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MILITARY HANDBOOK

GUIDELINES-DESIGN TO MINIMIZE CONTAMINATION AND TO FACILITATE DECONTAMINATION OF MILITARY VEHICLES AND OTHER EQUIPMENT: INTERIORS AND EXTERIORS



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DEPARTMENT OF DEFENSE
Washington, DC 20301

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Guidelines - Design to Minimize Contamination and to Facilitate Decontamination
of Military Vehicles and Other Equipment: Interior and Exterior

28 June 1985

1. This military handbook is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Chemical Research, Development and Engineering Center, ATTN: SMCCR-SPT-S, Aberdeen Proving Ground, MD 21010-5423, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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FOREWORD

This handbook was prepared by the Standardization and Specifications Branch, Technical Data Division, Research, Development and Engineering Support Directorate, U.S. Army Chemical Research, Development and Engineering Center.

This document was completed in June 1982 by Battelle Columbus Laboratories for the Physical Protection Division (CRDEC) and is available to all elements of DOD, other Government agencies and other interested parties. Comments and suggestions on this publication are welcome and should be addressed to:

Commander
U.S. Army Chemical Research, Development and Engineering Center
ATTN: SMCCR-SPT-S
Aberdeen Proving Ground, MD 21010-5423

The purpose of this handbook is to provide information and guidance in the design of military vehicles and other equipment so as to minimize contamination by nuclear, biological, and chemical (NBC) agents and to increase the effectiveness of decontamination processes. The guidelines are intended to focus on the problem areas that can be eliminated by designers when contamination and decontamination are considered as factors in design of military equipment. Those guidelines do not presume to dictate requirements for the layout, configuration, or construction of military hardware, nor do they prohibit presently used design techniques. Thus problems of contamination and decontamination are brought to the attention of designers. Approaches to reduce the size of those problems are suggested. Therefore, the information provided herein should be considered advisory only.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorizing documents.

Approved for public release; distribution is unlimited.

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1. SCOPE

This handbook provides guidelines for designing military equipment so as to minimize contamination by nuclear, biological, and chemical (NBC) agents and to increase the effectiveness of decontamination processes. In no way do these guidelines presume to dictate requirements for the layout, configuration, or construction of military hardware or for the selection of materials to be used therein; nor do they prescribe presently used design techniques. Rather, they are intended to bring the problems of contamination and decontamination to the attention of designers and to suggest approaches that can eliminate these problems and can make decontamination easier.

2. REFERENCED DOCUMENTS (Not applicable)

3. DEFINITIONS

(For the purpose of this handbook, the following definitions shall apply:)

- 3.1 Absorption The process whereby a contaminant or decontaminant penetrates a surface and remains within the contaminated material.
- 3.2 Adsorption The process whereby a contaminant or decontaminant adheres or becomes chemically attached to a surface.
- 3.3 Agent A substance that, depending upon the context in which the term is used, may contaminate equipment or that may be used to counter the effect of a contaminating substance. See contaminant or decontaminant.
- 3.4 Biological Contaminant A substance or living organism that produces the incapacitating or lethal effects by transferring or causing disease.
- 3.5 Chemical Contaminant A substance that produces its incapacitating or lethal effects by chemical action. See the list of chemical contaminants in Table A-1.
- 3.6 Contaminant A chemical or biological material, a toxin, or a nuclear material whose purpose is to incapacitate or to kill personnel.

Contaminants are chemical, biological, or nuclear materials that have been developed for the specific purpose of killing or incapacitating people. Other materials or agents developed for other military-related purposes, such as defoliation, also can have

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adverse effects on human and animal life; however, these other agents are not considered as contaminants within the context of this handbook and, therefore, are not discussed here. Anti-personnel contaminants are described in broad terms below.

3.6.1 Chemical Agents

Chemical contaminants may be categorized as nerve, choking, blood, blister, incapacitation, vomiting, and riot-control agents. They affect primarily the lungs, the eyes, or the skin; they may cause death or may only incapacitate for a few minutes. The severity of the effect depends upon the concentration of the agent, the toxicity of the agent, the amount transferred to a person, and the condition of the person exposed. However, the greater the amount of agent on or in equipment, the greater is the probability that an amount necessary to cause harmful effects will be transferred to personnel. The harmful effects that may result are listed in Table A-1 for the different categories of chemical agents.

3.6.2 Biological Agents

Biological contaminants may be broadly categorized as disease- or illness-causing agents. They are living organisms and include bacteria, fungi, protozoa, rickettsia, and viruses. Transfer can be by inhalation, ingestion, or through a break in the skin. Their effects can range from mild incapacitation to death, depending to a large degree upon the physical condition of the exposed person and the specific type, strain, and viability of the agent.

The major problem with such agents is that they may survive for a long period of time if environmental conditions are favorable. If trapped in areas that are hard to get to (and which normally would not represent exposure hazards to personnel), they may be uncovered at a later time and contaminate maintenance personnel. The problem is complicated by the fact that the hazardous dose varies widely, depending upon the specific biological agent, and by the danger that the agent or its disease may be transferred from one infected person to another.

3.6.3 Nuclear Contaminants

Nuclear contaminants include any radioactive material that may result from fallout after an atomic or nuclear attack or from induced radioactivity in soil and vegetation. Direct radiation from a nuclear blast, although it will contaminate equipment, is outside the scope of these guidelines. Thus, nuclear agents are substances that may be deposited on, or in

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compartments. The degree of hazard associated with these agents depends largely upon the amounts present; pockets or depressions may trap sufficient material to pose a hazard to unwary personnel.

- 3.7 Contamination The presence of a contaminant on equipment.
- 3.8 Decontaminant A substance whose purpose is to detoxify, physically remove, seal, or otherwise make harmless a contaminant. See list of decontaminants in Table A-2.
- Among the most effective decontaminants, particularly for chemical agents, are time and isolation. However, both time and isolation require that a contaminated piece of equipment be removed from service for an indefinite period. Furthermore, even when isolated, contaminated equipment can itself be a source of contamination if wind or precipitation carries the contaminating material into another area. Therefore, rather than rely upon natural processes for decontamination, positive techniques and substances must be applied to make the contaminated equipment safe for use. A number of substances that have been used with varying degrees of success for decontamination are listed in Table A-2. Although these substances are effective in neutralizing or removing contaminants, some of them have adverse chemical or physical effects on the materials to which they are applied.
- 3.9 Exposure Being in or passing through an area or atmosphere in which contaminants are present.
- 3.10 Incapacitation Physiological or visual effects of contamination that render individuals incapable of performing their assigned duties.
- 3.11 Persistency The effectiveness of a contaminant over time.
- 3.12 Nuclear Contaminant A substance that produces its incapacitating or lethal effects by releasing radiation, usually beta or gamma, that destroys living cells.
- 3.13 Toxin A substance, usually a product of animal or vegetable origin, that produces its incapacitating or lethal effects by poisoning the human organism.
- 3.14 Toxicity The degree of which a contaminant is effective in producing its incapacitating or lethal effects.

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4. GENERAL REQUIREMENTS

4.1 Relationship of Design to Contamination and Decontamination

Efforts to address the effects of NBC contamination, including their decontaminants, upon equipment was formally initiated by the Army in 1984 with the publication of AR 70-71, NBC Contamination Survivability of Army Materiel. This regulation established formal policy and procedures for the development and acquisition of equipment to ensure its survivability and sustainability on the NBC-contaminated battlefield. During June 1987 the Department of Defense published DOD Instruction 4245.13, Design and Acquisition of NBC Contamination Survivable Systems, which provides management and documentation requirements for the survivability of systems designed and acquired to perform mission-essential functions in an NBC contamination environment. Several handbooks and reports that provide guidance and technical assistance in addressing these NBC contamination survivability requirements are available from U.S. Army Chemical Research, Development and Engineering Center.

Contaminants are NBC agents that have been formulated to kill or to incapacitate human beings; that is, they are antipersonnel substances. Contaminants may be absorbed by certain materials (such as paints, lubricants, and fabrics), adsorbed on exposed surfaces, and retained in crevices, seams, concavities, and even on horizontal surfaces. They may also be absorbed or adsorbed by dust, mud, or vegetation, which may adhere to equipment surfaces. They can be transferred to personnel by direct contact, through vaporization and subsequent inhalation, ingestion, or infusion, or (in the case of nuclear contaminants) through emission and absorption. Furthermore, some agents, if absorbed into a material, may slowly desorb over an extended time and thus constitute a vapor and contact hazard of long duration.

Contamination, within the context of this handbook, means that NBC agents adhere to or enter a piece of equipment, a vehicle, or some part thereof. Here, the broadest interpretation is given. It includes not only the penetration of agent into compartment spaces, but also the absorption of agent into materials and the infiltration of agent into seams and crevices.

Contamination may result from a direct attack with NBC weapons, or it may result from exposure to wind-carried agent from another area or from moving over ground or vegetation that has been contaminated. Regardless of the cause, the result is the same: equipment vehicles are contaminated and, in turn, become potential sources of contamination to personnel in the area.

The actual time that equipment remains contaminated and poses a threat to personnel depends upon the properties of the agent, the duration of exposure of the equipment to the agent, the amount of agent remaining with the equipment, environmental conditions, and physical features of the equipment (which relate to the amount of agent remaining with the equipment). Neither the agent itself nor the exposure can be controlled by design, but design can reduce the amount of agent remaining on the equipment, and can affect the interaction of

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the environment with the agent. Thus, design to minimize contamination is, primarily, a matter of eliminating, restructuring, or shielding items that may trap or retain contaminants in areas that can be contacted by personnel or that can create a vapor hazard to personnel. Secondly, it is a matter of providing good air circulation and exposure to sunlight to items that cannot be shielded from contaminants.

However, these two concepts may result in two extreme views being taken in designing to minimize contamination. One view would presume that any agent absorbed, adsorbed, or otherwise retained on or in exterior items will dissipate or will naturally become detoxified before it can affect anyone coming into contact with the equipment, and that agent gaining access to interior areas will be rendered ineffective by the use of personnel protective gear. This view can result in few, if any, countermeasures being taken in design to prevent or to minimize contamination.

The other view could presume that any degree of exposure of the equipment will be severe, that the agent will be the most harmful and longest lasting, and that the contaminant will be absorbed, adsorbed, and retained, and will penetrate into interior spaces, unless every conceivable area of retention or avenue of entrance is eliminated or shielded. This view can result in over-design with potentially adverse effects on the primary function of the equipment.

The first view is unacceptable under the current doctrine of the U.S. Army, and the second is impractical. The designer must elect some less extreme view that results in the best protection against contamination commensurate with the functional requirements of the equipment. It is not the intent of this handbook to suggest tradeoffs between anti-contamination design and functional design, but rather to suggest alternatives that the designer may consider. That the designer may have some appreciation of the importance of preventing contamination, a general description of contaminants is provided in Appendix A.

Decontaminants are substances that remove, absorb, or detoxify NBC agents. They include liquids, slurries, and powders. No one decontaminant is entirely effective against all NBC agents, and some decontaminants are more effective against some agents than against others. Therefore, and because it is impossible to predict the type or category of agent that will be encountered, equipment and vehicle decontamination design cannot be based upon the probable use of any one decontaminant. Rather, the designer must be aware of the natures and properties of the range of decontaminants that may have to be used, and he should take these into consideration wherever practical - particularly when selecting materials of fabrication. A variety of decontaminants (such as those listed in Appendix A) must be considered primarily as field expedients, not because of their effectiveness against certain agents. If the standard decontaminants (DS2 and STB) are not available, most of the decontaminants listed in Appendix A will not be used.

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Decontamination, within the context of this handbook, means the reduction of hazards from NBC agents that have adhered to or entered a piece of equipment, a vehicle, or some part thereof. It may include the complete detoxification of agent, the removal of all agent from the equipment, or the reduction of the amount of active agent to a safe quantity by detoxification or removal.

Decontamination may be accomplished by reacting the NBC agent with a chemical that neutralizes or destroys it; by diluting or dissipating it; by absorbing it with disposable materials; by flushing, brushing, or wiping it from contaminated surfaces; or by heating it to degrade or destroy it. Moreover, decontamination will occur naturally with time, particularly when the contaminants are chemical agents, as the agents degrade, evaporate, or dissipate under the influence of sunlight, elevated temperatures, air currents, and precipitation. However, decontamination is always a problem in that it requires time and resources and removes the equipment or vehicle from use until the decontamination process has eliminated the contaminant or reduced its hazard to an acceptably low level. Therefore, from the standpoint of decontamination efficiency and effectiveness, the best design is the one that minimizes the need or the effort required for decontamination.

Such design can be effected by eliminating surface configurations and crevices that may trap or retain contaminants and by not using materials that absorb contaminants or that react adversely with decontaminants. When contaminants cannot be prevented, good decontamination design will provide adequate access to areas susceptible to contamination. Unless such access is provided, decontamination will be difficult, and in some cases it will be impossible. Access to areas where dust, dirt, mud, or grime may accumulate is particularly important. Biological agents can survive in such areas for weeks or months.

4.2 Potential Effects of Using the Guidelines

If the suggestions in these guidelines are followed, the affected items will be easier to decontaminate or will be less susceptible to serious contamination. These are desirable design effects from the point of view of operating personnel, inasmuch as the hazard from exposure to NBC agents will be reduced.

However, following these guidelines may have other, less desirable effects on costs, maintainability, and effectiveness. For example, providing sealed enclosures on the outside of a vehicle for tool storage will prevent contamination of the wooden handles on the tools, but may also increase the overall cost of the vehicle, make the tools less readily accessible, and (depending upon the location of the enclosure) interfere with normal procedures and make access to other areas of the vehicle more difficult.

The designer, therefore, must consider all of the potential effects of a suggestion and then choose the approach that is most feasible in light of the specific cost and functional constraints imposed upon the design. Moreover, it must be pointed out that the suggestions in these guidelines are based upon a study of contamination problems and not upon the consideration of design practicality.

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4.3 Layout of the Handbook

In addition to this introductory section, the handbook consists of two sections dealing with design. Each of these sections illustrates (1) features that, if used, may increase the likelihood of contamination, contribute to the severity or duration of contamination, or make decontamination difficult, and (2) suggestions for modifying those features to minimize contamination by NBC agents and to increase the ease and effectiveness of decontamination processes. It should be noted that some of the suggested solutions, such as using a strip-pable sealing compound, may not be entirely feasible within the current state-of-the-art.

The first section, General Design Criteria, illustrates general basic construction techniques that may or may not be used in presently fielded military equipment or vehicles. These include features that are undesirable with respect to the contamination/decontamination problem as well as features that are similar but more desirable. None have been considered with respect to the functional military use of the structures in which they may be applied. The designer must decide whether a more desirable feature or configuration can be incorporated into the hardware he is designing.

The second section illustrates items that are used on currently operational military equipment. For the most part, these items represent potential problems because they either are susceptible to contamination or are difficult to decontaminate.

These guidelines were developed by examining many pieces of military equipment, including tanks, missile launchers, trucks, and helicopters. Overview photographs of most of this equipment are included in Appendix C of these guidelines. Each specific item, such as a seat, that poses a contamination or decontamination problem is illustrated by a photograph in the Design Guidelines section, and each item is identified as to its source, such as the M60 tank or the M886 ambulance. Although an item may be shown as it is used on a specific piece of equipment, it sometimes may be found on other equipment as well. For instance, a door handle shown as it is used on one truck may also be found on other trucks. But that particular handle will be shown only once in these guidelines because the purpose here is to illustrate representative features that have been incorporated into equipment rather than to treat exhaustively any one feature or any one piece of equipment.

5. DETAILED REQUIREMENTS

5.1 General Design Criteria

In general, any feature that can trap or retain a solid, liquid, or gaseous material represents poor design with respect to contamination and decontamination. Such features not only tend to hold contaminants - and thus represent potential hazards to personnel - but also are difficult to clean adequately. Crevices where hatches meet deckplates, exposed springs connected to hatch

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covers, and restricted areas under tie-downs are representative of entrapment and hard-to-clean features. Anything that can be done to eliminate or to reduce the number of such features will improve the overall decontamination design of the equipment.

Present designs frequently incorporate canvas, elastomeric materials, and paints that absorb contaminants. If canvas must be used, the item should be designed so that the canvas is easily removable with a minimum of handling. If absorbent elastomers must be used, they should be shielded to the greatest extent possible from contaminants; alternatively, they should be incorporated as easily replaceable items that can be removed and discarded with a minimum of contact by personnel. If surfaces must be painted, chemical-agent-resistant coatings should be used (see Appendix B). Such paints can also be used to seal small crevices and capillaries under fasteners. In short, materials that absorb contaminants should not be used. If they must be used, they should be designed as disposable items and made easily removable. If they cannot be made disposable, they should be shielded to the greatest extent possible.

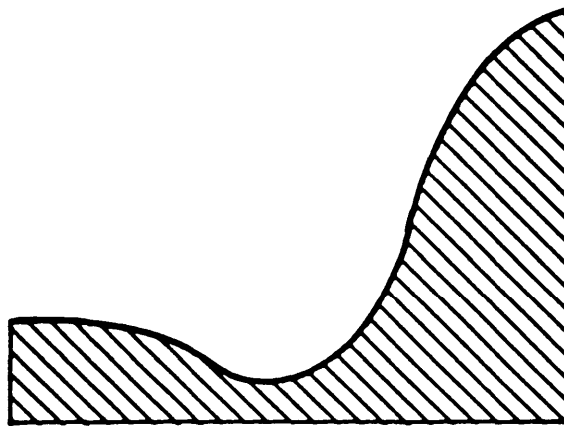
Non-absorbing seals and sheaths, metal covers, and wider spacing between adjacent parts may be used to improve the overall decontamination design, but they must be used with care to ensure that the intended effect is realized without introducing a problem of equal or greater magnitude - either from the standpoint of contamination or of function. For example, eliminating a concave surface may eliminate a contaminant trap, but if the function of the concavity is to deflect bullets or shrapnel, its elimination is not feasible. Rather, the surface must be designed for its functional purpose, and its configuration should be adjusted to the greatest extent feasible to make it less of a trap and to make it easier to clean.

The following pages in this section illustrate general features that have been observed in the field on numerous items of military equipment. Opposite each page that shows an undesirable configuration is a page showing a suggested modification that will reduce the contamination problem and that will facilitate decontamination.

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GENERAL DESIGN CRITERIA

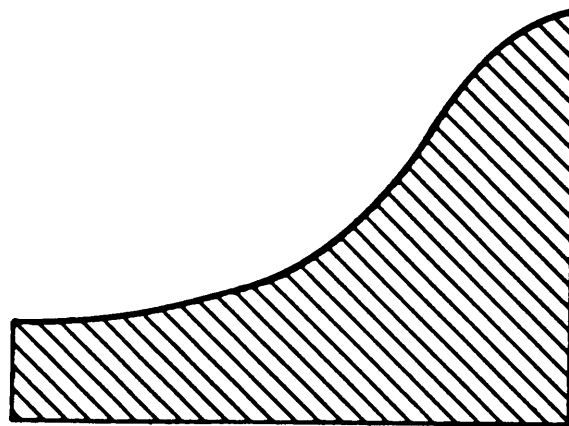
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CONCAVE SURFACE

Configuration with deep concavity traps liquids and solids, prevents runoff during decontamination. The deeper and narrower the concavity, the greater is the possibility that contaminating agents will be trapped and retained and the more likely that chemical decontamination will be totally ineffective.

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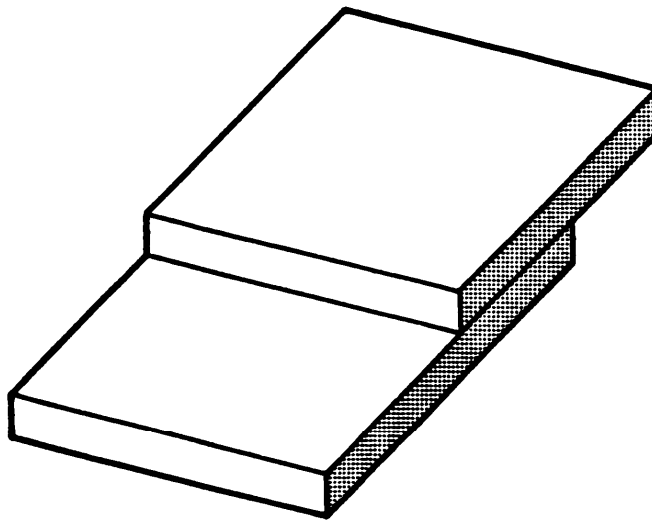


CONCAVE SURFACE

Eliminating the concavity, making it shallower or wider, filling it with a nonabsorbent material,* or shielding it will prevent entrapment of contaminant and will increase the effectiveness and efficiency of the overall decontaminating process.

*See Appendix B.

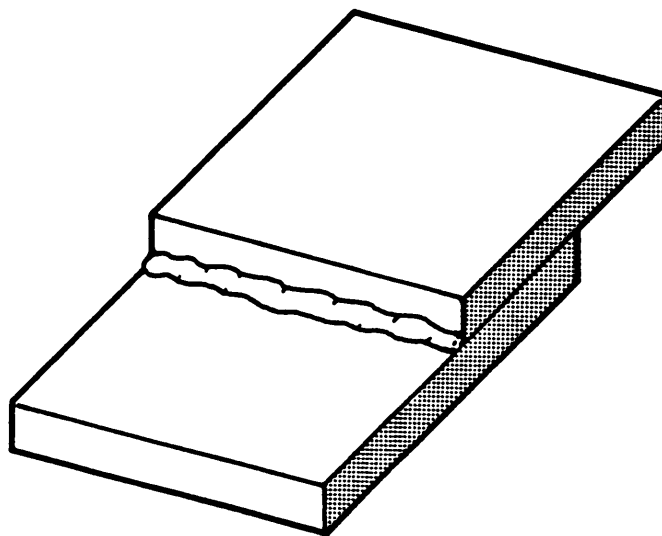
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LAPPED SURFACE

Lapped surfaces are typical of sheet-metal panels, cabinet walls and doors, compartment covers, and some deck plating. The lapped items may be bolted or riveted together, or one may merely be laid atop the other. Such a configuration results in a crevice between the sheets that can trap contaminant and that is impossible to decontaminate without removing at least the top sheet.

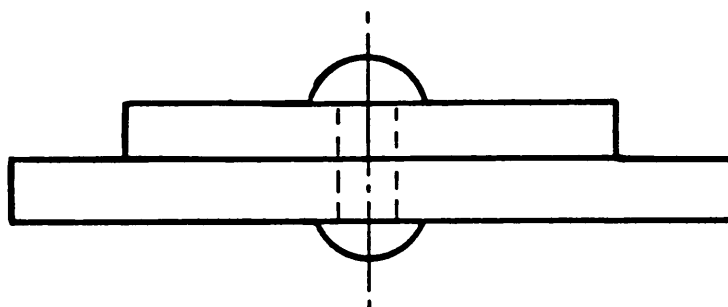
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LAPPED SURFACE

If one item must be lapped over another, the top item should be made easily removable to facilitate decontamination. Alternatively, the crevice between the items should be sealed by welding if the installation is permanent. Otherwise, the crevice should be sealed with non-absorbent paint or a strippable sealing compound,* as shown; or a preformed seal should be incorporated in the lower surface of the upper sheet, near the edge which forms the crevice.

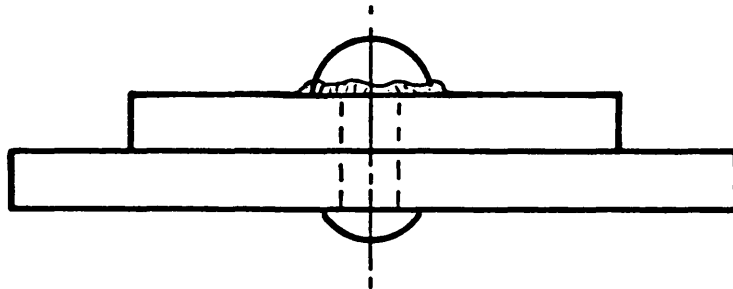
*See Appendix B.

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PERMANENT FASTENER

Permanent fasteners, such as rivets, may loosen due to vibration, working of the fastened panels, or faulty installation. Contaminant can be drawn into the capillary under the fastener head and even along the shank into interior spaces. Decontamination by chemical means is impossible.

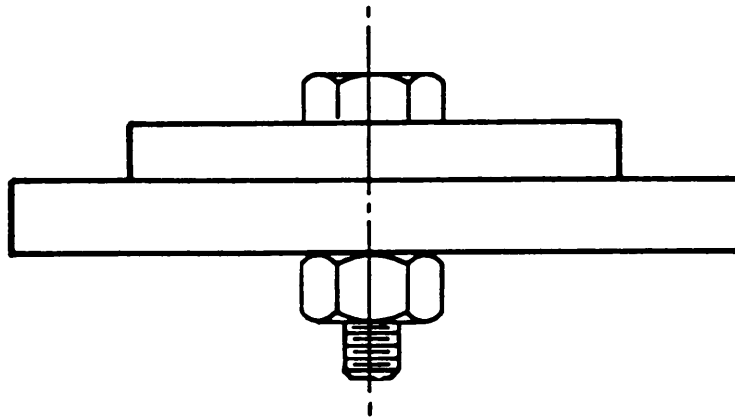
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PERMANENT FASTENER

Wherever feasible, permanent fasteners should be eliminated by using one-piece constructions or by welding. Otherwise, installed fasteners should be sealed by non-absorbent paint or by strippable, disposable coatings.* Although these latter techniques come more under the purview of maintenance than of design, they should be called out in design specifications and used initially in the construction and final assembly of the equipment.

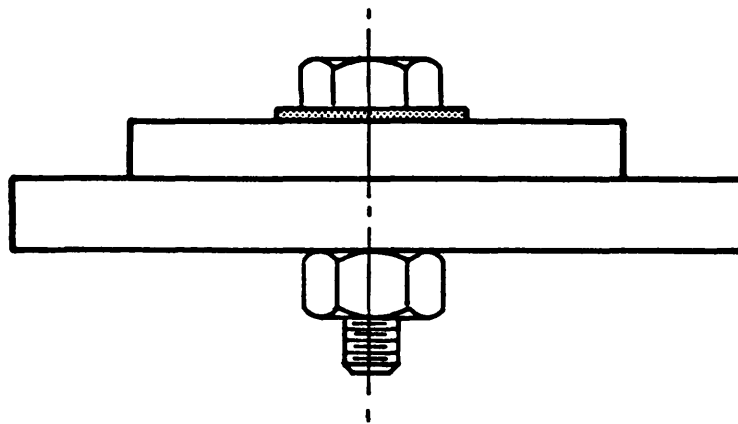
*See Appendix B.

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REMOVABLE FASTENER, PROTRUDING

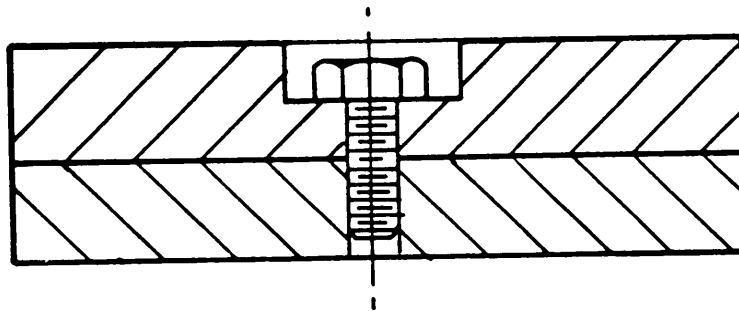
Removable fasteners work loose during equipment operation and are frequently lost and not replaced in the field. Contaminants can be drawn under the fastener head and into the bolt hole. When the hole is threaded--and especially when it is a tapped, blind hole--decontamination by chemical means is difficult if not impossible.

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REMOVABLE FASTENER, PROTRUDING

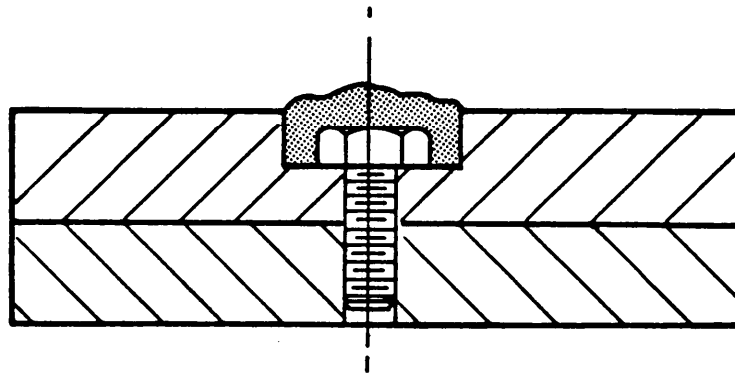
For some uses, a seal or flexible metal washer can be installed under the fastener head, as shown, to prevent the entrance of material into the bolt hole and to help keep the fastener tightly in place. However, this is not a universally practical solution. Other alternatives are to make the fastener easily removable, and to provide access from both ends of the bolt hole (eliminate blind holes) to make decontamination more effective. More permanent solutions include incorporating an O-ring seal into the under surfaces of the fastener head; eliminating the need for removable fasteners; and using quick-release fasteners to minimize the potential contact time during removal.

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REMOVABLE FASTENER, RECESSED

Recesses around fastener heads are impossible to decontaminate thoroughly without removing the item that contains the recess. Furthermore, a recess ensures that the fastener head is contaminated and may contribute to contaminant being drawn under the head of the fastener.

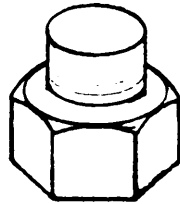
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REMOVABLE FASTENER, RECESSED

Wherever feasible, recesses should be eliminated and the bottom surfaces of fasteners made flush with the top surface of the fastened item. Or a metal cap, incorporating a seal, can be used to cover the recess. The recess may be filled with nonabsorbent sealer or filler,* which must be smoothed over to eliminate entrapment areas. With this latter approach, the filler must also be strippable or otherwise removable to allow access to the fastener head.

*See Appendix B.

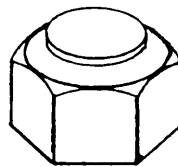
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REMOVABLE FASTENER, EXPOSED THREAD

Bolts, longer than their function requires, are used frequently, exposing various lengths of thread to contaminating environments. The thread grooves trap contaminant, particularly when they contain grease or dirt, and represent capillaries that can draw contaminant and decontaminant into nut recesses.

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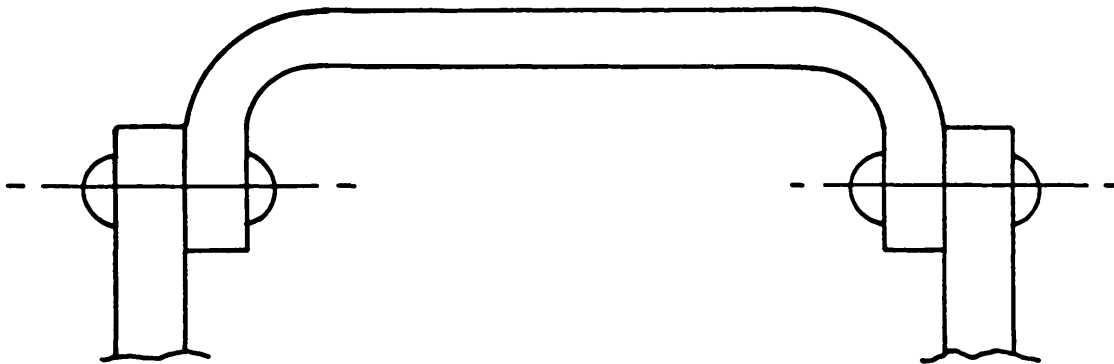


REMOVABLE FASTENER, EXPOSED THREAD

Bolt lengths should be specified to be as short as possible. To prevent access of contaminant, nuts should include an internal seal. Alternatively, the entire nut and the exposed end of the bolt can be covered with non-absorbent strippable sealant.*

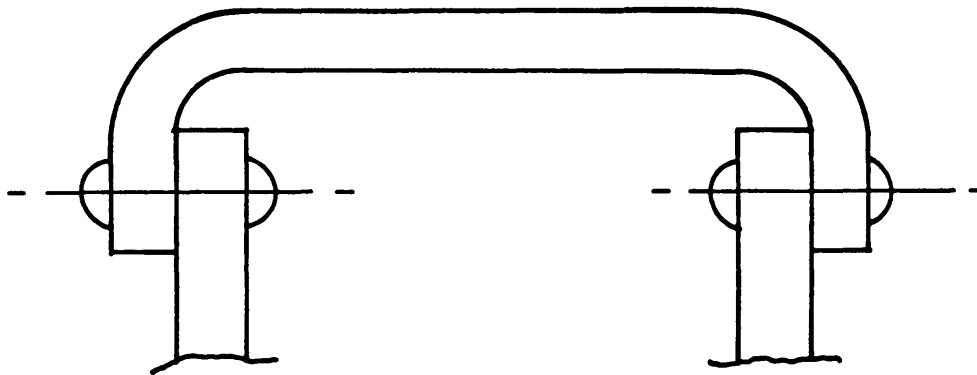
*See Appendix B.

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CLOSURE, COVER/CAP

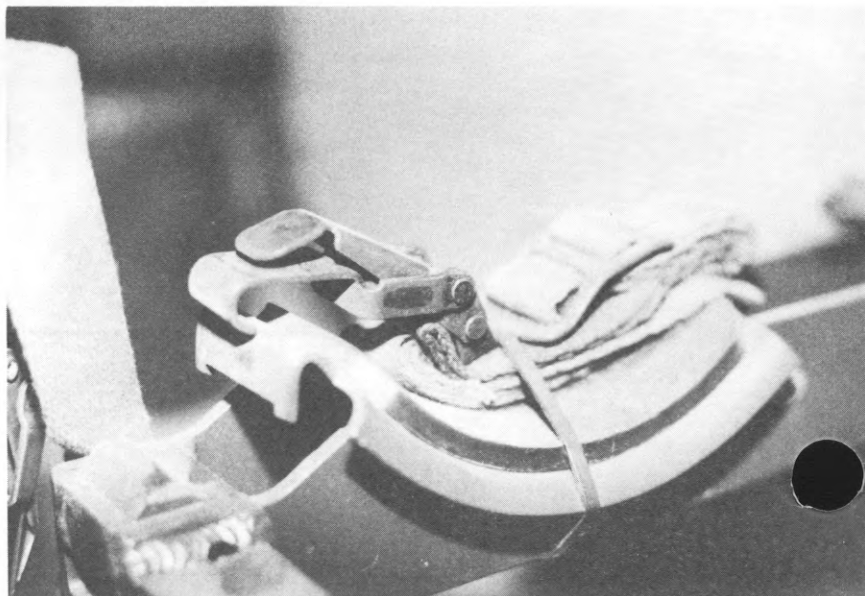
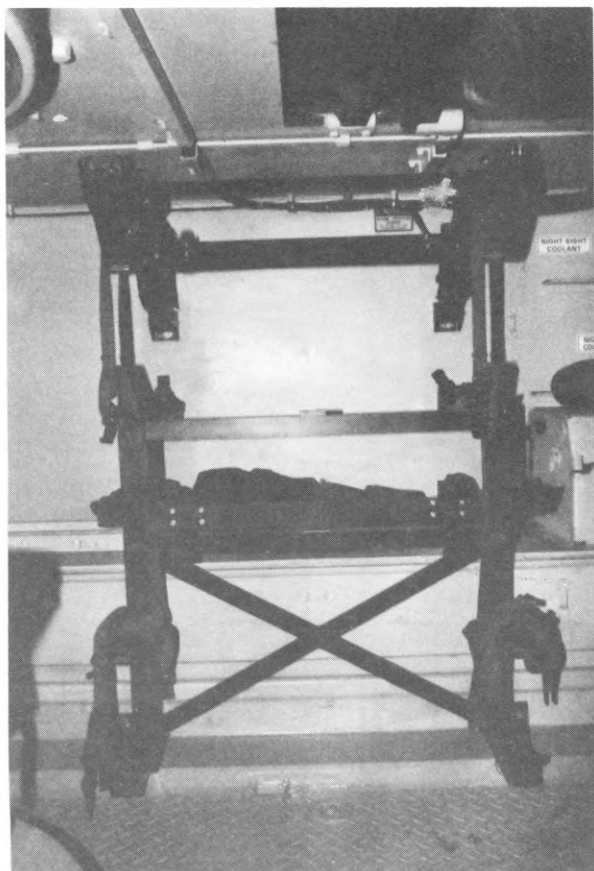
An inset cover may be bolted as shown, screwed in, or simply pressed into place, but regardless of how it is secured, the cap will allow contaminant and decontaminant to gravitate into the interface between cap and flange. If the interface is not completely sealed, material has access to the area under the cover.

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CLOSURE, COVER/CAP

If the inset configuration must be used, the cover-sidewall interface can be sealed with non-absorbent paint after the cover is installed, although this does not improve the basic design. A better approach is illustrated above. Overlapping rather than inseting the cover promotes runoff and makes the item easier to decontaminate. Furthermore, the exposed cover-sidewall crevice is eliminated. The design would be improved by not using through-the-wall fasteners and by incorporating a seal in the cover.

3. DESIGN GUIDELINES

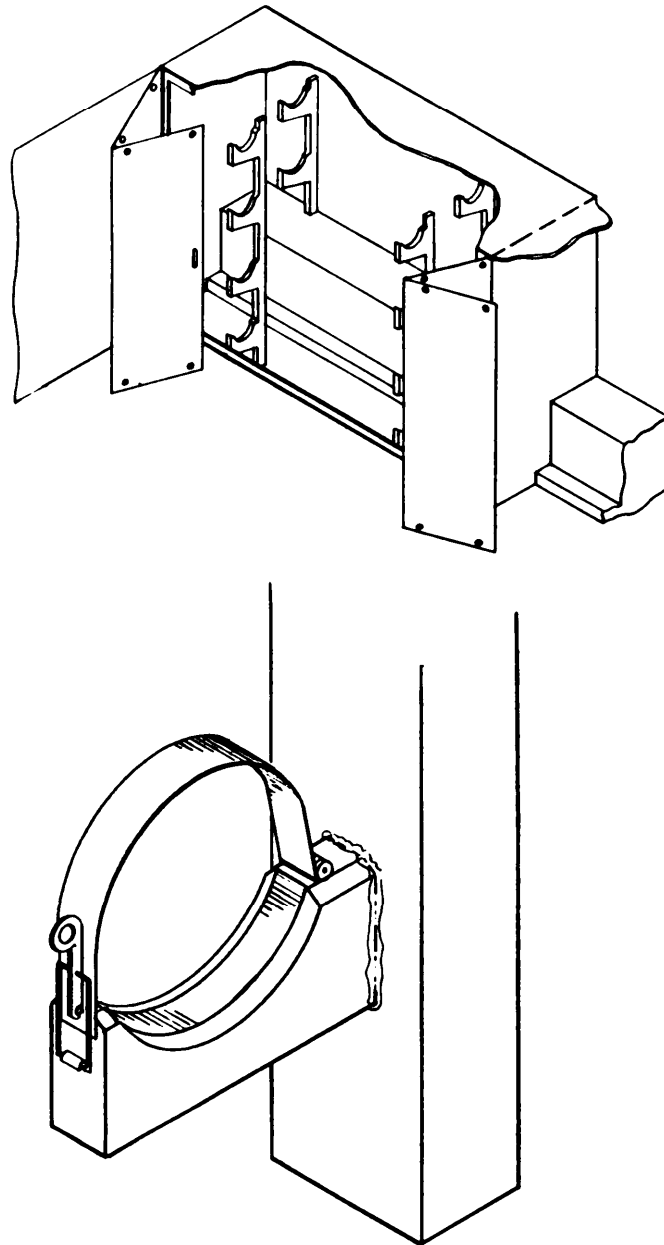


AMMUNITION HOLDERS

The rack for TOW missiles is exposed to contaminants, and canvas straps on the support brackets can absorb contaminants/decontaminants.

M113 Armored Personnel Carrier

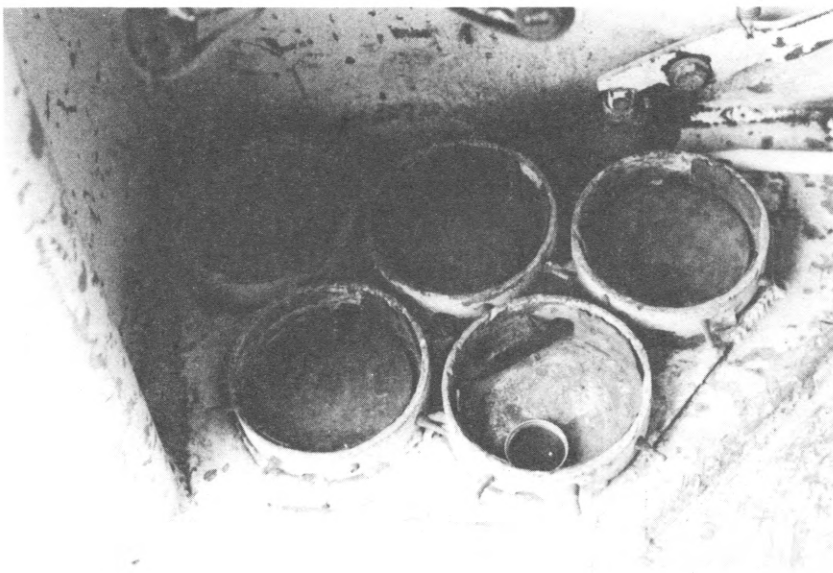
MIL-HDBK-784



AMMUNITION HOLDERS

(Top) A floor-to-ceiling sealed box protects rack and missiles. Folding doors minimize space requirements.

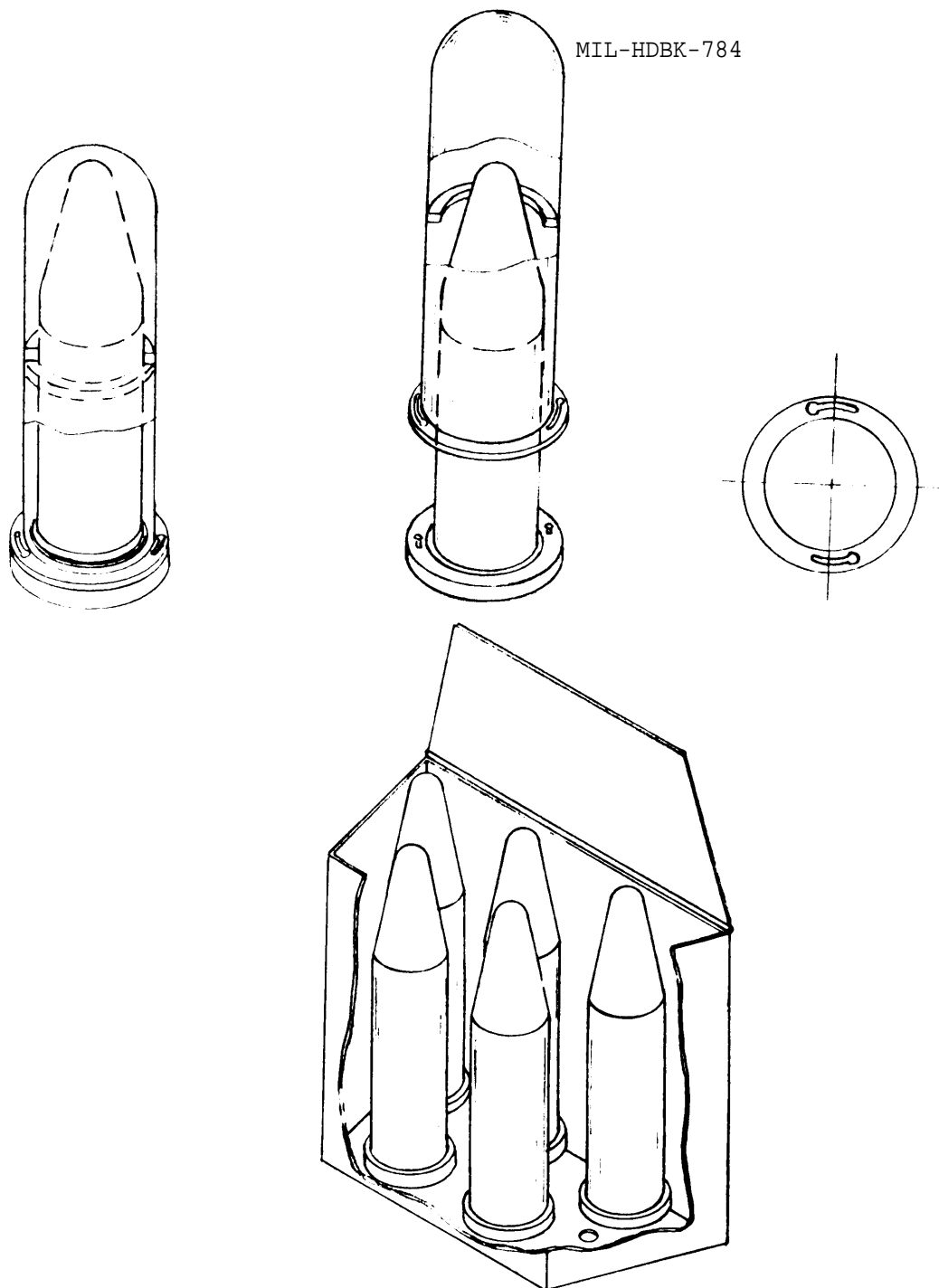
(Bottom) Alternatively, a spring-steel strap replaces canvas, attaching to a base welded to the post.



AMMUNITION HOLDERS

The holders leave shells exposed to contaminants and allow contaminants to mix with dirt.

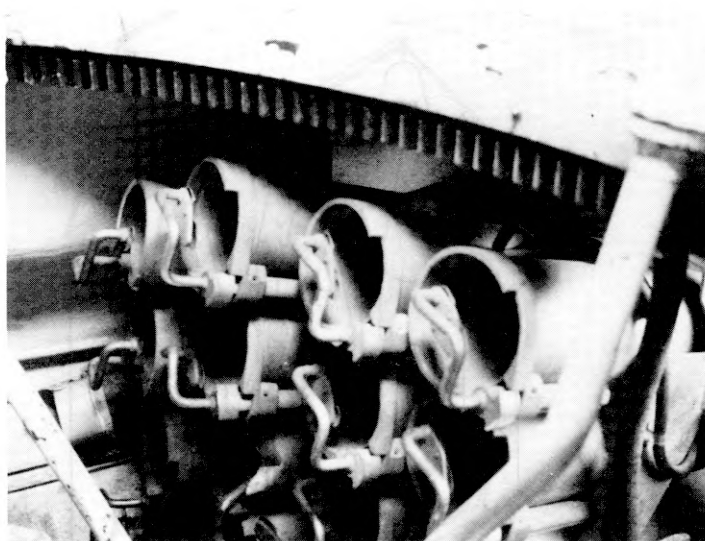
M109 Howitzer



AMMUNITION HOLDERS

(Top) Removable tubes protect shells from contaminants. The tube base attaches to slots in the floor base, and the grommet inside the tube holds the shell in place.

(Bottom) Alternatively, a sealed box protects the shells. The drain hole in the bottom facilitates decontamination.

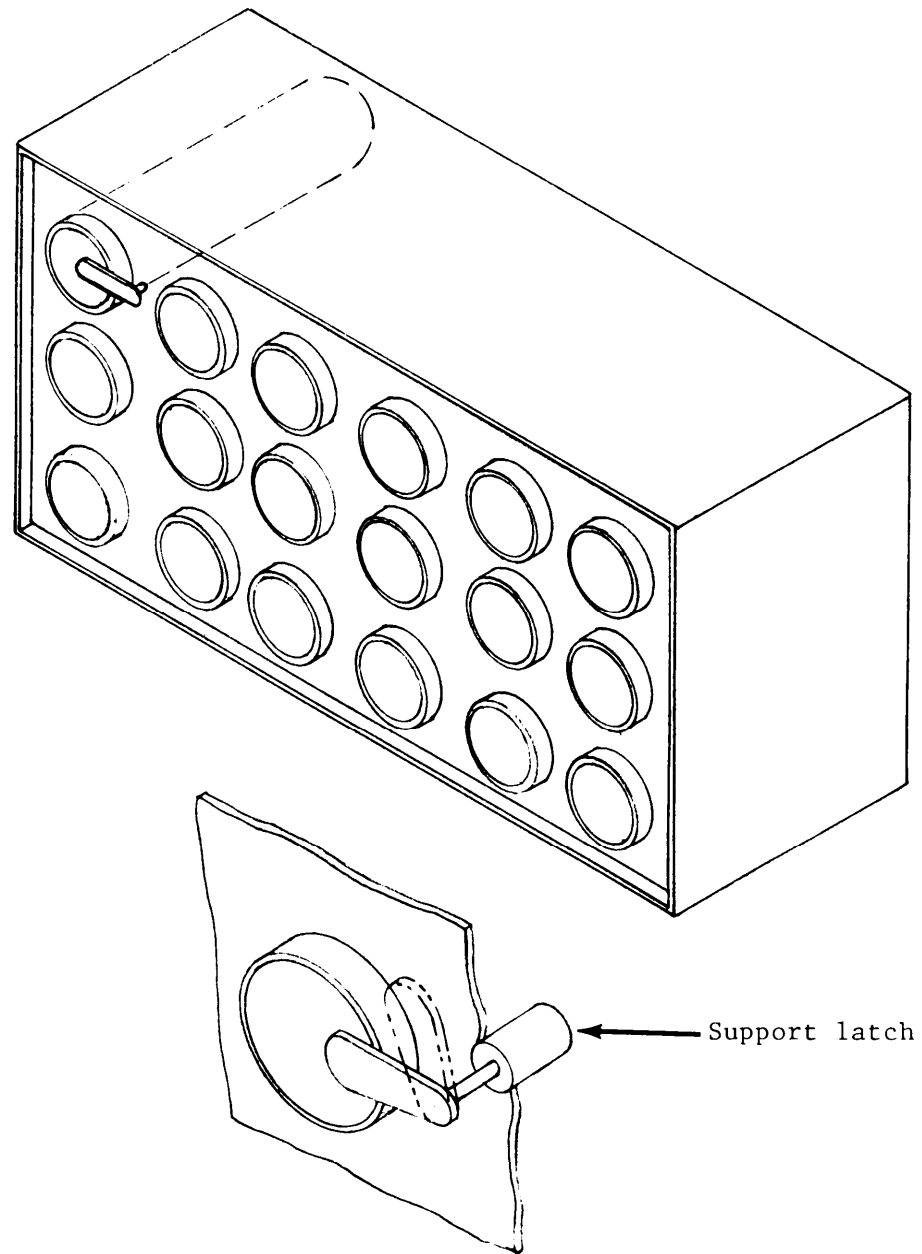


AMMUNITION HOLDERS

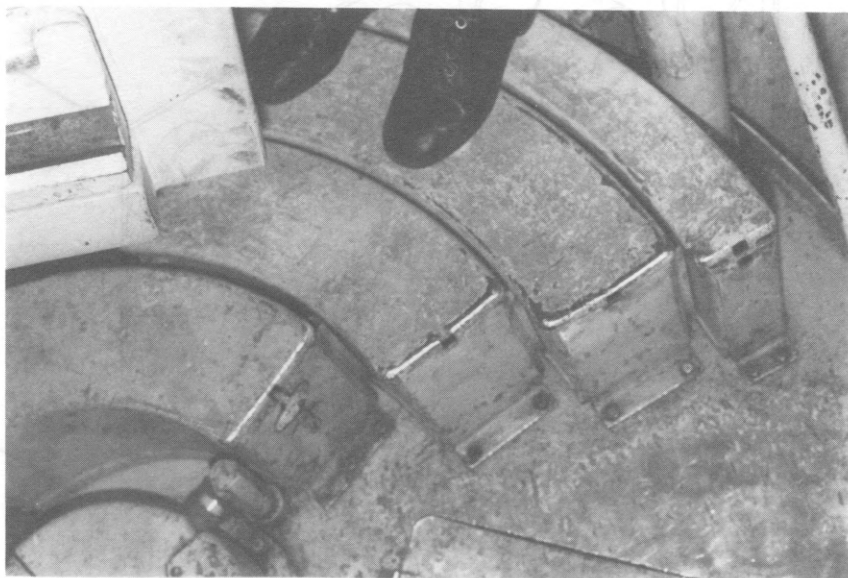
Decontaminant application and removal are difficult inside and between the shell storage tubes, particularly toward the rear of the tubes.

M60 Tank

MIL-HDBK-784

AMMUNITION HOLDERS

A box with built-in shell tubes allows quick access to and identification of shells while limiting exposure to contaminants. The support latch for each tube is sealed against contaminants. The box slants down at front to facilitate drainage.

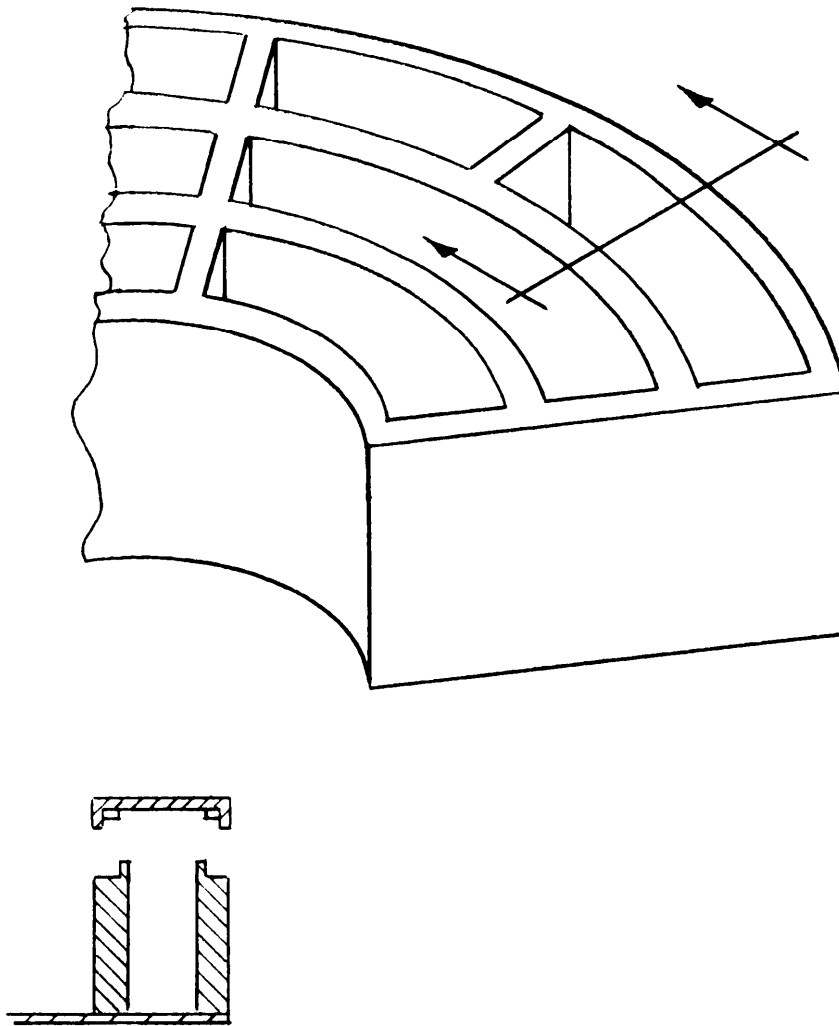


AMMUNITION HOLDERS

Separate containers create hard-to-decontaminate openings between the containers. In addition, the exposed fasteners can trap contaminants.

M60 Tank

MIL-HDBK-784



AMMUNITION HOLDERS

One large container, sealed to the floor, with several compartments eliminates the space between containers and the need for fasteners.

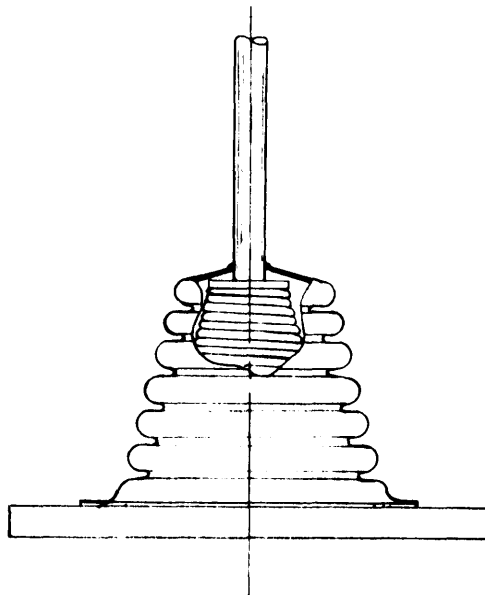
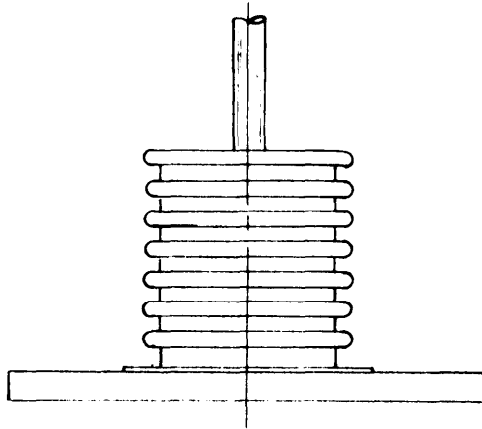


ANTENNAS

The support spring at the base of the antenna can trap contaminants and is difficult to decontaminate.

M88 Recovery Vehicle

MIL-HDBK-784



ANTENNAS

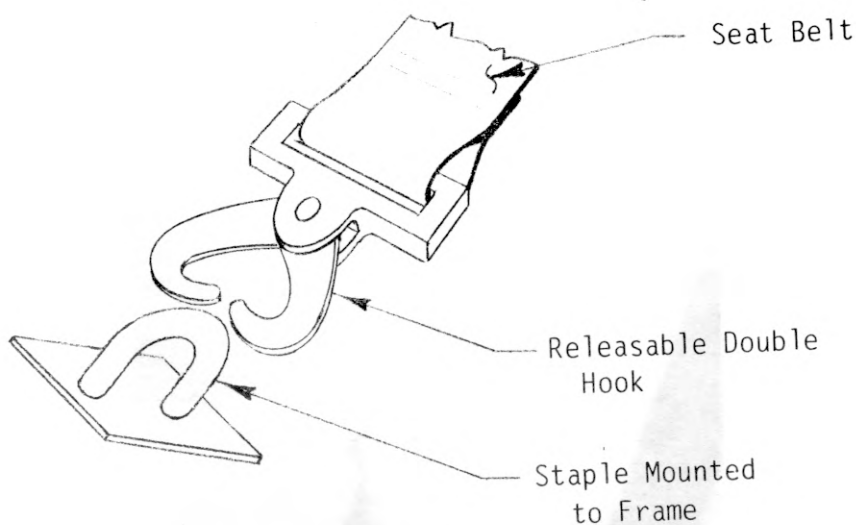
The spring is replaced with a metal bellows (top) or covered by a metal bellows (bottom), which seals the critical area and is easier to decontaminate.



BELTS

The seat belt absorbs contaminants and cannot be decontaminated in place. Moreover, fastened semipermanently to the frame of the vehicle, it cannot be removed easily for decontamination or disposal.

M886 Ambulance



BELTS

(Top) An easily releasable catch secures the seat belt to the vehicle frame and allows the contaminated belt to be removed with a minimum of handling.

(Bottom) Quick-release hooks anchor the seat belts to metal loops on the seat frames. The belts are easy to remove for disposal or decontamination. (UH-1H Helicopter)

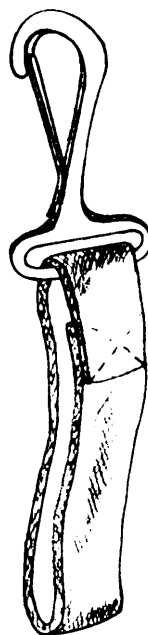
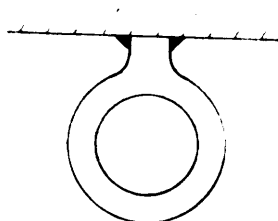


BELTS

Absorbent canvas strap on overhead door must be untied for removal.

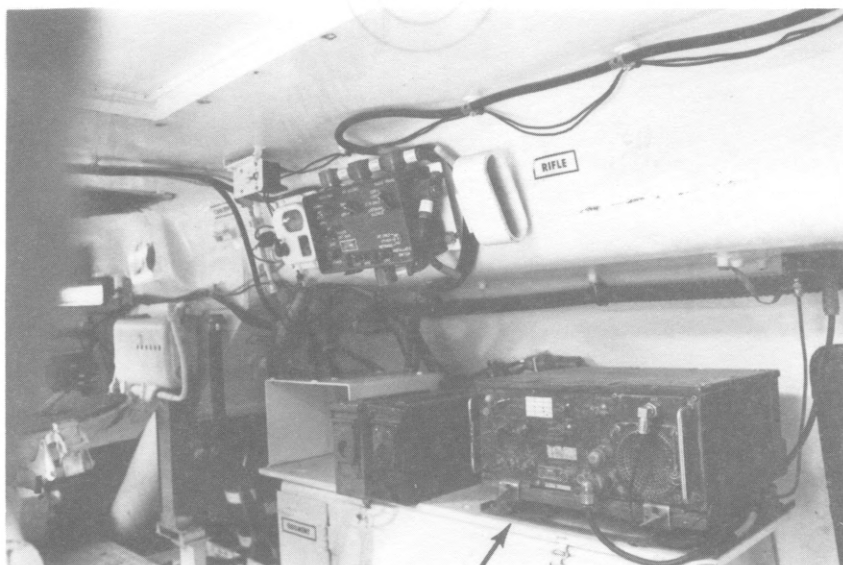
M113 Armored Personnel Carrier

MIL-HDBK-784



BELTS

Strap easily unclips from eyebolt for disposal, eliminating need to untie strap. This design is also applicable to seat belts.

