United States Environmental Protection Agency

EPA

Safety Manual for Hazardous Waste Site Investigations

DRAFT

September 1979

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 19 1979

OFFICE OF ENFORCEMENT

MEMORANDUM

SUBJECT: Safety Manual for Hazardous Waste Site Investigations

FROM: Jeffrey G. Miller, Director
Hazardous Waste Enforcement Task Force

Kenneth E. Biglane, Director
Oil & Special Materials Control Division

The attached Safety Manual for Hazardous Waste Site Investigations was developed jointly by the National Enforcement Investigations Center (NEIC) and by a specially formed Hazardous Waste Disposal Site Safety Task Force, chaired by Robert Magor of the EPA Office of Occupational Health and Safety. Members of that group represent several Headquarters offices and Regional Surveillance and Analysis Divisions. The manual discusses proper safety measures to be observed in conducting hazardous waste site investigations and in handling samples resulting from such inspections.

The manual will eventually receive the full Agency Red Border review and your comments on how it might be improved are welcome. However, in the interim this is considered to be the best information currently available regarding safety and should be used by all EPA offices and contractors involved with hazardous waste site investigations.

Attachment

Addressees

Deputy Project Officers, Region I-X
S&A Division Directors, Region I-X
Enforcement Division Directors, Region I-X
Air & Hazardous Division Directors, Region I-X
Hazardous Waste Site Contacts, Region I-X
Ken Biglane
Bob Magor
Bill Blackman

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

October 15, 1979

MEMORANDUM

OFFICE OF
PLANNING AND MANAGEMENT

SUBJECT: Transmittal of Manual

TO: Recipients of "Safety Manual for Hazardous Waste Site Investigations"

FROM: Robert C. Magor, Director
Office of Occupational Health and Safety (PM-273)

On August 17, 1979, Jeffrey Miller, Director, Hazardous Waste Task Force, and Kenneth Biglane, Director, Oil and Special Materials Control Division, jointly announced the formation of a Headquarters/ Regional Work Group to finalize a safety manual for the inspection and investigation of hazardous waste sites. This group met September 5, 1979, to review a draft prepared by NEIC on this subject; the attached Manual is the product of this meeting and subsequent work by NEIC and OOHS.

The implementation of these guidelines must take place immediately, since EPA and contractor personnel are already heavily involved in hazardous waste site inspections. The Work Group strongly encourages your acceptance of this Manual immediately as guidance for these activities. We will send this out for "red boarder" review as policy in the near future, and therefore the Work Group would appreciate any comments you may have on this issuance. Between now and when it becomes policy, though, I encourage you to abide by it, include it in contract language, and distribute it to states with whom you are jointly involved.

The structure of the Manual is that of policy statements in the text, followed by expandable appendices which contain the specifics. A suggestion that we issue this as a loose-leaf notebook has merit, since the Work Group believes that as our field activities increase, our experience will cause us to supplement and revise this Manual.

The Work Group discussed at length the section on the laboratory facility requirements. (The Work Group rapidly agreed on most other parts of the Manual.) The Office of Occupational Health and Safety will soon be proposing EPA laboratory standards, which will be very close to DHEW's, "Guidelines for the Laboratory Use of Chemical Substances Posing a Potential Occupational Carcinogenic Risk," June 5, 1979 (Revised Draft).

The Work Group agreed to make the recommendations in this Manual consistent with those guidelines: Whereas the most appropriate laboratory space for analytically supporting waste site investigations are laboratories meeting "containment" specifications (and soon EPA will have a sufficient number of containment laboratories to totally support this effort), we acknowledge that infrequent analyses of small quantities of material can be carried out safely in good convential laboratories with adherence to good laboratory practices.

If you have any comments, please contact either William Blackman, NEIC, or myself.

Attachment

United States Environmental Protection Agency

EPA

Safety Manual for Hazardous Waste Site Investigations

DRAFT

September 1979

I. INTRODUCTION

FOREWORD

The Hazardous Waste Site Investigation Safety Task Force has prepared this manual to provide the basis for organization safety plans and programs. It is intended to supplement existing safety manuals with elements necessary to safely conduct hazardous waste site investigations. The Task Force assumed it to be inappropriate to include all of the rules and advice contained in existing manuals pertaining to the more general field and laboratory operations. It is further assumed that as organizations revise and update existing safety manuals and programs, the principles contained herein will be incorporated.

It is also necessary to note the developing and evolving nature of hazardous waste site investigations and related operations. The techniques are subject to change and update as experience is gained. Users are encouraged to provide suggestions or comments to:

U.S. Environmental Protection Agency
Industrial Hygiene Programs Manager
Office of Occupational Health and Safety (PM-273)
Room 3503 Waterside Mall
401 M Street S.W.
Washington, D.C., 20460

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II. GENERAL SAFETY PRECAUTIONS

II. GENERAL SAFETY PRECAUTIONS

UNSAFE SITUATIONS

All employees are directed to bring to the attention of the most readily accessible Supervisor any unsafe condition, practice, or circumstance associated with or resulting from hazardous waste site (HWS) investigations.

In cases of immediate hazard to employees or the public, any employee on the scene should take all practicable steps to eliminate or neutralize the hazard; this may include leaving the site. Followup consultation with the Project Leader or Supervisor must then be made at the first opportunity. In such circumstances the Project Leader or Supervisor must take, or cause to be taken, the necessary steps to ensure that the investigation can be completed safely. Such steps may include changes in procedure, removal or neutralization of a hazard, consultation with appropriate experts, or bringing in specialists such as Explosive Ordinance Disposal (EOD) units. In cases where the hazard is not immediate, the employee should consult the Supervisor or management regarding appropriate corrective measures. Application of this rule requires exercising good judgment and common sense by all employees.

PROTECTIVE GEAR

Protective headgear, eyewear, footwear, and clothing are to be worn at all times on abandoned hazardous waste sites [see Appendix A]. Likewise, self-contained breathing apparatus (SCBA) will be worn unless the on-scene Project Leader has determined that the ambient air may be safely inhaled. On-scene Project Leaders should exercise informed judgment on protective gear requirements at active sites, or in cases where sites have been repeatedly entered or occupied without apparent harm. In any case where doubt exists, the safe course of action must be taken. SCBA will be worn

at all times when containers of suspected hazardous materials are being opened, or when operating in buildings or other enclosed spaces suspected of containing hazardous substances (see Chapter III).

RADIOACTIVITY AND EXPLOSIVITY

All suspect sites must be checked for radioactivity and explosivity during first entry onto the site. Normal background radioactivity is approximately 0.02 mr/hr; however activity of 10.0 mr/hr is acceptable for the period of exposure associated with a hazardous waste site investigation. Detecting levels of activity significantly greater than normal background is cause for a very careful survey of the entire site; if levels approaching 10 mr/hr are encountered, the advice of a competent radiation health physicist must be sought before continuing operations on the site.

If explosivity readings greater than 20% LEL* (not 20% concentration, which is frequently much higher than 20% LEL) are detected, very careful survey of the area, including ground-, waist-, and head-level readings, must be made. Readings approaching or exceeding 50% LEL are cause for immediately withdrawing personnel and notifying the fire department. A Supervisor or management is then to be consulted for direction regarding further operations. Supervisors or managers are then to take, or cause to be taken, actions necessary to safely resume the investigation.

SAMPLE HANDLING

Samples of runoff, ambient air, or groundwater from an HWS, or possibly affected areas, may be moved directly into laboratories and handled with normal safety precautions, unless the Supervisor or Project Leader

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* LEL = Lower Explosive Limit

determines that special handling is appropriate. However, samples of liquids or solid materials removed from containers or certain spill areas are to be processed and diluted in a controlled, or regulated, lab before analysis (see Chapters III and V).

FORBIDDEN PRACTICES

The following practices are expressly forbidden during operations on suspected or known hazardous waste disposal sites:

1. Smoking, eating or drinking while on site.

2. Ignition of flammable liquids within, on, or through improvised heating devices (barrels, etc.), or space heaters.

3. Entry into areas or spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment available to enable safe entry.

4. Conduct of on-site operations without off-site backup personnel.*

HEALTH AND TRAINING

All employees who will engage in HWS field investigations or laboratory analyses must complete a comprehensive health examination, be shown to be free of residual effects of exposure to hazardous materials, and be in general good health and physical condition. The comprehensive examination is to be repeated at intervals no greater than annually for so long as the employee continues HWS investigative work [see Appendix B].

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* On-scene Project Leaders should exercise informed judgment regarding the necessity for off-site backup at active sites, or in cases where sites have been repeatedly entered or occupied without apparent harm. In any case where doubt exists, off-site backup must be provided.

All employees engaged in HWS field work or laboratory analyses will receive training in basic first aid, cardio-pulmonary resuscitation, and the use of protective clothing and equipment [see Appendix C]. Management is responsible for providing training at the earliest practicable time, and refresher training at appropriate intervals.

Management, Supervisors, and Project Leaders are required to familiarize themselves with the EPA Occupational Health and Safety Manual; 29 CFR* 1910; 29 CFR 1960; and EPA Accident Reporting Procedures.

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* CFR = Code of Federal Regulations

III. SAFETY PROCEDURES FOR FIELD EVALUATIONS

III. SAFETY PROCEDURES FOR FIELD EVALUATIONS OF HAZARDOUS WASTE SITES

INTRODUCTION

The Project Leader is responsible for establishing, and adjusting as necessary, the level of safety precautions appropriate to the individual hazardous waste site (HWS) being evaluated --- such as use of SCBA, etc. The Project Leader ensures that all participants conduct their work in accordance with the study plan and applicable safety rules. He/she is authorized to direct any assigned employee to leave the HWS if the employee fails to observe safety requirements or in any way creates a safety hazard.

INFORMATION REVIEW AND RECONNAISSANCE

Developing a safe plan of HWS investigation must be preceded by thorough evaluation of existing data and a reconnaissance (see "Waste Disposal Site Hazard Assessment Manual"). The information search may indicate possible chemical hazards such as the presence of incompatible chemicals, toxic gases, explosives, etc. [see Appendix D]. Such indications will provide insight to specific safety precautions needed. Similarly, a perimeter inspection or aerial imagery, followed by an on-site reconnaissance, will reveal safety hazards requiring special attention.

The safety precautions necessary in field investigations will normally become more complex as the following order of tasks brings investigative personnel progressively closer to actual contact with waste materials:

1. Environmental Measurements (Off-site)

    a. Ambient air
    b. Runoff
    c. Groundwater (existing wells)
    d. Peripheral test holes

2. On-site Measurements (Accessible)

   a. Soil
   b. Spilled material
   c. Air
   d. Exposure (bioassay)
   e. On-site wells

3. On-Site Measurements (Entry)

   a. Barrels
   b. Tanks
   c. Enclosed spaces
   d. Test holes
   e. Feed and process lines and valves
   f. Sewers and manholes

It follows that the safety considerations in design of the investigation indicate selection of investigative methods that will minimize safety requirements and meet project objectives (i.e., enforcement or cleanup).

The information review and reconnaissance should also include careful examination of possible hazards to the public. Such hazards may include contamination of groundwater supplies by drilling operations, release of toxic gases, or explosion/fire. Any such hazards must be avoided or eliminated, or appropriate measures must be taken to protect the public and public property. Any indication of the presence of explosives is to be the basis for an initial investigation and appropriate followup by Army Explosive Ordinance Disposal (EOD) personnel or police explosives unit.

Before entry on a suspect or known HWS, all investigative personnel must know the locations and emergency telephone numbers for the nearest medical facility, ambulance service, fire department, police department, poison control centers [see Appendix E], and EPA Office contact.

FIELD SAMPLING

Clean Area

During operations on a suspect or known HWS, a "clean" area must be

established outside the area of suspected contamination. At least one backup team member* will remain in this area to:

1. Assist in emergency removal of team members from the HWS in the event of accident or injury. The backup must have readily available protective clothing, breathing apparatus and first aid equipment.

2. Assist in moving equipment, samples, and supplies.

3. Provide communication to emergency units.**

4. Assist in decontamination or removal of contaminated clothing from the individuals emerging from the contaminated area.

5. As appropriate, prevent entry of unauthorized persons to the HWS while operations are underway.

6. Provide other assistance as necessary, but with the primary objective of facilitating safe transfer of personnel and equipment to and from the contaminated area.

Sampling Equipment

As a general rule, sampling equipment used on an HWS should be disposable. Dippers, scoops, and similar devices for solids samples should be buried onsite, or placed in plastic bags for disposal or later decontamination. Liquid samples from barrels or tanks should be withdrawn in inert tubing, such as glass, and the tubing should then be broken and abandoned within the barrel or tank. If incineration or recycling of barrel contents is contemplated, the tubing may be disposed of in other

* On-scene Project Leaders may exercise informed judgment regarding the need for off-site backup at active sites, or in cases where sites have been repeatedly entered or occupied without apparent harm. In any case where doubt exists, the safe course of action must be taken.
** Radio contact must be maintained when visual contact cannot be maintained.

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suitable containers, or buried on the site. The widely discussed Composite Liquid Waste Sampler (or "Coliwasa") is unsuitable for use on HWS investigations because it is extremely difficult to decontaminate under field conditions.

Clothing

Protective clothing must be worn by all assigned personnel while on a suspected or confirmed HWS, until sufficient data has been acquired to enable the Project Leader to make an informed judgment regarding the need. Project Leaders must weigh the fact that fatigue and alertness on the part of the team members is a significant safety factor. Protective clothing is cumbersome, hastens the on-set of fatigue, and limits stay-time. In the absence of clear indications that work can proceed safely without protective clothing, required items include chemical-resistant pants and jacket, rubber boots, protective gloves, hard hat or head cover, face shield or chemical safety glasses [see Appendix A].

Disposable and reuseable clothing is available, and each has advantages and disadvantages. The presently available disposable clothing is fragile, easily torn, and especially vulnerable during cold weather. The "bootees" that are furnished with this clothing are highly vulnerable and are of limited value on rough ground or for walking through snagging objects. Reuseable clothing is available in much sturdier fabric and is generally preferred. The disadvantage is the necessity for decontamination on-site, or careful packaging, shipment, and later decontamination. The reuseable suits are worn with heavy rubber slip-on boots, which are easily decontaminated on-site with reagent solution [see Figure1].

Full-decontamination of reusable suits is accomplished in two steps. The first step is performed on-site using a reagent solution selected beforehand in consultation with Chemistry and Biology personnel, based on limited knowledge of chemical and biological hazards on the site at that time. After cleansing, protective clothing is turned inside out, if feasible, and sealed in plastic bags for return shipment. The second decontamination step is taken later, after enough of the sample has been

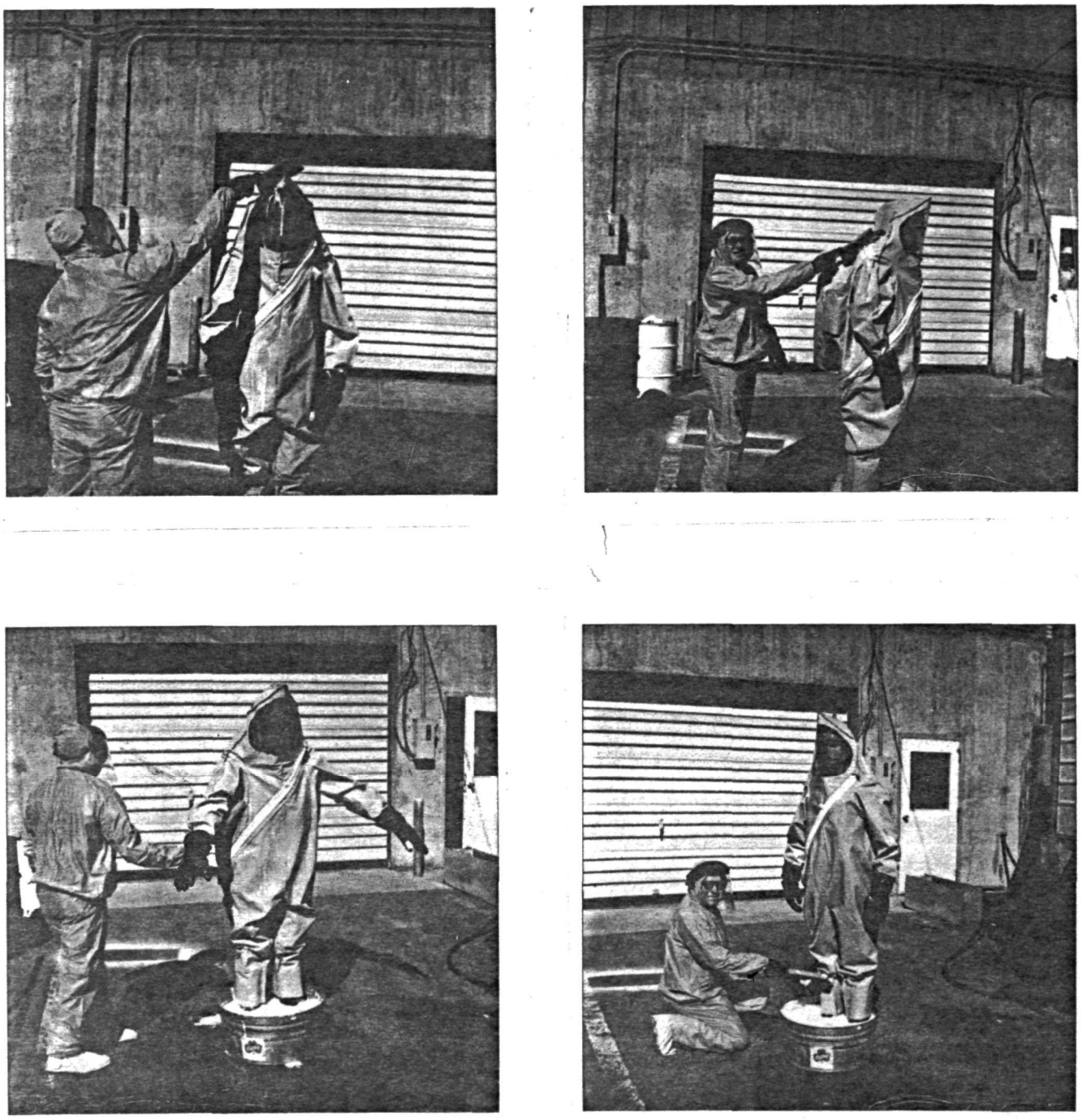

FIGURE 1. ON-SITE DECONTAMINATION OF PROTECTIVE CLOTHING

laboratory-analyzed to determine what decontamination reagents are most suitable for each case. This second cleaning is then performed by personnel wearing disposable safety clothing. Waste decontamination solution from the second step should be treated as hazardous waste and disposed of according to appropriate regulations.

SCBA/Respirators

Self-contained breathing apparatus (SCBA) must be worn on-site when:

1. Still air conditions prevail.
2. Containers of unknown or known hazardous materials are being opened.
3. When in enclosed spaces, such as unventilated buildings or rooms.
4. Under any circumstances where free-flow of air uncontaminated by toxics is in doubt.

In cases where the Project Leader has determined that on-site work may proceed without use of SCBA, participating personnel must carry respirators having organic vapor protection cartridges, or combination cartridges. An oxygen meter should be used to determine that at least 19.5% oxygen is present in the area where respirators are to be used. Respirators should be donned immediately upon experiencing breathing difficulty, dizziness or other distress, strong taste or smell, or mere judgement that precaution is in order. Once respirators have been donned, team members should withdraw from the site pending a decision by the Project Leader regarding continued operations. Cartridge respirators should not be relied upon for protection from organic vapors for extended periods. [See Appendix A for more information.]

Remember:

1. Respirator cartridges for organic vapors function as adsorbants. Once adsorptive capacity is reached, the cartridge no longer functions.*
2. Cartridge respirators do not supply oxygen. They are of no use in oxygen deficient atmospheres.*

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* See Pritchard, J., "A Guide to Industrial Respiratory Protection", NIOSH, Cincinnati, Ohio, June 1976.

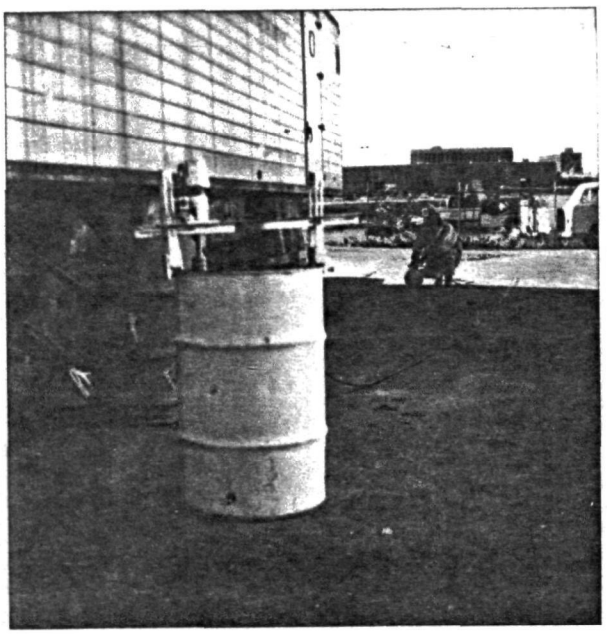
Sampling Procedures

Sampling methods are described in the "Waste Disposal Site Hazard Assessment Manual." As indicated under "Field Sampling" above, disposable sampling equipment should be used wherever possible. The guiding safety principle is to prevent exposure of personnel doing sampling, packaging, shipping, analysis, and to prevent exposure of others to spilled or residual waste materials.

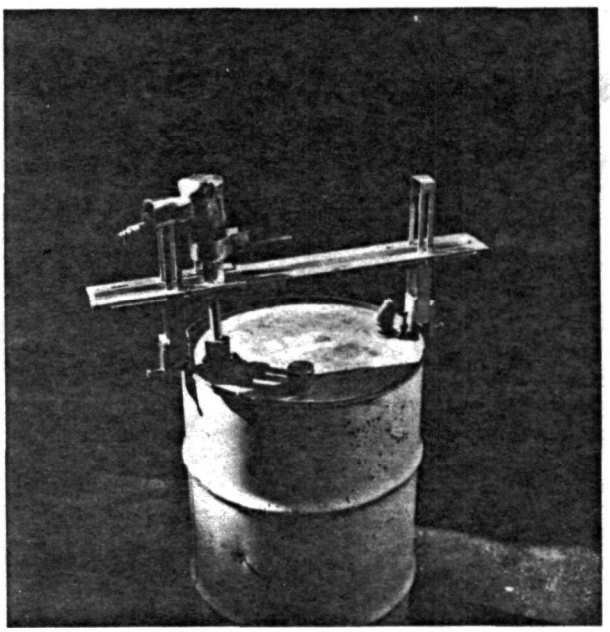
Containers (drums, tanks etc.) should only be sampled when necessary to meet enforcement or cleanup requirements. Opening drums or other sealed containers may be hazardous to sampling personnel unless proper safety procedures are followed. Gases can be released, or pressurized liquids can be expelled. A drum should not be moved or opened unless it can be ascertained beyond reasonable doubt that the drum is structurally sound. Drums standing on end, with bung up, should be opened by pneumatic impact wrench, operated from a remote site [Figure 2]. Drums on sides may be opened similarly if it is possible to safely rotate the drum so that the bung is high. If the bung can be removed, sampling contained liquids may be safely accomplished by glass tube, which is then broken and discarded within the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, may be safely sampled with a hydraulic penetrating device [Figure 3] operated remotely. The device is then abandoned in place, and disabled to prevent further withdrawal of liquids. Sealed or closed tanks should be opened remotely, using ropes to lift hatches, etc.

In general, metal sample containers should not be used on HWS investigations; if used, they must be grounded, preferably to the drum or tank being sampled, while sample transfer is accomplished.

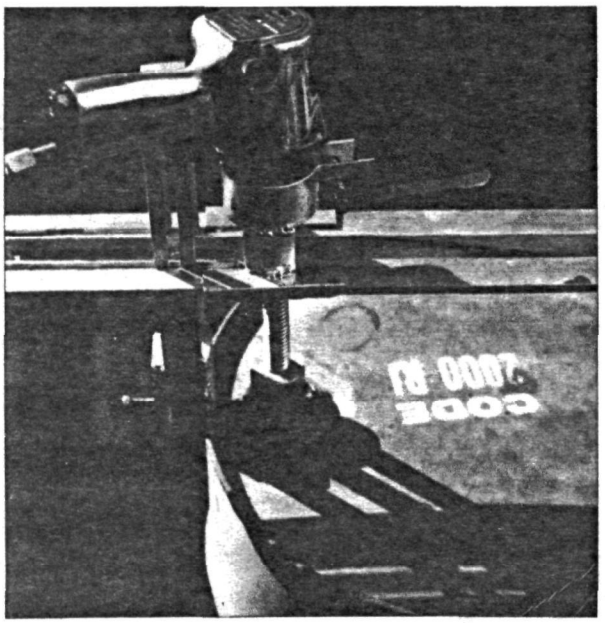
In all cases of entry into closed containers, the local fire department should be asked to stand by. In any case wherein presence of explosives is suspected or known, Army EOD or police bomb squads should be requested to remove or neutralize such materials. In no event may EPA employees handle explosives encountered on dump sites.



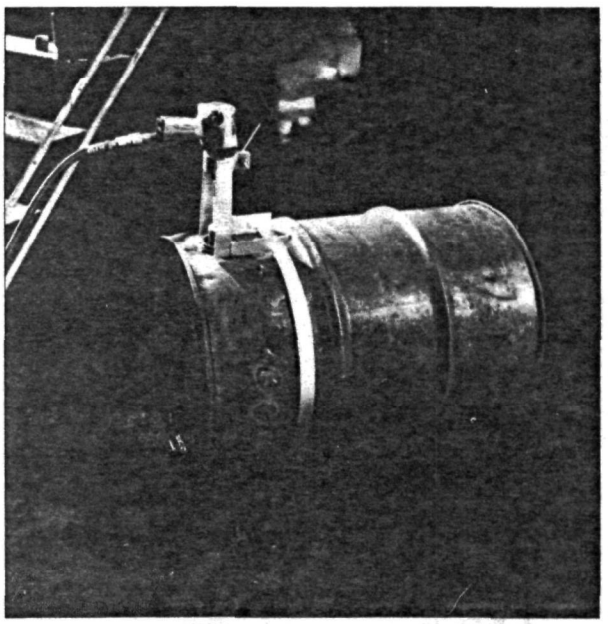
Remote bung removal. Man in background, dressed in protective clothing, operates bung-removal equipment on drum in foreground.



Bung-removal equipment; drum on end.

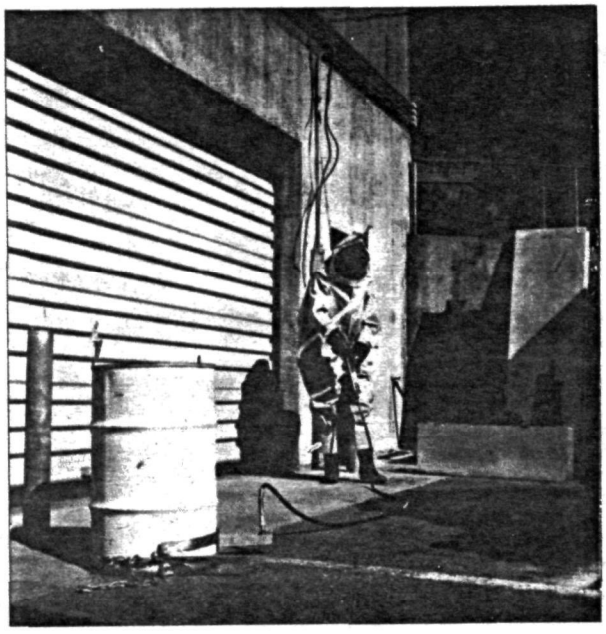


Equipment closeup.

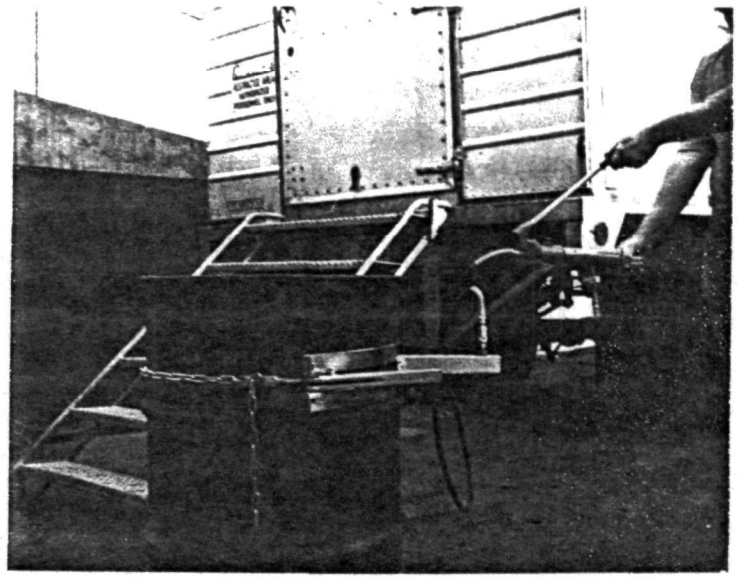


Remote bung-removal setup; drum on side.

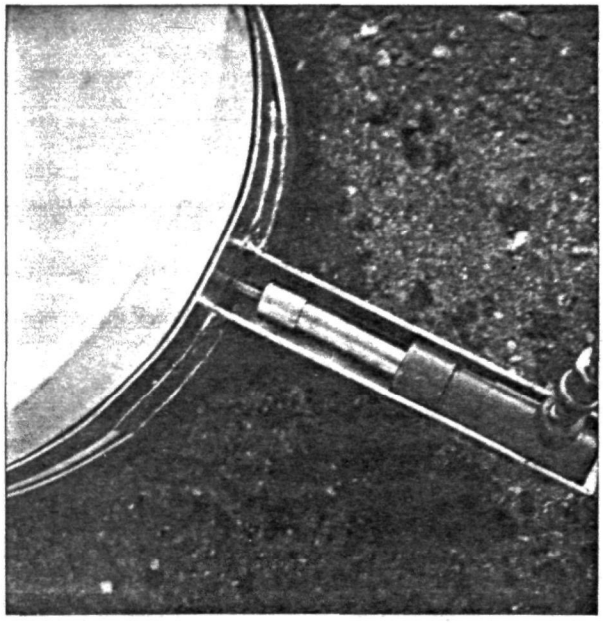
FIGURE 2. REMOTE REMOVAL OF BARREL BUNG



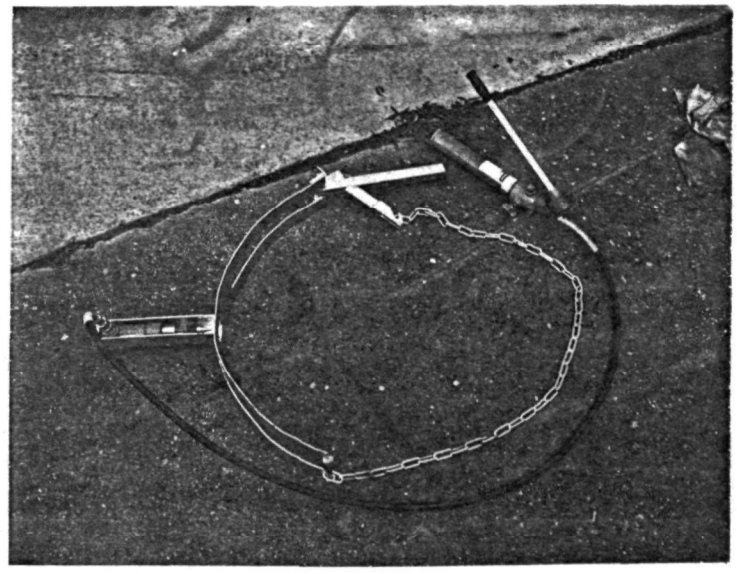
Remote operation of penetrating sampling device.



Drum attachment, connecting tube, and hand-held activator.



Sampling device penetrating drum.



Remote sampling equipment.

FIGURE 3. REMOTE SAMPLING

Subsurface sampling of an HWS can also create hazards to employees and the public, unless adequate safety precautions are followed. Biodegradation of refuse in dumps produces methane and other explosive gases. The escaping gases may be ignited by drill rigs or other ignition sources. Drilling into dump sites may cause discarded incompatibles to be mixed and thereby create reactive mixtures [see Appendix D]. Dump sites where leachate plumes are contained on impervious strata may be interconnected with producing aquifers if drilling is not planned according to competent groundwater technology and data.

Drilling in HWS investigations should be confined to the periphery of dump sites, with the objective of characterizing the leachate that may be moving away from the site. If subsurface sampling of dump sites is necessary, excavation must be accomplished by hand, and with spark-free equipment.

All drilling associated with HWS investigations must be accomplished under the responsible supervision of a competent geohydrologist, groundwater geologist, geological engineer, or a person similarly qualified by experience. Drilling must be preceded by sweeps with metal detectors, and drilling must be limited to areas where the presence of buried drums or tanks is not indicated. Test holes must be cased or plugged when the investigation is completed.

Ambient air sampling on an HWS must be accomplished with spark-free equipment if explosive vapors are present (most hi-vol samplers are spark sources).

Samples from HWS must not be preserved, or "fixed," by the addition of chemicals (see "Waste Disposal Site Hazard Assessment Manual" regarding cooling of samples in ice chests or refrigerators).

HWS sample volume should be the smallest consistent with analytical requirements. Sample containers must be cleaned and free of spilled or residual waste material, on the exterior of the container, prior to shipment (see Chapter IV - "Shipment of HWS Samples").

LEAVING THE SITE

Procedures for leaving the suspect contaminated area must be planned before entry. Provision must be made for: decontamination and safe packing of protective clothing; burial or safe packing of disposable gear; handling of samples and preparation of samples for shipment; transfer of equipment, gear, and samples from the "contaminated" area to the "clean" area; etc. Sequences will depend on several variables --- such as SCBA inside or outside of protective clothing --- but must be worked out in advance.

TRAINING

Personnel to be assigned on-site duties in HWS investigations must be provided hands-on training [see Appendix C] on simulated sites, to achieve competence in the safety and operational aspects. Preparation for on-site investigations must include detailed briefings, particularly for inexperienced personnel. The requirement for planning and carefully-thought-out sequences must be stressed.

IV. PACKAGING, MARKING, LABELING, SHIPPING

IV. PACKAGING, MARKING, LABELING, AND SHIPPING OF HAZARDOUS WASTE SITE SAMPLES

GENERAL PROVISIONS

These procedures apply to samples collected from a hazardous waste site (HWDS), but which in the judgment of the Project Leader cannot be considered to be "environmental" samples.

- Unanalyzed HWS samples may not be fixed with any preservative or preserved with ice or dry ice.

- If a material specifically identified in the Department of Transportation (DOT) Hazardous Material Table (49 CFR 172.101) is known to be contained in an HWS sample, that sample should be transported as prescribed in the table. Samples that are judged to be environmental samples may be shipped according to letters of understanding granted EPA by DOT. Other specific exemptions may also apply (e.g., use of Labelmaster, Inc. package #38, or Dow Chemical Co. Imbiber Pack for shipment of Poison B, n.o.s. by United Parcel Service).

- Unanalyzed HWS samples may be transported by rented or common carrier truck, bus, railroad, and by Federal Express Corporation* (air cargo); but they may not be transported by any other common carrier air transport, even "cargo only" aircraft. Those samples taken from closed drums or tanks, however, should not ordinarily be transported by Federal Express. (See 1 and 2 in "Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples Taken From Closed Drums" on p. IV-8.)

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* These procedures are designed to enable shipment by entities like Federal Express; however, they should not be construed as an endorsement by EPA of a particular commercial carrier.

- If samples are transported by any type of government-owned vehicle, including aircraft, DOT regulations are not applicable. However, EPA personnel will use the packaging procedures described below except that the bill of lading with certification form does not have to be executed (see "Shipping Papers" on p. IV-5).

PRELIMINARY STEPS

The following procedures should be followed before samples are shipped:

- Conduct a radiation measurement to eliminate the possibility of a sample being radioactive.

- Place a sufficient quantity of sample in glass and/or polyethylene containers to determine whether sample material will react with or substantially reduce the effectiveness of the container (this should be done at time of sampling).

- Pack samples according to either "Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples, Excluding Drum Samples," or "Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples taken from Closed Drums," as discussed below.

PACKAGING, MARKING AND LABELING REQUIREMENTS FOR UNANALYZED HAZARDOUS WASTE SITE SAMPLES, EXCLUDING DRUM SAMPLES

1. Collect sample in a 16-ounce* or smaller glass or polyethylene

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* Large quantities, up to one gallon, taken from wells may be collected if the flash point of the sample can be determined to be 73°F or higher. In this case, such should be marked on the outside container (carton, etc.) but only a single (one gallon or less) bottle may be packed in an outside container. Ten percent ullage and requirements 2,5,6, and 7 below must also be followed. On the shipping papers state that "flash point is 73°F or higher."

container with nonmetallic, teflon-lined screw cap. Allow sufficient ullage (approximately 10% by volume) so container is not liquid full at 130°F. If collecting a solid material, the container plus contents shall not exceed 1 pound net weight. If sampling for volatile organic analysis (VOA), fill special VOA container to septum but use special cap to accomplish an air space within the container.

2. Attach properly completed sample identification tag [Figure 4] to sample container.

3. Seal sample container and place in 2-mil-thick (or thicker) polyethylene bag, one sample per bag. (Tags should be positioned to enable them to be read through bag.)

4. Place sealed bag inside a metal can with incombustible, absorbent cushioning material (e.g., vermiculite or earth) to prevent breakage, one bag per can. Pressure-close the can and use clips, tape or other positive means to hold the lid securely, tightly and effectively.

5. Mark and label this container as indicated in No. 8 below.

6. Place one or more metal cans (or a single 1-gallon bottle; see footnote on p. IV-2), surrounded with incombustible packaging material for stability during transport, into a strong outside container, such as a picnic cooler or a fiberboard box.

7. Mark and label the outside container and complete shipping papers as described in No. 8 below.

8. Marking and labeling: Use abbreviations only where specified. Place the following information on a metal can (or bottle), either hand printed or in label form: laboratory name and address and "Flammable

FIGURE 4. SAMPLE IDENTIFICATION TAGS

Water Tag (White)

Proj. Code	Station No.	Mo./Day/Yr.	Time	Designate: Comp. / Grab
Station Location		Samplers: (Signature)		

Tag # 1234

Lab Sample #

Remarks:

	Bacteriology	Mutagenicity	Pesticides	Volatile Organics	Priority Pollutants	Organics GC/MS	Oil and Grease	Cyanide	Metals	Mercury	Phenolics	COD, TOC, Nutrients	Solids (TSS)(TDS)(SS)	BOD Anions

Analyses

Air Tag (Blue)

Proj. Code	Station No.	Mo./Day/Yr.	Time	Sequence No.
Station Location:		Samplers: (Signature)		

Tag # 1234

Lab Sample #

Remarks:

Sample Type:

- ☐ Source Filter
- ☐ Probe Wash
- ☐ Impinger Catch
- ☐ Ambient Filter
- ☐ Ambient Impinger
- ☐ Solid Adsorbant
- ☐ Liquid Adsorbant ☐

Reverse Side

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENFORCEMENT
NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
BUILDING 53, BOX 25227, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

EPA

Liquid, n.o.s.", (if not liquid, write "Flammable Solid, n.o.s."). *
Place the following labels on the outside of the can (or bottle), next to one another and near the "Flammable liquid, n.o.s." marking:

"Cargo Aircraft Only"; "Flammable Liquid"; (if not liquid, "Flammable Solid" and "Dangerous When Wet").

Note: If the cans are placed in an exterior container, both that container and inside cans must have the same markings and labels as above. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top of the outside container, and upward pointing arrows should be placed on all four sides of the exterior container.

Shipping Papers: Use abbreviations only where specified below.

Complete the carrier-provided bill of lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container.

"Flammable Liquid, n.o.s." (or "Flammable Solid, n.o.s", as appropriate); "Cargo Aircraft Only"; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight_____" or "Net Volume _____" (of hazardous contents), by item, if more than one metal can is inside an exterior container. The net weight or net volume must be placed just before or just after the "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." description.

A Chain-of-Custody Record form [Figure 5] should also be properly executed, and included in the exterior container.

---

* Using "Flammable" does not convey the certain knowledge that a sample is in fact flammable, or how flammable, but is intended to prescribe the class of packaging in order to comply with DOT regulations; "n.o.s." means not otherwise specified.

ENVIRONMENTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

NATIONAL ENFORCEMENT INVESTIGATIONS CENTER
Building 53, Box 25227, Denver Federal Center
Denver, Colorado 80225

Proj. No. | Project Name

SAMPLERS: *(Signature)*

STA. NO	DATE	TIME	Comp	Grab	STATION LOCATION	BOD, Anions	Solids	COD, TOC, Nutr	Phenolics	Mercury	Metals	Cyanide	Oil & Grease	Organics GC/MS	Priority Poll	Volatile Org	Pesticides	Mutagenicity	Bacteriology	NUMBER OF CONTAINERS	Remarks

ANALYSIS REQUIRED

nquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received *(Signature)*
nquished by *ature)*	Date/Time	Received by *(Signature)*	Relinquished by *(Signature)*	Date/Time	Received *(Signature)*
nquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time	Remarks	

ribution: Original Accompanies Shipment; Copy to Coordinator Field Files

FIGURE 5a. CHAIN-OF-CUSTODY RECORD (WATER)

ENVIRON .NTAL PROTECTION AGENCY
Office of Enforcement

CHAIN OF CUSTODY RECORD

NATIONAL ENFORCEMENT INVESTIGA NS CENTER
Building 53, Box 25227, Denver Federal Center
Denver, Colorado 80225

Proj. No.	Project Name
SAMPLERS: *(Signature)*	

STA. NO.	DATE	TIME	SEQ. NO.	STATION LOCATION	SAMPLE TYPE: Source Filter	Probe Wash	Impinger Catch	Ambient Filter	Ambient Impinger	Solid Absorbant	Liquid Adsorbant				NUMBER OF CONTAINERS	Remarks

Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received *(Signature)*
Relinquished by *(Signature)*	Date/Time	Received by *(Signature)*	Relinquished by *(Signature)*	Date/Time	Received *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

FIGURE 5b.
CHAIN-OF-CUSTODY RECORD (AIR)

9. Unless samples are driven to the laboratory, an EPA employee will accompany shipping container(s) to the transport carrier and, if required, open outside container(s) for freight inspection.

PACKAGING, MARKING AND LABELING REQUIREMENTS FOR UNANALYZED HAZARDOUS WASTE SITE SAMPLES TAKEN FROM CLOSED DRUMS

1. All samples from closed drums do not necessarily have to be shipped as below. The Project Coordinator must make a judgement as to the hazard class of samples gathered. This packaging, marking, labeling and shipping method provides a worst-case procedure for materials classed as "Poison A" (49 CFR 173.328).

2. These samples may not be transported by Federal Express Corporation (air cargo) or other common carrier aircraft, or by rental, non-government aircraft. (Samples may be shipped by ground transport or government aircraft.)

3. Collect sample in a polyethlylene or glass container which is of an outer diameter narrower than the valve hole on a DOT Spec. 3A1800 or 3AA1800 metal cylinder. Fill sample container allowing sufficient ullage (approximately 10% by volume) so it will not be liquid-full at 130°F. If sampling for volatile organic analysis, fill special VOA container to septum, but use special cap to achieve an air space within the container. Seal sample container.

4. Attach properly completed Sample Identification Tag [Figure 4] to sample container.

5. With a string or flexible wire attached to the neck of the sample container, lower it into a metal cylinder which has been partially

filled with incombustible, absorbent, loose packaging material (vermiculite or earth). Allow sufficient cushioning material between the bottom and sides of the container and the metal cylinder to prevent breakage. After the cylinder is filled with cushioning material, drop the ends of the string or wire into the cylinder valve hole. Only one sample container may be placed in a metal cylinder.

6. Replace valve and valve protector on metal cylinder.

7. Mark and label cylinder as described in No. 10 below.

8. One or more cylinders may be placed in a strong outside container.

9. Mark and label outside container and complete shipping papers as described in No. 10 below.

10. Marking and labeling: Use abbreviations only where specified. Place the following information on the side of the cylinder, or on a tag wired to the cylinder valve protector, either hand-printed or in label form.

"Poisonous Liquid or Gas, n.o.s"; laboratory name and address.*

Place the following label on the cylinder: "Poisonous Gas". ("Poisonous Liquid" label not acceptable here, even if liquid.)

Note: If the metal cylinders are placed in an outside container, both the container and cylinders inside must have the same markings and labels as above. In addition, "Laboratory Sample", and "Inside Packages Comply With Prescribed Specifications" should be marked on the top of the outside container. "THIS SIDE UP" marking should be placed on the outside container and upward pointing arrows on four sides.

---

* Using "Poisonous" does not convey the certain knowledge that a sample is in fact poisonous, or how poisonous, but is intended to prescribe the class of packaging in order to comply with DOT regulations.

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Shipping Papers: Complete the shipper-provided bill of lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container; use abbreviations only as specified:

> "Poisonous Liquid, n.o.s"; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight_____" or "Net Volume_____" (of hazardous contents), by cylinder, if more than one cylinder is inside an exterior container. The net weight or net volume must be placed just before or just after the "Poisonous Liquid, n.o.s" marking.

A Chain-of-Custody Record form [Figure 5] should also be properly executed and included in the container.

11. Unless samples are driven to the laboratory, an EPA employee will accompany shipping containers to the transport carrier and, if required, open outside container(s) for freight inspection.

V. REGULATED LABORATORY PROCEDURES

V. REGULATED LABORATORY PROCEDURES

INTRODUCTION

Samples of undiluted wastes obtained from drums, tanks, other containers, or spills, must be processed through a regulated laboratory before analysis in the conventional laboratory.* The regulated lab is physically separated from labs analyzing "environmental" samples; it is provided with a separate heating/cooling system and separate hood ducting; and it provides air-lock entrances, air-lock and shower-equipped change rooms, etc.

The major activities in the regulated laboratory are to:

- Receive hazardous waste samples while maintaining Chain-of-Custody.
- Store samples while they are being processed.
- Perform sample preparation procedures including sample extractions, concentrations, dilutions, weighing, and acid digestions.

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* Exceptions: Laboratories having infrequent need to analyze small samples suspected of containing hazardous materials may do so if the laboratories meet the requirements of "Guidelines for The Laboratory Use of Chemical Substances Posing a Potential Carcinogenic Risk" [see Appendix F of this HWS Safety Manual]. Laboratories contemplating such activity should consult with:

U.S. Environmental Protection Agency
Industrial Hygiene Programs Manager
Office of Occupational Health and Safety (PM 273)
Room 3503, Waterside Mall
401 M Street, S.W.
Washington, D.C. 70460

F6 9118

- Perform routine tests such as flammability, specific ion probe analysis (CN, S, pH, etc.), percent moisture, and flame-ionization gas chromatographic screens.

- Prepare and maintain hazardous or toxic organic chemical standards.

- Provide sample extracts or digestates for further analysis in main laboratories.

ACCESS - EXIT SAFEGUARDS

1. Personnel assigned to the regulated laboratory must participate in the medical monitoring program with preassignment and periodic health examinations, and records must be retained [see Chapter II and Appendix B].

2. Before being allowed to enter a regulated area, each employee must have received specific training in the following areas: the cancer-causing possibilities of these substances; the kind of assignments that could result in exposure; decontamination procedures; emergency procedures; the employee's specific role in recognizing situations that might result in the release of these substances; and first-aid procedures. [See Appendix C.]

   This training must be repeated yearly following the initial indoctrination. All training materials and related information must be available, on request, to the EPA Office of Occupational Health and Safety. Personnel must also be certified by the organizational Safety Officer.

3. At least two persons must work in the regulated area when handling samples and standards.

4. All personnel entering the regulated area must sign the entry logbook and record the date, time in, time out, and the project to be worked on. The logbook entries are maintained chronologically but limited to one project per page. Copies of the entry data are included with the project files.

5. Visitors must be accompanied by authorized personnel, visits kept as short as possible and groups kept small. No visitors are admitted when samples are being processed.

6. Before beginning work inside the regulated area, the water supply valves are opened and water flow is verified in the shower, eyewash, and sink.

7. The heating/cooling system must be adjusted to provide an acceptable working environment upon entry.

8. The fume hood is turned on at all times when personnel are in the lab. The manometer is visually checked for a reading near the marked optimum level.

9. There shall be no eating, drinking, smoking, chewing of gum or tobacco, application of cosmetics, or storage of food in laboratory areas where chemical carcinogens are used or stored.

10. Entrances to all work areas where chemical carcinogens are being used or stored shall be posted with signs bearing the legend: "CAUTION - CHEMICAL CARCINOGEN, Authorized Persons Only."

11. Each vacuum service, including water aspirators, shall be protected with an absorbent or liquid trap and a HEPA* filter to prevent entry of any chemical carcinogen into the system. When using a volatile carcinogen, a separate vacuum pump or other device placed in an appropriate laboratory-type hood shall be used.

12. Mechanical pipetting aids shall be used for all pipetting procedures. Oral pipetting shall be prohibited.

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* HEPA = high efficiency particulate air

13. Before leaving a regulated area, employees must wash their hands, forearms, faces, and necks. Prior to leaving for the day, they must take showers.

USE OF RESPIRATORS

A respirator-use program shall be provided for emergency and maintenance personnel who enter areas where a potential for inhalation exposure to a chemical carcinogen is present. This program shall meet the requirements of the OSHA Safety and Health Standards for respiratory protection as detailed in 29 CFR 1910.134. The respirators shall be selected in accordance with the requirements of the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR 11. The selection and use of respirators shall be approved by the Safety Officer.

PROTECTIVE CLOTHING

Personnel working inside the regulated area must bring a change of clothing to the lab in the event of accidental contamination.

Protective clothing such as a fully fastened laboratory coat with protective shoe covers (bootees) or a disposable jumpsuit shall be worn in any work area in which chemical carcinogens are being used. Clean laboratory clothing shall be provided weekly, or when necessary, and shall not be worn outside the work area.

Clothing contaminated by chemical carcinogens shall be decontaminated or disposed of immediately after an obvious exposure. Contaminated clothing shall not be sent to the laundry until decontaminated.

Gloves which are appropriate to the specific situation shall be used when handling chemical carcinogens. Disposable gloves shall be discarded after each use and immediately after known contact with a chemical carcinogen.

Devices to provide appropriate eye protection shall be worn in every laboratory work area.

SAMPLE PREPARATION - HANDLING AND STORAGE

1. Hazardous samples will be stored in the refrigerator at 4°C in the original metal cans.

2. Samples will be opened only in the glove box by personnel wearing protective clothing.

3. No more than one sample is allowed open in the glove box at one time.

4. Samples will be placed back into the original containers and resealed before returning them to storage.

5. If stock quantities of carcinogen reagents are used, they shall be stored in a properly ventilated storage area that is secured at all times. The storage area shall be posted with a sign bearing the legend: "CAUTION - CHEMICAL CARCINOGEN, Authorized Persons Only." An inventory of stock quantities shall be maintained by the laboratory Safety Officer. The inventory records shall include the quantities of chemical carcinogens acquired and dates of acquisition and disposition. Storage vessels containing stock quantities shall be labeled: CAUTION - CHEMICAL CARCINOGEN.

6. See the specific sample preparation procedure for details of readying a sample for analysis. The procedures described here reflect regulated-area operating procedures only.

7. Minimum quantities of water are used during sample handling and preparation. No solvents, samples or suspect contaminated materials are to be poured into any sink. Generally, concentrated sample is to contact disposable glassware only.

8. During sample preparation, separate contaminated glassware (glassware contacting the sample) from glassware for reagent handling. Disposable glassware, pipets, sample vials, etc., are placed in waste bottles for disposal. Other glassware is rinsed thoroughly (at least 3 rinses) with an appropriate solvent; the solvent is placed in waste bottles, and the glassware is washed with soap and water.

9. Any contaminated glassware or equipment that cannot be safely cleaned is to be disposed of.

10. Storage vessels containing samples or known carcinogens shall be first placed in an unbreakable outer container before being transported to laboratory work areas.

11. Contaminated materials which are transferred from work areas to disposal areas shall be first be placed in a closed plastic bag or other suitable impermeable and sealed primary container. The outer container shall be labeled with both the name of the chemical carcinogen and the warning: CAUTION - CHEMICAL CARCINOGEN.

HOUSKEEPING

General housekeeping procedures which suppress the formation of aerosols shall be used, such as the use of a wet mop or a vacuum cleaner equipped with a HEPA filter to remove particulates.

Dry sweeping and mopping are prohibited due to the hazard of aerosol formation. In those instances where samples or a known carcinogen is spilled, special cleanup procedures/compounds shall be followed. (See "Spill Cleanup Procedures" on p. V-9.)

All work surfaces (bench tops, hood floors, etc.) on which chemical carcinogens are used shall be covered with stainless steel or plastic trays, dry absorbent plastic-backed paper or other impervious material. The protective surfaces shall be examined for possible contamination immediately after completing each procedure that involves the chemical carcinogen. Contaminated surfaces shall be decontaminated or disposed of appropriately.

USE OF EQUIPMENT

Procedures involving volatile samples or known carcinogens, and those involving solid or liquid samples or known carcinogens that may result in the generation of aerosols, shall be conducted in an open face laboratory-type hood, a glove box or other suitable containment equipment. Examples of aerosol-producing procedures include: the opening of closed vessels; transfer operations; weighing; preparation of dry mixtures; and the application, injection or intubation of a chemical carcinogen into experimental animals. With the approval of the Safety Officer, laminar flow safety cabinets are suitable for conducting tissue culture and other biological procedures involving chemical carcinogens.

Primary containment equipment used for containment of chemical carcinogens shall display a label bearing the legend: CAUTION - CHEMICAL CARCINOGEN [see Appendix F for general information on primary containment equipment].

Analytical instruments should be placed entirely within an open-face laboratory-type hood. When this is impossible, vapors or aerosols produced by these instruments shall be captured through local exhaust ventilation at the site of their production. When a sample is removed from the analytical instrument, it should be placed in a tightly stoppered sample tube or otherwise safeguarded from contaminating the laboratory. In the event that the analytical equipment becomes contaminated, it shall be labeled CAUTION - CHEMICAL CARCINOGEN until it has been completely decontaminated.

WASTE DISPOSAL

The guiding principle behind waste disposal is that we are, or represent, the EPA and are enforcing provisions of Federal Law regarding proper disposal of waste material. We must, therefore, endeavor to be meticulous with our own waste disposal practices.

In this regard, we shall in all respects comply with 40 CFR 250 even though, strictly speaking, we may generate less than 100 kg per month of waste material, and may not therefore be considered a waste "generator" (40 CFR 250.29).

1. All contaminated chemical wastes (solvent, sample, water, etc.) shall be placed in waste bottles, the bottles labeled and placed into a contract hazardous waste disposal drum. An inventory of the waste materials shall be kept and a hazardous waste manifest given to the disposal contractor upon pickup (40 CFR 250.23). (Waste bottles typically are used solvent bottles that have been rinsed free of solvent.)

2. Potassium permanganate ($KMnO_2$) --- not chromic acid solution $K_2Cr_2O_7/H_2SO_4$) --- is used for glassware cleaning.

3. Wastepaper, disposable protective clothing and contaminated disposable equipment are placed in heavy plastic bags; the bags taped shut and placed in the waste disposal drum as above. Contaminated clothing, equipment and spill cleanup materials will be disposed of immediately in this manner. If items have protruding points that could puncture the plastic bags, use a cardboard carton, or similar device, inside the bags to prevent puncture.

4. Sample cans containing broken or leaking samples are to be resealed and labeled as "Unknown Hazardous Organic Chemicals" and disposed of directly into the waste drum.

SPILL CLEANUP PROCEDURES

1. Small, contained spills such a pipet drippings, etc., covering a limited area and involving a small quantity of material will be cleaned up with paper towels. The area will then be wiped clean with solvent. All contaminated material, including rubber gloves, will be immediately disposed of. If a sample container has leaked inside the metal can, record the data from the sample tag, including the tag number, reseal and dispose of the sample. Do not attempt to save the sample tag.

2. In the event of an uncontained spill, assess possible personnel contamination first and evacuate the regulated area if necessary. Also, if necessary, dispose of clothing; then shower, dress, and put on clean protective clothing before attempting cleanup. (Note that spills should not exceed the volume of samples or about 100 ml in the worst case.)

3. To cleanup a spill, change to heavy rubber gloves, use over-the-head protective hood or a respirator with organic vapor cartridge (SCBA must be worn if cleanup time is to be extensive), and proceed to contain and cleanup the spill with paper towels.

4. Wash the spill area with solvent if possible, followed by soap and water. Collect all wash solutions and dispose of in waste containers.

5. After cleanup, prepare a detailed written description of the spill and transmit it to the Supervisor and the organization Safety Officer, keeping a copy on record in the regulated laboratory.

ADDITIONAL WORK PRACTICE AND ENGINEERING CONTROLS FOR UNIQUE HAZARD SITUATIONS

Additional work practice and engineering controls may be required

for certain laboratory investigations that involve activities that pose a higher potential hazard than those subject to the general requirements. Additional requirements may also be needed for activities that involve known highly potent chemical carcinogens, for example: additional or more frequent changes of protective clothing; increasing showering frequency and shower facility requirements; use of primary containment devices; special handling of exhaust air from primary containment devices; work-area access control; and environmental monitoring where the potential of exposure to a known potent chemical carcinogen is great.

Personnel may also be required in some instances to wear full protective clothing such as pants and shirts or jumpsuits, special shoes or boots, and head covers.

This description of additional control measures that may be required for specific activities or compounds is illustrative only and is in no way meant to be all-inclusive.

ENVIRONMENTAL PROTECTION AGENCY

MANUAL

CHAPTER 9 - HAZARDOUS WASTE SITE INVESTIGATIONS AND ENVIRONMENTAL SPILL RESPONSES

OCCUPATIONAL HEALTH AND SAFETY

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David Weitzman, Manager
Industrial Hygiene Programs
Office of Occupational Health and Safety

DRAFT

ENVIRONMENTAL PROTECTION AGENCY

MANUAL

OCCUPATIONAL HEALTH AND SAFETY

CHAPTER 9

HAZARDOUS WASTE SITE INVESTIGATIONS AND ENVIRONMENTAL SPILL RESPONSES

1. POLICY AND RESPONSIBILITY.

a. Purpose. This chapter establishes policy, responsibilities, and procedures for the conduct of the Agency occupational health and safety program for hazardous waste site (HWS) investigations and environmental spill (ES) responses.

b. Policy. The EPA is committed to providing safe and healthful working conditions for EPA employees at hazardous waste sites and environmental spills.

c. Background. Executive Order 12196, 29 CFR 1960, and this EPA Occupational Health and Safety Manual require the EPA to provide safe and healthful working conditions for its employees. The EPA is responding to this requirement with this chapter, which is an adaptation of the "Safety Manual for Hazardous Waste Site Investigations", originally drafted by EPA's National Enforcement Investigation Center (NEIC). The draft manual has been developed further by a Work Group of the Hazardous Waste Task Force, NEIC, and the Office of Occupational Health and Safety (OOHS).

d. Discussion. Investigators and response personnel must effectively deal with the potential of facing a very high risk of incurring illness or injury while investigating a HWS or responding to an ES. They cannot anticipate every safety hazard associated with HWS investigations and ES responses,so they must take extraordinary precautions to prevent illness or injury to themselves, other workers, and the public.

Since the investigators and response personnel cannot obtain the ideal objective of complete elimination of risk, they must reduce the risk to the lowest feasible level. No set of rules can be applied uniformly to every situation. The application of the rules presented in this safety manual chapter to a specific HWS investigation or ES response must be based on the judgement of the Project Leader who is responsible for the safety of the investigation or response*. It is imperative, therefore, that the Project Leader assess those variables peculiar to each planned activity in establishing appropriate safeguards.

---

*The designation, Project Leader, originated from policies and procedures developed by NEIC for HWS investigations. The corresponding position at spill responses is the On-scene Coordinator. For the purposes of this manual, Project Leader will be used to designate both Project Leaders and On-scene Coordinators.

e. Responsibilities.

(1) Assistant Administrators (AA) and Regional Administrators (RA). AA's and RA's are responsible for:

- developing and implementing a health and safety program, consistent with this manual, for HWS investigations and ES responses conducted under their organizational jurisdiction;

- coordinating the development of their health and safety program with the Director, Office of Occupational Health and Safety (OOHS); and

- submitting their health and safety program to the Director, OOHS, for review to assure consistency of these programs throughout the EPA.

The AA for Planning and Management, as the Designated Agency Safety and Health Official, is responsible for:

- administering the EPA's health and safety program for HWS investigations and ES responses;

- ensuring the allocation of adequate resources in the EPA's Budget to support and monitor these programs; and

- identifying, with designated object class codes, the resources as required by OMB Circular No. A-11.

(2) Officers-in-Charge of Reporting Units (OIC's). OIC's are responsible for:

- implementing the health and safety program for HWS investigations and ES responses conducted by employees of their reporting unit. (See EPA Occupational Health and Safety Manual, CHAP 1, PAR 5, for a detailed description of OIC's health and safety responsibilities);

- assuring that any PL conducting a HWS investigation or ES response is qualified by training or experience, has the equipment to conduct the investigation or response safely, and plans an investigation or response which is safe to all concerned; and

- assuring the completion of semi-annual program reviews and audits.

(3) Safety Committee.

The Safety Committee is responsible for:

- aiding and advising the OIC on employee health and safety matters and policies and procedures for the Agency occupational health and safety

program for HWS investigations and ES responses. (See EPA Occupational Health and Safety Manual, CHAP 5 PAR 4, for a detailed description of the Safety Committee's health and safety responsibilities);

- promtly reviewing and approving Safety Plans prepared by each Project Leader and forwarding them to the Safety Designee; and

- advising the OIC on specific programs for medical surveillance.

(The Safety Committee should include or have access to individuals with a variety of technical backgrounds, so while not being able to solve technical problems or totally analyzing proposed activities, it can call to the attention of safety experts areas of concern.)

(4) Occupational Health and Safety Designee.

The Safety Designee is responsible for:

- advising and assisting the OIC in developing, organizing, directing, and evaluating the health and safety program for HWS investigations and ES responses; and

- coordinating accident reporting, recordkeeping and often the medical surveillance program. (See EPA Occupational Health and Safety Manual, CHAP 1, PAR 3 for a detailed description of the Safety Designee's health and saffety responsibilities).

Safety Designees must have either backgrounds and training in recognizing, evaluating, and controlling hazards at HWSs and ESs or access to this expertise. (Safety Designees should have or have access to expertise in field safety, industrial hygiene, respiratory protection, transportation of hazardous materials, occupational medicine, and geology.)

(5) Project Leader.

The Project Leader has the primary responsibility for:

- assuring the availability of personal protective equipment and selecting the level of personnel protection needed for use at HWS investigations and ES responses;

- selecting work practices and engineering controls for HWS investigations and ES responses;

- preparing a Safety Plan prior to the investigation or response (See Appendix 2 for details of the Safety Plan);

- submitting the Safety Plan prior to the investigation or response to the Safety Committee for their review and approval;

- making available to program and support staff copies of

the approved Safety Plan;

- assuring that the program and support staff are instructed, trained and certified in the work practices required to ensure safety and in planned procedures for dealing with emergencies, and are informed of the potential hazards associated with the planned investigation or response;

- designating one member of the investigation or response team as the site Safety Officer, and assuring that that person fulfills all safety responsibilities necessary for safe operations;

- supervising the safety performance of the staff to ensure that the required work practices are employed;

- arranging for immediate medical attention and reporting to the Safety Designee any incident that results in injury or overt exposure personnel by hazardous materials;

- assisting the Safety Designee in investigating accidents;

- investigating and reporting in writing to the Safety Designee any problem pertaining to operation and implementation of work practices;

- correcting work errors and conditions that may result in injury or exposure to hazardous materials; and

- assuring the health, welfare and safety of all Staff members at the HWS or ES.

(6) Safety Officer. The Safety Officer is responsible for implementing the Safety Plan at the site.

(7) Employees. Employees are responsible for:

- complying with the health and safety program established by this chapter on HWS investigations and ES responses;

- reporting to their supervisors or the Safety Designee any unsafe condition and all facts pertaining to incidents which resulted in employee injury or exposure to hazardous materials; and

- cooperating in the medical surveillance activities.

(8) Director, Office of Occupational Health and Safety. Under the supervision of the AA for Planning and Management, the Director, OOHS, is responsible for:

- reviewing and coordinating the health and safety programs developed by AA's and RA's for HWS investigations and ES responses for consistency with this chapter (See 1.e. (1));

- auditing investigation and response activities for compliance with Agency policy and practices and good work practices.

- informing responsible EPA officials of any problem areas;

- providing technical support; and

- approving training courses.

The Director, OOHS, is the top technical advisor for EPA on health and safety for HWS investigations and ES responses.

2. HEALTH AND SAFETY PROGRAM REQUIREMENTS

a. Safety Plan. The Project Leader must prepare and obtain approval of a Safety Plan (Appendix 2) before conducting a HWS investigation or ES response.* The Safety Committee, or similar group set up for this purpose, must review the Safety Plan and forward it to the Safety Designee with comments. The Safety Designee and the OIC must approve the Safety Plan before the investigation or response can proceed on-site. The Safety Designee must maintain the Safety Plan on file and available for distribution, provide a copy to each employee participating in the HWS investigation or ES response, and forward an information copy to the Director, OOHS.

b. Audit. The OIC must ensure that semi-annual program reviews, including on-site inspections, of the health and safety program for HWS investigations and ES responses are conducted by persons with appropriate background and training, and that any deficiencies are corrected as soon as possible (or immediately if the deficiency is an imminent hazard). The OIC must forward a copy of the program review and abatement actions to the Director, OOHS, for review. The Director, OOHS, may conduct independent audits.

c. Accident Reporting. The Safety Designee must coordinate the reporting of any incident involving injury or exposure (inoculation, injestion, dermal contact, inhalation) to a hazardous material in accordance with the procedures detailed in CHAP 3 of the Occupational Health and Safety Manual. In addition, the Safety Deesignee must forward a copy of the accident report to the employee's medical record (See 2.f.(3)).

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*For ES responses, generic Safety Plans must be prepared in advance, dealing with groups of possible spills, eg., Safety Plan for acid gas spill, etc. In addition, emergency support groups including fire, rescue and medical staffs, with telephone number, must be grouped together by area for easy access in the event of a hurried departure to a spill. This information must be readily available prior to spill response for attachment to the Safety Plan.

d. Training. The OIC must ensure that all employees, before conducting HWS investigations and ES responses, receive a minimum of 24 hours of training on HWS and ES safety (followed by 24 hour refresher courses annually) and receive training by 3 separate field experiences before conducting investigations and responses. The Safety Designee must obtain the approval of Director, OOHS, of the initial and annual 24 hour courses and must issue a certificate to employees upon completion of the courses and field experiences. In addition, the Safety Designee must maintain records of training and forward individual records to employees' personnel files. EPA ORDER___, "Health and Safety Requirements for Employees Engaged in Field Activities", provides detailed training requirements.

The Safety Designee must keep the Safety Plan, and other appropriate written information describing the potential health and physical injury hazards of a HWS investigation or ES response, in a file that is continuously and readily availably to employees.

e. Emergency Procedures. The Safety Designee must develop procedures to protect personnel in case of emergencies at the HWS or ES. The emergency procedures should include notifying emergency and other affected personnel and the locations and emergency telephone number of the nearest emergency medical facility, ambulance service, fire department, police department and Poison Control Center.

f. Medical Surveillance. EPA ORDER ___ "Health and Safety Requirements for Employees Engaged in Field Activities" provides medical surveillance requirements consistent with the requirements presented below.

(1) Pre-assignment Health Assessment. The OIC must ensure that all employees who work at HWSs and ESs receive a base-line health assessment. These health assessments must be consistent with the EPA Medical Monitoring Guidelines.

The purpose of this pre-assignment assessment is to establish a baseline health record and to seek conditions which would predispose the employee to illness due to exposure to hazardous materials or due to the physical demands of using personal protective equipment. The pre-assignment assessment includes a work history, a medical history, and a physical examination, which includes customary laboratory studies and agent-specific studies when appropriate.

(2) Periodic Health Assessments. The OIC must ensure that all employees who work at HWSs and ESs are offered periodic health assessments. The periodicity and content of these assessments must be determined by the OIC after consultation with an occupational physician, the Safety Designee, the medical monitoring coordinator, and the Project Leader.

These assessments include an updating of the employee's work and medical histories, including occurrences of any accidental exposures previously unreported. The following information must be included in the employee's medical record: names of hazardous materials to which the employees may have been exposed, information on the probability, frequency, and extent of exposures, and any environmental measurements relating to hazardous materials that may have been made. The periodic health assessment must include a physical examination and may also include biochemical or other surveillance of body fluids, and an evaluation of pertinent functional systems of the body (See Appendix 2).

The medical monitoring coordinator at each location is responsible for requesting and helping to schedule examinations and, assisted by the Safety Designee, must furnish employees, prior to each examination, exposure and environmental monitoring data as specified above for inclusion in their medical records.

(3) Records. Medical records must be maintained by the respective occupational physician for the duration of the employee's employment. Upon termination of the employee's employment, including retirement or death, the medical records must be maintained for an extended period of time in a manner that will ensure ready access as needed by the medical monitoring program of the EPA. The extended period of time must be at least 30 years after the individual's last work with hazardous materials. Forward the records to the Medical Monitoring Program Manager, OOHS, if custody of the records cannot be maintained locally.

3. WORK PRACTICES

The work practices specified in this section must be used by all HWS investigators and ES personnel.

a. Personnel Practices.

(1) Protective Clothing. Protective clothing must be worn by all personnel while on a suspected or confirmed HWS or ES unless sufficient data has been acquired to enable the Project Leader to make an informed judgment that pro tective clothing is not needed. In the absence of clear indications that work can proceed safely without protective clothing, required items include chemical-resistant pants, jacket, boots, gloves, and hard hat or head cover, and may include a fully encapsulating chemical protective suit.

Project Leader's must also consider the potential hazards of wearing protective clothing since protective clothing is cumbersome, hastens the on-set of fatigue, increases heat stress, and increases the time the personnel must spend in the high risk area.

(2) Heat Stress. Employees must compensate for the increased heat stress caused by wearing protective clothing in hot weather in order to prevent the on set of heat induced illnesses. Employees must maintain an appropriate work-rest regimen and water and salt balances (see 3.b. (9) for details).

(3) Eye Protection. Devices to provide appropriate eye protection must be worn on any HWS or ES and should meet ANSI Z87.1, "Practice for Occupational and Educational Eye and Face Protection".

(4) Forbidden Practices. The following practices are expressly forbidden during operations on suspected or known HWSs and ESs:

- Smoking, eating, drinking, chewing gum or tobacco; applying cosmetics; storing utensils, food or food containers while on site.
- Ignition of flammable liquids within, on, or through improvised heating devices (barrels, etc.) or space heaters.
- Approach or entry into areas or spaces where toxic or explosive concentrations of gases or dust may exist without proper equipment available to enable safe entry.
- Conduct of on-site operations without off-site backup personnel*

(5) Personal Hygiene. All personnel must wash the affected area immediately after obvious contact with a hazardous substance.

b. Operational Practices.

(1) Information Review and Reconnaissance. The Safety Plan for a HWS investigation or ES response must be based upon a thorough evaluation of existing data and a reconnaissance (see "Waste Disposal Site Hazard Assessment Manual", available from NEIC.) The information search may indicate possible chemical hazards such as the presence of incompatible chemicals, toxic gases, explosives, etc. (see Appendix D). Such indications may provide insight to specific safety precautions needed. Similarly, a perimeter inspection or aerial imagery, followed by an on-site reconnaissance, may reveal safety hazards requiring special attention.

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*On-scene Project Leader's may exericse informed judgment regarding the need for off- site backup at active sites, or in cases where sites have been repeatedly entered or occupied without apparent harm. In any case where doubt exists, backup personnel must be present.

Investigators and response personnel will normally become better able to specify appropriate safety precautions as they get progressively closer to, and measure, hazardous materials in air, runoff, groundwater, soil, spilled material, barrels, etc.

(2) Protection Levels. Although the Project Leader must determine the level of protection which is appropriate for each HWS and ES, four specific Protection Levels have been provided in this chapter as bench marks for the Project Leader to select from (See Appendix 3). The Project Leader must select a level based on aavailable information.

(3) Zones. Two or more zones must be established, clearly delineated, and posted.

° Decontamination Zone. During operations on a suspect or known HWS or ES, a zone must be established for decontamination of equipment and personel and access control just outside the area of suspected contamination. At least one employee will remain in this zone to:

°° Assist in emergency removal of personnel from the HWS or ES in the event of accident or injury. The backup must have readily available protective clothing, breathing apparatus and first aid equipment.

°° Assist in moving equipment, samples and supplies.

°° Provide communication to emergency units.

°° Assist in decontamination or removal of contaminated clothing from the individuals emerging from the contaminated area.

°° As appropriate, prevent entry of unauthorized persons to the HWS or ES while operations are underway.

°° Provide other assistance as necessary, but with the primary objective of facilitating safe transfer of personnel and equipment to and from the affected area.

° Contamination Zone(s). The area(s) which contain, or are suspected of containing, hazardous materials must be clearly delineated and posted. The Project Leader may establish more than one contamination zone for areas of different levels of potential personnel hazard. Only persons authorized by the Project Leader may enter a contamination zone.

(4) Radioactivity and Explosivity. All HWSs and ESs must be checked for radioactivity and explosivity during first entry onto the site. Normal background radioactivity is approximately 0.01 to 0.02 mR/hr. Detecting levels of activity significantly greater than normal background is cause for a very careful survey of the entire site; if levels approaching 2 mR/hr are encountered, the advice of a competent radiation health

physicist must be sought before continuing operations on the site. (EPA's Office of Air, Noise, and Radiation has radiation specialists in each Region as well as staff at HQ, EER-Montgomery and ORD Las-Vegas.)

If explosivity readings greater than 20% LEL* are detected, very careful survey of the area must be made. Readings approaching or exceeding 50% LEL are cause for immediately withdrawing personnel and notifying the emergency, fire, and explosion units. The Project Leader must be consulted before continuing operations.

(5) Buddy System. A minimum of two employees, in constant communication* with each other, are required to perform any work in contamination zones.

(6) Sampling Procedures. Sampling procedures must minimize the risk of personnel exposure to hazardous materials during sampling, packaging, shipping and analysis, and minimize the risk of exposure of others to spilled or residual waste materials. Disposable sampling equipment should be used wherever possible. (See Appendix 4, Sampling Procedures for more details).

(7) Sample Handing. Samples of runoff, ambient air, or groundwater from a HWS or ES or possibly affected areas, may be moved directly into laboratories and handled with normal safety precautions, unless the Project Leader determines that special handling is appropriate. However, samples of liquids or solid materials removed from containers or obviously contaminated spill areas must be assumed to be hazardous materials and handled in compliance with OOHS Safety Manual CHAP 8 "Laboratory Use of Toxic Substances".

(8) Use of Respirators as Personal Protective Devices. A respirator use program must be provided for HWS investigators and ES personnel who enter areas where a potential for inhalation exposure to a hazardous material is present. This program will meet the requirements of the OSHA General Industry Standards for respiratory protection as detailed in 29 CFR 1910.134 and EPA Order__. The respirators must be certified in accordance with the requirements of the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11. The selection and use of respirators must be approved by the Safety Designee.

(9) Use of Respirators. This section provides procedures which must be followed at HWSs and ESs but is not a substitute for the respirator use program described in 3.b.(8) directly above.

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*Lower Explosive Limit

- Self Contained Breathing Apparatus (SCBA). SCBA must be worn on-site when:

  - Containers of unknown or known hazardous materials are being opened.

  - When in enclosed spaces where hazardous materials are present, such as abandoned waste chemical storage buildings or manholes which have received spilled chemicals.

  - When the Project Leader judges that the concentration of hazardous materials in the air is greater than 10 times the OSHA PEL**.

- Cartridge Respirators. Cartridge respirators, which are easier to use but provide less protection than SCBA's, can be worn on-site only when:

  - Hazardous materials in the air are not greater than 10 times the PEL, and have good warning properties.

  - The Project Leader judges that respirators are needed as a precaution against generation of low levels of toxic substances in air due to sampling, handling, decontaminating, or other operations.

  - Extended periods of use on-site, which would cause the capacity of the cartridge to be exceeded, are <u>not</u> required.

  - Measurements have verified that at least 19.5% oxygen is present.

  - Emergency escape respirators are carried by cartridge respirator users. Escape respirator must be donned immediately upon experiencing any warning property such as difficulty breathing, dizziness, or other distress, strong taste,or smell. User must then leave the site.

- Carrying respirators. Cartridge or emergency escape respirators must be carried on-site when the Project Leader judges that, although the risk is very low, hazardous materials may become present in the air during operations. The respirators must be donned immediately upon experiencing any of the warning properties described immediately above. The user must leave the site immediately after donning an escape respirator or if the warning properties persist after donning a cartridge respirator.

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* Radio contact must be maintained when visual contact cannot be maintained.
** Permissible Exposure Level

(10) Heat Stress. The effectiveness of employees rest-regimen should be confirmed by monitoring heart rate. Use the Brouha guideline: pulse rate is counted for the last 30 seconds of the first three minutes after rest begins. If the first recovery pulse (i.e., from 30 to 60 sec onds) is maintained at 110 beats per minute or below and deceleration between the first and third minute is at least 10 beats per minute, no increasing strain occurs as the work day progresses.

Employees must replace water and salts lost from sweating. Use either 0.1% salt solution or commercial mixes (such as Gatorade). The commercial mixes may be preferable for employees on low sodium diets. In addition, on days when the potential for heat stress is apparent, advise employees to salt food more than usual.

(11) Sampling Equipment. As a general rule, sampling equipment used on a HWS or ES should be disposable. Sampling instruments and other non-disposable equipment should be kept clean with disposable protective covers. Dippers, scoops, and similar devices for solids samples should be buried on-site, or placed in plastic bags for disposal or later decontamination. Liquid samples from barrels or tanks should be withdrawn in inert tubing, such as glass, and tubing should then be broken and abandoned within the barrel or tank. If incineration or recycling of barrel contents is contemplated, the tubing may be disposed of in other suitable containers, or buried on the sites. The widely discussed Composite Liquid Waste Sampler (or "Coliwasa") is unsuitable because it is extremely difficult to decontaminate under field conditions.

(12) Decontamination. Whenever possible, equipment should be decontaminated prior to leaving the HWS or ES. Equipment which can not be decontaminated at the scene must be double bagged and transported to another area for eventual decontamination. Where possible, verify completeness of decontamination with sniffers, swipe tests, or other appropriate tests (See Appendix 6, Decontamination Procedures, for more detail).

(13) Packaging and Shipping. Hazardous materials must be packaged to withstand shocks, pressure changes, and any other conditions which might cause the leakage of contents incident to ordinary handling during transportation. Shipments of hazardous materials must be in accordance with DOT regulations. (See Appendix 4 for packaging and shipping guidance for hazardous waste samples).

(14) Leaving the Site. Procedures for leaving the suspect contaminated area must be planned before entry. Provision must be made for: decontamination and safe packaging of protective clothing; burial or safe packaging of disposable gear; handling of samples and preparation of samples for shipment; transfer of equipment, gear, and samples from the "contaminated" area to the "clean" area; etc. Sequences will depend on several variables --- such as SCBA inside or outside of protective clothing --- but must be worked out in advance.

(15) HWS and ES Monitoring Equipment. For immediate evaluat-on of potential health hazards, use direct reading instruments such as portable combustible gas and oxygen meters, photoionization meters, gas chromatographs, infrared spectrometers, radiation survey meters, and colorimetric detector tubes. The Project Leader must be aware of the limitation of these portable direct reading instruments when characterizing the unknown chemicals at unknown concentrations at HWSs and ESs.

(16) Decontamination Equipment. Equipment and supplies for decontamination must be available on-site. The equipment and supplies must allow employees to wash exposed areas of their bodies as well as equipment or other items which have been in the contamination zone, and collect the washwater and other contaminated materials for disposal. The equipment must include at least a 20 gallon emergency eye wash and may include a personnel shower.

APPENDIX I

SAFETY PLAN

Assistance in preparing the safety plan can be obtained from the Safety Designee _____ located in Room _____ of Building _____ or by telephoning _____

REVIEW

Safety Committee Chairperson _____

APPROVALS

Project Leader _____

Safety Designee _____

OIC _____

PROJECT LEADER _____

Branch _____

Building _____

Room _____

Phone _____

DATE OF PLAN PREPARATION _____

HAZARDOUS WASTE SITE OR ENVIRONMENTAL SPILL RESPONSE

Site Name _____ Site No. _____

HAZARDOUS/TOXIC MATERIAL (known or suspected, contaminated media or in storage container, etc.):

_____

_____

_____

_____

HAZARD ASSESSMENT(toxic and pharmacologic effects, reactivity, stability, flammability, and operational concernssampling, decontaminating, etc.):

_____

_____

_____

_____

MONITORING PROCEDURES(If required by the Project Leader)

Monitoring the site for identify and concentration of contamination:

_____

_____

_____

_____

Medical surveillance procedures for evidence of personnel exposure:

_____

_____

_____

_____

_____

Personnel monitoring procedures:

_____

_____

_____

_____

_____

_____

DECONTAMINATION AND DISPOSAL

Decontamination Procedures (contaminated: personnel surfaces, materials, instruments, equipment, etc.):

_____

_____

_____

_____

Disposal Procedures (contaminated equipment, supplies, disposable, washwater):

_____

_____

_____

_____

EMERGENCY PROCEDURES

In event of overt personnel exposure (skin contact, inhalation, ingestion):

_____

_____

_____

_____

In event of personnel injury:

_____

_____

_____

_____

In event of potential or actual fire or explosion:

_____

_____

_____

In event of potential or actual ionizing radiation exposure:

_____

_____

_____

_____

In event of environmental accident (spread of contamination outside HWS or ES):

_____

_____

_____

_____

PERSONNEL POTENTIALLY EXPOSED TO HAZARDOUS MATERIALS

Personnel Authorized to Enter HWS or ES

1. _____
2. _____
3. _____
4. _____
5. _____

Other Personnel Assigned to Handle Hazardous Materials (decontaminate, analyze samples)

1. _____
2. _____
3. _____
4. _____
5. _____

ALTERNATIVE WORK PRACTICES

(Describe alternative work practices not specified in this Chapter for HWS investigations and ES responses. Indicate work practices specified in the Chapter for which proposed alternative work practices will serve as substitute.)

_____

_____

_____

_____

APPROPRIATE LITERATURE CITATIONS

APPENDIX 2

PERIODIC HEALTH ASSESSMENT

1. ASSESSMENT FOR EVIDENCE OF EXPOSURE.

The nature of a program for providing periodic health assessments is complicated by several factors: (1) many workers handle a variety of hazardous materials so that the medical surveillance should ideally seek evidence of adverse effects from all these substances, (2) the hazardous materials may not be identified, (3) some hazardous materials may have chronic effects such as cancer but have little or no toxicity other than the production of neoplasms, and most tumors do not become evident until many years (often 20-30) after the initiating events.

Biologic monitoring will sometimes be a useful method of detecting exposure and, perhaps, of estimating the degree of exposure. Biologic monitoring usually involves the analysis of body fluids or excreta (usually urine, sometimes blood, rarely expired air) for the hazardous material or a biotransformation product. An example is the detection of reaction products of biphenyl amines in the urines of persons absorbing benzidine or its derivatives. Even if exposure cannot be quantitated, as is sometimes the case, the mere detection of the metabolite, if its presence is specific to the individual hazardous material or class, is sufficient to indicate the need for corrective action.

For chronic effects, medical monitoring will, sometimes for necessity and more often for efficiency, usually concentrate on events likely to precede overt evidence of serious health effects such as tumorigenesis. For example, some carcinogens, such as dimethylnitrosamine, have high acute toxicity, especially to the liver, and evidence of such acute toxicity can be obtained within a few hours or days following exposure. Some tumors, such as those induced by carbon tetrachloride, are normally preceded by marked changes in liver cells, usually detectable by clinical tests. Others, e.g., angiosarcomas induced by such substances as vinyl chloride, will often cause detectable cell changes in nearby tissue as the probable result of space occupation. It should be noted that detection of such toxic changes does not necessarily presage tumor development, but should nevertheless precipitate the institution of corrective work practices. The occupational physician, to be effective, must have relevent information, such as mode and mechanism of toxic action, frequency and severity of exposure, and exposure concentrations, if known. Some of this information will be available in individual safety data sheets for hazardous wastes once identified. However, this information should be supplemented by the Project Leader when appropriate.

In some cases, especially with some lesser known hazardous materials, there will be EPA investigators in research and analysis laboratories who will be better informed on possible biologic monitoring procedures than will the occupational physician. In such cases, the HWS investigators or ES response personnel should discuss the possibilities of specialized testing with the occupational physician and refer the physician to the appropriate EPA investigator for information. It may also be that specialized

analytical procedures and equipment will be needed for some of this monitoring, procedures and equipment that may not be available to the medical laboratory but which are available in the research laboratory. The investigators should have such monitoring procedures performed by EPA laboratories only with prior approval by and participation of the occupational physician. This is to ensure that appropriate precautions will be taken; such as (1) precautions necessary to data interpretation, such as standard corrections for dilution of urine, (2) precautions for the individual, such as assurance that invasive procedures will not be used, and (3) precautions for the individual's privacy, such as maintenance of appropriate security for individual records.

2. PREEMPLOYMENT EXAMINATIONS. The U.S. Office of Personnel Management MUST approve the requirement for having a preemployment examination of applicants for a federal employment position.

a. Criteria. The following criteria are recommended for individuals selected for arduous duty positions:

Vision--Binocular vision is required and must be at least 20/40 (Snellen) in one eye and 20/20 in the other, with or without corrective lenses. Near vision must be sufficient to read without strain printed material the size of typewritten characters. Normal depth perception, accommodation, and field of vision are required, as is the ability to distinguish basic colors.

Hearing--Without using a hearing aid, applicant must have no hearing loss in either ear of more than 30 decibels at 500-, 1,000-, or 2,000-cps range.

Speech--Diseases or conditions resulting in indistinct speech are disqualifying.

Olfactory Sense--Applicant must possess a normal sense of smell.

Respiratory System--Any chronic disease or condition affecting the respiratory system that would impair the full performance of duties is disqualifying; e.g., conditions that result in reduced pulmonary function, shortness of breath, or painful respiration.

Cardiovascular System--The following conditions are disqualifying:

a. Organic heart disease (compensated or not)

b. Hypertension with repeated readings that exceed 150 systolic and 90 diastolic without medication

c. Symptomatic peripheral vascular disease and severe varicose veins

Gastrointestinal System--Chronic symptomatic disabling diseases or conditions of the gastrointestinal tract are disqualifying.

Endocrine System--An uncontrolled systemic metabolic disease, such as diabetes or gout, is disqualifying.

Genitourinary Disorders--Chronic, symptomatic diseases or conditions of the genitourinary tract are disqualifying.

Extremities and Spine--Any deformity or disease that would interfere with range of motion or dexterity or that is severe enough to affect adversely the full performance of position duties is disqualifying.

Nervous System--Applicants must possess emotional and mental stability. Applicants with a history of epilepsy or convulsive disorder must have been seizure-free for the past 2 years without medication. Any neurological disorder with resulting decreased neurological or muscular function is disqualifying.

Miscellaneous--Although not mentioned specifically above, any other disease or condition that interferes with the full preformance of duties is also grounds for medical rejection.

b. Medical Examinations.

The arduous duty medical examination must include for each applicant:

A. A complete medical examination, by or under the supervision of a licensed physician, consisting of:

1. The obtaining of a thorough occupational and medical history.

2. The performance of a comprehensive physical examination of the following:

a. head, face, neck, and scalp

b. nose

c. mouth and throat, including general dental condition and hygiene

d. speech

e. ears, including drums

f. eyes, including pupils, ocular motility, field of vision, and fundi

g. lungs and chest

h. heart

i. vascular system

j. abdomen, viscera, and hernia

k. anus and rectum

l. endocrine system

m. genitourinary system

n. upper extremities

o. lower extremities, including feet

p. spine and musculoskeletal system

q. skin and lymphatics

r. identifying body marks, scars, or tatoos

s. neurological system

t. psychiatric system

Pelvic examination of females is not required. Proctosigmoidoscopic examination is not required.

3. The following parameters must be measured/tested and results recorded:

a. height (without shoes)

b. weight (undressed)

c. visual acuity, including distant and near vision corrected and uncorrected

d. color vision, using Ishihara or other color-plate method

e. depth perception

f. hearing acuity, by pure tone audiometry

g. blood pressure

h. pulse rate

4. The following tests must be performed, interpreted, and recorded:

   a. electrocardiogram (12 lead, resting)

   b. chest X-ray (PA single view, 14x17 inches)

   c. pulmonary function (forced vital capacity and forced expiratory volume in 1 second)

   d. urinalysis, complete (pH, glucose, ketones, albumin, occult blood)

   e. blood count, complete (white cell count, red cell count, hemoglobin determination, hematocrit determination, platelet estimation, scan of blood smear, and calculations of MCV, MCH, and MCHC indices)

   f. blood chemistries (cholesterol, glucose, urea nitrogen, uric acid, transaminase (SGOT), bilirubin, calcium, total protein, inorganic phosphate, alkaline phosphatase, lactic dehydrogenase (LDH), creatinine)

B. The applicant shall be advised of findings and counseled to seek medical attention as may be indicated.

C. The examination findings, results, recommendations, and opinions shall be reported to EPA on the Certificate of Medical Examination, Standard Form No. 78, revision of October 1969, Part C, to which may be appended test and other reports.

