambulatory patients to the ED.
- Ambulance entrance
  - —If the Decon area is going to block the ambulance entrance, your plan should address where EMS patients who are not related to the HAZMAT are going to enter the facility.
  - —Signage directing non-involved EMS patients and walk in patients should be preprinted and ready for deployment.
- Permanent Signs
  - —There has been some degree of success with facilities that post permanent, multilingual signs outside of the ED which give instructions not to enter the hospital and how to summon assistance if a patient is contaminated with a HAZMAT.
- Runoff Concerns
  - —The Decon area should be situated in an area that lends itself to containing the runoff water from the Decon effort. Efforts should be made to keep runoff from entering storm drains, sewers, drainage culverts, etc.
- Environmental/Engineering Concerns
  - —If the clean side of Decon is not in close proximity to the ED entrance, steps will have to be taken to protect patients during inclement weather.
  - —Sufficient lighting needs to be available for a nighttime operation.
  - —Power sources close the Decon area should be Ground Circuit Fault Interrupter (GCFI) protected.

## ED Staff Utilization

The following are **SUGGESTIONS** for staff utilization during a hospital HAZMAT incident. Each facility should determine how and where staff would be deployed during the incident. These duties and responsibilities should be clearly outlined in the Emergency Operations Plan (EOP) for the facility.

**Medical Staff (MDs RNs)**

- Used for traditionally medical duties; triage, treatment, etc.
- Also may provide direction and medical advice during Decon efforts
- May be used for Decon team

**Allied Staff (Techs, Nurses Aides, etc.)**

- Used for traditional duties
- May be used for Decon team

**Physical Plant/Maintenance**

- Ensures equipment is deployed
- Ensures equipment is in good working order
- Ensures water source is active
- Troubleshoots equipment

**Environmental/Housekeeping**

- May be used for Decon team
- Clean up of Decon area
- Provides support to Decon operations

**Safety and Health**

- Provides safety oversight to Decon operations
- May conduct chemical monitoring
- May conduct radiological monitoring
- May be involved in runoff analysis

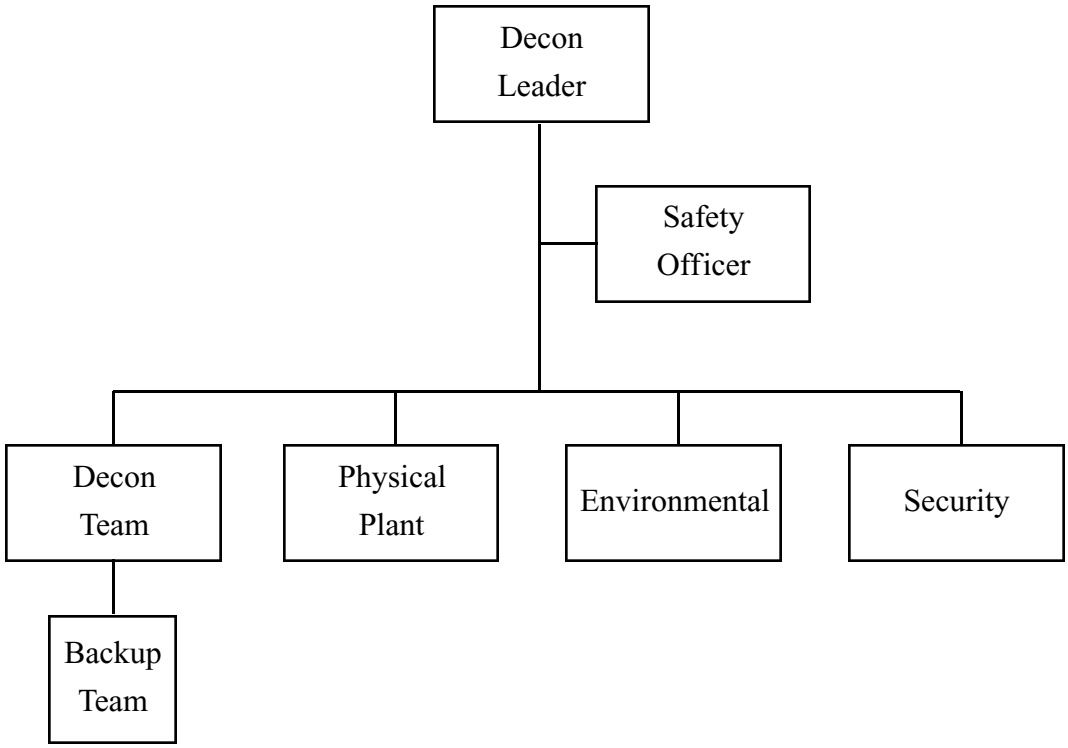
**Security**

- Provides overall physical security for the installation
- Assists in crow control of non-involved parties
- May conduct traffic redirection to support the Decon operation
- In the event of a Mass Decon situation, would be responsible for "locking down" the facility to prevent contaminated patients from entering through unguarded areas

## Organizational Structure

As with any operation, the Decon has to have some form of organization applied to it. This organizational method should fit into the Incident Management System used by the facility. Use of an organizational/management system benefits the operation insomuch that it enhances resource utilization; it eliminates duplication of efforts, and helps keep a manageable span of control over the operation.

A **SUGGESTED** organizational chart such as the one shown below will aid the Decon Team leader in managing his or her assets, however your organizational chart should follow the format set forth in the facilities EOP.



## Patient Management Under Mass Casualty Conditions Involving Hazardous Chemicals

Basic medical procedures in a large-scale hazardous materials incident are not substantially different from life-saving measures in other mass casualty disasters. Primary attention to the ABC's continues to have first priority with decontamination performed at the same time. A chemical disaster may overwhelm any one hospital, particularly if it occurs along with another disaster such as an earthquake. Hospitals need to preplan what they will do if they are overwhelmed with hazmat patients.

There are, however, several important differences in disasters involving hazardous materials. Such differences include the need for the effective decontamination of exposed patients and response personnel, and the need for effective safety measures to protect response personnel. Training in the appropritate procedures to be followed is essential for potential responders to a hazardous materials incident involving mass casualties. Standard principals of triage apply in chemical disasters, except in exposures to very toxic substances. The patient, injured or not, must be decontaminated before being allowed into the emergency department to protect Emergency Department and hospital staff.

## Considerations for Patient Treatment

Primary goals for hospital personnel in handling a contaminated patient include termination of exposure to the patient, patient stabilization, and patient treatment—while not jeopardizing the safety of hospital personnel. Termination of exposure can best be accomplished by removing the patient from the area of exposure and by removing contaminants from the patient. Basically, a contaminated patient is like any other and may be treated as such except that staff must protect themselves and others from dangers due to contamination.

Personnel must first address life-threatening issues and then decontamination and supportive measures. Priority should be given to the ABC with simultaneous contamination reduction. Once life-threatening matters have been addressed, medical personnel can then direct attention to thorough decontamination, secondary patient assessment, and identification of materials involved. It is important to remember that appropriate personal protective clothing must be worn until personnel are no longer in danger. Therefore, the sooner the patient becomes decontaminated the sooner personnel may reduce protective measures or downgrade the level of protection. Primary and secondary surveys should be completed as conditions allow. In treating

patients, personnel should consider the chemical specific information received from HAZMAT response resources. In multiple patient situations, proper triage procedures should be implemented. Presenting signs and symptoms should be treated as appropriate and when conditions allow. The sooner a patient has been decontaminated the sooner he or she can be treated like a "normal" patient. Orders of the poison control center and attending physician should be administered. Invasive procedures such as IVs or intubation, should be performed only for life threatening conditions, until decontamination is performed.

Medically trained Decon personnel may begin basic life support treatment during decontamination before the victim has been removed to triage.

## Triage and Patient Segregation

Contaminated patients presenting at the hospital must be decontaminated before definitive treatment can begin. A segregation area should be established AWAY FROM (and downwind of ) the ED entrance. Try to ensure that it is far enough away that a shift in wind direction will not necessitate moving your segregation area. Always choose security over proximity in selecting the patient containment area.

As you know, in triage the most critical injuries are identified and the priorities for treatment are established. Triage is an ongoing process that continues throughout the operation. When hazardous materials are involved, all personnel must remain on guard to avoid being contaminated by the victims.

In addition to the normal triage assessment the following information must be determined:

- To what degree is each injury related to the hazardous materials involved?
- Which injuries are most severe? (and should receive Decon and treatment first)
- What is the route of entry into the body (inhalation, ingestion, absorption, etc.)
- Are the materials still acting on the patient?

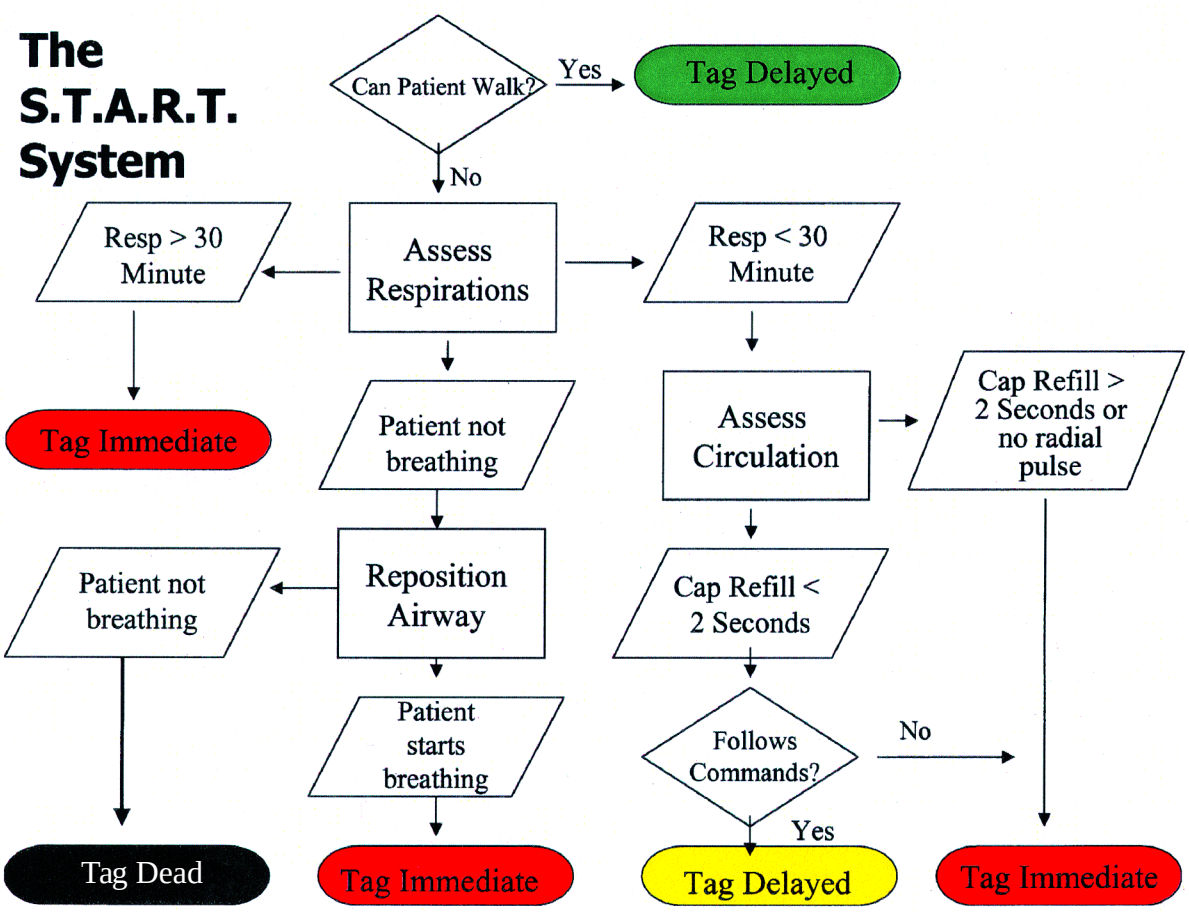
## Triage methods

### Utilize the S.T.A.R.T. System

The START system (Simple Triage and Rapid Treatment) should be used to evaluate all patients in mass casualty/Decon situations. It categorizes the patient by evaluation of the following body systems: mobility, airway, breathing, circulation and mental status.

Patients are divided into the following categories:

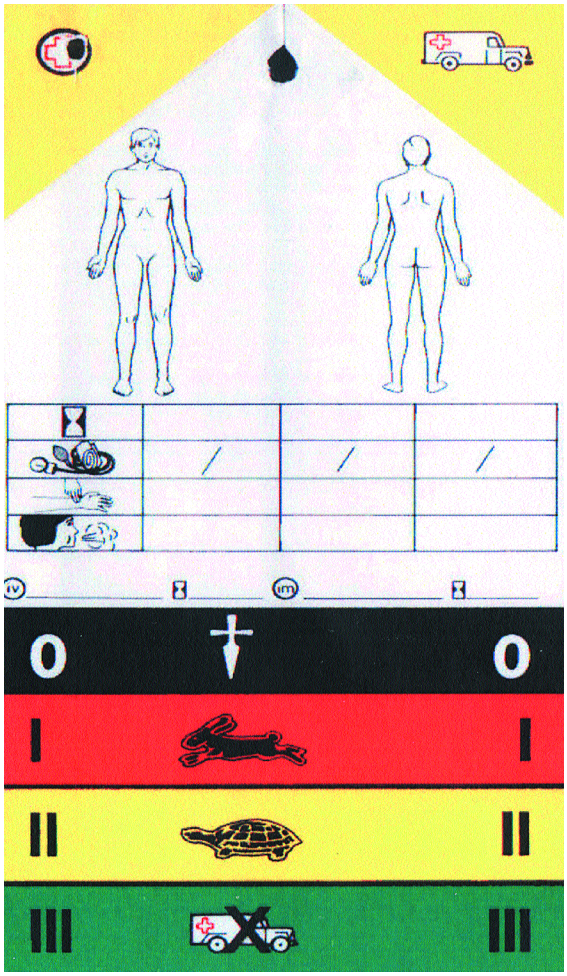
| Tag Color | Priority | Description |
|---|---|---|
| RED | 1 | Immediate |
| YELLOW | 2 | Delayed |
| GREEN | 3 | Ambulatory |
| BLACK | 4 | Expectant |



## Utilize MET-TAGS™

The MET-TAGS triage tag system is most effective with the START system of triage. It is the standard tag adopted by the State of NJ. The colors and priorities of the tags are listed in the S.T.A.R.T.System.

# The METTAG™ Triage Tag

# TAGGING PATIENTS

- Tagging (with triage assessment) is especially important when more than one patient is involved. Subsequent treatment is based on this information.
- Tag information should include:
- Decontamination completed—will be indicated by a large "D" written on the tag.

The following should be documented at the time of treatment:

- Vital signs and symptoms.
- Exposure materials, duration and routes.
- Treatment to date.
- Additional injury assessment.
- Chronic illness.
- Allergies.
- Current medication.

## WHAT OTHER TAGGING INFORMATION COULD BE ADDED?

_____

_____

_____

# POST-EVENT CONSIDERATIONS

## Personal Cleanup

The experienced professional never assumes he or she is "clean" of contamination after an incident. **Medical personnel MUST be decontaminated according to the established policies of the environmental agencies and industry experts.** Sometimes clothing, jewelry, etc. which was worn will have to be discarded if it is not possible to properly decontaminate. Contact DEP, CHEMTREC, the local HAZMAT Unit, Regional Poison Control Center or County Health Dept. for specific decontamination procedures required.

**Minimally:**

Use your best technique in removing protective outerwear so that you do not contaminate yourself. Be especially careful of the soles of shoes, cuffs on pants, etc. In general, do not wear home any potentially contaminated article of clothing (including underwear) which has not first been laundered.

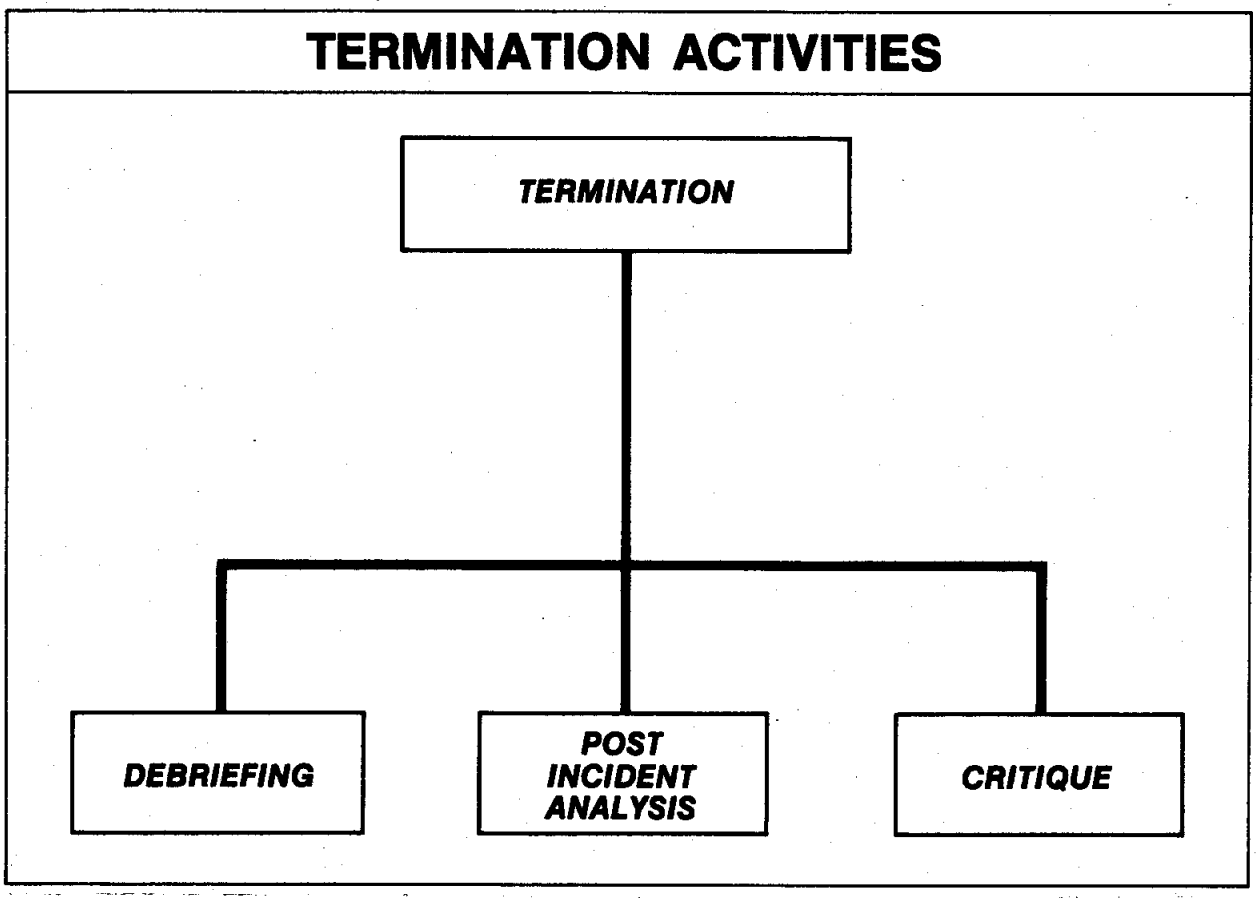
All Hospital personnel involved in the incident should shower and must change clothes. When showering, spend extra time on head and body hair (hair has an affinity for fine dusts).