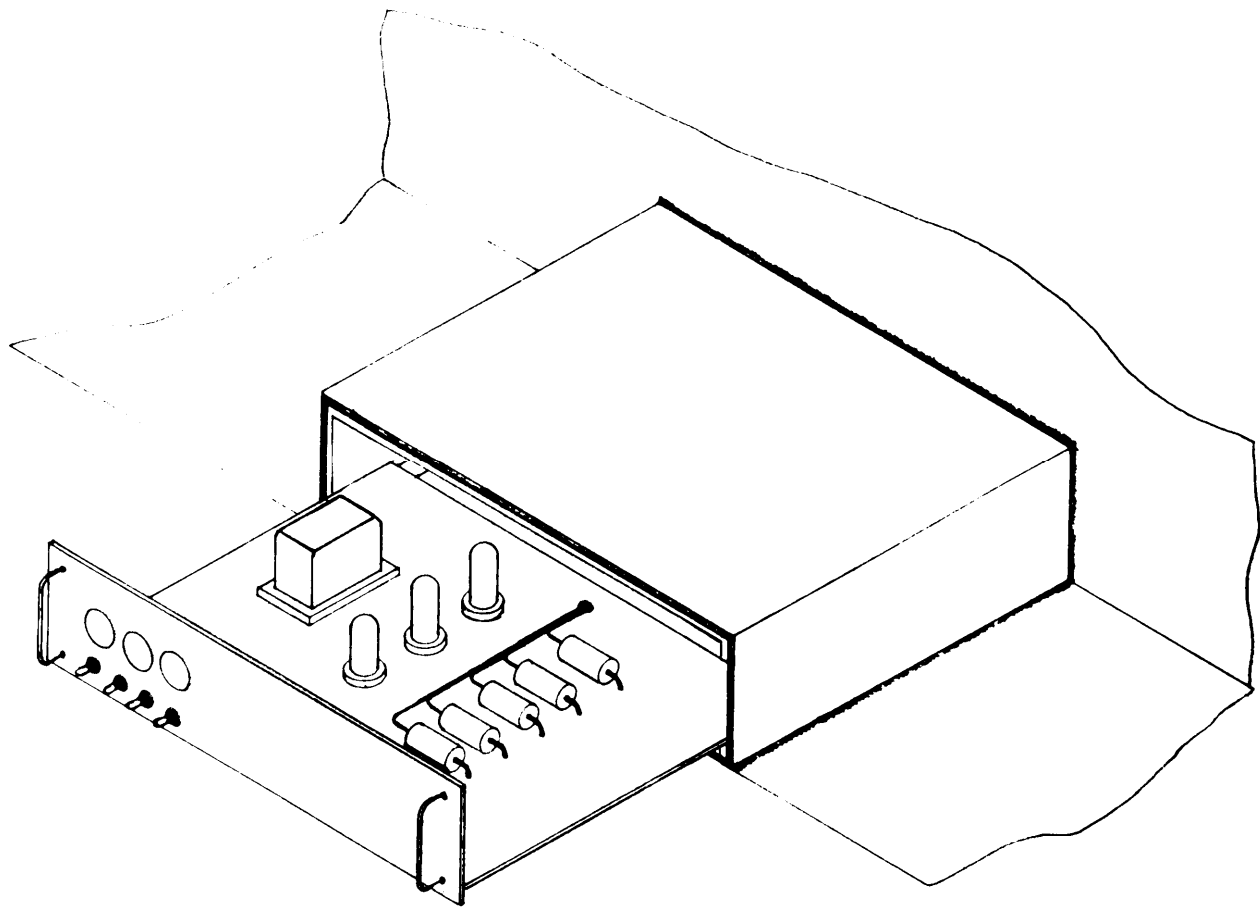


BOXES

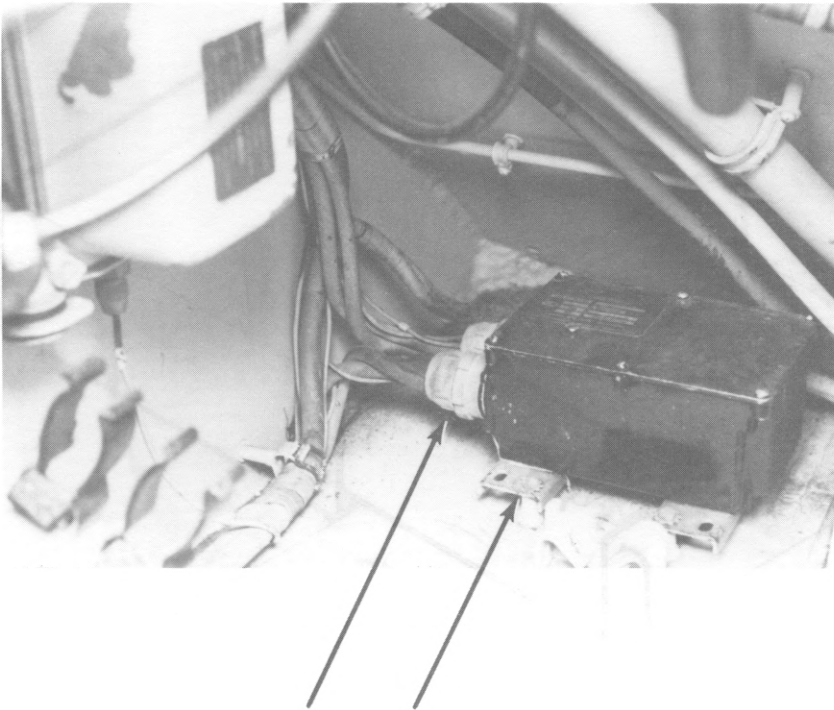
Electronic components may be adversely affected by contaminants or decontaminants. In addition, the mounting and placement of the components make decontamination difficult.

M88 Recovery Vehicle

MIL-HDBK-784

BOXES

A sliding chassis allows easy removal of electronics for cleaning, repair, or replacement. The housing is welded in place, preventing contaminants from being drawn underneath.

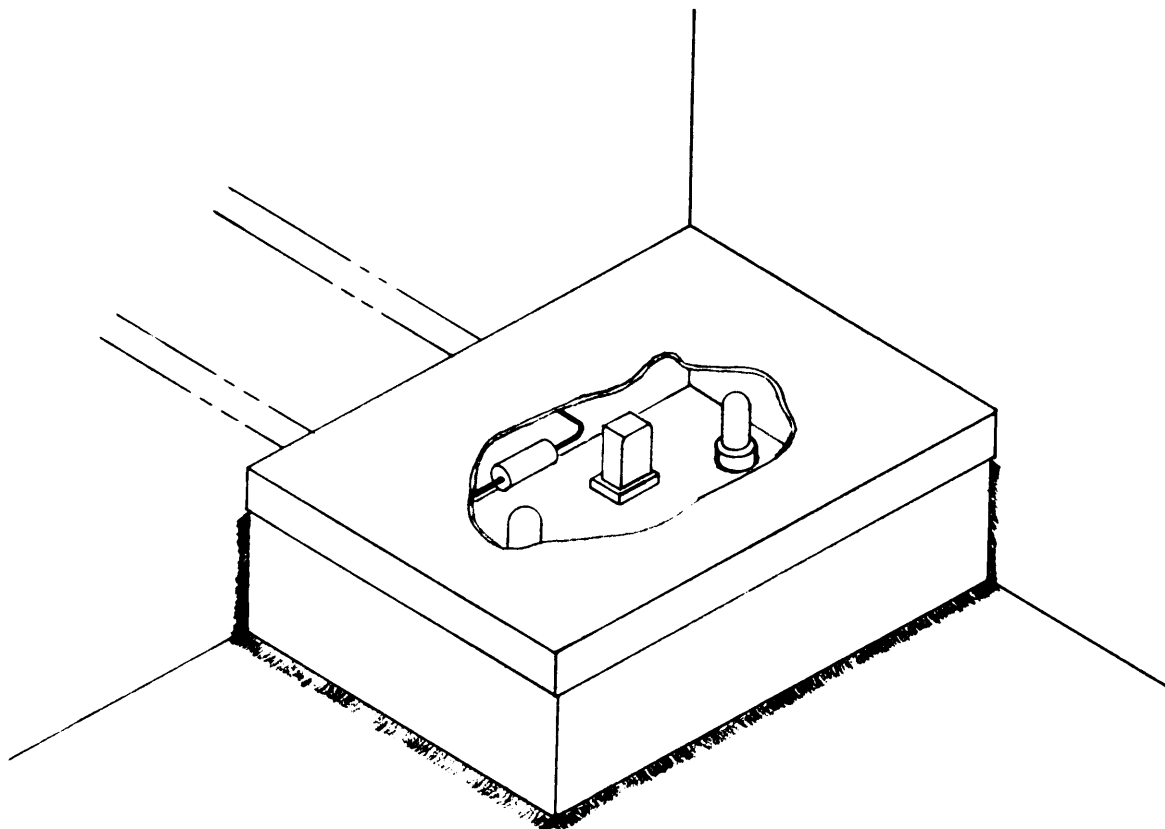


BOXES

Mountings and connections of the electrical box can trap contaminants and are difficult to decontaminate.

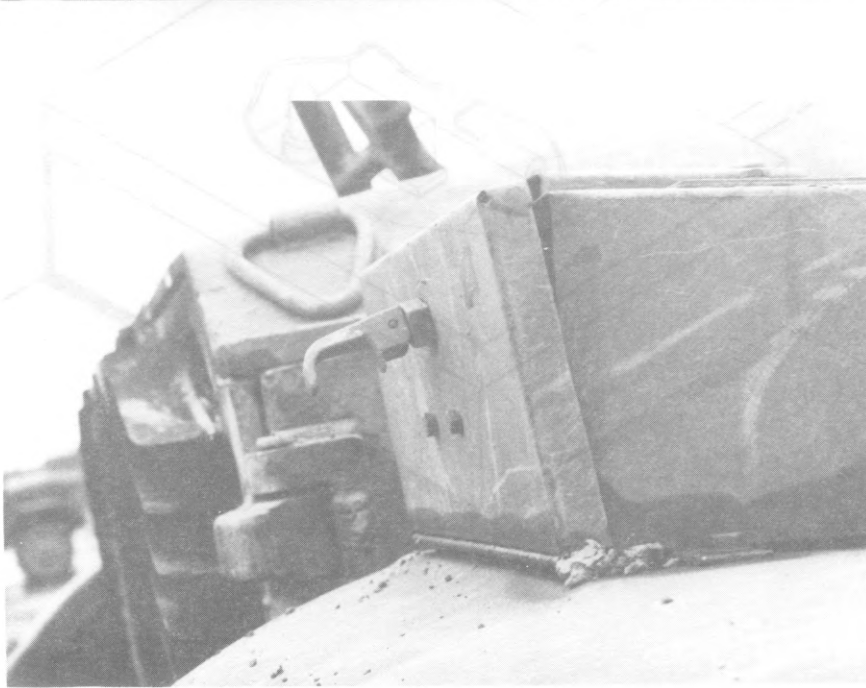
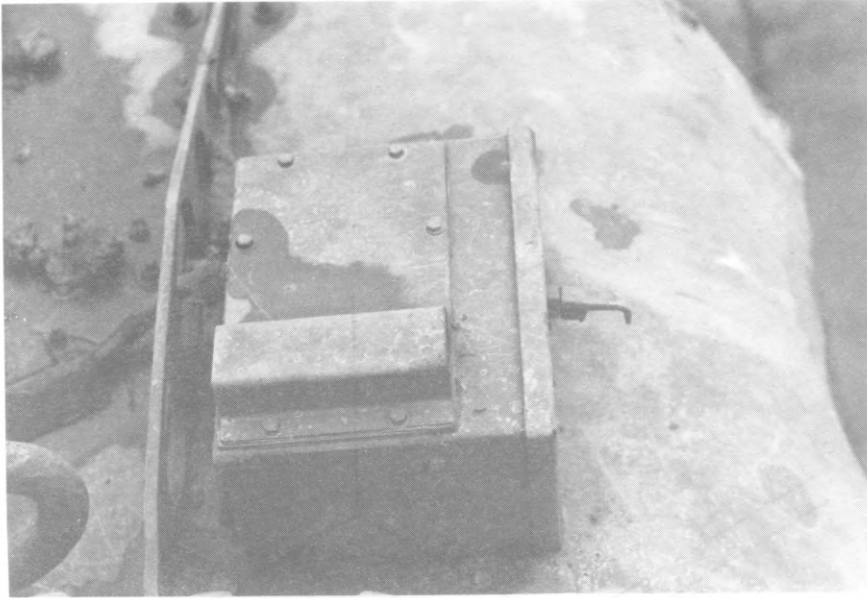
M113 Armored Personnel Carrier

MIL-HDBK-784



BOXES

A wall panel and/or conduit protects wiring, and a sealed box, welded to the floor, protects electronic components and connections. Electronic components are mounted on a removable chassis.

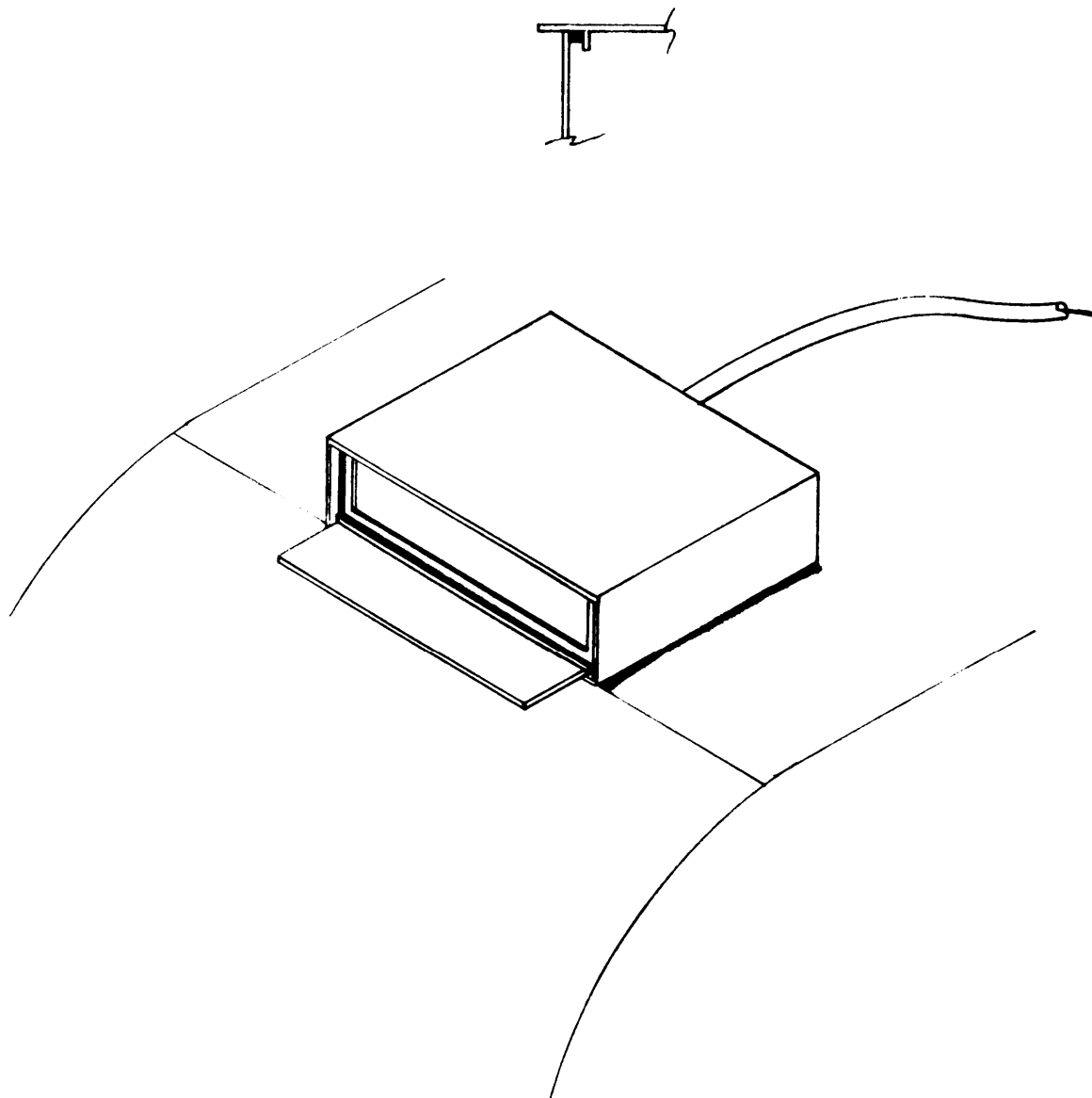


BOXES

The equipment box is bolted to the fender, leaving a difficult-to-decontaminate gap at the bottom. Also, the door overlap creates an entrapment area at the top and sides of the box.

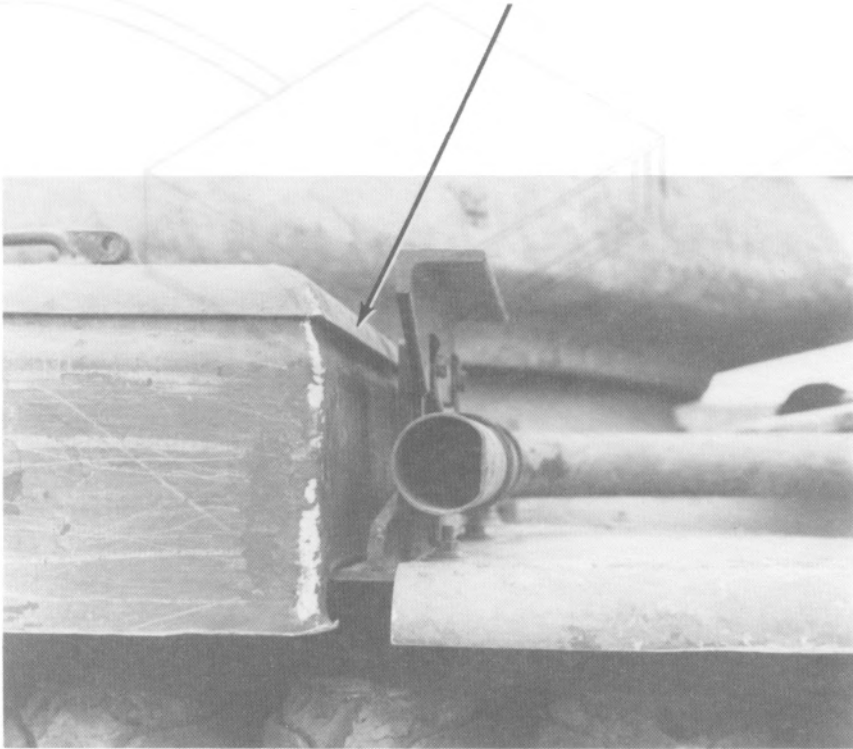
M60 Tank

MIL-HDBK-784



BOXES

Welding the box to the fender eliminates the trap beneath the box. In addition, the cover sets in against a seal, preventing the entrance of contaminants.

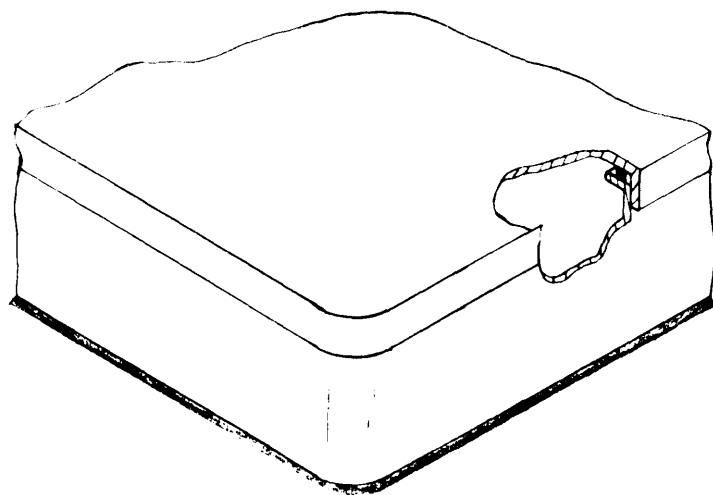


BOXES

Sloped-in sides on the toolbox result in an overhang between the lid and walls, allowing contaminant entry. In addition, the box is bolted to the fender, leaving a gap underneath.

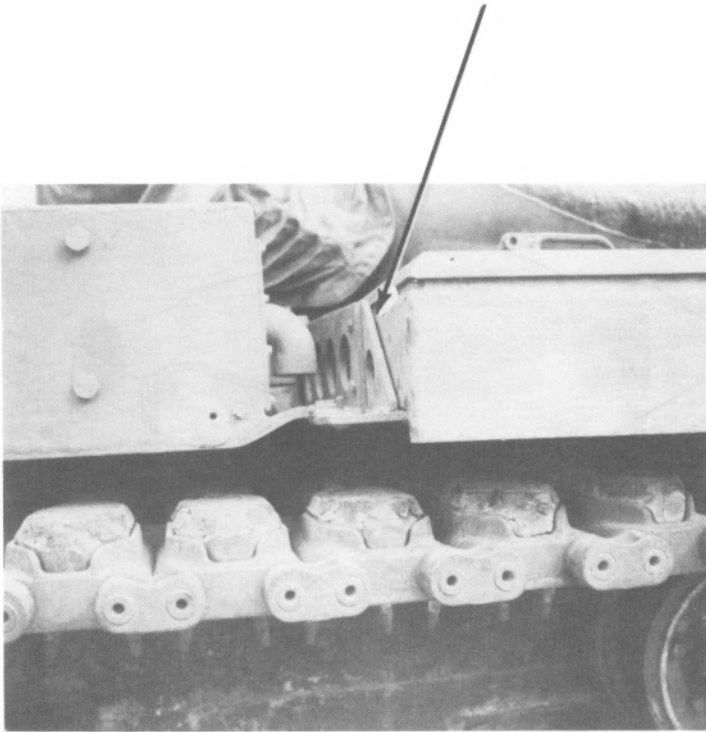
M60 Tank

MIL-HDBK-784



BOXES

Straight sides on the box, an overlapping lid, and a seal on the side flanges prevent contaminant entrance. In addition, welding the box to the fender eliminates an entrapment/hard-to-decontaminate area.

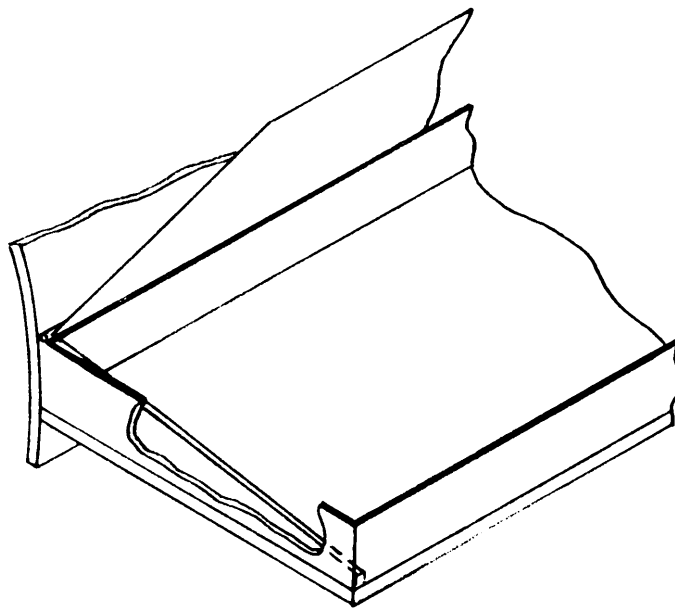


BRACKETS

The fender brace is close to the side of the toolbox, leaving a crevice between the brace and the box. In addition, the holes in the brace result in a complex surface exposed to contaminants.

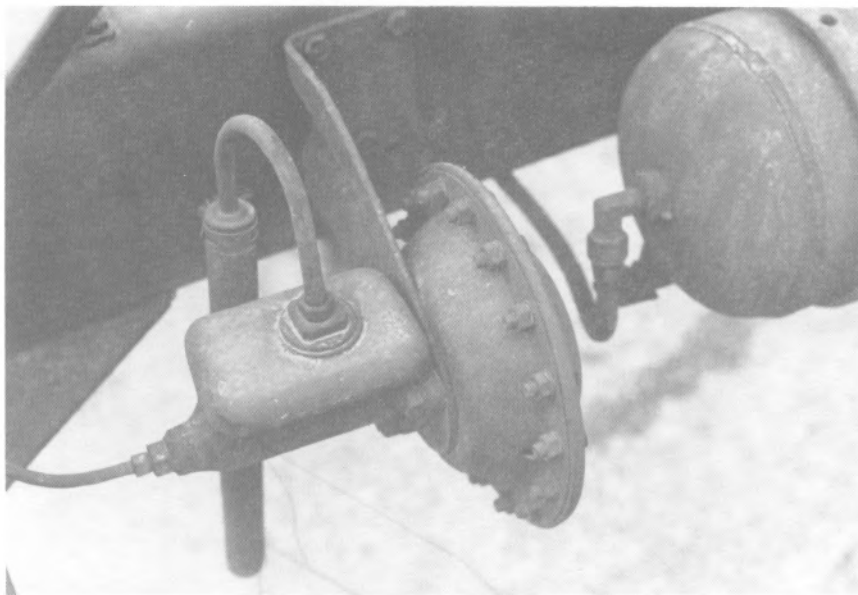
M60 Tank

MIL-HDBK-784



BRACKETS

Incorporating the fender brace into the container, either as a separate support member inside the box or as a sidewall of the box, eliminates the entrapment area and makes the exterior of the vehicle easier to decontaminate.

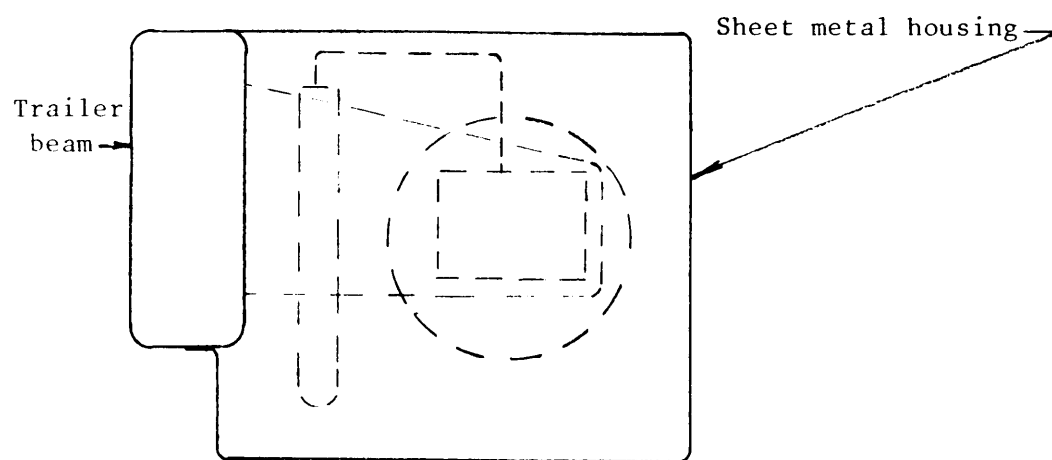


BRACKETS

Brackets and fasteners have many exposed areas that can trap contaminants and are difficult to decontaminate.

Diesel Generator

MIL-HDBK-784



BRACKETS

A sheet metal housing shields the areas from contaminants.

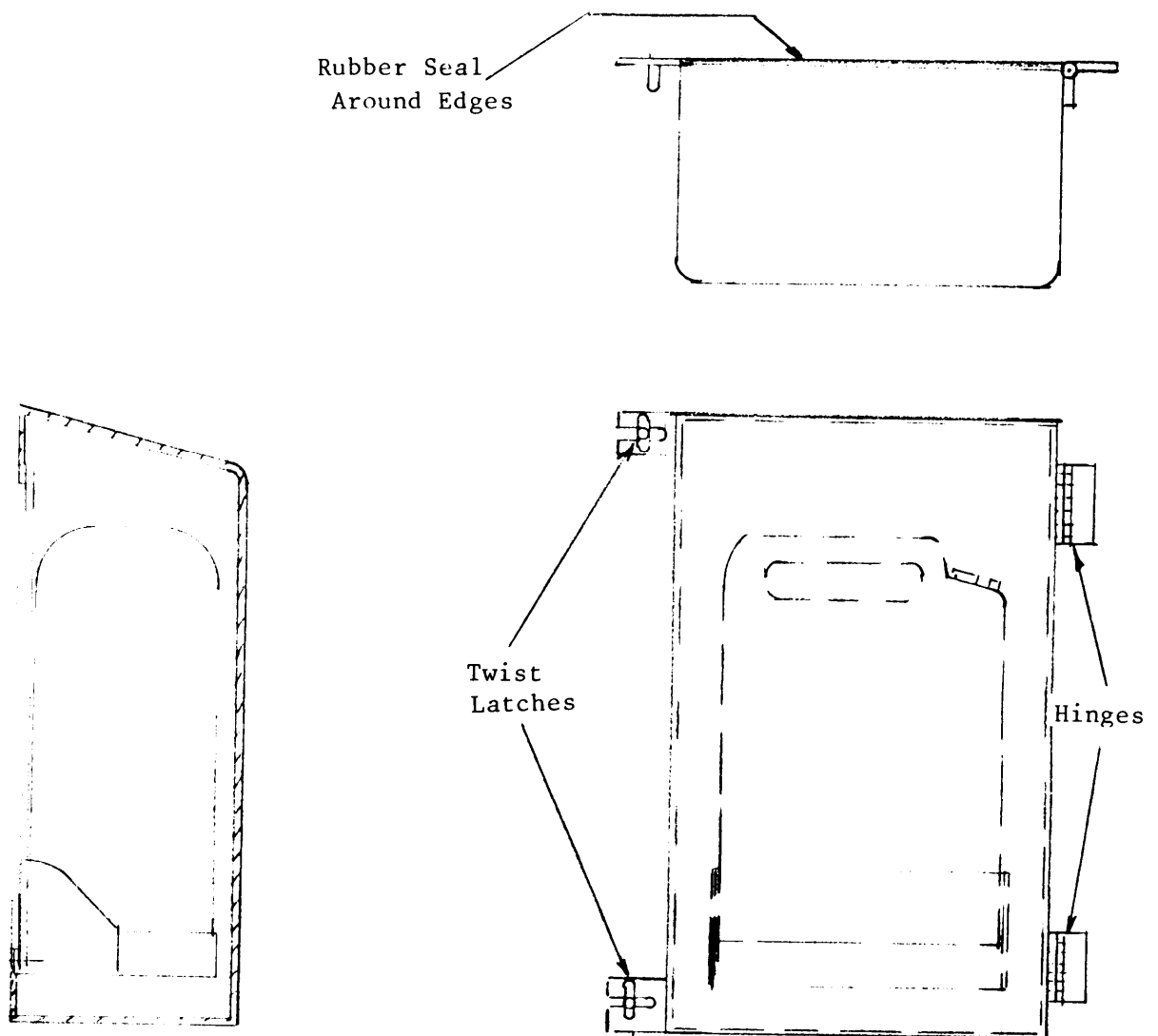


BRACKETS

External stowage exposes the jerrycan to airborne contaminants.

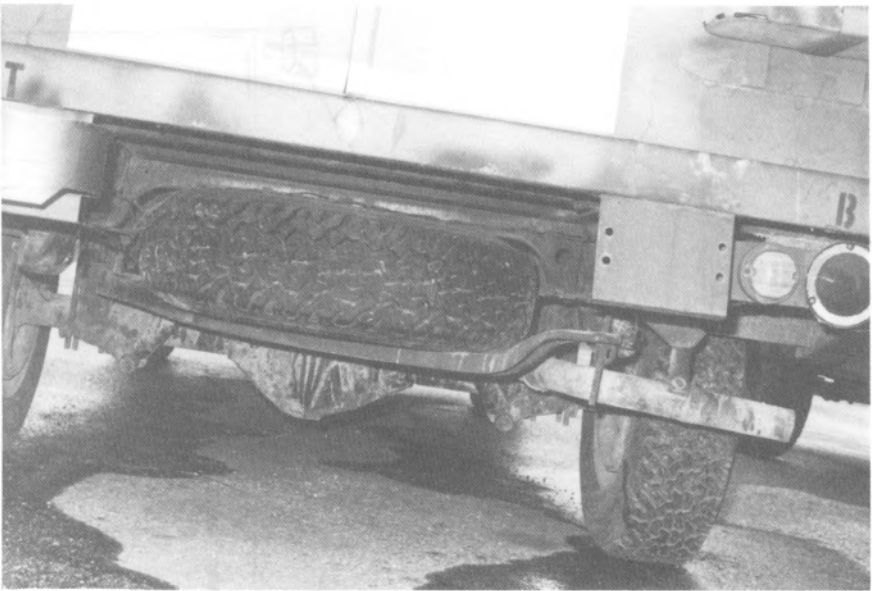
M886 Ambulance

MIL-HDBK-784



BRACKETS

Enclosing the jerry can and stowage rack with a sealed, hinged cover prevents contamination.

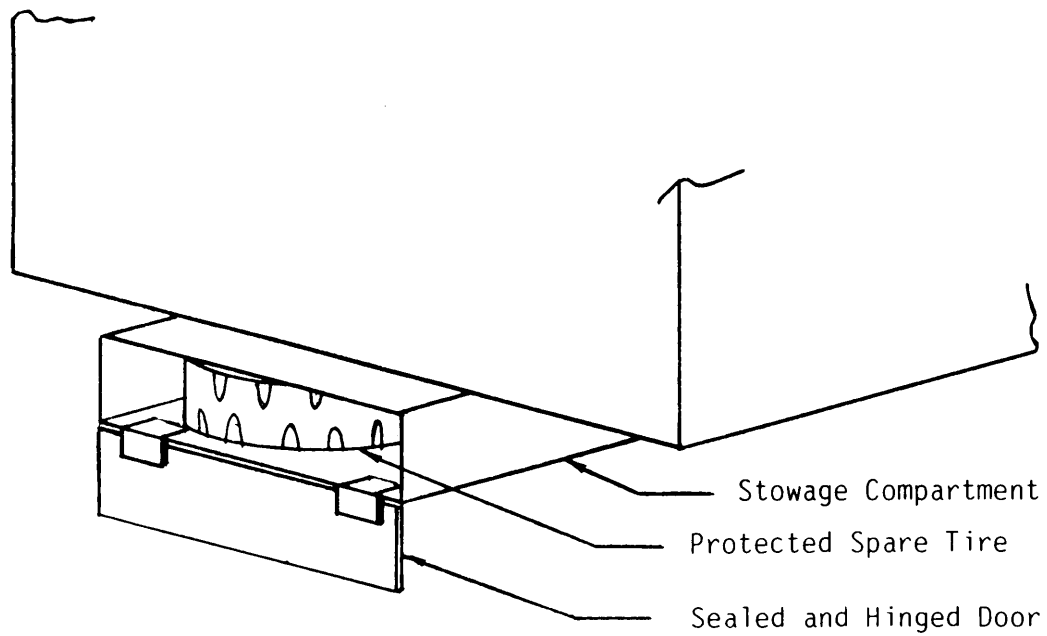


BRACKETS

Spare tire is exposed to contaminated dust and vegetation, cannot be decontaminated in place, and cannot be removed by personnel for use or for decontamination without contaminated surfaces being contacted.

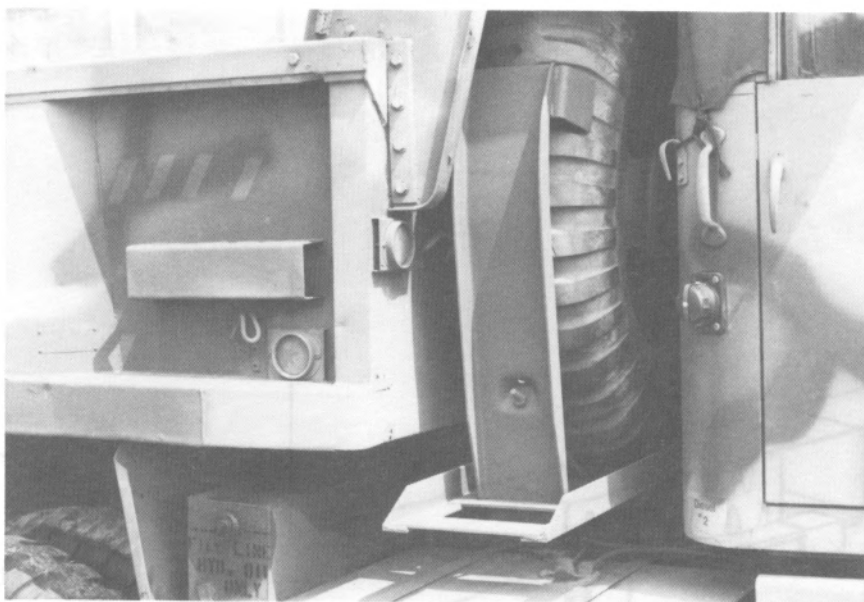
M886 Ambulance

MIL-HDBK-784



BRACKETS

Enclosing the tire in a sealed compartment protects it from such secondary contamination.

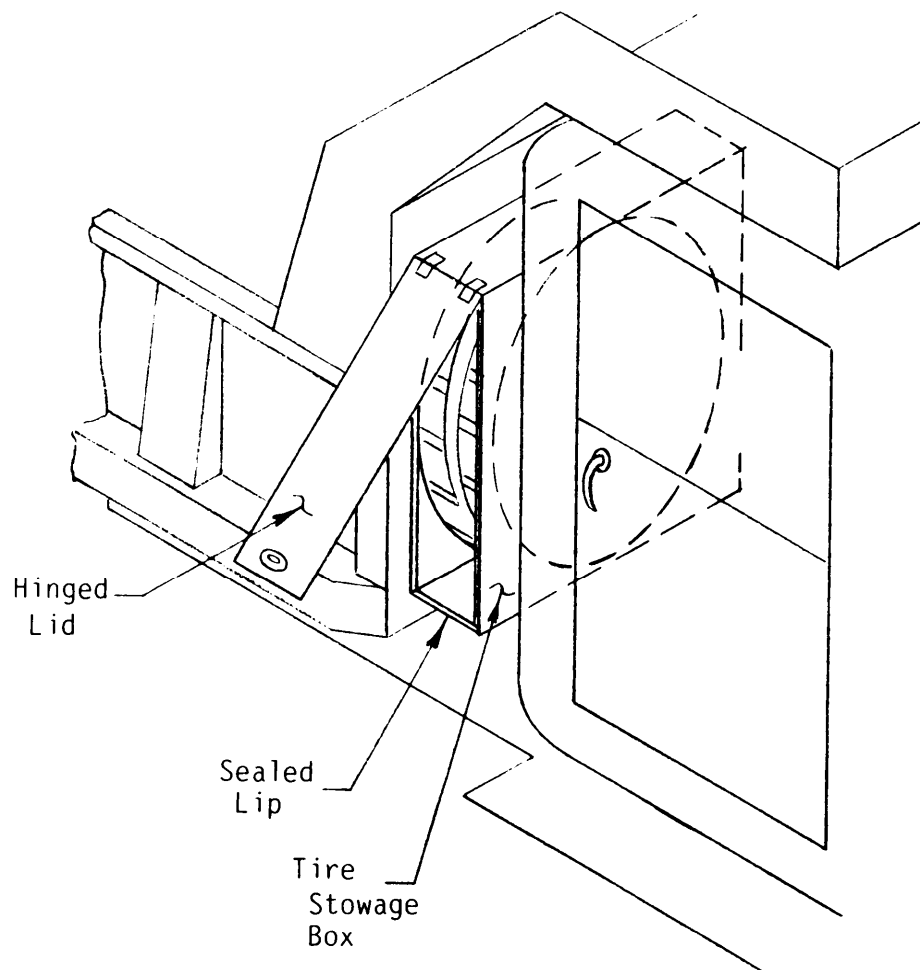


BRACKETS

Access to the spare-tire stowage rack is limited, hindering decontamination procedures.

M51A2 Dump Truck

MIL-HDBK-784



BRACKETS

A stowage box protects the tire and promotes decontaminant run-off.

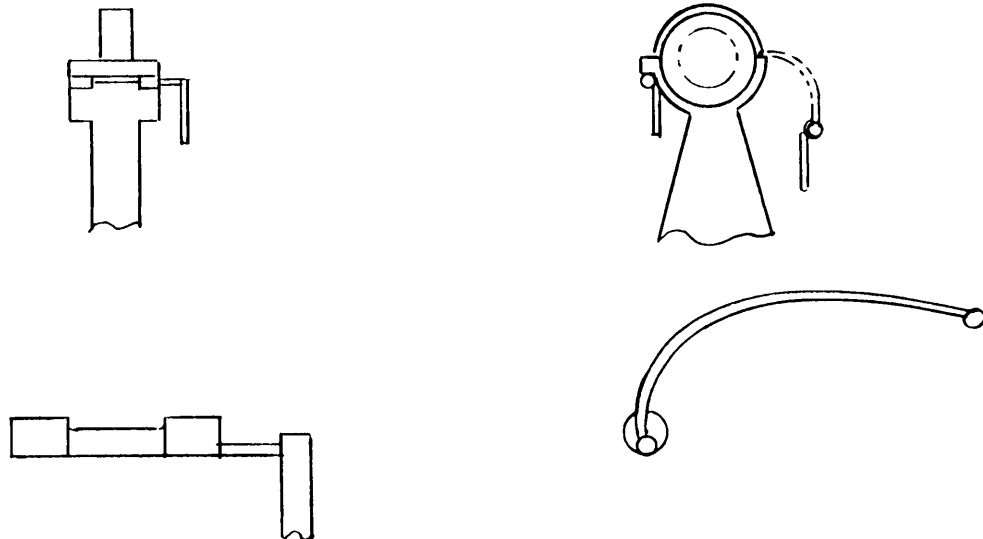
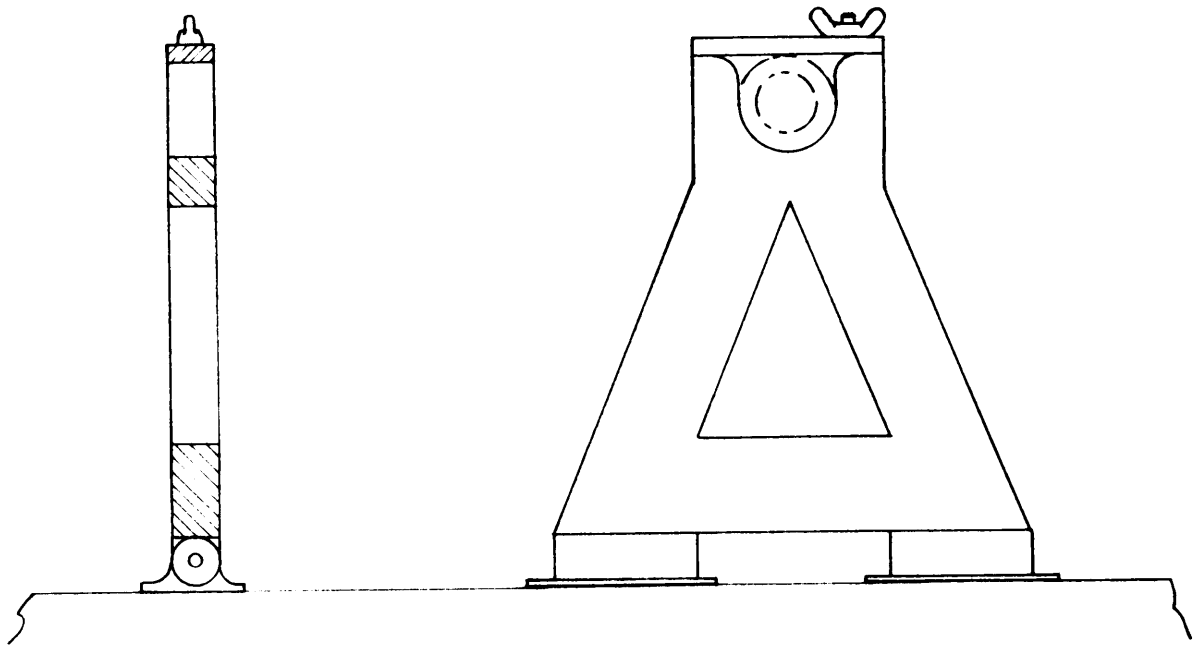


BRACKETS

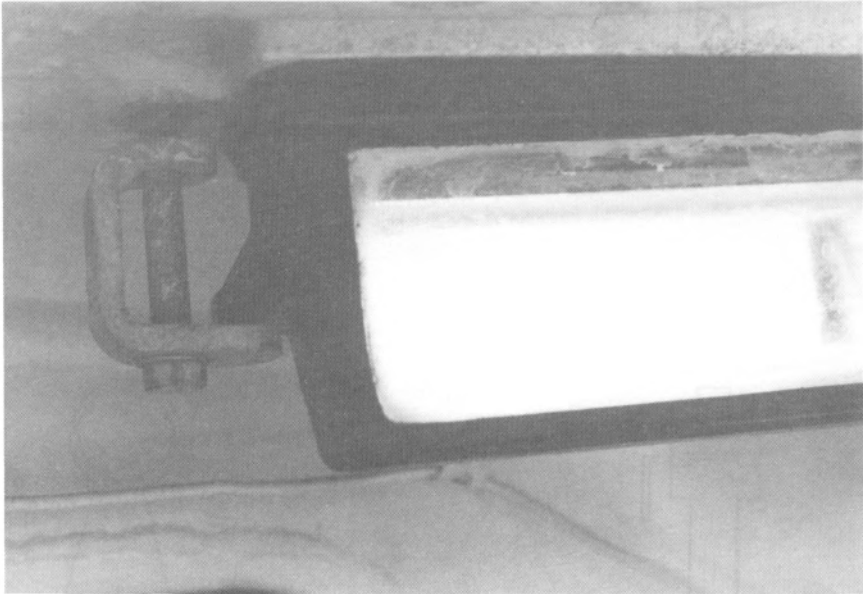
Contaminants can get into the joints of the hinge and latch on the gun-support cradle. These areas cannot be thoroughly decontaminated by chemical means.

M60 Tank

MIL-HDBK-784

BRACKETS

In the top drawing, a simple bar can be swung aside. In the lower drawing, a metal strap and cam shaft are used to tighten the strap to secure the gun tube. Both designs create fewer entrapment areas than the present assembly.

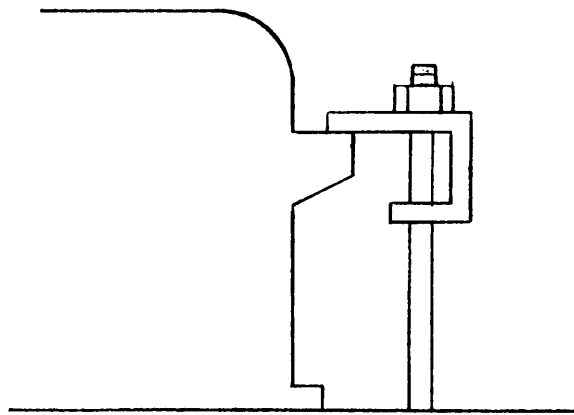


BRACKETS

The mounting bracket for the vision block includes a threaded bolt entering a blind tapped hole. Both the bolt threads and the tapped hole can trap contaminants and are difficult to decontaminate.

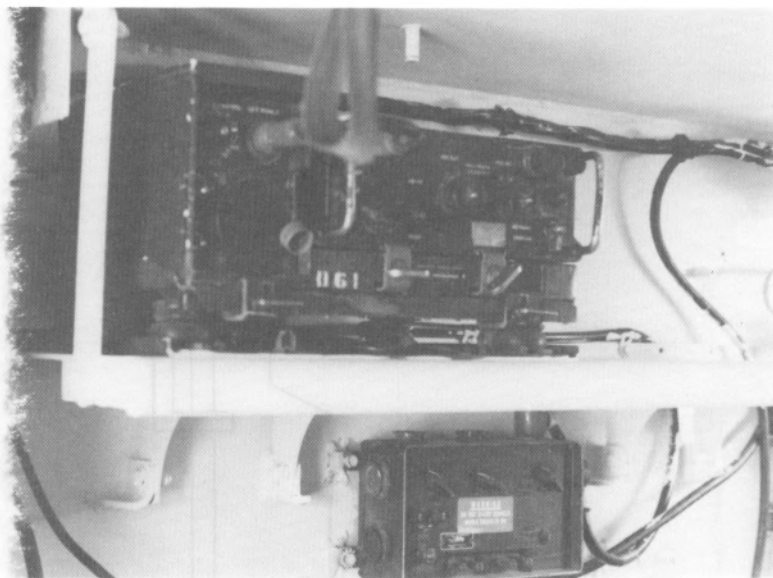
M60 Tank

MIL-HDBK-784



BRACKETS

Welding a stud bolt in place and cutting the bolt long enough that no threads show when it is tightened prevent contaminant entrapment.

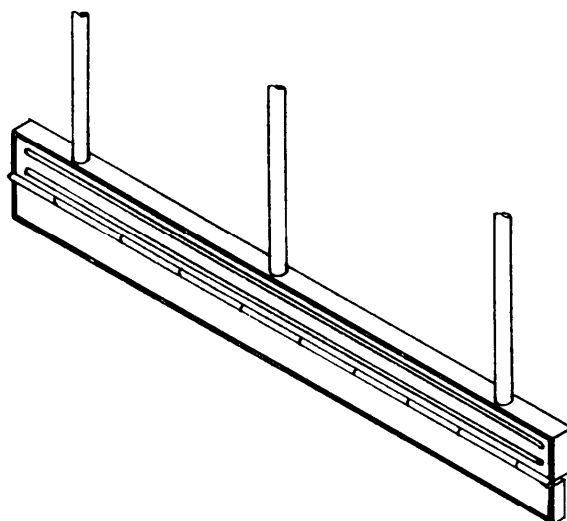


CABLES, ELECTRICAL

Wire insulation can absorb contaminants and can be adversely affected by decontaminants. Also, the areas between and under the wire bundles are difficult to decontaminate.

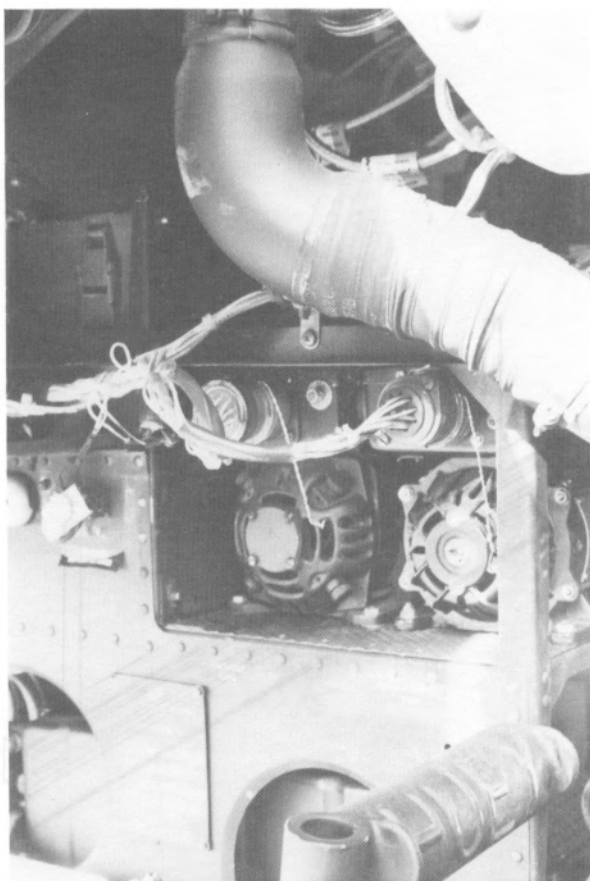
M88 Recovery Vehicle

MIL-HDBK-784



CABLES, ELECTRICAL

Double walls or box sections protect the wiring from contaminants while allowing easy repair access. The hinged cover has a sealed lip and the wire connections are also sealed.

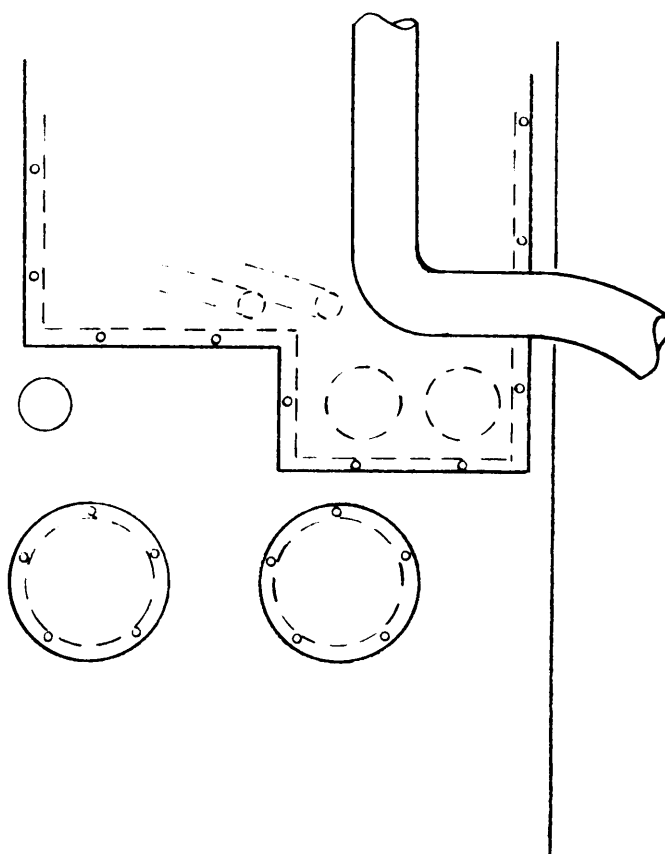


CABLES, ELECTRICAL

Wiring, tubing, motors, and other components are exposed to contaminants and are difficult to decontaminate.

UH-1H Helicopter (Huey)

MIL-HDBK-784



CABLES, ELECTRICAL

Sealed panels prevent contaminant entry and entrapment.

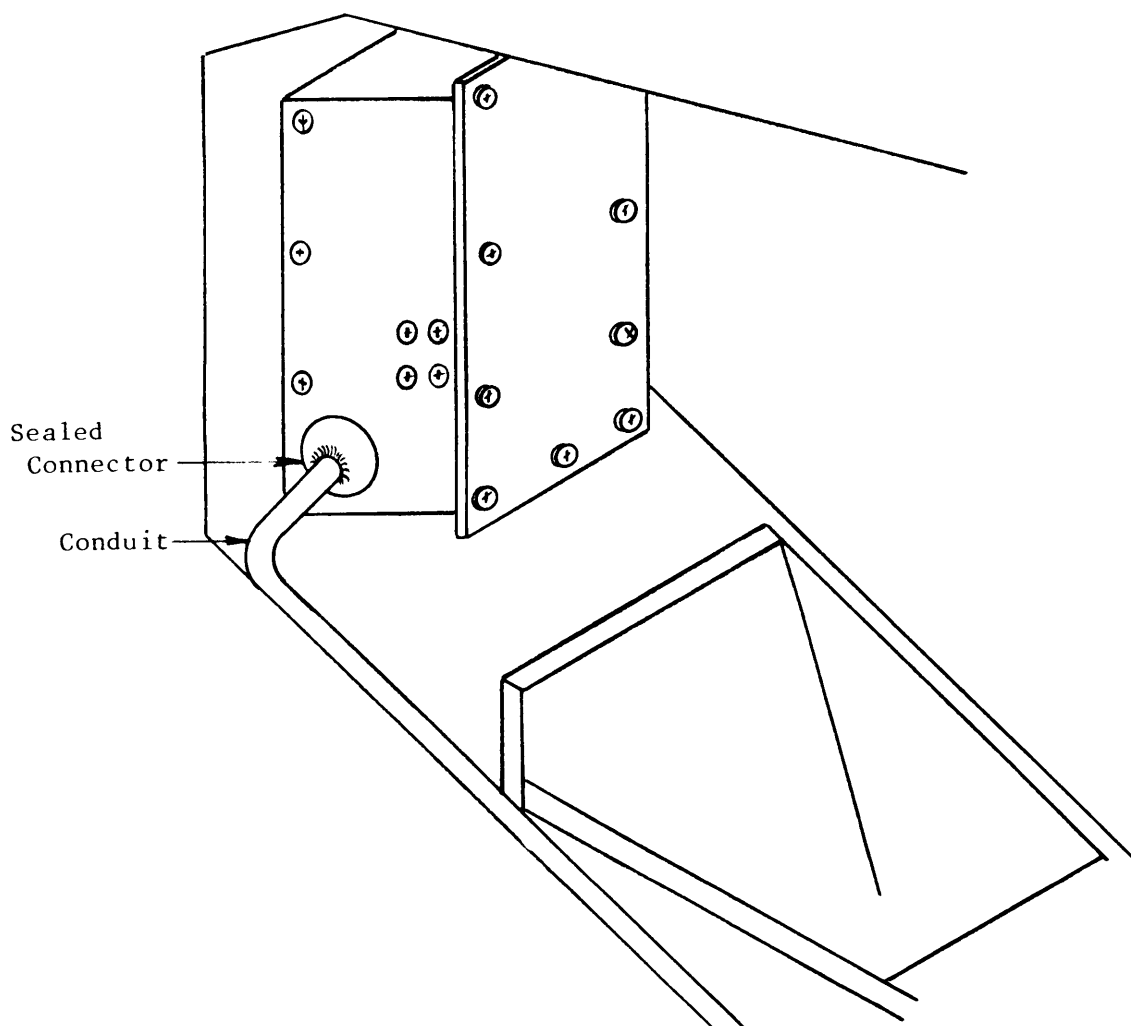


CABLES, ELECTRICAL

Wiring and connectors are exposed to contaminants and are difficult to decontaminate.

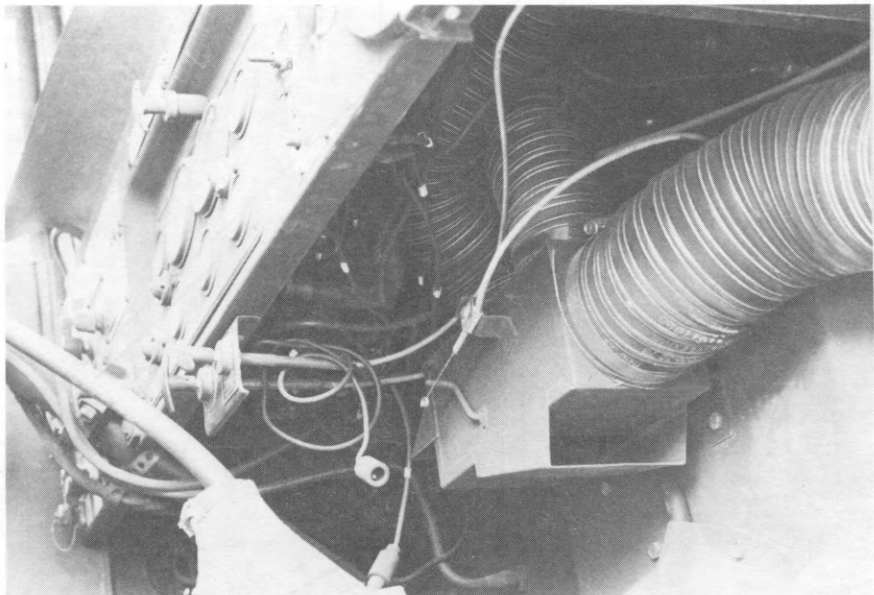
AH-1 Helicopter (Cobra)

MIL-HDBK-784



CABLES, ELECTRICAL

Conduits and sealed connectors limit contaminant entrapment and facilitate decontamination.

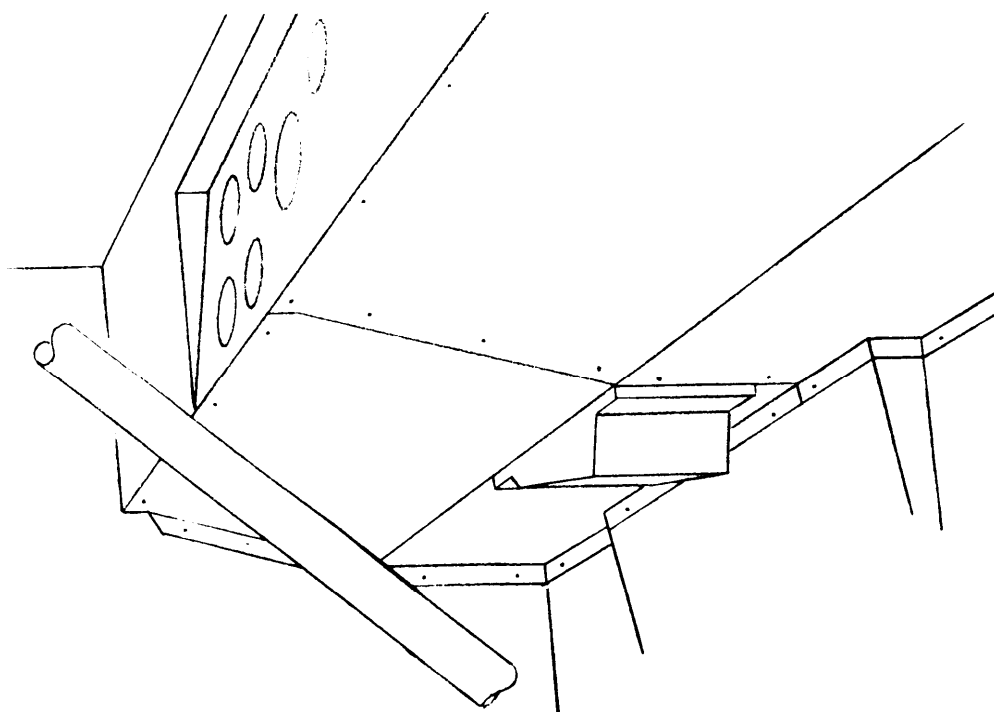


CABLES, ELECTRICAL

The arrangement of wiring and hoses creates many contaminant entrapment areas that are difficult to decontaminate.

