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Radiological Containment Guide

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RADIOLOGICAL CONTAINMENT GUIDE

1.0 PURPOSE AND SCOPE

This document provides uniform guidance for Westinghouse contractors on the implementation of radiological containments. This document reflects standard industry practices and is provided as a guide. The guidance presented herein is consistent with the requirements of the U. S. Department of Energy Radiological Control Manual (DOE/EH-0256T) (DOE 1994).

This guidance should further serve to enable and encourage the use of containments for contamination control and to accomplish the following:

- Control the spread of contamination
- Minimize the required use of protective clothing and personal protective equipment

2.0 DISCUSSION AND PROGRAM ELEMENTS

2.1 DISCUSSION

As used in this document, "containment" is not limited to the concept of total enclosure, but also encompasses various engineered barriers applied in varying degrees to prevent the spread of radioactive contamination.

Two key principles influence the application of containments:

- Establishing the contamination barrier (the containment) as near to the source as possible
- Whenever possible, using containments around the work area instead of requiring workers to use additional protective clothing or other personal protective equipment.

The challenges experienced at many individual facilities, for example, tritium, ^{238}Pu oxide, criticality issues, chemically active materials or processes, or other facility-specific issues, will affect the application of containment. This document is not intended to override established and safe work practices for these or other special applications.

2.2 PROGRAM ELEMENTS

A successful containment program should contain the following elements:

- Training of personnel who use, install, or certify containments
- Standardized selection process
- Defined specifications
- Installation/inspection criteria
- Operating guidelines.

The program elements are described in detail in the following sections.

3.0 TRAINING

Containment training should be accomplished on three levels: site-based training, facility-based training, and job-specific training. Each level of training should be performed in conjunction with training described in the U. S. Department of Energy Radiological Control Manual, Chapter 6.0.

3.1 SITE-BASED TRAINING

3.1.1 Radiological Worker Training

Site-based training should be integrated into Radiological Worker II training and should include the following program elements:

- Basic types and application of containments
- Standard features of containment devices
- Standard work practices
- Inspection criteria.

3.1.2 Radiological Control Technician Training

Radiological Control Technicians should receive training that includes the following elements:

- Basic types and application of containments
- Inspection criteria
- Standard work practices
- Standard features of containment devices.

3.1.3 Training for Planners and Engineers

Persons responsible for planning or overseeing tasks that involve the use of containment should receive training that includes the following elements:

- Selection
- Design
- Ventilation.

3.1.4 Containment Installer(s) Training

Personnel who install or are responsible for certifying containments should be specially trained for that function.

3.2 FACILITY-BASED TRAINING

Facility-based training should include the following elements (unless covered in site-based training):

- Facility-specific actions for abnormal conditions
- Installation/removal process for containments
- Facility-specific applications and rules.

3.3 JOB-SPECIFIC TRAINING

Job-specific training on containments is encouraged as part of facility work control or ALARA[1] programs. An example of job-specific training would be mock-up training for high-exposure or complex tasks, or when the application of a given containment would be unique to the job.

4.0 SELECTION, DESIGN, AND SPECIFICATION

4.1 METHODS OF CONTAINMENT

The various containment methods are summarized in the following discussion. Appendix B contains application guidance and drawings that identify the components discussed.

- Containment Tents — Containment tents are a class of large enclosures, generally constructed of flexible sheeting, which allow personnel to physically enter a contaminated environment to perform work. Containment tents can also be used as anterooms for access to cells, tank risers, and other highly contaminated environments.

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[1]ALARA = "As low as reasonably achievable."

- Glove Bags — A glove bag is a flexible containment used to establish a localized enclosure around a contaminated item, allowing personnel to accomplish repairs or manipulations via gloved sleeves without contacting the contaminated environment.

- Polyethylene (Poly) Bottles — Poly bottles are manufactured as 5- or 15-gallon polyethylene containers used to collect small quantities of contaminated liquids. Bottle assemblies generally include a filtered vent assembly.

- Miscellaneous — Other types of containment devices include sleeving, mechanical joint containments, plastic sheeting, and drop cloths. The following containments are discussed in more detail.

  - Catch Containments (Drapes) — Catch containments are partial enclosures usually used to collect falling debris or small amounts of liquid.

  - Wind Break or Bull Pen — A bull pen is a walled, or partially walled, enclosure that allows personnel to enter and work in a contaminated environment. They are generally roofless and are used on low risk activities to protect immediate area from contaminants, as well as protect the work area from external factors which could result in contaminated material being spread.

  - Air curtains — Air curtains use moving air to draw contaminants into a filtered exhaust plenum. Applications of air curtains include open faced hoods, strategically placed exhaust ducts, or any other means of capturing the contaminants at or near the source with filtered ventilation.

4.2 CONTAINMENT SELECTION PROCESS

Establishing an effective containment involves the following general steps: defining that a containment is needed, determining what type of containment is appropriate, designing the containment, and obtaining and using the containment. The process should consider the following elements:

- A standardized method of determining containment needs
- Design considerations for developing specific applications
- Integration of containment design process with the work planning process
- Standard specifications for commonly used containments.

The work control system is a logical place to implement selection criteria for containment. In addition to the radiological selection criteria, the implementation of the selection process will require the following controls be incorporated into work control systems to ensure containment selection is effective:

- Documents that control the work should indicate the need for and the type of containment to be used
- Tasks should be reviewed and the containment selected based on component size, arrangement, work requirements, and surrounding interferences.

- When more than one craft will use a single containment, all should be consulted on the type to be used.
- Document controlling work should state if liquid is expected in the containment, and if so, the probable composition and quantity of the liquid, and whether criticality concerns exist.

4.3 DESIGN CONSIDERATIONS

Contamination control and personnel safety are the key considerations when designing containments. Contamination levels, temperature, area configuration, isotope(s), and the radiological characteristics of the immediate vicinity should also be considered.

Designs of certifiable containments should be approved by the Radiological Control Organization and the Line Organization.

Detailed design considerations are described in Appendix B.

4.4 SPECIFICATIONS

Specifications should be written and approved using site-specific procedures. Specifications should address the following:

- Reference Standards
- Material
- Fabrication
- Framing
- Components
- Quality Assurance Requirements.

A detailed discussion of the specification process and sample specifications are contained in Appendix B.

5.0 APPLICATION

5.1 ADMINISTRATIVE CONTROLS

Administrative controls are necessary to ensure the standardized application of containments. As a minimum, the following items are recommended:

- Certification checklists — standardized checklists to document initial installation and inspection of certifiable containments.

- Identification — a method of identifying a containment that includes the job being performed and a record of the date and time of inspection. Such an identification should remain with the containment throughout the job or activity.

5.1.1 Inspection of Containment

Inspection of radiological containments is necessary to ensure the end product of the containment design and installation process meets established standards.

Containments generally fall into two categories: certified and non-certified. Certified containments are usually limited to tents and glovebags. All other methods of containment fall into the uncertified category.

5.1.1.1 Inspection and Certification of Certified Containments

Certification of containments should be performed after installation and before use. All necessary staged materials should be in place prior to certification. Certification should be performed by personnel who have completed training that defines site-specific acceptance criteria for certified containments. Deviations from standard acceptance criteria should be noted on the certification checklist with appropriate approvals. The certification checklist should become part of the work controlling document for the work activity.

Inspections, or recertifications, for certified containments should be performed after repair, daily while in use, and at least monthly when not in use to determine need for repairs, replacement, or decontamination and removal.

Standardized criteria for certified containments is contained on the checksheets contained in Appendix C.

5.1.1.2 Inspection of Non-Certified Containments

Non-certified containments, such as drapes, poly bottles, and sleeving should be inspected routinely. Routine walk through of the work area should ensure the devices are maintained properly; in some cases, formal inspection criteria may be included in the work controlling documents that required the devices. An example of a situation requiring formal inspection criteria is a poly bottle where liquid levels or dose rates may need to be monitored at some given frequency. A site-wide program isn't needed to support this, but the specific installation process should include steps to ensure any inspections beyond routine are performed.

5.1.2 Identification of Containment

Site-specific controls should be in place to ensure that the following information can be readily identified for containments in use:

- Responsible organization
- Installing organization
- Work controlling document
- Initial inspector/certifier
- Date and time of most recent inspection/certification

Where multiple containments are in extended use in a given site/facility, a containment tracking system should be considered. Such a system should allow the site/facility to document the number

types of certifiable containments used and manage their application. This will allow the facility to gauge the need for designing and installing permanent containments for specific jobs/systems.

5.2 USE OF CONTAINMENT

General guidelines and good work practices for the use of containments are included in Appendix D. These guidelines are not intended to serve as procedures, but do, in some cases, contain specific guidance on the operation of containment devices. The appendix includes separate discussions for

- General use criteria
- Tents
- Glove bags
- Poly bottles
- Other containments (i.e., catch containments, mechanical joint containments).

5.3 TESTING OF CONTAINMENTS

5.3.1 Containment Tents

Containment tents do not routinely undergo pre-installation tests; however, a smoke test is sometimes used to verify negative ventilation. The smoke test consists of releasing a small amount of nontoxic smoke near an opening and observing to see if it is drawn inside the tent.

5.3.2 Glove Bags

Because of their unique application as the sole barrier to contamination spreads, glove bags often require specific tests to verify their ability to contain contamination. Two specific types of tests are routinely performed: air testing and water testing, each has specific applications and should only be required when needed.

5.3.2.1 Air Testing.

(Air testing is described in greater detail in Appendix D, Section D.3.3.1.) Because air testing is generally used to determine glove bag integrity before installation, air testing is usually performed by the manufacturer or the installation craft. The test consists of pressurizing the glove bag to approximately 1.5 oz/in^2 (0.1 psi) and then applying leak detector (soap solution) to the seams. Variations to this specific method may be performed; however, the key function of the test is to detect faulty seams or detect deficiencies in the containment device. The use of an air test is generally limited to critical applications.

5.3.2.2 Water Testing.

(Water testing is described in greater detail in Appendix D, Section D.3.3.2.) Water testing is generally used on installed glove bags to ensure the containment will not leak liquid. The test consists

of putting a small amount of liquid (as a minimum, the amount expected to be accumulated) in the containment and verifying none leaks past the component seal or any other low points in the glove bag. The test is always used to test drain assembly installations and for any glove bag where liquid will be present.

5.4 ADEQUATE SUPPLIES

Adequate stocks of containment supplies are fundamental to any containment program. To accomplish this, standard containments and equipment should be identified and maintained accessible to the operations and maintenance organizations. An effective containment program should also include the collection and storage of containment materials that meet site-specific standards for reuse. Contamination control considerations should be included in any site policy concerning the reuse of containments or containment supplies.

6.0 REFERENCES

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APPENDIX A

CONTAINMENT SELECTION PROCESS

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A.1 PROCESS

Selecting the appropriate method of contamination control will often, but not always, include the application of containment devices. Selection of a containment device has one major principle, that being controlling the spread of contamination.

The general steps applied to the containment process are as follows:

- Define the work activity
- Determine level of containment needed
- Determine the type of containment needed
- Develop criteria for the containment
- Design the containment
- Obtain containment
- Use containment
- Remove containment

This section will assist the user in determining the level and type of containment needed for a given work activity based on the level of contamination control required.

A.2 DETERMINING CONTAINMENT NEED

The appropriate containment for a given task should be selected based on the fundamental concepts of contamination control and personnel safety. Table A-1, Recommended Containments for Specific Work Activities, provides a worksheet format applying the guidance contained in this section.

The level of containment is broken down into four "risk" categories: very low, low, moderate, and high. These categories are subjective in nature; accordingly, this process is a guide from which to begin the planning and evaluation process and is not intended to be the sole means of determining what level of containment should be used. Other considerations should include impact of containment failure, area dose rates, waste minimization, ventilation, etc. When all factors are considered, the final determination may vary from the matrix.

Table A-1. Recommended Containments for Specific Work Activities.

Removable Contamination Level	Contamination Stability	Operation	Containment Category
< 10 times Table 2-2 6	Very Stable 4	Simple material movement 5	Very Low Risk Total = 15-20
< 100 times Table 2-2 12	Moderately Stable 8	Vigorous material movement 10	Low Risk Total = 21-31
> 100 times Table 2-2 18	Low Stability 12	Use of power tools in area or manual cutting, shaping or abrading of material 15	Moderate Risk Total = 32-45
		Use of low velocity power tools to cut, shape or abrade material 20	High Risk Total > 45
		Use of high velocity power tools to cut, shape or abrade material 25	
___	+ ___	+ ___	= ___

Instructions: Select the appropriate block from each of the first three columns. Add the numbers from the appropriate block in each column and select the appropriate containment class.

NOTES:

1. Removable contamination level refers to the DOE Radiological Control Manual Table 2-2.

2. Containment requirements may be revised up or down based on general area contamination levels, dose rates, personal protective equipment needs, or other engineered controls applied in concert with a specific type of containment.

3. When contamination levels cannot be verified, either by survey or historical data, the most reasonable limiting level for contamination should be used.

4. The values on the chart call for subjective analysis. The Radiological Control Organization and Facility Management should be jointly responsible for making the final determination of the level of containment. This should be done in consultation with the performing crafts.

A.2.1 Assessment Criteria

To assess the need for containment, various criteria are considered. These criteria are broken down into primary criteria and secondary criteria. The primary criteria are those general to any work activity, the secondary criteria are usually area and job specific.

Three primary criteria are used to determine the appropriate level of containment. These criteria are: removable contamination levels, contamination stability, and the work activity to be performed. These criteria appear in the matrix contained in Table A-1 and are used in the initial determination of containment requirements.

Secondary criteria do not appear on the matrix and are a second check of the results; this is to allow for common sense adjustments. These other criteria include impact of containment failure, area dose rates, waste minimization, ventilation, and work configuration. When all factors are considered, the final determination may vary from the matrix.

In essence the primary criteria are independent of the area the job takes place in, the secondary criteria customize the selection to the work area, ensuring the decision is appropriate.

A.2.1.1 Primary Criteria

A.2.1.1.1 Removable Contamination Levels

Removable contamination is defined as radioactive material that can be removed from surfaces by nondestructive means such as casual contact, wiping, brushing, or washing. The table breaks the criteria down into three distinct categories: 1), less than 10 times Table 2-2 (< 10,000 dpm $\beta\tau$, 200 dpm α); 2) 10 to 100 times Table 2-2 (10,000 to 100,000 dpm β-τ or 200 to 2000 dpm α); or 3), greater than 100 times Table 2-2 (> 100,000 dpm β-τ, 2000 dpm α).

NOTE: If the likely contamination levels cannot be obtained from survey or historical data, the most limiting category should be used.

It is important not to confuse contamination contained in cracks, crevices, or other isolated portions of the work area with the general area contamination levels expected.

A.2.1.1.2 Contamination Stability

As noted above, removable contamination is defined as radioactive material that can be removed from surfaces by casual contact. Stability is a qualitative assessment of how easily this transfer occurs and how easily the contamination may be transported from surface to surface or surface to air. Containment stability is broken into three categories, high, medium, and low. For example: contamination that, if disturbed, readily resuspends into the air would be categorized as low stability, while contamination suspended in liquid, or on a moist or oily surface would generally be considered high stability, other contaminated surfaces would generally fall between these criteria based on surface texture, weathering and a variety of other factors to be considered.

A.2.1.1.3 Work Activity

Work activities are those actions which will be performed in the contaminated portion of the work area. The containment selection process breaks work activities into five categories:

1. Simple material movement such as walking, lifting, carrying.

2. Vigorous material movement such as repackaging waste, high-efficiency particulate air (HEPA) filter manipulation, valve packing replacement, etc.

3. Using power tools in the area or manually cutting, abrading, or shaping the material.

4. Using low-velocity power tools (portable band saws, electric drills operated at low speeds, etc.) on the contaminated components.

5. Using high-velocity power tools (grinders, high-speed drills, etc.) on the contaminated components.

A.2.1.2 Secondary Criteria

The following is a non-inclusive list of criteria with examples of how the initial containment selection criteria could be modified.

Impact of containment failure- If a failure of the selected containment would have far reaching impacts and the value obtained by using the matrix is near the boundary between two categories, the value should be adjusted upwards. For example a work activity next to a high traffic area or other location with a large potential for spread would have a greater impact from containment failure than one on an isolated system.

Area Dose Rates- Installation of a tent or a glove bag takes time, as does decontamination from performing work without adequate engineered controls. When planning work in a high dose rate area, the use of a drape may have some benefit over the use of a glovebag. As above this would generally apply only to those activities that are near the boundary between risk categories.

Surrounding Area Contamination Levels- If the surrounding area is contaminated, the containment device would not reduce the protective equipment required, and the contamination levels in the system are not substantially higher than the surrounding area, then the need for extensive containment is questionable.

Size of Area- If the system being accessed is highly contaminated there is a clear difference in the risks from a large open area and a small open area. For example, a glovebag might be appropriate for removing a blank flange from a system for a remote inspection, however if that same inspection will be accomplished by removing a small diameter plug, a catch containment and damp rags would likely provide equivalent contamination control.

Other criteria specific to work activities should be considered on a case by case basis.

A.2.2 Containment Categories

A.2.2.1 Very Low Risk

This category of tasks has a very low risk of contamination spread. For these work activities no specific containment beyond good work practices would apply. This does not preclude using containment; experience and training of the work force would be the basis for containment selection. In this category, containment might be a damp rag, sleeving, an air curtain, or even a plastic bag.

No certification or work controlling document description of the containment is routinely required for this category of work.

A.2.2.2 Low Risk

This category of tasks do have a risk of a contamination spread, but the risk is low. To keep the risk low, the containment device should be identified in the work controlling document. Examples of devices in this category are catch containments, drip pans, bull pens, sleeving, air curtains, etc.

No certification of the containment is routinely required, but the work package describes the containment device/method.

A.2.2.3 Moderate Risk

This category of tasks has a moderate risk of a contamination spread. Containment for this type of work is usually total enclosure such as heavy sleeving, glove bags, or containment tents. Where total enclosure is not feasible, the application of fixatives or other controls should be used.

The containment method should be called out in the work controlling document and the containment should be certified prior to use.

A.2.2.4 High Risk

This category of work contains an inherent risk of a contamination spread. Containment should be accomplished by ventilated tents or glove bags, or other means of enclosure used independently or in conjunction with each other.

Certification of the containment device is recommended. The work package must contain a certification checklist for the specific containment used.

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APPENDIX B

CONTAINMENT DESIGN AND SPECIFICATION

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CONTAINMENT DESIGN AND SPECIFICATION

B.1 PURPOSE

This appendix provides a uniform methodology for containment design and specification.

B.2 PROCESS

If the designers understand the facility and the job to be performed, designing a glove bag or tent is generally a simple process that can be easily documented.

A sample design checklist is attached (Attachment 1, Design Checklist). The containment design checklist is a two-page document; page 1 collects needed information, and page 2 includes a sketch that can be used to show the layout of the containment. The attachment includes two versions of page 2: one for glove bags, and one for tents. Some information is repeated, so the two pages may be used independently.

B.3 DESIGN CONSIDERATIONS

B.3.1 CONTAINMENT TENTS

The following features should be considered when designing a containment tent:

- Site Characteristics - Determine if special features are needed on the tent to compensate for uneven floors, obstructions, etc. Determine if the containment will require a special frame or can it be supported by components in the area. On soft surfaces, plywood may be needed under the floor. Determine if the work area is well lighted or whether temporary lights need to be installed on the top and sides of the containment to shine through the windows; this can affect the location and number of windows.

- External Frame — Containments should use an external frame. If, for structural or other reasons, an external frame is not practical, every effort should be made to prevent framing materials from becoming contaminated. Two basic types of frames are used, the first is the standard scaffolding material, the second is schedule 40 pipe, cut to length.

- Material — Material should be a flexible, impermeable fabric of sufficient strength to meet the specific environmental conditions. Generally any reenforced material meeting the requirements of Mil Spec 43006G, Type 1 material will work. As a note, other materials can be used if needed, but any material used must fulfill the requirements of NFPA 701 A, Large Scale, for fire retardant capability. Material used on the floor should be selected based on the expected

need, but consideration should be given to re-enforcing the floor where appropriate. The potential for liquid should be considered when determining the floor material as well.

- Support — For external applications, flexible supports are needed. All tents should have sufficient tie-offs (e.g., grommet tabs, molded tie-offs, or other such devices) to support the tent. This can be achieved in a variety of methods, however the basic fundamentals of securing a tent require that all external corners have a grommet strip or tie offs used to support the tent. This also applies to those corners on the ground, especially for out door applications. Figure 4 shows a routine pattern for tie offs on a tent, this pattern is also appropriate for grommet strips. Grommets should not be spaced more than 18" apart.

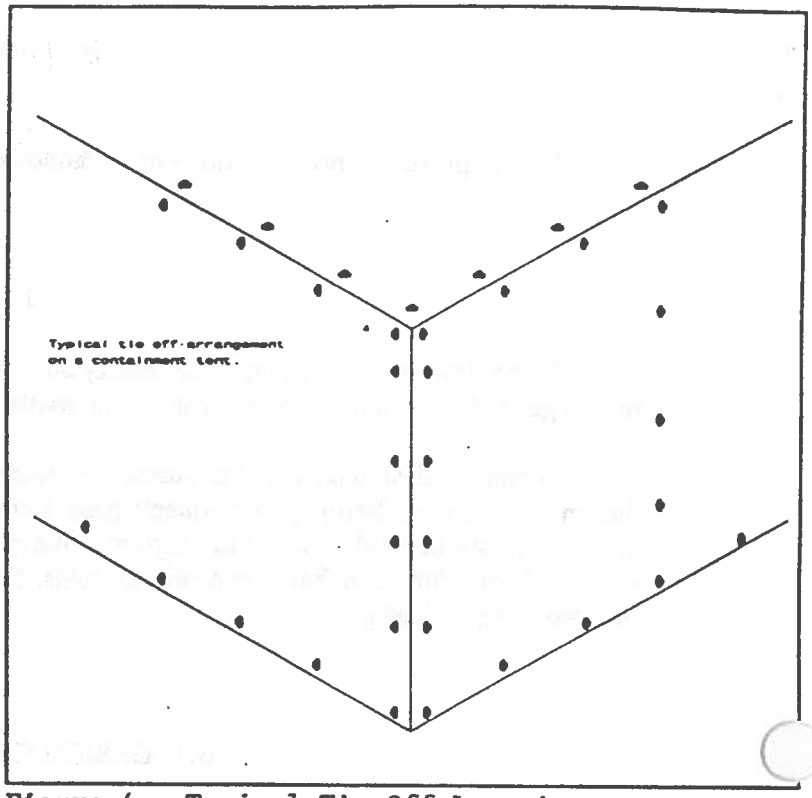

Figure 4: Typical Tie Off Locations

- Service Sleeves — Service sleeves are used to bring services such as power and air into a tent. As a rule, service sleeves should be a minimum of 3 in. in diameter. As a minimum, the sleeves should be large enough to accommodate air sampling lines. Panels to accommodate air lines or welding leads may be installed in lieu of service sleeves.

- Pass Sleeves — Pass sleeves are generally located near exit doors as a receptacle for waste and used protective clothing. Pass sleeves may have collars attached that allow sleeves to be replaced or have long sleeves attached. The advantage of long sleeves is to allow waste to be collected in the sleeve and removed using a standard bag out method as is used with glove bags. Pass sleeves are not a mandatory item on tents and should not be installed unless they will be used. Smaller pass sleeves can be used to support pipes, ducting, or other large penetrations.

- Color — Tents should be yellow or white and labeled to indicate its radiological status.

- Pass-out boxes - Passout boxes are small double-door boxes that allow small items such as air samples, survey media, and hand tools to be transferred in and out of containment tents.

- Windows — Windows should be clear and of sufficient number to allow use of external lighting. For outdoor applications, covers should be considered that allow sun side windows to be covered. This will help keep temperatures in the tent ALARA.

- Make up air — When ventilation is used on a tent, the tent must have a means of taking in make-up air. Acceptable methods of taking in make-up air include, but are not limited to, inlet breather filters or one-way louvers. Figure 5 shows typical breather filters. In dusty or smokey environments inlet filter media will reduce the possibility that the exhausting HEPA filter will be plugged or that smoke and/or debris could be sucked through the damper into a containment by the negative ventilation system.