All clothing worn at the emergency site must be decontaminated and laundered before being worn again. Remember: Contaminated clothing may be a fire hazard if not washed **IMMEDIATELY!**

# TERMINATION OF THE INCIDENT

Termination: The cessation of emergency tactical operations to include documentation, debriefing and the eventual post incident analysis, and critiquing.

Termination activities are divided into three phases: (1) debriefing the incident, (2) post-incident analysis, and (3) critiquing the incident.




**An effective debriefing should:**

- Inform workers exactly what hazmats they were exposed to.
- Identify equipment damage and unsafe conditions requiring attention.
- Assign information, gathering responsibilities for post-incident analysis and critique.
- Summarize the activities performed.
- Reinforce the positive aspects of the response.

**Post-incident analysis is conducted to:**

- Determine the level of financial responsibility.
- Establish a clear picture of the emergency response for further study.

The post-incident analysis should focus on four key topics:

- Command and control
- Tactical operations
- Resources
- Support services

## Critiques

Many injuries and fatalities have been prevented as a result of critique sessions. A commitment to critique all HAZMAT/Decon situations will improve emergency responder performance by improving efficiency and pinpointing weaknesses.

The crucial person to a good critique is the critique leader; the critique leader should:

- Control the critique.
- Ensure that direct questions receive direct answers.
- Ensure that all participants play by the critique rules.
- Ensure that each operational group presents their observations.
- Keep notes of important points.
- Sum up the lessons learned.

# SUMMARY

Hazardous materials incidents should be formally terminated to ensure personnel safety, to establish a record of events, and to document the lessons learned from the entire incident.

## Equipment Cleanup

The equipment must be decontaminated according to the established policies of environmental agencies and industry experts. (Some equipment will be discarded rather than decontaminated. Contact CHEMTREC or DEP for specific decontamination procedures.)

## Review Session

Hold an immediate review session to cover the following topics:

- Assess need for a Critical Incident Stress Debriefing.
- Areas of strongest performance.
- Areas needing additional work.
- Additional personnel and equipment needed next time.
- Items transported which were unnecessary.
- Restocking requirements.

Hospital personnel should have a post-event evaluation considering most of the list above. In addition, hospitals must be concerned with the effect of the hazard (if any) on the public, staff and other patients in the hospital, the security of the contaminated vehicles which may be parked in public places, the efficiency of specialized lab services and the adequacy of equipment, staff and facility.

# APPENDICES

- **Appendix A** **Suggested Equipment**
- **Appendix B** **MSDS Review**
- **Appendix C** **Useful Web Sites**
- **Appendix D** **Important Phone Numbers**
- **Appendix E** **Glossary**
- **Appendix F** **Student Exercises**
- **Appendix G** **Federal Regulations**

# APPENDIX A
# Suggested Equipment For Hospital Hazardous Materials Incidents

- Binoculars to assess scene or patients from a safe distance.
- Plastic (10-20 mil, preferably clear) trash bags (3 or 4 mil) to isolate and dispose of contaminated articles and toxic vomitus.
- A large supply of oxygen to treat breathing problems caused by exposure to Hazardous Materials.
- A large wash basin, bucket, or plastic waste basket which can be lined with a trash bag to collect contaminated eye wash water or vomitus.
- Disposable plastic-coated blankets (or "chucks") to soak up and isolate liquids from a decontaminated patient. Use these for absorbing toxic vomitus.
- Disposable gowns and slippers for patients who must remove contaminated clothes at the scene.
- Disposable surgical or examination gloves.
- Surgical or other paper masks.
- Waterproof disposable shoe covers.
- Splash goggles or face shields to protect personnel from splashes while they work on the patient.
- Inexpensive stethoscopes, blood pressure cuffs and other gear which can be discarded if contaminated.
- Isotonic saline and IV tubing for eye irrigation.
- A Bag-Valve Mask (BVM) or similar device in lieu of mouth to mouth respiration. (Pocket masks are NOT acceptable.)
- Liquid soap for washing off oily contaminants.
- Epsom salts for soaking hydrofluoric acid burns.
- Shears for removing clothing from victim.
- Copy of the current "D.O.T. Emergency Response Guidebook".
- Appropriate personal protective equipment.
- A generous supply of fresh warm water to flush away contaminants.

- Common food oil for removal of chemical tars.
- One or more of the following treatment guides:
  a. Bronstein & Currance's "Emergency Care for Hazardous Materials Exposure"
  b. Deichmann & Gerard's "Toxicology of Drugs & Chemicals"
  c. Dreisbach's "The Handbook of Poisoning"
  d. Patty's Volume 2, "A-B-C"
  e. Stutz & Janusz "Hazardous Materials Injuries"
- The contact number for the regional poison control center and a list of physicians or other knowledgeable contacts specializing in treating exposure to hazardous materials.

# APPENDIX B
# MSDS Review

Material Safety Data Sheets (MSDS) are critical documents. Getting them or getting any information about a hazardous material that might be involved in an incident can sometimes be a problem.

Here are some possible solutions:

1. Get MSDS from the responding agency with whom the MSDS should have been filed according to SARA Title III regulations or from the company whose product is involved.
2. Ask questions of any company personnel who may have manufacturing expertise.
3. Encourage local companies to place near their entrance a lock box with their MSDS inside, or provide MSDS inventories to your hospital.

## Using an MSDS

Materials Safety Data Sheets vary in format. Since there is no standard format, manufacturers can present their document information in their own way. The information you need to know, however, is always present—but you may have to hunt for it. Tip: Get MSDS from local companies and review their approach to communicating this kind of information.
In looking at an MSDS, search for:

1. The product name,
2. Precautionary statements,
3. First aid information regarding routes of exposure, exposure limits, effects of exposure (target organs),

Look for this information under headings such as:

"BLS/First Aid Procedures"
"Primary Routes of Entry"
"Emergency and First Aid Procedures"
"Health Hazard Information"

4. Personal protective clothing recommended.
5. Other chemical and physical characteristics such as fire, explosion and reactivity hazards.

6. The name of the manufacturer or MSDS preparer, address and emergency telephone number.
7. Safe handling procedures for spills or leaks.
8. An indication if the material is listed with National Toxicology Program, IARC or OSHA.

At times certain information on chemical contents will be withheld from the MSDS as "trade secrets." A treating physician can obtain this information on an emergency need to know basis from the manufacturer immediately. The physician will be required to follow up with a written request and sign a non-disclosure agreement.

Enclosed are **sections** from Materials Safety Data Sheets for your review. For each material, please discuss:

1. What should be your basic response to an incident involving this material?
2. What protective clothing would be needed?
3. What equipment would be needed?
4. What disposable equipment could we use?
5. What equipment could we commit that could be decontaminated later?

MSDS NO. 1218-04
CAS NO. ————————-
DATE: 10/03/86

## PRODUCT IDENTIFICATION

| | |
|---|---|
| TRADE NAME: | **ACCURAC(r) 135 RETENTION AID** |
| SYNONYMS: | Cationic polyacrylamide in water-in-oil emulsion |
| CHEMICAL FAMILY: | Cationic polyacrylamide |
| MOLECULAR FORMULA: | Mixture |
| MOLECULAR WGT.: | Mixture |



## WARNING

DANGER! CAUSES SKIN BURNS
HARMFUL IF INHALED
MAY CAUSE EYE IRRITATION

## HAZARDOUS INGREDIENTS

| COMPONENT | CAS. NO. | % | TWA/CEILING | REFERENCE |
|---|---|---|---|---|
| Petroleum distillate | 008002-05-9 | 26.5 | 500 ppm | OSHA |

## NFPA HAZARD RATING

Fire
1
Health 2 0 Reactivity
Special

FIRE: Material that must be preheated before ignition can occur.
HEALTH: Materials which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.
REACTIVITY: Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

| | | |
|---|---|---|
| **HEALTH HAZARD INFORMATION** | EFFECTS OF OVEREXPOSURE | The acute oral (rat) and acute dermal (rabbit) $LD_{50}$ values are both >10 ml/kg. Minimal eye irritation was produced during primary irritation testing in rabbits. When this product was tested for skin irritation under occlusive conditions, as would occur if the product was spilled into boots, irreversible skin damage was produced. However, when this product was tested under open conditions as would occur if the product was spilled on clothing, only mild skin irritation was produced after 24 hours of contact. Aspiration of the solvent, petroleum distillate, may cause chemical pneumonitis. Overexposure to vapor of petroleum distillates may cause dizziness, headache, nausea, and irritation of the respiratory tract. |
| | FIRST AID: | In case of skin contact, remove contaminated clothing without delay. Wear impervious gloves. Cleanse skin thoroughly with soap and water. Do not omit cleaning hair or under fingernails if contaminated. Do not reuse clothing without laundering. Do not reuse contaminated leatherware. In case of eye contact, immediately irrigate with plenty of water for 15 minutes. |

**PRODUCT NAME:** Glutaraldehyde (25% by weight)

## III. INGREDIENTS

| MATERIAL | % | TLV (Units) | HAZARD |
|---|---|---|---|
| Glutaraldehyde<br>CAS # 111-30-8 | 25 | See Section V | See Section V |
| Water<br>CAS # 7732-18-5 | ~75 | None established | See Section V |
| Methanol<br>CAS # 67-56-1 | <0.05 | See Section V | See Section V |

## IV. FIRE AND EXPLOSION HAZARD DATA



| | | |
|---|---|---|
| FLASH POINT<br>(test method(s)): | None, Tag Closed Cup ASTM D 56<br>None, Cleveland Open Cup ASTM D 92 | |
| FLAMMABLE LIMITS IN AIR,<br>% by volume: | LOWER:<br>UPPER: | Not determined (aqueous system)<br>Not determined (aqueous system) |
| EXTINGUISHING MEDIA: | Non-Flammable (Aqueous System): After the water evaporates, the remaining material will burn. Use alcohol-type or all-purpose-type foam applied by manufacturer's recommended technique for large fires. Use CO2 or dry chemical media for small fires. | |
| SPECIAL FIRE FIGHTING PROCEDURES: | Use self-contained breathing apparatus and protective clothing. | |
| UNUSUAL FIRE AND EXPLOSION HAZARDS: | None | |

PRODUCT NAME: Glutaraldehyde (25% by weight)

## V. HEALTH HAZARD DATA

| | |
|---|---|
| TLV AND SOURCE: | Glutaraldehyde—0.2 ppmv, ceiling OSHA & ACGIH 1988-89<br>Methanol—200 ppm, skin OSHA & ACGIH 1988-89 |
| EFFECTS OF SINGLE OVEREXPOSURE:<br>SWALLOWING: | Moderately toxic. May cause moderate to marked irritation or chemical burns of the mouth, throat, esophagus, and stomach. There will be discomfort or pain in the chest and abdomen, nausea, vomiting, diarrhea, dizziness, faintness, drowsiness, weakness, circulatory shock, collapse and coma. |
| SKIN ABSORPTION: | Toxicology studies indicate that prolonged or widespread contact could result in the absorption of potentially harmful amounts of material. |
| INHALATION: | Vapor is irritating and will cause stinging sensations in the nose and throat, coughing, chest discomfort and tightness, difficulty with breathing, and headache. |
| SKIN CONTACT: | Brief contact may result in mild to moderate local redness and possibly swelling. Prolonged contact may result in severe inflammation. |
| EYE CONTACT: | Liquid will cause severe conjunctivitis, seen as discharge with marked swelling and excess redness of the conjunctiva. Severe corneal injury may occur. Vapor will cause stinging sensations with excess lachrymation, but not injury. |
| EFFECTS OF REPEATED OVEREXPOSURE: | None known from currently available information. |
| MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: | Because of its irritating properties, this material may aggravate an existing dermatitis. |
| SIGNIFICANT LABORATORY DATA WITH POSSIBLE RELEVANCE TO HUMAN HEALTH HAZARD EVALUATION: | Laboratory studies have shown that glutaraldehyde is not teratogenic, and several studies have shown the material not to be a mutagen. |
| OTHER EFFECTS OF OVEREXPOSURE: | May cause skin sensitization in a small proportion of individuals, and present as an allergic contact dermatitis. |
| EMERGENCY AND FIRST AID PROCEDURES:<br>SWALLOWING: | Give at least two glasses of water. Do not induce vomiting.<br>Seek medical assistance with urgency. |
| SKIN: | Wash contaminated skin with soap and water. If contact has been widespread and prolonged, or if irritation persists, seek medical advice. Contaminated clothing should be washed before reuse. |
| INHALATION: | Remove to fresh air. If breathing is difficult, administer oxygen.<br>If symptoms persist, call a physician. |
| EYES: | Immediately flush eyes thoroughly with water and continue flushing for at least 15 minutes. See an ophthalmologist urgently. |

NOTES TO PHYSICIAN:

Aspiration may cause lung damage. Probable mucosal damage may contraindicate the use of gastric lavage; however, if gastric lavage is considered necessary, it should be undertaken with caution. Most of the adverse effects of glutaraldehyde are due to its intensely irritating properties. Because of this vomiting should not be induced in cases of poisoning by swallowing. There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition of the patient.

## IX. SPECIAL PRECAUTIONS



PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE:

DANGER: CORROSIVE
CAUSES IRREVERSIBLE EYE DAMAGE.
CAUSES SKIN IRRITATION.
HARMFUL IF INHALED.
HARMFUL IF SWALLOWED.
HARMFUL IF ABSORBED THROUGH SKIN.
MAY CAUSE SKIN SENSITIZATION.
Do not get in eyes, on skin, on clothing.
Avoid breathing vapor.
Do not swallow.
Wear goggles, protective clothing, and rubber gloves.
Wash thoroughly with soap and water after handling.
Remove contaminated clothing and wash before reuse.
FOR INDUSTRY USE ONLY

OTHER PRECAUTIONS:

Laboratory studies, using an odor test panel, indicated glutaraldehyde vapors in air may be 'irritating' to humans at about 0.3 ppm in air; the TLV has been established as 0.2 ppm ceiling. Thus, if vapors are concentrated enough to be irritating, the TLV is probably being exceeded.

## SECTION I PRODUCT IDENTIFICATION & EMERGENCY INFORMATION

PRODUCT NAME

ECA 10454



CHEMICAL FAMILY

Lube oil additive containing a zinc salt of dialkyl dithiophosphoric acid, borated polyisobutenyl succinic anhydride nitrogen functionalized dispersant, magnesium alkylaryl detergent, solvent extracted mineral oil, and other components judged not to affect the potential health or environmental impact of the product.

EMERGENCY TELEPHONE NUMBERS:

CHEMTREC 800-424-9300

## SECTION II HAZARDOUS COMPONENTS OF MIXTURES

THE PRECISE COMPOSITION OF THIS MIXTURE IS PROPRIETARY INFORMATION. A MORE COMPLETE DISCLOSURE WILL BE PROVIDED TO A PHYSICIAN OR NURSE IN THE EVENT OF A MEDICAL EMERGENCY. THE FOLLOWING COMPONENTS ARE DEFINED HAZARDOUS IN ACCORDANCE WITH 29 CFR 1910, 1200:

| OSHA HAZARD | COMPONENT |
|---|---|
| Eye irritant | Zinc salt of dialkyl dithiophosphoric acid |

For additional information see Section X.

## SECTION III HEALTH INFORMATION AND PROTECTION

FIRST AID & NATURE OF HAZARD

EYE CONTACT:

Flush eyes with large amounts of water until irritation subsides. If irritation persists, get medical attention.
Irritating, and may injure eye tissue if not removed promptly.

SKIN CONTACT:

Flush with large amounts of water; use soap if available.
Remove grossly contaminated clothing, including shoes, and launder before reuse.
Low order of toxicity.
Frequent or prolonged contact may irritate.

INHALATION:

Using proper respiratory protection, immediately remove the affected victim from exposure. Administer artificial respiration if breathing is stopped. Keep at rest. Call for prompt medical attention.
Negligible hazard at ambient (–18 to 38 Deg. C) or recommended blending temperature.
Warning if heated above 60 Deg. C (140 Deg. F) especially in the presence of water, hydrogen sulfide may be released; this can cause respiratory collapse, coma and death without necessarily any warning odor being sensed.
Avoid breathing vapors or mists.

INGESTION:

DO NOT induce vomiting. If individual is conscious, give milk or water to dilute stomach contents. Keep warm and quiet. Get prompt medical attention. DO NOT attempt to give anything by mouth to an unconscious person.
Minimal toxicity.

# APPENDIX C

## SOME USEFUL WEBSITES

## 1. FEDERAL RESOURCES:

## A. EPA/FEMA Websites:

**EPA Homepage:** http://www.epa.gov/
EPA News and Events, Laws and regulations, Offices, Publications and other resources available to access information about EPA.

**Brownfields:** http://www.epa.gov/brownfields/
This site provides information on all facets relating to Brownfields development. Information is provided on Brownfields Pilots, liability & cleanup, partnership & outreach, laws & regulations, publications, money matters and other resources.

**Chemical Accident Prevention and Risk Management Planning (RMP):**
http:/www.epa.gov/swercepp/acc-pre.html
Contains information on the Clean Air Act, Section 112(r) legislation, the Risk Management Program Rule, Fact Sheets, Basic Awareness brochures, training modules, Federal Register notices, press releases, technical guidance documents, model risk management program plans by industrial sector, downloadable computer software, downloadable RMP publications, and many other resource links.

**Chemical Emergency Preparedness and Prevention Office (CEPPO):**
http://www.epa.gov/swercepp/acc-pre.html
This site provides helpful information on Chemical Accident Prevention and Risk Management Planning. There are links to Fact Sheets, Laws & Regulations, Publications, Federal Register Notices, Press Releases, Technical Guidance Documents, and General Guidance for Risk Management Programs.

**Chemical Fact Sheets:** gopher://ecosys.drdr.Virginia.edu:70/11/library/gen/toxics
Summaries of information on over 300 chemicals including identifying characteristics, health hazards, ecological effects, and methods to reduce exposure to the chemical. Maintained by the University of Virginia.

**Current Hazardous Waste Sites (CERCLIS):**
http://www.epa.gov/superfund/oerr/impm/products/cursites/csitetoc.htm
A listing of sites on the CERCLIS list.

**Glossary of Terms of the Environment:** http://earth1.epa.gov:80/OCEPAterms/
An alphabetical listing of terms associated with the environment.

**Headquarters Resources Center Internet Newsbrief Resources:**
http://www.epa.gov/natlibra/hqire/inb.htm
A weekly service from EPA Headquarters Resources Center that provides a sampling of new and or useful internet resources for EPA staff or other Environmental Professionals.

**Index of EPA Clearinghouses:** http://www.epa.gov/epahome/clearing.htm
Includes a link to Air Risk Information Support Centers, Asbestos Management, Clean Air Technology, EPA Learning Institute, Indoor Air Quality, National Response Center, etc.