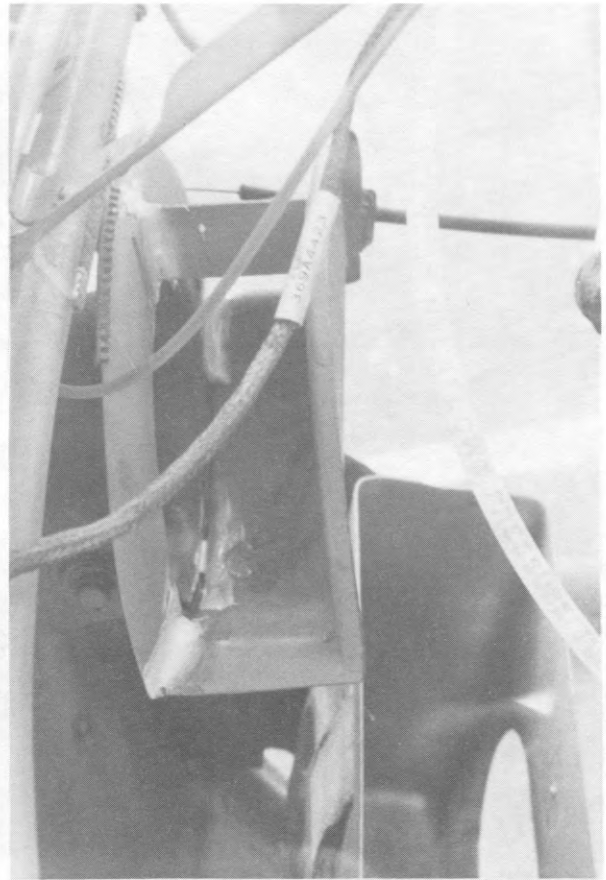
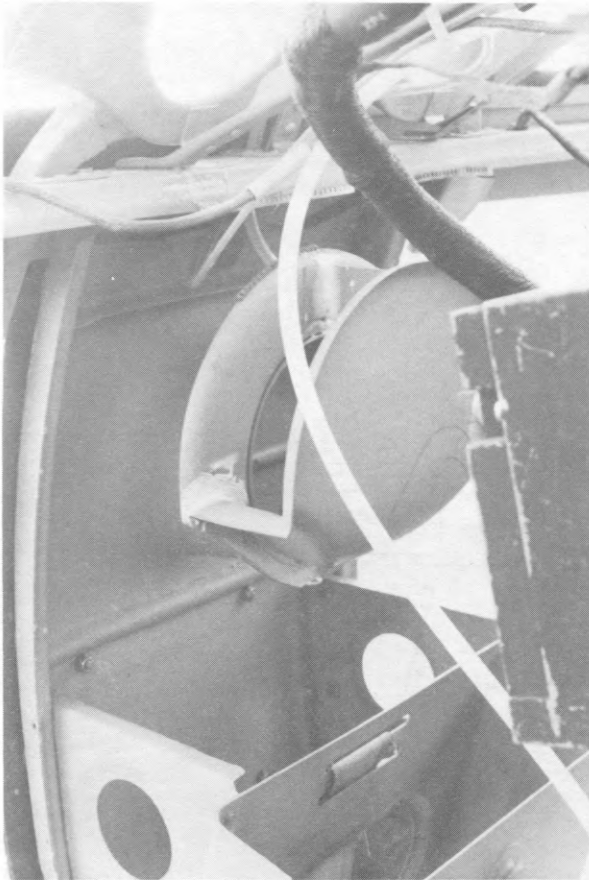
M818 Tractor Truck

MIL-HDBK-784



CABLES, ELECTRICAL

A sealed, removable plate protects the wiring and hoses from contaminants.

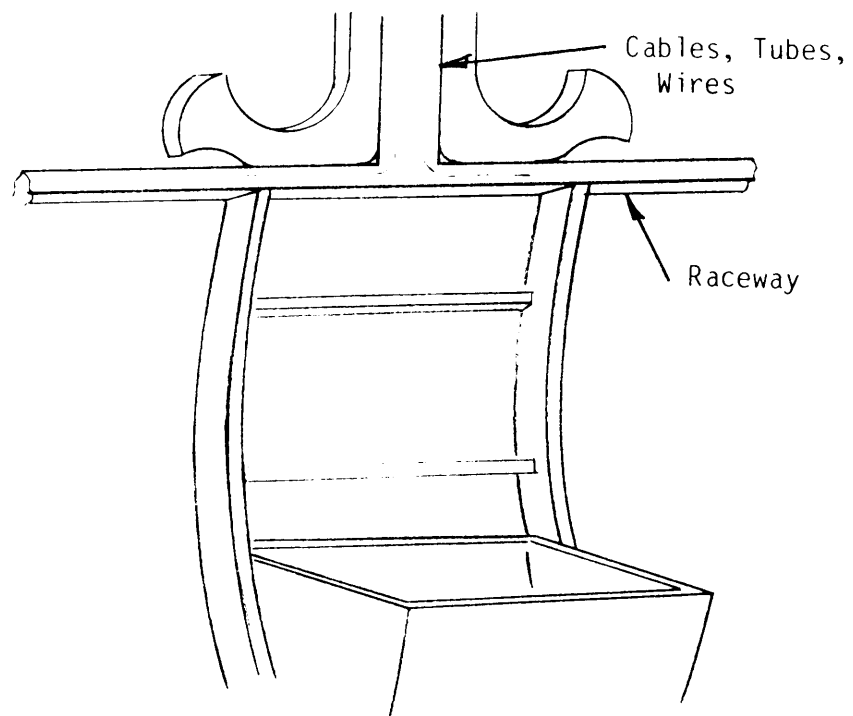


CABLES, ELECTRICAL

The interior wiring and tubing are exposed to contaminants and are difficult to decontaminate.

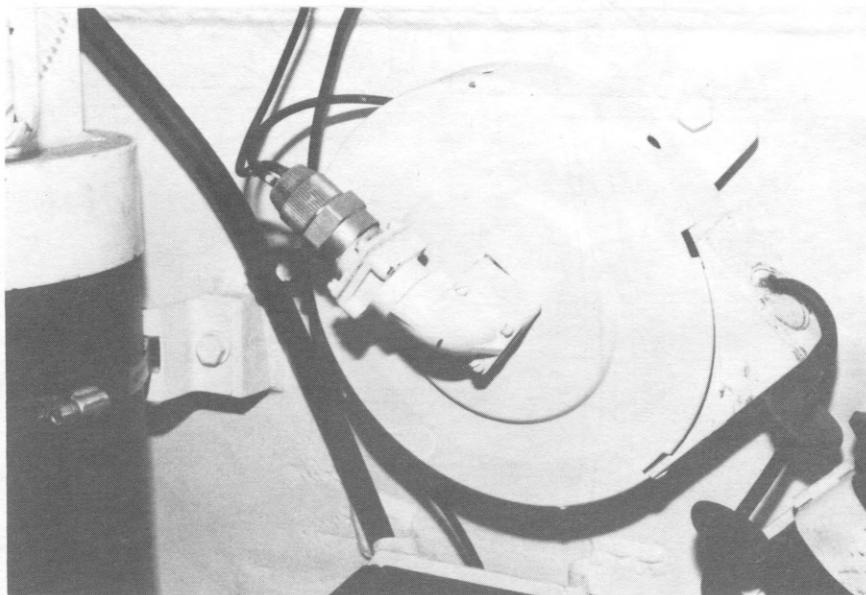
OH-6 Helicopter (Cayuse)

MIL-HDBK-784



CABLES. ELECTRICAL

A raceway protects the wiring and tubing from contaminants.

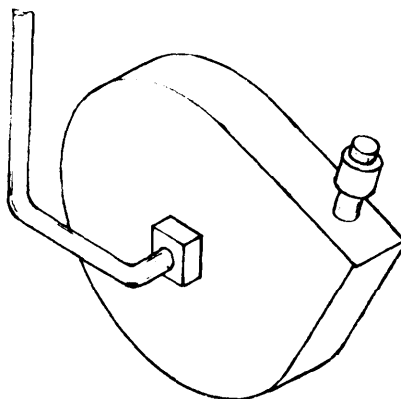


CABLES, ELECTRICAL

The wiring and connections are exposed to contaminants and are difficult to decontaminate.

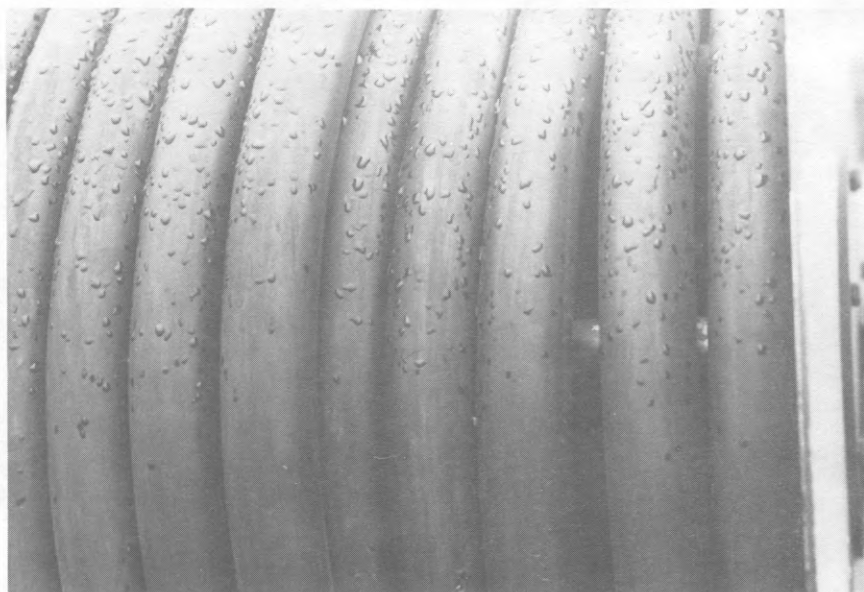
M88 Recovery Vehicle

MIL-HDBK-784



CABLES, ELECTRICAL

A sealed housing and sealed connectors protect the reel components and wiring from contaminants. A conduit also protects the wiring.

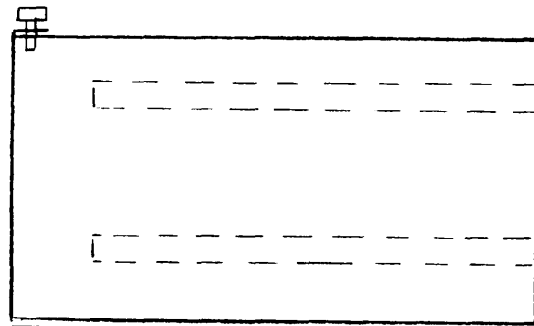
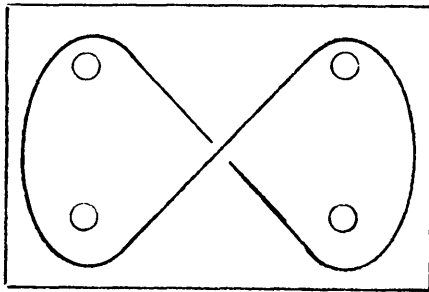


CABLES, ELECTRICAL

The pillow block and cable are exposed to contaminants and are difficult to decontaminate.

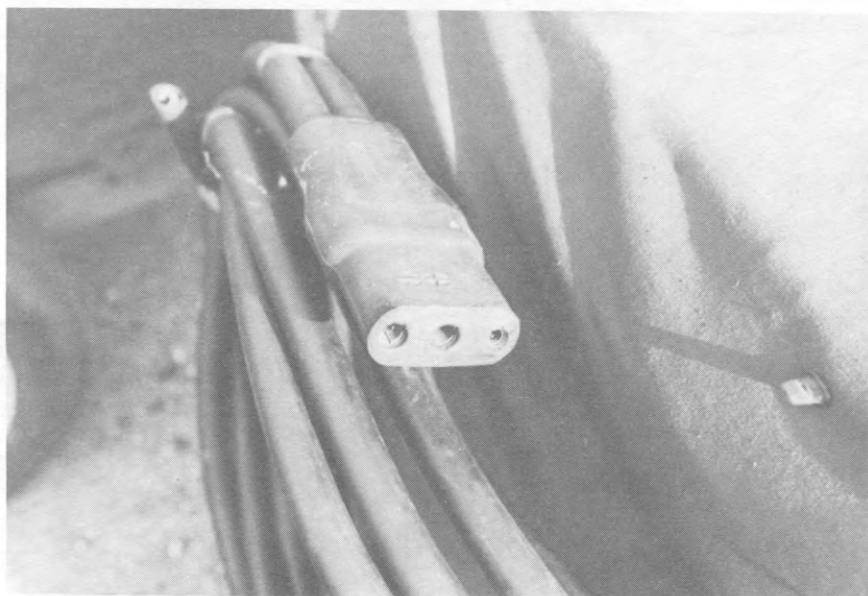
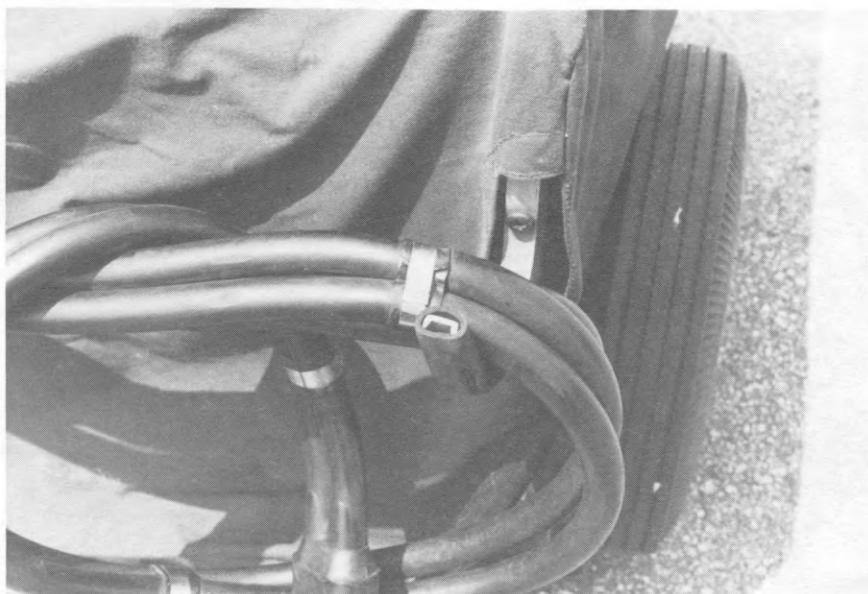
Diesel Generator

MIL-HDBK-784



CABLES, ELECTRICAL

A sealed box, in which the cable is stored in a figure-8 pattern, eliminates the pillow block and reel support structures.

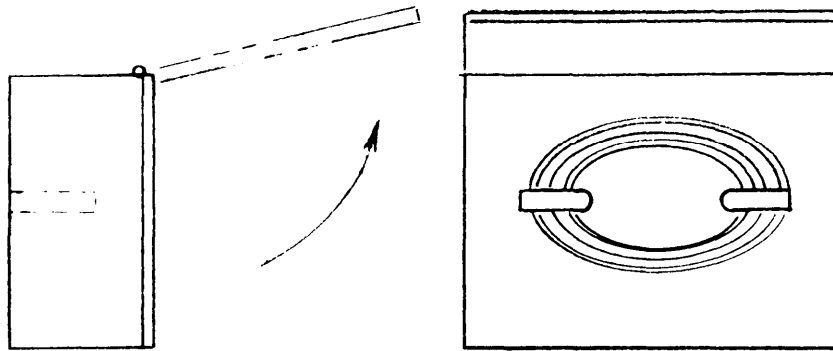


CABLES, ELECTRICAL

The power cord and support hook have openings that can trap contaminants and are difficult to decontaminate.

Generator (7.5 kW)

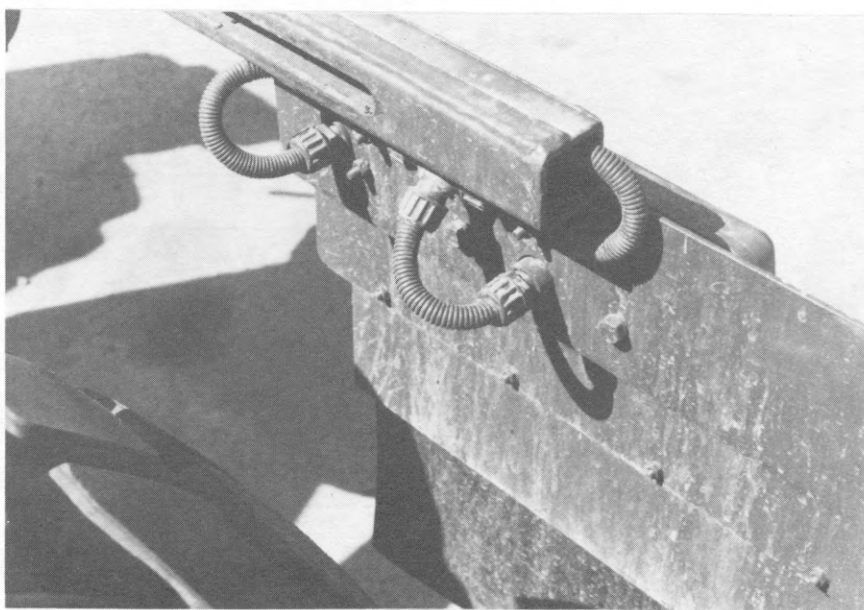
MIL-HDBK-784



CABLES, ELECTRICAL

A box with internal hooks shields the power cord from contaminants.

MIL-HDBK-784

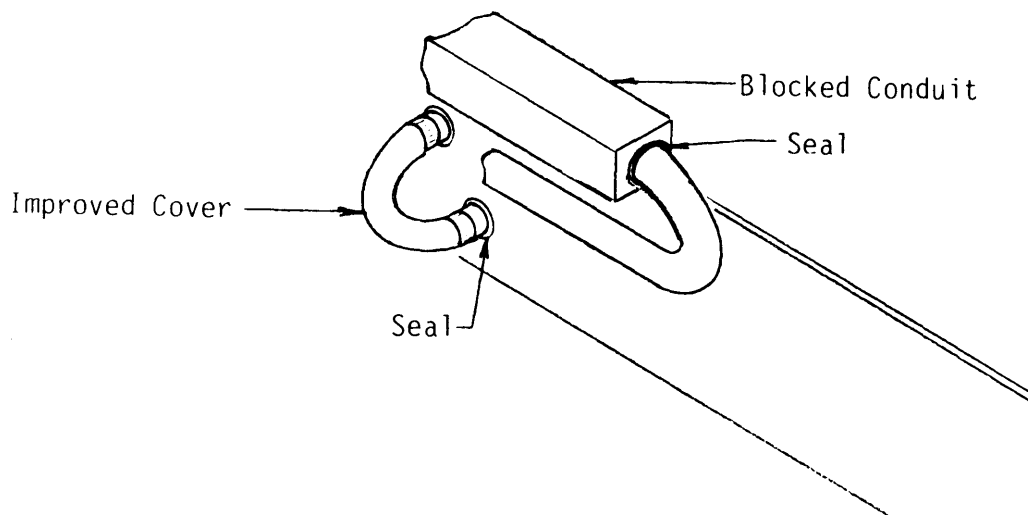


CABLES, ELECTRICAL

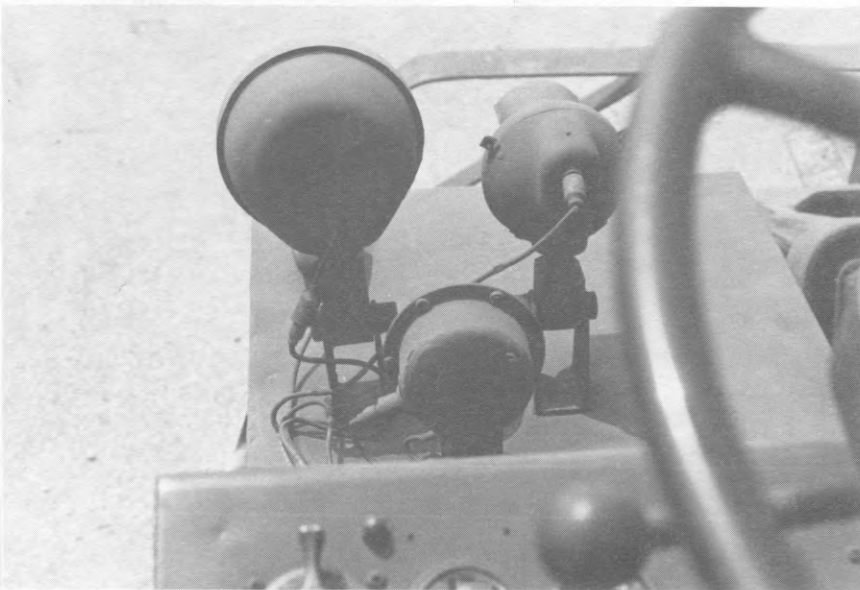
The ribbed tubing, pass-throughs, and channel collect contaminants in inaccessible spaces. Thorough cleaning is difficult without removing and immersing the contaminated items.

Tractor Truck (10-Ton, 8x8)

MIL-HDBK-784

CABLES, ELECTRICAL

Smooth tubing or a cover does not trap contaminants and is easier to clean than ribbed tubing. In addition, sealed pass-through and a closed, sealed channel eliminate inaccessible entrapment spaces.

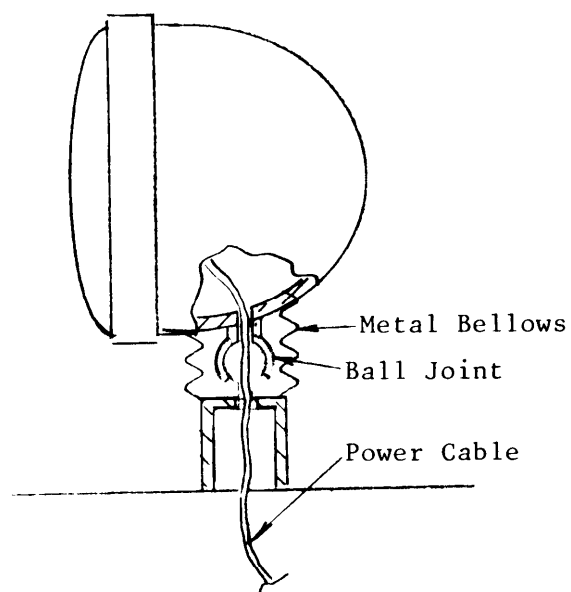


CABLES, ELECTRICAL

The wiring and connectors are exposed to contaminants and are difficult to decontaminate.

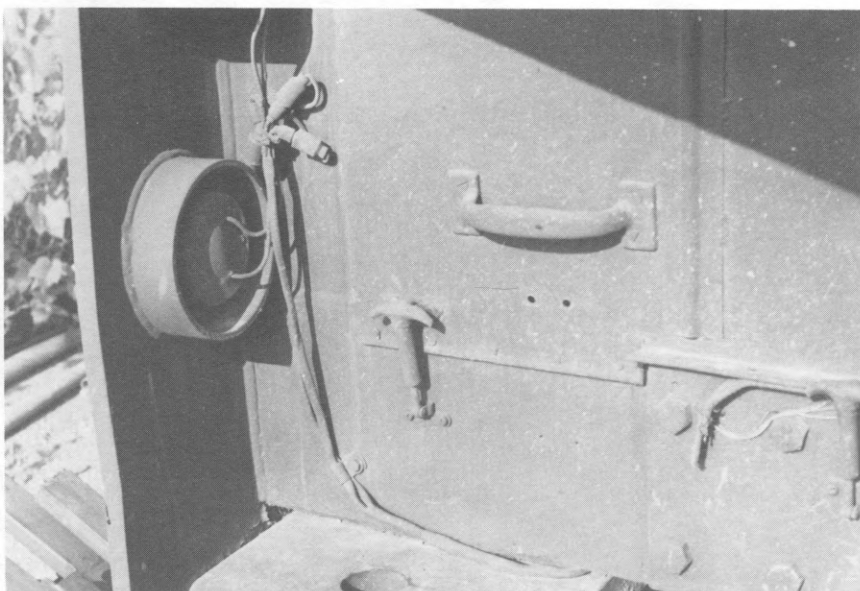
Forklift (10,000-lb capacity)

MIL-HDBK-784



CABLES, ELECTRICAL

Casing and metal bellows protect the wiring from contaminants.

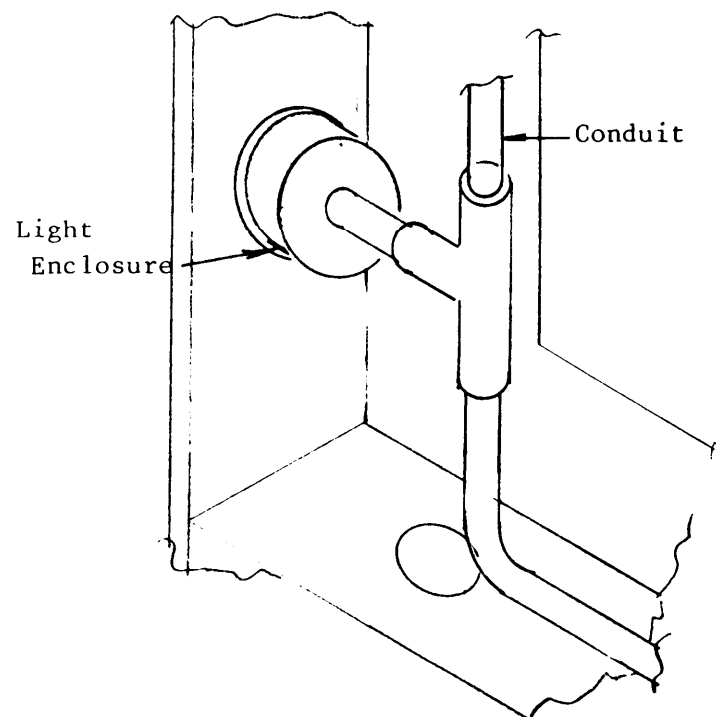


CABLES, ELECTRICAL

Exposed wiring and connections can trap contaminants and are difficult to decontaminate.

Forklift (6,000-lb capacity)

MIL-HDBK-784



CABLES, ELECTRICAL

Conduit and enclosure shield the wiring from contaminants.

MIL-HDBK-784

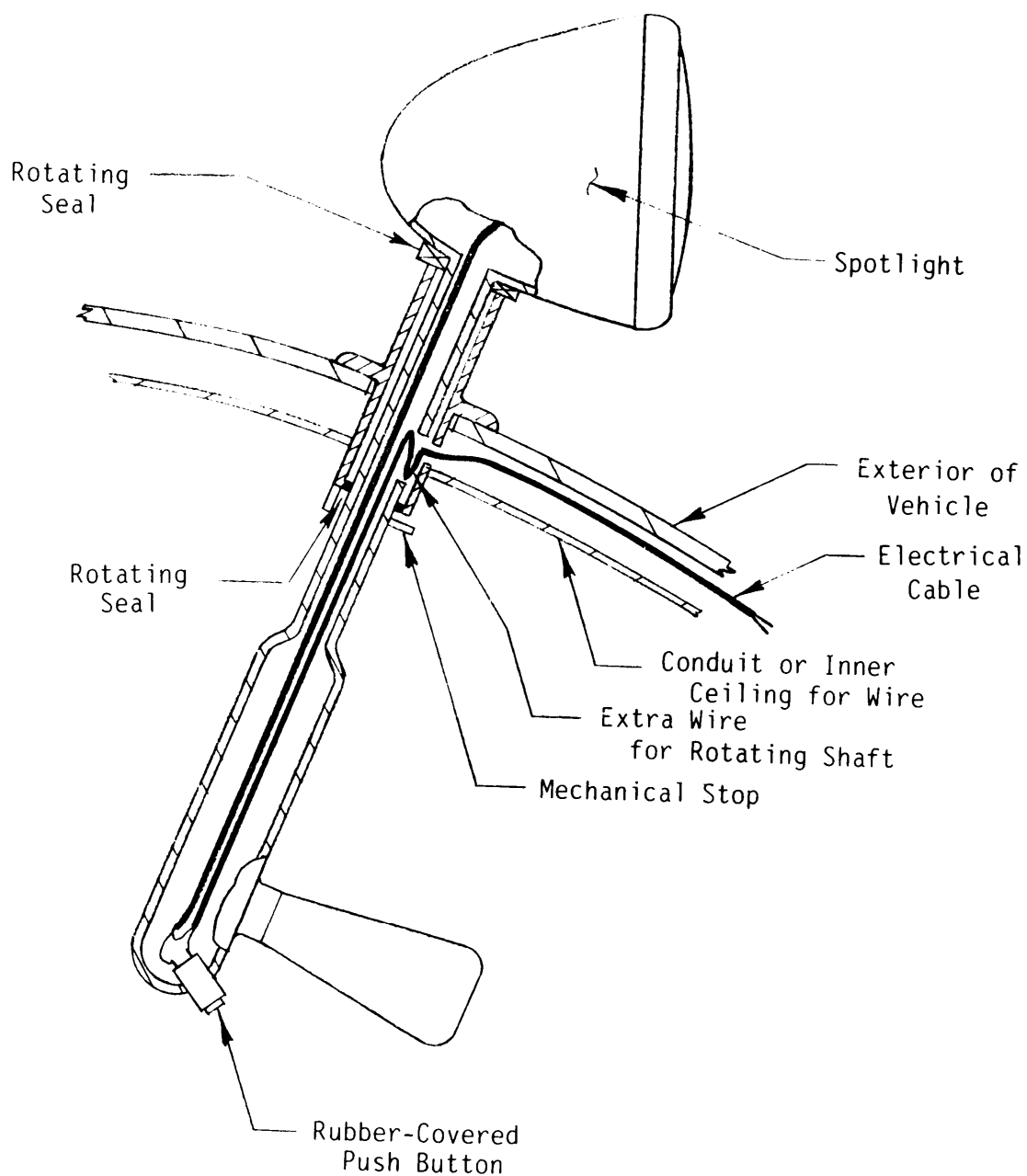


CABLES, ELECTRICAL

The spotlight and control have smooth surfaces with few entrapment spaces.

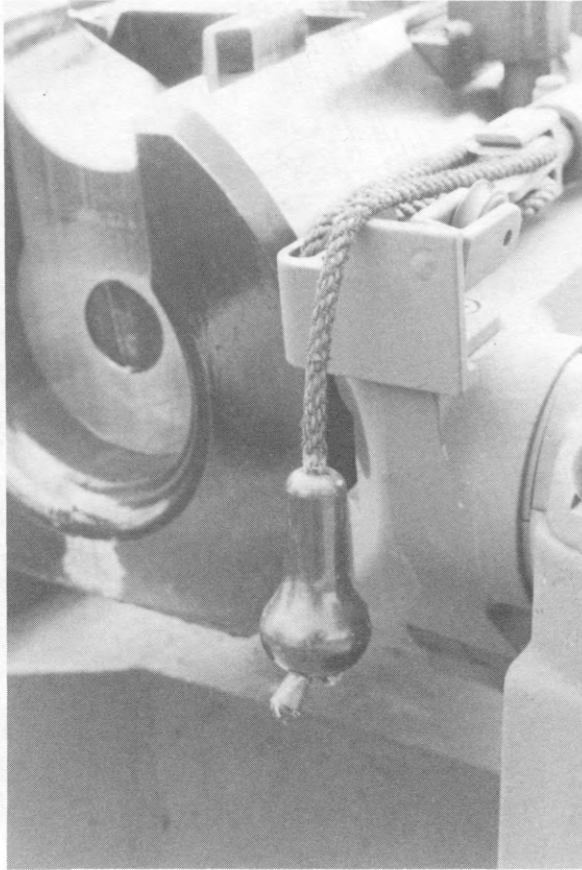
M886 Ambulance

MIL-HDBK-784



CABLES, ELECTRICAL

Adding seals to the basic design of the spotlight and enclosing the wiring eliminate the possibility of entrapment and absorption of contaminants.

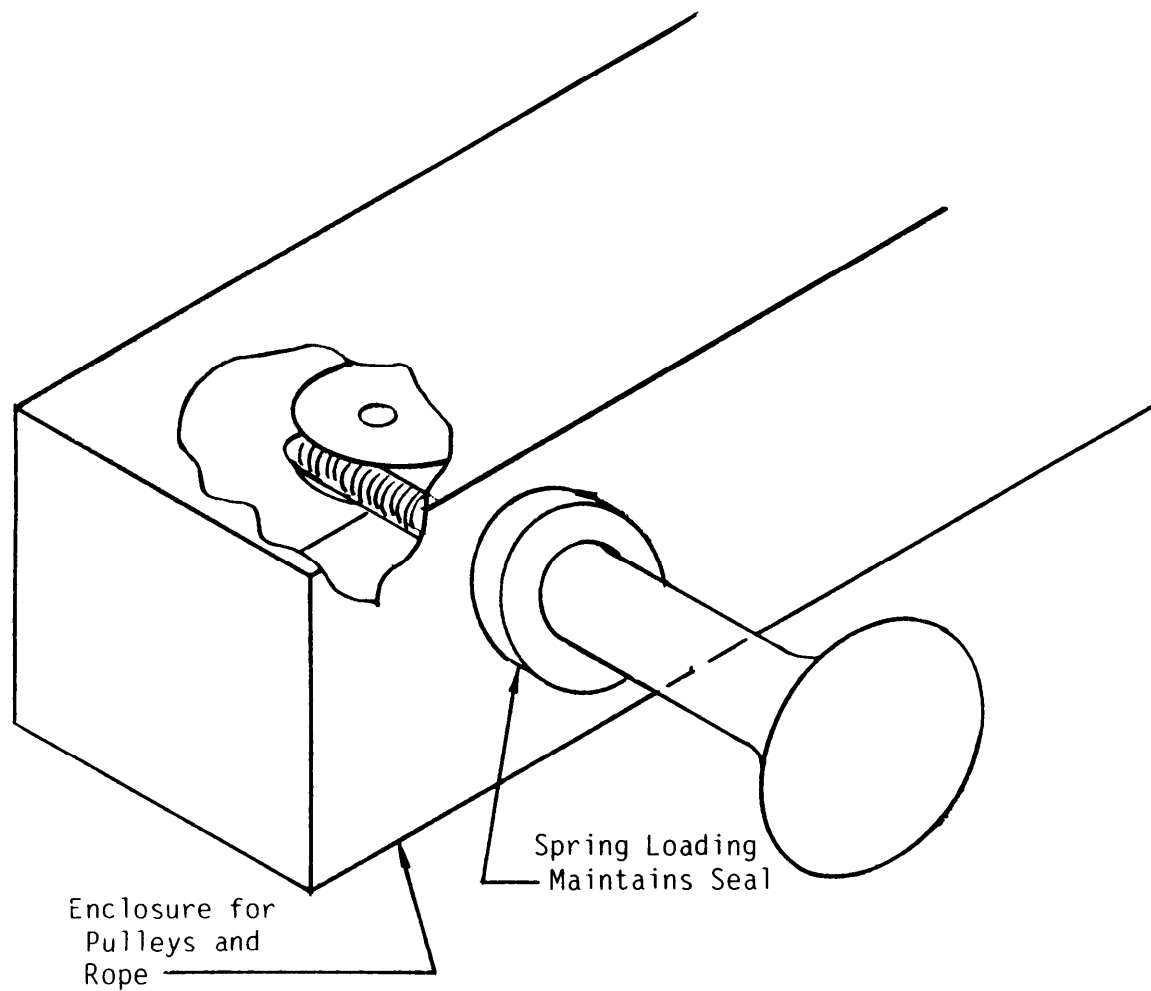


CABLES, STRUCTURAL

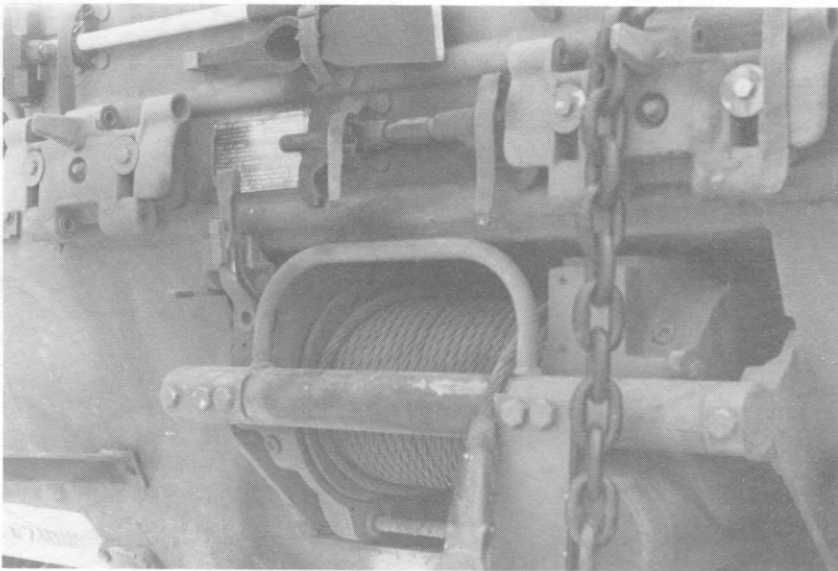
The rope and pulleys of the lanyard system are difficult to decontaminate. The rope can absorb contaminants and the pulley mechanism can trap contaminants.

M102 Howitzer

MIL-HDBK-784

CABLES, STRUCTURAL

An enclosure prevents contamination of the pulley mechanisms and rope. Spring-loading maintains a seal between the base of the lanyard handle and the surface of the enclosure.

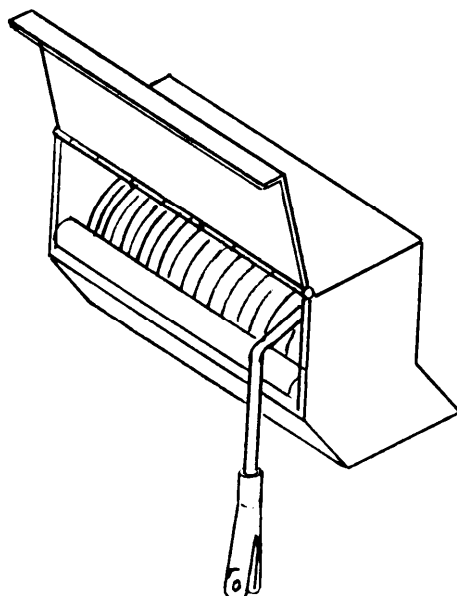


CABLES, STRUCTURAL

Contaminants/decontaminants can be trapped in the spaces between the strands of cable or absorbed by the grease and dirt on the cable. In addition, the winch spool, motor, and space behind the winch are inaccessible and difficult to decontaminate by chemical means.

Chaparral Missile Launcher

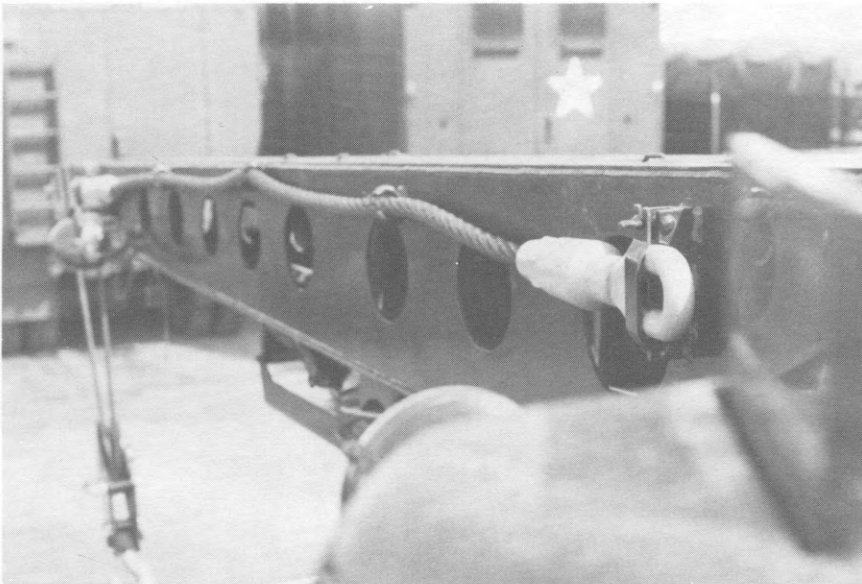
MIL-HDBK-784



CABLES, STRUCTURAL

A box, with a sealed lid, on the front of the vehicle covers the entire winch cavity and guide, protecting the area from contaminating materials.

MIL-HDBK-784

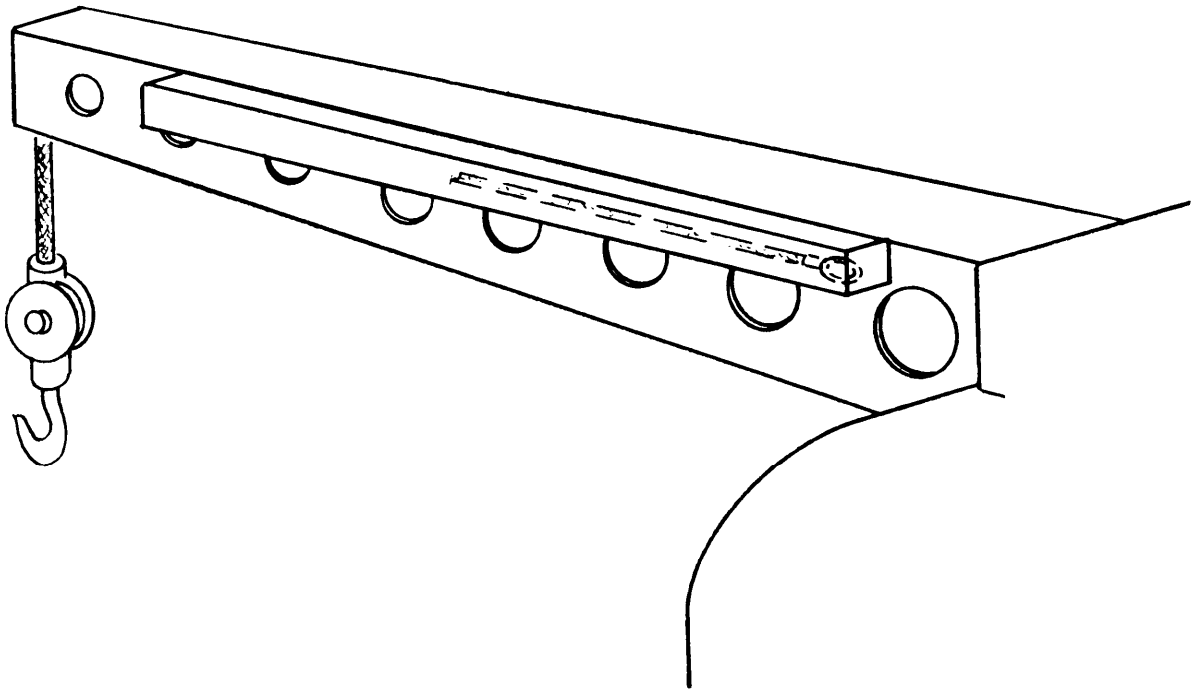


CABLES, STRUCTURAL

The wire rope and chain sling assembly are exposed to contaminants.

M578 Recovery Vehicle

MIL-HDBK-784



CABLES, STRUCTURAL

A covered box on the crane boom protects the wire rope and chain sling assembly from contaminants.

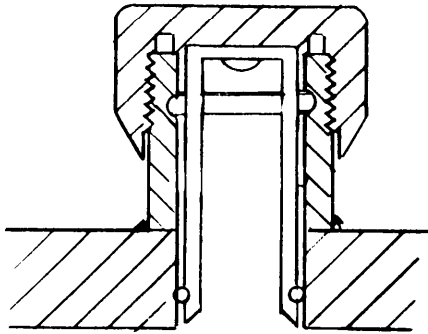


CAPS

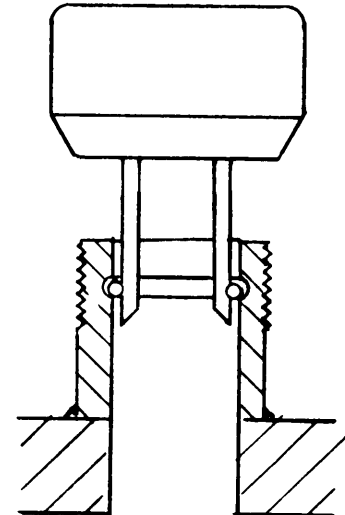
The retainer chain for the ballistic cover is exposed to contaminants and is difficult to decontaminate.

AVLB Bridge-Launching Vehicle

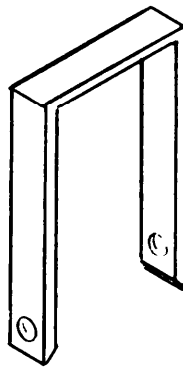
MIL-HDBK-784



(a)



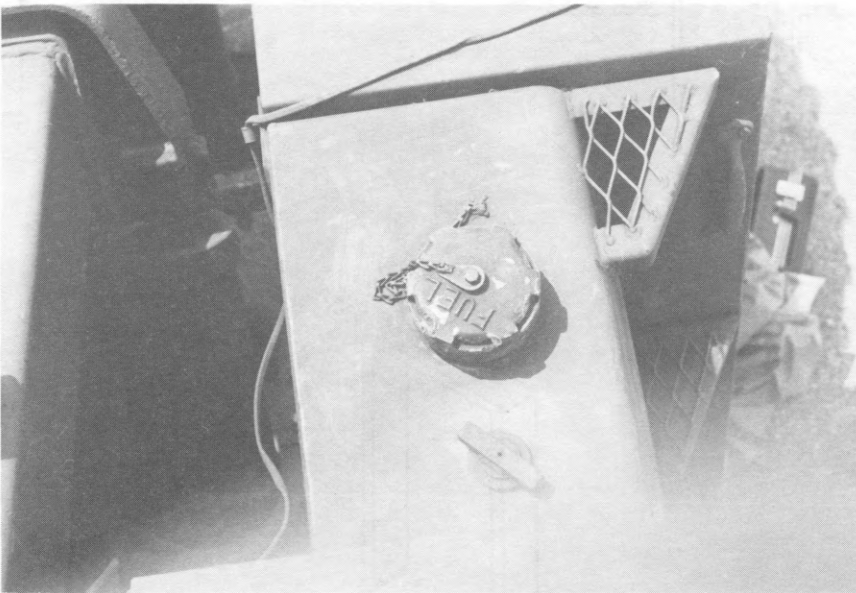
(b)



(c)

CAPS

A spring clip replaces the retainer chain (a). The cap can be popped up (b) or removed (c). If a chain is used, it should attach to the inside of the cap and the inside of the pipe.

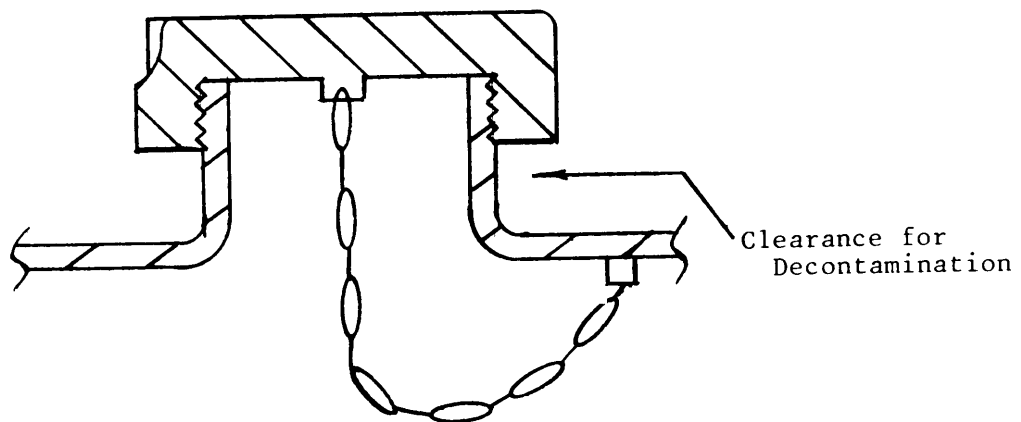


CAPS

The large flutes on the fuel cap facilitate decontamination. However, the retainer chain is exposed to contaminants and is difficult to decontaminate.

Forklift (6,000-lb capacity)

MIL-HDBK-784



CAPS

An internal retainer chain is protected from contaminants.

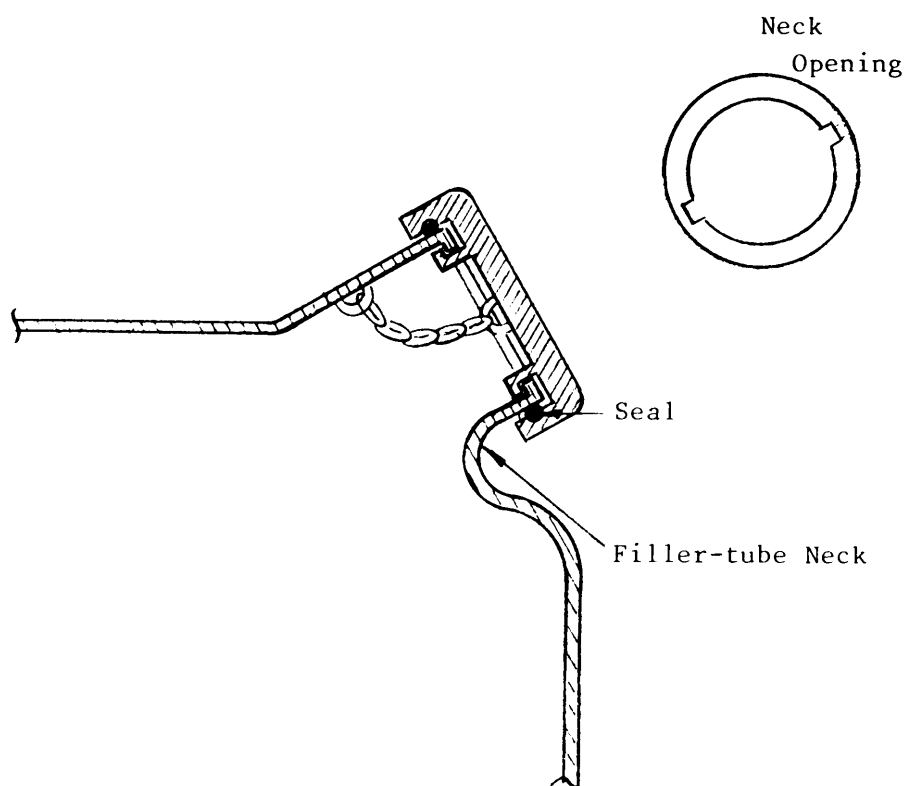


CAPS

Although the cap is easy to decontaminate, the retainer cable and cover can absorb contaminants.

Tractor Truck (10-Ton, 8x8)

MIL-HDBK-784



CAPS

An internal retaining chain is protected from contaminants.

MIL-HDBK-784

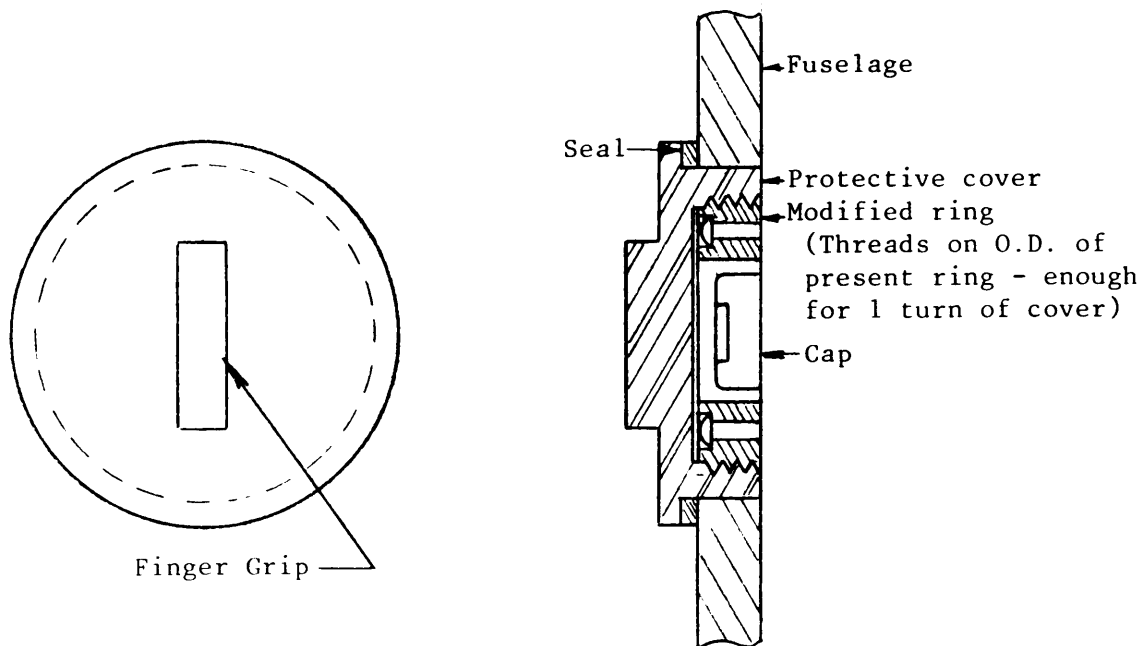


CAPS

The grooves on both sides of the ring, counterbores for screws, screw heads, and the area around and under the lift tab can trap contaminants and are difficult to decontaminate.

AH-1 Helicopter (Cobra)

MIL-HDBK-784



CAPS

A protective cover shields the cap area from contaminants.

MIL-HDBK-784

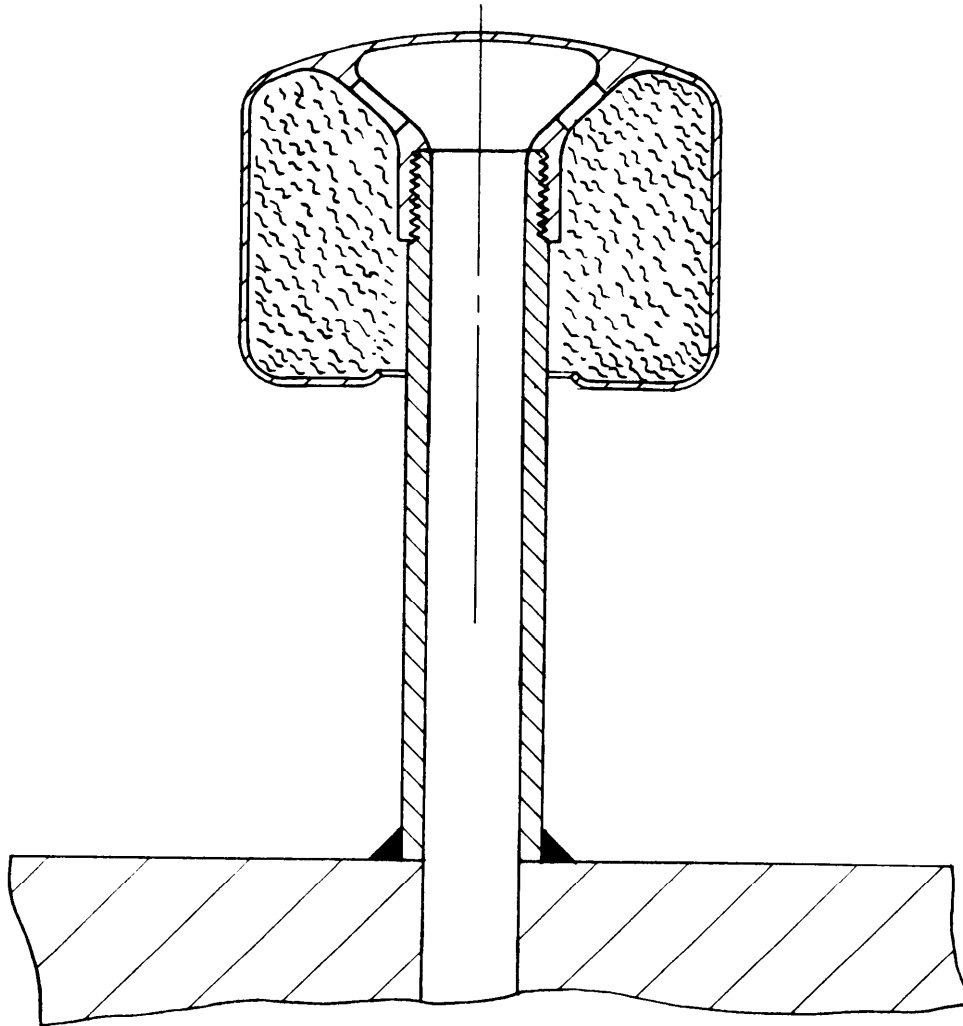


CAPS

Contaminants can be trapped around the wing nut, in the molded ridge along the top edge, and along the rolled flange at the bottom edge of the breather cap.

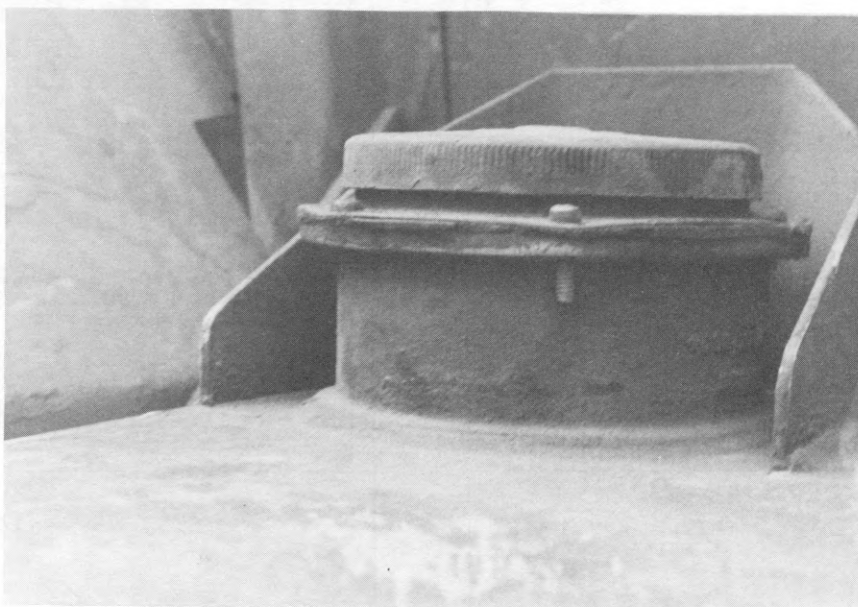
AVLB Bridge Launching Vehicle

MIL-HDBK-784



CAPS

A smooth outer surface allows easier decontamination. Internal fastening allows the cap to be replaced without exposing hard-to-decontaminate parts.

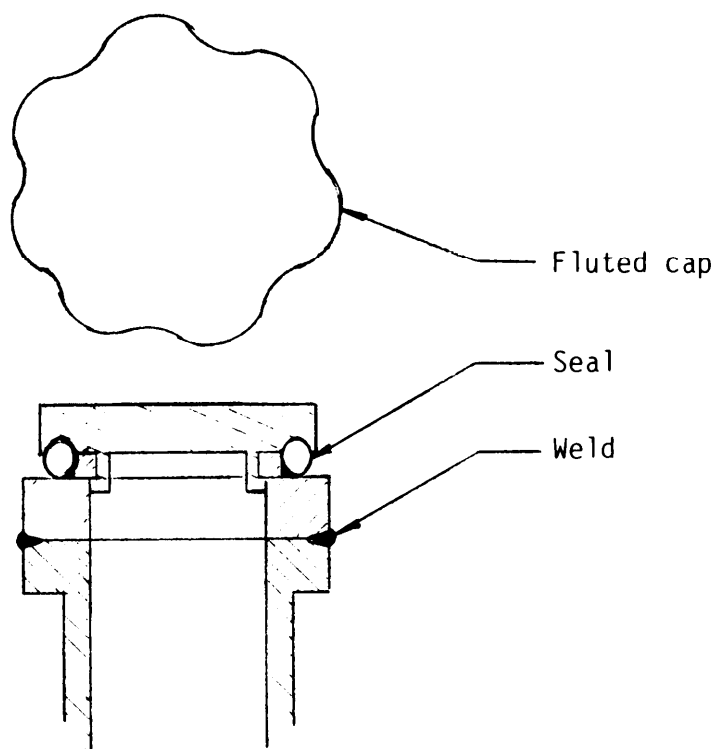


CAPS

The ridges on the edge of the cap, the space between the cap and the mounting flange, and the threads of the flange-attachment screws are difficult to decontaminate.

M561 Cargo Truck

MIL-HDBK-784



CAPS

Making the cap with gently curved flutes, extending the seal, and welding the flange eliminate hard-to-decontaminate spaces.