  Direction of flow is in a general downward direction towards the ventilation suction. Filter media is installed in a similar location. If the ventilation is secured, the filter media is covered to prevent contamination from escaping the containment.

- Doors — Doors should be designed to be opened and closed easily. If high radiation area controls are required, consideration should be given to using doors that can be locked. Doors should have a clear viewing panel in the upper half and have posting pouches capable of holding standard size signs on the lower half. For tents to be used for extended periods of time or under harsh conditions, spare or backup doors may be included in the tent. A sample door is shown in Attachment 2, Figure 5.

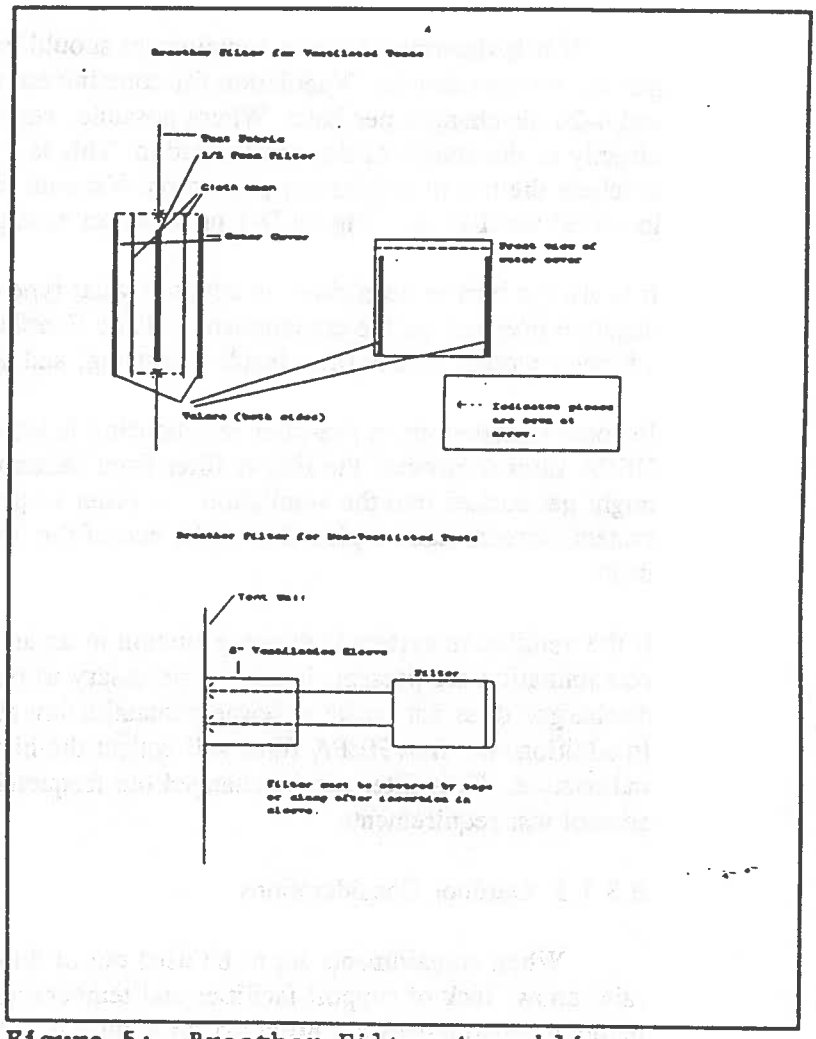

Figure 5: Breather Filter Assemblies.

- Ante Rooms - Ante rooms provide additional contamination control by providing directional air flow and barriers against the spread of contamination, as well as a location to remove contaminated clothing. Multiple ante rooms may be needed to accommodate dual entry points or, for highly contaminated applications, isolating additional dressing and undressing methods.

- Open Roofs - Crane operations often require an open roof during some operations. One option is to have the roof in the form of a semi-detachable flap that is firmly attached on one side, and

attached with Velcro[1] on the other three sides. The Velcro on the tent should be 8" wide, and the Velcro on the roof flaps, 4" wide. The roof flap should have a loop every 5' to allow a support to be installed that prevents sagging. For larger tents, two overlapping flaps may be needed. Roof openings should always be as small as reasonable for the intended work activities. Any method that effectively controls contamination is acceptable.

- Tool Pouches -In order to keep the floor of the work area free of tools and debris, tool pockets and straps can be added to the containment walls. If possible, determine their location in advance so they can be added during fabrication of the containment.

B.3.1.2 Ventilation of Containment Tents

If it is determined that a containment should be ventilated, the ventilation should be planned as part of the containment. Ventilation for containment tents usually is operated at 0.01-0.3 in. of water and 4-20 air changes per hour. Where possible, ventilation should be localized using flexible ducting directly to the source of the contamination. This is a far more efficient method of ventilation and may preclude the use of respiratory protection. Vacuum cleaners can also provide an effective source of localized ventilation. Figure D-1 provides an example of good and bad ventilation configurations.

It is always best to determine in advance what type of ventilation system will be used to draw a negative pressure on the containment. Note: Ventilation systems for containments normally consist of a blower motor, HEPA filter inside a housing, and associated vent hose or ducting.

In some installations, a pre-filter in a housing is located between the suction end of the hose and the HEPA filter to prevent the HEPA filter from becoming plugged with tape, absorbent, paper, etc, that might get sucked into the ventilation. In order to prevent materials from getting into the ventilation system, screens can be placed over the end of the hose so that only very small items can be sucked inside.

If the ventilation system is drawing suction in an area where very high levels of loose surface contamination are present, it may be necessary to put another HEPA filter in-line to assure that the air discharged does not create airborne contamination above limits outside the containment.
In addition, the first HEPA filter will collect the highly contaminated particulate and become highly radioactive. This filter can be changed out frequently without effecting the main HEPA filter or its aerosol test requirements.

B.3.1.3 Outdoor Considerations

When containments are to be used out of doors, key factors must be considered such as wind, rain, snow, lack of support facilities and temperature. Some of the essential features of indoor and outdoor containments are provided for comparison below.

- Indoor containments

  Lower gauge (10-14 mil) fabric (nylon reinforced plastic)

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[1]Velcro is the registered trademark of Velcro USA Inc. Manchester, N.H

Ultraviolet (UV) resistance and plastic stabilizer requirements are not critical

Structural members will not be required to withstand wind gusts of up to 50 mph

- Outdoor containments

  Higher gauge (14-18 mil) fabric (nylon reinforced plastic)

  UV resistant material should be used

  Structural members will be required to withstand wind gusts of up to 50 mph

  Flexible supports needed to connect tent to frame

B.3.1.3.1 Wind

Wind considerations will often mandate that an engineering assessment of outdoor containments be performed. For containment tents, material meeting Mil-C-43006G, Type 1 material requirements, attached with 2.5-in. molded plastic tie offs will generally endure winds >50 mph if the tie-offs are connected to the frame with flexible cord and the frame is adequately anchored.

Operating considerations for specific applications should include wind speeds at which containment tents are no longer considered stable. When this wind speed is expected, provisions for collapsing tents in place and securing them to frames should be considered.

B.3.1.3.2 Rain

Rain is only a problem to containments if it is allowed to pool or penetrate unsecured openings. All containment structures used out of doors should include a slope either built into the tent or a secondary cover added externally that allows the containment to shed rain water. Note that the slope should not direct rain water toward a door. If a flat topped containment is needed, drain fittings, such as could normally be used in a catch containment, can be installed in the roof and liquids routed outside the tent. Alternative methods of removing water from the roofs of containment should be considered.

B.3.1.3.3 Snow

Snow accumulation should be removed as quickly as is reasonable. No reasonably obtainable roof slope will shed all snow. A good method of dealing with snow is to install a secondary cover on the containment that can be put at a much steeper pitch than the roof of the containment and that is external to the frame.

B.3.1.3.4 Temperature

At colder temperatures many plastics become stiff; this can make many simple operations very difficult. For example it is very difficult change a pass out sleeve or tape up a service lead in cold weather. For tents, little can be done unless the tent can be heated. For glove bags, polyurethane is a viable alternative as it maintains flexibility in extreme cold.

Temperatures inside of containment tents can reach as high as 140 °F on a sunny day. Minimizing windows and using reflective materials to shade the containment can help to mitigate the affects of the sun.

B.3.1.3.5 Miscellaneous Considerations

Containment tents used outdoors have a tendency to begin deteriorating around doors and windows. The constant motion caused by wind action can cause door zippers to wear out very quickly. A proven method of resolving this is to have both Velcro and zipper door closures. Another method is to have spare doors actually installed in the containment but not placed in service until needed.

B.3.2 GLOVE BAGS

Design consideration for glove bags should consider the following:

- Support — External framing may be needed for support depending on application and ventilation requirements. Molded tie-offs, grommet tabs, or other tie-off devices should be included in the design of the glove bag. Elastic cord is preferable for connecting glove bags to an external frame.

- Service Sleeves — Service sleeves are used to bring needed services into a glove bag and to provide an outlet for air exhaust or liquid drains.

- Pass Sleeves - Pass sleeves should be made of a 4-12 mil, dependent on application, fabric compatible with the body of the bag. Where practical, metal or plastic collars should be used to attach additional sleeving.

- Color — Glove bags should be clear and/or yellow. Accessories need not be specially colored if they are appropriately labeled.

- Ventilation — All non-ventilated glove bags should contain a 2-CFM or larger HEPA filter located in the upper half of the glove bag. Glove bags having negative ventilation should contain breather filters to allow sufficient flow capacity to prevent the glove bag from collapsing. Reticulated foam, 1/2 inch thick 50 PPI, will provide 4-5 CFM per square inch of surface at 1" water gage. If air tools are used, the exhaust should be directed out of the glove bag, unless adequate exhaust ventilation is provided.

- Temperature — Glove bags that will be in contact with piping or components where temperatures may exceed 150 °F should be protected by heat insulating material.

- Liquid Collection — Where liquid is expected or likely to collect in the glove bag, the glove bag should be verified liquid tight. A drain assembly or pump suction should be included in the design. With the exceptions of drain fittings, there should be no penetrations in the lower portion of a glove bag.

- Seams - Seams should be as few as possible and designed to permit radio-frequency or heat sealing manufacture wherever possible.

B.3.3 POLY BOTTLE INSTALLATIONS

Design considerations for poly bottle installations should include the following:

- Volume — Estimated volumes of liquid expected should be planned for as part of poly bottle installations; staging of spare poly bottles should be considered.

- Location — Where possible, poly bottles should not be located in walkways or other locations where the bottle, hose, or attachments could easily become damaged, disconnected, or spilled.

- Sizing — Poly bottles generally come in two sizes, 5 and 15 gal. Where movement of a full or partially full bottle is difficult (i.e., stairwells, ladders), the smaller bottle should be used.

- Inspections — Since poly bottles are not routinely certified, consideration must be given to an inspection frequency during the design phase of the process. Considerations should include area traffic, contamination levels, radiation levels, and the expected flow rate into the bottle.

- Spillage — Poly bottles should be supported or tied off to a sturdy point to prevent tip over.

- Ventilation — Poly bottles should be vented in a controlled manner to allow displacement of air due to introduced liquid. Consider nature of hazard when designing ventilation for poly bottles (i.e., do not vent liquids which may contain tritium through HEPA filters).

- Criticality — The use of poly bottles should be evaluated by qualified personnel when used with fissile isotopes.

- Freezing — Where poly bottles are exposed to freezing conditions, freeze protection should be included in the design. Anti-freeze liquids are discouraged.

- Liquid Temperature — Liquids greater that 150 °F should be collected in bottles designed for high-temperature liquids. Poly bottles should not be used unless sufficient liquid is included in the bottle as a heat sink. For these applications, nylon reenforced tubing or metal piping should be used.

- Change out — The organization responsible for changing and/or emptying full poly bottles should be identified.

- Liquid Level — Poly bottles should have dye (red or blue food coloring) added to color the liquid when installed. This allows the liquid level to be observed without tipping the bottle.

B.5 SPECIFICATION

B.4.0 STANDARD SPECIFICATIONS

Standard specifications are a very useful method of simplifying the use of containment. In essence, standard specifications establish ground rules, within which many different versions of a containment can be obtained. No standard specification will address all needs.

Two sample generic specifications are attached: one for glove bags and one for tents. They are designed to provide standard guidelines when ordering a containment device, however, specific details, such as size, framing material, and drawings should be developed before ordering a containment.

B.4.1 QUALITY ASSURANCE

Quality assurance involvement is very important to the process, while most containments do not require stringent quality assurance programs, the following should have quality assurance verification:

- Bolts or fasteners used in framing
- Verification of any required tests (i.e., air tests)
- Material verification.

Note that in the attached specifications the vendor is required to maintain these records and provide them when requested. By doing this, you can easily obtain the needed records should the documentation be needed for a specific activity.

APPENDIX B, ATTACHMENT 1-A: DESIGN CHECKLIST

DESIGN CHECKLIST

JOB TITLE _____
WORK PROCEDURE _____
LOCATION _____

SUMMARY OF WORK _____
_____
_____
_____

CONTAINMENT TYPE: ( ) Tent ( ) Glove Bag ( ) Other
CONTAINMENT STYLE: ( ) Standard - Type: _____ ( ) Custom

REQUESTING ORG: _____

USERS: _____
SOURCE:
( ) Procured
( ) On Site Manufacture (J:
J:
WO/PO # _____)
( ) Field Construction

SPECIAL INSTRUCTIONS/TEST REQUIREMENTS: _____
_____
_____
_____

Preparer: _____
REVIEWERS:
User: _____
User: _____
Radiological Control: _____

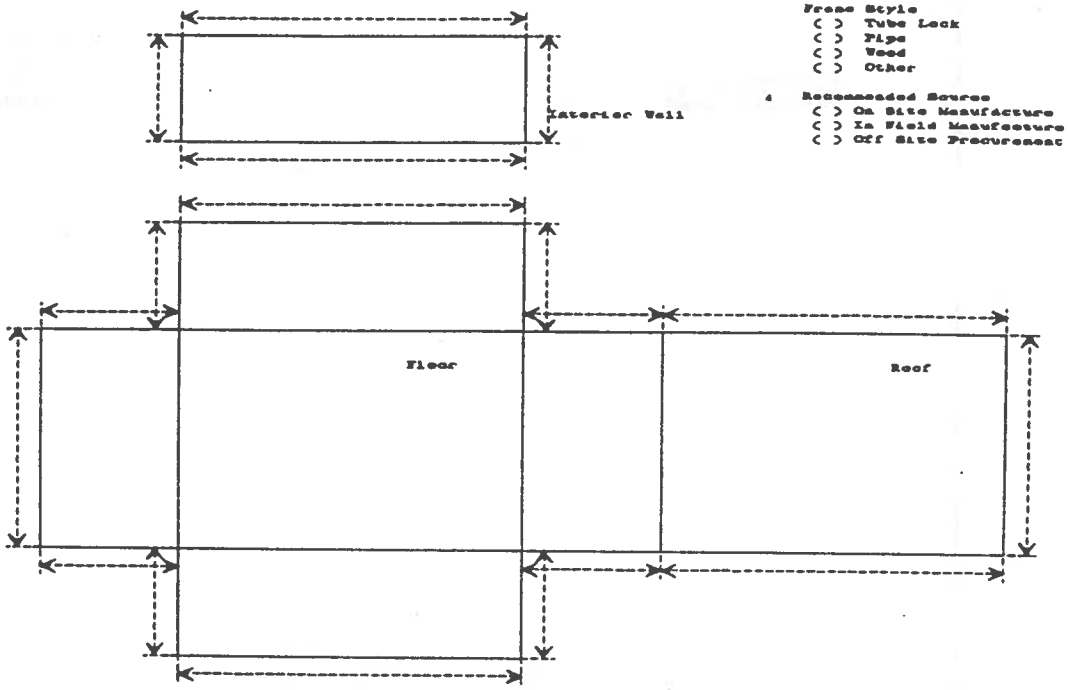
ATTACHMENTS:
() Tent Design Worksheet
() Glove Bag Design Worksheet
() Other

APPENDIX B, ATTACHMENT 1-B: DESIGN CHECKLIST - TENTS

Work Package _____ Job Summary _____

Location _____

Notes _____



Frame Style
( ) Tube Lock
( ) Pipe
( ) Wood
( ) Other

Recommended Source
( ) On Site Manufacture
( ) In Field Manufacture
( ) Off Site Procurement

Prepared By

Reviewed By
Radiological Control _____
Craft _____
Operations _____
Other _____

A 8" x 6" service sleeve
B ___ x ___ Service Sleeve
C ___ x ___ Service Sleeve
P Passout Box
W Window ___ x ____
D Door
Zipper
Velcro

APPENDIX B, ATTACHMENT 1-C: DESIGN CHECKLIST - GLOVE BAG

Work Package _____ Job Summary _____

Location _____ _____

Notes _____

_____

_____

SKETCH :

Recommended Source
( ) On Site Manufacture
( ) In Field Manufacture
( ) Off Site Procurement

Prepared By

Reviewed By

Radiological Control _____

Craft _____

Operations _____

Other _____

A Glove Ports
B 6" x 12" Service Sleeve
C 3" x 6" Service Sleeve
D ___" x ___" Service Sleeve
E Passout Box

Zipper

Velcro

APPENDIX B, ATTACHMENT 2: SAMPLE SPECIFICATION FOR SOFT-WALLED RADIOLOGICAL CONTAINMENT TENT

1.0 SCOPE

This specification defines recommended requirements for soft-walled radiological walk-in containment tents used for performing radiological work.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

MIL-C-43006G, Military Specification, Cloth and Strip, Laminated or Coated, Vinyl-Nylon or Polyester High Strength, Flexible

Federal Specification L-P-375C, Plastic Film, Flexible, Vinyl Chloride

2.2 Nongovernment Documents

ASTM A 47-84(1989)[1], Ferritic Malleable Iron Castings

3.0 TECHNICAL REQUIREMENTS

3.1 Item Definition

The containment tent specified in this document will consist of a soft-walled enclosure supported by a rigid external framework. The tent is intended to be installed over or around the work activity to provide protection against the spread of radioactive contamination.

3.1.1 Item Diagram

Diagrams are attached as Figures 1, 2, 3, 4, and 5.

3.2 Reliability

The tent shall be of construction such that minor repairs and modifications are possible in the field. Replacement parts shall be readily available from the supplier to allow repairs to be made in the field.

3.3 Design and Construction

3.3.1 Design

The containment tent shall be designed to include the following unless variations as noted in Section 3.3.5 are invoked:

- Ante room - The tent shall have an anteroom measuring at least 5 ft by 5 ft in area. The room should also contain two 24-in. exterior diameter sleeves, a pass-out box, a 4-in. service sleeve, two windows, four 3-in. service sleeves, and one breather filter (or air damper) located in an external wall.

- Doors - The tent should have doors separating the work area and ante room. The doors should be a minimum of 30 in. wide by 66 in. high and have a clear window in the upper half of the door. The tent should include a means to support the door while open.

NOTE: For tents designed for extended or outdoor use, spare doors, installed in the containment, should be considered.

- Work Area - The work area should contain two 24-in.-diameter exterior sleeves in the work area located as near the exit as possible. Each work area shall also contain, as a minimum, a pass-out box, two 4-in. service sleeves, windows, four 3-in. service sleeves, and breather filters (or air dampers). Figure 1 shows the approximate locations of each of these components in a standard tent.

- Pass-out Boxes - The tent should have pass-out boxes located within each section. Unless otherwise specified in the purchase order, the pass-out box should be 6 in. high by 6 in. wide by 4 in. deep. The pass-out boxes shall use either Velcro or zippers for the inner and outer seal closures. Circular passout boxes may be substituted.

- Posting Pouches - Two clear pouches (two pouches together), capable of holding a sign measuring 10 in. by 13 in., shall be located on the outer surface of both doors and immediately adjacent to the doors, such that the postings are visible if the door is open.

- Adequate Support - The tie-offs used to support the tent shall be of sufficient quantity and strength to support the tent with a differential negative pressure of 0.5 in. of water inside the tent.

- External Frame - The tent should be supported by an external frame capable of supporting the tent with a negative pressure of 0.5 in. of water.

- Roof Slope - Depending on location, tents should either have a sloped roof as part of the design or have a secondary structure fitted to the tent that will provide sufficient slope to allow the tent to shed water and snow accumulations.

3.3.2 Construction

The tent shall meet the following requirements:

- Walls, Floors and Ceilings - The walls, floors, and ceilings shall be fabricated from material meeting Military Specification (Mil-Spec) MIL-C-43006G; Type 1 material is required. The color of the material shall be yellow except where windows are installed. The floor section of the work area should be fabricated separately and affixed with a 4-in. Velcro seam as shown in Figure 1.

- Windows - Window material shall be fabricated from 20 gauge PVC meeting Federal Specification L-P-375C. The material shall be transparent, double polished, and fire retardant.

- Service/Pass Sleeves - Service and waste sleeves shall be fabricated from 12-mil-thick translucent yellow fire retardant PVC meeting Federal Specification L-P-375C or MIL-C-43006G.

- Tie-Offs - Tie-offs shall be 2.5-in.-diameter heavy-duty injection-molded PVC and be attached to the body of the containment at intervals consistent with the external frame, not to exceed 18-in. intervals. Tie-offs that support the weight of the tent shall be affixed to the tent fabric, and not to windows. Grommets may be substituted for tie-offs.

- Door Zippers - Door zippers should use double pull sliders or an overlapping Velcro flap. For outdoor applications, a combination of zipper and Velcro is recommended, however when used together, either the zipper or the Velcro must be able to seal the door independently as well as operate at the same time.

- Breather Filter - Breather filters allow make-up air to enter the tent as well as preventing buildup of gasses in the tent. Breather filters can be replaced with one way air dampers, however, if the potential exists for the tent to pressurize, HEPA-rated breather filters should be installed in sufficient quantity.

3.3.3 Frame Structure

The tent frame can be constructed of almost any material that can support the weight of a containment tent under negative pressure. Key considerations should be that the material be reusable. Two recommended methods are shown below:

- Schedule 40 Pipe — The tent frame shall be fabricated from 1-in. schedule 40 galvanized pipe. Connectors shall be fabricated from malleable iron castings meeting the requirements of ASTM A 47, Grade 32510 with case-hardened set screws, sized to fit 1-in. schedule 40 galvanized pipe. Pins with either threaded or hinged fittings that penetrate the piping may be used in lieu of set screws.

  Where schedule 40 pipe is used, all corners should be re-enforced by with ¼-in. bolts using nylon lock washers, the holes will be 5/16 in. in diameter and located such that he tent frame may be assembled without additional drilling of holes.

- Frame Scaffolding — Standard tube-type scaffolding material that can be fitted together so it forms an effective frame.

In order to ensure the tent does not sag, the tent frame should have vertical wall and lateral roof supports every 5 ft ± 1 ft.

3.3.4 Fabrication

The tent shall be constructed using the following methods:

- All seams on the walls and floors of the containment should be double sealed.
- All window seals should exhibit a minimum ½-in. overlap; transfer and access sleeves shall exhibit a minimum ¼-in. overlap.
- Tie-offs shall be heat sealed in place and shall be located in sufficient quantity to provide adequate support. Grommet tabs are an acceptable alternative.
- Double stitching is required on all door zippers.
- Velcro shall be placed to allow holding the doors in the open position.

3.3.5 Options and Variations

The following variations to the design should be acceptable with no formal approval.

- Color - The color of the containment may be white.
- Posting Pouches - Posting pouches may be relocated as needed.
- Door Sizes - Door sizes and location may vary as needed.
- Transfer Sleeves - Transfer sleeves may be eliminated or relocated as needed to support specific work activities.

4.0 QUALITY ASSURANCE REQUIREMENTS

4.1 Responsibility for Verification

Suppliers shall be responsible for performing all required tests before submitting any items to the buyer for acceptance. Except as otherwise specified, suppliers may use either their own or any commercial laboratory acceptable to the buyer. Records of all tests shall be kept complete and available to the buyer.

4.2 Documentation Submittals

The supplier shall provide copies of certifications as specified in the purchase order.