3. The preemployment medical examination for respirator users should consist of a general medical examination, similar in scope to the arduous duty examination, but with special attention to evaluation of the skin, cardiac and pulmonary systems, and evaluations of any history or symptoms of allergy. The examining physician should also be alert to any personality or psychological factors which may affect respirator use. The physician will usually not be knowledgeable about types and uses of respirators. He or she will need to evaluate the stress that may be associated with the assigned duties and respirator(s) used. Therefore, the physician should be informed of the characteristics of the required respirator(s): use and type, frequency and duration of expected use, use in hot or cold environments, etc. Detailed medical standards for respirator users are not available; the physician must form a medical judgement based on evaluation of respirator demands and stress and on the clinical findings in individual applicants.

APPENDIX 3

PERSONAL PROTECTION LEVEL DETERMINATIONS

a. Introduction

It is of the utmost importance that the Project Leader specify the correct level of protective equipment for each HWS investigation or ES response. The level of protective equipment shall be determined by the type and levels of waste or spill material present at the site. In situations where the types of waste or spill material on-site are unknown or the hazards are not clearly established, the Project Leader must make a reasonable determination of the level of protection that will assure the safety of investigators and response personnel until the potential hazards have been characterized. This level shall be maintained until the hazards have been determined through monitoring, sampling, informational access, or other reliable methods. Once the hazards have been determined, then protective levels commensurate with the hazards will be used.

The appropriate level of protection shall be determined prior to entering a hazardous waste site or responding to an environmental spill. The levels of protection are explained below and itemized in Table 3-1.

Level A

Level A protection must be worn when the Project Leader makes an reasonable determiantion that the highest available level of both respiratory and skin (and eye) contact protection is needed. It should be noted that while Level A provides maximum available protection, it does not protect against all possible hazards. Consideration of the heat stress that can arise from wearing Level A protection should also enter into the Project Leader's decision. (Comfort is not a decision factor, but heat stress will influence work rate, scheduling, and other work practices.)

Level B

The Project Leader must select Level B protection when the highest level of respiratory protection is needed, but hazardous material exposure to the few unprotected areas of the body(i.e., the back of the neck) is unlikely with Level B protective clothing.

Level C

The Project Leader may select Level C when the required level of respiratory protection is known, or reasonably assumed to be, not greater than the level of protection afforded by air purifying respirators; and hazardous materials exposure to the few unprotected areas of the body(i.e., the back of the neck) is unlikely with Level C protective clothing. Level C requires carrying an emergency escape respirator.

Level D

Level D is the basic work uniform. Investigators and response personnel must not be permitted to work in civilian clothes.

b. Protective equipment and criteria

Level A

(1) Personal Protective Equipment

- Open circuit, pressure-demand SCBA
- Totally encapsulated suit
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- Booties, chemical protective

(2) Criteria

- Sites known to contain hazards which
  - require the highest level of respiratory protection (as stated above)
  - will cause illness as a result of personal exposure, and
  - the Project Leader makes a reasonable determination that personal exposure could occur to any part of the body.
- Sites for which the Project Leader makes a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated directly above.

Level B

(1) Personal Protective Equipment

- Open circuit, pressure-demand SCBA
- Chemical protective
  - Overalls and long sleeved jacket, or
  - Coveralls
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- Booties, chemical protective

(2) Criteria

- Sites known to contain hazards which require the highest level of respiratory protection as stated above
  - will cause illness as a result of personal exposure, and
  - the Project Leader makes a reasonable determination that personal exposure to areas of the body not covered by Level B protective clothing is unlikely.
- Sites for which the Project Leader makes a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated above.

Level C

(1) Personal Protective Equipment

- Full face-piece air-purifying respirator
- Emergency escape respirator (carried)
- Chemical protective
  - Overalls and long sleeved jacket, or
  - Coveralls
- Gloves, inner (surgical type)
- Gloves, outer, chemical protective
- Boots, chemical protective, steel toe and shank
- Booties, chemical protective

(2) Criteria

- Sites known to contain hazards which
  - do not require a level of respiratory protection greater than the level afforded by air purifying respirators (nominal protection factor of 10) as stated above,
  - will cause illness as a result of personal exposure, and
  - the Project Leader makes a reasonble determination that personal exposure to areas of the body not covered by Level C protective clothing is unlikely.
- Sites for which the Project Leader makes a reasonable determination that, based on the lack of information to the contrary, the site may be described as stated above.

Level D

(1) Personal Protective Equipment

- Coveralls, cotton
- Boots/shoes, safety
- Safety glasses
- Hard hat with optional faceshield
- Air purifying respirator (readily available)

(2) Criteria

- Sites where the Project Leader makes a reasonable determination that hazards due to exposure to hazardous materials is unlikely.

APPENDIX 4

(These procedures are currently under revision to reflect the May 19, 1980 changes in the Department of Transportation regulations for shipment of hazardous materials.)

PACKAGING, MARKING, LABELING, AND SHIPPING OF HAZARDOUS WASTE SITE AND ENVIRONMENTAL SPILLS SAMPLES

a. General Provisions. Samples that are judged to be environmental samples may be shipped according to letters of understanding granted EPA by DOT. Other specific exemptions may also apply (e.g., use of Labelmaster, Inc. package #38, or Dow Chemical Co. Imbiber Pack for shipment of Poison B, n.o.s. by United Parcel Service).

The following procedures apply to samples collected from a hazardous waste site or environmental spill, and which in the judgment of the Project Leader cannot be considered to be "environmental samples".

- Unanalyzed HWS and ES samples may not be fixed with any preservative or preserved with ice or dry ice.

- If a material specifically identified in the Department of Transportation (DOT) Hazardous Material Table (49 CFR 172.101) is known to be contained in an HWS or ES sample, that sample should be transported as prescribed in the table.

- Unanalyzed HWS and ES samples may be transported by rented or common carrier truck, bus railroad, and by Federal Express Corporation* (air cargo); but they may not be transported by any other common carrier air transport, even "cargo only" aircraft. Those samples taken from closed drums or tanks, however, should not ordinarily be transported by Federal Express. (See 1 and 2 in "Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples Taken From Closed Drums").

- If samples are transported by any type of government-owned vehicle, including aircraft, DOT regulations are not applicable. However, EPA and FIT personnel will use the packaging procedures described below except that the Bill of Lading with certification form does not have to be executed (see "Shipping Papers" on under b.8).

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* These procedures are designed to enable shipment by entities like Federal Express; however, they should not be construed as an endorsement by EPA of a particular commercial carrier.

° Irrespective of type sample or container, after completion of the analyses the contractor will repackage the original sample bottles in the coolers or containers received, and return them to the originating Regional office. The packages will be sealed and shipped under custody procedures as they were received. Each originating office should make arrangements with the contractor through the Sample Management Office (VIAR) for the method of return and payment for shipping charges within 30 days after sample shipment. Organic extracts from the samples will be shipped by the analytical contractors to EPA's EMSL/Las Vegas office for archival storage.

b. Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples, Excluding Drum Samples.

(1) Collect sample in an 8-ounce* or smaller glass container with nonmetallic, teflon-lined screw cap. Allow sufficient ullage (approximately 10% by volume) so container is not liquid full at 130 F. If collecting a solid material, the container plus contents shall not exceed 1 pound net weight.

(2) Attach properly completed sample identification tag [Figure 4] to sample container.

(3) Seal sample container and place in 2-mil-thick (or thicker) polyethylene bag, one sample per bag. (Tags should be positioned to enable them to be read through bag.)

(4) Place sealed bag inside a metal can with incombustible, absorbent cushioning material (e.g., vermiculite or earth) to prevent breakage, one bag per can. Pressure-close the can and use clips, tape or other positive means to hold the lid securely, tightly and effectively.

(5) Mark and label this container as indicated in No. 8 below.

(6) Place one or more metal cans (or a single 1-gallon bottle*) surrounded with incombustible packaging material for stability during transport, into a strong outside container, such as a metal picnic cooler or a fiberboard box.

(7) Mark and label the outside container and complete shipping papers as described below.

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* Large quantities, up to one gallon, taken from wells may be collected if the flash point of the sample can be determined to be 73 F or higher. In this case, such should be marked on the outside container (carton, etc.) but only a single (one gallon or less) bottle may be packed in an outside container. Ten percent ullage and requirements 2,5,6, and 7 below must also followed. On the shipping papers state that "flash point is 73° or higher".

(8) Marking and labeling: Use abbreviations only where specifed. Place the following information on a metal can (or bottle), either hand printed or in label form: laboratory name and address and "Flammable Liquid, n.o.s.", (if not liquid, write "Flammable Solid, n.o.s.").* Place the following labels on the outside of the can (or bottle)

> "Cargo Aircraft Only"; "Flammable Liquid"; if not liquid, "Flammable Solid" ("Dangerous When Wet" label should be used if the solid has not been exposed to wet environment).

Note: If the cans are placed in an exterior container, both that container and inside cans must have the same markings and labels as above. "Laboratory Samples" and "THIS SIDE UP" or "THIS END UP" should also be marked on the top of the outside container, and upward pointing arrows should be placed on all four sides of the exterior container.

Shipping Papers: Use abbreviations only where specified below:

Complete the carrier-provided bill of lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container.

> "Flammable Liquid, n.o.s." (or Flammable Solid, n.o.s.", as appropriate); "Cargo Aircraft Only"; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight _____" or "Net Volume _____" (of hazardous contents), by item, if more than one metal can is inside an exterior container. The net weight or net volume must be placed just before or just after the "Flammable Liquid, n.o.s." or "Flammable Solid, n.o.s." description.

A Chain-of-Custody Record form should also be properly executed, and included in the exterior container.

(9) Unless samples are driven to the laboratory, a team member must accompany shipping container(s) to the transport carrier and, if required, open outside container(s) for freight inspection.

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* Using "Flammable" does not convey the certain knowledge that a sample is in fact flammable, or how flammable, but is intended to prescribe the class of packaging in order to comply with DOT regulations; "n.o.s." means not otherwise specified.

c. Packaging, Marking and Labeling Requirements for Unanalyzed Hazardous Waste Site Samples Taken from Closed Drums.

(1) All samples from closed drums do no necessarily have to be shipped as below. The Project Leader must make a judgement, based on the information available, as to the hazard class of samples gathered. This packaging, marking, labeling and shipping method provides a worst-case procedure for materials classed as "Poison A" (49 CFR 173.328).

(2) These samples may not be transported by Federal Express Corporation (air cargo) or other common carrier aircraft, or by rental, non-government aircraft. (Samples may be shipped by ground transport or government aircraft.)

(3) Collect sample in a polyethlylene or glass container which is of an outer diameter narrower than the valve hole on a DOT Spec. 3A1800 or 3AA1800 metal cylinder. Fill sample container allowing sufficient ullage (approximately 10% by volume) so it will not be liquid-full at 130° F. Seal sample container.

(4) Attach properly completed Sample Identification Tag (Figure 4) to sample container.

(5) With a string or flexible wire attached to the neck of the sample container, lower it into a metal cylinder which has been partially filled with incombustible, absorbent loose packaging material (vermiculite or earth). Allow sufficient cushioning material between the bottom and sides of the container and the metal cylinder to prevent breakage. After the cylinder is filled with cushioning material, drop the ends of the string or wire into the cylinder valve hole. Only one sample container may be placed in a metal cylinder.

(6) Replace valve, torque to 250 ft-lb (for 1 inch opening) and replace valve protector on metal cylinder, using teflon tape.

(7) Mark and label cylinder as described below.

(8) One or more cylinders may be placed in a strong outside container.

(9) Mark and label outside container and complete shipping papers as described below.

(10) Marking and labeling: Use abbreviations only where specified. Place the following information on the side of the cylinder, or on a tag wired to the cylinder valve protector, either hand-printed or in label form.

"Poisonous Liquid or Gas, n.o.s.", laboratory name and address.* Place the following label on the cylinder: "Poisonous Gas". ("Poisonous Liquid" label not acceptable here, even if liquid.)

Note: If the metal cylinders are placed in an outside container, both the container and cylinders inside must have the same markings and labels as above. In addition, "Laboratory Sample", and "Inside Packages Comply With Prescribed Specifications" should be marked on the top of the outside container. "THIS SIDE UP" marking should be placed on the outside container and upward pointing arrows on four sides.

Shipping Papers: Complete the shipper-provided Bill of Lading and sign the certification statement (if carrier does not provide, use standard industry form) with the following information in the order listed. One form may be used for more than one exterior container; use abbreviations only as specified:

"Poisonous Liquid, n.o.s."; "Limited Quantity" or "Ltd. Qty."; "Laboratory Samples"; "Net Weight_____" or "Net Volume_____" (of hazardous contents), by cylinder, if more than one cylinder is inside an exterior container. The net weight or net volume must be placed just before or just after the "Poisonous Liquid, n.o.s." marking.

A Chain-of-Custody Record form (Figure 5) should also be properly executed and included in the container, or with the cylinder.

(11) Unless samples are driven to the laboratory, an EPA employee will accompany shipping container to the transport carrier and, if required, open outside container(s) for freight inspection.

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*Using "Poisonous" does not convey the certain knowledge that a sample is in fact poisonous, or how poisonous, but is intended to prescribe the class of packaging in order to comply with DOT regulations.

APPENDIX 5

SAMPLING PROCEDURES

Containers (drums, tanks, etc.) should only be sampled when necessary to meet enforcement or cleanup requirements. Opening drums or other sealed containers may be hazardous to sampling personnel unless proper safety procedures are followed. Gases can be released, pressurized liquids can be expelled, or explosions can occur. A drum should not be moved or opened unless it can be ascertained beyond reasonable doubt that the drum is structurally sound. Drums standing on end, with bung up, should be opened by pneumatic impact wrench, operated from a remote site (Figure 5.1). Drums on sides may be opened similarly if it is possible to safely rotate the drum so that the bung is high. If the bung can be removed, sampling contained liquids may be safely accomplished by glass tube, which is then broken and discarded within the barrel. A barrel that has a badly rusted bung, or that cannot be sampled as above, may be safely sampled with a hydraulic penetrating device (Figure 5.2) operated remotely. The device is then abandoned in place, and disabled to prevent further withdrawal of liquids. Sealed or closed tanks should be opened remotely, using ropes to lift hatches, etc.

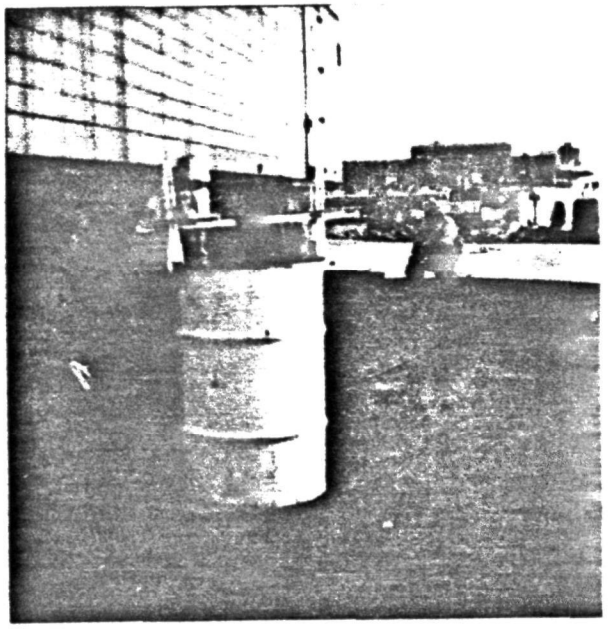
In general, metal sample containers should not be used on HWS investigations and ES responses; if used, they must be grounded, preferably to the drum or tank being sampled, while sample transfer is accomplished. In all cases of entry into closed containers, the local fire departmnt should be asked to stand by. In any case wherein presence of explosives is suspected or known, Army EOD or police bomb squads should be requested to remove or neutralize such materials. In no event may EPA employees handle explosives encountered on sites.

Subsurface sampling of an HWS or ES can also create hazards to employees and the public, unless adequate safety precautions as followed. Biodegradation of refuse in dumps produces methane and other explosive gases. The escaping gases may be ignited by drill rigs or other ignition sources. Drilling into dump sites may cause discarded incompatibles to be mixed and thereby create reactive mixtures. Dump or spill sites where leachate plumes are contained in impervious strata may be interconnected with producing aquifers if drilling is not planned according to competent ground water technology and data.

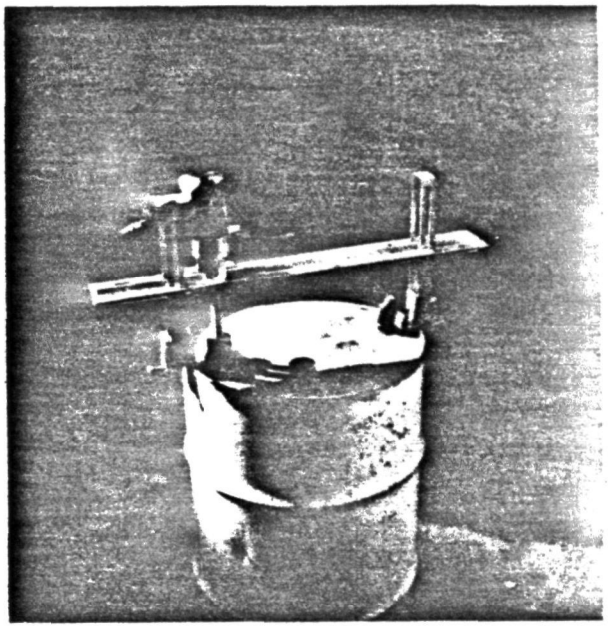
Drilling in HWS investigations and ES responses should be confined to the periphery of sites, with the objective of characterizing the leachate that may be moving away from the site. If subsurface sampling of dump sites is necessary, excavation must be accomplished by hand, and with sparkfree equipment.

All drilling associated with HWS and ES activities must be accomplished under the responsible supervision of a competent geohydrologist, ground water geologist, geological engineer, or a person similarly qualified by experience. Drilling must be preceded by sweeps with metal detectors, and drilling must be limited to areas where the presence of buried drums or tanks is not indicated. Test holes must be cased or plugged when the activites is completed.

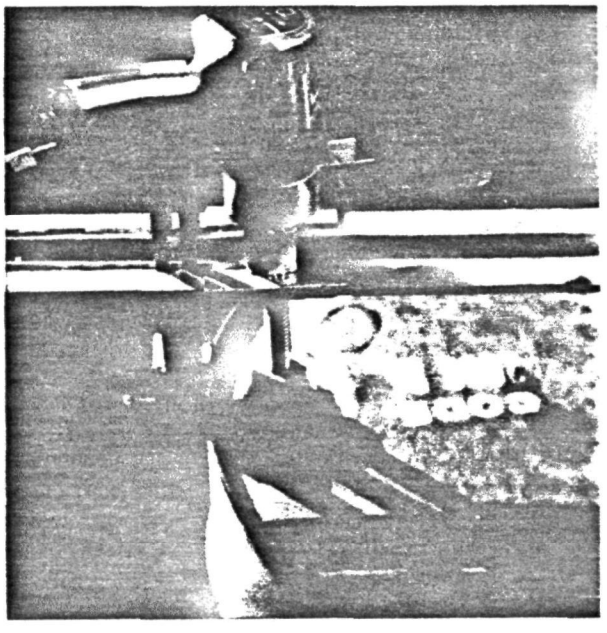
FIGURE 5.1



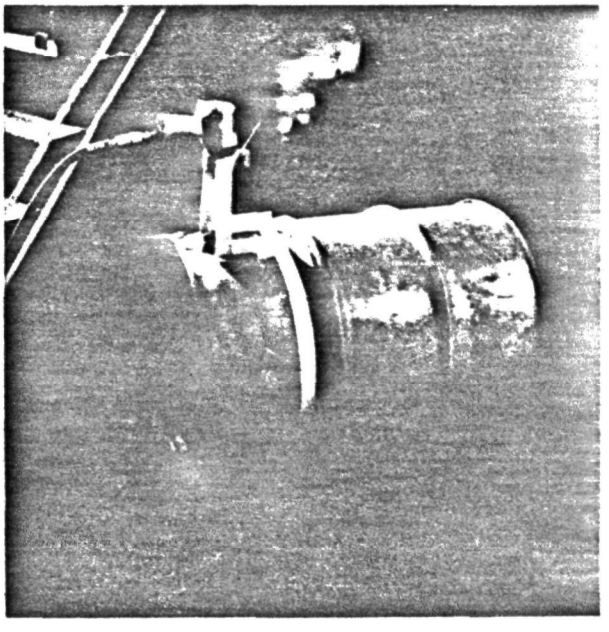
Remote bung removal. Man in background, dressed in protective clothing, operates bung-removal equipment on drum in foreground.



Bung-removal equipment; drum on end.



Equipment closeup.

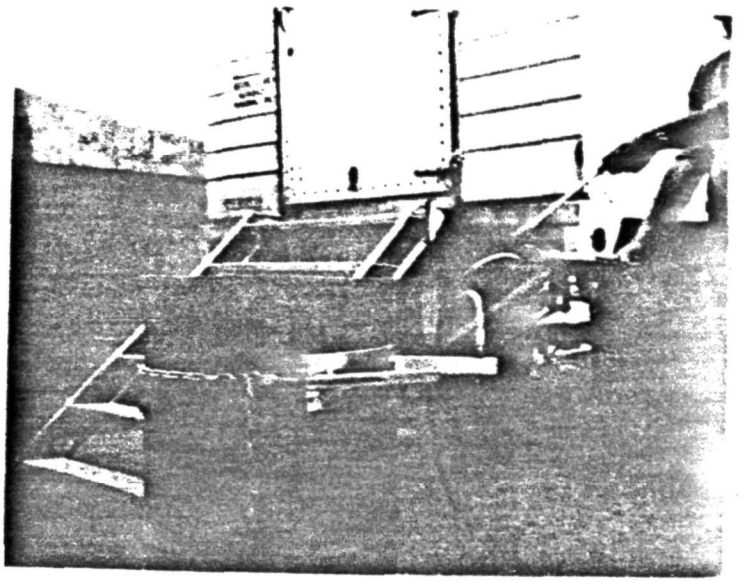


Remote bung-removal setup; drum on side.

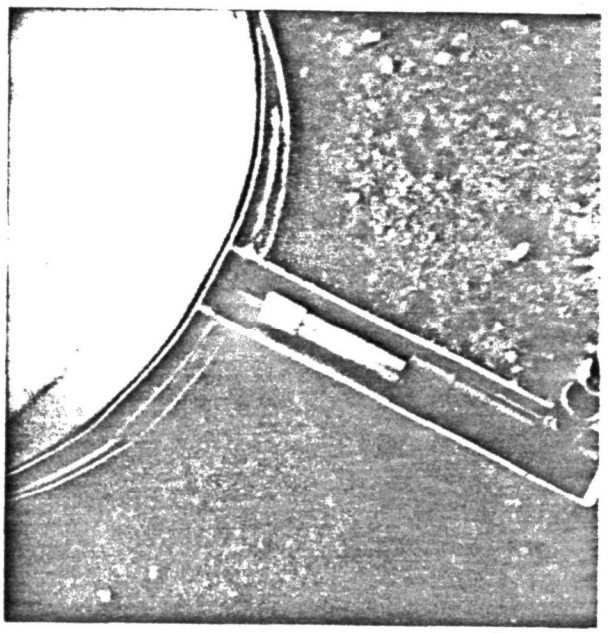
FIGURE 2. REMOTE REMOVAL OF BARREL BUNG

FIGURE 5.2

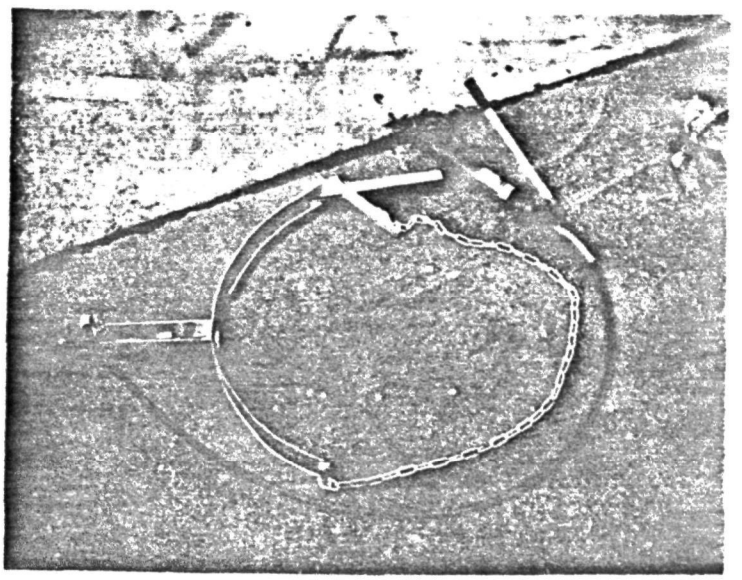
Remote operation of penetrating sampling device.



Drum attachment, connecting tube, and hand-held activator.



Sampling device penetrating drum.



Remote sampling equipment.

FIGURE 3. REMOTE SAMPLING

APPENDIX 6

DECONTAMINATION PROCEDURES

A. Introduction

The need for personnel decontamination can vary greatly. Operations such as walking through an area may require only a simple controlled undressing procedure and bagging of contaminated clothing. In operations in which extensive work is performed in a contaminated area, cross contamination of protective clothing and equipment can occur. In this case, a controlled undressing and bathing facility will be needed.

For those situations in which gross contamination may occur, a sophisticated personnel decontamination station, as illustrated in Figure 6.1, should be established. It provides for a controlled undressing and washing system that is designed to avoid transfer of chemical contamination from protective clothing. The number of stations can be adjusted to the protective clothing system being used. All field personnel should shower as soon as possible after leaving a contaminated area.

Full-decontamination of reusable suits is accomplished in two steps. The first step is performed on-site using solutions selected beforehand in consultation with chemists and toxicologists based on limited knowledge of the hazardous materials on the site at the time (see Figure 6.2). Usually an adequate decontamination solution consists only of water. However, the decontamination solutions may be solutions of water and detergents, water and chemical compounds designed to react with and neutralize specific contaminents, or solvents. After cleansing, protective clothing is turned inside out, if feasible, and sealed in plastic bags for return shipment. The second decontamination step is taken later, after the contaminant has been latoratory-analyzed to determine what decontamination reagents are most suitable for each case. This second cleaning is then performed by personnel wearing disposable protective clothing. Waste decontamination solution from the second step should be treated as hazardous waste and disposed of accordingly.

B. Model for Decontamination Procedures-

Organization of the Personnel Decontamination Station (PDS)

Once the contamination zone and the clean zone have been established, the PDS is set up.

1. Layout of the PDS

An example of a PDS is shown in Figure C-1 and is as follows:

STATION A - A plastic ground sheet on which field equipment is dropped by returning members team.

STATION B - A wash tub filled with a decontamination solution

- A second wash tub filled with rinse solution
- A third wash tub filled with decontamination solution
- A fourth wash tub filled with rinse solution
- Each wash tub should be equipped with a large sponge and brush

STATION C - A bench or stool for personnel to sit on during removal of booties

- A ten (10) gallon pail with plastic liner where disposable boot covers are discarded

STATION D - Two ten (10) gallon buckets filled with decontamination solution

STATION E - A ten (10) gallon bucket filled with rinse solution

STATION F - A 32 gallon trash can with plastic liner (container for rubber items)

STATION G - 30 meters upwind from Station F

- A plastic ground sheet for SCBA drop

STATION H - A bench or stool for personnel

- A 32 gallon trash can with plastic liner (container for cloth items)

STATION I - A field shower set-up

STATION J - A redressing and first aid station. This station defines the boundary between the Contamination Control Area and the Clean Area

FIGURE 6.1

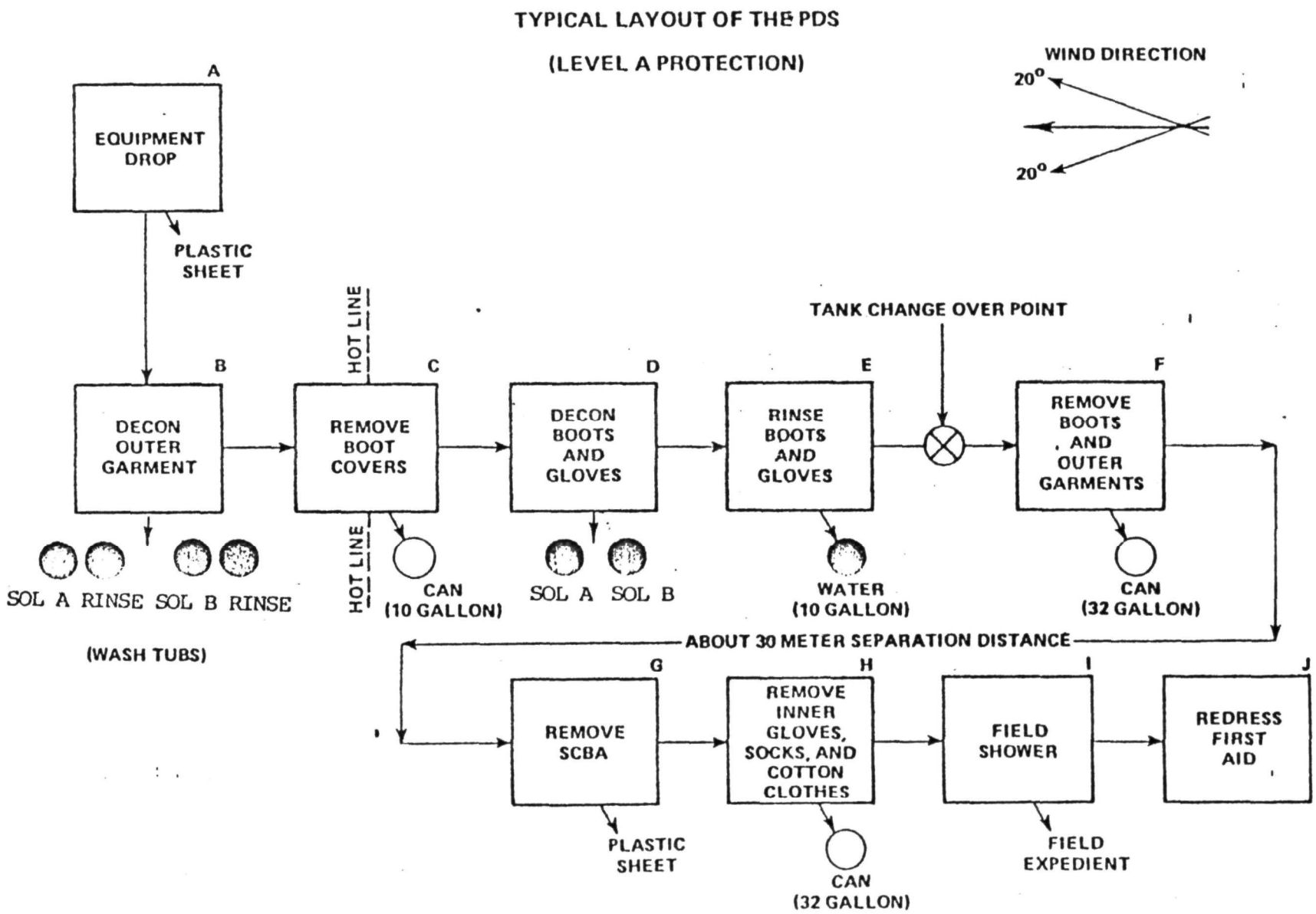


FIGURE C-1

FIGURE 6.2

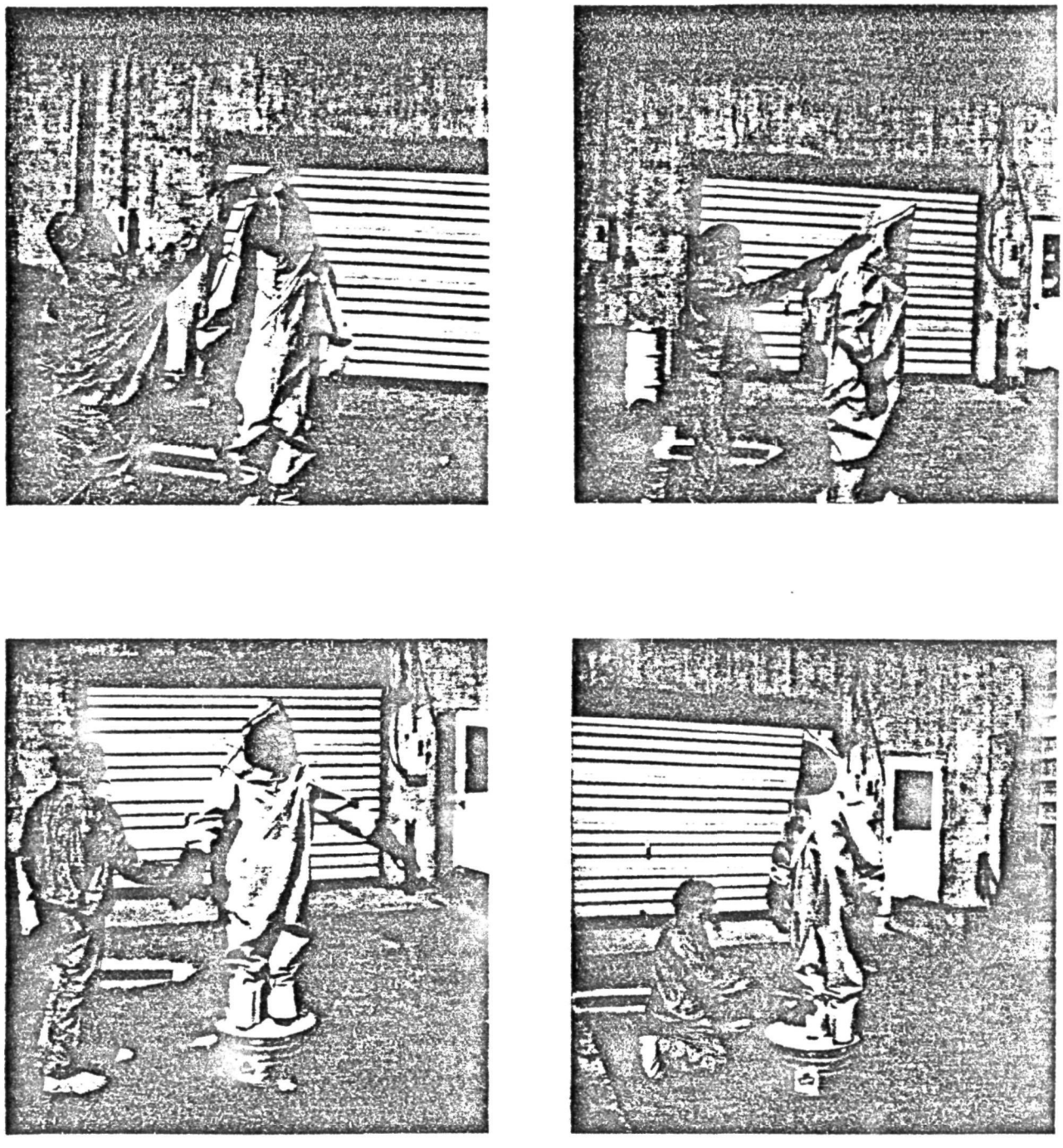


FIGURE 1. ON-SITE DECONTAMINATION OF PROTECTIVE CLOTHING

TABLE OF

PARAGRAPH TITLES	PARAGRAPH NUMBERS
Policy and Resp	1
Health and Safe quirements	2
Work Pract	3

APPENDICES	APPENDIX NUMBER
Safety Plan	1
Periodic He th	2
Personal Pr ec terminations	3
Packaging, rl , and Shipping of Hazardous Waste Site/E i l Samples	4
Sampling P r	5
Deconta o	6

David Weitzman, Manager
Industrial Hygiene Programs
Office of Occupational Health
and Safety

APPENDICES

APPENDIX A

PERSONAL PROTECTIVE EQUIPMENT

- Respirators
- Chemical Protective Clothing

RESPIRATORS

- Excerpts From: *A Guide to Industrial Respiratory Protection*
- Typical Vendor Literature*

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* *Use of typical vendor literature in this Manual does not constitute official endorsement of products by the Environmental Protection Agency.*

CHEMICAL PROTECTIVE CLOTHING

- Selection: Quantitative & Qualitative
  - *Methods for Prevention and Control of Occupational Skin Disease*
  - *The Permeability of Laboratory Gloves to Selected Solvents*
  - *The Permeability of Laboratory Gloves to Selected Nitrosamines*
  - *Permeation of Glove Materials by Physiologically Harmful Chemicals*
  - *Development of Performance Criteria for Protective Clothing Used Against Carcinogenic Liquids*

- Typical Vendor Literature*

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* *Use of typical vendor literature in this Manual does not constitute official endorsement of products by the Environmental Protection Agency.*

METHODS FOR PREVENTION AND CONTROL OF OCCUPATIONAL SKIN DISEASE

This section considers the variety of methods of preventing and controlling occupational cutaneous injury and illness. Control methods for skin disease are similar to those used to prevent or control other occupational health and safety problems. The techniques used to provide workers with a workplace free of occupational hazards are well known and fairly widely used throughout industry. Virtually every known job-related skin hazard can be controlled by using one of these protective techniques.

GENERAL PRINCIPLES OF HAZARD RECOGNITION AND EVALUATION

Prevention and control of skin disease and injury involve several key steps, including recognition of exposure potentials, evaluation of the workplace exposure, and application of appropriate controls. Recognition of potential skin hazards is the first step in any prevention and control program, and it requires both employers and employees to know as much as they can about materials, processes, and plant layout, and to have a thorough understanding of the toxic effects of materials and processes.

To evaluate potential workplace exposures, information should be assembled about the chemicals or other agents involved, the physical layout of the plant and equipment, the number of workers, and the frequency and duration of exposure. Process flow charts, workplace inspections, and relevant publications are also helpful in making such evaluations.

Four classes of hazardous agents are generally found in industry: chemical (vapors, mists, fogs, liquids, solids, etc.), physical (ionizing and non-ionizing radiation, heat, cold, vibration, etc.), biological (bacteria, viruses, fungi, etc.), and ergonomic (workplace and tool match to worker). Skin damage is associated primarily with chemical and physical agents, but biological and ergonomic factors must also be considered. Employers often list, in writing, materials used in their operations, whether known to be toxic or not, to aid in recognizing and assessing any risk and controlling any hazard.

Once potential hazards have been recognized, each must be evaluated to determine the degree of hazard. Fundamental to this evaluation is a recognition that toxicity and hazard are not synonymous (see Glossary). Determination of hazard requires the circumstances of the exposure to be taken into account. For example, a chemical may be highly toxic, but the particular circumstances of its use may be such that the associated hazard is low. Conversely (and this has often been the case with compounds affecting the skin), a substance's basic toxicity may be low, but prolonged and repeated contact may result in a high level of hazard. Similarly, many physical agents may have potentially adverse effects on workers (noise, ionizing radiation, ultraviolet light, etc.), but the true hazard of each will only be determined by the particular circumstances of the specific exposure.

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Evaluation of a prevention and control program includes sampling and measurement of the actual workplace environment. The data derived are compared with any standards available, to make a preliminary assessment of hazard. Sampling strategies must be related to the exposure and the agent.

An important first step to measurement is the development of a complete list of agents used in the operation, the sources of exposure to these agents by any route (skin, respiratory, or digestive), and all control measures in use. Such a list may point out potential skin hazards such as solvents, acids, alkalies, lubricants, reactive raw materials or intermediates, catalysts, and so forth. Physical agents listed might include lasers, ionizing radiation, ultraviolet, microwaves, infrared, vibration, and temperature or humidity extremes. Detection of many of these agents requires special instrumentation; monitoring the worker's actual exposure might require either continuous or intermittent personal sampling. Biologic or ergonomic factors are less likely than chemical or physical agents to cause skin hazards.

Two types of control techniques, primary (immediate) and indirect, are used for reducing or minimizing occupational exposure to chemical or physical agents. The primary methods are classified in six categories: substitution/process change, design and component specification, isolation/enclosure, ventilation, good housekeeping, and personal protection. Indirect methods include training and education of employees and supervisors, medical programs, and environmental monitoring; they are of prime importance in preventing and controlling occupational skin disease and injury.

PRIMARY (IMMEDIATE) CONTROL TECHNIQUES

1. *Substitution and Process Change*

Hazards associated with particular agents, equipment, or processes can be minimized or eliminated by substituting a less hazardous agent, equipment, or process. This procedure has been used most frequently with chemical agents; examples of such substitution include the use of toluene for benzene or methyl chloroform for carbon tetrachloride. An example of process substitution is the use of mechanical seals on pumps instead of gasket seals. In situations where skin irritation might be a problem, non-ionic surfactants might be substituted for cationic or anionic surfactants.

Process change is a form of substitution; it involves changing an industrial process to reduce or eliminate the hazardous exposure. Substituting automatic dipping for manual dipping of parts into solvent degreasers is an example of process change, in this case through mechanization. The risk of dermatitis is eliminated when skin surfaces are no longer exposed to solvent or solvent fumes. Changing the consistency of a material may also be effective in reducing hazard. For example, handling a loose powder consisting of some hydroscopic materials was causing eye and skin irritation; the irritation was eliminated by using a compressed form of the material, which created no dust when handled. This new and safer operation was also much cheaper, since the compressed material was much simpler to handle than the loose powder. The so-called "wet methods" have also been used successfully to eliminate or control irritating dust; water is sprayed over the dust or mixed with the material to form a slurry to prevent dust.

2. *Design and Component Specification*

This is a procedure for eliminating or minimizing hazards at the design or purchase stage. A common example would be requiring a vibration specification before purchasing rotating equipment. A product specification that limits the impurity in a compound to a nonhazardous level also minimizes the user's risk. Government regulatory bodies are looking into the effectiveness of this control method.

3. *Isolation and Enclosure*

An agent or an operation can be isolated in space or time to reduce the average exposure or the number of people exposed. Locating units in regulated areas or performing potentially hazardous activities such as radiography at night or in other slack periods is an example of this control technique. As a corollary, the worker can also be isolated from the agent, process, or area by being placed in an air-conditioned control room.

Another form of isolation is enclosure. This procedure involves placing some form of barrier between the agent/process and the work force/workplace. Those agents and processes that do not require constant attending are particularly amenable to this technique. As an example, installing splash guards and hoods over machining operations involving cutting fluids has resulted in lower rates of dermatitis. A closed system that eliminates all worker exposure to certain toxic agents such as formaldehyde (strong skin sensitizer) or mevinphos (a highly toxic organophosphate pesticide readily absorbed through the skin) is another example of the enclosure method of control.

4. *Ventilation*

This method includes both general dilution ventilation and local exhaust ventilation; it is used to reduce exposure to airborne physical, chemical, or other agents. In some operations, such as those involving epoxies, good local exhaust ventilation has been quite effective in reducing outbreaks of dermatitis.

5. *Good Housekeeping*

Though this technique is often overlooked, it is an efficient and inexpensive means of controlling exposure to hazardous agents in the workplace. Of particular value with respect to personal safety, good housekeeping also extends to the control of chemical and physical agents. Simple measures such as providing tools or equipment for proper and safe handling of materials in transport and during use, adequate storage space, prompt cleanup of spills, adequate sanitary facilities, proper signs and labeling in work areas, and means for discarding used or off-specification materials have a great impact on exposure control. These procedures reduce the potential for direct skin contact and also minimize the entrainment of material into the air from tracking, impact, etc. Poor housekeeping techniques can cause toxic materials to be reintroduced into the air, causing additional and needless exposure. Careless or inappropriate use, handling, or storage of chemical or physical agents presents a direct threat of skin exposure if there is close worker contact with the hazardous process or materials.

The value of good housekeeping is shown in the following example involving fibrous glass, a well-known skin irritant; failure to clean equipment surfaces and floors creates many possibilities for skin contact with this substance and dry sweeping increases the problem; vacuuming, however, greatly reduces potential irritation.

6. *Personal Protection*

Whenever it is impossible to provide adequate control of a hazard at its source, or during the interval when controls are

being implemented, it may be necessary to rely largely on personal protective equipment. A combination of good engineering, plant hygiene, and personal hygiene is often required to achieve effective hazard control. Using personal protective equipment alone, however, should be regarded as a control method of last resort.

Protective clothing

To protect against chemical agents, there is clothing that is reasonably impervious. Clothing to cover all parts of the body is available: work shirts and pants, coveralls, aprons, caps, gloves, boots, safety glasses or goggles, and face shields. A test method of determining permeability of materials used for protective clothing may be found in a NIOSH performance criteria document. Additional information on testing procedures for face shields for splash protection are described in another NIOSH document. For physical agents, there is clothing to protect workers from ultraviolet light, ionizing, microwave and laser radiation, and heat and cold. Clothing and equipment are also available to protect against exposure to biological agents.

Protective devices are readily available, and protective clothing constitutes the bulk of this type of equipment. Specific information may be obtained from NIOSH publications and the manufacturers of these products. The degree of protection afforded varies for different combinations of chemical agent and protective material. This information is summarized in Tables 13, 14, and 15.

TABLE 13

EXTENT OF SOLVENT PENETRATION THROUGH GLOVE MATERIALS AFTER 0.5 HOURS

Solvent	Glove Material					
	Natural Rubber (0.4 mm)	Neoprene (0.4 mm)	Neoprene + Nat'l Rubber (0.5 mm)	Nitrile (0.4 mm)	PVC (0.2 mm)	PVA (0.4 mm)
Carbon Tetrachloride	D	D	D	A	D	A
Chloroform	D	D	D	D	D	A
Methylene Chloride	D	D	D	D	D	A
Methyl Iodide	D	D	D	D	D	A
1,1,2,2-Tetrachloroethane	D	D	D	C	D	A
1,1,2-Trichloroethane	D	D	D	D	D	A
Perchloroethylene	D	D	D	A	D	A
Methanol	A	A	A	A	B	D
Ethanol	A	A	A	A	B	C
2-Propanol	A	A	A	A	B	B
n-Butanol	A	A	B	A	B	A
Benzene	D	D	D	C	D	A
Toluene	D	D	D	C	D	A
Aniline	A	A	A	C	D	A
Phenol (10% water)	B	A	B	A	B	C
Acetone	B	C	B	D	D	A
Methyl Ethyl Ketone	C	D	C	D	D	A
Tetrahydrofuran	D	D	D	D	D	A
Dimethyl Sulfoxide	A	A	A	A	B	D
Dimethyl Formamide	B	A	A	C	D	D
Pyridine	C	C	C	D	D	C
Dioxane	B	B	B	A	D	A
n-Hexane	C	A	C	A	D	A
Water (H_2O)	A	A	A	A	A	D

Key A=<0.1%, B=0.1-1%, C=1-10%, D=>10%, see text.

TABLE 14

EXTENT OF SOLVENT PENETRATION THROUGH GLOVE MATERIALS AFTER 4 AND 8 HOURS

Solvent	Glove Material					
	Natural Rubber (0.4 mm)	Neoprene (0.4 mm)	Neoprene + Nat'l Rubber (0.5 mm)	Nitrile (0.4 mm)	PVC (0.2 mm)	PVA (0.4 mm)
Carbon Tetrachloride				Ad		Aa
Chloroform						B
Methylene Chloride						B
Methyl Iodide						B
1,1,2,2-Tetrachloroethane						Ab
1,1,2-Trichloroethane						Ab

TABLE 14—Contd.

EXTENT OF SOLVENT PENETRATION THROUGH GLOVE MATERIALS AFTER 4 AND 8 HOURS

Solvent	Glove Material					
	Natural Rubber (0.4 mm)	Neoprene (0.4 mm)	Neoprene + Nat'l Rubber (0.5 mm)	Nitrile (0.4 mm)	PVC (0.2 mm)	PVA (0.4 mm)
Perchloroethylene			C	C		Aa
Methanol	B	B	B	C		
Ethanol	B	Ab	B	Ab		
2-Propanol	B	Aa	B	Aa		
n-Butanol	C	Aa		Aa		C
Benzene						Ab
Toluene						Aa
Aniline	C	D	C			B
Phenol (10% water)		Ac		D		
Acetone						C
Methyl Ethyl Ketone						B
Tetrahydrofuran						C
Dimethyl Sulfoxide	Ab	B	B	B		
Dimethyl Formamide		C	C			
Pyridine						
Dioxane				D		C
n-Hexane		C		Aa		Aa
Water (H_2O)	Aa	Aa	Aa	Ab	B	

Key Upper case letters are used for 4 hour data. Lower case letters are used for 8 hour data.
A,a=<0.1%, B,b=0.1-1%, C,c=1-10%, D,d=>10%, see text.

TABLE 15

SUMMARY OF BREAKTHROUGH TIMES OF SELECTED CHEMICALS THROUGH PROTECTIVE CLOTHING MATERIALS AT 22° C

Carcinogen	Detection Limit (ppm)	Clothing Material		Break-through Time (min)
		Composition	Thickness (cm)	
Trichloroethylene	1	Nitrile rubber	0.094	10-15
		Neoprene rubber	0.079	10-15
		Polyvinyl alcohol	0.009	<15
Epichlorodydrin	1-5	Polyvinyl alcohol	0.008	<5
		Neoprene rubber	0.076	60-80
		Butyl rubber	0.084	4740
Coal-Tar Creosote	1-5	Neoprene rubber	0.076	270
		Butyl rubber	0.081	>5400
		Viton	0.043	>5760
Benzene	5-10	Polyethylene	0.006	<1
		Polyurethane-coated nylon	0.02	2
		Natural rubber	0.028	2
		Nitrile rubber	0.041	5
		PVC-coated nylon	0.043	6
		Polyvinyl alcohol	0.023	10
		Neoprene rubber	0.076	25
		Butyl rubber	0.084	88
		Viton	0.16	900
Ethylenimine	10-30	Neoprene rubber	0.02	<5
		Butyl rubber	0.084	600-960
1,1-Dimethylhydrazine	10	PVC-coated nylon	0.043	5-10
		Neoprene rubber	0.076	25-40
		Butyl rubber	0.084	1380-1620
2-Nitropropane	10	Polyvinyl alcohol	0.02	<5
		Nitrile rubber	0.09	25-60
		Butyl rubber	0.08	>6060
β-Propiolactone	10	Polyurethane-coated nylon	0.003	<5
		Natural rubber	0.03	15-20
		Polyethylene	0.006	10-30
Hexemethylphosphoromide	3	Polyethylene	0.006	15-25
		Butyl rubber	0.084	60-90
		Nitrile rubber	0.094	60-90

Barrier agents

Barrier agents are somewhat effective in cases in which gloves or other protective clothing cannot be used. Several types of barrier creams are available; vanishing creams, which have limited effectiveness against dusts, fibrous glass, and heavy oils; water repellent, effective against water-soluble chemicals, mild acids, and alkalies, oil repellent, which protect against oils and to a limited extent against organic solvents; solvent repellents, which have some effectiveness against organic solvents; and other miscellaneous types of creams that protect against sunlight or ultraviolet light, coal tar, insects, poisonous plants, and so forth.

There is some controversy about the use of barrier creams, but on balance they are of limited benefit in an overall skin protection program. This benefit derives from the nominal barrier properties provided by a properly selected agent, and the good obtained by washing during the work shift. Each wash-up should remove the agent and any entrapped chemicals or other potential skin irritants; barrier cream should not be reapplied after the final wash-up. The major problem associated with barrier creams is the selection of an incorrect cream. For example, using an oil-repelling cream with aqueous agents or a water-repelling cream with fatty or oily agents actually enhances contact and may increase absorption. The result may be more severe than if no barrier cream had been used. Whenever possible, barrier creams should not be used as the sole means of protection.

Personal hygiene

Personal hygiene can also play a significant role in reducing many dermatologic problems. Many industrial skin cleaners are available, including soaps, synthetic detergents, and waterless cleaners. Waterless cleaners generally contain different amounts of organic solvent or alkali and may therefore be drying or irritating to the skin. There are now waterless cleaners available that do not contain organic solvents.

Washing time should be adequate and should be considered work time. The washing facilities should be conveniently located near the worksite to be easily accessible to the workers. In occupational settings involving highly toxic agents or high exposure risk, the employer should provide showers, clothing changes, and lockers so that employees may leave work each day free of toxic contaminants on their skin, hair, or street clothes.

It is widely recognized that organic solvents should not be used for cleaning the skin. Common shop practices that cause unnecessary chemical insult to the skin are, for example, using mineral spirits to remove oily or greasy material and using a container of old lubricating oil as a dip tank for machine parts.

RELATED CONTROL TECHNIQUES

Education and Training

A good educational program is an essential element in any comprehensive hazard control program and should involve joint effort by management, workers, and worker representatives. The primary purpose of education is to ensure both management and workers understand the hazards and necessary control measures. Training should be conducted by qualified and prepared instructors. The elements of a management educational program and the staff to whom parts of the program should be directed are:

1) Senior officials, who should be provided with sufficient information on the toxicity and hazard of company products or processes to permit them to develop policies and procedures consistent with employees' and customers' need for protection.

2) The company's health and safety staff, which needs opportunities for continuing education and training and access to outside consultants to maintain the necessary level of professional skill.

3) Line supervisors, who need knowledge geared to the appropriate level of supervision, e.g., foremen should have sufficient training in health and safety to train the workers under their supervision.

Education and training of employees should be a cooperative effort involving employee representatives and management personnel, especially line supervisors. Worker's training should include, as a minimum:

1) Qualitative and quantitative identification of agents involved
2) Potential risks of exposure
3) Types of symptoms and signs that might develop
4) Results of environmental and biological monitoring
5) Management's plans for hazard control
6) Instruction for emergencies
7) Safe job procedures

Every worker should be taught to perform assigned tasks safely. Understanding safety information and being aware of hazards are important worker responsibilities.

Good opportunities to provide worker education occur:

1) At medical examinations (provided by the medical professional);

2) At the time of job training (provided by the foreman); and

3) At special health and safety meetings (provided by foreman or company safety specialists).

All workers new to a job (new hires or transfers into a new department, or those involved in a change in processes used) need to be trained in the safety aspects of their jobs. Refresher training should be provided regularly and periodically for all affected employees and management personnel.

The best training is not general but is instead based on a Job Safety Analysis of each individual job. The Job Safety Analysis ideally is conducted by a safety specialist who has reviewed the job to identify possible hazards and has developed procedures to control the hazard. Results of this analysis should be written out and used throughout the training program. Whenever possible, a summary of the analysis should be posted at the specific job site.

Whenever chemical products are used, Hazardous Material Manuals should be developed for each department (or plant or area, as appropriate); these should be used as the basis for training workers in that department. The manuals should contain a safety data sheet on each potentially hazardous material used, containing information on the identity of the material, hazardous effects, control measures, and emergency procedures. The manual should always be available for consultation by any worker and should be readily accessible at or near the job site.

A material labeling program is an important supplement to this training program. In addition, there should be a formal program to instruct workers about the effects of any hazardous process by-products, such as dusts or fumes, if necessary.

Smaller companies obviously usually cannot achieve the sophistication of a larger company, but small companies nevertheless have an obligation to meet the safety conditions specified above. Experience shows that labor unions can play a key role in the development and implementation of worker education programs on health and safety. One way in

which a union is involved is making an agreement with management for company-provided training of workers; another way for the union to be involved is to use its own internal resources, such as meetings and publications, to train its own members.

Medical Surveillance

Pre-placement medical examinations are important because they are the basis for preventing adverse health effects. They should be offered and encouraged for the following reasons:

1) To establish a base line for each employee's health status.

2) To identify pre-existing illnesses or other conditions so that individuals can be placed in occupational settings consistent with their health and other physical capabilities.

3) To provide a data base for determining incidence and prevalance of occupational skin diseases.

As a base-line medical record, the pre-placement examination services to protect the interests of both employer and employee. To determine whether or not a specific skin problem is occupational in origin, it may be helpful to review the employee's health file.

The pre-placement evaluation should include a comprehensive medical, family, and occupational history, emphasizing existing or pre-existing skin problems. The physical examination should be complete and include a careful examination of the skin. At the time of the examination, the employer should provide the physician with a description of the employee's prospective job, and identification of any skin hazards that might be encountered. The physician should order appropriate tests based on this information and the results of the physical examination. In particular, diagnostic patch testing should not be done as a pre-placement screening procedure because it will not identify those who will become sensitized, and the patch test itself could sensitize the prospective worker. Once the medical examination and tests are completed, the physician should prepare a written report for the employer. For specific recommendations on the content of this report, see the sections on medical reporting and recordkeeping. Whenever the physician's report recommends that the prospective worker not be placed in a particular job, the worker should have the opportunity to obtain a second opinion from a physician of his/her choice. This opportunity for a second medical opinion also should be extended to the employee for periodic and other interim examinations, which are discussed in detail below. After any examination over which there is disagreement between the two physicians, the issue should be resolved by a mutually agreed on refereeing process.

The importance of the physician's report cannot be overstated. For example, a person with chronic eczematous dermatitis should not be subjected to occupational exposures that might severely aggravate the condition, such as manufacturing phenol, disinfectants, dyes, pharmaceuticals, or plastics that involve the risk of phenol exposure. An individual with a cutaneous fungus infection would be well advised not to work with potent skin irritants or sensitizers temporarily until the infection has been eradicated with proper treatment. However, someone with a mild skin disorder could function well in jobs involving solvents, providing the exposure was limited by reasonably effective control measures.

At the time of the work assignment, management should provide an appropriate education and training program (see the section on education and training). Health personnel should conduct periodic on-site inspections of plant operations to detect breaches in procedure or hygiene, or any skin disease. Frequency of inspections should depend on the agent (toxicity) and process (exposure) involved. For example, operations involving agents such as acrylate monomers (strong irritants and sensitizers) should be inspected more often than work activities requiring the handling of only marginally irritating substances such as acetone, which might not even require on-site evaluation unless medical complaints were noted. Employees should report to health personnel any skin problems, regardless of how trivial they might appear. The health personnel then should determine whether or not the affected worker needs to be referred to a physician for evaluation and treatment. In cases where the environment cannot be satisfactorily controlled, the worker may have to be transferred to another job to protect his health.

Workers whose jobs involve exposure to cutaneous hazards should be provided with periodic examinations and encouraged to take them. These examinations should consist of an interim history and physical examination and any tests, based on the results of the examination and knowledge of the risk of occupational exposure, that the physician deems necessary to ensure that the employee's health is compatible with the demands of the job. Appropriate medical and/or engineering measures should be taken to correct any health problems discovered.

In general, routine periodic examinations should be performed annually, but they may need to be conducted more often in high-risk settings and less often in well-controlled or low-risk situations. In addition to regularly scheduled examinations, it is often desirable to assess a worker's health at other times, e.g., at job transfer or after an illness or injury.

Medical personnel should educate plant personnel about prevention and control techniques, including the proper use of protective clothing, work procedures, personal hygiene, the nature of specific hazards, and the symptoms of toxic exposure. Such an education program should be on-going and enlist the cooperation of nurses, hygienists, health physicists, other safety professionals, and supervisors. In some situations, properly trained non-professional staff members can conduct such programs successfully. The plant physician and other health professionals and administrators should encourage safe and healthy practices by their own example. Their attitude should also encourage workers to report promptly to the medical department for advice and treatment of injury or illness.

Finally, it is essential that the physician maintain complete and accurate medical records (see below).

Medical Reports and Recordkeeping

Whenever an employee is seen by a physician for an occupationally related medical examination (pre-placement evaluation, periodic examination, or work-related skin problem), the physician should prepare a report for the employer. Each report should continue information and recommendations relating the affected person's health to the occupational exposure or risk, and it should be limited to a determination of the employee's ability to work under the specific conditions of a given job. Also, the report should contain a statement that the worker has been informed of all medical findings and diagnoses and it should contain no medical information of a personal or nonoccupational nature. The employer should furnish a copy of each report to the affected employee.

Maintenance of complete and accurate medical records is one of the physician's important jobs and should be done for the duration of each individual's employment and for a

period of time thereafter consistent with the types of exposure the job entailed. The quality of the recordkeeping is an indication of the quality of the medical program and surveillance: the program is as good as the record. For example, a worker may develop skin cancer only after a latent period of many years after occupational exposure to a carcinogen such as arsenic. The medical records should include precise information about work done with agents having skin toxicity, including the levels of exposure to the agents, whenever practicable. As with all medical records, the legal and ethical bounds of confidentiality must be maintained strictly.

It should be the employer's responsibility to maintain a complete record of the physician's reports pertaining to each worker. As with the medical records kept by the physician, the report records should be maintained for the duration of employment plus a period of time consistent with the types of exposure the job entailed.

The maintenance of environmental monitoring records also should be the responsibility of the employer, and the recommendations regarding the keeping of physician's reports should also apply to environmental monitoring records.

Environmental Monitoring

Environmental monitoring is valuable in determining the nature and extent of potential problems or, conversely, the effectiveness of control methods. Sampling the environment involves determining what, where, whom, how many, and for how long. Health and industrial hygiene personnel should maintain a continued surveillance when new materials or operations are being introduced to prevent the unregulated use of toxic agents.

With respect to skin hazards, accepted monitoring practice includes obtaining wipe samples of surfaces with which the employee comes in contact, including surfaces at the work site, in eating areas, and in restrooms. Wipe sampling is also used as a check on general housekeeping and as a measure of the pervasiveness of an agent in the workplace. Samples also may be taken, if needed, from the worker's breathing zone, the general workroom air, or at the source of possible leaks. In general, environmental monitoring is necessary where there are potential exposures to irritating, corrosive, or sensitizing particulates, liquids, mists, or vapors, or to physical or biological agents.

Environmental sampling and analysis

Two collection methods are recommended for skin-active substances: wipe sampling and atmospheric sampling. The basic techniques of wipe sampling were developed in radiation monitoring. The method consists of simply wiping a defined area with a piece of filter paper or a moistened cotton swab. Solid or condensed gas/liquids could cover work surface or general area surfaces; the exact area to be monitored should therefore be identified and measured so that the findings can be expressed in suitable units (grams per square centimeters, etc.). The paper filters or swabs should be properly labeled and then stored for weighing or laboratory analysis.

How atmospheric samples are collected depends on the physical form of the agent being monitored. Dust particulates and aerosols can be collected on filters or impingers; samples should be, as far as possible, personal breathing zone samples taken at periods throughout the work shift. Portable pumps are available to collect air samples. Area sampling using high-volume collection helps to identify sources of contamination and unusual concentrations, e.g., spills, but cannot be relied upon for determining individual exposure during a shift unless a rigorous time-motion study is also performed. Electric air pumps are available to collect air samples at rates on the order of 10^2 liters per minute. The material retained in filters and impingers should then be stored and analyzed.

Vapors and gases are collected on surface-active granules such as charcoal and silica gel. The collecting media are packed in small glass tubes suitable for personal or area samples. Pumps similar to those described above for paper filters and impingers are available for use with these tubes.

When skin-active substances have been collected, a properly qualified analytical or industrial hygiene laboratory should perform the sample analysis. In the case of wipe samples and vapors/gases, the analysis is preceded by the desorption of the sample from the collecting medium. Wet chemistry, gas chromatography, colorimetry, and infrared spectrometry are common analytical techniques used to quantify these substances. The final laboratory results should be reported in mg/cm^2 for wide samples and mg/m^3 or ppm for atmospheric samples.

Problems in Medical and Environmental Surveillance

The recommendations on medical and environmental surveillance made in this report reflect the complexity of the doctor-patient relationship in the workplace. The Committee recognized the significance and delicacy of some of these issues, but considered recommendations in these areas beyond the scope of this report. However, it was agreed that these problems should be mentioned. They are outlined below.

Medical removal protection

In some cases, employees may refuse to notify employers of any symptoms or may decline to submit to medical examination for fear of losing their jobs or being transferred to lower paying ones on the basis of the medical findings. What to do about this issue, commonly referred to as rate retention, is presently under consideration by OSHA. The principle of rate retention is that any worker who is transferred from one job to another because of medical findings would retain the same rate of pay, seniority, and other benefits as if the employee had continued in his regular job. This provision is incorporated in the OSHA lead standard.

Preplacement examinations

There is some controversy about the purpose and use of preplacement examinations. This concern is reflected in the choice of the term preplacement rather than pre-employment in this report. A preplacement examination is designed to determine the health status and any health limitations of an employee, so that the employee can be placed in a job appropriate to his health status and capabilities. The Committee's position on preplacement examinations is described [in the section on medical surveillance].

Screening for high risk

An important issue in both pre-placement and periodic medical examinations is the examination's intent. One purpose is to identify high-risk individuals so that they may be protected from potentially harmful exposure by not being assigned to the high-risk (for them) job, or by being transferred if they are already working in the high-risk job. Currently, considerable effort is being expended nationally to develop methods of detecting individual worker susceptibility to job hazards.

Some maintain that this use of medical examinations is inconsistent with the legislative intent of OSHA, which is to

provide a workplace safe for all employees; they are concerned that high-risk screening may break the important link between discovery of medical findings and subsequent improvement in the work environment. Others believe that the available screening tests are not sufficiently reliable or predictive to be useful. There are also those who are concerned that such screening tends inherently to select along ethnic, racial, or sexual lines. The Committee's position on the positive value of preplacement examinations as they relate to risk is cited [in the section on medical surveillance].

Communications

At the present time, an area of much controversy involves the communication of the results of medical examinations. Medical ethics and legal precedents dictate that workers be told of the results of their medical examinations, but there is some disagreement over how much of this information the employee should receive and whether the employee should be told by the examining doctor or his/her private physician.

The employer must know of medical findings that would affect job placement or adequacy of workplace controls, but how much information the employer should be given is open to question. It is argued that this issue directly affects the privacy and economic security of the involved employees. Medical records often are released for review by other parties as part of an epidemiological or public health survey, and maintaining the employee's privacy and security is also involved in these situations. The Committee's views on medical reporting are described [in the section on medical reports and recordkeeping].

Choice of physician

Another issue is whether the employee has the right to choose a physician other than the one selected by the company. Related to this problem is the question of how a difference in medical opinion between a company doctor and the employee's physician should be resolved. The Committee's position on medical surveillance may be found [above].

Quality control

In recent years, there has been increasing interest in clarifying and maintaining high ethical standards in the medical services offered in the occupational setting, extending to providing peer review and record review where none exists at present. The American Occupational Medical Association made an effort in this direction in 1976, when it published *Code of Ethical Conduct for Physicians Providing Occupational Medical Services*. Concern over quality control in laboratories which analyze biological monitoring samples has also been expressed.

Environmental surveillance

There are a number of problems that affect monitoring programs for hazardous materials in the workplace. Many of these problems are technical and concern such things as the accuracy of analytic techniques, the availability and expense of chemical sampling and analysis, and the availability of information on the identity of substances in the workplace. Additionally, thousands of substances to which workers are exposed have not been adequately researched and adequate standards or guidelines for the safe use of these substances have not been developed. For many of these agents, no standards at all are available. Furthermore, there is a shortage of trained industrial hygienists to perform the necessary environmental sampling to obtain this information.

APPLICATION OF GENERAL CONTROL PRINCIPLES TO PREVENTION OF OCCUPATIONAL SKIN DISORDERS

Successful prevention of skin disorders caused by chemical, physical or other agents encountered in industry requires a comprehensive effort on the part of management, labor, and health specialists. The accompanying diagram (Fig. 1) shows the interrelation of engineering, medical, industrial hygiene and educational efforts in managing the worker-agent-process interfaces. The reason for these efforts is attaining the worker's right to a workplace free of hazards, and employers should accept responsibility for ensuring that the entire safety program functions well.

With respect to the *worker*, prevention and control begin at the time of placement, with appropriate medical review to determine the presence of pre-existing skin disease or any other conditions that might later put the worker at undue risk. Once the worker is assigned to the job, there should be proper and continuing education with respect to safe work practices and potentially hazardous agents in the workplace. The final step of the program should be combining the training program, a knowledge of toxicological effects, and hazard information with personal protective equipment for the employee.

In the case of the *agent*, the first step involves development of basic toxicity information, followed by an evaluation of hazard and the provision of proper labels and other warnings. As noted earlier, this information is either keyed to the worker training effort or is related to process layout; through enclosure, substitution, isolation, ventilation, etc., exposure potential should be reduced. Biological and environmental monitoring are checks on these steps, and there should be continued reassessment of the effort.

The third major factor is the *process*. Initial design reviews take into account what is known about the toxicity of the agents employed and the final process layout reflects the need for labeling, signing, area restrictions, and so forth. The result of the interaction is the use of enclosures, substitutes, and other control methods, and then a program of continuing biological and environmental monitoring.

ILLUSTRATION OF WORKPLACE INTERACTIONS AND THE SEQUENCE OF ACTIVITIES NECESSARY TO PREVENT OCCUPATIONAL DISEASE

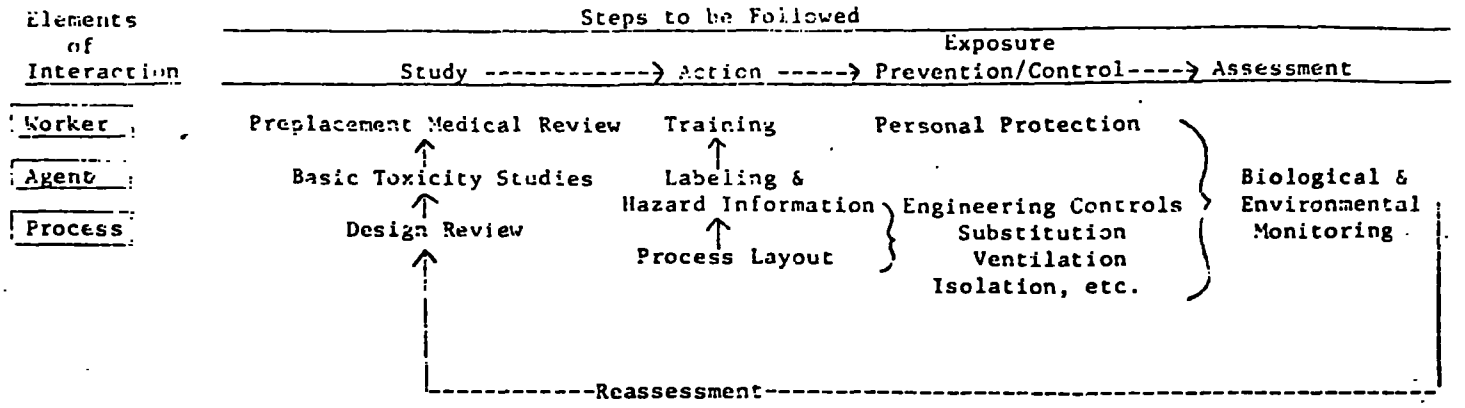

FIGURE 1

Case Examples of Controls

Powered Epoxy Spraying Operation

A manufacturer of household washing machines began using an epoxy material as a finished surface on its products. The epoxy material came in powdered form and was sprayed on the parts to be assembled, which were then baked in an oven to form an extremely hard surface. The spraying was done automatically, inside a booth. The parts passed through the booth hanging from an overhead conveyor. Overspray was exhausted out the bottom of the booth and into a barrel; some overspray remained on the inside walls of the booth. The only worker in the area during the spraying was an operator who sat inside an enclosed control booth and thus was not exposed to the epoxy powder.

On the midnight shift, however, when production was stopped, a clean-up crew entered the area to perform a number of duties:

(1) They used air hoses to blow out the overspray that had accumulated on the inside walls of the spray booth.

(2) They dumped barrels of exhausted overspray back into the supply system for reuse.

(3) They swept floors and other surfaces outside the booth to clean some spray that had escaped the booth.

The powder was very fine and the slightest turbulence caused it to become airborne, and consequently, a great concentration of epoxy dust was in the air. The clean-up crew was equipped with disposable respirators, hair covers, boots and complete coveralls. Despite the personal protection, several members of the clean-up crew broke out in rashes after the spraying had been performed for a few weeks.

The problem was solved, after an investigation, by changing the overspray exhaust system to return the overspray directly into the supply system, thus eliminating one major source of dust. Using a vacuum system rather than sweeping or air hoses eliminated the other sources of dust. No cases of dermatitis recurred.

Machining Operations

Exposure to cutting fluids in machining operations constitutes one of the major causes of industrial dermatitis. Controls that have virtually eliminated dermatitis have been instituted in many machining operations. For example, in one well-controlled plant that produces diesel engines, over 2,000 workers on two shifts operating approximately 1,000 machines had not a single case of recordable occupational dermatitis in 1977, in contrast to some poorly controlled operations in which roughly 30% of the work force have skin problems.

Control programs put into effect included:

(1) Careful identification, by generic name, of all ingredients in the cutting fluids used

(2) Programs to keep the coolant free of tramp oil, foreign particles and dirt through the use of effective filters and redesigning the coolant flow system to eliminate "eddies" and "backwaters" of coolant

(3) Daily programs to monitor coolant characteristics, such as pH, bacteria count, etc.

(4) Daily programs, such as hosing down, to keep machinery clean

(5) Redesigning spray application to minimize coolant splash and spray

(6) Using splash goggles and curtains

(7) Use of local exhaust systems and oil collectors to reduce airborne oil mist

(8) Use of abundant quantities of shop rags

(9) Provision of paid wash time to allow operators to keep clean

Experience shows that when the coolant is well controlled and measures are taken to reduce the amount of coolant splashed on the worker, the rate of dermatitis is reduced.

Rubber Manufacturing

Improvements in rubber manufacturing operations have reduced problems with skin disease in those plants where the improvements were made. These improvements have taken many forms:

(1) Improved methods of material handling to reduce the amount of skin contact with rubber and related chemicals.

(2) Substitution of known skin sensitizers by other, less hazardous chemicals, such as the replacement of isopropyl-phenyl-paraphenyl-diamine (IPPD), used as an anti-oxidant in tires, with other less toxic derivatives of paraphenylene diamine.

(3) Improved methods of mixing rubber chemicals to reduce exposure to a wide variety of known skin irritants and sensitizers: such improvements have included preblending

chemicals, using exhaust-ventilated mixing booths, and automation of the mixing process.

(4) In one plant, an air-conditioned isolation booth was installed for a worker who was strongly sensitized to an anti-ozonent.

Chemical Manufacturing

A major producer of industrial chemicals has instituted a wide variety of controls that have resulted in a reduced rate of dermatitis. Their program includes:

(1) Extensive use of self-contained systems to handle chemicals to eliminate worker exposure to dermatitis-producing substances; operations were designed with a goal of zero emissions.

(2) Mechanization of material-handling systems to eliminate worker exposure to chemicals.

(3) Emphasis on good plant housekeeping.

(4) Use of wipe testing to check equipment surfaces for films of toxic materials.

(5) Adoption of extensive employee education programs to inform them of the risks of chemicals.

(6) Implementation of programs of personal hygiene, which, in the case of one particularly hazardous material, included three daily showers for the exposed employee.

(7) For handling liquid chemicals, use of seal-less pumps and, where leaks cannot be permanently sealed, use of local exhaust systems; grouping of all pumps in one central area for better control; and scaling of floors around the pumps.

(8) Preparation of educational materials to be supplied to purchasers of chemicals, including proper controls for the materials.

Journal

MEETINGS SCHEDULED

April 11-12 — Hazardous Chemical Safety Seminar and Workshop, Santa Barbara, Calif. (Carol Morris, Office of Safety Training, J.T. Baker Chemical Company, Phillipsburg, N.J. 08865; tel: (201) 454-2500).

The seminar also will be held on the following dates at these locations:

April 11-12 — Ottawa, Ontario
April 17-18 — Philadelphia, Pa; Phoenix, Ariz.
April 19-20 — Halifax, Nova Scotia; Salt Lake City, Utah
April 23-24 — Minneapolis, Minn.
April 26-27 — Chicago, Ill.
April 30 — May 1 — Buffalo, N.Y.

April 11-12 — Regional Safety and Fire Conference and Exhibit, Philadelphia, Pa. (James J. McCarey, Greater Philadelphia Chamber of Commerce, Suburban Station Bldg., Suite 1960, 1617 J.F. Kennedy Blvd., Philadelphia, Pa. 19103; tel: (215) 568-4040).

April 11-12 — 45th Annual West Virginia Governor's Safety and Health Conference and Exposition, Charleston, W. Va. (W. Va. Safety Council, 1550 Fourth Ave., Charleston, W. Va. 25312).

April 12 — How to Develop a Safety Training Program, Allentown, Pa. (Lynn Whittier, Starson Corporation, P.O. Box 133, Stanton, N.J. 08885; tel: (201) 236-6015).

The course also will be offered throughout the month at the following locations:

April 17 — Anaheim, Calif.
April 24 — Oakland, Calif.

April 17-18 — Equal Employment and Collective Bargaining, sponsored by the Federal Bar Association and BNA Education Systems, New Orleans, La. (Equal Employment Conference Secretary, Suite S-150, BNA Education Systems, 1231 25th St., N.W., Washington, D.C. 20037; tel: (800) 424-8039).

April 23-27 — Basic Industrial Hygiene Course, Ann Arbor, Mich. (J.R. Conti, American Industrial Hygiene Association, 475 Wolf Ledges Parkway, Akron, Ohio, 44311; tel.: (216) 762-7294).

April 23-25 — 6th Colorado Safety Congress and Exposition, Denver, Colo. (Colorado Safety Association, 1726 Champa St., Denver Colo.; tel: (303) 629-6255).

April 23-May 4 — Industrial Hygiene for Safety Professionals, Beckley, W. Va. (National Mine Health and Safety Academy, Box 1166, Beckley, W. Va. 25801).

The seminar also will be held in the same location on May 7-18.

April 24-25 — 49th Annual Michigan Safety Conference, Lansing, Mich. (Andy Anderson, Michigan Safety Conference, Box 21211, Lansing, Mich. 48909; tel.: (517) 349-1003).

April 25 — Fundamentals of Workers Compensation, Burbank, Calif. (The Training Institute, 616 S. Westmoreland Ave., Los Angeles, Calif. 90005; tel: (213) 385-6461).

April 26 — Forklift Operators Training, Carson, Calif. (National Safety Council, The Training Institute, 616 S. Westmoreland, Ave., Los Angeles, Calif. 90005; tel.: (213) 385-6461).

April 26-27 — A Training Course for Occupational Health Nurses, Pittsburgh, Pa. (George Reilly, Industrial Health Foundation, 5231 Centre Ave., Pittsburgh, Pa. 15232; tel.: (412) 687-2100).

April 30-May 3 — 49th Ohio Safety Congress and Exhibit, Columbus, Ohio (Industrial Commission of Ohio, Division of Safety and Hygiene, 246 North High St., Columbus, Ohio 43215; tel.: (800) 282-3045).

April 30-May 3 — International Tool and Manufacturing Engineering Conference and Exposition, Detroit, Mich. (Tom Akas, Public Relations Department, Society of Manufacturing Engineers, 20501 Ford Rd., P.O. Box 930, Dearborn, Mich. 48128; tel.: (313) 271-1500).

April 30-May 3 — Mobile Cranes and Rigging Safety Training Program, Orlando, Fla. (United States Crane Certification Bureau, Inc., Thomas Poulos, Jr., 8000 S. Orange Ave., P.O. Box 13568, Orlando, Fla. 32859; tel: (800) 327-0300).

April 30-May 4 — 1979 American Occupational Health Conference, Anaheim, Calif. (Priscilla Campbell, AOMA, Box P, 150 North Wacker Dr., Chicago, Ill. 60606; tel: (312) 782-2166).

May 1-2 — Key Person Leadership Development, Burbank, Calif. (The Training Institute, Greater Los Angeles Chapter, National Safety Council, 616 S. Westmoreland Ave., Los Angeles, Calif. 90005; tel.: (213) 385-6461).

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The permeability of laboratory gloves to selected solvents*

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Samples of laboratory gloves of various compositions and thicknesses were used as the barrier between several common solvents and water or an n-alkane. The concentration of permeated solvent was measured periodically. Nearly all gloves tested were permeable to the solvents. The results indicate that gloves should not be assumed to provide full protection. When working with hazardous materials, gloves should be discarded immediately following overt contamination; gloves should not be reused.

introduction

The effectiveness of personal protective equipment is important because it is often used as a supplement to, and sometimes as a substitute for, environmental control, and because it is the last barrier between the worker and potentially hazardous materials. The occupational safety and health standards[1] use the words "suitable" and "adequate" in connection with eye and face protection, and refer to an "impervious suit" for use with carcinogens.[2]

Since workers' hands are usually in the most intimate and prolonged contact with potentially harmful materials, the permeability of gloves is of considerable importance. There have been reports of methylmethacrylate monomer,[3] tetraethyllead and ethylene bromide,[4] allergens and irritants,[5] and various organic compounds[6-9] penetrating gloves of various chemical composition and thickness. Manufacturers often describe the performance of glove materials exposed to chemicals in qualitative terms, without identifying the criteria on which their evaluations are based.

Because of the potential hazard associated with exposure to chemical carcinogens, a program to investigate the permeability of laboratory gloves to carcinogens was initiated. The results obtained when gloves were exposed to solutions of nitrosamines demonstrated that the solvent could facilitate the penetration of the

*Research sponsored by the National Cancer Institute under Contract NO1-CO-25423, with Litton Bionetics, Inc.

TABLE I
Extent of Solvent Penetration Through Glove Materials After 0.5 Hours

Solvent	Glove Material					
	Natural Rubber (0.4 mm)	Neoprene (0.4 mm)	Neoprene + Natural Rubber (0.5 mm)	Nitrile (0.4 mm)	PVC (0.2 mm)	PVA (0.4 mm)
Carbon Tetrachloride	D	D	D	A	D	A
Chloroform	D	D	D	D	D	A
Methylene Chloride	D	D	D	D	D	A
Methyl Iodide	D	D	D	D	D	A
1,1,2,2-Tetrachloroethane	D	D	D	C	D	A
1,1,2-Trichloroethane	D	D	D	D	D	A
Perchloroethylene	D	D	D	A	D	A
Methanol	A	A	A	A	B	D
Ethanol	A	A	A	A	B	C
2-Propanol	A	A	A	A	B	B
n-Butanol	A	A	B	A	B	A
Benzene	D	D	D	C	D	A
Toluene	D	D	D	C	D	A
Aniline	A	A	A	C	D	A
Phenol (10% Water)	B	A	B	A	B	C
Acetone	B	C	B	D	D	A
Methyl Ethyl Ketone	C	D	C	D	D	A
Tetrahydrofuran	D	D	D	D	D	A
Dimethyl Sulfoxide	A	A	A	A	B	D
Dimethyl Formamide	B	A	A	C	D	D
Pyridine	C	C	C	D	D	C
Dioxane	B	B	B	A	D	A
n-Hexane	C	A	C	A	D	A
Water (^1H_2O)	A	A	A	A	A	D

Key A = <0.1%, B = 0.1-1%, C = 1-10%, D = >10%, see text.

nitrosamine.[10] Since some solvents are very commonly used and some are skin penetrants, we determined which gloves should be used (or avoided) when employing selected solvents.

methods

glove materials

Disks about 2.5 cm in diameter were cut from flat areas of gloves for testing. Gloves were obtained from commercial suppliers and were of a variety of compositions: natural rubber, polyvinylchloride (PVC), polyvinylalcohol (PVA), nitrile (a copolymer of 1,3-butadiene and acrylonitrile), Neoprene, and a mixture of Neoprene and natural rubber. Before use, glove samples were rinsed in water and air-dried at room temperature (PVA samples were wiped and air-dried). Sample thickness was measured with a micrometer; samples were tested for leaks by securing them in an apparatus to which a cylinder containing pressurized halocarbon vapor was connected. The apparatus was pressurized to about 1 cm H_2O gauge with the vapor; and a halogen leak detector (General Electric Co., West Lynn, MA) was used to detect any escaping vapor. Samples which leaked were rejected.

permeants

The permeants (Table I) were obtained from commercial suppliers and were used as received. The permeants were at least 95% pure; the water was double-distilled and deionized; the n-alkanes were at least 99% pure.

permeability apparatus

A standard test method for the determination of permeability is available.[11] However, this method does not establish a time period for which a material may be considered impermeable under a given set of conditions. In addition, the test requires 200 ml of permeant. These disadvantages outweigh the benefits of using this standard technique.

Many permeation apparatuses have been described.[12] Because we would be working with chemical carcinogens, we wanted to handle as small a volume of material as possible. The apparatus used for permeability testing was made from glass O-ring joints (Figure 1). The material being tested partitioned the apparatus into two compartments which contained, respectively, the permeant and double-distilled, deionized water; for PVA samples an n-alkane was used instead of water. (The original concept was to use an emulsion of fats and water which would simulate the sebum normally secreted by human skin. Since this would have caused major analytical difficulties, physiological saline was used. This was fairly satisfactory, but comparative measurements showed that the results obtained with distilled water were the same as those obtained with saline.) A spring-loaded clamp was used to hold the apparatus securely together. To test the integrity of the assembly, cells containing CCl_4 and H_2O were maintained at room temperature (~20°C) and were weighed daily. The weight loss of two samples was less than 0.5% after 24 hours, and was less than 2.5% after 7 days.

For testing, a measured volume of permeant was added to the solid-bottom portion of the apparatus and the glove material sample was placed on top. (This established the starting time for each run.) The other portion of the apparatus was clamped in place and an equal volume of water was added to it. After the septum was attached, the assembled apparatus was placed with the long axis horizontal. Two or more tests were made at room temperature for each glove material - permeant combination. Samples from the same gloves were usually used for replicate determinations. After gently agitating the apparatus, samples (~2 μl) were extracted periodically from the water side with a microsyringe. Samples were usually extracted at 0.5, 1, 2, 4, 6, and 8 hours after assembling the permeability apparatus.

solubility

When data for the solubility of permeant in water or n-alkanes were not available in the literature,[13] solubility was determined by direct measurement. Excess permeant was mixed with water or n-alkane at room temperature for 30 minutes or allowed to stand overnight. A portion of the water or n-alkane phase was withdrawn with a microsyringe and assayed for permeant concentration by gas chromatography.

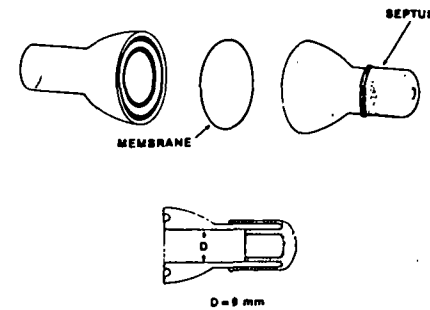

Figure 1—Permeability cell.

analysis

Samples extracted from permeation cells were injected onto the column of a Hewlett-Packard gas chromatograph for analysis. A flame ionization detector was used for the determination of all permeants. The stationary phase used was 5% DEGS or 3% SE-30. Chromosorb W-AW-DMCS (80/100 mesh) was the support material. The injection ports and detectors of the gas chromatograph were ventilated.[14]

The permeability of glove materials to water was determined by using tritiated water (New England Nuclear Corp., Boston, MA) as the permeant. The specific activity was 0.63 mCi/ml. Samples (5 μl) were added to 10 ml of Biofluor (New England Nuclear Corp., Boston, MA) and were counted for 5 minutes on a Beckman Model LS-350 liquid scintillation counter.

results

The data obtained from gas chromatographic analysis were converted from volume percent penetrant in water (or n-alkane) to percent of equilibrium achieved. (That is, if a penetrant were soluble to the extent of 15 volume percent, and analysis showed that at a given time a sample contained 0.3 volume percent of the penetrant, the percent equilibrium achieved at that time would be 2%).

The percent equilibrium achieved values were ranked as follows: If the amount penetrated was less than 0.1% of the equilibrium value, the glove material - penetrant system was given an A; if 0.1-1% penetrated, a B; if 1-10% penetrated, a C;

TABLE II
Extent of Solvent Penetration Through Glove Materials After 4 and 8 Hours

	Glove Material					
Solvent	Natural Rubber (0.4 mm)	Neoprene (0 4 mm)	Neoprene + Natural Rubber (0 5 mm)	Nitrile (0 4 mm)	PVC (0 2 mm)	PVA (0 4 mm)
Carbon Tetrachloride				Ad		Aa
Chloroform						B
Methylene Chloride						B
Methyl Iodide						B
1,1,2,2-Tetrachloroethane						Ab
1,1,2-Trichloroethane						Ab
Perchloroethylene				C		Aa
Methanol	B	B	B	C		
Ethanol	B	Ab	B	Ab		
2-Propanol	B	Aa	B	Aa		
n-Butanol	C	Aa		Aa		C
Benzene						Ab
Toluene						Aa
Aniline	C	D	C			B
Phenol (10% Water)		Ac		D		
Acetone						C
Methyl Ethyl Ketone						B
Tetrahydrofuran						C
Dimethyl Sulfoxide	Ab	B	B	B		
Dimethyl Formamide		C	C			
Pyridine						
Dioxane				D		C
n-Hexane		C		Aa		Aa
Water (^1H_2O)	Aa	Aa	Aa	Ab	B	

Key Upper case letters are used for 4 hour data, lower case letters for 8 hour data. A,a = <0 1%, B,b = 0 1-1%, C,c = 1-10%, D,d = >10%, see text.

and if more than 10% penetrated, the system was given a D. Where low solubility of the penetrant in water made this quasi-quantitative ranking equivocal, tests were repeated using an n-alkane.

The results for all penetrant-glove material systems at 0.5 hours are shown in Table I. The nominal sample thickness is also shown. The variation in PVA sample thicknesses was ±0.1 mm. For other glove materials the variation was half this value. The results at 4 hours for all systems which got an A at 0.5 hours are shown in Table II. Table II also shows the results at 8 hours for all systems which got an A at 4 hours.