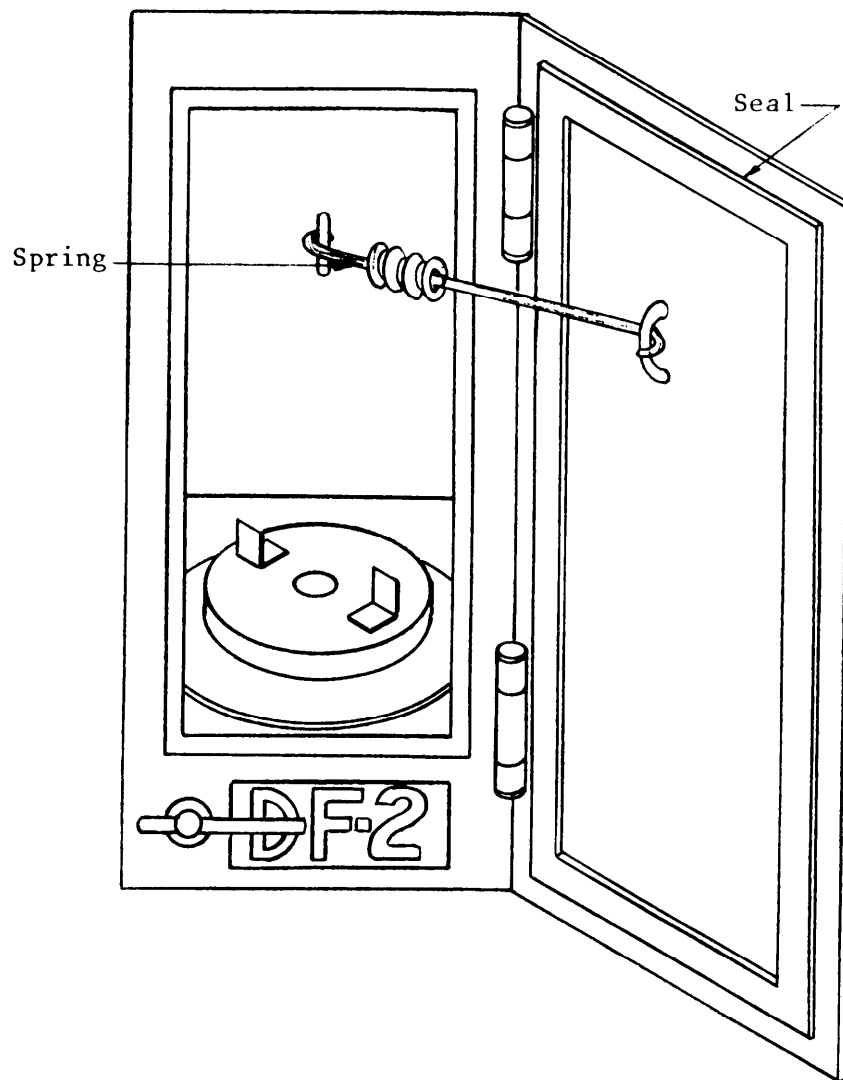


CAPS

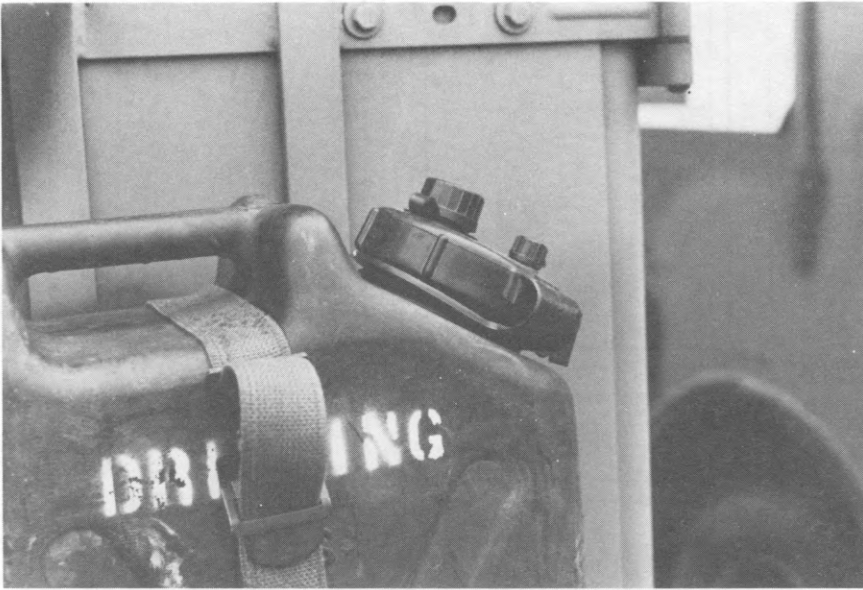
The fuel cap assembly is exposed to contaminants and is difficult to decontaminate.

Diesel Generator

MIL-HDBK-784

CAPS

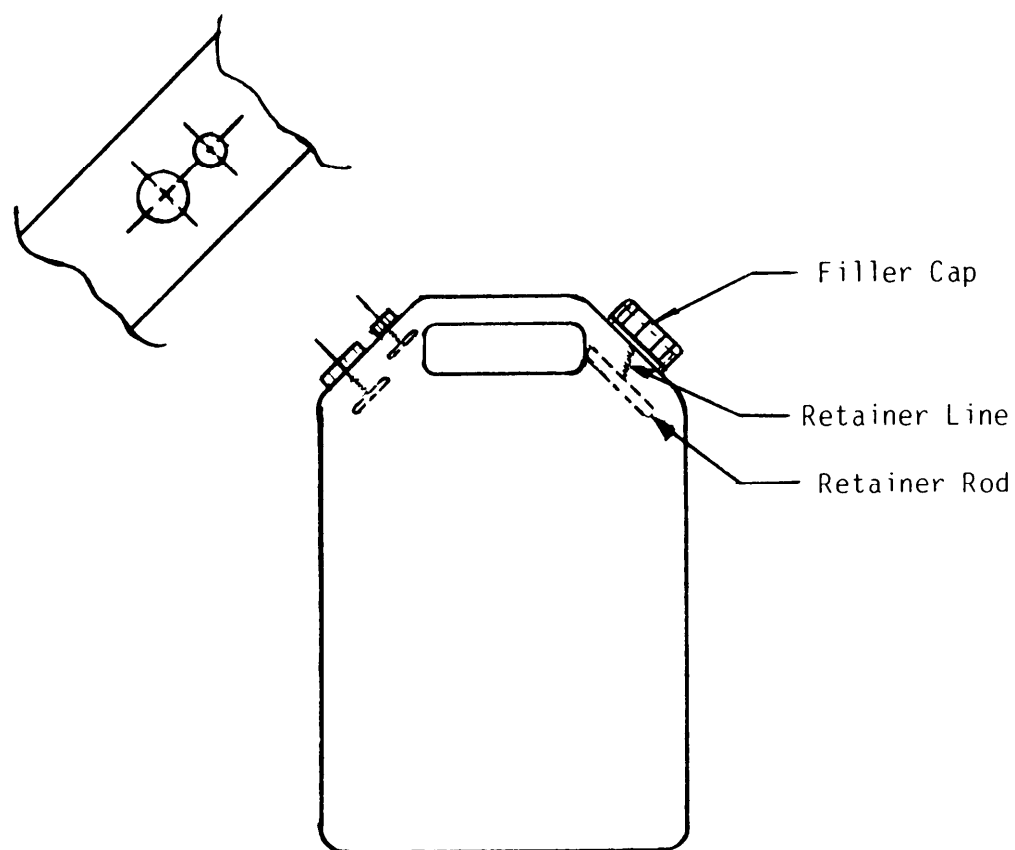
The cap assembly is protected from contaminants by a sheet metal cover.



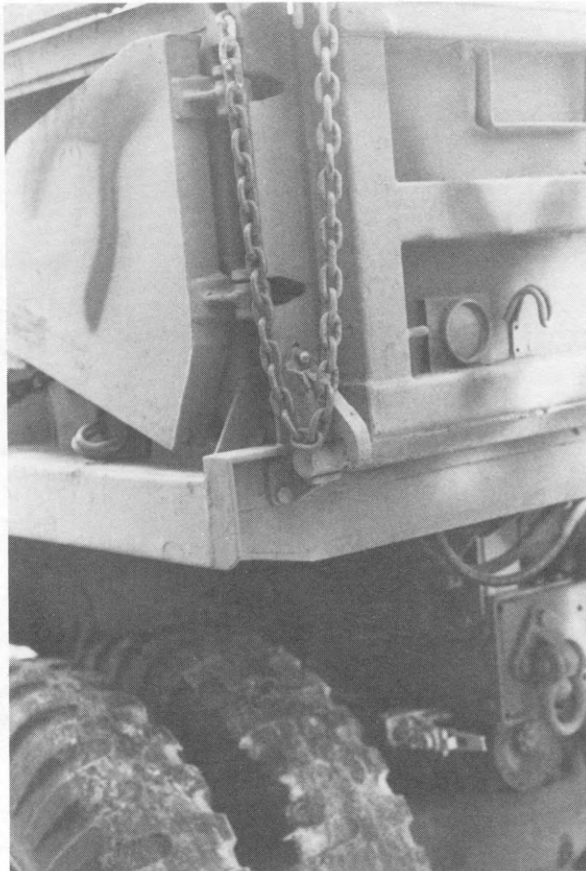
CAPS

The standard jerry can is molded with one threaded spout; the three-in-one cap is designed for filling, pouring, and venting through the single spout. Contaminants and contaminated dust can settle within the loops of the external retainer straps on each cap. Thorough decontamination is possible only by removing the caps, with the possibility of contaminating the interior of the jerry can.

MIL-HDBK-784

CAPS

Using interior retainers on the three-in-one cap facilitates decontamination. Alternatively, a jerry can with three separate spouts, each with its own interior retainer, can be used.

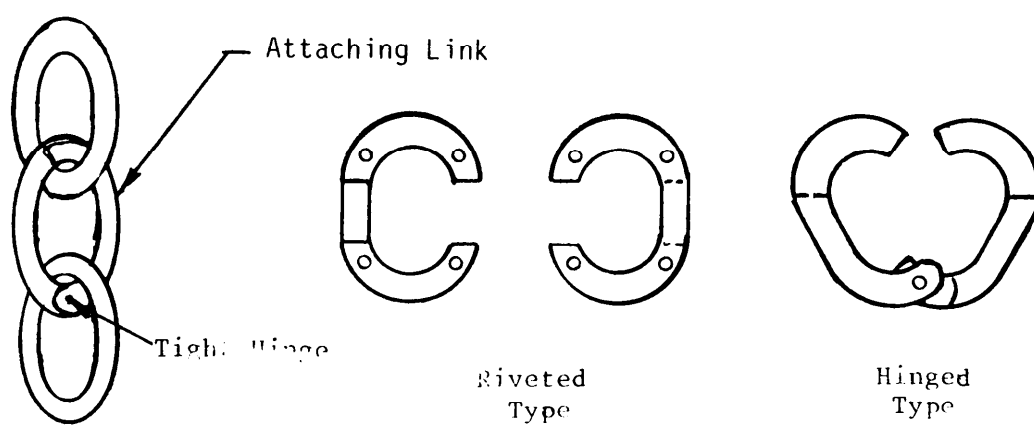


CHAINS

The tailgate support chain is difficult to remove and to decontaminate in place.

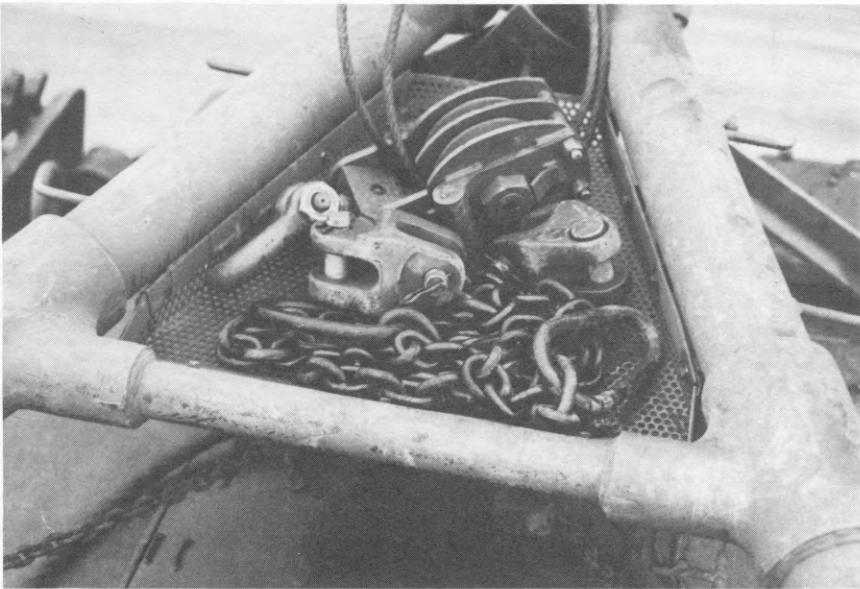
M51A2 Dump Truck

MIL-HDBK-784



CHAINS

Easily removable chain can be dipped in decontaminating solution.

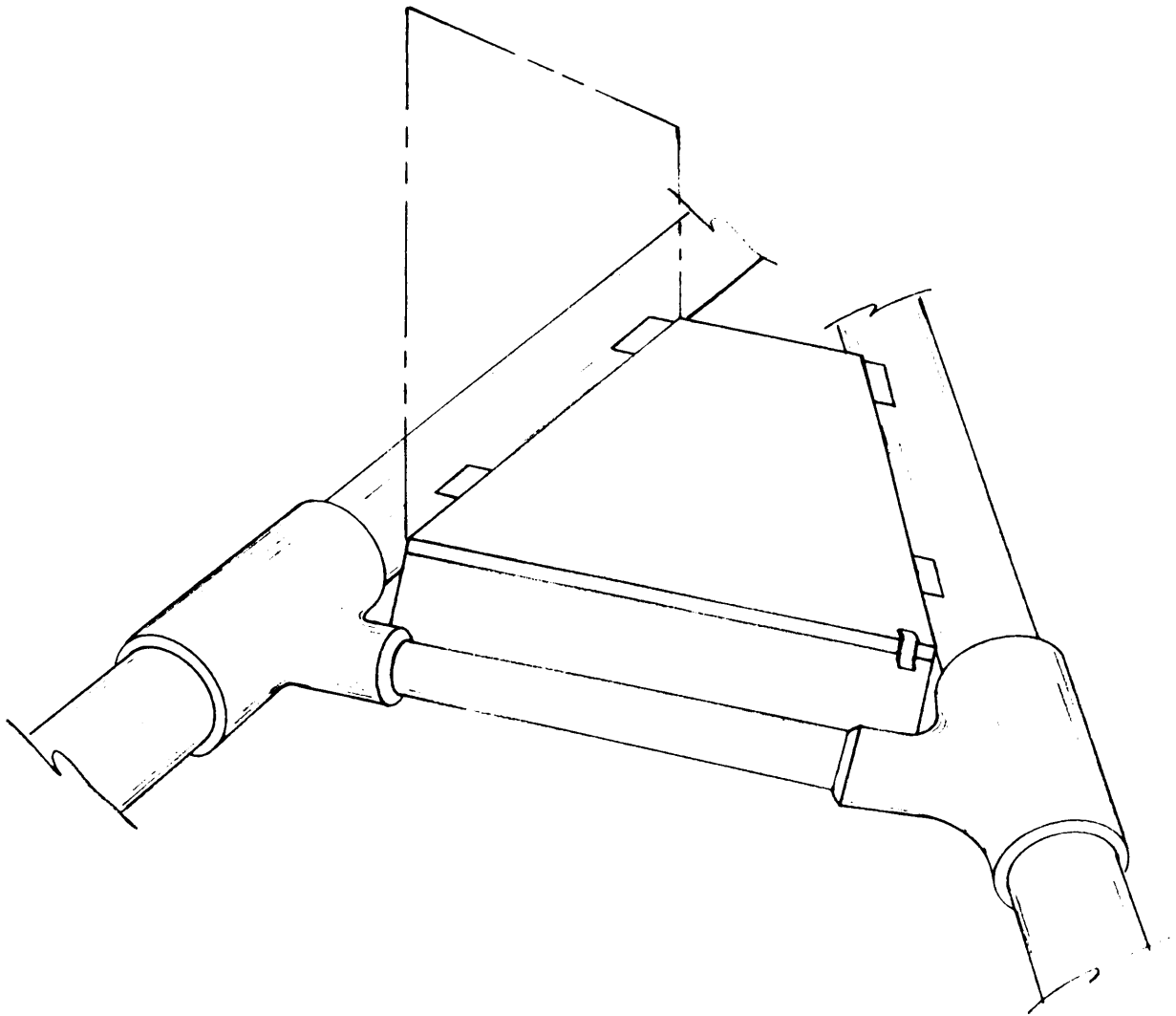


CHAINS

The chain, block and tackle, hooks, and shackles are stored in an open mesh rack built into the A-frame. The tools as well as the open mesh rack are difficult to decontaminate.

M88 Recovery Vehicle

MIL-HDBK-784



CHAINS

A box with a sealing cover replaces the open mesh rack, prevents contamination of the equipment, and is easier to decontaminate.

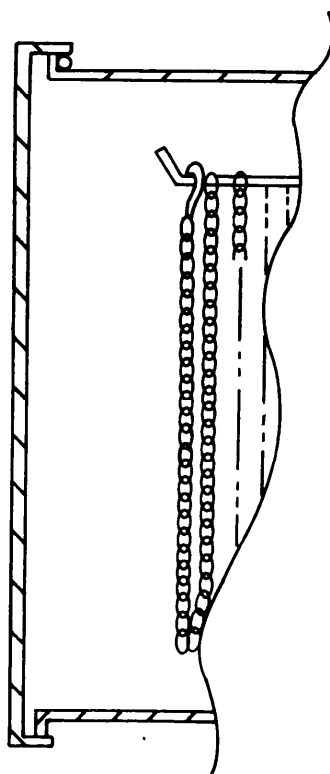
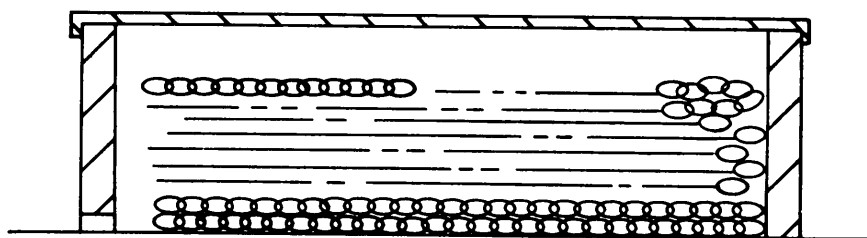


CHAINS

Exposed chains must be removed and soaked in decontaminating solution for effective decontamination.

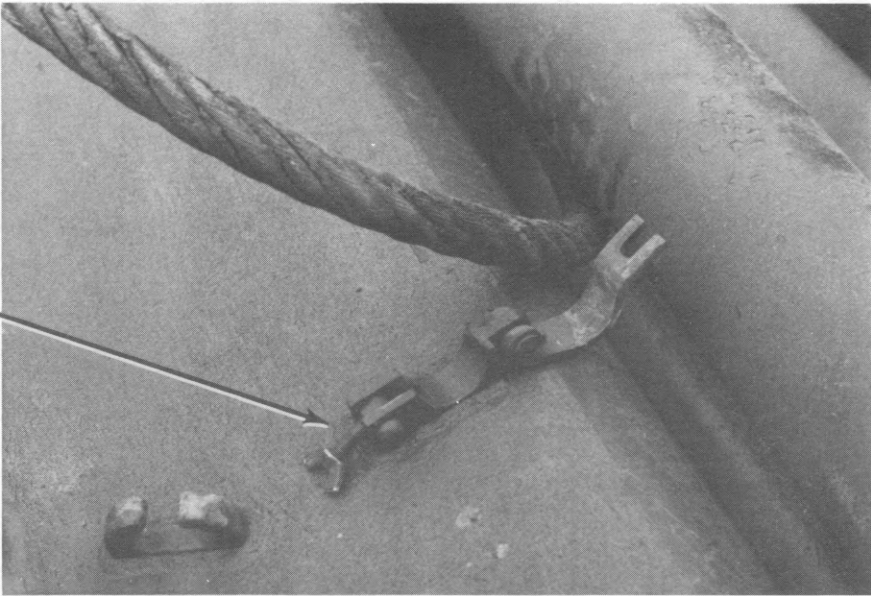
M88 Recovery Vehicle

MIL-HDBK-784



CHAINS

A locker protects the chain from contaminants. Hanging storage limits tangles and allows easier access.

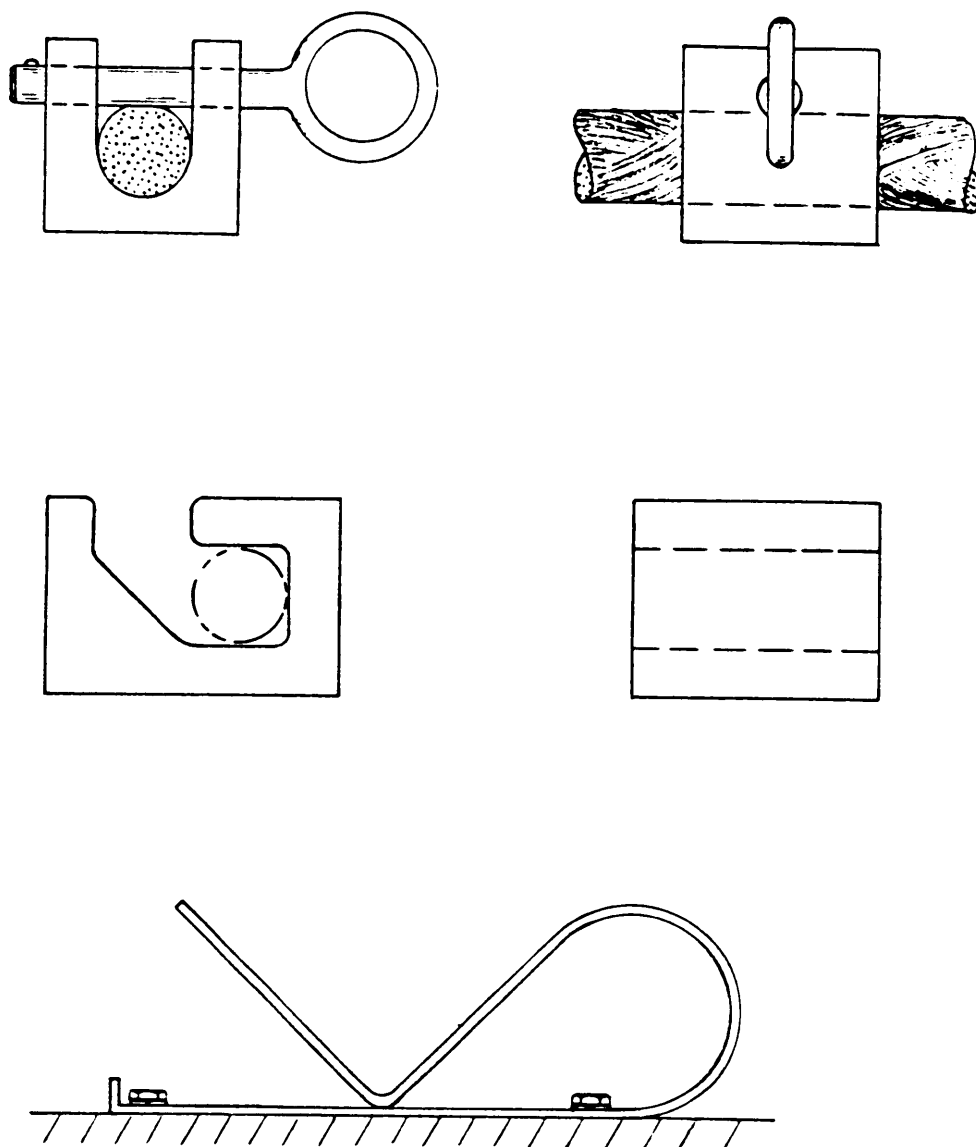


CLAMPS

The clamps used to hold the cables are complicated and difficult to decontaminate.

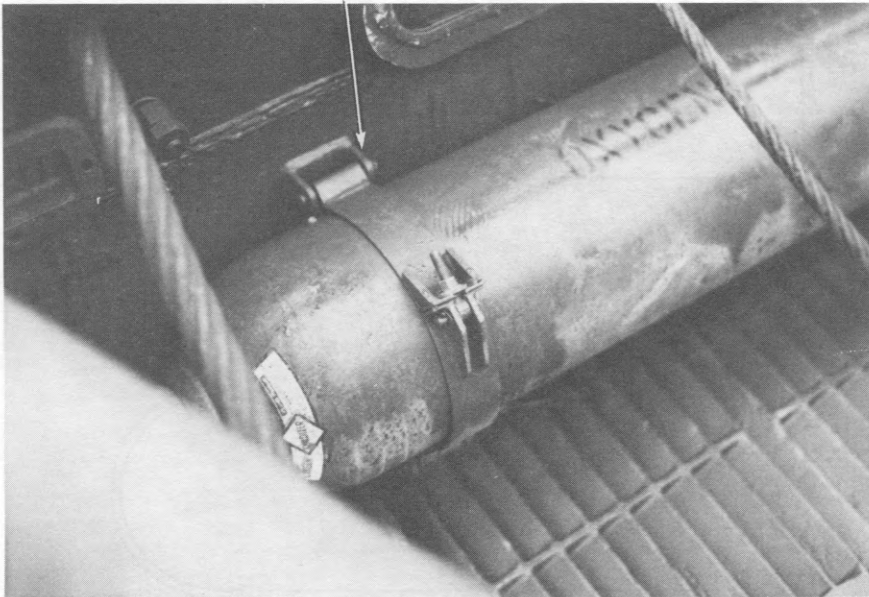
M88 Recovery Vehicle

MIL-HDBK-784



CLAMPS

Simpler clamp designs facilitate decontamination.

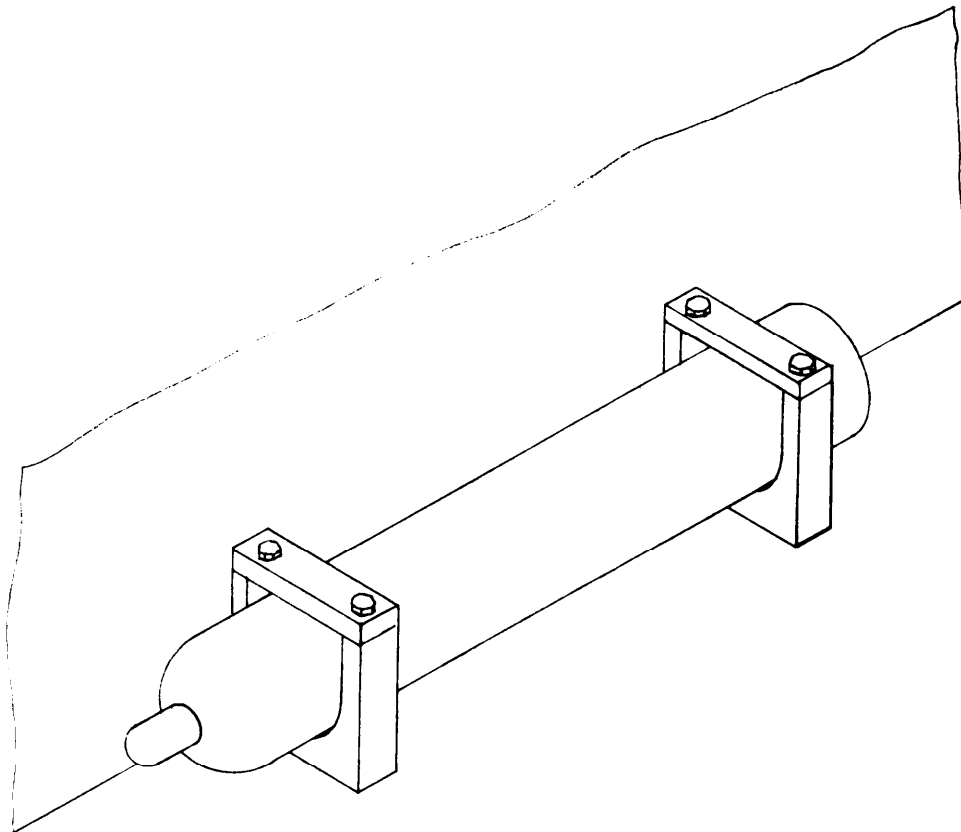


CLAMPS

The gas bottle strap and clamp have many small areas that are difficult to decontaminate.

M88 Recovery Vehicle

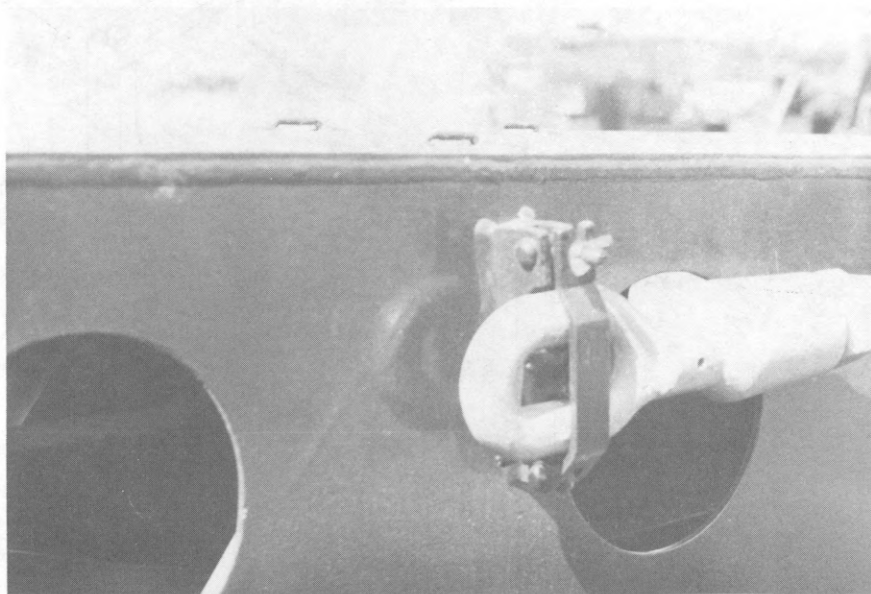
MIL-HDBK-784



CLAMPS

A simpler, more permanent type of mount is easier to decontaminate.

MIL-HDBK-784

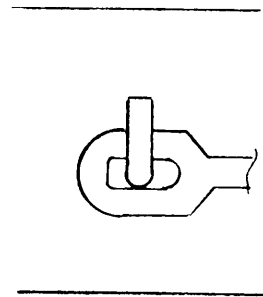
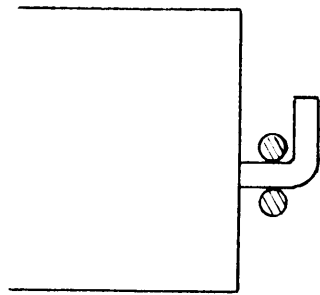


CLAMPS

The clamp fixture is exposed to and can trap contaminants and is difficult to decontaminate.

M578 Recovery Vehicle

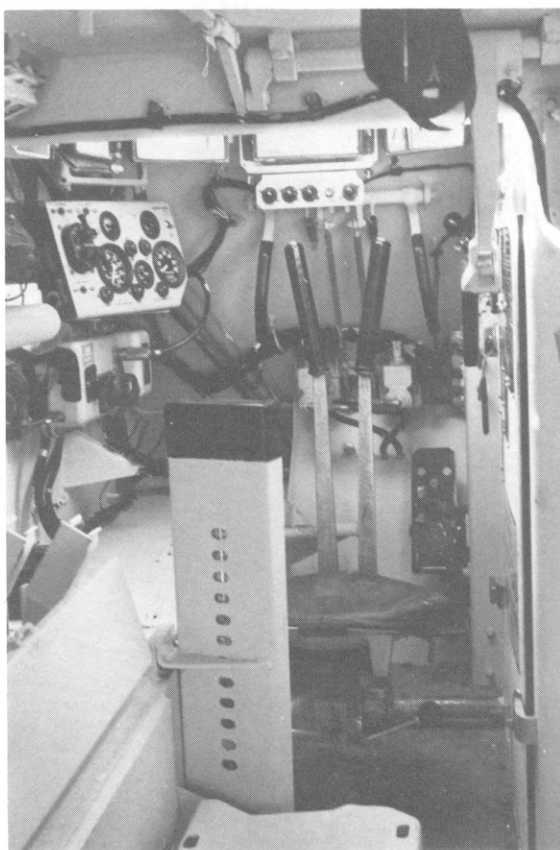
MIL-HDBK-784



CLAMPS

A solid hook prevents contaminant entrapment and facilitates decontamination.

MIL-HDBK-784

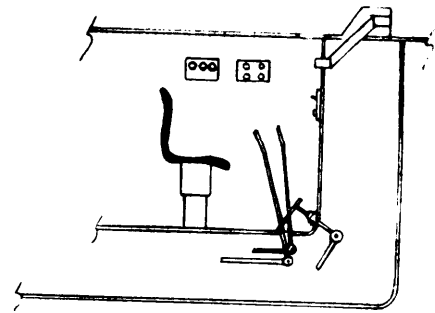
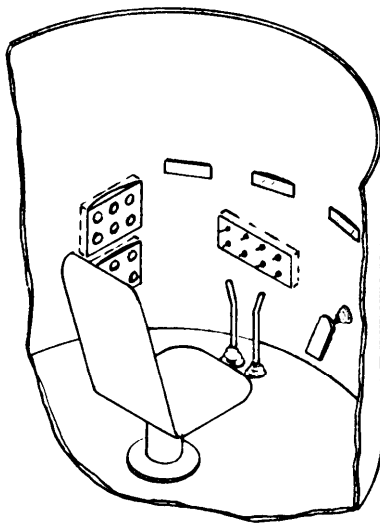


CONTROL COMPARTMENTS

Complicated arrangement exposes numerous poor-access areas to contaminants and makes decontaminant application and removal difficult.

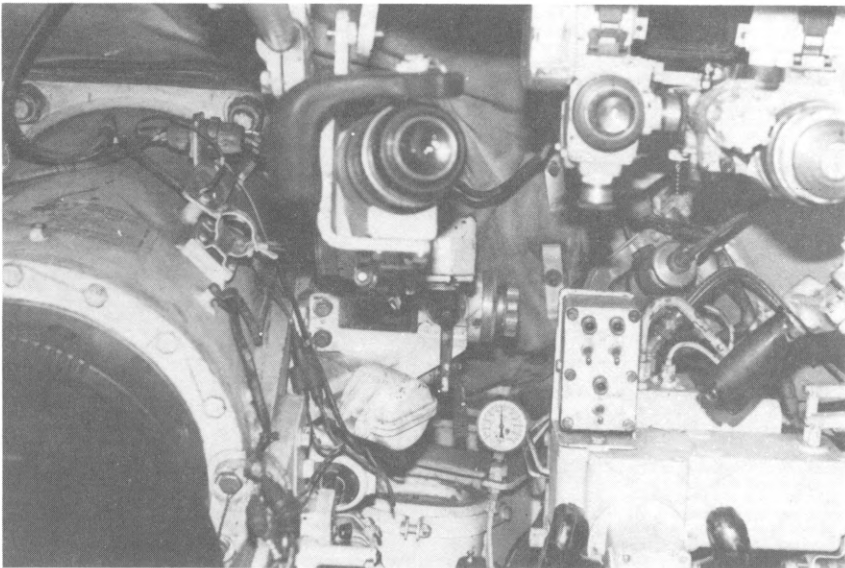
M113 Armored Personnel Carrier

MIL-HDBK-784



CONTROL COMPARTMENTS

Wall panels protect the wires, connections, electronics, cabling, and linkages from contaminants.

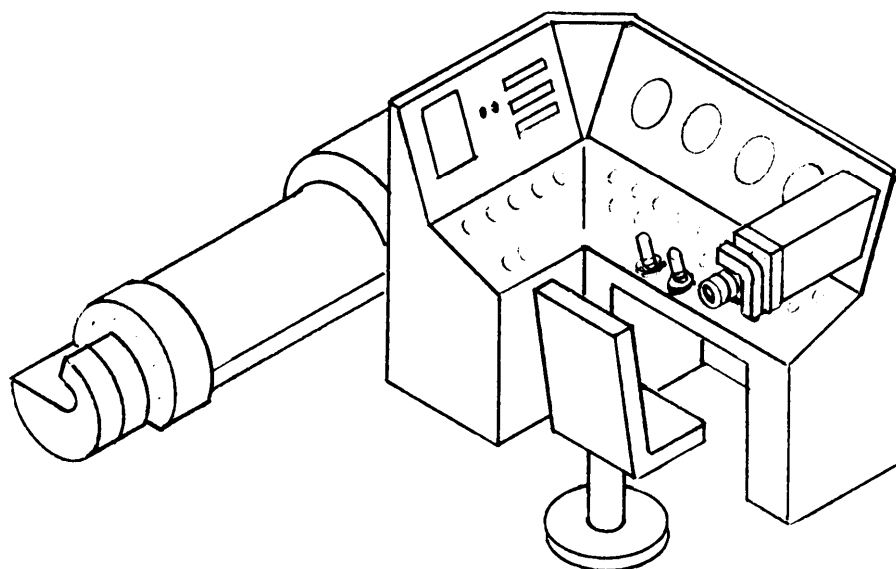


CONTROL COMPARTMENTS

Complicated arrangement exposes numerous poor-access areas to contaminants and makes decontaminant application and removal difficult.

M60 Tank

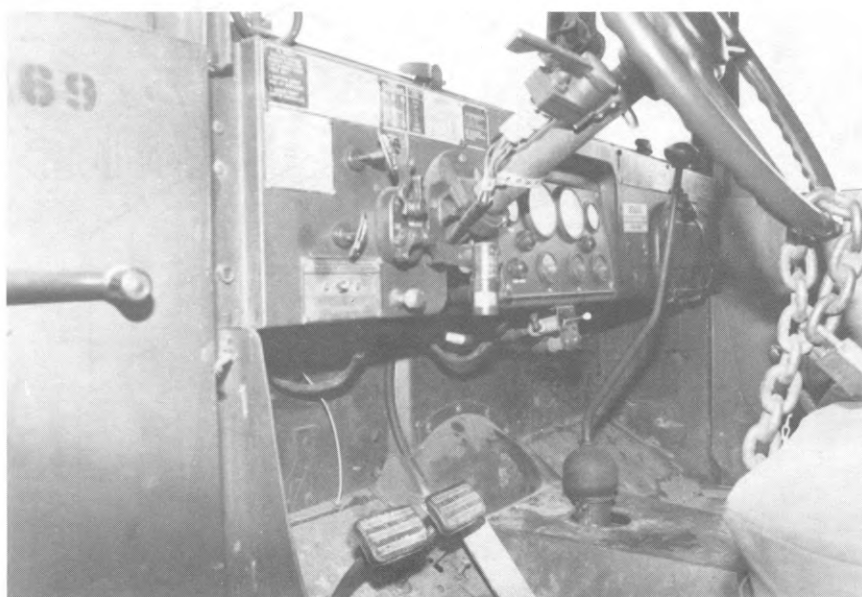
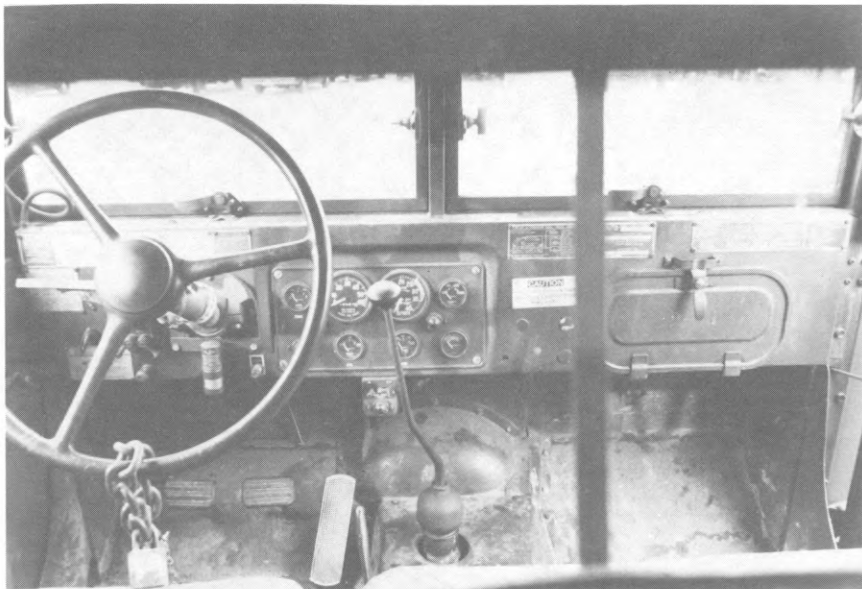
MIL-HDBK-784



CONTROL COMPARTMENTS

A control panel protects the electronics and wiring from contaminants and facilitates decontamination.

MIL-HDBK-784

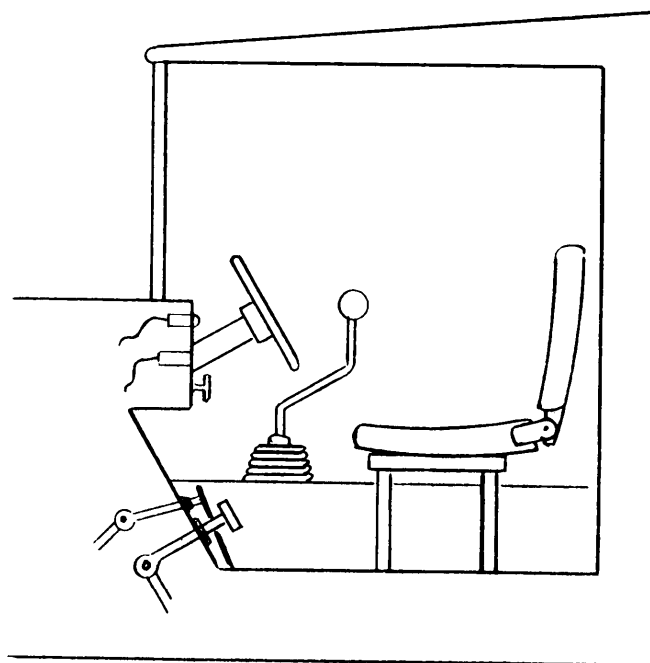


CONTROL COMPARTMENTS

The cab design exposes many poor-access areas to contaminants and makes the application and removal of decontaminants difficult.

M35 Truck

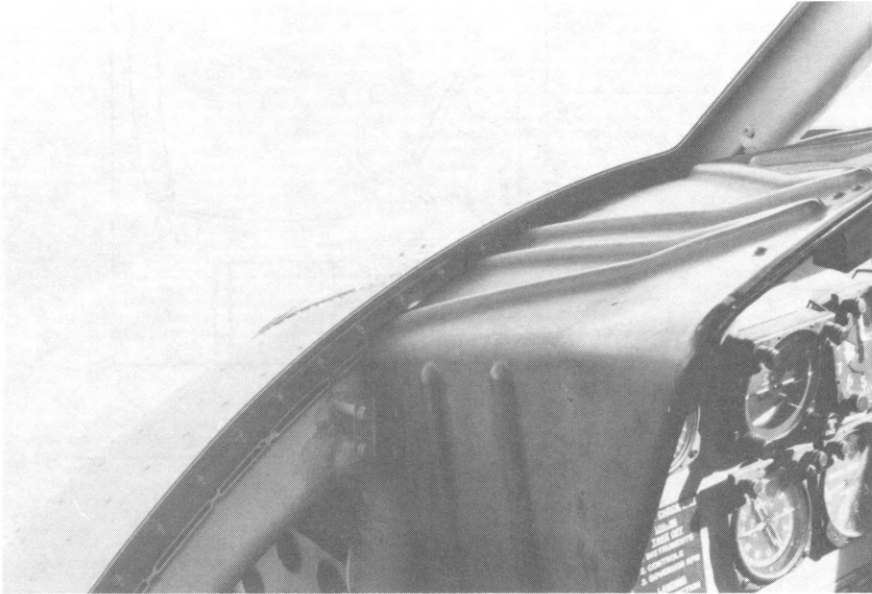
MIL-HDBK-784



CONTROL COMPARTMENTS

A simplified design includes panels and bellows for protection against contaminants and folding molded metal seats to reduce contaminant/de-contaminant absorption.

MIL-HDBK-784

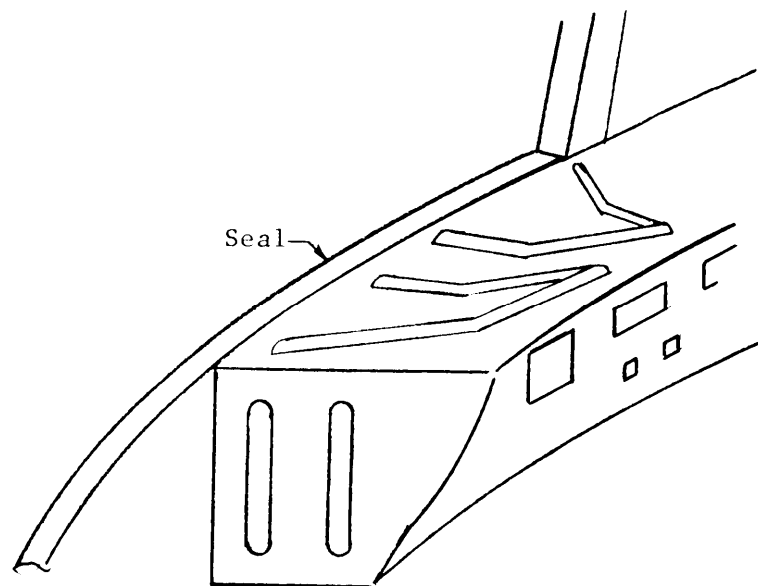


CONTROL COMPARTMENTS

The gap above the instrument panel allows contaminant entry and complicates decontamination.

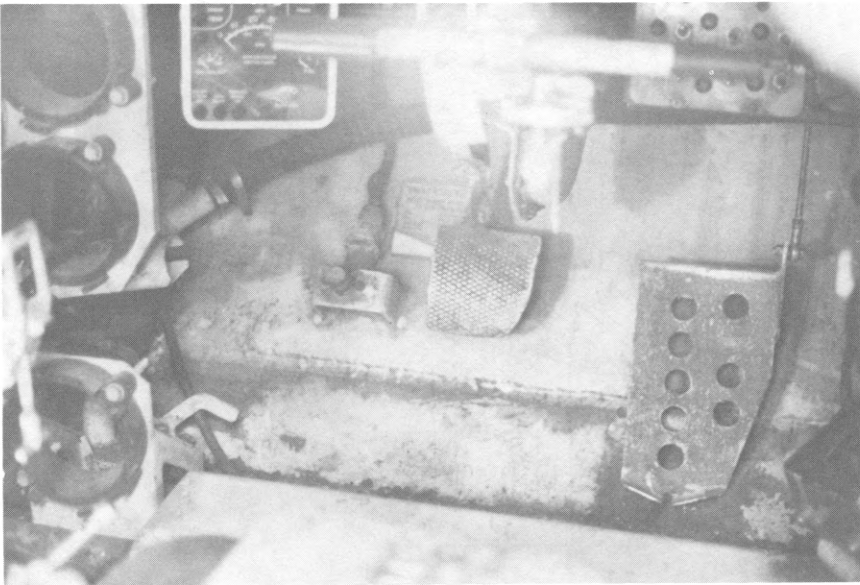
UM-1M Helicopter (Huey)

MIL-HDBK-784



CONTROL COMPARTMENTS

A seal eliminates the gap.

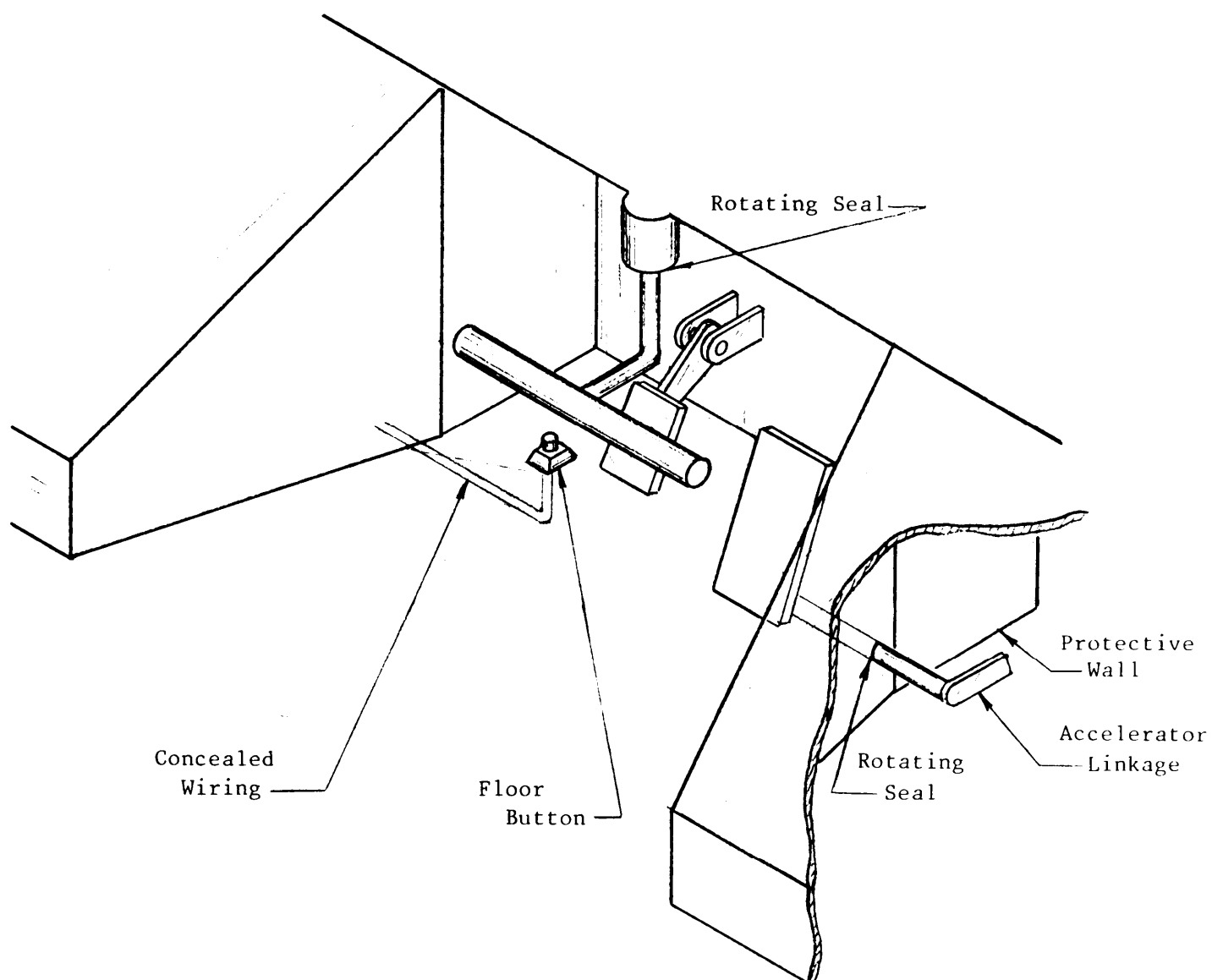


CONTROL COMPARTMENTS

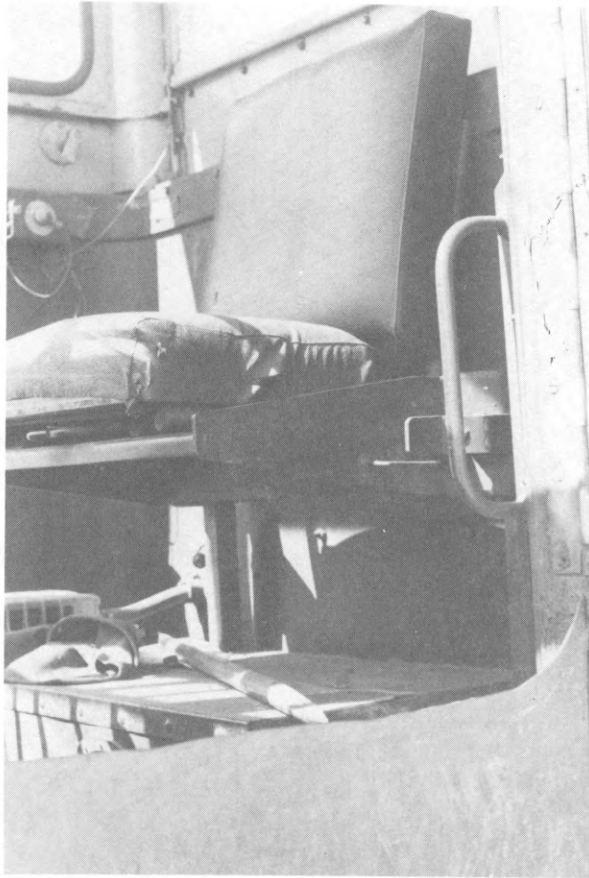
The steering mechanism and linkage, pedals, and switches are exposed to contaminants and are difficult to decontaminate.

M551 Tank (Sheridan)

MIL-HDBK-784

CONTROL COMPARTMENTS

Wall panels and seals prevent contaminant entrapment and facilitate decontamination.

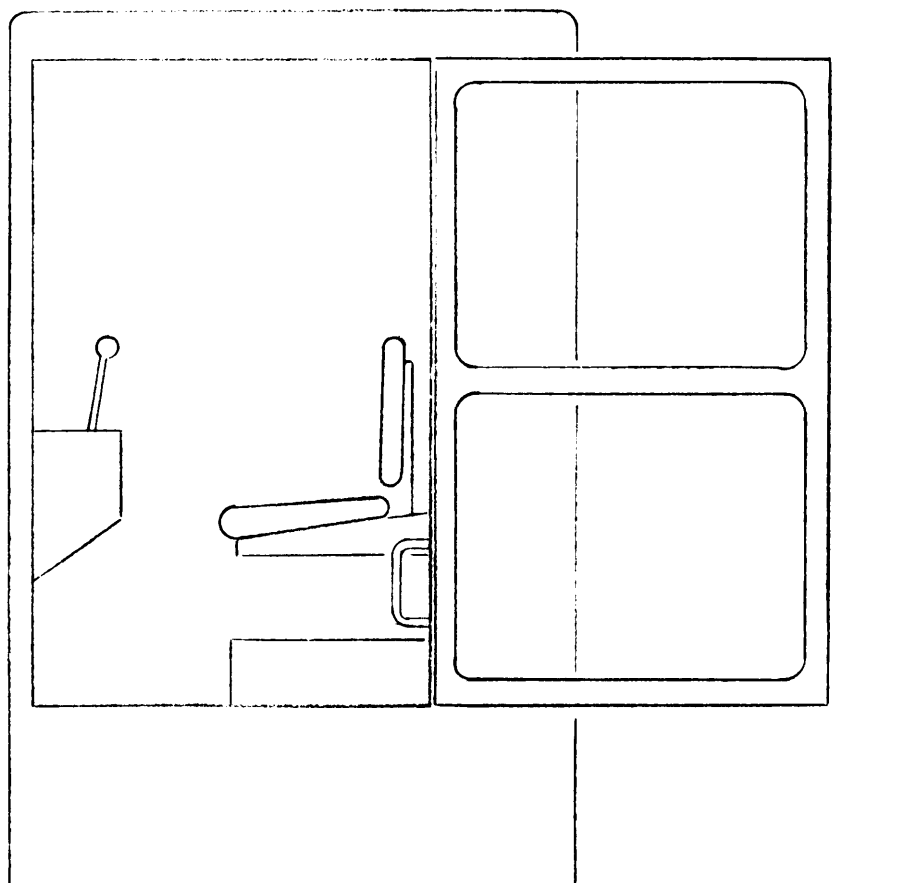


CONTROL COMPARTMENTS

The seat design is generally good from a contamination/decontamination viewpoint, provided that the cushions are easily removable for replacement. The handhold also is generally well designed. However, the lip along the edge of the floor hinders drainage of liquid decontaminants.

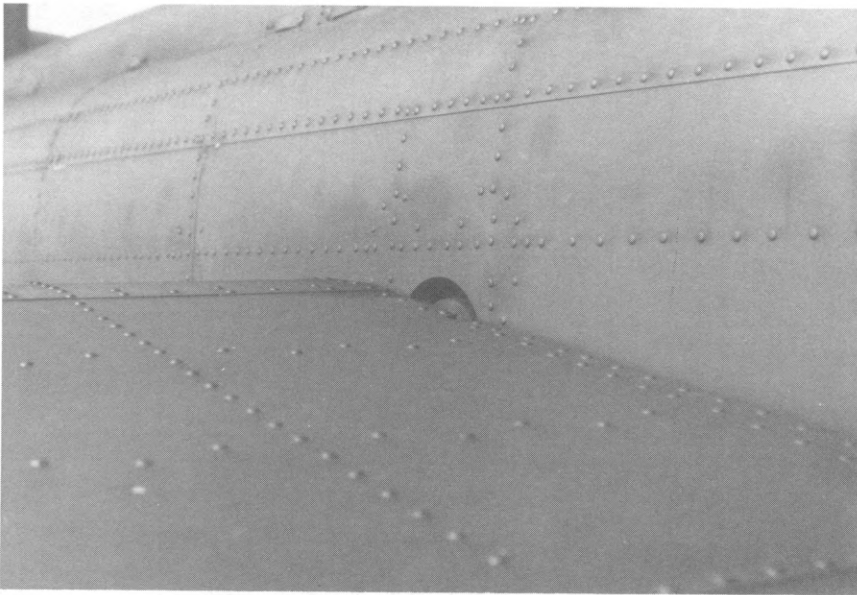
Road Grader

MIL-HDBK-784



CONTROL COMPARTMENTS

Removing the lip along the edge of the floor facilitates drainage of liquid decontaminants.

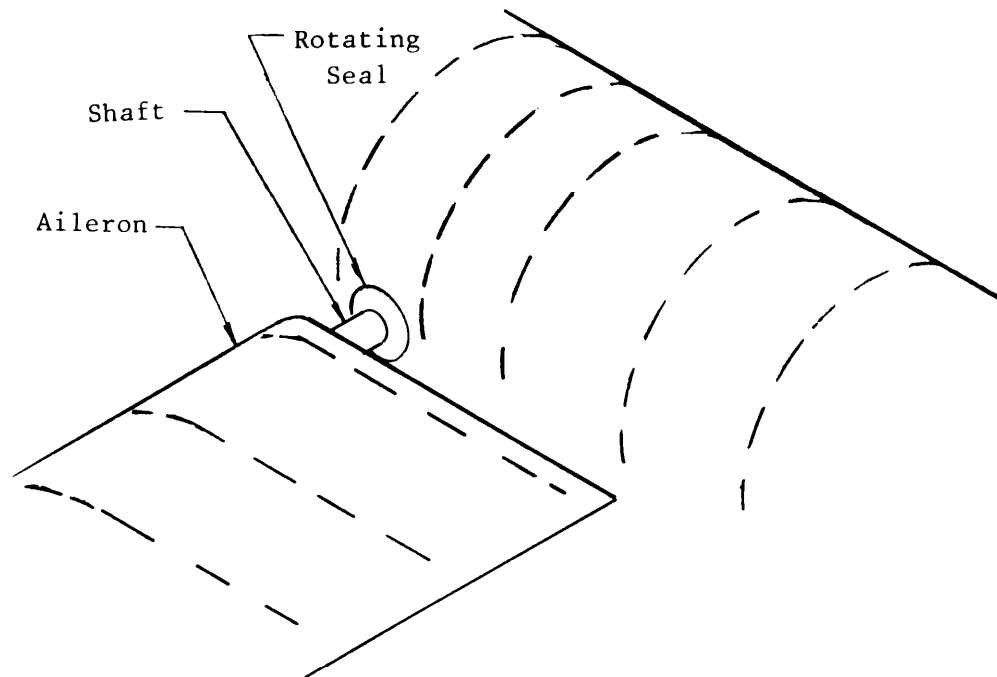


CONTROL SURFACES, AIRCRAFT

The opening in the fuselage for the rotary shaft can trap airborne contaminants and contaminated dust. The area inside the opening is difficult to decontaminate, particularly if lubricant is present.

UH-1H Helicopter (Huey)

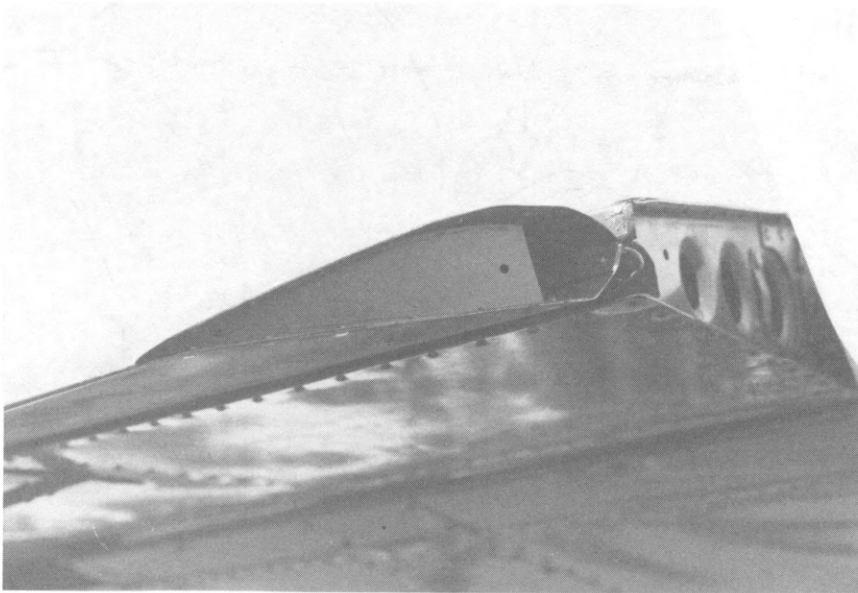
MIL-HDBK-784



CONTROL SURFACES, AIRCRAFT

Installing a rotating seal in the fuselage opening and around the aileron shaft prevents contaminants from entering the fuselage.

MIL-HDBK-784

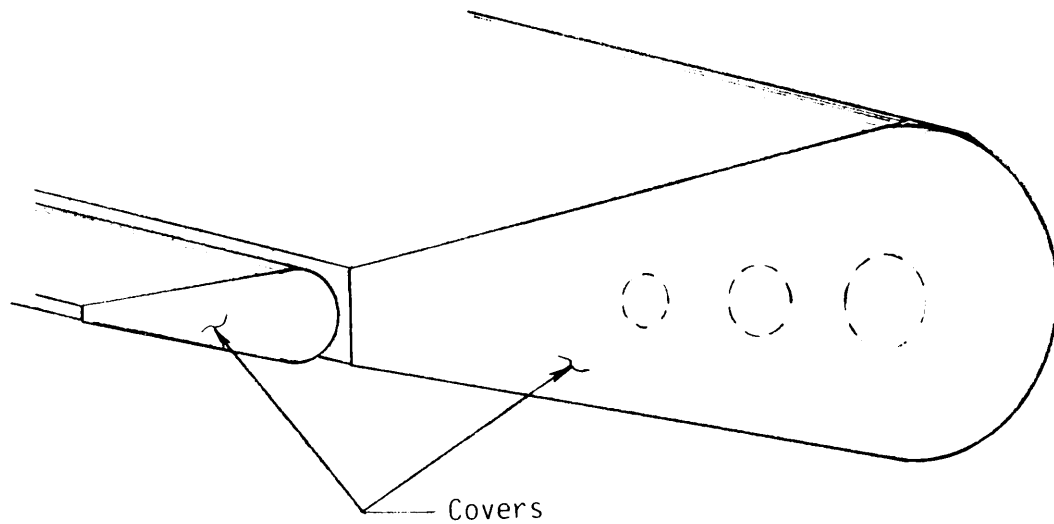


CONTROL SURFACES, AIRCRAFT

The openings in the ends of the flaps allow contaminant entry.