5.0 PREPARATION FOR DELIVERY

5.1 Preservation and Packaging

The tent components shall be shipped in appropriately labeled containers constructed in a manner that will ensure damage-free delivery. An assembly list and assembly instructions shall be enclosed referencing both item and packing box numbers to permit easy assembly in the field.

5.2 Marking

Each packing box shall be legibly and conspicuously marked with the purchase order number, specification number, name of supplier, name of component, and weight (gross and net).

Figure 1. Generic Containment Tent.

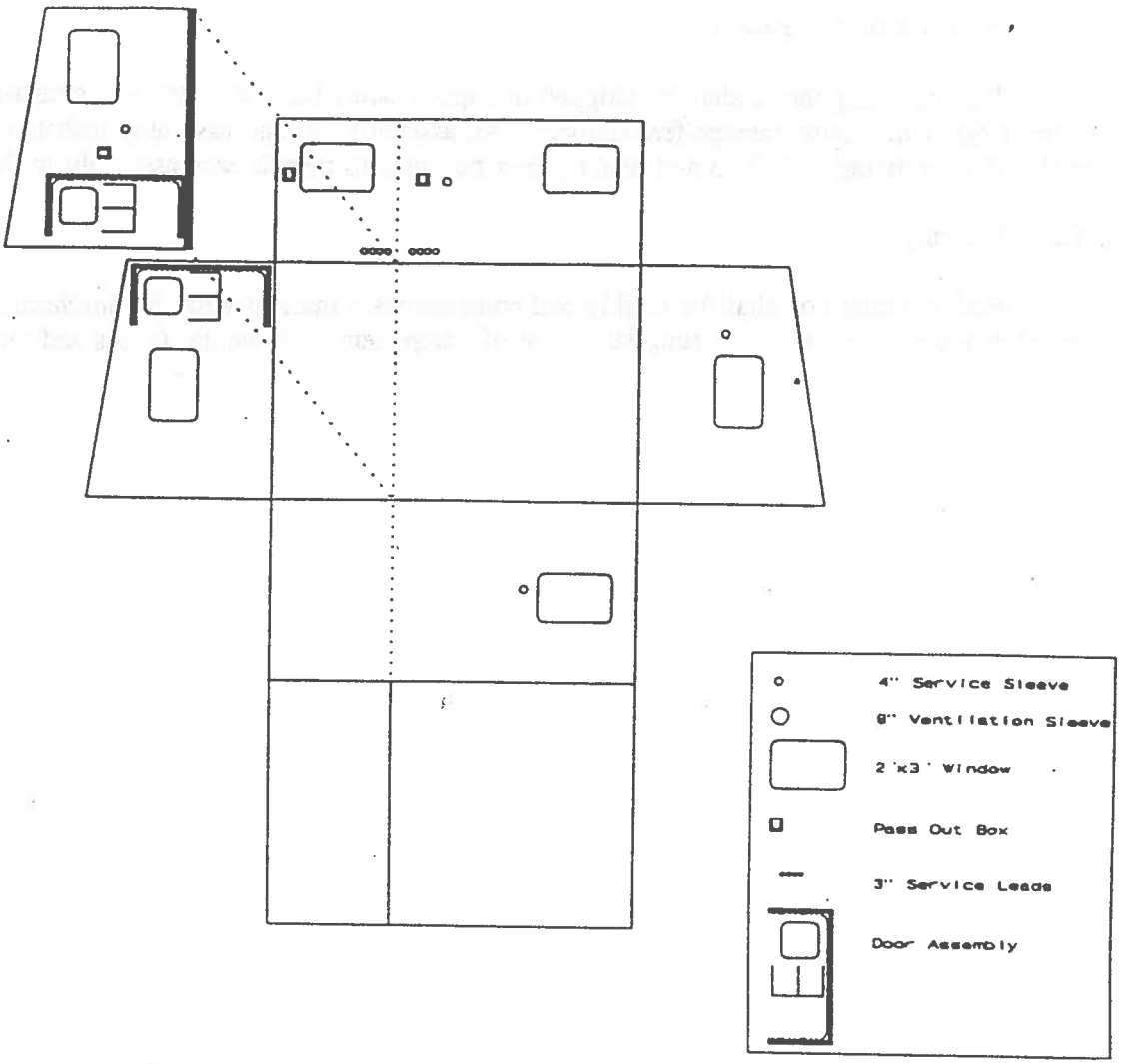


Figure 2. Tie-Off Location on Containment Tent.

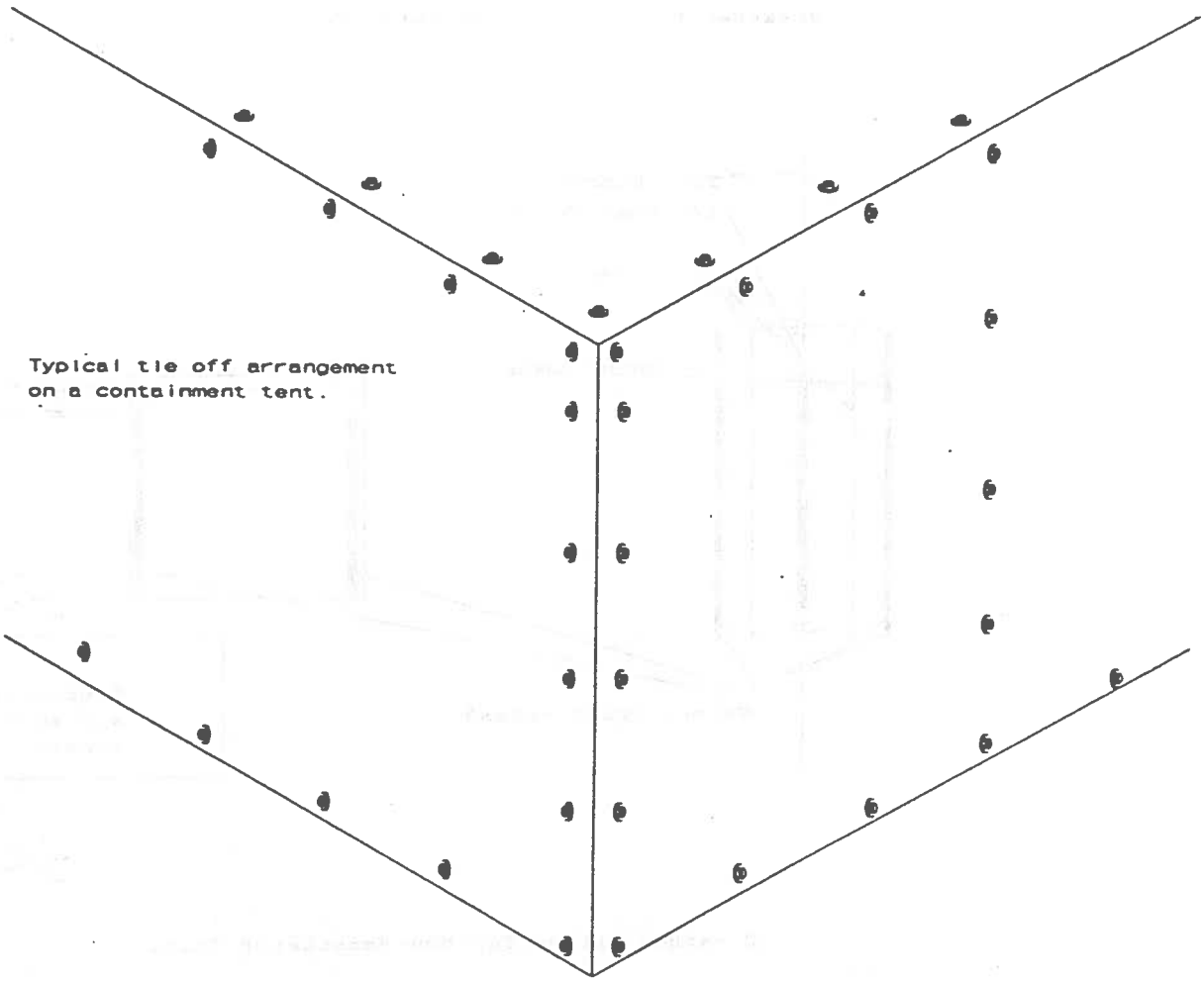
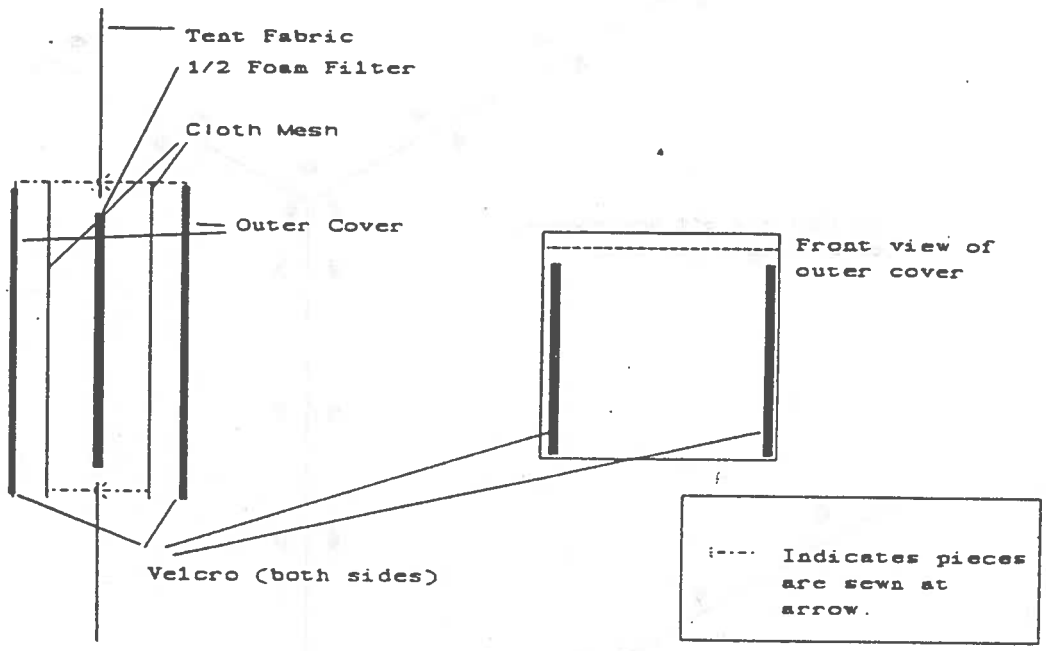


Figure 3. Breather Filter Assemblies.

Breather Filter for Ventilated Tents



Breather Filter for Non-Ventilated Tents

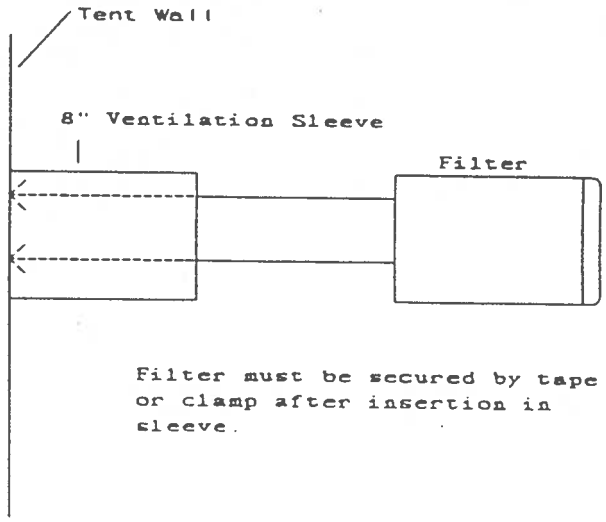


Figure 4. Air Flow Regulator.

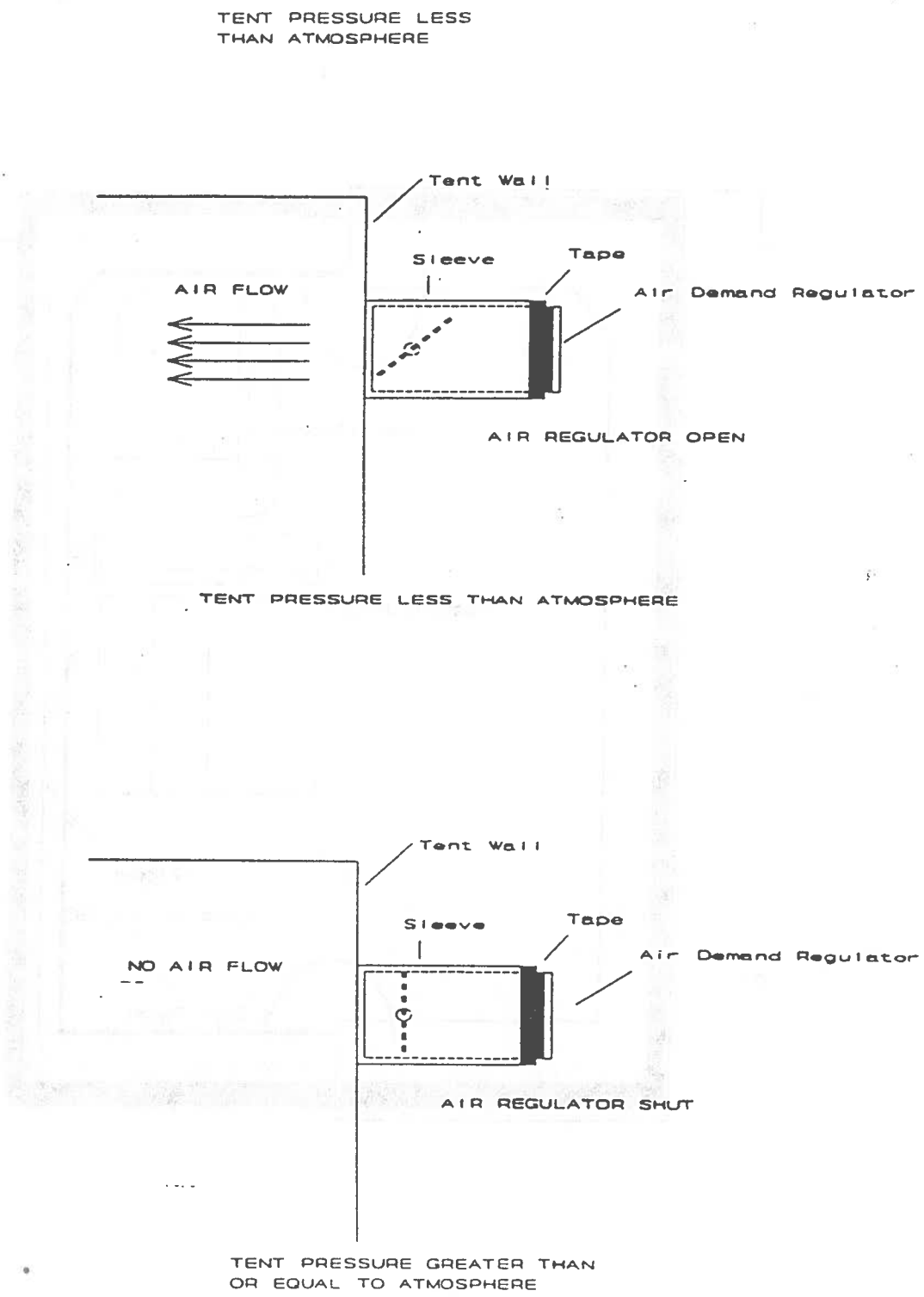
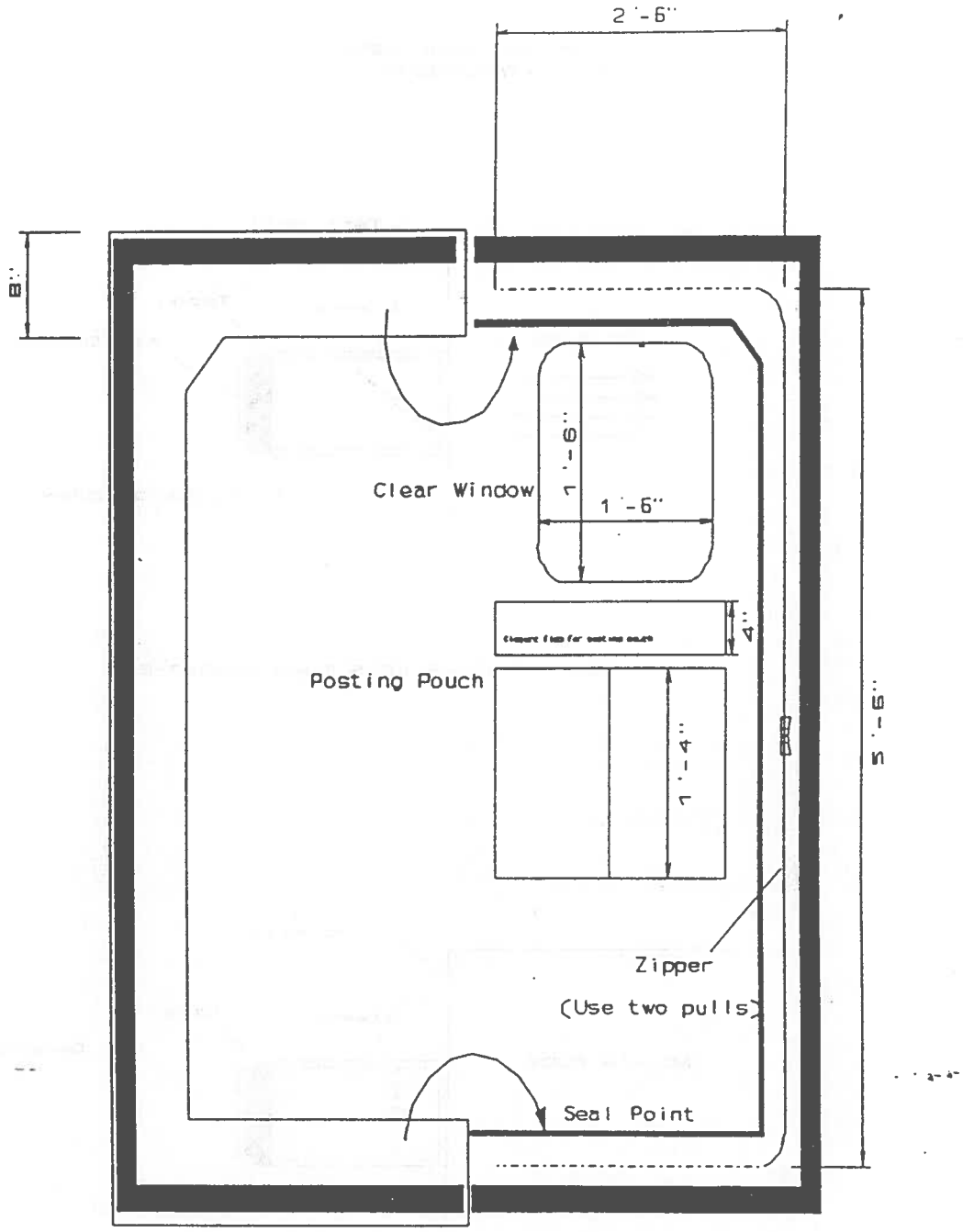


Figure 5: Door Assembly



APPENDIX B, ATTACHMENT 3: SAMPLE SPECIFICATION FOR GENERIC GLOVE BAGS

1.0 SCOPE

This specification defines the requirements for nonstandard glove bags used for performing radiological work.

2.0 APPLICABLE DOCUMENTS

2.1 Government Documents

MIL-C-43006G, Military Specification, Cloth and Strip, Laminated or Coated, Vinyl-Nylon or Polyester High Strength, Flexible

Federal Specification L-P-375C, Plastic Film, Flexible, Vinyl Chloride

2.2 Nongovernment Documents

2.2.1 ASTM Standards

ASTM A 47-84(1989)$^{\epsilon 1}$, Ferritic Malleable Iron Castings

3.0 TECHNICAL REQUIREMENTS

3.1 Item Definition

The containment specified in this document will consist of a soft-sided enclosure supported by a either a rigid external framework or tie-offs. The glove bag is intended to be installed over the work activity to provide protection against the spread of radioactive contamination during work activities.

3.2 Characteristics

3.2.1 Reliability

The glove bag shall minimize the transfer of either airborne or surface contamination to the environment. Replacement parts shall be readily available from the supplier to allow repairs in the field.

3.2.2 Safety

If additional safety requirements are needed for a glove bag purchase, the applicable safety requirements should be specified in the purchase requisition.

3.3 Design and Construction

3.3.1 Design

The glove bag should be designed with the following features:

NOTE: For cold weather applications polyurethane may be substituted for any material requiring conformance to Federal Mil. Spec. LP375C where fire retardant material is not required. Polyester based polyurethane should be used for sleeves and other areas where visibility is not required, poly-ether based polyurethane should be used where visibility is required.

- Armsleeves - Armsleeves must be 16-18 in. long, tapering from 9 in. in diameter at the shoulder to 5¾ in. in diameter at the wrist. They must be made of 8-mil PVC, yellow in color, conforming to Federal Mil. Spec. LP375C.

NOTE: Longer glove sleeves can be used if specifically requested.

- Pass-out Boxes - Pass-out boxes shall have an inner opening and an outer opening that can be secured by a Velcro or zippered seal. The box will be located on the outside of the containment and should be approximately 4 x 6 x 6 in. Pass-out boxes should be located in the upper half of the containment where possible.

- Service Sleeves - The glovebag should contain at least two 3-in. service sleeves for service leads.

- Bottom -The bottom of the glove bag should be designed based on the planned work. Heavier applications will require the use of nylon re-enforced material, dual floors, secondary drapes, or even a sturdy tray, external to the glove-bag.

- Sides and Top - The sides and top of the glove bag should be clear PVC, at least 8 mil thick, conforming to Federal Mil. Spec. LP375C.

- Glove Rings - Glove rings must be constructed of hard plastic and sized to be 5 1/2" inside diameter.

- Tie-offs - Glove bag support should be provided by either tie-offs made of heavy duty injection-molded PVC, grommets, or support tabs.

- Pass Sleeves - An 18 inch long transfer sleeve, 7 inches in diameter, should be included in the body of the glove bag.

3.3.2 Construction

The glove bag shall be constructed as follows.

- All seals in the main body have a minimum of ½-in. overlap, seals in the transfer and access sleeves have a minimum of ¼-in. overlap.
- Tie-offs attached by heat sealing and in sufficient quantity to provide adequate support.
- Double stitching is required on all stitched seams.
- Velcro or other type of closure device should be used to seal any openings.

3.3.3 Frame Structure

Where required, the frame shall be fabricated from material sufficient to support the glove bag when exposed to a negative pressure of 0.5 in. of water.

4.0 QUALITY ASSURANCE REQUIREMENTS

4.1 Required Tests

Where called out on the purchase requisition, the supplier will test glovebags to the required standard.

4.2 Responsibility for Verification

Suppliers shall be responsible for the performing all required tests and inspections before submitting any items to the buyer for acceptance. Except as otherwise specified, suppliers may use either their own or any commercial laboratory acceptable to the buyer. Records of all tests shall be kept complete and available to the buyer.

4.3 Documentation Submittals

The supplier shall provide copies of certifications as specified in the purchase order.

5.0 PREPARATION FOR DELIVERY

5.1 Preservation and Packaging

The components shall be shipped in appropriately labeled containers constructed in a manner that will ensure damage-free delivery. An assembly list and assembly instructions shall be enclosed referencing both item and packing box numbers to permit easy assembly in the field.

5.2 Marking

Each packing box shall be legibly and conspicuously marked with the following data:

- Purchase order number
- Specification number
- Name of supplier
- Components by name and reference key enclosed
- Gross and net weights.

APPENDIX C

SAMPLE CHECKLISTS AND INSTRUCTIONS

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The following provides guidance for the use of the Containment Certification Checklist

1. The tent is free of tears, loose seams, cuts and other loss of integrity.

   The tent should be thoroughly inspected to make sure it has no tears or loose seams. Give special emphasis to those areas where higher levels of contamination will be present.

2. The tent is properly orientated and supported.

   The tent should be supported so the walls are not bunched or sagging and not collapse when the HEPA-filtered ventilation is operated. This may require the sides and bottom of the containment to be tied off as well as the top.