**Integrated Risk Information System (IRIS):** http://www.epa.gov/ngispgm3/iris/index.html
IRIS Homepage, database of human health effects that may result from exposure to various substances found in the environment.

**Numbers (EPA):** http://www.epa.gov/epanumbers.html
Lists the various programs and updated telephone #'s for EPA. The site is supposed to update when changes occur.

**Office of Solid Waste and Emergency Response:** http://www.epa.gov/swerrims/index.htm
Information on RCRA, Superfund Sites, Solid Waste, Underground Storage Tanks, Chemical Emergency Preparedness and Prevention, Oil Spill Program, etc.

**Regional EPA Offices:** http://www.epa.gov/swercepp/pubs/regions.html
A listing of all EPA Regional Offices.

**Regional FEMA Offices:** http://www.epa.gov/swercepp/pubs/fema.html
A listing of all the FEMA Regional Offices.

**Whats Hot in EPA:** http://www.epa.gov/epahome/hot.html
What is hot on the EPA server.

**Whats New in EPA:** http://www.epa.gov/docs/WhatsNew.html
Lists daily minutes, updates, documents, standards, etc. as they are released.

## B. Federal General Environmental:

**Centers for Disease Control and Prevention (CDC):** http://www.cdc.gov
This site provides links to health information, travelers' health, subscriptions, publications and products, data & statistics, training & employment opportunities, and funding.

**Federal Emergency Management Agency (FEMA):** http://www.fema.gov:80/fema/
An index of links alphabetically listed to all FEMA related sites.

**National Institute for Occupational Safety & Health (NIOSH):**
http://www.cdc.gov/niosh/homepage.html
Information on NIOSH services, publications, documents, training, research, patterns and general information. There are also links to databases and health hazard evaluations.

**Occupational Safety and Health Administration (OSHA):**
http://www.OSHA.gov/index.html
Information regarding OSHA news releases, regulations, compliance, programs, statistics, training and a myriad of many other topics can be found here.

**USGS Guide to Federal Environmental Laws and Regulations:**
http://water.usgs.gov/public/eap/env guide/
Contains information on: Air Quality, Water Quality, Solid and Hazardous Substances, Lists of Statutes by Sections, etc.

## C. Federal HAZMAT:

**DOT's Office of Hazardous Materials Safety:** http://hazmat.dot.gov
Contains information on: Rules and Regulations, Exemptions and Approvals, Hazmat Enforcement, Spills, International Standards, COHMED, Emergency Response Guidebook, etc.

**The National Clearinghouse for Worker Safety and Health Training for Hazardous Materials:** http://www.niehs.nih.gov/wetp/clear.htm
Contains information on Safety and Health Resources.

## D. Federal Other:

**Federal Bureau of Investigation** www.FBI.gov

**Code of Federal Regulations (CFR):** http://www.access.gpo.gov/nara/cfr/cfr-table-search.html
A listing of all available CFR tables available for internet access, search engine for CFR databases, browse capability for all CFR titles and Federal Registry access.

**Federal Registry:** http://www.access.gpo.gov/su docs/
Access to Federal Registry books, Private Act Issuances, Public laws, United States Government Manual and US Congress Information.

**Keeping America Informed—U.S. Government Printing Office:** http://www.gpo.gov/
This site provides access to the Code of Federal Regulations, the Federal Register, Public Laws, etc. This is probably todays best and fastest way to access the Federal Register and the CFRs.

**National Archives and Records Administration, Code of Federal Regulations:**
http://www.access.gpo.gov/nara/cfr/cfr-table-search.html#page1
Official Electronic Copy. Contains information on: Search CFR databases by keywords, Search CFR titles and/or volumes, Search the Federal Register for related documents, etc.

## 2. STATE RESOURCES:

## A. New Jersey Department of Environmental Protection (NJDEP) Websites:

**NJDEP Home Page:** http://www.state.nj.us/dep/

**Air Quality Permitting Program (AQPP):** http://www.state.nj.us/dep/aqpp/
This site provides links to help sources on Minor Facilities & Preconstruction Permits, Major Facilities & Operating Permits, Stack Testing, CEMs, Modeling & Risk Assessment, Engineering, and RADIUS and electronic applications.

**Bureau of Discharge Prevention:**
http://www.state.nj.us/dep/enforcement/relprev/dpcc/fsdpcc.html

**Compliance and Enforcement:** http://www.state.nj.us/dep/enforcement/index.html

**Division of Solid and Hazardous Waste:** http://www.state.nj.us/dep/dshw/

**Division of Water Quality:** http://www.state.nj.us/dep/dwq/

**Office of the Commissioner:** http://www.state.nj.us/dep/commissioner/index.html

**Radiation Protection Programs:** http://www.state.nj.us/dep/rpp/
**Radon Section:** http://www.state.nj.us/dep/rpp/ber/radon/index.htm
This site provides useful information on radon testing and mitigation for home buyers and sellers, and testing for radon in your home. It also provides information on average radon levels and tier assessment in New Jersey. There is information on the Radon Certification Program as well as a list of Certified Radon Testing Businesses and Certified Radon Mitigation Businesses in New Jersey.

**Site Remediation Program:** http://www.state.nj.us/dep/srp
Contains information on: ISRA, Brownfields, Superfund, UST, Known Contaminated Sites, Regulations and Guidance, and Financial Assistance.

## B. State & Local Resources:

**State of New Jersey Homepage:** http//www.state.nj.us
Access to state agencies, Governor's office, and Legislature.

**LOIS, Electronic Law Library:** http://www.pita.com
Regulations for Other States.

**New Jersey Online (NJO):** http://www.njo.com/
Lists communities, forums, news, sports, entertainment, businesses, living, classifieds/ads, user guides, etc.

**New Jersey State Police:** http://www.state.nj.us/lps/njsp/
Academy, Special School and EMS training, recruiting, current events and road and weather conditions can be found here.

**State, County and Local Governments on the net:**
http://www.piperinfo.com/piper/state/states.html
A site that gives you links to all state and local government sponsored websites. Also included are some Federal Resources, National Organizations and other miscellaneous links.

# 3. OTHER RESOURCES:

## A. Miscellaneous Resources

**Clay Net:** http://www.clay.net/ep1.html
Good links to federal/state websites run by EPA, OSHA, DOD, NJDEP, PADEP, etc. It also contains industry sites and links to professional organizations and references.

**The Weather Channel:** http://www.weather.com/twc/homepage.twc

## B. General Environmental:

**Agency for Toxic Substances and Disease Registry (ATSDR):**
http://atsdr1.atsdr.cdc.gov:8080/atsdrhome.html

All information about the ATSDR program can be found here: Announcements, Address and Phone numbers, Health Assessments and Consultations, Education and Communication, HazMat databases, health studies and many other topics are addressed at this website.

## C. Organizations/Commissions:

**Academy of Certified Hazardous Materials Managers (ACHMM):** http://www.achmm.org
Access to state, federal and other hazardous materials management, safety and environmental links as well as job postings, resumes, and current technical articles.

**American Congress of Governmental Industrial Hygienists (ACGIH) Publications:**
http://www.acgih.org/catalog/catfind.asp
Provides a catalog list of ACGIH publications, meeting and event information, and membership.

**Chemical Manufacturers Association (CMA):** http://www.cmahq.com
Provides links to information on Responsible Care®, publications, workshops/seminars, CHEMTREC, CHEMSTAR, ChemEcology, Health Research.

**Joint Commission for Accreditation of Healthcare Organizations** http://www.jcaho.org

**N.J. Water Environment Association:** http://www.njwea.org

**Union/Middlesex County Hazardous Materials Advisory Council (HMAC):**
http://www.hmac-inc.org
HMAC is a non-profit organization who's mission is to promote the responsible handling of hazardous materials. Committee projects support HMAC's goals: to contribute to a reduction in hazardous materials incidents; promote education to responders, industry, government and the public regarding hazardous materials and their proper handling; promote open communications among all types of residents in Union/Middlesex Counties; and to enhance preparedness, response and recovery capabilities in the event of incidents in Union/Middlesex Counties. Information on the committees and their projects can be found here along with available HMAC publications, training and seminar information and other resource links.

## D. Chemical Databases:

**NJ DHSS:** http//www.state.nj.us/health/eoh/odisweb/
Access to information from NJRTK (imel. FactSheets) and Occupational Health programs.

**Chemfinder:** http://chemfinder.camsoft.com/
Allows you to locate common types of chemical information by entering a chemical name, molecular weight or CAS registry number.

**Chemical Abstracts Service:** http://www.cas.org
Database includes approximately 14 million document records and more than 18 million substance records respectively. Includes databases of chemical reactions, commercially available chemicals and listed regulated chemicals.

**Material Safety Data Sheet (MSDS) Search:** http://www.msdssearch.com/
A forms-searchable database of MSDS entries providing FREE access to over 750,000 MSDSs.

**RTK-Net, the Right to Know Network:** http://rtk.net/www/rtknet/homepage.html
A network providing free access to numerous databases, text files and conferences on the environment, housing and sustainable development.

**Toxic Release Inventory (TRI):** http://www.epa.gov/opptintr/tri/
Contains information on the TRI Program. TRI data, chemicals, envirofacts, national and international programs and TRI contacts are some of the topics found on this page.

## E. Bioterrorism Information:

**Federal Bureau of Investigation:** www.fbi.gov

**Medical Management of Chemical and Biological Casualties:** www.nbc-med.org

**Anthrax Advisory:** www.emergency.com

**National Workshop on Domestic Preparedness:** www.wmdnationalworkshop.com

**Counter Terrorism Program Link:** www.oep.dhhs.gov

**Chemical and Biological Information Analysis Center:** www.cbiac.apgea.armymil

**Federal Emergency Management Agency** www.fema.gov

**Soldier Biological and Chemical Command:** www.sbccom.gov

**National Emergency Management Association:** www.nemaweb.org

**CDC Bioterrorism Preparedness & Response Network:** www.bt.cdc.gov

**US Army Medical Research Institute for Infectious Disease:** www.dad.gov

# APPENDIX D

## IMPORTANT TELEPHONE NUMBERS

## EMERGENCY RESPONSE

NJ DEP HOTLINE . . . (EMERGENCY ACTION LINE) .....1-877-WARNDEP
NEW JERSEY STATE POLICE NORMAL WORK HOURS .....609-882-2000 x. 6453
AFTER WORK HOURS
(Weeknights, Weekends) .....609-882-2000 x. 6311
CHEMTREC .....800-424-9300
ASSOCIATION OF AMERICAN RAILROADS
BUREAU OF EXPLOSIVES .....202-639-2222
EPA REGION II EMERGENCY RESPONSE .....908-321-6657
NATIONAL RESPONSE CENTER (U.S.C.G.) .....800-424-8802
NEW JERSEY POISON CONTROL CENTER.....800-962-1253
NATIONAL POISON CONTROL HOTLINE .....800-764-7661

## STATE AGENCIES

**NEW JERSEY STATE POLICE:**
OFFICE OF EMERGENCY MANAGEMENT .....609-882-2000 x. 6453
DOMESTIC PREPAREDNESS/HAZ MAT EMERGENCY
RESPONSE PLANNING UNIT .....732-721-4040
HAZ MAT TRANSPORTATION .....609-882-2000 x. 2586

**DEPARTMENT OF ENVIRONMENTAL PROTECTION:**
COMMUNITY RIGHT TO KNOW .....609-292-6714
TOXIC CATASTROPHE PREVENTION ACT.....609-633-7289
COUNTY ENVIRONMENTAL HEALTH ACT.....609-292-6028
DISCHARGE PREVENTION CONTAINMENT &
COUNTERMEASURE .....609-633-0610
RESPONSIBLE PARTY SITE REMEDIATION .....609-633-2168
BUREAU OF HAZARDOUS WASTE ENFORCEMENT .....609-984-5855

**DEPARTMENT OF HEALTH:**
WORKER RIGHT TO KNOW .....609-984-2202
PUBLIC EMPLOYEES OSH SERVICE .....609-984-1863

**DEPARTMENT OF LABOR:**

WORKER RIGHT TO KNOW .....609-292-7036
DEPARTMENT OF PERSONNEL—HUMAN RESOURCE
DEVELOPMENT INSTITUTE (HRDI) .....609-292-7115

## FEDERAL AGENCIES

FEDERAL BUREAU OF INVESTIGATION .....973-792-3000

**OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION**

OSHA .....202-219-7162
OSHA REGION II OFFICE .....212-337-2378
NEW JERSEY AREA OSHA OFFICES:
HASBROUCK HEIGHTS .....201-288-1700
DOVER .....201-263-1003
AVENEL .....908-750-3270
CAMDEN .....609-757-5181
NIOSH HOTLINE .....800-356-4674
NIOSH HEADQUARTERS .....404-639-3771
NIOSH REGION II OFFICE .....212-264-4600

**ENVIRONMENTAL PROTECTION AGENCY**

EPA HOTLINE .....202-382-3000
EPA SUPERFUND HOTLINE .....800-424-9346
REGION II SARA TITLE III ASSISTANCE .....908-906-6900

**DEPARTMENT OF TRANSPORTATION**

U.S. COAST GUARD THIRD DISTRICT .....212-668-7152
ATLANTIC STRIKE TEAM .....
DAYTIME 609-724-0008
NIGHTTIME (ANSWERING MACHINE) .....609-562-6730
DOT HOTLINE (CFR TITLE 49) .....202-366-4488
DOT/FEMA HAZ MAT TRANSPORTATION HOTLINE .....800-752-6367
DOT/REGIONAL EMERGENCY TRANSPORTATION .....617-223-8480

**OTHER FEDERAL AGENCIES**

DEPARTMENT OF ENERGY .....800-428-2525
TOXIC SUBSTANCES CONTROL ACT HOTLINE .....202-554-1404
U.S. ARMY CORPS OF ENGINEERS .....202-272-0001
U.S. AGENCY FOR TOXIC SUBSTANCES AND
DISEASE REGISTRY HOTLINE .....404-639-0615
CENTERS FOR DISEASE CONTROL .....404-639-3291

**OTHER ASSOCIATIONS**

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH) .....513-661-7881
AMERICAN INDUSTRIAL HYGIENE ASSOCIATION .....216-873-2442
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS .....201-763-2877
AMERICAN SOCIETY OF SAFETY ENGINEERS.....312-692-4121
AMERICAN TRUCKING ASSOCIATION.....800-ATA-LINE
CHEMICAL INDUSTRY COUNCIL OF NJ.....609-392-4214
CHEMICAL MANUFACTURERS ASSOCIATION (CMA) .....202-887-1100
CMA CHEMICAL REFERRAL CENTER (NON-EMERGENCY CHEMICAL INFORMATION) .....800-CMA-8200
NATIONAL SAFETY COUNCIL (NSC) .....312-527-4800
NATIONAL FIRE PROTECTION ASSOCIATION .....617-770-3000
TEXAS TECH UNIVERSITY PESTICIDE HOTLINE .....800-858-7378

# APPENDIX E
# GLOSSARY

**-A-**

**29 CFR 1910.120**—Hazardous Waste Operations and Emergency Response (OSHA)

**A-310**—(Public Law 1984, Ch. 210) Inter-Agency Notification

**ABSORBANT MATERIAL**—Loose or bagged material like commercial bagged clay, kitty litter, Zorbal, or "pigs" used to soak up liquid hazardous materials.

**ACTIVE IMMUNIZATION**—The administration of a vaccine to stimulate the host immune system to develop immunity (protection) against a specific pathogen or toxin.

**ACGIH**—**A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists. Recommends upper limits (TLVs) for exposure to workplace chemicals.

**AIRBORNE PRECAUTIONS**—Standard Precautions plus: Placing the patient in a private room that has negative air pressure, at least six air changes/hour, and appropriate filtration of air before it is discharged from the room. Use of respiratory protection when entering the room. Limiting movement and transport of the patient. Using a mask on the patient if he needs to be moved.

**AIR REACTIVE MATERIALS**—Materials that will react with atmospheric moisture and rapidly decompose.

**ANSI**—**A**merican **N**ational **S**tandards **I**nstitute

**APR**—**A**ir **P**urifying **R**espirator

**ASPHYXIANT**—A substance that can cause unconsciousness or death by lowering the concentration of oxygen in the air by out competing oxygen metabolically in the body.

**AST**—**A**bove Ground **S**torage **T**ank

**ASYMPTOMATIC**—Exposed persons who are not exhibiting signs/symptoms of exposure.

## -B-

**BACTERIAL AGENT**—A live pathogenic organism that can cause disease, illness, or death.

**BER**—**B**ureau of **E**mergency **R**esponse (of DEP)

**BIOLOGICAL CONTAMINATION**—The presence of an infectious agent on a body surface or on an environmental surface.

**BIOLOGICAL WARFARE AGENT**—A biological warfare agent is a pathogen (microorganism capable of causing disease) or toxin derived from a living organism that is deliberately used to produce disease or death in humans, animals, or plants.

**BLEVE**—**B**oiling, **L**iquid **E**xpanding **V**apor **E**xplosion

**B-NICE**—Pertaining to biological, nuclear, incendiary, chemical, or explosives.

**BPU**—**B**oard of **P**ublic **U**tilities (now the BRC)

**BRC**—**B**oard of **R**egulatory **C**ommissioners (formerly the BPU)

**BULK PACKAGING**—Packaging other than a vessel or barge in which materials are loaded with no intermediate form of containment. It includes transport vehicles and freight containers which have an internal volume greater than 450 Liters (118.9 gallons) for liquids, 400 Kilograms (881.8 pounds) for solids, or a water capacity greater than 453.6 Kilograms (1000 pounds) for gas.

**BUNG**—1) The cap or plug used to seal the small opening in the top of a drum or barrel. 2) The small opening in the top of a drum or barrel.

## -C-

**CAA**—**C**lean **A**ir **A**ct

**CARCINOGEN**—A substance that causes cancer.

**CARGO TANK**—Bulk packaging which is a tank intended for carrying liquids or gases, is attached to a motor vehicle or not detached for unloading, and is not fabricated under other specifications (as for cylinders, portable tanks, tank cars, etc.).

**CAS**—**C**hemical **A**bstract **S**ervice

**CASUALTY COLLECTION POINT (CCP)**—Predefined location at which patients are collected, triaged, and provided with initial medical care.

**CEHA**—**C**ounty **E**nvironmental **H**ealth **A**ct

**CEPP**—**C**hemical **E**mergency **P**reparedness **P**rogram

**CERCLA**—**C**omprehensive **E**nvironmental **R**esponse, **C**ompensation, and **L**iability **A**ct (the Superfund Law)

**CFR**—**C**ode of **F**ederal **R**egulations

**CGI**—**C**ombustible **G**as **I**ndicator

**CHEMOPROPHYLAXIS**—The administration of an antibiotic to prevent an infection, or to prevent an incubating infection from progressing to disease, or to eliminate a carrier state to prevent transmission and disease in others.

**CHEMTREC**—**Chem**ical **Tr**ansportation **E**mergency **C**enter

**COCARCINOGEN**— (or promoter)—Not a carcinogen by itself, but promotes the effects of a carcinogen.

**COLD (SUPPORT) ZONE**—Clean area outside the inner perimeter where command and support functions take place. Special protective clothing is not required in this area.