L23F Airplane

MIL-HDBK-784



CONTROL SURFACES, AIRCRAFT

A cover over the openings prevents contaminant entry.

MIL-HDBK-784

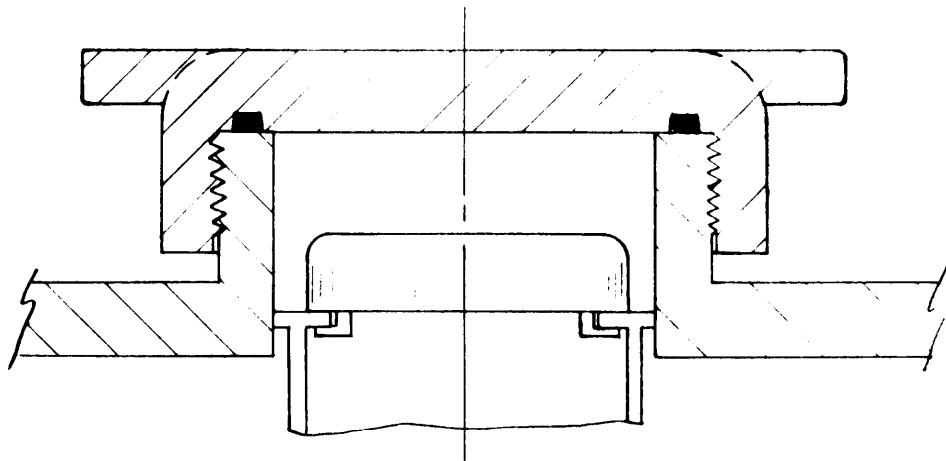


COVERS

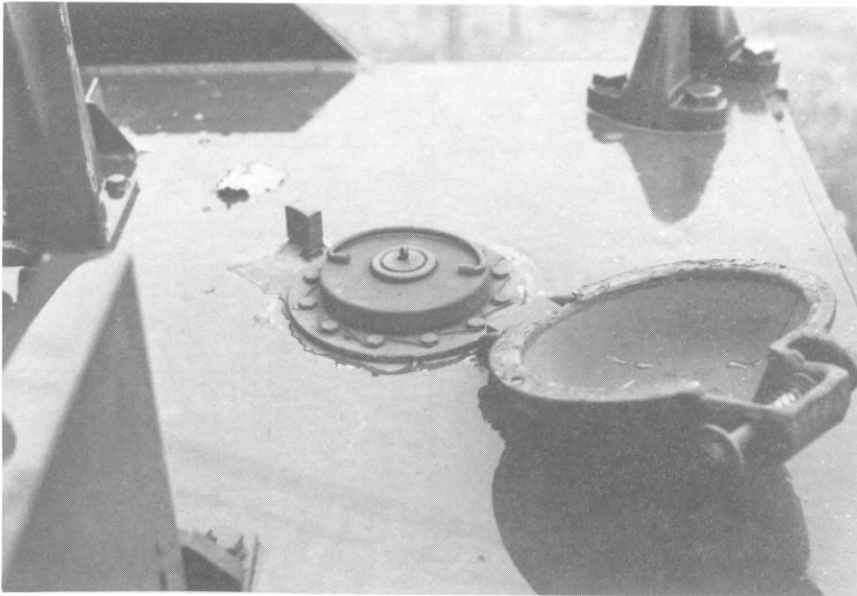
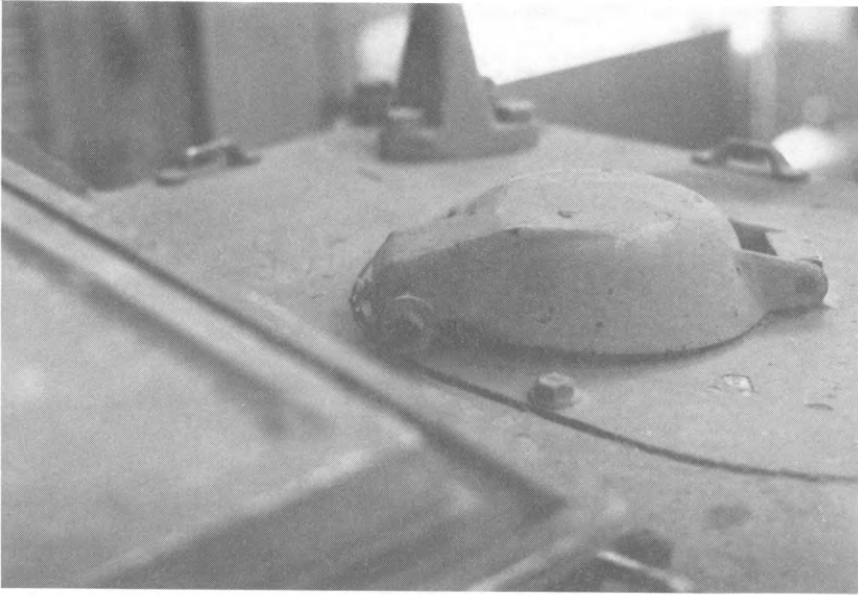
The pin attachment for the fuel cap cover is highly susceptible to contamination and is difficult to decontaminate. Contaminants have access to the inner cap under the lower edge of the cover.

M60 Tank

MIL-HDBK-784

COVERS

A raised ring around the inner cap blocks access by contaminants. A threaded, sealed cover provides positive protection, has fewer entrapment areas, and is easier to clean.

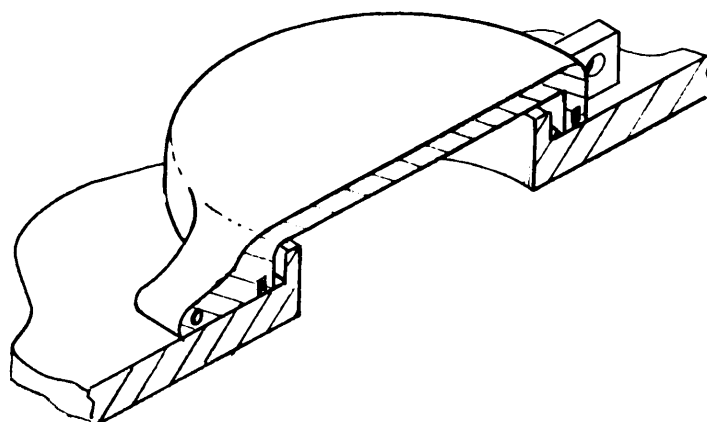


COVERS

The ballistic cover allows contaminant/decontaminant access to the filler cap.

M113 Armored Personnel Carrier

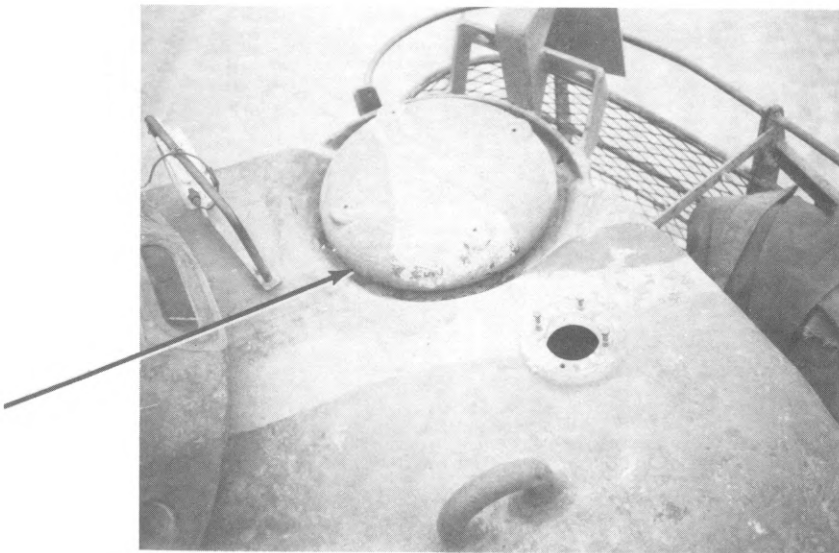
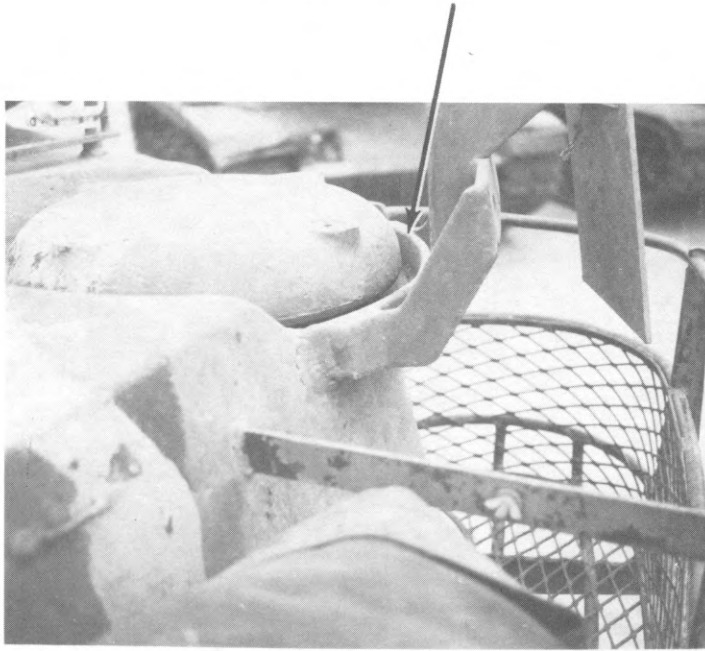
MIL-HDBK-784



COVERS

A flange on the deck surface surrounds the inner cap and prevents material from being washed against the cap. A seal in the cover is flush with the deck, preventing contaminant access.

MIL-HDBK-784

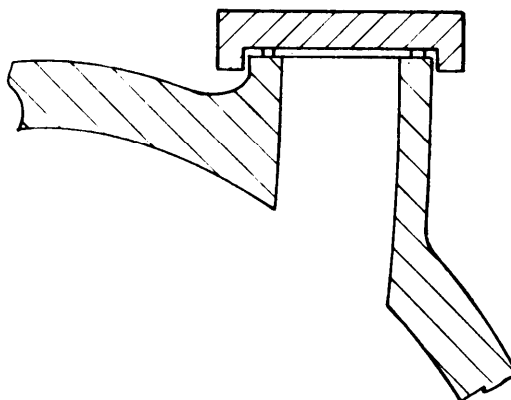


COVERS

The recess around and under the gas evacuation cover traps contaminant and is difficult to decontaminate.

M60 Tank

MIL-HDBK-784



COVERS

Eliminating the recess around the gas evacuator cover allows decontaminating solution to flow around the flange, washing contaminant down the rear of the turret.

MIL-HDBK-784

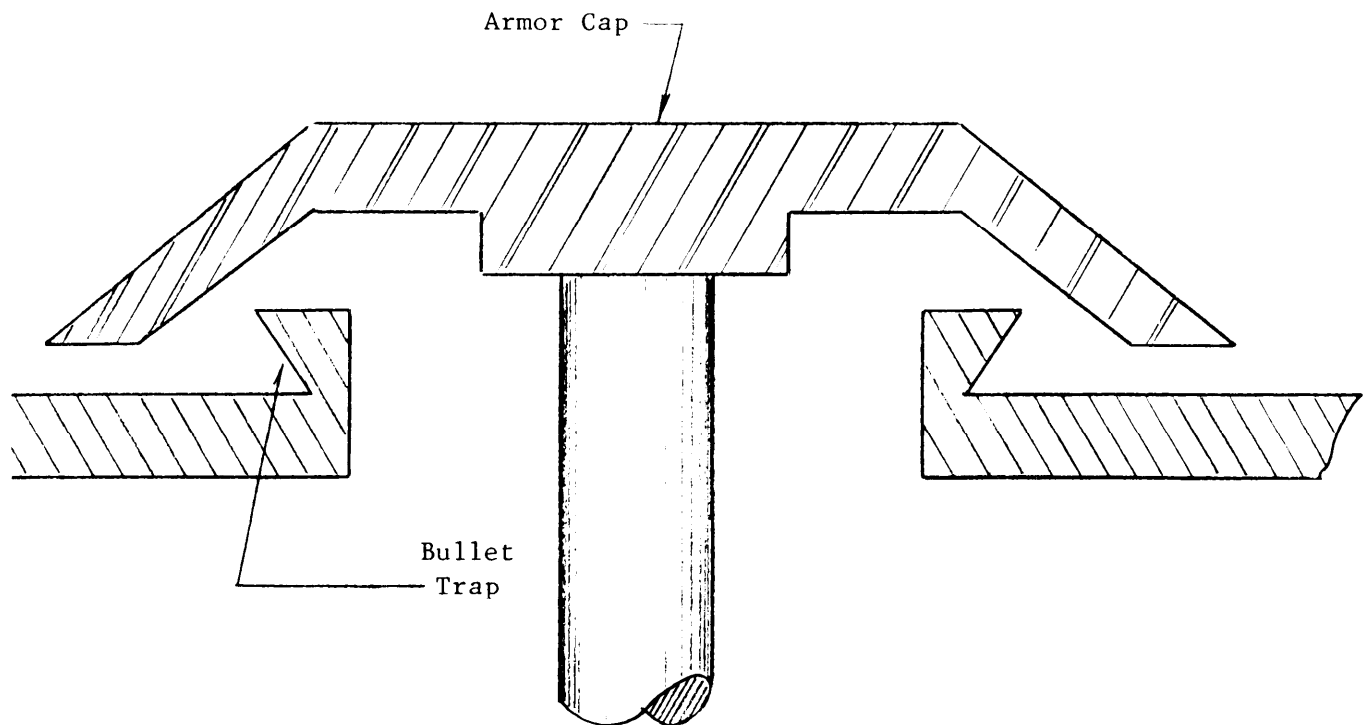


COVERS

The gaps between the tank hull and the cover of the gun gas exhaust vent are exposed to contaminants and are difficult to decontaminate.

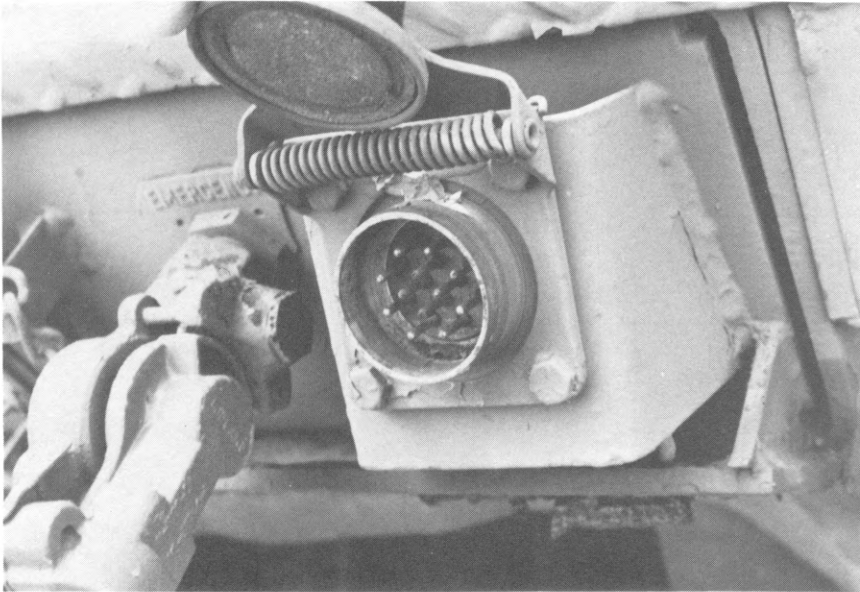
M551 Tank (Sheridan)

MIL-HDBK-784



COVERS

A protective ring around the inside of the cap eliminates the exposed gaps.

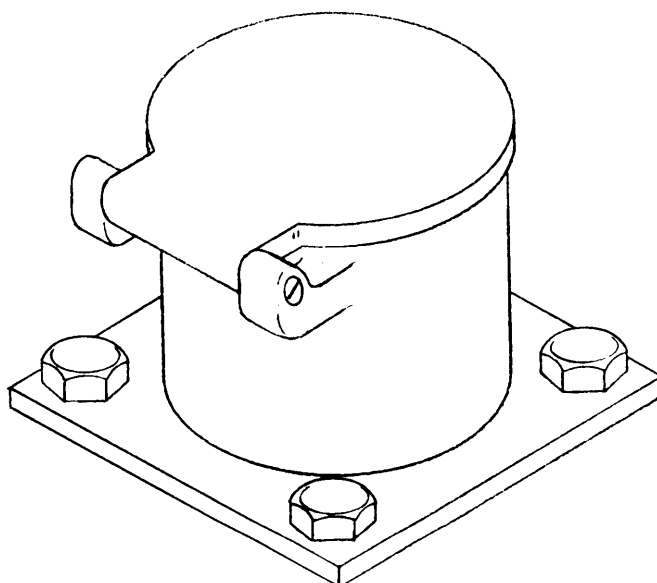


COVERS

The exposed closure spring can trap contaminants and is difficult to decontaminate.

M818 Tractor Truck

MIL-HDBK-784



COVERS

An enclosed spring is protected from contaminants.

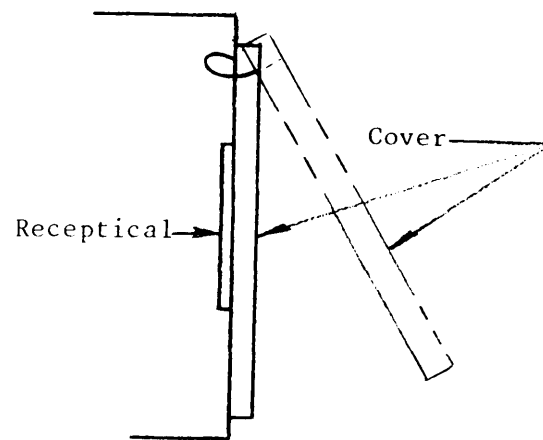


COVERS

The hinges and attaching plate of the receptacle covers are difficult to decontaminate.

Diesel Generator

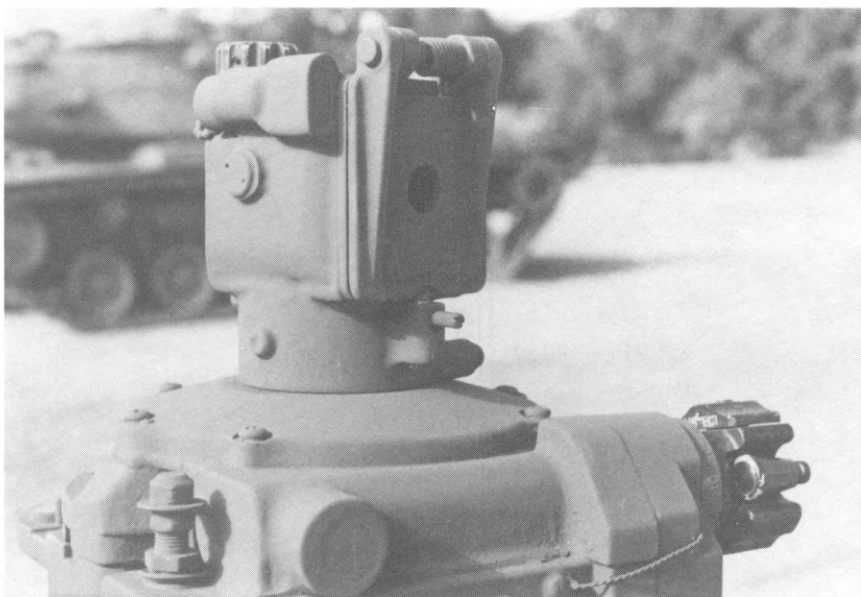
MIL-HDBK-784



COVERS

A simplified design, with a closing spring on the inside of the cover, limits contaminant entrapment.

MIL-HDBK-784

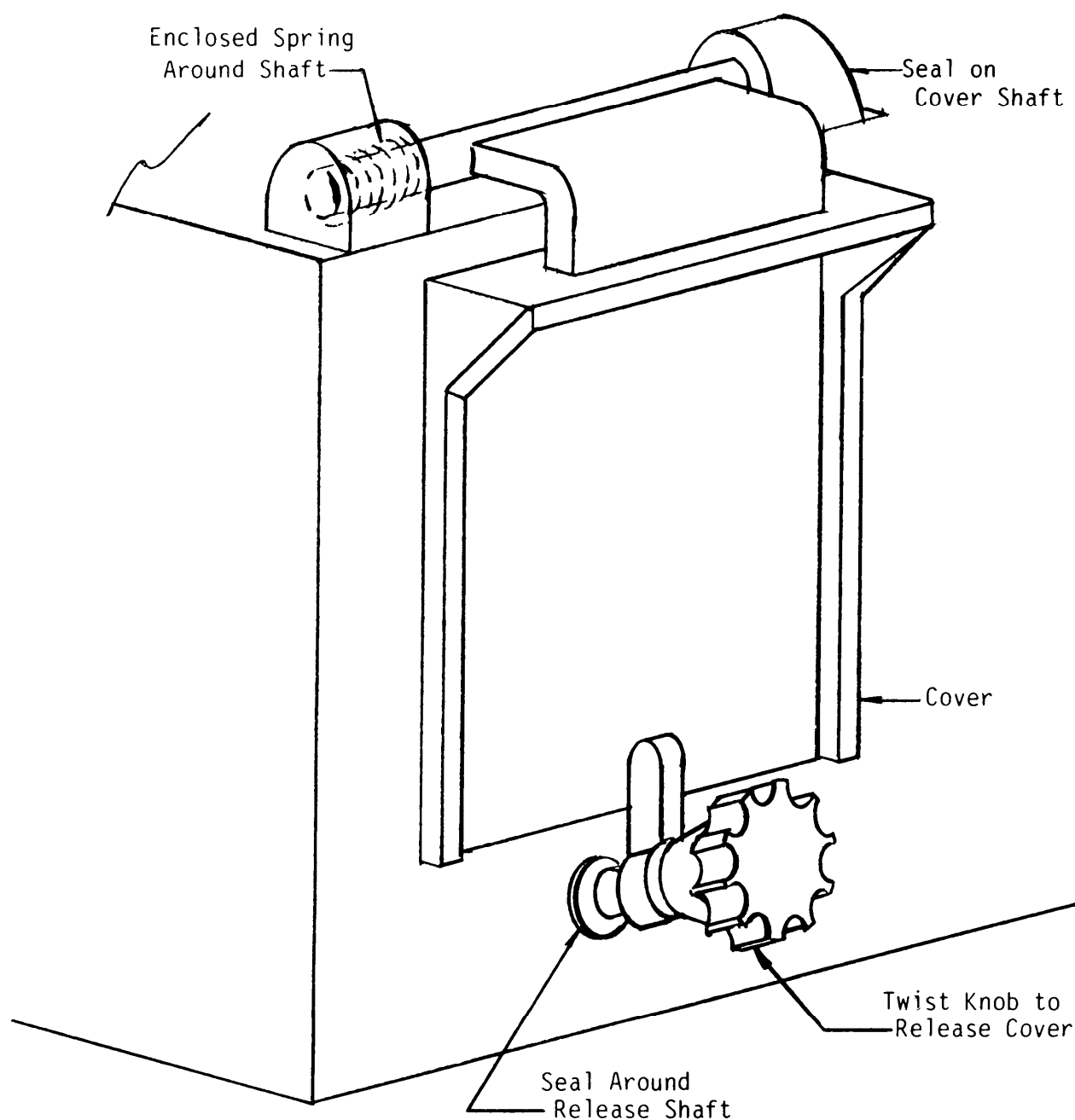


COVERS

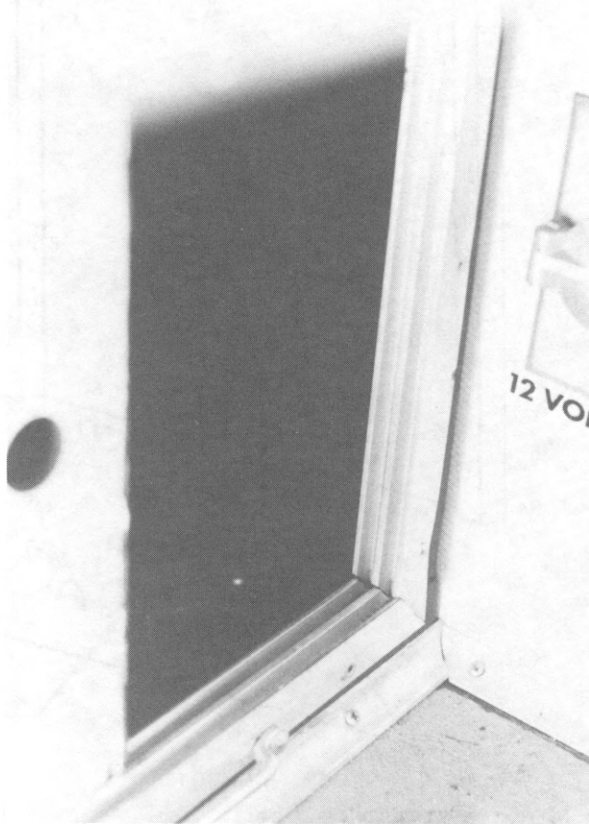
The instrument cover is accessible from both sides and is easy to decontaminate. However, the exposed spring that opens the cover, and the spring-loaded latch, trap contaminants and are difficult to decontaminate.

M102 Howitzer

MIL-HDBK-784

COVERS

Replacing the spring-loaded latch with a rotary catch and installing the opening hinges inside sealed lugs prevent entrapment of contaminants.

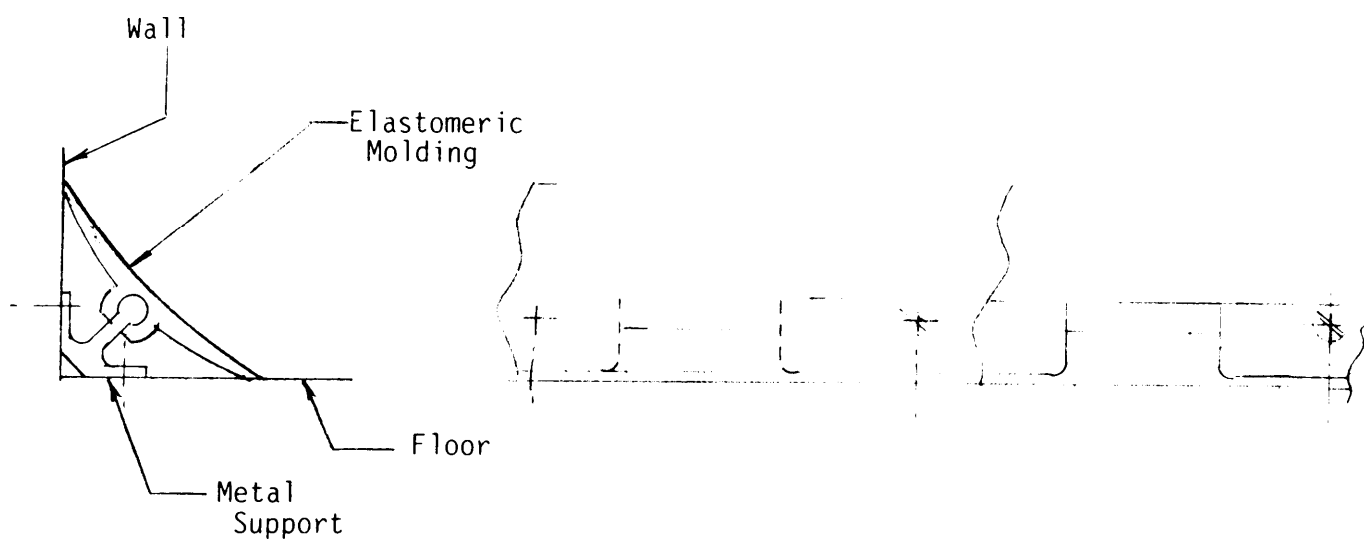


DECKS

Rigid, metal molding is difficult to install without gaps between the molding and floor and between the molding and walls. In addition, sheet metal screws with cross-point heads are difficult to decontaminate.

M886 Ambulance

MIL-HDBK-784



DECKS

A semi flexible molding, pressed onto permanently installed metal studs, may decrease the problem of gaps and reduce the number of contaminant traps. Such molding will be relatively easier to remove than screwed-on molding.

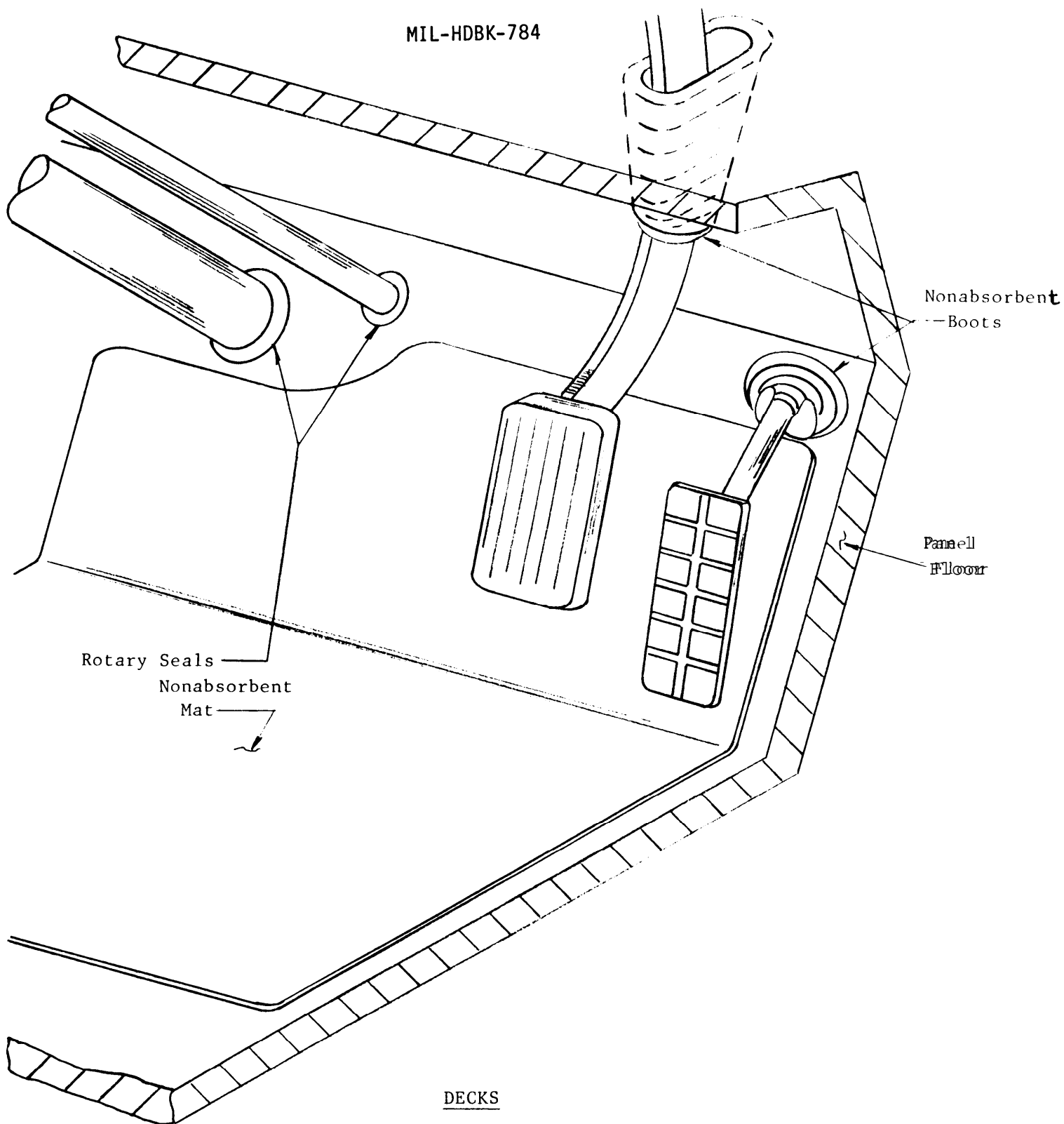


DECKS

The rubber floor mat in the driver's area can absorb contaminants or trap contaminants between the mat and floor. In addition, the rods through the floor lack seals and would be difficult to decontaminate, and contaminants can collect between the grooves on the pedals.

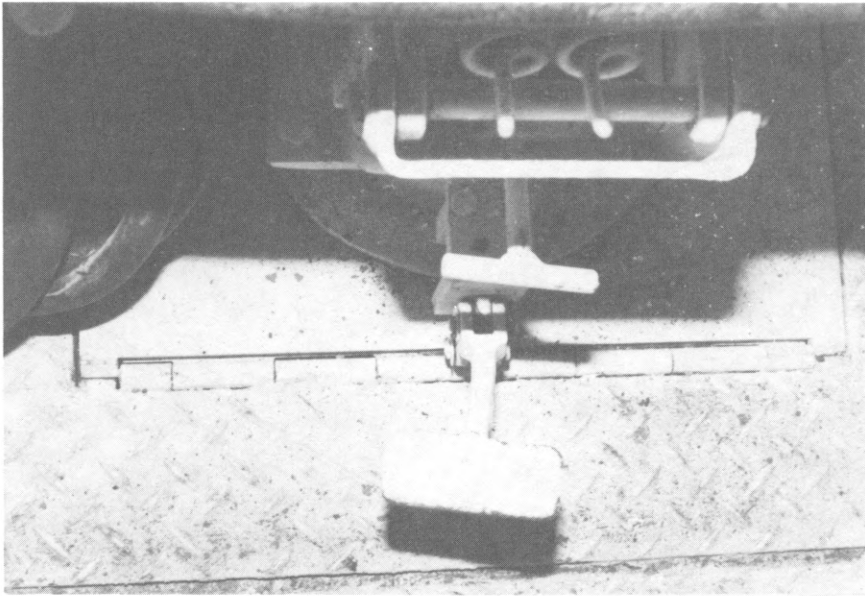
Stake Truck (Loadstar)

MIL-HDBK-784



A nonabsorbent material replaces the rubber mat. Seals around the rods prevent contaminant entry and entrapment. In addition, holes or wider grooves in the pedals facilitate decontamination.

MIL-HDBK-784

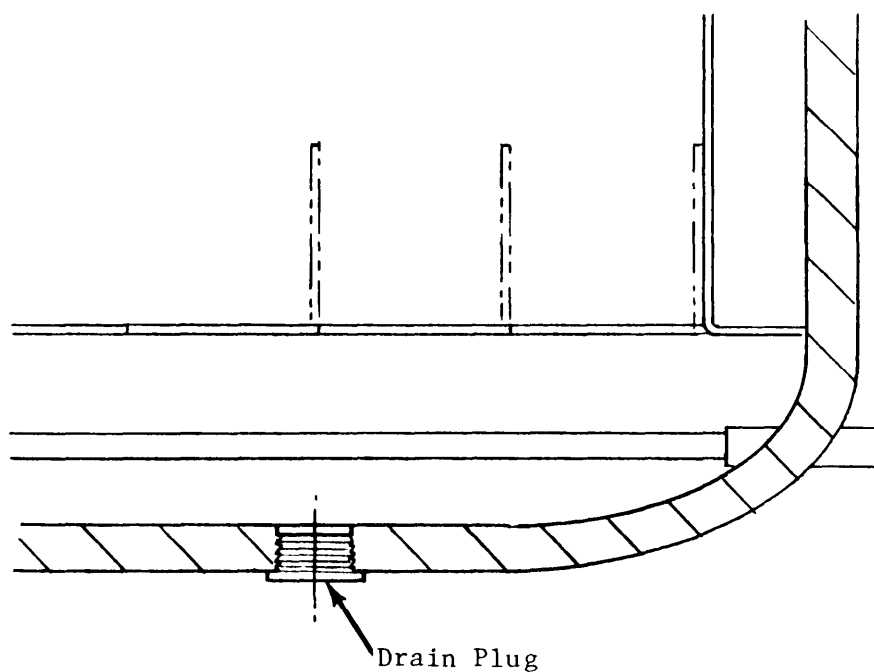


DECKS

The floor plates cannot be easily removed for decontamination.

M88 Recovery Vehicle

MIL-HDBK-784



DECKS

Easily removable floor plates facilitate decontamination. The plates should be positioned so that their removal does not require moving major items. Drains in the sump allow draining of decontaminants. To facilitate decontamination, the sump should not be sealed from the main compartment; however, the instrument panels and wiring should be sealed from the sump.

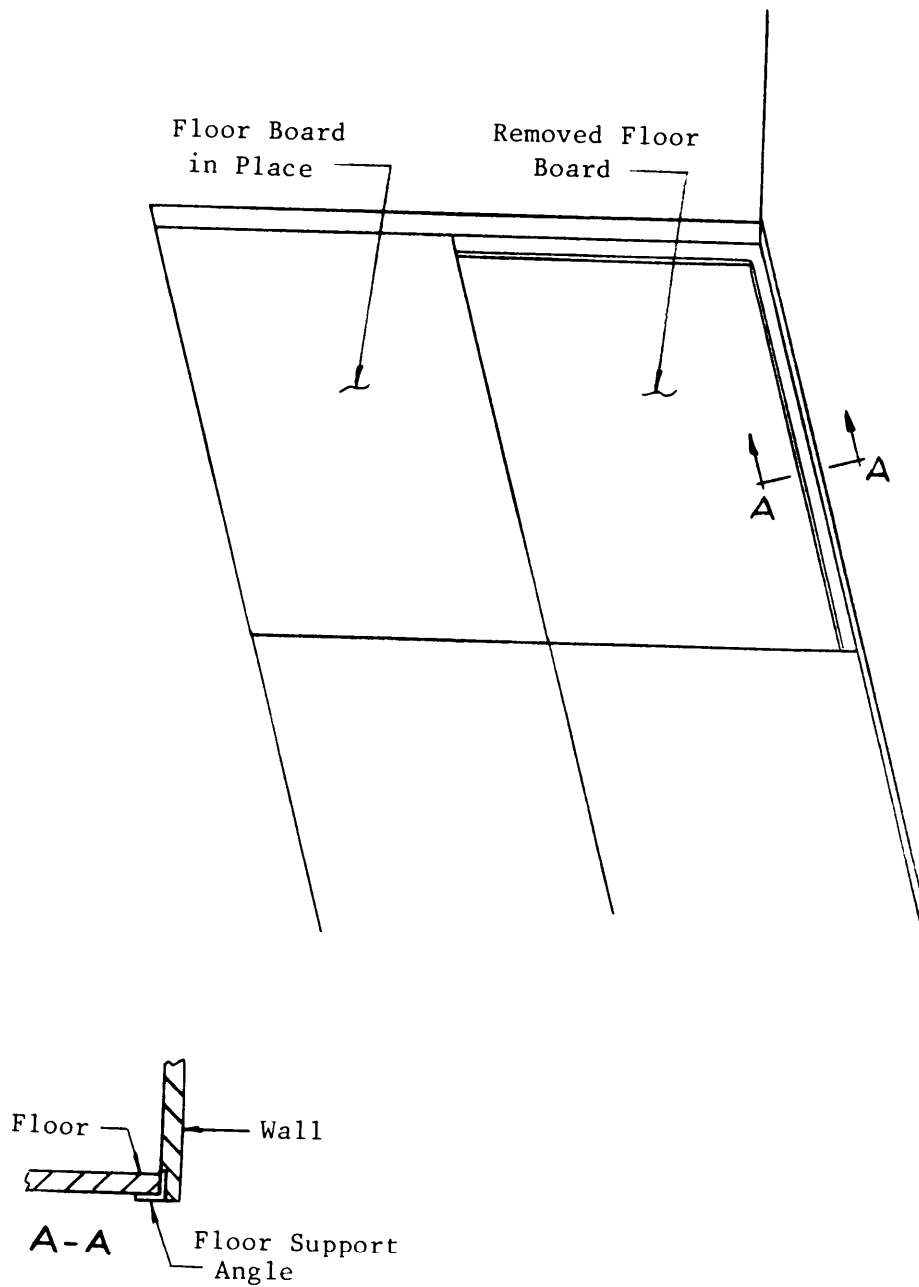


DECKS

Wooden boards may absorb, and board joints may trap, contaminants.

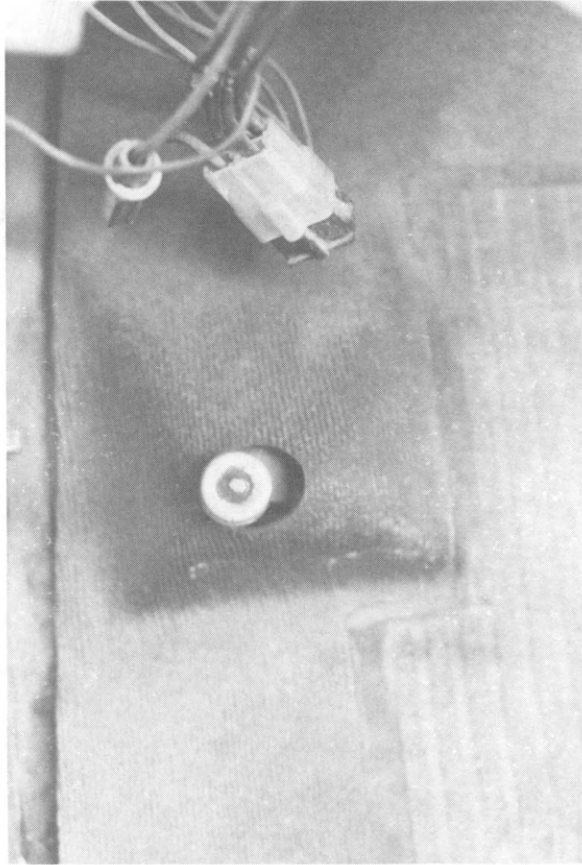
M109 Shop Van Truck

MIL-HDBK-784



DECKS

Removable metal deck plates eliminate absorption and entrapment problems and are easy to decontaminate.

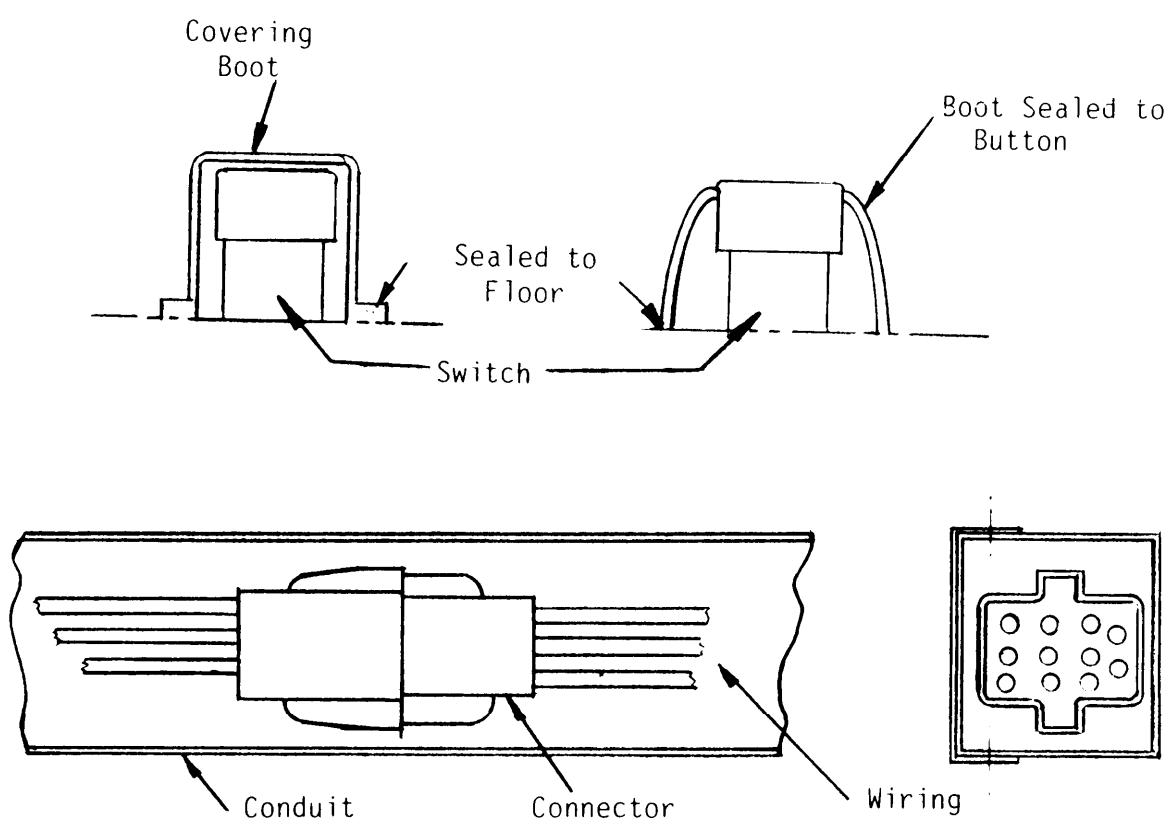


DECKS

The open dimmer switch and the hole in the floor allow contaminant entry. In addition, loose wiring and connectors are difficult to decontaminate or replace.

Stake Truck (Loadstar)

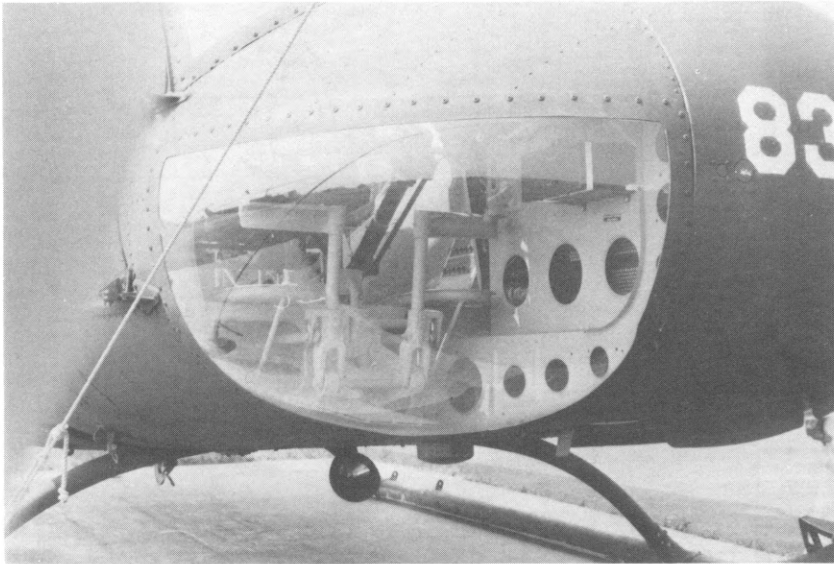
MIL-HDBK-784



DECKS

A boot protects the switch from contaminants (top) and a conduit protects the wiring (bottom).

MIL-HDBK-784

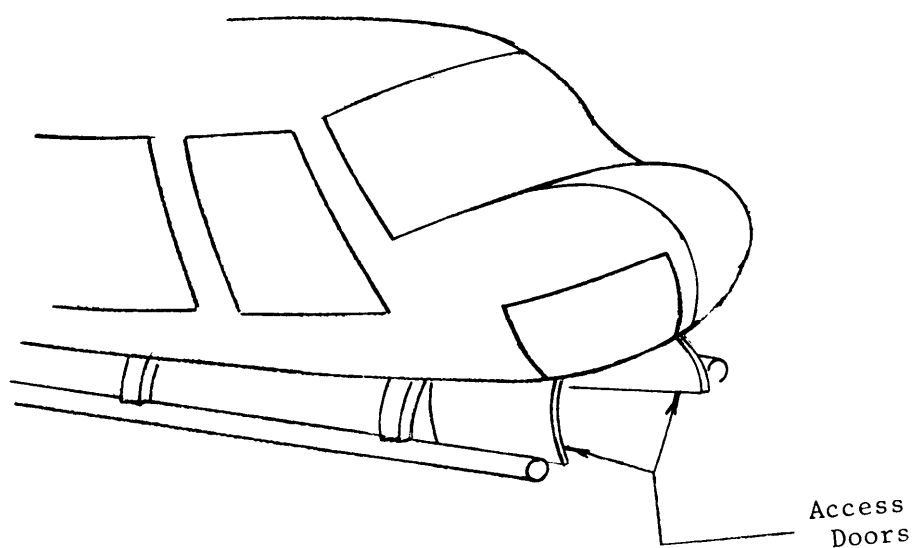


DECKS

Interior decontamination is hindered by poor access and poor drainage.

UH-1M Helicopter (Huey)

MIL-HDBK-784



DECKS

A large access panel or doors in the bottom of the fuselage allows frames , floor plates, and control bars to be sprayed with decontaminating solution.

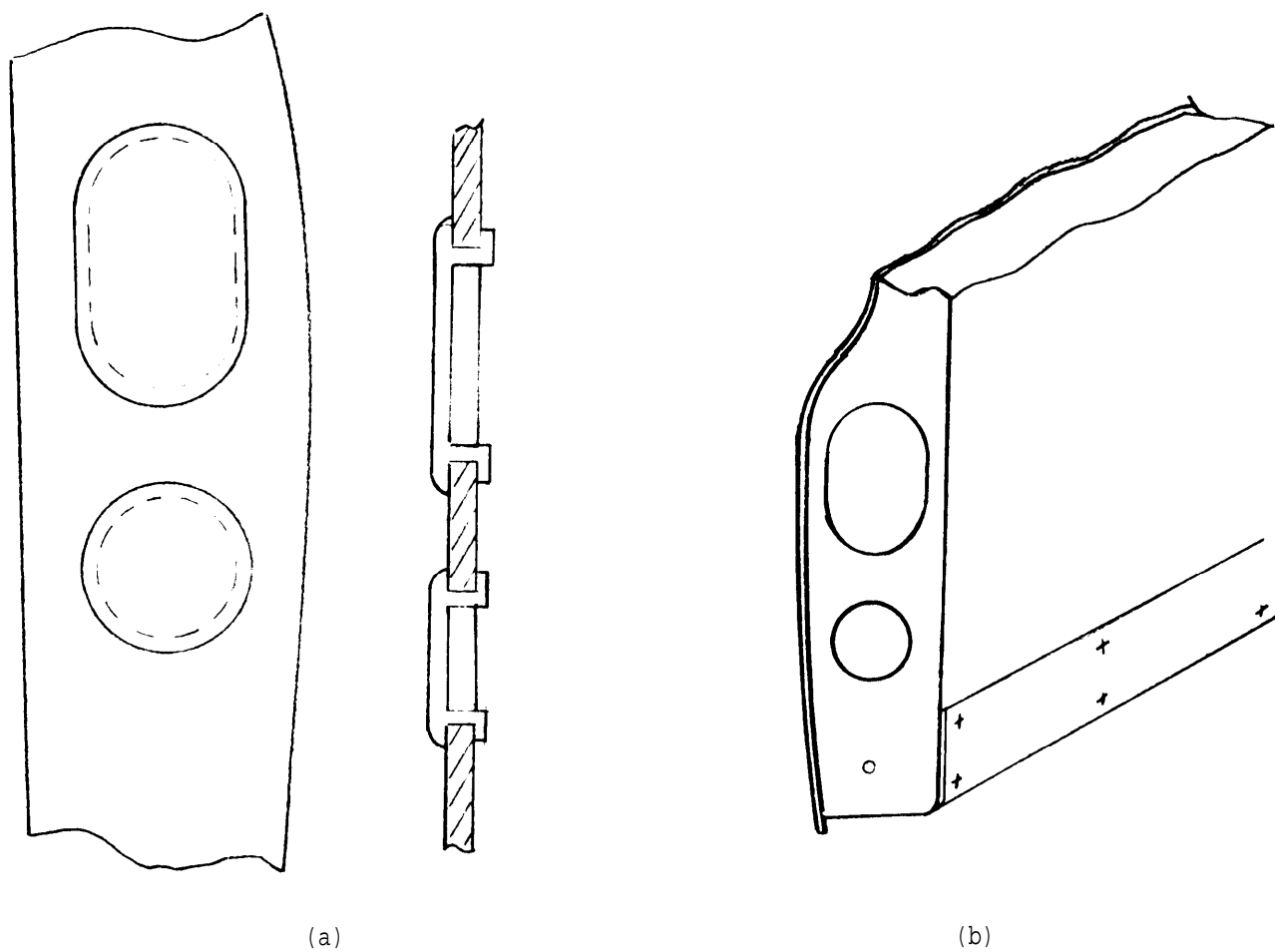


DOORS

The openings in the door allow contaminant entry into the inner door and latch area. In addition, poor access and drainage hinder decontamination of the inner door area and latch mechanism.

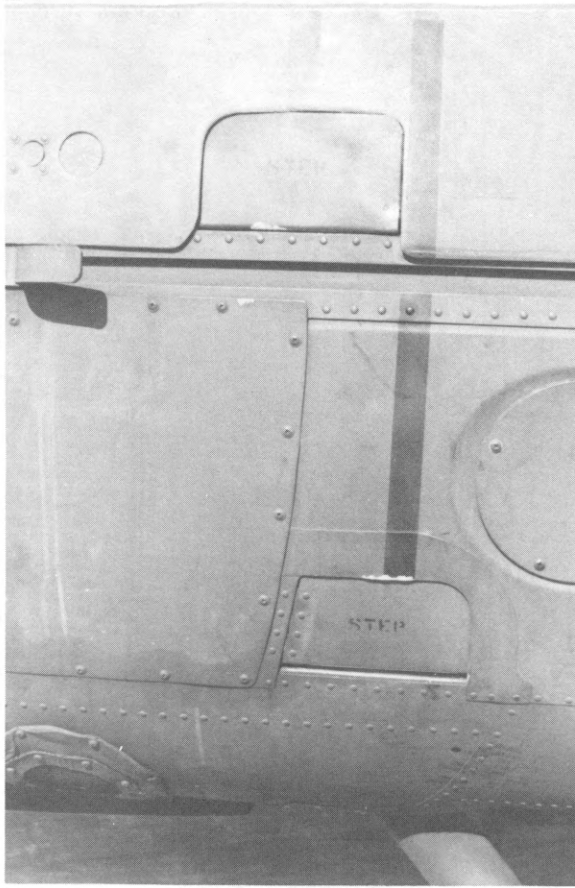
UH-1M Helicopter (Huey)

MIL-HDBK-784



DOORS

Removable plugs or panels over the openings prevent contaminant entry (a).
A removable inner panel along the bottom of the door facilitates decontamination (b).

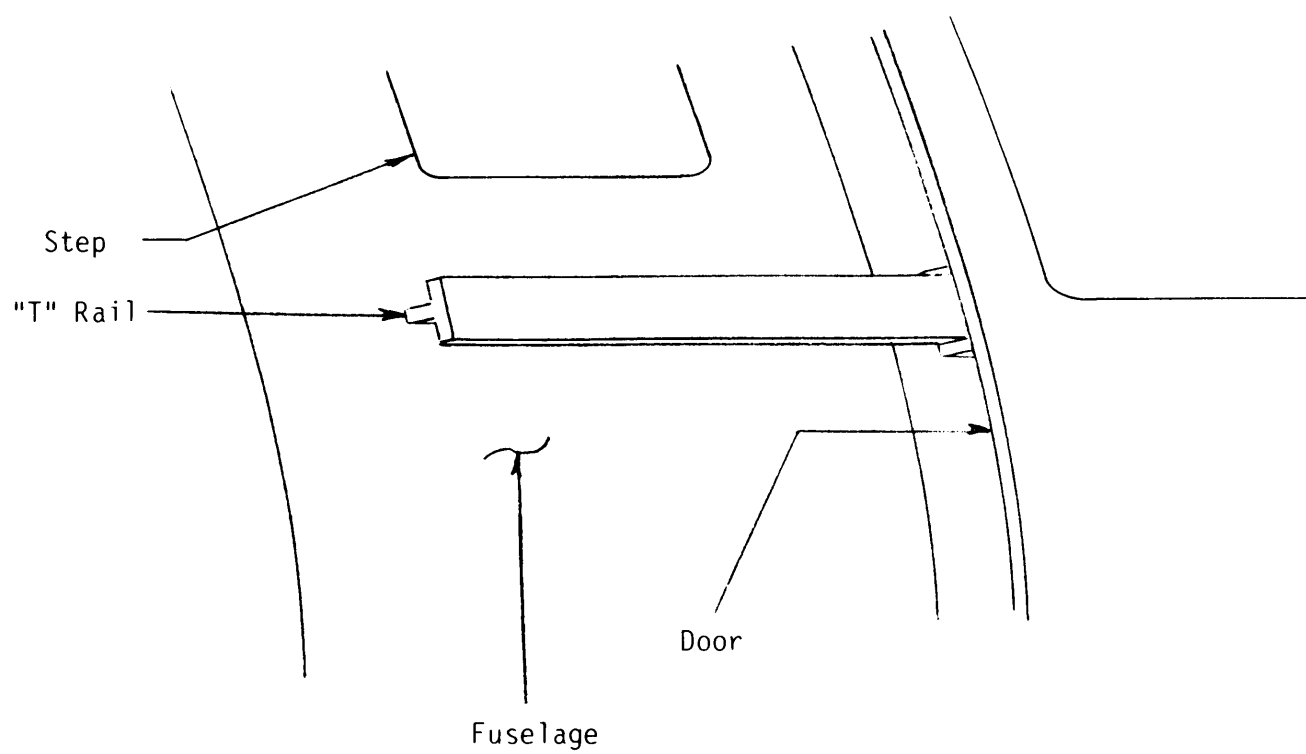


DOORS

The channel for the sliding door on the rear compartment is difficult to decontaminate.

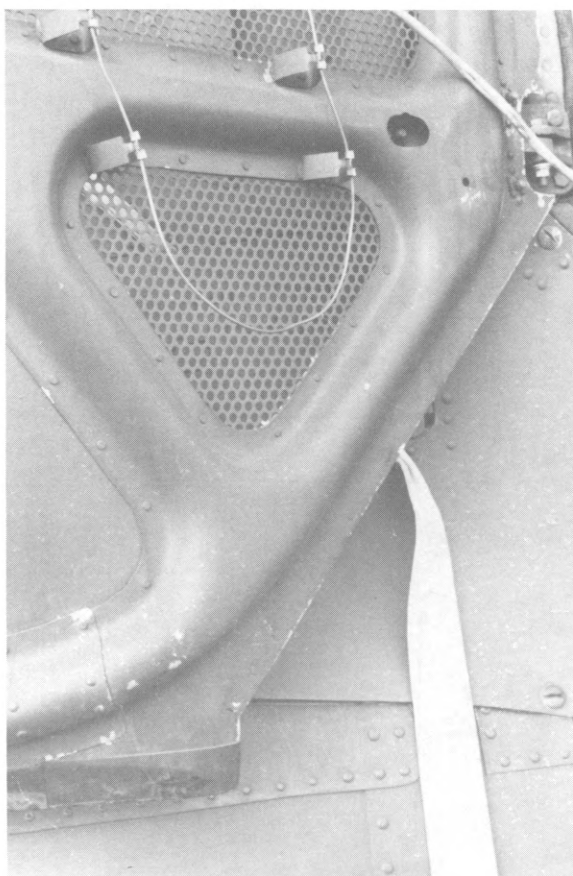
UH-1M Helicopter (Huey)

MIL-HDBK-784



DOORS

An external "T" rail in place of the internal channel facilitates decontamination.

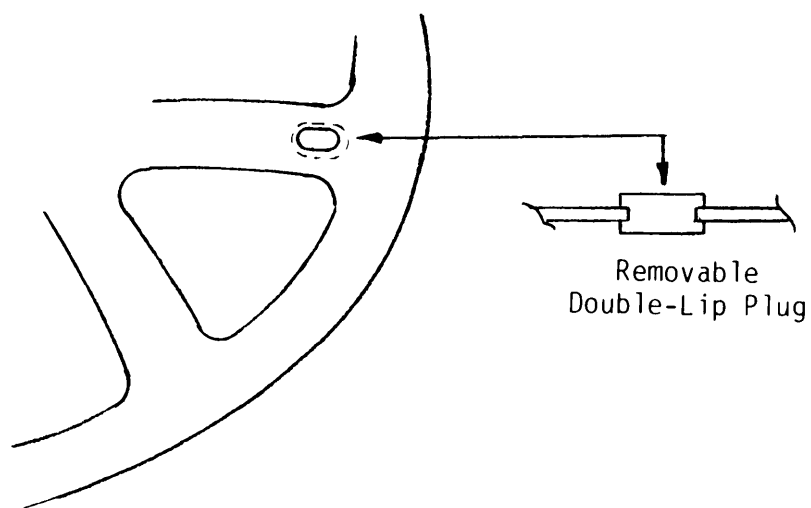


DOORS

The access door on the engine compartment can be cleaned on all exterior surfaces. However, the opening in the shaped reinforcement channel for the hinge fastener provides access for contaminated dust and for decontaminating solutions.