Replicate measurements were usually reproducible to within 10%. In less than 15% of the cases did replicates yield different rankings; in all cases where this occurred, the rankings were always adjacent (i.e., A and B, B and C, or C and D), and the poorer was tabulated. A limited number of tests were done using samples of natural rubber from two manufacturers. No substantial difference in penetration characteristics was observed.

discussion

The results shown in Table I indicate that, in many cases, substantial amounts of solvent penetrate the glove material within half an hour. The scope of potential worker exposure to solvents resulting from inadequate protective equipment can be roughly estimated. U.S. production figures for 1970 or 1969 are available for 14 of the solvents listed in Table I;[15-17] over 13 billion kilograms were produced. More than 2.5 million workers are potentially exposed to these materials.[18-22]

The penetration of glove materials other than PVA by water and of PVA by n-hexane was slight (Tables I and II), suggesting that these solvents had little effect on the glove materials and that the water or n-alkane used as the third component when testing glove material - solvent combinations did not contribute materially to the penetration observed. Overall, the polyvinylalcohol glove material gave the best performance, and polyvinylchloride gave the worst. (So far as we are aware, unsupported

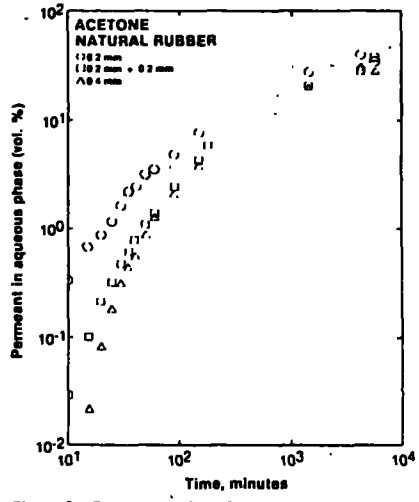

Figure 2—The penetration of acetone through natural rubber samples of different thickness.

PVA gloves are not commercially available.) Supported gloves with a 0.4 mm coating may not be well received by laboratory workers because of their unwieldiness. Several glove materials performed well with the alcohols tested; in general, Neoprene and nitrile were best.

Increasing the thickness of the glove material should improve its performance. Samples of natural rubber, 0.2 mm, 0.4 mm, and two 0.2 mm thick samples together, were exposed to acetone. The results (Figure 2) show that the 0.4 mm sample and the two 0.2 mm thicknesses had similar penetration characteristics. Both performed better than the single 0.2 mm sample.

The adequacy of a glove material when used with a particular agent depends on a number of factors. Among these are the degree to which the glove material resists penetration by the agent, the effect of exposure on the structural characteristics of the glove, the skin penetrability of the agent, and its toxicity. About half the solvents tested in this investigation can be absorbed through the skin;[23] toxic effects are associated with overexposure to several of them;[24] and some have been identified as suspected carcinogens.[25] Work reported elsewhere,[10] employing differential scanning calorimetry and electron microscopy of nitrile glove samples before and after exposure to ethanol, demonstrated that structural alteration of glove materials can occur. This finding suggests that even though a glove material may resist penetration by a solvent, it cannot be assumed that under conditions of repeated use the glove will continue to provide protection.

The experimental conditions under which the data presented above were obtained were rigorous in that the glove materials were completely wetted with the solvent. (It has been shown[26] that liquid and saturated vapor permeate at the same rate.) However, the following points should be taken into consideration. About 5% of the glove samples leaked and were not tested for permeability; gloves are not usually tested before use. Any glove could have a thin spot, through which permeation would occur at a higher rate. (This probably accounts for some of the variability in replicate measurements.) Skin temperature is about 35°C, about 10° higher than the temperatures at which the permeation tests were made; permeation is invariably higher at elevated temperatures.

We have established that, in some cases, laboratory gloves (and presumably industrial gloves and other protective equipment) do not provide full protection. When working with hazardous materials, gloves should be discarded immediately following overt contamination; gloves should not be reused. Gloves, and other protective equipment, should be tested under appropriate conditions by the manufacturer or the user to ensure satisfactory performance and full protection of the worker.

acknowledgments

We thank T.L. Clark of Edmont-Wilson for making the PVA film available to us.

references

1. Code of Federal Regulations, Title 29, Chapter XVII, Part 1910.133.
2. Code of Federal Regulations, Title 29, Chapter XVII, Parts 1910.1003, .1004, .1006 - .1016.
3. Pegum, J.S. and F.A. Medhurst: Contact Dermatitis from Penetration of Rubber Gloves by Acrylic Monomer. *Brit. Med. J.* 2:141 (1971).
4. Calingaert, G. and H. Shapiro: Permeability of Protective Glove Materials to Tetraethyllead and

Ethylene Bromide. *Ind. Eng. Chem. 40*:332 (1948).
5. **Moursiden, H.T. and O. Faber**: Penetration of Protective Gloves by Allergens and Irritants. *Trans. St. John's Hosp. Dermatol. Soc. 59*:230 (1973).
6. **Mueller, W.J.**: Permeability of Rubber to Organic Liquids. *Rubber Age 81*:982 (1957).
7. **McFee, D.R.**: How Well Do Gloves Protect Hands - Against Solvents? *Am. Soc. Safety Engrs. Journal 9*:11 (1964).
8. **Johnson, T.C. and W.D. Merciez**: Permeation of Halogenated Solvents through Drybox Gloves. U.S. Atomic Energy Comm., RFP-1608 (1971).
9. **Banthorpe, D.V. and D.M. Lamont**: Potential Toxicity of Solutions of Dimethyl Sulphoxide. *Nature 215*:1296 (1967).
10. **Sansone, E.B. and Y.B. Tewari**: The Permeability of Laboratory Gloves to Selected Nitrosamines. In *Environmental Aspects of N-Nitroso Compounds*, 1978 (Walker, E.A., Castegnaro, M., Griciute, L. and Lyle, R.E., eds.) Lyon, International Agency for Research on Cancer (in press).
11. **American Society for Testing and Materials**. Permeability of Vulcanized Rubber or Synthetic Elastomers to Volatile Liquids. ASTM Standards *28*.403 (1968).
12. **Crank, J. and G.S. Park**: Methods of Measurement. In CRANK, J. and G.S. PARK (eds.) *Diffusion in Polymers*, pp. 1-39, Academic Press, New York (1968).
13. **Seidell, A.**: *Solubilities of Organic Compounds*. 3rd Ed. *passim*, Van Nostrand, New York (1941)
14. **Sansone, E.B., H. Wolochow and M.A. Chatigny**: Potential Hazards Associated with Removal of Needles from Septa in Injection Ports of a Gas Chromatograph. *Anal. Chem. 49*:670 (1977).
15. **Austin, G.T.**: The Industrially Significant Organic Chemicals - Parts 1-3, 5-7. *Chem. Eng. 81*: #2,127; #4,125; #6,87; #9,143; #11,101; #13,149 (1974).
16. **U.S. Department of Health, Education, and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . . *Occupational Exposure to Benzene*, p. 21 U.S. Government Printing Office, Washington, D.C. (1974)
17. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . . *Occupational Exposure to Toluene*, p. 14, U.S. Government Printing Office, Washington, D.C. (1973).
18. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . .*Occupational Exposure to Chloroform*, p. 16, U.S. Government Printing Office, Washington, D.C. (1974).
19. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . .*Occupational Exposure to Methylene Chloride*, p. 17, U.S. Government Printing Office, Washington, D.C. (1976).
20. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . .*Occupational Exposure to Methyl Alcohol*, p. 19, U.S. Government Printing Office, Washington, D.C. (1976).
21. **U.S. Department of Health, Education, and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . . *Occupational Exposure to Isoprophyl Alcohol*, p.22, U.S. Government Printing Office, Washington, D.C. (1976).
22. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. Criteria for a Recommended Standard . . . *Occupational Exposure to Phenol*, p. 24, U.S. Government Printing Office, Washington, D.C. (1976).
23. **American Conference of Governmental Industrial Hygienists**. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977. ACGIH, Cincinnati, OH (1977).
24. **American Conference of Governmental Industrial Hygienists**. Documentation of the Threshold Limit Values for Substances in Workroom Air. 3rd. Ed. (1971). Supplement (1972-1973), Supplement (1974-1975), ACGIH, Cincinnati, OH.
25. **U.S. Department of Health, Education and Welfare**, National Institute for Occupational Safety and Health. *Registry of Toxic Effects of Chemical Substances*. U.S. Government Printing Office, Washington, D.C. (1976).
26. **Stannett, Y. and H. Yasuda**: Liquid versus Vapor Permeation through Polymer Films. *J. Poly. Sci. B1*:289 (1963).

summary reports . . .

Penetration of protective clothing materials by 1,2-dibromo-3-chloropropane, ethylene dibromide, and acrylonitrile

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Recent concern over the toxicity and potential carcinogenicity of 1,2-dibromo-3-chloropropane (DBCP), ethylene dibromide (EDB), and acrylonitrile (AN), led us to determine whether, and to what extent, they penetrated common protective clothing materials after relatively brief exposures. EDB has been shown to penetrate a variety of materials;[1] however, most exposures were for 20-24 hours.

Materials tested by us were 0.4 mm natural rubber, 0.4 mm neoprene, a 0.5 mm mixture of natural rubber and neoprene, 0.2 mm polyvinylchloride (PVC), 0.4 mm polyvinylalcohol (PVA), and 0.4 mm nitrile (a copolymer of 1,3-butadiene and AN). For DBCP only, 0.4 mm butyl rubber and 0.04 mm and 0.08 polyethylene were also tested. Materials from commerical suppliers were leak tested, washed with water, and air-dried at room temperature before use (PVA samples were wiped and air-dried). Sources of chemicals and reported purities were: DBCP, Dow Chemical Co., 97.4%; EDB, Fisher Scientific Co., 99%; and AN, Aldrich Chemical Co., 99+%.

In an apparatus described elsewhere,[2] the material under test initially separated equal volumes of the penetrant and a liquid which was miscible with the penetrant and had a negligible effect on the material. Two μL samples of the latter were extracted 5, 15, 30, 60, 120, and 240 minutes after assembly of the apparatus, and were analyzed by gas chromatography. Duplicate runs were made with each material and penetrant. The materials which performed best were retested in quintuplicate. A portion of these results is shown in Table I. Measurable penetration usually occurred after 5 minutes. In some cases substantial penetration was observed.

The chemicals tested are readily adsorbed through the skin;[3,4] therefore, gloves and protective clothing should be discarded immediately after they become contaminated. The adjective "impervious" has been applied to

TABLE I
Range of Penetrant Concentrations (Volume Percent) Observed After 5 and 240 Minutes

Penetrant	Material	Concentration: 5 minutes	Concentration: 240 minutes
DBCP	PVA	$<10^{-4}$ - 3.3×10^{-4}	3.6×10^{-1} - 8.3×10^{-1}
	nitrile	$<10^{-4}$ - 3.1×10^{-4}	0.53 - 2.75
	neoprene	$<10^{-4}$ - 6.6×10^{-4}	5.2 - 14.5
	butyl rubber	$<10^{-4}$	$<10^{-4}$ - 1.7×10^{-4}
	0.08 mm polyethylene	$<10^{-4}$ - 6.2×10^{-4}	0.068 - 0.119
	0.04 mm polyethylene	2.9×10^{-1} - 6.4×10^{-1}	0.178 - 0.377
EDB	PVA	1.3×10^{-4} - 3.7×10^{-1}	1.3×10^{-1} - 9.8×10^{-1}
	nitrile	2.3×10^{-4} - 5.6×10^{-1}	15.5 - 27.5
AN	PVA	none detected*	0.090 - 0.166
	natural rubber	none detected	0.162 - 0.292
	neoprene	none detected	2.60 - 4.85

*Limit of detection (N-P detector) was about 10^{-1} volume percent.

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the performance of protective clothing and equipment intended for use with carcinogens.[5] If the chemicals tested are carcinogenic, our results suggest that none of the materials tested is suitable for use.

acknowledgements

Research supported by the National Cancer Institute. We thank Dow Chemical for the DBCP and Edmont-Wilson for the PVA film and the polyethylene boots and gloves.

references

1. **Callingaert, G. and H. Shapiro:** Permeability of Protective Glove Materials to Tetraethyllead and Ethylene Bromide. *Ind. Eng. Chem. 40*:332 (1948).
2. **Sansone, E.B. and Y.B. Tewari:** In *Environmental Aspects of N-Nitroso Compounds*, (E.A. Walker, M. Castegnaro, L. Gricitue, R.E. Lyle, eds.) International Agency for Research on Cancer, Lyon (1978) in press.
3. **American Conference of Governmental Industrial Hygienists:** Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1977. ACGIH, Cincinnati, OH (1977).
4. **Torkelson, T.R., S.E. Sadek, V.K. Rowe, J.K. Kodama, H.H. Anderson, G.S. Loquvan and C.H. Hine:** Toxicologic Investigations of 1,2-Dibromo-3-Chloropropane. *Toxicol. Appl. Pharmacol. 3*:545 (1961).
5. **U.S. Code of Federal Regulation,** Title 29, Chapter XVII, Parts 1910.1003, .1004, .1006-.1016

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THE PERMEABILITY OF LABORATORY GLOVES TO SELECTED NITROSAMINES

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INTRODUCTION

Manufacturers often describe the performance of glove materials exposed to chemicals in qualitative terms, without identifying the criteria on which their evaluations are based. Reported work (Banthorpe & Lamont, 1967; Calingaert & Shapiro, 1948; Johnson & Merciez, 1971; McFee, 1964; Moursiden & Faber, 1973; Mueller, 1957; Pegum & Medhurst, 1971) suggests that manufacturers' claims may be optimistic.

Because of the potential hazard associated with exposure to chemical carcinogens, a program to investigate the permeability of laboratory gloves to such agents was initiated. The nitrosamines were selected for investigation for a number of reasons. Several of them have been shown to be carcinogenic in a variety of animal species (for example, Druckrey et al., 1967 and Magee & Barnes, 1967), they are frequently used in experimental carcinogenesis and one of them (nitrosodimethylamine) has been defined as a potential human carcinogen by Federal regulation (U.S. Department of Labor, 1974). In addition, no published reports concerning their ability to penetrate protective equipment have appeared[1].

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[1] Solutions of nitrosodimethylamine, nitrosodiethylamine, nitrosodipropylamine, nitrosodibutylamine, nitrosopiperidine and nitrosopyrrolidine in dichloromethane and n-hexane at 20°C readily penetrated latex and polyvinylchloride gloves (personal communication, K.S. Webb, Laboratory of the Government Chemist, London, November 1976).

Analysis

Samples extracted from permeation cells were injected on to the column of a Hewlett-Packard gas chromatograph for analysis. A flame ionization detector was used for the determination of acetone, ethanol and dichloromethane, for solutions of nitrosamines in dichloromethane and for relatively high concentrations of nitrosamines in other solvents. A nitrogen-phosphorus detector (Hewlett-Packard 18847A) was used for the determination of low concentrations of nitrosamines in acetone, ethanol and water. The stationary phase used for acetone, ethanol and dichloromethane was 3% SE-30; for the nitrosamine solutions, 5% DEGS was used. Chromosorb W-AW-DMCS (80/100 mesh) was the support material.

The permeability of glove materials to water was determined by using tritiated water (New England Nuclear Corp, Boston, Ma.) as the permeant compound. The specific activity was about 0.63 mCi/ml. Samples (5 µl) were added to 10 ml of Biofluor (New England Nuclear Corp, Boston, Ma.) and were counted for 5 minutes on a Beckman Model LS-350 liquid scintillation counter. Background counts were made for Biofluor and Biofluor + 5 µl water.

Safety precautions

Work was performed in a restricted access area by workers who wore protective clothing and gloves for all operations. Dilutions of nitrosamines were made in a chemical fume hood (face velocity > 0.5 m/sec). All work with diluted nitrosamines (with the exception of analysis) was performed in a closed-front hood equipped with arm-length gloves and an iris diaphragm for removing syringes. The floors of the hoods and trays were covered with plastic-backed absorbent paper. Hoods were equipped with HEPA and charcoal filters. The injection ports and detectors of the gas chromatograph were ventilated (Sansone et al., 1977).

Contaminated, disposable, solid wastes were double-bagged and incinerated. Contaminated liquid wastes and reusable equipment (permeation cells and volumetric flasks) were treated by the technique described by Gangolli et al. (1974). The resulting liquid wastes were poured over absorbent material in one-gallon plastic containers. These were bagged and incinerated. Micro-syringes were rinsed repeatedly with water and ether until injection on the gas chromatograph gave no response. The syringes were vacuum-dried in the hood; a liquid trap was placed in the vacuum line.

RESULTS

Permeability of glove materials to solvents

The results obtained when glove materials were exposed to dichloromethane, acetone, ethanol and tritiated water are shown in Figures 2-5.

FIG. 2. PERMEABILITY OF GLOVE MATERIALS TO DICHLOROMETHANE

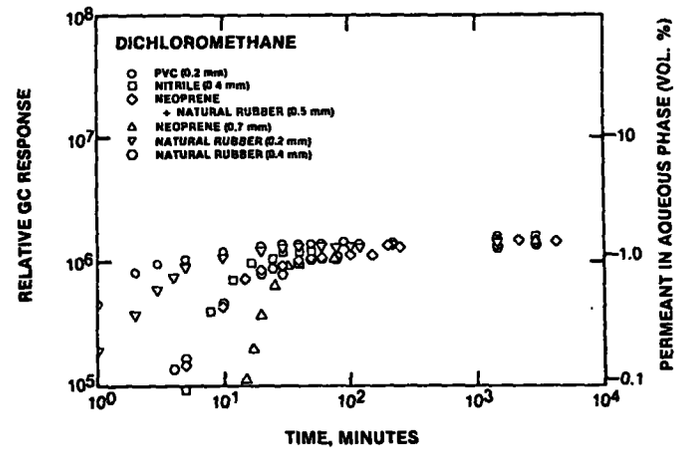


FIG. 3. PERMEABILITY OF GLOVE MATERIALS TO ACETONE

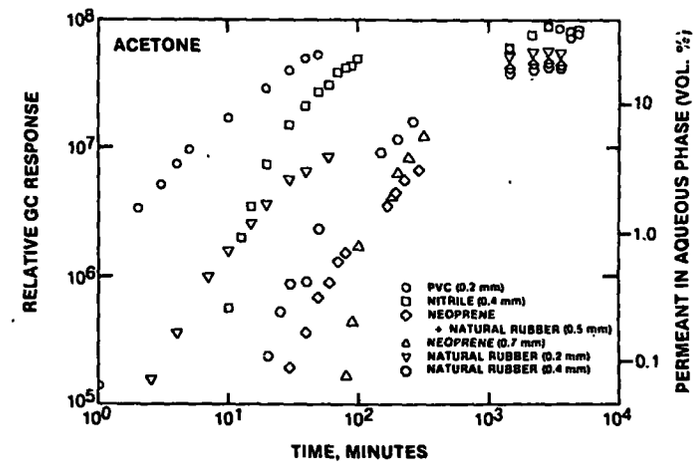


FIG. 4. PERMEABILITY OF GLOVE MATERIALS TO ETHANOL

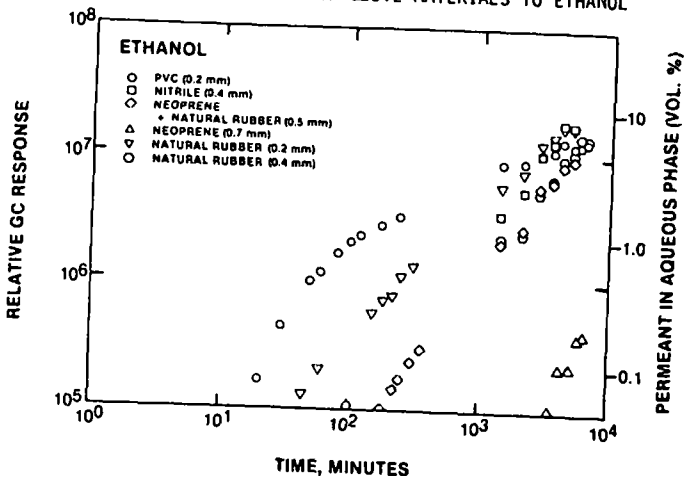
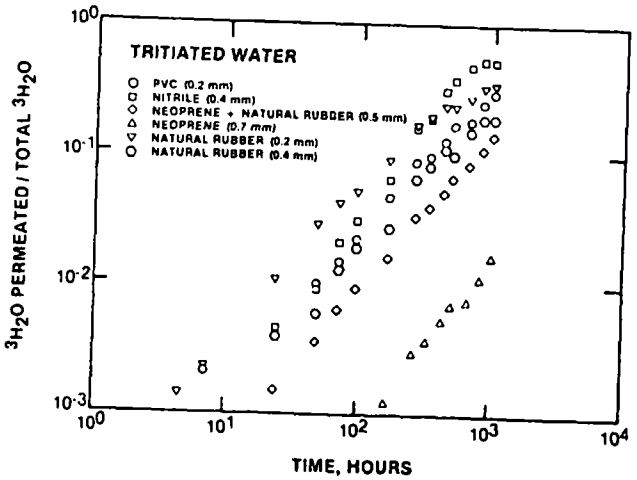


FIG. 5. PERMEABILITY OF GLOVE MATERIALS TO TRITIATED WATER



These data were used for comparative purposes; only single runs were made.

Dichloromethane rapidly penetrated all glove materials tested, acetone and ethanol penetrated less readily and tritiated water quite slowly. In general, the rate of penetration for a solvent appeared to be inversely proportional to the thickness of the material tested.

Permeability of glove materials to nitrosamines

The nitrosamines used were dimethyl- (NDMA), ethylmethyl- (NEMA), diethyl- (NDEA), n-butylmethyl- (NBMA), di-n-propyl- (NDPA), di-isopropyl- (NDiPA) and di-sec-butyl- (NDsBA). Each nitrosamine-solvent combination was tested with four or five glove materials. Triplicate tests were made for the two (sometimes three or four) glove materials which were least permeable. Samples were usually extracted for analysis at 0.5, 1, 2, 4, 6 and 8 hours after assembling the permeation apparatus.

A portion of the results appears in Tables 1-4. The entries are the highest nitrosamine concentrations in the aqueous phase observed after 6-8 hours.

Solutions of nitrosamines in dichloromethane and acetone rapidly penetrated the glove materials tested (Tables 1 & 2). Nitrosamines of increasing molecular weight penetrated less readily. No glove material is obviously superior for use with dichloromethane; probably because it passes rapidly through all glove materials (Fig. 2). With acetone, 0.4 mm natural rubber and 0.5 mm neoprene + natural rubber performed better than the other glove materials.

Table 1. Maximum penetration (m-mol/l) through glove materials after 6-8 hours: 0.136 M solutions of nitrosamines in dichloromethane

Nitrosamine	Glove material					
	Nitrile (0.4 mm)	Neoprene (0.4 mm)	Natural rubber (0.4 mm)	Natural rubber (0.2 mm)	Neoprene + natural rubber (0.5 mm)	PVC (0.2 mm)
NDMA	38.0	34.3	35.8	34.3	NT[a]	32.6
NEMA	20.7	14.4	12.3	11.3	NT	9.9
NDEA	4.5	3.8	4.1	NT	4.3	4.5
NBMA	4.1	2.1	1.2	1.4	3.1	1.5
NDPA	b	0.2	0.3	NT	0.3	0.8
NDIPA	1.4	0.5	0.5	NT	0.4	1.6
NDsBA	2.0	<0.2	<0.2	NT	< 0.2	0.3

[a] NT - Not tested
[b] Glove failed
In most cases, maximum penetration was reached in four hours or less.

Table 2. Maximum penetration (m-mol/l) through glove materials after 6-8 hours: 0.136 M solutions of nitrosamines in acetone

Nitrosamine	Glove material					
	Nitrile (0.4 mm)	Neoprene (0.4 mm)	Natural rubber (0.4 mm)	Natural rubber (0.2 mm)	Neoprene + natural rubber (0.5 mm)	PVC (0.2 mm)
NDMA	81.6	24.1	5.0	12.5	8.6	NT[a]
NEMA	72.1	12.1	2.7	15.6	8.2	NT
NDEA	80.2	16.1	6.8	NT	6.8	75.1
NBMA	65.6	15.0	5.7	9.0	3.7	77.5
NDPA	63.1	3.5	2.0	NT	3.0	63.2
NDiPA	52.4	4.1	2.3	NT	2.3	63.9
NDsBA	[b]	0.7	0.5	NT	0.4	25.8

[a] NT - Not tested
[b] Glove failed

Solutions of nitrosamines in ethanol (Table 3) penetrated the glove materials tested less readily than when dichloromethane or acetone was the solvent. In general, penetration of nitrosamines decreased with increasing molecular weight. The 0.4 mm nitrile and the 0.4 mm neoprene glove materials performed best.

Table 3. Maximum penetration (m-mol/l) through glove materials after 6-8 hours: 0.136 M solutions of nitrosamines in ethanol

Nitrosamine	Glove material					
	Nitrile (0.4 mm)	Neoprene (0.4 mm)	Natural rubber (0.4 mm)	Natural rubber (0.2 mm)	Neoprene + Natural rubber (0.5 mm)	PVC (0.2 mm)
NDMA	ND[a]	0.7	2.4	6.4	NT[b]	NT
NEMA	0.3	0.5	1.2	2.3	1.8	NT
NDEA	0.8	< 0.2	1.3	NT	0.6	5.6
NBMA	0.1	0.4	2.1	4.2	1.1	2.6
NDPA	0.4	0.3	0.7	NT	0.3	2.6
NDiPA	0.03	0.02	0.3	NT	0.3	1.1
NDsBA	0.05	0.02	0.09	NT	0.08	0.1

[a] ND - Not detected
[b] NT - Not tested

With water as the solvent (Table 4), nitrosamines penetrated more readily as their molecular weight increased. The nitrile glove allowed least penetration.

Table 4. Maximum penetration (m-mol/l) through glove materials after 6-8 hours: 0.136 M solutions of nitrosamines in water

Nitrosamine	Glove material					
	Nitrile (0.4 mm)	Neoprene (0.4 mm)	Natural rubber (0.4 mm)	Natural rubber (0.2 mm)	Neoprene + natural rubber (0.5 mm)	PVC (0.2 mm)
NDMA	ND[a]	0.2	0.7	4.6	NT[b]	NT
NEMA	ND	0.3	2.2	6.8	1.4	NT
NDEA	ND	0.2	4.8	NT	3.0	12.9
NBMA	<0.02	2.5	9.5	30.2	6.8	NT
NDPA[c]						
NDiPA[c]						
NDsBA[c]						

[a] ND - Not detected
[b] NT - Not tested
[c] Not sufficiently soluble to yield 0.136 M solution

Effect of nitrosamine concentration

In addition to the concentration specified in Table 2, 0.5 mm neoprene + natural rubber was tested with 0.0136 M and 1.36 M NEMA in acetone.. The data obtained, when expressed as the time to reach a given fraction of the initial concentration, were not very different from that for 0.136 M NEMA. This suggests that, over this range of concentrations, the rate at which NEMA penetrated neoprene + natural rubber was independent of concentration. However, it should be noted that the permeant solutions are at least 90% acetone, possibly implying that the acetone is controlling penetration, rather than the nitrosamine.

Effect of glove material thickness

To quantify the effect of thickness, samples of natural rubber (0.2 mm, 0.4 mm, two thicknesses of 0.2 mm and two thicknesses of 0.2 mm separated by a 0.6 mm stainless steel spacer) were tested with acetone. The 0.4 mm glove provided more protection than a 0.2 mm glove; two thicknesses of 0.2 mm provided about the same protection as a single 0.4 mm sample. The double thickness glove with spacer provided somewhat more protection than the double thickness glove alone (probably because of the increased resistance to mass transfer imposed by the air space).

Effect of permeant solution on glove material

The finding that a particular permeant solution penetrates a given glove material to a very limited extent does not ensure that the material remains suitable for use. As a means of assessing alteration in a glove material exposed to a permeant solution, differential scanning calorimetry was used to determine the glass transition temperature (T_g) of samples of 0.4 mm nitrile gloves. Samples were untreated or exposed to ethanol or 0.136 M NEMA in ethanol for 1, 2 or 8 days and dried for 1 or 8 days following treatment. Electron photomicrographs were made of selected samples.

The results presented in Table 5 show that T_g is lowered by exposure to ethanol, that addition of NEMA made no significant difference, that T_g was not reduced by treatments exceeding one day in length and that drying for 8 days allowed T_g to return to its original (untreated) value.

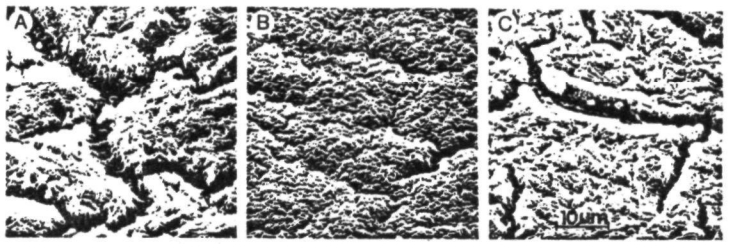
Table 5. Glass transition temperatures (°K) determined by differential scanning calorimetry of 0.4 mm nitrile glove samples subjected to various treatments[a]

Drying period (days)	Ethanol			0.136 M ethylmethylnitrosamine in ethanol		
	Treatment period (days)			Treatment period (days)		
	1	2	8	1	2	8
1	252	251	249	252	251	249
	252	251	247	253	252	249
8	260	258	256	259	258	258
	259	258	256	259	258	258

[a] Replicate measurements made on untreated samples yielded $T_g = 258 \pm 1$°K

The electron photomicrographs demonstrate a clear difference between the untreated and the 8 days treated + 1 day dried samples (Fig. 6A,B) and considerable similarity between the untreated and the 8 days treated + 8 days dried samples (Fig. 6A,C).

FIG. 6. ELECTRON PHOTOMICROGRAPHS ILLUSTRATING THE EFFECT OF ETHANOL ON 0.4 mm NITRILE GLOVE SAMPLES



DISCUSSION

The data obtained showed that, in nearly all cases, readily measurable amounts of nitrosamines penetrated glove materials within half an hour. This suggests that gloves be discarded immediately following overt contamination. It is probably wise also to dispose of gloves following completion of an operation. Limited work using differential scanning calorimetry suggests that exposure of glove materials to solvent and/or carcinogen may lead to a change in the glass transition temperature. Electron photomicrographs stregthen the hypothesis that this is an indication of structural alteration. Even if such changes are reversible, reusing gloves is ill-advised.

The nitrosamine penetration data presented were the most conservative, from the point of view of safety, in that the maximum observed concentration was cited. The maximum concentration was used, rather than the mean or a range, for the following reasons: about 5% of the gloves leaked and were not tested for permeability (gloves are not usually tested before use); any nonleaking glove could have a thin spot, through which permeation would occur at a high rate; skin temperature is about 35°C, about 10° higher than the temperatures at which the permeation tests were made (permeation is invariably higher at elevated temperatures). Another conservative factor arose from the complete wetting of both sides of the glove materials, so that permeation was maximized[1].

[1] Stannett & Yasuda (1963) have shown that liquid and saturated vapour permeate at the same rate.

Some of the uncertainties associated with these measurements (variations in response as a function of time in the N-P detector, incomplete mixing of the transferred material and water, for example) cannot be quantitatively estimated. Nevertheless, it is clear that the nitrosamines tested can penetrate glove materials, as can the organic solvents used, and that the laboratory gloves commonly used do not provide full protection from possible exposure to potentially harmful materials.

SUMMARY

Samples of laboratory gloves of various composition and thicknesses were used as barriers between 0.136 M solutions of nitrosamines (dimethyl-, ethylmethyl-, diethyl-, n-butylmethyl-, di-n-propyl-, di-iso-propyl- and di-sec-butyl- in dichloromethane, acetone, ethanol and double-distilled, deionized water) and water. The concentration of permeated nitrosamine was measured periodically. Nearly all gloves tested were permeable to the nitrosamine solutions. The results indicate that: (1) gloves should not be assumed to provide full protection, (2) gloves should be discarded immediately following overt contamination and (3) gloves should not be reused.

ACKNOWLEDGEMENTS

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REFERENCES

American Society for Testing and Materials (1968) Permeability of vulcanized rubber or synthetic elasmomers to volatile liquids. *ASTM Standards, 28*, 403-405

Banthorpe, D.V. & Lamont, D.M. (1967) Potential toxicity of solutions of dimethyl sulphoxide. *Nature (Lond.), 215*, 1296-1297

Calingaert, G. & Shapiro, H. (1948) Permeability of protective glove materials to tetraethyllead and ethylene bromide. *Ind. Eng. Chem., 40*, 332-335

Druckrey, H., Preussman, R., Ivankovic, S. & Schmähl, D. (1967) Organotrope carcinogene Wirkungen bei 65 verschiedenen N-Nitroso-Verbindungen an BD-Ratten. *Z. Krebsforsch., 69*, 103-210

Gangolli, S.D., Shilling, W.H. & Lloyd, A.G. (1974) A method for the destruction of nitrosamines in solution. *Food Cosmet. Toxicol., 12*, 168

Johnson, T.C. & Merciez, W.D. (1971) Permeation of halogenated solvents through drybox gloves. *U.S. Atomic Energy Comm.*, RFP-1608

Magee, P.N. & Barnes, J.M. (1967) Carcinogenic nitroso compounds. *Adv. Cancer Res., 10*, 163-246

McFee, D.R. (1964) How well do gloves protect hands - against solvents? *Am. Soc. Saf. Eng. J., 9 (5)*, 11-16

Moursiden, H.T. & Faber, O. (1973) Penetration of protective gloves by allergens and irritants. *Trans. St. John's Hosp. Dermatol. Soc., 59*, 230-234

Mueller, W.J. (1957) Permeability of rubber to organic liquids. *Rubber Age, 81*, 982-987

Pegum, J.S. & Medhurst, F.A. (1971) Contact dermatitis from penetration of rubber gloves by acrylic monomer. *Br. Med. J., 2*, 141-143

Sansone, E.B., Wolochow, H. & Chatigny, M.A. (1977) Potential hazards associated with removal of needles from septa in injection ports of a gas chromatograph. *Anal. Chem., 49*, 670-671

Stannett, Y. & Yasuda, H. (1963) Liquid versus vapor permeation through polymer films. *J. Poly. Sci., B1*, 289-293

U.S. Department of Labor (1974) Carcinogens. *Fed. Reg., 39(20)*, 3756-3797

The breakthrough times and permeation rates of 1,4-dichloro-2-butene, benzene, carbon tetrachloride, and 2-chloro-1,3-butadiene for eleven commercially available gloves were determined. Four methods of determining the breakthrough time and permeation rate were evaluated. A wide variation in the glove material thickness and protection time was found showing that the adequate protection time can only be determined by testing the proposed glove with the chemicals to be handled.

Permeation of glove materials by physiologically harmful chemicals

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Introduction

The potential hazards associated with handling corrosive, toxic and carcinogenic chemicals are generally recognized. In the chemical industry, protective equipment ranging from gloves to complete acid suits with self-contained breathing air are used to prevent chemical contact through inhalation and skin contact. The major areas of contact are the hands and forearms which are exposed during routine sampling of plant and laboratory reactors. The use of proper gloves coupled with a high standard of hygiene can minimize the contact and provide adequate protection. Information needed to select the proper glove for a specific chemical or mixture of chemicals is not readily available. The ratings found in glove manufacturers catalogs such as good, excellent, and superior are qualitative and are based on the stability of the glove material. The ratings relate to such physical properties as abrasion resistance, elongation, and tear resistance but do not give information on the breakthrough times and permeation rates which are important in determining the chemical protection afforded by the glove. The period of adequate protection, which is equal to the breakthrough time plus an acceptable time during chemical permeation, can only be determined by testing of the proposed glove with the chemical to be handled. Several studies[1-7] have shown the importance of various polymer films and glove materials as a protective barrier to selected chemicals and solvent mixtures. Standard methods have also been developed for determining the permeation rate of volatile chemicals through sheet materials,[8,9] but are not designed to accurately determine the breakthrough time. In this study an easily assembled apparatus was constructed to facilitate the testing of sheet type protective materials. Four methods of breakthrough detection were evaluated to develop a method that was versatile, easily setup and would give reproducible results from different laboratories. The breakthrough times and permeation rates of eleven commercially available gloves were determined for benzene, 1,4-dichloro-2-butene, carbon tetrachloride and 2-chloro-1,3-butadiene.

experimental reagents

All chemicals were ACS reagent grade or better. The gloves are commercially available and were obtained from the following suppliers: Best Manufacturing Corp., Southwest Gloves Inc., Granet Corp., and Edmont Wilson. The test specimens were cut from the flat sections of the gloves. The glove material compositions consisted of neoprene, polyvinylchloride (PVC), polyvinyl alcohol (PVA) and a copolymer of acrylonitrile and butadiene (NBR) either unsupported or as a coating supported on a cloth backing.

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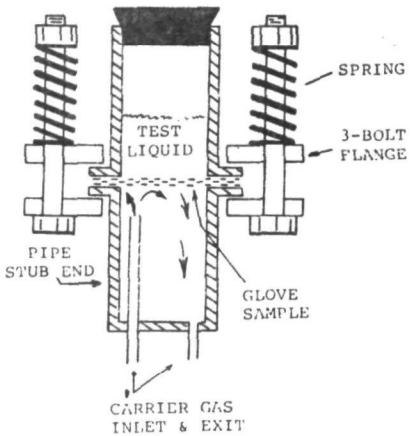

Figure 1 — Glove breakthrough time and permeation rate test apparatus.

apparatus

The apparatus used to determine the breakthrough time and permeation rate in this study is shown in Figure 1. The test specimen was a 50 mm circular section of the glove material and was placed as a membrane between two one-inch pipe stub ends of 316 stainless steel. The diameter of the surface exposed to the liquid was 29 mm but could be varied by using appropriate gaskets or by changing the diameter of the stub ends. The pipe stub ends were lightly compressed between two flanges to make a gas-tight seal. The apparatus was placed in an eight place holding rack, then an inert gas line was connected to one of the tubes in the lower pipe stub end. The inert gas was used to purge the lower compartment and to carry the permeant to the detector. After purging the lower compartment with inert gas for ten minutes, the gas flow rate was checked and reset if necessary. Fifteen mL of the test chemical was then added to the top compartment in contact with the normally exterior surface of the glove material. initial tests showed that no significant variation in the breakthrough time existed for sample additions ranging from 0.5 to 25 mL. The carrier gas exit of the apparatus was continually monitored to detect the initial appearance of the permeant and the change in the concentration with time. Four or more tests were made for each glove with each chemical.

detection methods

Four methods for determining the breakthrough time and permeation rate were evaluated. The first method consisted of a gravimetric analysis using commercially available air sampling tubes containing 150 mg of charcoal. The air sampling tube was placed in the apparatus effluent gas stream to adsorb the permeant on the active charcoal. The breakthrough time was determined by removing the tube at two-minute intervals and weighing on an analytical balance. From a plot of the air sampling tube mass versus time, the breakthrough time was determined by projecting the curve to zero mass gain on the time axis. The accuracy of the method was improved by the use of alternating tubes and shorter sampling times. The steady state permeation rate was determined at three hourly intervals by weighing the tube after a fixed time in the effluent gas stream. The permeation rate was calculated as follows:

$$\text{Permeation rate} = \frac{\text{mass gain of tube}}{\text{time x exposed area of specimen}} = \frac{\text{gram}}{\text{min x Cm}^2}$$

Quantitative information on the permeant purity and the variety of compounds extracted from the glove material was also obtained. The procedure consisted of extracting the adsorbants from the charcoal with carbon disulfide followed by gas chromatographic analysis.

The second method utilized a halogen leak detector. The detector was first calibrated using samples of known concentrations of the chlorinated hydrocarbons in nitrogen. The detector was then placed in the apparatus effluent gas stream and the halide concentration continually monitored. The breakthrough time was defined as the time at which the permeation rate exceeded $\sim 1 \times 10^{-7}$ gram/min Cm^2. This permeation rate corresponds to ~0.5 ppm of the chlorinated hydrocarbon in the carrier gas. The sensitivity of this method was varied by changing the instrument sensitivity and/or the carrier gas flow rate.

The third method used Drager gas detector tubes. The procedure consisted of connecting a Drager tube to a vacuum source and continually drawing a sample from the apparatus effluent carrier gas stream. The color change of the tube packing signaled the presence of the permeant in the carrier gas. The sensitivity was essentially the same as that of the leak detector as determined by simultaneously sampling of the effluent gas stream with the two detectors.

The fourth method utilized an inline gas chromatograph to detect the presence of the permeant in the gas stream. The gas chromatograph carrier gas passed through the lower section of the apparatus sweeping out the permeating chemical and carrying it to a thermal conductivity detector. The concentration of the permeant in the gas stream was recorded on a strip chart. From the recording of concentration versus time, the breakthrough time, and the steady state permeation rates were determined. The use of a multiport sampling valve enabled the sampling of eight test apparatuses sequentially. A comparison of the halogen, Drager and GC detection methods was done by simultaneously sampling ten test runs. The breakthrough times of the tests were all within ±6 seconds. This minor variation in breakthrough time is due to the sensitivity of the different detectors and is much less than the variation in the breakthrough times of the glove material.

TABLE I
Glove Material Composition and Thickness

Glove Material	Thickness (mm)	Standard (mm)	Deviation (%)
37-175 NBR	0.41	0.02	6
29-865 Neoprene	0.51	0.04	8
810 PVC, supported	1.06	0.09	8
9-352 Neoprene, supported	0.77	0.08	10
721R PVC, supported	1.04	0.07	7
G-1314 PVC, supported	1.11	0.10	9
610 Neoprene, supported	1.10	0.09	8
15-554 PVA, supported	0.87	0.08	10
531 Neoprene	0.49	0.10	21
AF-18 NBR	0.43	0.04	11
NS-35 Neoprene	0.43	0.03	8

TABLE II
Breakthrough Time for Dichlorobutene as a Function of Glove Thickness

Glove	Average Thickness (mm)	Breakthrough Time (minute)
37-175	0.37	16
	0.41	20
9-352	0.69	10
	0.79	13
721R	1.06	22
	1.18	36
610	1.04	46
	1.19	66
29-865	0.50	21
	0.51	22

results and discussion

The types of glove materials tested and the variations in thickness are shown in Table I. The highest standard deviation in the glove test specimen thickness was 21% but extremes of >30% were found in one of the materials. To determine the effect of thickness on the breakthrough time, selected samples of the same glove having a different thickness but essentially the same surface texture, were compared for breakthrough time with DCB, Table II. The protection of the glove increased with thickness but was accompanied by a loss in physical dexterity, which is vital to laboratory manipulations. Larger variations in breakthrough times were found for specimens with surface imperfections such as dimples and poorly coated seams. The breakthrough times and steady state permeation rates for the eleven gloves tested are shown in Tables III and IV. In general the longer the breakthrough time the lower the permeation rate. An example of the variation in the permeation rate with time is shown in Figure 2. For some of the gloves the permeation rate passed through a maximum in the first hour possibly due to interaction of the permeant and glove material. It is of interest to note that for some chemical-glove combinations

TABLE III
Breakthrough Times of Glove Materials

Glove	Breakthrough Times (min)			
	Dichlorobutene	Benzene	Chloroprene	Carbon Tetrachloride
37-175	26.5 ± 3	13.7 ± 2	7.1 ± 1	>200
29-865	29.1 ± 2	11.4 ± 0.5	5.7 ± 0.5	19.2 ± 1
810	34.8 ± 0.5	10.2 ± 1	4.4 ± 1.5	13.2 ± 3
9-352	21.8 ± 7	8.1 ± 4	2.9 ± 1	10.3 ± 3
721R	31.1 ± 3	18.2 ± 3	5.5 ± 2	30.6 ± 8
G-1314	34.8 ± 5	18.8 ± 7	5.0 ± 1	39.5 ± 9
610	34.3 ± 5	17.2 ± 2	2.8 ± 0.5	14.5 ± 1.5
15-554[a]	>5000	>2000	>1000[b]	>200[b]
531	13.5 ± 2	6.0 ± 0.5	6.7 ± 1.5	8.5 ± 0.5
AF-18	19.7 ± 1	19.1 ± 3	3.5 ± 0.5	>200
NS-35	15.5 ± 0.5	7.0 ± 0.5	3.9 ± 0.2	14.5 ± 0.5

[a]Tests were terminated at this time without breakthrough
[b]Some early failures but less than the 0.1 μ gram/min Cm² threshold rate.

(example CCl_4 with PVC gloves) in which the gloves had the same composition and thickness but different manufacturers, the breakthrough time varied by a factor of three possibly indicating the importance of manufacturing techniques on glove performance.

Gass chromatographic analysis of the test apparatus effluent gas showed that with some glove material compositions, compounds were extracted from the glove. The significance of the extraction by the permeating chemical is twofold: first, the physical properties of the material such as flexibility and resistance to abrasion were found to be drastically changed; secondly, the hands will be contacted by both the permeant and the extracjants such as plasticizers, and low molecular weight glove components for which the combined effect on the skin is not known.

The adequate protection time is the sum of the breakthrough time and the estimated permeation rate up to an allowable concentraion inside the glove. Therefore both breakthrough times and permeation rates must be determined for a complete evaluation of the glove protection. In one of five tests a PVA coated glove had the lowest breakthrough time of the gloves tested; on this basis it would have the lowest protection time. The actual protection afforded by the glove is much higher because the permeation rate was two orders of magnitude lower than the other gloves. It is important to note that these tests were run using new gloves with neat chemicals at ~21°C, with the

TABLE IV
Permeation Rates of Glove Materials

Glove	Permeation Rate (μgram/min cm²)			
	Dichlorobutene	Benzene	Chloroprene	Carbon Tetrachloride
37-175	156 ± 4	869 ± 50	2073 ± 60	0
29-865	126 ± 1	1890 ± 90	3158 ± 80	1753 ± 100
810	87 ± 7	598 ± 20	953 ± 100	496 ± 90
9-352	51 ± 3	1165 ± 280	1761 ± 250	618 ± 150
721R	108 ± 10	481 ± 50	850 ± 150	250 ± 90
G-1314	72 ± 10	421 ± 80	668 ± 70	203 ± 30
610	118 ± 10	516 ± 80	782 ± 120	300 ± 50
15-554	0	0	0	3 ± 3
531	41 ± 1	Saturated	Saturated	2240 ± 150
AF-18	Ruptured ~1 hr.	938 ± 250	2325 ± 180	0
NS-35	Saturated	Saturated	Saturated	1994 ± 50

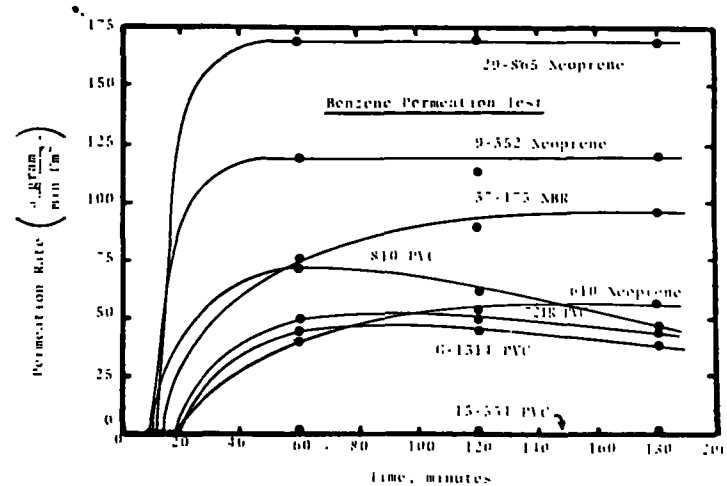

Figure 2 — Permeation rate of benzene through glove materials as a function of time.

comparisons valid only for new gloves. In use, the physical properties such as abrasion, tear and heat resistance can change both the relative and absolute chemical protection afforded by the gloves.

Repeated contact of chemicals with some glove materials can change the protection afforded by the gloves. Several tests were run to determine the effect of repeated exposure on breakthrough time and the physical properties. The specimens were tested for breakthrough time and permeation rate, allowed to stand until all traces of the chemical were gone, then retested. The data in Table V show that the neoprene glove does not change in physical properties and that the protection was increased. The PVC coated glove showed a reduction in both the chemical protection and physical properties. The breakthrough time decreased from 30 minutes to two minutes, the material became stiff and could be cracked with repeated flexing following the second contact. The data show that repeated testing is required before considering commerical reclamation of highly contaminated gloves. The results of this study indicate that a universal glove is not available and that complete testing of a proposed glove is necessary to determine the period of adequate protection.

TABLE V
Repeated Contact of Glove Materials With Dichlorobutene

Glove	Sample	Breakthrough Time (min)		Permeation Rate (μ gram/min cm²)	
		First Test	Second Test	First Test	Second Test
610	A	21.0	45.0	35	40
Neoprene	B	36.5	58.5	65	39
	C	36.0	51.5	20	50
	D	42.5	60.0	55	31
G-1314					
PVC	A	39.8	2.0	75	70
	B	23.5	2.5	62	60
	C	25.0	2.2	105	65
	D	29.0	3.0	94	60

summary

The protection afforded by glove materials is dependent upon a number of factors. Among these are composition, thickness, surface texture, method of manufacture and interaction of the chemical with the glove material. In this study a wide variation in the protection time was found among the gloves tested. In general the longer the breakthrough time the lower the steady state permeation rate. In some cases a glove with a low breakthrough time had better overall protection due to a low rate of steady state permeation. Therefore to determine the overall protection or period of adequate protection it is necessary to obtain both the breakthrough time and the steady state permeation rate. The material thickness was an important factor in controlling the permeation rate but increasing glove thickness reduced the dexterity in performing laboratory operations. The material composition was found to be the most important factor in preventing chemical contact. A significant difference was found in the breakthrough times among the different manufacturers gloves having the same composition and thickness.

Analysis of the chemicals permeating the gloves showed that in some cases compounds were being extracted from the glove material and would be carried to the skin. Repeated chemical contact was found in some cases to drastically alter the physical properties and the protection afforded by the gloves. The key to hand protection is through the use of quality gloves, as determined by thorough testing, coupled with a high standard of hygiene.

references

1. **Weeks, R.W., Jr. and B.J. Dean:** Permeation of Methanolic Aromatic Amine Solutions Through Commercially Avaliable Glove Materials. *Am. Ind. Hyg. Assoc. J. 38*:721-725 (1977).
2. **Sansone, E.B. and Y.B. Tewair:** The Permeability of Laboratory Gloves to Selected Solvents. *Am. Ind. Hyg. Assoc. J. 39*:169-173 (1978).
3. **Stannett, Y. and H. Yasuda:** Liquid Versus Vapor Permeation Through Polymer Films. *J. Poly. Sci. Bl.*:289-293 (1963).
4. **Mourisiden, H.T. and O. Faber:** Penetration of Protective Glvoes by Allergens and Irritants. *Trans. St. John's Hosp. Dermatol. Soc. 59*:230-234 (1973).
5. **Crank, J. and G.S. Park:** Methods of Measurement. Crank, J. and G.S. Park (eds) *Diffusion in Polymers*, pp. 1-39, Academic Press, NY (1968).
6. **Johnson, T.C. and W.D. Merciez:** Permeation of Halogenated Solvents Through Drybox Gloves. *U.S. Atomic Energy Comm., RFP-1608*:1-5 (1971).
7. **McFee, D.R.:** How Well do Gloves Protect Hands Against Solvents? *Am. Soc. Safety Engs. Journal 9*:11-16 (1964).
8. **American Society for Testing and Materials.** Permeability of Vulcanized Rubber or Synthetic Elastomers to Volatile Liquids. *ASTM Standards 37*:189-190 (1975).
9. **American Society for Testing and Materials.** Determining Permeability of Thermoplastic Containers. *ASTM Standards. 36*:488-492 (1975).

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DEVELOPMENT OF PERFORMANCE CRITERIA FOR PROTECTIVE CLOTHING USED AGAINST CARCINOGENIC LIQUIDS

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FOREWORD

The National Institute for Occupational Safety and Health (NIOSH) is responsible for helping ensure that every person in the Nation has safe and healthful working conditions. To accomplish this end, the Institute engages in research on occupational safety and health problems, including the evaluation of hazards and the development of testing and performance requirements for personal protective equipment.

One of the many work-place hazards considered to be significant by the Institute is dermal contact with carcinogenic liquids. At the present time, there are no comprehensive criteria or other guidelines available to assist in the manufacture, selection, and testing of protective clothing materials and garments used to protect against this hazard. Therefore, Arthur D. Little, Inc., is pleased to publish this initial research effort for development of such criteria.

It should be noted that the research described here was contracted under a specific scope of work. Further evaluation and validation of the developed criteria are necessary.

PREFACE

This report addresses three principal topics:

1. An identification of occupational exposures to carcinogenic liquids (Section II).
2. The development of performance criteria for materials used in protective clothing for use against carcinogenic liquids (Section III); and
3. The development of a permeation test method for evaluating clothing materials (Section IV).

Of particular interest are the results of the permeation experiments. In these experiments, clothing materials were evaluated as barriers to several industrially important chemicals suspected of being carcinogenic (e.g., benzene and trichloroethylene). The results suggest that several commercially-available materials may not offer adequate protection in certain applications.

Further, it should be noted that Appendix A is a collection of "overview documents" for each chemical used in the experimental program. Each document is a summary of the primary sources, uses, properties, hazards, and recommended handling procedures of the subject chemical.

Arthur D. Little, Inc., has carried out this research assignment for the National Institute for Occupational Safety and Health (NIOSH) under the direction of Project Officer William F. Todd of the Protective Equipment Section, Control Technology Research Branch, Division of Physical Sciences and Engineering. NIOSH, a research institute of the U.S. Department of Health, Education, and Welfare, was created by the Occupational Safety and Health Act of 1970. As mandated by this Act, NIOSH performs and sponsors research, and develops criteria for recommended standards applicable to the problems of occupational safety and health.

The data collected in this and subsequent investigations are intended to support safety standards needed to ensure the proper protection of workers who handle potentially harmful chemicals.

ABSTRACT

Workers who produce, use, and transport liquid chemicals can be exposed to many compounds capable of causing harm to the human body. The deleterious effects of contacting these liquids can range from acute trauma, such as skin irritation and burn, to chronic degenerative disease, such as cancer. Contacts can extend from one-time splashes to continuous 15-60 minute wettings due to accidental spills or emergency situations. Accordingly, there is a strong need for clothing that will protect workers for at least 60 minutes of continuous contact. However, comprehensive performance criteria for protective clothing is lacking.

In this study, a set of recommended performance criteria was compiled. Further, to fill a void in the coverage of available test methods, a simple experimental procedure was developed to measure the resistance to permeation of protective clothing materials by liquid chemicals. Using this procedure, the barrier properties of several polymeric materials were evaluated against nine carcinogenic liquids (e.g., benzene, trichloroethylene and β-propiolactone). Breakthrough times, steady state fluxes, and chemical solubilities were measured. In many cases, the breakthrough times for widely used materials were less than the recommended 60 minutes.

Such results suggest that many workers may not be protected by currently recommended clothing. However, substantially improved protection could be provided if comprehensive performance profiles were generated and made available for the design and specification of protective clothing. Clothing materials should be subjected to a comprehensive performance evaluation. Evaluations, including permeation testing against the specific chemical to be handled, should be performed over the range of anticipated exposure conditions.

This report was submitted in fulfillment of Contract No. 210-76-0130 by Arthur D. Little, Inc., under the sponsorship of the National Institute for Occupational Safety and Health.

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I. INTRODUCTION

Workers involved in the production, use, and transportation of industrial chemicals can be exposed to numerous compounds capable of causing harm to the human body. These chemicals can be in the form of vapors, mists, dusts, liquids, and solids. Exposures can occur during routine work-place activities as well as during emergency situations, even with chemical processing systems incorporating state-of-the-art designs and controls. One of the most serious hazards of exposure to chemicals is skin contact by liquids. The deleterious effects of certain liquids can range from acute trauma, such as skin irritation and burn, to chronic degenerative disease, such as cancer. This strongly suggests that emphasis should be placed on eliminating skin contacts through measures such as the use of protective clothing.

However, although considerable effort has been expended in the development of many other areas of personal protection, relatively little effort has gone into developing criteria for the proper specification and use of protective clothing. In fact, there is almost no comprehensive information available which describes the properties that clothing materials should have in order to provide protection against harmful liquids. Clothing materials appear to be selected most often on the basis of their resistance to visible degradation by common solvents, acids or alkalies. In many cases the test chemical may not be the chemical of concern (i.e., an analog is used) and, therefore, may not interact with clothing materials in the same way. Further, even if clothing materials resist visible degradation or swelling, a question remains as to the completeness of protection actually provided since permeation of small amounts of liquid can occur without gross interactions with the barrier. This question is especially important when considering resistance to permeation by carcinogenic chemicals which have no established threshold levels for carcinogenicity on skin contact.

While guidelines for safe exposures* have been developed for other toxic chemicals, few such guidelines have been promulgated for carcinogenic chemicals. Accordingly, the Occupational Safety and Health Administration (OSHA) recommends that protective clothing materials be impermeable to carcinogenic liquids.[1] However, OSHA does not offer recommendations for assessing the barrier properties of such clothing materials.

Because of the absence of this important information, the National Institute for Occupational Safety and Health (NIOSH) has sponsored this program to investigate the performance of protective clothing materials against selected carcinogenic chemicals. Emphasis has been placed on studying permeation of chemicals handled in the liquid state. The results of this work, as presented in this report include:

(1) A description of the form and extent of worker needs for protective clothing;

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* Defined as time-weighted average (TWA) concentrations for an 8-hour work day.

(2) A recommended criterion for clothing resistance to permeation and an overview of several other functional requirements;

(3) Recommended test methods for evaluating the performance of clothing materials; and,

(4) Data showing the resistance of currently-used clothing materials to permeation by selected carcinogens.

The next section begins this presentation with a review of occupational exposures to carcinogenic liquids.

TABLE 5

TRICHLOROETHYLENE SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Nitrile rubber[1]	2.17	0.87
Neoprene rubber[1]	1.18	0.73
PVC-coated nylon[2]	0.14	0.15
Polyvinyl alcohol[3]	0.03	0.04
Polyethylene[4]	0.06	0.41
Polyurethane-coated nylon[2]	1.15	0.95
Viton[1]	0.02	0.04
Butyl rubber[1]	1.48	0.87

TABLE 6

TRICHLOROETHYLENE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time (minutes)[5]	Steady State Flux, J(gm/cm^2/min)
Nitrile Rubber [1]	0.094	10-15	6.0×10^{-5}
Neoprene Rubber[1]	0.079	10-15	5.3×10^{-5}
Polyvinyl alcohol[3]	0.009	< 15	0.8×10^{-5}

1. MIL. Spec. sheet.
2. Outerwear material.
3. Cast film.
4. Glove material.
5. At a minimum detection limit of 1 ppm.

TABLE 7

EPICHLOROHYDRIN SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Nitrile rubber[1]	0.28	0.23
Neoprene rubber[1]	0.44	0.37
PVC-coated nylon[2]	1.03	0.60
Polyvinyl alcohol[3]	Negligible	Negligible
Polyethylene[4]	0.12	0.10
Polyurethane-coated nylon[2]	2.70	0.86
Viton[1]	0.42	0.46
Butyl rubber[1]	0.05	0.05

TABLE 8

EPICHLOROHYDRIN PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time[5]	Steady State Flux, J(gm/cm^2/min)
Neoprene Rubber[1]	0.076	60-80 min.	11.0×10^{-5}
Polyvinyl alcohol[3]	0.008	$<$ 5 min.	13.0×10^{-5}
Butyl Rubber[2]	0.084	79 hrs.	0.02×10^{-5}

1. MIL. Spec. sheet.
2. Outerwear material.
3. Cast film.
4. Glove material.
5. At a minimum detection limit of 1-5ppm.

TABLE 9

CREOSOTE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time (minutes)[2]
Neoprene rubber[1]	0.076	270
Viton[1]	0.043	>5760 (96 hours)
Butyl rubber[1]	0.081	>5400 (90 hours)

1. MIL. Spec. sheet.
2. At a minimum detection limit of 1-5 ppm.

TABLE 10

BENZENE SOLUBILITY IN AND PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Solubility @ 22°C		Thickness	Breakthrough Time (min)[6]		Steady State Flux ($gm/cm^2/min$)	
	gm/gm	C_s, gm/cm^3 of Swollen Material	ℓ (cm)	Run 1	Run 2	Run 1	Run 2
Natural rubber[1]	3.2	0.7	0.028	2	1.5	50×10^{-5}	50×10^{-5}
Nitrile rubber[1]	–	–	0.023	6	5.5	50×10^{-5}	60×10^{-5}
Nitrile rubber[2]	1.1	0.5	0.041	5	5.5	50×10^{-5}	50×10^{-5}
Neoprene rubber[2]	–	–	0.041	6	7	50×10^{-5}	50×10^{-5}
Neoprene rubber[2]	0.9	0.5	0.076	24.5		23×10^{-5}	
Neoprene rubber[2]	–	–	0.16	60		8×10^{-5}	
Neoprene rubber[2]	–	–	0.241	186		5×10^{-5}	
Neoprene rubber[1]	–	–	0.038	6		30×10^{-5}	30×10^{-5}
Neoprene-coated fabric[1]	–	–	0.069[5]	15	23	8×10^{-5}	6×10^{-5}
Neoprene/natural rubber[1]	2.8	0.7	0.046	3	5	40×10^{-5}	50×10^{-5}
Neoprene (milled)[1]	–	–	0.036	6.5		52×10^{-5}	
PVC-coated nylon[3]	–	–	0.043	6	6.5	15×10^{-5}	15×10^{-5}
Polyvinyl alcohol[1]	0.03	0.03	0.023	10	10	0.8×10^{-5}	
Polyvinyl alcohol[4]	–	–	0.008	3		3.9×10^{-5}	
Polyethylene[1]	0.3	0.2	0.006	<1	<1	35×10^{-5}	35×10^{-5}
Polyethylene-back Tyvek[3]	–	–	0.009[5]	1	2	22×10^{-5}	22×10^{-5}
Polyurethane-backed nylon[3]	0.6	0.4	0.02	1.5	2	11×10^{-5}	11×10^{-5}
Viton[2]	0.04	0.06	0.16	900		0.05×10^{-5}	
Butyl-coated nylon[3]	–	–	0.056	60		9×10^{-5}	
Butyl sheet[2]	0.6	0.35	0.084	88		13×10^{-5}	

1. Glove material.
2. Military Specification sheet.
3. Outerwear material.
4. Cast film.
5. Material is a membrane/fabric laminate. Thickness is only that of the membrane.
6. At a minimum detection limit of 5-10 ppm.

TABLE 11

ETHYLENIMINE SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Natural rubber[1]	0.15	0.12
Neoprene rubber[1]	gummy	–
Viton[2]	decomposed	–
Butyl rubber[2]	0.14	0.12

TABLE 12

ETHYLENIMINE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time[3]	Steady State Flux, J(gm/cm^2/min)
Neoprene[1]	0.020	$<$5 min.	–[4]
Butyl rubber[2]	0.084	10 – 16 hrs.	0.45×10^{-5}

1. Glove material.
2. Military Specification sheet.
3. At a minimum detection limit of 10-30 ppm.
4. Steady state was never achieved because degradation of the material was too quick.

TABLE 13

1,1-DIMETHYLHYDRAZINE SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Nitrile rubber[1]	0.38	0.32
Neoprene rubber[1]	0.30	0.33
PVC-coated nylon[2]	0.35	0.36
Polyvinyl alcohol[3]	Dissolved	–
Polyethylene[4]	Slight weight loss	–
Polyurethane-coated nylon[2]	Polyurethane decomposed	–
Viton[1]	Decomposed	–
Butyl rubber[1]	0.1	0.1

TABLE 14

1,1-DIMETHYLHYDRAZINE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time[5]	Steady State Flux, J(gm/cm^2/min)
Neoprene[1]	0.076	25-40 min.	45.0×10^{-5}
PVC-coated nylon[2]	0.043	5-10 min.	19.0×10^{-5}
Butyl rubber[1]	0.084	23-27 hrs.	0.29×10^{-5}

1. Mil. Spec. sheet.
2. Outerwear material.
3. Cast film.
4. Glove material.
5. At a minimum detection limit of 10 ppm.

TABLE 15

2-NITROPROPANE SOLUBILITY IN SELECTED CLOTHING MATERIAL AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Nitrile rubber[1]	0.72	0.41
Neoprene rubber[1]	0.23	0.22
PVC-coated nylon[2]	0.42	0.34
Polyvinyl alcohol[3]	Negligible	Negligible
Polyethylene[4]	0.07	0.06
Polyurethane-coated nylon[2]	0.99	0.54
Viton[1]	1.07	0.66
Butyl rubber[1]	0.02	0.02

TABLE 16

2-NITROPROPANE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time	Steady State Flux, J(gm/cm^2/min)
Nitrile Rubber[1]	0.09	25-50 min.	20.0×10^{-5}
Polyvinyl alcohol[3]	0.02	$<$ 5 min.	4.4×10^{-5}
Butyl Rubber[1]	0.08	$>$ 101	–

1. MIL. Spec. sheet.
2. Outerwear material.
3. Cast film.
4. Glove material
5. At a minimum detection limit of 10 ppm.

TABLE 17

β-PROPIOLACTONE SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility: gm/gm of Material	Solubility: C_s, gm/cm^3 of Swollen Material
Natural rubber[1]	0.09	0.01
Nitrile rubber[2]	0.29	0.23
Neoprene rubber[2]	0.31	0.29
Butyl rubber[2]	0.01	0.01
PVC-coated nylon[3]	0.15	0.16
Polyvinyl alcohol[4]	reacted	–
Polyethylene[1]	0.18	0.15
Polyurethane-coated nylon[3]	1.85	0.75
Viton[2]	0.69	0.60

TABLE 18

β-PROPIOLACTONE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time[6] (minutes)	Steady State Flux, J(gm/cm^2/min)
Natural rubber[1]	0.030	15-20	0.43×10^{-5}
Polyethylene[1]	0.006	10-30	0.12×10^{-5}
Polyurethane-coated nylon[3,5]	0.003	<5	83.0×10^{-5}

1. Glove material.
2. MIL. Spec. sheet.
3. Outerwear material
4. Cast film.
5. Thickness measurement represents polyurethane only.
6. At a minimum detection limit of 2 ppm.

TABLE 19

HEXAMETHYLPHOSPHORAMIDE SOLUBILITY IN SELECTED CLOTHING MATERIALS AT 22°C

Clothing Material	Solubility	
	gm/gm of Material	C_s, gm/cm^3 of Swollen Material
Nitrile rubber[1]	0.78	0.44
Neoprene rubber[1]	2.72	0.79
PVC-coated nylon[2]	Dissolved	–
Polyvinyl alcohol[4]	Dissolved	–
Polyethylene[3]	0.22	0.17
Polyurethane-coated nylon[2]	2.42	0.76
Viton[1]	2.50	0.84
Butyl rubber[1]	0.08	0.07

TABLE 20

HEXAMETHYLPHOSPHORAMIDE PERMEATION THROUGH SELECTED CLOTHING MATERIALS

Material	Thickness, ℓ (cm)	Breakthrough Time[5]	Steady State Flux, J(gm/cm^2/min)
Nitrile rubber[1]	0.094	1.0-1.5 hrs.	1.3×10^{-5}
Butyl rubber[1]	0.084	1.0-1.5 hrs.	0.002×10^{-5}
Polyethylene[3]	0.006	15-25 min.	0.4×10^{-5}

1. Mil. Spec. sheet
2. Outerwear material
3. Glove material
4. Cast film
5. At a minimum detection limit of 3 ppm

4. Supplementary Test Results

The permeation data presented above relate to new, unused protective clothing materials tested at 22°C (ambient temperature) and in a non-strained condition. In actual use, clothing materials can be exposed to carcinogenic liquids at temperatures other than 22°C, and these materials are usually subject to flexing and stretching (e.g., at finger, elbow and knee joints). In addition, protective clothing is often reworn after contact with a carcinogen. Therefore, several tests were carried out to ascertain whether resistance to permeation is influenced by one or more of these factors.

a. Non-ambient Temperatures

Neoprene was tested against benzene at 7°C and 37°C in order to investigate the influence of temperature on breakthrough and permeation rate. The tests followed the usual protocol except that the test cell was immersed in a water bath at the appropriate temperatures. The results of these tests, in addition to the earlier results at 22°C, are reported in Table 21. The solubility of benzene in neoprene at each temperature is also included.

TABLE 21

BENZENE PERMEATION THROUGH NEOPRENE[1] AT THREE TEMPERATURES

Test Temperature (°C)	Solubility, C_s (gm/cm^3 of Swollen Neoprene)	Breakthrough Time[2] (min)	Steady State Flux, J (gm/cm^2/min)
7	0.49	40	19×10^{-5}
22	0.49	24	23×10^{-5}
37	0.49	16	33×10^{-5}

1. MIL. Spec. sheet, at a thickness of 0.08 cm.
2. At a minimum detection limit of 5-10 ppm.

There was a significant decrease in breakthrough time and an increase in steady state flux as the temperature is increased. This result is not unexpected, and confirms that clothing permeation should be evaluated over the range of temperatures expected under actual use conditions. The constant solubility over this temperature range is not unusual as many other elastomers are known to exhibit similar behavior above their glass transition temperatures.

b. Strained and Strain-cycled Materials

Protective clothing materials can be exposed to carcinogenic liquid while strained or after undergoing strain-cycling. Strained materials represent the condition of stretched materials covering the knee, elbow, and finger joints during flexure. Strain-cycled materials simulate the

TABLE 22

PERMEATION THROUGH STRAINED AND STRAIN-CYCLED CLOTHING MATERIALS

Carcinogen	Material[1]	Test Condition[2]	Thickness, ℓ (cm)	Breakthrough Time[3]	Steady State Flux J ($gm/cm^2/min$)
Benzene	Butyl Rubber	relaxed	0.076	54 min	20×10^{-5}
	Butyl Rubber	strained	0.073	53 min	18×10^{-5}
	Butyl Rubber	cycled	0.076	52 min	28×10^{-5}
	Neoprene	relaxed	0.080	24 min	23×10^{-5}
	Neoprene	strained	0.076	25 min	32×10^{-5}
	Neoprene	cycled/relaxed	0.080	24 min	35×10^{-5}
Epichlorohydrin	Butyl Rubber	relaxed	0.084	79 hr	0.02×10^{-5}
	Butyl Rubber	strained	0.073	~100 hr	0.01×10^{-5}
	Butyl Rubber	cycled/relaxed	0.076	80-100 hr	0.01×10^{-5}
	Neoprene	relaxed	0.076	60-80 min	11×10^{-5}
	Neoprene	strained	0.076	~70 min	11×10^{-5}
	Neoprene	cycled/relaxed	0.080	80-110 min	11×10^{-5}

1. MIL. Spec. sheet.
2. Strained: tested at 120% of unstrained length; Cycled: tested unstrained after 1000 cycles of stretching to 120% of unstrained length, followed by folding to 80% of unstrained length.
3. At a minimum detection limit of 5.10 ppm.

TABLE 23

PERMEATION OF BENZENE THROUGH PRE-EXPOSED[1] CLOTHING MATERIALS

Clothing Material	Pre-exposed (?)	Thickness, ℓ (cm)	Breakthrough Time[3] (min)	Steady State Flux, J ($gm/cm^2/min$)
Neoprene[2]	Yes	0.076	26	31×10^{-5}
	No	0.076	24	23×10^{-5}
Butyl Rubber[2]	Yes	0.084	51	20×10^{-5}
	No	0.084	54	20×10^{-5}

1. Material specimens saturated with benzene and then air-dried for 18 hours.
2. MIL. Spec. sheet.
3. At a minimum detection limit of 5-10 ppm.

FIGURE 4

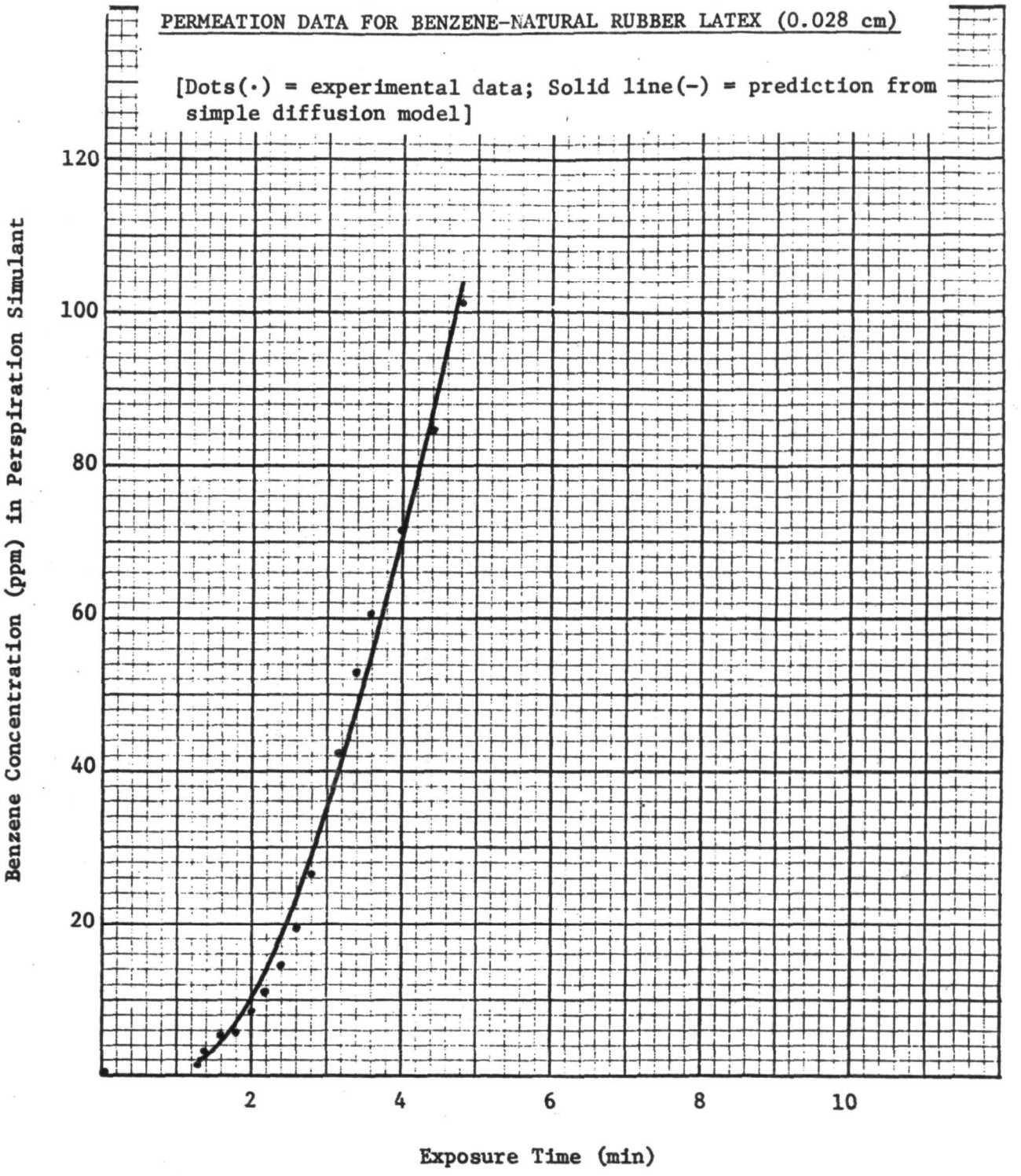
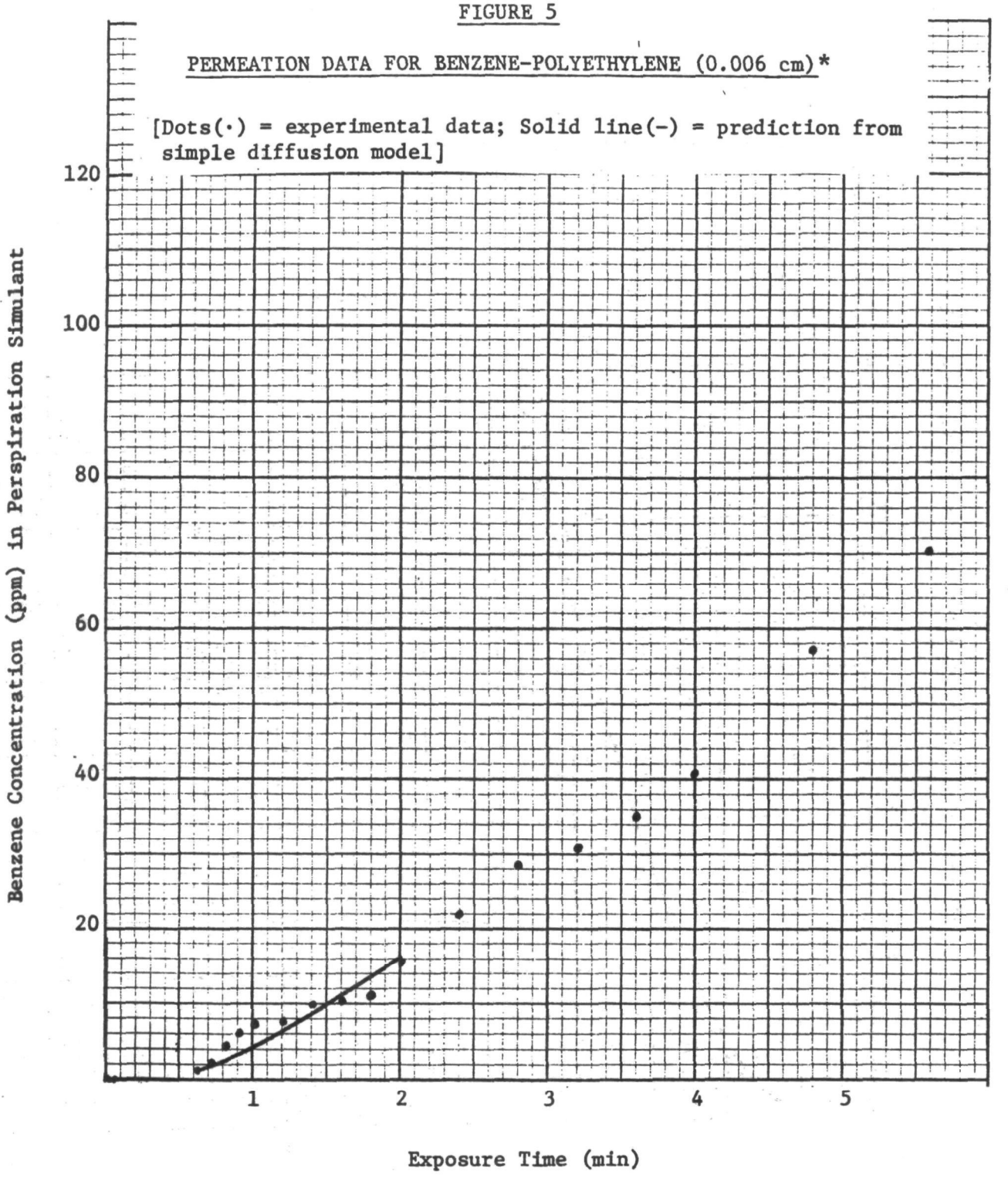

PERMEATION DATA FOR BENZENE-NATURAL RUBBER LATEX (0.028 cm)
[Dots(·) = experimental data; Solid line(-) = prediction from simple diffusion model]
Benzene Concentration (ppm) in Perspiration Simulant
120
100
80
60
40
20
2
4
6
8
10
Exposure Time (min)

FIGURE 5

PERMEATION DATA FOR BENZENE-POLYETHYLENE (0.006 cm)*



*Thickness of material.

FIGURE 6

PERMEATION DATA FOR BENZENE-VITON (0.16 cm)

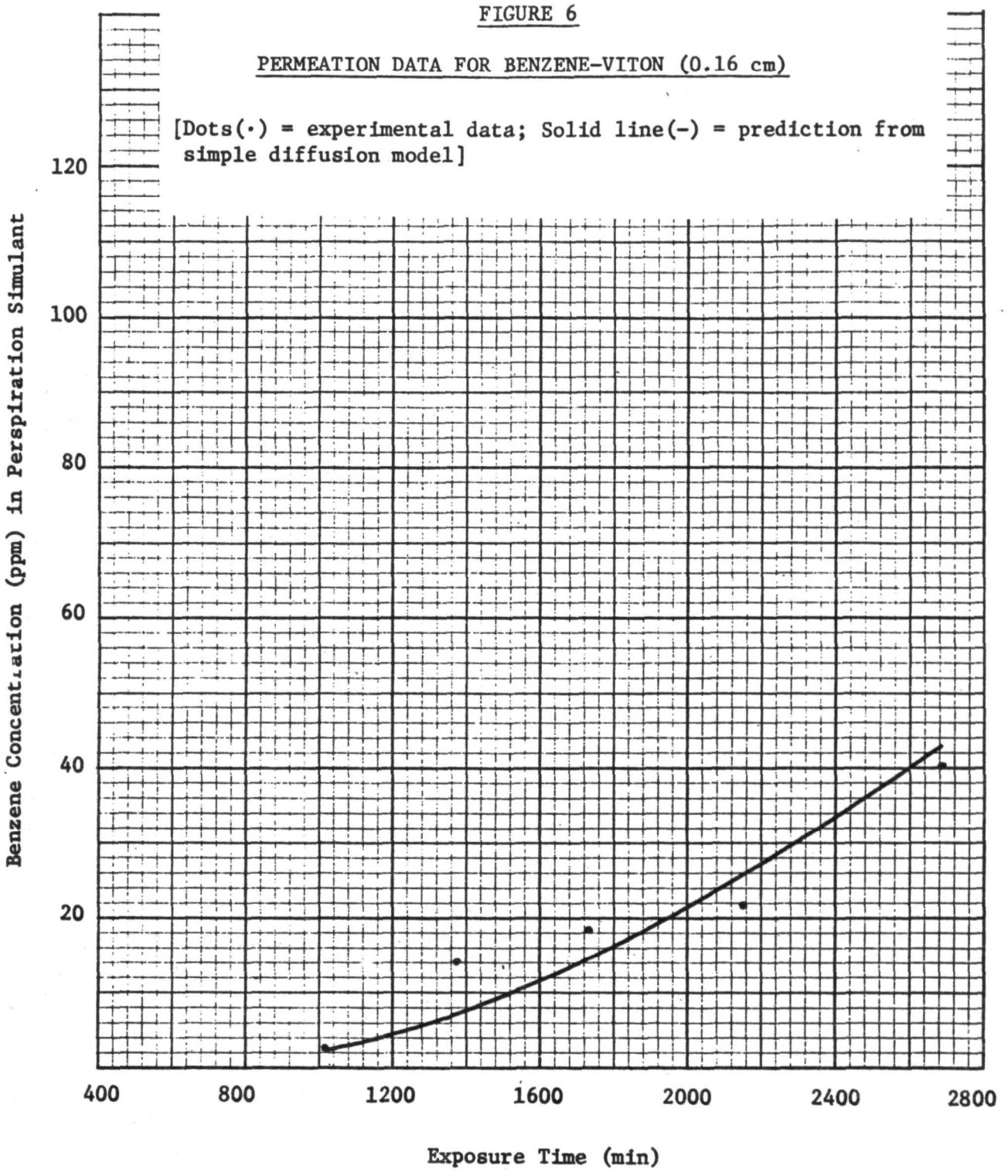


FIGURE 7

EXAMPLE OF POOR FIT OF SIMPLE DIFFUSION MODEL TO EXPERIMENTAL DATA FOR NITRILE RUBBER LATEX GLOVE MATERIAL

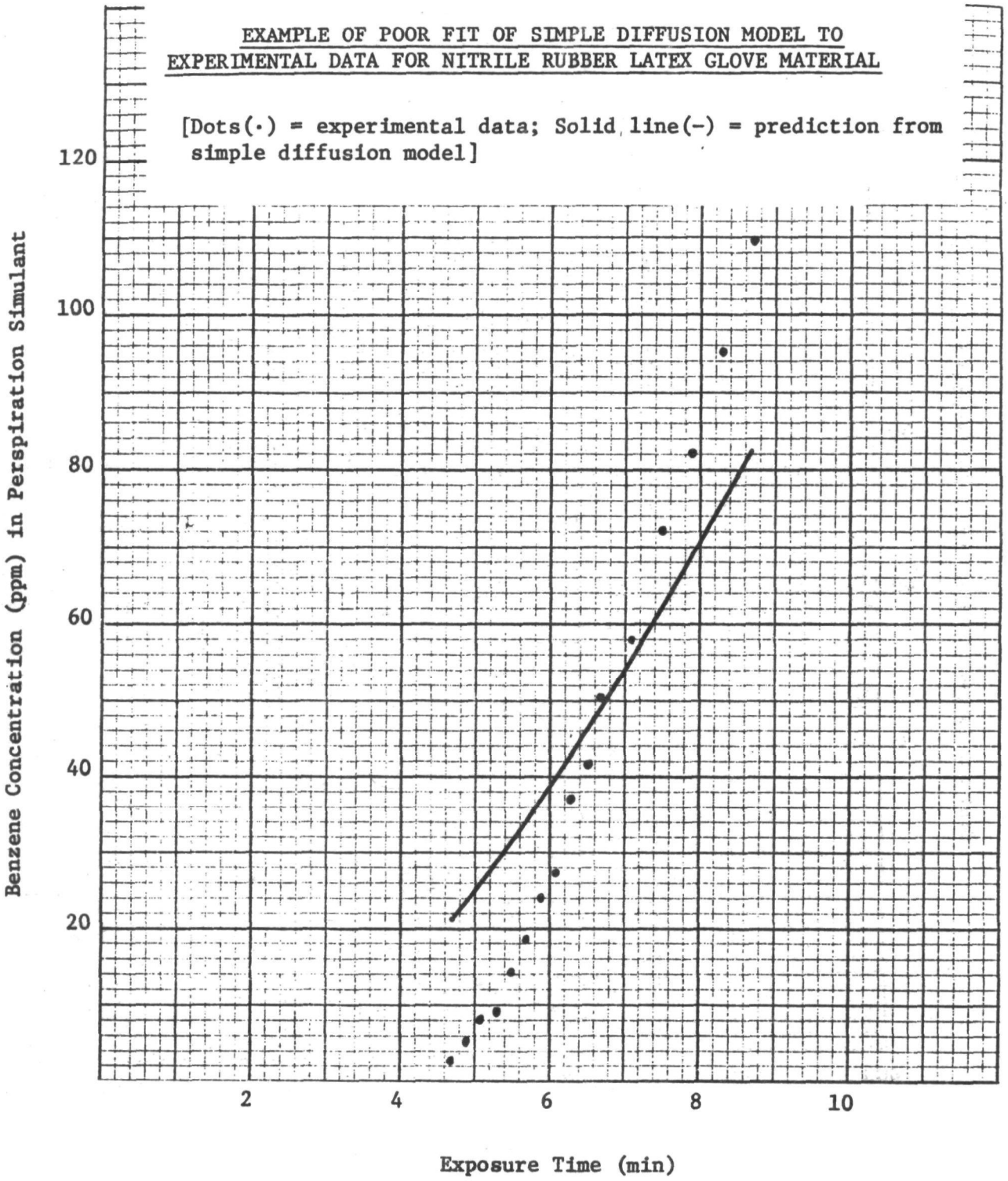


TABLE 24

SUMMARY OF BREAKTHROUGH TIMES OF SELECTED CHEMICALS THROUGH PROTECTIVE CLOTHING MATERIALS AT 22°C

Carcinogen	Detection Limit (ppm)	Clothing Material: Composition	Clothing Material: Thickness (cm)	Breakthrough Time (min)
Trichloroethylene	1	Nitrile rubber	0.094	10-15
		Neoprene rubber	0.079	10-15
		Polyvinyl alcohol	0.009	<15
Epichlorodydrin	1-5	Polyvinyl alcohol	0.008	< 5
		Neoprene rubber	0.076	60-80
		Butyl rubber	0.084	4740
Coal-Tar Creosote	1-5	Neoprene rubber	0.076	270
		Butyl rubber	0.081	>5400
		Viton	0.043	>5760
Benzene	5-10	Polyethylene	0.006	<1
		Polyurethane-coated nylon	0.02	2
		Natural rubber	0.028	2
		Nitrile rubber	0.041	5
		PVC-coated nylon	0.043	6
		Polyvinyl alcohol	0.023	10
		Neoprene rubber	0.076	25
		Butyl rubber	0.084	88
		Viton	0.16	900
Ethylenimine	10-30	Neoprene rubber	0.02	<5
		Butyl rubber	0.084	600-960
1,1-Dimethylhydrazine	10	PVC-coated nylon	0.043	5-10
		Neoprene rubber	0.076	25-40
		Butyl rubber	0.084	1380-1620
2-Nitropropane	10	Polyvinyl alcohol	0.02	<5
		Nitrile rubber	0.09	25-60
		Butyl rubber	0.08	>6060
β-Propiolactone	10	Polyurethane-coated nylon	0.003	<5
		Natural rubber	0.03	15-20
		Polyethylene	0.006	10-30
Hexemethylphosphoromide	3	Polyethylene	0.006	15-25
		Butyl rubber	0.084	60-90
		Nitrile rubber	0.094	60-90

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
I Inorganic salts	E	E	E	E	E
Iodine	G	F	G	G	G
Isooctane	F	P	E	P	E
Isopropanol	E	E	E	E	E
Isopropyl alcohol	E	E	E	E	E
K Kerosene	E	F	E	F	E
Ketones	G	E	P	E	P
L Lacquer thinners	G	F	P	F	P
Lactic acid	E	E	E	E	E
Lauric acid	E	F	E	E	E
Lineolaic acid	E	P	E	F	G
Linseed oil	E	P	E	F	E
M Maleic acid	E	E	E	E	E
Mercuric chloride	G	E	G	E	E
Mercury	G	G	G	E	G
Methane gas	E	E	E	E	E
Methanol	E	E	E	E	E
Methyl acetate	G	F	P	G	P
Methyl alcohol	E	E	E	E	E
Methylamine	F	F	G	G	G
Methyl bromide	G	F	F	G	F
Methyl cellosolve	G	G	G	G	G
*Methyl chloride	NR	NR	NR	NR	NR
*Methyl ethyl ketone	G	G	NR	E	NR
Methyl formate	G	F	F	G	F
Methylene bromide	G	G	F	G	F
Methylene chloride	G	F	F	G	F
*Methyl isobutyl ketone	F	F	P	E	P
Methyl methacrylate	G	G	F	E	F
Mineral oils	E	F	E	F	E
*Monochlorobenzene	F	P	P	F	P
Monoethanolamine	E	G	E	E	E
Morpholine	E	E	G	E	G
Muriatic acid	E	G	G	E	G
N Naphthalene	G	F	G	F	G
Naphthas, aliphatic	E	F	E	F	E
Naphthas, aromatic	G	P	G	P	G
*Nitric acid	G	F	F	F	F
*Nitric acid, red and white fuming	P	P	P	P	P
*Nitrobenzene	F	P	F	F	F
*Nitroethane	F	P	F	F	F
Nitrogen gas	E	E	E	E	E
*Nitromethane	F	P	F	F	F
*Nitropropane	F	P	F	F	F
Nitrous oxide	G	G	G	G	G
O Octyl alcohol	E	E	E	E	E
Oleic acid	E	F	E	G	E
Oxalic acid	E	E	E	E	E
Oxygen, liquid	F	P	NR	F	NR
Ozone	G	P	P	G	P
P Paint thinners	G	F	G	F	G
Paint and varnish removers	G	F	F	F	F
Palmitic acid	E	E	E	E	E
*Paradichlorobenzene	E	F	E	E	E
Parathion	P	F	F	F	F
Pentaborane	F	P	F	F	F
Pentachlorophenol	F	G	G	G	G
Pentane	E	G	E	G	E
Perchloric acid	E	F	G	G	G
Perchloroethylene	F	NR	G	NR	G
Perklene	E	NR	G	NR	E
Permachlor	E	F	E	NR	E
Petroleum distillates (naphtha)	G	P	E		E
Petroleum spirits	E	F	E	F	E
Phenol	E	F	F	G	F
Phenylenediamine	G	P	G	G	G
Phenylhydrazine	G	G	G	G	G
Phil-solv	E	F	E	G	E

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
Phosphoric acid	E	G	E	E	E
Pickling solution	G	G	G	E	G
Picric acid	E	G	E	G	E
Pine oil	E	P	E	F	E
Pitch	E	P	E	F	E
Plating solutions	E	E	E	E	E
Potassium alum	G	G	G	E	G
Potassium bromide	G	G	G	E	G
Potassium chrome alum	G	G	G	E	G
Potassium dichromate	F	F	F	E	F
Potassium ferrocyanide	G	G	G	E	G
Potassium hydroxide	E	E	E	E	E
Printing inks	E	G	G	G	G
Propane gas	E	E	E	E	E
Propanol (iso)	E	E	E	E	E
Propyl acetate	G	F	F	G	F
Propyl alcohol	E	E	E	E	E
Propyl alcohol (iso)	E	E	E	E	E
Propylene gas	E	F	E	E	E
Propyne gas	E	F	E	E	E
Pyrethrum	E	E	E	E	E
R *Red fuming nitric acid	P	P	P	P	P
Rhodium fume and dust	E	E	E	E	E
S Silver nitrate	E	G	E	E	E
Skydrol 500	P	G	P	G	P
Sodium carbonate metol	G	G	G	E	G
Sodium hydroxide	E	E	E	E	E
Sodium sulfite	G	G	E	E	E
Sodium thiosulfide	G	G	E	E	E
Solvarsol	E	F	E	F	E
Solvessos	P	P	G	P	G
Stearic acid	E	E	E	E	E
Stoddard solvent	E	F	E	G	E
Styrene	P	P	F	P	F
Styrene 100%	P	P	F	P	F
Sulfuric acid	G	G	G	G	G
T Tannic acid	E	E	E	E	E
Tetrahydroborane	F	P	F	F	F
Tetraethyl lead	E	F	E	G	E
Tetrahydrofuran	P	F	F	F	F
*Toluene	F	P	F	NR	F
Toluene diisocyanate	F	G	F	G	F
*Toluol	F	P	F	NR	F
Trichlor	F	P	G	P	G
*Trichloroethylene	F	F	G	P	G
*Trichloroethane	P	P	F	P	F
Tricresyl phosphate	G	F	E	F	E
Tridecyl alcohol	G	F	E	F	E
Triethanolamine	E	G	E	G	E
Trinitrotoluene	G	P	G	F	G
Trinitrotoluol	G	P	G	F	G
Triptane	E	P	E	F	E
Tung oil	E	P	E	F	E
Turco No. 2998	P	P		F	
Turpentine	G	F	E	F	E
U Unsymmetrical Dimethylhydrazine	F	P	F	P	F
V Varnoline gas	E	F	E	F	E
Vanadium fume and dust	E	E	E	E	E
Varsol	G	F	G	F	E
Vegetable oils	E	G	E	G	E
W Wood alcohol	E	E	E	E	E
Wood preservatives	G	F	G	G	G
*Woodyouth	F	P	F	G	F
X *Xylene	P	P	F	P	F
*Xylol	P	P	F	P	F
*Xylidene	E	F	F	F	F
Z Zinc chloride	E	E	E	E	E

If glove swells, remove it from service and replace with a new one; or rinse glove with plain water and allow it to return to original shape.