**COMBUSTIBLE SUBSTANCE**—A solid, liquid, or gas that will burn.

**COMMON NAME**—Each of the agents has a complex chemical name based on its composition and formula. They also have a common name that you need to recognize.

**CONFINED SPACE**—A space which, by design, has limited openings for entry and exit, unfavorable natural ventilation which could contain or produce dangerous air contaminants, could contain a hazardous atmosphere and which is not intended for continuous employee occupancy. A confined space includes (but is not limited to) a tank, vessel, pit, ventilation duct work, vat, boiler, sewer, or underground utility vault. (NJAC 12:100-9.2).

**CONSUMER COMMODITY**—A material that is packaged and distributed in a form intended for sale through retail agencies from consumption by individuals for purposes of personal care or household use.

**CONTACT PRECAUTIONS**—Standard Precautions plus: Placing the patient in a private room or with someone with the same infection, if possible. Using gloves when entering the room. Changing gloves after contact with infective material. Using gown when entering the room if contact with patient is anticipated or if the patient has diarrhea, or colostomy, or wound drainage not covered by a dressing. Limiting the movement or transport of the patient from the room. Ensuring that patient care items, bedside equipment, and frequently touched surfaces receive daily cleaning. Dedicating use of noncritical patient-care equipment to a single patient, or cohort of patients with the same pathogen. If not feasible, adequate disinfection between patients is necessary.

**CONTAINMENT**—The act of preventing or confining the spread, for further spread, of a hazardous material.

**CRYOGENIC**—Pertaining to materials at extreme low temperatures (below –90 degrees C or –130 degrees F).

**CWA**—**C**lean **W**ater **A**ct

**CYLINDER**—A pressure vessel designed for pressures above 40 psia and having a circular cross section.

**-D-**

**DECOMPOSITION**—The basic breakdown of a substance into different substances. Energy will be released by this reaction; in the case of highly reactive materials, the release may be sudden i.e. explosive.

**DECONTAMINATION**—The process of removing hazardous substances to prevent adverse health, safety, or environmental effects. Takes place at three levels based on exposure.

**DEGRADATION**—(applied to protective clothing) Chemical decomposition brought about by exposure to heat, sunlight, solvents, or oxidation.

**DEP**—**D**epartment of **E**nvironmental **P**rotection

**DMAT**—**D**isaster **M**edical **A**ssistance **T**eam

**DMORT**—**D**isaster **Mo**rtuary **R**esponse **T**eam

**DOE**—**D**epartment **O**f **E**nergy

**DOH**—**D**epartment **O**f **H**ealth

**DOL**—**D**epartment **O**f **L**abor

**DOT**—**D**epartment **O**f **T**ransportation

**DOWNWIND**—The area directly in the path of the wind from the incident site.

**DPW**—**D**epartment **O**f **P**ublic **W**orks

**DROPLET PRECAUTIONS**—Standard Precautions plus: Placing the patient in a private room or with someone with the same infection. If not feasible, maintaining at least 3 feet between patients. Using a mask when working within 3 feet of the patient. Limiting movement and transport of the patient. Using a mask on the patient if he needs to be moved.

**-E-**

**ECRA**—New Jersey **E**nvironmental **C**leanup **R**esponsibility **A**ct

**EFFLUENT**—Waste material (such as smoke, liquid industrial refuse, or sewage) discharge into the environment. It generally refers to water pollution.

**EGRESS**—Designated exit area.

**EIS**—**E**mergency **I**nformation **S**ystem

**EMS**—**E**mergency **M**edical **S**ervice

**ENDEMIC**—A disease that is present in a human population, or in an animal population that is transmittable to humans, but has a very low morbidity rate.

**ENZOOTIC**—A disease that is present in an animal population at all times, but has a low morbidity rate.

**EOC**—**E**mergency **O**perations **C**enter

**EOD**—**E**xplosive **O**rdinance **D**isposal

**EPA**—United States **E**nvironmental **P**rotection **A**gency

**EPIDEMIC**—A disease that is only present for a limited time in a human population or animal population that is transmittable to humans, and has a very high morbidity rate.

**EPIZOOTIC**—A disease that is only present in an animal population for limited periods, but has a high morbidity rate.

**ERG**—USDOT **E**mergency **R**esponse **G**uidebook

**ERP**—**E**mergency **R**esponse **P**lan

**ETIOLOGIC**—Cause of the disease/illness.

**EXPLOSIVE LIMITS**—The range of concentration of a gas or vapor (measured in percent by volume in air) that can explode upon ignition in a confined space. The highest and lowest concentration are called, respectively, the Upper Explosive Limit **(UEL)** and the Lower Explosive Limit **(LEL)**. At concentrations lower than the LEL, there is not enough product in the air to explode; the mixture is "too lean." At concentrations above the UEL, there is not enough oxygen to sustain an explosion; the mixture is "too rich."

**EXPLOSIVE RANGE**—The number (as a percentage) that results from subtracting the LEL of a substance from its UEL.

**-F-**

**FEMA**—**F**ederal **E**mergency **M**anagement **A**gency

**FLAMMABLE SUBSTANCE**—A solid, liquid, vapor, or gas that will ignite easily and burn rapidly.

**FLASH POINT (FP)**—The lowest temperature at which the vapor given off by a liquid within a test vessel forms an ignitable mixture with air. This is *only* a flash, not a sustained fire.

**FR**—**F**ederal **R**egister

**FRA**—**F**irst **R**esponder **A**wareness

**FREEZING POINT**—The freezing point or melting point of a substance is the temperature at which its crystals are at equilibrium with its liquid state. The terms melting point and freezing point are used interchangeably, depending on whether that temperature is approached by heating or cooling the substance.

**FREIGHT CONTAINER**—A reusable container having a volume of 64 cubic feet or more. It is designed and constructed to permit lifting with its contents intact.

**FRO**—**F**irst **R**esponder **O**perations

**FUMES**—The particulate, smoke-like emanation from the surface of heated metals. Also, the vapor from concentrated acids, evaporating solvents, or as a result of combustion or other decomposition reaction.

**-G-**

**GROSS DECONTAMINATION**—Initial decontamination to remove large amounts of decontaminants.

**-H-**

**HAZARDOUS MATERIAL**—Any substance that, when released from its container, is a potential or actual threat to the safety of life or property when it touches or impinges upon them.

**HAZARDOUS MATERIAL INCIDENT**—The unintentional or uncontrolled release of a hazardous material.

Level I: contamination is likely but unknown.
Level II: contamination is known to have occurred but skin contact or irritation is not evident.
Level III: contamination is known to have occurred and skin contact or irritation is evident.

**HAZARDOUS WASTE**—Any substance that may pose an unreasonable risk to health, safety, or property when transported in commerce for the purpose of treatment, storage, or disposal as waste.

**HAZMAT**—**Haz**ardous **Mat**erials

**HAZWOPER**—**H**azardous **W**aste **Op**erations and **E**mergency **R**esponse

**HMERP**—New Jersey State Police **H**azardous **M**aterials **E**mergency **R**esponse **P**lanning Unit

**HMT**—**H**az**m**at **T**echnician

**HMRT**—**H**azardous **M**aterials **R**esponse **T**eam

**HOT (EXCLUSION) ZONE**—Area immediately around the incident where serious threat of harm exists. It should extend far enough to prevent adverse effects from B-NICE agents to personnel outside the zone. Entry into the hot zone requires appropriately trained personnel and use of proper personal protective equipment.

**HSFS**—**H**azardous **S**ubstance **F**act **S**heet (NJDOH publication)

**HVAC**—**H**eating, **V**entilating, and **A**ir **C**onditioning

**-I-**

**IC**—**I**ncident **C**ommander

**ICS**—**I**ncident **C**ommand **S**ystem

**IDLH**—**I**mmediately **D**angerous to **L**ife and **H**ealth

**IGNITION TEMPERATURE** (Ign. Temp.)—The minimum temperature required to initiate sustained self-combustion of a material or compound.

**INNER PERIMETER**—Secured inner area of operations.

**INOCULUM**—The amount of microorganisms introduced into a host.

**-L-**

**LEL**—**L**ower **E**xplosive **L**imit

**LEPC**—**L**ocal **E**mergency **P**lanning **C**ommittee

**LINCS**—**L**ocal **I**nformation **N**etwork **C**ommunication **S**ystem

**-M-**

**MASS DECONTAMINATION**—Decontamination process used on large number of contaminated victims.

**MISCIBILITY**—The ability of a liquid or gas to dissolve completely and evenly in another liquid or gas at any concentration.

**MMRS**—**M**etropolitan **M**edical **R**esponse **S**ystem

**MSDS**—**M**aterial **S**afety **D**ata **S**heet

**MSHA**—**M**ine **S**afety and **H**ealth **A**dministration

**MUTAGEN**—A substance that causes mutations. A mutation is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

**-N-**

**N.O.S.**—**N**ot **O**therwise **S**pecified

**NFPA**—**N**ational **F**ire **P**rotection **A**ssociation

**NIEHS**—**N**ational **I**nstitute of **E**nvironmental **H**ealth **S**ciences

**NIOSH**—**N**ational **I**nstitute for **O**ccupational **S**afety and **H**ealth

**NMRT**—**N**ational **M**edical **R**esponse **T**eam

**NJAC**—**N**ew **J**ersey **A**dministrative **C**ode

**NJPDES**—**N**ew **J**ersey **P**ollutant **D**ischarge **E**limination **S**ystem

**NJRTK**—**N**ew **J**ersey **R**ight **T**o **K**now law (also called Worker and Community Right To Know)

**NJSA**—**N**ew **J**ersey **S**tatutes **A**nnotated

**NJSP**—**N**ew **J**ersey **S**tate **P**olice

**NON-BULK PACKAGING**—(see bulk packaging) Packaging smaller than bulk packaging.

**NON-LIQUIFIED GAS**—Under pressure, is entirely in the gaseous state at 21.1°C (70°F).

**-O-**

**OEM**—**O**ffice of **E**mergency **M**anagement

**ORM**—**O**ther **R**egulated **M**aterial

**OSHA**—**O**ccupational **S**afety and **H**ealth **A**dministration

**OSIC**—**O**n **S**cene **I**ncident **C**ommander

**OUTER PERIMETER**—Outermost area from hazard that is secure.

**OVERPACK**—An enclosure used by a consignor to provide protection or convenience in handling a package or to consolidate two or more packages. It does not include a freight container.

**-P-**

**PEL**—**P**ermissible **E**xposure **L**imit

**PENETRATION**—1) Refers to chemicals physically passing through protective clothing by way of a tear, cut, or improperly sealed closure. 2) Introducing contaminants into the body by way of exposed cuts or injection by sharp materials (broken glass, metal shards, etc.).

**PEOSHA**—**P**ublic **E**mployee **O**ccupational **S**afety and **H**ealth **A**ct

**PERMEATION**—Refers to chemicals passing through protective clothing by absorption. **All** protective clothing is permeable to some extent.

**PERSISTENT AGENT**—An agent that upon release retains its casualty-producing effects for an extended period of time, usually anywhere from 30 minutes to several days. A persistent agent usually has a low evaporation rate and its vapor is heavier than air. Therefore, its vapor cloud tends to hug the ground. It is considered to be a long-term hazard. Although inhalation hazards are still a concern, take extreme caution to avoid skin contact as well.

**PILE**—Any non-contaminated accumulation of solid, nonflowing hazardous wastes that is used for treatment or storage.

**PLUME**—A vapor cloud formation which has shape and buoyancy.

**POC**—**P**oint **O**f **C**ontact

**POINT SOURCE**—Any discernible, confined, and discrete conveyance (pipe, ditch, channel, conduit, well, etc.) from which pollutants are, or may be discharged.

**POISON**—Any substance that is harmful to living tissue when applied in relatively small doses. (See toxin).

**PORTABLE TANK**—A bulk packaging designed to be loaded onto or temporarily attached to a transport vehicle or ship.

**PPE**—**P**ersonal **P**rotective **E**quipment

**PROTECT IN PLACE**—Method of protecting public by limiting exposure.

**PULMONARY EDEMA**—The condition of having fluid in the lungs.

**-R-**

**RALLY POINT**—A predetermined location to which all persons evacuate in an emergency. In industry, facilities are evacuated and a rally point is usually predetermined. It is at this rally point that resources can regroup and a revised plan can be established.

**RATE OF ACTION/ONSET TIME**—The rate of action or onset time is the period of time that elapses before a victim begins to show or feel the symptoms of the particular agent. With some agents, this time will be just a few seconds; in other cases it could be minutes to hours.
Knowing onset time is important because it tells you how much time you have to react.

**RCRA**—**R**esource **C**onservation and **R**ecovery **A**ct

**REACTIVE SUBSTANCE**—A solid, liquid, or gas that can cause an explosion under certain conditions or on contact with other specific substances.

**RESIDUE**—The hazardous material that remains in a packaging after its contents have been unloaded to the maximum extent practicable and before the packaging is refilled or cleaned and purged to remove any hazardous vapors.

**ROUTE OF ENTRY**—The route of entry is how the agent gets into your body. Most of the agents will enter through the respiratory tract, that is, through inhalation. Some of the agents can also attack through skin and eye.

**RTK**—**R**ight **T**o **K**now; May refer to State or Federal law

## -S-

**SAMPLE**—Material collected from a source other than an animal or man for laboratory analysis (such as water sample or soil sample).

**SARA**—**S**uperfund **A**mendments and **R**eauthorization **A**ct of 1986

**SCBA**—**S**elf-**C**ontained **B**reathing **A**pparatus

**SHIPPING PAPER**—A shipping order, bill of lading, manifest or other document containing the information required by 172.202, 172.203 and 172.204.

**SLUDGEM**—Acronym for salivation, lacrimation, urination, defecation, gastric distress, emesis, and miosis.

**SOLUBILITY**—The ability or tendency of one substance to dissolve evenly in another.

**SOLVENT**—A substance capable of dissolving another substance (the solute) to form a uniformly dispersed mixture (the solution). Water, referred to as the "universal solvent," is a strongly polar solvent.

**SOP**—**S**tandard **O**perating **P**rocedure

**SPECIMEN**—Material collected from a man or animal for laboratory analysis (such as tissue or blood specimen).

**SPONTANEOUSLY COMBUSTIBLE**—The ignition of a substance from the rapid oxidation of its own constituents.

**STANDARD PRECAUTIONS**—Handwashing after patient contact. Using gloves when touching blood, body fluids, secretions, excretions, and contaminated items. Using mask, eye protection, and gown during procedures likely to generate splashes or sprays of blood, body fluids, secretions, or excretions. Handling contaminated patient-care equipment and linens in a manner that prevents the transfer of microorganisms to people or equipment. Practicing care when handling sharps and using a mouthpiece or other ventilation device as an alternative to mouth-to-mouth resuscitation, when practical. Placing the patient in a private room if they contaminate the environment, when feasible.

**STCC**—**S**tandard **T**ransportation **C**ommodity **C**ode

**STEL**—**S**hort **T**erm **E**xposure **L**imit

**STLC**—**S**hort **T**erm **L**ethal **C**oncentration

**SUMP**—Lowest point of a tank. The emergency valve or outlet valve is usually attached to a tank's sump.

**SYMPTOMATIC**—Exhibiting signs/symptoms of exposure.

**SYMPTOMS**—Every chemical will cause the victim to exhibit symptoms. In many cases these symptoms can be recognized and provide an indicator of the type of agent.

**-T-**

**TERATOGEN**—A substance that causes birth defects by damaging a fetus.

**TCPA**—**T**oxic **C**atastrophe **P**revention **A**ct

**TIME, DISTANCE AND SHIELDING (TDS)**—Three types of protective measures commonly associated with hazardous materials training.

**TLV**—**T**hreshold **L**imit **V**alue—recommended air concentration in which most persons can work for an 8-hour work day without ill effects. Set by the ACGIH.

**TLV-C**—**T**hreshold **L**imit **V**alue—**C**eiling—Exposure level to employees that shall not be exceeded during any part of the work day.

**TLV-STEL**—See STEL

**TOXICITY**—The state or degree of being poisonous; a harmful effect on biological mechanisms.

**TOXIN**—Anything harmful, destructive, or poisonous to the body (adj. Toxic). (See Poison.)

**TOXIN AGENTS**—Poisonous by-products of living organisms used to cause disease, illness or death in susceptible individuals.

**TSCA**—**T**oxic **S**ubstance **C**ontrol **A**ct

**TWA**—**T**ime **W**eighted **A**verage—The calculated average concentration for an 8-hour work day, 10-hour work day or 40-hour work week to which workers may be exposed over their working career without ill effects. Set by the ACGIH.

**TRACEM**—The acronym used to identify the six types of harm one may encounter at a terrorist incident: thermal, radioactive, asphyxiation, chemical, etiological, and mechanical. Note: Some sources use the acronym TEAM CPR, which stands for thermal, etiological, asphyxiation, mechanical, chemical, psychological, and radioactive.

**-U-**

**UNIFIED COMMAND**—In ICS, Unified Command is a unified team effort which allows all agencies with responsibility for the incident to establish a common set of incident objectives and strategies. This is accomplished without losing or abdicating agency authority, responsibility or accountability.

**UNSTABLE MATERIALS**—Those which, in the pure state, will vigorously polymerize, decompose, condense, or become self-reactive, and undergo other violent chemical changes.

**UPWIND**—The direction from which the wind is coming.

**UST**—**U**nderground **S**torage **T**ank

**-V-**

**VAPOR**—An air dispersion of molecules of a substance that is liquid or solid in its normal state (room temperature).

**VEE**—**V**enezuelan **E**quine **E**ncephalitis

**VIRAL AGENTS**—A group of viruses that have been selected as BW agents because of their ability to produce disease, illness, and death in susceptible individuals.

**VOC**—**V**olatile **O**rganic **C**ompound

**VOLATILITY**—The tendency of a solid or liquid to pass into the gaseous state at a given temperature.

**VOLATILITY/PERSISTENCY**—Volatility is important because it gives you an indication of how rapidly an agent will evaporate. The more volatile an agent is, the more rapidly it will evaporate. Evaporation will cause the agent to become a true gas or vapor and reduce the liquid hazard. Temperature, wind speed and humidity at the incident site influence how rapidly an agent will evaporate.

This evaporation process is also referred to as persistency, or the amount of time an agent will remain a threat in the incident site. A non-persistent agent will not remain at the incident site as long as a persistent agent. Obviously, if an agent is released inside an enclosed space, weather will not play a role and the persistency will normally increase.

Most of the agents we will discuss will be disseminated as gases or vapors and are heavier than air.

**-W-**

**WARM ZONE**—In HAZMAT incidents, this zone is the contamination reduction zone where initial decontamination activities occur. This zone requires the use of proper personal protective equipment once contaminated people or equipment enter the zone.

**WATER REACTIVE MATERIALS**—Materials which will violently decompose and/or burn vigorously when they come in contact with water.

**WATER SOLUBILITY**—The degree to which a material, or its vapors, are soluble in water. Materials that are completely soluble in water are said to be **miscible**.