3. Sharp objects are properly covered to prevent inadvertent penetration of the tent.

   If sharp or heavy objects are going to used inside the containment, you should consider placing a liner made from metal, wrapped plywood or other padding on the floor to prevent damage to the containment. Sharp tools used in the containment should be kept covered when not in use.

4. Installed services use service sleeves and are taped.

   All services should be supplied through service sleeves instead of doors or slits in the tent. All service sleeves should be securely taped if the membrane has been cut. The length of each service in the containment should be long enough to perform its function but, not a large amount of extra material that will create additional radioactive waste.

5. Unused service sleeves are sealed or taped closed.

   Check each sleeve to ensure it is sealed or taped properly.

6. Radiological posting and protective clothing removal procedures are prominently posted at the entrance/exit.

   The undressing sequence posted in each containment section should be "walked-down" to ensure it can be followed verbatim.

7. Proper lighting is provided.

   Clear or translucent windows will generally allow sufficient light. However, temporary lighting may be installed to illuminate the containment. This is usually accomplished with "shatter-proof" florescent lights which provide more even distribution of the light with less chance of fire if the bulb touches the containment. If an incandescent light must be used, each bulb should be 50 watts or less and have a protective shroud. Containment tents being certified for use at night should include a check of the lighting as part of the certification process.

8. Doors work properly.

   Check the operation of all doors, if possible, to make sure they work properly. If not, make a close visual inspection. Zippers tend to fail where they turn corners. If the door was made so that it can be locked by lacing wire through grommets (or equivalent), make sure the door can be locked properly.

9. The tent seal to the component is properly made.

   This is critical. If the containment is sealed to a component and then loosens during work, high levels of contamination could be spread. Where possible, the seal should be made with clamps, double sided tape, cable ties, bolting rings, etc., rather than just taping to the component. The more positive this connection, the less chance it will fail during work.

10. If HEPA-filtered ventilation is used, the system is properly installed, including connections, proper labeling, and current efficiency test label.

    Verify there is a measurable in-flow of air at the containment entrance by observing for a bowing in of the containment walls and door or by checking with a smoke tube or a powder "gun".

    If possible, the ventilation hose inside the containment should be movable so that it can be positioned by the workers close to the area being worked to draw airborne contamination away from their location. The fundamental rule when using ventilation is to draw air from areas of lesser contamination to areas of greater contamination. If needed, screens should be placed over the hose end to prevent loose materials such as tape and rags from being sucked into the ventilation and plugging the filter.

    Make-up air usually enters the containment through breather filters, demand regulators or filter-media.

11. Step-off pad(s) and clothing and waste receptacles are in place.

    The number and locations should be verified as part of the "walk-down" of the undressing sequence.

12. If welding, grinding or burning is to be done inside or near a containment tent, the affected areas are covered with flame-resistant materials.

    In addition to the flame resistant materials inside the containment, a fire extinguisher should be immediately available near the containment entrance.

13. The inspection certification is posted on or near the containment.

    The person responsible for installing the containment should have completed the Containment Identification Tag and attached it to the containment.

Containment Tent Certification Checklist.		
Location		Work Package #
Activity		
Check if waived *	Check if adequate at installation	CRITERIA
		1. The tent is free of tears, loose seams, cuts or other loss of integrity.
		2. The tent is properly oriented and supported.
		3. Sharp objects are properly covered to prevent inadvertent penetration of the tent.
		4. Installed services use service sleeves and are taped.
		5. Unused service sleeves are sealed or taped closed.
		6. Radiological postings and protective clothing removal procedures are prominently posted at the entrance/exit.
		7. Proper lighting is provided.
		8. Doors work properly.
		9. The tent seal to the component is properly made.
		10. If HEPA filtered ventilation is used, the system is properly installed, including connections, proper labeling, proper flow, and current efficiency test label.
		11. Step-off pad(s) and clothing and waste receptacles are in place.
		12. If welding, grinding, or burning is to be done inside or near a containment tent, the affected areas are covered with flame-resistant materials.
		13. The inspection certification is posted on or near the containment.
		14. Other
		15. Other
		16. Other

Comments:

_____

_____

_____

* Check-offs in this column must be supported by comments and/or approval signatures, if no criteria are waived or added, approval signatures are not required.

Waiver Approval:

Radiological Controls _____

Operations _____

The following provides guidance for use of the Glovebag Certification Checklist

1. The glove bag is free of holes, tears or defects in materials.

   Inspect all seams. Using the thumb, apply moderate pressure to the seam to verify is completely sealed. Inspect the seams where sleeves attach to the glove bag, tug on the sleeves to verify the connection is sealed.

2. Components and surfaces inside the glove bag are covered to minimize decontamination.

   Non-essential surfaces that could become contaminated during work should be covered with tape or plastic materials. Glove bags installed on valves or switches should not cover the identification plates, if possible. Notify the PIC to have temporary label plates installed, if required.

3. The containment is protected from sharp objects, internal and external.

   Corners of sharp objects outside the glove bag should be padded or taped before the glove bag is installed. In addition, protective covers should be installed on components near the glove bag that could be damaged during work.

4. The glove bag and installed service sleeves are properly supported.

   Elastic cord should always be used to support a glove bag so the worker will not damage the bag during work operations. Services passing through the sleeve should be supported independently of the glove bag.

5. The gloves are properly attached and free of cracks, splits or holes.

   Ensure the right and left hand gloves are installed in the proper sleeves with the thumb tilted slightly inward.

6. The glove bag seal to the component is adequate.

   The connection between the glove bag and the component is a critical connection that is often made over an irregular surface. Special consideration may be required to ensure this connection remains secure during operation.

7. The glove bag is properly aligned to allow access to the work.

   A person working in the glove bag must be able to reach the work. Verify the alignment of the glove bag is such to minimize interference.

8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.

   If liquids will be deliberately introduced into the glove bag during the job, a "leak test" of the glove bag should have been accomplished as part of the installation process. Glove bags containing drain fittings should not have absorbent material in the bag and the drain should be connected to an appropriate collection device.

9. If a vacuum is used with the glove bag, it is HEPA filtered and has a efficiency test label.

   Operate the vacuum cleaner to ensure the glove bag does not collapse during use. A breather filter should be installed to allow make-up air to enter the glove bag when the vacuum cleaner is operated. A tag on the vacuum cleaner should indicate the date of the last efficiency test and its expiration date. If the date will expire before the job is complete, consider retesting the vacuum cleaner now or replace with a different vacuum cleaner.

   If pneumatic powered tools will be used in the glove bag determine how the air discharged from the tool will removed from the glove bag. A remote exhaust hose may be able to be attached to the tool or the vacuum cleaner could be operated while the tool is being used.

   NOTE: Article 464.6 of Reference (b) requires that a nuclear safety review be performed and documented prior to the use of a vacuum cleaner for fissile material. Recommend verifying this review has bee conducted prior to certifying a glove bag used on a system that contains fissionable materials.

Glove Bag Certification Checklist

Location	Work Package #
Activity	

Check if Waived *	Check if adequate at installation	CRITERIA
		1. The glove bag is free of holes, tears, or defects in materials.
		2. Components and surfaces inside the glove bag are covered to minimize decontamination.
		3. The containment is protected from sharp objects, internal and external.
		4. The glove bag and installed service sleeves are properly supported.
		5. The gloves are properly attached and free of cracks, splits, or holes.
		6. The glove bag seal to the component is adequate.
		7. The glove bag is properly aligned to allow access to the work.
		8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.
		9. If a vacuum is used with the glove bag, it is HEPA filtered and has a current efficiency test label.
		10. Other
		11. Other
		12. Other

Comments:

_____

_____

_____

_____

* Check-offs in this column must be supported by comments and/or approval signatures, if no criteria are waived or added, approval signatures are not required.

Approval: Radiological Controls _____

Operations _____

Figure C-3. Containment Identification Tag.

Work Package # _____					
Installed By _____ Date: _____					
Initial Inspection By _____ Date: _____					
Record of Routine Inspection					
Date	Time	Signature	Date	Time	Signature

(reverse)

Routine Containment Tent Inspection

1. The tent is free of tears, loose seams, cuts or other loss of integrity.
2. The tent is properly oriented and supported.
3. Sharp objects are be properly covered to prevent inadvertent penetration of the tent.
4. Installed services use service sleeves and are taped.
5. Unused service sleeves are sealed or taped closed.
6. Radiological postings and protective clothing removal procedures are prominently posted at the entrance/exit.
7. Proper lighting is provided.
8. Doors work properly.
9. The tent seal to the component is properly made.
10. If HEPA filtered ventilation is used, the system is properly installed, including connections, proper labeling, proper flow and current efficiency test label.
11. Step-off pad(s) and clothing and waste receptacles are in place.
12. If welding, grinding, or burning is to be done inside or near a containment tent, the affected area are covered with flame-resistant materials.
13. The inspection certification is posted on or near the containment.

Routine Glove Bag Inspection

1. The glove bag is free of holes, tears, or defects in materials.
2. Components and surfaces inside the glove bag are covered to minimize decontamination.
3. The containment is protected from sharp objects, internal and external.
4. The glove bag and installed service sleeves are properly supported.
5. The gloves are properly attached and free of cracks, splits, or holes.
6. The glove bag seal to the component is adequate and inside seals are used (if possible).
7. The glove bag is properly aligned to allow access to the work.
8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.
9. If a vacuum is used with the glove bag, it is HEPA filtered and has a current efficiency test label.

APPENDIX D

GUIDANCE ON USE OF CONTAINMENTS

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GUIDANCE ON USE OF CONTAINMENTS

This appendix provides industry-accepted good practices and methods of using containments. Section D.1 provides general guidance; subsequent sections provide specific guidance for tents, glove bags, poly bottles, and other containments such as catch containments and drop cloths.

D.1 GENERAL GUIDANCE

D.1.1 CONTAINMENT USE

- Inform the Radiological Controls Department of intentions to work in a specific containment, and ensure the containment is in working condition and has been certified for use.
- Notify Radiological Control personnel if the containment is damaged before or during work or if you question the appropriateness of the containment device for the planned activity.
- Establish contamination limits for the containment for both stop work and in process decontamination.
- Do not step on containments or use them to support other equipment unless the containment or support device is specifically designed for this purpose.
- Do not step on temporary drain or drain collection systems.
- If a containment support must be moved, ensure that it will provide the same support as the original location.
- Use only facility ventilation, high-efficiency particulate air (HEPA)-filtered vacuum cleaners, or portable HEPA ventilation units to exhaust from a containment.
- Use trained personnel to either supervise or install and remove containments.
- Prefabricate/pretest containments as much as practical outside of the radiologically posted areas. This will
  - Reduce personnel exposure
  - Reduce radioactive waste volume in case containments fail pretest.
  - Eliminate the need for wearing protective clothing or respirators during fabrication.

- When more than one craft is involved in the use of a containment, all should be consulted on the containment to be used.

- Each job should have assigned contamination limits for both inside and outside the containment. Surveys should be performed during the job to ensure the contamination levels remain within the prejob guidelines. It may be necessary to stop work and decontaminate the containment in order to keep the contamination levels as low as reasonably achievable (ALARA).

D.1.2 HOT WORK

Hot work such as welding, burning, or grinding may be performed in a containment only if flame retardant material, such as fire retardant blankets, has been provided to protect the containment from damage.

D.1.3 LIGHTING

D.1.3.1 Incandescent Lighting

When used, incandescent lights shall be enclosed and less than 50 watts. Unenclosed incandescent droplights are prohibited for use in containments.

D.1.3.2 Fluorescent Lighting

Enclosed fluorescent lighting is the preferred method of providing lighting for containments when natural light is insufficient.

D.2 GUIDANCE ON USE OF CONTAINMENT TENTS

Containment tents use the basic approach of donning and removing protective clothing, step off pad arrangement, and waste handling associated with activities that may encounter radioactive contamination, more so than glove bags, catch containments, or poly bottles. Because the U. S. Department of Energy Radiological Control Manual addresses many of these issues, much of that information is not covered in this appendix. Only those aspects of radiological controls unique to containment tent operations are discussed.

D.2.1 GOOD PRACTICES ASSOCIATED WITH TENT INSTALLATION

Containment Installation: The following list can be used by the installing craft as an aid in installing the containment. The list is general and each item may not apply to every containment. As much preparation of the containment as practical should be performed outside radiation areas to conserve radiation exposure.

(1) Work site preparation - Identify/remove interferences, pad sharp edges, and install temporary protective covers, support for the containment, and temporary shielding.

(2) Install the Containment- Special attention should be given to the work section in the areas where liquids may be encountered or high levels of contamination may be present. The installer may want to glue strips over the seams in these areas. All service leads are required to be wrapped in plastic sleeving. If it is known in advance that all service leads are to be disposed of as radioactive waste, the sleeving requirement may be eliminated to reduce the amount of material treated as radioactive waste.

(3) If the protective clothing requirements will require personnel to wear air-supplied respirators, it will be necessary to plan exactly where the air hoses enter the containment and where the workers will connect their respiratory equipment to the hose. If possible, the air hoses should enter the containment via service sleeves at a point midway between the containment entrance and the work area. This will result in the smallest amount of breathing air hose in the tent. Note: The breathing air hose becomes tangled easily and if there is more hose in the containment than needed, the harder it is to maintain "good housekeeping" conditions. In addition, if the hose becomes contaminated, it will add an extra amount of material that has to be treated as solid radioactive waste when the hose is removed at the end of the job. The hose ends should be located close to the containment entrance so personnel can connect to the breathing hose easily.

(4) Install tool pockets and straps for holding air lines or other equipment.

(5) If a communications system is installed it should be tested.

(6) Pass sleeves made of yellow or yellow-tinted material are installed to the containment by banding to metal or heavy plastic collars which are banded to sleeves located on the containment walls. Note: The purpose of the collars is to maintain the shape of the round opening and provide a place to attach the pass sleeves.

(7) The person installing the containment should complete the containment identification ta and notify Radiological Control personnel the containment is ready for certification.

D.2.2 GOOD PRACTICES ASSOCIATED WITH TENT OPERATION

- Tents and enclosures use the "bagging the worker" concept; therefore, consideration must be made for the removal of protective clothing and respiratory protection. Standard application of step-off pads, unsuiting methodology, and waste handling generally apply.
- When portable ventilation systems are used, the system should be verified operational prior to each entry. This will be evident by tent sides bowing in and air rushing in through any penetrations. This can also be verified routinely by smoke testing. Dampers should be secured when the tent is not in service and the ventilation is secured. If the ventilation is not in service and the tent will be used, dampers should be verified closed prior to any work.
- All doors should be closed, sleeves closed, etc. before the start of work.
- All tools needed to start a job should be staged in the tent before start of work.
- Protective clothing should be worn in accordance with the requirements of the work controlling document or the radiological work permit (RWP).
- If hot work is to be done inside or nearby the outside of a containment tent, cover the affected areas with flame retardant cloths.
- Firmly anchor and support all tents and enclosures. Tape over any sharp or rough edges that could puncture or abrade the containment.
- Do not allow incandescent lights to come in contact with containment tent material. Fluorescent lights are the preferred method of lighting in tents. Where used, incandescent lights should always be less than 50 watts and enclosed in a protective housing.
- All penetrations (i.e., ventilation duct, air lines, electrical cords, etc.) should gain access through service sleeve(s) securely attached to the tent and taped to the sleeve.
- Containments should have the floors covered with an easily removable material for ease of decontamination. Multiple layers of flooring should be considered for jobs where high contamination levels are expected.
- Ante rooms should be used for personnel entry and exit with areas maintained at lower contamination levels than the work area.
- Don't abandon basic contamination control techniques because of the containment; basic measures such as controlling contamination at the source should be used to reduce the time to decontaminate the containment during the job.

D.2.3 GOOD PRACTICES ASSOCIATED WITH THE REMOVAL OF CONTAINMENT TENTS

- Tents should be decontaminated to acceptable levels before removal.
- Service leads should be removed or disconnected before removal.
- HEPA-filtered vacuum cleaners or exhausters are an effective way of collapsing a tent. The supports can be removed gradually allowing sections of the tent to collapse preferentially, this makes the packaging of a tent, either for waste or reuse much easier.
- Containment Tent Removal: When work is complete and the containment is no longer required, it should be removed using the following sequence as a guide:

  (1) User shops remove all tools, waste, floor liners and unnecessary services. All tool pockets and straps should be cut off and removed if the tent is not being saved for reuse.

  (2) Service leads being saved for reuse: Disconnect service lead, untape sleeve, pull service lead into the containment and retape the sleeve. Seal the bag and mark the outside with the word "save" and identify its contents.

  (3) It is extremely important that all electrical services be deenergized before they are cut for containment removal as serious injury could result. All electrical leads not being saved for reuse shall be deenergized and cut as close as possible to the outer wall of the containment. Then cut the electrical lead inside the containment within 6" of the wall.

  (4) Prior to removing air lines, verify they are disconnected and unpressurized. All air lines not being saved for reuse shall be cut as close as possible to the outer wall. Then untape the sleeve, pull the line into the containment and retape the sleeve.

  (5) Vacuum cleaner and air sample hoses which penetrate the containment wall: Cut the hose within 6" of the inner containment wall and bag the hose end.

  (6) Ventilation ducting: With the ventilation running, remove the screen from the end of the duct and cut off the duct within 6" of the inner wall.

  (7) Decontaminate the containment to acceptable levels. These levels will depend on whether the containment is to be stored for reuse or disposed as radioactive waste. For tents that will not be re-used, applying a fixative is an acceptable alternative to decontaminating the tent multiple times.

  (8) Remove any remaining waste and shorten the pass sleeves as much as practical.

  (9) Conduct a briefing with shop personnel involved to ensure each step of the removal is understood, tooling/equipment/materials are staged and protective clothing requirements are established.

(10) Post the work area as a Contamination Area and install a rope boundary if not already accomplished.

(11) With the ventilation running, remove the containment and padding in slow, deliberate steps. Start with the entrance and remove the containment by cutting and collapsing into about 3-4 foot wide sections. As each section is removed, cut out the non-compressible waste e.g., sleeve collars, plug boards, dampers) and bag separately. Cut the lanyards supporting the containment and fold each removed section into as small a package as possible to make it easier to bag. After each section is cut up and bagged, survey the newly exposed area. Any contamination found should be decontaminated before proceeding to the next section. On some jobs, the containment may be able to be removed in larger sections and placed into burial boxes without having to remove the non-compressible waste. The actions necessary should be determined prior to the pre-job briefing.

(12) When the containment has been completely removed, secure and bag the ventilation ducting. Perform housekeeping to restore the work area.

(13) Take additional surveys as required to verify the radiological conditions of the area.

(14) Reinstall any removed interferences. Remove protective covers, padding and temporary shielding, as required.

D.2.4 GOOD PRACTICES ASSOCIATED WITH USE OF SUPPLIED AIR

The use of supplied air in containment tents causes unique problems. Air lines should not be laid in door ways during tent operations. When using supplied air in conjunction with a containment tent, observe the following good practices:

- Keep breathing air lines off the floor near the entrance to the tent to preclude contaminating the air supply and to allow quick access upon entry. The female quick disconnect inside the tent should be surveyed for removable contamination before and after each use. Airline hose hangers should be securely attached to the containment and used for hanging and separating airlines inside the containment.

- Airline check box, if used, should be securely attached to the containment and used for hanging and separating the airline hose ends. The airline check box should be mounted to allow the Radiological Control Technician to check the airline connection for contamination from outside the containment.

- Numbers should be placed on the utility ports, airline hose hangers, and airline check boxes so that each air line can be idenified. Airlines are marked or tagged with the corresponding number on the utility ports, hangers, and check boxes. When the airline connections are found to be contaminated, the line is easier to trace and replace.

D.2.5 GOOD PRACTICES ASSOCIATED WITH USE OF VENTILATION

Most issues regarding ventilation will be dealt with in the design section of this document (Appendix B). However, once the tent is designed, ventilation is installed, tent is certified, and work is begun, the ventilation configuration is a major concern to tent operation. Most tents will have flexible ventilation trunk(s) extended into the work area. A major consideration for ventilation design and installation is to ensure the ventilation system draws contaminates away from the workers. Figure D-1 shows an example of good ventilation configuration.

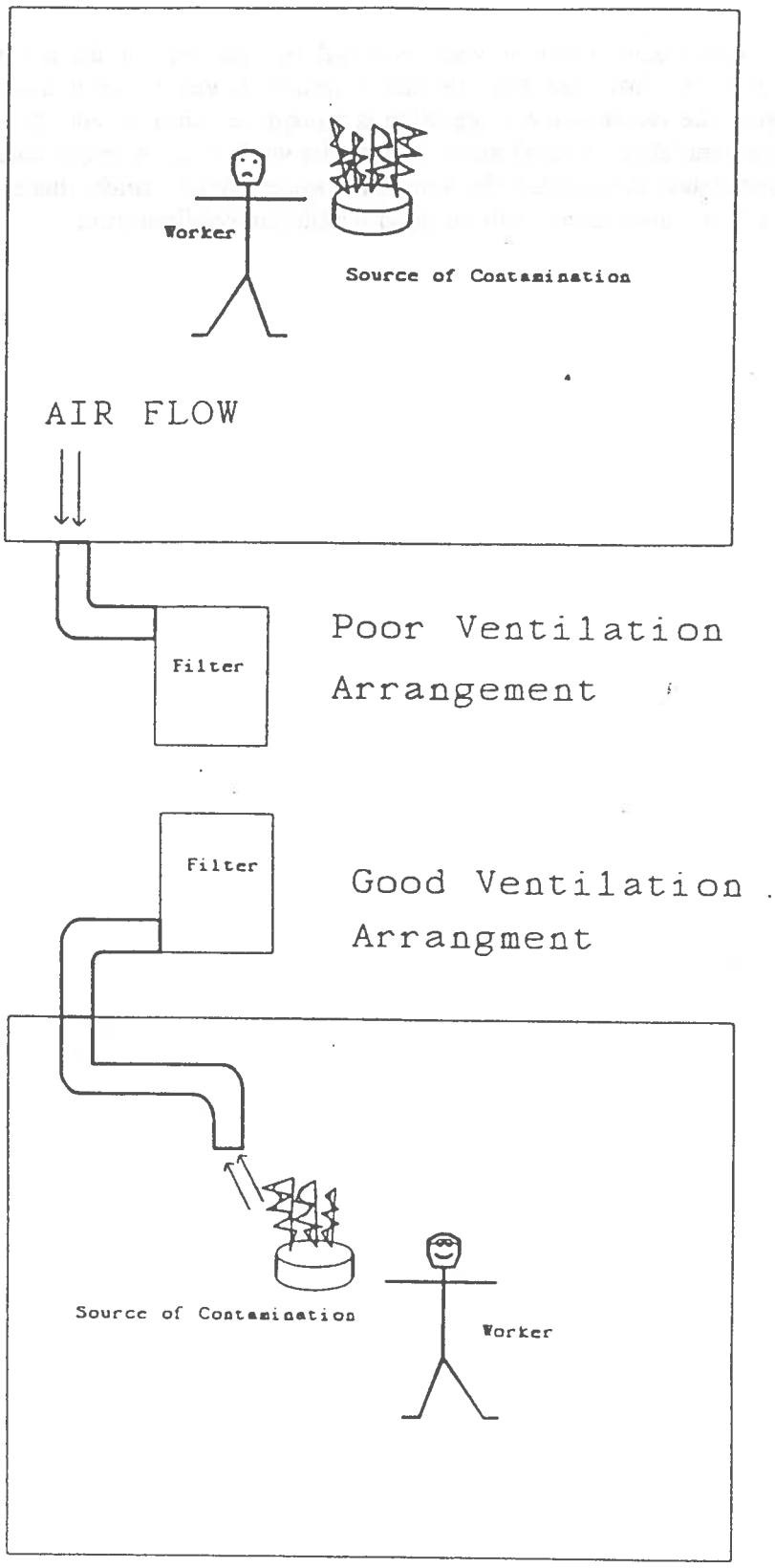


Figure D-1 Ventilation Configuration.

D.3 GUIDANCE ON USE OF GLOVE BAGS

Glove bags are an effective proven method of radioactive contamination control. The following instructions are provided as guides and are not inclusive of all methods of glove bag preparation, installation, use, or removal.