Find the right glove for each job

Select the coating with the highest rating in the Physical Properties Chart, then check the Chemical Resistance Chart.

CHEMICAL RESISTANCE CHART	NYGRAN	PYTHON (Neoprene)	DYNAGLUV (Vinyl Plastic)	DYNAGRIP (Vinyl Plastic)	GRANFLEX (Vinyl Plastic)	SLIP-NOT (Rubber Latex)	GRANECON (Vinyl Plastic)	NITRILE (Unsupported)	SYNTHETIC LATEX (Unsupported)	NATURAL LATEX (Unsupported)
ALCOHOLS										
Methanol / Butyl Alcohol / Glycerine / Ethanol / Isopropanol	E	E	E	E	E	G	E	E	E	G
CAUSTICS										
Ammonium Hydroxide 38% / Sodium Hydroxide 50% / Potassium Hydroxide 50%	E	E	E	E	E	E	E	E	E	E
CHLORINATED SOLVENTS										
Carbon Tetrachloride / Perchlorethylene / Trichlorethylene	E	G	F	F	F	NR	F	E	G	NR
KETONES										
Methyl Ethyl Ketone / Methyl Isobutyl Ketone / Acetone	G	G	NR	NR	NR	G	NR	G	G	G
PETROLEUM SOLVENTS										
White Gasoline / Naphtha / Mineral Thinner / Kerosene	S	E	G	G	E	F	G	S	E	F
ORGANIC ACIDS										
Citric / Formic / Tannic / Acetic	E	E	E	E	E	E	E	E	E	E
INORGANIC ACIDS										
Hydrochloric 38% / Hydrochloric 10% / Sulphuric 10% / Nitric 10%	S	E	E	E	E	G	E	S	E	G
Chromic	S	E	G	G	E	NR	G	S	E	NR
Sulphuric 98% / Nitric 70%	G	F	G	G	G	NR	G	G	F	NR
HYDROCARBONS										
Stoddard Solvent / Toluene / Benzene / Xylene	G	G	F	F	G	NR	F	G	G	NR
Coal Tar Distillate	S	E	F	F	G	NR	F	S	E	NR
Styrene	G	F	G	G	G	F	G	G	F	F
MISCELLANEOUS										
Lacquer Thinner	G	F	F	F	G	NR	F	G	F	NR
Cutting Oil	S	E	E	E	E	F	E	S	E	F
Battery Acid	S	E	E	E	E	G	E	S	E	G
Phenol	S	E	G	G	G	G	G	S	E	G
Insecticides	S	E	E	F	E	F	G	S	E	F
Printing Ink	S	E	E	E	E	F	E	S	E	F
Dyestuffs	S	E	E	E	E	G	E	S	E	E
Penta	S	G	E	E	E	F	E	S	G	F
Formaldehyde	S	E	E	E	E	E	E	S	S	E
Vegetable Oil	S	E	E	E	E	G	E	S	E	G
Animal Fat	S	E	E	E	E	G	E	S	E	G
Acrylonitrile	S	E	G	F	E	F	G	S	E	E
Steam	S	E	E	E	E	E	E	S	E	E
Aniline	S	E	E	E	E	F	E	G	E	E
Hydraulic Fluid	S	E	E	E	E	F	E	G	E	F
Turpentine	F	G	E	E	E	F	E	E	G	F
Linseed Oil	S	E	G	G	E	NR	G	S	E	NR
Soya Bean Oil	S	E	G	G	E	F	G	S	E	F
Carbon Disulfide	F	NR	NR	F	F	G	F	F	NR	G
Creosote	E	G	G	G	G	F	G	E	G	F
Paint & Varnish Remover	E	F	F	F	F	NR	F	E	F	NR

PHYSICAL PROPERTIES CHART

COATING	Abrasion Resistance	Cut Resistance	Snag Resistance	Heat Resistance	Low-Temp. Resistance	Flexibility	Dry Grip	Wet Grip
NYGRAN	S	S	S	G	E	G	E	G
NEOPRENE	G	E	E	G	E	G	E	F
PYTHON	G	E	E	G	E	G	G	E
SLIP-NOT	G	E	E	E	E	G	E	E
DYNAGLUV	E	NR	E	F	NR	G	E	F
DYNAGRIP	E	NR	G	F	NR	E	E	E
GRANFLEX	E	NR	G	F	G	E	E	G
GRANECON	E	NR	G	F	E	E	E	E

S — Superior E — Excellent G — Good F — Fair NR — Not Recommended

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High density, plastic finger caps help protect tips against "pinch points" and minor blows. Worn inside work gloves. Stay in place until removed. Reusable when gloves wear out. Packaged six to a unit for index, middle and ring fingers, or, in bulk for one finger on each hand.

How to order:

For faster service, contact your nearest Granet distributor with the style number and quantity you desire. If a Granet distributor is not listed in your area, write: The Granet Division, ESB Inc., Framingham, MA 01701.

Glove control:

Work glove cost can be reduced by glove control. (1) Use the right glove for the job and standardize on as few glove styles as possible. (2) Granet distributors can do a "glove survey" in your plant. (3) Issue new gloves only when the worn out ones are returned by the wearer. (4) Check and see if one hand wears out faster than the other. If so, order and issue one hand only.

Glove care and replacement:

To add life to coated gloves being heavily exposed to **solvents** and **acids** it is always a good idea to alternate the wearing of two pairs. Wear one pair for half the work shift and the other pair for the other half. Rinse outer surface with water after each wearing.

Replacement of gloves is dependent on the wear factor created by the job application. Check gloves frequently for cracks, tears, splits, wear points, leakage and the like. Be sure to use a gauntlet glove long enough for the job application.

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GRANET DIVISION
ESB INCORPORATED

ESB Granet

Form 845 Printed in U.S.A.

BFGoodrich chemical comparison chart

chemical	Neo-prene	Natural Rubber or Latex	Nitrile (Buna – N)	PVC
A – Acetaldehyde	E	G	F	G
Acetate	G	F	G	P
Acetic Acid	E	E	E	E
Acetone	G	E	F	F
Acetylene Gas	E	E	E	G
Acetylene Tetrachloride	F	NR	G	P
Acrylonitrile	G	F	F	F
Amidol	G	E	G	E
Amine Hardeners	F	F	G	F
Ammonium Hydroxide	E	E	E	E
Amyl Acetate	F	P	F	P
Amyl Alcohol	E	E	E	G
Anhydrous Ammonia	G	E	G	E
Aniline	G	F	G	G
Aniline Hydrochloride	F	P	F	F
Aniline Oil	F	P	F	G
Animal Fats	E	P	E	G
Animal Oils	E	F	E	G
Anodex	G	E	G	E
Anthracene	F	P	G	F
Aromatic Fuels	P	NR	G	F
B – Banana Oil	F	P	G	F
Benzaldehyde	F	F	G	F
Benzene	P	NR	G	F
Benzyl Alcohol	E	E	E	G
Benzyl Benzoate	G	F	G	F
Benzyl Chloride	F	P	G	G
Blacosolve	G	P	G	F
Butane	E	F	E	P
Butyl Acetate	G	F	F	P
Butyl Alcohol	E	E	E	G
Butylaldehyde	G	G	G	G
Butylene	E	G	E	F
C – Calcium Hydroxide	E	E	E	E
Carbolic Acid	E	E	E	G
Carbon Dioxide	E	E	E	E
Carbon Disulphide	F	F	G	F
Carbon Tetrachloride	F	P	G	F
Castor Oil	F	P	E	G
Cello-Solve	F	G	P	F
Cello-Solve Acetate	G	F	G	F
Chlorophenylene Diamine	G	P	F	F
Chlorine	G	F	G	F
Chlorine Gas	G	F	G	F
Chloro Benzene	F	P	P	P
Chloroacetone	E	E	F	F
Chloroform	G	P	G	P
Chloronaphthalene	F	P	F	F
Chloropicrin	P	P	P	G
Chlorothene	P	NR	F	P
Chromic Acid	F	P	F	G
Chromotex	G	G	G	G
Citric Acid	E	E	E	E
Cotton Seed Oil	G	P	E	G
Creosote	G	G	G	G
Cresol	G	G	G	G
Cupric Nitrate	G	G	G	G
Cyclohexane	G	F	G	F
Cyclohexanol	G	F	G	F
Cyclohexanone	G	E	G	F
D – Decaborane	F	P	F	P
Degreasing Fluids	F	P	G	P
Diacetone Alcohol	E	E	E	P
Diethyltiamine	G	F	E	F
Di-Isocyanate	G	P	F	F
Diborane	F	P	F	P
Dibenzyl Ether	G	G	G	F
Dibutyl Phthalate	G	P	G	P
Dichlorethane	P	NR	F	P
Dichloroporopene	P	P	G	F
Diesel Fuel	G	P	G	F
Diethanolamine	E	G	E	E
Diethylamine	E	G	E	F
Diisobutyl Ketone	P	F	P	P
Dimethyl Formamide	F	F	P	G
Dioctyl Phthalate	G	P	G	P
Diosane	E	G	G	P
E – Emulsifying Agent	G	F	G	F
Emulthogene	G	F	G	F
Epichloro	G	P	P	F
Epoxy Resins, Dry	E	E	E	E
Esters	F	P	F	P
Ethane Gas	E	G	E	G
Ethanol	E	E	G	G
Ethers	E	G	E	P
Ethyl Acetate	G	F	F	P
Ethyl Alcohol	E	E	G	G
Ethyl Ether	E	G	E	P
Ethyl Formate	G	F	G	P
Ethylaniline	F	F	F	P
Ethylenediamine	E	G	E	F
Ethylene Dichloride	F	P	F	P
Ethylene Gas	E	G	E	G
Ethylene Glycol	E	E	E	G
Ethylene Trichloride	F	P	G	P
F – Fatty Acids	E	P	E	G
Ferrocyanide	F	G	F	F
Fluoric Acid	E	G	E	F

chemical	Neo-prene	Natural Rubber or Latex	Nitrile (Buna – N)	PVC
Fluorine	G	F	G	F
Fluorine Gas	G	F	G	F
Formaldehyde	E	E	E	F
Formic Acid	E	E	E	E
Freon 11	G	P	F	F
Freon 12	G	P	F	F
Freon 21	G	P	F	F
Freon 22	G	P	F	F
Furfural	G	G	F	F
G – Gasoline, Leaded	G	P	G	F
Gasoline, Unleaded	F	P	E	F
Glycerine	E	E	E	E
Glycerol	E	E	E	E
Glycol	E	E	E	E
Gold Fluoride	G	E	G	E
Grain Alcohol	E	E	G	G
H – Halogens	G	F	G	F
Hexamethylene Tetramine	F	G	F	G
Hexane	F	P	E	F
Hexyl Acetate	F	P	F	F
Hydraulic Oil:				
Petroleum Base	G	P	E	F
Ester Base	E	P	G	P
Hydrazine	F	G	G	E
Hydrochloric Acid	E	E	G	G
Hydrofluoric Acid	E	E	G	F
Hydrogen Gas	E	E	E	G
Hydrogen Peroxide – 30%	G	G	G	F
Hydro-Quinone	G	G	G	F
Hydrafluosilic Acid	F	F	G	F
I – Inorganic Salts	E	E	E	G
Iso-octane	F	G	P	P
Isopropanol	E	E	E	G
Isopropyl Alcohol	E	E	E	G
K – Kerosene	E	E	F	F
Ketones	G	F	E	F
L – Lacquer Thinners	G	G	F	F
Lactic Acid	E	E	E	G
Lauric Acid	E	E	F	G
Lineoleic Acid	E	E	P	G
Linseed Oil	E	E	P	F
M – Maleic Acid	E	E	E	G
Mercuric Chloride	G	G	E	F
Mercury	G	P	G	F
Methane Gas	E	E	E	G
Methanol	E	G	E	G
Methyl Acetate	G	G	F	P
Methyl Alcohol	E	G	E	G
Methylamine	F	G	F	F
Methyl Bromide	G	G	F	P
Methyl Cellosolve	G	E	G	P
Methyl Chloride	G	G	G	P
Methyl Ethyl Ketone	G	F	G	NR
Methyl Formate	G	F	F	F
Methylene Bromide	G	G	G	P
Methylene Chloride	G	G	F	P
Methyl Isobutyl Ketone	G	F	G	NR
Methyl Methacylate	G	G	G	F
Mineral Oils	E	E	F	G
Monochlorbenzene	F	P	P	P
Monoethanolamine	E	E	G	G
Morpholine	E	E	E	G
Muriatic Acid	E	E	G	G
N – Naphthalene	G	F	G	G
Naphthas, Aliphatic	E	F	E	P
Naphthas, Aromatic	G	P	G	P
Nitric Acid	G	F	F	F
Nitric Acid, Red & White Fuming	P	P	P	P
Nitrobenzene	F	P	F	P
Nitroethane	F	P	F	P
Nitrogen Gas	E	E	E	G
Nitromethane	F	P	F	P
Nitropropane	F	P	F	P
Nitrous Oxide	G	G	G	F
O – Octyl Alcohol	E	E	E	F
Oleic Acid	E	F	E	F
Oxalic Acid	E	E	E	G
Oxygen Liquid	F	P	F	P
P – Paint Thinners	G	F	G	F
Paint and Varnish Removers	G	F	G	P
Palmitic Acid	E	E	E	G
Paradichlorobenzene	E	F	G	E
Parathione	P	F	F	P
Penta Borane	F	P	F	P
Pentachloraphenol	F	G	F	F
Pentane	E	G	E	P
Perchloric Acid	E	F	F	P
Perchlorethylene	F	NR	E	NR
Permachlor	E	F	E	NR
Petroleum Spirits	E	F	E	P
Phenol	E	F	G	G
Phenylene Diamine	G	P	F	P
Phenyl Hydrazine	G	G	G	F
Phil-solv	E	F	E	F
Phosphoric Acid	E	G	E	G

chemical	Neo-prene	Natural Rubber or Latex	Nitrile (Buna – N)	PVC
Pickling Solution	G	G	G	G
Picric Acid	E	G	E	F
Pine Oil	E	P	E	G
Pitch	E	P	E	F
Plating Solutions	E	E	E	E
Potassium Alum	G	G	G	E
Potassium Bromide	G	G	G	E
Potassium Chrome Alum	G	G	G	G
Potassium Dichromate	F	F	F	G
Potassium Ferrocyanide	G	G	G	G
Potassium Hydroxide	E	E	E	G
Printing Inks	E	G	E	F
Propane Gas	E	E	E	G
Propanol-iso	E	E	E	G
Propyl Acetate	G	F	G	F
Propyl Alcohol	E	E	E	G
Propyl Alcohol Iso	E	E	E	G
Propylene Gas	E	F	E	G
Propyne Gas	E	F	E	G
R – Red Fuming Nitric Acid	P	P	P	P
S – Silver Nitrate	E	G	G	F
Skydrol 500	P	G	P	P
Sodium Carbonate Metol	G	G	G	G
Sodium Hydroxide	E	E	E	G
Sodium Sulphite	G	G	G	G
Sodium Thiosulphide	G	G	G	F
Solvarsol	E	F	E	F
Solvessos	P	P	E	P
Stearic Acid	E	E	E	G
Stoddards Solvent	E	F	E	F
Styrene	P	P	F	P
Styrene 100%	P	P	F	P
Sulphuric Acid	G	G	G	F
T – Tannic Acid	E	E	E	E
Tetra Hydro Borane	F	P	F	P
Tetraethyl Lead	E	F	E	P
Tetrahydrofuran	P	F	P	F
Toluene Di-isocyanate	F	G	F	P
Toluol	F	P	E	P
Trichlor	F	P	G	P
Trichlorethylene	F	P	G	P
Trichloroethane	P	P	F	P
Tricresyl Phosphate	G	F	F	NR
Tridecyl Alcohol	G	F	E	F
Triethanolamine	E	G	E	G
Trinitrotoluene	G	P	E	G
Trinitrotoluol	G	P	E	G
Triptane	E	P	E	P
Tung Oil	E	P	E	F
Turco No. 2998	P	P	P	P
Turpentine	G	F	E	G
U – Unsymmetrical Dimethyl Hydrazine	F	P	G	P
V – Varnoline Gas	E	F	E	F
Varsol	G	F	G	F
Vegetable Oils	E	G	E	G
W – Wood Alcohol	E	E	G	G
Wood Preservatives	G	F	G	F
Woodyouth	F	P	E	P
X – Xylene	P	P	E	P
Xylidene	E	F	E	P
Z – Zinc Chloride	E	E	E	F

PHYSICAL CHARACTERISTICS

Tensile Strength	E	E	E	F
Elongation	E	E	F	F
Tear Resistance	G	G	F	F
Abrasion Resistance	G	G	E	G
Heat Resistance	E	F	G	P
Ozone Resistance	E	G	G	E
Sunlight Aging	E	F	G	F
Shelf Life Aging	E	E	E	F

KEY:

E – Excellent G – Good F – Fair P – Poor
NR – Not Recommended

This comparison chart shows the relative resistance ratings of various glove materials to solvents commonly used in industry. We recommend rotation of gloves in service according to prevailing conditions. If excessive swelling occurs, change to another pair allowing swollen gloves to dry.

In general gloves should be cleaned immediately after use, particularly when using acids or other chemicals. This information is based on room temperature. Increases in room temperature should be watched as to its effect on gloves. Proper care will insure longer life.

Protective Clothing & Gloves

HOW TO SELECT THE CORRECT GLOVE FOR *YOUR* JOB! (Chemical Comparison Chart)

CHEMICAL	Neoprene	Natural Rubber or Latex	Nitrile Buna-N	PVC
A—Acetaldehyde	E	G	F	G
Acetate	G	F	G	P
Acetic Acid	E	E	E	E
Acetone	G	E	F	F
Acetylene Gas	E	E	E	G
Acetylene Tetrachloride	F	NR	G	P
Acrylonitrile	G	F	F	F
Amidol	G	E	G	E
Amine Hardeners	F	F	G	F
Ammonium Hydroxide	E	E	E	E
Amyl Acetate	F	P	F	P
Amyl Alcohol	E	E	E	G
Anhydrous Ammonia	G	E	G	E
Aniline	G	F	G	G
Aniline Hydrochloride	F	P	F	F
Aniline Oil	F	P	F	G
Animal Fats	E	P	E	G
Animal Oils	E	F	E	G
Anodex	G	E	G	E
Anthracene	F	P	G	F
Aromatic Fuels	P	NR	G	F
B—Banana Oil	F	P	G	F
Benzaldehyde	F	F	G	F
Benzene	P	NR	G	F
Benzyl Alcohol	E	E	E	G
Benzyl Benzoate	G	F	G	F
Benzyl Chloride	F	P	G	G
Blacosolve	G	P	G	F
Butane	E	F	E	P
Butyl Acetate	G	F	F	P
Butyl Alcohol	E	E	E	G
Butylaldehyde	G	G	G	G
Butylene	E	G	E	F
C—Calcium Hydroxide	E	E	E	E
Carbolic Acid	E	E	E	G
Carbon Dioxide	E	E	E	E
Carbon Disulphide	F	F	G	F
Carbon Tetrachloride	F	P	G	F
Castor Oil	F	P	E	G
Cello-Solve	F	G	P	F
Cello-Solve Acetate	G	F	G	F
Chlorophenylene Diamine	G	P	F	F
Chlorine	G	F	G	F
Chlorine Gas	G	F	G	F
Chloro Benzene	F	P	P	P
Chloroacetone	E	E	F	F
Chloroform	G	P	G	P
Chloronaphthalene	F	P	F	F
Chloropicrin	P	P	P	G
Chlorothene	P	NR	F	P
Chromic Acid	F	P	F	G
Chromotex	G	G	G	G
Citric Acid	E	E	E	E
Cotton Seed Oil	G	P	E	G
Creosote	G	G	G	G
Cresol	G	G	G	G
Cupric Nitrate	G	G	G	G
Cyclohexane	G	F	G	F
Cyclohexanol	G	F	G	F
Cyclohexanone	G	E	G	F
D—Decaborane	F	P	F	P
Degreasing Fluids	F	P	G	P
Diacetone Alcohol	E	E	E	P
Diethyltiamine	G	F	E	F
Di-Isocyanate	G	P	F	F
Dibcrane	F	P	F	P
Dibenzyl Ether	G	G	G	F
Dibutyl Phthalate	G	P	G	P
Dichlorethane	P	NR	F	P
Dichloroporopene	P	P	G	F
Diesel Fuel	G	P	G	F
Diethanolamine	E	G	E	E
Diethylamine	E	G	E	F
Diisobutyl Ketone	P	F	P	P
Dimethyl Formamide	F	F	P	G
Dioctyl Phthalate	G	P	G	P
Diossne	E	G	G	P
E—Emulsifying Agent	G	F	G	F
Emulthogene	G	F	G	F
Epichloro	G	P	P	F
Epoxy Resins, Dry	E	E	E	E
Esters	F	P	F	P
Ethane Gas	E	G	E	G
Ethanol	E	E	G	G
Ethers	E	G	E	P
Ethyl Acetate	G	F	F	P
Ethyl Alcohol	E	E	G	G
Ethyl Ether	E	G	E	P
Ethyl Formate	G	F	G	P
Ethylaniline	F	F	F	P
Ethylenediamine	E	G	E	F
Ethylene Dichloride	F	P	F	P
Ethylene Gas	E	G	E	G
Ethylene Glycol	E	E	E	G
Ethylene Trichloride	F	P	G	P

CHEMICAL	Neoprene	Natural Rubber or Latex	Nitrile Buna-N	PVC
F—Fatty Acids	E	P	E	G
Ferrocyanide	F	G	F	F
Fluoric Acid	E	G	E	F
Fluorine	G	F	G	F
Fluorine Gas	G	F	G	F
Formaldehyde	E	E	E	F
Formic Acid	E	E	E	E
Freon 11	G	P	F	F
Freon 12	G	P	F	F
Freon 21	G	P	F	F
Freon 22	G	P	F	F
Furfural	G	G	F	F
G—Gasoline, Leaded	G	P	G	F
Gasoline, Unleaded	F	P	E	F
Glycerine	E	E	E	E
Glycerol	E	E	E	E
Glycol	E	E	E	E
Gold Fluoride	G	E	G	E
Grain Alcohol	E	E	G	G
H—Halogens	G	F	G	F
Hexamethylene Tetramine	F	G	F	G
Hexane	F	P	E	F
Hexyl Acetate	F	P	F	F
Hydraulic Oil:				
Petroleum Base	G	P	E	F
Ester Base	E	P	G	P
Hydrazine	F	G	G	E
Hydrochloric Acid	E	E	G	G
Hydrofluoric Acid	E	E	G	F
Hydrogen Gas	E	E	E	G
Hydrogen Peroxide—30%	G	G	G	F
Hydro-Quinone	G	G	G	F
Hydrafluosilic Acid	F	F	G	F
I—Inorganic Salts	E	E	E	G
Iso-octane	F	G	P	P
Isopropanol	E	E	E	G
Isopropyl Alcohol	E	E	E	G
K—Kerosene	E	E	F	F
Ketones	G	F	E	F
L—Lacquer Thinners	G	G	F	F
Lactic Acid	E	E	E	G
Lauric Acid	E	E	F	G
Lineoleic Acid	E	E	P	G
Linseed Oil	E	E	P	F
M—Maleic Acid	E	E	E	G
Mercuric Chloride	G	G	E	F
Mercury	G	P	G	F
Methane Gas	E	E	E	G
Methanol	E	G	E	G
Methyl Acetate	G	G	F	P
Methyl Alcohol	E	G	E	G
Methylamine	F	G	F	F
Methyl Bromide	G	G	F	P
Methyl Cellosolve	G	E	G	P
Methyl Chloride	G	G	G	P
Methyl Ethyl Ketone	G	F	G	NR
Methyl Formate	G	F	F	F
Methylene Bromide	G	G	G	P
Methylene Chloride	G	G	F	P
Methyl Isobutyl Ketone	G	F	G	NR
Methyl Methacylate	G	G	G	F
Mineral Oils	E	E	F	G
Monochlorbenzene	F	P	P	P
Monoethanolamine	E	E	G	G
Morpholine	E	E	E	G
Muriatic Acid	E	E	G	G
N—Naphthalene	G	F	G	G
Naphthas, Aliphatic	E	F	E	P
Naphthas, Aromatic	G	P	G	P
Nitric Acid	G	F	F	F
Nitric Acid, Red & White Fuming	P	P	P	P
Nitrobenzene	F	P	F	P
Nitroethane	F	P	F	P
Nitrogen Gas	E	E	E	G
Nitromethane	F	P	F	P
Nitropropane	F	P	F	P
Nitrous Oxide	G	G	G	F
O—Octyl Alcohol	E	E	E	F
Oleic Acid	E	F	E	F
Oxalic Acid	E	E	E	G
Oxygen Liquid	F	P	F	P
P—Paint Thinners	G	F	G	F
Paint and Varnish Removers	G	F	G	P
Palmitic Acid	E	E	E	G
Paradichlorobenzene	E	F	G	E
Parathione	P	F	F	P
Penta Borane	F	P	F	P
Pentachlorophenol	F	G	F	F
Pentane	E	G	E	P
Perchloric Acid	E	F	F	P
Perchlorethylene	F	NR	E	NR
Permachlor	E	F	E	NR

CHEMICAL	Neoprene	Natural Rubber or Latex	Nitrile Buna-N	PVC
Petroleum Spirits	E	F	E	P
Phenol	E	F	G	G
Phenylene Diamine	G	P	F	P
Phenyl Hydrazine	G	G	G	F
Phil-solv	E	F	E	F
Phosphoric Acid	E	G	E	G
Pickling Solution	G	G	G	G
Picric Acid	E	G	E	F
Pine Oil	E	P	E	G
Pitch	E	P	E	F
Plating Solutions	E	E	E	E
Potassium Alum	G	G	G	E
Potassium Bromide	G	G	G	E
Potassium Chrome Alum	G	G	G	G
Potassium Dichromate	F	F	F	G
Potassium Ferrocyanide	G	G	G	G
Potassium Hydroxide	E	E	E	G
Printing Inks	E	G	E	F
Propane Gas	E	E	E	G
Propanol-iso	E	E	E	G
Propyl Acetate	G	F	G	F
Propyl Alcohol	E	E	E	G
Propyl Alcohol Iso	E	E	E	G
Propylene Gas	E	F	E	G
Propyne Gas	E	F	E	G
R—Red Fuming Nitric Acid	P	P	P	P
S—Silver Nitrate	E	G	G	F
Skydrol 500	P	G	P	P
Sodium Carbonate Metol	G	G	G	G
Sodium Hydroxide	E	E	E	G
Sodium Sulphite	G	G	G	G
Sodium Thiosulphide	G	G	G	F
Solvarsol	E	F	E	F
Solvessos	P	P	E	P
Stearic Acid	E	E	E	G
Stoddards Solvent	E	F	E	F
Styrene	P	P	F	P
Styrene 100%	P	P	F	P
Sulphuric Acid	G	G	G	F
T—Tannic Acid	E	E	E	E
Tetra Hydro Borane	F	P	F	P
Tetraethyl Lead	E	F	E	P
Tetrahydrofuran	P	F	P	F
Toluene Di-isocyanate	F	G	F	P
Toluol	F	P	E	P
Trichlor	F	P	G	P
Trichlorethylene	F	P	G	P
Trichloroethane	P	P	F	P
Tricresyl Phosphate	G	F	F	NR
Tridecyl Alcohol	G	F	E	F
Triethanolamine	E	G	E	G
Trinitrotoluene	G	P	E	G
Trinitrotoluol	G	P	E	G
Triptane	E	P	E	P
Tung Oil	E	P	E	F
Turco No 2998	P	P	P	P
Turpentine	G	F	E	G
U—Unsymmetrical Dimethyl Hydrazine	F	P	G	P
V—Varnoline Gas	E	F	E	F
Varsol	G	F	G	F
Vegetable Oils	E	G	E	G
W—Wood Alcohol	E	E	G	G
Wood Preservatives	G	F	G	F
Woodyouth	F	P	E	P
X—Xylene	P	P	E	P
Xylidene	E	F	E	P
Z—Zinc Chloride	E	E	E	F

PHYSICAL CHARACTERISTICS

Tensile Strength	E	E	E	F
Elongation	E	E	F	F
Tear Resistance	G	G	F	F
Abrasion Resistance	G	G	E	G
Heat Resistance	E	F	G	P
Ozone Resistance	E	G	G	E
Sunlight Aging	E	F	G	F
Shelf Life Aging	E	E	E	F

KEY: E—Excellent G—Good F—Fair P—Poor NR—Not Recommended

This "Comparative Use Chart" shows the relative resistance ratings of various glove materials to solutions commonly used in industry. When selecting gloves for applications not shown on the "Comparative Use Chart", call your local Vallen office giving as much detailed information as possible including the following points:

1. Chemical composition of the solution
2. Degree of concentration
3. Temperature Conditions
4. Abrasive effects of materials being handled
5. Time cycle of usage

ILC DOVER TOTAL ENCAPSULATING CHEMICAL PROTECTIVE SUIT

Note: we are redoing the chart & this will be the front page

MATERIAL COMPATIBILITY CHART

The following pages are offered as a general guide and indication of the suitability of the basic suit materials for service in specific chemicals. The ratings are based on published literature of various polymer suppliers (*) and in most cases were developed under laboratory conditions at room temperatures on the polymer and not the end use material. These conditions may not apply directly to user conditions. This data is offered only as a guide. We cannot guarantee thier accuracy nor assume responsibility for use thereof. The user is responsible to test/verify the compatibility of suit materials with intended use environments.

Several factors must always be considered in using an elastomer part in service. The most important are:

1. The Temperature of Service: Higher temperatures increase the effect of all chemicals on polymers. The increase varies with the polymer and the chemical. A compound quite suitable at room temperature might fail miserably at elevated temperature.

2. Conditions of Service: A compound that swells badly might still function well in a static mode yet fail in any dynamic application.

3. The Grade of the Polymer: Many types of polymers are available in different grades that vary greatly in chemical resistance.

4. The Compound Itself: Compounds designed for other outstanding properties may be poorer in performance in a chemical than one designed especially for fluid resistance.

5. Combinations: Mixtures of chemicals can frequently produce different effects on materials rather than when used alone.

NOTE: When the secondary visor is installed, the polyvinyl chloride is not exposed and the polyester rating will be applicable.

KEY:
- A - Little or no effect.
- B - Minor effect such as slight swelling, stains, etc.
- C - Conditional effect varies from minor to severe under different conditions.
- X - Severe effect.
- I - Insufficient data to rate.

* Sources will be provided on request.

CHEMICAL BASE	CPE	PVC (1)	BUTYL	URETHANE
Acids				
Strong, Non-Oxidizing	A	A	A	X
Strong, Oxidizing	X	B-X	B-X	X
Organic	A	B-C	B	X
Caustics				
Strong Alkalis	A	A-B	A	B-C
Ammonia	A	A	A	A
Solvents				
Aliphatic Hydrocarbons	A	B	X	A
Aromatic Hydrocarbons	B	B	X	B
Chlorinated Hydrocarbons	C	X	C	X
Esters	C	X	A-B	X
Ketones	C	X	X	X
Nitrohydrocarbons	C	X	C-X	X
Petroleum Products				
Gasoline & Kerosene	A-B	B-C	X	A-B
Fuel Oils	A-B	B-C	X	A-B
Greases	A	A-B	X	A
Tars & Asphalt	B	B	X	B-C
Phenolics	A	B-C	B-C	X
Animal & Vegetable Oils	A	A	A-B	A
Acetaldehyde		X	A	X
Acetic Acid, Glacial	A	X	B-C	X
Acetic Acid, 30-50% @ 70°F	A	B	B	C
Acetic Anhydride	A	X	X	X
Acetone	A	X	A	X
Acetyl Chloride	A	X	X	X
Acrylic Acid	A	X		X
Acrylonitrile	A	X	X	
Allyl Alcohol	A	X		
Aluminum	A	A	A	
Aluminum Acetate	A	A	A	
Aluminum Chloride	A	B	A	
Aluminum Fluoride		B	A	
Aluminum Hydroxide	A	B	B	
Ammonia, Anhydrous, Gas	A	A	A-B	
Ammonium Hydroxide	A	A	A	A
Amyl Acetate	C	X	A	X
Amyl Alcohol	A	A	A	X
Aniline	B	X	B	X
Ammonium Salts, General	A	A	A	A
Ammonium Nitrate	A	A	A	X
Ammonium Persulfate	A	A	X	X
Amyl Borate			X	
Amyl Chloro Naphthaline			X	X
Aqua Regia	C	C	C	X
Arsenic Acid	A		A	C
Asphalt		B	X	B
Barium Salts & Hydroxide	A	A	A	A
Benzaldehyde	C	X	B	X
Benzene (Benzol)	C	X	X	X
Benzoic Acid	A	B		
Benzene Sulfonic Acid	A		X	X
Benzoyl Chloride	X	X		
Benzyl Acetate	B	B		
Benzyl Alcohol	A	X	B	
Brine	A	A	A	A
Bromobenzene	X	X	X	X
Bromobutane	C	X	X	X
Bromochloromethane	C	X	X	X
Bromotoluene	X	X	X	X
Butyl Alcohol	B	B	B	X
Butyl Acetate	B	X	C	X
Butyl Acrylate	B	X	C	X
Butadiene	B	B	X	X
Bromine		X	X	X
Butyraldehyde	B	X	B	X
Butylamine	B		X	X
Butylbromide	C	X	C	X
Butyric Acid	A	A		
Butter	A	A	A	A
Calcium Acetate	A	A	A	A
Calcium Salts, General	A	A	A	A
Calcium Bisulfite	A	A	X	A
Cane Sugar Liquors			A	X

CHEMICAL BASE	CPE	PVC (1)	BUTYL	URETHANE
Carbolic Acid (Phenol)	A	C	C	X
Carbon Disulfide	C	X	X	
Carbon Monoxide & Dioxide			A	A
Carbon Tetrachloride	C	X	X	C
Castor Oil	A	B	B	A
Chloroacetone	X	X	B-C	X
Chlorobenzene	X		X	C
Chlorine (wet)			C	X
Chloroform	X	X	X	
Chlorinated Aliphatics	C	X	X	X
Chloroaromatics	X	X	X	C
Chlorox Solution	A	B	A	B
Chromic Acid, 30%	A		C	X
Chrome Plating Solutions			X	X
Cinnamene (Styrene)	C	X	X	
Copper Salts (Solutions)	A	A	A	A
Cyclohexane	A	B	X	B
Cyclohexanol	A	C	X	
Cyclohexanone	C	X	B-C	X
Denatured Alcohol	A	B	A	C
Detergent Solutions	A-B	B	B	C-X
Developing Fluids			B	
Diacetone Alcohol	A		A	B
Dibutyl Amine	A		X	
Dibutyl Ether	A	X	C	B
Diisobutyl Ketone	C	X	C	B
Dibutyl Phthalate	C	X	B	C
Dibutyl Sebacate	B	X	B	X
Dichlorobenzene	X	X	X	X
Dichloroethylene	C	X		
Diesel Fuel*			X	B
Dichloromethane	C	X	X	X
Diethyl Ether	A	C	X	A
Diethylene Glycol		A	A	X
Dimethyl Formamide			B	X
Dimethyl Benzene (Xylene)	X	X	X	C
1,4 Dioxane	B	X	B	
Dowtherm Oil	C		C	B
Dry Cleaning Fluids	B	C	X	B
Epichlorhydrin			B	
Ethane	B	B	X	B
Ethanol (Ethyl Alcohol)		B	B	B
Ethanolamine	A		B	C
Ethyl Acetate	B	X	C	X
Ethyl Acetoacetate	A		B	
Ethyl Acrylate	B	X	B	
Ethyl Benzene	C		X	X
Ethyl Bromide	C	X	C	
Ethyl Chloride		X	A	B
Ethyl Ether	A	X	C	B
Ethyl Iodide	C	X	X	
Ethylene Diamine	C		A	
Ethylene Dichloride	C	X	C	X
Ethylene Glycol	A	A	A	B
Ferric & Ferrous Salts	A	A	A	A
Fluorine (Liquid)		X	C-X	
Fluosilicic Acid	A	C	B	
Formaldehyde (Formalin)	A	A	A	X
Formic Acid	A	B (2)	A	X
Fuel Oils	B	B	X	B
Freon 11			X	X
Freon 12			B	
Freon 13			A	
Freon 21			X	
Freon 22			A	X
Freon 31			A	
Freon 32			A	
Freon 112			X	
Freon 113			X	B
Freon 114			A	A
Freon 115			A	
Freon 142b			A	
Freon 152a			A	
Freon 218			A	
Freon C316			A	
Freon C318			A	
Freon 13B1			A	A
Freon 11482			X	

*own accumulation... ILC Dover

CPE - Chlorinated Polyethylene

PVC - Polyvinyl Chloride

NOTE: ALL DATA FOR 70° - 75°F

KEY:
A-Excellent
B-Good
C-Conditional
X-Not Recommended

(1) Max. Service Temp. 145 ± 5°F
(2) To 50°
(3) 40% Max
(4) [illegible]

CHEMICAL NAME	CPE	PVC (1)	BUTYL	URETHANE
[illegible]			X	A
[illegible]			A	A
[illegible]			B	B
[illegible]			A	A
[illegible]			A	A
[illegible]			A	A
[illegible]			X	C
[illegible]			X	
[illegible]			C-X	
[illegible]	A	X	B	
[illegible]	A-B	B-C	X	A
[illegible]	A	A	A	A
[illegible]	A	A	A	A
[illegible] (water base)	A	A	A	A
[illegible]	A	A	A	B
[illegible]	A-B	A-B	X	A
[illegible] (Petroleum Base)	C		B	B
[illegible]	A-B	A-B	X	B
[illegible]	A	B	C	X
[illegible] (Benzyl Alcohol)			A	X
[illegible]			A	X
Hydrazine	A	A	A	X
Hydrobromic Acid	A	A	A	X
Hydrochloric Acid	A	C(3)	B(4)	X
Hydrofluoric Acid		B	A	
Hydrocyanic Acid			A	A
Hydrogen Gas	A	A	C	
Hydrogen Peroxide (90%)		A	A	
Hydrogen Sulfide		A		
Hydroquinone	A	X		
Iodine		X	A	B
Isophorone	A	B	X	B
Isooctane	B	B	B	X
Isobutyl Alcohol	B	X	A	A
Isopropyl Acetate	A	B	A	C
Isopropyl Alcohol	A	B	X	B
Kerosene		X	X	X
Lacquers & Lacquer Solvents	A	A	A	C
Lactic Acid	A	A	X	A
Lard @ 212°F	A	A	A	A
Lead Salts	A	A	A	
Lime	A	B	B	B
Linseed Oil	A	A	X	B
Lube Oils (Petroleum)			A	B
Lye	A	A	A	A
Magnesium Salts			C	
Maleic Acid			C	
Maleic Anhydride			X	
Malic Acid	A	A	A	A
Mercury		X	A	
Mercuric Chloride	B	X	B	
Mesityl Oxide			X	B
Methane	A	X	B	
Methyl Acetate			B	
Methyl Acrylate	A	A	A	X
Methyl Alcohol	A	B	A	X
Methyl Butyl Ketone	C	X	C-X	X
Methylene Chloride	C	X	B	X
Methyl Ethyl Ketone	C	X	X	X
Methyl Methacrylate	A	A	A	C
Milk	A	A	X	A
Mineral Oil	A		A	C
Mustard Gas				
Naphtha	A	C	X	C
Naphthalene	A	X	X	B
Nickel Salts	A	A	A	A
Nitric Acid - Conc.	X	X	C	X
Nitric Acid - Dilute	A	B	B	C
Nitric Acid - Fuming	X	X	X	X
Nitro Benzene	C	X	X	X
Nitroethane	A	X	B	
Nitrogen	A	A	A	A
Nitrogene Tetroxide			C	

CHEMICAL NAME	CPE	PVC (1)	BUTYL	URETHANE
Octane, N & ISO	A		X	A
Oleic Acid	A	A	A	B
Oxalic Acid	A	A	A	B
Oxygen - cold	A	A	A	A
Oxygen - 201°-400°F			X	X
Ozone	A		B	A
Oils, Crude, Lube, Veg.	A	A-B	X-C	A-B
Paraffin Wax	A	A	B	A
Perchlorethylene	C	X	X	X
Phenol	A	C	C	X
Phenylhydrazine		X	C	
Phosphoric Acid Oil	A	A	A	A
Phosphoric Acid Conc.	A	A	B	A
Pinene	B		X	B
Pine Oil	B		X	
Potassium Salts, General	A	A	A	A
Potassium Hydroxide, 50%	A	A	B	B
Propane			X	B
Pyridine			B	
Red Oil	A	B	X	A
Sodium Salts - General	A	A	A	A
Sodium Hypochlorite	A	B	B	X
Sodium Hydroxide 50%	A	A	A-B	B
Soybean Oil	A	A	C	B
Stanous (IC) Chloride	A	A	C	
Steam - under 300°F		X	A	X
Steam - over 300°F		X	C	X
Stoddard's Solvent	A	C	X	A
Styrene	C	X	X	X
Sulfuric Acid, to 50%	A	A	B	B
Sulfuric Acid, Conc.	X	X	B	X
Sulfuric Acid, Fuming	X	X	X	X
Sulfurous Acid, Oil	A	B	B	X
Sulfurous Acid, Conc.	A	B	B	X
Tannic Acid	A	A	A	A
Tar, Bituminous			X	
Toluene	C	X	X	C
Triacetin			A	X
Tributyl Phosphate	C	X	A	X
Trichloroethane	C	X	X	X
Trichlorethylene	C	X	X	X
Triethanolamine	A	B	B	X
Tricresyl Phosphate	A	C	A	B
Turpentine	B		X	X
Urea	A	A	A	A
Varnish			X	
Vinegar	A	A	A	A
Vinyl Acetate	A	X		
Vinyl Chloride		X		
Vinyl Cyanide	A			
Vinyl Styrene	X			
Vinyl Toluene	C			
Vinyl Trichloride	C			
Water	A	A	A	A
Xylene	X	X	X	C
Xylidine	C	X	X	
Zinc Salts, General	A	A	A	A

CPE - Chlorinated Polyethylene

PVC - Polyvinyl Chloride

NOTE: ALL DATA FOR 70° - 75°F

KEY:
- A-Excellent
- B-Good
- C-Conditional
- X-Not Recommended
- Blank—Insufficient Data to Rate

(1) Max. Service Temp. 145 ± 5°F
(2) To 50%
(3) 40% Max
(4) Except Hot Concentrated

EAST WIND INDUSTRIES, INC.

Specification #200, Adendum A

CHEMICAL RESISTANCE OF NEOPRENE, P.V.C. & BUTYL

These tables, based on data from laboratory tests and records of service performance, have been prepared as a guide to the serviceability of properly compounded products in contact with a variety of chemicals.

The tables should be used as a guide only. All requirements necessary to satisfactory performance must be taken into consideration. Temperature; intermittent or continuous exposure to the chemical involved; and area of the resilient part which will be in direct contact with the chemical are all factors which affect servicoability. The effect of those chemicals listed as injurious to these compounds may be of such nature that these compounds will deliver adequate service life. The fact that these compounds are found satisfactory for a given service is no assurance that the same compounds will be successful under different service conditions.

To determine whether these products will be satisfactory for a given application, test it in actual service. If this is impractical, then devise tests which simulate actual service conditions as closely as possible.

	P.V.C.	NEO-PRENE	BUTYL
Acetaldeyde	NR	R	R
Acetamide	*	L	L
Acetate	*	L	L
Acetic Acid, 80%	R	R	R
Acetone	NR	L	R
Acetophenone	*	NR	
Acetyl Cloride	*	NR	
Acetylene Gas	*	R	R
Acetylene Tetracloride	*	NR	NR
Acrylonitrile	NR	L	L
Aluminum Chloride	R	R	*
Aluminum Nitrate	R	R	*
Aluminum Sulfate	R	R	*
Amidol	*	L	R
Amine hardeners	NR	NR	L
Ammonia Gas-Dry	R	R	*
Ammonia, Aqua - 10%	R	R	*
Ammonia, Liquid	NR	R	*
Ammonium Hydroxide	R	R	R
Amyl Acetate	NR	NR	NR
Amyl Alcohol	*	R	R
Anhydrous Ammonia	*	L	R
Aniline	NR	NR	NR
Aniline Hydrocloride	NR	NR	NR
Aniline Oil	*	NR	NR
Animal Fats	*	R	L
Animal Oils	*	R	L
Anodex	*	L	R
Anthracene	*	NR	NR
Aromatic Fuels	*	NR	NR
Arsenic Acid	R	R	*
Arsine	*	R	R

	P.V.C.	NEO-PRENE	BUTYL
Asbestos	*	R	R
Asphalt	*	L	NR
Banana Oil	*	NR	NR
Barium Chloride	R	R	*
Benzaldehyde, 10%	R	NR	L
Benzaldehyde, above 10%	NR	NR	*
Benzene	NR	NR	NR
Benzene Benzol	NR	NR	*
Benzene Sulfonic Acid, 10%	R	R	*
Benzol	*	NR	NR
Benzyl Alcohol	*	R	R
Benzyl Benzoate	*	L	NR
Benzyl Chloride	*	NR	L
Blacosolve	*	L	NR
Boric Acid	R	R	*
Boron Tribromide	*	L	NR
Bromine	*	L	NR
Bromoform	*	L	NR
Butane	R	R	NR
2-Butanone	*	L	L
Butyl Acetate	L	NR	NR
Butyl Alcohol	L	R	R
Butylaldehyde	*	L	L
Butylene	NR	R	L
Butyric Acid, 50%	R	R	*
Cadmium Oxide Fume	*	R	R
Calcium Hydroxide, 50%	R	R	R
Carbolic Acid	*	R	R
Carbon Bisulfide	NR	NR	*
Carbon Dioxide, Dry	R	R	R
Carbon Disulfide	NR	NR	NR
Carbon Tetracloride	NR	NR	NR
Castor Oil	R	NR	NR
Cellosolve	L	NR	L
Cellosolve Acetate	NR	L	L
Chlordane	*	L	NR
Chlorine	NR	L	R
Chlorine Gas, Dry	NR	NR	L
Chlorine Gas, Wet	NR	NR	R
Chlorine, Liquid	NR	NR	R
Chlorobenzene	NR	NR	NR
Chloroacetone	*	L	R
Chlorobromomethane	*	NR	NR
Chloroform	NR	NR	NR
Chloronaphthalene	NR	NR	NR
Chlorophenylene Diamine	*	L	NR
Chloropicrin	NR	NR	NR
Chlorothene	NR	NR	NR
Chromic Acid	R	NR	NR
Chromic Acid, 50%	R	NR	*
Chromotex	*	L	L
Citric Acid	R	R	R
Coal Tar Pitch Volatiles	NR	NR	*
Cottonseed Oil	*	L	NR
Cotton Dust (Raw)	*	R	R
Creosote	L	L	NR
Cresol	L	L	NR

	P.V.C.	NEO-PRENE	BUTYL
Cresylic Acid, 50%	R	NR	*
Cupric Nitrate	*	L	R
Cyanide	*	L	L
Cyclohexane	*	L	NR
Cyclohexanol	NR	L	L
Cyclohexanone	NR	L	L
Decaborane	*	NR	NR
Degreasing Fluids	*	NR	NR
Diacetone Alcohol	*	R	R
Diborane	*	NR	NR
Dibenzyl Ether	*	L	L
Dibutyl Phthalate	NR	NR	L
Dichlorobenzene (Ortho)	NR	NR	*
Dichloroethane	*	NR	NR
Dichloropropene	*	NR	NR
Diesel Fuel	R	R	NR
Diethanolamine	*	R	R
Diethylamine	NR	L	L
Diethyltriamine	*	L	L
Diisobutyl Ketone	NR	NR	L
Diisocyanate	*	L	R
Dimethyl Formanide	NR	NR	L
Dioctyl Phthalate	NR	L	NR
Dioxane	*	R	L
Emulsifying Agent	*	L	R
Emulthogene	*	L	R
Epichlorohydrin	*	L	L
Epoxy Resins, Dry	*	R	R
Esters	*	NR	NR
Ethane Gas	*	R	R
Ethanol	L	R	R
Ethers	*	R	L
Ethyl Acetate	NR	NR	L
Ethyl Alcohol	*	R	R
Ethyl Ether	NR	L	R
Ethyl Formate	NR	L	L
Ethylaniline	*	NR	L
Ethylene Diamine	*	R	L
Ethylene Dichloride	NR	NR	NR
Ethylene Gas	*	R	R
Ethylene Glycol	L	R	R
Ethylene Oxide	NR	L	*
Ethylene Trichloride	*	NR	NR
Fatty Acids	R	R	NR
Ferric Chloride	R	L	*
Ferric Nitrate	R	R	*
Ferric Sulfate	R	R	*
Ferrocyanide	*	NR	R
Ferrous Sulfate	R	R	*
Fluorine Gas, Wet	R	L	L
Fluoric Acid	R	R	R
Fluorine	*	L	L
Fluosilicic Acid	R	R	*
Formaldehyde, 50%	R	R	R
Formic Acid	R	R	R
Freon F-11	NR	L	NR
Freon F-12	NR	L	

	P.V.C.	NEO-PRENE	BUTYL
Freon F-21	NR	L	NR
Freon F-22	NR	L	NR
Fuel Oil	R	R	R
Furfural	NR	L	L
Gallic Acid	R	*	*
Gasoline, Leaded	R	L	NR
Gasoline, Unleaded	R	L	NR
Glycerine	*	R	R
Glycerol	*	R	R
Glycol	*	R	R
Gold Fluoride	*	L	R
Grain Alcohol	*	R	R
Halogens	*	L	L
Hexamethylenetetramine	*	NR	L
Hexane	NR	NR	NR
Hexl Acetate	*	NR	NR
Hydraulic Oil			
Ester Base	*	R	L
Petroleum Base	NR	L	NR
Hydrazine	*	NR	L
Hydrochloric Acid	*	R	L
Hydrofluoric Acid	*	R	L
Hydrofluoric Acid, 30%	R	R	*
Hydrofluoric Acid, 50%	L	R	*
Hydrofluosilicic Acid	R	NR	L
Hydrogen Gas	*	R	R
Hydrogen Peroxide - 30%	*	L	L
Hydroquinone	R	L	L
Inorganic Salts	*	R	R
Iodine	NR	L	L
Isooctane	*	R	NR
Isopropanal	*	R	R
Isopropyl Alcohol	R	R	R
Kerosene	R	R	NR
Ketones	NR	L	R
Lacquer Thinners	NR	L	NR
Lactic Acid	L	R	R
Lactic Acid, 25%	R	R	R
Lauric Acid	L	R	R
Lineoleic Acid	*	R	NR
Linseed Oil	R	R	NR
Lubricating Oil	R	R	*
Magnesium Hydroxide	R	R	*
Magnesium Nitrate	R	R	*
Magnesium Sulfate	R	R	*
Maleic Acid	L	R	R
Mercuric Chloride	R	L	R
Mercury	R	L	R
Methane Gas	*	R	R
Methanol	L	R	R
Methylamine	NR	NR	*
Methyl Acetate	*	L	L
Methyl Alcohol	*	R	R
Methylamine	*	NR	L
Methyl Bromide	NR	L	NR
Methyl Cellosolve	R	R	L

	P.V.C.	NEOPRENE	BUTYL
Methyl Chloride	NR	NR	NR
Methyl Ethyl Ketone	NR	L	R
Methyl Formate	•	L	L
Methyl Isobutyl Ketone	NR	L	R
Methyl Methacrylate	NR	L	R
Methylene Bromide	•	NR	L
Methylene Chloride	NR	NR	L
Minderal Oil	R	R	NR
Monochlorobenzene	•	NR	NR
Monoethanolamine	L	R	R
Morpholine	•	R	R
Muriatic Acid	•	R	R
Naptha	NR	R	•
Napthalene	•	L	NR
Napthas, Aliphatic	•	R	NR
Napthas, Aromatic	•	L	NR
Napthalene	NR	NR	NR
Nickel Acetate	R	R	•
Nickel Chloride	R	R	•
Nickel Nitrate	R	R	•
Nickel Sulfate	R	R	•
Nitric Acid	NR	L	NR
Nitric Acid, red & white fuming	•	NR	NR
Nitrobenzene	NR	NR	NR
Nitroethane	•	NR	NR
Nitrogen Gas	•	R	R
Nitromethane	NR	NR	NR
Nitropropane	NR	NR	NR
Nitrous Oxide	R	L	L
Octyl Alcohol	NR	R	R
Oleic Acid	NR	R	L
Oxalic Acid	NR	R	R
Oxygen, Liquid	•	NR	NR
Ozone	R	L	L
Paint Thinners	NR	L	NR
Paint & Varnish Removers	NR	L	NR
Palmitic Acid	L	R	R
Paradichlorobenzene	•	R	R
Parathion	•	NR	NR
Pentaborane	•	NR	NR
Pentachlorophenol	•	NR	L
Pentane	R	R	L
Perchloric Acid	NR	R	L
Perchloroethylene	NR	NR	NR
Perklene	•	R	NR
Permachlor	NR	L	NR
Petroleum Spirits	NR	R	NR
Phenol	L	R	R
Penylenediame	•	L	L
Penylhydrazine	NR	L	L
Phil-solve	•	R	L
Phosphoric Acid	L	L	R
Pickling Solution	L	L	R
Picric Acid	NR	R	L
Pine Oil	L	R	NR
Pitch	NR	R	NR

	P.V.C.	NEO-PRENE	BUTYL
Plating Solutions	R	R	R
Potassium Alum	R	L	R
Potassium Bisulfate	R	R	*
Potassium Bromide	R	L	R
Potassium Carbonate	R	R	*
Potassium Chloride	R	R	*
Potassium Chrome Alum	*	L	R
Potassium Cyanide	R	R	*
Potassium Dichromate	R	L	NR
Potassium Ferrocyanide	R	L	R
Potassium Hydroxide	R	R	R
Potassium Iodide	*	R	
Potassium Nitrate	R	R	*
Potassium Sulfate	R	R	*
Printing Inks	*	R	L
Propane Gas	*	R	R
Propanol (iso)	*	R	R
Propyl Acetate	NR	L	L
Propyl Alcohol	L	R	R
Propyl Alcohol (iso)	L	R	R
Propylene Gas	*	R	R
Propyne Gas	*	R	R
Pyrethrum	*	R	R
Red Fuming Nitric Acid	*	NR	NR
Rhodium Fume & Dust	*	R	R
Silver Nitrate	R	R	R
Skydrol 500	*	NR	L
Sodium Carbonate Metol	*	L	R
Sodium Hydroxide	L	R	R
Sodium Hypochlorite	R	NR	*
Sodium Sulfite	R	L	R
Sodium Thiosulfide	*	L	R
Solvarsol	*	R	NR
Solvessos	*	NR	NR
Stearic Acid	R	L	R
Stoddard's Solvent	NR	L	L
Styrene	NR	NR	NR
Styrne 100%	*	NR	NR
Sulfur Trioxide	R	NR	*
Sulfuric Acid, 80%	L	L	R
Sulfuric Acid, 94%	NR	NR	R
Tannic Acid	R	R	R
Tetraethyl Lead	R	R	L
Tetrahydroborane	*	NR	NR
Tetrahydrofuran	NR	L	NR
Toluene	NR	NR	NR
Toluene Diisocyanate	NR	NR	L
Toluol	NR	NR	NR
Trichlor	*	NR	NR
Trichloroacetic Acid	*	L	L
Trichloroethylene	NR	L	NR
Trichloroethane	*	NR	NR
Tricresyl Phosphate	NR	L	NR
Tridecyl Alcohol	*	L	NR
Triethanolamine	L	R	L
Trinitrotoluene	*	R	NR
Trinitrotoluol	L	L	NR
Triptane	NR	R	NR
Tung Oil	NR	R	NR

	P.V.C.	NEO-PRENE	BUTYL
Turco No. 2998	*	NR	NR
Turpentine	L	NR	NR
Unsymmetrical Dimethylhydrazine	*	NR	NR
Varnoline Gas	*	R	NR
Vanadium Fume & Dust	*	R	R
Varsol	*	L	NR
Vegetable Oils	*	R	L
Wood Alcohol	L	R	R
Woodyouth	*	NR	L
Xylene (Xylol)	NR	NR	NR
Xylol	NR	NR	NR
Zinc Chloride	R	R	R

R - Recommended
L - Limited Resistance
NR- Not Recommended
* - Information Not Available

TYPICAL PHYSICAL PROPERTIES OF TYVEK® SPUNBONDED OLEFIN TYPES 14 AND 16

(Machine Direction x Cross-Machine Direction)

	Style 1421	Style 1422	Style 1443	Style 1445	Style 1622
Thickness (mils)	5.0	5.5	6.0	6.0	6.0
Strip Tensile (lbs./in.)	6.0x9.0	7.5x9.0	9.0x11	9x12	6.5x7.7
Elongation to Break (%)	12x19	12x12	12x12	12x18	14x14
Tongue Tear (lb.)	1.9x2.1	1.9x2.1	2.1x2.1	2.3x2.5	1.5x1.7
Mullen Burst ($lb./in.^2$)	40	43	50	50	42
MIT Flex (cycles)	>100M	>100M	>100M	>100M	>100M
Frazier Permeability ($ft.^3 air/ft.^2/min.$)	<1	<1	<1	<1	45

RESISTANCE OF TYVEK® SPUNBONDED OLEFIN TYPE 14 TO ACIDS

Reagent	Exposure Conditions Concentration %	Temperature °F.	Time Hrs.	Percent Breaking Strength Retained
Sulfuric Acid	1.0	70	1000	90-100
" "	10.0	70	1000	90-100
" "	10.0	210	10	90-100
" "	60.0	70	10	90-100
" "	60.0	70	1000	90-100
" "	60.0	210	10	90-100
" "	80.0	70	1000	90-100
" "	96.0	70	1000	90-100
Hydrochloric Acid	1.0	70	1000	90-100
" "	10.0	70	1000	90-100
" "	10.0	160	10	90-100
" "	37.0	160	10	90-100
Nitric Acid	1.0	70	1000	90-100
" "	10.0	70	1000	90-100
" "	10.0	210	10	90-100
" "	70.0	70	10	80-90
" "	95.0	70	1000	80-90
Phosphoric Acid	10.0	70	1000	90-100
" "	10.0	210	10	90-100
" "	85.0	70	10	90-100
Hydrofluoric Acid	10.0	70	10	90-100
Chromic Acid	10.0	70	10	90-100
Hydrobromic Acid	10.0	70	10	90-100
Sulfamic Acid	10.0	70	10	90-100

RESISTANCE OF TYVEK® SPUNBONDED OLEFIN TYPE 14 TO BASES

Reagent	Exposure Conditions Concentration %	Temperature °F.	Time Hrs.	Percent Breaking Strength Retained
Ammonium Hydroxide	1.0	70	1000	90-100
" "	58.0	70	10	80-90
" "	58.0	70	1000	80-90
Sodium Hydroxide	10.0	70	1000	90-100
" "	10.0	210	10	80-90
" "	40.0	70	1000	90-100
" "	40.0	210	10	90-100
Sodium Carbonate	1.0	70	1000	90-100
Sodium Orthosilicate	1.0	210	10	90-100

RESISTANCE OF TYVEK® SPUNBONDED OLEFIN TYPE 14 TO SALT SOLUTIONS

The breaking strength of Tyvek® spunbonded olefin Type 14 was unaffected by exposure to the following salt solutions under these conditions:

- Saturated solution
- 70°F. temperature of exposure
- 1,000 hours

Some yellowing was noted after exposure to ferrous and ferric salt solutions.

Aluminum Chloride
Aluminum Sulfate

Ammonium Chloride
Ammonium Nitrate
Ammonium Sulfate
Ammonium Thiocyanate

Cadmium Chloride

Calcium Chloride
Calcium Thiocyanate

Chromic Sulfate

Cobaltous Sulfate

Copper Chloride
Copper Sulfate

Ferric Ammonium Sulfate

Ferric Chloride
Ferric Citrate
Ferric Nitrate
Ferric Oxalate
Ferric Sulfate

Ferric Potassium Sulfate

Ferrous Sulfate

Magnesium Chloride

Manganous Chloride

Mercuric Chloride

Nickel Chloride

Potassium Chloride
Potassium Thiocyanate

Silver Nitrate

Sodium Bisulfate
Sodium Bromide
Sodium Chloride
Sodium Fluoride
Sodium Nitrate
Sodium Nitrite
Sodium Sulfate
Sodium Thiocyanate

Stannic Chloride

Stannous Bromide
Stannous Chloride

Zinc Chloride

RESISTANCE OF TYVEK® SPUNBONDED OLEFIN TYPE 14 TO OXIDIZING AND REDUCING AGENTS

Agent	Exposure Conditions: Concentration	Temp. °F.	Time Hrs.	pH	Percent Breaking Strength Retained
Calcium Hypochlorite	Sat. Solution	70	1	11.8	90-100
Chlorine Water	Sat. Solution	70	10	1.3	80-90
Hydrogen Peroxide	90%	70	10	-	80-90
Sodium Chlorite	0.6%*	210	10	4.5	80-90
Sodium Hypochlorite	0.3%*	70	10	4.5	60-80
Sodium Hypochlorite	5.26	70	1	12.2	90-100
Sodium Sulfite	3.0	210	10	10.1	90-100

*Acetic acid as additive

RESISTANCE OF TYVEK® SPUNBONDED OLEFIN TYPE 14 TO ORGANIC SOLVENTS

Organic Chemical	Exposure Conditions Concentration (%)	Temperature °F.	Time (Hrs.)	Percent Breaking Strength Retained
Acetamide	100	200	10	90-100
Acetic Acid	100	70	1,000	90-100
Acetone	100	70	1,000	90-100
Aniline	100	70	1,000	90-100*
Benzene	100	70	1,000	90-100
Carbon Tetrachloride	100	70	1,000	90-100
Chloroform	100	70	1,000	90-100
Ether	100	70	1,000	80-90
Ethyl Alcohol	100	70	1,000	90-100
Ethylene Glycol	100	70	1,000	90-100
Formaldehyde	10% in H_2O	70	1,000	90-100
Formic Acid	91% in H_2O	70	1,000	80-90
Freon 113 Refrigerant	100	70	1,000	90-100
Gasoline (leaded)	100	70	1,000	80-90
Glycerol	100	70	1,000	90-100
Kerosene	100	70	1,000	80-90
Methyl Alcohol	100	70	1,000	90-100
Methylene Chloride	100	70	1,000	90-100
Mineral Oil	100	70	1,000	90-100
Perchlorethylene	100	70	1,000	90-100
Phenol	100	200	10	90-100
Trichloroethylene	100	70	1,000	90-100
Trifluoroacetic Acid	100	70	1,000	90-100
Turpentine	100	70	1,000	90-100

*Material yellow after exposure

DURAFAB HAZARD/GUARDS®

The most complete line of economical, reusable protective clothing available to the food processing, industrial, medical and nuclear fields.

Reusable/disposable Durafab Hazard/Guard garments are used wherever protective clothing is required: in laboratories, food processing and handling, nuclear power plants, chemical plants, clean rooms, automotive and service areas, for painting, maintenance, highway work, warehousing and visitor protection.

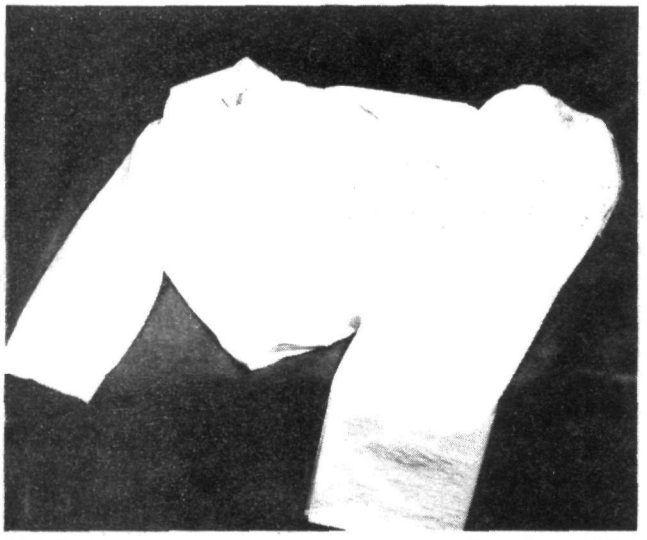
All Durafab protective garments, except for the PVC and reinforced cellulosic lines, are made of tough, tear-free, snag- and puncture-proof spunbonded olefin. They're virtually unaffected by acids, acrylic lacquers, most organic and inorganic chemicals and have a slow penetration rate or total resistance to most liquids.

Durafab Hazard/Guard garments are full-fashioned for comfort with rolled or bound seams and polyester thread for less linting and added strength.

They can be worn comfortably over street clothes; their opaque color eliminates embarrassing show-through.

All Durafab Hazard/Guards are treated with a soluble anti-static agent to prevent them from attracting dust and clinging.

Durafab Hazard/Guards can be custom designed for specific needs, including special garment features as well as custom colors, patterns, and coatings. Colors include white, yellow, blue, green, magenta and fluorescent orange for safety.



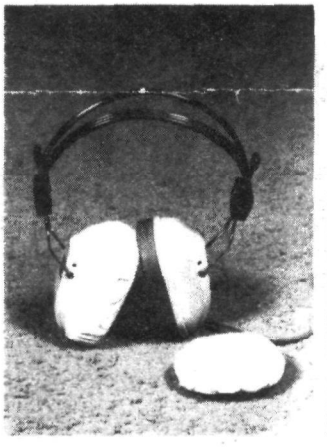
Shirt K4160 Pants K4150

Lab Coat
K4120

Zippered Coveralls
K4120Z

Shoe Covers
2200AC

Head Covers
193FR



Headset Covers
2195

Snoods
194FR

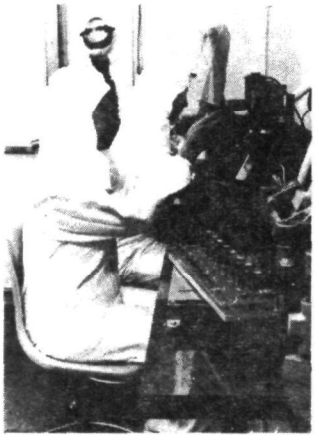
Reinforced cellulosics

These garments are treated for water repellancy and flame retardancy to afford maximum economical protection. They have a cloth-like quality of hand and drape and are lightweight, strong and afford greater wear and comfort.

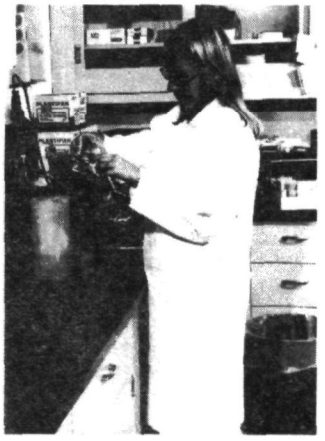
Protective Accessories

Durafab manufactures a complete line of economical, comfortable, high-quality items for special purpose applications. These include complete head protection – hair covers, hard hat liners and covers, and hoods. Durafab provides footing protection with low- and high-top shoe covers and wing walks. Other accessory items available are headset covers, sleeve protectors, and bib aprons. Durafab accessories are available in these features: Regular Tyvek, Porous, Striped Porous, Polylaminated and Scrim Reinforced Cellulosic. Special colors can be ordered for specific applications.

Shop Coats
2140



Hooded Coveralls
2125



Lab Coat
P2140

Snap Coveralls
P2120

Smock
2175

Coveralls
2120

Slicker Suits
P2180

Sack Suits
P2126

Durafab regular spunbonded olefin protective garments.

Perfect protection for those jobs requiring worker/clothing protection from damaging chemicals, dusts or other materials; in extremely dirty areas; where limited linting is desired; or where cleanliness from outside dirt is required.

Polylaminated protective garments

Made of spunbonded olefin, these protective garments are available in a variety of styles to meet your requirements. These garments are impervious to most liquids, including acids, and feature yellow coloring for added safety and positive identification.

COMPARATIVE TESTING DATA

	Durafab Disposable Type 31	Disposable Nonwoven Fabric (Control)
Breaking Strength, lbs.		
warp	11.2	8
filling	14.1	1.45
Elongation %		
warp	21.0	15%
filling	40.0	53%
Tear Strength, lbs.		
warp	3.9	.5
Instron filling	2.1	.8
Tear Strength, grams		
warp	54.0	60
Elmendorf filling	46.0	30
Puncture, lbs.	10.5	3.7
Wear, Stoll, 1/8" bar, cycles		
warp	>5000	265
Wear, Stoll, Inflated Diaphragm, 5 psia, 2 lbs. pressure, cycles	12	11
Taber Abrasion, CS 17,500 g, cycles	187	19
WYCO, 600 grit, 6 lb. tension, 3½ lb., warp pressure, cycles	70	46
WYCO, 180 grit, 6 lb. tension, 3½ lb., warp pressure, cycles	8	5
Stiffness in lbs.		
warp	.0025	.0007
filling	.0015	0
Folding Endurance, cycles, warp	>5000	0
filling	>5000	0
Frazier Air Permeability, in.^{3}/ft.^{2}/24 hrs.	1.01	400
Burst Strength, psi	35	14
Electrostatic Charge, Nanocoulombs	6.2	.2
Conductivity, cal/cm/sec	3.45×10^{-4}	3.79×10^{-4}
Stencilability	poor	—
Sealability	poor	—
Resistance to HCl 37%	good	poor
Resistance to H_2SO_4 90%	good	good
Resistance to H_2O_2 50%	good	good
Resistance to Isopropyl Alcohol	good	good
Resistance to Acetic Acid	good	good
Resistance to Ethylene Glycol	good	good
Resistance to Freon	good	good

RESISTANCE OF TYVEK* SPUNBONDED OLEFIN TO BASES

Reagent	Exposure Conditions: Concentration %	Temperature °F	Time Hrs.	Effect On Breaking Strength + Tyvek* Style 1421
Ammonium Hydroxide	1.0	70	1000	None
" "	58.0	70	10	Slight
" "	58.0	70	1000	Slight
Sodium Hydroxide	10.0	70	1000	None
" "	10.0	210	10	Slight
" "	40.0	70	1000	None
" "	40.0	210	10	None
Sodium Carbonate	1.0	70	1000	None
Sodium Orthosilicate	1.0	210	10	None

RESISTANCE OF TYVEK* SPUNBONDED OLEFIN TO ACIDS

Reagent	Exposure Conditions: Concentration %	Temperature °F	Time Hrs.	Effect On Breaking Strength + Tyvek* Style 1421
Sulfuric Acid	1.0	70	1000	None
" "	10.0	70	1000	None
" "	10.0	210	10	None
" "	60.0	70	10	None
" "	60.0	70	1000	None
" "	60.0	210	10	None
" "	80.0	70	1000	None
" "	96.0	70	1000	None
Hydrochloric Acid	1.0	70	1000	None
" "	10.0	70	1000	None
" "	10.0	160	10	None
" "	37.0	160	10	None
Nitric Acid	1.0	70	1000	None
" "	10.0	70	1000	None
" "	10.0	210	10	None
" "	70.0	70	10	Slight
" "	95.0	70	1000	Slight
Phosphoric Acid	10.0	70	1000	None
" "	10.0	210	10	None
" "	85.0	70	10	None
Hydrofluoric Acid	10.0	70	10	None
Chromic Acid	10.0	70	10	None
Hydrobromic Acid	10.0	70	10	None
Sulfamic Acid	10.0	70	10	None

Sold through authorized distributors only.
United States, Canada and Japan.

DURA FAB

General Offices
P. O. Box 658
1102 Kilpatrick
Cleburne, Texas 76031

MSA

Data Sheet
13-01-06

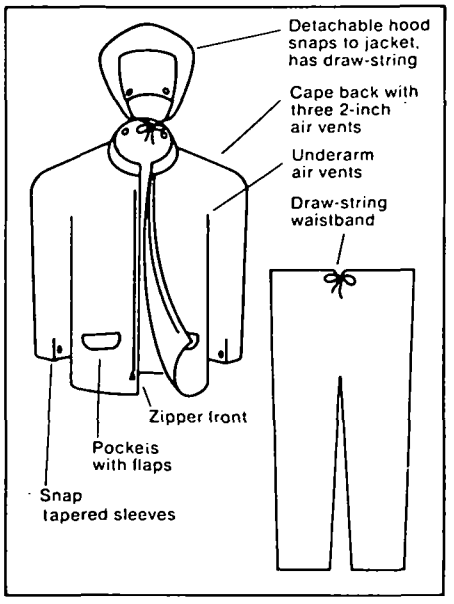
Economy Line Rainwear

Application

MSA® Economy Line Rainwear garments are designed for construction and general industrial use. Lightweight jacket and pants resist water, acids, heat, cold, aging, and industrial liquids. Suit is disposable/reusable.

Description

MSA Economy Line Rainwear garments are three-piece suits made of unsupported 5-gauge polyvinylchloride plastic. Seams are lapped and locked for additional strength. Jacket has zipper front, cape back with three 2-inch air vents, and underarm air vents. Pants have a draw-string waistband. Hood snaps to jacket. Suit is disposable/reusable and available in 3 sizes: Small, Medium, and Large.



Ordering Information

Catalog numbers

Size	Economy Line, 3-piece suit Includes jacket, trousers and hood Cat. No.
Small	**695173**
Medium	**695174**
Large	**695175**

Note: This data sheet is a guide, containing only a general description of construction, properties, and use of MSA Economy Line Rainwear garments. Before use refer to and strictly follow all instructions, cautions, and warnings on or with the product. For more complete information, contact MSA.

MSA Mine Safety Appliances Company
600 Penn Center Boulevard
Pittsburgh, Pennsylvania 15235

At your service: 25 branch offices in the United States;
MSA CANADA, Downsview, Ontario (Metro Toronto), Halifax, Montreal, Winnipeg, Saskatoon, Edmonton, Calgary, Vancouver; representatives in principal cities of the world.
Cable address—"MINSAF" Pittsburgh

Data Sheet 13-01-06 Printed in U.S.A. 774(L)

How to buy a boot

TINGLEY

TINGLEY RUBBER CORPORATION, 280 SOUTH AVE., S. PLAINFIELD, N.J. 07080

Use # 106 On Reader's Card (End of Book)

OTHER MANUFACTURERS of Firefighter Boots: (For addresses, see Source Index)

Fyrepel Products Inc.
Goodall Rubber Co.
Plasco
Servus Rubber Co.

BOOT—RUBBER—CONDUCTIVE

These rubber boots are designed to ground static charges built up in potentially explosive atmospheres. They are used in conjunction with grounded conductive floors. Metal fittings and safety toe box, where necessary, are coated with non-ferrous metal to prevent sparking. To ensure good electrical contact with the conductive sole, the wearer should avoid foot powders and silk or woolen stockings, and should keep the sole free of oils. RECOMMENDED USES: For workers in explosive atmospheres of grain or metal dusts, volatile flammable liquids, etc.

WITHOUT SAFETY TOE

★**Custom Materials Inc.**, 279 Billerica Rd., Chelmsford, MA 01824
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760

WITH SAFETY TOE

★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049

BOOT—MOLDED RUBBER—STRETCH TYPE

Molded rubber boots stretch to fit over all types of shoes, including heavy work shoes, within each size range. RECOMMENDED USES: Ordinary rubber is available

for water or snow service and a neoprene synthetic serves to protect against oil, grease, barnyard acids or chemicals.

★**Iron Age Shoe Co.**, 2406 Woodmere Dr., Pittsburgh, PA 15205
★**Knapp Saf-Test Div., ATT: E. Gravlin**, 1 Knapp Centre, Brockton, MA 02401
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Tingley Rubber Corp.**, 280 South Ave., S. Plainfield, NJ 07080

(Other Manufacturers: (For addresses, see Source Index)

Plasco
Record Industrial Co.

BOOT—SAFETY TOE—METATARSAL GUARD

This type of rubber boot has a jointed steel plate that protects the instep as well as the toes while allowing full

(CONTINUED ON NEXT PAGE)

★See Advertisement & Index to Distributors.

mobility for the foot. The entire assembly moves on steel rivets which insures the ability to flex the foot freely and naturally. Thick foam padding surrounds the plate to absorb and distribute shock. RECOMMENDED USES: For workers likely to encounter falling or rolling objects, such as miners, firemen, etc.

★**Iron Age Shoe Co.**, 2406 Woodmere Dr., Pittsburgh, PA 15205
★**Knapp Saf-Test Div., ATT: E. Gravlin**, 1 Knapp Centre, Brockton, MA 02401
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Steel Grip Safety Apparel Co. Inc.**, 700 Garfield St., Danville, IL 61832

Other Manufacturers: (For addresses, see Source Index)

Plasco
Servus Rubber Co., The

BOOT—RUBBER—STEEL INNERSOLE—SAFETY TOE

A rubber boot with both a safety toe and a steel innersole to protect the wearer against injury from falling, rolling, and impact hazards as well as from punctures from nails, glass, and other sharp objects. The steel innersole is fully flexible and runs the entire length of the boot. RECOMMENDED USES: Used by construction workers, ditch diggers, foundry workers, miners, etc.

★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770
★**Wolverine Products, Dept. CP, Wolverine World Wide Inc.**, Rockford, MI 49351

Other Manufacturers: (For addresses, see Source Index)

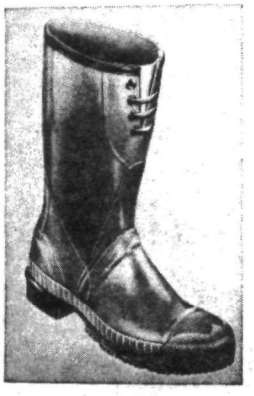
Fyrepel Products Inc.
Goodall Rubber Co.
Plasco
Servus Rubber Co., The

PAC—RUBBER

A short boot 10 or 15 in. high, with laces or straps to give a snug fit around the leg. The rubber pac protects the feet and lower legs from water and dampness and also keeps gravel and chips from getting inside the footwear. RECOMMENDED USES: Designed for miners, construction men and other outdoor workers, and also for food processing, washing and similar indoor workers. Available with or without the safety toe, which gives added protection against falling and moving objects. Pacs of synthetic materials resist oils and greases.

RUBBER PAC WITHOUT SAFETY TOE

★**Dorsey Safe-T-Shoe Co.**, 1220 Market St., Chattanooga, TN 37401
★**La Crosse Rubber Mills Co., Dept. B**, La Crosse, WI 54601
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Snyder, M.L., Div. Boss Mfg. Co.**, 221 W. 1st St., Kewanee, IL 61443
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770



RUBBER PAC WITH SAFETY TOE

★**Dorsey Safe-T-Shoe Co.**, 1220 Market St., Chattanooga, TN 37401
★**Iron Age Shoe Co.**, 2406 Woodmere Dr., Pittsburgh, PA 15205
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Snyder, M. L., Div. Boss Mfg. Co.**, 221 W. 1st St., Kewanee, IL 61443
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

OIL RESISTANT PAC WITHOUT SAFETY TOE

★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

OIL RESISTANT PAC WITH SAFETY TOE

★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

OTHER MANUFACTURERS of Rubber Pacs: (For addresses, see Source Index)

Converse Rubber Co.
Dorsey Co., John E.
Goodall Rubber Co.
Goodrich Co., B. F.
Plasco
Record Industrial Co.
Servus Rubber Co., The

PAC—RUBBER—COLD INSULATION

Various types of rubber boots and pacs are available for personnel exposed to cold weather or working conditions. To insulate the feet, the footwear has an inner liner which may be of plastic foam, nylon fleece, wool, etc. Models generally feature anti-slip soles for added safety.

★**Dorsey Safe-T-Shoe Co.**, 1220 Market St., Chattanooga, TN 37401
★**La Crosse Rubber Mills Co., Dept. B**, La Crosse, WI 54601
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

Other Manufacturers: (For addresses, see Source Index)

Converse Rubber Co.
Dorsey Co., John E.
Goodall Rubber Co.
Servus Rubber Co., The

★See Advertisement & Index to Distributors.

OUR LINE OF RUBBER FOOTWEAR HAS THE WIDEST STRETCH IN THE BUSINESS.

The Ranger line stretches all the way from lightweight sports boots to metatarsal guard hip-boots with all kinds of models in between.

And there's a model for every occupation: fire-fighting, factory work, farming, food and beverage plants.

With and without steel toes, steel midsoles, non-skid outsoles; suction grip bottoms.

Durability is assured with Ranger's exclusive Poly-rubber formulation that resists cracking, abrasion, grease and caustics. Ranger may be tough, but they have all the needed soft touches, too, like felt linings and cushion insoles for all day comfort.

Your local Ranger distributor is the man to contact for the industry's most complete line of rubber footwear—and that's not stretching the truth a bit. If your local distributor doesn't have the type you need, call or write: John O'Brien, V.P., Ranger Rubber Co., 1100 East Main St., Endicott, N.Y. 13760 (607) 785-9911.

RANGER
A division of Endicott Johnson Corp.

Use # 107 On Reader's Card (End of Book)

SOCK—INSULATING—COLD WEATHER

Lightweight and durable, these socks use such materials as foam or quilted synthetics to insulate the feet, keeping them warm in cold weather. Insulating socks can be worn inside pacs, boots and various types of rubber footwear. The socks are usually non-absorbent and washable.

★**Refrigiwear Inc.**, 71-T Inip Dr., Inwood, NY 11696

PAC—HIGH VISIBILITY

Heavy duty, acid resistant pacs made with daylight fluorescent or bright yellow pigments may be used in conjunction with similarly made clothing to draw attention to the wearer. RECOMMENDED USES: In construction, maintenance or industries where the worker may be endangered by the actions of others.

★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105

OVERSHOE—RUBBER OR SYNTHETIC

Rubber overshoes, 10½ to 15 inches high, are worn over regular dress or work shoes. Buckles, snaps, lacings or draw strings at the top held to protect the feet and lower legs from water. Rubber uppers are waterproof and resistant to most chemicals. Synthetic rubber or plastic uppers are recommended where oils and grease may be encountered. RECOMMENDED USES: For miners, pipeline and petroleum workers, chemical workers, farmers, fishermen, dock workers, wash rack men, etc.

NATURAL RUBBER OVERSHOE

★**Dorsey Safe-T-Shoe Co.**, 1220 Market St., Chattanooga, TN 37401
★**Iron Age Shoe Co.**, 2406 Woodmere Dr., Pittsburgh, PA 15205
★**La Crosse Rubber Mills Co., Dept. B**, La Crosse, WI 54601
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Snyder, M.L., Div. Boss Mfg. Co.**, 221 W. 1st St., Kewanee, IL 61443
★**Surety Rubber Co., The**, Box 97-G-12, Carrollton, OH 44615
★**Tingley Rubber Corp.**, 280 South Ave., S. Plainfield, NJ 07080
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

SYNTHETIC OVERSHOE

★**Dorsey Safe-T-Shoe Co.**, 1220 Market St., Chattanooga, TN 37401
★**Iron Age Shoe Co.**, 2406 Woodmere Dr., Pittsburgh, PA 15205
★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Snyder, M. L., Div. Boss Mfg. Co.**, 221 W. 1st St., Kewanee, IL 61443
★**Tingley Rubber Corp.**, 280 South Ave., S. Plainfield, NJ 07080
★**Wheeler Protective Apparel Inc.**, 226 W. Huron St., Chicago, IL 60610

RUBBER OVERSHOE WITH ANTI-SLIP SOLE

★**Lehigh Safety Shoe Co.**, First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.**, 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.**, 9th & Greenleaf Sts., Allentown, PA 18105
★**Standard Safety Equipment Co.**, 431 N. Quentin Rd., Palatine, IL 60067
★**Tingley Rubber Corp.**, 280 South Ave., S. Plainfield, NJ 07080
★**Uniroyal Protective Footwear**, Naugatuck, CT 06770

★**See Advertisement & Index to Distributors.**

OTHER MANUFACTURERS of Rubber or Synthetic Rubber Overshoes: (For addresses, see Source Index)

Converse Rubber Co.
Dorsey Co., John E.
Goodall Rubber Co.
Olympic Glove Co. Inc.
Plasco
Record Industrial Co.
Servus Rubber Co., The

OVERSHOE—HIGH VISIBILITY

Heavy duty, acid resistive overshoes made with daylight fluorescent or bright yellow pigments may be used in conjunction with similarly made clothing to draw attention to the wearer. RECOMMENDED USES: In construction or industries where the worker may be endangered by the actions of others.