**WEAPON OF MASS DESTRUCTION (WMD)**—1) Any explosive, incendiary, poison gas, bomb, grenade, or rocket having a propellant charge of more than four ounces, missile having an explosive or incendiary charge of more than one-quarter ounce, or mine or device similar to the above. 2) Poison gas. 3) Any weapon involving a disease organism. 4) Any weapon designed to release radiation at a level dangerous to human life.

# APPENDIX F
# EXERCISES

# Student Exercise A

At 3 PM on a weekday afternoon two males wearing work clothes covered with a white powder present themselves at the triage desk. They are in mild respiratory distress, have runny noses, and state they are having trouble with their vision. It's your turn to take over. Step into the triage nurses shoes.

**These Patients have already made it into the facility. What should you do?**

- What will your initial actions be?
    - What is the plan for your facility?
    - Who needs to be notified?
- Where will you direct the patients?
    - Where can they be safely isolated?
    - What should they do once they are isolated?
- What level of protective clothing are you wearing at this point?
    - What can your personal actions be, given this level of protective clothing?

**Your Decon plan has been activated and the patients are safely isolated, while waiting for Decon one of the patients falls to the ground and states he is unable to walk.**

- How does this alter your original plan?
- What are your Decon priorities?
- What level of Decon do these patients need?
- What level of PPE is needed to deal with the non-ambulatory patient?
- From the scant information you have what substance would you suspect these patients are contaminated with?

**While the ambulatory patient performs Decon on himself, your Decon team has prepared itself to deal with the non-ambulatory patient.**

- What should their initial actions be?
- What level of Decon would the non-ambulatory patient need?
- What questions would you ask the ambulatory patient, after he is clean?
    - Who else would you share this information with?
- What information is needed to bring a safe end to this event?
    - What reference sources would you use?

## Student Exercise A

The patients in this scenario were cleaning out a basement at a nearby house when they found a plastic garbage bag with a label stating "PESTICIDE" on it. While carrying it out of the basement it was dropped and ruptured, covering the basement in a white powder as if a bag of flour had been dropped. After Decon they are treated for organophosphate exposure and make a full recovery.

# Student Exercise B

At 6 PM on a Friday night, you are the charge nurse and receive a call from the local Police Department. They state that they have a situation at a local high school basketball game in which approximately 200 people began to complain of burning eyes, runny noses, coughing, and respiratory distress. They believe that they have all of the occupants of the gym contained at the site, but wanted to give you a "heads up."

- What should your initial actions be?
- Who will you notify?
- What should you tell the staff?
- What are your security concerns?

**Within 30 minutes of the phone call, three carloads of people from the basketball game arrive in your ED lot, there are now 10 people trying to get into your waiting room.**

- What preparatory steps have you taken to receive these patients?
- Who do you notify at this point?
- How will you communicate with them?
- What will you do to keep them from contaminating your ED?

**1 hour after the original call from the police, the HAZMAT Commander contacts you. He states that they have positively identified the substance as Oleoresin Capsicum (pepper spray). He goes on to tell you that while a large amount was released, it should pose no lasting threat.**

- What actions have you taken to this point?
- How does this phone call effect your plan?
- What is your next step?

# Scenario #1

You are working at a triage desk when a man dressed in work clothes approaches you. He tells you that his co-worker is out in his truck and is very sick. While walking out to the lot with him, he relates the following story: The sick man was sent to clean up the back of a truck whose load had shifted during transport. After 15 minutes he came to the office and stated he felt sick. After asking the man about the possibility of hazardous materials he hands you the pick up tickets from the truck the sick man was sent to clean. The tickets indicate that the commodities involved were consumer goods. The load includes:

| | | |
|---|---|---|
| Calcium Hypochlorite Mixtures | 1 pallet | DOT 2208 |
| Carbonated Beverages | 4 pallets | |
| Ammonia Solution | 1 55-gal. drum | DOT 2672 |
| Chlorine | 3 x 1-gal. liquid | DOT 1017 |
| Adhesives | | DOT 1133 |

**What are your actions?**

# Scenario #2

A local squad calls on the HEAR radio to notify you that they are in route to your location from a local home improvement store. Their patient was found lying on the floor in a puddle. Apparently while stacking cases of extra supplies, the forklift he was operating skidded into a stack of cases containing pool chemicals. The cases were marked with yellow labels and there was a strong irritating odor in the area.

After striking the stacked cases he fell from the forklift to the floor, sustaining an obvious open fracture to his right forearm and a possible fractured left ankle. He is conscious but dazed. The squad has an ETA of 10 minutes.

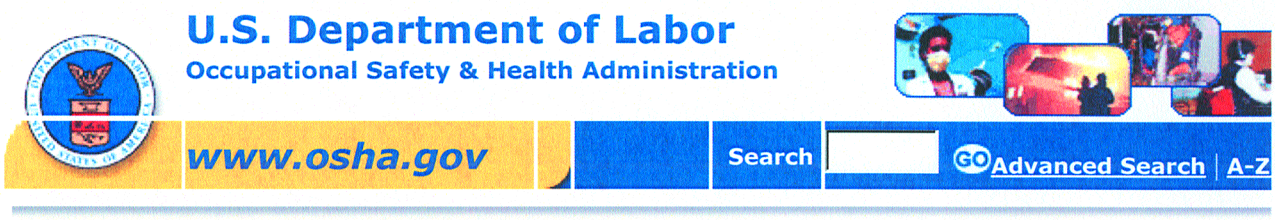
**What are your actions?**

# Scenario #3

You are working at the triage desk. A distraught young woman approaches the desk. She tells you that she works in the mail room at a large pharmaceutical company. While opening mail today some powder fell out of an envelope onto her lap. Upon further inspection of the letter she was opening she realized that it was an "anthrax" threat letter addressed to the president of her company.

**What are your actions?**

# APPENDIX G
# FEDERAL GUIDELINES




## OSHA TECHNICAL MANUAL

### SECTION VIII: CHAPTER 2 [New addition to OTM]

### Respiratory Protection

**Contents**

## I. **INTRODUCTION.**

A. Wearing respiratory protective devices to reduce exposure to airborne contaminants is widespread in industry. An estimated 5.0 million workers wear respirators, either occasionally or routinely. Although it is preferred industrial hygiene practice to use engineering controls to reduce contaminant emissions at their source, there are operations where this type of control is not technologically or economically feasible or is otherwise inappropriate.

B. Since respirators are not as consistently reliable as engineering and work practice controls, and may create additional problems, they are not the preferred method of reducing exposures below the occupational exposure levels. Accordingly, their use as a primary control is restricted to certain circumstances. In those circumstances where engineering and work practice controls cannot be used to reduce airborne contaminants below their occupational exposure levels (e.g., certain maintenance and repair operations, emergencies, or during periods where engineering controls are being installed), the use of respirators could be justified to reduce worker exposure. In other cases, where work practices and engineering controls alone cannot reduce exposure levels to below the occupational exposure level, the use of respirators would be essential for supplemental protection.

C. There are many variables that affect the degree of protection afforded by respiratory protective devices, and the misuse of respirators can be hazardous to employee safety and health. Selection of the wrong equipment, one of the most frequent errors made in respiratory protection, can result in the employee being exposed to increased concentrations of the harmful contaminant. This error may result in a broad range of health effects caused by the harmful contaminants, including silicosis, asbestosis, permanent lung damage, and cancer. Respirators that are not maintained and inspected can be less effective at reducing exposure to the harmful contaminants, and can place a greater burden on the respiratory system. Respirators that are not clean can cause dermatitis or skin irritation. Because respirator use may give the employee a false sense of security and presumed protection, an improper respirator program can actually present a high degree of hazard for the employee.

D. Respirators can only provide adequate protection if they are properly selected for the task; are fitted to the wearer and are consistently donned and worn properly; and are properly maintained so that they continue to provide the protection required for the work situation. These variables can only be controlled if a comprehensive respiratory protection program is developed and implemented in each workplace where respirators are used. When respirator use is augmented by an appropriate respiratory protection program, it can prevent fatalities and illnesses from both acute and chronic exposures to hazardous substances.

E. The primary aim of this chapter is to give detailed instruction in the selection of the proper respirator and its use and maintenance. The emphasis is on the implementation of a respiratory protection program developed in a logical progression of steps, outlined below:

- A clear definition of the hazards that will be encountered and the degree of protection required;
- The selection and fitting of the respirator;
- Medical evaluation for respirator selection and use;
- The required training in the correct use and care of the respirator; and
- The implementation of a maintenance program that will ensure that a high level of respiratory protection is maintained.

## II. HISTORY OF THE DEVELOPMENT OF RESPIRATORY PROTECTION.

A. **EARLY PRACTICES**. The concept of using respiratory protective devices to reduce or eliminate hazardous exposures to airborne contaminants first came from Pliny (circa A.D. 23-79) who discussed the idea of using loose fitting animal bladders in Roman mines to protect workers from the inhalation of red oxide of lead. (See proposed respiratory protection standard, *59 Federal Register 58885*) Later, in the 1700s, the ancestors of modern atmosphere-supplying devices, such as the self-contained breathing apparatus or hose mask, were developed. Although the devices themselves have become more sophisticated in design and materials, respirators' performance is still based on one of two basic principles: purifying the air by removing contaminants before they reach the breathing zone of the worker, or providing clean air from an uncontaminated source.

B. **DEVELOPMENT OF MODERN METHODS**. In 1814, a particulate-removing filter encased in a rigid container was developed—the predecessor of modern filters for air purifying respirators. In 1854 it was recognized that activated charcoal could be used as a filtering medium for vapors. During World War I, with the use of chemical warfare, improvements in the design of respirators was necessary. In 1930 the development of the resin-impregnated dust filter made available efficient, inexpensive filters that have good dust-loading characteristics and low breathing resistance.

C. **LATEST ADVANCES**. A more recent development was the high efficiency particulate filter made with very fine glass fibers. These extremely efficient filters are used for very small airborne particles and produce little breathing resistance. Some features that are currently being incorporated into respirator design include a smaller facepiece, which translates into a better field of vision and a low profile that permits the respirator to fit under other protective gear such as a welder's helmet. Over the years there have been continuing major developments in the basic design of respirators. Modern design improvements have created products that are both more comfortable to wear and more protective than earlier respirators.

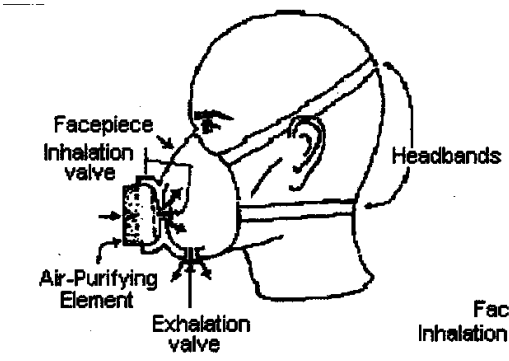
## III. **GENERAL INFORMATION.**

A. **PURPOSE**. The purpose of a respirator is to prevent the inhalation of harmful airborne substances and/or an oxygen-deficient atmosphere. Functionally, a respirator is designed as an enclosure that covers the nose and mouth or the entire face or head. Respirators are of two general "fit" types, *tight-fitting* and *loose-fitting*

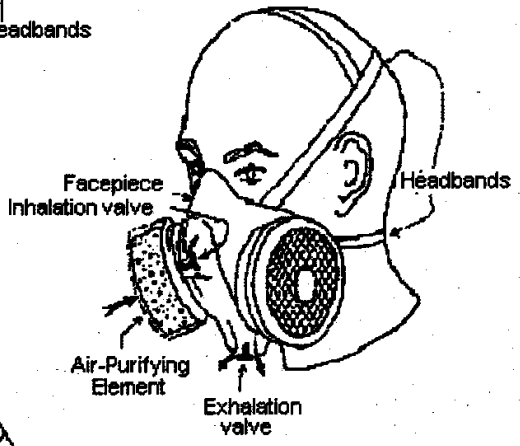
1. **The tight-fitting respirator** (Figure VIII:2-1) is designed to form a seal with the face of the wearer. It is available in three types: quarter mask, half mask, and full facepiece. The quarter mask covers the nose and mouth, where the lower sealing surface rests between the chin and the mouth. The half mask covers the nose and mouth and fits under the chin. The full facepiece covers the entire face from below the chin to the hairline.

2. **The loose-fitting respirator** (Figure VIII:2-2) has a respiratory inlet covering that is designed to form a partial seal with the face. These include loose-fitting facepieces, as well as hoods, helmets, blouses, or full suits, all of which cover the head completely. The best known loose-fitting respirator is the supplied air hood used by the abrasive blaster. The hood covers the head, neck, and upper torso, and usually includes a neck cuff. Air is delivered by a compressor through a hose leading into the hood. Because the hood is not tight-fitting, it is important that sufficient air is provided to maintain a slight positive-pressure inside the hood relative to the environment immediately outside the hood. In this way, an outward flow of air from the respirator will prevent contaminants from entering the hood.

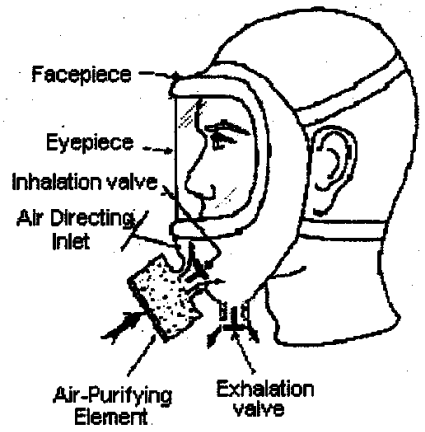
**Figure VIII:2-1. Tight-Fitting Respirators**




**Typical Quarter-Mask Respirator**

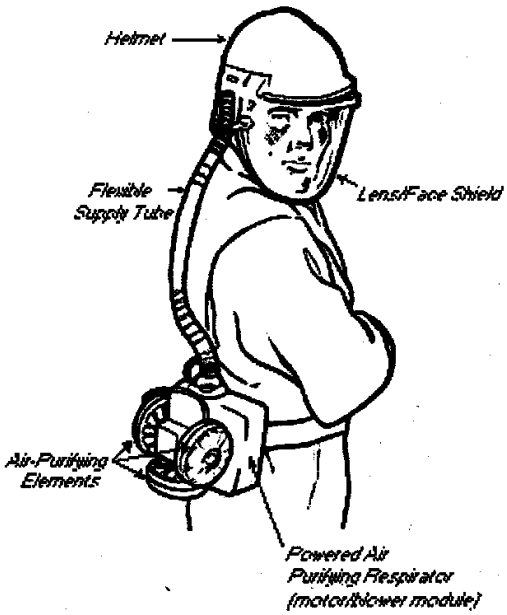



**Typical Half-Mask Respirator**

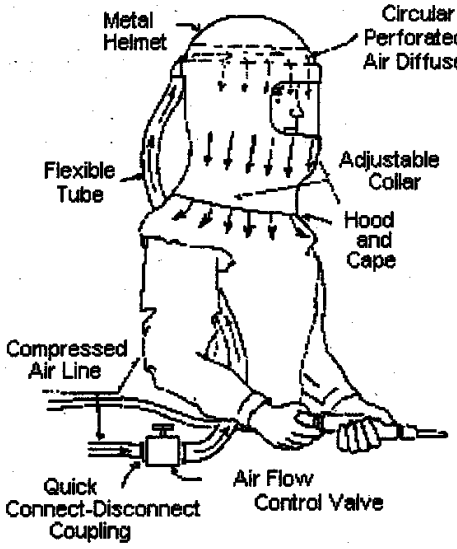



**Typical Full-Facepiece Respirator**

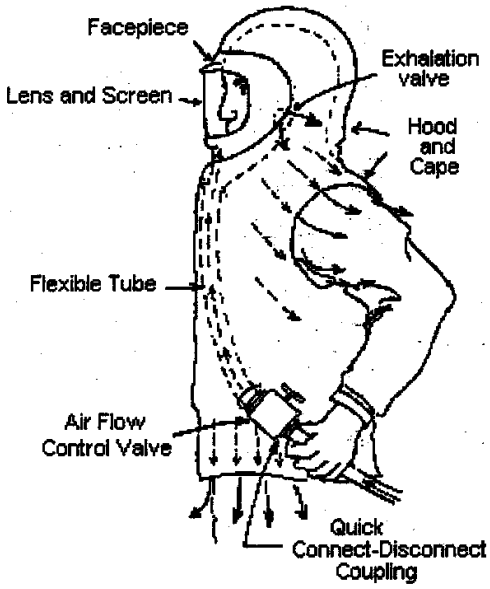
**Figure VIII:2-2. Loose-Fitting Respirators**




**Loose-Fitting Facepiece**




**Abrasive Blasting Respirator (Hood Respirator)**




**Loose-Fitting Hood with Blouse**

IV. **AIRBORNE (OR RESPIRATORY) HAZARDS** may result from either an oxygen deficient atmosphere or breathing air contaminated with toxic particles, vapors, gases, fumes or mists. The proper selection and use of a respirator depend upon an initial determination of the concentration of the hazard or hazards present in the workplace, or the presence of an oxygen deficient atmosphere.

Airborne hazards generally fall into the following basic categories:

1. **Dusts**. Particles that are formed or generated from solid organic or inorganic materials by reducing their size through mechanical processes such as crushing, grinding, drilling, abrading, or blasting.

2. **Fumes**. Particles formed when a volatilized solid, such as a metal, condenses in cool air. This physical change is often accompanied by a chemical reaction, such as oxidation. Examples are lead oxide fumes from smelting, and iron oxide fumes from arc-welding. A fume can also be formed when a material such as magnesium metal is burned or when welding or gas cutting is done on galvanized metal.

3. **Mists**. A mist is formed when a finely divided liquid is suspended in the air. These suspended liquid droplets can be generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming, or atomizing. Examples are the oil mist produced during cutting and grinding operations, acid mists from electroplating, acid or alkali mists from pickling operations, paint spray mist from spraying operations, and the condensation of water vapor to form a fog or rain.

4. **Gases**. Gases are formless fluids that occupy the space or enclosure and which can be changed to the liquid or solid state only by the combined effect of increased pressure and decreased temperature. Examples are welding gases such as acetylene, nitrogen, helium and argon; and carbon monoxide generated from the operation of internal combustion engines. Another example is hydrogen sulfide, which is formed wherever there is decomposition of materials containing sulfur under reducing conditions.

5. **Vapors**. Vapors are the gaseous form of substances that are normally in the solid or liquid state at room temperature and pressure. They are formed by evaporation from a liquid or solid, and can be found where parts cleaning and painting takes place and where solvents are used.

6. **Smoke**. Smoke consists of carbon or soot particles resulting from the incomplete combustion of carbonaceous materials such as coal or oil. Smoke generally contains droplets as well as dry particles.

7. **Oxygen deficiency**. An oxygen deficient atmosphere has an oxygen content below 19.5% by volume. Oxygen deficiency may occur in confined spaces, which include, but are not limited to, storage tanks, process vessels, towers, drums, tank cars, bins, sewers, septic tanks, underground utility tunnels, manholes, and pits.