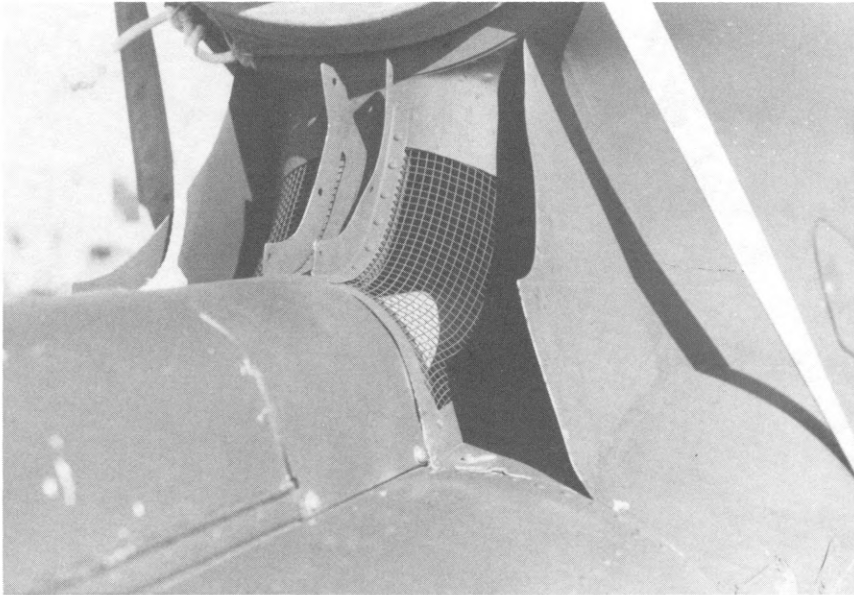
UH-1M Helicopter (Huey)

MIL-HDBK-784



DOORS

Sealing the opening for the hinge attachment nut with a removable double-lip plug prevents contaminants and decontaminating solutions from entering the reinforcement channel.

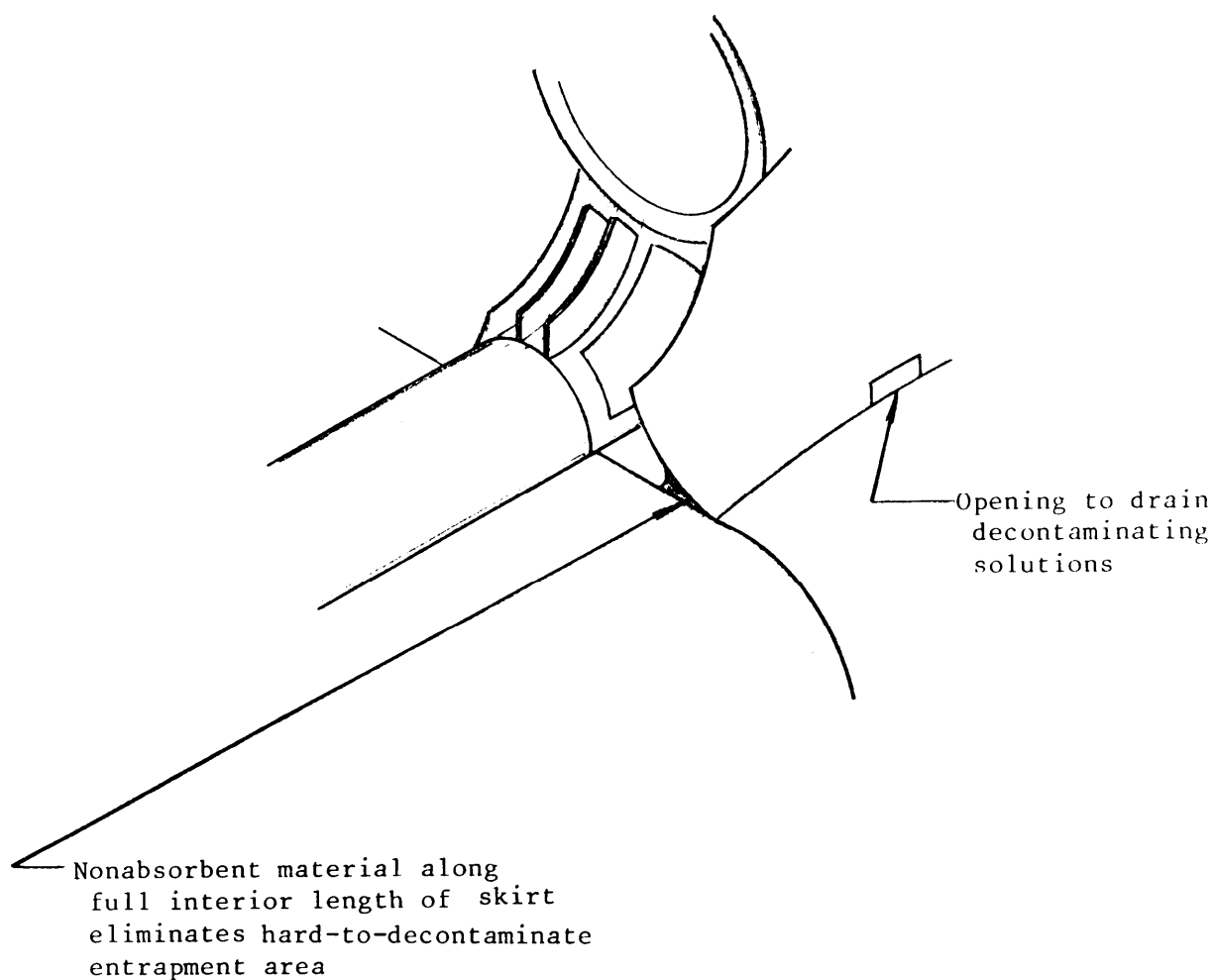


FAIRINGS

Skirts on both sides of the grill for the rear rotor transmission make acute angles with other panels. These angles and the areas shielded by the skirts are difficult to decontaminate thoroughly.

AH-1 Helicopter (Cobra)

MIL-HDBK-784



FAIRINGS

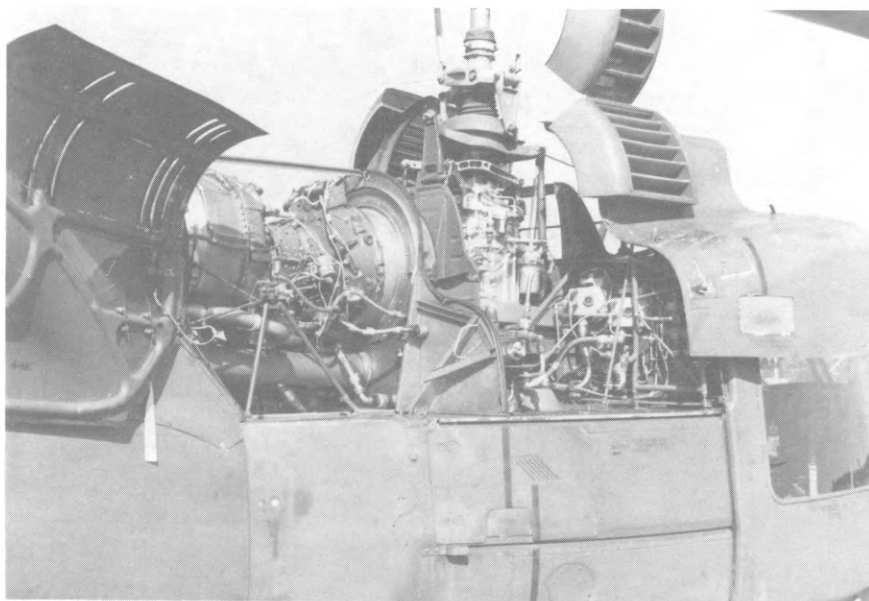
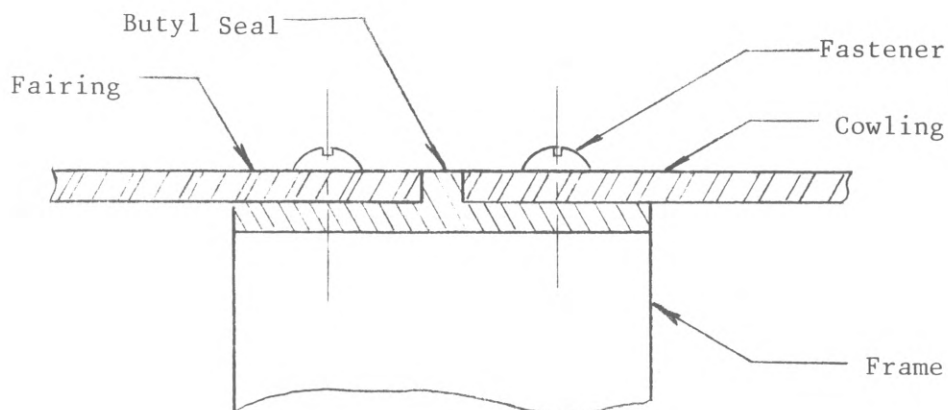
Providing a drain facilitates decontamination; eliminating the acute angles limits contaminant entrapment.



FAIRINGS

The space between the fairing and cowling segments allows contaminants to be drawn in and is difficult to decontaminate.

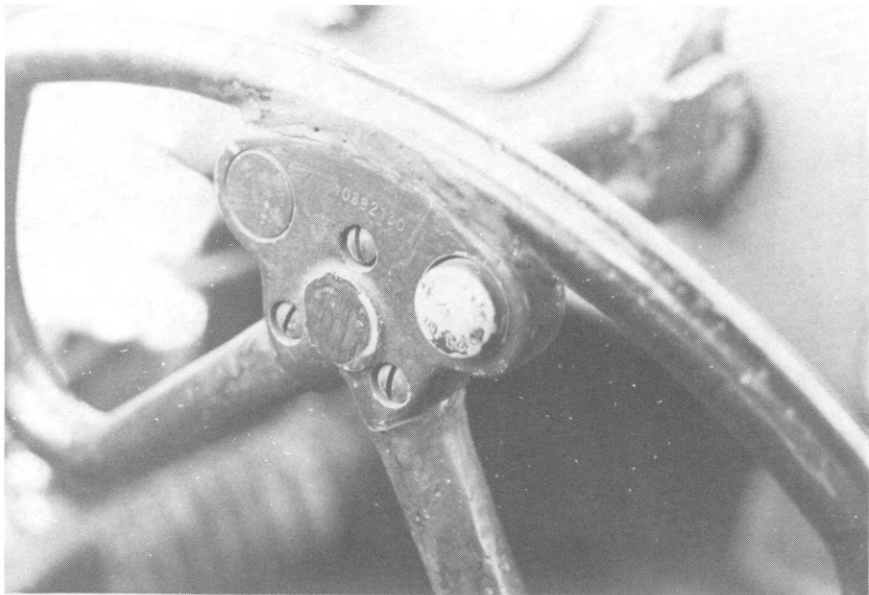
UH-1H Helicopter (Huey)



FAIRINGS

(Top) Butyl rubber (or other nonabsorbent materials) provides seal against contaminants.

(Bottom) The cowling opens completely, giving access to both surfaces of the panels and to the engine compartment for decontamination (UH-1M Helicopter).

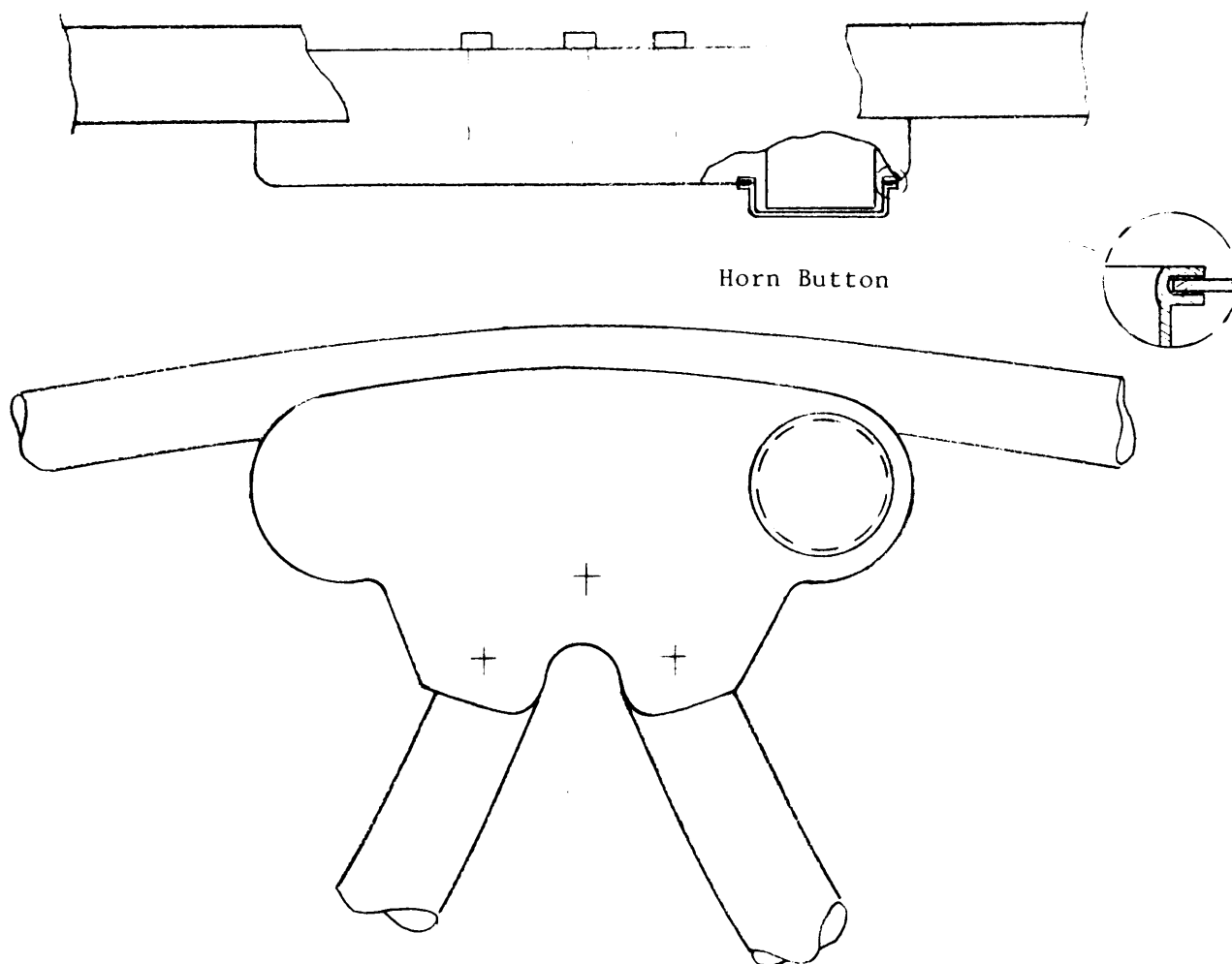


FASTENERS

The counterbored holes for the steering-wheel attachment screws and the crevice around the horn button draw in and trap contaminants and are difficult to decontaminate.

M116 Cargo Carrier

NIL-HDBK-784



FASTENERS

Installing hexagonal-head bolts flush with the rear of the steering wheel and covering the horn button with a beaded diaphragm will eliminate contaminant traps.

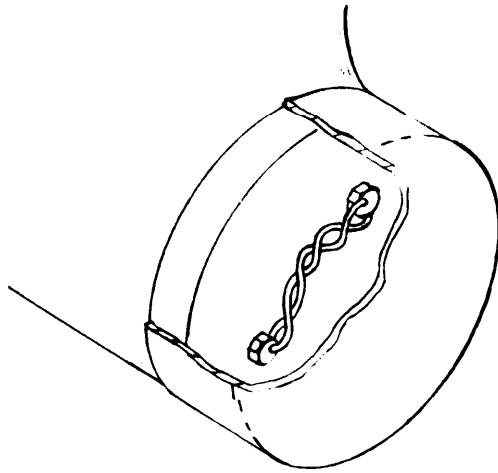


FASTENERS

The hatch-cover hinge plate is secured by safety-wired bolts. Twisted wires and holes through the bolt heads retain contaminants and may be contacted by both operating and maintenance personnel.

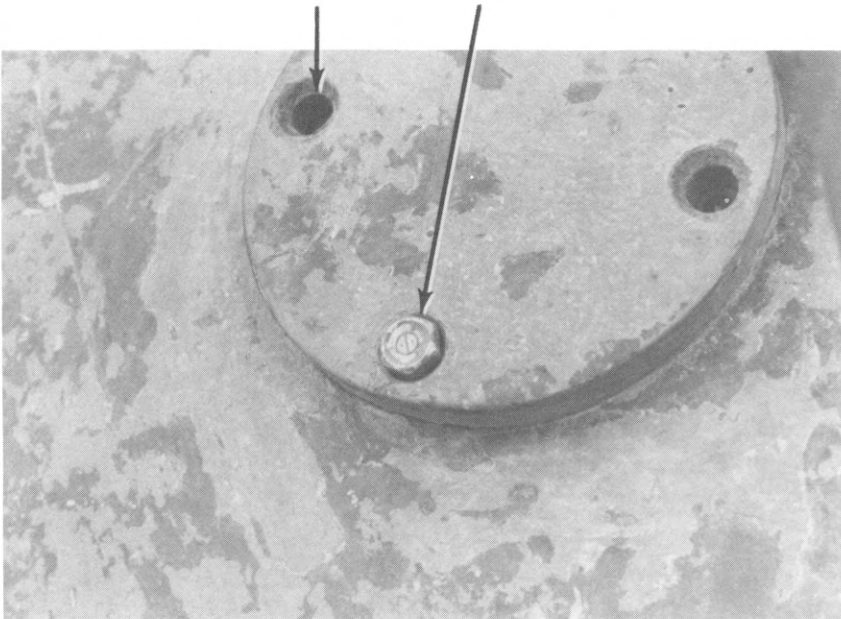
M60 Tank

MIL-HDBK-784



FASTENERS

A thin sheet-metal cap over the hinge plate protects the bolts and wire from a contaminating atmosphere.

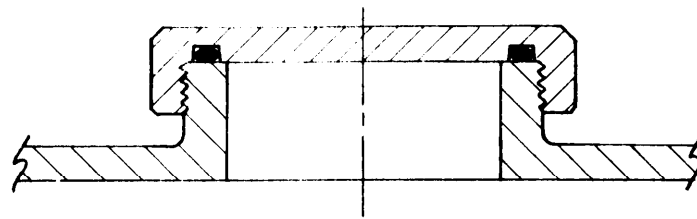


FASTENERS

Countersunk bolt holes trap contaminants/decontaminants. The holes for missing bolts are extremely difficult to decontaminate chemically. In addition, the area beneath the cover can act as a capillary and draw in contaminants and decontaminants.

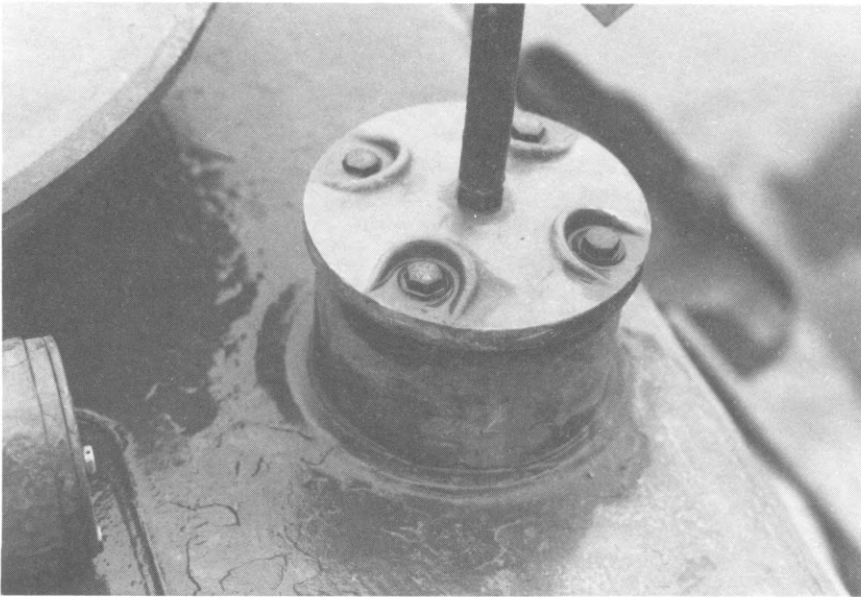
M113 Armored Personnel Carrier

MIL-HDBK-784



FASTENERS

A threaded flange eliminates the capillary beneath the cover, a seal in the cover excludes contaminants, and a screw-on cover eliminates the need for bolts and bolt holes.

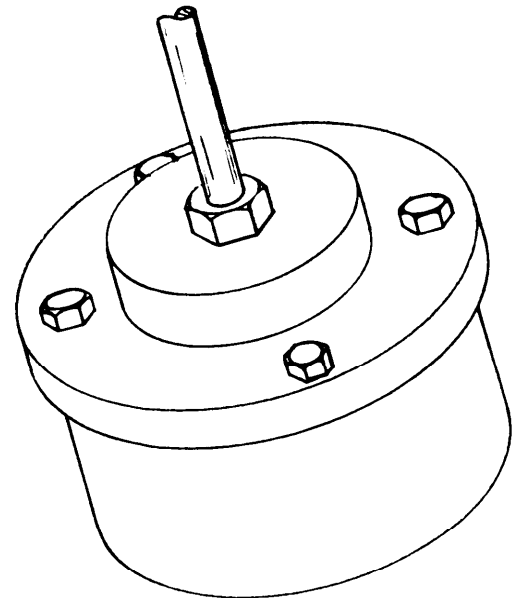
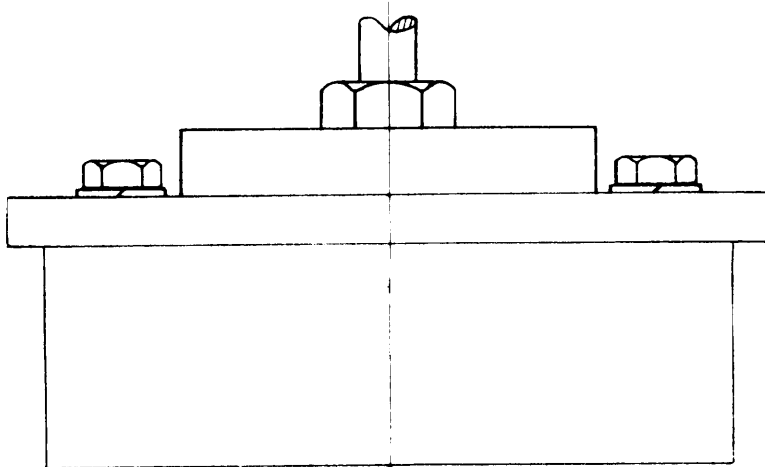
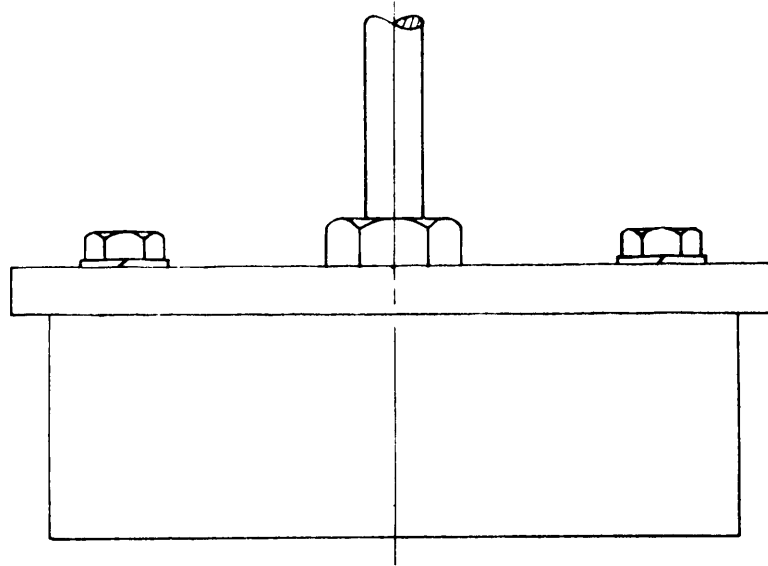


FASTENERS

The recesses for the antenna-mounting fasteners form entrapment areas. Contaminants are difficult to remove or to neutralize in the area between the back wall of the recess and the fastener head.

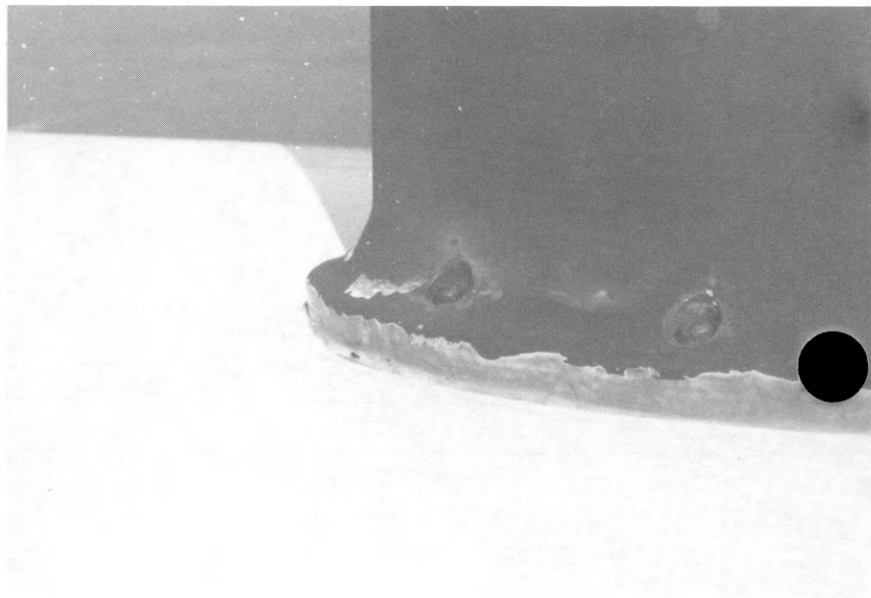
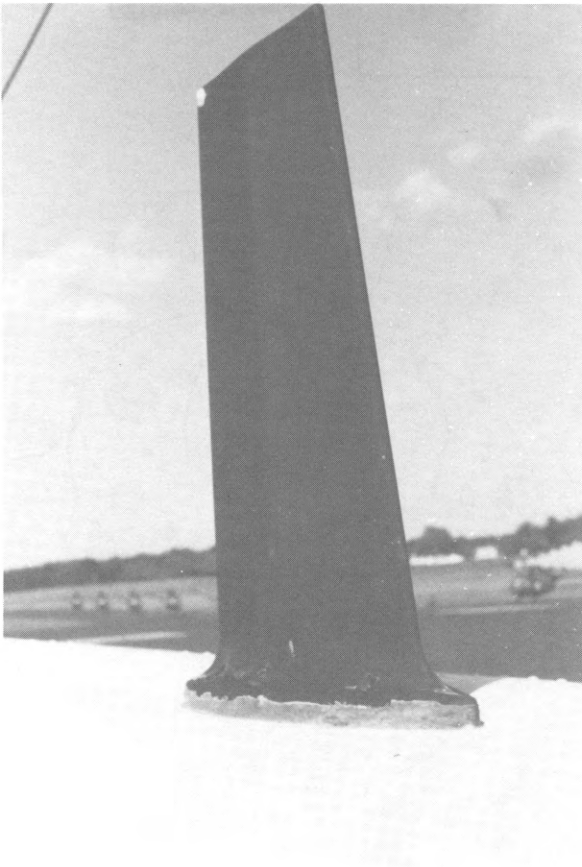
M60 Tank

MIL-HDBK-784



FASTENERS

Flush-mounted fasteners eliminate the recesses. Painting over the fasteners and mounting with nonabsorbent paint (see Appendix B) will prevent material from being drawn under the fastener head and will make hardware easier to decontaminate.

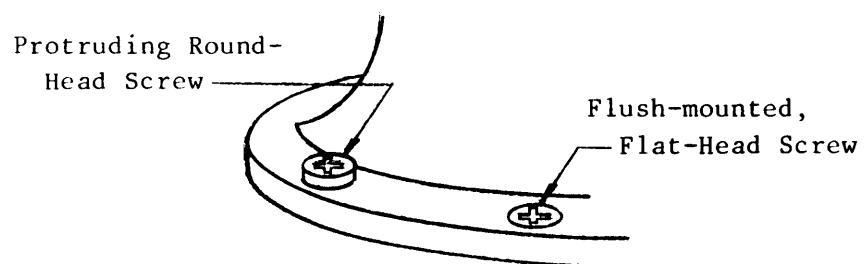


FASTENERS

Sealed interface prevents contaminant entrapment and is easy to decontaminate. However, screw insets are difficult to decontaminate.

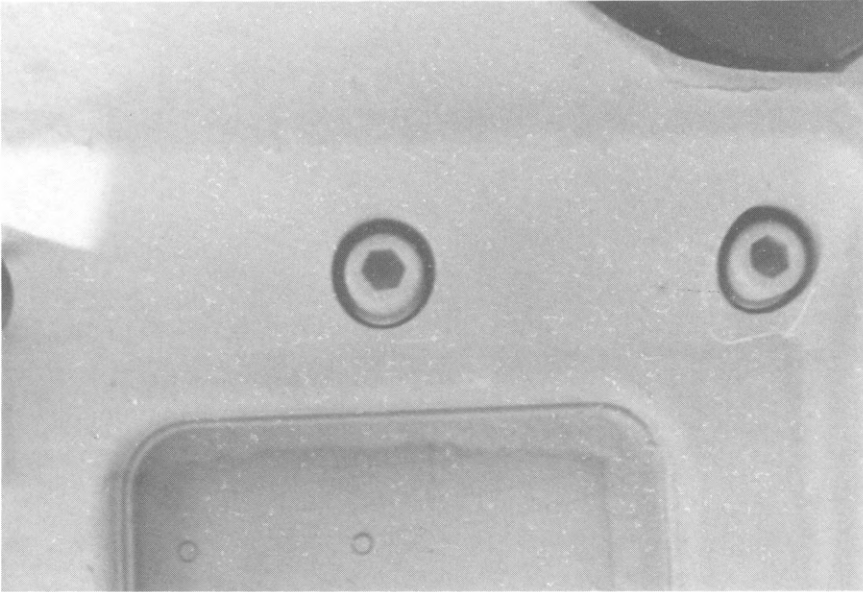
L23F Airplane

MIL-HDBK-784



FASTENERS

Using a protruding round-head screw or a flat-head screw mounted flush with the surface facilitates decontamination.

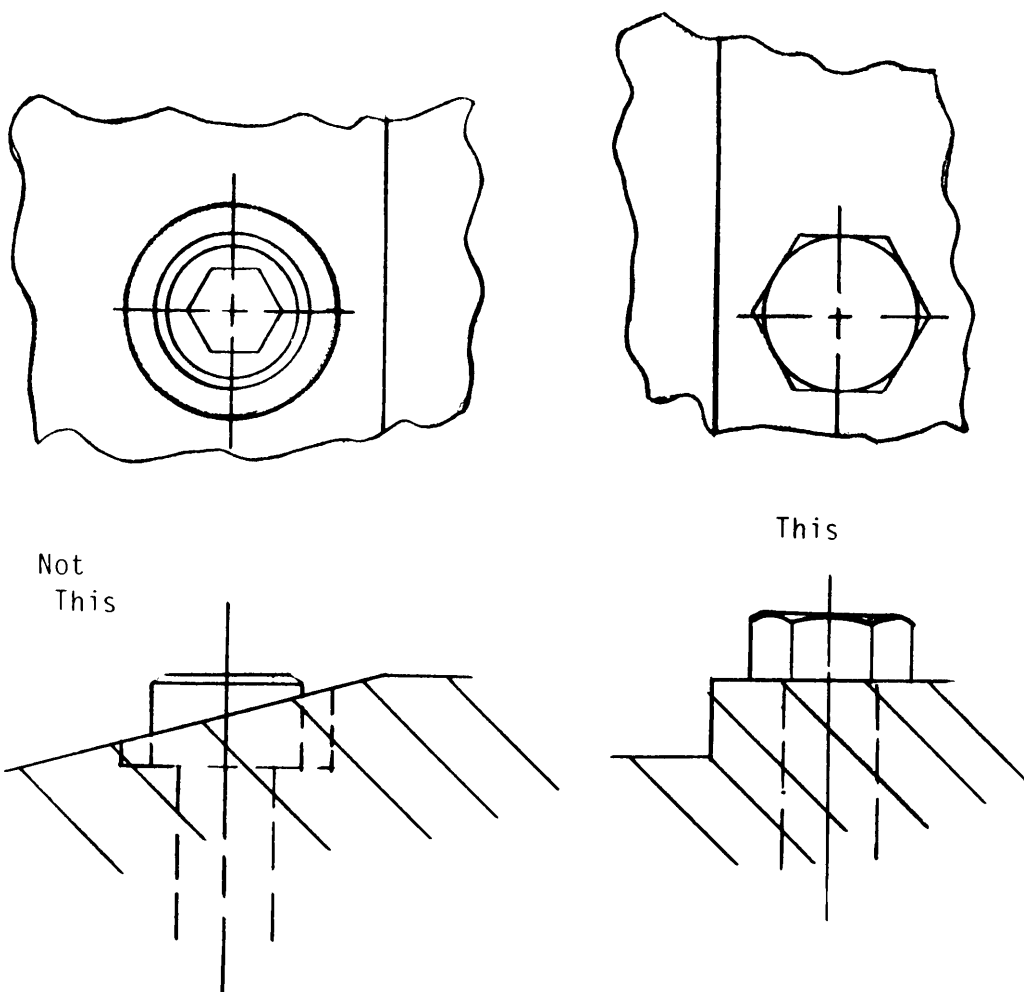


FASTENERS

The hexagonal socket in the bolt head and the counterbored hole for inserting the bolt can trap contaminants and cannot be flushed out completely.

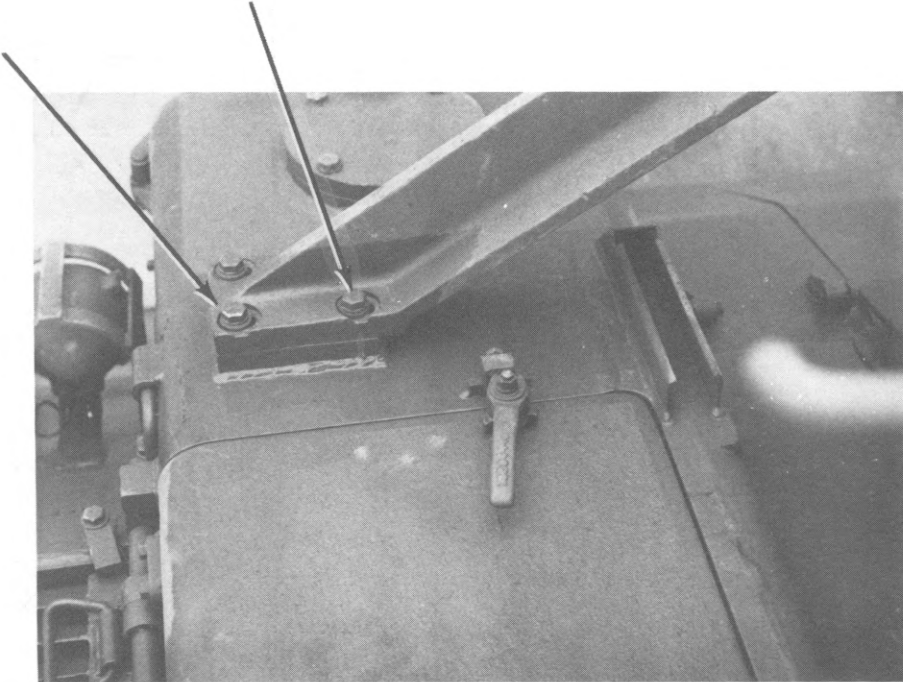
M102 Howitzer

MIL-HDBK-784



FASTENERS

Changing from counterbore to flush insertion eliminates a contaminant trap around the bolt and allows the exterior surface of the bolt head to be easily decontaminated. Using a hex-head bolt rather than a socket-head would eliminate another trap.

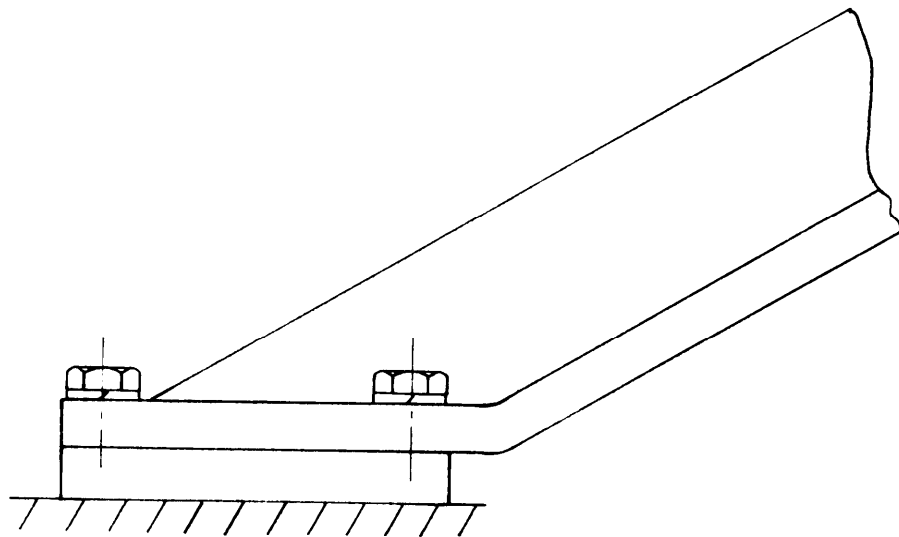


FASTENERS

The bolts fastening the A-frame rack to the deck are located in counter-sunk holes that can trap contaminants and that are difficult to decontaminate.

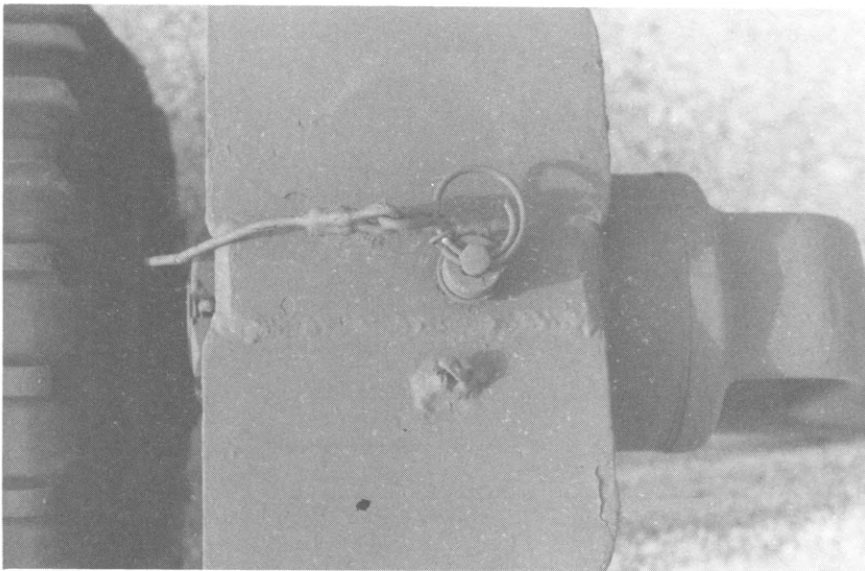
M88 Recovery Vehicle

MIL-HDBK-784



FASTENERS

Bosses replace countersinks, preventing contaminant entrapment and facilitating decontamination. Self-locking bolts may be used instead of lock washers.

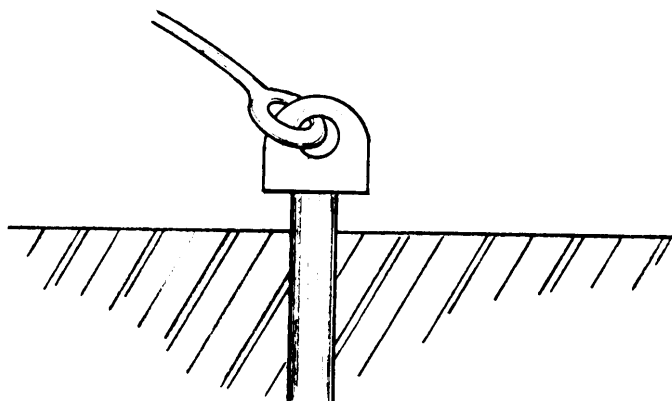


FASTENERS

The wire and keeper can trap contaminants and be difficult to decontaminate. In addition, the cracks in the covering of the keeper can allow contaminants to be drawn in.

M102 Howitzer

MIL-HDBK-784



FASTENERS

A simplified pin and keeper eliminate entrapment areas. Using a non-cracking covering material on the keeper, or using solid wire, will also limit contaminant entrapment.

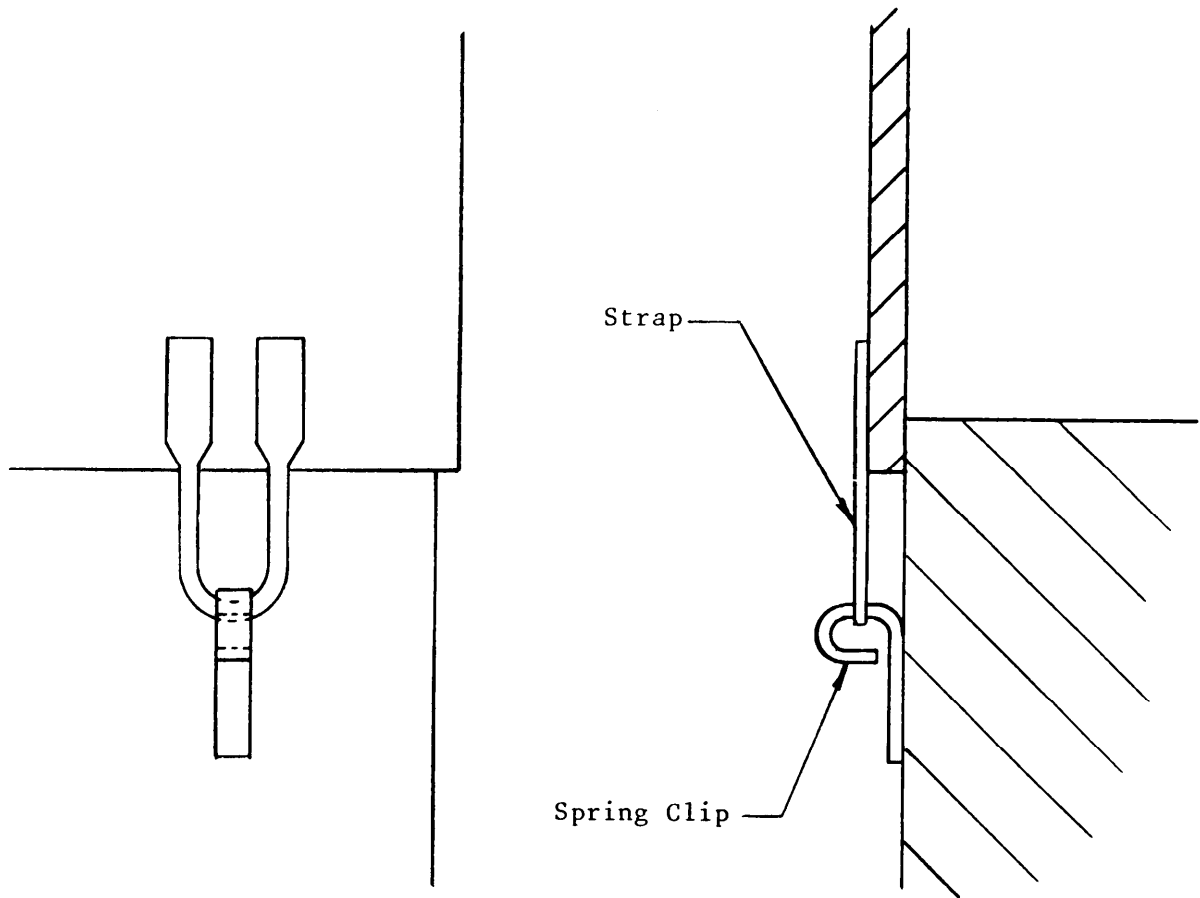


FASTENERS

Contaminants can enter the generator through the eyelets and can also be trapped in the twist lock.

Generator (7.5 kW)

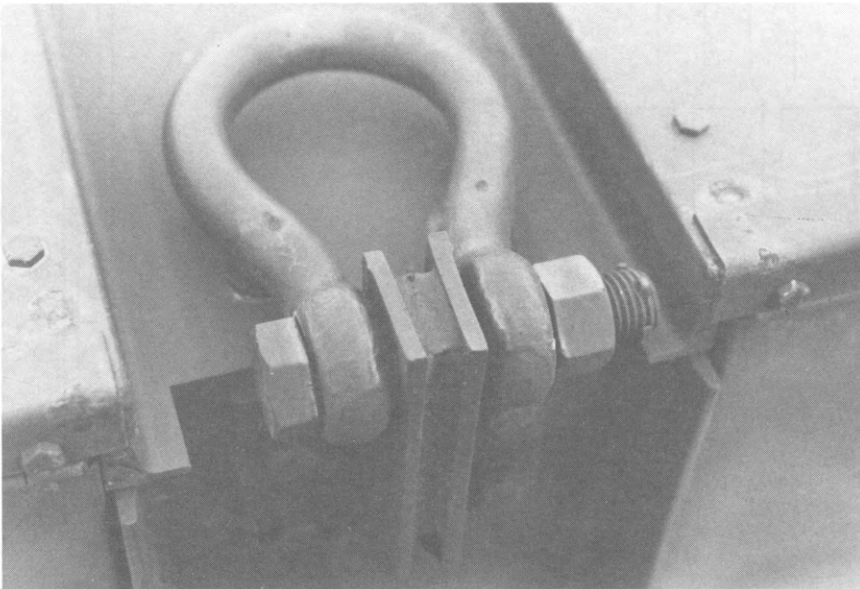
MIL-HDBK-784



FASTENERS

A spring-clip and strap arrangement eliminates the eyelets and twist locks.

MIL-HDBK-784

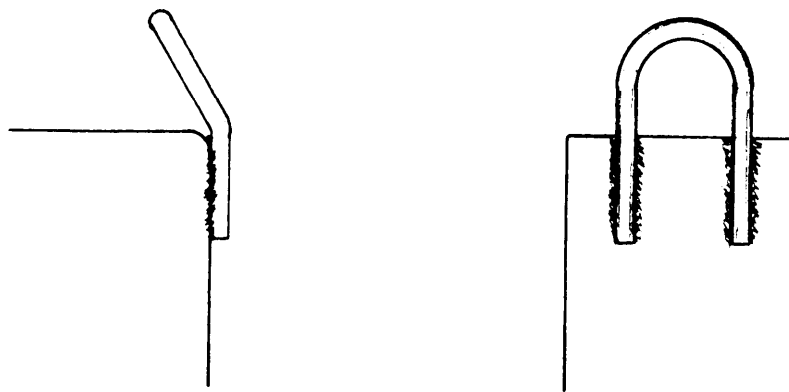


FASTENERS

Contaminants may be trapped in the threads of the shackle bolt and the nut as well as in the bolt holes in the shackle and the bracket.

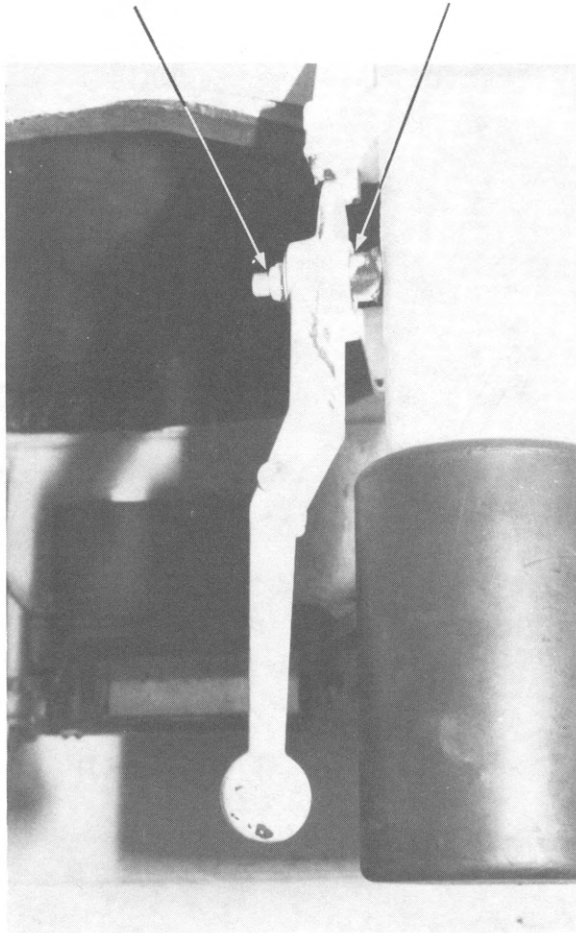
Diesel Generator

MIL-HDBK-784



FASTENERS

A welded-on bracket prevents contaminant entrapment and is easy to decontaminate.

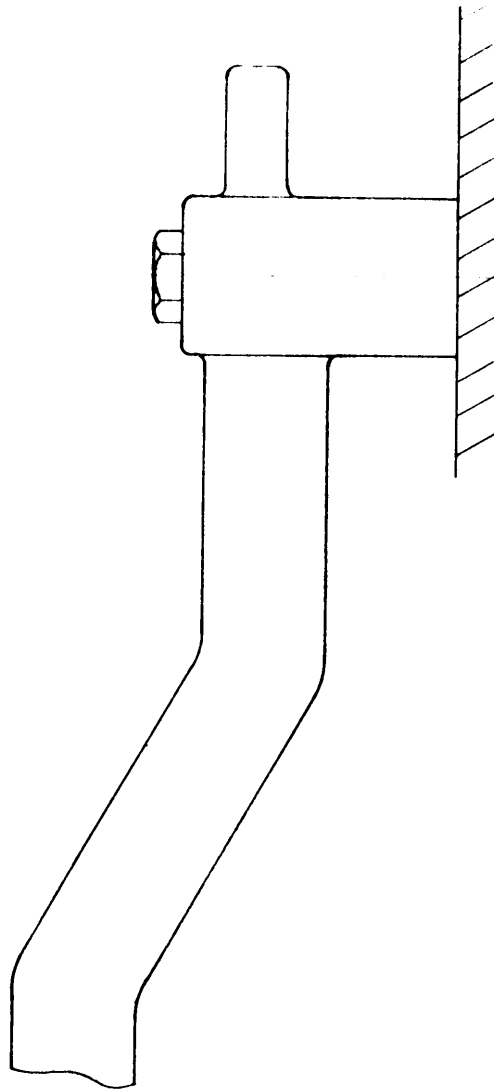


FASTENERS

Exposed screw threads can trap contaminants and be difficult to decontaminate.

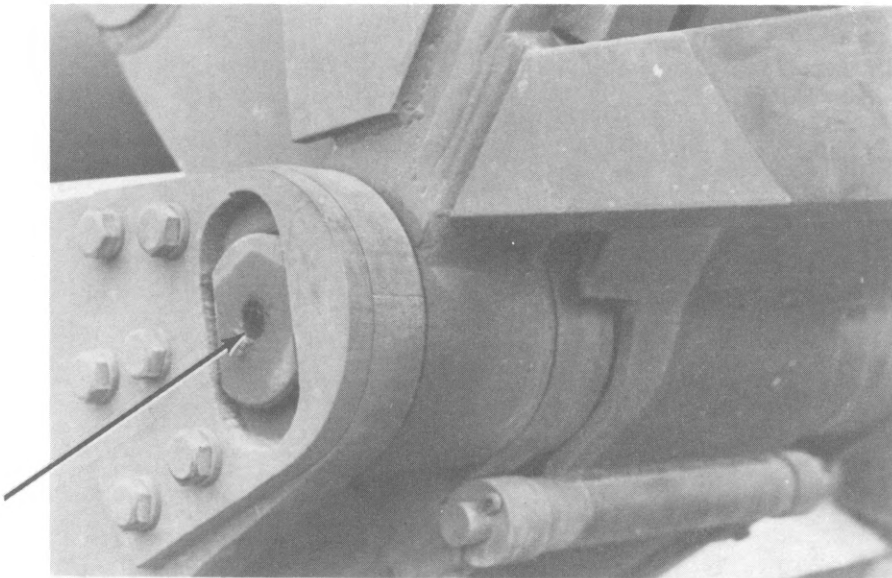
M88 Recovery Vehicle

MIL-HDBK-784



FASTENERS

A bolted one-piece handle eliminates exposed screw threads.

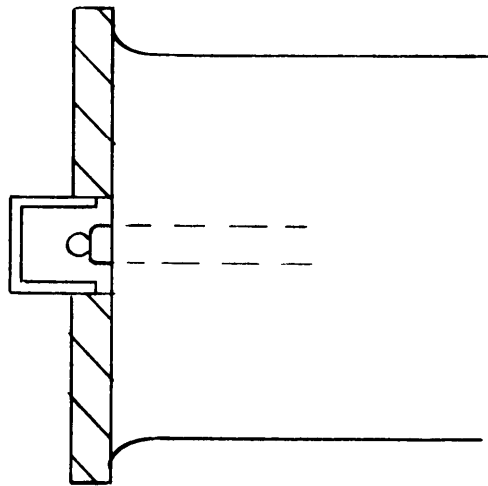


FITTINGS

Excess grease near the grease fitting can absorb contaminants and is difficult to decontaminate in recessed area.

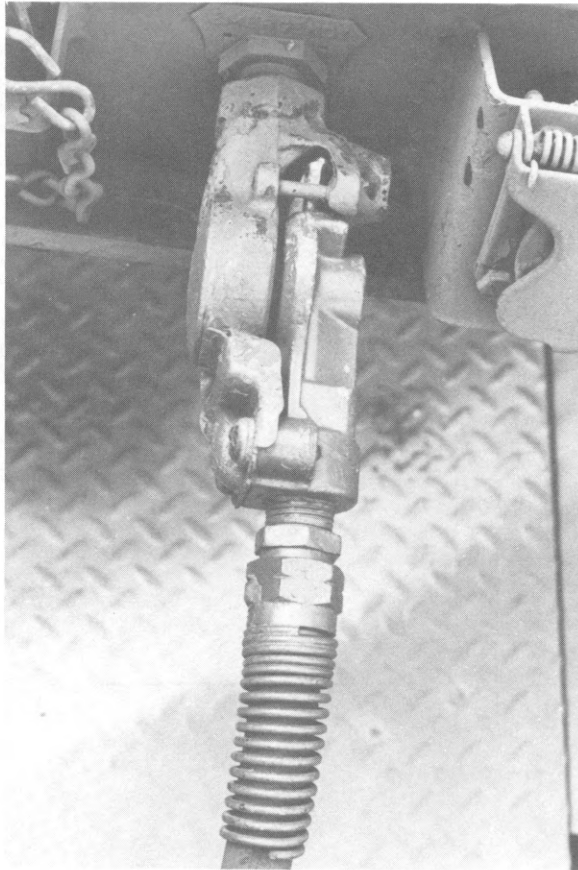
AVLB Bridge Launching Vehicle

MIL-HDBK-784



FITTINGS

A removable cover protects the area from contamination between lubrications.

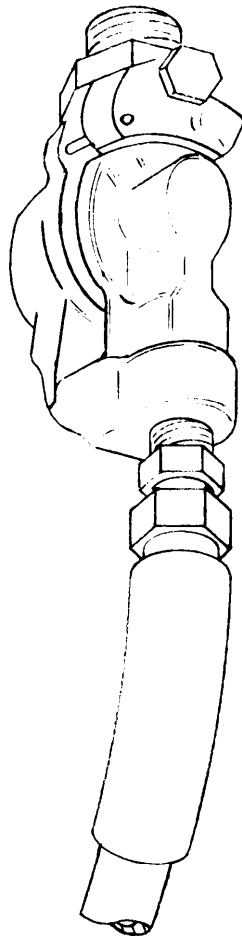


FITTINGS

The hose connector and strain relief have many entrapment areas and are difficult to decontaminate.

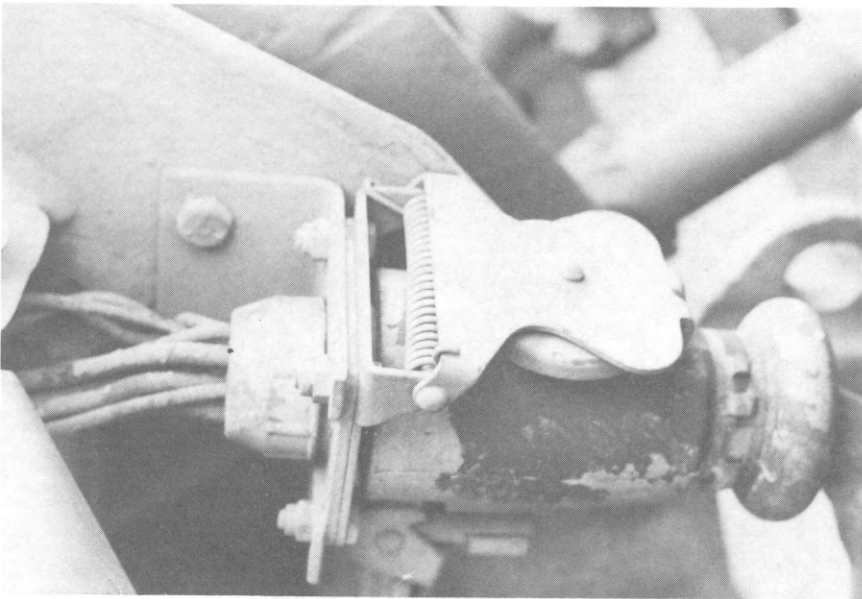
M818 Tractor Truck

MIL-HDBK-784



FITTINGS

An enclosure protects the strain relief from contaminants. Sharp corners are eliminated in the connector design, reducing the number of entrapment areas.

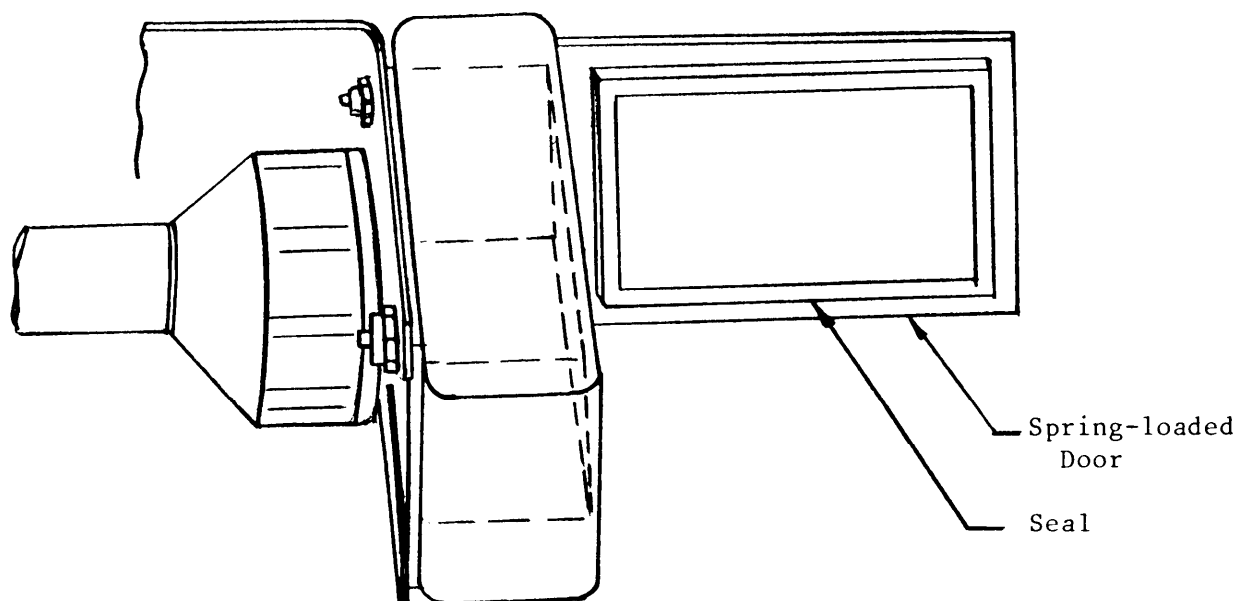


FITTINGS

Contaminants and contaminated dust can be trapped in the spaces between the electrical wires and between the coils of the cap spring. Decontaminating these spaces is difficult, and decontaminating solutions may damage the coating and insulation of the wiring.

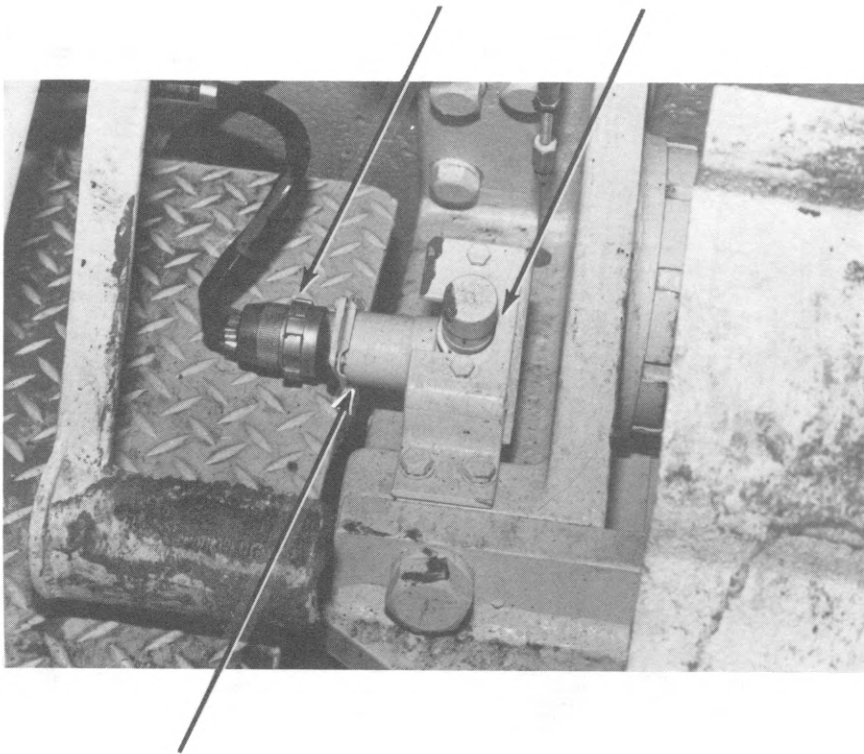
M561 Cargo Truck

MIL-HDBK-784



FITTINGS

Running the wiring bundle to the connector through smooth-wall conduit protects the wiring from contamination and facilitates decontamination. The box and door over the connector protect the contacts when the connector is not in use.