D.3.1 PREREQUISITES, PRECAUTIONS, AND LIMITATIONS

- Appendix B contains a design checklist to assist in ensuring the glove bag is appropriately designed for the application.

- Use trained personnel for fabrication, installation, and removal of glove bags.

- Fabricate/pretest glove bags as much as practical outside of the radiologically posted areas. This will

  - Reduce personnel exposure

  - Reduce radioactive waste volume in case glove bags fail pretest

  - Eliminate the need for wearing protective clothing or respirators during fabrication.

- Do not use absorbent material in glove bags equipped with a drain.

  CAUTION: If the containment assembly is used to control/collect liquids or materials that could create a criticality concern, contact Criticality Safety for geometry, design criteria, and acceptance of the glove bag and collection bottle.

- The work package should state if liquid is expected, and if so, the probable composition and quantity of liquid. When poly bottles are used in conjunction with glove bags, the organization responsible for changing and/or emptying full bottles should be identified and should stage a spare bottle in the area if deemed necessary.

- Verify that the area intended for glove bag installation is free of any obstructions before the glove bag is installed.

D.3.2 PREINSTALLATION, FABRICATION

- Accumulate the glove bag(s) and accessories (i.e., gloves, glove rings, filters, drain assemblies).

- Visually check the glove bag body, gloves, and sleeving for holes, tears, or defects.

NOTE: Allow sufficient time for containments that have been stored in a cold/cool area to warmup. Flexing of cold polyvinyl chloride (PVC) may cause premature failure of the containment.

- Install rubber gloves (size 10 or 11 gloves are suggested), at locations indicated in the installation sheet (see Figure D-2). Ensure proper orientation for working position.

- Install Canister (30-40 CFM) filter(s) (if required) (see Figure D-3, Canister Filter Installation).

  NOTE: Canister HEPA filters are generally used if the glove bag has negative ventilation; 2-CFM filters are used on nonventilated glove bags.

  - Tape over possible sharp edges on the filter to protect sleeving.

  - Trim excess sleeving (concentric taper) and install filter as close to containment as practical to prevent the sleeving from twisting or folding over and pinching off the air flow path.

- Install 2-CFM filter(s) (if required) (Figure D-4, 2-CFM Filter Installation).

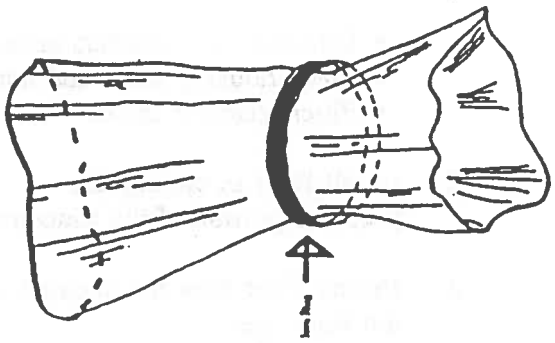
  - Install filter(s) in the highest practical position on the glovebag, at least one inch from seals, and as far away from the operators face as reasonable.

  - Ensure the filter(s) does not obstruct visibility of the work area.

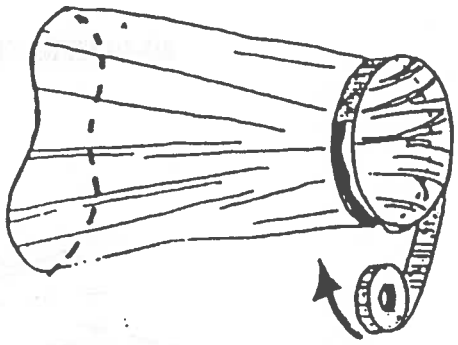
  - Check the following:
    - Filter housing is intact
    - Elements are intact
    - Threads on the filter are in good condition.

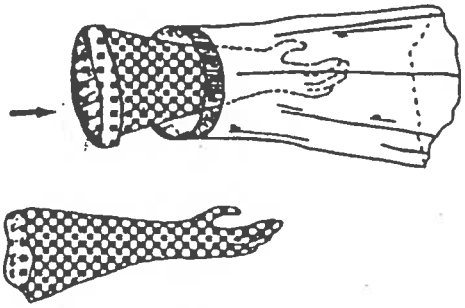
- Install pass sleeve - prepare the ring and sleeving (Figure D-5A, Pass Sleeve and Figure D-5B, Pass Sleeve - Alternative Method).

- Install gravity drain in the lowest portion of the containment at least one inch from seams (Figure D-6, Drain Fitting).



1) Insert the end of the sleeve through the ring; fold the end of the sleeve out to cover the glove ring and tape the sleeve into the groove of the glove ring securely.

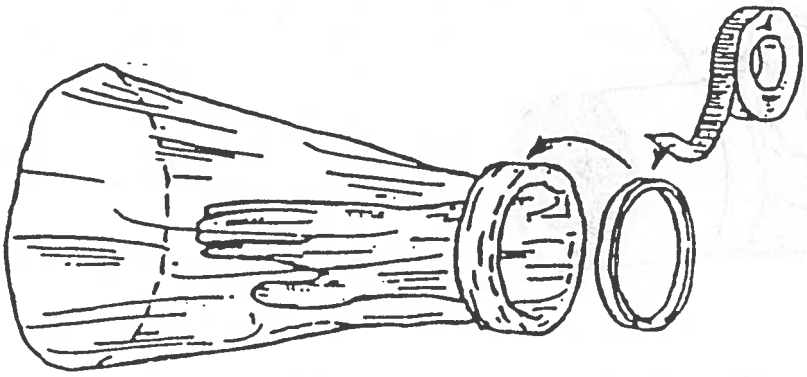




2) Insert the glove into the sleeve in the appropriate working position and fold the cuff of the glove over the glove ring.

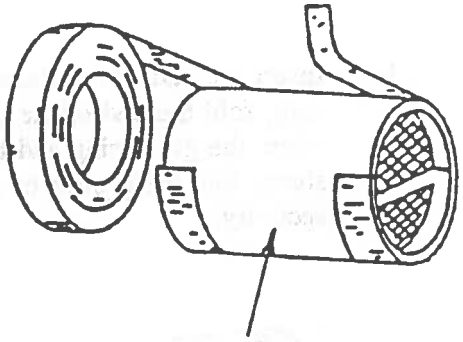
3) Place the rubber ring (optional) over glove and sleeve and into the groove in the glove ring.

4) Apply tape over rubber ring.



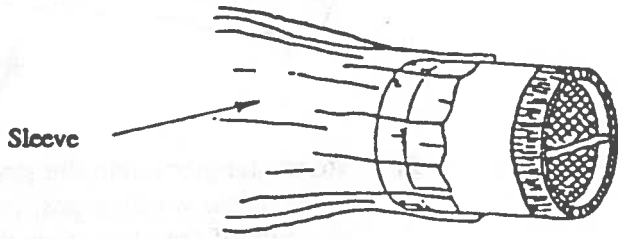
5) Push glove and sleeve inside the containment.

Figure D-2. Glove Installation.



30-40 CFM Filter

1. Check the following:
   - Efficiency test stickers attached
   - Metal housing intact and not deformed
   - Filter elements intact.
2. Install filter in the highest practical portion of the containment.
3. Ensure filter does not obstruct visibility of the work area.
4. Attach tie-off rubber band and cord to metal strap on filter.



Seal Sleeve To Filter

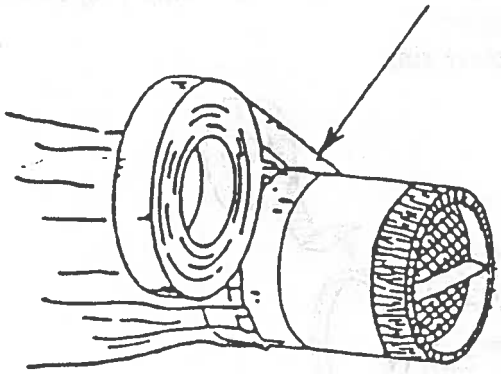


Figure D-3 Canister Filter (30-40 CFM) Installation.

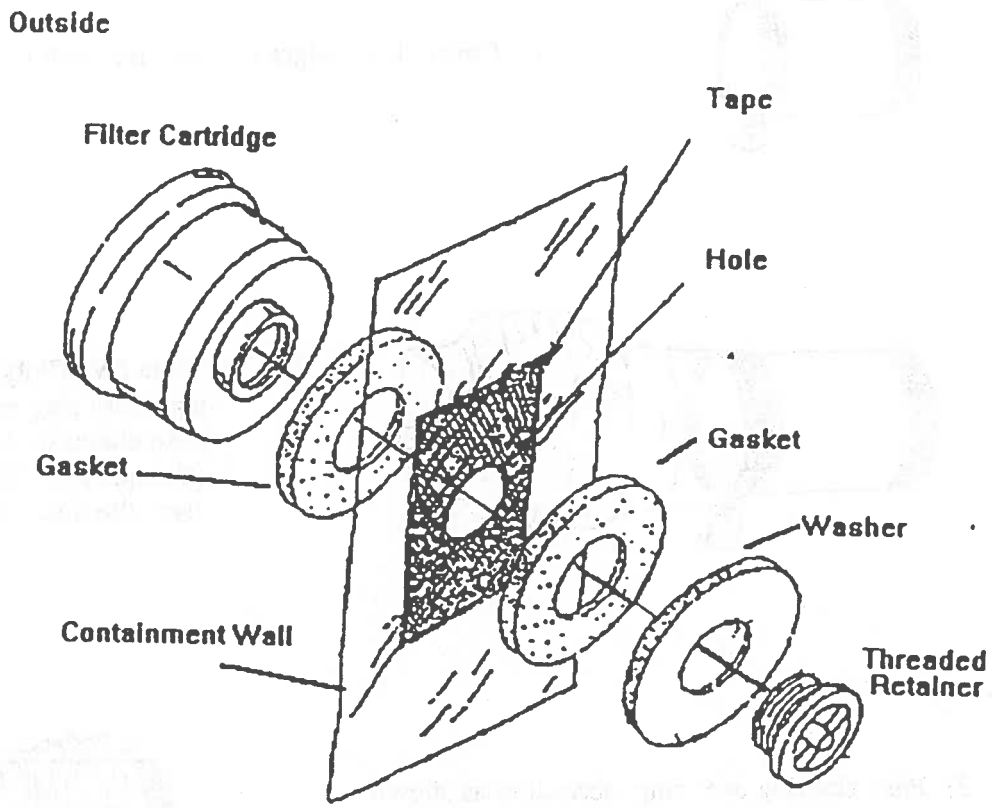
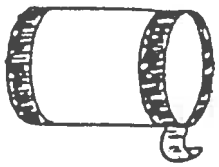
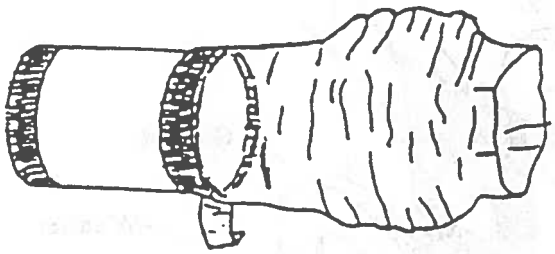


Figure D-4. 2-cfm Filter Installation.

1. Apply tape to an area (approx. 2" x 2") inside and outside containment in the area selected for the filter.
2. Cut or punch an appropriate size diameter hole through the tape.
3. Install HEPA filter as illustrated.

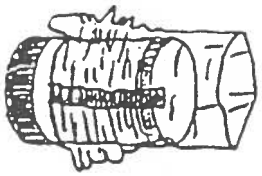


1) Cover sharp edges of pass ring with tape.

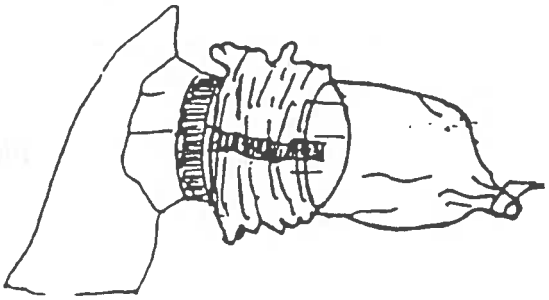


2) Slide PVC/Poly sleeving over ring, tape onto ring end as shown. Install hose clamp or double cable ties (if required). Tape should be applied over the hose clamp.

3) Push sleeving over ring, accordion as shown. Apply tape strips to hold sleeving in place.



4) Install plastic ring in glove bag sleeve. Secure with tape, clamp over tape, then tape over clamp.



5) Tape open end of sleeve closed using a "J" seal.
6) Ensure the transfer ring and sleeve are properly supported and not obstructing work area.

Figure D-5A. Pass Sleeve.

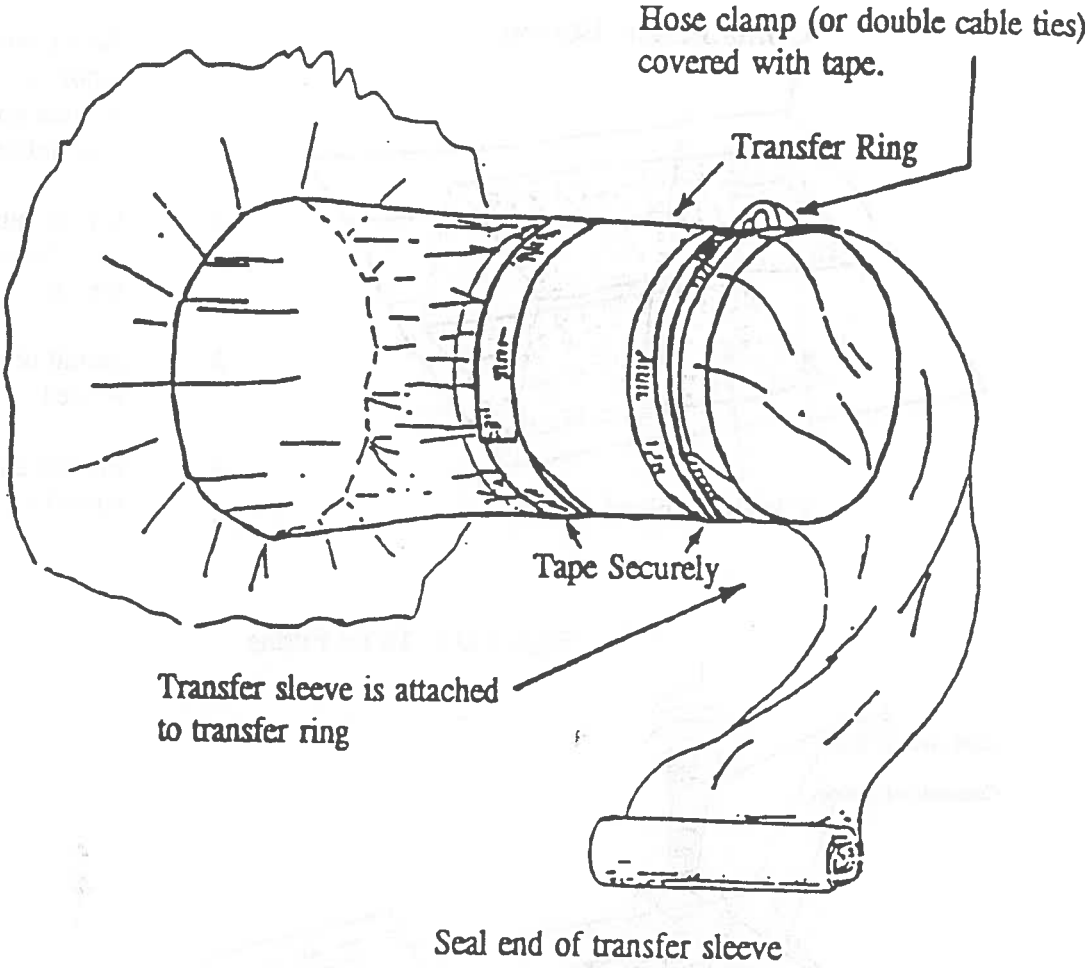
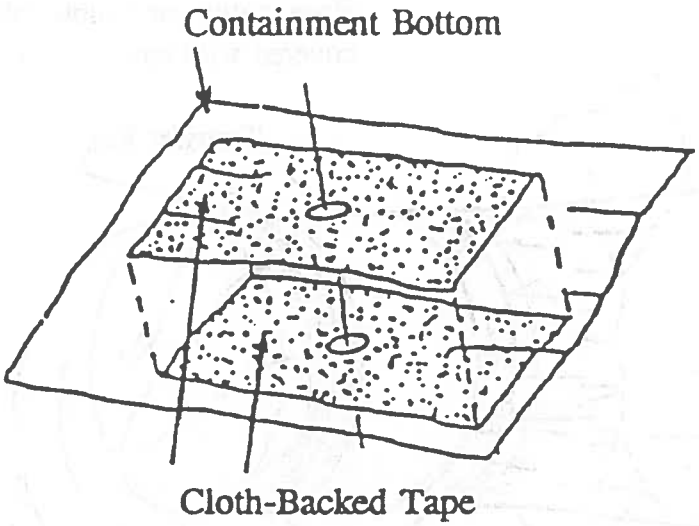


Figure D-5B. Transfer Sleeve (Alternative Method).



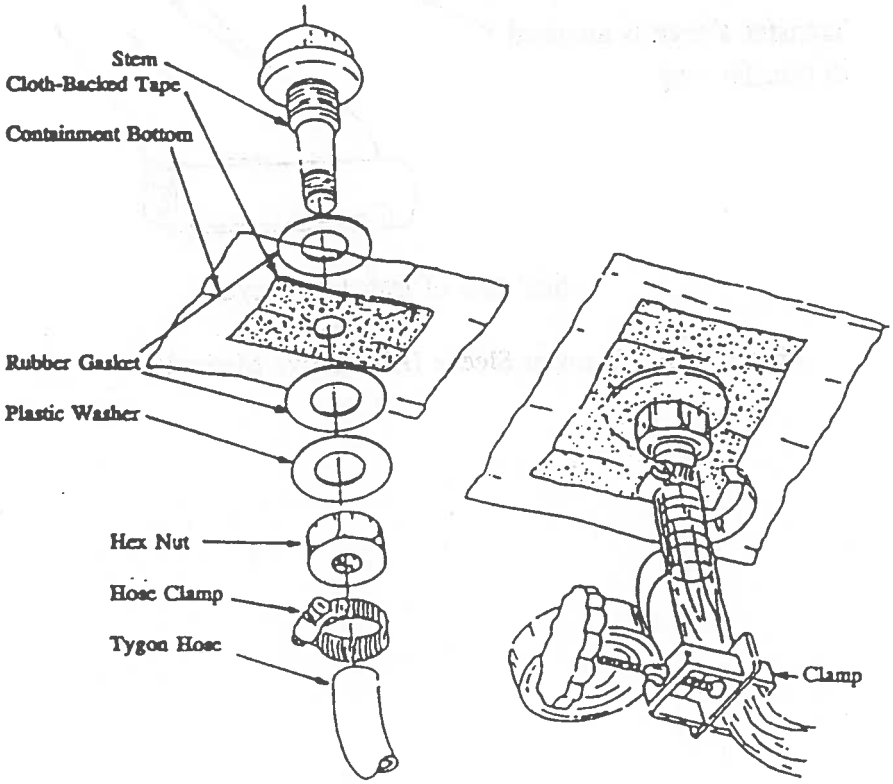
1. Apply tape to an area (approx. 2" x 2") inside and outside containment in the area selected for the drain.

2. Cut or punch an appropriate size diameter hole through the tape.

3. Install drain fitting as illustrated.

4. Protect sharp edges with tape (i.e., hose clamps)

Figure D-6. Drain Fitting



D.3.3 TESTING

Testing is often required to confirm the integrity of the glove bag before installation and after installation is complete.

D.3.3.1 Air Testing

NOTE: Air tests are often used to verify the integrity of construction of a glove bag in the shop, before installation in the work place. An air test may be used to verify the installation integrity if pressurization of the glove bag is anticipated.

If an air test is required, use an inflation test rig as shown in Figure D-7 (Inflation Test Assembly) or other suitable arrangement that will verify containment integrity at 1.5-5 oz/in^2 (0.1-0.3 psi).

1. Attach air supply to inflation test rig.

2. Insert the supply tube through an available sleeve or other opening. Obtain an air-tight seal by taping the sleeve around the supply tube. An option is to connect the air line to the drain fitting (if installed).

3. Secure any remaining openings, including filters and drain fittings. Installing gloves in glove sleeves for shop tests is not mandatory.

4. Pressurize the glove bag and allow the pressure to stabilize for approximately two minutes.

5. Apply a leak detector solution to the outside of all seams (e.g., snoop, 50/50 mix Ivory soap and water) or likely leak points. Any leakage (indicated by bubbles) constitutes rejection of the unit, unless repairable.

   NOTE: Leakage from temporarily taped openings (applied for the leak test) does not constitute a failure.

6. Inspect any sleeve(s) which is isolated from the main body (membrane is not removed, but sleeve may be used later).

7. If the glove bag is free of defects, remove air test rig.

D.3.3.2 Water Testing

NOTE: Water tests are often used to test glove bag integrity following installation and before use. A water test may also be used to test plant fabricated (non-heat-sealed) glove bags with glued or sewn joints.

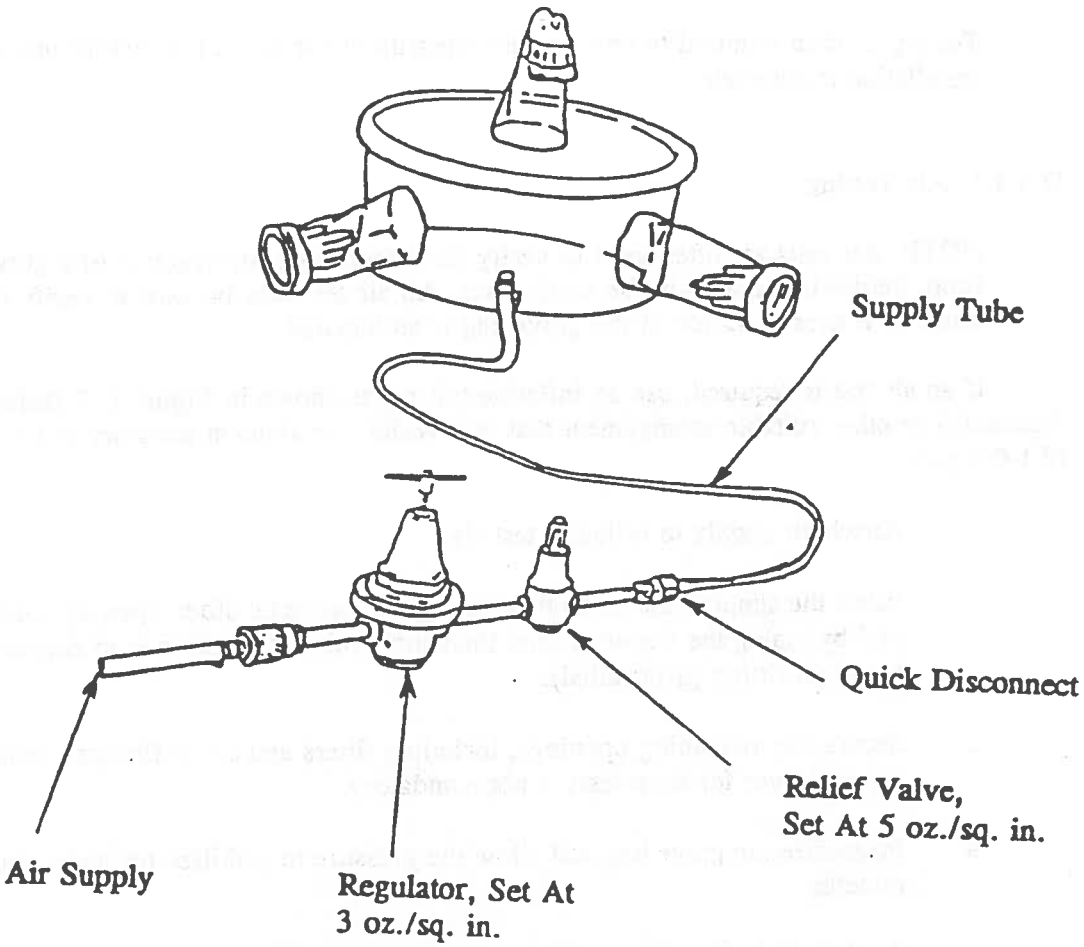


Figure D-7. Inflation Test Assembly.