V. **RESPIRATORY CLASSIFICATIONS**. Respirators provide protection either by removing contaminants from the air before they are inhaled or by supplying an independent source of respirable air. There are two major classifications of respirators:

0. Air purifying respirators (devices that remove contaminants from the air); and

1. Atmosphere-supplying respirators (those devices that provide clean breathing air from an uncontaminated source).

Each class of respirator may have tight-fitting and loose-fitting facepieces. An important aspect of respirator operation and classification is the air pressure within the facepiece. When the air pressure within the facepiece is negative during inhalation with respect to the ambient air pressure, the respirator is termed a negative-pressure respirator. When the pressure is normally positive with respect to ambient air pressure throughout the breathing cycle, the respirator is termed a positive-pressure respirator. The concept of negative and positive pressure operation is important when considering potential contaminant leakage into the respirator.

VI. **AIR PURIFYING RESPIRATORS** are grouped into three general types: *particulate removing*, *vapor and gas removing*and *combination* Elements that remove particulates are called filters, while vapor and gas removing elements are called either chemical cartridges or canisters. Filters and canisters/cartridges are the functional portion of air-purifying respirators, and they can generally be removed and replaced once their effective life has expired. The exception would be filtering facepiece respirators (commonly referred to as "disposable respirators," "dust masks," or "single-use respirators"), which cannot be cleaned, disinfected, or resupplied with an unused filter after use.

0. **Particulate-removing** respirators are designed to reduce inhaled concentrations of nuisance dusts, fumes, mists, toxic dusts, radon daughters, asbestos-containing dusts or fibers, or any combination of these substances by filtering most of the contaminants from the inhaled air before they enter the breathing zone of the worker. They may have single-use or replaceable filters. These respirators may be non-powered or powered air-purifying. A powered air-purifying respirator (PAPR) uses a blower to force the ambient atmosphere through air purifying elements to the inlet covering.

1. **Vapor- and gas-removing** respirators are designed with sorbent elements (canisters or cartridges) that adsorb and/or absorb the vapors or gases from the contaminated air before they can enter the breathing zone of the worker. *Combination* cartridges and canisters are available to protect against particulates, as well as vapors and gases.

VII. **ATMOSPHERE-SUPPLYING RESPIRATORS** are respirators that provide air from a source independent of the surrounding atmosphere instead of removing contaminants from the atmosphere. These respirators are classified by the method that is used to supply air and the way in which air supply is regulated. Basically, these methods are: self-contained breathing apparatus (air or oxygen is carried in a tank on the worker's back, similar to SCUBA gear); supplied-air respirators (compressed air from a stationary source is supplied through a high-pressure hose connected to the respirator); and combination self-contained and supplied air respirators.

VIII. **LIMITATIONS OF RESPIRATOR USE**. Not all workers can wear respirators. Individuals with impaired lung function, due to asthma or emphysema for example, may be physically unable to wear a respirator. Individuals who cannot get a good facepiece fit, including those individuals whose beards or sideburns interfere with the facepiece seal, will be unable to wear tight-fitting respirators. An adequate fit is required for a respirator to be effective. In addition to these problems, respirators may also be associated with communication problems, vision problems, fatigue, and reduced work efficiency.

In principle, respirators usually are capable of providing adequate protection. However, problems associated with selection, fit, and use often render them less effective in actual application; these problems prevent the assurance of consistent and reliable protection, regardless of the theoretical capabilities of the respirator. Occupational safety and health experts have spent considerable effort over the years developing fit-testing procedures and methods of measuring respirator effectiveness, thereby improving protection for those employees required to wear them.

IX. **RESPIRATOR PROTECTION PROGRAM.**

0. **THE STANDARD**. Whenever respirators are required to be worn, a written respirator protection program must be developed and implemented in accordance with OSHA's respirator standard, 29 CFR 1910.134. (Additional program requirements may be found in the standards that regulate the hazards to which the employee is exposed.) Because workplaces differ substantially, each program must be tailored to the specific conditions of the workplace. The program must consist of worksite-specific procedures governing the selection, use, and care of respirators. The program must be updated as often as necessary to reflect changes in workplace conditions and respirator use.

1. **THE WORKSITE-SPECIFIC PROCEDURES** must contain all the information needed to maintain an effective respirator program to meet the user's individual requirements. These procedures are a set of step-by-step instructions written so that a task (i.e., respirator use, fit-testing procedures, cleaning and storage, etc.) can be performed by all personnel in a uniform and consistent way, while supplying the maximum protection for workers who use respirators in the workplace. The employer must anticipate both the routine and non-routine use of respirators, as well as any possible emergency use based on the conditions in the workplace in which they are to be used. Worksite-specific procedures must be written so as to be useful to those who are directly involved in the respirator program: the program administrator, those fitting the respirators and training the workers, respirator maintenance workers, and the supervisors responsible for overseeing respirator use on the job.

2. **ADMINISTRATION**. In addition, the respirator standard requires that the respiratory protection program be administered by one qualified individual to ensure that the integrity of the respiratory protection program is maintained through the continuous oversight of one responsible person. The program administrator must be qualified by appropriate training and/or experience in the proper selection, use, and maintenance of respirators, be responsible for implementing the respiratory protection program, and conduct regular evaluations of the program's effectiveness.

   Although responsibility for respirator program oversight rests with the program administrator, he or she may delegate responsibilities to other qualified individuals. For instance, a large facility may find it practical and economical to have a staff of personnel involved in the respirator program, each with their own area of responsibility. However, each of these people must report to the one administrator who has overall responsibility for the program. This approach promotes coordination of all facets of the program. The administrator should have the full support of higher level management; without it, an effective respirator program is difficult to initiate and maintain.

3. **ELEMENTS**. The respiratory protection program must cover the following basic elements, as applicable:

   - Procedures for selecting respirators for use in the workplace;
   - Medical evaluations of employees required to use respirators;
   - Fit testing procedures for tight-fitting respirators;
   - Use of respirators in routine and reasonably foreseeable emergency situations;
   - Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, and otherwise maintaining respirators;
   - Procedures to ensure adequate air quality, quantity and flow of breathing air for atmosphere-supplying respirators;
   - Training of employees in the respiratory hazards to which they are potentially exposed;

- Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and maintenance procedures; and
- Procedures for regularly evaluating the effectiveness of the program.

## X. **RESPIRATOR SELECTION.**

Respirator selection requires correctly matching the respirator with the hazard, the degree of hazard, and the user. The respirator selected must be adequate to effectively reduce the exposure of the respirator user under all conditions of use, including reasonably foreseeable emergency situations. Proper respirator selection involves choosing a device that fully protects the worker from the respiratory hazards to which he or she may be exposed and permits the worker to perform the job with the least amount of physical burden.

0. **SELECTION FACTORS**. Many factors must be considered carefully in respirator selection. In choosing the appropriate respirator, one must consider the nature and extent of the hazard, work requirements and conditions, and the characteristics and limitations of the respirators available. The following categories of information must be taken into account:

   - Nature of the hazard, and the physical and chemical properties of the air contaminant;
   - Concentrations of contaminants;
   - Relevant permissible exposure limit or other occupational exposure limit;
   - Nature of the work operation or process;
   - Time period the respirator is worn;
   - Work activities and physical/psychological stress;
   - Fit testing; and
   - Physical characteristics, functional capabilities and limitations of respirators.

   - **Nature of the hazard, and the physical and chemical properties of the air contaminant**. The nature of the hazard, whether it is in the form of a gas, dust, organic vapor, fume, mist, oxygen deficiency or any combination of hazards, needs to be taken into account. The physical and chemical properties of the contaminant that affect respirator selection, and the selection of respirator components such as cartridges, canisters, and filters, must also be considered. Physical properties include such factors as particle size for dusts, and vapor pressure for gases and vapors. Chemical properties of the air contaminant that affect breakthrough times, and the ability of the filter material to remove, adsorb, or absorb the contaminant must also be considered.

- **Concentrations of contaminants**. Sampling and analysis of the workplace air determines what degree of exposure is occurring, and thus what degree of protection is required. Where such sampling and analysis have been done, the results are to be used as a point of comparison with the occupational exposure level, i.e., to determine how much the concentration must be lowered by the respirator to reduce employee exposure to a safe level.

- **The relevant permissible exposure limit or other occupational exposure limit**. Respirators selected must be capable of protecting against overexposure by reducing and maintaining exposure to or below the relevant overexposure limit. In addition to the OSHA limits, employers should refer to the ACGIH (American Conference of Governmental Industrial Hygienists) recommended Threshold Limit Values (TLVs), the NIOSH (National Institute for Occupational Safety and Health) Recommended Exposure Limits (RELs), or other occupational exposure limits.

- **Nature of the work operation or process**. The type of job operation, the equipment or tools that will be used, and any motion or travel the job requires can influence the type of respirator selected, particularly when supplied-air respirators, which require a connection to a clean air source, are used.

- **Time period respirator is worn**. The employer must also consider the period of time during which the respirator will be used by employees during a work shift. Breakthrough times for different chemicals can vary greatly, and are dependent on the concentrations of contaminants in the workplace air, patterns of respirator use, and environmental factors including temperature and humidity. A respirator that provides adequate protection for one chemical may be inadequate for another chemical with a different breakthrough time. In addition, employees wearing respirators for longer periods of time may need respirators that impose the minimum possible physical burden.

- **Work activities and stress**. The work activities of employees while wearing respirators are also a factor. Heavy work that is physically draining may affect an employee's capability of wearing certain types of respirators. Temperature and humidity conditions in the workplace may also affect the physical/psychological stress level associated with wearing a respirator, as well as the effectiveness of respirator filters and cartridges. These types of factors must be assessed in selecting the appropriate equipment for a particular work situation.

- **Fit testing**. Some employees may be unable to achieve an adequate fit with certain respirator models or a particular type of respirator—such as half-mask air-purifying respirators—so an alternative respirator model with an adequate fit or other type of respirator that provides adequate protection must be used. Therefore, it is necessary for employers to provide a sufficient number of respirator models and sizes from which employees can choose an acceptable respirator that fits correctly.

- **Physical characteristics, functional capabilities, and limitations of respirators.** The last category of information to be considered when selecting respiratory protection is the physical characteristics, functional capabilities, and limitations of the respiratory protection equipment itself. Respirators selected must not impair the worker's vision, hearing, communication, and physical movement necessary to perform jobs safely. For example, airline respirators should not be used by mobile employees around moving machinery to avoid entanglement of the respirator in the equipment.

1. **SELECTION.** Once the above factors have been taken into account, the employer must select a NIOSH-certified respirator. Where NIOSH has not specifically certified any respirator for use against the particular contaminant present in the workplace, the employer must select a NIOSH-certified respirator that has no limitation prohibiting its use for that contaminant. The respirator must be appropriate for the contaminant's physical form and chemical properties and the conditions under which it will be used. All respirators must be chosen and used according to the limitations of the NIOSH certification, which appears on the NIOSH certification label.

2. **ASSIGNED PROTECTION FACTORS.** Until such time as OSHA addresses the issue of assigned protection factors (APF's), employers may rely on APF's published by NIOSH and ANSI. Where there are conflicts between the NIOSH and ANSI APF's, the employer should apply the more protective APF.

3. **WARNING SYSTEM.** When air-purifying respirator is selected for protection against gases and vapors, a system must be in effect that will reliably warn respirator wearers of contaminant breakthrough. These systems are: a respirator equipped with an end-of-service life indicator (ESLI) certified by NIOSH for the contaminant, or an established and enforced cartridge/canister change schedule that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life.

4. **ATMOSPHERES REQUIRING HIGHEST LEVEL OF PROTECTION.** For atmospheres that are immediately dangerous to life and health (IDLH), the highest level of respiratory protection and reliability is required. These atmospheres, by definition, are the most dangerous environments in which respirators are used. In these atmospheres, there is no tolerance for respirator failure. Consequently, only the following respirators must be provided and used: full-facepiece pressure demand self-contained breathing apparatus (SCBA) certified for a minimum service life of thirty minutes, or a combination full-facepiece pressure demand supplied-air respirator (SAR) with an auxiliary self-contained air supply.

## XI. MEDICAL EVALUATION.

0. **OVERVIEW.** Persons assigned to tasks that require the use of a respirator must be physically able to perform the work while using the respirator. Accordingly, employers have the responsibility of ensuring that employees are medically fit to tolerate the physical and psychological stress imposed by respirator use, as well as the physical stress originating from job workplace conditions.

   Employees must be medically evaluated and found eligible to wear the respirator selected for their use prior to fit testing or first-time use of the respirator in the workplace. Medical eligibility is to be determined by a physician or other licensed health care professional (referred to as a "PLHCP"). A variety of qualified health care providers, besides physicians, including occupational health nurses, nurse practitioners, and physician assistants, can perform the medical evaluations provided they are licensed to do so in the state in which they practice.

1. **QUESTIONNAIRE.** In assessing the employee's medical eligibility to use a respirator, the PLHCP must perform a medical evaluation using a medical questionnaire (Appendix C to 1910.134) or provide a medical examination that obtains the same information as the medical questionnaire. The medical evaluation must be administered confidentially and at a time and place, during working hours, that is convenient to the employee. Employers are free to provide respirator users with a medical examination in lieu of the medical questionnaire if they chose to do so, but they are not required by the standard to administer a medical examination unless the employee gives a positive response to specific questions on the questionnaire.

2. **MEDICAL FACTORS AND CONDITIONS.** The purpose of a medical evaluation program is to determine if employees can tolerate the physiological burden associated with respirator use, including: the burden imposed by the respirator itself (e.g., its weight and breathing resistance during both normal operation and under conditions of filter, canister, or cartridge overload); musculoskeletal stress (e.g., when the respirator to be worn is a SCBA); limitations on auditory, visual, and olfactory sensations;

and isolation from the workplace environment. Since certain jobs and workplace conditions in which a respirator is used can also impose a physiological burden on the user, the medical evaluation must also consider the following factors: type and weight of the respirator to be worn; duration and frequency of respirator use; expected physical work effort; use of protective clothing and equipment to be worn; and temperature and humidity extremes that may be encountered. This information must be provided to the PLHCP before the PLHCP makes a recommendation regarding an employee's ability to use a respirator.

The medical evaluation is designed to identify general medical conditions that place employees who use respirators at risk of serious medical consequences. Medical conditions known to compromise an employee's ability to tolerate respirator-, job-, and workplace-related physiological stress include: cardiovascular and respiratory diseases (e.g., a history of high blood pressure, angina, heart attack, cardiac arrhythmias, stroke, asthma, chronic bronchitis, emphysema); reduced pulmonary function caused by other factors (e.g., smoking or prior exposure to respiratory hazards); neurological or musculoskeletal disorders (e.g., ringing in the ears, epilepsy, lower back pain); impaired sensory function (e.g., perforated ear drums, reduced or absent ability to smell); and psychological disorders (e.g., claustrophobia and severe anxiety).

3. **STANDARD OF EVALUATION.** The employer must obtain a written recommendation from the PLHCP on whether the employee is medically able to wear a respirator. The recommendation must identify any limitations on the employee's use of the respirator, as well as the need for follow-up medical evaluations that are needed to assist the PLHCP in making a recommendation. The employee must also receive a copy of the PLHCP's written recommendations.

   A powered air-purifying respirator (PAPR) must be provided to an employee if information from the medical evaluation indicates that the employee can use a PAPR but not a negative pressure respirator. If, subsequent to this evaluation, the PLHCP determines that the employee is able to wear a negative pressure respirator, the employer is no longer required to provide a PAPR to that employee.

   In addition, the standard requires the employer to medically re-evaluate an employee when:

   - That employee reports medical signs or symptoms that are related to the employee's ability to use a respirator;

   - A PLHCP, supervisor, or the respirator program administrator observes that the employee is having a medical problem during respirator use and they inform the employer of their observation;

- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee re-evaluation; or

- A change occurs in workplace conditions (e.g., physical work effort, type of respirator used, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

## XII. **FIT TESTING.**

It has long been recognized that respirators must fit properly to provide protection. To obtain adequate respiratory protection, there must be a proper match between respirator and wearer. Respirators that don't seal properly around the face offer only the illusion of protection. To accommodate the variability of face size characteristics among individuals, a number of manufacturers offer facepieces in several sizes and models.

0. **PURPOSE.** The primary purpose of fit testing is to identify the specific make, model, style, and size of the respirator best suited for each employee. In addition, fit testing also provides an opportunity to check on problems with respirator wear, and reinforces respirator training by having wearers review the proper methods of donning and wearing the respirator.

1. **REQUIREMENT.** Fit testing is required for all negative or positive pressure tight-fitting facepiece respirators. The OSHA respiratory protection standard requires that fit testing be performed before an employee first starts wearing a respirator in the work environment, whenever a different respirator facepiece is used, and at least annually thereafter.

2. **METHOD.** Prior to the actual fit test, the employee must be shown how to put on a respirator, position it on the face, set strap tension, and determine an acceptable fit. Next, the employee must be allowed to choose a respirator from a sufficient number of models and sizes so that the employee can find an acceptable and correctly fitting respirator. Once an acceptable respirator has been found—which takes into account the position of the mask on the face, nose, and cheeks; room for eye protection; and room to talk—a user seal check must be conducted (refer to on "Use of Respirators").

3. **TYPES OF FIT TESTING.** Fit testing may either be *qualitative (QLFT)* or *quantitative (QNFT)* and must be administered using an OSHA-accepted QLFT or QNFT protocol. These protocols are described in mandatory Appendix A to 1910.134. Prior to the commencement of the fit test, the employee must be given a description of the fit test and a description of the exercises that he or she will be performing during fit testing. The respirator to be tested must be worn for at least five minutes before the start of the fit test. The employee must be fit tested with the same make, model, style, and size of respirator that will be used in the workplace.

   - **Qualitative fit testing (QLFT).** Qualitative fit testing involves the introduction of a gas, vapor, or aerosol test agent into an area around the head of the respirator user. A determination is then made as to whether or not the wearer can detect the presence of the test agent through means such as odor, taste, or nasal irritation. If the presence of the test agent is detected inside the mask, the respirator fit is considered to be inadequate.

     There are four qualitative fit test protocols approved in OSHA's standard. The isoamyl acetate (IAA) test determines whether a respirator is protecting a user by questioning whether the user can smell the distinctive odor of IAA. Both the saccharin and Bitrex™ tests involve substances with distinctive tastes that should not be detected through an effective respirator. The irritant smoke (e.g., stannic chloride) test involves a substance that elicits an involuntary irritation response in those exposed to it.

     Before conducting a qualitative test, the worker must undergo a sensitivity test to determine if he or she can taste, smell or react to the substance. When performing the isoamyl acetate test, the protocol requires that separate rooms be used for the odor screening and fit tests, and that the rooms be sufficiently ventilated to ensure that there is no detectable odor of IAA prior to a test being conducted. This will prevent olfactory fatigue among workers being fit tested by preventing a buildup of IAA in the general room air.

   - **Quantitative fit testing (QNFT).** In a quantitative fit test, the adequacy of respirator fit is assessed by numerically measuring the amount of leakage into the respirator. This testing can be done by either generating a test aerosol as a test atmosphere, using ambient aerosol as the test agent, or using controlled negative pressure (CNP) to measure the volumetric leak rate. Appropriate instrumentation is required to quantify respirator fit.