★**Surety Rubber Co., The,** Box 97-G-12, Carrollton, OH 44615
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770

WORK RUBBER—CLEATED

Rubbers with built-in rubber cleats give traction on wet floor surfaces, ice and snow, or other uncertain footing. RECOMMENDED USES: Particularly useful for dairies, meat packing plants, and other industries where wet floors are a common hazard.

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, TN 37401
★**Lehigh Safety Shoe Co.,** First & Minor Sts., Emmaus, PA 18049
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105
★**Tingley Rubber Corp.,** 280 South Ave., S. Plainfield, NJ 07080
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770

WORK RUBBER—HEAVY DUTY

These rubbers are strongly constructed for wear over shoes. Made in a variety of styles, the heavy duty rubber gives protection against shallow water and underfoot dampness. RECOMMENDED USES: For farmers, railroad men, construction workers, truck drivers, policemen and industrial workers. For specially designed rubbers suitable for linemen, see the Lineman's Clothing & Safety Equipment section.

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, TN 37401
★**Iron Age Shoe Co,** 2406 Woodmere Dr, Pittsburgh, PA 15205
★**La Crosse Rubber Mills Co., Dept. B,** La Crosse, WI 54601
★**Lehigh Safety Shoe Co.,** First & Minor Sts., Emmaus, PA 18049
★**Ranger Rubber Co.,** 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105
★**Tingley Rubber Corp.,** 280 South Ave., S. Plainfield, NJ 07080
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770

For Other Manufacturers, see general list below

WORK RUBBER—OIL RESISTANT

For wear over work shoes as protection against underfoot dampness and shallow puddles, these rubbers are made of synthetics which make them resistant to oils, greases, and acids. RECOMMENDED USES: Suitable for garage workers, machinists, oil workers, etc.

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, TN 37401
★**Iron Age Shoe Co.,** 2406 Woodmere Dr., Pittsburgh, PA 15205
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105
★**Tingley Rubber Corp.,** 280 South Ave., S. Plainfield, NJ 07080
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770
★**Wolverine Products, Dept. CP, Wolverine World Wide Inc.,** Rockford, MI 49351

GENERAL MANUFACTURERS of Work Rubbers: (For addresses, see Source Index)

Dorsey Co., John E.
Goodall Rubber Co.
Plasco
Record Industrial Co.

RUBBER WORK SHOE

Industrial work shoes of the 6-inch style, with or without safety toes are available in natural rubber, which is waterproof, impervious to most chemicals, and provides insulation against electricity; and in synthetic rubber, which is highly resistant to the deteriorating effects of oils and grease, as well as many chemicals. Rubber shoes may have built-in metal safety toe caps and also metatarsal guards. RECOMMENDED USES: Food processing, creamery, bottling, washing, etc.

NATURAL RUBBER WITHOUT SAFETY TOE

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, TN 37401
★**Ranger Rubber Co.,** 1100 E. Main St., Endicott, NY 13760
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770
★**Wolverine Products, Dept. CP, Wolverine World Wide Inc.,** Rockford, MI 49351

NATURAL RUBBER WITH SAFETY TOE

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, IN 37401
★**Iron Age Shoe Co,** 2406 Woodmere Dr, Pittsburgh, PA 15205
★**Lehigh Safety Shoe Co.,** First & Minor Sts., Emmaus, PA 18049
★**On Gard Industrial Footwear,** 5516 W. Cermak Rd., Cicero, IL 60650
★**Ranger Rubber Co.,** 1100 E. Main St., Endicott, NY 13760
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105
★**Snyder, M.L., Div. Boss Mfg. Co.,** 221 W. 1st St., Kewanee, IL 61443
★**Uniroyal Protective Footwear,** Naugatuck, CT 06770
★**Wolverine Products, Dept. CP, Wolverine World Wide Inc.,** Rockford, MI 49351

SYNTHETIC RUBBER WITHOUT SAFETY TOE

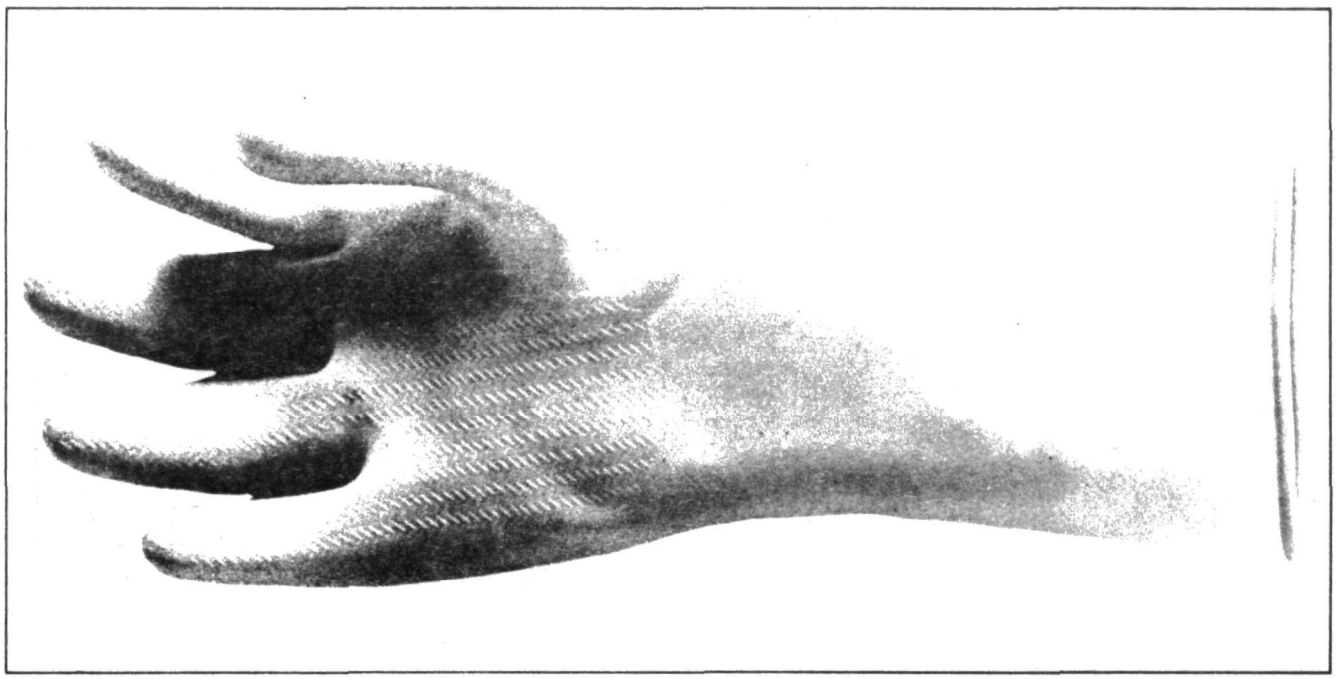
★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, IN 37401
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105

SYNTHETIC RUBBER WITH SAFETY TOE

★**Dorsey Safe-T-Shoe Co.,** 1220 Market St., Chattanooga, TN 37401
★**Knapp Saf-Test Div., ATT: E. Gravlin,** 1 Knapp Centre, Brockton, MA 02401
★**On Gard Industrial Footwear,** 5516 W. Cermak Rd., Cicero, IL 60650
★**Reece Wooden Sole Shoe Co., Dept. H,** Box 496, Columbus, NB 68601
★**Safety First Shoes Inc.,** 9th & Greenleaf Sts., Allentown, PA 18105

★See Advertisement & Index to Distributors.

Molded Handwear



Application

MSA® unsupported gloves are made of a variety of specially compounded materials: natural-latex and nitrile-latex, neoprene, milled-nitrile, (Buna-N), and butyl synthetic-rubbers. The variety of materials available makes it possible to match the glove to the need for resistance to chemical solutions, solvents, abrasives, gases, and to punctures, abrasion, tearing, etc. MSA Industrial Gloves are widely recognized for their durability under continuous service. Check the MSA Glove Selection Guide on Page 2 for the glove material best suited to your needs.

Description

Natural-latex gloves

MSA Natural-latex Gloves are known for their comfortable curved finger design, their pliability and their long-wearing characteristics. A special treatment on the inside and outside of the natural latex assures easy-on and easy-off, and no tack. Natural-latex gloves are recommended for resistance to many acids and caustics, abrasions occurring in sandblasting, grinding and polishing, and for general-purpose use.

Unlined natural-latex gloves are USDA-accepted for meat and poultry plants.

Butyl synthetic-rubber gloves

MSA Butyl Gloves provide protection from a variety of toxic chemicals. Butyl compounding ensures high impermeability to gases, chemicals and water vapor, and resistance to oxidation and ozone attack.

Neoprene synthetic-rubber gloves

MSA Neoprene Gloves offer resistance to oils, greases, petroleum hydrocarbons, acids, and caustics. They have good pliability and finger dexterity, high density and tensile strength, and high tear resistance.

Milled-nitrile (Buna-N) gloves

MSA Milled-nitrile Gloves are designed for mechanically severe uses that require touch sensitivity and dexterity. They are exceptionally sheer, yet they stand up under mechanical use even after prolonged exposure to substances that cause other glove materials to deteriorate.

Nitrile-latex gloves

MSA Nitrile-latex Gloves are made of acrylonitrile synthetic rubber. They are intended for jobs requiring dexterity and sensitivity and good contol of cleanliness. These green gloves have good resistance to a broad variety of chemicals and excellent resistance to abrasion, puncturing, snagging, and tearing.

Heavy-duty natural-rubber gloves

MSA Natural-rubber Gloves have three important characteristics: maximum pliability over a wide temperature range; long-term resistance to industrial chemicals and acids; curved fingers for wearer comfort.

Selecting the glove for the job

Length

Most MSA gloves are available in several lengths from 11 inches to 18 inches. Choose the length that best suits your particular needs.

Weight

Weight	Approx. thickness in. (mm)
Light	.010 to .017 (.25 to .43)
Medium	.018 to .025 (.46 to .64)
Heavy	.026 to .030 (.66 to .76)
Extra-Heavy	.050 to .065 (1.27 to 1.65)

Heavy (thick) gloves wear longer and resist snags, abrasions, and punctures better than light (thin) gloves of the same material. But because light gloves are thin, they offer flexibility and sensitivity to the touch for jobs in which dexterity is important.

Finish

MSA gloves are available in smooth, rough or embossed finishes. Smooth finish gloves in light and medium weights are recommended for jobs where sensitive touch is important. Rough or embossed gloves are recommended where a firm, nonslip grip is necessary.

Size

MSA gloves range in size from 7 to 11. The lighter weights are usually available in sizes 7 to 11, the heavy gauntlet types in 9 to 11.

Material

Gloves in individual use must resist various chemical products and atmospheres, and types of mechanical abuse. The following charts list the physical and chemical-resistance characteristics of MSA Molded Handwear.

Lining

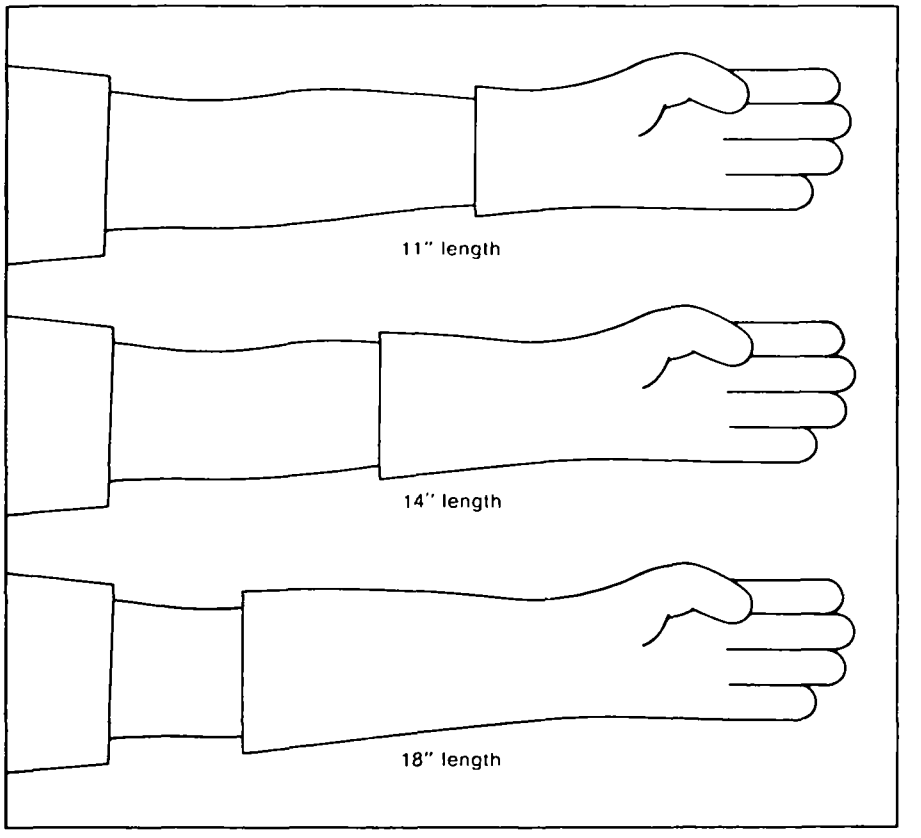
Lined gloves are flock lined with cotton fibers.

Comparative physical characteristics

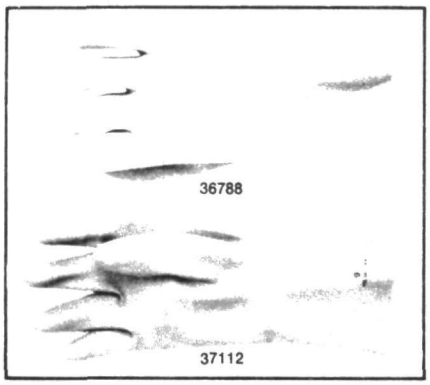
Key: E excellent; G good; F fair; P poor

Characteristic	Neoprene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
Tensile strength	G	G	F	G	E
Elongation	E	E	G	G	G
Tear resistance	F	G	F	G	F
Abrasion resistance	G	G	E	G	E
Ozone resistance	E	F	P	E	P
Sunlight aging	E	F	G	E	G
Shelf-life aging*	F	E	E	E	E

* Gloves stored in original containers at room temperature in dry location. Fluorescent light and exposure to ozone-producing motors can damage gloves not properly packaged or protected.



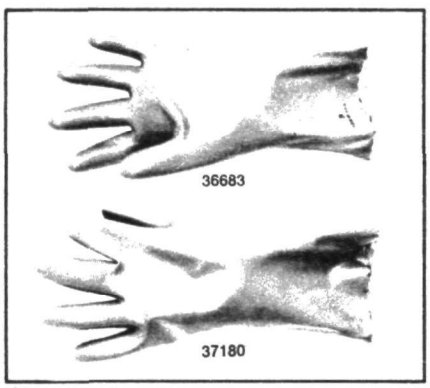
MSA Natural-latex Gloves



MSA Latex Gloves are made from natural liquid latex processed for extra-high tensile strength. These gloves, with their excellent wearing qualities, pliability, and comfort are recommended for use in most water solutions of acids, alkalies and salts and in ketones.

Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)	Packing
Unlined						
36788 **36789** **36790** **37110**	7½ 8 9 10	Embossed	Tan	.017 (.43)	12 (30)	Bulk 12 pr.
Flock-lined						
37183 **37978** **37112** **37113**	7½ 8 9 10	Embossed, Lined	Tan	.017 (.43)	12 (30)	Bulk 12 pr.

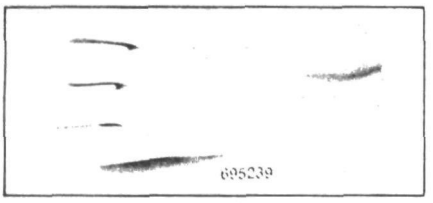
MSA Heavy-duty Natural-rubber Gloves (acid type)



In MSA Natural-rubber Gloves, high-quality latex rubber content ensures maximum pliability in a broad range of temperatures. These gloves stand up under years of service in industrial chemicals and acids. Curved fingers provide comfort and flexibility.

Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)
36683 **36684** **36685**	9 10 11	Smooth	Tan	.050 (1.27)	18 (46)
36686 **36688** **36690**	9 10 11	Smooth	Tan	.050 (1.27)	14 (36)
37180 **37181** **37182**	9 10 11	Smooth	Tan	.025 (.64)	14 (36)

MSA Nitrile-latex (Water Based Compounding) Synthetic-rubber Gloves

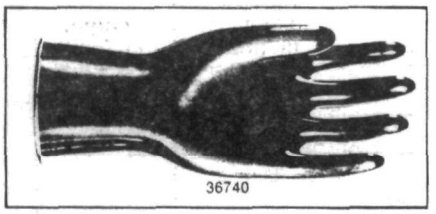


MSA Nitrile-latex Gloves are made of acrylonitrile latex synthetic rubber, which is outstanding in its resistance to a broad range of chemical materials: acids, alcohols, alkalies, ammonia, animal fats, battery acid, cleaning fluids, commercial solvents and degreasers, emulsifying agents, esters, grease, hydraulic fluid, kerosene, naphtha, oils, petroleum derivatives, phenol, photographic solutions, plating and pickling solutions, printing ink, Stoddard's solvent, turpentine, vegetable oils, wood preservatives. These gloves, in addition to their ability to resist a broad range of chemical materials, are also less expensive than Nitrile Synthetic Gloves.

These green gloves are suitable for work situations in which cleanliness is critical—workers and supervisors can tell when gloves need to be changed or cleaned. This is particularly important where glove staining warns of accumulation of harmful solvents or substances such as tetraethyl lead.

Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)
695229 **695230** **695232** **695234** **695235**	7 8 9 10 11	Embossed	Green	.014 (.36)	12 (31)
695236 **695237** **695239** **695241** **695242**	7 8 9 10 11	Embossed (Flock lined)	Green	.014 (.36)	12 (31)
695243 **695244** **695245**	9 10 11	Smooth	Green	.026 (.66)	14 (36)
695246 **695247** **695248**	9 10 11	Smooth	Green	.026 (.66)	18 (46)

MSA Milled-nitrile (Buna-N) Gloves

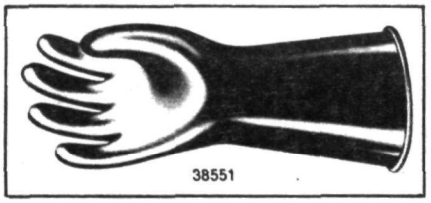


MSA Milled-nitrile Synthetic Rubber Gloves have remarkable resistance to many greases, oils, solvents, and chemicals. These gloves give extra-long wear with good resistance to abrasion and exceptionally good resistance to punctures, snagging, and extreme temperatures.

Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)
Unlined					
38874 **38875** **38876** **36740** **36741**	7½ 8 9 10 11	Smooth	Black	.010 (.25)	11 (28)
38908 **38909** **38910** **38911** **38912**	7½ 8 9 10 11	Rough	Black	.010 (.25)	11 (28)
36750 **36751** **36752**	9 10 11	Smooth*	Black	.030 (.76)	14 (36)
36756 **36757** **36758**	9 10 11	Smooth*	Black	.030 (.76)	18 (46)
Flock-lined					
695211 **695212** **695213** **695214**	7½ 8 9 10	Embossed	Black	.011 (.28)	12 (31)

* Available in rough finish upon request.

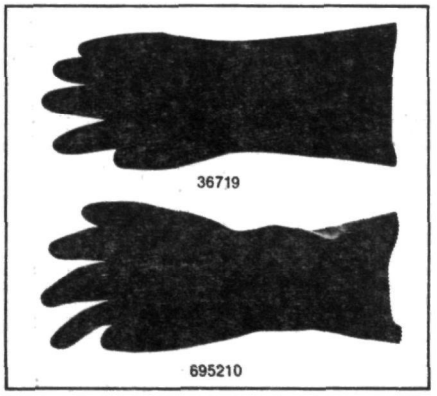
MSA Butyl-rubber Gloves



MSA Butyl-rubber Gloves show unusually high resistance to oxidation and oxidizing chemicals. They are ideally suited for use with nitric acid, sulfuric acid, hydrofluoric acid, rocket fuels, and peroxide. These gloves have high abrasion resistance and remain flexible at low temperatures.

Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)
38551 **38552** **38553**	9 10 11	Smooth	Black	.017 (.43)	14 (36)
38554 **38555** **38556**	9 10 11	Smooth	Black	.032 (.81)	14 (36)

MSA Neoprene Gloves



Cat. No.	Size	Finish	Color	Approx. thickness, in. (mm)	Length, in. (cm)
Unlined					
36714 **36715** **36716**	9 10 11	Smooth	Black	.030 (.76)	14 (36)
36718 **36719** **36720**	9 10 11	Smooth	Black	.030 (.76)	18 (46)
Flock-lined *					
695208 **695209** **695210**	8 9 10	Embossed, Lined	Black	.018 (.46)	13 (33)

Neoprene has been tested and approved by thousands of users all over the world. Products made from this long-wearing synthetic will not deteriorate from age or exposure to sunlight. It makes an ideal protective material for the hands because it is almost completely free of any allergens that might irritate sensitive skin.

MSA Neoprene Gloves are highly resistant to most of the oils, greases, solvents, and caustics used in modern industry. In many cases, neoprene and natural latex gloves have almost equal resistance qualities, but neoprene gloves are always superior in oils, greases, and petroleum solvents. They provide excellent protection from paint and varnish remover, naphtha, alcohol, gasoline, lacquer, turpentine, acids, and many other fluids and solutions.

* Also available in sizes 7 and 11.

Comparative chemical resistance

Key: E—excellent; G—good; F—fair; P—poor; NR—not recommended; *—limited service

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
A *Acetaldehyde	E	G	G	E	G
Acetate	G	F	P	G	P
Acetic acid	E	E	E	E	E
*Acetone	G	E	P	E	P
Acetylene gas	E	E	E	E	E
Acetylene tetrachloride	F	NR	F	F	F
Acrylonitrile	G	F	F	G	F
Amidol	G	E	F	E	F
Amine hardeners	F	F	G	G	G
Ammonium hydroxide	E	E	E	E	E
*Amyl acetate	F	P	P	F	P
Amyl alcohol	E	E	E	E	E
Anhydrous ammonia	G	E	E	E	E
Aniline	G	F	P	F	P
Aniline hydrochloride	F	G	P	F	P
Aniline oil	F	G	P	F	P
Animal fats	E	P	E	G	E
Animal oils	E	F	E	G	E
Anodex	G	E		E	
Anthracene	F	P	F	P	F
*Aromatic fuels	P	NR	F	NR	F
Arsine	E	E	E	E	E
Asbestos	E	E	E	E	E
Asphalt	G	F	E	F	E
B Banana oil	F	P	P	F	P
*Benzaldehyde	F	F	G	G	G
*Benzene	P	NR	F	NR	F
Benzol	P	NR	F	NR	F
*Benzyl alcohol	E	E	E	E	E
Benzyl benzoate	G	F	G	F	G
*Benzyl chloride	F	P	F	G	F
Blacosolve	G	P	G	P	G
Boron tribromide	G	P	P	P	P
Bromine	G	P	P	P	P
Bromoform	G	P	P	P	P
Butane	E	F	E	F	E
2-Butanone	G	G	F	G	F
Butyl acetate	G	F	P	F	P
Butyl alcohol	E	E	E	E	E
*Butylaldehyde	G	G	E	G	E
Butylene	E	G	E	G	E
C Cadmium oxide fume	E	E	E	E	E
Calcium hydroxide	E	E	E	E	E
Carbolic acid	E	E	F	E	F
Carbon dioxide	E	E	E	E	E
Carbon disulfide	F	F	F	F	F
*Carbon tetrachloride	F	P	G	P	G
Castor oil	F	P	E	F	E
Cellosolve	F	G	G	G	G
Cellosolve acetate	G	F	G	G	G
Chlordane	G	F	G	F	G
Chlorine	G	F	F	G	F
Chlorine gas	G	F	F	G	F
*Chlorobenzene	F	P	P	F	P
*Chloroacetone	F	F	P	E	P
Chlorobromomethane	F	P	F	P	F
*Chloroform	G	P	E	P	E
Chloronaphthalene	F	P	F	F	F
Chlorophenylene diamine	G	P	F	F	F
Chloropicrin	P	P	P	F	P
*Chlorothene	P	NR	F	NR	F
Chromic acid	F	P	F	F	F
Chromotex	G	G	G	G	G
Citric acid	E	E	E	E	E
Coal tar pitch volatiles	F	P	F		F
Cottonseed oil	G	G	E	F	E
Cotton dust (raw)	E	E	E	E	E
Creosote	G	G	F	G	F
Cresol	G	G	F	G	F
Cupric nitrate	G	G	E	E	E
Cyanide	G	G	G	G	G
Cyclohexane	G	F	G	F	G
Cyclohexanol	G	F	E	G	E
*Cyclohexanone	G	E	F	G	F

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
D Decaborane	F	P	F	F	F
Degreasing fluids	F	P	G	P	G
Diacetone alcohol	E	E	E	E	E
Diborane	F	P	F	F	F
*Dibenzyl ether	G	G	F	G	F
*Dibutyl phthalate	G	P	G	G	G
Dichloroethane	P	NR	F	NR	F
Dichloropropene	P	P	F	F	F
Diesel fuel	G	P	E	P	E
Diethanolamine	E	G	E	E	E
Diethylamine	E	G	E	G	E
Diethyltriamine	G	F	E	G	E
Diisobutyl ketone	P	F	P	G	P
Diisocyanate	G	P	G	E	G
Dimethylformamide	F	F	G	G	G
Dioctyl phthalate	G	P	E	F	E
Dioxane	E	G	G	G	G
E Emulsifying agent	G	F	E	E	E
Emulthogene	G	F	G	E	G
Epichlorohydrin	G	P	F	G	F
Epoxy resins, dry	E	E	E	E	E
*Esters	F	P	P	F	P
Ethane gas	E	G	E	E	E
Ethanol	E	E	E	E	E
Ethers	E	G	G	G	G
*Ethyl acetate	G	F	F	G	F
Ethyl alcohol	E	E	E	E	E
Ethyl bromide			P		P
*Ethyl ether	E	G	G	E	G
Ethyl butyl ketone			P		P
Ethyl formate	G	F	G	G	G
*Ethylaniline	F	F	P	G	P
Ethylenediamine	E	G	E	G	E
*Ethylene dichloride	F	P	P	F	P
Ethylene gas	E	G	E	E	E
Ethylene glycol	E	E	E	E	E
Ethylene oxide	G	F	G		G
*Ethylene trichloride	F	P	G	P	G
F Fatty acids	E	P	E	F	E
Ferrocyanide	F	G	G	E	G
Fluoric acid	E	G	E	E	E
Fluorine	G	F	F	G	F
Fluorine gas	G	F	F	G	F
Formaldehyde	E	E	E	E	E
Formic acid	E	E	E	E	E
Freon 11	G	P	G	F	G
Freon 12	G	P	G	F	G
Freon 21	G	P	G	F	G
Freon 22	G	P	G	F	G
*Furfural	G	G	G	G	G
G Gasoline, leaded	G	P	E	F	E
Gasoline, unleaded	G	P	E	F	E
Glycerine	E	E	E	E	E
Glycerol	E	E	E	E	E
Glycol	E	E	E	E	E
Gold fluoride	G	E	E	E	E
Grain alcohol	E	E	E	E	E
H Halogens	G	F	F	G	F
Hexamethylenetetramine	F	G	F	G	F
Hexane	F	P	G	P	G
Hexyl acetate	F	P	P	F	P
Hydraulic oil					
ester base	E	P	F	G	F
petroleum base	G	P	E	P	E
Hydrazine	F	G	G	G	G
Hydrochloric acid	E	G	G	G	G
Hydrofluoric acid	E	G	G	G	G
Hydrogen gas	E	E	E	E	E
Hydrogen peroxide—30%	G	G	G	G	G
Hydrofluosilicic acid	F	G	G	G	G
Hydroquinone	G	G	F	G	F

This chart gives the **relative** resistance ratings of various glove materials to solutions commonly used in industry. When selecting gloves for applications not listed, write Mine Safety Appliances Company, 600 Penn Center Boulevard, Pittsburgh, Pa. 15235, and give as much detailed information as possible according to the following points: 1. Chemical composition of the solution. 2. Degree of concentration (strength) of the solution. 3. Temperature conditions. 4. Abrasive effects of materials being handled. 5. Time cycle of usage.

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
I Inorganic salts	E	E	E	E	E
Iodine	G	F	G	G	G
Isooctane	F	P	E	P	E
Isopropanol	E	E	E	E	E
Isopropyl alcohol	E	E	E	E	E
K Kerosene	E	F	E	F	E
Ketones	G	E	P	E	P
L Lacquer thinners	G	F	P	F	P
Lactic acid	E	E	E	E	E
Lauric acid	E	F	E	E	E
Lineoleic acid	E	P	E	F	G
Linseed oil	E	P	E	F	E
M Maleic acid	E	E	E	E	E
Mercuric chloride	G	E	G	E	E
Mercury	G	G	G	E	G
Methane gas	E	E	E	E	E
Methanol	E	E	E	E	E
Methyl acetate	G	F	P	G	P
Methyl alcohol	E	E	E	E	E
Methylamine	F	F	G	G	G
Methyl bromide	G	F	F	G	F
Methyl cellosolve	G	G	G	G	G
*Methyl chloride	NR	NR	NR	NR	NR
*Methyl ethyl ketone	G	G	NR	E	NR
Methyl formate	G	F	F	G	F
Methylene bromide	G	G	F	G	F
Methylene chloride	G	F	F	G	F
*Methyl isobutyl ketone	F	F	P	E	P
Methyl methacrylate	G	G	F	E	F
Mineral oils	E	F	E	F	E
*Monochlorobenzene	F	P	P	F	P
Monoethanolamine	E	G	E	E	E
Morpholine	E	E	G	E	G
Muriatic acid	E	G	G	E	G
N Naphthalene	G	F	G	F	G
Naphthas, aliphatic	E	F	E	F	E
Naphthas, aromatic	G	P	G	P	G
*Nitric acid	G	F	F	F	F
*Nitric acid, red and white fuming	P	P	P	P	P
*Nitrobenzene	F	P	F	F	F
*Nitroethane	F	P	F	F	F
Nitrogen gas	E	E	E	E	E
*Nitromethane	F	P	F	F	F
*Nitropropane	F	P	F	F	F
Nitrous oxide	G	G	G	G	G
O Octyl alcohol	E	E	E	E	E
Oleic acid	E	F	E	G	E
Oxalic acid	E	E	E	E	E
Oxygen, liquid	F	P	NR	F	NR
Ozone	G	P	P	G	P
P Paint thinners	G	F	G	F	G
Paint and varnish removers	G	F	F	F	F
Palmitic acid	E	E	E	E	E
*Paradichlorobenzene	E	F	E	E	E
Parathion	P	F	F	F	F
Pentaborane	F	P	F	F	F
Pentachlorophenol	F	G	G	G	G
Pentane	E	G	E	G	E
Perchloric acid	E	F	G	G	G
Perchloroethylene	F	NR	G	NR	G
Perklene	E	NR	G	NR	E
Permachlor	E	F	E	NR	E
Petroleum distillates (naphtha)	G	P	E		E
Petroleum spirits	E	F	E	F	E
Phenol	E	F	F	G	F
Phenylenediamine	G	P	G	G	G
Phenylhydrazine	G	G	G	G	G
Phil-solv	E	F	E	G	E

Chemical	Neo-prene	Natural latex or rubber	Milled nitrile	Butyl	Nitrile latex
Phosphoric acid	E	G	E	E	E
Pickling solution	G	G	G	E	G
Picric acid	E	G	E	G	E
Pine oil	E	P	E	F	E
Pitch	E	P	E	F	E
Plating solutions	E	E	E	E	E
Potassium alum	G	G	G	E	G
Potassium bromide	G	G	G	E	G
Potassium chrome alum	G	G	G	E	G
Potassium dichromate	F	F	F	E	F
Potassium ferrocyanide	G	G	G	E	G
Potassium hydroxide	E	E	E	E	E
Printing inks	E	G	G	G	G
Propane gas	E	E	E	E	E
Propanol (iso)	E	E	E	E	E
Propyl acetate	G	F	F	G	F
Propyl alcohol	E	E	E	E	E
Propyl alcohol (iso)	E	E	E	E	E
Propylene gas	E	F	E	E	E
Propyne gas	E	F	E	E	E
Pyrethrum	E	E	E	E	E
R *Red fuming nitric acid	P	P	P	P	P
Rhodium fume and dust	E	E	E	E	E
S Silver nitrate	E	G	E	E	E
Skydrol 500	P	G	P	G	P
Sodium carbonate metol	G	G	G	E	G
Sodium hydroxide	E	E	E	E	E
Sodium sulfite	G	G	E	E	E
Sodium thiosulfide	G	G	E	E	E
Solvarsol	E	F	E	F	E
Solvessos	P	P	G	P	G
Stearic acid	E	E	E	E	E
Stoddard solvent	E	F	E	G	E
Styrene	P	P	F	P	F
Styrene 100%	P	P	F	P	F
Sulfuric acid	G	G	G	G	G
T Tannic acid	E	E	E	E	E
Tetrahydroborane	F	P	F	F	F
Tetraethyl lead	E	F	E	G	E
Tetrahydrofuran	P	F	F	F	F
*Toluene	F	P	F	NR	F
Toluene diisocyanate	F	G	F	G	F
*Toluol	F	P	F	NR	F
Trichlor	F	P	G	P	G
*Trichloroethylene	F	F	G	P	G
*Trichloroethane	P	P	F	P	F
Tricresyl phosphate	G	F	E	F	E
Tridecyl alcohol	G	F	E	F	E
Triethanolamine	E	G	E	G	E
Trinitrotoluene	G	P	G	F	G
Trinitrotoluol	G	P	G	F	G
Triptane	E	P	E	F	E
Tung oil	E	P	E	F	E
Turco No. 2998	P	P		F	
Turpentine	G	F	E	F	E
U Unsymmetrical Dimethylhydrazine	F	P	F	P	F
V Varnoline gas	E	F	E	F	E
Vanadium fume and dust	E	E	E	E	E
Varsol	G	F	G	F	E
Vegetable oils	E	G	E	G	E
W Wood alcohol	E	E	E	E	E
Wood preservatives	G	F	G	G	G
*Woodyouth	F	P	F	G	F
X *Xylene	P	P	F	P	F
*Xylol	P	P	F	P	F
*Xylidene	E	F	F	F	F
Z Zinc chloride	E	E	E	E	E

If glove swells, remove it from service and replace with a new one; or rinse glove with plain water and allow it to return to original shape.

NOTE: This Data Sheet is a guide containing only a general description of the uses and performance capabilities of MSA Molded Handwear. For more complete information, contact MSA, 600 Penn Center Boulevard, Pittsburgh, Pennsylvania 15235.

MSA Mine Safety Appliances Company
600 Penn Center Boulevard
Pittsburgh, Pennsylvania 15235

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Cable address—"MINSAF" Pittsburgh

Data Sheet 13-00-18

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MSA

Data Sheet
13-00-17

Coated Work Gloves

Application

MSA® Coated Work Gloves meet a variety of needs. The line contains plastic, neoprene, and natural rubber coated types; vinyl treated types; jersey, flannel, and thermal lined models. Styles include knitwrist, bandtop, safety cuff, gauntlet, mitten, and slip-on with elastic or perforated back. Some of the uses for Coated Work Gloves are handling oils, acids, chemicals, and solvents. They offer resistance to abrasion, cutting, and punctures.

Description

Plastic Coated Gloves

All-purpose Gloves: Bright-green, vinyl plastic coated gloves afford positive wet and dry grip. Two-piece pattern jersey lining allows finger dexterity and comfort. Fingers are curved to hand contour. Seamless surface has excellent abrasion- and chemical-resistant qualities and is especially suited for handling oils, acids, caustics, and many solvents.

Utility Gloves: PVC coated dark-green work gloves with high abrasion resistance, and built-in flexibility which permits dexterity. Combination of soft jersey lining and no seams on the wearing area reduces irritation.

Super Flexible Vinyl Plastic Gloves: Pliable, yellow-coated work gloves with curved finger construction that permits flexibility and dexterity. Two-piece soft jersey lining helps avoid irritation and eliminate surface seams. Have good abrasion resistance and dry-gripping qualities.

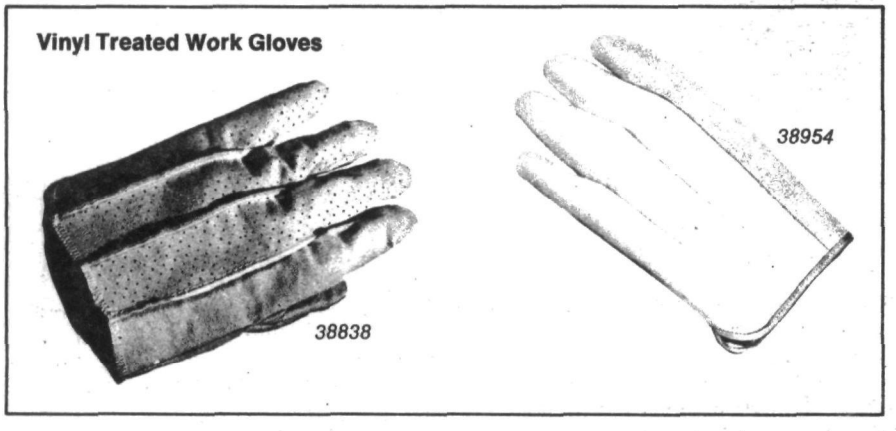
Flexible Vinyl Plastic Gloves: Oil, solvent, and abrasion resistant with the flexibility and dexterity of molded rubber gloves. Have washable interlock lining, nonirritating seams, and two-piece wing thumb construction. Long wearing, maroon, vinyl plastic coated.

Glow Gloves: Have high-visibility orange, vinyl plastic coating for hand signaling in industrial operations; feature positive grip, flexibility, and comfort. Available in three lengths, with jersey or thermal lining. Suggested for policemen, firemen, and outdoor workers.

Thermal Gloves: Waffle-weave lining provides insulation while permitting air circulation. Tan vinyl coating is abrasion resistant and flexible even in subzero temperatures.

Thermal Glow Gloves: The insulating qualities of MSA Thermal Gloves are combined with the high-visibility orange vinyl of MSA Glow Gloves.

Rubber and Neoprene Work Gloves



Vinyl Treated Work Gloves

Rubber and Neoprene Coated Gloves

Ripple-Texture Gloves: Rugged, rubber coating over cotton fabric with soft comfortable lining. Rippled texture for firm gripping. Excellent for handling sharp wire, sheet metal, nails, glass, tubing, or lumber. Coated palm with knitwrist or safety cuff.

Neoprene Gloves: Smooth-finish black neoprene with Canton flannel lining and curved finger construction. Chemical resistant and liquidproof. Recommended where heat, acids, solvents, caustics, snagging, or cutting is a danger.

Python Neoprene Gloves: Black neoprene latex glove offers chemical resistance and wet grip. Has soft, absorbent, Canton flannel lining and wing thumb design.

Vinyl Treated Gloves

Workall Gloves: Vinyl impregnated for long wear, and silicone treated for water repellence and flexibility. Have nonslip grip, close fit, and last five times as long as 8-oz canvas gloves.

Workmore Gloves: Made from soft cotton base specially treated with a unique vinyl compound for longer wear, liquid repellence, launderability, and good wet or dry gripping.

Glove Selector Chart

Determine the chemical or physical requirements of your job. Example: Nitric 10%, or abrasion resistance and flexibility. Then in the proper chart, chemical or physical, select the glove that is listed as best for your particular needs.

CHEMICAL RESISTANCE SELECTOR CHART

	MSA NEOPRENE AND PYTHON GLOVES	MSA ALL-PURPOSE GLOVES	MSA UTILITY GLOVES	MSA FLEXIBLE VINYL PLASTIC GLOVES	MSA RIPPLE-TEXTURE GLOVES	MSA SUPER FLEXIBLE VINYL PLASTIC GLOVES
ALCOHOLS						
Methanol/Butyl/Alcohol/ Glycerine/Ethanol/ Isopropanol	E	E	E	E	G	E
CAUSTICS						
Ammonium Hydroxide 38%/ Sodium Hydroxide 50%/ Potassium Hydroxide 50%	E	E	E	E	E	E
CHLORINATED SOLVENTS						
Carbon Tetrachloride/ Perchlorethylene/ Trichlorethylene	G	F	F	F	N.R.	F
KETONES						
Methyl Ethyl Ketone/ Methyl Isobutyl Ketone/ Acetone	G	N.R.	N.R.	N.R.	G	N.R.
PETROLEUM SOLVENTS						
White Gasoline/Naphtha/ Mineral Thinner/Kerosene	E	G	G	E	F	G
ORGANIC ACIDS						
Citric/Formic/ Tannic/Acetic	E	E	E	E	E	E
INORGANIC ACIDS						
Hydrochloric 38%/ Hydrochloric 10%/ Sulphuric 10%/ Nitric 10%/	E	E	E	E	G	E
Chromic	E	G	G	E	N.R.	G
Sulphuric 98%/ Nitric 70%	F	G	G	G	N.R.	G
HYDROCARBONS						
Stoddard Solvent/ Toluene/Benzene/ Xylene	G	F	F	G	N.R.	F
Coal Tar Distillate	E	F	F	G	N.R.	F
Styrene	F	G	G	G	F	G
MISCELLANEOUS						
Lacquer Thinner	F	F	F	G	N.R.	F
Cutting Oil	E	E	E	E	F	E
Battery Acid	E	E	E	E	G	E
Phenol	E	G	G	G	G	G
Insecticides	E	E	E	E	F	E
Printing Ink	E	E	E	E	F	F
Dyestuffs	E	E	E	E	E	E
Penta	G	E	E	E	F	E
Formaldehyde	E	E	E	E	E	E
Vegetable Oil	E	E	E	E	G	E
Animal Fat	E	E	E	E	G	E
Acrylonitrile	E	G	G	E	E	G
Steam	E	E	E	E	E	E
Aniline	E	E	E	E	E	E
Hydraulic Fluid	E	E	E	E	F	E
Turpentine	G	E	E	E	F	E
Linseed Oil	E	G	G	E	N.R.	G
Soya Bean Oil	E	G	G	E	F	G
Carbon Disulfide	N.R.	F	F	F	G	F
Creosote	G	G	G	G	F	G
Paint & Varnish Remover	F	F	F	F	N.R.	F

E–Excellent G–Good F–Fair N.R.–Not Recommended

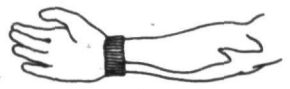
PHYSICAL PROPERTIES SELECTOR CHART

MSA GLOVE	ABRASION RESISTANCE	CUT RESISTANCE	SNAG RESISTANCE	HEAT RESISTANCE*	LOW-TEMP RESISTANCE	FLEXIBILITY	DRY GRIP	WET GRIP
NEOPRENE	G	E	E	G	E	G	E	F
PYTHON NEOPRENE	G	E	E	G	E	G	G	E
RIPPLE-TEXTURE	G	E	E	E	E	F	E	E
ALL-PURPOSE	E	N.R.	G	F	G	E	E	E
UTILITY	E	N.R.	G	F	F	E	E	F
FLEXIBLE VINYL PLASTIC	E	N.R.	G	F	G	E	E	E
SUPER FLEXIBLE VINYL PLASTIC	E	N.R.	G	F	E	E	E	G

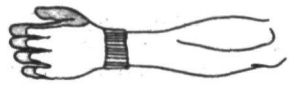
E–Excellent G–Good F–Fair N.R.–Not Recommended

*Coated fabric gloves are generally not recommended for continual exposure to hot objects because the heat builds up in the coating and does not dissipate rapidly. For periodic handling of hot objects in a heat range under 250 F, they are satisfactory.

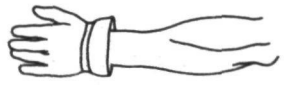
GLOVE LENGTHS CHART



Fully Coated Knitwrist



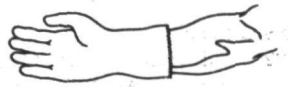
Palm Coated Knitwrist



Fully Coated Safety Cuff (Band Top)

Palm Coated Safety Cuff

Fully Coated 10" Gauntlet (10" Safety Cuff)

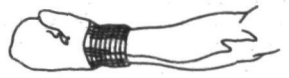


Fully Coated 12" Gauntlet

Fully Coated 14" Gauntlet

Fully Coated 18" Gauntlet

Fully Coated 11" Gauntlet (Cadet Size)



Fully Coated Knitwrist Mitten

Ordering information

Catalog numbers (for pair; shipped 6 doz pr per case unless otherwise indicated)

Plastic Coated Gloves

(All-purpose Gloves*)

37648 Knitwrist, coated palm; case shipping weight, 26 lb
37650 Bandtop, coated palm; case shipping weight, 26 lb
37653 Ladies knitwrist, fully coated; case shipping weight, 26 lb
37647 Knitwrist, fully coated; case shipping weight, 31 lb
37649 Bandtop, fully coated; case shipping weight, 31 lb
37651 Safety cuff, 10 in.; fully coated, case shipping weight, 36 lb
37652 Gauntlet, 12 in.; fully coated, case shipping weight, 42 lb
37727 Gauntlet, 14 in.; fully coated, case shipping weight, 49 lb

*The All-purpose Glove is not designed for handling extremely hot, abrasive, or sharp materials, or to provide dielectric protection.

(Utility Gloves)

34333 Knitwrist, coated palm; case shipping weight, 38 lb
34335 Safety Cuff, coated palm; case shipping weight, 38 lb
34332 Knitwrist, fully coated; case shipping weight, 24 lb
34331 Safety Cuff, fully coated; case shipping weight, 28 lb
34334 Gauntlet, 12 in., fully coated; case shipping weight, 35 lb
38931 Gauntlet, 14 in., fully coated; case shipping weight, 42 lb

(Super Flexible Vinyl Plastic Gloves)

37642 Knitwrist, fully coated; case shipping weight, 31 lb
37643 Gauntlet, 12 in., fully coated; case shipping weight, 42 lb

(Flexible Vinyl Plastic Gloves)

37644 Knitwrist, fully coated; case shipping weight, 28 lb
37646 Gauntlet, 12 in., fully coated; case shipping weight, 40 lb
37515 Gauntlet, 14 in., fully coated; case shipping weight, 46 lb
37645 Cadet, 11 in., fully coated; case shipping weight, 34 lb

(Glow Gloves)

37999 Knitwrist, fully coated; case shipping weight, 30 lb
38000 Gauntlet, 12 in., fully coated; case shipping weight, 40 lb
38096 Mitten, fully coated; case shipping weight, 34 lb

(Thermal Gloves)

38580 Knitwrist, fully coated; case shipping weight, 38 lb
38647 Gauntlet, 10 in., fully coated; case shipping weight, 43 lb
38648 Gauntlet, 12 in., fully coated; case shipping weight, 49 lb

(Thermal Glow Gloves)

38578 Knitwrist, fully coated; case shipping weight, 38 lb
38645 Gauntlet, 10 in., fully coated; case shipping weight, 43 lb
38646 Gauntlet, 12 in., fully coated; case shipping weight, 49 lb
38579 Mitten, knitwrist, fully coated; case shipping weight, 41 lb

Rubber and Neoprene Coated Gloves

(Rubber Ripple-Texture Gloves)

695087 Knitwrist, coated palm
695086 Safety Cuff, coated palm

(Neoprene Gloves)

37726 Knitwrist, coated palm; case shipping weight, 24 lb
37610 Knitwrist, lightweight, fully coated; case shipping weight, 27 lb
34323 Knitwrist, fully coated; case shipping weight, 31 lb
37611 Gauntlet, 10 in., fully coated; case shipping weight, 34 lb
34324 Gauntlet, 12 in., fully coated; case shipping weight, 39 lb
37612 Gauntlet, 14 in., fully coated; case shipping weight, 40 lb
37613 Gauntlet, 18 in., fully coated; case shipping weight, 49 lb
37616 Knitwrist, extra-heavyweight, fully coated; case shipping weight, 38 lb
37617 Gauntlet, 12 in., extra-heavy-weight, fully coated; case shipping weight, 46 lb
37618 Gauntlet, 14 in., extra-heavy-weight, fully coated; case shipping weight, 48 lb

(Python Neoprene Gloves)

37993 Knitwrist, fully coated; case shipping weight, 32 lb
37996 Gauntlet, 12 in., fully coated; case shipping weight, 42 lb
37994 Gauntlet, 14 in., fully coated; case shipping weight, 45 lb

Vinyl Treated Gloves

(Workall Gloves—vinyl impregnated)

38651 Slip-on, medium; 12 doz pr per case, shipping weight, 25 lb
38652 Slip-on, large; 12 doz pr per case, shipping weight, 25 lb
38838 Slip-on perforated back, medium; 12 doz pr per case, shipping weight, 25 lb
38839 Slip-on, perforated back, large; 12 doz pr per case, shipping weight, 25 lb
38842 Knitwrist, medium; 12 doz pr per case, shipping weight, 25 lb
38843 Knitwrist, large; 12 doz pr per case, shipping weight, 25 lb
38846 Slip-on, Glow Glove,* medium; 12 doz pr per case, shipping weight, 25 lb
38847 Slip-on, Glow Glove,* large; 12 doz pr per case, shipping weight, 25 lb
38848 Knitwrist, Glow Glove,* medium; 12 doz pr per case, shipping weight, 25 lb
38849 Knitwrist, Glow Glove,* large; 12 doz pr per case, shipping weight, 25 lb

*Workall Glow Gloves—the backs of the last three fingers are blaze orange.

(Workmore Gloves—vinyl treated)

38953 Knitwrist, Clute cut palm, full forefinger; 12 doz pr per case, shipping weight, 38 lb
38954 Slip-on, Clute cut palm, full forefinger; 12 doz pr per case, shipping weight, 38 lb
38959 Slip-on, perforated back, Clute cut palm, full forefinger; 12 doz pr per case, shipping weight, 38 lb

Note: This Data Sheet is a guide, containing only a general description of uses and performance capabilities of certain MSA Coated Work Gloves. Before use, refer to and strictly follow all instructions, cautions, and warnings on or with the products. For more complete information, contact MSA, 600 Penn Center Blvd., Pittsburgh, Pa. 15235.

MSA Mine Safety Appliances Company
600 Penn Center Boulevard
Pittsburgh, Pennsylvania 15235

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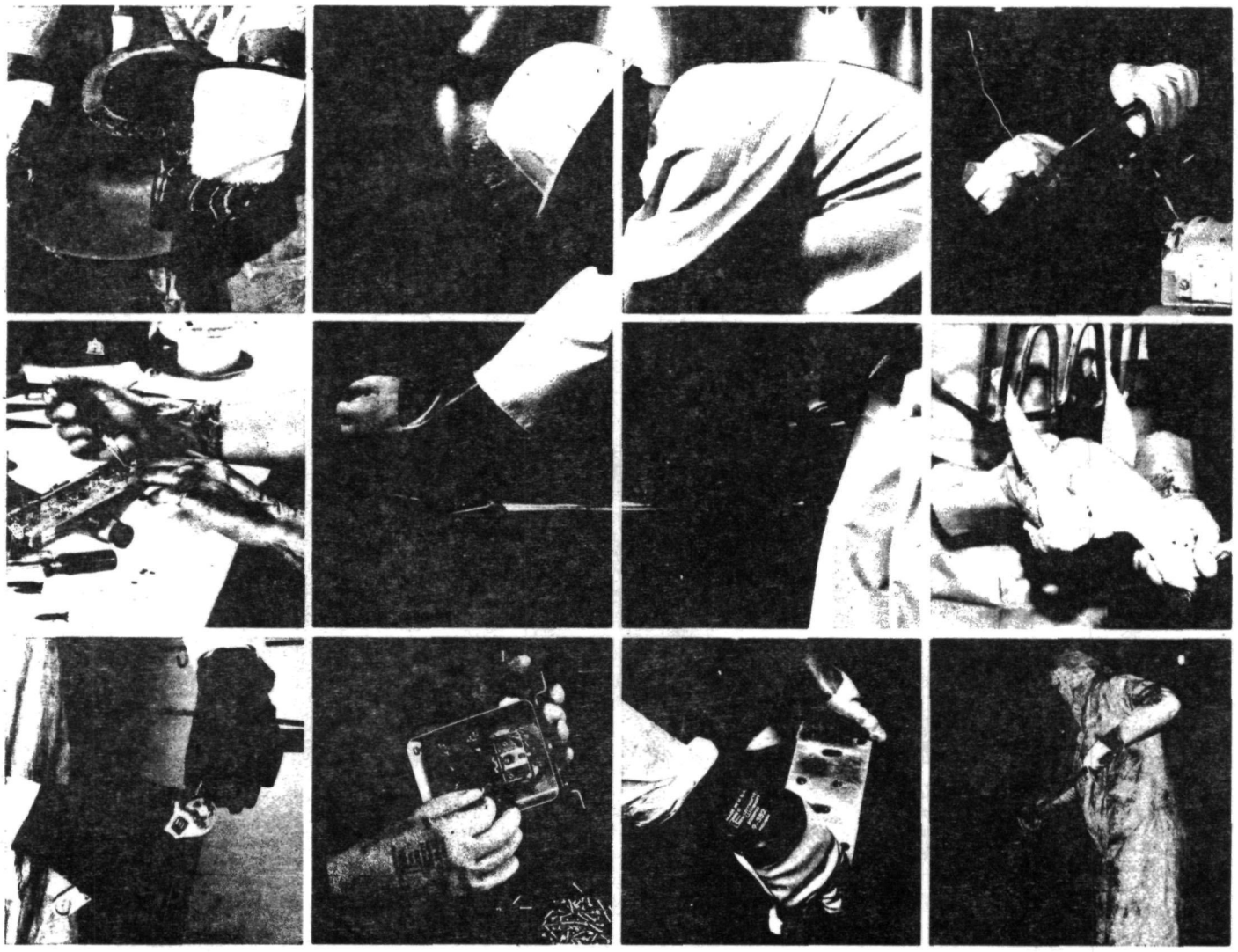
Edmont-Wilson



Job-Fitted Gloves and Protective Clothing

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The Chemical Degradation Guide is provided as an aid in determining the general suitability of various Edmont-Wilson glove and clothing materials for use with specific chemicals. It indicates only the degrading effect of the chemicals on those materials. It does not consider permeability of the materials, or the variable conditions which can influence product performance on actual job applications. Such conditions include chemical concentration, temperature, and combinations, and the length of time the product is in contact with the chemical. In addition, products of the same material but of different thicknesses may perform differently on the same job.

Since the actual use of the gloves or clothing may differ from that known to Edmont-Wilson, the suitability of the product for a specific job should be determined by testing by the purchaser. Upon written request, Edmont-Wilson will provide a sample of the material to aid you in making this determination.

CHEMICAL	RUBBER	NEOPRENE	NBR HYCAR	PVC POLY VINYL CHLORIDE	PVA POLY VINYL ALCOHOL
Acetaldehyde	G	E	G	G	F
Acetic Acid	E	E	G	G	NR
Acetone	E	G	P	P	F
Acrylonitrile	G	G	F	F	E
Ammonium Hydroxide	E	E	E	E	NR
Amyl Acetate	P	F	F	P	G
Aniline	F	G	P	G	F
Benzaldehyde	F	F	F	F	G
Benzene	NR	P	G	P	S
Benzol	NR	P	G	P	S
Butanol	E	E	E	G	F
Butyl Alcohol	E	E	E	G	F
Butyl Acetate	P	F	G	P	G
Butylene	F	E	E	F	S
Carbon Disulfide	P	F	G	F	E
Carbon Tetrachloride	P	F	G	F	S
Castor Oil	P	G	E	G	E
Chlorobenzene	P	F	F	P	S
Chloroform	P	P	P	P	S
Chloronaphthalene	P	F	F	F	S
Chromic Acid	P	F	F	G	NR
Citric Acid	E	E	E	E	F
Cotton Seed Oil	P	G	E	G	E
Creosote	G	G	G	G	F
Cyclohexanol	F	G	G	F	E
Dibutyl Phthalate	P	G	G	NR	E
Dichlorethane	NR	P	F	P	S
Diethylamine	G	G	E	F	F
Diisobutyl Ketone	F	P	F	P	G
Diisocyanate	P	G	G	F	F
Dimethyl Formamide	F	F	P	P	G
Dioctyl Phthalate	P	G	G	NR	E
Dioxane	G	P	G	P	P
Ethanol	E	E	G	G	F
Ethyl Alcohol	E	E	G	G	F
Ethyl Acetate	F	G	G	P	P
Ethylene Dichloride	P	F	F	P	S
Ethylene Glycol	E	E	E	G	G
Ethyl Ether	G	E	E	P	G
Formaldehyde	E	E	E	E	P
Formic Acid	E	E	F	E	P
Freon 11-12-21-22	P	G	F	F	E
Furfural	G	G	F	F	F
Gasolene	F	G	E	F	S
Glycerine	E	E	E	E	F
Grain Alcohol	E	E	G	G	F
Hexane	P	G	E	F	S
Hydrazine	G	F	G	E	NR
Hydrochloric 38% Acid	G	E	E	G	NR
Hydrochloric 10% Acid	E	E	E	E	NR
Hydrofluoric 48% Acid	G	E	E	G	NR
Hydrogen Peroxide 30%	G	G	G	F	P
Hydroquinone	G	G	G	F	P
Isobutyl Alcohol	E	E	E	G	F
Iso-octane	P	F	E	P	S
Isopropanol	E	E	E	G	F
Isopropyl Alcohol	E	E	E	G	F
Kerosene	F	E	S	F	S

CHEMICAL	RUBBER	NEOPRENE	NBR HYCAR	PVC POLY VINYL CHLORIDE	PVA POLY VINYL ALCOHOL
Lactic Acid	E	E	G	G	P
Lauric Acid	F	E	E	G	E
Linoleic Acid	P	E	E	G	E
Linseed Oil	P	G	E	F	E
Maleic Acid	E	E	E	G	E
Methanol	E	E	G	G	F
Methyl Alcohol	E	E	G	G	F
Methylamine	F	F	G	F	F
Methyl Bromide	F	G	G	P	E
Methyl Chloride	F	P	G	P	S
Methylene Bromide	G	G	G	P	G
Methylene Chloride	F	P	G	P	S
Methyl Ethyl Ketone	E	G	F	NR	F
Methyl Isobutyl Ketone	E	G	F	F	G
Methyl Methacrylate	G	G	G	F	G
Monoethanolamine	G	E	E	G	F
Morpholine	E	NR	NR	G	F
Muriatic Acid	G	E	E	G	NR
Naphtha	F	E	S	F	S
Nitric 70% Acid	F	G	P	F	NR
Nitric 10% Acid	G	E	F	G	NR
Nitric Acid Red Fuming	P	P	P	P	NR
Nitric Acid White Fuming	P	P	P	P	NR
Nitro Methane	P	F	F	P	E
Nitro Propane	P	F	F	P	E
Octyl Alcohol	E	E	E	F	G
Oleic Acid	F	E	E	F	E
Oxalic Acid	E	E	E	G	E
Palmitic Acid	E	E	E	G	E
Pentane	F	E	E	P	S
Perchlorethylene	NR	P	G	NR	S
Perchloric Acid	F	E	G	P	NR
Phenol	F	E	G	G	F
Phosphoric Acid	G	E	E	G	NR
Picric Acid	G	E	E	F	F
Potassium Hydroxide 50%	E	E	E	G	NR
Propyl Alcohol	E	E	E	G	F
Propyl Acetate	F	G	G	F	G
Sodium Hydroxide 50%	E	E	E	G	NR
Stearic Acid	E	E	E	G	E
Styrene	P	F	G	P	E
Sulfuric 95% Acid	G	G	F	F	NR
Sulfuric 10% Acid	E	E	G	G	NR
Tannic Acid	E	E	E	E	F
Tetrahydrofuran	F	P	P	P	G
Toluene	NR	F	G	P	S
Toluene Diisocyanate	G	F	G	P	G
Toluol	NR	F	G	P	S
Trichlorethylene TCE	P	P	P	NR	S
Tricresyl Phosphate	F	G	G	NR	G
Triethanolamine	G	E	E	G	F
Triptane	P	E	E	P	E
Tung Oil	P	E	E	F	E
Turpentine	F	G	E	G	E
Wood Alcohol	E	E	G	G	F
Xylene	NR	P	G	P	S
Xylol	NR	P	G	P	S

S—Fluid has no degrading effect. E—Fluid has very little degrading effect. G—Fluid has minor to moderate degrading effect. F—Fluid has moderate degrading effect. P—Fluid has pronounced degrading effect. NR—Not suitable for use in fluid.

The chemicals in the above Guide highlighted in blue are known carcinogens. Those highlighted in green have been identified as suspected carcinogens. The Guide indicates only the degrading effect of these chemicals on product materials. Permeability of the product materials by these chemicals is *not* considered.

Physical Characteristics	Neoprene	Rubber	NBR	Vinyl
Tensile Strength	E	E	E	F
Elongation	E	E	G	F
Tear Resistance	G	G	G	F
Abrasion Resistance	G	G	E	G
Heat Resistance	E	F	E	P
Ozone Resistance	E	G	G	E

KEY TO CHART: S—Superior E—Excellent G—Good F—Fair P—Poor.

PHYSICAL PERFORMANCE	HYCRON	NEOX	REDMONT	SCORPIO	GRAB-IT	SNORKEL	GRAPPLER	MONKEY GRIP	PVA
Abrasion Resistance	E	F	G	F	F	G	S	S	F
Cut Resistance	G	E	S	G	E	F	F	F	F
Dry Grip	E	G	G	G	E	E	G	E	G
Flexibility	E	G	F	S	F	E	F	G	F
Puncture Resistance	E	E	E	F	E	G	G	G	F
Wet Grip	F	F	G	S	G	E	E	F	F

KEY TO CHART: S—Superior E—Excellent G—Good F—Fair P—Poor.

Knit-Rite

vinyl coated

AIR-CONDITIONED LINE

Provides the coolness of cotton, yet outwears 8 oz. cotton at least 4 to 1 on straight abrasion. Special knitted lining and porous coating let air come thru to keep hands cooler and drier. Simplified construction eliminates seams from the working areas which usually rub fingers and knuckles. Stretches to allow unrestricted dexterity, and for easy on and off. Excellent dry grip. Glove is machine washable, and lining won't ball up. "Job-fitted" for general plant use; shipping and receiving; assembly, inspection, and packaging; light fabrication; general maintenance.

33-105: Slip-on. Men's M & L.
33-106: Slip-on. Women's L.
(M size to be available 1/1/76)

33-105

KSR

vinyl coated

KNIT LINED

Extra light, flexible and comfortable, yet outwears 8 oz. cotton gloves at least 8 to 1 on straight abrasion. Inter-lock knit lining stretches to a snug, sensitive fit, and for easy on and off. Vinyl coating provides an excellent grip, breathes for ventilation and is liquid repellent (not liquidproof). Glove is machine washable, and lining won't ball up. Replaces brown jersey, goatskin, light leather, cotton, and light-duty vinyl impregnated gloves. "Job-fitted" for general use, assembly, inspection, packaging, shipping, receiving and maintenance.

22-515: Slip-on. Men's M, L, & Ex-L.
22-516: Slip-on. Women's M & L.

22-515

Hynit

nbr impregnated

KNIT LINED

Excellent abrasion and cut resistance. Outwears light vinyl impregnated gloves as much as 5 to 1, and light to medium leather as much as 3 to 1, on straight abrasion. Excellent dry grip—makes handling safer and easier. Interlock knit lining and flexible coating stretch to provide a snug fit, good dexterity, and easy on and off. Repellent but not liquidproof. Glove is machine washable, and lining won't ball up. "Job-fitted" for general plant use; assembly, inspection, and packaging; shipping and receiving; light to medium metal fabrication; general maintenance.

32-105: Slip-on. Men's M & L.
32-106: Slip-on. Women's M & L.

PERFORATED STYLES

Same as above except backs of last three fingers are perforated for "air-conditioned" comfort.

32-125: Slip-on. Men's M & L.
32-126: Slip-on. Women's M & L.

U.S.D.A. accepted for food and meat handling.

32-105

STD

vinyl impregnated

SUPER-FLEXIBLE LINE

Provides excellent dexterity and grip. Stretches to a snug fit, and for easy on and off. Replaces 8 oz. cotton, goatskin and light leather gloves because it grips better, provides greater dexterity and usually wears longer. Vinyl impregnated, inter-lock knit fabric breathes for coolness. Repellent but not liquidproof. Glove is machine washable, and lining won't ball up. "Job-fitted" for general plant use, and for assembling, inspecting and packaging small or delicate parts.

1-114: Slip-on. Men's M, L & Ex-L.
1-116: Slip-on. Women's S, M & L.

WHITE STD

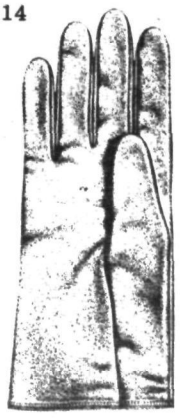
"Job-fitted" for clean-rooms, food plants and other areas where white gloves are desirable. Same grip, wear and launderability as the brown STD.

1-124: Slip-on. Men's M, L & Ex-L.
1-126: Slip-on. Women's S, M & L.

STD gloves have colored stitching on cuffs for quick size mating after laundering. Men's M size has yellow stitching, L has brown, Ex-L has black. Women's S size has green, M has red, L has blue.

Patent No. 3050738

1-114



20-115

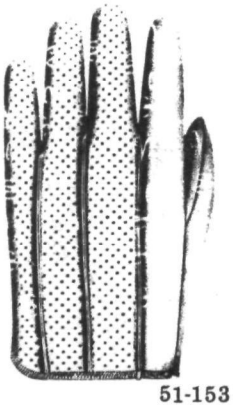
vinyl coated
SUPER COMFORT LINE

Preferred for its superior comfort. Unique construction puts the seams on the outside, leaves nothing but soft jersey inside. Reinforced thumb crotch provides extended service on jobs which subject this area to excessive stress and abrasion. Other benefits include an excellent grip, good flexibility, a low cost-to-wear ratio, and machine washability. Tough vinyl coating outwears 8 oz. cotton at least 10 to 1 on straight abrasion. It breathes for ventilation and is liquid repellent (not liquidproof). Replaces cotton, goatskin and light leather gloves. "Job-fitted" for general plant use, assembly line, shipping, receiving and maintenance.

20-112: Knitwrist. Men's M & L.
20-115: Slip-on. Men's M & L.
20-116: Slip-on. Women's M & L.

Same as above except without thumb crotch reinforcement.

20-102: Knitwrist. Men's M & L.
20-105: Slip-on. Men's M & L.
20-106: Slip-on. Women's M & L.



51-153

vinyl impregnated
REGULAR DUTY LINE

Replaces 8 and 10 oz. cotton, goatskin and light leather gloves. Provides good dexterity and grip. Outwears 8 oz. cotton at least 5 to 1 on straight abrasion. Back is perforated for "air-conditioned" comfort. Repellent but not liquidproof. Machine washable. "Job-fitted" for general plant use, assembling, receiving and shipping.

51-103: Perforated slip-on. Women's M & L.
Patent No. 2913729

51-153: Perforated slip-on. Men's M & L.
Patent No. 2913729

51-101: Slip on. Women's M & L.
51-152: Knitwrist. Men's M & L.
51-151: Slip-on. Men's M & L.

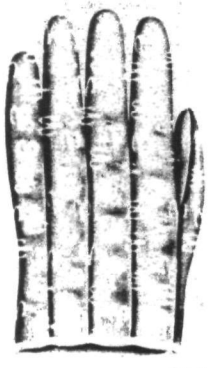
LIGHT DUTY LINE

Outwears 8 oz. cotton at least 3 to 1 on straight abrasion. Flexible and comfortable. Gives a good sense of touch and grip. Repellent but not liquidproof. Machine washable. "Job-fitted" for inspection, receiving, shipping, assembling small parts, and general use.

41-141: Slip-on. Men's M & L.
41-171: Slip-on. Women's M.

Colored stitching on cuffs and colored knitwrists permit quick size mating after laundering. Men's M size Slip-on has yellow stitching, L has brown. Men's M size Knitwrist is white, L is brown. Women's M size Slip-on has red stitching, L has blue. Women's M size Knitwrist is white, L is blue.

Werx was the first vinyl impregnated glove made for industry. Today there are many imitations. The genuine Werx is identified by this mark in the fabric. It is your guarantee of proven performance and value.



41-141

21-704

vinyl impregnated
HEAVY DUTY LINE

Gives an excellent grip, good dexterity and long service. Outwears medium to heavy leather gloves on many jobs, and regular jersey at least 10 to 1 on straight abrasion. Coating is repellent (not liquidproof), oil-resistant, and stays soft when cold. Palm is impregnated with heavy gauge vinyl. Back is lightly coated. Machine washable. "Job-fitted" for chemical plants, yard work, truck driving, warehousing and general use.

21-700: Knitwrist. Men's size.
21-704: Driver's style with elastic wrist. Men's M & L.
21-707: Safety cuff. Men's M & L.
21-752: 12" gauntlet. Men's M & L.

Uncoated fabric back ventilates to work cooler. Same tough coating on palm.

21-744: Driver's style with elastic wrist. Men's M & L.
21-747: Safety cuff. Men's M & L.

All Tuf-Duk gloves, except the Knitwrist, have colored stitching on cuffs for quick size mating after laundering. The M size has black stitching, L has gray.

Patent No. 3050738

Hycron

nbr coated

ABRASION RESISTANT LINE

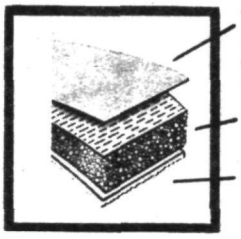
Combines exceptional toughness and flexibility. Exclusive NBR coating gives superior service handling rough, abrasive materials. Also provides an excellent dry grip, and high resistance to cuts, snags, punctures, grease and oils. Soft, jersey lining is a 2-piece pattern. It eliminates seams from the working area to prevent hand irritation and premature wear-thru. Curved, preflexed fingers and wing thumb. Excellent replacement for leather gloves. "Job-fitted" for general use, for handling castings, coils, fabricated metal, and production of fabricated building materials such as concrete block, brick tile, lumber, plywood, and drywall.

27-600: Palm coated knitwrist. Men's size.
27-601: Women's size. Palm coated knitwrist.
27-602: Fully coated knitwrist. Men's size.
27-603: Women's size. Fully coated knitwrist.
27-607: Palm coated safety cuff. Men's size.

U.S.D.A. accepted for food and meat handling

27-607

Foam Insulated



TOUGH COATING of vinyl or neoprene resists abrasion, oils, chemicals. Stays soft when cold.

FOAM INSULATION locks out cold, keeps hands warm.

DEEP-FLEECE LINING helps retain warmth, feels good on the hand.

"Job-fitted" for winter transportation, yard and field work, cold storage and unheated warehouses, laboratories, construction, and other winter jobs.

WINTER MONKEY GRIP Liquidproof vinyl coating resists oil, acids, chemicals, and caustics. Curved fingers, wing thumb, and general softness make this glove very comfortable and easy to wear.

23-152: 12" fully coated gauntlet. Men's size.
23-189: Fully coated one finger mitten. Free index finger allows more dexterity than full mitten, provides more warmth than a glove. Men's size.
23-191: Fully coated knitwrist. Men's size.
23-193: Fully coated safety cuff. Men's size.

Patent Nos. 3173150, 3468735

WINTER FIREBALL Liquidproof vinyl coating. Fluorescent fire-orange color is easier to see. Improves safety and hand signaling for transportation, traffic control, construction, etc.

23-429: Fully coated mitten. Provides most warmth. Extra long elastic wrist. Men's size.
23-491: Fully coated knitwrist. Extra long elastic wrist. Men's size.

Patent Nos. 3173150, 3468735

WINTER TUF-DUK Vinyl impregnated to provide an excellent grip and long wear. Sheds snow, sleet and rain (not liquidproof).

31-790: Knitwrist style. Men's M & L.
31-791: Driver's style with elastic wrist. Men's M & L.

23-191

23-491

31-791

GOLDEN Grab-it

rubber coated

CRINKLE-FINISHED LINE

Premium quality. Outperforms ordinary rubber coated gloves. Provides a safer wet or dry grip, greater cut resistance, longer wear, and improved cushioning of the hands against vibration and jolts. Crinkle-textured, heavy-duty coating has no rubber particles to shed. Curved, preflexed fingers and wing thumb give extra working comfort. "Job-fitted" for handling smooth, slippery or sharp-edged materials like glass, sheet metal, and tin plate.

16-300: Palm coated knitwrist. Men's size.
16-301: Women's size. Palm coated knitwrist.
16-307: Palm coated safety cuff. Men's size.
16-362: 12" palm coated gauntlet. Elastic wrist and knuckle strap. Men's size.

16-307

6-620

Grab-it

rubber coated

FLOCK-FINISHED LINE

Provides an excellent grip for handling wet or dry materials. Rough-finished rubber coating has high abrasion and cut resistance. 2-piece jersey lining greatly improves puncture resistance, and eliminates seams from the working areas to prevent hand irritation and premature wear thru. "Job-fitted" for general use, handling multi-wall paper bags, glass, castings, cores, scrap metal, tile, block, lumber, logs, and veneer, and in acids, caustics, alcohols and many solvents.

6-600: Palm coated knitwrist. Curved fingers, wing-thumb. Men's size.

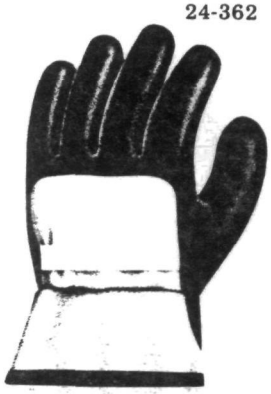
6-620: Palm coated safety cuff. Curved fingers, wing-thumb. Men's size.

6-622: 12" fully coated gauntlet. Curved fingers, wing thumb. Men's size.

6-660: Fully coated knitwrist. Men's size.

6-662: 10" fully coated gauntlet. Men's size.

24-362



Grappler

vinyl coated

PREMIUM PVC LINE

Premium quality for heavy duty protection and long service. Outperforms regular vinyl coated gloves as much as 50%. Soft jersey lining, and reinforced vinyl coating produced only by Edmont-Wilson, provide good comfort and flexibility. 2-piece liner construction eliminates seams from the working areas to prevent hand irritation and premature wear thru. Special, rough finish gives a good grip. Curved, preflexed fingers and wing thumb. "Job-fitted" for the tougher assembly line jobs, general plant use, handling concrete block, and in chromatic acid, caustics, oils and petroleum solvents.

24-360: Palm coated knitwrist. Men's size.
24-362: Palm coated safety cuff. Men's size.
24-363: 12" fully coated gauntlet. Men's size.
24-364: 14" fully coated gauntlet. Men's size.
24-366: Fully coated knitwrist. Men's size.

3-312

Monkey Grip

vinyl coated

STANDARD PVC LINE

Economical for a broad range of jobs. Has a tough, vinyl coating with excellent abrasion resistance and good flexibility. 2-piece lining provides extra comfort because the hand never works over rough seams. Curved, preflexed fingers and wing thumb. "Job-fitted" for general plant use and handling in oils, acids, caustics and alcohols.

3-303: Fully coated knitwrist. Men's size.
3-312: 12" fully coated gauntlet. Men's size.
3-314: 14" fully coated gauntlet. Men's size.
3-318: 18" fully coated gauntlet. Men's size.
3-360: 10" fully coated gauntlet. Men's size.

13-152

EVER-FLEX Monkey Grip

vinyl coated

SUPER-FLEXIBLE PVC LINE

Very light, flexible and easy to wear. Special vinyl coating stays soft when cold. Has good chemical and abrasion resistance. 2-piece lining gives extra comfort and service. It eliminates seams from the working areas to prevent hand irritation and premature wear thru. Curved, preflexed fingers and wing thumb. "Job-fitted" for handling in oils, acids, caustics and alcohols.

13-102: Fully coated knitwrist. Men's size.
13-402: **EVER-FLEX FIREBALL** Same as 13-102 except fluorescent fire-orange color for extra visibility and safety. Men's size.
13-152: 12" fully coated gauntlet. Men's M & L.
13-158: 18" fully coated gauntlet. Men's size.
13-452: **EVER-FLEX FIREBALL** Same as 13-152 except fluorescent fire-orange color for extra visibility and safety. Men's size.

Snorkel

vinyl coated

SUPER-FLEXIBLE PVC LINE

Provides excellent wet grip, flexibility and comfort. A dipped finish makes handling slippery materials safer and easier. Available with jersey lining, or inter-lock knit which works cooler, is more flexible, and won't ball up when laundered. Jersey lining feels soft, and insulates against moderate heat and cold. 2-piece liner construction eliminates seams from the working areas to prevent hand irritation, and premature wear thru. Comfortable curved fingers and wing thumb. "Job-fitted" for handling materials coated with grease or oil film, and in acids, caustics and many solvents.

4-452: Knit lined. 12" fully coated gauntlet. Men's M & L.

4-454: Knit lined. 14" fully coated gauntlet. Men's M & L.

4-404: Jersey lined. Fully coated knitwrist. Men's size.

4-405: Jersey lined. Women's size. Fully coated knitwrist.

4-412: Jersey lined. 12" fully coated gauntlet. Men's M & L.

4-414: Jersey lined. 14" fully coated gauntlet. Men's M & L.

4-460: Jersey lined. 10" fully coated gauntlet. Men's M & L.

4-412

PVA

polyvinyl alcohol coated

ORGANIC SOLVENT RESISTANT LINE

"Job-fitted" for handling in strong organic solvents such as aromatics, and chlorinated . . . the types which quickly deteriorate rubber, neoprene and polyvinyl chloride coated gloves. PVA coating is nearly inert to these solvents. There is no absorption to cause swelling, and almost no extraction to cause shrinking. Very comfortable and provides excellent dexterity. Weighs only half as much as a neoprene coated gauntlet. Curved, preflexed fingers and wing thumb.

15-552: 12" fully coated gauntlet. Men's size.
15-554: 14" fully coated gauntlet. Men's size.
15-561: 12" fully coated gauntlet. Women's size.

CAUTION

PVA coating is water soluble. Do not use in water or water based solutions.

15-554

Scorpio

neoprene coated

KNIT LINED SUPER-FLEXIBLE LINE

Excellent dexterity and comfort. An inter-lock knit lining and flexible coating stretch to provide a snug fit, and easier on and off. 2-piece lining construction eliminates seams from the working areas to prevent hand irritation and premature wear thru. Reinforced neoprene coating protects against abrasion, cutting, and a broader range of chemicals than any other glove coating. A dipped finish makes handling wet, slippery materials safer and easier. Curved, preflexed fingers and wing thumb. "Job-fitted" for handling in oils, acids, caustics, alcohols, and solvents.

8-352: 12" fully coated gauntlet. Sizes S, M, L, & Ex-L.

U.S.D.A. accepted for food and meat handling

8-352

Redmont

neoprene coated

HEAVY DUTY LINE

Premium quality for maximum protection in oils, acids, caustics, alcohols and solvents. Reinforced neoprene coating has a dipped finish which gives an excellent wet grip. Outwears regular neoprene coated gloves as much as 30%. Fabric lining substantially increases snag and puncture resistance. Curved fingers and wing thumb provide extra comfort.

19-930: 10" fully coated gauntlet. Men's size.
19-932: 12" fully coated gauntlet. Men's size.
19-934: 14" fully coated gauntlet. Men's size.
19-938: 18" fully coated gauntlet. Men's size.

19-932

9-922

Neox

neoprene coated

STANDARD LINE

Reinforced neoprene coating protects against abrasion, cutting and a broader range of chemicals than any other glove coating. Fabric lining greatly improves snag and puncture resistance. Knitwrist styles have 2-piece linings. All styles have curved fingers and wing thumbs for a natural fit and greater comfort. "Job-fitted" for handling in oils, acids, caustics, alcohols and solvents.

9-022: Hi-Lo Temperature glove. 12" fully coated gauntlet. Quilted cotton liner insulates against heat or cold. Men's size.

9-909: Fully coated knitwrist. Men's size.
9-920: 10" fully coated gauntlet. Men's size.
9-922: 12" fully coated gauntlet. Men's size.
9-924: 14" fully coated gauntlet. Men's size.
9-928: 18" fully coated gauntlet. Men's size.
9-430: 31" fully coated gauntlet. Protects to shoulder. Available in pairs or single hands. Men's size.

LIGHTER WEIGHT STYLES

Same compound but a lighter coating for extra flexibility.

9-908: Fully coated knitwrist. Men's size.
9-912: 12" fully coated gauntlet. Men's size.

29-865

Neoprene

UNSUPPORTED LINE

Provides excellent protection in a broad range of chemicals, and against abrasions, cuts and punctures. **Case hardened** to increase chemical and abrasion resistance over other neoprene gloves. Comfortable curved fingers and contoured palm. Available smooth, or with embossed or dipped finish for better gripping. Smooth finish gloves have ribbed backs to provide air circulation and eliminate tightness over knuckles when hands are closed. Improves comfort and reduces hand fatigue. "Job-fitted" for handling in oils, acids, caustics, alcohols and solvents, and for food processing.

REGULAR DUTY STYLES

Made from latex neoprene compound.

29-840: .015" gauge, 11" length. Smooth. Rolled cuff. Sizes 8-9-10-11.
29-845: .017" gauge, 12" length. Embossed. Rolled cuff. Sizes 7-7½-8-8½-9-10-11.
29-870: .018" gauge, 11" length. Smooth. Rolled cuff. Sizes 7-8-9-10-11.
29-875: .019" gauge, 12' length. Embossed. Rolled cuff. Sizes 8-9-10-11.

SOFT-LINED STYLE

Made from latex neoprene compound.

Soft, cotton-flock lining absorbs perspiration and feels good on the hand. The lining, plus generously proportioned wrist, make the glove easier on and off. Embossed finish gives a good wet grip.

29-865: .018" gauge, 12" length. Pinked cuff. Sizes 7-8-9-10-11.

U.S.D.A. accepted for food and meat handling.

37-175

Sol-Vex

unsupported

SOLVENT RESISTANT NBR (BUNA-N) LINE

Exclusive NBR compound is far superior to natural rubber and neoprene in aromatic, petroleum and chlorinated solvents. Protects against abrasion, cuts, snags and punctures better than any other type of unsupported glove. **Case hardened** to give extra chemical and abrasion resistance. Comfortable curved fingers and contoured palm fit the hand naturally. Embossed finish provides better gripping. "Job-fitted" for handling in solvents, oils, grease, fats, acids, caustics and alcohols, and for food processing.

37-145: .011" gauge, 12" length. Pinked cuff. Sizes 7-8-9-10-11.
37-155: .015" gauge, 12" length. Pinked cuff. Sizes 7-8-9-10-11.
37-165: .022" gauge, 14" length. Pinked cuff. Sizes 9-10-11.
37-185: .022" gauge, 18" length. Pinked cuff. Sizes 9-10-11.

SOFT-LINED STYLE

Soft, cotton-flock lining absorbs perspiration, feels good on the hand, and makes the glove easier on and off.

37-175: .015" gauge, 12" length. Pinked cuff. Sizes 7-8-9-10-11.

U.S.D.A. accepted for food and meat handling

Tan Rubber

SIZES FOR WOMEN TOO

unsupported PREMIUM LINE

Case hardened for greater chemical and abrasion resistance. Gives longer service than regular rubber gloves. Curved fingers and contoured palm provide an easy-working fit. Available smooth, or with sprayed or embossed finish for better gripping. The smooth and sprayed finish gloves have ribbed backs to provide air circulation and eliminate tightness over knuckles when hands are closed. Improves comfort and reduces hand fatigue. "Job-fitted" food processing, electronics manufacturing, and handling in acids, alkalies, salts and ketones.

26-640: .015" gauge, 11" length. Smooth. Rolled cuff. Sizes 7½-8-8½-9-9½-10-11.

26-641: .015" gauge, 11" length. Smooth. Pinked cuff. Sizes 7½-8-8½-9-10-11.

26-645: .015" gauge, 11" length. Sprayed. Rolled cuff. Sizes 7½-8-8½-9-9½-10-11.

26-646: .015" gauge, 11" length. Sprayed. Pinked cuff. Sizes 7-7½-8-8½-9-9½-10-11.

26-670: .018" gauge, 11" length. Smooth. Rolled cuff. Sizes 7½-8-8½-9-9½-10-11.

26-675: .018" gauge, 11" length. Sprayed. Rolled cuff. Sizes 8-9-10-11. 11.

26-680: .021" gauge, 11" length. Smooth. Rolled cuff. Sizes 8-9-10-11. 11.

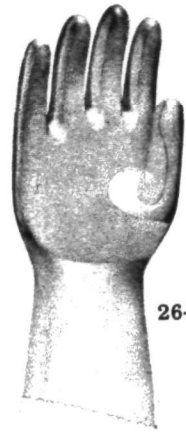
26-685: .021" gauge, 11" length. Sprayed. Rolled cuff. Sizes 8-9-10-11. 11.

SOFT-LINED STYLE

Soft, cotton-flock lining absorbs perspiration and feels good on the hand. The lining, plus generously proportioned wrist, makes the glove easier on and off. Embossed finish gives a good wet grip.

26-665: .018" gauge, 13" length. Pinked cuff. Sizes 7-8-9-10-11.

U.S.D.A. accepted for food and meat handling



26-665

SIZES FOR WOMEN TOO

Long Service Rubber

unsupported STANDARD LINE

Case hardened for greater resistance to chemicals and abrasion. Comfortable curved fingers and contoured palm are easy to work in. Choice of sprayed or embossed finish. Sprayed finish gloves have ribbed backs to provide air circulation and eliminate tightness over knuckles when hands are closed. Improves comfort and reduces hand fatigue. "Job-fitted" for food processing and handling in acids, alkalies, salts and ketones.

36-124: .018" gauge, 12" length. Generously proportioned wrists make on and off easier. Embossed. Pinked cuff. Sizes 7-7½-8-8½-9-9½-10-11.

KANRY-TEX

Has 37% thicker rubber on fingers. Extends glove life on jobs where fingers are subjected to excessive wear. Sprayed finish gives an excellent wet grip.

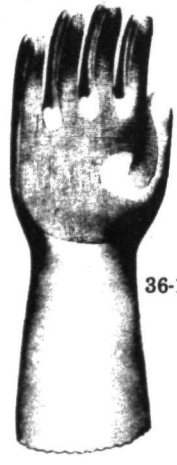
36-555: .016"–.022" gauge, 11" length. Pinked cuff. Sizes 7½-8-9-10.

HEAVY DUTY STYLE

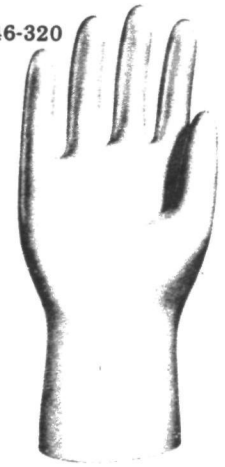
For plywood gluing and heavy duty liquidproof protection. Made of tough, heavy gauge rubber for extra abrasion and puncture resistance. Embossed finish gives a good wet grip.

36-755: .040" gauge, 14" length. Pinked cuff. Sizes 10-11.

U.S.D.A. accepted for food and meat handling.



36-124



46-320

Premium White Rubber

A premium quality, surgeon's-type rubber glove designed for industrial use. Strong, yet thin and snug-fitting. Provides superior dexterity and sensitivity. Resists acids, alkalies, salts and ketones. Curved fingers and contoured palm give extra working ease. Available smooth, or with sprayed finish for safer gripping. "Job-fitted" for electronics manufacturing, research laboratory work and assembling small parts.

46-320: .009" gauge, 11½" length. Smooth. Rolled cuff. Sizes 6½-7-7½-8-8½-9-9½-10.

46-321: .009" gauge, 11½" length. Sprayed. Rolled cuff. Sizes 6½-7-7½-8-8½-9-9½.

46-710: .0075" gauge, 11½" length. Smooth. Flat cuff. Sizes 6½-7-7½-8-9. Bulk packed 12 doz. per case, rights and lefts separated.

CASE HARDENED STYLES

Case hardening toughens the glove surface for increased chemical and abrasion resistance.

46-322: .017" gauge, 11" length. Smooth. Pinked cuff. Sizes 7-7½-8-8½-9-10.

46-323: .017" gauge, 11" length. Sprayed. Pinked cuff. Sizes 7-7½-8-8½-9-10.

46-322 and 46-323 are U.S.D.A. accepted for food and meat handling.

35-125

Poly-D

POLYETHYLENE LINE

The **POLY-D GLOVE** gives low-cost product protection for food and precision parts handling. Superior touch sensitivity. Powderless and sulphur-free — can't mark delicate materials. Fits either hand. Disposable.

35-112 Roll: 100 gloves, .00125" gauge, no paper. S, M, L.
35-119 Box: 1000 gloves, .00125" gauge, no paper. S, M, L.
35-122 Roll: 100 gloves, .00125" gauge. Sizes S, M, L.
35-125 Dispenser: 100 gloves, .00125" gauge. Sizes S, M, L.
35-126 Dispenser: 1000 gloves, .00125" gauge. Sizes S, M, L.
35-129 Roll: 1000 gloves, .00125" gauge. Sizes S, M, L.