If a water test is required, sufficient liquid should be used to adequately test the glove bag under expected or likely use conditions. As a minimum, 500 mL should be used.

1. Secure drain line with pinch clamp or crimp and tape.
2. Pour a suitable amount of water through an available opening being careful not to wet the outside of the containment; use enough water to "puddle" around any lower penetrations or seals (e.g., drain fitting).
3. After approximately 2 minutes, check for leaks.
4. Correct deficiencies if practical, or reject the containment.
5. Remove water from the containment after completion of the water test and before start of work.

D.3.4 INSTALLATION

1. Prepare the area in the vicinity of the proposed glove bag installation. Cover any sharp or rough edges that could puncture or abrade the glove bag. If the glove bag is to be exposed to the environment, weather protection should be considered.

2. Cover with fiberglass cloth or equivalent adjacent piping and/or components that are hot (have surface temperatures in excess of 150 °F) and may come in contact with the containment.

3. Exposed piping and/or components that will be inside the glove bag should be covered to minimize contamination. Figure D-8 (Tape Application for Component Surface Protection) illustrates this by using tape to cover the exposed surfaces, note that this also provides a better sealing surface.

4. Make up bottom or component seal as shown in Figure D-9 (Sealing Containment to a Component). Inside seals are normally required for the lower portion of the containment when liquids are expected, unless otherwise authorized by Radiological Control personnel.

5. If required, install drain assembly per Figure D-6, Drain Fitting. Connect drain line to pump (if used) and to the appropriate collection container (Figure D-10, Hand Pump Assembly). If the drain assembly will be subjected to stress, consider using a sealant when installing.

   NOTE: Ensure drain is in the lowest portion of the glove bag and that undue strain is not put on the lower seal.

6. Tape any openings if membranes have been removed. Ensure presslock zipper tracks and glider zipper tracks are properly aligned. Apply tape over the zipper on the inside and outside if the zipper will be under stress during the job.

7. Connect and adjust tie offs to obtain the best working position for the containment (Figure D-11, Tie Off Assembly). Multiple methods of supporting glove bags exist, however, elasticized supports are preferable.

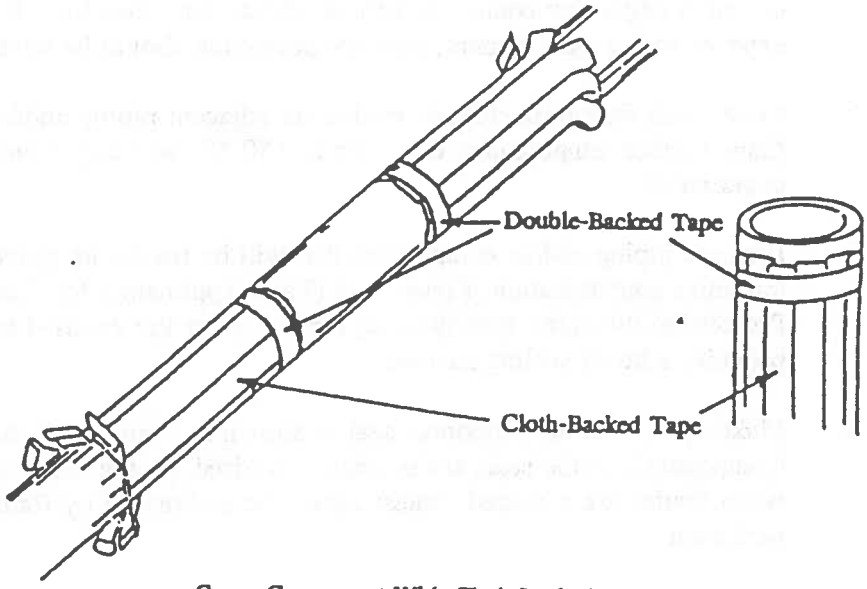
8. Connect required services (e.g., air, vacuum cleaner, etc.) through service or glove sleeves not equipped with a glove assembly (Figure D-12, Service Lead Installation). Vacuum cleaners should be operated to ensure they do not cause the glove bag to collapse during operation.

9. Independently support items, such as hoses, cords, etc. that are connected to the containment to avoid unnecessary strain on the containment. Some applications may require an external platform under the glove bag to support heavy items.

   CAUTION: Ensure CAUTION/DANGER tags or other labeling devices are not obscured by the glove bag.

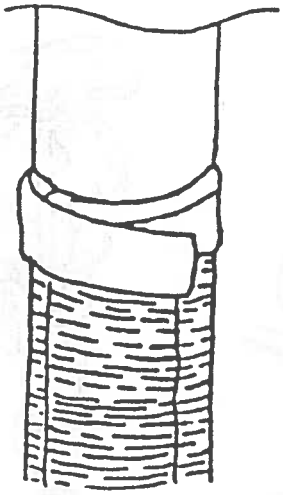
10. Complete and attach Containment Identification Tag, if used.

11. Contact Radiological Control Personnel and have the glove bag inspected, tested (if required), and certified.

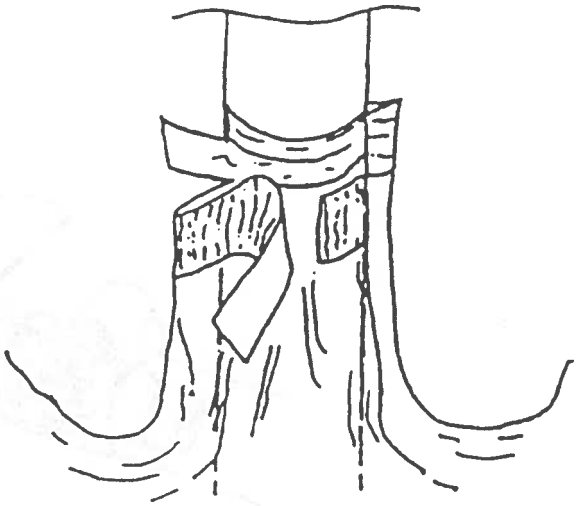


Cover Component With Cloth-Backed Tape And Apply Double-Backed Tape.

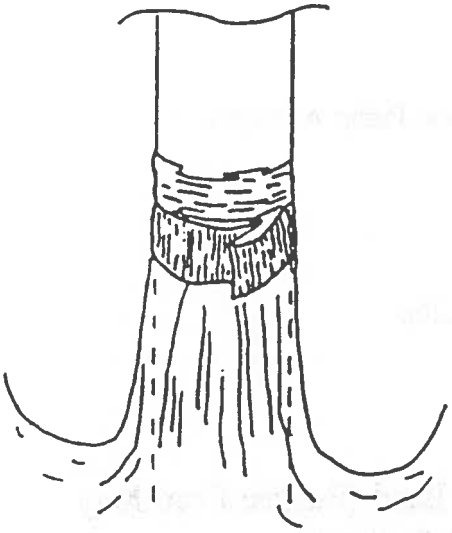
Figure D-8. Tape Application for Component Surface Protection.



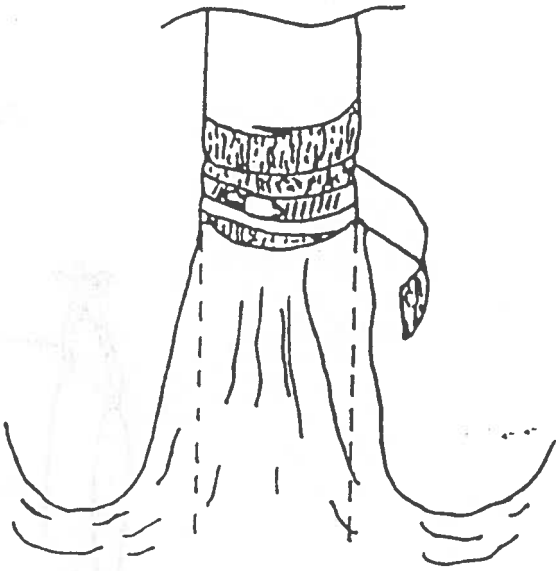
1. Cover piping with tape or film material.



2. Apply tape to sleeve. Gather excess material equally on either side of pipe, commonly called "wings".



3. Fold "wings" back across pipe and tape securely in place.



4. For critical seals install a hose clamp, tape over clamp.

Figure D-9. Sealing Containment to a Component.

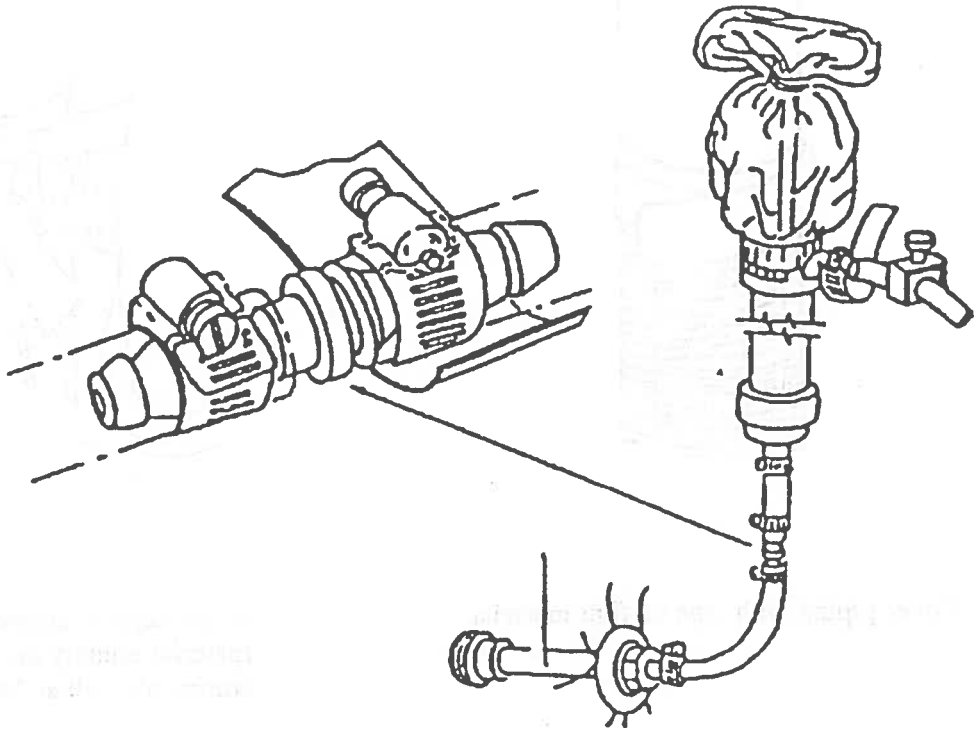


Figure D-10. Hand Pump Assembly

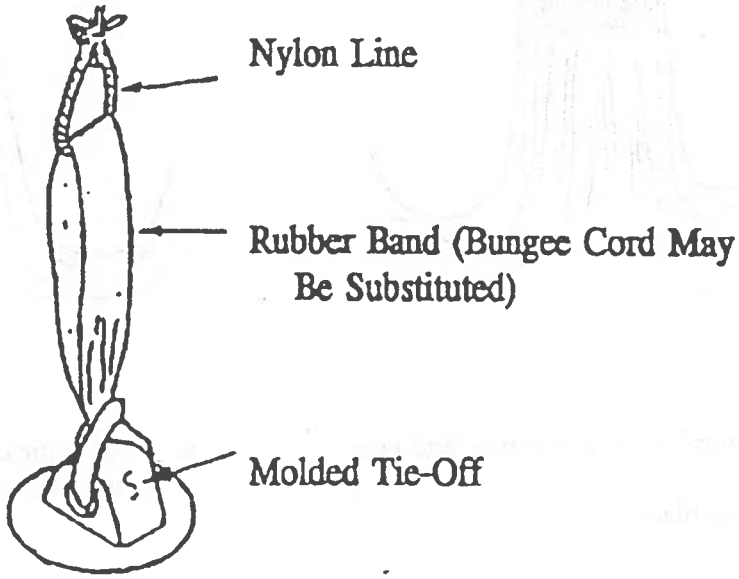


Figure D-11 Tie-Off Assembly.

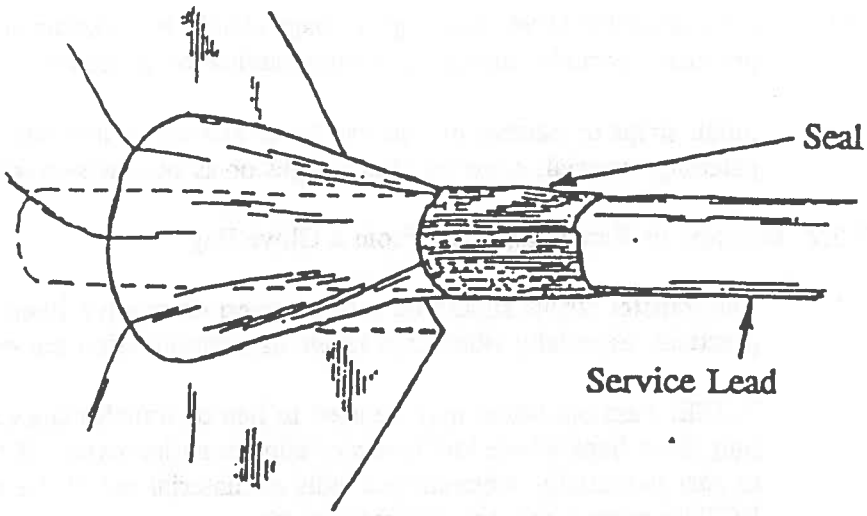


Figure D-12 Service Lead Installation.

D.3.5 WORK IN A GLOVE BAG

D.3.5.1 Precautions

1. The glove bag should be inspected and certified by radiological control personnel before use.

2. Do not overload containments. Install hooks, staging, or other support devices to suspend or support heavy tools, materials, or components.

3. Use only HEPA-filtered ventilation units to exhaust from a glove bag.

4. Additional protective gloves should be worn to protect hands from contamination if the containment gloves are at risk of being punctured or cut.

5. Durable work gloves may be worn inside, over the containment gloves when needed to prevent puncturing of containment gloves.

6. Sharp edges of unused tools and equipment should be covered to prevent puncturing the glove bag.

7. Gloves and glove sleeves should remain inside the glove bag after removing hands from the containment gloves.

8. The worker should always inspect the glove bag following any work activity.

9. Use of chemicals in a glove bag should be evaluated carefully as some chemicals can cause the fabric to deteriorate.

10. Materials kept in the glove bag should be minimized.

11. Contamination levels inside glove bags should be minimized by use of good work practices, periodic surveys and decontamination as needed.

12. Small strips or patches of tape can be staged inside and outside the glove bag to provide patching material, covering sharp edges or as otherwise needed.

D.3.5.2 Inserting or Removing Items From a Glove Bag

1. The transfer sleeve should be used to insert or remove items from glove bags whenever practical, especially when high levels of contamination are expected.

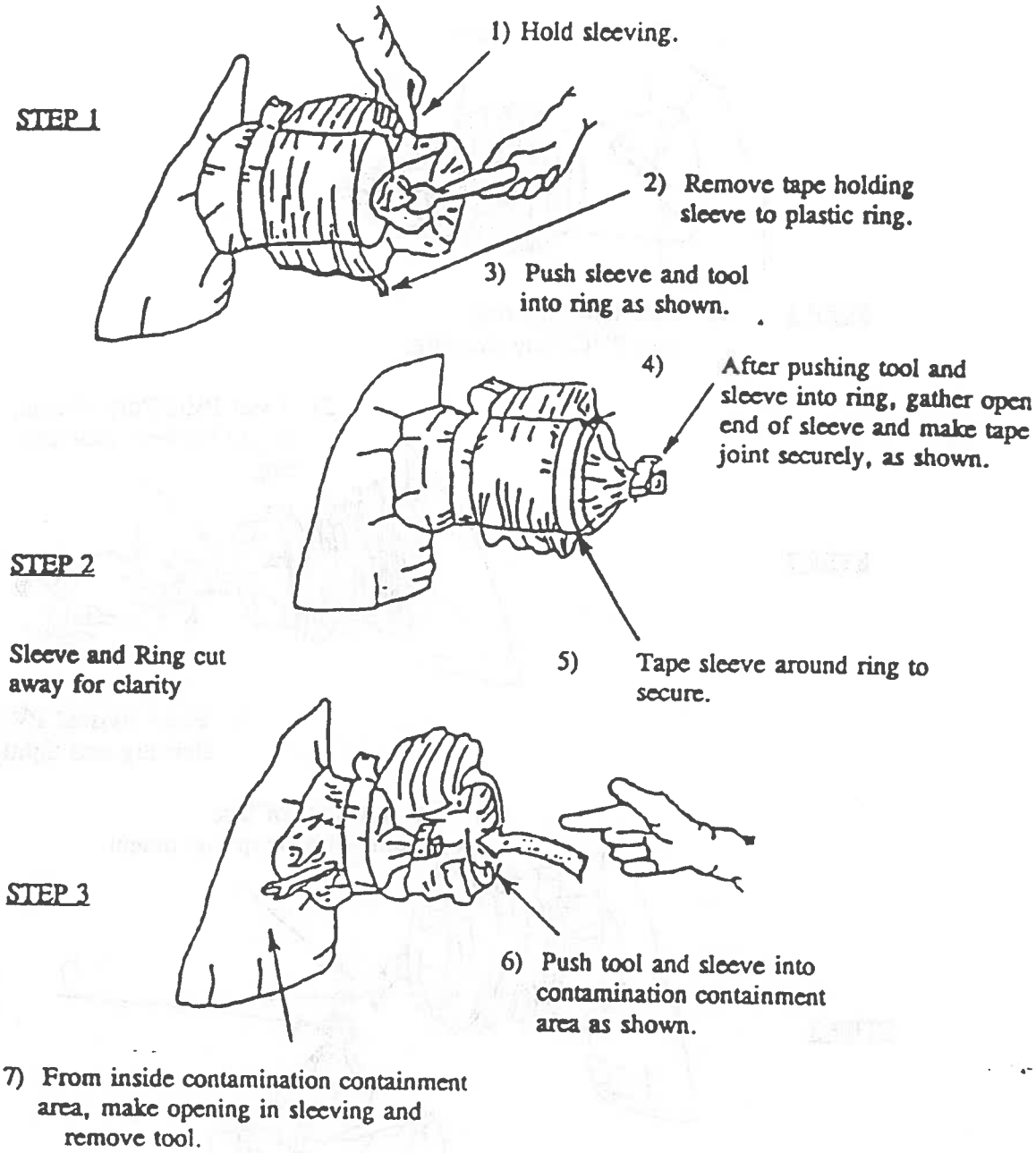
   NOTE: Pass out boxes may be used in lieu of transfer sleeves for transferring small items into glove bags where low levels of contamination exist.* If the pass out box is to be used to pass potentially contaminated tools or material out of the glove bag, recommend an RCT be present to take required surveys.

2. Insertion and removal of contaminated items from a glove bag is illustrated in Figure D-13 (Tool/Item Insertion Into a Containment), Figure D-14 (Tool/Item Removal From a Containment) and Figure D-15 (Removing Items Through Zipper/Velcro[1] Opening).

   NOTE: A contamination survey should be performed to ensure contamination is below acceptable levels prior to opening zipper or Velcro openings.

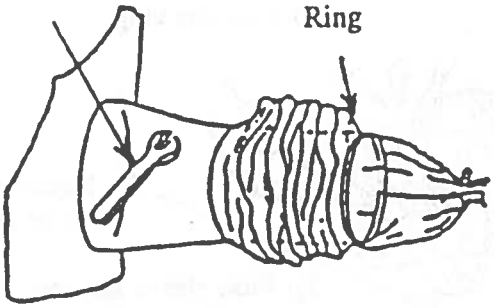
3. When inserting/removing items through zippers or Velcro openings, ensure negative ventilation is operating (if installed).

[1]Velcro is a trademark of Velcro USA, Inc.



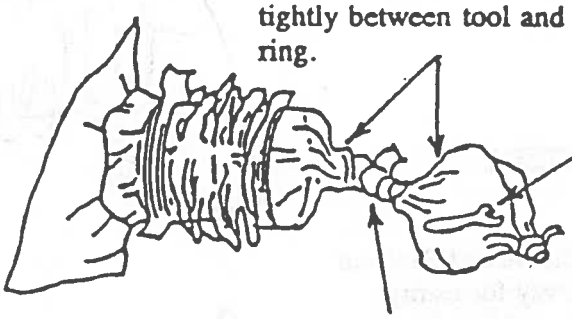
NOTE: After completing item of step 3, disregard cut portion of sleeving, continue as required with next removal or insertion.

Figure D-13. Tool/Item Insertion into a Containment.



STEP 1 1) Pass tool thru ring into PVC/Poly sleeving.

STEP 2



STEP 3

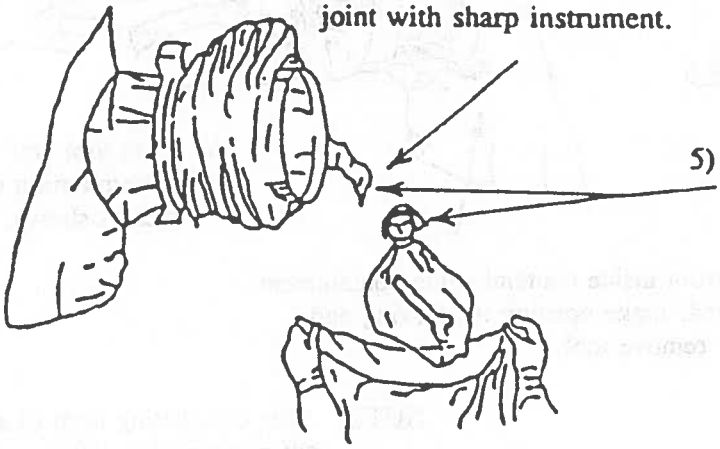
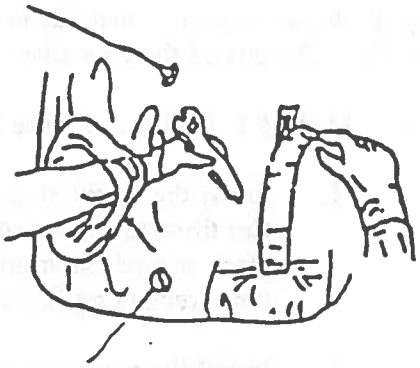
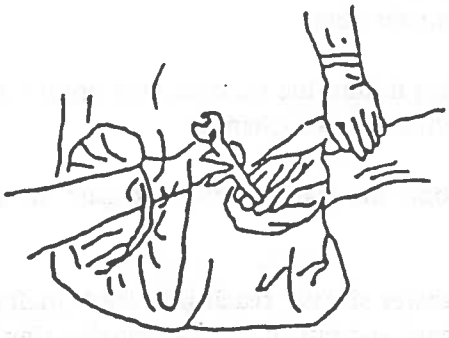


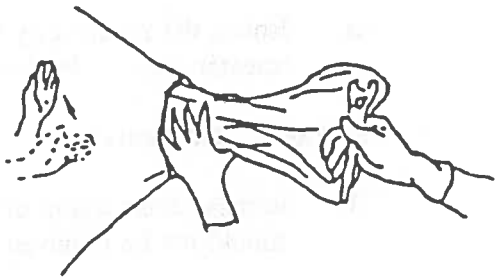
Figure D-14. Tool/Item Removal from a Containment.



STEP 1 Carefully untape the zipper and open it to the minimum required width.



STEP 2 Invert a poly bag about halfway and place it over the zipper opening to prevent any contamination spread. Slip a hand through the inverted poly bag while the other hand holds the bag. Grasp the item with the hand in the poly bag.



STEP 3 Slowly pull the hand, item, and the bag out and down until it is right side out.

STEP 4 Re-seal the zipper with a new piece of cloth-backed tape. Seal the poly bag and remove it from the area.

Figure D-15. Removing Items Through Zipper/Velcro Opening.

D.3.5.3 Glove Bag Maintenance

D.3.5.3.1 Adding Additional Transfer Sleeving Onto A Glove Bag. Frequently, transfers into and out of a glove bag will deplete the supply of transfer sleeving initially installed on a glove bag. The following are some suggested methods to replace sleeving on a glove bag.