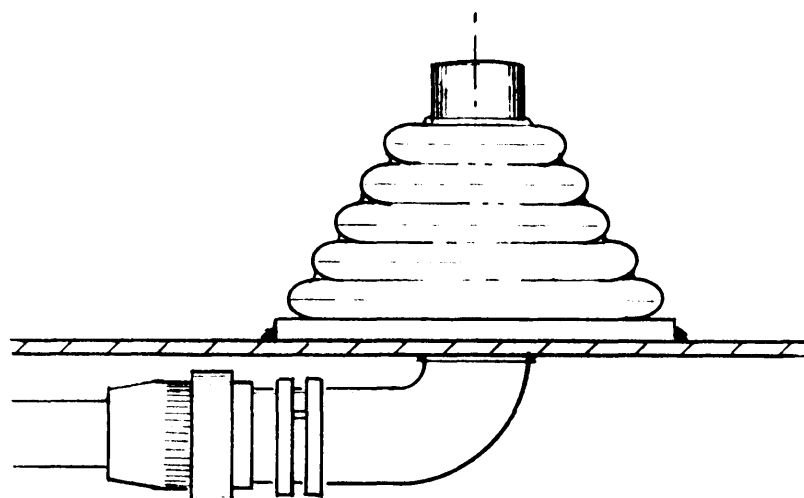


FITTINGS

Poor-access areas are exposed to contaminants and make decontaminant application and removal difficult.

M88 Recovery Vehicle

MIL-HDBK-784



FITTINGS

A metal bellows welded to the floor seals the pushbutton. The wiring is protected by the floor and has a quick-connect coupling.

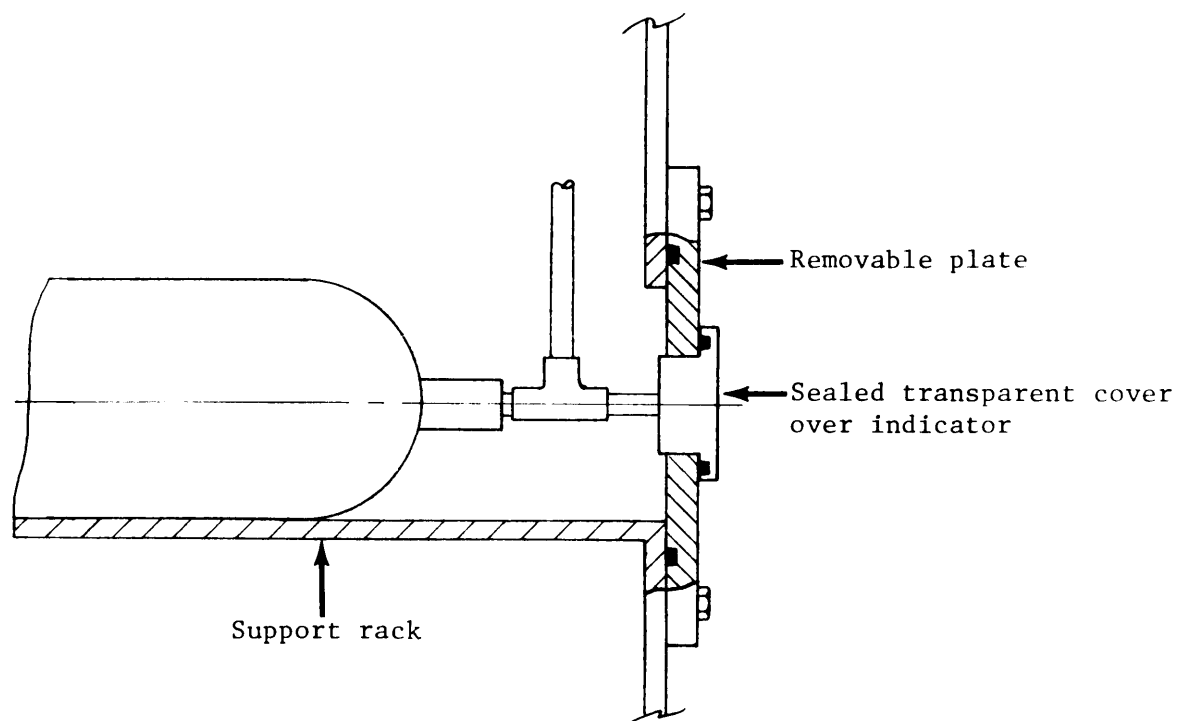


FITTINGS

The gas-bottle connections, hoses, and supports are all exposed to contaminants and are difficult to decontaminate.

AVLB Bridge-Launching Vehicle

MIL-HDBK-784



FITTINGS

A removable plate connects to the wall panel, shielding the gas bottle and connections from contaminants.

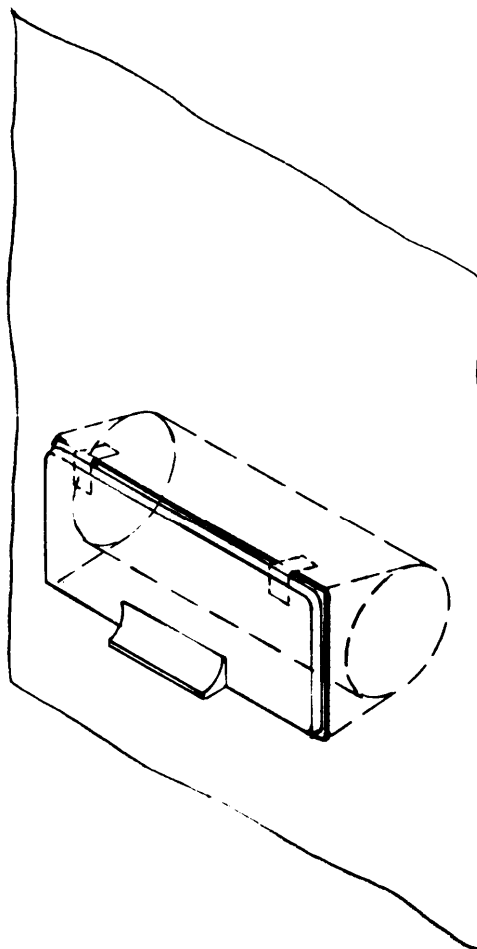


FITTINGS

The gas bottle and attachments are exposed to contaminants and are difficult to decontaminate.

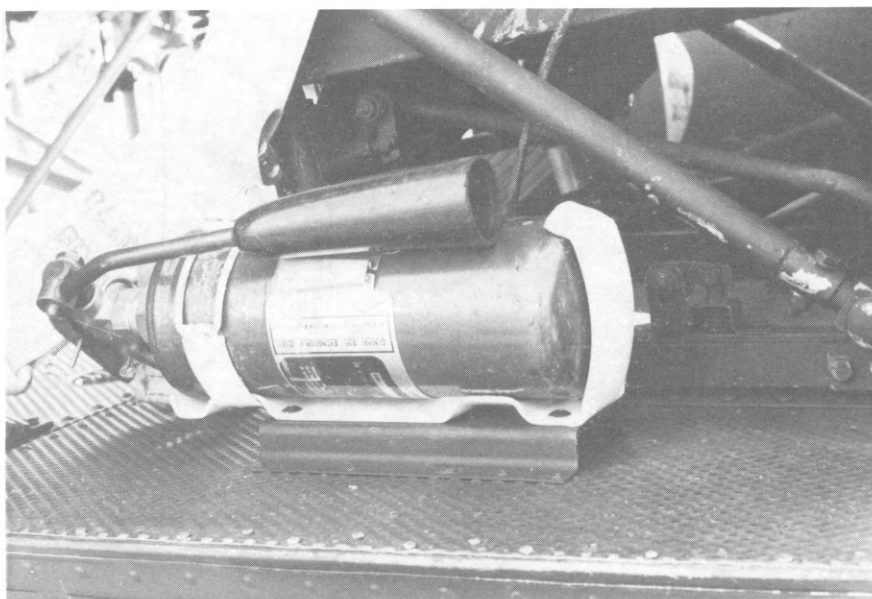
M88 Recovery Vehicle

MIL-HDBK-784



FITTINGS

A sealed, quick-opening instrument panel protects the bottle from contaminants. The door should be transparent or labeled for high visibility.

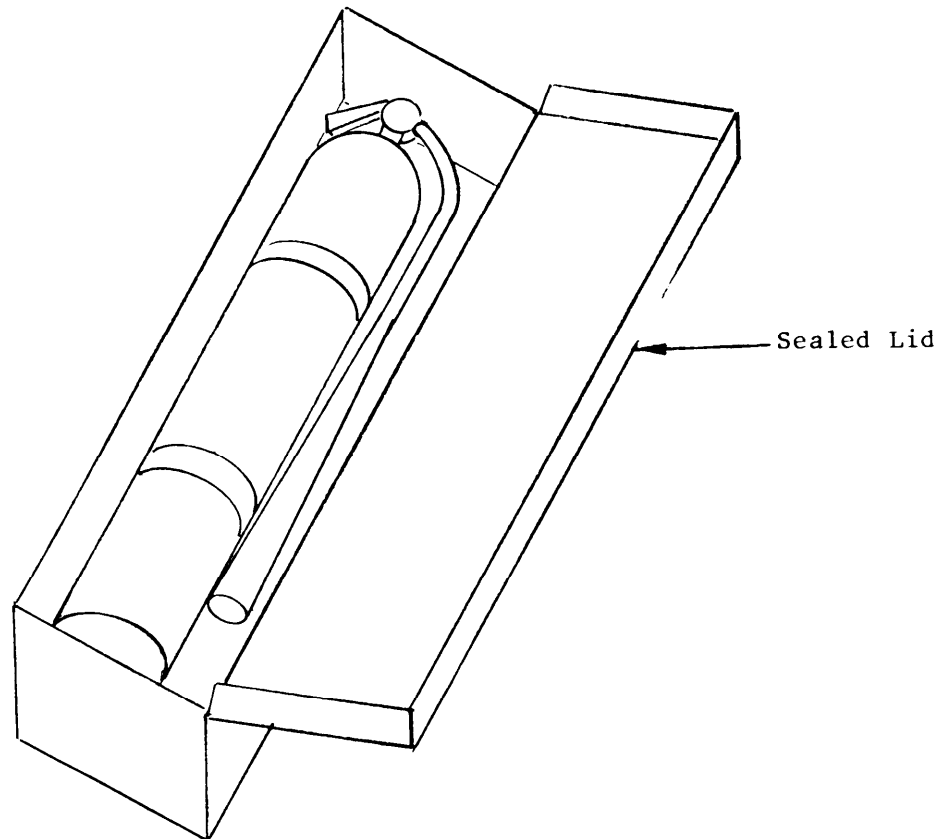


FITTINGS

The fire extinguisher is exposed to contaminants and is difficult to decontaminate.

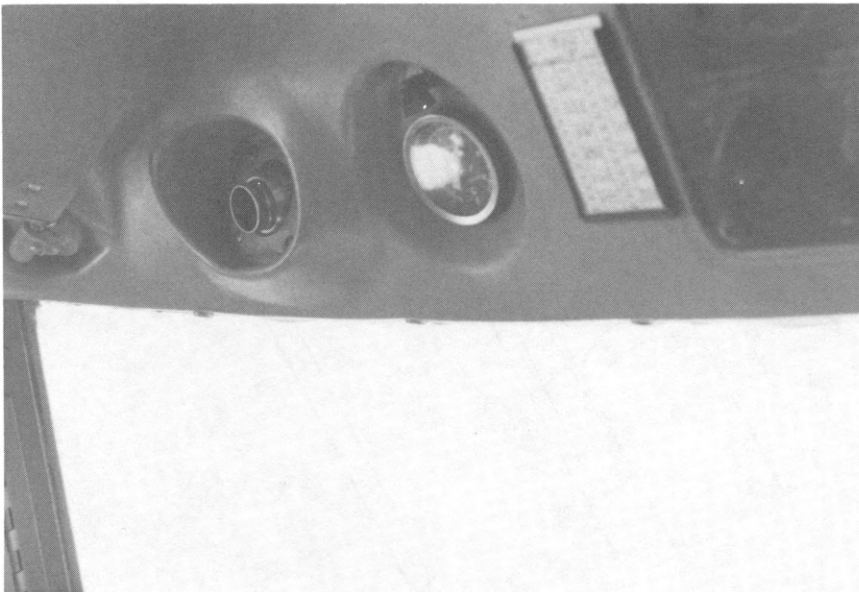
UH-1M Helicopter (Huey)

MIL-HDBK-784



FITTINGS

An enclosure protects the extinguisher from contaminants. The enclosure should be mounted flush to a wall, with no gaps between the enclosure and the wall.

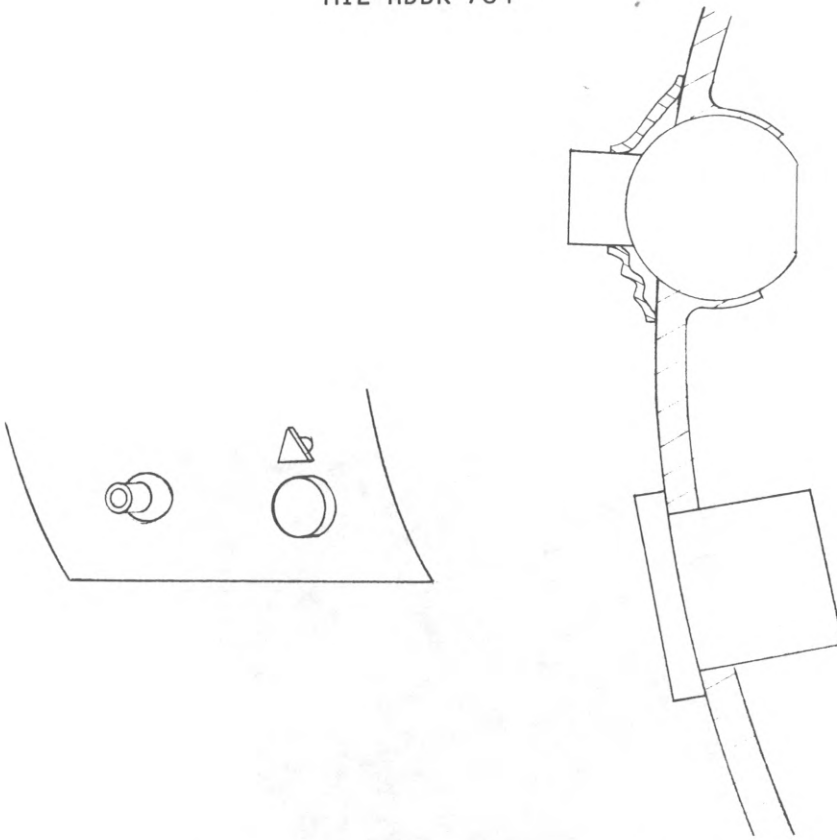


GAGES

The gage and air nozzle recesses and mountings may trap contaminants and they are difficult to decontaminate.

L23F Airplane

MIL-HDBK-784

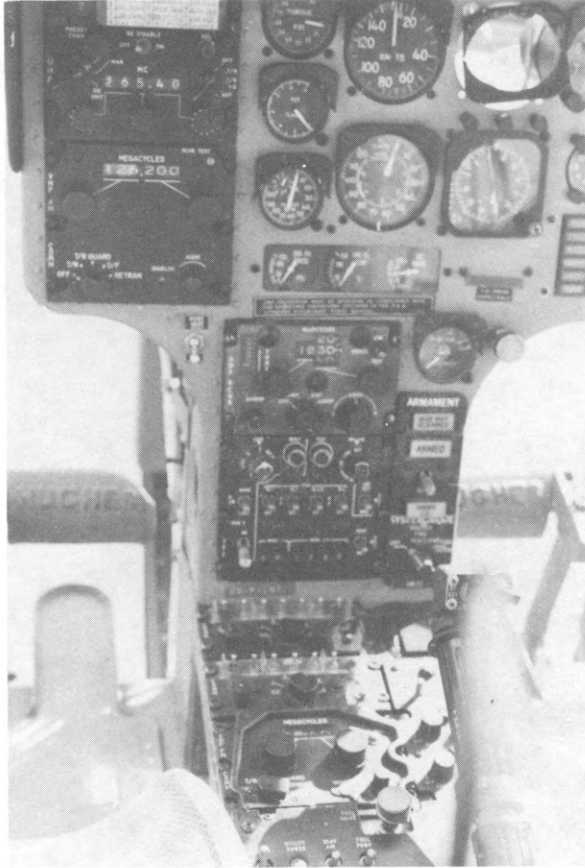


GAGES

(Top) A flush-mounted, sealed gage and a protective boot around the air nozzle prevent contaminant entrapment.

(Bottom) The gages are well mounted, with minimal entrapment crevices. In addition, the mounting rings have smooth surfaces and are well sealed against the dial covers and panel (Tractor Truck, 10-ton, 8x8).

MIL-HDBK-784

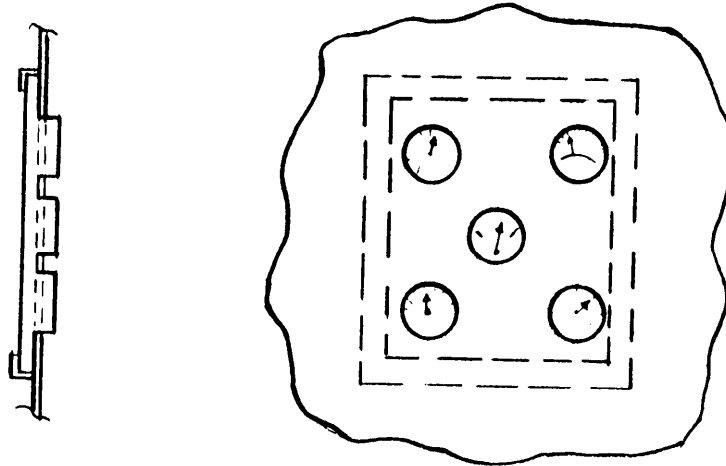


GAGES

Exposed gages and mounting can collect and trap contaminants and are difficult to decontaminate.

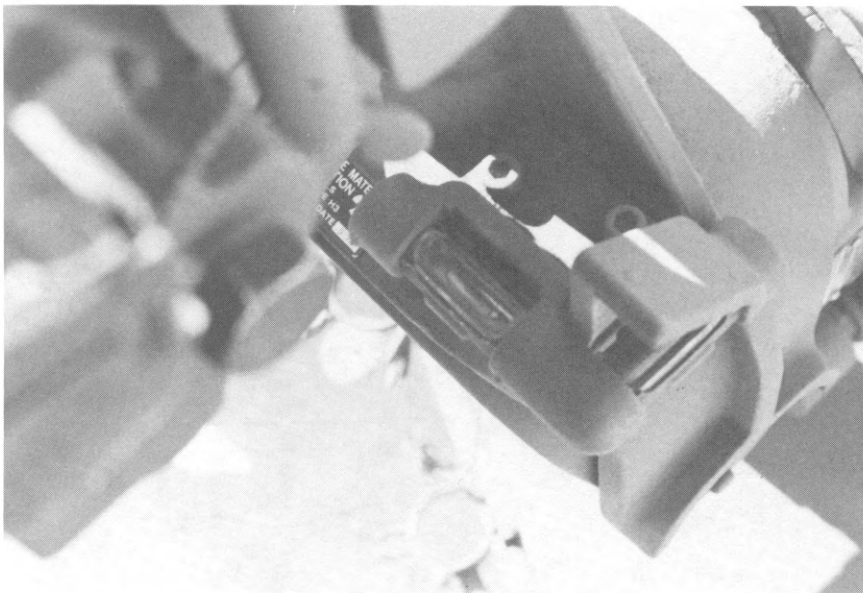
OH-6 Helicopter (Cayuse)

MIL-HDBK-784



GAGES

A sealed, transparent cover such as safety glass protects the gages from contaminants and is easy to decontaminate.

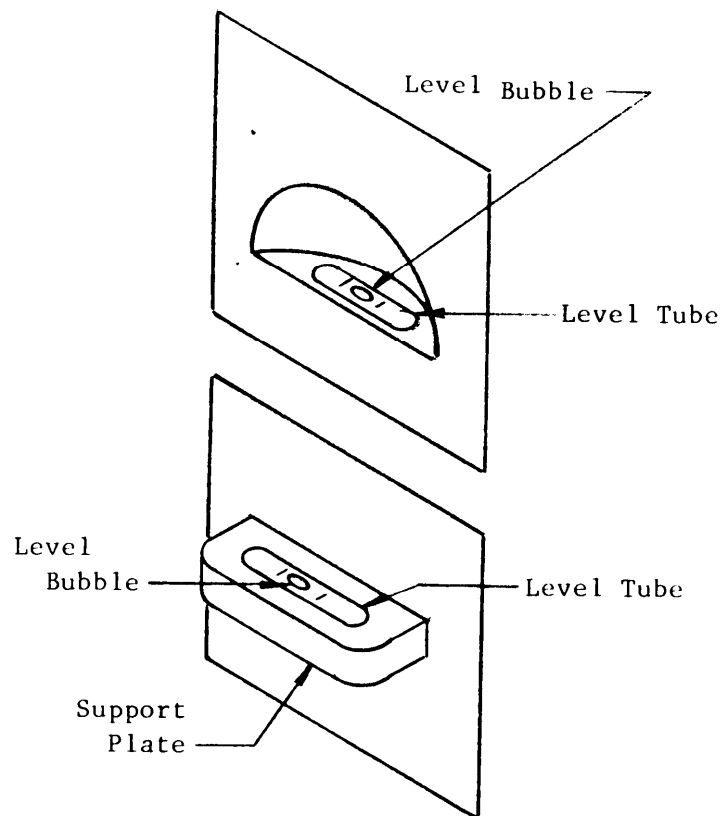


GAGES

The level sight glass is difficult to decontaminate because of poor access and gaps that form entrapment areas.

M102 Howitzer

MIL-HDBK-784



GAGES

Alternative design has no gaps and is easier to decontaminate.

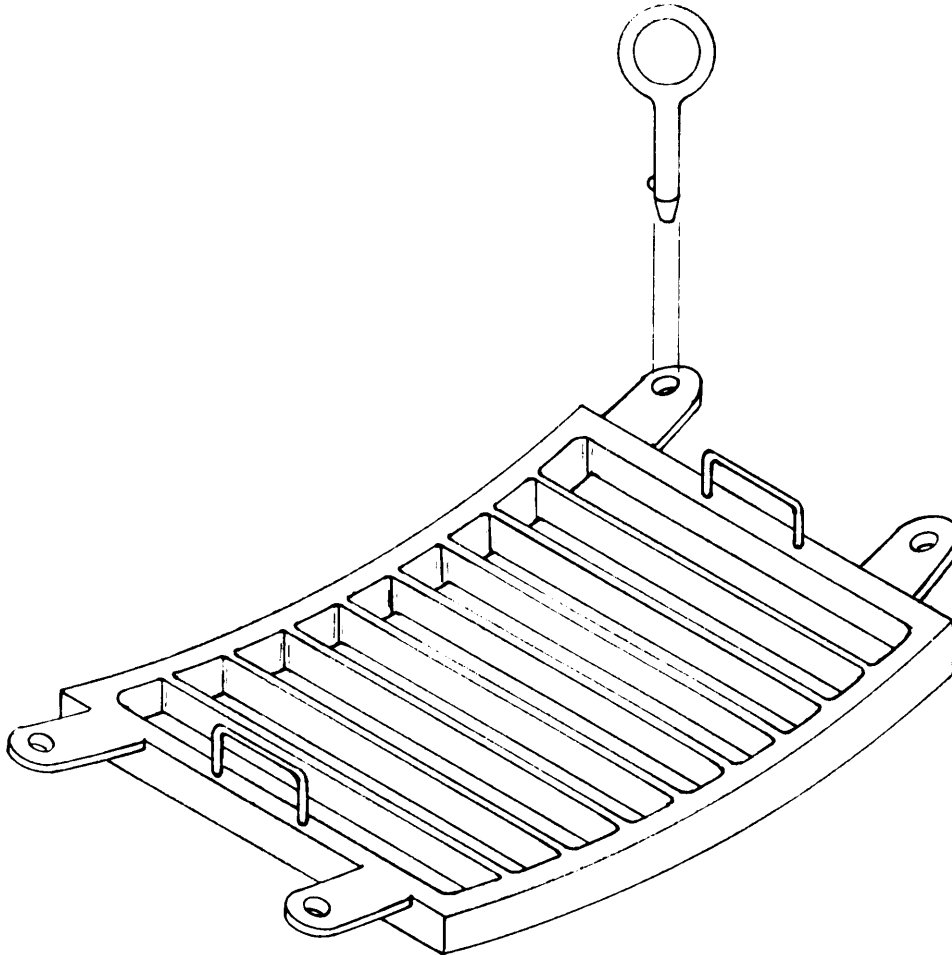


GRATINGS

The grating is hinged for access to the compartment, and the lifting handles pivot in sleeves. The hinges and handles have complex, hard-to-decontaminate surfaces. Decontaminating these items in place may wash contaminants/decontaminants into ballistic traps or into the compartment. The grating itself is difficult to decontaminate from both sides.

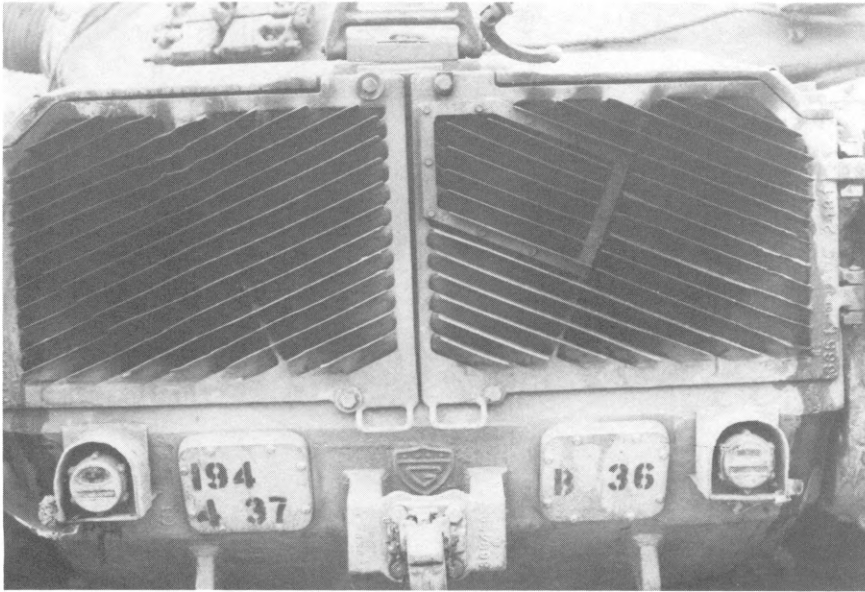
M60 Tank

MIL-HDBK-784



GRATINGS

A fixed handle on the ballistic grate is easier to decontaminate and eliminates a source of secondary contamination. Pins instead of hinges make the grating easier to remove, allowing it to be submerged in decontaminant or cleaned from both sides without washing contaminants or decontaminants into ballistic channels or into the compartments below the grates.

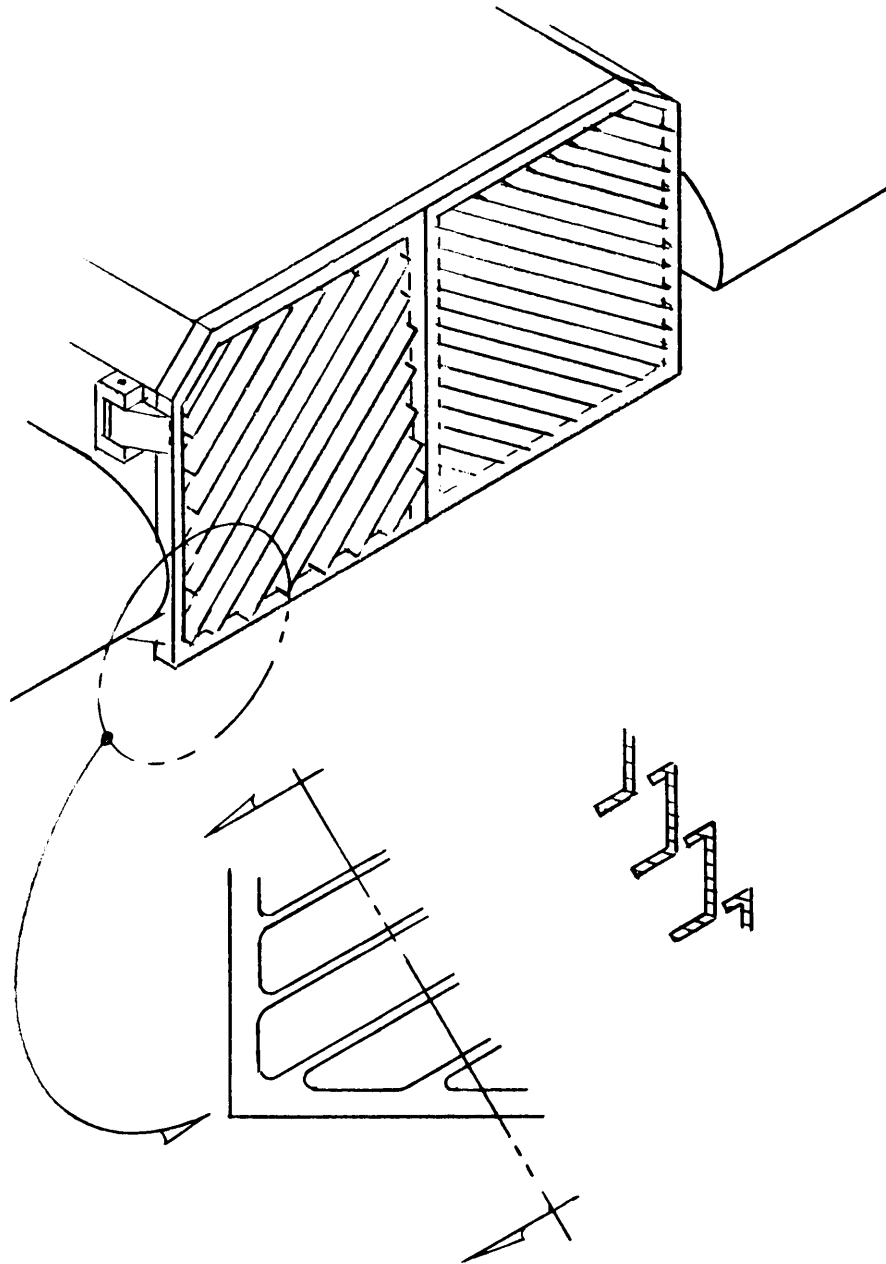


GRATINGS

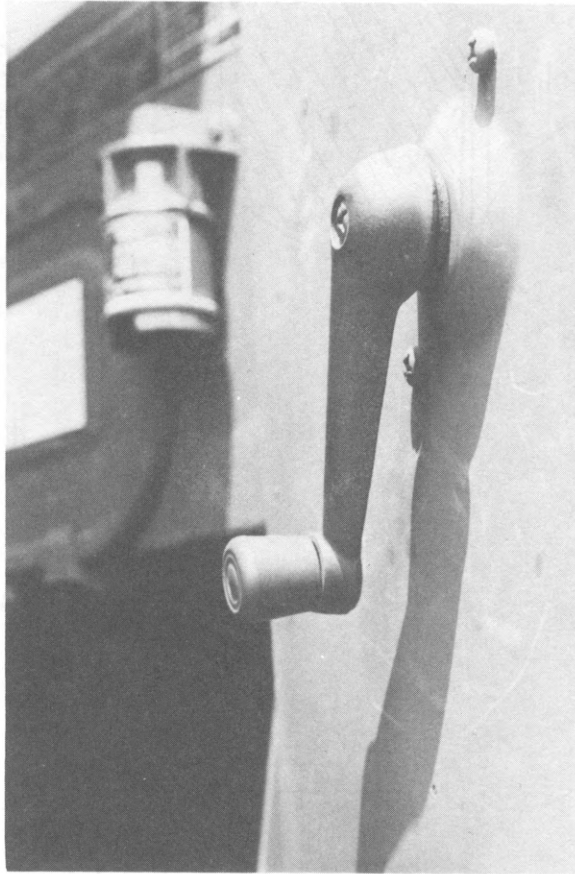
The ballistic grating can trap contaminants and prevents decontaminating liquid from draining out.

M60 Tank

MIL-HDBK-784

GRATINGS

Modification of louvers on doors eliminates liquid traps and allows thorough flush-out of contaminants/decontaminants. Liquids will run down toward lower corner of door, and rounding in this area will allow liquids to run out.

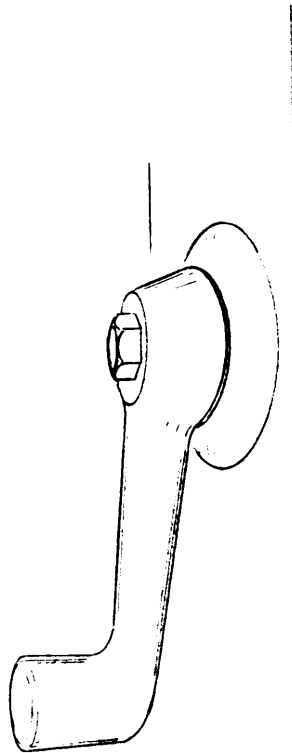


HANDLES

The rotating knob and recessed fastener head have crevices that can draw in contaminants.

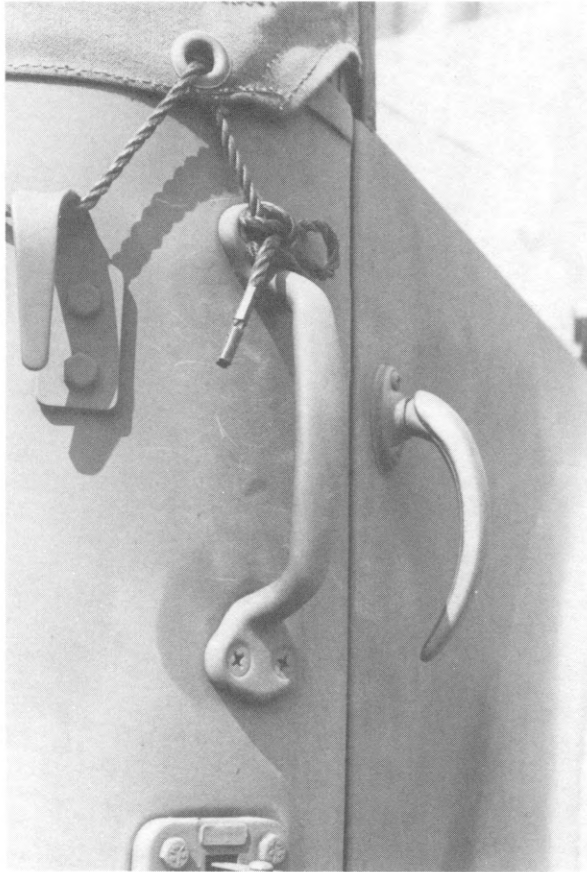
M818 Tractor Truck

MIL-HDBK-784



HANDLES

A one-piece handle with a protruding, sealed fastener has fewer crevices to trap contaminants.

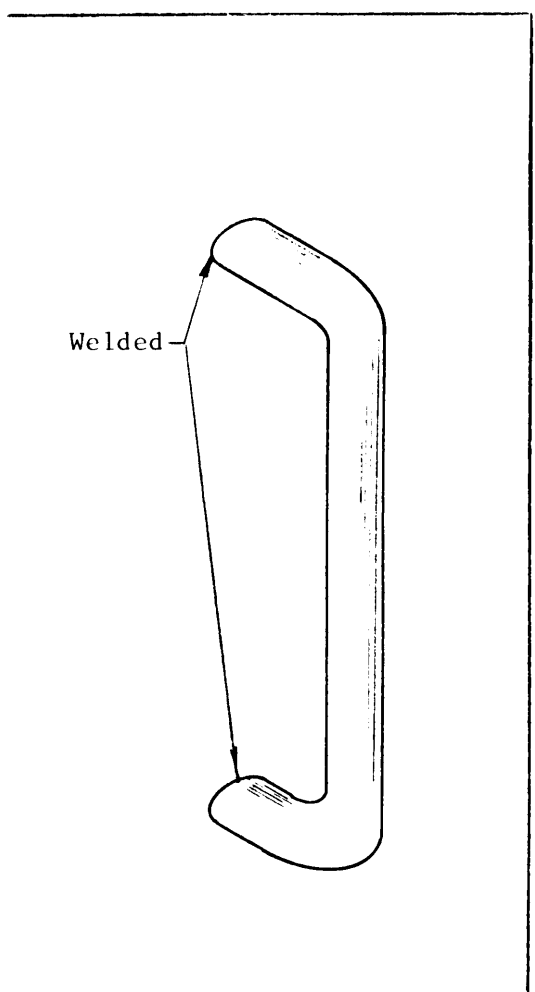


HANDLES

The handgrip, made of a single, solid piece of metal, is easy to decontaminate. Only the attachment screws and the grip-cab interface represent possible contaminant traps.

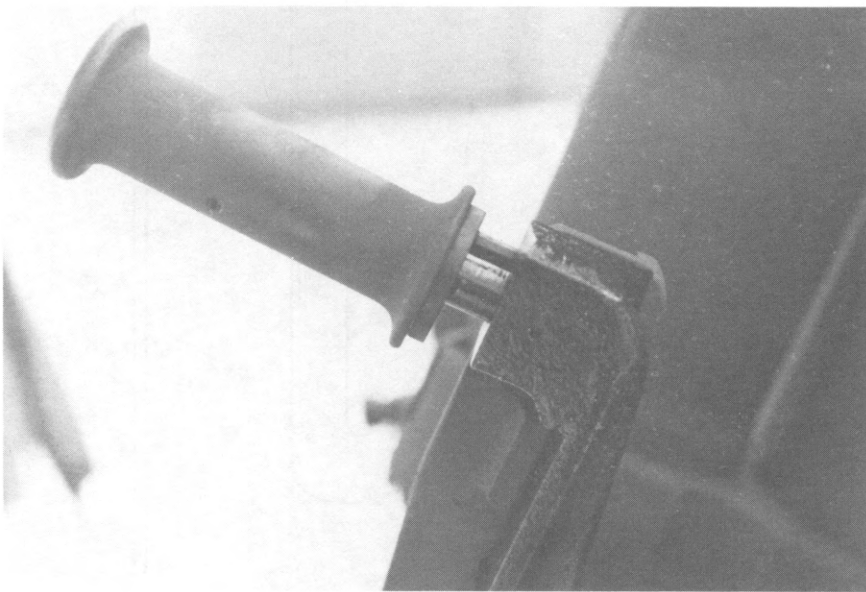
M819 Tractor Truck

MIL-HDBK-784



HANDLES

Installing the handgrip by welding, or filling the screw heads and grip-cab interface with nonabsorbent, nonreactive paint or sealant (see Appendix B), will eliminate potential contaminant traps.

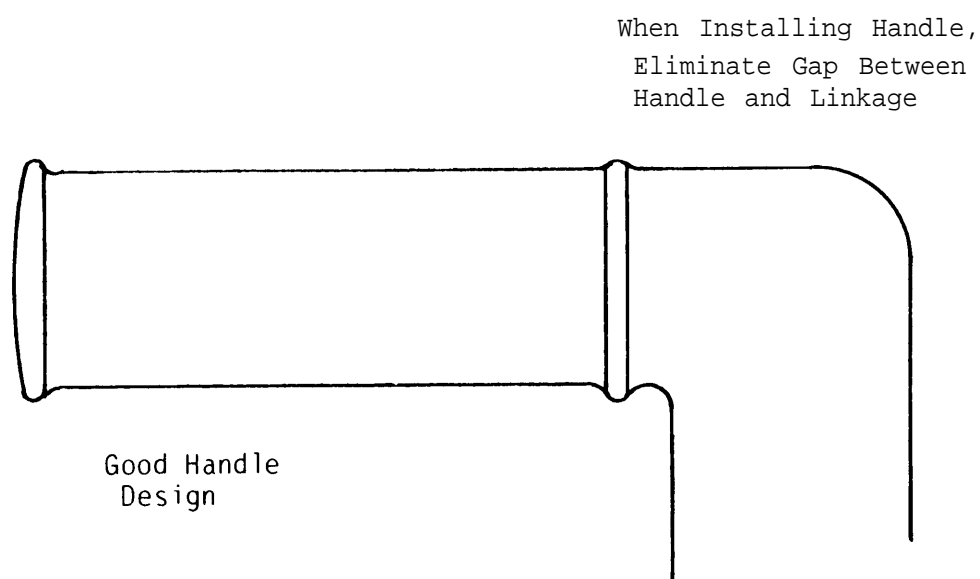


HANDLES

The simple, smooth surface of the handle does not trap contaminants and is easy to decontaminate. However, the roll pin attaching the handle to the shaft should be replaced with a solid pin.

M102 Howitzer

MIL-HDBK-784



HANDLES

Installing the handle fully onto the shaft eliminates a hard-to-decontaminate area.

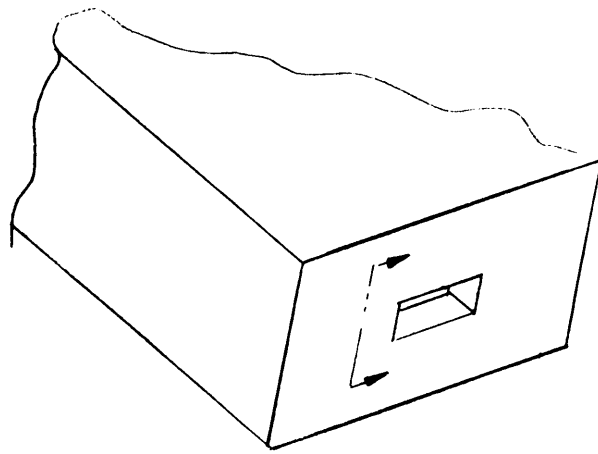
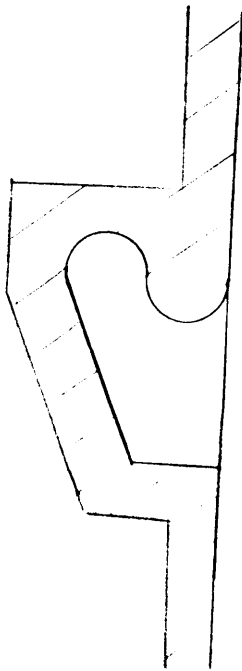


HANDLES

The hinged handle on the toolbox may trap contaminants and is difficult to decontaminate.

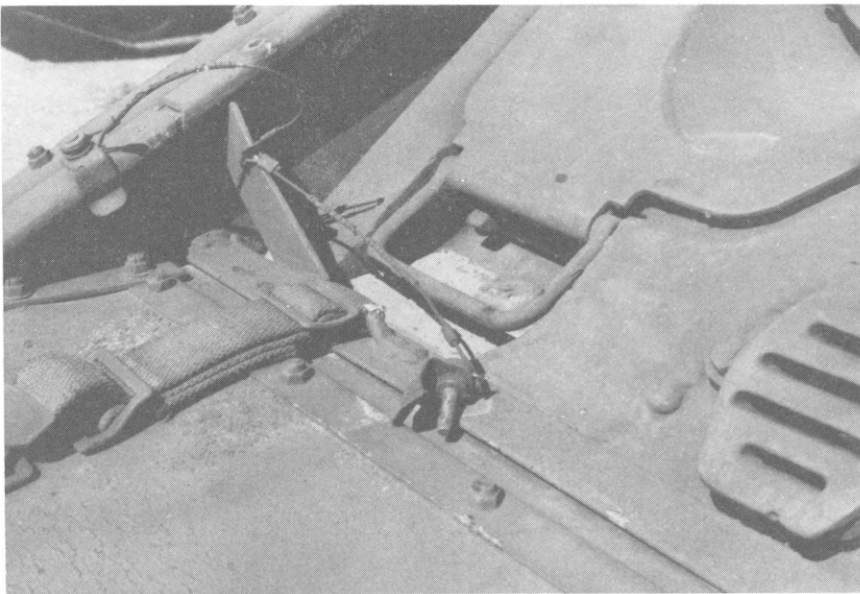
Forklift (6,000-lb capacity)

MIL-HDBK-784



HANDLES

A built-in handle prevents contaminant entrapment and is easy to decontaminate.

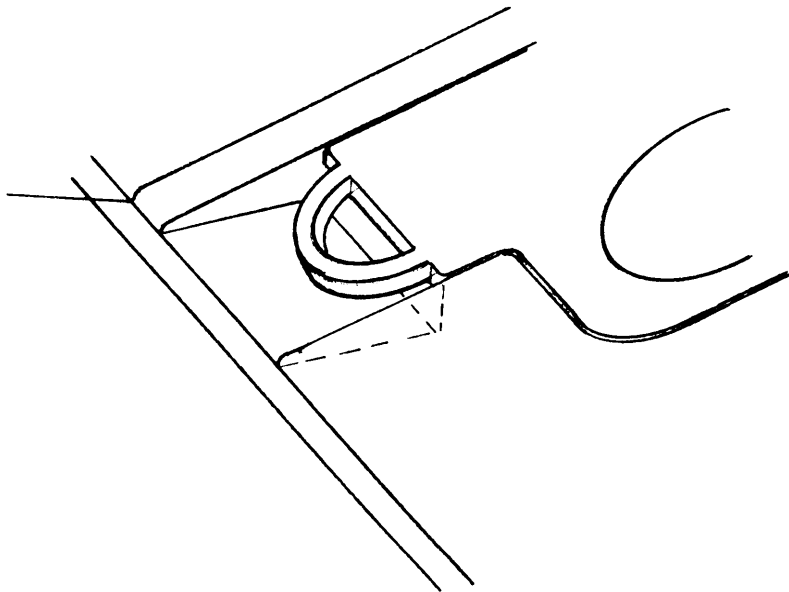


HANDLES

The hatch handle is difficult to decontaminate; contaminants can be trapped in the hinge or drawn in under the handle.

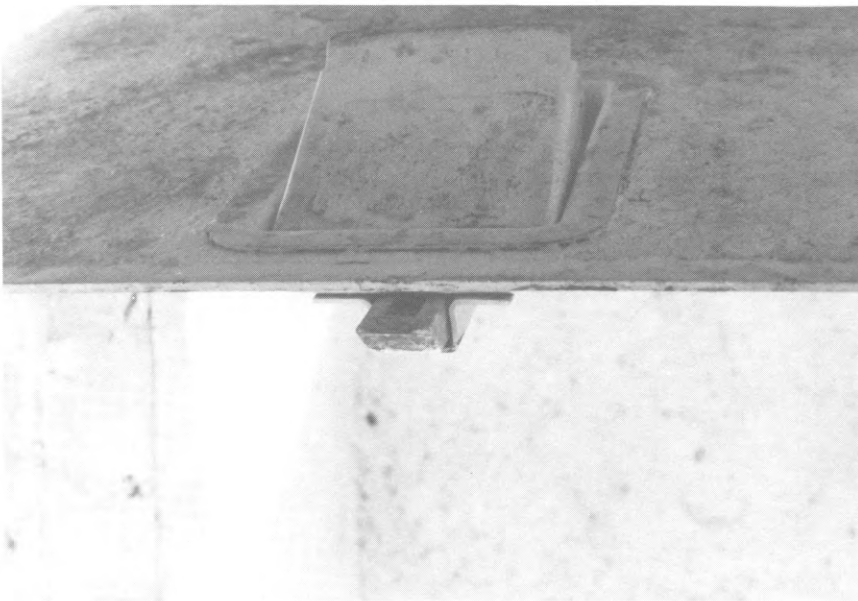
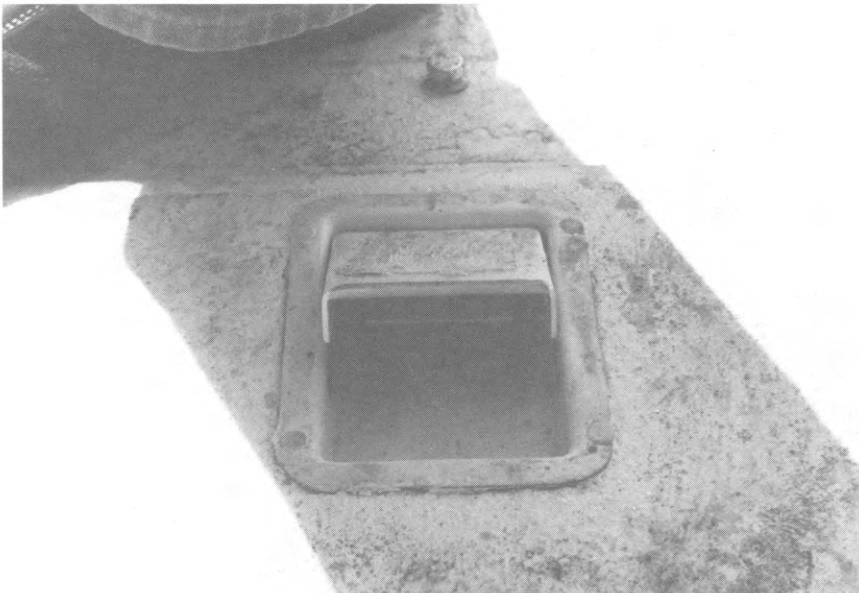
M551 Tank (Sheridan)

MIL-HDBK-784



HANDLES

A solid handle limits contaminant entrapment. In addition, increased clearance around the handle facilitates decontamination.

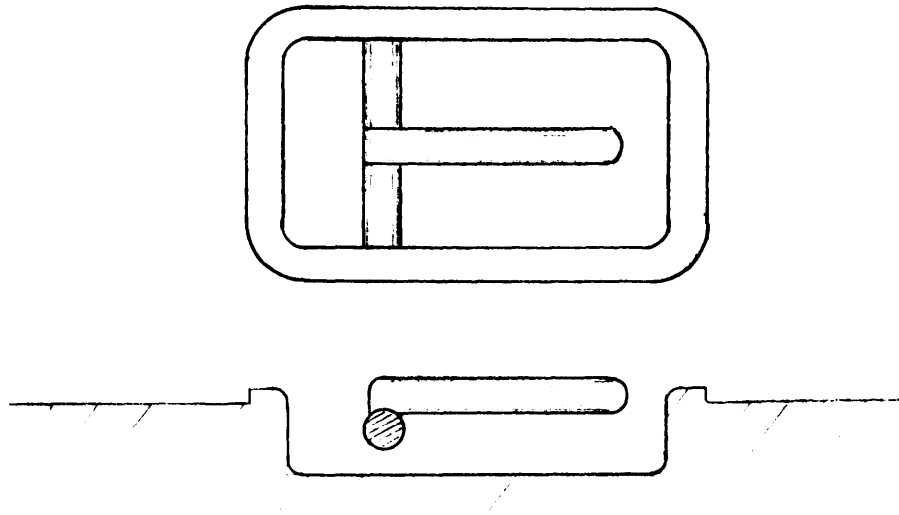


HANDLES

The latch mechanism may trap contaminants beneath the handle, and the inset cavity prevents drainage of decontaminating solutions.

M578 Recovery Vehicle

MIL-HDBK-784



HANDLES

A rod-type handle limits entrapment and is easier to decontaminate.

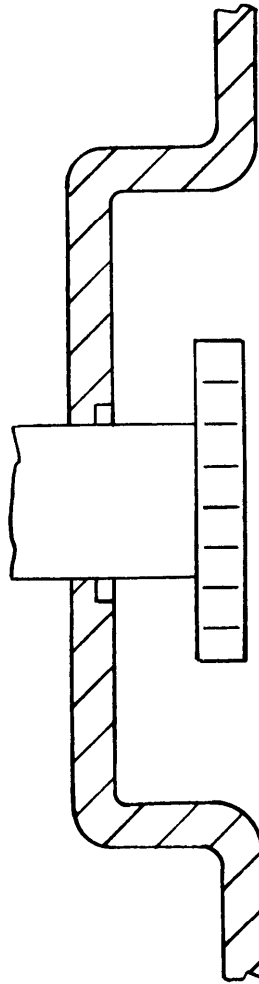


HANDLES

Limited clearance around the handle hinders decontamination.

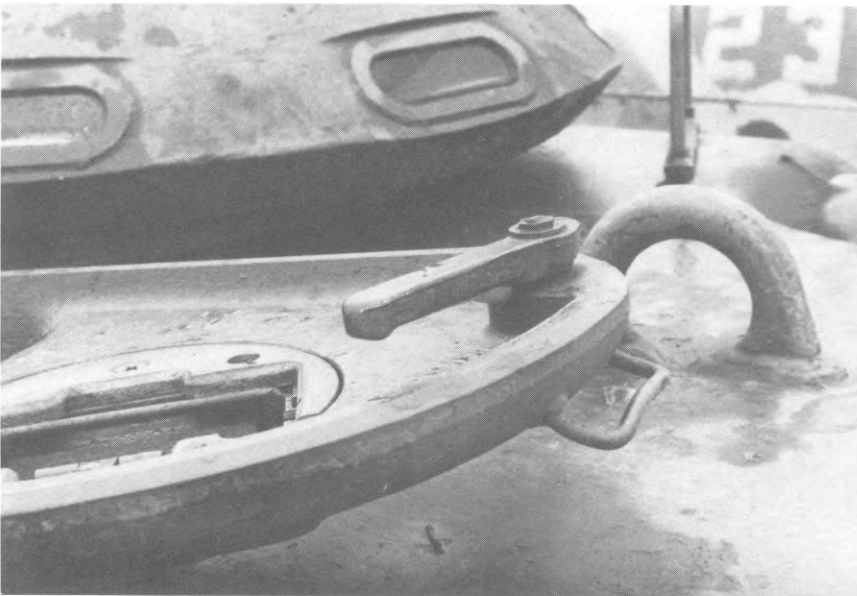
Reciprocating Compressor (covered)

MIL-HDBK-784



HANDLES

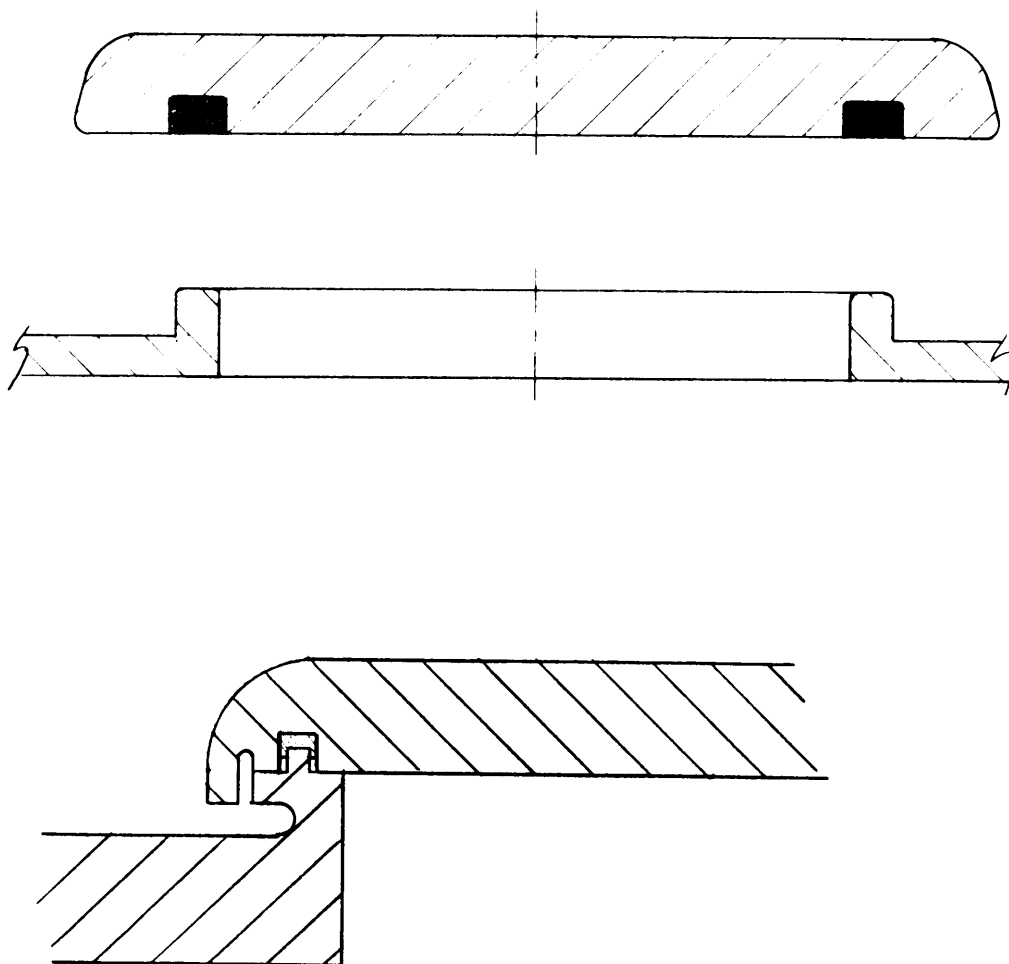
A round handle provides greater clearance.



HATCHES

The hatch seal is recessed in the hull opening, where it is subjected to wear from personnel entering the hatch. Also, the recess forms a trap that is difficult to decontaminate without the possibility of washing contaminants/decontaminants into the interior of the vehicle.

MIL-HDBK-784

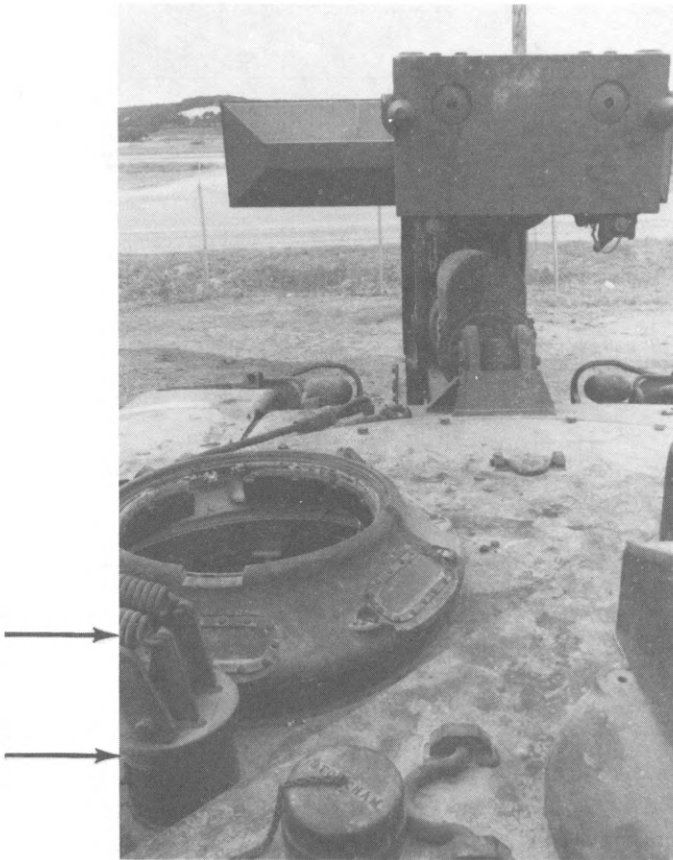


HATCHES

(Top) The seal is protected by being inset into the hatch cover, and the slightly raised ring around the hatch provides a positive seal with the cover, eliminating the entrapment groove around the hatch opening. The area around the opening can be decontaminated without washing material into the interior of vehicle.

(Bottom) A splash trap protects the hatch-flange interface from contaminants.

MIL-HDBK-784

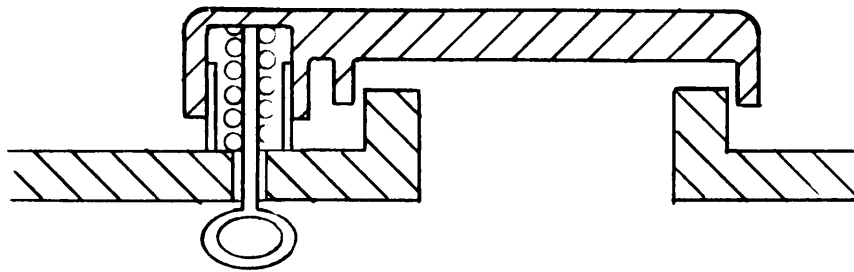


HATCHES

The spring-loaded cover is raised and rotated to the side to uncover the hatch opening. The springs and hinge mechanism are susceptible to contamination and are difficult to clean.

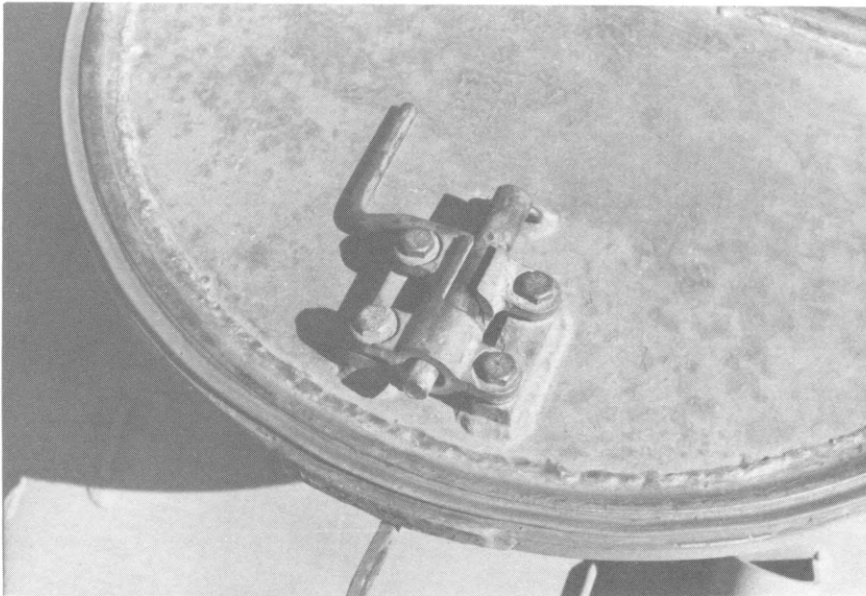
AVLB Bridge-Launching Vehicle

MIL-HDBK-784



HATCHES

In an alternative design, the spring is protected from contaminants. The cover can be opened from the inside by popping up and then twisting the handle to move the cover out of the hatch opening.