35-137 Roll: 25 gloves, .00175" gauge, 32" length. Size L.
35-150 Roll: 50 gloves, .00175" gauge, 22" length. Size L.
35-152 Roll: 100 gloves, .00175" gauge. Sizes S, M, L.
35-159 Roll: 1000 gloves, .00175" gauge. Sizes S, M, L.

The **POLY-D-BOOT** is ideal for clean rooms, food processing and poultry plants. Liquidproof, chemical resistant and fits either foot. Available in .00175" and .003" gauges, S, M and L sizes. S fits men's shoes thru size 9-1/2, M 10 to 11, L 11 thru 12. Order size S for women.

35-300 Roll: 50 boots. .00175" gauge.
35-350 Roll: 50 boots. 003" gauge.

U.S.D.A. accepted for food and meat handling.

Tru-Touch

Tru-Touch

DISPOSABLE OR REUSABLE

ECONOMICAL. Replace rubber gloves and reduce costs for hand or product protection where glove contamination is high.

REUSABLE OR DISPOSABLE. Tough enough to reuse. Inexpensive enough to use once and throw away.

LIQUIDPROOF . . . no seams to split and leak.

EXCELLENT SENSITIVITY . . . the thin vinyl provides a keen sense of touch and great dexterity.

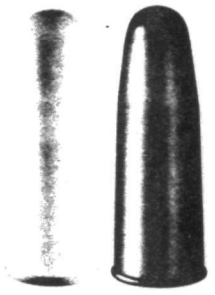
FIT EITHER HAND . . . makes issuing easier — no need to pair lefts and rights.

Available in 3 styles

Tru-Touch Featherweight: .004" thick. "Job-Fitted" for handling very small parts, precision assembly, scientific research, and food processing.
34-600 Dispenser: 100 gloves. Sizes S, M, L.

Tru-Touch Sheer: .005" thick. "Job-Fitted" for scientific research, inspecting and assembling small parts.
34-550 Dispenser: 50 gloves. Sizes S, M, L, Ex-L.

Tru-Touch Ambi: .0065" thick. "Job-Fitted" for small parts handling, laboratories, painting, polishing, equipment clean-up.
34-100 Dispenser: 100 gloves. Sizes S, M, L, Ex-L.
34-300 Dispenser: 300 gloves. Sizes S, M, L, Ex-L.



45-070 45-060

Finger Cots

PREMIUM RUBBER

Select the thickness to fit the job:

SHEER . . . for light-duty use where sensitive touch is needed.

REINFORCED . . . for general-duty use. Medium thickness with reinforced work surface.

Available in 3 thicknesses and 4 sizes.

45-060 Box: 1 gross, sheer, .0035" gauge, 2¾" length. Sizes 1-2-3.
45-600 Bag: 10 gross, same as 45-060 except bulk packed.
45-610 Bag: 10 gross, sheer, powderless, .0035" gauge, 2¾" length. Size 1-2-3.
45-070 Box: 1 gross, reinforced, .007"-.013" gauge, 2¾" length. Sizes 1-2-3.
45-770 Box: 1 gross, reinforced, .012"-.016" gauge, 2¾" length. Sizes 1-2-3-4.

LAB COAT Ideal for lab and process technicians. Buttons in front. Two sewn-on utility pockets.
55-430: Splash resistant. Sizes S, M, L, XL.
55-440: Air conditioned. Sizes S, M, L, XL.

SMOCK Collarless, wrap-around style. Ideal for production and processing line jobs where product protection is important.
55-330: Splash resistant. Sizes S, M, L, XL.

SHIRT Buttons in front.
55-130: Splash resistant. Sizes S, M, L, XL.

PANTS Elasticized waist.
55-230: Splash resistant. Sizes S, M, L, XL.

SPLASH RESISTANT — Protects against moderate splash and spray. Also ideal for clean room use, and high dust level applications.

	Heavy-Duty (Blue)	Regular-Duty (White)
Coverall	X	X
Shop Coat	X	
Hood	X	
Lab Coat		X
Smock		X
Shirt		X
Pants		X

AIR-CONDITIONED—Has thousands of tiny perforations which ventilate the garments.

	Heavy-Duty (Blue)	Regular-Duty (White)
Coverall	X	X
Lab Coat		X

polyolefin

REUSABLE OR DISPOSABLE . . . tough enough to launder and reuse. Inexpensive enough to wear once on messy jobs and throw away.

LIGHTWEIGHT COMFORT . . . JFA garments weigh less than 6 ounces—cotton garments are as much as 10 times heavier.

EASY TO WEAR . . . generous sizing and raglan sleeves permit free and easy movement.

STRONG POLYOLEFIN FABRIC . . . has excellent resistance to snags, tears, punctures, and many chemicals. It is also splash, stain, and perspiration resistant, anti-static, lint free, and biologically and chemically inert.

OVERCAST STITCHING . . . provides extra seam strength.

EASY SIZE ADJUSTMENT . . . garment length and sleeves are easily shortened without ravelling, using scissors.

HIGH OPACITY . . . prevents show thru and allows wearing without other clothing underneath.

	Shirt Coat Smock	Coverall			Pants	
Size	Chest	Chest	Waist	Inseam	Waist	Inseam
S	48"	45"	45"	26"	36"	30"
M	51"	48"	48"	26"	38"	31"
L	55"	51"	51"	27"	40"	33"
XL	58"	56"	56"	29"	42"	33"

COVERALL Aluminum zipper. Reinforced crotch. Mandarin-style collar.

55-510: Splash resistant. Sizes S, M, L, XL.
55-520: Air conditioned. Sizes S, M, L, XL.

Makes size sorting after laundering quicker and easier. Small size has red stitching, medium blue, large yellow, and extra large white.

(Continued)

REUSABLE OR DISPOSABLE . . . tough enough to launder and reuse. Inexpensive enough to wear once on messy jobs and throw away.

LIGHTWEIGHT COMFORT . . .cotton garments are as much as 10 times heavier.

EASY TO WEAR . . . generous sizing and raglan sleeves permit free and easy movement.

STRONG POLYOLEFIN FABRIC . . . has excellent resistance to snags, tears, punctures, and many chemicals. It is also splash, stain, and perspiration resistant, anti-static, lint free, and biologically and chemically inert.

OVERCAST STITCHING . . . provides extra seam strength.

EASY SIZE ADJUSTMENT . . . garment length and sleeves are easily shortened without ravelling, using scissors.

HIGH OPACITY . . . prevents show thru and allows wearing without other clothing underneath.

HOOD

SHOP COAT Extra long for extra protection. Ideal for supervisory personnel and plant visitors. Two utility pockets. Buttons in front.

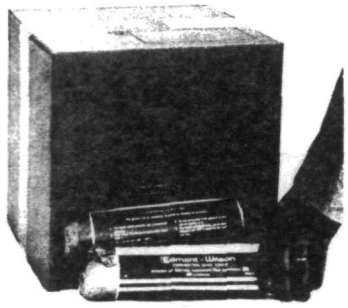
55-415: Sizes S, M, L, XL.

HOOD Slips on and off easily. Tie ties hold it snugly in place. One size for all.

55-908: One size.

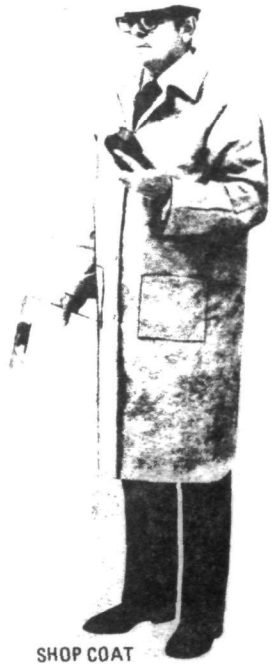
WRIST CLOSURE Elastic with rust-resistant metal tip and slide for size and tension adjustment.

55-909



Stackable, side-dispensing box simplifies storage and issuing. Requires less than one cubic foot of space. Contains 25 individually rolled and paper-banded garments of one style and size. Helps keep garments neat and clean until issued. In-plant laundry instructions are printed on each wrapper.

SEE PAGE 20 FOR ORDERING INFORMATION



SHOP COAT

WRIST CLOSURE

polyethylene coated polyolefin

LIGHTWEIGHT, LIQUID PROTECTION CLOTHING

ECONOMICAL . . . replaces expensive PVC and neoprene clothing on wet, messy jobs.

TOUGH POLYOLEFIN FABRIC . . . coated with polyethylene to repel liquids and resist snags, tears, punctures, abrasion, and chemicals.

COMFORTABLE . . . cool and lightweight—as much as 75% lighter than PVC garments.

OVERCAST STITCHING . . . provides extra seam strength.

GENEROUS SIZING . . . permits free, easy movement.

EASY LENGTH ADJUSTMENT . . . sleeve and pant leg lengths are easily shortened with scissors. Fabric won't ravel.

VINYL SNAPS . . . on jacket are chemical resistant—can't rust or corrode.

"Job-Fitted" for: Turnarounds • Tank cleaning • Replacing pipe • Washdowns • Steam cleaning • Maintenance • Weed spraying • Degreasing • Fiberglass layup

Available as a suit (jacket and elastic waist pants).

55-755: Sizes S, M, L, XL.

POLYETHYLENE

Polyethylene Disposable Apron

USDA ACCEPTED

LOW COST PROTECTION . . . for light-duty food processing, laboratory, and general clean up uses. Can be reused or worn once and thrown away.

ONE-PIECE DESIGN . . . eliminates folds, hems, and seams that can trap bacteria, dirt, or liquids.

LIQUIDPROOF . . . resists many chemicals, fats, grease, oils.

EMBOSSED FINISH . . . helps prevent heat build-up and static "cling."

COMPACT DISPENSER BOX . . . issues aprons one at a time. Keeps them handy at work station.

54-290: 100 per dispenser.

MONOTEX

"MONOTEX" 1-PIECE DESIGN
No folds, hem, or seams to trap bacteria, dirt, or liquids.

Monotex 7½-Mil Vinyl Aprons

TOUGH 7½-MIL VINYL . . . semiopaque virgin material (not reprocessed) for greatest flexibility and resistance to abrasion, oils, fats, chemicals, and punctures.

36" WIDE . . . provides wrap-around protection.

REVERSIBLE/LAUNDERABLE . . . for extended service.

"MONOTEX" STYLE . . . unique, 1-piece design* eliminates folds, hems, and seams which can trap bacteria.

Available in 2 colors and 3 lengths.

54-613: White, 36" length.
54-621: Blue, 40".
54-623: White, 40".
54-631: Blue, 45"
54-633: White, 45"

*Patent Nos. 3781916, 3815153

HEMMED EDGE

PLAIN EDGE

Regular Duty 7½-Mil Vinyl Aprons

STRONG . . . virgin material (not reprocessed) provides greatest flexibility and resistance to abrasion, oils, fats, chemicals, and punctures. Semiopaque.

NYLON NECK & WAIST TIES . . . extra long, and pre-attached for immediate use. Plastic tips prevent fraying. Chrome-plated steel grommets resist rusting.

HEMMED EDGE STYLES

Edges are hemmed with continuous-filament nylon thread. Available in 2 colors and 4 lengths for men and women.

54-421: Blue, 40".
54-431: Blue, 45".
54-433: White, 45".
54-441: Blue, 50".
54-443: White, 50".
54-451: Blue, 55".

PLAIN EDGE STYLES

Entire apron, including edges, is easily wiped clean. Available in 2 colors and 45" length.

54-531: Blue, 45".
54-533: White, 45".

Regular Duty
(Continued)

COAT/APRON Elasticized wrists give a snug fit. Ideal for extra wet, messy jobs such as poultry killing, metal degreasing, spraying, and finishing. Available in 3 sizes.
54-161: Blue, sizes S, M, and L.

TROUGH APRON Bottom edge folds up to catch liquid running down the front and channel it to the side for run-off. Trough is held in place with PVC snaps, and unfolds completely for easy cleaning. Extra long nylon ties cross over and tie in back to provide easy size adjustment and greater comfort.
54-573: White, 45".

SLEEVE/LEGGING Liquidproof seam is electronically sealed. Sewn-in elastic ties, with rust-resistant metal tips, permit size and tension adjustment at both ends. **54-103: White, 18" length.**

COAT/APRON HEAVY DUTY HEAVY DUTY WITH PANEL

Heavy Duty 20-Mil Vinyl Aprons

TOUGH, VIRGIN VINYL . . . for longer service and extra protection against oils, fats, chemicals, and punctures. 36" wide. Opaque.
ECONOMICAL . . . replace heavy neoprene and rubber aprons for food processing, plating, metal fabricating, and general clean-up.
PLAIN EDGES . . . eliminate bacteria and dirt traps. Entire apron is easily wiped clean.
NYLON NECK & WAIST TIES . . . extra long and pre-attached for immediate use. Plastic tips keep ends from fraying. Chrome plated steel grommets resist rust.

"Job-Fitted" for: Metal fabricating • Foundry work • Food processing.

54-733: White, 45".
54-742: Green, 50".

HEAVY DUTY with PANEL

Same as above except with a 24" x 17" panel, electronically welded at mid-section, to provide extended service. When worn thru, panel can be removed to expose new surface underneath.

54-932: Green, 45".
54-933: White, 45".

Reinforced Heavy Duty Apron
hycar coated

EXTRA TOUGH . . . heavy-duty fabric is coated on both sides to provide extended service. Wears up to 20% longer than neoprene on straight abrasion.
EXCELLENT PROTECTION . . . far superior to natural rubber and neoprene for protection against abrasion, cuts, snags, punctures, and animal fats.
STAYS FLEXIBLE . . . even when cold.
WIDE BIB . . . provides extra splash protection for upper chest.
COMFORTABLE NECK STRAP . . . is adjustable for proper fit. Buckle snaps on, and off for quick release.

"Job-Fitted" for: Meat packing and processing • Canning plants • Chemical plants • Fishing industry • Plating • Foundries • Metal fabricating • Battery reclamation • General clean-up.

54-365: White, 35" wide x 47" long.
54-367: Yellow

Wet-Wear 600

CLOTHING FOR WET WEATHER & CHEMICAL PROTECTION

MADE IN THE U.S.A. TO RIGID STANDARDS OF QUALITY!

1.

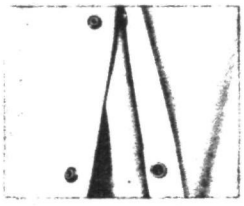
Lightweight Fabric
Comfortable yet tough. No stiff, restricted feeling. Made with nylon netting bonded between layers of vinyl. Won't let punctures tear and spread. Has excellent resistance to oil, caustics, alcohols, oxidation and mildew.

2.

Non-corrosive, Non-conductive Snaps
You get both safety and convenience with quick release and protection from electric shock. Snaps won't rust and can be opened even while wearing gloves.

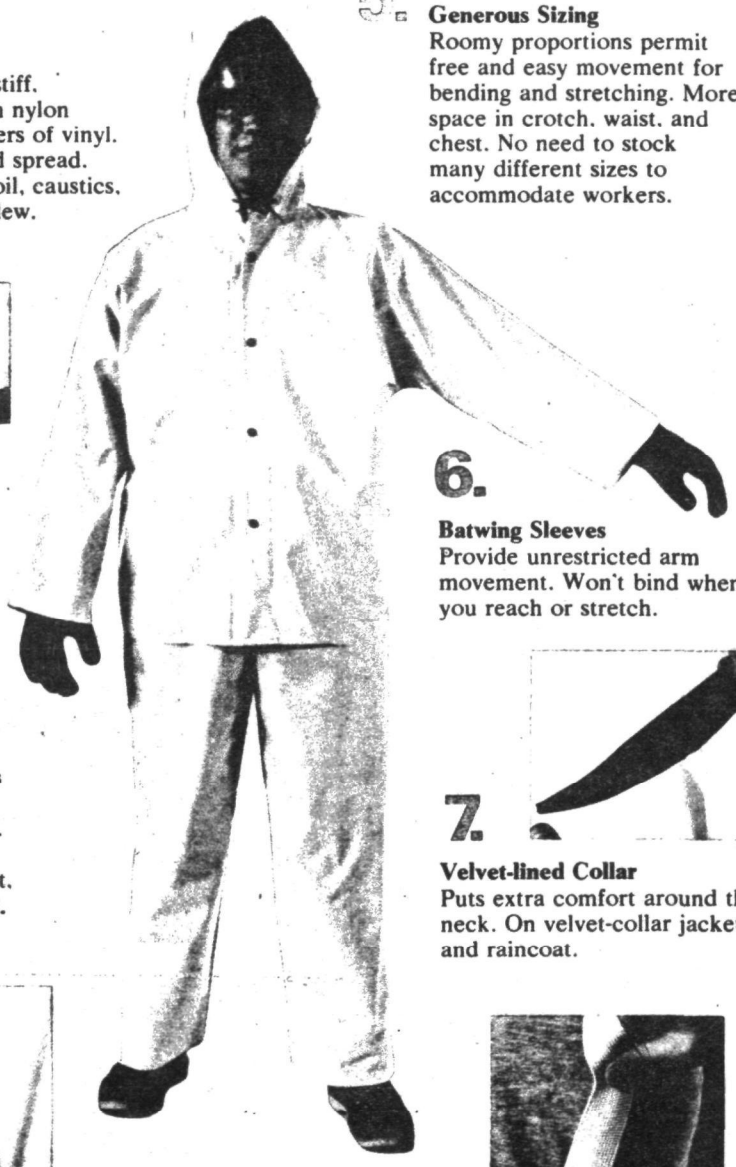
3.

Dielectrically Welded Seams
Weak and split seams are obsolete with Wet-Wear 600. Using the most advanced dielectric welding equipment, seams are uniformly bonded.



4.

Storm-fly Front
Helps keep rain and chemicals out. On hooded and velvet-collar jackets, and raincoat.

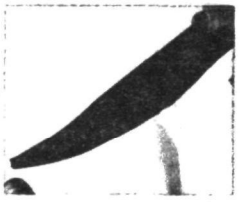


5.

Generous Sizing
Roomy proportions permit free and easy movement for bending and stretching. More space in crotch, waist, and chest. No need to stock many different sizes to accommodate workers.

6.

Batwing Sleeves
Provide unrestricted arm movement. Won't bind when you reach or stretch.

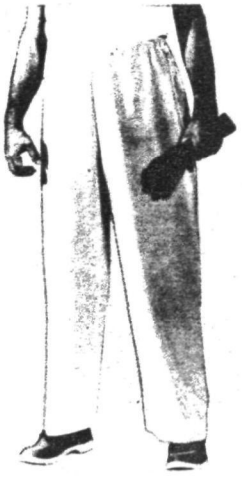


7.

Velvet-lined Collar
Puts extra comfort around the neck. On velvet-collar jacket, and raincoat.

8.

Elasticized Suspenders
"Give and take" with body movements to prevent binding and provide extra comfort. On overalls.



PANTS
Elasticized waistband gives extra comfort. Can be matched with any Wet-Wear 600 jacket to make a suit.

65-627: Sizes S, M, L, XL, XXL.

ECONOMY JACKET
Simple styling provides economical protection. Combine with the pants to make a basic suit.

65-620: Sizes S, M, L, XL, XXL.

(Continued on next page)

Comfort is the reason so many are choosing Wet-Wear 600

BIB OVERALLS
Elasticized suspenders with non-corrosive slides for length adjustment. Available with or without one-snap fly.
65-605: Sizes S, M, L, XL, XXL.
65-615: With fly front.

RAINCOAT
49" long. Velvet-lined, mandarin-style collar. Storm-fly front. Two patch pockets with flaps.
65-602: Sizes S, M, L, XL.

Extra-small size and accessories . . . available on special order

Ask your Wet-Wear 600 distributor for details and prices, or contact Edmont-Wilson 1300 Walnut Street, Coshocton, Ohio 43812. Phone: (614) 622-4311.

EXTRA-SMALL SIZE JACKET
Sized and tailored to fit women and men under 5'5" and 130 lbs. Has storm-fly front and velvet-lined collar.

EXTRA-SMALL SIZE OVERALLS
Sized and tailored to fit women and men under 5'5" and 130 lbs. Has elasticized suspenders with non-corrosive slides for length adjustment.

CONCEALED SNAP FASTENERS ON HOODED AND VELVET COLLAR JACKETS
Special cover flap on jacket front helps prevent fasteners from becoming entangled in fishing nets and other equipment. Available on all sizes.

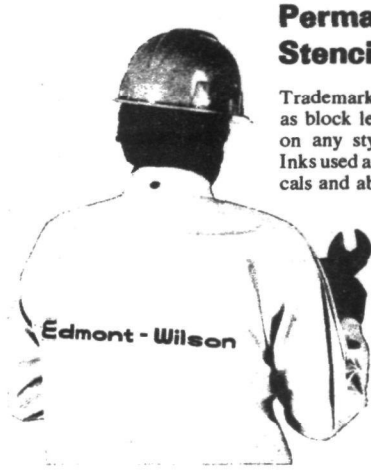
8" INNER SLEEVE ON HOODED JACKET
Doubles the liquid-protection for hand and forearm. Elastic at wrist provides a snug fit to help keep splash and spray out. Available on all sizes.

HOODED JACKET
Full sized hood, with nylon drawstring, is dielectrically welded to jacket. Storm-fly front.
65-600: Sizes S, M, L, XL, XXL.

VELVET COLLAR JACKET
Velvet-lined, mandarin style collar. Storm-fly front. Hood (shown at **left**) attaches with non-corrosive snaps.
65-610: Sizes S, M, L, XL, XXL.

Perma-Bond Stenciling

Trademarks and special designs, as well as block lettering can be silk-screened on any style Wet-Wear 600 garment. Inks used are formulated to resist chemicals and abrasion.



DETACHABLE HOOD
For velvet collar jacket. Attaches with non-corrosive snaps. Nylon drawstring. **65-611.**

SOU'WESTER HAT
Four piece crown with soft cotton lining, ear flaps, and chin ties. **65-609:** Sizes M & L.

Edmont-Wilson, Coshocton, OH 43812
Division of Becton, Dickinson and Company

Fireball, Grab-it, Grappler, Hycron, Hynit, JFA, Job-Fitted, Kanry-Tex, Knit-Rite, Monotex, Neox, Poly-D, Seams-Rite, Snorkel, STD, Tru-Touch, Tuf-Duk, Werx, Wet-Wear, Edmont, B-D are registered trade marks.

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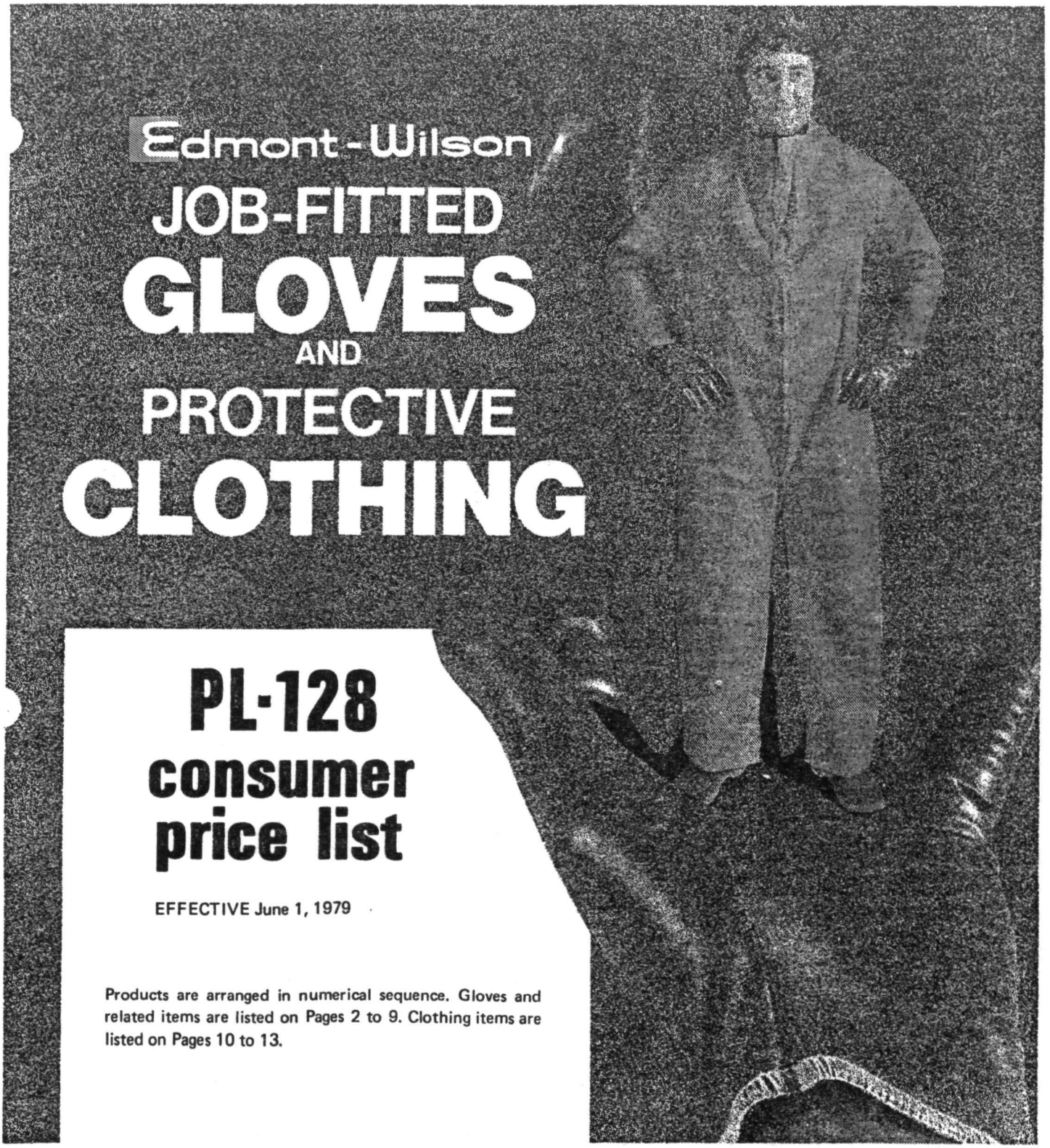
Edmont-Wilson

JOB-FITTED GLOVES AND PROTECTIVE CLOTHING



PL-128 consumer price list

EFFECTIVE June 1, 1979

Products are arranged in numerical sequence. Gloves and related items are listed on Pages 2 to 9. Clothing items are listed on Pages 10 to 13.

DISTRIBUTED BY

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/DZ. CASE LOT	DZ. CASE	LBS. CASE
			STD - SUPER FLEXIBLE VINYL IMPREGNATED			
1-114	01000	Men's M	Slip-on style	$ 16.50	12	19
	01001	Men's L				
	01002	Men's ExL				
1-116	01126	Women's S	Slip-on style	16.20	12	16
	01127	Women's M				
	01128	Women's L				
1-124	01241	Men's M	Slip-on style	17.00	12	19
	01242	Men's L				
	01243	Men's ExL				
1-126	01305	Women's S	Slip-on style	16.65	12	16
	01306	Women's M				
	01307	Women's L				
			MONKEY GRIP - STANDARD PVC LINE			
3-303	10090	Men's	Fully coated knitwrist	$ 19.40	6	34
3-312	10322	Men's	Fully coated 12" gauntlet	28.50	6	42
3-314	10464	Men's	Fully coated 14" gauntlet	30.75	6	50
3-318	10534	Men's	Fully coated 18" gauntlet	49.15	3	35
3-360	10744	Men's	Fully coated 10" gauntlet	22.75	6	38
			SNORKEL - FLEXIBLE PVC LINE - ROUGH FINISH			
4-404	10974	Men's	Fully coated knitwrist	$ 18.40	6	30
4-405	11064	Women's	Fully coated knitwrist	18.10	6	24
4-412	11134	Men's M	Fully coated 12" gauntlet	27.05	6	35
	11135	Men's L				
4-414	11229	Men's M	Fully coated 14" gauntlet	29.00	6	44
	11230	Men's L				
4-452	11431	Men's M	Knit lined fully coated 12" gauntlet	27.05	6	33
	11432	Men's L				
4-454	11504	Men's M	Knit lined fully coated 14" gauntlet	29.00	6	42
	11505	Men's L				
4-460	11577	Men's M	Fully coated 10" gauntlet	21.80	6	32
	11578	Men's L				
			GRAB-IT - RUBBER COATED FLOCK FINISH LINE			
6-600	02125	Men's	Palm coated knitwrist	$ 22.10	6	30
6-620	02385	Men's	Palm coated safety cuff	26.60	6	33
6-622	02475	Men's	Fully coated 12" gauntlet	33.45	6	48
6-660	02775	Men's	Fully coated knitwrist	23.40	6	36
6-662	02865	Men's	Fully coated 10" gauntlet	30.10	6	41
			SCORPIO - NEOPRENE COATED - KNIT LINED			
8-352	12450	S	Fully coated 12" gauntlet	$ 26.90	6	25
	12451	M				
	12452	L				
	12453	ExL		33.45	6	29

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/DZ. CASE LOT	DZ. CASE	LBS. CASE
			NEOX - NEOPRENE COATED - STANDARD LINE			
9-022	12340	Men's	HiLo 12" gauntlet	$ 77.95	6	55
9-430	12471	Men's	Fully coated 31" shoulder length	17.50 pr.	1	13
9-908	12812	Men's	Flexible weight fully coated knitwrist	23.70	6	31
9-909	12895	Men's	Standard weight fully coated knitwrist	26.10	6	33
9-912	12997	Men's	Flexible weight fully coated 12" gauntlet	32.80	6	34
9-920	13129	Men's	Standard weight fully coated 10" gauntlet	32.80	6	35
9-922	13200	Men's	Standard weight fully coated 12" gauntlet	36.65	6	40
9-924	13290	Men's	Standard weight fully coated 14" gauntlet	40.00	6	43
9-928	13321	Men's	Standard weight fully coated 18" gauntlet	63.70	3	28
			EVER-FLEX - SUPER FLEXIBLE PVC LINE			
13-102	13823	Men's	Fully coated knitwrist	$ 18.90	6	29
13-152	13963	Men's M	Fully coated 12" gauntlet	27.40	6	35
	13965	Men's L				
13-158	13997	Men's	Fully coated 18" gauntlet	48.65	3	38
13-402	14046	Men's	Fully coated knitwrist, fluorescent	20.20	6	29
13-452	14116	Men's	Fully coated, 12" gauntlet, fluorescent	29.00	6	37
			PVA - ORGANIC SOLVENT RESISTANT LINE			
15-552	14246	Men's	Fully coated 12" gauntlet	$ 97.95	6	26
15-554	14306	Men's	Fully coated 14" gauntlet	101.80	6	28
15-561	14366	Women's	Fully coated 12" gauntlet	97.65	6	22
			GOLDEN GRAB-IT - RUBBER COATED CRINKLE FINISH LINE			
16-300	03145	Men's	Palm coated knitwrist	$ 23.55	6	25
16-301	03215	Women's	Palm coated knitwrist	23.20	6	20
16-307	03285	Men's	Palm coated safety cuff	26.75	6	26
16-362	03355	Men's	Palm coated 12" gauntlet	32.20	6	32
			REDMONT - NEOPRENE COATED - HEAVY DUTY LINE			
19-930	14796	Men's	Fully coated 10" gauntlet	$ 37.00	6	40
19-932	14876	Men's	Fully coated 12" gauntlet	40.80	6	44
19-934	14956	Men's	Fully coated 14" gauntlet	45.30	6	46
19-938	15026	Men's	Fully coated 18" gauntlet	66.40	3	30
			SEAMS-RITE - SUPER COMFORT VINYL COATED			
20-102	03425	Men's M	Knitwrist style	$ 21.30	12	38
	03426	Men's L				
20-105	03549	Men's M	Slip-on style	18.10	12	36
	03550	Men's L				
20-106	03611	Women's M	Slip-on style	17.80	12	36
	03612	Women's L				
20-112	03673	Men's M	Reinforced knitwrist style	23.05	12	38
	03674	Men's L				
20-115	03724	Men's M	Reinforced slip-on style	20.20	12	38
	03725	Men's L				
20-116	03775	Women's M	Reinforced slip-on style	19.90	12	34
	03776	Women's L				

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/DZ. CASE LOT	DZ. CASE	LBS. CASE
			TUF-DUK · NON-SLIP VINYL IMPREGNATED			
21-704	04305	Men's M	Driver's	$ 32.35	8	28
	04306	Men's L				
21-707	04390	Men's M	Safety cuff	35.70	8	32
	04391	Men's L				
21-747	04609	Men's M	Palm style safety cuff	37.15	6	30
	04610	Men's L				
			KSR · VINYL COATED · KNIT LINED			
22-515	03938	Men's M	Slip-on style	$ 16.50	12	22
	03939	Men's L				
	03940	Men's ExL				
22-516	04000	Women's M	Slip-on style	16.20	12	19
	04001	Women's L				
			WINTER MONKEY GRIP · FOAM INSULATED			
23-152	04828	Men's	Fully coated 12" gauntlet	$ 53.45	3	27
23-189	04888	Men's	Fully coated one finger mitten	41.60	6	38
23-191	04968	Men's	Fully coated knitwrist	41.60	6	38
23-193	05059	Men's	Fully coated safety cuff	43.85	6	38
23-429	05199	Men's	Fully coated mitten, fluorescent	45.60	8	39
23-491	05309	Men's	Fully coated knitwrist, fluorescent	46.25	6	35
			GRAPPLER · HEAVY DUTY PVC LINE			
24-360	05379	Men's	Palm coated knitwrist	$ 23.20	6	30
24-362	05459	Men's	Palm coated safety cuff	28.00	6	35
24-363	05539	Men's	Fully coated 12" gauntlet	35.20	6	50
24-364	05619	Men's	Fully coated 14" gauntlet	37.80	6	48
24-366	05679	Men's	Fully coated knitwrist	24.00	6	36
			TAN RUBBER			
26-640	15266	7½	.015", 11", smooth, rolled	$ 14.90	6	10
	15267	8				
	15268	8½				
	15269	9				
	15270	9½		17.15	6	14
	15271	10				
	15272	11				
26-641	15340	7½	.015", 11", smooth, pinked	13.00	6	11
	15341	8				
	15342	8½				
	15343	9				
	15345	10		14.90	6	15
	15346	11				
26-645	15397	7½	.015", 11", sprayed, rolled	15.40	6	15
	15398	8				
	15399	8½				
	15400	9				
	15401	9½		17.60	6	16
	15402	10				

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/DZ. CASE LOT	DZ. CASE	LBS. CASE
			TAN RUBBER (Continued)			
26-646	15487	7	.015", 11", sprayed, pinked	$ 13.30	6	10
	15488	7½				
	15489	8				
	15490	8½				
	15491	9				
	15492	9½		15.40	6	14
	15493	10				
	15494	11				
26-665	15601	7	.018", 13", soft-lined, embossed, pinked	15.40	6	15
	15603	8				
	15605	9				
	15607	10		19.20	6	19
	15608	11				
26-670	15675	7½	.018", 11", smooth, rolled	17.60	6	13
	15676	8				
	15677	8½				
	15678	9				
	15679	9½		19.70	6	15
	15680	10				
	15681	11				
26-675	15807	8	.018", 11", sprayed, rolled	17.92	6	12
	15809	9				
	15811	10		20.20	6	16
	15812	11				
26-680	15938	8	.021", 11", smooth, rolled	18.40	6	14
	15940	9				
	15942	10		21.30	6	17
	15943	11				
26-685	15995	8	.021", 11", sprayed, rolled	18.75	6	13
	15997	9				
	15999	10		21.60	6	19
	16000	11				
			HYCRON · NBR COATED			
27-600	05809	Men's	Palm coated knitwrist	$ 23.20	6	21
27-601	05889	Women's	Palm coated knitwrist	23.05	6	18
27-602	05959	Men's	Fully coated knitwrist	23.70	6	24
27-603	06029	Women's	Fully coated knitwrist	23.40	6	20
27-607	06099	Men's	Palm coated safety cuff	27.52	6	22
			BLACK NEOPRENE			
29-840	16166	8	.015", 11", smooth, rolled	$ 16.80	6	13
	16168	9				
	16170	10		21.15	6	19
	16171	11				
29-845	16237	7	.017", 12", embossed, rolled	17.15	6	18
	16238	7½				
	16239	8				
	16240	8½				
	16241	9				
	16243	10		21.60	6	20
	16244	11				
29-865	16311	7	.018", 12", soft-lined, embossed, pinked	17.00	6	16
	16312	8				
	16313	9				
	16314	10		20.65	6	22
	16315	11				

* An additional charge will be added for less than case lot purchases.

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/UNIT CASE LOT	UNITS CASE	LBS. CASE
			BLACK NEOPRENE (Continued)			
29-870	16379	7	.018", 11", smooth, rolled	$ 20.20 Dz.	6	15
	16381	8				
	16383	9				
	16385	10		22.60	6	20
	16386	11				
29-875	16438	8	.018", 12", embossed, rolled	20.35	6	17
	16440	9				
	16442	10		23.05	6	24
	16443	11				
			WINTER TUF-DUK - FOAM INSULATED			
31-790	06279	Men'sM	Knitwrist	$ 51.20 Dz.	6	32
	06280	Men's L				
31-791	06353	Men's M	Driver's	51.20	6	32
	06354	Men's L				
			HYNIT - NBR IMPREGNATED			
32-105	08002	Men's M	Slip-on style	$ 22.10 Dz.	12	18
	08003	Men's L				
32-106	08000	Women's M	Slip-on style	21.80	12	14
	08001	Women's L				
32-125	08021	Men's M	Slip-on style, perforated	23.20	12	18
	08030	Men's L				
32-126	08025	Women's M	Slip-on style, perforated	22.90	12	14
	08028	Women's L				
			KNIT-RITE - VINYL COATED - BREATHABLE			
33-105	09000	Men's M	Slip-on style	$ 14.75 Dz.	12	30
	09005	Men's L				
33-106	09008	Women's M	Slip-on style	14.40	12	30
	09010	Women's L				
			TRU-TOUCH PVC LINE			
34-100	25000	S	.0065", 100 gloves per dispenser	$ 10.55 Disp.	4	14
	25001	M				
	25002	L				
	25003	ExL				
34-300	25053	S	.0065", 300 gloves (bulk pack)	30.30	1	12
	25054	M				
	25055	L				
	25056	ExL				
34-550	25163	S	.005", 50 gloves per dispenser	4.35	20	24
	25164	M				
	25165	L				
	25166	ExL				
34-600	25167	S	.004", 100 gloves per dispenser	7.15	10	17
	25168	M				
	25169	L				

* An additional charge will be added for less than case lot purchases.

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/UNIT CASE LOT	UNITS CASE	LBS. CASE
			POLY-D POLYETHYLENE LINE			
35-112	25267	S	.00125", 100 gloves per dispenser box	$ 1.85 Disp.	10	9
	25268	M	(no paper)			
	25268	L				
35-119	25277	S	.00125", 1000 gloves per case	16.25 Case	1	9
	25278	M	(no paper)			
	25279	L				
35-122	25284	S	.00125", 100 gloves per roll	2.65 Roll	10	10
	25285	M				
	25286	L				
35-124	25631	L	.00125", 50 gloves per disp. - 22" long	4.10 Disp.	10	14
35-125	25316	S	.00125", 100 gloves per dispenser box	2.35 Disp.	10	11
	25317	M				
	25318	L				
35-126	25368	S	.00125", 1000 gloves per dispenser box	20.95 Disp.	1	10
	25369	M				
	25370	L				
35-129	25420	S	.00125", 1000 gloves per roll	19.60 Roll	1	10
	25421	M				
	25422	L				
35-137	25472	L	.00175", 25 gloves per roll - 32" long	3.15 Roll	10	11
35-152	25227	S	.00175", 100 gloves per roll	3.00 Roll	10	14
	25228	M				
	25229	L				
35-159	25241	S	.00175", 1000 gloves per roll	24.00 Roll	1	11
	25242	M				
	25243	L				
35-300	25572	S	.00175", 50 Boots per roll	2.75 Roll	10	16
	25573	M				
	25574	L				
35-350	25624	S	.003", 50 boots per roll	4.00 Roll	10	20
	25625	M				
	25626	L				
			"LONG SERVICE" RUBBER			
36-124	16625	7	.018", 12", natural, embossed, pinked	$ 10.25 Dz.	6	13
	16626	7½				
	16627	8				
	16628	8½				
	16629	9				
	16630	9½		12.35	6	17
	16631	10				
	16632	11				
36-555	16776	7½	.016-022", 11", natural, sprayed, pinked	15.85	6	13
	16777	8				
	16779	9				
	16781	10		17.80	6	16
36-755	16832	10	.040", 14", amber, embossed, pinked	42.40	1	8
	16834	11				

* An additional charge will be added for less than case lot purchases.

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/UNIT CASE LOT	UNITS CASE	LBS. CASE
			SOL-VEX · NBR LINE			
37-145	17073	7	.011", 12", embossed, pinked	$ 15.85 Dz.	6	11
	17074	8				
	17075	9				
	17076	10		20.65	6	13
	17077	11				
37-155	17141	7	.015", 12", embossed, pinked	19.85	6	12
	17142	8				
	17143	9				
	17144	10		21.80	6	17
	17145	11				
37-165	17209	9	.022", 14", embossed, pinked	44.35	6	31
	17210	10				
	17211	11				
37-175	17273	7	.015", 12", soft-lined, embossed, pinked	17.45	6	12
	17274	8				
	17275	9				
	17276	10		21.80	6	15
	17277	11				
37-185	17300	9	.022", 18", embossed, pinked	60.35	1	6
	17301	10				
	17302	11				
			WERX-LITE · VINYL IMPREGNATED			
41-141	06487	Men's M	Slip-on style	$ 13.80 Dz.	12	17
	06488	Men's L				
41-171	06599	Women's M	Slip-on style	13.45	12	14
			FINGER COTS · RUBBER			
45-060	65001	1	.0035", 2¾", white, 1 gross per box	$ 2.40 Gross	100	23
	65002	2				
	65003	3				
45-600	65214	1	.0035", 2¾", white, 10 gross per bag	2.00	100	18
	65215	2				
	65216	3				
45-610	65267	1	.0035", 2¾", white, 10 gross per bag	2.15	100	16
	65268	2	(Powderless)			
	65269	3				
45-070	65053	1	.007-013", 2¾", white 1 gross per box	5.60	24	17
	65054	2				
	65055	3				
45-770	65374	1	.012-016", 2¾", white 1 gross per box	15.05	6	6
	65375	2				
	65376	3				
	65377	4				

* An additional charge will be added for less than case lot purchases.

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/UNIT CASE LOT	UNITS CASE	LBS. CASE
			PREMIUM · WHITE RUBBER			
•46-320	25923	6½	.009", 11½", smooth, rolled	$ 12.35 Dz.	6	8
	25924	7				
	25925	7½				
	25926	8				
	25927	8½				
	25928	9				
	25929	9½		14.10	6	9
	25930	10				
46-321	25981	6½	.009", 11½", sprayed, rolled	13.15	6	7
	25982	7				
	25983	7½				
	25984	8				
	25985	8½				
	25986	9				
	25987	9½		14.72	6	8
46-322	26039	7	.017", 11", smooth, pinked	13.00	6	10
	26040	7½				
	26041	8				
	26042	8½				
	26043	9				
	26045	10		15.55	6	14
46-323	26097	7	.017", 11", sprayed, pinked	13.75	6	10
	26098	7½				
	26099	8				
	26100	8½				
	26101	9				
	26103	10		16.35	6	14
46-710	26281	6½	.0075", 11½", disposable, smooth,	10.40	12 (bulk)	11
	26282	7	flat cuff			
	26283	7½				
	26284	8				
	26286	9				
			WERX · VINYL IMPREGNATED			
51-101	06659	Women's M	Slip-on style	$ 15.70 Dz.	12	23
	06660	Women's L				
51-103	06783	Women's M	Perforated back slip-on style	17.00	12	23
	06784	Women's L				
51-151	06897	Men's M	Slip-on style	16.00	12	28
	06898	Men's L				
51-152	06959	Men's M	Knitwrist style	17.00	12	30
	06960	Men's L				
51-153	07021	Men's M	Perforated back slip-on style	17.30	12	27
	07022	Men's L				
			HANDLES and BLADES			
92-450	65477		Handle, plastic	$ 4.35 each		3 oz.
92-660	65577		Blades, 2-7/8" length (150 per box)	70.10 box		2 lbs.

SINGLE HAND GLOVES ONLY – Add 10%, minimum order is 144 gloves.
Specify quantity by total number of gloves instead of dozens.

LESS THAN CASE LOTS – * An additional charge will be added for less than case lot purchases.

APRONS

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* NET/UNIT CASE LOT	UNITS CASE	LBS. CASE
			SLEEVE / LEGGING - COAT / APRON			
54-103	72010	18"	.0075", sleve/legging, white	$ 18.00 Dz. Pr.	4	16
54-161	72030	S	.0075", coat/apron, blue	86.70 Dz.	2	38
	72031	M				
	72032	L				
			POLYETHYLENE "200" LINE - Dispenser Pack			
54-290	72155	Med.	28"x45", embossed, 100/dispenser	$ 15.35 Disp.	6	45
			REINFORCED HEAVY DUTY - HYCAR COATED			
54-365	72260	47"	.023", white, 35"x47"	$ 89.10 Dz.	1	20
54-367	72261	47"	.023", yellow, 35"x47"	89.10	1	20
			REGULAR DUTY - HEMMED EDGE			
54 421	72305	40"	.0075", blue	$ 20.75 Dz.	6	36
54-431	72310	45"	.0075", blue	21.30	6	40
54-433	72340	45"	.0075", white	21.30	6	40
54-441	72315	50"	.0075", blue	22.60	6	44
54-443	72345	50"	.0075", white	22.60	6	44
54-451	72320	55"	.0075", blue	23.95	6	47
			REGULAR DUTY - PLAIN EDGE			
54-531	72410	45"	.0075", blue	$ 19.30 Dz.	6	40
54-533	72440	45"	.0075", white	19.30	6	40
54-573	72470	45"	.0075", trough, white	21.35	6	43
			MONOTEX LINE - NARROW SHOULDER PANELS			
54-613	72530	36"	.0075", white	$ 13.10 Dz.	6	37
54-621	72505	40"	.0075", blue	13.90	6	40
54-631	72510	45"	.0075", blue	14.80	6	42
54-633	72540	45"	.0075", white	14.80	6	42
			PREMIUM LINE - HEAVY DUTY			
54-733	72640	45"	.0200", white	$ 36.00 Dz.	1	17
54-742	72615	50"	.0200", green	28.95	1	19
			PREMIUM LINE - WITH PANEL			
54-932	72810	45"	.0200", green	$ 44.20 Dz.	1	22
54-933	72840	45"	.0200", white	44.20	1	22

* An additional charge will be added for less than case lot purchases.

JFA APPAREL

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	PER DISPENSER PRICE 1-9 Disp.	PRICE 10 Plus Disp.	QUANTITY Per Disp.	LBS.
			WHITE / BLUE TRIM				
55-130	75060	S	Shirt, splash resistant	$ 36.50	$ 34.75	25	5
	75061	M					
	75062	L					
	75063	XL		40.00	38.00	25	5
55-230	75160	S	Pants, splash resistant	36.25	34.50	25	5
	75161	M					
	75162	L					
	75163	XL		39.75	37.75	25	5
55-430	75390	S	Lab Coat, splash resistant	46.50	44.25	25	7
	75391	M					
	75392	L					
	75393	XL		51.50	49.00	25	7
55-440	75400	S	Lab Coat, air conditioned	49.25	46.75	25	7
	75401	M					
	75402	L					
	75403	XL		54.00	51.25	25	7
			ECONOMY WHITE / BLUE TRIM				
55-530	75472	S	Coverall, splash resistant	$ 69.75	$ 66.50	25	9
	75473	M					
	75474	L					
	75475	XL		76.75	73.00	25	9
55-540	75487	S	Coverall, air conditioned	72.00	68.50	25	9
	75488	M					
	75489	L					
	75490	XL		79.25	75.50	25	9
			HEAVY DUTY / BLUE				
55-415	75335	S	Shop coat, splash resistant	$ 52.25	$ 49.75	25	8
	75336	M					
	75337	L					
	75338	XL		57.50	54.75	25	8
55-510	75420	S	Coverall, splash resistant	76.25	72.50	25	9
	75421	M					
	75422	L					
	75423	XL		84.00	80.00	25	9
55-520	75428	S	Coverall, air conditioned	79.75	75.75	25	9
	75429	M					
	75430	L					
	75431	XL		87.75	83.50	25	9
			"EXTRA SERVICE" / GOLD				
55-755	75534	S	Utility suit	$ 55.75	$ 53.00	10	8
	75535	M					
	75536	L					
	75537	XL		61.25	58.25	10	8
			ACCESSORIES				
55-908	75822	ONE SIZE	Hood, splash resistant	$ 12.25	$ 11.75	25	1
55-909	75823		Wrist closure, elastic	8.80	8.40	25 pr.	1

WET-WEAR

GENERAL DUTY WET-WEAR · 600

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	* PRICE EACH	QUANTITY PER CASE	LBS. CASE
65-600	73200	S	Jacket, hooded style, storm flap, yellow	$ 12.80 Garment	5	10
	73201	M				
	73202	L				
	73203	XL		13.75	5	10
	73204	XXL				
65-602	73205	S	Raincoat, yellow	15.10	5	12
	73206	M				
	73207	L				
	73208	XL		16.20	5	12
65-605	73209	XS	Bib Overalls, yellow	10.75	5	9
	73210	S				
	73211	M				
	73212	L				
	73213	XL		11.75	5	9
	73214	XXL				
65-609	73215	M	Sou'wester hat, (lined)	4.20	5	2
	73216	L				
65-610	73238	XS	Jacket, velvet collar, yellow	11.55	5	9
	73217	S				
	73218	M				
	73219	L				
	73220	XL		12.60	5	9
	73221	XXL				
65-611	73222	ONE SIZE	Hood, yellow	2.75	5	2
65-615	73223	S	Bib overall, fly front, yellow	11.80	5	9
	73224	M				
	73225	L				
	73226	XL		12.95	5	9
	73227	XXL				
65-620	73228	S	Jacket, yellow	8.95	5	9
	73229	M				
	73230	L				
	73231	XL		9.50	5	9
	73232	XXL				
65-627	73233	S	Pants, elastized waist, yellow	8.30	5	8
	73234	M				
	73235	L				
	73236	XL		8.90	5	8
	73237	XXL				

* An additional charge will be added for breaking cases

ALL WEATHER WET-WEAR · 700

STYLE NO.	STOCK NO.	SIZE	DESCRIPTION	PRICE EACH	QUANTITY PER CASE	LBS CASE
65-700	73300	S	Jacket, Hooded style with Fly Front	$ 15.15 Garment	5	9
	73301	M				
	73302	L				
	73303	XL		16.70	5	9
65-705	73304	S	Bib Overall, No Fly Front	13.20	5	8
	73305	M				
	73306	L				
	73307	XL		14.55	5	8
65-710	73440	S	Jacket, Velvet Collar with Snaps for Detachable Hood	13.45	5	9
	73441	M				
	73442	L				
	73443	XL		14.80	5	9
65-711	73444	ONE	Hood, for above Jacket	3.15	5	2
65-715	73436	S	Bib Overalls, Fly Front	14.20	5	8
	73437	M				
	73438	L				
	73439	XL		15.65	5	8

Requests for W-W "700" special items not listed above will be handled on an individual quotation basis. The quotation will outline description, price and delivery.

Job-Fitted Personal Safety and Protection

Edmont - Wilson

DIVISION OF BECTON, DICKINSON AND COMPANY B·D

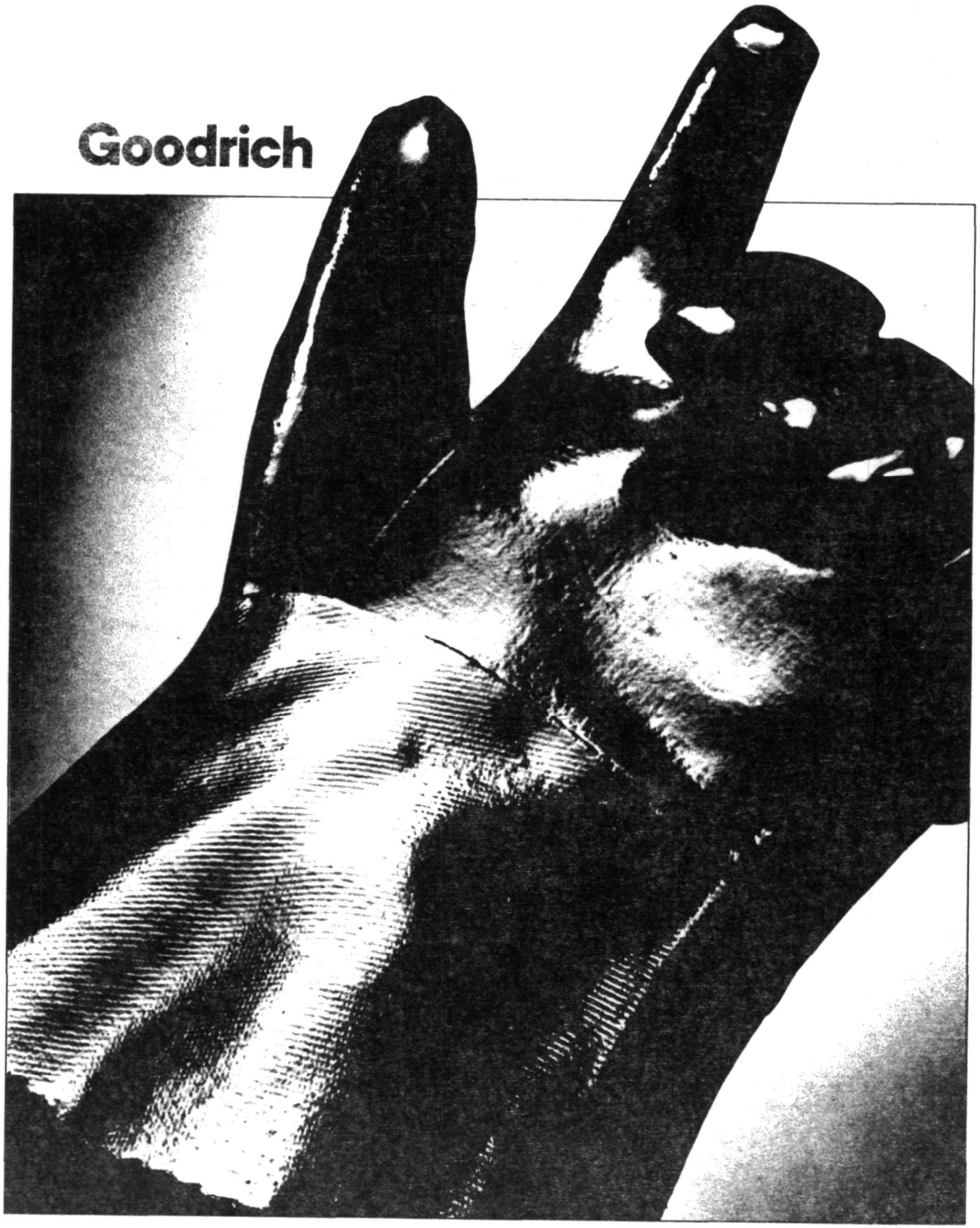
COSHOCTON, OHIO 43812

SUPERCEDES ALL PREVIOUS PRICE LISTS AND QUOTATIONS ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE

STD, Werx, Seams-Rite, Tuf-Duk, Hycron, Grab-it, Grappler, Edmont Fireball, Kanry-Tex, Snorkel, Neox, Tru-Touch, Poly-D, JFA, Wet-Wear, Monotex, Job-Fitted, Hynit, Edmont and B-D are registered trademarks of Becton, Dickinson and Company

Industrial Gloves

Goodrich



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Design Details

Tensile strength

High quality and dependability are maintained through modern technical equipment and experience. Special instruments test the tensile strength and stretchability of the latex-coated gloves. This assures the utmost in flexibility, long wear, dependability and economy.

Careful inspection

Famous for high manufacturing standards and workmanship. These standards have been maintained not only through continuous research, but through frequent and careful inspections during production. They also undergo rigid inspection when completed.

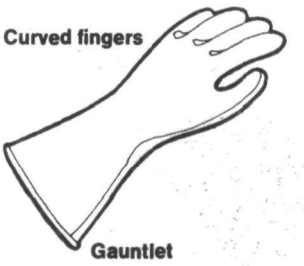
Natural latex—Neoprene

Natural rubber gloves are made by a special process that assures uniform gauge, high tensile strength and excellent resistance to tearing and snagging. They will withstand the action of most acids except the strong oxidizing acids. Not recommended for use with oil or grease. Neoprene gloves have high resistance to acids, alkalies, oil and grease, long aging qualities, good flexibility, high tensile strength.

Reinforced thumb crotch

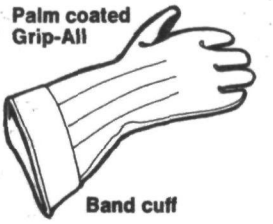
Reinforced cuff band

Curved fingers



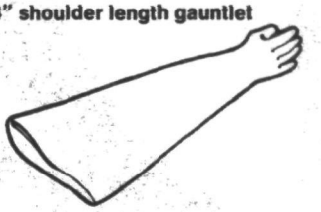
Gauntlet

Palm coated Grip-All



Band cuff

34" shoulder length gauntlet



Knit wrist

BFGoodrich chemical comparison chart

chemical	Neo-prene	Natural Rubber or Latex	Nitrile (Buna – N)	PVC
A – Acetaldehyde	F	G	F	G
Acetate	G	F	G	P
Acetic Acid	E	E	E	E
Acetone	G	E	F	F
Acetylene Gas	E	E	E	G
Acetylene Tetrachloride	F	NR	G	P
Acrylonitrile	G	F	F	F
Amidol	G	E	G	E
Amine Hardeners	F	F	G	F
Ammonium Hydroxide	E	E	E	E
Amyl Acetate	F	P	F	P
Amyl Alcohol	E	E	E	G
Anhydrous Ammonia	G	E	G	E
Aniline	G	F	G	G
Aniline Hydrochloride	F	P	F	F
Aniline Oil	F	P	F	G
Animal Fats	E	P	E	G
Animal Oils	E	F	E	G
Anodex	G	E	G	E
Anthracene	F	P	G	F
Aromatic Fuels	P	NR	G	F
B – Banana Oil	F	P	G	F
Benzaldehyde	F	F	G	F
Benzene	P	NR	G	F
Benzyl Alcohol	E	E	E	G
Benzyl Benzoate	G	F	G	F
Benzyl Chloride	F	P	G	G
Blacosolve	G	P	G	F
Butane	E	F	E	P
Butyl Acetate	G	F	F	P
Butyl Alcohol	E	E	E	G
Butylaidehyde	G	G	G	G
Butylene	E	G	E	F
C – Calcium Hydroxide	E	E	E	E
Carbolic Acid	E	E	E	G
Carbon Dioxide	E	E	E	E
Carbon Disulphide	F	F	G	F
Carbon Tetrachloride	F	P	G	F
Castor Oil	F	P	E	G
Cello-Solve	F	G	P	F
Cello-Solve Acetate	G	F	G	F
Chlorophenylene Diamine	G	P	F	F
Chlorine	G	F	G	F
Chlorine Gas	G	F	G	F
Chloro Benzene	F	P	P	P
Chloroacetone	E	E	F	F
Chloroform	G	P	G	P
Chloronaphithalene	F	P	F	F
Chloropicrin	P	P	P	G
Chlorothene	P	NR	F	P
Chromic Acid	F	P	F	G
Chromotex	G	G	G	G
Citric Acid	E	E	E	E
Cotton Seed Oil	G	P	E	G
Creosote	G	G	G	G
Cresol	G	G	G	G
Cupric Nitrate	G	G	G	G
Cyclohexane	G	F	G	F
Cyclohexanol	G	F	G	F
Cyclohexanone	G	E	G	F
D – Decaborane	F	P	F	P
Degreasing Fluids	F	P	G	P
Diacetone Alcohol	E	E	E	P
Diethyltiamine	G	F	E	F
Di-Isocyanate	G	P	F	F
Diborane	F	P	F	P
Dibenzyl Ether	G	G	G	F
Dibutyl Phthalate	G	P	G	P
Dichlorethane	P	NR	F	P
Dichloroporopene	P	P	G	F
Diesel Fuel	G	P	G	F
Diethanolamine	E	G	E	E
Diethylamine	E	G	E	F
Diisobutyl Ketone	P	F	P	P
Dimethyl Formamide	F	F	P	G
Dioctyl Phthalate	G	P	G	P
Diosane	E	G	G	P
E – Emulsifying Agent	G	F	G	F
Emulthogene	G	F	G	F
Epichloro	G	P	P	F
Epoxy Resins, Dry	E	E	E	E
Esters	F	P	F	P
Ethane Gas	E	G	E	G
Ethanol	E	E	G	G
Ethers	E	G	E	P
Ethyl Acetate	G	F	F	P
Ethyl Alcohol	E	E	G	G
Ethyl Ether	E	G	E	P
Ethyl Formate	G	F	G	P
Ethylaniline	F	F	F	P
Ethylenediamine	E	G	E	F
Ethylene Dichloride	F	P	F	P
Ethylene Gas	E	G	E	G
Ethylene Glycol	E	E	E	G
Ethylene Trichloride	F	P	G	P
F – Fatty Acids	E	P	E	G
Ferrocyanide	F	G	F	F
Fluoric Acid	E	G	E	F
Fluorine	G	F	G	F
Fluorine Gas	G	F	G	F
Formaldehyde	E	E	E	F
Formic Acid	E	E	E	E
Freon 11	G	P	F	F
Freon 12	G	P	F	F
Freon 21	G	P	F	F
Freon 22	G	P	F	F
Furfural	G	G	F	F
G – Gasoline, Leaded	G	P	G	F
Gasoline, Unleaded	F	P	E	F
Glycerine	E	E	E	E
Glycerol	E	E	E	E
Glycol	E	E	E	E
Gold Fluoride	G	E	G	E
Grain Alcohol	E	E	G	G
H – Halogens	G	F	G	F
Hexamethylene Tetramine	F	G	F	G
Hexane	F	P	E	F
Hexyl Acetate	F	P	F	F
Hydraulic Oil				
Petroleum Base	G	P	E	F
Ester Base	E	P	G	P
Hydrazine	F	G	G	E
Hydrochloric Acid	E	E	G	G
Hydrofluoric Acid	E	E	G	F
Hydrogen Gas	E	E	E	G
Hydrogen Peroxide – 30%	G	G	G	F
Hydro-Quinone	G	G	G	F
Hydrafluosilic Acid	F	F	G	F
I – Inorganic Salts	E	E	E	G
Iso-octane	F	G	P	P
Isopropanol	E	E	E	G
Isopropyl Alcohol	E	E	E	G
K – Kerosene	E	E	F	F
Ketones	G	F	E	F
L – Lacquer Thinners	G	G	F	F
Lactic Acid	E	E	E	G
Lauric Acid	E	E	F	G
Lineoleic Acid	E	E	P	G
Linseed Oil	E	E	P	F
M – Maleic Acid	E	E	E	G
Mercuric Chloride	G	G	E	F
Mercury	G	P	G	F
Methane Gas	E	E	E	G
Methanol	E	G	E	G
Methyl Acetate	G	G	F	P
Methyl Alcohol	E	G	E	G
Methylamine	F	G	F	F
Methyl Bromide	G	G	F	P
Methyl Cellosolve	G	E	G	P
Methyl Chloride	G	G	G	P
Methyl Ethyl Ketone	G	F	G	NR
Methyl Formate	G	F	F	F
Methylene Bromide	G	G	G	P
Methylene Chloride	G	G	F	P
Methyl Isobutyl Ketone	G	F	G	NR
Methyl Methacylate	G	G	G	F
Mineral Oils	E	E	F	G
Monochlorbenzene	F	P	P	P
Monoethanolamine	E	E	G	G
Morpholine	E	E	E	G
Muriatic Acid	E	E	G	G
N – Naphthalene	G	F	G	G
Naphthas, Aliphatic	E	F	E	P
Naphthas Aromatic	G	P	G	P
Nitric Acid	G	F	F	F
Nitric Acid, Red & White Fuming	P	P	P	P
Nitrobenzene	F	P	F	P
Nitroethane	F	P	F	P
Nitrogen Gas	E	E	E	G
Nitromethane	F	P	F	P
Nitropropane	F	P	F	P
Nitrous Oxide	G	G	G	F
O – Octyl Alcohol	E	E	E	F
Oleic Acid	E	F	E	F
Oxalic Acid	E	E	E	G
Oxygen Liquid	F	P	F	P
P – Paint Thinners	G	F	G	F
Paint and Varnish Removers	G	F	G	P
Palmitic Acid	E	E	E	G
Paradichlorobenzene	E	F	G	E
Parathione	P	F	F	P
Penta Borane	F	P	F	P
Pentachloraphenol	F	G	F	F
Pentane	E	G	E	P
Perchloric Acid	E	F	F	P
Perchlorethylene	F	NR	E	NR
Permachlor	E	F	E	NR
Petroleum Spirits	E	F	E	P
Phenol	E	F	G	G
Phenylene Diamine	G	P	F	P
Phenyl Hydrazine	G	G	G	F
Phil-solv	E	F	E	F
Phosphoric Acid	E	G	E	G
Pickling Solution	G	G	G	G
Picric Acid	E	G	E	F
Pine Oil	E	P	E	G
Pitch	E	P	E	F
Plating Solutions	E	E	E	E
Potassium Alum	G	G	G	E
Potassium Bromide	G	G	G	E
Potassium Chrome Alum	G	G	G	G
Potassium Dichromate	F	F	F	G
Potassium Ferrocyanide	G	G	G	G
Potassium Hydroxide	E	E	E	G
Printing Inks	E	G	E	F
Propane Gas	E	E	E	G
Propanol-iso	E	E	E	G
Propyl Acetate	G	F	G	F
Propyl Alcohol	E	E	E	G
Propyl Alcohol Iso	E	E	E	G
Propylene Gas	E	F	E	G
Propyne Gas	E	F	E	G
R – Red Fuming Nitric Acid	P	P	P	P
S – Silver Nitrate	E	G	G	F
Skydrol 500	P	G	P	P
Sodium Carbonate Metol	G	G	G	G
Sodium Hydroxide	E	E	E	G
Sodium Sulphite	G	G	G	G
Sodium Thiosulphide	G	G	G	F
Solvarsol	E	F	E	F
Solvessos	P	P	E	P
Stearic Acid	E	E	E	G
Stoddards Solvent	E	F	E	F
Styrene	P	P	F	P
Styrene 100%	P	P	F	P
Sulphuric Acid	G	G	G	F
T – Tannic Acid	E	E	E	E
Tetra Hydro Borane	F	P	F	P
Tetraethyl Lead	E	F	E	P
Tetrahydrofuran	P	F	P	F
Toluene Di-isocyanate	F	G	F	P
Toluol	F	P	E	P
Trichlor	F	P	G	P
Trichlorethylene	F	P	G	P
Trichloroethane	P	P	F	P
Tricresyl Phosphate	G	F	F	NR
Tridecyl Alcohol	G	F	E	F
Triethanolamine	E	G	E	G
Trinitrotoluene	G	P	E	G
Trinitrotoluol	G	P	E	G
Triptane	E	P	E	P
Tung Oil	E	P	E	F
Turco No 2998	P	P	P	P
Turpentine	G	F	E	G
U – Unsymmetrical Dimethyl Hydrazine	F	P	G	P
V – Varnoline Gas	E	F	E	F
Varsol	G	F	G	F
Vegetable Oils	E	G	E	G
W – Wood Alcohol	E	E	G	G
Wood Preservatives	G	F	G	F
Woodyouth	F	P	E	P
X – Xylene	P	P	E	P
Xylidene	E	F	E	P
Z – Zinc Chloride	E	E	E	F

PHYSICAL CHARACTERISTICS

Tensile Strength	E	E	E	F
Elongation	E	E	F	F
Tear Resistance	G	G	F	F
Abrasion Resistance	G	G	E	G
Heat Resistance	E	F	G	P
Ozone Resistance	E	G	G	E
Sunlight Aging	E	F	G	F
Shelf Life Aging	E	E	E	F

KEY:

E – Excellent G – Good F – Fair P – Poor
NR – Not Recommended

This comparison chart shows the relative resistance ratings of various glove materials to solvents commonly used in industry. We recommend rotation of gloves in service according to prevailing conditions. If excessive swelling occurs change to another pair allowing swollen gloves to dry.

In general gloves should be cleaned immediatter use particularly when using acids or other chemicals. This information is based on room temperature. Increases in room temperature should be watched as to its effect on gloves. Proper care will insure longer life.

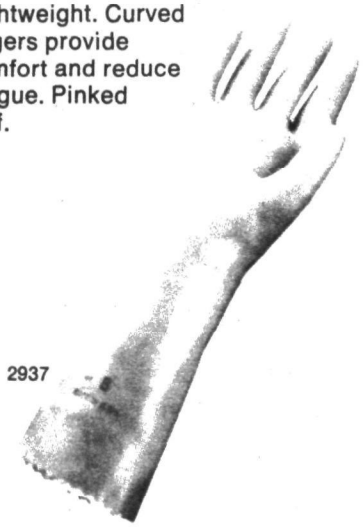
lightweight natural latex

Each of these gloves has an embossed design on the palm and fingers to insure a comfortable, firm, easy grip. And all these gloves are U.S.D.A. approved, and meet OSHA standards.

2937

Gauge	Sizes	Length	Color
Light (.015)	7-9½, 10, 11	12"	Amber

Lightweight. Curved fingers provide comfort and reduce fatigue. Pinked cuff.



2937

2938

Gauge	Sizes	Length	Color
Light (.018)	7-9½, 10, 11	12"	Natural

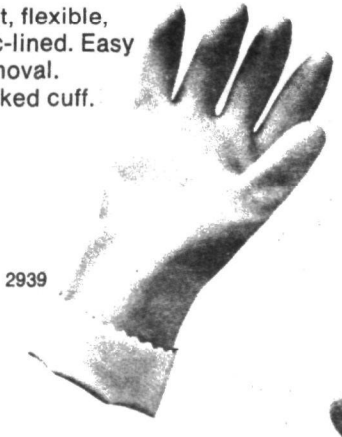
Maximum resistance to tear and puncture. Pinked cuff.

2938

2939

Gauge	Sizes	Length	Color
Light (.018)	7-9½, 10, 11	12"	Gold

Soft, flexible, floc-lined. Easy removal. Pinked cuff.



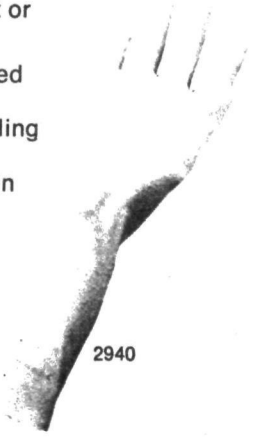
2939

2940
litentuf glove

Gauge	Sizes	Length	Color
(.015)	7-9½, 10, 11	12"	Natural

Combining dexterity and sensitivity with an excellent wet or dry grip.

Recommended for use in liquids, handling glass or ceramics, or in food processing.



2940

BFGoodrich lightweight industrial gloves

lightweight neoprene gloves

2941

flexiprene glove

Gauge	Sizes	Length	Color
Light (.015)	7, 8, 9, 10, 11	11"	Black

Combining the resistance of neoprene with the sensitivity of latex by utilizing natural latex on the inside and neoprene on the outside. Grip design palm.

Recommended for work requiring resistance to oils, acids, alcohols and solvents. Also has many applications in food processing.

lightweight nitrile (nbr) gloves

2942

nitrile (nbr) gloves

Gauge	Sizes	Length	Color
2942 Light (.015)	7, 8, 9, 10, 11	11"	Ivory

Resists abrasion, puncture and chemicals better than any other glove. Nitrile gloves are especially suitable for use in chlorinated solvents. They are also well suited for use in the food processing industry. Grip design palm.

powdered PVC disposable gloves

3000

Gauge	Sizes	Length	Color
.005	S, M, L, X-L	10"	Sheer

U.S.D.A. approved. Sheer, seamless, extra-sensitive construction. Excellent for food handling, meat packing and clean room environments. Applicable for the electronic, pharmaceutical and printing industries.

natural latex

The gloves on this page are made by a special process that assures uniform gauge, high tensile strength and excellent resistance to tearing and snagging. BFGoodrich rubber gloves will withstand the action of most acids except the strong oxidizing acids. Not recommended for use with oil or grease.

2921

Gauge	Sizes	Length	Color
Medium (.045)	9, 10, 11	14"	Black

Curved fingers. Molded non-slip palm and fingers. Recommended for heavy industrial use.

2921

2911

Gauge	Sizes	Length	Color
Extra Heavy (.055)	9, 10, 11	14"	Black

Smooth finish. Curved fingers. Recommended for heavy industrial use. Excellent for sandblasting.

2911

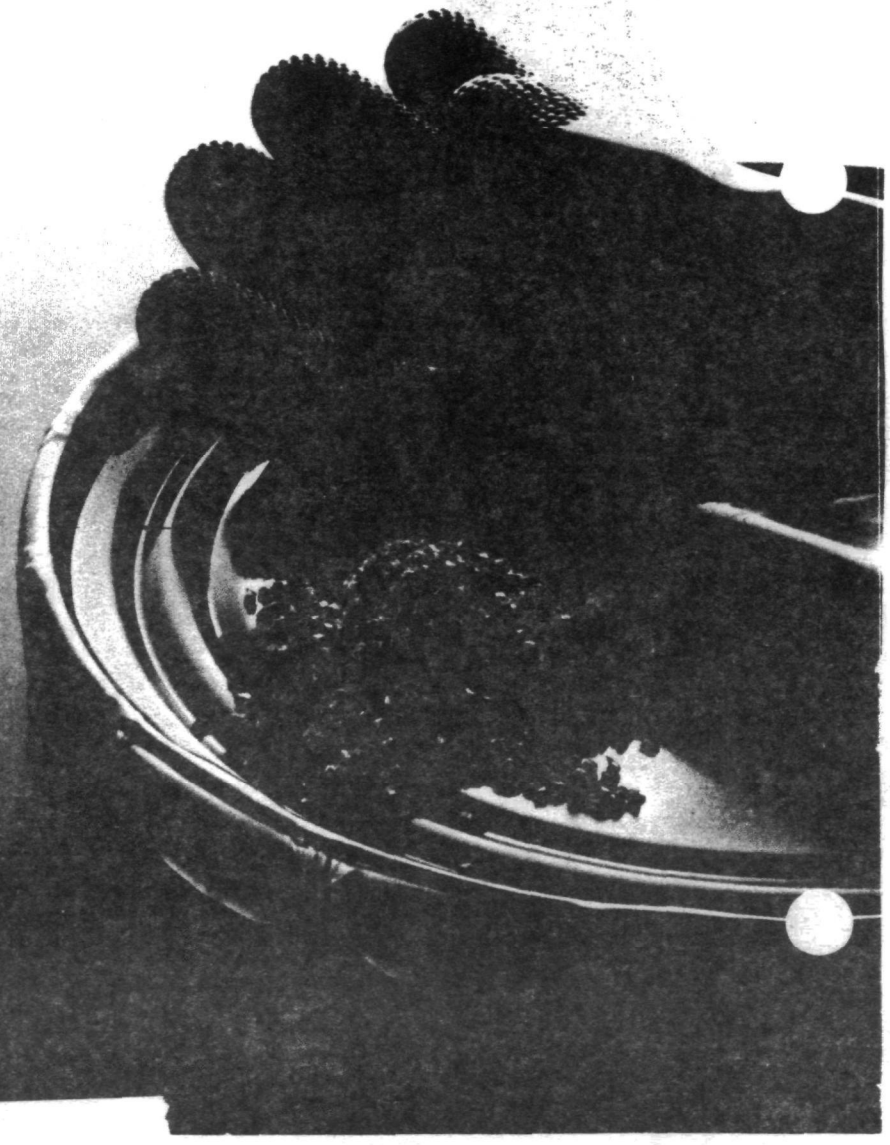
2912

Gauge	Sizes	Length	Color
Heavy (.040)	9, 10, 11	14"	Black

Smooth finish. Curved fingers. Recommended for heavy industrial use.

2912

BFGoodrich heavy duty industrial gauntlets



heavy duty neoprene

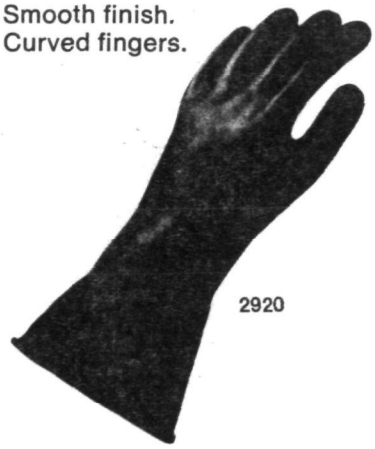
Service: for assembly operation, leather and textile processing, polishing, paint spraying, photo engraving, dye manufacturing, electroplating, petroleum refining, lithography and soap manufacturing.

Features: Neoprene gloves have high resistance to acids, alkalies, oil and grease, long aging qualities, good flexibility, high tensile strength. Gauges indicated are nominal.

2920

Gauge	Sizes	Length	Color
Medium (.035)	9, 10, 11, 12	14″	Black

Smooth finish. Curved fingers.



2920

2935

Gauge	Sizes	Length	Color
Medium (.035)	10, 11	18″	Black

Smooth finish. Curved fingers.

2935

2930

Gauge	Sizes	Length	Color
Medium (.045)	9, 10, 11	14″	Black

Curved fingers. Molded non-slip palm and fingers.

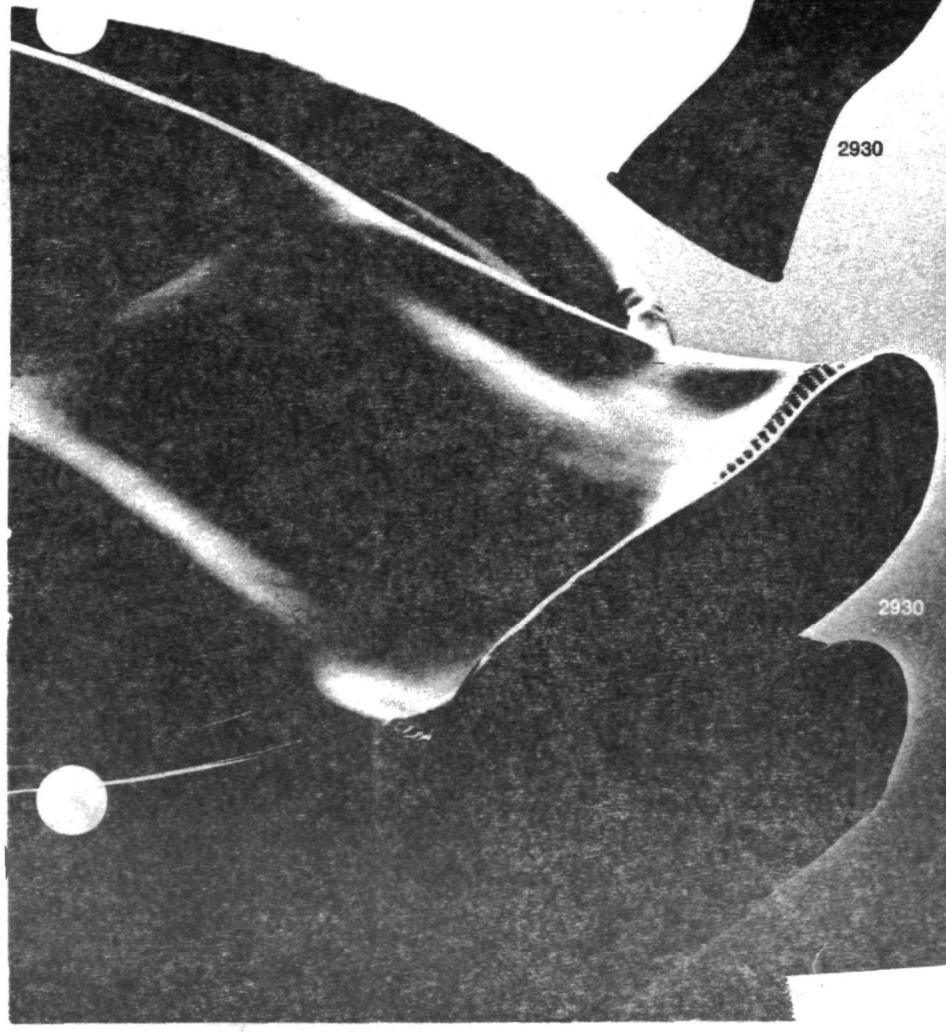
2930

007

Gauge	Sizes	Length	Color
Light (.018)	7, 8, 9, 10½	11″	Black

Curved fingers. Ribbed gripping surface. Straight edge.

007



2930

7701-P 7703

No.	Style	Weight	Color
7701-P	12" gauntlet	Standard	Black
7703	14½" gauntlet with cuff band	Standard	Black

Reinforced thumb crotch gives extra protection where the wear occurs. Tough and durable standard weight. Gives economy through cut and tear resistant features. Neoprene coated to resist oils, grease, chemicals and abrasion. Coated fabric cuff.

7701-P

4710

No.	Style	Weight	Color
4710	Knit wrist	Heavy	Black

Palm coated with acid and oil-resistant Neoprene for additional protection. Heavyweight, knit wrist glove. for use where all-over protection is not necessary.

4710

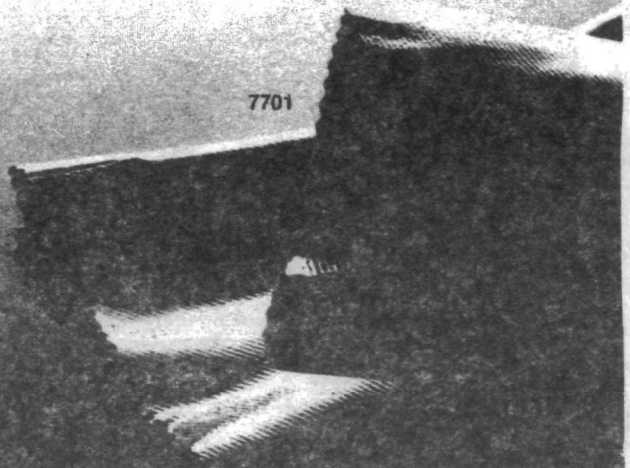
4700 4702 4703

No.	Style	Weight	Color
4700	Knit wrist	Standard	Black
4702	Knit wrist (straight fingers)	Heavy	Black
4703	Knit wrist	Heavy	Black

Industrial heavyweight and Neoprene coated. Highly resistant to acids, caustics, oils, grease and abrasion. Especially recommended in industries where knit wrist protective gloves are needed, such as, automotive, fishing, mining, steel and chemical.

4703

Hood neoprene coated gloves

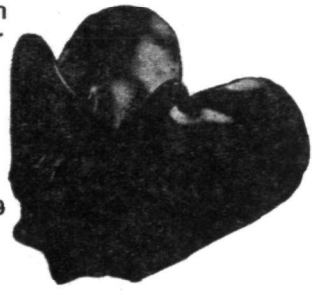


7701

4749

No.	Style	Weight	Color
4749	Knit wrist	Standard	Black

A standard weight, fully Neoprene coated, jumbo mitten with knit wrist. Made extra large to allow a woolen glove to be worn inside for warmth. Particularly recommended for commercial fishermen, firemen, policemen, lumbermen and for all outdoor work that involves handling large objects in stormy or cold weather.



4749

7700 7701 7705

No.	Style	Weight	Color
7700	10″ gauntlet	Standard	Black
7701	12″ gauntlet	Standard	Black
7705	12″ gauntlet	Heavy	Black

A standard weight, fully Neoprene coated, 12″ gauntlet. Highly resistive to chemicals, oils, grease and abrasion. Offers complete wrist protection against sharp objects. Also made in 10″ gauntlet styles.

7701

7702 7706

No.	Style	Weight	Color
7702	14½″ gauntlet	Standard	Black
7706	14½″ gauntlet	Heavy	Black

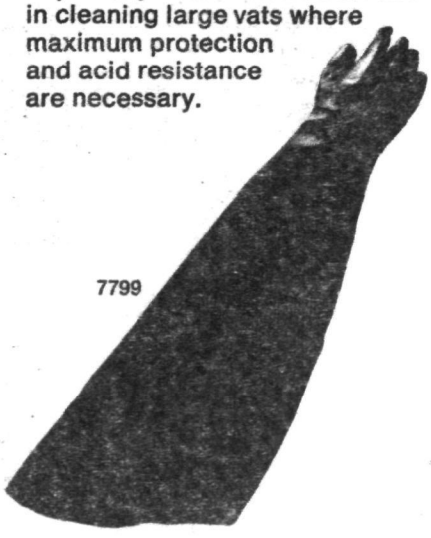
A standard weight, fully coated 14½″ gauntlet. Ideal for jobs that require prolonged submersion of the hands in chemicals, oils and other liquids. Also comes in a heavier weight which is highly abrasion and cut-resistant.

7702

7799

No.	Style	Weight	Color
7799	34″ shoulder length gauntlet	Standard	Black

A standard weight, fully coated, 34″ shoulder length gauntlet. Especially recommended for use in cleaning large vats where maximum protection and acid resistance are necessary.



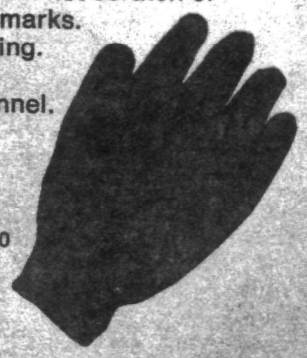
7799

Hood magnet gloves

M-500 M-501 M-502 M-503

Product No.	Cuff Style	Color
M-500	Knit wrist	Black
M-501	12" gauntlet	Black
M-502	14½" gauntlet	Black
M-503	10" gauntlet	Black

Made of Neoprene. Resists oil, sunlight and ozone. A non-slip glove that will not scratch or leave ugly marks. Long wearing. Lined with Canton flannel.



M-500

Excellent for handling hose, pipe, metals with oily or wet surfaces. Recommended for usage when a non-slip, firm grip glove is required. Standard weight and fully coated. Comes in most widely used styles.

M-503

Hood koroseal gloves

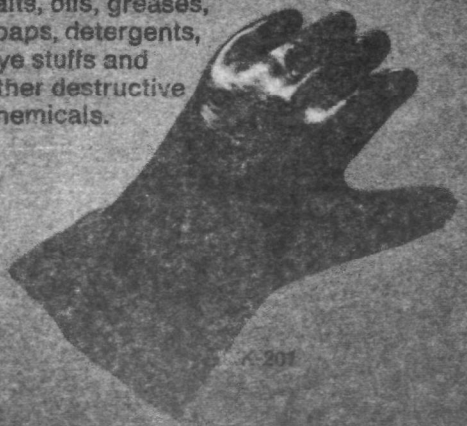
K-200 K-201 K-202 K-203

Product No.	Cuff Style	Color
K-200	Knit wrist	Blue
K-201	12" gauntlet	Blue
K-202	14½" gauntlet	Blue
K-203	Safety cuff	Blue

Made with premium quality PVC compound. Industrial weight, fully coated with cotton jersey liner. Greater resistance to destructive solvents, caustics, and light oils. Longer wearing because its two-piece jersey shell has no seams on wearing surfaces.

K-200

Remains flexible at low temperatures. Leaves no odors on the hands. Especially recommended for jobs that require resistance to caustics, solvents, salts, oils, greases, soaps, detergents, dye stuffs and other destructive chemicals.



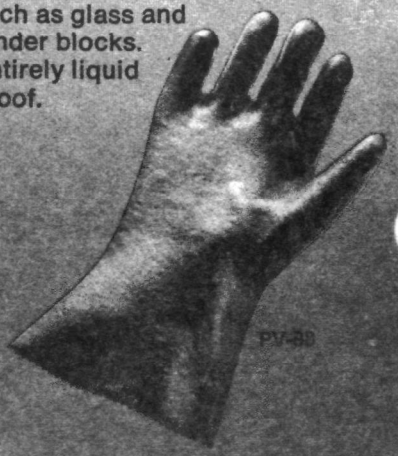
K-201

Hood pvc coated gloves

PV-96 PV-97 PV-98 PV-99

No.	Cuff Style	Color
PV-96	Knit wrist	Yellow
PV-97	2" band cuff	Yellow
PV-98	12" gauntlet	Yellow
PV-99	14½" gauntlet	Yellow

Fully plastic coated with Vinyl over Cotton Jersey for maximum wear. Standard weight. Very resistive to abrasion. Ideal for use in greases, oils and in handling abrasive materials such as glass and cinder blocks. Entirely liquid proof.



PV-99

Hood ruf-n-tuf gloves

5000 5001 5002 5003 5004 5005

No.	Cuff Style	Color
5000	Knit wrist Fully coated	Tan
5001	Palm coated Safety cuff, Elastic wrist	Tan
5002	Knit wrist Palm coated	Tan
5003	10" gauntlet Fully coated	Tan
5004	12" gauntlet Fully coated	Tan
5005	Palm coated 12" gauntlet, Elastic wrist	Tan

Coated with natural rubber latex, crinkle finish which offer excellent resistance to slipping — plus long wear. Enable the wearer to have a stronger, firmer grip. Very flexible and heavyweight. Can be worn on most wet or dry jobs where oil or grease is non-existant. Especially recommended for use in industries that require handling of glass, sheet metals or other sharp materials. Excellent gripping qualities for lifting all types of heavy bagged materials. Resist cuts and puncture.