NOTE: The end of the new sleeving should be secured prior to installation.

- Method 1 (Refer to Figure D-16A: Replace Transfer Sleeve (pages 1 and 2).

  1. Invert the sleeve remnant into the transfer ring, remove hose clamp, if installed. Cut through the approximate center of the tape securing the transfer sleeve in place around the transfer ring (Step 1). Leave the sleeve remnant intact at this time, remaining inside the transfer ring.

  2. Install the new sleeving, taping it onto the transfer ring approximately 1.5 in. past the securing point of the previous sleeve (Step 2).

  3. Accordion the new sleeving onto the transfer ring and tape the sleeving end closed (Step 3).

  4. Working through the new transfer sleeve, reach into the transfer ring, grasp the depleted transfer sleeve remnant and pull it off the transfer ring (Step 4) and into the end of the new transfer sleeve (Step 5).

  5. Isolate the remnant by taping the sleeve closed. Perform an umbilical cut of the transfer sleeve. Properly dispose of the waste material (Step 6).

- Method 2 (No figure)

  1. Remove hose clamp or cable ties (if used). Tape holding the sleeving in place should not be removed.

  2. Install the new sleeving over the depleted sleeve and tape in place.

  3. From inside the glove bag, cut off the depleted transfer sleeve remnant, exercising extreme caution to prevent cutting the new sleeving or any part of the glove bag.

- Method 3 (Refer to Figure D-16B: Replace Transfer Sleeve)

  1. Remove hose clamp or cable ties holding the depleted transfer sleeve in place. Do not untape the sleeve.

  2. Place a large rubber band over the end of the transfer sleeve to hold the depleted transfer sleeve in place. An appropriate length of 3/16 or 1/4 inch surgical tubing may be substituted for a rubber band.

  3. Untape the depleted transfer sleeve and roll the edges over the rubber band.

  4. Tape the new transfer sleeving to the transfer ring and install the hose clamp or cable ties. Cover the clamp/ties with tape.

5. Working through the new transfer sleeve, grasp the depleted transfer sleeve remnant and pull it free of the transfer ring.

6. The remnant and rubber band should be moved to the end of the new sleeving, isolated by taping the sleeve closed, and removed performing an umbilical cut.

D.3.5.4 Damaged Glove Replacement

Three recommended methods of changing a damaged glove are described below. When damaged gloves are discovered, they should be immediately isolated and assessed to determine the appropriate method for changing the glove.

- Method 1 (Refer to Figure D-17A: Glove Replacement)

  1. Pull the damaged glove hand up and out until just the glove is in the sleeve and remove the rubber ring from the sleeve glove ring.

  2. Carefully roll the damaged glove cuff lip to the center of the glove ring (Step 1).

  3. Place the replacement glove cuff lip over the glove ring (Step 2).

  4. Secure the glove in place with tape or by reinstalling the rubber ring, if used.

  5. With the replacement glove in place, cautiously roll or lift the damaged glove cuff lip over the end of the glove ring. Pull the damaged glove free and draw it into the glove bag for transfer sleeve removal (Step 3).

- Method 2 (No figure)

  1. Remove hose clamp or cable ties (if used). Do not remove tape holding the glove.
  2. Install the new glove over the damaged glove and tape in place.

  3. From inside the glove bag, cut off the damaged glove, exercising extreme caution to prevent cutting the new glove or any part of the glove bag.

- Method 3 (Refer to Figure D-17B: Glove Replacement)

  1. Pull the damaged glove hand up and out until just the glove is in the sleeve and remove the rubber ring from the sleeve glove ring.

  2. Pinch closed and tape around the glove sleeve, isolating the damaged glove (Step 1).

  3. Remove tape, hose clamp (if used), and rubber ring (Step 2).

  4. Remove the glove and allow it to fall into a bag (Step 3).

  5. Insert the new glove into the glove bag sleeve. Place the glove lip over the glove ring. Reinstall the glove ring and retape.

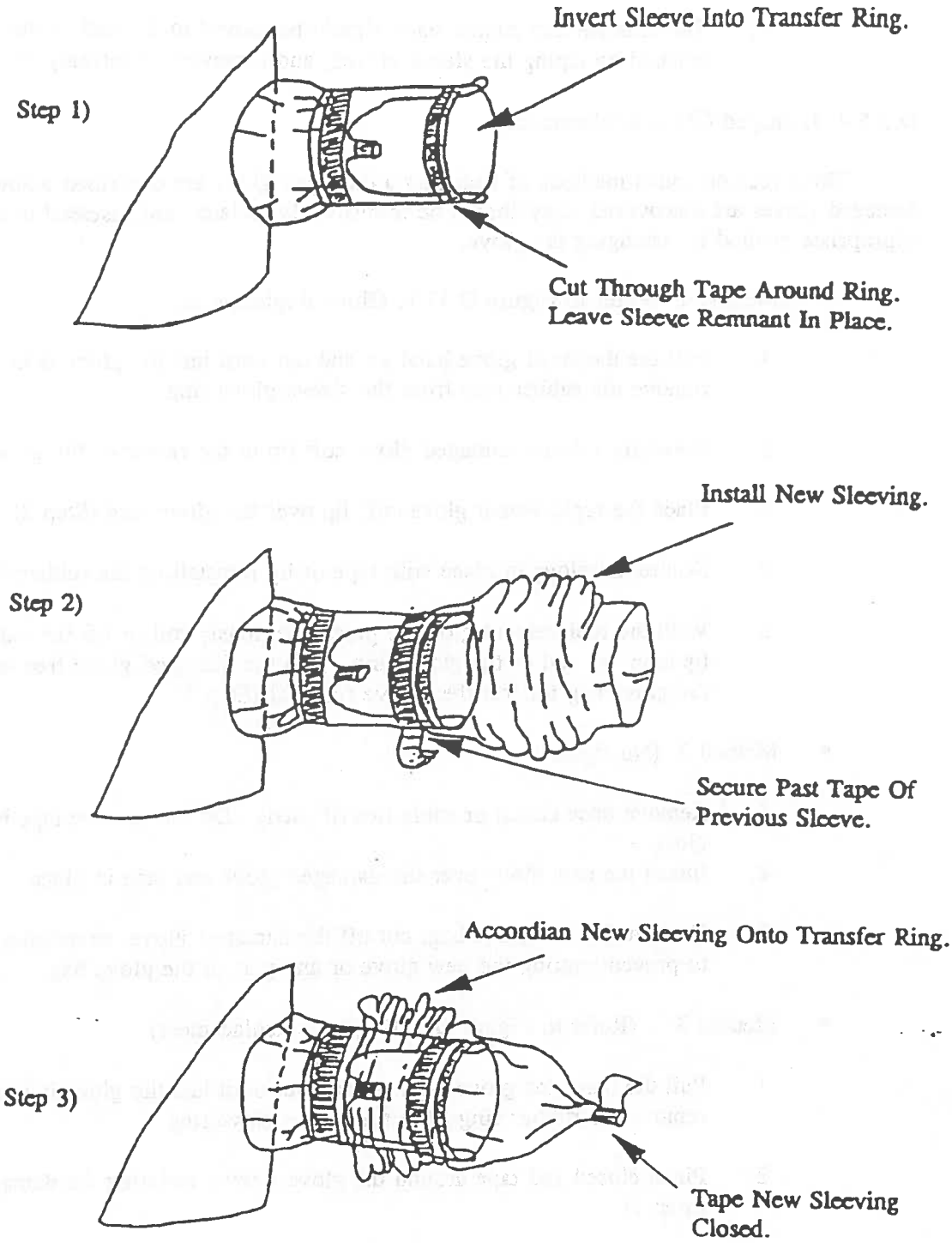


Figure D-16A. Replace Transfer Sleeve. (sheet 1 of 2)

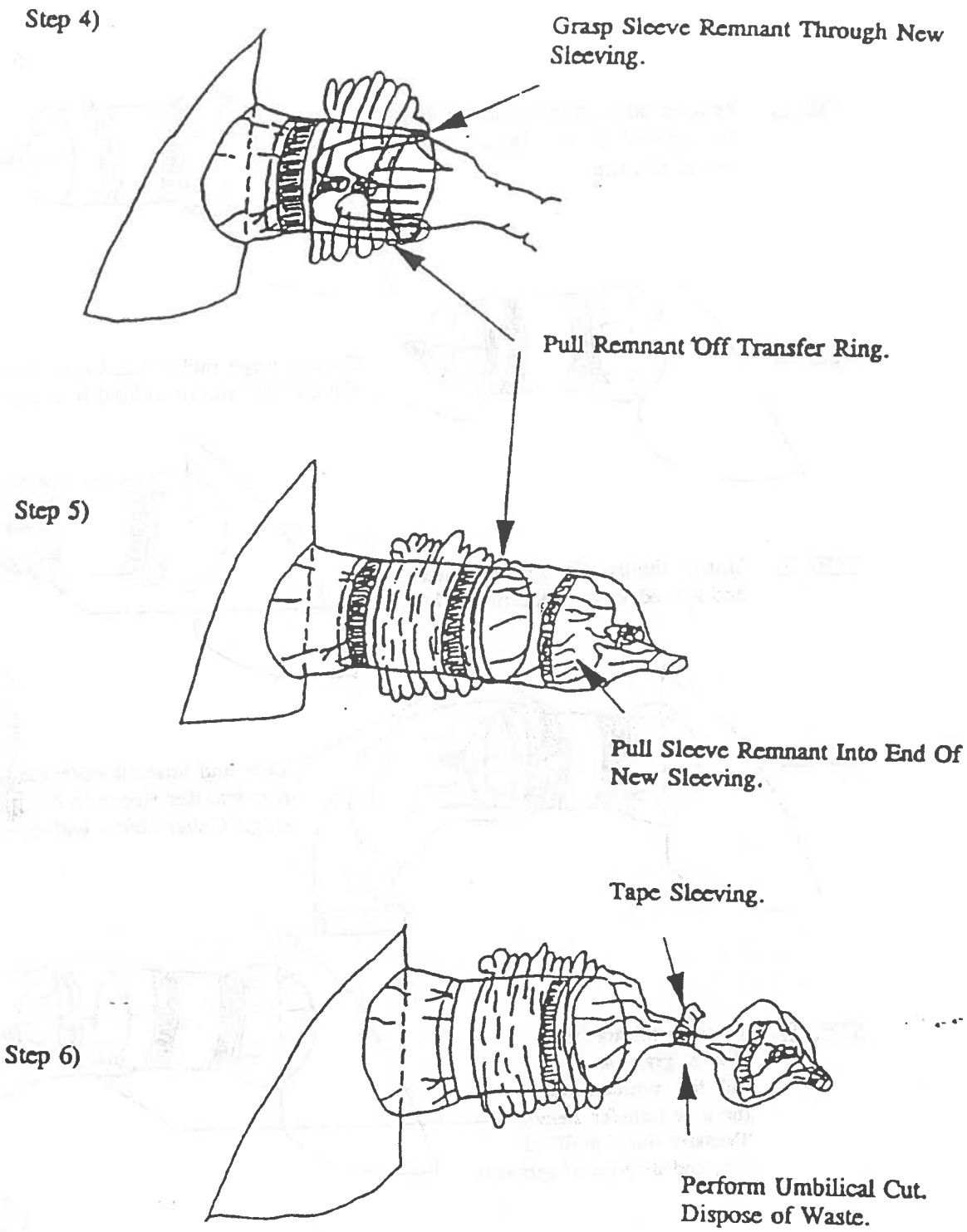


Figure B-16A. Replace Transfer Sleeve. (sheet 2 of 2)

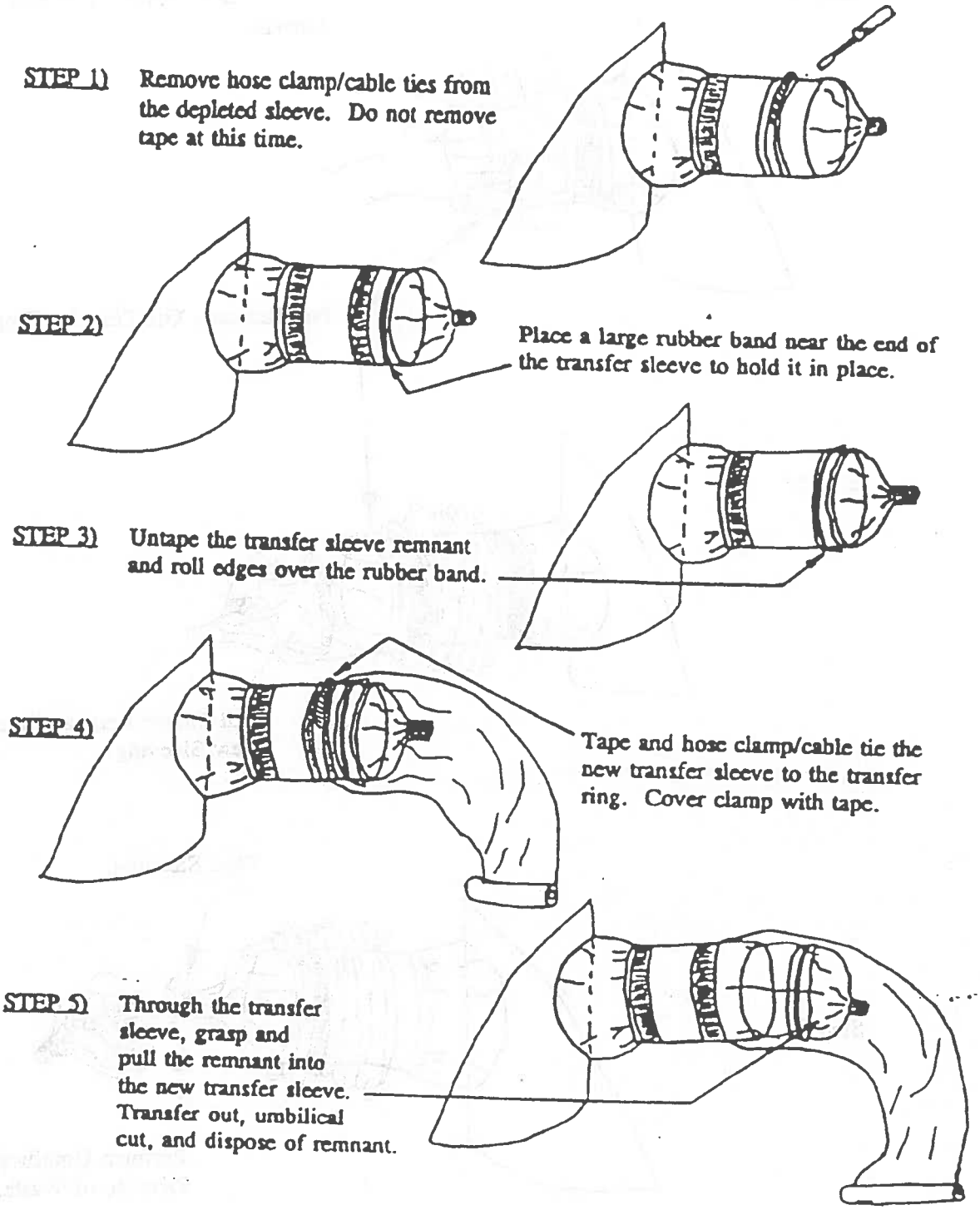


Figure D-16B. Replace Transfer Sleeve (Alternative Method).

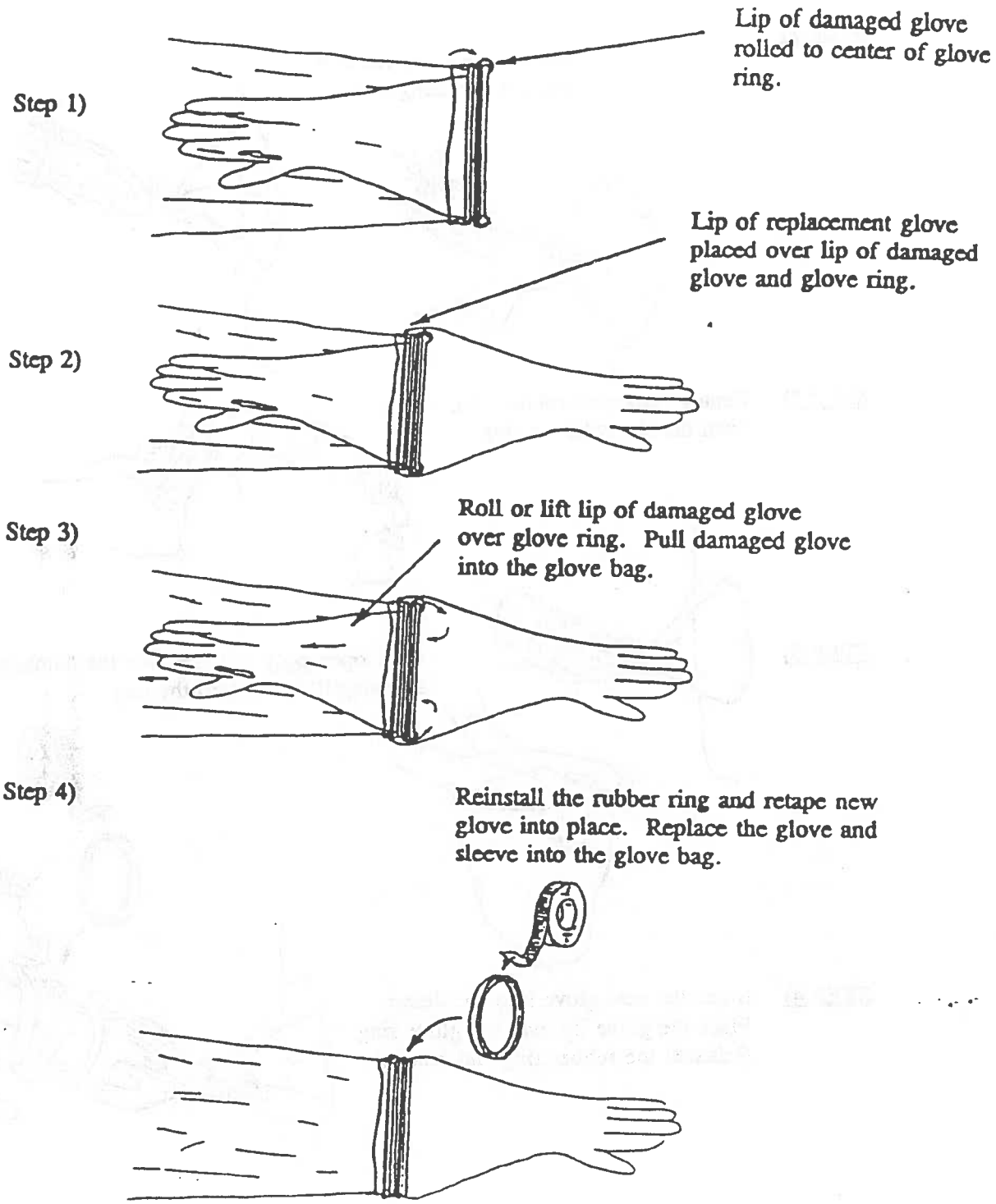


Figure D-17A. Glove Replacement.

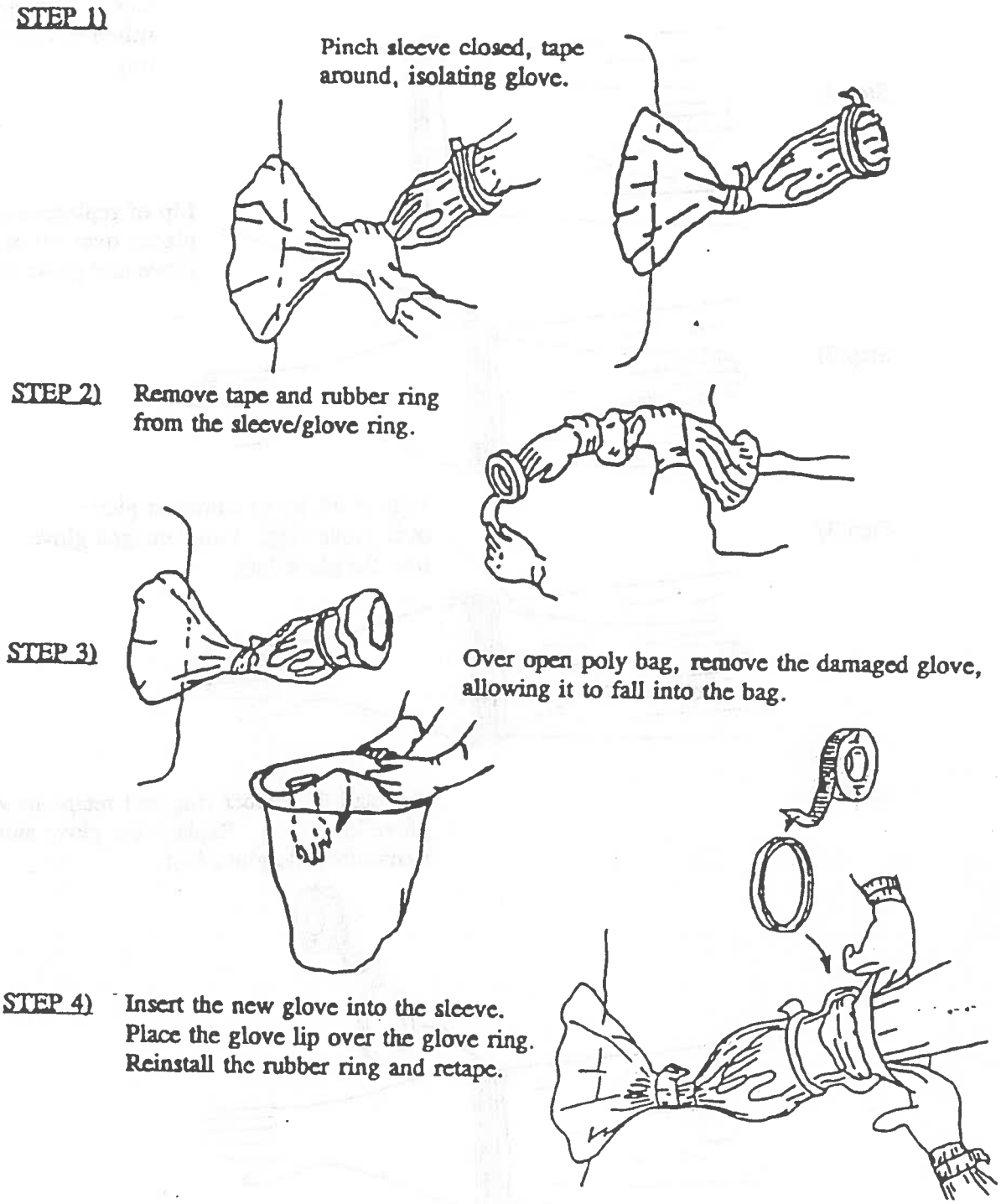


Figure D-17B. Glove Replacement (Alternative Method).

D.3.5.5 Patching Holes/Tears in a Glove Bag

Holes or tears discovered in a glove bag should be patched with tape immediately, on both the inner and outer surfaces. Upon evaluation and concurrence of a Radiological Control Technician, work may continue in the glove bag. The hole should be permanently patched as soon as practical.

D.3.5.6 Securing Containments After Work

1. Glove sleeves should be tucked in the containment body so they cannot form a water collection point or be exposed to damage.

2. Disconnect the air supply (if used) from the air tool lead. Tape over the lead end at the completion of use.

3. Check that the drain hose and poly bottle (if used) remains secured and are unobstructed.

4. At completion of work, make a final check of the containment and nearby work area. Correct any potential hazard, if possible, and report problems to Radiological Control personnel.

D.3.6 GLOVE BAG REMOVAL

Removing craft should make sure that all liquids, tools and nonwaste items have been removed from the containment and required radiological control surveys have verified contamination levels allow containment removal.

1. Using the containment gloves, remove tape covering the component seal clamp and then remove the clamp (Figure D-18, Removing Tape and Clamp). Do not remove tape under clamp at this time.