4. **FIT TEST EXERCISES.** The following test exercises must be performed for all fit testing methods described in the OSHA standards, except the CNP method which has its own fit testing exercise regimen:

   - Normal breathing in a normal standing position, without talking;
   - Deep breathing in a normal standing position, breathing slowly and deeply, taking precaution not to hyperventilate;
   - Turning the head slowly from side to side, while standing in place, with the employee holding his/her head momentarily at each extreme so that the employee can inhale at each side;
   - Moving the head up and down slowly, while standing in place, inhaling in the up position when looking toward the ceiling;
   - Talking out loud slowly, reading from a prepared text such as the Rainbow Passage (see Appendix A of the standard), counting backward from 100, or reciting a memorized poem or song;
   - Grimacing by smiling or frowning (only for QNFT testing);
   - Bending at the waist as if to touch toes (jogging in place can be done when the fit test enclosure doesn't permit bending at the waist); and
   - Normal breathing (as described above).

Each test exercise must be performed for one minute, except for the grimace exercise which must be performed for 15 seconds. The respirator must not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

The employee must perform exercises in the test environment while wearing any applicable safety equipment that may be worn during actual respirator use and that could interfere with respirator fit. If the employee exhibits breathing difficulty during the fit test, he or she must be referred to a physician or other licensed health care professional to determine whether the employee can wear a respirator while performing his or her duties.

5. **RETESTING.** If the employee finds the fit of the respirator unacceptable, he or she must be given a reasonable opportunity to select a different respirator and to be retested. In addition, retesting is required whenever an employee reports, or the employer, PLHCP, supervisor, or program administrator observe changes in an employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes (e.g., wearing new dentures), cosmetic surgery, or an obvious change in body weight.

## XIII. **USE OF RESPIRATORS.**

0. **CONDITIONS.** Once the respirator has been properly selected and fitted it is necessary to ensure that the respirator is used properly in the workplace. The following conditions may compromise the effective use of the respirator and jeopardize worker protection: facepiece seal leakage; removing the respirator at the wrong times in hazardous atmospheres; not properly performing user seal checks; or not properly repairing defective parts. In these circumstances, there is the danger that employees may have a false sense of security in feeling that they are protected when they are not.

   The employer must also be aware of the conditions in the work areas where employees are using respirators. Employers are required to routinely evaluate workplace conditions, the degree of employee exposure, and physical stress so that they can provide additional or different respiratory protection when necessary. By observing respirator use under actual workplace conditions, employers can note problems such as changes in the fit of a respirator due to the use of other protective equipment, or conditions leading to skin irritation.

1. **FACEPIECE SEAL PROTECTION.**

   - **Seal of Tight-Fitting Respirators and Valve Function.** The employer must not permit respirators with tight-fitting facepieces to be worn by employees who have conditions that would compromise the facepiece-to-face seal. Examples of these conditions include facial hair that interferes with the facepiece seal or valve function, absence of normally worn dentures, facial deformities (e.g., scars, deep skin creases, prominent cheekbones), or the use of jewelry or headgear that projects under the facepiece seal.

   - **Corrective Glasses or Goggles.** Corrective glasses or goggles, or other personal protective equipment, must be worn in such a way that they do not interfere with the seal of the facepiece to the face. Since eye glasses or goggles may interfere with the seal of half-facepieces, it is strongly recommended that full-facepiece respirators be worn where either corrective glasses or eye protection is required, since corrective lenses can be mounted inside a full facepiece respirator. In addition, the full-facepiece respirator may be more comfortable, and less cumbersome, than the combination of a half-mask and chemical goggles. OSHA's current standard on respiratory protection, unlike the previous one, allows the use of contact lenses with respirators where the wearer has successfully worn such lenses before.

- **User Seal Check.** A user seal check (formerly known as a fit check) must be performed every time a tight-fitting respirator is put on or adjusted to ensure proper seating of the respirator to the face. The user seal check conducted must be either the positive and/or negative pressure checks described in Appendix VIII: 2-2 of this chapter, or the manufacturer's recommended procedures (when equally protective). If the employee fails the user seal check test, another facepiece must be selected.

  The employee must not have any hair growth (e.g., beard stubble, sideburns, or beard) that comes between the sealing surface of the respirator facepiece and the face, as well as hair that interferes with valve function, or any other condition that might interfere with the facepiece-to-facepiece seal such as jewelry or facial make-up. The user seal check must be used for all respirators on which such checks are possible. If a user seal check cannot be performed on a tight-fitting respirator, the OSHA standard prohibits that respirator from being used.

2. **CONTINUING RESPIRATOR EFFECTIVENESS.**

- **Skin or Eye Irritation.** Skin or eye irritation can result from wearing a respirator in hot, humid conditions, as well as in contaminated environments. Such irritation can be distressing to workers, causing them to remove or adjust the respirator, or to refrain from wearing the respirator altogether. Therefore, to prevent skin or eye irritation associated with respirator use, employees must be permitted to leave the respirator use area to wash their faces and respirator facepieces as needed.

- **Filter, Canister, and Cartridge Elements for Air-Purifying Respirators.** Whenever the respirator user can detect vapor or gas breakthrough (by odor, taste, and/or irritation effects), a change in breathing resistance or leakage of the facepiece, the worker must be allowed to leave the respirator use area to replace the respirator or the filter, cartridge, or canister elements. Similarly, employees must be permitted to leave the respirator use area if they are replacing cartridge or canister elements according to a change schedule, or when the end-of-service-life indicator shows that the canister or cartridge(s) must be changed.

- **Repair, Disposal, and Replacement of Respirators.** Since respirators must be in good working condition to function, it is imperative that they not be used if they have been impaired in any way. Impairments include a broken strap, loss of respirator shape, and a face seal that can no longer be maintained. Therefore, respirators that are not properly functioning must be replaced, repaired, or discarded. The respirator manufacturers can supply replacement parts for damaged parts on elastomeric respirators. Only when the respirator has been replaced or repaired can the employee return to the respirator use area.

3. **IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH) ATMOSPHERES.** Atmospheres are IDLH when they pose an immediate threat to life, would cause irreversible adverse health effects, or would interfere with an individual's ability to escape from a dangerous atmosphere. Care must be exercised in these situations since failure of the respirator to provide the appropriate protection may result in serious injury or death. Consequently, the employer must develop and implement specific procedures for the use of respirators in IDLH atmospheres that include the following provisions:

   - At least one employee (referred to as the "standby employee") is to be located outside the IDLH atmosphere and maintain visual, voice, or signal line communication with the employee(s) in the IDLH atmosphere;

   - The standby employee(s) located outside the IDLH atmosphere must be trained and equipped to provide effective emergency rescue;

   - The employer or authorized designee is to be notified before the standby employee(s) enter the IDLH atmosphere to provide emergency rescue;

   - The employer or authorized designee, once notified of such entry, must provide the necessary assistance appropriate to the situation;

   - Standby employee(s) must be equipped with pressure demand or other positive pressure SCBA, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and

   - Standby employee(s) must be equipped with appropriate retrieval equipment for lifting or removing the employee from the hazardous atmosphere, or, when such retrieval equipment cannot be used because it would increase the overall risk resulting from entry, ensure that equivalent provisions for rescue have been made.

4. **INTERIOR STRUCTURAL FIREFIGHTING.** In the ultra-hazardous situation of interior structural firefighting, firefighters must operate using a buddy system. Safeguards that may be adequate for well-controlled and well-characterized IDLH situations are not adequate in the uncontrolled and unpredictable situation characterized by a burning building. Therefore, in addition to the above safeguards for IDLH atmospheres, the following requirements apply to interior structural firefighting:

   - Two or more firefighters must always be sent in together and remain in visual or voice contact with one another at all times;

   - At least two standby personnel are to be located outside the fire area; and

   - All personnel engaged in interior structural firefighting must use SCBA.

The "two-in/two-out" requirement does not take effect until firefighters begin to perform interior structural fire fighting. While the fire is in the incipient stage (as determined by the commander or other person in charge), or when emergency rescue operations are required before the entire team has assembled, the standard does not require two-member teams inside and outside the structure.

## XIV. **MAINTENANCE AND CARE.**

0. **REQUIREMENTS.** The OSHA standard requires that employers provide each respirator user with a respirator that is clean, sanitary, and in good working order. These requirements are a vital part of any successful respiratory protection program. To ensure that the respirator remains serviceable and delivers effective protection, a maintenance program must be in place prior to respirator use.

   The OSHA respirator standard strongly emphasizes the importance of good maintenance program, but permits its tailoring to the type of facilities, working conditions, and hazards involved. However, all programs are required to include at least:

   - Cleaning and disinfecting procedures;
   - Proper storage;
   - Regular inspections for defects (including leak check); and
   - Repair methods.

   In addition to the OSHA requirements, the manufacturer's instructions for inspection, cleaning, and maintenance of respirators should be consulted to ensure that the respirator continues to function properly. A proper maintenance program ensures that the worker's respirator remains as effective as when it was new.

### 1. **CLEANING AND DISINFECTING.**

- Cleaning and sanitizing respirators are necessary to prevent skin irritation, dermatitis, and to encourage worker acceptance. Where the contaminant is a dust, mist, or fume, build-up on the respirator face-to-facepiece seal or within the respirator will reduce the protection provided by the respirator because the contaminant is in the breathing zone or has compromised the seal. In addition, the build-up of contamination on the respirator can contribute to the deterioration of the respirator's materials, which can lead to reduced protection. Full facepieces must be cleaned to ensure that employees can see through the facepiece.

- Respirators that are issued for the exclusive use of an employee must be cleaned and disinfected as often as necessary to be maintained in a sanitary condition. Respirators used by more than one employee must be cleaned and disinfected prior to being used by a different individual. Respirators maintained for emergency use as well as respirators used in fit testing and training, must be cleaned and disinfected after each use. The employer must use either the OSHA cleaning and disinfecting procedures recommended in Appendix VIII: 2-3 of this chapter or the procedures recommended by the respirator manufacturer, as long as they are equivalent in effectiveness to the OSHA method.

2. **STORAGE.**

- All respirators must be stored so that they are protected against damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. When respirators are packed or stored, the facepiece and exhalation valve must be stored in a manner that will prevent deformation. Each respirator should be positioned so that it retains its natural configuration. Synthetic materials and even rubber will warp if stored in an unnatural shape, thus affecting the fitting characteristics of the facepiece.

- Respirators intended for emergency use must be kept accessible to the work area, but not in an area that might itself be involved in the emergency because such an area may become contaminated or inaccessible. Emergency-use respirators must be stored in compartments or covers that are clearly marked to indicate that they contain emergency respirators, and stored according to any applicable manufacturer instructions.

3. **INSPECTION.** To ensure the continued reliability of respiratory equipment, it must be inspected on a regular basis. The frequency of inspection and the procedures to be followed depend on whether the respirator is intended for non-emergency, emergency, or escape use only.

- The OSHA standard requires that all respirators used in *non-emergency situations* be inspected before each use and during cleaning. Respirators designated for use in an emergency situation are to be inspected at least monthly and in accordance with the manufacturer's instructions, and checked for proper function before and after each use. *Emergency escape-only* respirators must be inspected before being carried into the workplace.

- For all respirators, inspections must include a check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters, or filters. In addition, the elastomeric parts must be evaluated for pliability and signs of deterioration.

- For *SCBA's* which require monthly inspections, the air and oxygen cylinders must be maintained in a fully charged state and recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. In addition, the regulator and warning devices must be inspected to ensure that they function properly.

- For respirators that are maintained for use in emergencies, the OSHA standard requires certifying the respirator by documenting the date that the inspection was performed, the name or signature of the inspector, the findings of the inspection, any required remedial action, and a serial number or other means of identifying the inspected respirator. This information must be provided on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is stored in the form of inspection reports (paper or electronic). The information must be maintained until it is replaced following a subsequent certification.

4. **REPAIR.** Respirators that fail to pass inspection or are otherwise found to be defective, must be removed from service, and discarded, repaired, or adjusted. Repairs or adjustments to respirators must be done only by appropriately trained personnel, using only the respirator manufacturer's NIOSH-approved parts designed for that respirator. The repairs also must be made in accordance with the manufacturer's recommendations and specifications regarding the type and extent of repairs to be performed. Because components such as reducing and admission valves, regulators, and alarms are complex and essential to the safe functioning of the respirator, they are required to be adjusted and repaired only by the manufacturer or a technician trained by the manufacturer.

## XV. BREATHING AIR QUALITY AND USE.

### 0. STANDARDS AND SPECIFICATIONS.

- Breathing air for atmosphere-supplying respirators must be of high purity, meet quality levels for content, and not exceed certain contaminant levels and moisture requirements. Compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration must be in accordance with the following requirements.

  - Compressed and liquid oxygen must meet the United States Pharmacopoeia for medical or breathing oxygen.

- Compressed breathing air must meet at least the requirements for Grade D breathing air as described in the ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989.

- Compressed oxygen must not be used in atmosphere-supplying respirators, including open circuit SCBA's, that have previously used compressed air. This prohibition is intended to prevent fires and explosions that could result if high-pressure oxygen comes into contact with oil or grease that has been introduced to the respirator or the air lines during compressed-air operations. In addition, oxygen in concentrations greater than 23.5% can only be used in equipment designed for oxygen service or distribution.

- Breathing air may be supplied to respirators from cylinders or air compressors. Where cylinders are used, they must be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR parts 173 and 178). Cylinders of purchased breathing air must have a certificate of analysis from the supplier stating that the air meets the requirements for Grade D breathing air. The moisture content of the compressed air in the cylinder cannot exceed a dew point of –50°F (–45.6°C) at 1 atmosphere pressure. This requirement will prevent respirator valves from freezing, which can occur when excess moisture accumulates on the valves. All breathing gas containers must be marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

1. **OTHER SPECIFIC REQUIREMENTS.**

- Where compressors are used for supplying air, the compressor must be constructed and situated so contaminated air cannot enter the air-supply system. The location of the air intake is very important, and must be in an uncontaminated area where exhaust gases from nearby vehicles, the internal combustion engine that is powering the compressor itself (if applicable), or other exhaust gases being ventilated from the plant will not be picked up by the compressor air intake.

- In addition, compressors must be equipped with suitable in-line, air-purifying sorbent beds and filters to further ensure breathing air quality, and to minimize moisture content so that the dew point at 1 atmosphere pressure is 10°F (5.56°C) below the ambient temperature. Sorbent beds and filters must be maintained and replaced or refurbished periodically according to the manufacturer's recommendations, and a tag must be kept at the compressor indicating the most recent change date and the signature of the person authorized by the employer to perform the change.

- For compressors that are not oil-lubricated, the employer must ensure that carbon monoxide levels do not exceed 10 ppm. This requirement can be met by several different methods, including the use of continuous carbon monoxide alarms, carbon monoxide sorbent materials, proper air intake location in an area free of contaminants, frequent monitoring of air quality, or the use of high-temperature alarms and automatic shutoff devices, as appropriate. Employers have flexibility in selecting the method(s) most appropriate for conditions in their workplace. Since no single method will be appropriate in all situations, several methods may be needed. For example, it may be necessary to combine the use of a carbon monoxide alarm with a carbon monoxide sorbent bed where conditions are such that a reliable carbon monoxide-free area for intake cannot be found.

- Oil-lubricated compressors can produce carbon monoxide if the oil enters the combustion chamber and is ignited. This problem can be particularly severe in older compressors with worn piston rings and cylinders. Consequently, if an oil-lubricated compressor is used, it must have a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only a high-temperature alarm is used, the air from the compressor must be tested for carbon monoxide at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

- Breathing air couplings must be incompatible with outlets for non-respirable plant air or other gas systems to prevent accidental servicing of air line respirators with non-respirable gases or oxygen. Also, no asphyxiating substance must be allowed in the breathing air lines.

## XVI. **PROGRAM LOGISTICS.**

0. **IDENTIFICATION OF FILTERS, CARTRIDGES, AND CANISTERS.** The employer must ensure that all filters, cartridges, and canisters used in the workplace are labeled and color coded with the NIOSH approval label, and ensure that the label is not removed and remains legible.

1. **TRAINING AND INFORMATION.**

- Employee training is an important part of the respiratory protection program and is essential for correct respirator use. The OSHA respiratory protection standard requires employers to provide training before the employee uses a respirator in the workplace. For the training to be effective, the training information must be comprehensive and presented in an understandable way.

- Employers should develop training programs based upon the employees' educational level and language background. Such an approach will ensure that all employees receive training that enables them to maximize the effectiveness of the respirators they use. As a result of this training, the employee will be able to understand the operation of the respirator and demonstrate the ability to properly use the respirator.

- Employee training must include a discussion of why the use of the respirator is necessary. Such training would address the identification of the hazards involved, the extent of employee exposures to those hazards, and the potential health effects of such exposures.

- Information regarding the consequences of improper fit, usage, or maintenance on respirator effectiveness must also be provided to employees. Inadequate attention to any of these program elements would obviously defeat the effectiveness of the respirator. Proper fit, usage, and maintenance of respirators are critical to ensure employee protection.

- Employees must also be provided with an explanation of the limitations and capabilities of the respirator selected for employee use. A discussion of the limitations and capabilities of the respirator must address how the respirator operates. This training would include, for example, an explanation of how the respirator provides protection by either filtering the air, absorbing the vapor or gas, or providing clean air from an uncontaminated source. Where appropriate, it should include limitations on the use of the equipment, such as prohibitions against using an air-purifying respirator in IDLH atmospheres and an explanation of why such a respirator should not be used in these situations.

- Employees must also know how to use the respirator effectively in emergency situations, including those in which the respirator malfunctions. Comprehensive training is necessary where respirators are used in IDLH situations, including oxygen-deficient atmospheres such as those that occur in firefighting, rescue operations, and confined-area entry.

- Training must include the procedures for inspecting the respirator, donning and removing it, checking the fit and respirator seal, and actually wearing the respirator. Employees must also be capable of recognizing any problems that may threaten the continued protective capability of the respirator. The training must include the steps employees are to follow if they discover any problems during inspection, that is, who the problems are to be reported to and where they can obtain replacement equipment if necessary.

- Instructions must be given to respirator users regarding the proper procedures for maintenance and storage of respirators. The extent of training may vary according to workplace conditions. In some cases, where employees are responsible for performing some or all respirator maintenance and for storing respirators while not in use, detailed training in maintenance and storage procedures may be necessary. In other facilities, where specific personnel or central repair facilities are assigned to perform these tasks, most employees may need to be informed only of the maintenance and storage procedures without having to learn detailed technical information. By providing this training, respirator users will be able to identify respirator deficiencies that can result from improper maintenance and storage of respirators so that they will not use improperly functioning respirators.

- The training program must also provide employees with medical information that is sufficient for them to recognize the signs and symptoms of medical conditions (e.g., shortness of breath, dizziness) that may limit or prevent the effective use of respirators. Employee knowledge of this information is important to ensure implementation of a successful respirator program.