5001

Hood rubber coated gloves

5043

No.	Cuff Style	Color
5043	Knit wrist	Tan

A standard weight glove, fully coated with natural rubber latex over Cotton Jersey shell offers complete leak-proof protection. Very flexible. Has a wide range of uses in most industries where greases and oil are not used. Ideal for commercial fisherman because of flexibility.

5043

measure BFGoodrich products by the work they do. you'll find they're a bargain.

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Franklin Park, Illinois 60131
312—455-6600

Dallas District
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Dallas, Texas 75247
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2500 West 8th Avenue
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Southfield, Mich. 48076
313—357-3939

Minneapolis District
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Plymouth, Minn. 55441
612—559-0535

Philadelphia District
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Goodrich
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Akron, Ohio 44318

Litho in U.S.A.

IPC 77-PC-1 2/78 REV

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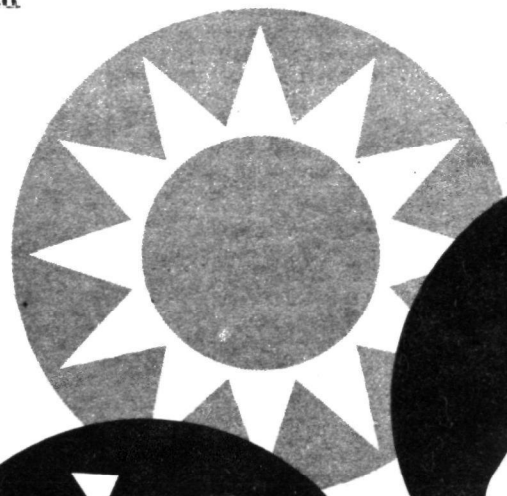
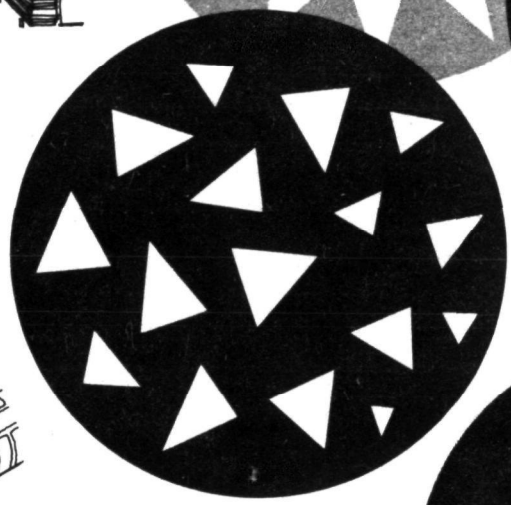
OCCUPATIONAL HEALTH AND SAFETY

Granet

Leader in Hand Safety





Granet Miller ESU Willson

Hand Safety is Our Business

There is no all-purpose form of hand protection. The material used for gloves depends largely upon what is being handled. Granet glove coatings are designed to give protection from a variety of hazards. These coatings surpass leather, canvas and cotton in wearing ability depending on the job application. Some gloves have granules or rough materials incorporated in the base coating for better gripping ability. Several Granet glove models are coated with rubber, synthetic elastomers and plastics which offer protection against all types of petroleum products, caustic soda, tannic acid and hydrochloric acid. These gloves are available in varying coatings and styles to meet individual conditions.

How to select the proper Granet Glove

Matching specific gloves to the many materials, conditions and operations requiring some degree of hand protection is a complex and often times, confusing job. The majority of accidents involving hands and arms can be classified under four major hazard factors: Chemicals, Abrasion, Cutting and Heat.

To facilitate Granet glove selection, each model's performance in one or more major hazard category is identified as a symbol and resistance rating. The symbols and recommendations made herein relate only to products depicted in this catalog.

SYMBOLS:

CHEMICALS ABRASION CUTTING HEAT

RESISTANCE RATING:

S - Superior, **E** - Excellent, **G** - Good, **F** - Fair

NOTE: Many Granet Glove models offer superior and excellent resistance in more than one hazard category. These multiple benefits per glove model, keep glove costs down by reducing glove inventories.

To select the proper glove for hand protection against a specific chemical ... see Physical Properties and Chemical Resistance Charts on the back cover.

ROYALTON 600

F E G F

Plastic impregnated cotton

ROYALTON "600" is a standard weight, 6-ounce cotton flannel sheeting impregnated with our own long wearing plastic compound. Replaces goatskin and light leather gloves. Outwears 8-ounce cotton gloves.

Recommended for inspection work, handling small parts, truck driving, warehouse handling, metal fabricating, maintenance and general work inside and out.

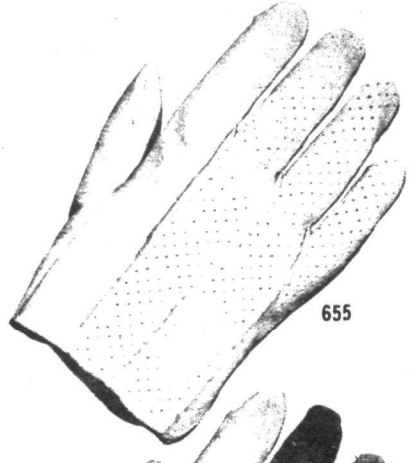
Features:

- Tailored design.
- Slip-on style available with perforated back for coolness.
- Finger dexterity.
- Nonslip grip.
- Liquid repellent. (Not liquid proof)
- Can be laundered repeatedly.

No.	Style	Size
604	Women's Knitwrist	M,L
605	Women's Slip-on perforated back	M,L
606	Women's Slip-on	M,L
654	Men's Knitwrist	M,L
655	Men's Slip-on perforated back	M,L
656	Men's Slip-on	M,L
657	Men's Slip-on Glo-Gluv	M,L
658	Men's Knitwrist Glo-Gluv	M,L
659	Women's Slip-on Glo-Gluv	M,L

Color stitching on cuff allows for size matching after laundering.

Women's Medium ..... Red
Large ..... Blue
Men's Medium ..... Yellow
Large ..... Black



655

657

ROYALTON 700

F E G F

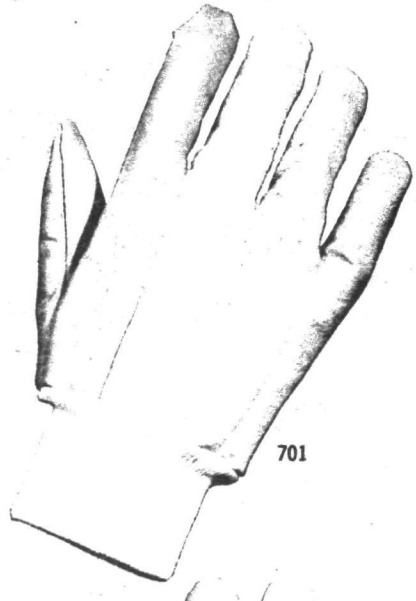
Plastic impregnated cotton Heavy weight

ROYALTON "700" is a rugged work glove, made from cotton fabric finished with a special heavy-weight plastic, and incorporates the same excellent features of the ROYALTON "600".

Features:

- Liquid repellent (not liquid proof).
- Cool and comfortable.
- Good grip wet or dry.

No.	Style
701	Men's Knitwrist, clute cut, "600" back cloth binding
702	Men's Slip-on, clute cut, "600" back cloth binding
754	Men's Knitwrist
756	Men's Slip-on



701

756

ROYALTON 900 & 1000

F E G F

Plastic impregnated/Stretch gloves

ROYALTON "900" and "1000" stretch gloves are made of a stretchable interlock lining, impregnated with an exclusive plastic compound. Their finger dexterity, grip, fit and comfort excels characteristics of goatskin, capeskin and cotton at lower cost per man hour of use.

These gloves are ideal for jobs involving assembly, inspection, machining and packaging small sensitive parts. ROYALTON "1000" is white, USDA accepted. Ideal for food processing, pharmaceutical, TV manufacturing and clean room operations where cleanliness is vital.

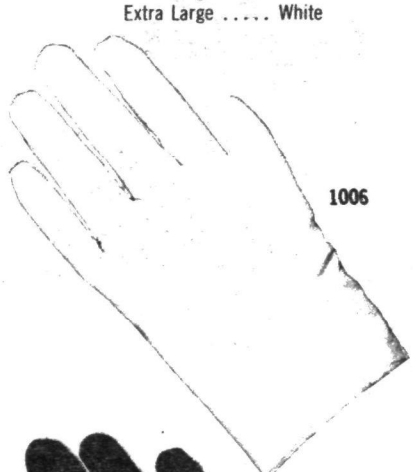
Features:

- Tailored—has snug fit of goatskin and capeskin leather gloves.
- Fully launderable.
- Maximum dexterity and "feel".
- Cool and comfortable.

No.	Style	Size
906	Women's Slip-on	S,M,L
956	Men's Slip-on	M,L,XL
1006	Women's Slip-on	S,M,L
1056	Men's Slip-on	M,L,XL

Color stitching on cuff allows for size matching after laundering.

Women's	Small	Green
	Medium	Red
	Large	Blue
Men's	Medium	Yellow
	Large	Black
	Extra Large	White



1006

956

DYNAGRIP

E S G G

Plastic coated/Wet grip

DYNAGRIP is an abrasion resistant work glove, superior for handling oil, acids, caustics and many solvents. Made with a 2-piece jersey shell and special plastic overcoating, DYNAGRIP offers double thickness protection with the comfort and flexibility of one. This model features a wet grip that lasts for the life of the glove.

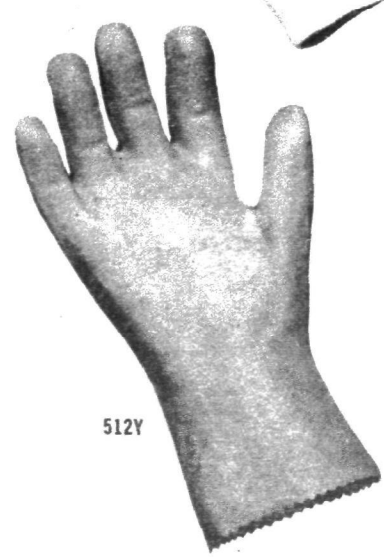
Features:

- Nonslip wet grip finish.
- Curved fingers—fit natural contour of the hand.
- No seams on wearing surface.
- Superior flexibility.
- Color choice—green or yellow*.

No.	Style	Size	Coated
52	Knitwrist		Fully
53	Knitwrist		Palm
510	Band Top		Fully
520	10" Gauntlet	M,L	Fully
512	12" Gauntlet	M,L	Fully
514	14" Gauntlet	M,L	Fully
518	18" Gauntlet		Fully
522	Women's Knitwrist		Fully

*If yellow color is desired—specify "Y" after style number.

53



512Y

GRANFLEX

E S G G

Plastic coated/Washable lining

GRANFLEX is an abrasion resistant glove for handling oil and many solvents. This model has an interlock fabric lining coated with Granet's own special plastic compound, offering the flexibility and dexterity of a molded rubber glove. GRANFLEX gloves outwear ordinary rubber and most coated gloves on similar operations without cracking or peeling.

Features:

- Two-piece wing thumb construction.
- Curved fingers—fit the natural contour of the hand.
- Invisible seams.
- Nonslip grip finish.
- Lining will not "ball up" from perspiration or laundering.

No.	Style	Coated
92	Knitwrist	Fully
920	10" Gauntlet	Fully
902	11" Gauntlet Cadet	Fully
912	12" Gauntlet	Fully
914	14" Gauntlet	Fully

92

912

GRANECON

E S G F

Plastic coated/Super flexible

GRANECON is an excellent general purpose work glove with exceptional pliability, permitting finger dexterity not possible in most work gloves. Its soft jersey lining, formed out of two separate pieces, eliminates seams on the wearing surface and helps eliminate irritation from within.

GRANECON offers abrasion resistance with excellent gripping qualities.

Features:

- Economical general purpose glove.
- Curved fingers—fits natural shape of hand.
- Abrasion resistant.
- Good gripping qualities.
- Available with a thermal lining for cold weather applications.

No.	Style	Coated
82	Knitwrist	Fully
820	10" Gauntlet	Fully
812	12" Gauntlet	Fully
WITH THERMAL LINING		
2082	Knitwrist	Fully
2084	10" Gauntlet	Fully
2086	12" Gauntlet	Fully

82

2086

GLO-GLUVS®

E S G

Plastic coated/Blaze orange

Highlight safety in your plant with GLO-GLUVS® that afford maximum visibility, positive grip, flexibility and comfort. A jersey lining, coated with a Blaze Orange plastic compound, makes them liquid-proof, and abrasion resistant.

Regular GLO-GLUVS are recommended where worker safety and "spot" identification are imperative.

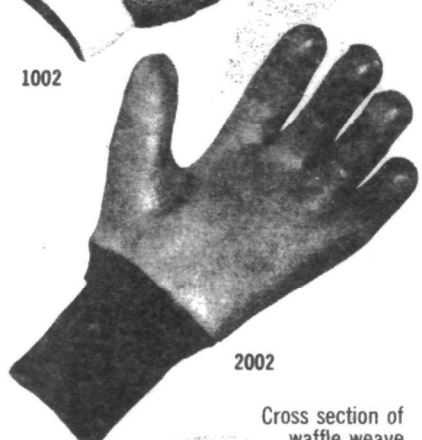
Thermal-lined GLO-GLUVS feature a soft napped, waffle weave thermal liner for warmth and comfort. Ideal for outdoor workers, policemen and firemen in cold weather.

Features:

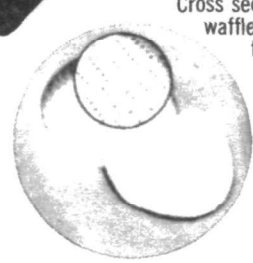
- Abrasion resistant.
- Maximum visibility for signaling and safety.
- Excellent gripping qualities.
- Two types of lining available.

No.	Style	Coated
1002	Knitwrist	Fully
1012	12" Gauntlet	Fully
1027	Knitwrist-Mitt	Fully
WITH THERMAL LINING		
2002	Knitwrist	Fully
2020	10" Gauntlet	Fully
2012	12" Gauntlet	Fully
2027	Knitwrist-Mitt	Fully

1002



2002



Cross section of waffle weave thermal liner

NEOPRENE

S E S E

Liquid proof/Heavy duty

Granet NEOPRENE work gloves are made with a neoprene latex bonded to a soft cotton shell.

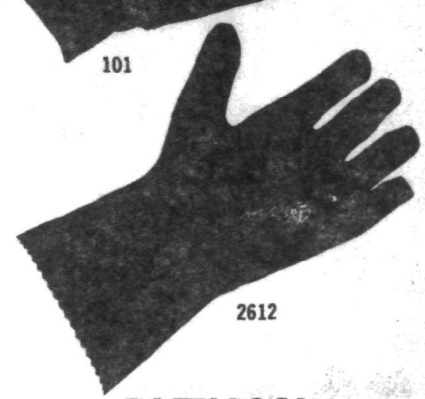
NEOPRENE gloves are liquid-proof and resistant to most chemicals. Recommended where acids, solvents and caustics are used.

Features:

- Excellent cut and chemical resistance.
- Smooth finish.
- Curved fingers—natural fit.
- Full size—wing thumb.
- Superior bonding between fabric and coating.
- Some models available with heavy palm or thumb patch.

No.	Style	Coated
101	Knitwrist	Fully
104	Knitwrist	Palm
123	Knitwrist Lightweight	Fully
212	12" Gauntlet Extra Heavy	Fully
214	14" Gauntlet Extra Heavy	Fully
610	10" Gauntlet	Fully
612	12" Gauntlet	Fully
714	14" Gauntlet	Fully
714P	14" Gauntlet with thumb patch	Fully
718	18" Gauntlet	Fully
731	31" Gauntlet	Fully

101



2612

PYTHON

S E S E

Neoprene/Wet grip

PYTHON gloves have all the chemical resistance of neoprene latex plus a "wet-grip" finish.

No.	Style	Coated
2101	Knitwrist	Fully
2612	12" Gauntlet	Fully
2714	14" Gauntlet	Fully
2718	18" Gauntlet	Fully

ROYALTON 900 & 1000

F E G F

Plastic impregnated/Stretch gloves

ROYALTON "900" and "1000" stretch gloves are made of a stretchable interlock lining, impregnated with an exclusive plastic compound. Their finger dexterity, grip, fit and comfort excels characteristics of goatskin, capeskin and cotton at lower cost per man hour of use.

These gloves are ideal for jobs involving assembly, inspection, machining and packaging small sensitive parts. ROYALTON "1000" is white, USDA accepted. Ideal for food processing, pharmaceutical, TV manufacturing and clean room operations where cleanliness is vital.

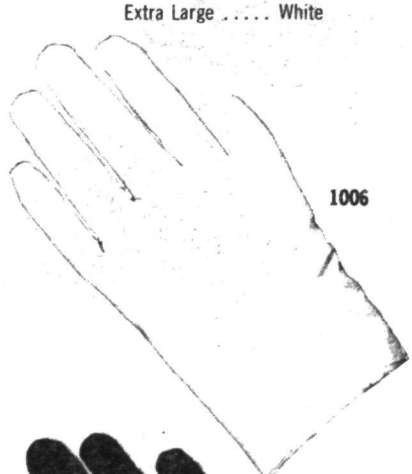
Features:

- Tailored—has snug fit of goatskin and capeskin leather gloves.
- Fully launderable.
- Maximum dexterity and "feel".
- Cool and comfortable.

No.	Style	Size
906	Women's Slip-on	S,M,L
956	Men's Slip-on	M,L,XL
1006	Women's Slip-on	S,M,L
1056	Men's Slip-on	M,L,XL

Color stitching on cuff allows for size matching after laundering.

Women's	Small	Green
	Medium	Red
	Large	Blue
Men's	Medium	Yellow
	Large	Black
	Extra Large	White



1006

956

DYNAGRIP

E S G G

Plastic coated/Wet grip

DYNAGRIP is an abrasion resistant work glove, superior for handling oil, acids, caustics and many solvents. Made with a 2-piece jersey shell and special plastic overcoating, DYNAGRIP offers double thickness protection with the comfort and flexibility of one. This model features a wet grip that lasts for the life of the glove.

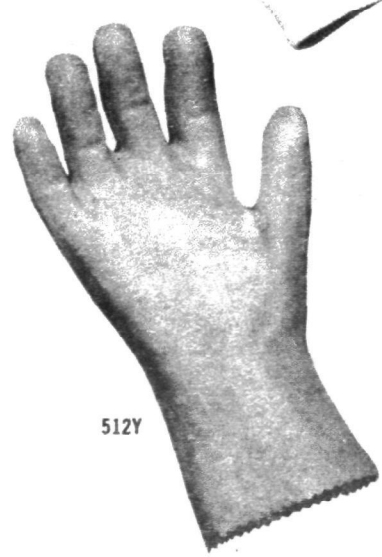
Features:

- Nonslip wet grip finish.
- Curved fingers—fit natural contour of the hand.
- No seams on wearing surface.
- Superior flexibility.
- Color choice—green or yellow*.

No.	Style	Size	Coated
52	Knitwrist		Fully
53	Knitwrist		Palm
510	Band Top		Fully
520	10" Gauntlet	M,L	Fully
512	12" Gauntlet	M,L	Fully
514	14" Gauntlet	M,L	Fully
518	18" Gauntlet		Fully
522	Women's Knitwrist		Fully

*If yellow color is desired—specify "Y" after style number.

53



512Y

GRANFLEX

E S G G

Plastic coated/Washable lining

GRANFLEX is an abrasion resistant glove for handling oil and many solvents. This model has an interlock fabric lining coated with Granet's own special plastic compound, offering the flexibility and dexterity of a molded rubber glove. GRANFLEX gloves outwear ordinary rubber and most coated gloves on similar operations without cracking or peeling.

Features:

- Two-piece wing thumb construction.
- Curved fingers—fit the natural contour of the hand.
- Invisible seams.
- Nonslip grip finish.
- Lining will not "ball up" from perspiration or laundering.

No.	Style	Coated
92	Knitwrist	Fully
920	10" Gauntlet	Fully
902	11" Gauntlet Cadet	Fully
912	12" Gauntlet	Fully
914	14" Gauntlet	Fully

92

912

GRANECON

E S G F

Plastic coated/Super flexible

GRANECON is an excellent general purpose work glove with exceptional pliability, permitting finger dexterity not possible in most work gloves. Its soft jersey lining, formed out of two separate pieces, eliminates seams on the wearing surface and helps eliminate irritation from within.

GRANECON offers abrasion resistance with excellent gripping qualities.

Features:

- Economical general purpose glove.
- Curved fingers—fits natural shape of hand.
- Abrasion resistant.
- Good gripping qualities.
- Available with a thermal lining for cold weather applications.

No.	Style	Coated
82	Knitwrist	Fully
820	10" Gauntlet	Fully
812	12" Gauntlet	Fully
WITH THERMAL LINING		
2082	Knitwrist	Fully
2084	10" Gauntlet	Fully
2086	12" Gauntlet	Fully

82

2086

GLO-GLUVS®

E S G

Plastic coated/Blaze orange

Highlight safety in your plant with GLO-GLUVS® that afford maximum visibility, positive grip, flexibility and comfort. A jersey lining, coated with a Blaze Orange plastic compound, makes them liquid-proof, and abrasion resistant.

Regular GLO-GLUVS are recommended where worker safety and "spot" identification are imperative.

Thermal-lined GLO-GLUVS feature a soft napped, waffle weave thermal liner for warmth and comfort. Ideal for outdoor workers, policemen and firemen in cold weather.

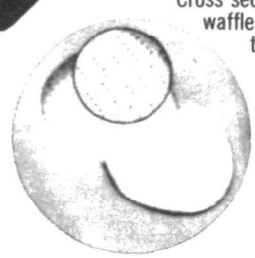
Features:

- Abrasion resistant.
- Maximum visibility for signaling and safety.
- Excellent gripping qualities.
- Two types of lining available.

No.	Style	Coated
1002	Knitwrist	Fully
1012	12" Gauntlet	Fully
1027	Knitwrist-Mitt	Fully
WITH THERMAL LINING		
2002	Knitwrist	Fully
2020	10" Gauntlet	Fully
2012	12" Gauntlet	Fully
2027	Knitwrist-Mitt	Fully

1002

2002



Cross section of waffle weave thermal liner

NEOPRENE

S E S E

Liquid proof/Heavy duty

Granet NEOPRENE work gloves are made with a neoprene latex bonded to a soft cotton shell.

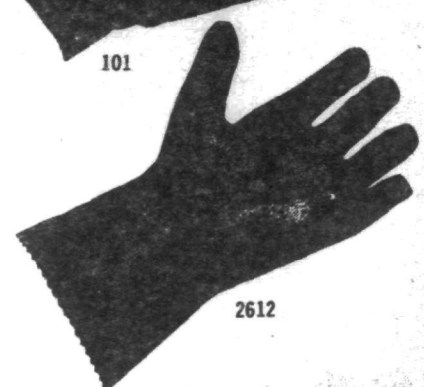
NEOPRENE gloves are liquid-proof and resistant to most chemicals. Recommended where acids, solvents and caustics are used.

Features:

- Excellent cut and chemical resistance.
- Smooth finish.
- Curved fingers—natural fit.
- Full size—wing thumb.
- Superior bonding between fabric and coating.
- Some models available with heavy palm or thumb patch.

No.	Style	Coated
101	Knitwrist	Fully
104	Knitwrist	Palm
123	Knitwrist Lightweight	Fully
212	12" Gauntlet Extra Heavy	Fully
214	14" Gauntlet Extra Heavy	Fully
610	10" Gauntlet	Fully
612	12" Gauntlet	Fully
714	14" Gauntlet	Fully
714P	14" Gauntlet with thumb patch	Fully
718	18" Gauntlet	Fully
731	31" Gauntlet	Fully

101



2612

PYTHON

S E S E

Neoprene/Wet grip

PYTHON gloves have all the chemical resistance of neoprene latex plus a "wet-grip" finish.

No.	Style	Coated
2101	Knitwrist	Fully
2612	12" Gauntlet	Fully
2714	14" Gauntlet	Fully
2718	18" Gauntlet	Fully

CUTLESS®

F S S G

Natural rubber coated
Wet or dry grip

CUTLESS is a ripple-textured work glove which provides excellent protection against cuts, punctures, and slivers. A soft, comfortable lining with a rugged natural rubber coating makes the CUTLESS an excellent replacement for leather gloves.

Recommended for handling wire, tin, sheet metal, nails and glass.

Features:

- Tough crinkle finish.
- Cut and puncture resistant.
- Hand heat dissipates through uncoated back.
- Firm Grip.

No.	Style	Coated
2404	Knitwrist	Palm
2411	Safety Cuff	Palm
2413	12" Gauntlet	Palm
2421	Women's Safety Cuff	Palm
2424	Women's Knitwrist	Palm

2404

2411

SLIP-NOT®

E S S G

Natural rubber coated
Wet or dry grip

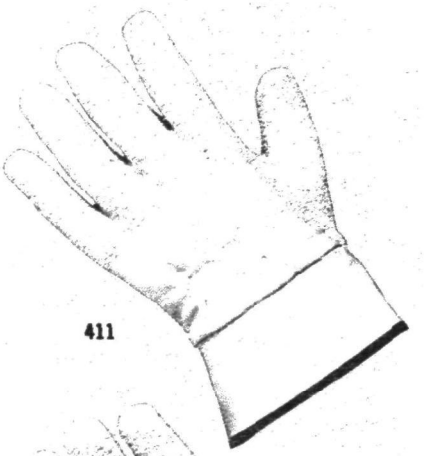
SLIP-NOT is a rugged, general purpose glove for handling rough or slippery material. A rough-finish latex coating over a soft cotton lining provides thousands of gripping edges for excellent holding power. Easily outwears canvas and leather gloves on the same job.

Recommended for cutting and fabricating tin and sheet metal; glass cutting and handling; moving lumber, brick and concrete blocks; handling scrap metal and steel drums.

Features:

- Curved fingers and thumb for natural fit and comfort.
- Natural rubber coating impregnated with "rubber dust" for extra wear and positive grip.
- Extreme resistance to abrasion and cutting.
- Also available without rubber dust. Specify "B" for BALD.

No.	Style	Coated
401	Knitwrist	Fully
404	Knitwrist	Palm
409	Band Top	Palm
411	Safety Cuff	Palm
420	10" Gauntlet	Fully
412	12" Gauntlet	Fully
413	12" Gauntlet	Palm
424	Women's Knitwrist	Palm



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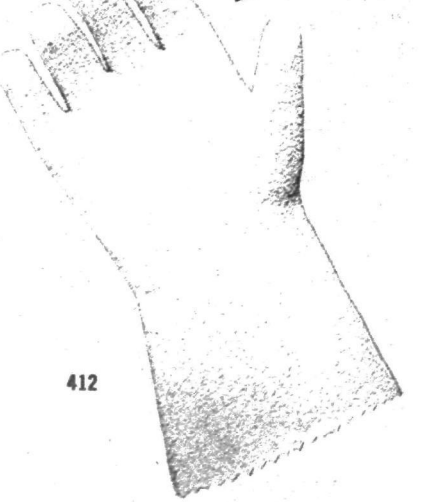


412

NYGRAN

S S S G

Nitrile rubber coated/Multi-purpose

NYGRAN gloves coated with nitrile rubber, a synthetic latex made from butadiene and acrylonitrile. Recommended for protecting hands exposed to hazardous liquids, operations involving cutting or abrasives, handling oily or greasy materials. Excellent dry grip on extremely smooth-finish surfaces.

NYGRAN gloves with their superior coating, soft cotton lining, curved fingers and wing thumb offer a premium quality product for the toughest jobs.

Features:

- Superior cut, snag and chemical resistance.
- Nitrile rubber coating.
- 8-ounce cotton lining.
- Excellent adhesion of coating to fabric.
- Curved fingers—minimum hand fatigue.
- Full size wing thumb.

No.	Style	Coated
N1	Knitwrist	Fully
N4	Knitwrist	Palm
N9	Band Top	Palm
*N11	Safety Cuff	Palm
N13	12" Gauntlet	Palm
N24	Women's Knitwrist	Palm

*N11J - Jersey Lining
N11F - Flannel Lining

N4

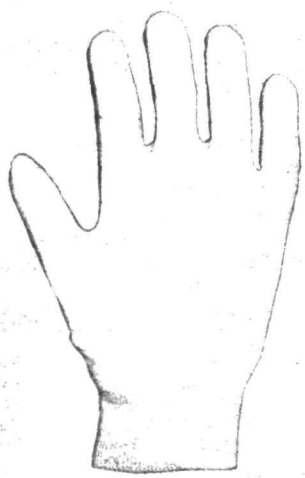
N11J

SPECIAL APPLICATIONS

SLIP-NOT®
Natural rubber coated

USDA accepted for poultry, meat packing, canning operations and food processors. Curved fingers and thumb for natural fit and comfort. Excellent abrasion and cut resistance.

No.	Style	Coated
401B	Knitwrist	Fully



401B

PYTHON NEOPRENE
Wet-Grip with Thermal Lining

This model has all the characteristics and quality features of neoprene latex plus a "wet-grip" finish and a thermal lining. The ideal glove for outdoor workers handling smooth or slippery materials in cold weather.

No.	Style	Coated
2201	Knitwrist	Fully

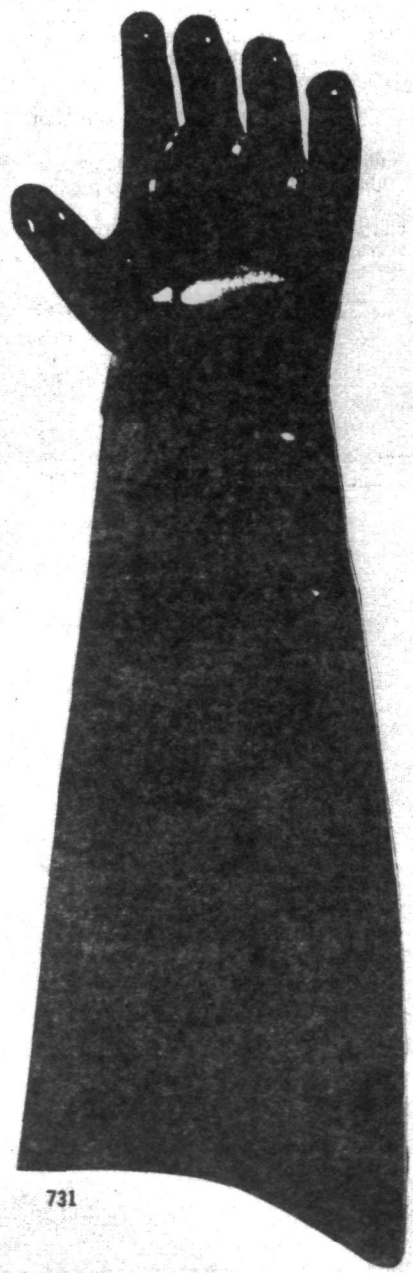
2201

SPECIAL APPLICATIONS

TRAPPERS GLOVE
Heavy duty neoprene

Shoulder length neoprene; good chemical, cut and abrasion resistance and liquid proof. Recommended for deep tank cleaning and dipping operations. Also used by tanners and trappers.

No.	Style	Coated
731	31" Gauntlet	Fully



731

NITRILE

Unsupported

If the job calls for hand protection ... check the advantages you get with Granet's Nitrile Unsupported Gloves.

- **Superior chemical resistance** to most solvents, acids, bases, animal fats and alcohols. The Butadiene Acrylonitrile compound offers better chemical resistance than neoprene and natural latex gloves.
- **Excellent resistance to punctures, snags, cuts and abrasions.** This tough, rugged glove outwears ordinary rubber gloves.
- **Embossed palm.** Grip surface is molded (not etched), for good wet and dry grip qualities.
- **Hand-contoured fit.** Comfortable, flexible and sensitive, this glove is ideally suited for many applications requiring dexterity.

USDA accepted. Ideal for poultry, meat packing, fish, canning, cleaning parts, and electronics industries.

Size Chart: Small: 6-6½; Medium: 7-7½; Large: 8-8½; Ex.Large: 9-9½; Super Ex. Large:10-10½.

Style No. 490	Style No. 492
Color: Green Length: 12½" Thickness: .015" Unlined	Same as No. 490 but flock-lined

490

NATURAL LATEX

Unlined

Natural latex with firm gripping surface. Unlined smooth inner surface provides comfort, easy wash and dry characteristics. Has excellent tensile strength for jobs such as poultry processing. Also good for many jobs in Atomic energy, pharmaceutical and chemical plants.

Style No. 541
Color: Natural
Sizes: Sm., Med., Lg., Ex. Lg., Super Ex. Lg.
Length: 12½"
Thickness: .018

541

USDA accepted for Food & Meat Handling

SYNTHETIC LATEX

Flock-lined

Composed of synthetic bayprene latex and natural latex. Has firm gripping surface and flock-lined for easy on and off. It has bacteriostatic treatment. This special compound of latex was formulated to add the mechanical resistance of natural rubber and the chemical resistance of bayprene.

Style No. 2444
Color: Orange
Sizes: SM., Med., Lg., Ex. Lg., Super Ex. Lg.
Length: 12½"
Thickness: .020

2444

USDA accepted for Food & Meat Handling

Size Chart: Small: 6-6½; Medium: 7-7½; Large: 8-8½; Ex. Large: 9-9½; Super Ex. Large: 10-10½

SYNTHETIC LATEX

Flock-lined

Synthetic bayprene latex with a rough surface for gripping wet and greasy objects. Flock-lined for easy on and off. Has bacteriostatic treatment. Recommended for: chemical, mechanical, building, metal cleaning, automotive, bleaching, dairy, food and pharmaceutical industries.

Style No. 2002
Color: Black
Sizes: Sm., Med., Lg., Ex. Lg., Super Ex. Lg.
Length: 12½"
Thickness: .028

Style No. 2005
Same as No. 2002 but 16½" Length

2002

USDA accepted for Food & Meat Handling

NATURAL LATEX

Flock-lined

Natural latex with firm gripping surface. Flock-lined for easy on and off comfort. Has bacteriostatic treatment. Good tensile strength and resistance to household detergents and light acids. Used by food processors, laboratories, maintenance, etc.

Style No. 444
Color: Yellow
Sizes: Sm., Med., Lg., Ex. Lg., Super Ex. Lg.
Length: 12½"
Thickness: .020

444

USDA accepted for Food & Meat Handling

GRANET 3 POINT HAND PROTECTION PROGRAM

Just starting to organize a hand safety program? Looking for a simplified method of matching the proper work glove to a job? Seeking "fresh", new, safety motivation material for inplant display?

Outlined in Granet's latest Safety folder is a simplified 3 step procedure for developing a plantwide hand safety program through...

#1 Investigation...suggestions for making a self-evaluation of all "trouble" areas requiring some degree of hand protection.

#2 Selection...new system of symbols, representing the 4 major hazard factors, for matching the proper glove to the job.

#3 Promotion... material for promoting greater worker awareness of their hands and the importance of wearing the correct glove on the job.

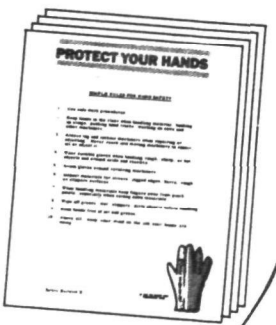
Send for your copy today. Granet's 3 Point Hand Protection Program, could be the answer to your hand protection problem.

COLORFUL POSTERS

POCKET PROTECTORS

DECALS

HAND SAFETY SCOREBOARD



SAFETY BULLETINS

Find the right glove for each job

Select the coating with the highest rating in the Physical Properties Chart, then check the Chemical Resistance Chart.

CHEMICAL RESISTANCE CHART	NYGRAN	PYTHON (Neoprene)	DYNAGLUV (Vinyl Plastic)	DYNAGRIP (Vinyl Plastic)	GRANFLEX (Vinyl Plastic)	SLIP-NOT (Rubber Latex)	GRANECON (Vinyl Plastic)	NITRILE (Unsupported)	SYNTHETIC LATEX (Unsupported)	NATURAL LATEX (Unsupported)
ALCOHOLS										
Methanol / Butyl Alcohol / Glycerine / Ethanol / Isopropanol	E	E	E	E	E	G	E	E	E	G
CAUSTICS										
Ammonium Hydroxide 38% / Sodium Hydroxide 50% / Potassium Hydroxide 50%	E	E	E	E	E	E	E	E	E	E
CHLORINATED SOLVENTS										
Carbon Tetrachloride / Perchlorethylene / Trichlorethylene	E	G	F	F	F	NR	F	E	G	NR
KETONES										
Methyl Ethyl Ketone / Methyl Isobutyl Ketone / Acetone	G	G	NR	NR	NR	G	NR	G	G	G
PETROLEUM SOLVENTS										
White Gasoline / Naphtha / Mineral Thinner / Kerosene	S	E	G	G	E	F	G	S	E	F
ORGANIC ACIDS										
Citric / Formic / Tannic / Acetic	E	E	E	E	E	E	E	E	E	E
INORGANIC ACIDS										
Hydrochloric 38% / Hydrochloric 10% / Sulphuric 10% / Nitric 10%	S	E	E	E	E	G	E	S	E	G
Chromic	S	E	G	G	E	NR	G	S	E	NR
Sulphuric 98% / Nitric 70%	G	F	G	G	G	NR	G	G	F	NR
HYDROCARBONS										
Stoddard Solvent / Toluene / Benzene / Xylene	G	G	F	F	G	NR	F	G	G	NR
Coal Tar Distillate	S	E	F	F	G	NR	F	S	E	NR
Styrene	G	F	G	G	G	F	G	G	F	F
MISCELLANEOUS										
Lacquer Thinner	G	F	F	F	G	NR	F	G	F	NR
Cutting Oil	S	E	E	E	E	F	E	S	E	F
Battery Acid	S	E	E	E	E	G	E	S	E	G
Phenol	S	E	G	G	G	G	G	S	E	G
Insecticides	S	E	E	E	E	F	E	S	E	F
Printing Ink	S	E	E	E	E	F	E	S	E	F
Dyestuffs	S	E	E	E	E	E	E	S	E	E
Penta	E	G	E	E	E	F	E	E	G	F
Formaldehyde	S	E	E	E	E	E	E	S	S	E
Vegetable Oil	S	E	E	E	E	G	E	S	E	G
Animal Fat	S	E	E	E	E	G	E	S	E	G
Acrylonitrile	S	E	G	G	E	E	G	S	E	E
Steam	S	E	E	E	E	E	E	S	E	E
Aniline	S	E	E	E	E	E	E	S	E	E
Hydraulic Fluid	S	E	E	E	E	F	E	S	E	F
Turpentine	E	G	E	E	E	F	E	E	G	F
Linseed Oil	S	E	G	G	E	NR	G	S	E	NR
Soya Bean Oil	S	E	G	G	E	F	G	S	E	F
Carbon Disulfide	F	NR	NR	F	F	G	F	F	NR	G
Creosote	E	G	G	G	G	F	G	E	G	F
Paint & Varnish Remover	E	F	F	F	F	NR	F	E	F	NR

PHYSICAL PROPERTIES CHART

COATING	Abrasion Resistance	Cut Resistance	Snag Resistance	Heat Resistance	Low-Temp. Resistance	Flexibility	Dry Grip	Wet Grip
NYGRAN	S	S	S	G	E	G	E	G
NEOPRENE	G	E	E	G	E	G	E	F
PYTHON	G	E	E	G	E	G	G	E
SLIP-NOT	G	E	E	E	E	G	E	E
DYNAGLUV	E	NR	E	F	NR	G	E	F
DYNAGRIP	E	NR	G	F	NR	E	E	E
GRANFLEX	E	NR	G	F	G	E	E	G
GRANECON	E	NR	G	F	E	E	E	E

S — Superior E — Excellent G — Good F — Fair NR — Not Recommended

DIGICAP®

Finger guards

High density, plastic finger caps help protect tips against "pinch points" and minor blows. Worn inside work gloves. Stay in place until removed. Reusable when gloves wear out. Packaged six to a unit for index, middle and ring fingers, or, in bulk for one finger on each hand.

How to order:

For faster service, contact your nearest Granet distributor with the style number and quantity you desire. If a Granet distributor is not listed in your area, write: The Granet Division, ESB Inc., Framingham, MA 01701.

Glove control:

Work glove cost can be reduced by glove control. (1) Use the right glove for the job and standardize on as few glove styles as possible. (2) Granet distributors can do a "glove survey" in your plant. (3) Issue new gloves only when the worn out ones are returned by the wearer. (4) Check and see if one hand wears out faster than the other. If so, order and issue one hand only.

Glove care and replacement:

To add life to coated gloves being heavily exposed to **solvents** and **acids** it is always a good idea to alternate the wearing of two pairs. Wear one pair for half the work shift and the other pair for the other half. Rinse outer surface with water after each wearing.

Replacement of gloves is dependent on the wear factor created by the job application. Check gloves frequently for cracks, tears, splits, wear points, leakage and the like. Be sure to use a gauntlet glove long enough for the job application.

There is no such thing as maximum hand protection.

Lower glove costs:

Make your own evaluation of protection and economy by testing glove recommended by your Granet trained representative.

Granet 3 Point Hand Protection Program:

A simplified 3-step procedure for developing a plantwide hand safety program is contained in a FREE folder. Send for your copy today.

Main Plant — Sales Headquarters (U.S.A.)
P.O. Box 588
25 Loring Drive, Framingham, MA 01701
Phone: (617) 873-3521

North Carolina Plant — Snow Hill, NC 28580

GRANET DIVISION
ESB INCORPORATED

ESB Granet

Form 845 Printed in U.S.A.

AO®/Goggles

American Optical Corporation, Safety Products Division
14 Mechanic Street, Southbridge, MA 01550

FLEXIBLE MASK GOGGLES

482B Impact Goggle

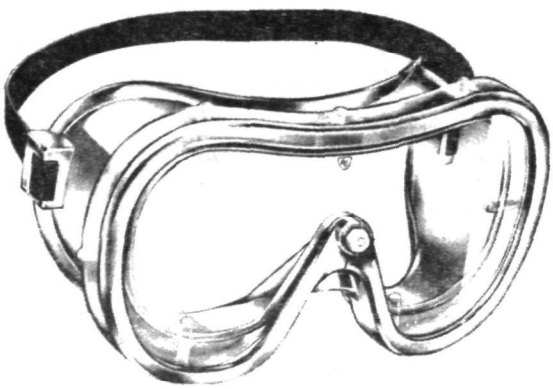
- For impact protection on chipping, metal cutting, light grinding operations
- Fits over personal glasses
- Anti-fog DURAFON™ lenses available
- Comfortable flexible vinyl masks offer maximum ventilation
- .050" thick polycarbonate lenses in clear or green
- Elastic headband

Cat. No.	Code No.	Description
Clear Mask		
482B	40811	Clear Lens
482B	40812	Green Lens
Anti-Fog, Clear Mask		
482BAF	40838	Clear DURAFON Lens
482BAFG	40839	Green DURAFON Lens
Transparent Green Mask		
487B	40819	Clear Lens
487B	40820	Green Lens
Anti-Fog, Transparent Green Mask		
487BAF	40779	Clear DURAFON Lens
487BAFG	40780	Green DURAFON Lens
Replacement Parts		
209C	44613	Clear Lens
209CAF	44621	Clear DURAFON Lens
210C	44615	Green Lens
210CAF	44625	Green DURAFON Lens
213	23139	Elastic Headband

484B Chemical Splash Goggle

- For protection against splashing liquids, dusts, flying particles
- Fits over personal glasses
- Anti-fog DURAFON™Lenses available
- 4 vents help prevent fogging in normal atmospheres
- .050" thick polycarbonate lenses in clear or green
- Rubber headband

Cat. No.	Code No.	Description
Clear Mask		
484B	40815	Clear Lens
484B	40816	Green Lens
Anti-Fog, Clear Mask		
484BAF	40832	Clear DURAFON Lens
484BAFG	40780	Green DURAFON Lens
Transparent Green Mask		
499	40906	Clear Lens
499	40937	Green Lens
Anti-Fog Transparent Green Mask		
499AF	40934	Clear DURAFON Lens
499AFG	40936	Green DURAFON Lens
Replacement Parts		
209C	44613	Clear Lens
209CAF	44621	Clear DURAFON lens
210C	44615	Green Lens
210CAF	44625	Green DURAFON Lens
251	23155	Rubber Headband



710B Deluxe Chemical Splash Goggle

- For protection against splash, dusts, impact
- Fits over personal glasses
- Fully vented rim keeps goggle fog-free twice as long as standard splash goggles
- DURAFON anti-fog lenses available
- .050" thick polycarbonate lenses in clear or green
- Rubber headband

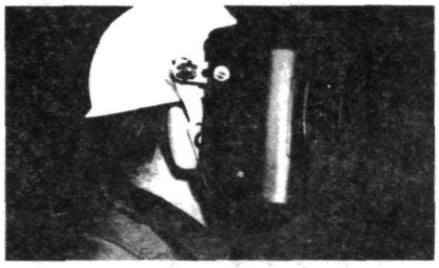
Cat. No.	Code No.	Description
Clear Mask		
710B	40978	Clear Lens
710B	40981	Green Lens
Anti-Fog		
710BAF	40989	Clear DURAFON Lens
710BAFG	40990	Green DURAFON Lens
Replacement Parts		
259P	44679	Clear Lens
259GP	44680	Green Lens
259AF	44677	Clear DURAFON Lens
259GAF	44678	Green DURAFON Lens

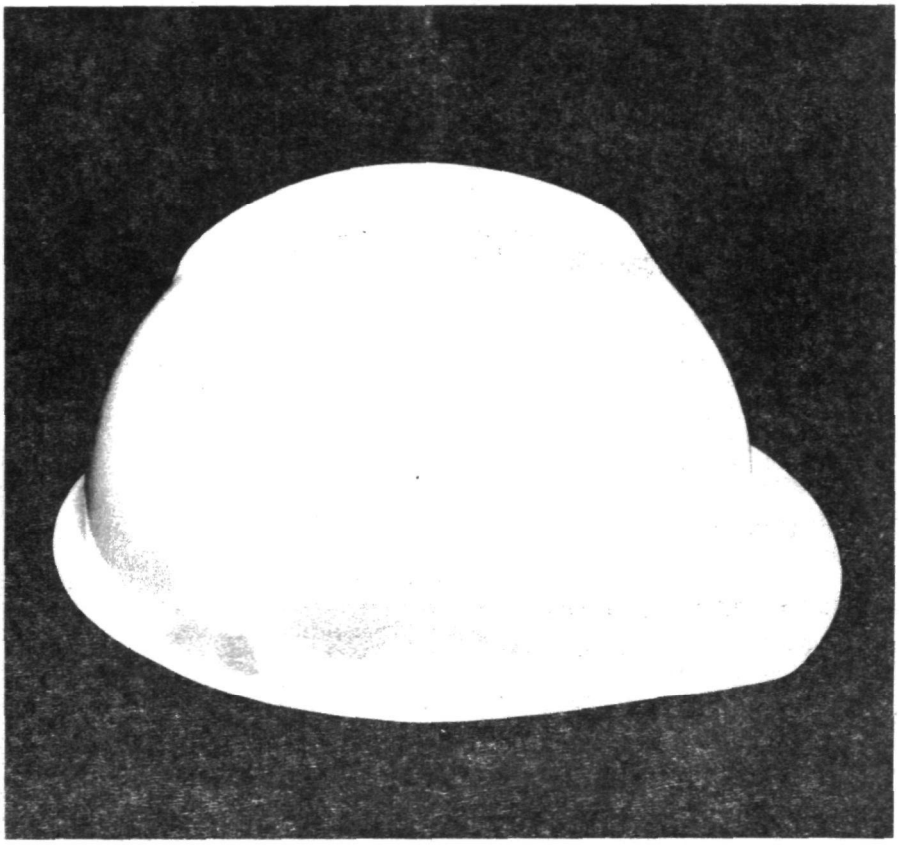
These goggles meet requirements of ANSI Z87.1-1968 Standard.

MSA

Data Sheet
06-01-01

V-Gard® Slotted Cap





Application

The V-Gard Slotted Cap provides head protection from impact hazards in industrial and general use as specified in the performance requirements of ANSI Z89.1—1969 and ANSI Z89.2—1971, and, at the same time, provides capability for wearing hearing protection devices, and faceshields or welding helmets. Widely used in construction industry, government, utilities, manufacturing plants.

Description

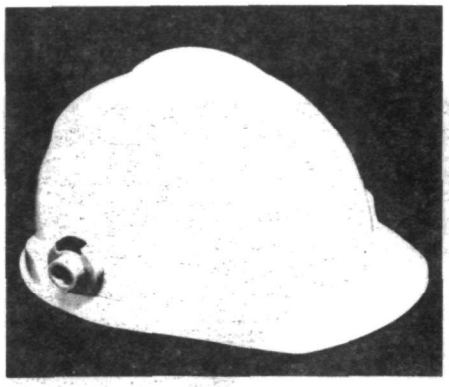
The V-Gard Slotted Cap consists of a shell and suspension working together as a protection system.

The rigid shell is lightweight and balanced for all-day wearing comfort. It is one-piece injection molded of high-density polyethylene and has high dielectric strength (non-conduction of electrical current). The V-Gard design features advanced styling, and the cap is available in seven molded-in colors that will not fade: white, blue, yellow, orange, green, red, and gray.

The Staz-on™ Suspension has two major components—adjustable headband, and double crown straps. Four plastic clips slide into recessed slots in the shell to hold the suspension in place eliminating pressure points around the headband. The suspension supports the shell away from the head to provide a minimum 1¼ inches of crown clearance between top of head and shell. This allows both the shell and the suspension to work together as a system to absorb energy in case of a blow.

Approximate weight of shell and suspension: 12 oz.

(For additional information on the Staz-on Safety Helmet Suspension, refer to MSA Data Sheet 06-00-12.)



Systems III Kits

The V-Gard Slotted Cap accommodates the Systems III Adapter Kit for Hearing Protection (Catalog No. 463695), and Systems III Adapter Kit for attaching Faceshield or Welding Helmet (Catalog No. 463694).

See MSA Data Sheet 06-02-01 for details.

Approvals and standards

The V-Gard Slotted Cap complies with all the test requirements of ANSI Z89.1—1969 Class A (Industrial Head Protection), and ANSI Standard Z89.2—1971 Class B (Industrial Protective Helmets for electrical workers).

Inspection and maintenance

V-Gard Slotted Caps should be regularly inspected for signs of deterioration, damage, or wear. In accordance with ANSI Z89.1 and ANSI Z89.2, all components, including the shell, suspension, headband, sweatband, and any accessories should be visually inspected daily for signs of dents, cracks, penetration, or any other damage due to impact, rough treatment, or wear that might reduce the degree of safety originally provided. Any industrial helmet that requires replacement should be removed from service.

Inspection should be accompanied by a program of properly cleaning the helmets and keeping them in good condition. Most stains or dirt can be removed from V-Gard Slotted Caps with the use of warm water and MSA Cleaner-Sanitizer solution.

The suspension should be routinely replaced at least twice a year under normal wear conditions. It should be examined closely for cracking, torn adjustment slots, fraying of material, or other signs of wear, especially at the suspension clips. The suspension can be cleaned with MSA Cleaner-Sanitizer and warm water using a sponge or soft brush to remove most dirt, perspiration, and skin oils. Do not use heat in drying. If other material such as tar or grease is on the suspension, it should be replaced.

Ordering information

Catalog numbers

V-Gard Slotted Cap:	**Color**
463942	White
463943	Blue
463944	Yellow
463945	Orange
463946	Green
463947	Red
463948	Gray
464852	Gold

V-Gard Hat (non-slotted)

A hat, with all the design and construction features of the V-Gard Slotted Cap except the slots, is available for those who prefer full-brim head protection.

V-Gard Hat (non-slotted):	**Color**
454730	Yellow
454731	Gray
454732	Blue
454733	White
454734	Orange
454735	Green
454736	Red

Note: This Data Sheet is a guide, containing only a general description of the uses and performance capabilities of the V-Gard Slotted Cap and V-Gard Hat. Before use, refer to and strictly follow all instructions, cautions, and warnings on or with the products. For more complete information, contact MSA, 600 Penn Center Blvd., Pittsburgh, Pa. 15235.

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Mine Safety Appliances Company
600 Penn Center Boulevard
Pittsburgh, Pennsylvania 15235

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Cable address—"MINSAF" Pittsburgh

Printed in U.S.A. 783 (L)

MSA

Data Sheet
06-02-01

Systems III™ Adapter Kits for use with MSA Slotted Headwear

Application

Used in conjunction with MSA slotted headwear, the Systems III Adapter Kits permit workers to wear hearing protection devices and/or faceshields and welding helmets with their head protection. The combination provides head and face protection against certain specific hazards encountered in the construction industry, government, utilities, manufacturing plants, and other industrial applications.

Description

The basic component of the Systems III adapter is a pair of mounting brackets with tension springs and lock tabs to retain the brackets firmly in two headwear slots, one on each side of the cap. Two Adapter Kits are available for attaching accessories—one for hearing protection and one for a faceshield or welding helmet. The mounting brackets are of rugged Delrin* plastic, and feature a quick-release mechanism that allows the attached faceshield or welding helmet to be detached without removing the mounting brackets from the slots.

The mounting brackets are designed to accommodate ear muffs and welding helmet or faceshield simultaneously. And the welding helmet can be worn with the peak of the Slotted V-Gard Cap in the normal forward position instead of having to reverse the cap to accommodate the accessory. The welding helmet can be adjusted both in and out as well as up and down for individual fit and best downward vision.

The new Systems III Adapter Kits for Slotted Headware will accommodate almost all MSA standard welding helmets and the Super-Gard® or Sightgard® faceshield frames.

*Trademark of E.I.du Pont de Nemours & Co. (Inc.)

Approvals and standards

MSA Welding Helmets, with appropriate plates, and MSA Faceshield Assemblies used with the Systems III Adapter Kit, meet the requirements of ANSI Z87.1—1968.

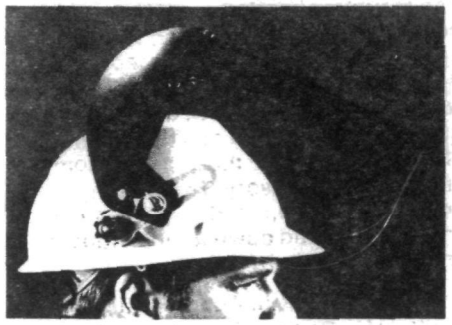
Ordering information

Catalog numbers

463695 Systems III Adapter Kit for Hearing Protection, complete with ear muffs (includes 2 mounting arms, 2 earcups with cushion and damping pad, 2 spring washers, one right bracket, and one left bracket).

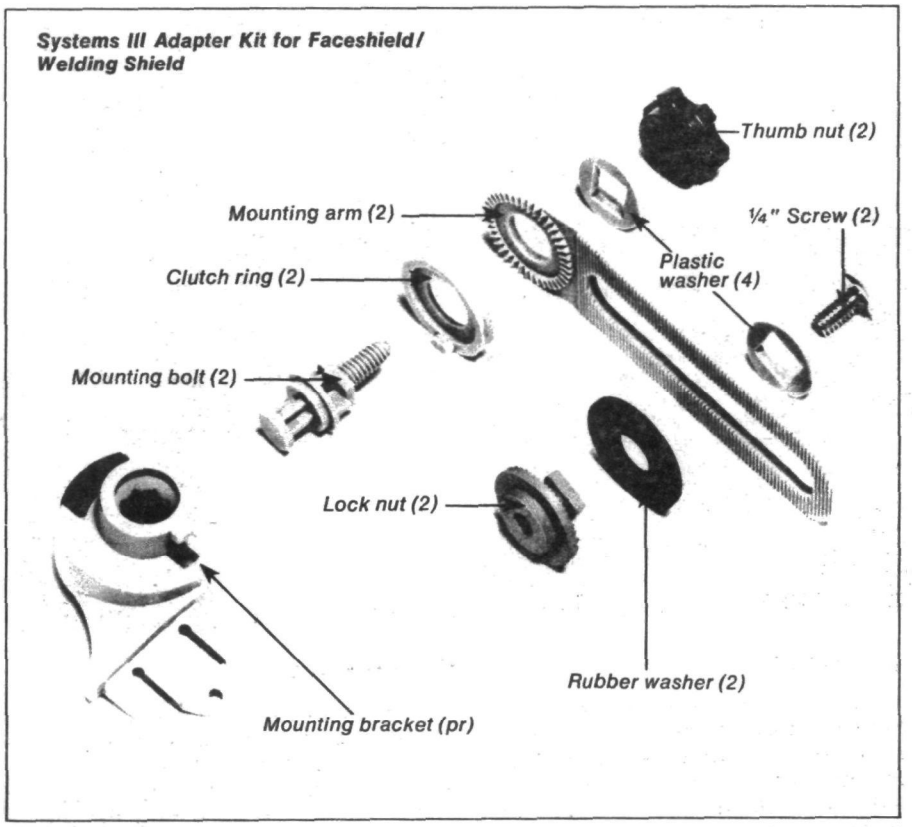
463694 Systems III Adapter Kit for Faceshield and Welding Helmet (includes one right bracket, one left bracket, 2 mounting bolts, 4 plastic washers, 2 thumb nuts, 2 mounting arms, 2 clutch rings, 2 lock nuts, 2 screws ¼"-20, and 2 rubber washers)—faceshield or welding helmet not included.

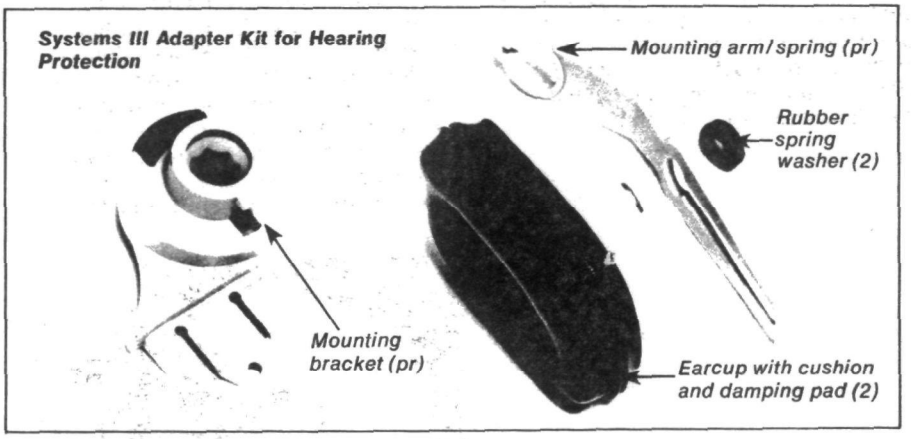
Note: For ordering information on Welding Helmets, see MSA Data Sheet 06-00-17 and refer to "Shell Only" column for part numbers. For ordering information on Faceshields, see MSA Data Sheet 06-00-16 and order either Super-Gard (shell only) or Sightgard (shell only) with proper visor. Slotted U-Gard Caps are available in seven colors —see MSA Data Sheet 06-01-01.



Clutch ring of Faceshield/Welding Helmet mounting arm can be adjusted to hold shield in any desired position.

Quick-release mechanism on mounting bracket permits detaching shield without removing bracket itself from cap, and without disturbing ear muffs if worn with shield.





Note: This Data Sheet is a guide, containing only a general description of the uses and performance capabilities of the Systems III Adapter Kits. Before use, refer to and strictly follow all instructions, cautions, and warnings on or with the product. For more complete information, contact MSA, 600 Penn Center Blvd., Pittsburgh, Pa. 15235.

MSA Mine Safety Appliances Company
600 Penn Center Boulevard
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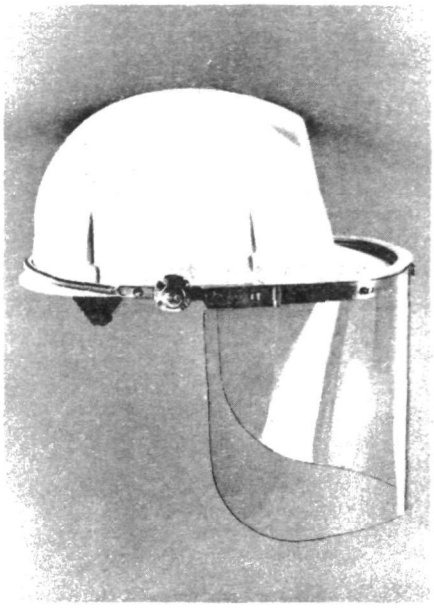
MSA

Data Sheet
06-00-15

Foldback Faceshield



Description

The Foldback Faceshield provides limited eye and face protection for wearers of MSA industrial head protection and the Topgard® Fireman's Helmet.

The faceshield is available in two models:

1. Hat (full brim) model—will fit all MSA and most other protective hats.

2. Cap ("peak" or "visor" partial brim) model—will fit all MSA and most other wide peak caps and, when worn with an optional cap spacer, will fit most small peak caps.

Both models have two components, the faceshield adapter which attaches to the hat or cap, and the faceshield protective visor (window).

Faceshield Adapter: Has an aluminum U-shaped channel that fits over the front of the hat brim or the peak of the cap (a cap spacer is needed to fit the channel to the brim of small peak caps).

A metal spring attaches to each end of the channel and stretches around the back of the helmet above the brim area to hold the channel firmly in place.

An aluminum L-shaped visor support is attached to the channel with a position-stop friction joint that holds the visor in the raised position or in the protective (down) position.

The visor support folds back over the crown of the helmet when not in the protective position. In the protective position, the support seats completely on the top of the channel, without gaps or open spaces between the hat or cap and the visor support to which the visor is attached.

The support accommodates the protective visor with two end spring clips and three male snap studs.

Faceshield Protective Visor (window): Protective visors are available in three materials: wire screen mesh, polycarbonate, and cellulose acetate.

Wire screen visors are 24 mesh, black lacquer-coated for work involving high heat exposure. A partial visor, 4" x 8" (10.16 cm x 20.32 cm) of dark green cellulose acetate and a visor spacer are available for additional glare protection when used behind the wire screen visor.

Polycarbonate (plastic) visors are stronger and more heat resistant than cellulose acetate. Cellulose acetate (plastic) visors are more scratch resistant and generally less expensive than polycarbonate visors.

Both the polycarbonate and cellulose acetate visors are clear plastic, and the cellulose acetate visors also are available with a green tint to reduce effects of nuisance glare.

The protective visor is furnished in a 6" (15.24 cm) length. It also is available in an 8" (20.32 cm) length if additional protection is desired or if work is being performed above eye level. To provide full 180° protection, plastic visors are 17½" (44.45 cm) wide and the wire mesh screen visor is 18" (45.72 cm) wide. Plastic visors are furnished in .040" (.1016 cm) thickness or .060" (.1524 cm) thickness for heavier duty.

Application

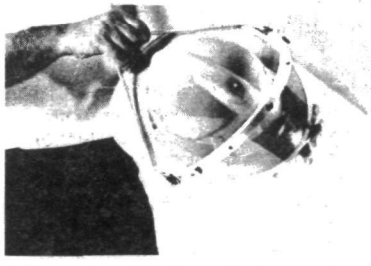
ANSI Standard Z87.1-1968 for eye and face protection states that the faceshield is designed to provide protection to the face (i.e., the front part of the head including forehead, cheeks, nose, mouth, chin) and neck, where required, from flying particles and sprays of hazardous liquids and, in addition, to provide antiglare protection where required. The faceshield should be worn over suitable basic eye protection devices. The following recommendations are based on the selection chart in this ANSI Standard.

For Severe Exposures: The Foldback Faceshield (with suitable protective visor), when used with appropriate head protection, is recommended for eye and face protection as follows:

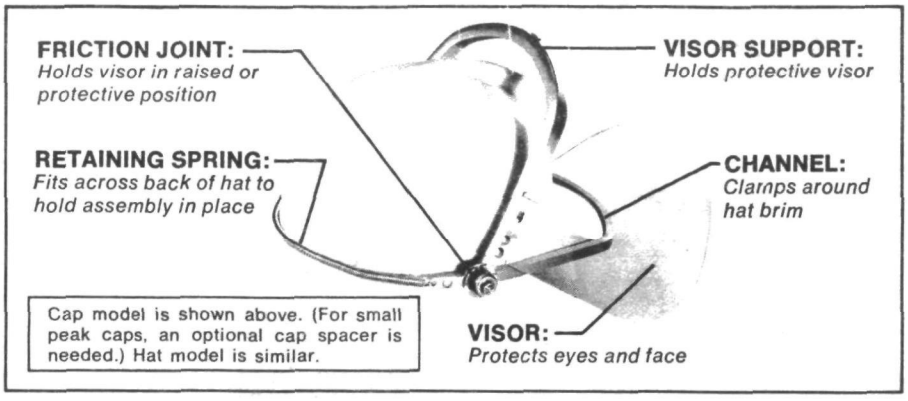
- In chemical handling operations involving splash, acid burns, and fume hazards (when worn over appropriate goggles).
- In furnace operations involving glare, heat, and molten metal hazards (when worn over appropriate welding goggles).
- In heavy grinding operations involving flying particle hazards (when worn over appropriate goggles or chippers' goggles).

For Other Than Severe Exposures: The Foldback Faceshield (with suitable protective visor), when used with appropriate head protection is acceptable (though not preferred) for eye and face protection as follows:

- In chemical handling operations involving splash, acid burns, and fume hazards.
- In light grinding operations involving flying particle hazards.
- In laboratory operations involving chemical splash and glass breakage hazards (when worn with sideshield spectacles).
- In machining operations involving flying particle hazards.
- In molten metals operations involving heat, glare, sparks, and splash hazards (when worn with sideshield spectacles with tinted lenses).
- In spot welding applications involving flying particle and spark hazards.



A formed metal channel clamps around the front brim of the hat, while a retaining spring fits across the back above the brim to hold the Foldback Faceshield in place.



Cap model is shown above. (For small peak caps, an optional cap spacer is needed.) Hat model is similar.

Approvals and Standards

The Foldback Faceshield Assembly and all protective visors (windows) comply with regulations of the Occupational Safety and Health Act, Part 1910—Safety and Health Standards, which require that these products be in accordance with ANSI Standard Z87.1-1968 Practice for Occupational and Educational Eye and Face Protection. Use of the Foldback Faceshield with approved head protection meets the requirements of ANSI Z87.1-1968 for eye and face protection and ANSI Z89.1-1969 for industrial head protection.

Polycarbonate visors are self extinguishing when tested according to ASTM D 635.

Inspection and Maintenance

The Foldback Faceshield should be routinely inspected for signs of wear at the friction joints, for any bending of the aluminum channel which would affect its correct fit at the brim, for proper resilience of the retaining spring, and for any scratching or signs of cracking in the visor. Replace damaged parts immediately.

In keeping with the ANSI Standard Z87.1-1968, daily cleaning of the visor is recommended because continuous vision through a dirty visor can cause eye fatigue and become a contributory factor to accidents. The entire assembly should be cleaned after each use with warm water and MSA Cleaner-Sanitizer solution using a sponge or soft brush. Rinse thoroughly and let dry at room temperature.

Caution

Do not allow the Foldback Faceshield and protective helmet to come in contact with energized electrical conductors (live wires).

Never alter or modify the Foldback Faceshield in any way. Never use the faceshield or its components for anything other than its intended purpose.

Never use the Foldback Faceshield if it has been damaged in any way; replace damaged parts immediately.

Ordering Information

457908	Foldback Faceshield (hat model)
459749	Foldback Faceshield (cap model)
459975	Cap Spacer (for use with small peak caps)
457409	Visor, wire-mesh screen, 18 in. x 8 in.
457406	Visor, glare, dark green, 4 in. x 8 in., cellulose acetate, .040 in. thick
457402	Visor Spacer (for use with glare visor and wire-mesh screen combination, only)
458973	Visor, polycarbonate, 17½ x 6 x .040 in., clear
458976	Visor, polycarbonate, 17½ x 6 x .060 in., clear
458967	Visor, polycarbonate, 17½ x 8 x .040 in., clear
458970	Visor, polycarbonate, 17½ x 8 x .060 in., clear
458972	Visor, cellulose acetate, 17½ x 6 x .040 in., clear
458975	Visor, cellulose acetate, 17½ x 6 x .060 in., clear
458971	Visor, cellulose acetate, 17½ x 6 x .040 in., green
458974	Visor, cellulose acetate, 17½ x 6 x .060 in., green
458706	Visor, cellulose acetate, 17½ x 8 x .040 in., clear
458969	Visor, cellulose acetate, 17½ x 8 x .060 in., clear
458705	Visor, cellulose acetate, 17½ x 8 x .040 in., green
458968	Visor, cellulose acetate, 17½ x 8 x .060 in., green

Note: This Data Sheet is a guide, containing only a general description of the uses and performance capabilities of Foldback Faceshield. Before use, refer to and strictly follow all instructions, cautions, and warnings on or with the product. For more complete information contact MSA, 600 Penn Center Blvd., Pittsburgh, Pa. 15235.

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APPENDIX B

EPA MEDICAL MONITORING GUIDELINES

EQUITABLE
ENVIRONMENTAL
HEALTH
INC.

Chicago
New York
Washington, D.C.

A Subsidiary of The Equitable Life Assurance Society of the United States

EEH/WC-79L-356

October 25, 1979

TO: Don Webb, Project Officer, EPA Contract, #68-03-2789

FROM: Gordon S. Siegel, M. D. Project Director Gordon S. Siegel, M.D.

SUBJECT: Comments on Medical Services and Medical Monitoring-- Hazardous Waste Sites

Hazardous waste sites, by definition, have potential for adverse health effects on the workers who may be required to conduct operations there. The determination of the probability of adverse effect--risk assessment--is often complex and difficult.

The safe conduct of investigations and operations at such sites involves multiple factors, including waste identification, the condition of stored materials, the nature of the storage site, use of appropriate equipment and devices, training of personnel, etc.

Medical services and the medical monitoring of personnel can contribute to both the safety and efficiency of hazardous waste site work. Such medical services can be considered under four general classifications or types:

- Assessment of the heath status of individuals prior to work.
- Support of the health of workers at work.
- Evaluation and care of individuals with work-related injuries and illnesses.
- Monitoring of workers for evidence of post-work adverse health effects and suitability for future assignments.

A particular medical examination or procedure may contribute to the goals or requirements of more than one class. It is important to note that the evaluation of human health, and an assessment of adverse health effects in relation to occupational factors, is an inexact science. The judgment of informed and experienced health professionals must often be relied upon, rather than recourse to formal "standards".

It is also important to maintain perspective about the "ideal" and the "practical" in regard to health suitability for work. The imposition of stringent, rigid medical standards for any work is rarely justified, rather the application of general principles of medical services should be

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carefully fitted to individual workers and particular work situations. Very little of the world's work is performed under ideal conditions by ideal workers. However, this fact cannot be a justification for occupational health and safety abuses.

1. Assessment of the health status of individuals prior to work.

A thorough pre-employment or pre-placement medical examination for hazardous waste site workers provides:

- an evaluation of suitability, physically and psychologically, for the kinds of work that may be required.
- identification of health factors that may preclude or require modification of certain assignments.
- assessment of capability for proper use of necessary personal protective equipment.
- determination of base-line or reference data to help evaluate the significance of findings on future examinations.

The examination should consist of a detailed medical and occupational history, a thorough physical examination with particular attention to the cardiopulmonary systems, general physical fitness, skin, blood forming, hepatic, renal and nervous systems. Tests should include chest X-ray, electrocardiogram, simple ventilatory pulmonary function, urinalysis, a complete bood count, and a blood chemistry profile. Additional tests and procedures may be indicated in the judgment of the examining physician, based on knowledge of the work to be performed.

2. Support of the health of workers while working.

There must be provision of adequate first-aid services and supplies, and planning, where possible, for first-aid services appropriate to the work engaged in, for example, treatment of chemical burns.

An emergency medical transport plan and services, to an identified medical care facility, is necessary.

Medical consultation services to advise on health and medical questions and problems arising in the course of work should be identified and made available.

3. Evaluation and care of individuals with work-related injuries and illness.

Appropriate medical care providers for evaluation and treatment of workers with suspect or definite occupational illnesses and injuries should be identified. The planning for such services should include provision for transmittal of pertinent work condition and exposure information to assist the medical care providers in their evaluation, diagnosis and treatment.

4. Monitoring workers for evidence of work-related adverse health effects and continued suitability for work.

A program of periodic medical examination and health status evaluation of workers should be established to:

- assist in early detection of work-related adverse health effects in individual workers.
- assess the health status of individual workers as to fitness for assignments and their use of protective equipment.
- provide individualized occupational health guidance and counseling.
- assemble group data useful for epidemiological purposes.

The scope and content of such periodic examinations will be influenced by the kinds of work and exposures encountered in the intervals between examinations. They will usually include an interval medical and occupational history, a physical examination, and selected blood, urine, and pulmonary function tests. Periodic cardiograms and chest X-rays, as well as other special tests, may be recommended by the examining physican in certain circumstances. The periodicity of such examinations is influenced by the work performed, but an annual examination is common.

ENVIRONMENTAL PROTECTION AGENCY

FY 1980-81

MEDICAL MONITORING PROGRAM GUIDELINES

The following information and attachments are intended for use by Agency components that conduct occupational medical monitoring programs. These guidelines outline the minimum essential elements for such a program and should not be regarded as being comprehensive. Some Agency workplaces may have potential exposure hazards that will require medical monitoring procedures not covered in this basic description; however, it is essential that each local program include at least the elements described herein. As more Federal regulations and recommendations appear for employees potentially exposed to toxic chemical and physical agents, program updates and modifications are to be expected. When such changes occur, they will be presented by the Agency's Office of Occupational Health and Safety.

Who should be included in a medical monitoring program?

This medical monitoring program is designed basically for laboratory and field workers whose work regularly poses the possibility of exposure to toxic materials. In addition, the program should meet the needs of other diverse groups of employees whose jobs require preplacement and/or periodic health assessment. Generally, administrative, fiscal, secretarial, statistical, and other support personnel who are exposed to toxic materials indirectly, infrequently, or inconsequentially should not be included. Representative job categories that should have medical monitoring made available on exposure include chemists, microbiologists, toxicologists, physical scientists, and the technical personnel who support these disciplines. Employees who collect various types of polluted samples should be included if the sampling requires exposure to pollutants significantly in excess of ambient concentrations. Maintenance personnel normally should be included, since they are occasionally exposed to toxicants at unexpectedly high concentrations, as should those who perform custodial services in actual laboratories or in areas where toxic materials are stored. Part-time and temporary employees should be included if their jobs are similar to the categories previously mentioned. The decision as to which employees are nominated should rest with the program director or supervisor most familiar with the possible hazards involved.

Is the program voluntary?

Employees whose jobs justify inclusion in the program have the option to participate or not, with the exception of those few persons whose jobs require such examinations as a condition of employment. Future Agency policy may expand the number of job categories that will require

preplacement and periodic health assessment. Experience indicates that about 85% of nominated employees will elect to participate in the program. A written record of those deferring or declining participation should be kept to protect the Agency against accusations that such a program was not made available. A simple notation to the effect that an individual has declined is sufficient. Declining employees should be reinvited to participate regularly if they remain eligible for the program. Each facility should review its entire roster periodically to assure the inclusion of all "at-risk" personnel.

Who will pay for the program?

Medical monitoring is the responsibility of the employer, and the Agency must bear the entire cost. When a preexisting or non-job-related condition is detected in the course of a health monitoring examination, the individual is to be referred to his/her private physician for further evaluation, treatment, and followup. The individual must bear these additional costs. When a condition appears to have resulted from employment, the employee may seek compensation and the payment or recovery of medical expenses from the Department of Labor, Office of Workers' Compensation Programs.

Consultation is available from the Agency Office of Occupational Health and Safety when job-related illness is detected or suspected.

How are physician services obtained?

The fact that most EPA operations are able to use purchase orders to obtain local physician services simplifies this procurement. Ideally, the physician chosen should be board certified in occupational medicine; however, this is unrealistic because the number of such physicians available is quite small and most serve as full-time program directors for large industrial corporations.

For the purpose of this program, a local physician in a practice of internal medicine or in general practice will usually suffice. A physician who belongs to the American Occupational Medical Association or a local occupational health society is preferred; the names of these physicians may be obtained from the American Occupational Medical Association, 150 North Wacker Drive, Chicago, Illinois 60606 (312/782-2166).

The important requirements are that the physician is capable, is equipped to conduct a thorough physical examination, and has a high interest in the program. A local physician is in the best position to provide a continuity of service over the years and to handle referrals when non-job-related conditions are detected. On occasion, local U.S. Public Health Service facilities are willing to perform this service. The use of a Federal facility generally offers an economic advantage and is encouraged whenever such services are offered.

How are related laboratory services obtained?

These services must be performed by a clinical laboratory that is competent, is licensed, participates in a proficiency testing program(s), and maintains rigorous quality control. It should be licensed by the Federal government. A number of large interstate laboratories provide satisfactory service, rapid turnaround, and reasonable fees. These laboratories usually provide their own collection and mailing containers at no extra cost, and most have government "rates" that are competitive. Since these are large laboratories, they can provide, at a reasonable additional cost, special tests that may be essential for those employees who have been exposed to specified chemicals. Many hospital and local laboratories can supply only a portion of the laboratory tests that may be needed; also, in performing more complex tests, these hospitals and laboratories may be less reliable than the large interstate laboratories that routinely carry out such procedures.

The local examining physician will be responsible for requesting, interpreting, and evaluating laboratory reports. A laboratory of the physician's choice is preferable, provided that it meets quality and cost reasonability standards.

How often should examinations be offered?

Ideally, the periodicity and content of monitoring examinations should be determined by an evaluation of the occupational risk; i.e., the probability of adverse effects of exposure. When the program was initiated, it was recommended that an annual examination suffice for most participants. Until better criteria are developed from a study of EPA operations and monitoring findings, an annual evaluation is still recommended.

The first, or baseline, examination offered to each participant should consist of a complete medical examination. This examination will be useful in providing reference information for the evaluation of subsequent periodic examination findings. Subsequent monitoring examinations, for most EPA operations, can be of more limited scope.

Is the program a substitute for "general checkups"?

Participants should be advised that this program of medical monitoring examinations is not a direct substitute for "general checkups" or other periodic examinations designed to monitor or promote general health. The occupational medical monitoring program is designed to screen for evidence of adverse effects of occupational exposure, particularly exposure to toxic substances. The examinations do not provide a comprehensive health evaluation; neither do they provide significant screening for many of the common nonoccupational chronic disorders.

Medical examination content recommendations

Current FY 1980-81 recommendations are to continue to provide a comprehensive baseline examination for new participants in the program and to provide periodic screening examinations for other participants.

Periodic monitoring should include, as a minimum, an interim medical and occupational history review, a screening physical examination, basic blood and urine laboratory tests (as discussed below), and a physician's evaluation. The monitoring examination should be supplemented by procedures and special tests only as warranted by exposure to specific significant hazards or stresses.

What are the basic laboratory tests to be included for each participant?

Each individual should receive a basic panel of blood counts and chemistries to evaluate blood-forming, kidney, liver, and endocrine/metabolic function. The following blood tests are considered to be the minimum desirable:

- White blood cell count and differential cell count
- Hemoglobin and/or hematocrit
- Albumin, globulin, and total protein
- Total bilirubin
- Serum glutamic oxalacetic transaminase (SGOT)
- Lactic dehydrogenase (LDH)
- Alkaline phosphatase
- Calcium
- Phosphorus
- Uric acid
- Creatinine
- Urea nitrogen
- Cholesterol
- Glucose

Each employee should have a routine urinalysis that consists of the following:

- Specific gravity
- pH
- Microscopic examination
- Protein

- Acetone
- Glucose

What other tests are recommended?

X-Ray

A baseline chest X-ray should be a standard 14- x 17-inch P-A (posterior-anterior) exposure. The lateral view is not necessary for routine screening purposes. The X-ray may be obtained from the examining physician, a local radiologist, or a local hospital. The film should be read or reviewed by a board-certified radiologist or other competent medical specialist. Subsequent periodic chest X-rays should be performed only when clinically indicated and not as a routine measure.

Electrocardiogram

An electrocardiogram should be included in the baseline examination. It ordinarily should be of the standard 12-lead resting type and interpreted by an internist or cardiologist. Subsequent periodic electrocardiograms should be obtained only when recommended by the examining physician, and not as a routine measure.

Pulmonary function

Pulmonary function testing is desirable as a part of the baseline examination. It may be indicated periodically for employees at respiratory system risk, such as those with significant exposure to toxic dusts and irritants. As a minimum, it should consist of simple tests of lung ventilation: forced expiratory volume in 1 second (FEV_1) and forced vital capacity (FVC).

Other special tests

Workers who are significantly exposed to certain designated materials may require additional special procedures in addition to the basic panel of tests. These tests are listed in Table 1 and are obtainable at an additional cost. The physician should determine who is in need of special tests after reviewing the history forms and after consulting with supervisors and/or medical monitoring coordinators and health and safety designees. Provision should be made for repeating tests when necessary. Consultative assistance is available from the Office of Occupational Health and Safety regarding special tests.

Tests dropped from 1977 guidelines

The following tests, recommended in the 1977 guidelines, are no longer recommended as routine tests for occupational monitoring, either baseline or periodic:

- VDRL or other serologic test for syphilis
- Serum specimen for freezing and storage
- Female cervical cytology test (Pap test)
- Serum glutamic pyruvic transaminase (SGPT)
- Serum triglycerides
- Serum sodium, chloride, and potassium
- Carcino-embryonic antigen

What medical monitoring records and forms are required?

Forms

To provide uniformity of data collection and to expedite analysis, it would be desirable to have an EPA standard form(s) for use in medical monitoring examinations. However desirable, this goal does not appear possible in the immediate future. Private medical examiners use a variety of forms and automated systems to obtain and record medical information. The scope and quality of information-gathering and recording systems used should be at least equal to that of the forms discussed below.

Participants should be advised that the medical monitoring examinations are voluntary and that they are not required to answer any specific questions.

Medical history

The medical history will normally be obtained by having each participant fill out a medical and occupational history form before seeing a physician (Attachment 1 provides an EPA-developed sample). Usually, this is done several days preceding the date of the physical examination. All programs are urged to adopt this form, or its equivalent, since most "standard" medical history forms are too sketchy, especially in terms of occupational history and exposure. The occupational exposure information may be reviewed by occupational health and safety personnel to assist the examining physician in performing an examination of appropriate scope. When completed, the form should be turned over to the physician or physician's designee in a manner safeguarding privacy and confidentiality of the participant.

Physical examination form

The physical examination should be recorded on a standard form such as Government Standard Form 88 (Attachment 2). This form is available in quantity and is used by nearly all governmental health providers. Although the local physician may have similar forms that he or she uses routinely, all workplaces are urged to adopt S.F. 88 to achieve Agencywide uniformity. Sections 60-63, 66-69, and 70-72 are not normally carried out as part

of monitoring physical examinations and may be omitted. Audiometry, item 71, is indicated for all employees regularly exposed to high noise levels; i.e., over 85 dB.

Privacy Act

Since the Health Monitoring Program will establish a set of records on individual citizens, it must meet the requirements of the Privacy Act of 1974 (P.L. 93-579). Each participant is required to read and sign a copy of the Privacy Statement (Attachment 3), which explains the authority for collecting the information, uses to be made of the information, rules of confidentiality, and disclosure information. The original of this statement should be made part of the employee's medical monitoring records, and a copy should be provided to the employee. Written requests for release of this information may be made by the employee, and such requests should also be made a permanent part of the record. Each Agency program area will be responsible for seeing that the provisions of this Act are met.

Required reports and actions

The examining physician must communicate all examination findings and opinions to the examinee. In addition, the examining physician should furnish the Agency a written report on any examinee with findings that, in the physician's opinion, indicate an adverse effect of occupational exposure. This report should detail the occupationally related findings and the basis for the physician's opinion. The physician should be instructed, however, not to reveal any specific findings or diagnoses unrelated to occupational exposure in the report to the Agency.

On receipt of such a report, the local medical monitoring coordinator shall promptly send a copy to:

Manager of Medical Monitoring
Office of Occupational Health and Safety (PM-273)
401 M Street, S.W.
Washington, D.C. 20460

Local management, safety officers, and supervisors should take prompt investigative and remedial action after being alerted to a possible occupational health and safety problem by a medical report. Technical assistance is available from the Office of Occupational Health and Safety.

TABLE 1

SPECIAL TESTS

An annual monitoring examination will be satisfactory for most workers. Additional special tests may be indicated for those workers who have significant exposures to chemical or physical agents, in accordance with OSHA or other applicable standards.

Substance	Special Tests
Acrylonitrile	Chest X-ray, fecal occult blood, procto-sigmoidoscopy
Inorganic arsenic	Chest X-ray, sputum cytology
Asbestos	Chest X-ray, pulmonary function
Benzene	Reticulocyte count
Coke oven emissions	Chest X-ray, pulmonary function, sputum cytology, urinary sediment cytology
Cotton dust	Pulmonary function
Dichlorobromopropane	Sperm count (male), serum follicle stimulating hormone, serum luteinizing hormone, serum total estrogen (female)
Inorganic lead	Blood lead, peripheral blood smear morphology, blood zinc protoporphyrin
Noise (above 85 dB)	Audiometry
Organophosphate pesticides	Blood cholinesterase

Primate handlers should have an annual HB_sAg (hepatitis B surface antigen) test and a tuberculin test (unless known to be tuberculin positive).

EPA OMQ-1 Attachment 1

U.S. ENVIRONMENTAL PROTECTION AGENCY
OCCUPATIONAL MEDICAL QUESTIONNAIRE

For Medical Use Only

Date _____

Name _____
(Last) (First) (Middle)

EPA Organizational Unit _____

Location _____

Regular Workplace _____
(Building and Room Number)

Job Title and GS Series _____ Years in Present Job _____

Male [ ] Female [ ]

Age _____ Date of Birth _____
(Month, Day, Year)

Marital Status: Married [ ] Single [ ] Separated [ ] Divorced [ ] Widowed [ ]

Please answer the following questions by checking the applicable blocks:

Have you ever been hospitalized? No [ ] Yes [ ]

If yes, give details and dates:

Have you ever had an operation(s)? No [ ] Yes [ ]

If yes, give details and dates:

Have you ever been a resident outside the United States? No [ ] Yes [ ]

If yes, please list location(s) and date(s):

Indicate any job-related illnesses or injuries you have experienced since being employed by EPA:

EPA OMQ-2

In your work are you now or have you been exposed to any of the following agents?

Exposure	Present	Past
Inorganic fluorides	[ ]	[ ]
Lead	[ ]	[ ]
Benzene	[ ]	[ ]
Coke oven emissions	[ ]	[ ]
Inorganic arsenic	[ ]	[ ]
Methylene chloride	[ ]	[ ]
Vinyl chloride	[ ]	[ ]
Toluene diisocyanate	[ ]	[ ]
Excessive noise	[ ]	[ ]
Nitrogen oxides	[ ]	[ ]
Crystalline silica	[ ]	[ ]
Nitric acid	[ ]	[ ]
Ammonia	[ ]	[ ]
Beryllium	[ ]	[ ]
Phosgene	[ ]	[ ]
Allyl chloride	[ ]	[ ]
Asbestos	[ ]	[ ]
Suspect or known carcinogens	[ ]	[ ]
Pesticides	[ ]	[ ]
Bacteria or viruses	[ ]	[ ]
Primate animals	[ ]	[ ]
Vibrating tools	[ ]	[ ]
Radiation	[ ]	[ ]

EPA OMQ-3

Please make a list of those substances that you handle in your work. Star those that particularly concern you from a health standpoint.

Do you have any suggestions to reduce potential exposures?

Indicate any symptoms that you have experienced that might be due to exposure at work and indicate the suspected cause.

EPA OMQ-4

Do you have or are you concerned about any of the following? If so, please check the appropriate box or boxes.