2. To the extent practical, place a large yellow plastic bag around and under the glove bag so that any material or contamination that falls will be contained in the bag.

3. Cut the glove bag support cords and place cord pieces in the poly bag.

   NOTE: A vacuum cleaner may be used on large containments (Figure D-19, Collapsing Containment Using HEPA-Filtered Vacuum Cleaner). Allow the vacuum cleaner to collapse the containment and make an umbilical cut below the vacuum cleaner hose.

4. Cut the containment free from the component over a poly bag or over a drop cloth (Figure D-20, Cutting and Removing Containment). Newly exposed surfaces should be surveyed as they become exposed.

5. Place the containment and all attached accessories into the previously positioned poly bag (Figure D-21, Lowering Containment into Bag).

6. Carefully remove remaining tape and protective coverings and place in the poly bag. Tape the poly bag closed.

7. When complete, personnel should clean up the area to restore it to its original condition. Remove padding, protective covers and temporary shielding, if installed. Replace interferences, if removed.

8. Final radiological surveys will be taken in the area that was covered by the glove bag as well as the general area to ensure no contamination was spread.

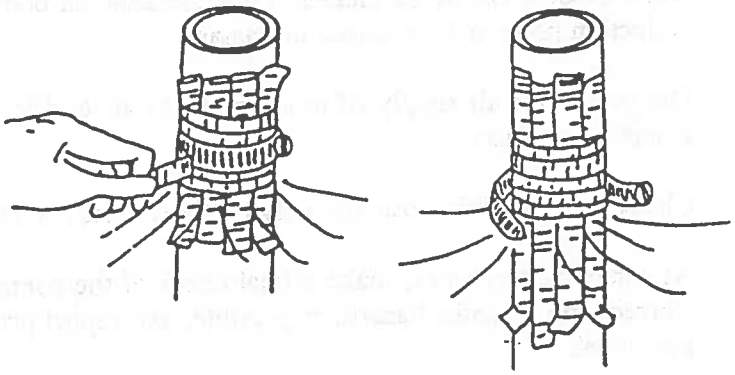


Figure D-18. Removing Tape and Clamp.

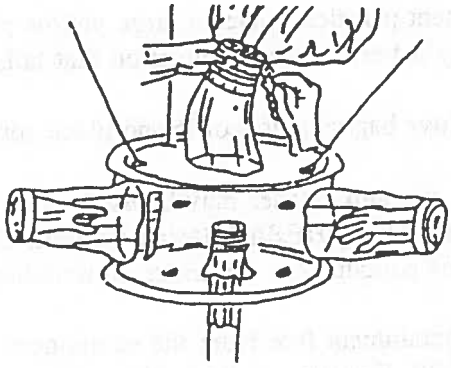


Figure D-19. Collapsing Containment using HEPA-Filtered Vacuum Cleaner.

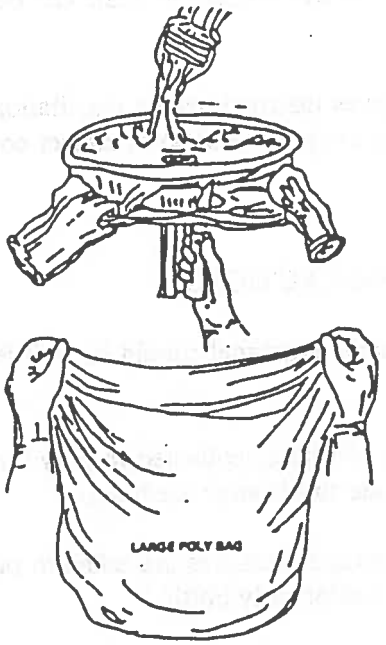


Figure D-20. Cutting and Removing Containment.

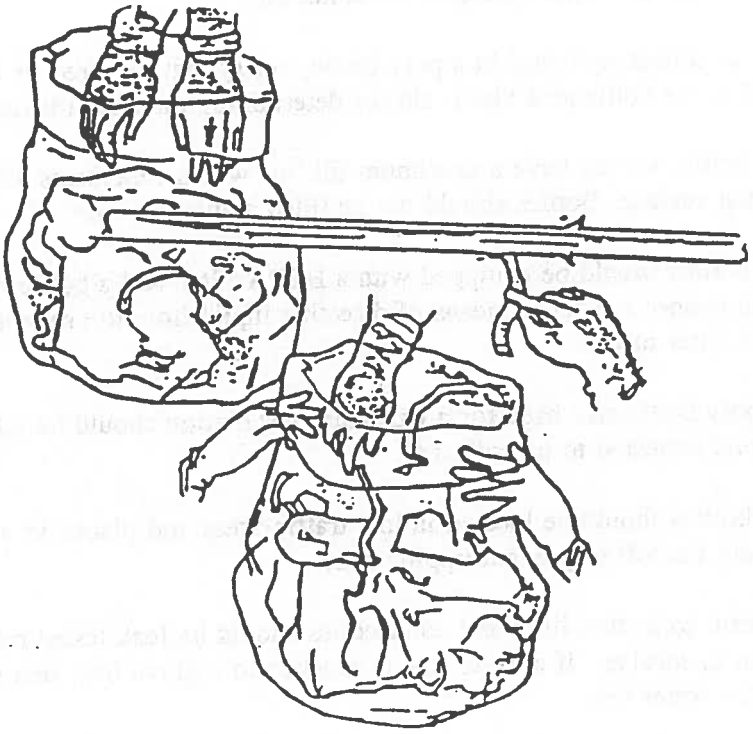


Figure D-21. Lowering Containment into Bag.

D.4 GUIDANCE ON USE OF POLY BOTTLE ASSEMBLIES

This procedure gives instructions for installation and removal of temporary drain systems that use polyethylene containers (poly bottles) to collect contaminated fluid from radiological containments and/or systems.

D.4.1 LIMITS AND PRECAUTIONS

Radiological Control personnel should be notified before the installation or removal of poly bottles.

The temperatures of liquids collected in poly bottles should not exceed 150 °F unless provisions are made to disperse the heat.

Ensure that appropriate measures are taken to prevent freezing of the liquid in the temporary collection tubing and/or poly bottle.

Precautions should be taken to prevent spillage of liquids during installation and removal of poly bottles.

Prior to poly bottle use, verify each bottle to be installed has a label identifying the bottle's location and the liquid source to be collected.

Prior to collecting liquid in a poly bottle, verify that dye (red or blue food coloring) has been added to the bottle as a visual aid for determining the liquid level.

Poly bottles should have a maximum fill line which represents 75% capacity marked on the external surface. Bottles should not be filled above this line.

Poly bottles should be equipped with a HEPA filter and a bottle adaptor. The adaptor provides a hose connection and a means of directing liquid flow to prevent moisture from contacting the HEPA filter media.

The poly bottle size used for a particular installation should be adequate to contain the amount of liquid expected to be collected.

Poly bottles should be located in low traffic areas and placed in a poly bottle containment and securely tied off to prevent tipping over.

All drain collection lines and connections should be leak tested prior to placing the collection system in service. If a drain line is attached to a glove bag, this step should be done in concert with the water test.

Drain installation tubing connections should be secured using hose clamps covered with tape.

Drain lines between poly bottles and catch containments should be arranged and supported so that low points where liquid can collect are minimized.

Drain lines should be routed and secured in a manner that will prevent them from being inadvertently pulled out of their connections, pinched off or damaged in any way.

Drain hoses should be identified at frequent intervals with "CAUTION-INTERNALLY CONTAMINATED" tape.

Poly bottles should not be stacked. This applies to installed bottles, filled bottles, and those awaiting removal from the collection area.

Poly bottles containing liquid should be moved using techniques that avoid tipping.

Poly bottles shall not be used with solutions containing or systems which may contain fissile materials unless evaluated by criticality engineering.

When it becomes necessary to tip a poly bottle in order to remove it from interferences, remove the fill and vent assembly and install the bottle plug prior to moving.

D.4.2 PREREQUISITES

Requirements for installation and amount of liquid expected should be determined and all necessary sketches, drawings, and plans for the installation have been approved and are available to be used with the work procedure.

Required system isolation, tagging, draining and venting should be completed.

All required tools, equipment and protective equipment should be assembled. The following equipment and supplies should be used to perform this procedure:

- Protective clothing
- Poly bottle(s), bottle adaptor(s) and HEPA filters required by the installation design
- Clear Tygon[1] tubing of length and size required by the installation design.
- Hose clamps, pinch clamp as required by the installation design.
- Absorbent cloth, tape and suitable sized yellow poly bags for removal of contaminated materials, tools and equipment.
- Hand tool required to install drain fittings and drain hose.
- Plug wrench for removing and reinstalling poly bottle plugs.

[1]Tygon is a registered trademark of U.S. Stoneware Co.

If the poly bottle collection assembly is to be connected to a system line fitting, the drain hose should be connected to the poly bottle and the entire drain collection system leak tested prior to line fitting connection.

If the collection assembly is connected to a catch containment, the assembly should be leak tested in place using the steps shown in Appendix D, Section D.3.3.2.

D.4.3 PROCEDURE

D.4.3.1 Installation of Poly Bottle Adaptor and Filter

Refer to Figures D-22 through D-24 for aid in performing Steps 1 through 10

1. Inspect the poly bottle and poly bottle containment and ensure they are in good condition and free of damage or holes.

2. Remove the poly bottle closure plug and cut out plug diaphragm (see Figure D-22).

3. Remove the shipping plug from the closure plug (if included), place it in a poly bag and tape it to the top of the poly bottle.

4. Reinstall the closure plug gasket.

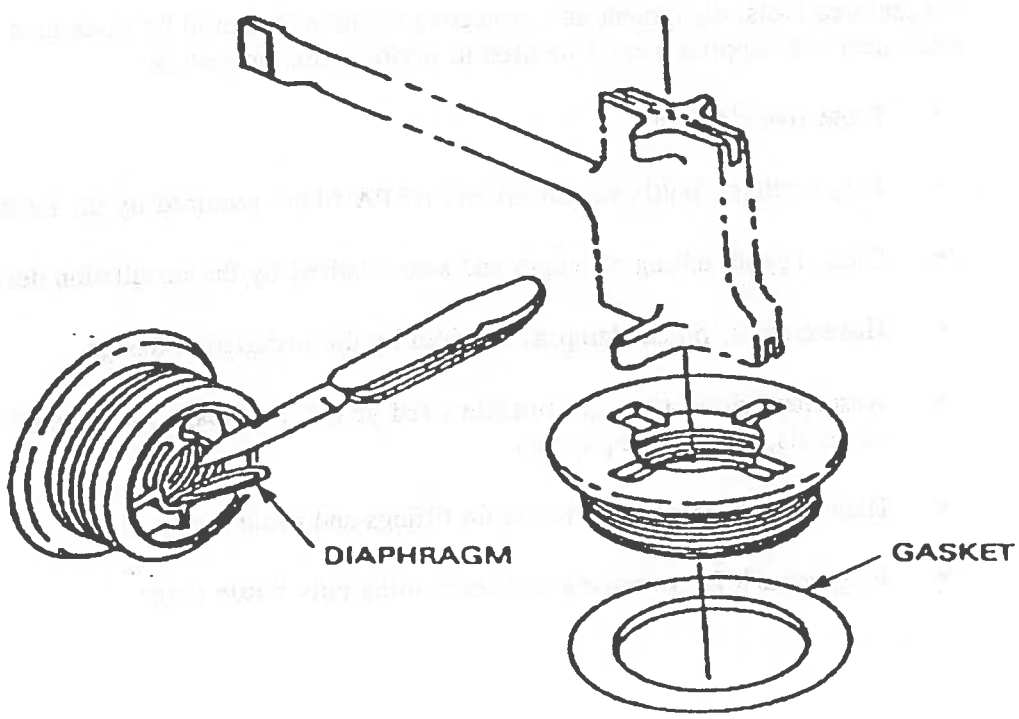


Figure D-22. Closure Plug Removal.

CAUTION: Over-tightening the closure plug, bottle adaptor or HEPA filter may cause damage to these components.

5. Reinstall the closure plug and tighten it snugly with a plug wrench.

CAUTION: Failure to install the bottle adaptor so the filter connector faces inward could result in damage to the filter and/or the adaptor.

6. Screw the bottle adapter into the closure plug, ensuring that the filter connection faces inward (see Figure D-23).

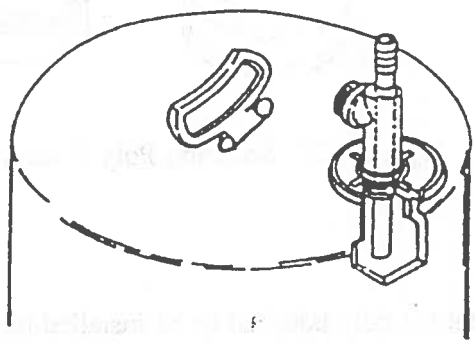


Figure D-23. Bottle Adaptor Installation.

7. Ensure the filter rubber gasket is properly in place.

8. Screw the filter on to the filter connector and tighten snugly by hand.

9. Remove the covering from the face of the filter (if installed, see Figure D-24).

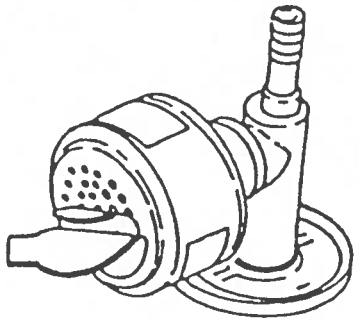


Figure D-24. Removing Filter Face Cover.

D.4.3.2 Installation of Poly Bottle at Collection Location

NOTE: Rigid structures such as hangers, stanchions or other components should be used to secure poly bottles (see Figure D-25 for examples).

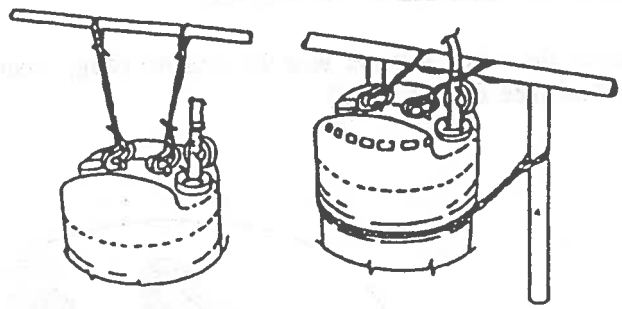


Figure D-25. Securing Poly Bottles to Prevent Tipping.

- Check that the poly bottle(s) to be installed have a properly filled out identification label attached.
- Locate the poly bottles in a low traffic area as near as possible to the point of collection.

Refer to Figures D-26 and D-27 for aid in performing steps 1 through 12.

1. Place the poly bottle in a poly bottle containment (if not already done) at the desired collection location and secure it in place.

2. Install the drain hose (usually Tygon) onto the barbed fitting of the bottle adapter (see Figure D-26)

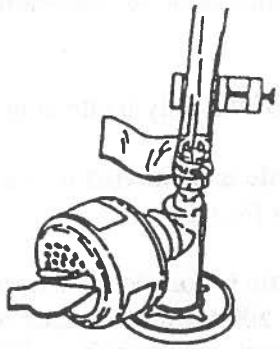


Figure D-26. Drain Hose Installation.

3. Install and tighten a hose clamp to secure the drain hose to the bottle connector.

4. Install tape over the hose clamp.

5. Route the drain hose between the poly bottle and the collection drain point.

6. If the arrangement of the drain installation will not support gravity draining to the poly bottle, install a hand pump between the collection point and the poly bottle to facilitate pumping the liquid to the poly bottle (see Figure D-27). The pump should be sleeved as shown.

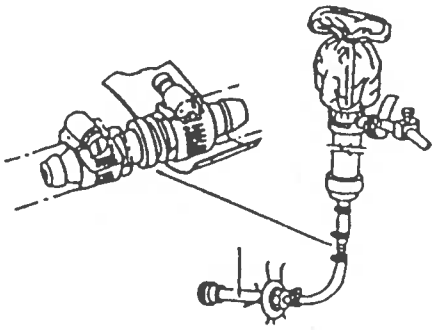


Figure D-27. Hooking Up to Designated Drain (connect hand pump if needed).

NOTE: If a hand pump is installed, ensure that it is installed in the vertical position with the suction of the pump at the lowest possible point in the collection system.

7. Connect the drain hose to the designated drain connection.

8. Attach an identification tag (indicating the source of the fluid) to the drain line near the poly bottle.

9. Close the top of the poly bottle containment, if applicable.

10. If the poly bottle is connected to a system, wrap and tape absorbent around the drain hose to system fittings.

11. If the poly bottle is connected to a catch containment, perform a leak test by pouring approximately 500 ml of deionized water into the catch containment and inspect the catch containment and drain hose fittings for leaks. Perform leak repairs as necessary.

12. Loosen the "pinch" clamp to allow flow through the drain line to the poly bottle. If water was added to a catch containment per the above step, ensure that the liquid flows freely from the catch containment to the poly bottle.

D.4.3.3 Disconnection and Removal of Poly Bottles

Refer to Figures D-28 through D-33 for aid in performing Steps 1 through 13.

1. Ensure that the drain hose is completely drained. Gently tap the hose and/or rearrange it as necessary to promote draining on gravity systems.

2. Tighten the drain line "pinch clamp" to isolate the drain line.

3. Open the top of the poly bottle containment, if applicable.

4. Remove the tape from the hose clamp securing the drain hose to the poly bottle connector and remove the hose clamp (see Figure D-28).

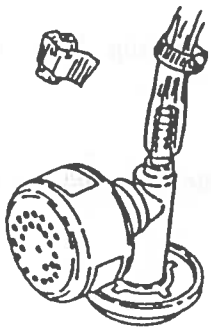


Figure D-28. Removing Tape from Hose Clamp.

5. Wrap a piece of absorbent around the bottle adaptor just below the barbed fitting and gently remove the hose with an up and twisting motion, keeping the absorbent around and under the hose end as it becomes free (see Figure D-29).

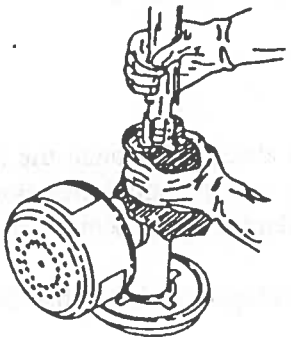


Figure D-29. Removing Drain Hose from Poly Bottle Adaptor.

6. Place the loose end of the drain hose and the absorbent into a poly bag and tape it securely (see Figure D-30).

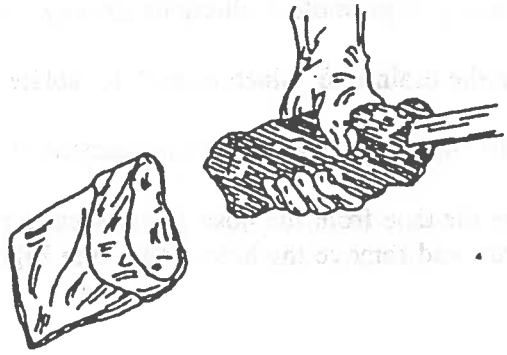


Figure D-30. Placing Drain Hose and Absorbent into a Poly Bag.

7. Install a piece of tape over the end of the bottle adaptor barbed fitting (see Figure D-31).

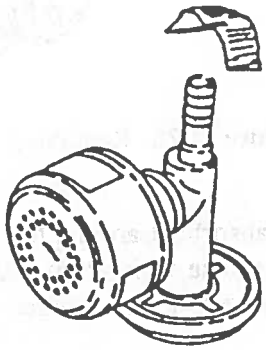


Figure D-31. Taping Over End of Bottle Adaptor Fitting.

8. Wrap a piece of absorbent around the base of the bottle adaptor and gently unscrew the adaptor plug (so that the bottle plug does not also loosen). Keep the absorbent around and under the adaptor as it becomes free of the bottle plug (see Figure D-32)

9. Place the bottle adaptor and the absorbent in a poly bag and tape it securely (see Figure D-33).

10. Remove the shipping plug from the poly bag that should be taped to the bottle and reinstall it into the bottle closure plug (see Figure D-34).

11. Tighten (snug tight only) the shipping plug using the plug wrench.

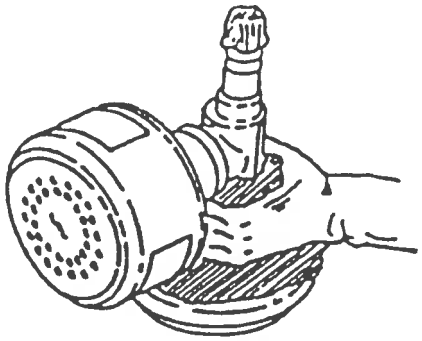


Figure D-32. Removal of Closure Plug.

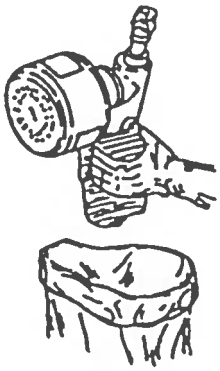


Figure D-33. Placing Bottle Adaptor into Poly Bag.

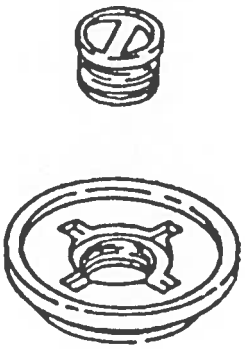


Figure D-34. Reinstalling Shipping Plug Into the Closure Plug.

12. Install and tape absorbent around the closure plug.

13. Move the poly bottle to a temporary storage area at a nearby location or transport it out of the area.

APPENDIX E

SAMPLE TRAINING GUIDES

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APPENDIX F

GLOSSARY

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GLOSSARY

ABBREVIATIONS, ACRONYMS, AND INITIALISMS

ALARA	as low as reasonably achievable
DOE	U. S. Department of Energy
HEPA	high-efficiency particulate air (filter)
PVC	polyvinyl chloride
RWP	radiation work permit
UV	ultraviolet

DEFINITIONS OF TERMS

Air Curtain Containment. Air curtains use moving air to draw contaminants into a filtered exhaust plenum. Application of air curtains include open faced hoods, strategically placed exhaust ducts, or any other means of capturing the contaminants at or near the source with filtered ventilation.

Bull Pen. A bull pen is a walled or partially walled enclosure that allows personnel to enter and work in a contaminated environment. Bull pens are generally roofless and used on low-risk activities to protect immediate area from contaminants, as well as protect the work area from external factors which could result in contaminated material being spread.

Catch Containment. Catch containments are partial enclosures usually used to collect falling debris or to collect and direct liquid contaminants from a source to a collecting device such as a poly bottle or drain line.

Containment Tent. Containment tents are large enclosures which allow personnel to physically enter a contaminated environment to perform work. Containment tents can also be used to provide ante rooms for access to cells, tank risers, and other highly contaminated environments.

Curtain Wall. A temporary installation used to partially isolate a work area thereby permitting personnel to work in adjacent areas with no significant impact from the work area operation. A bullpen consists of multiple adjacent curtain walls.

Drop Cloth. Absorbent material with a waterproof backing.

Electronic (RF) Sealing. Sealing process used to bond materials in the manufacture of glove bags, tents, etc.

Glove Bag. A flexible containment which is used to establish a complete enclosure around a small work area or component. Personnel work inside the containment through glove sleeves while remaining outside the contaminated environment.

Glovebox. A rigid sealed enclosure in which workers can handle radioactive materials safely from the outside using gloves attached to and passing through openings in the box.

Laydown Area. An area where contaminated or potentially contaminated tools or components used while working on contaminated systems are staged or placed during work operations.

Mechanical Joint Containment. A containment used to wrap mechanical joints to contain any minor leakage, provide spray protection, and prevent spills.

Membrane. Containment wall fabric left intact after the attachment of a sleeve, door, zipper or other component.

Rigid Panel Containment. A large enclosure constructed largely of interchangeable standard size panels made of Lucite, sheet stainless steel or other rigid and easily decontaminatable material.

Special Containment. Containments that are designed for specific tasks and that are engineered and manufactured on an as-required basis.

Standard Containment. Containment designs that are intended for general use and are available off-the-shelf.

Poly Bottle. A 5- or 15-gal polyethylene container used to collect small quantities of contaminated liquids (generally includes a filtered vent assembly).

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