- In addition to specific training requirements regarding the proper use of respirators, employees must be informed of the general requirements of the OSHA respiratory protection standard. This discussion could simply inform employees that employers are obligated to develop a written program, properly select respirators, evaluate respirator use and correct deficiencies in use, conduct medical evaluations, provide for the maintenance, storage, and cleaning of respirators, and retain and provide access to specific records. Thus, employees will know in general what the employer's obligations are under the standard with respect to employee protection.

- At a minimum, annual training is required by the OSHA respiratory protection standard. With few exceptions, a new employee must be provided with respirator training prior to using a respirator in the workplace. OSHA believes that annual training is necessary and appropriate to ensure that employees know about the respiratory protection program and that they cooperate and actively participate in the program. Training and interaction with respirator instructors on at least an annual basis reinforces employee knowledge about the correct use of respirators and other pertinent elements of the respiratory protection program. It also builds employee confidence when using respirators.

- Under some conditions, additional training will be required to supplement the annual training. Circumstances which require additional training include situations where changes in the workplace (e.g., process changes, increase in exposure, emergence of new hazards) or the type of respirator used by the employee render previous training obsolete. Additional training is also required when the employee has not retained the requisite understanding or skill to use the respirator properly, or when any other situation arises in which retraining appears necessary.

2. **PROGRAM EVALUATION.**

- The employer must conduct evaluations of the workplace as necessary to ensure that the provisions of the current written respirator program are being properly implemented for all employees required to use respirators. In addition, evaluations must be conducted to ensure the continued effectiveness of the program. Evaluations of the workplace will determine whether the correct respirators are being used and worn properly, and will also serve to determine whether the training program is effective.

- The employer must regularly consult with employees wearing respirators to ascertain the employees' views on program effectiveness and to identify any problems. This assessment must determine if the respirators are property fitted. It must also evaluate whether: employees are able to wear the respirators without interfering with effective workplace performance; respirators are correctly selected for the hazards encountered; respirators are being worn when necessary; and respirators are being maintained properly. The employer must correct any problems associated with wearing a respirator that are identified by employees, or that are revealed during any other part of this evaluation.

3. **RECORDKEEPING.** The OSHA respiratory protection standard requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will promote employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

- The employer must retain a medical evaluation record for each employee subject to medical evaluation. This record is to include the result of the medical questionnaire and, if applicable, a copy of the PLHCP's written opinion and recommendations, including the results of relevant medical examinations and tests. Records of medical evaluations must be retained and made available as required by 29 CFR 1910.1020, OSHA's Access to Employee Exposure and Medical Records rule.

- Fit test records must be retained for respirator users until the next fit test is administered. These records consist of:

  - Name or identification of the employee tested;

  - Type of fit test performed (QLFT, QNFT—irritant smoke, saccharin, etc.);

  - Make, model, and size of the respirator fitted;

  - Date of the fit test;

- Pass/fail results if a QLFT is used; or

- Fit factor and strip chart recording or other record of the test results if quantitative fit testing was performed.

- If the employee's use of a respirator is discontinued (e.g., because of a change of duties or successful implementation of engineering controls), fit test records need not be retained for the employee. Fit test records must be maintained to determine whether annual fit testing has been done, and whether the employee who was tested passed the QLFT, or passed the QNFT with a fit factor that was appropriate for the type of respirator being used.

- All written materials required to be maintained under the recordkeeping requirements must be made available, upon request, to the employee who is subject of the records and to the Assistant Secretary for OSHA or designee for examination and copying.

4. **NIOSH GUIDELINES FOR THE SELECTION AND USE OF PARTICULATE RESPIRATORS.** In June 1995, NIOSH updated and modernized the Federal Regulation for certifying air-purifying particulate respirators [42 CFR part 84]. As a consequence of this new regulation, NIOSH developed a User's guide to familiarize respirator users with the new Part 84 certification regulations for particulate respirators, and to provide guidance for the selection and use of the new particulate respirators. The new regulation became effective on July 10, 1995, and replaces 30 CFR part 11 under which NIOSH and the Mine Safety and Health Administration (MSHA) jointly certified respirators before that date. The respirators certified under this new regulation are tested under much more demanding conditions than under the old regulation to provide increased worker protection. See Appendix VIII: 2-4 of this chapter for a summary of the NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84.

## APPENDIX VIII: 2-1. GLOSSARY.

**Air-purifying respirator** a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

**Assigned protection factor (APF)** [reserved]

**Atmosphere-supplying respirator** a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SAR's) and self-contained breathing apparatus (SCBA) units.

**Canister or cartridge** a container with a filter, sorbent, or catalyst, or a combination of these items, that removes specific contaminants from the air passed through the container.

**Demand respirator** an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

**Emergency situation** any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled substantial release of an airborne contaminant.

**Employee exposure** an exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**End-of-service-life indicator (ESLI)** a system that warns the respirator user of the approach of the end of adequate respiratory protection; for example, that the sorbent is approaching saturation or is no longer effective.

**Escape-only respirator** a respirator intended to be used only for emergency exit.

**Filtering facepiece (dust mask)** a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

**Filter or air purifying element** a component used in respirators to remove solid or liquid aerosols from the inspired air.

**Fit factor** a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

**Fit test** the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. See also "Qualitative fit test (QLFT)" and "Quantitative fit test (QNFT)."

**Helmet** a rigid respiratory inlet covering that also provides head protection against impact and penetration.

**High efficiency particulate air (HEPA) filter** a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter and larger. The equivalent NIOSH 42 CFR part 84 particulate filters are the N100, R100, and P100 filters.

**Hood** a respiratory inlet covering that completely covers the head and neck, and may also cover portions of the shoulders and torso.

**Immediately dangerous to life or health (IDLH)** an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

**Interior structural firefighting** the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures that are involved in a fire situation beyond the incipient stage.

**Loose-fitting facepiece** a respiratory inlet covering that is designed to form a partial seal with the face.

**Maximum use concentration (MUC)** [reserved]

**Negative pressure respirator (tight fitting)** a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

**Oxygen deficient atmosphere** an atmosphere with an oxygen content below 19.5% by volume.

**Physician or other licensed health care professional (PLHCP)** an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by 29 CFR 1910.134(e), "Medical evaluation."

**Positive-pressure** a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

**Powered air-purifying respirator (PAPR)** an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

**Pressure demand respirator** a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

**Qualitative fit test (QLFT)** a pass/fail fit test to assess the adequacy of respiratory fit that relies on the individual's response to the test agent.

**Quantitative fit test (QNFT)** an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

**Respiratory inlet covering** the portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

**Self-contained breathing apparatus (SCBA)** an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**Service life** the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

**Supplied-air respirator (SAR) or airline respirator** an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

**Tight-fitting facepiece** a respiratory inlet covering that forms a complete seal with the face.

**User seal check** an action conducted by the respirator user to determine if the respirator is properly seated to the faced.

# APPENDIX VIII: 2-2. USER SEAL CHECK.

## A. Facepiece Positive and/or Negative Pressure Checks

### Positive Pressure Check

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve, and then carefully replacing it after the test.

### Negative Pressure Check

Close off the inlet opening of the canister or cartridge(s) by covering it with the palm of the hand(s) or by replacing the filter seal(s). Inhale gently so that the facepiece collapses slightly, and hold your breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand, which requires that the test be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition, and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

## B. Manufacturer's Recommended User Seal Check Procedures

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the employer demonstrates that the manufacturer's procedures are equally effective in detecting seal leakage compared to the positive pressure and negative pressure checks described above.

## APPENDIX VIII: 2-3. RECOMMENDED PROCEDURES FOR CLEANING RESPIRATORS.

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer, as an alternative, may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in this Appendix (i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user).

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand or pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43°C/110°F maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43°C/110°F maximum), preferably running, water. Drain the components.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in:

- Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43°C/110°F; or
- Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodine/100 cc of 45% alcohol) to one liter of water at 43°C/110°F; or
- Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43°C/110°F maximum), preferably running, water. Drain the components. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean, lint-free cloth, or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.

# APPENDIX VIII: 2-4. NIOSH GUIDE TO THE SELECTION AND USE OF PARTICULATE RESPIRATORS CERTIFIED UNDER 42 CFR 84.

**Summary for Respirator Users**

This summary presents a brief overview of what the respirator user needs to know about the new categories of particulate respirators certified by the National Institute for Occupational Safety and Health (NIOSH).

NIOSH has developed a new set of regulations in 42 CFR 84 (also referred to as "Part 84") for testing and certifying nonpowered, air-purifying, particulate-filter respirators. The new Part 84 respirators have passed a more demanding certification test than the old respirators (e.g., dust and mist [DM], dust, fume and mist [DFM], spray paint, pesticide, etc.) certified under 30 CFR 11 (also referred to as "Part 11").

Changes in the new regulations involve only nonpowered, air-purifying, particulate-filter respirators. Certification requirements for all other classes of respirators (e.g., chemical cartridges, self-contained breathing apparatus [SCBA], airlines, gas masks without a particulate filter, powered air-purifying respirators [PAPR's] equipped with high-particulate air [HEPA] filters, etc.) have been transferred to Part 84 without change. Until further notice, the Occupational Safety and Health Administration (OSHA) is allowing the continued use of Part 11 particulate-filter respirators. Under Part 84 NIOSH is allowing manufacturers to continue selling and shipping Part 11 particulate filters as NIOSH-certified until July 10, 1998.

The new Part 84 regulation provides for nine classes of filters (three levels of filter efficiency, each with three categories of resistance to filter efficiency degradation). The three levels of filter efficiency are 95%, 99%, and 99.97%. The three categories of resistance to filter efficiency degradation are labeled N, R, and P. The class of filter will be clearly marked on the filter, filter package, or respirator box. For example, a filter marked N95 would mean an N-series filter that is at least 95% efficient. Chemical cartridges that include particulate filter elements will carry a similar marking that pertains only to the particulate filter element.

Filter efficiency is the stated percentage of particles removed from the air. Filter efficiency degradation is defined as a lowering of filter efficiency or a reduction in the ability of the filter to remove particles as a result of workplace exposure.

The new classes of nonpowered particulate respirators require new decision logic for selection of the proper respirator. The selection process for using the new particulate classification is outlined as follows and is discussed in Section II of *NIOSHGuide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84*

1. The selection of N-, R-, and P-series filters depends on the presence or absence of oil particles, as follows:

   - If no oil particles are present in the work environment, use a filter of any series (i.e., N-, R-, or P-series).

   - If oil particles (e.g., lubricants, cutting fluids, glycerine, etc.) are present, use an R- or P-series filter.
     **Note:** N-series filters cannot be used if oil particles are present.

   - If oil particles are present and the filter is to be used for more than work shift, use only a P-series filter.
     **Note:** To help you remember the filter series, use the following guide:
     N for *Not* resistant to oil
     R for *Resistant* to oil
     P for oil-*Proof*

2. Selection of filter efficiency (i.e., 95%, 99%, or 99.97%) depends on how much filter leakage can be accepted. Higher filter efficiency means lower filter leakage.

3. The choice of facepiece depends on the level of protection needed—that is, the assigned protection factor (APF) needed.

Call 1-800-35-NIOSH (1-800-356-4674) for additional information or for free single copies of the complete document **NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84** [DHHS (NIOSH) Publication No. 96-101].

NIOSH is the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Public Health Service, U.S. Department of Health and Human Services.

# STANDARD NUMBER: 1910.134 APP C STANDARD TITLE: OSHA RESPIRATOR MEDICAL EVALUATION QUESTIONNAIRE (MANDATORY).

## SubPart Number: I SubPart Title: Personal Protective Equipment

Appendix C to Sec. 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:

Can you read? (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. (Mandatory) The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: _____
2. Your name: _____
3. Your age (to nearest year): _____
4. Sex (circle one): Male/Female
5. Your height: _____ ft. _____ in.
6. Your weight: _____ lbs.
7. Your job title: _____
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code): _____
9. The best time to phone you at this number: _____

10. Has your employer told you how to contact the health care professional who will review this questionnaire? (circle one): Yes/No

11. Check the type of respirator you will use (you can check more than one category):

    a. __ N, R, or P disposable respirator (filter-mask, non-cartridge type only).

    b. __ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus.

12. Have you worn a respirator? (circle one): Yes/No

    If "yes," what type(s): _____

    _____

**Part A. Section 2. (Mandatory) Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").**

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes/No

2. Have you ever had any of the following conditions?

    a. Seizures (fits): Yes/No

    b. Diabetes (sugar disease): Yes/No

    c. Allergic reactions that interfere with your breathing: Yes/No

    d. Claustrophobia (fear of closed-in places): Yes/No

    e. Trouble smelling odors: Yes/No

3. Have you ever had any of the following pulmonary or lung problems?

    a. Asbestosis: Yes/No

    b. Asthma: Yes/No

    c. Chronic bronchitis: Yes/No

    d. Emphysema: Yes/No

    e. Pneumonia: Yes/No

    f. Tuberculosis: Yes/No

    g. Silicosis: Yes/No

h. Pneumothorax (collapsed lung): Yes/No

i. Lung cancer: Yes/No

j. Broken ribs: Yes/No

k. Any chest injuries or surgeries: Yes/No

l. Any other lung problem that you've been told about: Yes/No

4. Do your currently have any of the following symptoms of pulmonary or lung illness?

a. Shortness of breath: Yes/No

b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No

c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No

d. Have to stop for breath when walking at your own pace on level ground: Yes/No

e. Shortness of breath when washing or dressing yourself: Yes/No

f. Shortness of breath that interferes with your job: Yes/No

g. Coughing that produces phlegm (thick sputum): Yes/No

h. Coughing that wakes you early in the morning: Yes/No

i. Coughing that occurs mostly when you are lying down: Yes/No

j. Coughing up blood in the last month: Yes/No

k. Wheezing: Yes/No

l. Wheezing that interferes with your job: Yes/No

m. Chest pain when you breathe deeply: Yes/No

n. Any other symptoms that you think may be related to lung problems: Yes/No

5. Have you ever had any of the following cardiovascular or heart problems?

a. Heart attack: Yes/No

b. Stroke: Yes/No

c. Angina: Yes/No

d. Heart failure: Yes/No

e. Swelling in your legs or feet (not caused by walking): Yes/No

f. Heart arrhythmia (heart beating irregularly): Yes/No

g. High blood pressure: Yes/No

h. Any other heart problem that you've been told about: Yes/No

6. Have you ever had any of the following cardiovascular or heart symptoms?
    a. Frequent pain or tightness in your chest: Yes/No
    b. Pain or tightness in your chest during physical activity: Yes/No
    c. Pain or tightness in your chest that interferes with your job: Yes/No
    d. In the past two years, have you noticed your heart skipping or missing a beat: Yes/No
    e. Heartburn or indigestion that is not related to eating: Yes/No
    f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No

7. Do you currently take medication for any of the following problems?
    a. Breathing or lung problems: Yes/No
    b. Heart trouble: Yes/No
    c. Blood pressure: Yes/No
    d. Seizures (fits): Yes/No

8. If you've used a respirator, have you ever had any of the following problems? (If you've never used a respirator, check the following space and go to question 9):
    a. Eye irritation: Yes/No
    b. Skin allergies or rashes: Yes/No
    c. Anxiety: Yes/No
    d. General weakness or fatigue: Yes/No
    e. Any other problem that interferes with your use of a respirator: Yes/No

9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you ever lost vision in either eye? (temporarily or permanently): Yes/No

11. Do you currently have any of the following vision problems?
    a. Wear contact lenses: Yes/No
    b. Wear glasses: Yes/No
    c. Color blind: Yes/No
    d. Any other eye or vision problem: Yes/No

12. Have you ever had an injury to your ears, including a broken ear drum: Yes/No

13. Do you currently have any of the following hearing problems?
    a. Difficulty hearing: Yes/No
    b. Wear a hearing aid: Yes/No
    c. Any other hearing or ear problem: Yes/No

14. Have you ever had a back injury: Yes/No

15. Do you currently have any of the following musculoskeletal problems?
    a. Weakness in any of your arms, hands, legs, or feet: Yes/No
    b. Back pain: Yes/No
    c. Difficulty fully moving your arms and legs: Yes/No
    d. Pain or stiffness when you lean forward or backward at the waist: Yes/No
    e. Difficulty fully moving your head up or down: Yes/No
    f. Difficulty fully moving your head side to side: Yes/No
    g. Difficulty bending at your knees: Yes/No
    h. Difficulty squatting to the ground: Yes/No
    i. Climbing a flight of stairs or a ladder carrying more than 25 lbs.: Yes/No
    j. Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

**Part B. Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.**

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No

   If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No

2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No

   If "yes," name the chemicals if you know them: _____

   _____

   _____

3. Have you ever worked with any of the materials, or under any of the conditions, listed below?
   a. Asbestos: Yes/No
   b. Silica (e.g., in sandblasting): Yes/No
   c. Tungsten/cobalt (e.g., grinding or welding this material): Yes/No
   d. Beryllium: Yes/No
   e. Aluminum: Yes/No
   f. Coal (for example, mining): Yes/No
   g. Iron: Yes/No
   h. Tin: Yes/No
   i. Dusty environments: Yes/No
   j. Any other hazardous exposures: Yes/No

   If "yes," describe these exposures: _____

   _____

   _____

4. List any second jobs or side businesses you have: _____

   _____

5. List your previous occupations: _____

   _____

6. List your current and previous hobbies:_____

   _____

7. Have you been in the military services: Yes/No

   If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes/No

8. Have you ever worked on a HAZMAT team: Yes/No

9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes/No

   If "yes," name the medications if you know them: _____

10. Will you be using any of the following items with your respirator(s)?
    a. HEPA Filters: Yes/No
    b. Canisters (for example, gas masks): Yes/No
    c. Cartridges: Yes/No

11. How often are you expected to use the respirator(s)? (circle "yes" or "no" for all answers that apply to you):
    a. Escape only (no rescue): Yes/No
    b. Emergency rescue only: Yes/No
    c. Less than 5 hours per week: Yes/No
    d. Less than 2 hours per day: Yes/No
    e. 2 to 4 hours per day: Yes/No
    f. Over 4 hours per day: Yes/No

12. During the period you are using the respirator(s), is your work effort:

    a. Light (less than 200 kcal per hour): Yes/No

    If "yes," how long does this period last during the average shift:
    _____ hrs. _____ mins.

    Examples of a light work effort are sitting while writing, typing, drafting, or performing light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

    b. Moderate (200 to 350 kcal per hour)

    If "yes," how long does this period last during the average shift:
    _____ hrs. _____ mins.

    Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

    c. Heavy (above 350 kcal per hour): Yes/No

    If "yes," how long does this period last during the average shift:
    _____ hrs. _____ mins.

    Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up on an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No

    If "yes," describe this protective clothing and/or equipment: _____

    _____

14. Will you be working under hot conditions (temperature exceeding 77 deg. F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s):

_____

_____

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

_____

_____

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):

Name of the first toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

Name of the second toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

Name of the third toxic substance: _____

Estimated maximum exposure level per shift: _____

Duration of exposure per shift: _____

The name of any other toxic substances that you'll be exposed to while using your respirator: _____

_____

_____

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):

_____

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