[ ] Allergies
[ ] Back pain
[ ] Blood in urine, sputum, or stool
[ ] Blood pressure
[ ] Bowel problems
[ ] Cancer
[ ] Chest pain
[ ] Chronic cough
[ ] Cold or painful fingers
[ ] Constipation
[ ] Dental or gum problems
[ ] Depression or excessive worry
[ ] Diabetes
[ ] Diarrhea
[ ] Difficulty in sleeping
[ ] Dizziness
[ ] Ear or hearing problems
[ ] Edema (foot or leg swelling)
[ ] Eye trouble (other than glasses)
[ ] Fainting spells or unconsciousness
[ ] Fever
[ ] Frequent or severe headaches
[ ] Frequent indigestion
[ ] Heart condition
[ ] Heart murmur
[ ] Hemorrhoids (piles)
[ ] Hives
[ ] Hot flashes
[ ] Kidney problems
[ ] Joint pains
[ ] Leg cramps
[ ] Liver problems
[ ] Loss of memory
[ ] Lung or breathing difficulty
[ ] Menopause
[ ] Muscle aches or pains
[ ] Nervousness
[ ] Sexual problems
[ ] Sickle cell disease or trait
[ ] Skin disease
[ ] Stomach pain
[ ] Swollen glands
[ ] Thyroid gland problem
[ ] Tremor of hands or head
[ ] Tumors or cysts
[ ] Unexpected weight gain
[ ] Unexpected weight loss
[ ] Unusual weakness
[ ] Venereal disease

EPA OMQ-5

FAMILY HISTORY

Indicate any blood relatives who have or have had any of the following:

Disease	Relationship to Me				
	Mother	Father	Grandparent	Brother or Sister	My Children
Anemia	[ ]	[ ]	[ ]	[ ]	[ ]
Allergy (asthma,	[ ]	[ ]	[ ]	[ ]	[ ]
eczema, hay fever)	[ ]	[ ]	[ ]	[ ]	[ ]
Alcoholism	[ ]	[ ]	[ ]	[ ]	[ ]
Arthritis	[ ]	[ ]	[ ]	[ ]	[ ]
Bleeding disorders	[ ]	[ ]	[ ]	[ ]	[ ]
Cancer	[ ]	[ ]	[ ]	[ ]	[ ]
Congenital malformations	[ ]	[ ]	[ ]	[ ]	[ ]
Diabetes	[ ]	[ ]	[ ]	[ ]	[ ]
Emphysema	[ ]	[ ]	[ ]	[ ]	[ ]
Epilepsy	[ ]	[ ]	[ ]	[ ]	[ ]
Glaucoma	[ ]	[ ]	[ ]	[ ]	[ ]
Gout	[ ]	[ ]	[ ]	[ ]	[ ]
Heart attack	[ ]	[ ]	[ ]	[ ]	[ ]
High blood pressure	[ ]	[ ]	[ ]	[ ]	[ ]
Kidney disease	[ ]	[ ]	[ ]	[ ]	[ ]
Kidney stones	[ ]	[ ]	[ ]	[ ]	[ ]
Gallbladder disease	[ ]	[ ]	[ ]	[ ]	[ ]
Mental illness	[ ]	[ ]	[ ]	[ ]	[ ]
Mental retardation	[ ]	[ ]	[ ]	[ ]	[ ]
Sickle cell disease	[ ]	[ ]	[ ]	[ ]	[ ]
Stomach ulcers	[ ]	[ ]	[ ]	[ ]	[ ]
Stroke	[ ]	[ ]	[ ]	[ ]	[ ]
Tuberculosis	[ ]	[ ]	[ ]	[ ]	[ ]

If either of your parents is dead, list age and cause of death, if known:

Mother died age ____ of _____

Father died age ____ of _____

Are you aware of any diseases or illnesses that run in your family?

Yes [ ] No [ ]

If yes, please list:

_____

_____

EPA OMQ-6

Do you drink alcoholic beverages? Yes [ ] No [ ]

If yes, please answer the following:

Do you average drinking more than one bottle of beer per day?

Yes [ ] No [ ]

Do you drink more than a bottle of wine per week? Yes [ ] No [ ]

Do you drink more than a fifth of liquor per week? Yes [ ] No [ ]

Do you smoke? Yes [ ] No [ ]

If no, are you a former smoker? Yes [ ] No [ ]

If yes, how long ago did you quit? _____ Years

How many years did you smoke before quitting? _____ Years

How much were you smoking when you quit; i.e., number of cigarettes, "pipes," or cigars smoked per day?

_____

If yes, please answer the following:

How long have you smoked? _____ Years

How many of the following do you smoke per day?

Cigarettes _____

"Pipes" of tobacco _____

Cigars _____

EPA OMQ-7

Have you had or do you now have ary of the following illnesses or conditions? If so, please check the appropriate block(s):

[ ] Abnormal Bleeding
[ ] Anemia
[ ] Arthritis
[ ] Asthma
[ ] Cancer
[ ] Cirrhosis of the liver
[ ] Dermatitis
[ ] Diabetes
[ ] Dizziness or fainting
[ ] Epilepsy
[ ] Erysipelas
[ ] Gallbladder/stones
[ ] Glaucoma
[ ] Gonorrhea
[ ] Gout
[ ] Hay fever
[ ] Heart attack or trouble
[ ] Hepatitis
[ ] Hernia or rupture
[ ] High blood pressure
[ ] Hives
[ ] Jaundice
[ ] Kidney trouble or stones
[ ] Leukemia
[ ] Malaria
[ ] Migraine
[ ] Mumps
[ ] Nephritis (Bright's disease)
[ ] Nervous breakdown
[ ] Neuritis
[ ] Paralysis of any type
[ ] Piles or hemorrhoids
[ ] Pneumonia
[ ] Polio
[ ] Rheumatic fever
[ ] Scarlet fever
[ ] Swollen joints
[ ] Stroke
[ ] Syphilis
[ ] Tuberculosis
[ ] Ulcer (stomach or duodenal)

FEMALES ONLY:

Number of pregnancies _____

Number of living children _____

Number of miscarriages _____

Date of last Pap test _____

Date of last period _____

Have you had any unusual discharge or bleeding in the past three months?

Yes [ ] No [ ]

Have you reached menopause? Yes [ ] No [ ]

EPA OMQ-8

MEDICATION HISTORY

Are you now taking or have you taken any of the following within the past month?

[ ] Antacids
[ ] Antibiotics
[ ] Anticoagulant (blood thinner)
[ ] Antidepressants
[ ] Antihistamines
[ ] Appetite depressants
[ ] Aspirin
[ ] Benzedrine
[ ] Birth control pills
[ ] Blood pressure medication
[ ] Codeine
[ ] Cortisone or steroids
[ ] Dexedrine
[ ] Digitalis
[ ] Diuretic
[ ] Hormones
[ ] Insulin or oral anti-diabetic drug
[ ] Laxatives
[ ] Morphine
[ ] Sleeping pills
[ ] Sulfa preparations
[ ] Thyroid
[ ] Tranquilizers
[ ] Vitamins

List any drugs you take regularly:

_____

_____

Have you been on any special diet(s) in the past year? Yes [ ] No [ ]

If yes, describe type _____

_____

Are you allergic to any of the following?

[ ] Pollens
[ ] House dust
[ ] Animal dander, feathers, or fur
[ ] Drugs
[ ] Vaccines
[ ] Serum
[ ] Metal, jewelry
[ ] Foods
[ ] Sunlight or cold

If yes, please list or provide details.

_____

_____

EPA OMQ-9

IMMUNIZATION, VACCINES, ANTITOXINS

Check if you have received any of the following, and give approximate date(s) when last received, if known:

[ ] Tetanus _____

[ ] Poliomylitis _____

[ ] Influenza _____

[ ] Typhoid _____

[ ] Diphtheria _____

[ ] Rabies _____

[ ] Rubella (German measles) _____

[ ] Measles (Rubeola or red measles) _____

[ ] BCG _____

[ ] Yellow fever _____

[ ] Small pox _____

[ ] RhoGAM (Rh immune globulin) _____

[ ] Immune serum globulin for hepatitis _____

[ ] Others (please list) _____

_____

[ ] Mantoux, patch test, or other skin test for tuberculosis

Give date and result of last test, if known:

Date _____ Result [ ] Positive [ ] Negative

When you have finished this Medical and Occupational History form, hand it directly to the doctor or nurse, or, if mailed, mark envelope "To Be Opened Only by Medical Personnel."

EPA OMQ-10

FOR PHYSICIAN'S USE ONLY

Physician's summary and elaboration of all pertinent data. (Physician shall comment on all positive answers. Physician may develop by interview any additional medical history he deems important, and record any significant findings here.)

Typed or Printed Name of Physician _____ Date _____

Signature _____

MEASUREMENTS AND OTHER FINDINGS

51. HEIGHT	52. WEIGHT	53. COLOR HAIR	54. COLOR EYES	55. BUILD: ☐ SLENDER ☐ MEDIUM ☐ HEAVY ☐ OBESE	56. TEMPERATURE

57. BLOOD PRESSURE (*Arm at heart level*)						58. PULSE (*Arm at heart level*)				
A. SITTING	SYS	B RECUMBENT	SYS.	C STANDING (3 min.)	SYS.	A SITTING	B. AFTER EXERCISE	C 2 MIN. AFTER	D. RECUMBENT	E. AFTER STANDING 3 MIN.
	DIAS.		DIAS.		DIAS.					

59. DISTANT VISION		60. REFRACTION			61. NEAR VISION	
RIGHT 20/	CORR. TO 20/	BY	S.	CX	CORR. TO	BY
LEFT 20/	CORR TO 20/	BY	S.	CX	CORR. TO	BY

62. HETEROPHORIA (*Specify distance*)

ES° EX° R. H. L. H. PRISM DIV. PRISM CONV. CT PC PD

63. ACCOMMODATION		64. COLOR VISION (*Test used and result*)	65. DEPTH PERCEPTION (*Test used and score*)	UNCORRECTED
RIGHT	LEFT			CORRECTED
66. FIELD OF VISION		67. NIGHT VISION (*Test used and score*)	68. RED LENS TEST	69. INTRAOCULAR TENSION

70. HEARING			71. AUDIOMETER									72. PSYCHOLOGICAL AND PSYCHOMOTOR (*Tests used and score*)
RIGHT WV	/15 SV	/15		250 256	500 512	1000 1024	2000 2048	3000 3072	4000 4096	6000 6144	8000 8192	
LEFT WV	/15 SV	/15	RIGHT									
			LEFT									

73. NOTES (*Continued*) AND SIGNIFICANT OR INTERVAL HISTORY

(*Use additional sheets if necessary*)

74. SUMMARY OF DEFECTS AND DIAGNOSES (*List diagnoses with item numbers*)

75. RECOMMENDATIONS—FURTHER SPECIALIST EXAMINATIONS INDICATED (*Specify*)	76. A. PHYSICAL PROFILE					
	P	U	L	H	E	S

77. EXAMINEE (*Check*)

A. ☐ IS QUALIFIED FOR
B. ☐ IS NOT QUALIFIED FOR

B. PHYSICAL CATEGORY

78. IF NOT QUALIFIED, LIST DISQUALIFYING DEFECTS BY ITEM NUMBER	A	B	C	E

79. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
80. TYPED OR PRINTED NAME OF PHYSICIAN	SIGNATURE	
81. TYPED OR PRINTED NAME OF DENTIST OR PHYSICIAN (*Indicate which*)	SIGNATURE	
82. TYPED OR PRINTED NAME OF REVIEWING OFFICER OR APPROVING AUTHORITY	SIGNATURE	NUMBER OF ATTACHED SHEETS

Attachment 3

Environmental Protection Agency

Privacy Statement

Occupational Medical Monitoring Program Records

A. Authority under which the information is requested:

Executive Order 11807 which requires that the Occupational Safety and Health Act, P.L. 91-596 with its standards, Code of Federal Regulations, Title 29, Chapter XVII, Part 1910 of the Code of Federal Regulations be applied to Federal employees; Code of Federal Regulations Title 29, Chapter XVII, Part 1960, Federal Workers Safety and Health. Other authority: FPM Chapter 339 (Medical examination for appointment); FPM Chapter 752 (Adverse actions); FPM Chapter 810 (Claims for disability under worker's compensation); FPM Chapter 831 (Disability retirement); and FPM Chapter 339.

B. Uses to be made of the information:

The purpose of requesting personal information is to enable the Agency Occupational Medical Officer, examining physician, and other health personnel to provide an occupational health program directed primarily to protecting you and your fellow workers from potential hazards in your work environment and the reduction of these hazards. The records will document your health status, changes in physical conditions through the years, and provide an account of any care rendered, advice given, and consultations that are recommended.

This information may be used to determine unusual susceptibility to illness or injury from exposures in your work environment, to determine suitability for assignments, to permit medical surveillance for potential harmful effects of toxicants used in your work, and to provide medical treatment and advice. It may be used to plan, implement and evaluate occupational and preventive health programs, conduct epidemiologic research, teach, and compile statistical data. It may be used to adjudicate claims and determine benefits, and report medical conditions required by law to Federal, State and local agencies. It may be used for other lawful purposes including litigation.

C. Rules of confidentiality:

The information contained in these files will be open to review and usage by the Agency Medical Office, the examining physician and/or duly authorized assistants except as noted below.

Information to be utilized for research, teaching, statistical, or epidemiologic purposes will have all identifying data obliterated and made unrecognizable as to the identity of an individual.

The records will be in the local custody of the examining physician and will be maintained in a locked filing cabinet. Access will be limited to the custodian and/or duly appointed health assistants. A copy of these records may be maintained in the Agency Occupational Medical Office. These will be maintained in locked cabinets with access limited to the Director or to authorized assistants.

Upon death, retirement, resignation, or other termination of Government service, the records will be forwarded to the US Office of Personnel Management or Public Health Service Commissioned Officer Department of Personnel for inclusion with the Official Personnel Records and the custody thereof will fall to the custodian of such records.

Medical information about an applicant, employee or annuitant shall not be made available to the public.

Medical information about an applicant, employee or annuitant may be disclosed to the applicant, employee, or annuitant, or a representative designated in writing, except that medical information concerning a mental or other condition of such a nature that a prudent physician would hesitate to inform a person suffering from it of its exact nature and probable outcome may be disclosed only to a licensed physician designated in writing for that purpose by the individual or his designated representative. The determination on whether information falls into the purview above will rest with the custodian.

The applicant, employee, or annuitant may request release of records or information, and/or designate a representative, in a letter directed to the custodian of the records. The request will give the full name of the representative and indicate the records to be released.

D. Disclosure of information by participants:

Disclosure of the required information is entirely voluntary except for employees for whom disclosure is a condition of employment or where a medical certificate is required before assignment to positions which involve: (a) operation of motor vehicles; (b) exceptional stress; (c) food handling; (d) direct physical contact with people - for example, nurses and physical therapists; (e) work above ground level or around hazardous power-driven machinery; or, (f) strenuous exertion or hazardous duty or physical requirements more arduous than those described on SF-177 - for example, aircraft pilots and flight crew members, underwater divers, and firefighters. Pilots, flight crew members, and divers will not be certified or recertified if the information is not furnished. Other persons may decline to participate in or withdraw from the Occupational Medical Monitoring Program at any time without prejudice to themselves or to their jobs. If the information is not furnished, however, a complete occupational health

evaluation cannot be done and will not be attempted; optimum advice and care may therefore not be possible. Delay in certain benefits may result from the lack of available information about an employee.

E. Certification:

I have received a copy of this statement which I may retain and I understand that I may receive additional copies of this statement upon request. I understand that a copy of this statement will be placed in my health records as evidence of this notification.

_____
(Typed or printed name)

_____ _____
(Signature) (Date)

APPENDIX C

TRAINING REQUIREMENTS

U.S. ENVIRONMENTAL PROTECTION AGENCY

TRAINING OUTLINE FOR EMPLOYEES ENTERING SITES OF UNKNOWN TOXICITY

1. PURPOSE OF TRAINING

   - o Ensure that EPA employees are aware of the hazards of their job and that they perform their work in a manner where risk to personal health and safety is reduced to the greatest extent feasible.
   - o Ensure that regard for the health and safety of the employees of other agencies, the public, and the environment is maximal.
   - o To comply with all laws, rules, and regulations to safeguard the health and safety of its employees, the public, and the environment.
   - o Increase the personal confidence of employees to react responsibly and to handle emergency situations in a safe manner.

2. GENERAL FIELD SAFETY TECHNIQUES (Recommended 4 hours of instruction)

   - o Responsibilities
     - . Site surveillance/observation/plan development
     - . Restricted zones
     - . Safe zones
     - . Rules for VIP's
   - o Vehicles (cars, trucks, mobile labs, boats, aircraft, etc.)
     - . Inspection
     - . Operation
     - . Mandatory rules, regulations, and orientation
     - . Checklist
   - o Hazardous Materials in the Field
     - . Hazards
     - . Storage
     - . Transportation (DOT requirements for common sample preservatives, plus general "common sense" rules.)

- o Use of Field Equipment and Supplies
  - Work Tools
  - Testing Equipment
  - Sampling Equipment
  - Checklist
- o Working Alone (Buddy System)
  - Isolated Areas
  - Streams, Rivers, Lakes
  - Hazardous Waste Sites
  - Hazardous Materials Spills, etc.
- o Work Limitations
  - Weather (severe, inclement, hot, cold)
  - Fatigue
  - Hours of Work

3. PERSONAL PROTECTIVE EQUIPMENT AND CLOTHING (Minimum 8 hours instruction)

- o General
- o Availability
- o Respiratory Protection
  - Selection
  - Fit
  - Donning and Use
- o Personal Protection Apparel
  - Clothing (gloves, aprons, coveralls, etc.)
    - Disposable
    - Reusable
    - Totally enclosed suits

- Eye Protection
- Foot Protection
- Head Protection
- Hearing Protection

o Limitations of Clothing and Equipment

o Decontamination of Clothing and Equipment

o Disposal of Contaminated Clothing and Equipment

o Hands on Practical Exercise w/Protective Clothing and/or Equipment

4. EMERGENCY HELP AND SELF-RESCUE (Minimum 8 hours instruction)

o Recommended Supplies

o Principles of First Aid

- Restoration of Breathing
- Control of Bleeding
- Recognition and Treatment of Physical Shock
- Open and Closed Wounds and Burns
- Franctures and Dislocations
- Transportation

o Cardiopulmonary Resuscitation

o Availability of Emergency Services

- Poison Control Centers
- Hospitals and Ambulance Services
- Army EOD,
- Local fire and police departments

- How to Obtain Emergency Treatment in the Field
- How and when to file a report of accident/incident
- Employee Compensation Benefits

5. SAMPLING TECHNIQUES (Recommended 4 hours instruction)
   - Hazards of Sampling
   - Amount of Samples
   - Containers for Samples
   - Field Tests, Yes or No?
     - Radioactive
     - Explosivity
     - Other
   - Sample Security
   - Packaging (DOT/EPA)
   - Shipment (DOT/EPA

6. FREQUENCY OF TRAINING
   - New or inexperienced employees should complete 24 hours of initial training before beginning their duties, and at least 8 hours of refresher training annually.
   - Experienced employees should complete 8 hours of initial refresher training and at least 8 hours of refresher training annually.

7. RECORD OF TRAINING
   - A record of training should be maintained in the employee's official personnel file.

APPENDIX D

INCOMPATIBLE WASTE

(Federal Register, Vol. 43, No. 243, Dec. 18, 1978)

federal register

MONDAY, DECEMBER 18, 1978
PART IV

ENVIRONMENTAL PROTECTION AGENCY

Hazardous Waste

Proposed Guidelines and Regulations and Proposal on Identification and Listing

[6560-01-M]

APPENDIX I

INCOMPATIBLE WASTE

Many wastes, when mixed with others at a hazardous waste facility, can potentially produce adverse human health and environmental effects through means such as the following: (1) heat generation, (2) violent reaction, (3) release of toxic fumes and gases as a result of mixing, (4) release of toxic substances in case of fire or explosion, (5) fire or explosion, and (6) generation of flammable or toxic gases.

Below is a summary list of potentially incompatible waste materials or components and the adverse consequences resulting from mixing of waste in one group with waste in another group.

The mixing of a Group A waste with a Group B waste may have the potential consequence as noted.

Group 1-A	*Group 1-B*
Acetylene sludge	Acid sludge
Alkaline caustic liquids	Acid and water
Alkaline cleaner	Battery acid
Alkaline corrosive liquids	Chemical cleaners
Alkaline corrosive battery fluid	Electrolyte, acid
Caustic wastewater	Etching acid liquid or solvent
Lime sluuge and other corrosive alkalies	Liquid cleaning compounds
Lime wastewater	Pickling liquor and other corrosive acids
Lime and water	Spent acid
Spent caustic	Spent mixed acid
	Spent sulfuric acid

Potential consequences: Heat generation, violent reaction.

Group 2-A	*Group 2-B*
Asbestos waste, and other toxic wastes	Cleaning solvents
Beryllium wastes	Data processing liquid
Unrinsed pesticide containers	Obsolete explosives
Waste pesticides	Petroleum waste
	Refinery waste
	Retrograde explosives
	Solvents
	Waste oil and other flammable and explosive wastes

Potential consequences: Release of toxic substances in case of fire or explosion.

Group 3-A	*Group 3-B*
Aluminum	Any waste in Group 1-A or 1-B
Beryllium	
Calcium	
Lithium	
Magnesium	
Potassium	
Sodium	
Zinc powder and other reactive metals and metal hydrides	

Potential consequences: Fire or explosion; generation of flammable hydrogen gas.

Group 4-A	*Group 4-B*
Alcohols	Any concentrated waste in Groups 1-A or 1-B
Water	Calcium
	Lithium
	Metal hydrides
	Potassium
	Sodium
	SO_2Cl_2, $SOCl_2$, PCl_3, CH_3SiCl_3, and other water-reactive wastes

Potential consequences: Fire, explosion, or heat generation; generation of flammable or toxic gases.

Group 5-A	*Group 5-B*
Alcohols	Concentrated Group 1-A or 1-B wastes
Aldehydes	Group 3-A wastes
Halogenated hydrocarbons	
Nitrated hydrocarbons and other reactive organic compounds and solvents	
Unsaturated hydrocarbons	

Potential consequences: Fire, explosion or violent reaction.

Group 6 A	*Group 6-B*
Spent cyanide and sulfide solutions	Group 1-B wastes

Potential consequences: Generation of toxic hydrogen cyanide or hydrogen sulfide gas.

Group 7-A	*Group 7-B*
Chlorates and other strong oxidizers	Acetic acid and other organic acids
Chlorine	Concentrated mineral acids
Chlorites	Group 2-B wastes
Chromic acid	Group 3-A wastes
Hypochlorites	Group 5-A wastes and other flammable and combustible wastes.
Nitrates	
Nitric acid, fuming	
Perchlorates	
Permanganates	
Peroxides	

Potential consequences: Fire, explosion, or violent reaction.

Source: "Law, Regulations and Guidelines for Handling of Hazardous Waste". California Department of Health, February 1975.

APPENDIX E

POISON CONTROL CENTERS

National Clearinghouse for Poison Control Centers

BULLETIN

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
FOOD AND DRUG ADMINISTRATION
Bureau of Drugs
Division of Poison Control
5600 Fishers Lane, Room 1345
Rockville, Maryland 20857
(301) 443-6260

VOLUME 23, NO. 8

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DIRECTORY

This Directory of Poison Control Centers has been compiled from information received from the centers and State Departments of Health. It will be revised periodically in an attempt to keep it current. Since changes occur frequently, it is impossible for the Directory to be completely current; indeed, some of the material may already be incorrect. Notwithstanding this limitation, the Clearinghouse receives many requests for a listing of Poison Control Centers and feels that a periodic issue of a Directory Bulletin would serve a useful purpose. The ultimate usefulness of the Directory, however, will be determined by the response of the Centers and State Departments of Health in notifying the Clearinghouse of changes. Your cooperation will be greatly appreciated.

ARIZONA

STATE COORDINATOR 602 882-6300
College of Pharmacy
University of Arizona
Tucson 85721

DOUGLAS 602 364-7931	Cochise County Hospital Rural Route #1 85607
FLAGSTAFF 602 774-5233 Ext. 255	Flagstaff Hospital 1215 N. Beaver St. 86001
GANADO 602 755-3411	Navajo Health Foundation Sage Memorial Hospital P.O. Box 457 86505
KINGMAN 602 757-2101 Ext. 247	Mohave General Hospital 3269 Stockton Hill Rd. 86401
NOGALES 602 287-2771 Ext. 200	St. Joseph's Hospital Target Range Road P.O. Box 1809 85621
PHOENIX 602 257-4545	Good Samaritan Hospital 1033 E. McDowell Rd. 85006
602 267-5011 Ext. 5411	Maricopa County General Hospital 2601 E. Roosevelt 85008
602 252-5911 Ext. 391	Memorial Hospital 1201 S. 7th Ave. 85007
602 277-6611 Ext. 3581	St. Joseph's Hospital 350 W. Thomas Rd. 85013
602 253-3334	St. Luke's Hospital Medical Center 525 N. 18th St. 85006
PRESCOTT 602 445-2700 Ext. 25, 28	Yavapai Community Hosp. 1003 Willow Creek Rd. 86301
TUCSON 602 624-2721 Ext. 220	Kino Community Hospital (Pima County General) 2800 E. Ajo Way 85713
602 622-5833 Ext. 724	St. Mary's Hospital 1601 W. St. Mary's Rd. 85703
602 327-5431 Ext. 111	Tucson General Hospital 3838 N. Campbell Ave. 85719
602 327-5461 Ext. 428	Tucson Medical Center East Grant Rd. and Beverly Blvd. 85716
602 626-6016	Arizona Hlth. Sciences Ctr. University of Arizona 85721
WINSLOW 602 289-4691	Winslow Memorial Hosp. 1500 Williamson Ave. 86047
YUMA 602 344-2000 Ext. 321	Yuma Regional Med. Center Avenue A and 24th St. 85364

ALABAMA

STATE COORDINATOR: Department of Public Health, Montgomery 36117, 205 832-3194

ANNISTON 205 237-5421 Ext. 307	N.E. Alabama Regional Medical Center 400 E. 10th St. 36201	GADSDEN 205 492-8111	Baptist Memorial Hosp. 1007 Goodyear Avenue 35903
AUBURN 205 826-4037	Auburn University School of Pharmacy 36830	HUNTSVILLE 205 539-6320	Huntsville Hospital 101 Sivley Road 35801
BIRMINGHAM 205 933-4000	Children's Hospital 1601 6th Ave., S. 35233	MOBILE 205 473-3325	University of So. Alabama Medical Center 2451 Fillingim St., 36617
DOTHAN 205 794-3131	Southeast Alabama Medical Center 36301	OPELIKA 205 749-3411 Ext. 258	Lee County Hospital 2000 Pepperill Parkway 36801
FLORENCE 205 767-1111 Ext. 2045, 2046	Eliza Coffee Memorial Hospital P.O. Box 1079 35630	TUSKEGEE 205 727-8583	John A. Andrews Hosp. Tuskegee Institute 36088

ALASKA

STATE COORDINATOR: Department of Health & Social Services, Juneau 99811, For Administration, 907 465-3100

ANCHORAGE 907 274-6535	Providence Hospital 3200 Providence Dr. 99504

ARKANSAS

STATE COORDINATOR: Department of Health, Little Rock 72201, 501 661-2397

EL DORADO 501 863-2266	Warner Brown Hospital 460 West Oak St. 71730	HELENA 501 338-6411 Ext. 340	Helena Hospital Newman Drive 72342
FORT SMITH 501 452-5100 Ext. 2043	St. Edward's Mercy Medical Center 7301 Rogers Ave. 72903	LITTLE ROCK 501 661-6161	Univ. of Arkansas Medical Center 4301 W. Markham St. 72201
501 441-5011	Sparks Regional Med. Ctr. 1311 S. Eye St. 72901	OSCEOLA 501 563-7180	Osceola Memorial Hosp. Grandview & Lee Sts. 72370
HARRISON 501 741-6141 Ext.275,276	Boone County Hospital 620 N. Willow St. 72601	PINE BLUFF 501 535-6800 Ext. 4706	Jefferson Hospital 1515 W. 42nd Ave. 71601

CALIFORNIA

STATE COORDINATOR: Department of Health, Sacramento 95814, 916 322-2300

FRESNO 209 442-6000 Ext. 3131	Fresno Community Hospital Fresno & R Sts. P.O. Box 1232 93715	SACRAMENTO 800 852-7221 916 453-3692	Emergency Medical Services Sacramento Medical Center Univ. of California, Davis 2315 Stockton Blvd. 95817
LOS ANGELES 213 664-2121 213 669-2401	Thos. J. Fleming Memorial Center Children's Hospital of Los Angeles P.O. Box 54700 4650 Sunset Blvd. 90054	SAN DIEGO 714 294-6000	University of California San Diego Medical Ctr. 225 Dickinson St. 92103
OAKLAND 415 652-8171	Alameda-Contra Costa Medical Association 6230 Claremont Ave. 94619	SAN FRANCISCO 800 792-0720 415 666-2845	San Francisco Bay Area Poison Center San Francisco General Hosp. 1001 Potrero Ave., Room 1E-6 94110
415 547-2928	Children's Hosp. Med. Ctr. of Northern California 51st & Grove Sts. 94609	SAN JOSE 408 279-5112	Santa Clara Valley Medical Center 751 S. Bascom Avenue 95128
ORANGE 714 634-5988	University of California Irvine Medical Center 101 City Drive South 92668		

CANAL ZONE

BALBOA HEIGHTS 52-7500 — Gorgas Hospital, Box O

COLORADO

STATE COORDINATOR 303 320-8476 — Department of Health; EMS Division, Denver 80220

DENVER 303 629-1123 — Rocky Mt. Poison Center, West 8th & Cherokee, 80204

CONNECTICUT

STATE COORDINATOR 203 674-2782 — University of Connecticut Health Center, Farmington 06032

BRIDGEPORT 203 384-3566 — Bridgeport Hospital, 267 Grant St. 06602

203 576-5178 — St. Vincent's Hospital, 2820 Main St. 06606

DANBURY 203 797-7300 — Danbury Hospital, 95 Locust Ave. 06810

FARMINGTON 203 674-2782 — University of Connecticut Health Center 06032

MIDDLETOWN 203 347-9471 — Middlesex Memorial Hosp., 28 Crescent St. 06457

NEW HAVEN 203 789-3464 — The Hosp. of St. Raphael, 1450 Chapel St. 06511

203 436-1960 — Drug Information Center, Dept. of Pharm. Serv., Yale-New Haven Hospital, 789 Howard Ave. 06504

NORWALK 203 852-2160 — Norwalk Hospital, 24 Stevens St. 06852

WATERBURY 203 574-6011 — St. Mary's Hospital, 56 Franklin Street 06702

DELAWARE

WILMINGTON 302 655-3389 — Poison Information Service, 501 W. 14th St. 19899

DISTRICT OF COLUMBIA

STATE COORDINATOR 202 673-6694 — Department of Human Resources, Washington, D.C. 20009

WASHINGTON, DC 202 745-2000 — Children's Hospital National Medical Center, 111 Michigan Avenue., N.W. 20010

FLORIDA

STATE COORDINATOR 904 487-1566 — Department of Health and Rehabilitative Services, Tallahassee 32301

APALACHICOLA 904 653-8853 — George E. Weems Mem. Hosp. P.O. Box 610, Franklin Square 32320

BARTOW 813 533-1111 Ext. 204-237 — Polk General Hospital, 2010 E. Georgia St., P.O. Box 81 33830

BRADENTON 813 746-5111 Ext. 466 — Manatee Memorial Hosp., 206 2nd St. E. 33505

DAYTONA BEACH 904 258-1515 — Halifax Hospital, Dept. of Emerg. Serv., P.O. Box 1990 32014

FT. LAUDERDALE 305 463-3131 Ext. 1511 — Broward General Med. Ctr., 1600 S. Andrews Ave. 33316

FORT MYERS 813 332-1111 Ext. 285 — Lee Memorial Hospital, 2776 Cleveland Ave., P.O. Drawer 2218 33902

FT. WALTON BEACH 904 242-1111 Ext. 106 — General Hospital of Ft. Walton Beach, 1000 Mar-Walt Drive 32548

GAINESVILLE 904 392-3746 — Shands Teaching Hosp. and Clinics, University of Florida 32610

JACKSONVILLE 904 389-7751 Ext. 8315 — St. Vincent's Med. Ctr., Barrs & Johns Ave. 32204

KEY WEST 305 294-5531 — Florida Keys Mem. Hosp., 600 Junior College Rd., Stock Island 33040

LAKELAND 813 686-4913 — Lakeland General Hosp., Lakeland Hills Blvd., P.O. Box 480 33802

LEESBURG 904 787-7222 Ext. 381 — Leesburg General Hosp., 600 E. Dixie 32748

MELBOURNE 305 727-7000 Ext. 675 — James E. Holmes Reginal Medical Center, 1350 S. Hickory St. 32901

MIAMI 305 325-6799 — Jackson Memorial Hosp., Att: Pharmacy, 1611 N.W. 12th Ave. 33136

NAPLES 813 262-3131 Ext. 2221 — Naples Community Hosp., 350 7th St. N. 33940

OCALA 904 732-1111 Ext. 187 — Munroe Memorial Hosp., 140 S.E. Orange St., P.O. Box 6000, 32670

ORLANDO 305 841-5222 — Orlando Reg. Med. Ctr., Orange Memorial Division, 1416 S. Orange Avenue 32806

PANAMA CITY 904 769-1511 Ext. 415-416 — Bay Memorial Med. Ctr., 600 N. MacArthur Ave. 32401

PENSACOLA 904 434-4811 — Baptist Hospital, 1000 W. Moreno St. 32501

PUNTA GORDA 813 639-3131 — Medical Center Hospital, 809 E. Marion Ave. 33950

FLORIDA (Continued)

ROCKLEDGE 305 636-2211 Ext. 108	Wuesthoff Mem. Hosp. 110 Longwood Ave. 32955	TAMPA 813 251-6995	Tampa General Hospital Davis Island 33606
ST. PETERSBURG 813 821-5858	Bayfront Medical Center, Inc. 701 6th St., S. 33701	TITUSVILLE 305 269-1100 Ext. 194	Jess Parrish Mem. Hosp. 951 N. Washington Ave. P.O. Drawer W 32780
SARASOTA 813 953-1332	Memorial Hospital 1901 Arlington St. 33579	WEST PALM BEACH 305 655-5511 Ext. 4250	Good Samaritan Hosp. Flagler Dr. at Palm Beach Lakes Blvd. 33402
TALLAHASSEE 904 599-5411	Tallahassee Mem. Reg. Med. Ctr. Magnolia Dr. and Miccouskee Rd. 32304	WINTER HAVEN 813 299-9701	Winter Haven Hosp.,Inc. 200 Avenue F., N.E. 33880

GEORGIA

STATE COORDINATOR: Department of Human Resources, Atlanta 30308, 404 894-5068

ALBANY 912 883-1800 Ext. 158	Phoebe Putney Mem. Hosp. 417 Third Avenue 31705	MACON 912 742-1122 Ext. 3144	Medical Center of Central Georgia 777 Hemlock St. 31201
ATHENS 404 549-9977 Ext. 446	Athens General Hosp. 797 Cobb St. 30601	ROME 404 232-1541 Ext. 747	Floyd Hospital P.O. Box 233 30161
ATLANTA 404 588-4400 800 282-5846 (Toll Free) 404 525-3323 (Deaf)	Georgia Poison Control Ctr. Grady Memorial Hosp. 80 Butler Street, S.E. 30303	SAVANNAH 912 355-5228	Savannah Regional Poison Ctr. Department of Emergency Med. Memorial Med. Ctr. P.O. Box 23089 31403
AUGUSTA 404 722-9011 Ext. 2440	University Hospital 1350 Walton Way 30902	THOMASVILLE 912 226-4121 Ext. 169	John D. Archbold Memorial Hosp. 900 Gordon Ave. 31792
COLUMBUS 404 324-4711 Ext. 6431	The Medical Center 710 Center Street 31902	VALDOSTA 912 242-3450 Ext. 717	S. Georgia Medical Ctr. P.O. Box 1727 31601
		WAYCROSS 912 283-3030 Ext. 170	Memorial Hospital 410 Darling Ave. 31501

GUAM

STATE COORDINATOR: Guam Memorial Hospital, P.O. Box AX, Agana 96910, 646-5801

AGANA 344-9265 344-9354	Pharmacy Service, Box 7696 U.S. Naval Regional Medical Center (GUAM) FPO San Francisco, CA 96630

HAWAII

STATE COORDINATOR: Department of Health, Honolulu 96801, 808 531-7776

HONOLULU 808 941-4411	Kapiolani-Children's Medical Center 1319 Punahou St. 96826

IDAHO

STATE COORDINATOR: Department of Health and Welfare, Boise 83701, 208 384-2125

TOLL-FREE-STATEWIDE NUMBER 1-800 632-8000

BOISE 208 376-1211 Ext. 707	St. Alphonsus Hospital 1055 N. Curtis Rd. 83704	POCATELLO 208 232-2733 Ext. 244	St. Anthony Hospital 650 North 7th St. 83201
IDAHO FALLS 208 522-3620 Ext. 208	Idaho Falls Hospital Emergency Department 900 Memorial Dr. 83401		

ILLINOIS

STATE COORDINATOR 217 785-2080 — Division of Emergency Medical Services and Highway Safety, Springfield 62761

POISON INFORMATION & TREATMENT

Chicago Area Poison Resource Center

CHICAGO 312 942-5969	Rush-Presbyterian-St. Lukes Medical Center 1753 West Congress Parkway 60612

Northern and Central Poison Resource Center

PEORIA 1-800 322-5330	St. Francis Hospital & Medical Center 530 N.E. Glen Oak Avenue 61637

Central and Southern Poison Resource Center

SPRINGFIELD 217 753-3330 1-800 252-2022	St. John's Hospital 800 East Carpenter 62702

INDIANA

STATE COORDINATOR 317 633-0332 — State Board of Health, Indianapolis 46206

ANDERSON 317 646-5198	Community Hospital 1515 N. Madison Ave. 46012
317 646-8251	St. John's Hickey Memorial Hospital 2015 Jackson St. 46014
ANGOLA 219 665-2141 Ext. 42 or 665-2166	Cameron Memorial Hospital, Inc. 416 East Maumee St. 46703
COLUMBUS 812 376-5277	Bartholomew County Hosp. 2400 East 17th St. 47201
CROWN POINT 219 738-2100	St. Anthony Med. Ctr. Main at Franciscan Rd. 46307
EAST CHICAGO 219 392-1700 392-7203	St. Catherine Hospital 4321 Fir Street 46312
ELKHART 219 294-2621	Elkhart General Hosp. 600 East Blvd. 46514
EVANSVILLE 812 426-3405	Deaconess Hospital 600 Mary St. 47710
812 477-6261	St. Mary's Hospital 3700 Washington Ave. 47715
812 426-8000	Welborn Memorial Baptist Hospital 401 S.E. 6th St. 47713
FORT WAYNE 219 458-2211	Lutheran Hospital Emergency Dept. 3024 Fairfield Ave. 46807
219 484-6636 Ext. 7800	Parkview Memorial Hosp. 220 Randalia Dr. 46805
FORT WAYNE 219 423-2614	St. Joseph's Hospital 700 Broadway 46802
FRANKFORT 317 654-4451	Clinton County Hosp. 1300 S. Jackson St. 46041
GARY 219 886-4710	Methodist Hospital of Gary, Inc. 600 Grant Street 46402
GOSHEN 219 533-2141 Ext. 462	Goshen General Hosp. 200 High Park Ave. 46526
HAMMOND 219 932-2300 Ext. 700	St. Margaret Hospital 25 Douglas St. 46320
HUNTINGTON 219 356-3000	Huntington Mem. Hosp. 1215 Etna Ave. 46750
INDIANAPOLIS 317 927-3033	Methodist Hospital of Indiana, Inc. 1604 N. Capi ɔl Ave. 46202
317 630-7351 800 382-9097 (TOLL-FREE)	Wishard Memorial Hosp. 1001 West 10th St. 46202
KENDALLVILLE 219 347-1100	McCray Memorial Hosp. Hospital Drive 46755
KOKOMO 317 453-0702 Ext. 444	Howard Community Hosp. 3500 S. LaFountain St. 46901
LAFAYETTE 317 447-6811	Lafayette Home Hospital 2400 South Street 47902
317 423-6271	St. Elizabeth Hospital 1501 Hartford St. 47904
LaGRANGE 219 463-2144	LaGrange County Hosp. Route #1 46761
LaPORTE 219 362-7541 Ext. 212	LaPorte Hospital, Inc. 1007 Lincolnway 46350

INDIANA (Continued)

LEBANON 317 482-2700 Ext. 44	Witham Memorial Hosp. 1124 N. Lebanon St. 46052	RICHMOND 317 692-7010 Ext. 622	Reid Memorial Hospital 1401 Chester Blvd. 47374
MADISON 812 265-5211 Ext. 14	King's Daughter's Hosp. 112 Presbyterian Ave. P.O. Box 447 47250	SHELBYVILLE 317 392-3211 Ext. 52	Wm. S. Major Hospital 150 W. Washington St. 46176
MARION 317 662-4694	Marion General Hosp. Wabash & Euclid Ave. 46952	SOUTH BEND 219 234-2151 Ext. 253,264	St. Joseph's Hospital 811 E. Madison St. 46622
MISHAWAKA 219 259-2431	St. Joseph's Hospital 215 W. 4th St. 46544	TERRE HAUTE 812 238-7000 Ext. 7523	Union Hospital, Inc. 1606 N. 7th St. 47804
MUNCIE 317 747-3241	Ball Memorial Hospital 2401 University Ave. 47303	VALPARAISO 219 464-8611 Ext. 232, 312, 334	Porter Memorial Hosp. 814 LaPorte Ave. 46383
PORTLAND 317 726-7131 Ext. 159	Jay County Hospital 505 W. Arch St. 47371	VINCENNES 812 885-3348	The Good Samaritan Hospital 520 S. 7th St. 47591

IOWA

STATE COORDINATOR 515 281-4964 — Department of Health, Des Moines 50319

DES MOINES 515 283-6212	Iowa Methodist Hosp. 1200 Pleasant St. 50308	IOWA CITY 319 356-2922 800 272-6477 (All Iowa Residents)	Univ. of Iowa Hosp. and Clinics Pharmacy Department 52240
DUBUQUE 319 588-8210	Mercy Medical Center Mercy Drive 52001	WATERLOO 319 235-3893	Allen Memorial Hosp. 1825 Logan Avenue 50703
FORT DODGE 515 573-3101	Trinity Regional Hosp. Dept. of Pharmacy Kenyon Rd. 50501		

KANSAS

STATE COORDINATOR 913 862-9360 Ext. 542 — Kansas Dept. of Health & Environment, Topeka 66620

ATCHISON 913 367-2131	Atchison Hospital 1301 N. 2nd St. 66002	DODGE CITY 316 225-2036	Dodge City Reg. Hosp. Ross & Ave. "A" P.O. Box 1478 67801

KANSAS (Continued)

EMPORIA 316 343-6800 Ext. 545	Newman Memorial Hosp. 12th & Chestnut Streets 66801	KANSAS CITY 913 281-8880	Bethany Medical Ctr. 51 No. 12th St. 66102
FORT RILEY 913 239-2923	Irwin Army Hospital 66442	LAWRENCE 913 843-3680 Ext. 162,163	Lawrence Memorial Hosp. 325 Maine St. 66044
FORT SCOTT 316 223-2200 Night: 0476	Mercy Hospital 821 Burke St. 66701	PARSONS 316 421-4880 Ext. 320	Labette County Medical Center S. 21st St. 67357
GREAT BEND 316 793-3523 Night: 792-2511	Central Kansas Medical Center 3515 Broadway 67530	SALINA 913 827-5591 Ext. 112	St. John's Hospital 139 N. Penn St. 67401
HAYS 913 628-8251	Hadley Regional Medical Center 201 E. 7th St. 67601	TOPEKA 913 354-6100	Stormont-Vail Hosp. 10th & Washburn Sts. 66606
KANSAS CITY 913 588-6633	Univ. of Kansas Medical Center 39th & Rainbow Blvd. 66103	WICHITA 316 685-2151 Ext. 7515	Wesley Medical Ctr. 550 N. Hillside Ave. 67214

KENTUCKY

STATE COORDINATOR 502 564-4935 — Department For Human Resources, Frankfort 40601

ASHLAND 606 324-2222	King's Daughters Hosp. 2201 Lexington Ave. 41101	LOUISVILLE 502 589-8222	Norton-Children's Hosp. Pharmacy Dept. 200 E. Chestnut St. 40202
BEREA 606 986-3061	Porter Moore Drug, Inc. 124 Main St. 40403	MURRAY 502 753-7588	Murray-Calloway County Hospital 803 Popular 42071
FORT THOMAS 606 292-3215	St. Lukes Hospital 85 N. Grand Ave. 41075	OWENSBORO 502 926-3030 Ext. 180 Night-174	Owensboro-Daviess County Hospital 811 Hospital Court 42301
LEXINGTON 606 278-3411 Ext. 152	Central Baptist Hosp. 1740 S. Limestone St. 40503	PADUCAH 502 444-6361 Ext. 105 Night-199	Western Baptist Hosp. 2501 Kentucky Ave. 42001
606 233-5320	Drug Information Ctr. University of Kentucky Medical Center 40536	PRESTONSBURG 606 886-8511	Poison Control Center Highlands Reg. Med. Ctr. 41653

LOUISIANA

STATE COORDINATOR: Bureau of Emergency Medical Services, Baton Rouge 70801, 504 342-2600

ALEXANDRIA 318 487-8111	Rapides General Hosp. Emergency Dept. P.O. Box 7146 71301
BATON ROUGE 504 927-9050	Doctors Hospital 2414 Bunker Hill Dr. 70808
LAFAYETTE 318 234-7381	Our Lady of Lourdes Hosp. P.O. Box 3827 611 St. Landry St. 70501
LAKE CHARLES 318 478-6800	Lake Charles Memorial Hospital P.O. Drawer M 70601
MONROE 318 342-3008	Northeast University Dept. of Pharmacology Drug Information Ctr. 700 University Ave. 70201
318 325-6454	St. Francis Hospital P.O. Box 1901 71301
NEW ORLEANS 504 568-5222	Charity Hosp. of New Orleans 1532 Tulane Avenue 70140
SHREVEPORT 318 425-1524	LSU Medical Center P.O. Box 33932 71130

MAINE

STATE COORDINATOR: Maine Poison Control Center, Portland 04102, 1-800 442-6305

PORTLAND 207 871-2950 1-800 442-6305 (TOLL FREE)	Maine Medical Center 22 Bramhall Street 04102

MARYLAND

STATE COORDINATOR: Maryland Poison Information Center, University of Maryland School of Pharmacy, 301 528-7604 21201

BALTIMORE 301 528-7701 800 492-2414 (TOLL FREE IN MARYLAND)	Maryland Poison Inf. Ctr. Univ. of MD. Sch. of Ph. 636 W. Lombard St. 21201
CUMBERLAND 301 722-6677	Sacred Heart Hospital 900 Seton Drive 21502

MASSACHUSETTS

STATE COORDINATOR: Department of Public Health, Boston 02111, 617 727-2670

BOSTON 617 232-2120 1-800 682-9211	Massachusetts Poison Control System 300 Longwood Avenue 02115

MICHIGAN

STATE COORDINATOR: Division of Emergency Medical Services, Lansing 48909, 517 373-1406

ADRIAN 517 263-2412	Emma L. Bixby Hosp. 818 Riverside Ave. 49221
ANN ARBOR 313 764-5102	University Hospital 1405 E. Ann St. 48104
BATTLE CREEK 616 963-5521	Community Hospital 183 West St. 49016
BAY CITY 517 892-6589	Bay Medical Center 100 15th St. 48706
BERRIEN CENTER 616 471-7761	Berrien General Hosp. Dean's Hill Rd. 49102
COLDWATER 517 278-7361	Community Health Ctr. of Branch County 274 E. Chicago St. 49036
DETROIT 313 494-5711	Children's Hospital of Michigan 3901 Beaubien 48201
313 864-5400 Ext. 416	Mount Carmel Mercy Hospital 6071 W. Outer Dr. 48235
ELOISE Day: 313 722-3748 Night: 274-3000-6231	Wayne County General Hospital 30712 Michigan Avenue 48132
FLINT 313 766-0111	Hurley Hospital 6th Ave. & Begole 48502
GRAND RAPIDS 616 774-6794	St. Mary's Hospital 201 Lafayette, S.E. 49503
800 442-4571 800 632-2727 (TOLL FREE)	Western Michigan Poison Center 1840 Wealthy, S. E. 49506
HANCOCK 906 482-1122 Ext. 209	Portage View Hospital 200-210 Michigan Ave. 49930
HOLLAND 616 396-4661	Holland Community Hosp. 602 Michigan Ave. 49423
JACKSON 517 788-4816	W.A. Foote Memorial Hospital 205 N. East St. 49201

MICHIGAN (Continued)

KALAMAZOO 616 383-4815	Borgess Hospital - Ambulatory Care Svc. 1521 Gull Rd. 49001	PETOSKEY 616 347-7373	Little Traverse Hosp. 416 Connable 49770
616 383-6409	Bronson Methodist Hosp. 252 E. Lovell St. 49006	PONTIAC 313 858-7373 858-7374	St. Joseph Mercy Hosp. 900 Woodward Avenue 48053
LANSING 517 372-5112 372-5113	St. Lawrence Hospital 1210 W. Saginaw St. 48914	PORT HURON 313 987-5555 987-5000	Port Huron Hospital 1001 Kearney St. 48060
MARQUETTE 800 562-9723	Marquette General Hosp. 420 W. Magnetic Dr. 49855	SAGINAW 517 755-1111	Saginaw General Hosp. 1447 N. Harrison 48602
MIDLAND 517 631-7700 Ext. 304	Midland Hospital 4005 Orchard Dr. 48640	TRAVERSE CITY 616 947-6140	Munson Medical Ctr. Sixth St. 49684

MINNESOTA

STATE COORDINATOR 612 296-5276 — State Department of Health, Minneapolis 55415

BEMIDJI 218 751-5430	Beuidji Hospital 56601	MINNEAPOLIS 612 588-0616	North Memorial Hospital 3220 Lowry North 55422
BRAINERD 218 829-2861 Ext. 211	St. Joseph's Hospital 56401	612 874-4233	Northwestern Hospital 810 E. 27th St. 55407
CROOKSTON 218 281-4682	Riverview Hospital 320 S. Hubbard 56716	MORRIS 612 589-1313	Stevens County Memorial Hospital 56267
DULUTH 218 727-6636	St. Luke's Hospital Emergency Department 915 E. First St. 55805	ROCHESTER 507 285-5123	Southeastern Minnesota Poison Control Center St. Mary's Hospital 1216 Second St., S. W. 55901
218 727-4551 Ext. 359	St. Mary's Hospital 407 E. 3rd St. 55805	ST. CLOUD 612 251-2700 Ext. 221	St. Cloud Hospital 1406 6th Avenue, N. 56301
EDINA 612 920-4400	Fairview-Southdale Hosp. 6401 France Ave., S. 55435	ST. PAUL 612 221-2301	Bethesda Lutheran Hosp. 559 Capitol Blvd. 55103
FERGUS FALLS 218 736-5475	Lake Region Hospital 56537	612 227-6521	The Children's Hosp. Inc. 311 Pleasant Ave. 55102
FRIDLEY 612 786-2200	Unity Hospital 550 Osborne Rd. 55432	612 228-3132	St. John's Hospital 403 Maria Ave. 55106
MANKATO 507 387-4031	Immanuel - St. Joseph's Hospital 325 Garden Blvd. 56001	612 291-3348 291-3139	St. Joseph's Hospital 69 W. Exchange 55102
		612 298-8402	United Hospitals, Inc. St. Luke's Division 300 Pleasant Ave. 55102
MARSHALL 507 532-9661	Louis Weiner Memorial Hospital 56258		
MINNEAPOLIS 612 371-6402	Fairview Hospital Outpatient Department 2312 S. 6th St. 55406	612 221-2113	St. Paul-Ramsey Hosp. 640 Jackson St. 55101
612 347-3141	Hennepin County Medical Center 701 Park Ave. 55415	WILLMAR 612 235-4543	Rice Memorial Hospital 402 W. 3rd St. 56201
		WORTHINGTON 507 372-2941	Worthington Regional Hospital 1016 6th Ave. 56187

MISSISSIPPI

STATE COORDINATOR: State Board of Health, Jackson 39205, 601 354-6650

BILOXI 601 388-1919	Gulf Coast Community Hosp. 4642 West Beach Blvd. 39531
601 377-2516 377-6555 377-6556	USAF Hospital Keesler Keesler Air Force Base 39534
BRANDON 601 825-2811 Ext.487,488	Rankin General Hospital 350 Crossgates Blvd. 39042
COLUMBIA 601 736-6303 Ext. 217	Marion County General Hospital 39429
GREENWOOD 601 453-9751 Ext. 633	Greenwood-Leflore Hospital River Road 38930
HATTIESBURG 601 264-4235	Forrest County General Hospital 400 S. 28th Ave. 39401
JACKSON 601 968-1704	Mississippi Baptist Medical Center 1225 N. State St. 39201
601 982-0121 Ext. 345	St. Dominic-Jackson Memorial Hospital 969 Lakeland Dr. 39216
JACKSON 601 354-6650	State Board of Health Bureau of Disease Control 39205
601 354-7660	University Medical Center 2500 N. State Street 39216
LAUREL 601 649-4000 Ext.207,218, 220,248	Jones County Community Hospital Jefferson St. at 13th Ave. 39440
MERIDIAN 601 483-6211 Ext. 54, 71	St. Joseph's Hospital Highway 39, North 39301
PASCAGOULA 601 938-5162	Singing River Hospital Highway 90 East 39567
UNIVERSITY 601 234-1522	School of Pharmacy University of Mississippi 38677
VICKSBURG 601 636-2131 Ext.250,276	Mercy Regional Medical Center 100 McAuley Dr. 39181

MISSOURI

STATE COORDINATOR: Missouri Division of Health, Jefferson City 65102, 314 751-2713

CAPE GIRARDEAU 314 335-1251 Ext. 217	St. Francis Medical Ctr. St. Francis Drive 63701
COLUMBIA 314 882-4141	University of Missouri Medical Center 807 Stadium Rd. 65201
HANNIBAL 314 221-0414 Ext.101,183	St. Elizabeth's Hospital 109 Virginia St. 63401
JEFFERSON CITY 314 635-7141 Ext. 215	Charles E. Still Osteopathic Hosp. 1125 S. Madison 65101

MISSOURI (Continued)

JOPLIN 417 781-2727 Ext. 393	St. John's Medical Ctr. 2727 McClelland Blvd. 64801
KANSAS CITY 816 471-0626 Ext.383,384	Children's Mercy Hosp. 24th at Gillham Rd. 64108
KIRKSVILLE 816 626-2266	Kirksville Osteopathic Hospital 800 W. Jefferson St. 63501
POPLAR BLUFF 314 785-7721	Lucy Lee Hospital 330 N. 2nd St. 63901
ROLLA 314 364-3100 Ext.136,137	Phelps County Memorial Hospital 1000 W. 10th St. 65401
ST. JOSEPH 816 271-7580 232-8481	Methodist Medical Ctr. Seventh to Ninth on Faraon Street 64501
ST. LOUIS 314 772-5200	Cardinal Glennon Memorial Hospital for Children 1465 S. Grand Boulevard 63104
314 367-2034	St. Louis Children's Hospital 500 S. Kingshighway 63110
SPRINGFIELD 417 831-9746 1-800 492-4824 (TOLL FREE)	Lester E. Cox Medical Ctr. 1423 N. Jefferson St. 65802
417 885-2115	St. John's Hospital 1235 E. Cherokee 65802
WEST PLAINS 417 256-9111 Ext.258,259	West Plains Memorial Hospital 1103 Alaska Avenue 65775

MONTANA

STATE COORDINATOR: Department of Health and Environmental Sciences, Helena 59601, 1-800 525-5042

1-800 525-5042 (TOLL FREE) Montana Poison Control System

NEBRASKA

STATE COORDINATOR: Department of Health, Lincoln 68502, 402 471-2122

OMAHA 402 553-5400 800 642-9999 (NEBRASKA) 800 228-9515 (SURROUNDING STATES)	Children's Memorial Hosp. 44th & Dewey Sts. 68105

NEVADA

STATE COORDINATOR: Department of Human Resources, Carson City 89710, 702 885-4750

LAS VEGAS 702 385-1277	Southern Nevada Memorial Hospital 1800 W. Charleston Blvd. 89102
702 731-8000	Sunrise Hospital Med. Ctr. 3186 South Maryland Parkway 89109
RENO 702 323-2041	St. Mary's Hospital 235 W. 6th 89503
702 785-4129 Night: -4140	Washoe Medical Center 77 Pringle Way 89502

NEW HAMPSHIRE

HANOVER 603 643-4000	New Hampshire Poison Center Mary Hitchcock Hospital 2 Maynard St. 03755

NEW JERSEY

STATE COORDINATOR: Department of Health, Trenton 08625, 609 292-5666

ATLANTIC CITY 609 344-4081	Atlantic City Medical Center 1925 Pacific Ave. 08401
BELLEVILLE 201 751-1000 Ext. 781,2, 783	Clara Maass Memorial Hospital 1A Franklin Ave. 07109
BOONTON 201 334-5000 Ext.186,187	Riverside Hospital Powerville Rd. 07055
BRIDGETON 609 451-6600	Bridgeton Hospital Irving Ave. 08302
CAMDEN 609 795-5554	West Jersey Hospital Evesham Ave. and Voorhees Twp. 08104
DENVILLE 201 627-3000 Ext. 6063	St. Clare's Hospital Pocono Rd. 07834
EAST ORANGE 201 672-8400 Ext. 223	East Orange General Hospital 300 Central Ave. 07019
ELIZABETH 201 527-5059	St. Elizabeth Hosp. 225 Williamson St. 07207
ENGLEWOOD 201 568-3400	Englewood Hospital 350 Engle St. 07631
FLEMINGTON 201 782-2121	Hunterdon Medical Ctr. Route #31 08822
LIVINGSTON 201 992-5161	St. Barnabas Medical Center Old Short Hills Rd. 07039
LONG BRANCH 201 222-2210	Monmouth Medical Ctr. Dunbar & 2nd Ave. 07740

NEW JERSEY (Continued)

MONTCLAIR 201 746-6000	Mountainside Hospital Bay & Highland Aves. 07042
MOUNT HOLLY 609 267-7877	Burlington County Memorial Hosp. 175 Madison Ave. 08060
NEPTUNE 800 822-9761	Jersey Shore Medical Ctr.-Fitkin Hosp. 1945 Corlies Ave. 07753
NEWARK 201 926-7240 926-7241, 2, 926-7243	Newark Beth Israel Medical Center 201 Lyons Ave. 07112
201 589-1300	St. James Hospital 155 Jefferson Street 07105
NEW BRUNSWICK 201 828-3000	Middlesex General Hosp. 180 Somerset Street 08903
201 745-8526	St. Peter's Medical Ctr. 254 Easton Ave. 08903
NEWTON 201 383-2121 Ext. 270,1,2, 273	Newton Memorial Hosp. 175 High St. 07860
ORANGE 201 678-1100 Ext. 231	Hospital Center at Orange 188 S. Essex Ave. 07051
PASSAIC 201 473-1000	St. Mary's Hospital 211 Pennington Ave. 07055
PERTH AMBOY 201 442-3700 Ext. 2500	Perth Amboy General Hosp. 530 New Brunswick Ave. 08861
PHILLIPSBURG 201 859-1500 Ext. 280	Warren Hospital 185 Roseberry St. 08865
POINT PLEASANT 201 892-1100 Ext. 385	Point Pleasant Hosp. Osborn Ave. & River Front 08742
PRINCETON 609 921-7700 Ext. 241	The Medical Center at Princeton 253 Witherspoon St. 08540
SADDLE BROOK 201 368-6023	Saddle Brook General Hospital 300 Market St. 07662
SOMERS POINT 609 653-3515	Shore Memorial Hosp. Brighton & Sunny Aves. 08244
SOMERVILLE 201 725-4000 Ext.431,432	Somerset Medical Center Rehill Ave. 08876
SUMMIT 201 522-2232	Overlook Hospital 193 Morris Ave. 07901
TEANECK 201 837-3070	Holy Name Hospital 718 Teaneck Rd. 07666
TRENTON 609 396-1077	Helene Fuld Med. Ctr. 750 Brunswick Ave. 08607
UNION 201 687-1900 Ext. 237	Memorial General Hosp. 1000 Galloping Hill Rd. 07083
WAYNE 201 684-6900 Ext. 224,5 226	Greater Paterson Gen. Hospital 224 Hamburg Tnpk. 07470

NEW MEXICO

STATE COORDINATOR 505 843-2551 — The University of New Mexico, Albuquerque 87131

STATE COORDINATOR
ALBUQUERQUE 505 843-2551 (1-800 432-6866 Within NM) — New Mexico Poison, Drug Inf. & Med. Crisis Ctr., Univ. of New Mexico 87131

NEW YORK

STATE COORDINATOR 518 474-3664 — Department of Health, Albany 12210

BINGHAMTON 607 772-8929 — Binghamton General Hosp. Mitchell & Lark Sts. 13903

607 798-5231 — Our Lady of Lourdes Memorial Hosp. 169 Riverside Drive 13905

BUFFALO 716 878-7654 — Western New York Poison Control Center at Children's Hospital 219 Bryant St. 14222

DUNKIRK 716 366-1111 Ext.414,415 — Brooks Memorial Hosp. 10 West 6th St. 14048

EAST MEADOW 516 542-2323 542-2324 542-2325 — Nassau County Medical Center 2201 Hempstead Tnpk. 11554

ELMIRA 607 737-4194 — Arnot Ogden Memorial Hospital Roe Ave. & Grove Street 14901

607 734-2662 — St. Joseph's Hospital Health Center 555 E. Market St. 14901

ENDICOTT 607 754-7171 — Ideal Hospital 600 High Ave. 13760

GLENS FALLS 518 792-3151 Ext. 456 — Glens Falls Hospital 100 Park St. 12801

JAMESTOWN 716 487-0141 484-8648 — W. C. A. Hospital 207 Foote Ave. 14707

JOHNSON CITY 607 773-6611 — Wilson Memorial Hosp. 33-57 Harrison St. 14707

NEW YORK (Continued)

KINGSTON 914 331-3131 — Kingston Hospital 396 Broadway 12401

NEW YORK 212 340-4494 340-4495 — N.Y. City, Dept. of Hlth. Bureau of Laboratories 455 First Ave. 10016

NIAGARA FALLS 716 278-4511 — Niagara Falls Memorial Medical Center 621 Tenth St. 14302

NYACK 914 358-5581 358-6200 Ext.451,452 — Hudson Valley Poison Ctr. Nyack Hospital (Pharmacy) North Midland Avenue 10960

ROCHESTER 716 275-5151 — Strong Memorial Hosp. 260 Crittenden Blvd. 14620

SCHENECTADY 518 382-4039 382-4121 — Ellis Hospital 1101 Nott Street

SYRACUSE 315 476-7529 — Onondaga County Health Dept. Poison Control Center Upstate Medical Center 750 E. Adams Street 13210

WATERTOWN 315 788-8700 — House of the Good Samaritan Hospital Washington & Pratt Sts. 13602

NORTH CAROLINA

STATE COORDINATOR 919 684-8111 — Duke University Medical Center, Durham 27710

ASHEVILLE 704 255-4660 — Memorial Mission Hosp. 509 Biltmore Ave. 28801

CHARLOTTE 704 372-5100 — Mercy Hospital 2001 Vail Ave. 28207

DURHAM 919 684-8111 — Duke University Medical Center Box 3007 27710

GREENSBORO 919 379-4105 — Moses Cone Hospital 1200 N. Elm St. 27401

HENDERSONVILLE 704 693-6522 Ext. 222 — Margaret R. Pardee Hospital Fleming St. 28739

HICKORY 704 322-6649 — Catawba Memorial Hosp. Fairgrove-Church Rd. 28601

JACKSONVILLE 919 353-1234 Ext. 240 — Onslow Memorial Hosp. Western Blvd. 28540

WILMINGTON 919 343-7046 — New Hanover Memorial Hospital 2131 S. 17th St. 28401

NORTH DAKOTA

STATE COORDINATOR 701 224-2388 — Department of Health, Bismarck 58505

BISMARCK 701 223-4357	Bismarck Hospital, 300 North 7th St. 58501
FARGO 701 280-5575	St. Luke's Hospital, Fifth St. at Mills Ave. 58102
GRAND FORKS 701 780-5000	United Hospital, 1200 S. Columbia Rd. 58201
MINOT 701 857-2553	St. Joseph's Hospital, Third St. & Fourth Ave., S.E. 58701
WILLISTON 701 572-7661	Mercy Hospital, 1301 15th Avenue 58801

OHIO

STATE COORDINATOR 614 466-2544 — Department of Health, Columbus 43216

AKRON 216 379-8562	Children's Hospital, Buchtel at Bowery 44308
CANTON 216-452-9911 Ext. 203	Aultman Hospital Emergency Rm., 2600 Sixth Street S.W. 44710
CINCINNATI 513 872-5111	Drug & Poison Inf. Ctr. Univ. of Cincinnati Med. Ctr., Room 7701, Bridge 45267
CLEVELAND 216 231-4455	Academy of Medicine, 11001 Cedar Avenue 44106
COLUMBUS 614 228-1323	Children's Hospital, 700 Children's Dr. 43205
DAYTON 513 222-2227	Children's Medical Ctr., 1735 Chapel St. 45404
LORAIN 216 282-2220	Lorain Community Hosp., 3700 Kolbe Rd. 44053
MANSFIELD 419 522-3411 Ext. 545	Mansfield General Hosp., 335 Glessner Ave. 44903
SPRINGFIELD 513 325-1255	Community Hospital, 2615 E. High St. 45505
TOLEDO 419 381-3897	Medical College Hosp., P.O. Box 6190 43609
YOUNGSTOWN 216 746-2222	Mahoning Valley Poison Center, St. Eliz. Hosp. & Med. Ctr., 1044 Belmont Avenue 44505
ZANESVILLE 614 454-4221	Bethesda Hospital, Poison Information Center, 2951 Maple Avenue 43701

OKLAHOMA

STATE COORDINATOR 405 271-5454 or 800 522-4611 — Oklahoma Poison Control Center, Oklahoma Children's Memorial Hospital, P.O. Box 26307, 73126

ADA 405 322-2323 Ext. 200	Valley View Hospital, 1300 E. 6th St. 74820
ARDMORE 405 223-5400	Memorial Hospital of Southern Oklahoma, 1011-14th Ave. 73401
LAWTON 405 355-8620	Comanche County Memorial Hosp., 3401 Gore Blvd. 73501
McALESTER 918 426-1800 Ext. 240	McAlester General Hosp., Inc. West, P.O. Box 669 74501
OKLAHOMA CITY 405 271-5454 or 800 522-4611 (Oklahoma)	Oklahoma Poison Control Center, Oklahoma Children's Memorial Hospital, P.O. Box 26307 73126
PONCA CITY 405 765-3321	St. Joseph Medical Ctr., 14th & Hartford 74601
TULSA 918 584-1351 Ext. 6165	Hillcrest Medical Ctr., 1653 East 12th 74104

OREGON

PORTLAND 503 225-8500	Oregon Poison Control & Drug Inf. Center, Univ. of Oregon Hlth. Sciences Center, 3181 S. W. Sam Jackson Park Road 97201

PENNSYLVANIA

STATE COORDINATOR 717 787-2307 — Department of Health, Harrisburg 17120

ALLENTOWN 215 921-2121	Lehigh Valley Poison Center, 17th & Chew Sts. 18102
ALTOONA 814-946-3711	Altoona Region Poison Center, Mercy Hospital, 2500 Seventh Ave. 16603
BETHLEHEM 215 691-4141	St. Luke's Hospital, 800 Ostrum St. 18015
BLOOMSBURG 717 784-7121	The Bloomsburg Hospital, 549 E. Fair St. 17815
BRADFORD 814 368-4143	Bradford Hospital, Interstate Pkwy. 16701
BRYN MAWR 215 527-0600	The Bryn Mawr Hospital 19010
CHAMBERSBURG 717 264-5171 Ext. 431	The Chambersburg Hosp., 7th and King St. 17201
CHESTER 215 494-0721 Ext. 232	Sacred Heart General Hospital, 9th and Wilson St. 19013
CLEARFIELD 814 765-5341	Clearfield Hospital, 809 Turnpike Ave. 16830
COALDALE 717 645-2131	Coaldale State General Hospital 18218
COUDERSPORT 814 274-9300	Charles Cole Memorial Hospital, RD #3, Route 6 16915
DANVILLE 717 275-6116	Susquehanna Poison Center, Geisinger Medical Ctr., North Academy Ave. 17821
DOYLESTOWN 215 345-2281	Doylestown Hospital, 595 W. State St. 18901
DREXEL HILL 215 259-3800	Delaware County Memorial Hospital, Lansdowne & Keystone Ave. 19026
EAST STROUDSBURG 717 421-4000	Pocono Hospital, 206 E. Brown St. 18301
EASTON 215 258-6221	Easton Hospital, 21st & Lehigh St. 18042
ERIE 814 455-3961	Doctors Osteopathic, 252 W. 11th St. 16501
814 864-4031	Erie Osteopathic Hosp., 5515 Peach St. 16509
814 455-6711 Ext. 521	Hamot Medical Center, 4 E. Second St. 16512
814 452-3232	Northwest Poison Center, St. Vincent Health Ctr., P.O. Box 740 16512
GETTYSBURG 717 334-2121	Annie M. Warner Hosp., S. Washington St. 17325
GREENSBURG 412 837-0100	Westmoreland Hosp. Assn., 532 W. Pittsburgh St. 15601
HANOVER 717 637-3711	Hanover General Hospital, 300 Highland Ave. 17331

PENNSYLVANIA (Continued)

HARRISBURG 717 782-3639	Harrisburg Hospital, S. Front & Mulberry St. 17101
717 782-4141 Ext. 4132	Polyclinic Hospital, 3rd & Polyclinic Ave. 17105
HERSHEY 717 534-6111	Milton S. Hershey Medical Center, University Dr. 17033
JEANNETE 412 527-3551	Jeannete District Memorial Hosp., 600 Jefferson Ave. 15644
JERSEY SHORE 717 398-0100	Jersey Shore Hospital, Thompson St. 17740
JOHNSTOWN 814 535-5351	Conemaugh Valley Memorial Hosp., 1086 Franklin St. 15905
814 535-7541	Lee Hospital, 320 Main St. 15901
814 536-5353	Mercy Hospital, 1020 Franklin St. 15905
LANCASTER 717 299-5511	Lancaster General Hosp., 555 North Duke St. 17604
717 299-4546	St. Joseph's Hospital, 250 College Ave. 17604
LANSDALE 215 368-2100	North Penn Hospital, 7th & Broad St. 19446
LEBANON 717 272-7611	Good Samaritan Hosp., 4th & Walnut Sts. 17042
LEHIGHTON 215 377-1300	Gnaden-Huetten Memorial Hospital, 11th & Hamilton St. 18235
LEWISTOWN 717 248-5411	Lewistown Hospital, Highland Ave. 17044
MUNCY 717 546-8282	Muncy Valley Hospital, P.O. Box 340 17756
NANTICOKE 717 735-5000	Nanticoke State Hospital, W. Washington St. 18634
PAOLI 215 647-2200	Paoli Memorial Hospital 19301
PHILADELPHIA 215 922-5523 922-5524	Philadelphia Poison Information, 321 University Avenue 19104
PHILIPSBURG 814 342-3320	Philipsburg State General Hosp. 16866
PITTSBURGH 412 681-6669	Children's Hospital, 125 Desoto St. 15213
PITTSTON 717 654-3341	Pittston Hospital, Oregon Heights 18640
POTTSTOWN 215 327-1000	Pottstown Memorial Medical Ctr., High St. & Firestone Blvd. 19464
POTTSVILLE 717 622-3400	Good Samaritan Hospital, E. Norwegian and Tremont St. 17901
READING 215 376-4881	Community General Hosp., 145 N. 6th St. 19601
215 378-6218	Reading Hospital and Medical Ctr. 19603
SAYRE 717 888-6666	The Robert Packer Hosp., Guthrie Square 18840

PENNSYLVANIA (Continued)

SELLERSVILLE 215 257-3611	Grandview Hospital 18960	TUNKHANNOCK 717 836-2161	Tyler Memorial Hosp. RD #1 18657
SOMERSET 814 443-2626	Somerset Community Hospital 225 South Center Ave. 15501	YORK 717 843-8623	Memorial Osteopathic Hospital 325 S. Belmont St. 17403
STATE COLLEGE 814 238-4351	Centre Community Hospital 16801	717 771-2311	York Hospital 1001 S. George St. 17405
TITUSVILLE 814 827-1851	Titusville Hospital 406 W. Oak St. 16354		

PUERTO RICO

STATE COORDINATOR: University of Puerto Rico, Rio Piedras
809 765-4880
765-0615

ARECIBO 809 878-7272 Ext. 7459 7510	District Hospital of Arecibo 00613	PONCE 809 842-8364	District Hospital of Ponce 00731
		RIO PIEDRAS 809 764-3515	Medical Center of Puerto Rico 00936
FAJARDO 809 863-3792 863-0939	District Hospital of Fajardo 00649		
MAYAGUEZ 809 832-8686 Ext. 1224	Mayaguez Medical Ctr. Department of Health P.O. Box 1868 00709		

RHODE ISLAND

STATE COORDINATOR: Department of Health, Providence 02908
401 277-2401

KINGSTON 401 792-2775 792-2762	College of Pharmacy University of Rhode Island 02881	PROVIDENCE 401 277-4000	Rhode Island Hospital 593 Eddy St. 02902
		401 521-5055	Roger Williams General Hospital 825 Chalkstone Ave.
PAWTUCKET 401 724-1230	Memorial Hospital Prospect St. 02860		

SOUTH CAROLINA

STATE COORDINATOR: Department of Health & Environmental Control, Columbia 29201
803 758-5625

CHARLESTON 803 792-4201	Poison Information Serv. Medical University of South Carolina 171 Ashley Ave. 29403	COLUMBIA 803 765-7359	Poison & Drug Inf. Ctr. College of Pharmacy Room 313 Coker Life Science Bldg. University of S.C. 29208

SOUTH DAKOTA

STATE COORDINATOR: Department of Health, Pierre 57501
605 773-3361

RAPID CITY 605 343-3333 1-800 742-8925 (TOLL FREE)	West River Poison Ctr. Rapid City Regional Hospital East 57701	SIOUX FALLS 605 336-3894 1-800 952-0123 (TOLL FREE)	McKennan Hospital Poison Ctr. 800 East 21st St. 57101

TENNESSEE

STATE COORDINATOR 615 741-2407 — Department of Public Health, Nashville 37219

CHATTANOOGA 615 755-6100	T.C. Thompson Children's Hospital, 910 Blackford St. 37403
COOKEVILLE 615 528-2541	Cookeville General Hosp., 142 W. 5th St. 38501
JACKSON 901 424-0424	Madison General Hosp., 708 W. Forest 38301
JOHNSON CITY 615 926-1131	Memorial Hospital, Boone & Fairview Ave. 37601
KNOXVILLE 615 971-3261	Memorial Research Center and Hospital, 1924 Alcoa Highway 37920
MEMPHIS 901 528-6048	University of Tennessee College of Pharmacy, 874 Union Avenue 38163
NASHVILLE 615 322-3391	Vanderbilt University Hospital, 21st & Garland 37232

TEXAS

STATE COORDINATOR 512 458-7254 — Department of Health, Austin 78756

ABILENE 915 677-3551 Ext.266,267	Hendrick Hospital, 19th & Hickory Sts. 79601
AMARILLO 806 376-4431 Ext.501,502 503,504	Amarillo Hospital District, Amarillo Emergency Receiving Ctr., P.O. Box 1110, 2203 W. 6th St. 79175
AUSTIN 512 478-4490	Brackenridge Hospital, 14th & Sabine Sts. 78701
BEAUMONT 713 833-7409	Baptist Hospital of Southeast Texas, P.O. Box 1591, College & 11th St. 77701
CORPUS CHRISTI 512 884-4511 Ext.556,557	Memorial Medical Center, P.O. Box 5280, 2606 Hospital Blvd. 78405
EL PASO 915 544-1200	R.E. Thomason General Hospital, P.O. Box 20009, 4815 Alameda Ave. 79905
FORT WORTH 817 336-5521 Ext. 17 or 336-6611	W.I. Cook Children's Hospital, 1212 Lancaster 76102

TEXAS (Continued)

GALVESTON 713 765-1420 or 713 765-1561	Southeast Texas Poison Control Center, 8th & Mechanic Sts. 77550
GRAND PRAIRIE 214 647-1141	Grand Prairie Community Hospital, 2709 Hospital Blvd. 75051
HARLINGEN 512 423-1224 Ext. 283	Valley Baptist Hospital, P.O. Box 2588, 2101 S. Commerce St. 78550
LAREDO 512 722-2431 Ext. 29	Mercy Hospital, 1515 Logan St. 78040
LUBBOCK 806 792-1011 Ext. 315	Methodist Hospital Pharmacy, 3615 19th St. 79410
MIDLAND 915 684-8257	Midland Memorial Hospital, 1908 W. Wall 79701
ODESSA 915 337-7311 Ext.250,252	Medical Center Hospital, P.O. Box 633 79760
PLAINVIEW 806 296-9601	Plainview Hospital, 2404 Yonkers St. 79072
SAN ANGELO 915 653-6741 Ext. 210	Shannon West Texas Memorial Hospital, P.O. Box 1879, 9 S. Magdalen St. 76901
SAN ANTONIO 512 223-1481	Bexar County Hospital District, c/o Department of Pediatrics, Univ. of Texas Medical School at San Antonio, 7703 Floyd Dr. 78229
TYLER 214 597-0351 Ext. 255	Medical Center Hospital, 1000 S. Beckham St. 75701
WACO 817 753-1412 756-6111	Hillcrest Baptist Hosp., 3000 Herring Ave. 76708
WICHITA FALLS 817 322-6771	Wichita General Hospital Emergency Room, 1600 8th St. 76301

UTAH

STATE COORDINATOR 801 533-6191 533-6131 — Division of Health, Salt Lake City 84113

SALT LAKE CITY 801 581-2151	Intermountain Regional Poison Control Center, 50 N. Medical Drive 84132

VIRGINIA

STATE CORDINATOR 804 786-5188 — Bureau of Emergency Medical Services, Richmond, 23219

ALEXANDRIA	703 370-9000 Ext. 555	Alexandria Hospital, 4320 Seminary Rd., 22314
ARLINGTON	703 558-6161	Arlington Hospital, 5129 N. 16th St., 22205
BLACKSBURG	804 951-1111	Montgomery County Community Hosp., Rt. 460, S., 24060
CHARLOTTESVILLE	804 924-5543	Blue Ridge Poison Center, University of Virginia Hospital 22908
DANVILLE	804 799-2100 Ext. 3869	Danville Memorial Hosp., 142 S. Main St., 22201
FALLS CHURCH	703 698-3600, 698-3111	Fairfax Hospital, 3300 Gallows Rd., 22046
HAMPTON	804 722-1131	Hampton General Hosp., 3120 Victoria Blvd., 23661
HARRISONBURG	804 434-4421 Ext. 225	Rockingham Memorial Hosp., 738 S. Mason St., 22801
LEXINGTON	804 463-9141	Stonewall Jackson Hosp., 22043
LYNCHBURG	804 528-2066	Lynchburg Gen. Marshall Lodge Hosp., Inc., Tate Springs Rd., 24504
NASSAWADOX	804 442-8000	Northampton-Accomack Memorial Hosp., 23413
NORFOLK	804 489-5111	DePaul Hospital, Granby St. at Kingsley Lane 23505
PETERSBURG	804 861-2992	Petersburg General Hosp., 801 South Adams Street, 23803
PORTSMOUTH	804 397-6541 Ext. 418	U.S. Naval Hospital, 23708
RICHMOND	804 786-9123	Virginia Poison Center, Virginia Commonwealth Univ., Box 763 MCV Station 23298
ROANOKE	703 981-7336	Roanoke Memorial Hosp., Belleview at Jefferson St., P.O. Box 13367 24033
STAUNTON	703 885-0361 Ext. 209,247	King's Daughters' Hosp., P.O. Box 2007, 24401
WAYNESBORO	703 942-8355 Ext. 440,500	Waynesboro Community Hospital, 501 Oak Ave. 22980
WILLIAMSBURG	804 229-1120 Ext. 65	Williamsburg Community Hospital, Mt. Vernon Ave., Drawer H 23185

VIRGIN ISLANDS

STATE COORDINATOR 809 774-1321 Ext. 275 — Department of Health, St. Thomas 00801

ST. CROIX	809 773-1212, 773-1311 Ext. 221	Charles Harwood Memorial Hospital, Christiansted 00820
	809 772-0260, 772-0212	Ingeborg Nesbitt Clinic, Fredericksted 00840
ST. JOHN	809 776-1469	Morris F. DeCastro Clinic, Cruz Bay 00830
ST. THOMAS	809 774-1321 Ext.224,225	Knud-Hansen Memorial Hospital, 00801

WASHINGTON

STATE COORDINATOR 206 633-0505 — Department of Social & Health Services, Seattle, WA 98105

ABERDEEN	206 533-0450 Ext. 277	St. Joseph's Hospital, 1006 North H St., 98520
BELLINGHAM	206 676-8400, 676-8401, 1-800 562 8816, 562 8817 (Toll Free)	St. Luke's General Hosp., 809 E. Chestnut St., 98225
LONGVIEW	206 636-5252	St. John's Hospital, 1614 E. Kessler, 98632
MADIGAN	206 967-6972	Madigan Army Medical Ctr. Emergency Rm., 98431
OLYMPIA	206 491-0222	St. Peter's Hospital, 413 N. Lilly Rd., 98506
SEATTLE	206 634-5252	Children's Orthopedic Hosp. & Med. Ctr., 4800 Sandpoint Way, N. 98105
SPOKANE	509 747-1077	Deaconess Hospital, W. 800 5th Ave., 99210
TACOMA	206 272-1281 Ext. 259	Mary Bridge Children's Hospital, 311 S. L St. 98405
VANCOUVER	206 256-2067	St. Joseph Community Hospital, 600 N.E. 92nd St., 98664
YAKIMA	509 248-4400	Yakima Valley Memorial Hospital, 2811 Tieton Dr. 98902

WEST VIRGINIA

STATE COORDINATOR Department of Health
Charleston 25305
304 348-2971

BECKLEY 304 252-6431 Ext. 10	Beckley Hospital 1007 S. Oakwood Ave. 25801
BELLE 304 949-4313 Ext. 261	E.I. DuPont de Nemours and Company 25015
CHARLESTON 304 348-4211	Charleston Area Medical Ctr. Memorial Division 3200 Noyes Ave. 25304
CLARKSBURG 304 623-3444 Ext. 251	United Hospital Ctr. Inc. Downtown Division Washington & Chestnut Sts. 26301
HUNTINGTON 304 696-6160	Cabell-Huntington Hosp. 1340 16th St. 25701
304 696-3760	St. Mary's Hospital 2900 1st Ave. 25701
MARTINSBURG 304 263-8971	City Hospital Dry Run Rd. 25401
MORGANTOWN 304 293-5341	Mountain State Poison Ctr. Department of Pediatrics West Virginia University Medical Center 26506
PARKERSBURG 304 428-8011 Ext. 28 & 130	Camden-Clark Hospital 717 Ann St. 26101
304 422-8535 Ext. 251	St. Joseph's Hospital 19th St. & Murdoch Ave. 26101
PT. PLEASANT 304 696-6160 696-3762	Pleasant Valley Hospital Valley Drive 25550
RONCEVERTE 304 647-4411 647-4412,13 Ext. 33	Greenbrier Valley Hosp. 608 Greenbrier Ave. 24970
WEIRTON 304 748-3232 Ext. 208	Weirton General Hosp. St. John's Road 26062
WESTON 304 269-3000 Ext. 201,228	Stonewall Jackson Hosp. 507 Main Ave. 26452
WHEELING 304 233-4455 Ext. 224	Wheeling Hospital 109 Main St. 2600.

WISCONSIN

STATE COORDINATOR Department of Heath & Social Services, Div. of Health
Madison 53701
608 266-0923

EAU CLAIRE 715 835-1515	Luther Hospital 310 Chestnut St. 54701
GREEN BAY 414 432-8621	St. Vincent Hospital 835 S. Van Buren St. 54305
LACROSSE 608 784-3971	St. Francis Hospital 709 S. Tenth St 54601
MADISON 608 262-3702	University Hospitals & Clinics 600 Highland Avenue 53792
MILWAUKEE 414 931-1010	Milwaukee Children's Hospital 1700 W. Wisconsin 53233

WYOMING

STATE COORDINATOR Department of Hlth. & Social Services
Cheyenne 82001
307 777-7955

CHEYENNE 307 635-9256	Wyoming Poison Center DePaul Hospital 2600 East 18th St. 82001

APPENDIX F

SUBSTANCES POSING POTENTIAL OCCUPATIONAL CARCINOGENIC RISK

GUIDELINES FOR THE LABORATORY USE OF CHEMICAL SUBSTANCES POSING A POTENTIAL OCCUPATIONAL CARCINOGENIC RISK

LABORATORY CHEMICAL CARCINOGEN SAFETY STANDARDS SUBCOMMITTEE

OF THE

DHEW COMMITTEE TO COORDINATE TOXICOLOGY AND RELATED PROGRAMS

June 5, 1979

REVISED DRAFT

APPENDIX A

Substances Posing a Potential Occupational Carcinogenic Risk

Substances Currently Regulated by the Occupational Safety and Health Administration as Carcinogens

Asbestos
4-Nitrobiphenyl
alpha-Naphthylamine
Methyl chloromethyl ether
3,3' - Dichlorobenzidine (and its salts)
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminodiphenyl
Ethylenimine
beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic arsenic
Benzene
Coke oven emmissions

Current List of Substances Selected by the DHEW Committee to Coordinate Toxicology and Related Programs for Inclusion Under these Guidelines

(This list of substances is not to be considered all inclusive. Rather, it serves as a list of substances for which Safety Data Sheets are currently being prepared)

Benzo[a]pyrene
Benz[a]anthracene
3-Methylcholanthrene
N-Nitrosodiethylamine
N-Nitrosodi-n-propylamine
N-Nitrosodi-n-butylamine
N-Nitroso-N-methylurea
N-Nitroso-N-ethylurea
N-Nitroso-N-methylurethane
2-Aminofluorene
N-Hydroxy-2-acetylaminofluorene
N-Acetoxy-2-acetylaminofluorene
Dimethylethylenimine
3,3'-Dimethoxybenzidine
3,3'-Dimethylbenzidine
4,4'-Methylene bis-(2-chloroaniline)
m-Toluenediamine
Polychlorinated biphenyls
Diepoxybutane
p-Dioxane
N-[4-(5-Nitro-2-furyl)-2-thiazolyl]-formamide
Bromoethyl methanesulfonate
Ethyl methanesulfonate
Methyl methanesulfonate
1,3-Propane sultone
Ethionine
Urethane
7,12-Dimethylbenz[a]anthracene
Dibenz[a,h]anthracene
N-Nitrosopiperidine
1,4-Dinitrosopiperazine
N-Nitroso-N-ethylurethane
1-Methyl-3-nitro-1-nitrosoguanidine
1,1-Dimethylhydrazine
1,2-Dimethylhydrazine
Hydrazine
Methylhydrazine
Procarbazine
Chlorambucil
Uracil mustard
Carbon tetrachloride
Chloroform
1,2-Dibromo-3-chloropropane
Ethylene Dibromide
Propylenimine
4-Nitroquinoline-1-oxide
Diazomethane
Cycasin
o-Aminoazobenzene
3'-Methyl-4-aminoazobenzene
Aflatoxins

APPENDIX F

PRIMARY CONTAINMENT EQUIPMENT

The purpose of primary containment equipment is to protect the laboratory worker from exposure to vapors or aerosols of hazardous materials that may be released by procedures performed within the equipment. Primary containment equipment that is properly designed, located, maintained, and operated can prevent or minimize the escape of hazardous materials from the equipment into the laboratory. The open face laboratory-type hood and the glove box are the principal primary containment equipment upon which laboratory workers depend for their protection while working with chemical carcinogens.

Open face laboratory-type hood

The laboratory fume hood and the Class I and II biological safety cabinets are examples of open face laboratory-type hoods. Protection is provided by the flow of air from the laboratory into the hood through the open face. This air flow reduces the potential for escape of airborne contaminants from the hood into the laboratory. This type of equipment does not provide protection against direct contact with hazardous materials when procedures are performed with the equipment. Such protection is dependent on strict adherence to good laboratory practice.

The performance of this type of equipment in protecting the laboratory worker from exposure to airborne contaminants is dependent on the design of the face opening, the location of the equipment within the laboratory, how well it is maintained, the manner in which the equipment is used, as well as the quantity and velocity of air that passes across the open face. The face opening should be designed so that air turbulence around the edges of the open face is avoided and uniform face velocities are maintained. The equipment

should be located in an area of the laboratory away from doorways, supply air diffusers, and spaces of high activity. Generally, the best location for this equipment is at the end of the room away from the laboratory door. Equipment users should be trained to avoid abrupt movements of the arms and body which tend to draw air from the hood into the laboratory. Open face laboratory-type hoods that are designed, located, maintained and operated properly can provide excellent worker protection for any activity which should be performed in such equipment when the velocity of air crossing the open face is maintained at approximately 100 feet per minute.

Equipment descriptions, recommended specifications and certification procedures can be found in the following documents:

(1) Laboratory Fume Hood Standards, Recommended for the U.S. Environmental Protection Agency. Contract No. 68-01-4661. Jan. 15, 1978.

(2) Laboratory Safety Monograph, A Supplement to the NIH Guidelines for Recombinant DNA Research. U.S. Department of Health, Education, and Welfare, Public Health Service, National Institutes of Health. January, 1979.

(3) National Sanitation Foundation Standard No. 49. National Sanitation Foundation, Ann Arbor, Michigan, 1976.

Glove Box

The Glove Box or Class III biological safety cabinet is a totally enclosed ventilated cabinet of gastight construction. Operations within this equipment are conducted through attached rubber gloves. When in use, the equipment is maintained under negative air pressure of at least 0.5 inches water gage. Supply air is drawn into the equipment through HEPA filters and the exhaust air is treated to prevent the discharge of contaminants into the

environment. This equipment provides the highest level of personnel and environmental protection.

The Glove Box is generally recommended for the isolation of procedures involving stock quantities of chemical carcinogens. Worker protection can be compromised by puncture of the gloves or accidents creating positive pressure. Flammable solvents should not be used in this equipment unless a careful evaluation has been made to determine that concentrations do not reach dangerous levels. When required and determined safe, these materials should only be introduced in the equipment in closed, nonbreakable containers. These materials should not be stored in the equipment. Flammable gas should not be piped to this equipment.