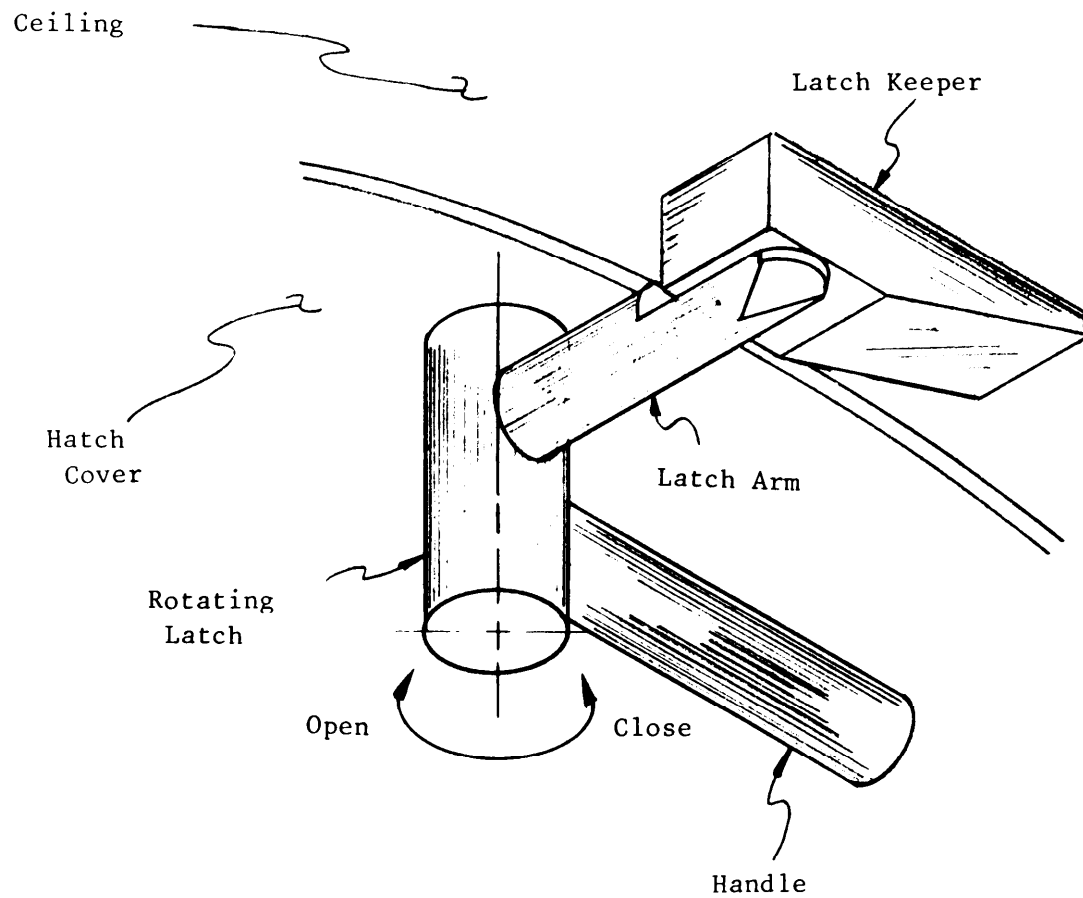


HATCHES

The gaps and crevices formed by the latch configuration can trap contaminants and are difficult to decontaminate.

M551 Tank (Sheridan)

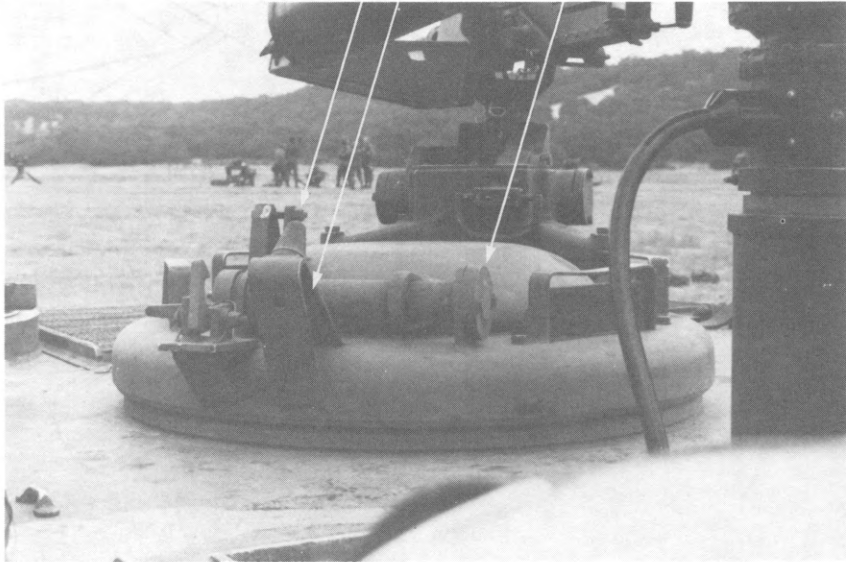
MIL-HDBK-784



HATCHES

A twist-type latch limits entrapment and is easy to decontaminate.

MIL-HDBK-784

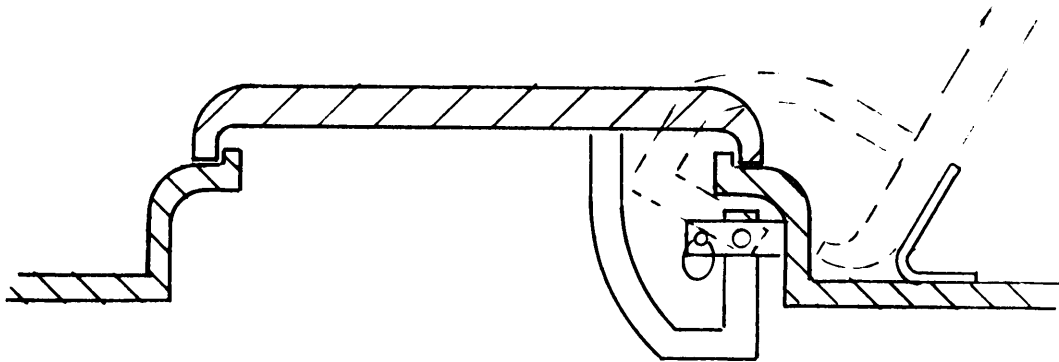


HINGES

Contaminants can be trapped in the pivot area of the hatch cover hinge and be difficult to remove or neutralize by chemical means. The stop has an interior area that is difficult to reach with a decontaminant stream and has a rubber tip that can absorb contaminants/decontaminants.

M113 Armored Personnel Carrier

MIL-HDBK-784



HINGES

The hinge is entirely enclosed within the hatch opening, protected from the contaminating atmosphere. Stiff spring steel substitutes for the complex stop, eliminating the need for a rubber tip to absorb shock.

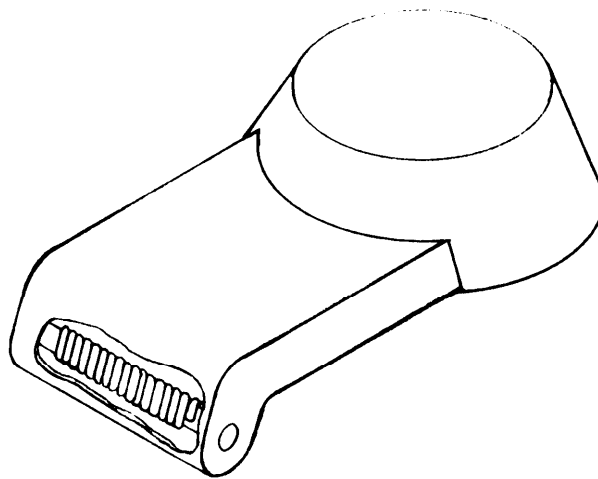
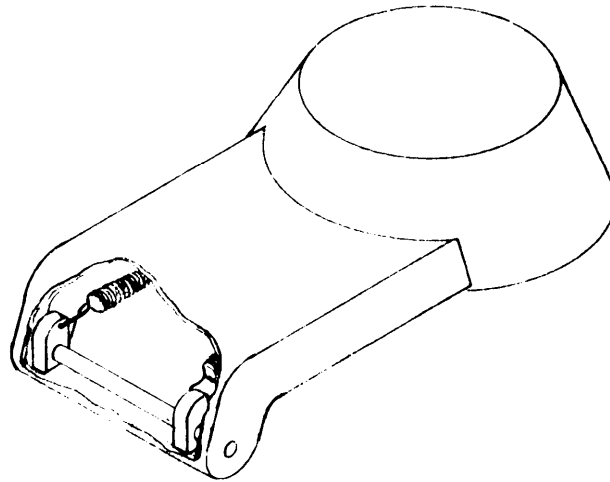


HINGES

Exposed springs and hinges can trap contaminants and are difficult to decontaminate.

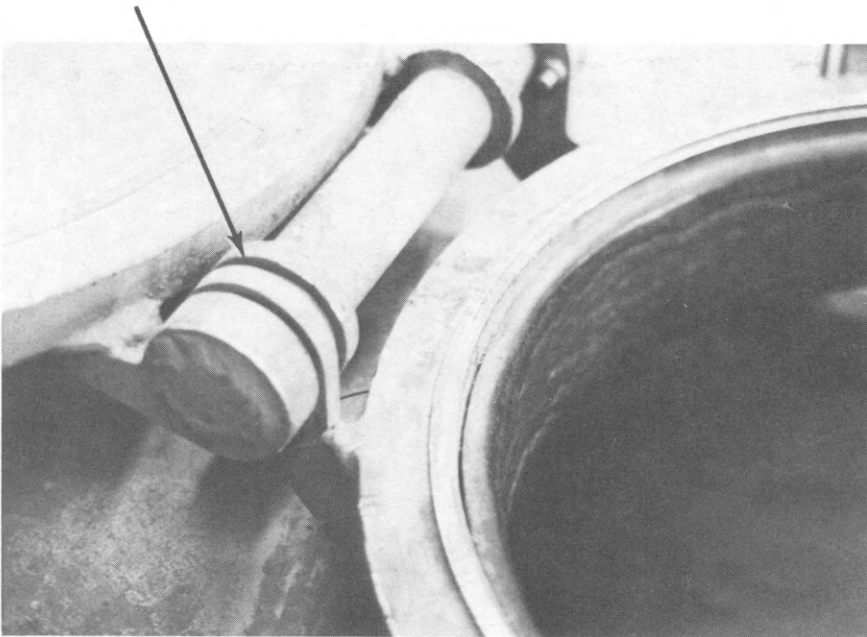
AVLB Bridge-Launching Vehicle

MIL-HDBK-784



HINGES

A fairing covers and protects extension springs (top) or a torsion spring (bottom) from contaminants.

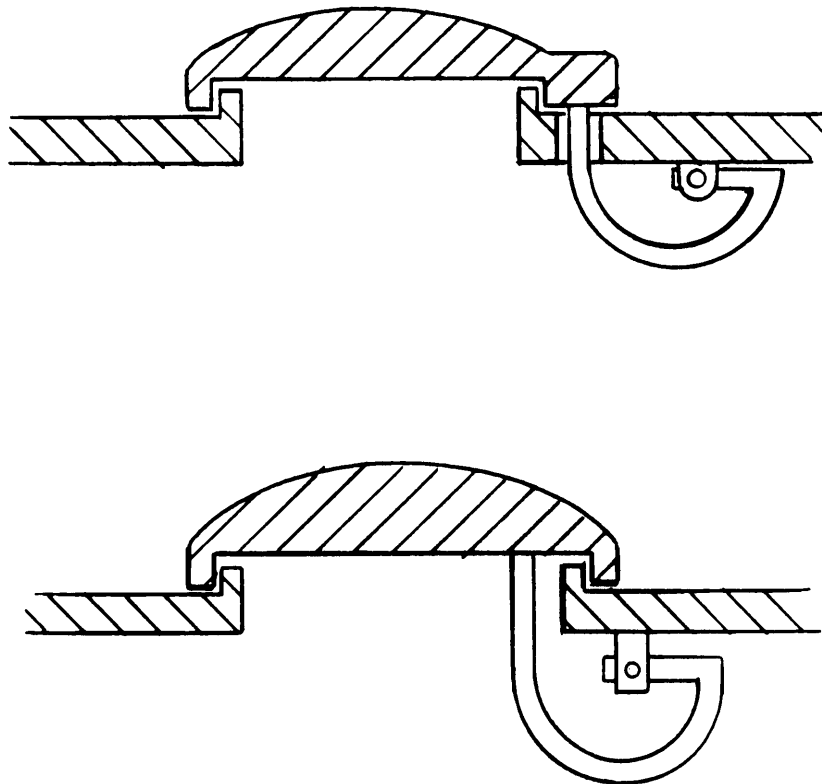


HINGES

The pivot area between the hinge pin and flange is wide enough to trap contaminant, but too narrow for effective chemical decontamination.

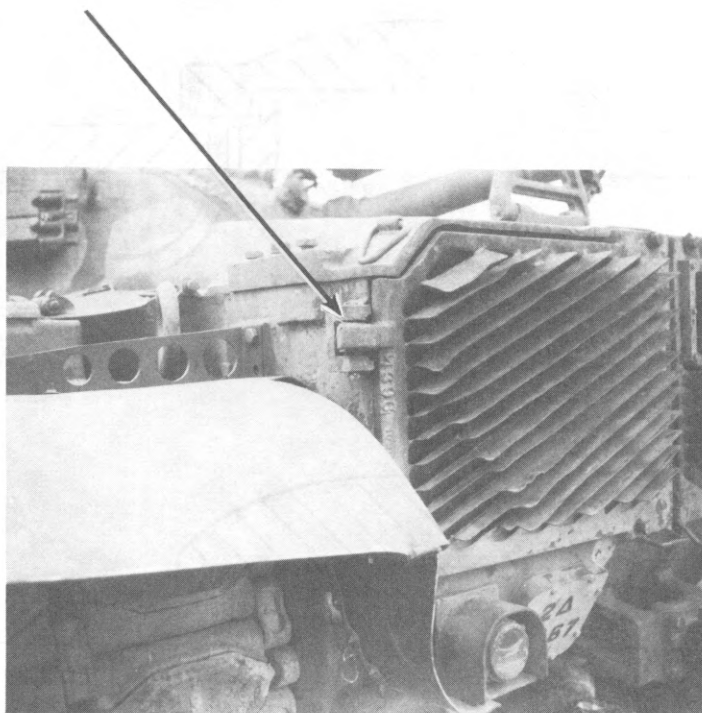
M113 Armored Personnel Carrier

MIL-HDBK-784



HINGES

In both designs, the hinges are entirely within the vehicle, protected from the contaminating atmosphere. The upper configuration requires a sliding seal to close off the hinge arm and vehicle interior from the outside environment.

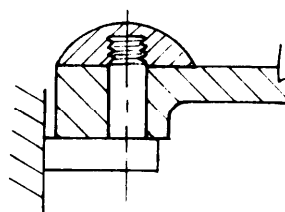
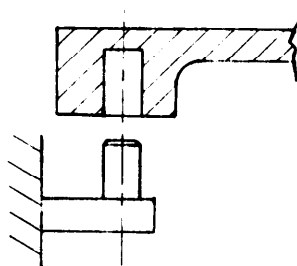
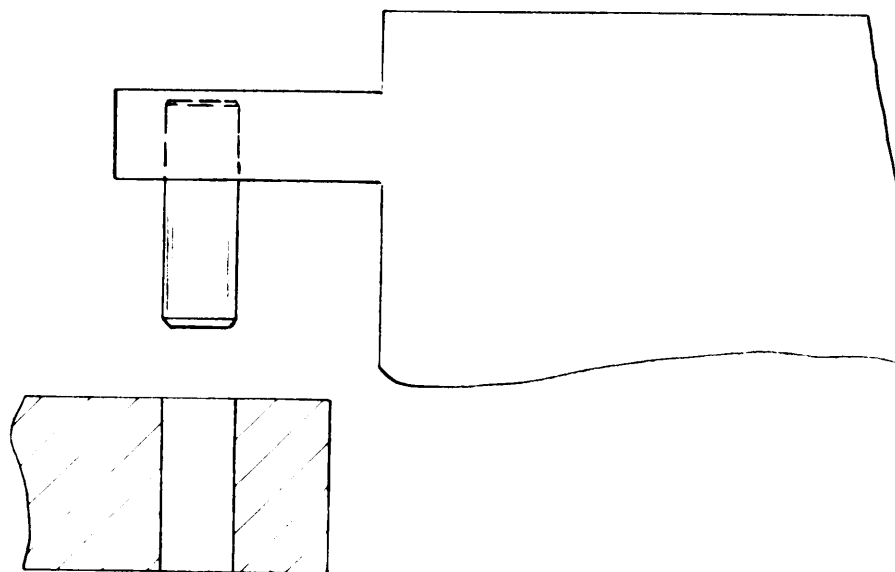


HINGES

The present hinge design allows contaminants to enter the pin cavity on the door flange and on the hull. This cavity, as well as the hinge pin, is difficult to decontaminate. In addition, the door is difficult to remove for thorough decontamination.

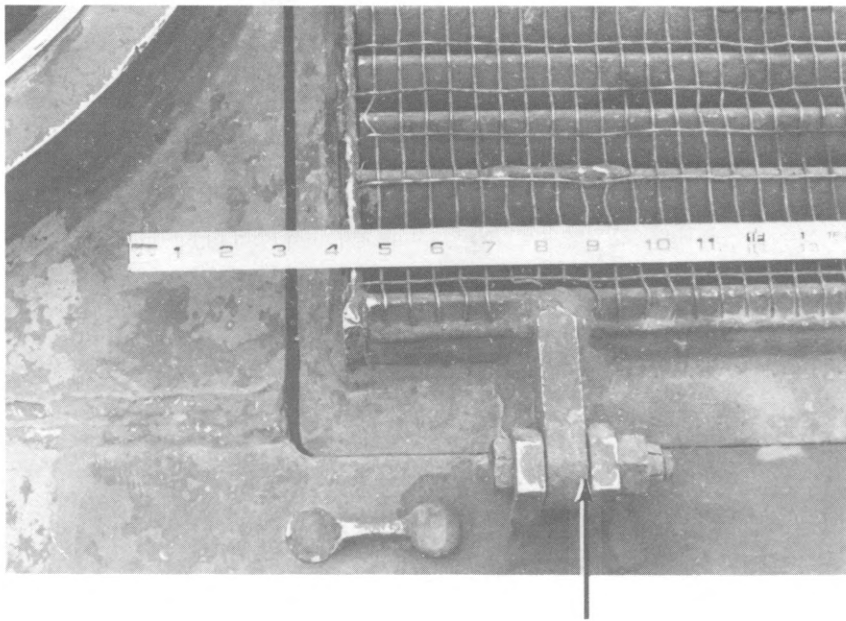
M60 Tank

MIL-HDBK-784



HINGES

Simpler designs allow the door to be easily removed for thorough decontamination. The top configuration allows contaminants to be flushed through the hinge post. The middle configuration prevents contaminants from entering the hinge post and limits access of contaminants to the door flange cavity. The bottom configuration is a composite of the first two, and also provides a capability for securing the hinge.

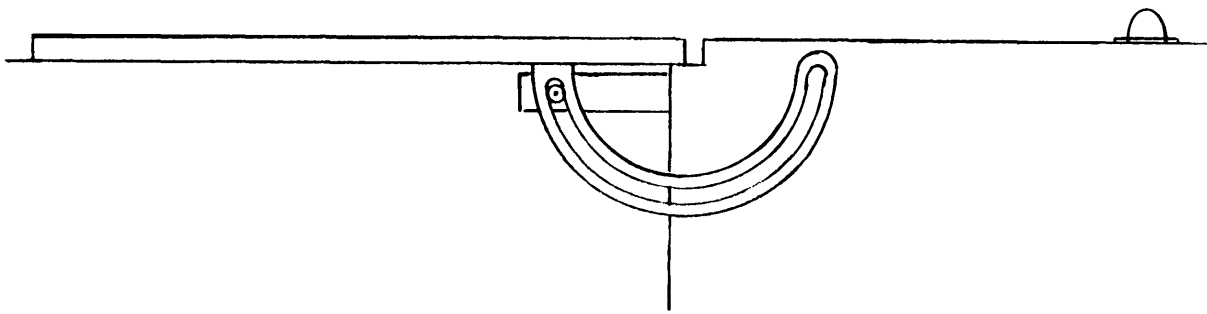


HINGES

The pivot area of the ballistic grating hinge, including the bolt shank, can draw contaminants into the capillary gap between the hinge components.

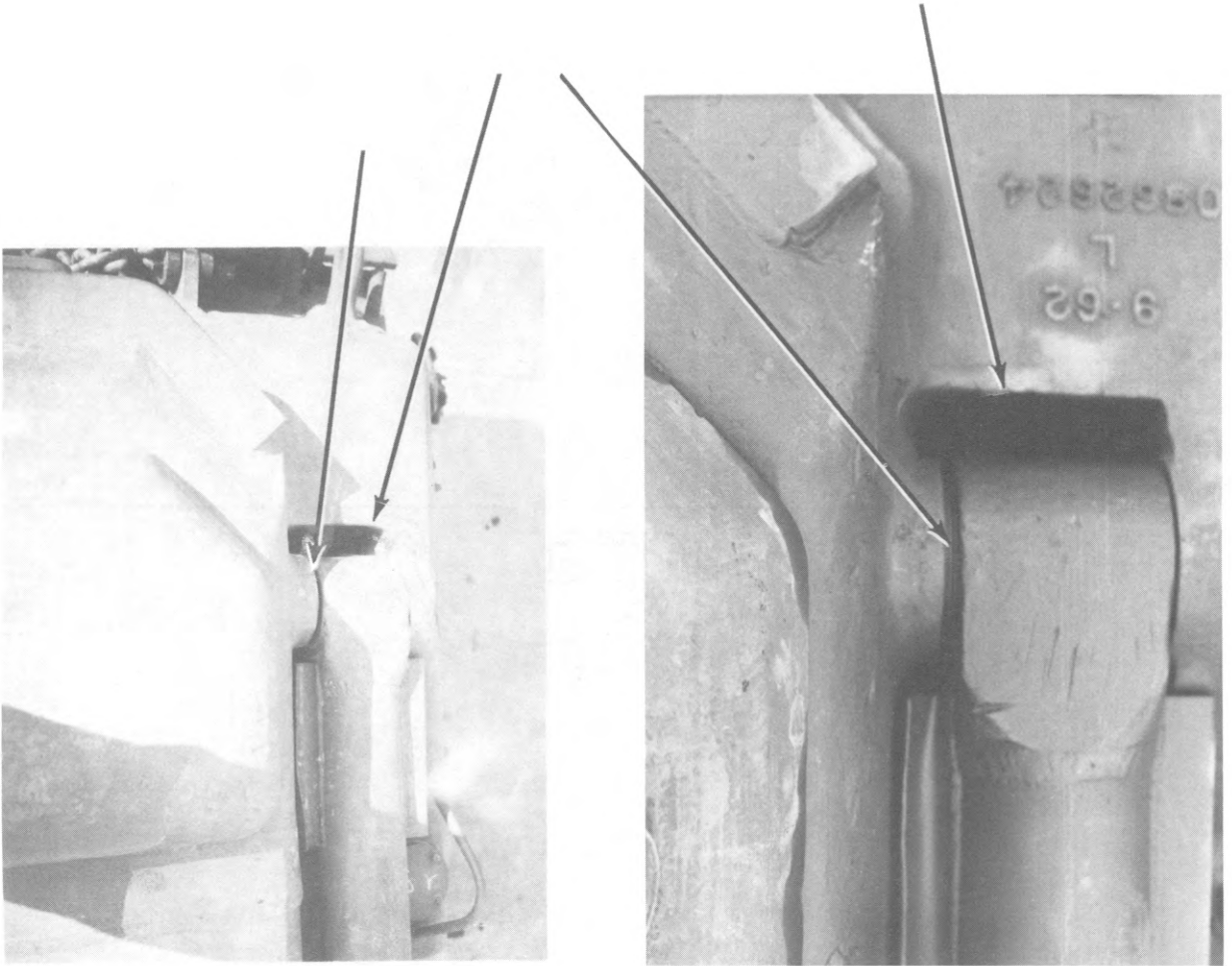
M113 Armored Personnel Carrier

MIL-HDBK-784



HINGES

The hinge is entirely inside the engine compartment, covered and protected by the ballistic grating.

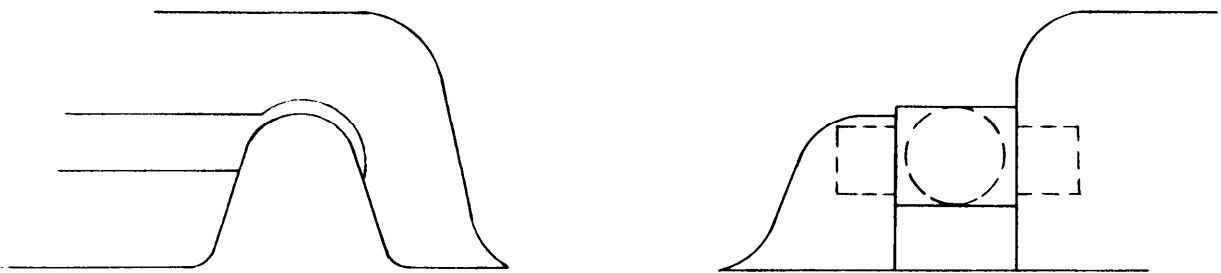


HINGES

The hinges and support areas for the A-frame have small spaces that are difficult to decontaminate.

M88 Recovery Vehicle

MIL-HDBK-784



HINGES

A raised hinge provides better access for decontamination.

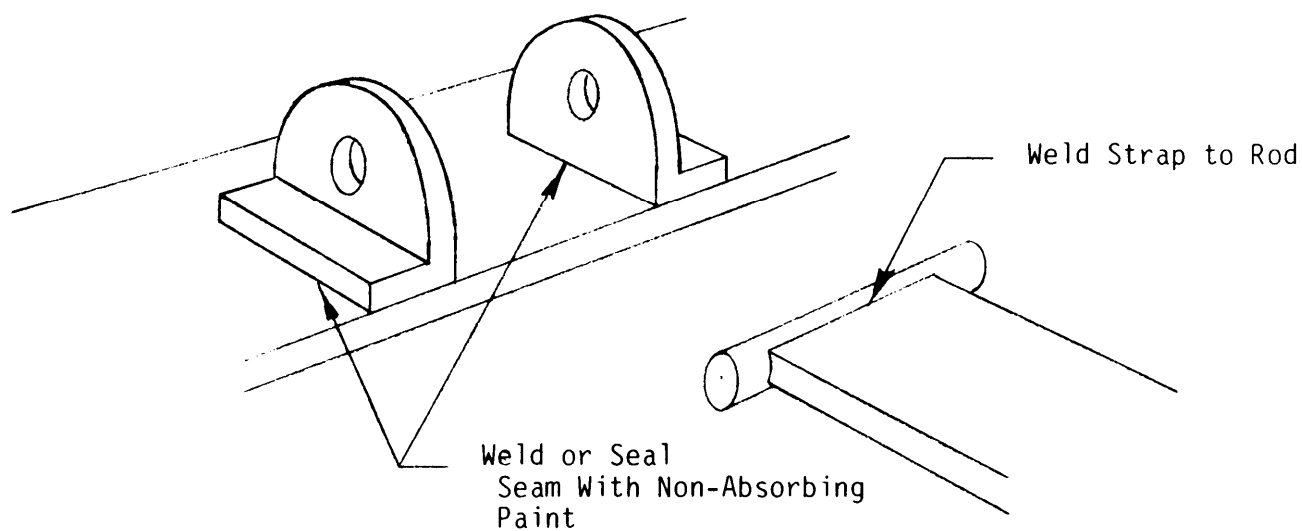


HINGES

The rear seat-step is hinged to the frame of the rear compartment. Contaminants from the air and from dirt on the shoes of personnel can be trapped in the crevices between the hinge strap and the hinge flanges and in the slot in the attachment plate. Decontamination of these openings is difficult.

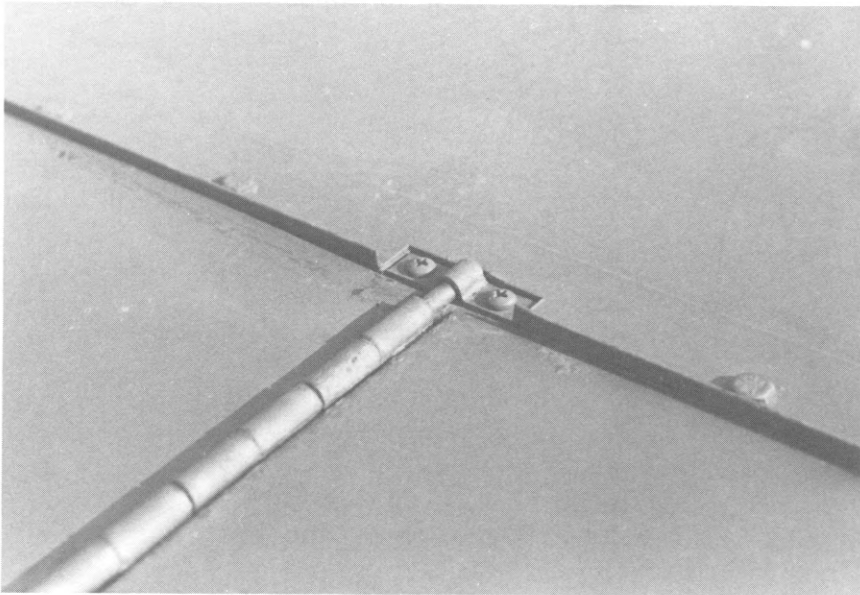
MIL-HDBK-784

Assemble Hinge, Then Weld Supports to Frame



HINGES

A three-part hinge, assembled in place by welding, eliminates most entrapment crevices and is easier to decontaminate than the bolted-on plate-strap-pin hinge.

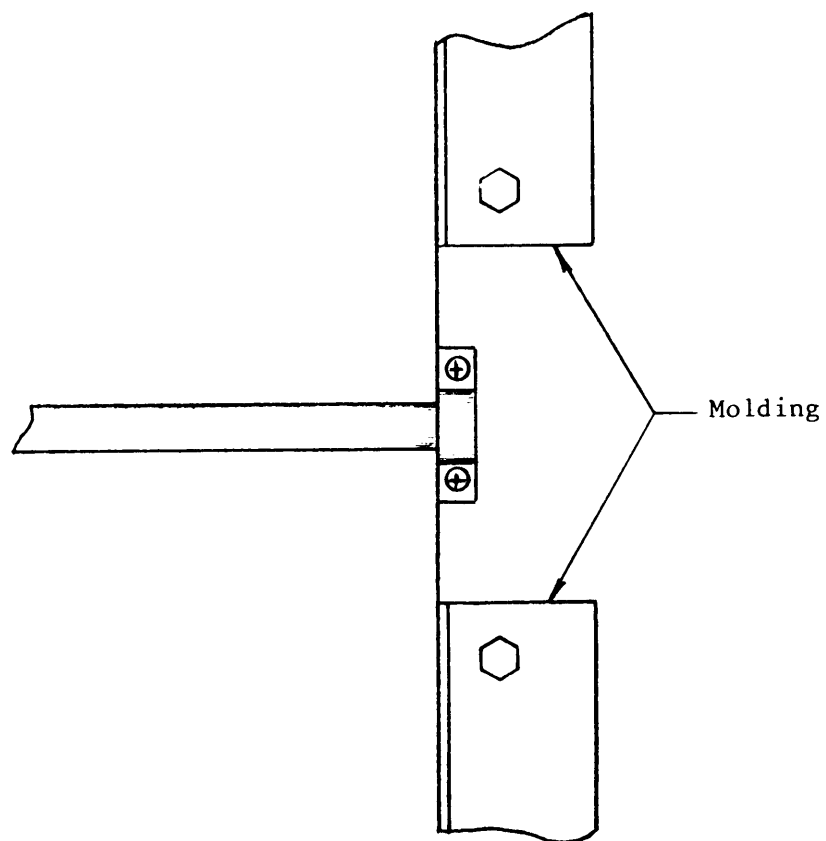


HINGES

The side molding around the bearing bracket forms a narrow groove, which can draw in contaminants and which hinders decontamination of the bracket itself.

Reciprocating Compressor (covered)

MIL-HDBK-784



HINGES

Cutting away a portion of the molding strip provides greater clearance around the bracket.

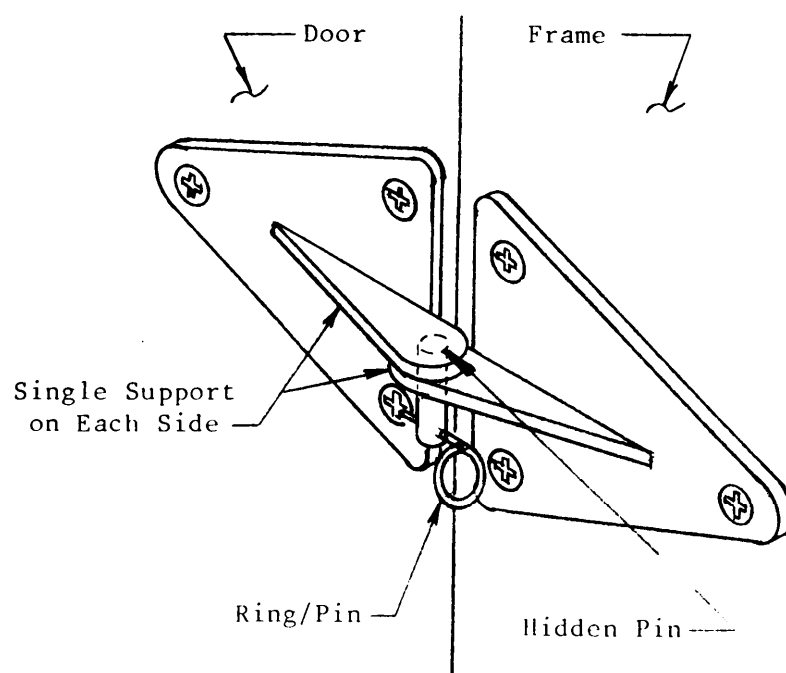


HINGES

The quick-release hinge can trap contaminants and is difficult to decontaminate.

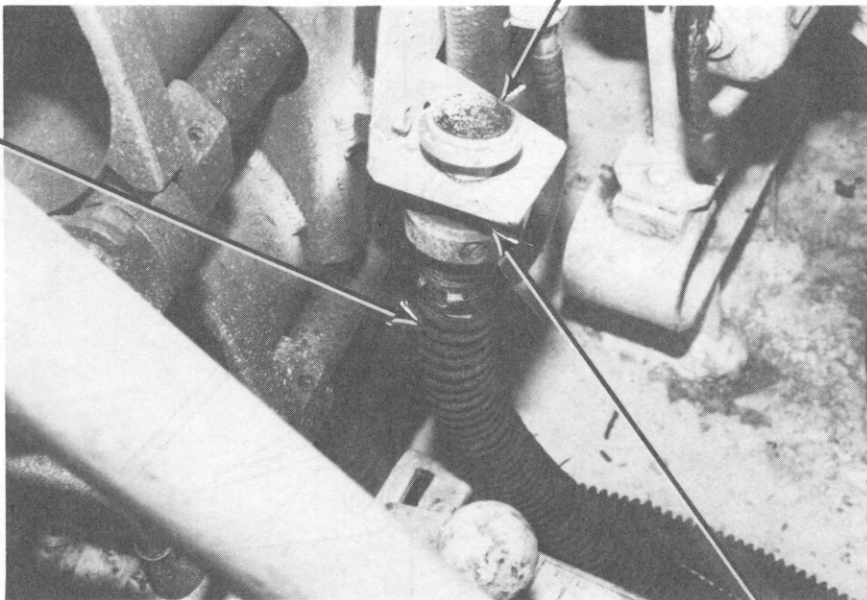
UH-1M Helicopter (Huey)

MIL-HDBK-784



HINGES

Decontamination is facilitated by removing the yoke on one side and replacing it by a single support with a welded-in pin.

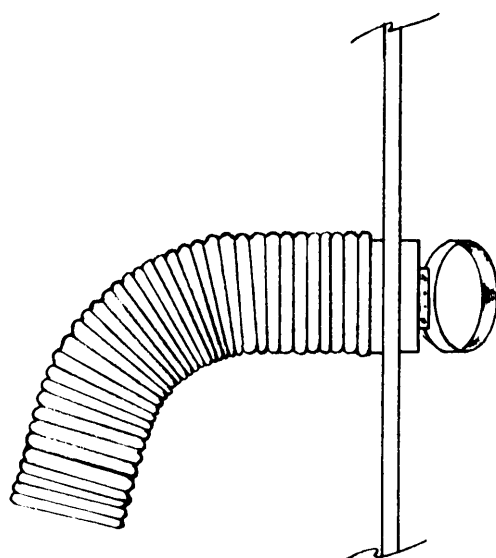


HOSES

The end of the air supply hose is exposed to contaminants. The hose mounting and ridges on the hose can trap contaminants and are difficult to decontaminate.

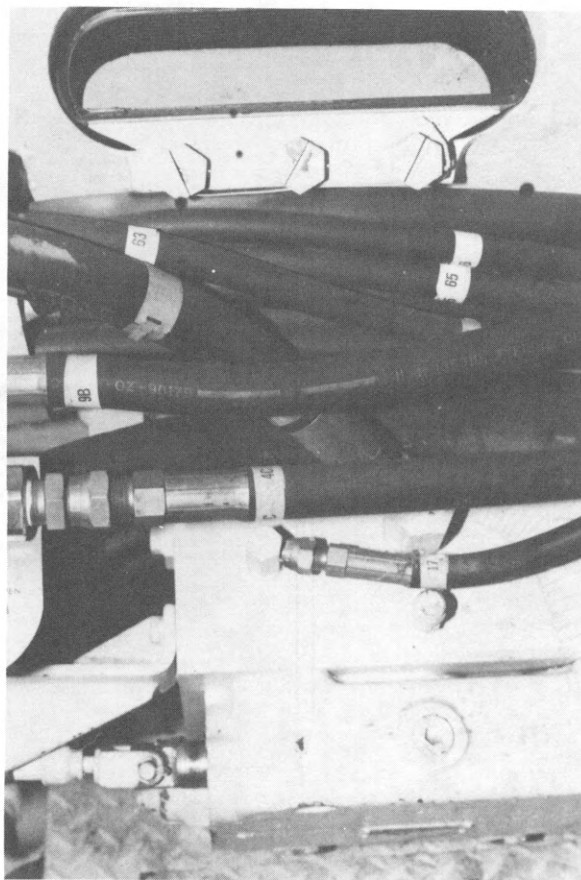
M60 Tank

MIL-HDBK-784



HOSES

A panel protects the body of the hose. The mounting includes a quick-connect for attaching to the face-mask hose and a cap to cover the opening when the hose is not in use.

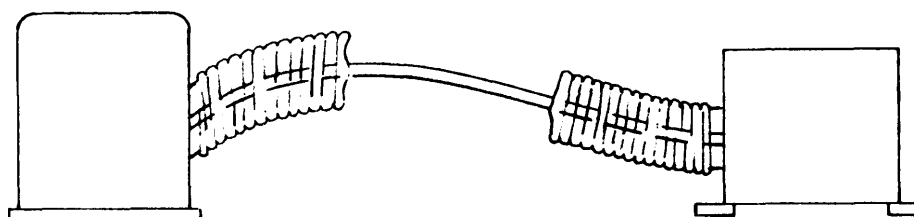
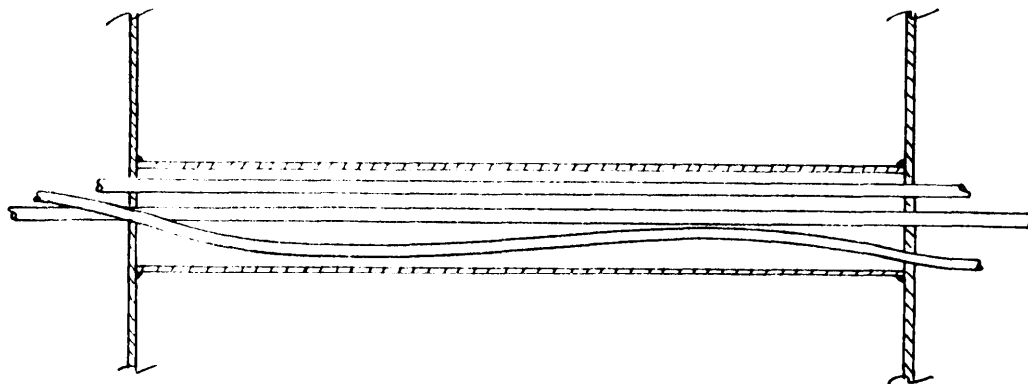


HOSES

Gangs of hoses are difficult to decontaminate without removing them.

M88 Recovery Vehicle

MIL-HDBK-784



HOSES

(Top) A sealed tube or box protects the hoses from contaminants.

(Bottom) A metal bellows allows relative movement between the parts while protecting the hose connections.

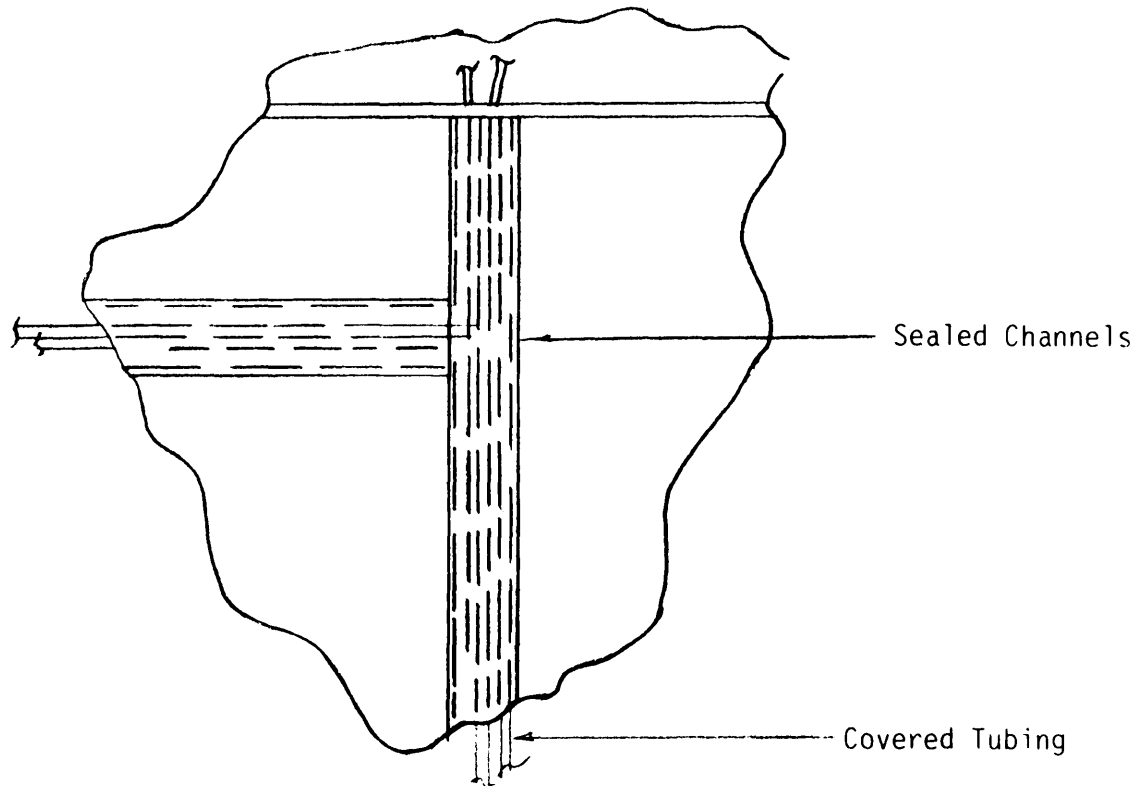


HOSES

The hose bundles are difficult to decontaminate. In addition, the cover material may absorb contaminants or be incompatible with decontaminants.

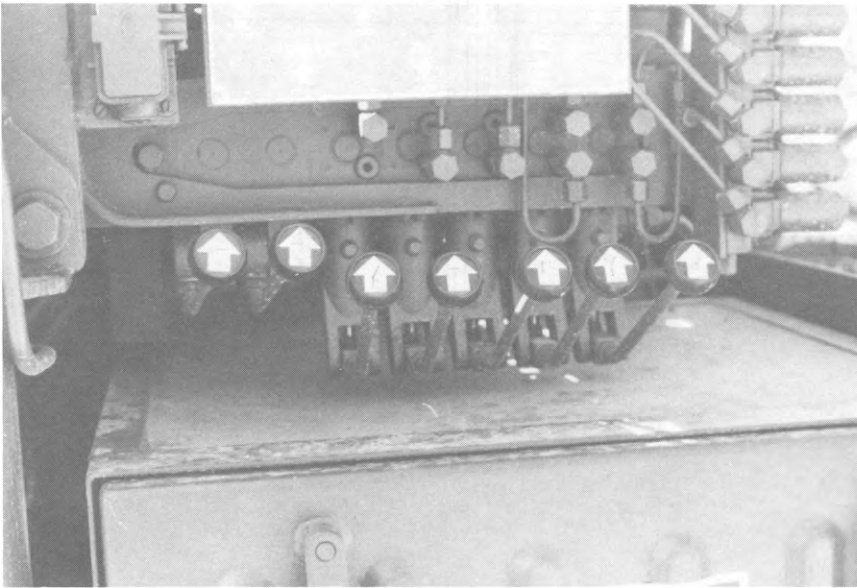
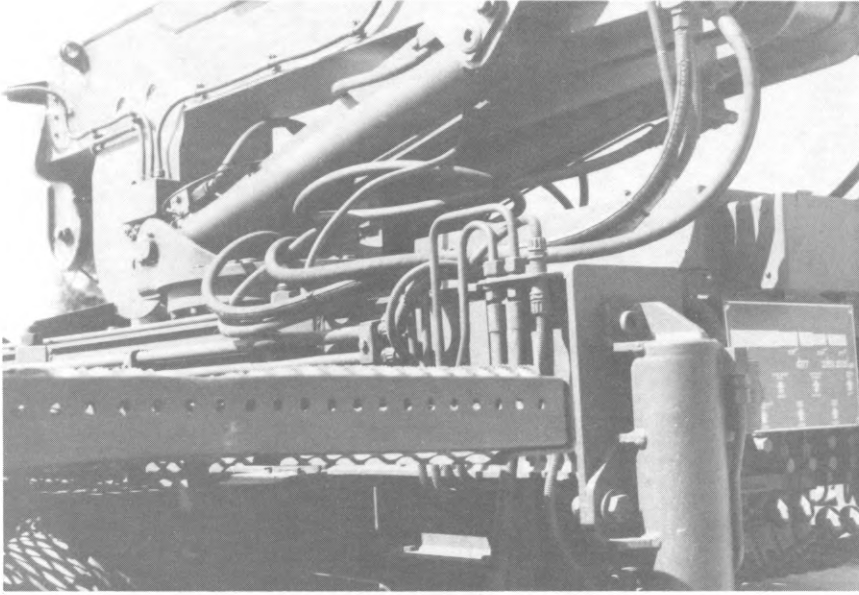
M820 Van Truck

MIL-HDBK-784



HOSES

Running the tubing through sealed channels protects the cover material from contaminants and decontaminants.

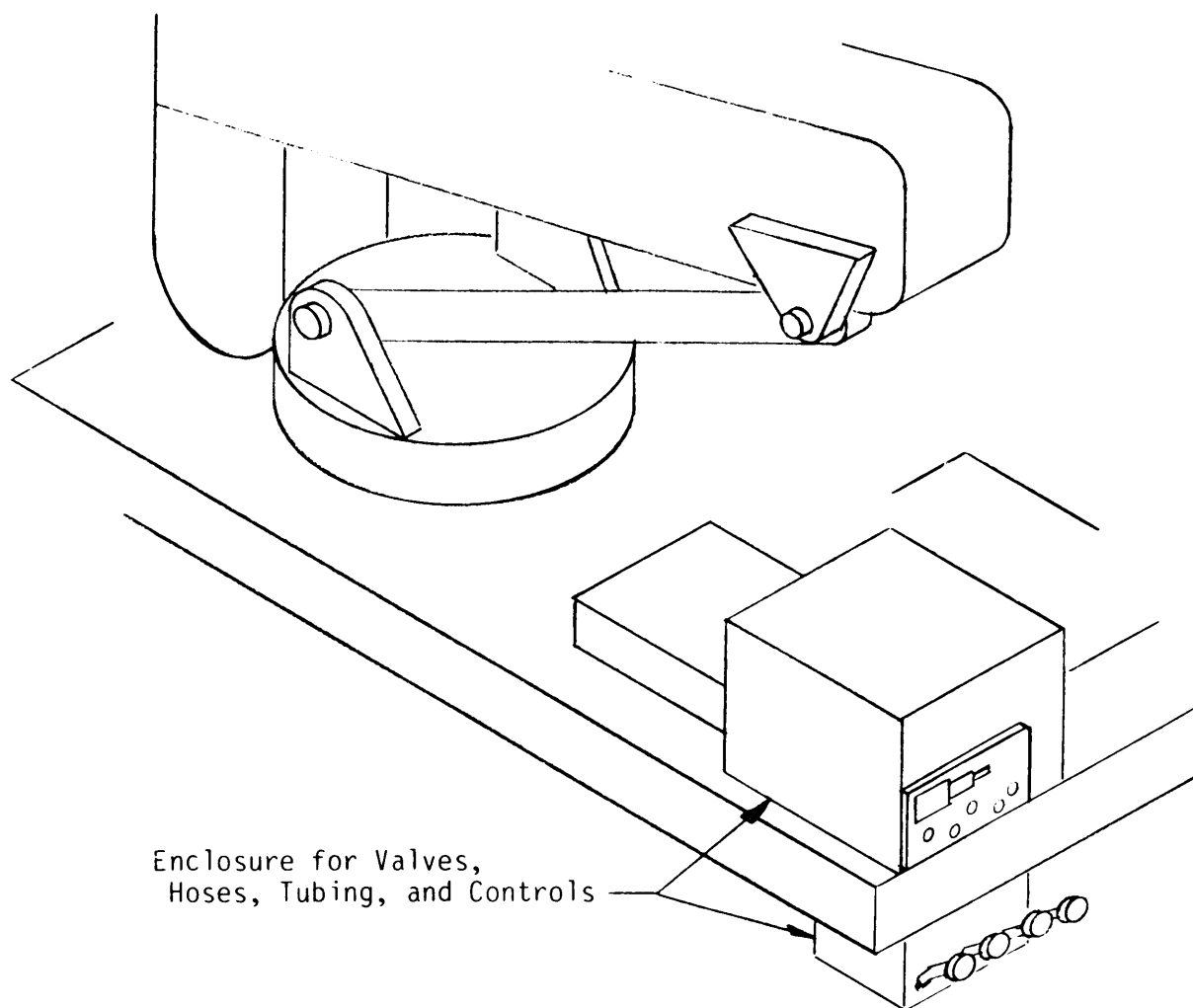


HOSES

Exposed hoses, tubing, valve levers, and connector banks are difficult to decontaminate, and the areas around and under these items are hard to get to.

Tractor Truck (10-Ton, 8x8)

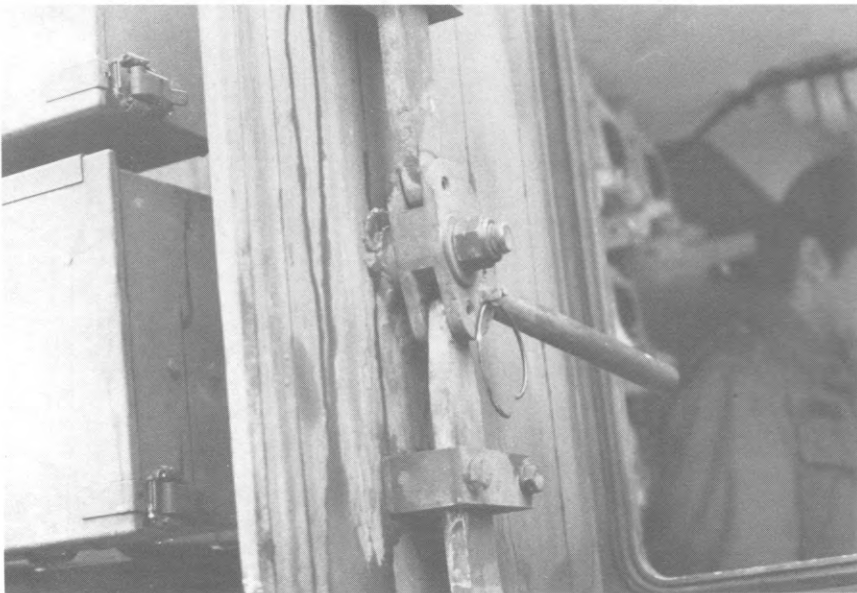
MIL-HDBK-784



HOSES

A protective cover over the nonmoving parts prevents contamination and eliminates the need for decontamination.

MIL-HDBK-784

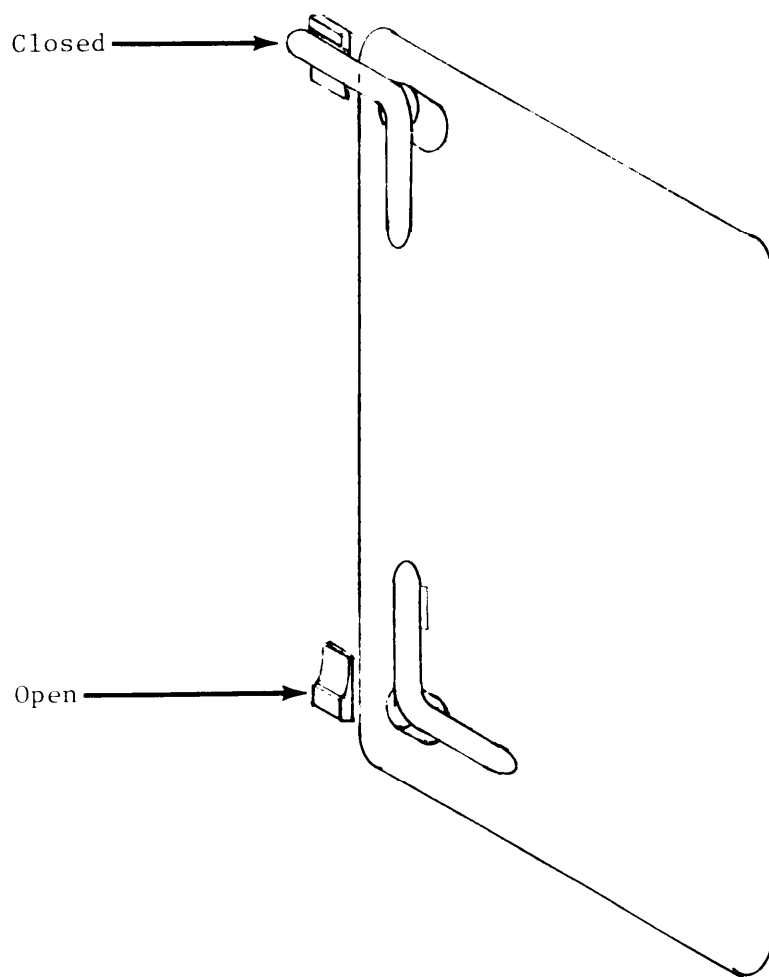


LATCHES

The complicated lock has several exposed openings that can trap contaminants and that make decontamination difficult.

M109 Howitzer

MIL-HDBK-784



LATCHES

A simpler latch, with a sealed shaft welded to the door and a locking plate welded to the wall, will not trap contaminants and is easier to decontaminate.

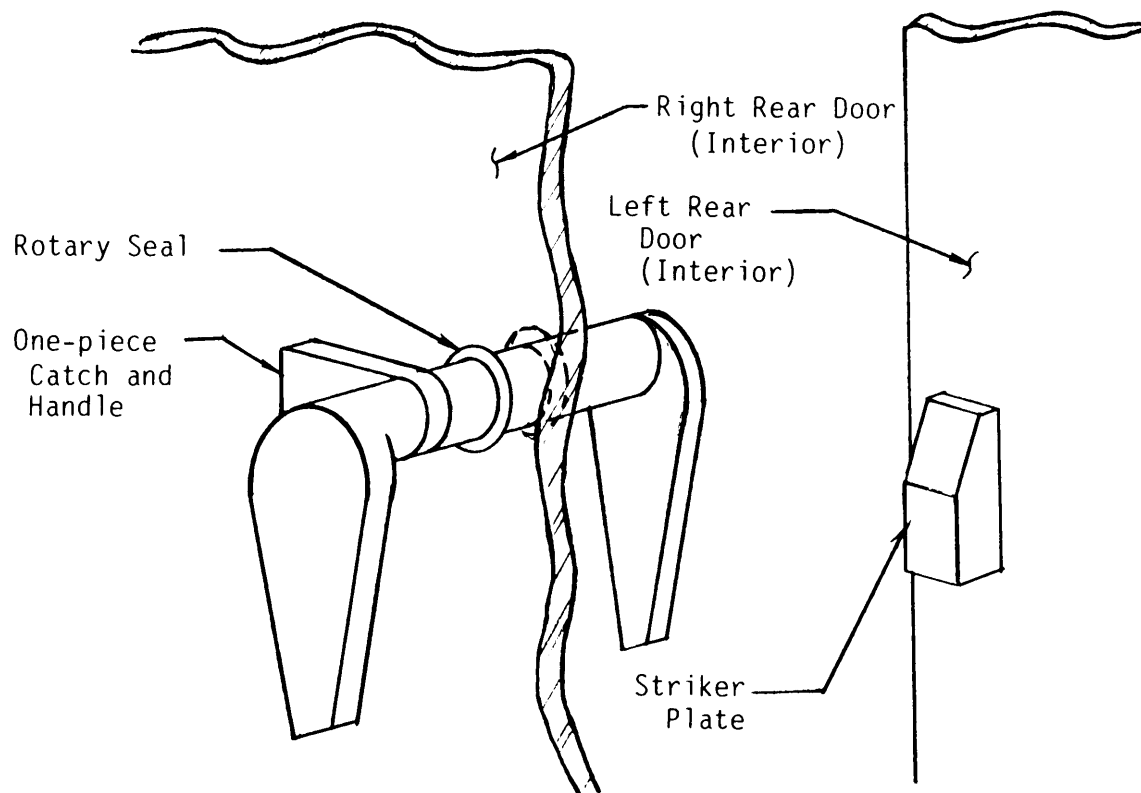


LATCHES

The internal mechanism and the area under the sliding tongue of the rear door latch are difficult to decontaminate.

M886 Ambulance

MIL-HDBK-784

LATCHES

A one-piece handle and catch, installed through a rotary seal, contains no contaminant traps and is easy to decontaminate.

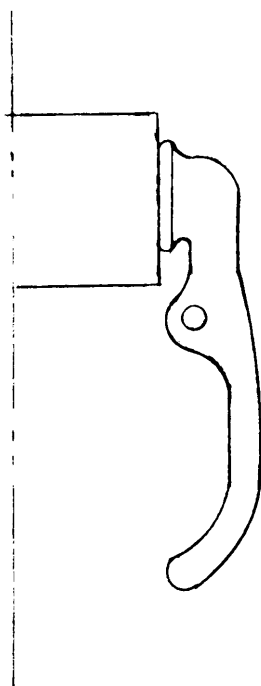


LATCHES

The latch mechanism can trap contaminants and is difficult to decontaminate.

M109 Shop Van Truck

MIL-HDBK-784



LATCHES

An enclosure protects the latch mechanism from contaminants and is easy to decontaminate.

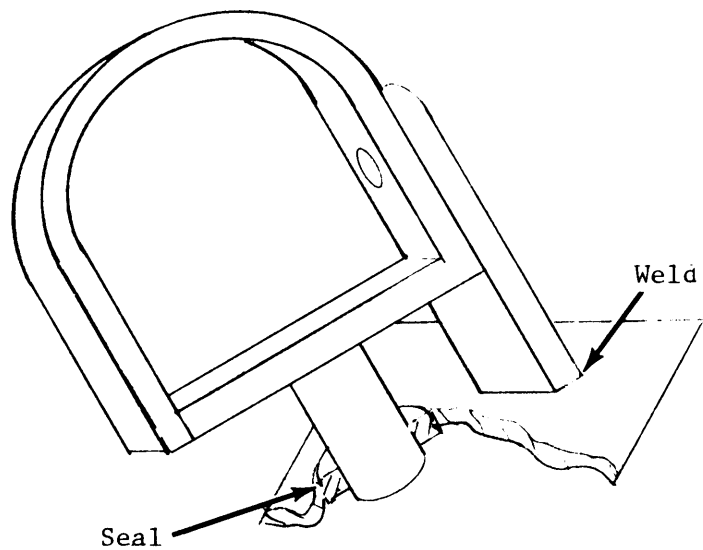


LATCHES

The door latch handle sweeps a wide area and, because of its closeness to the door surface, is difficult to decontaminate thoroughly. In addition, contaminants/decontaminants have access along the pivot shaft to the interior of the vehicle.

M88 Recovery Vehicle

MIL-HDBK-784



LATCHES

A simpler latch does not sweep as broad an area. The locking post is welded to the hull, and the latch shaft enters the door surface through a seal and is set out from the surface to allow easier decontamination underneath.

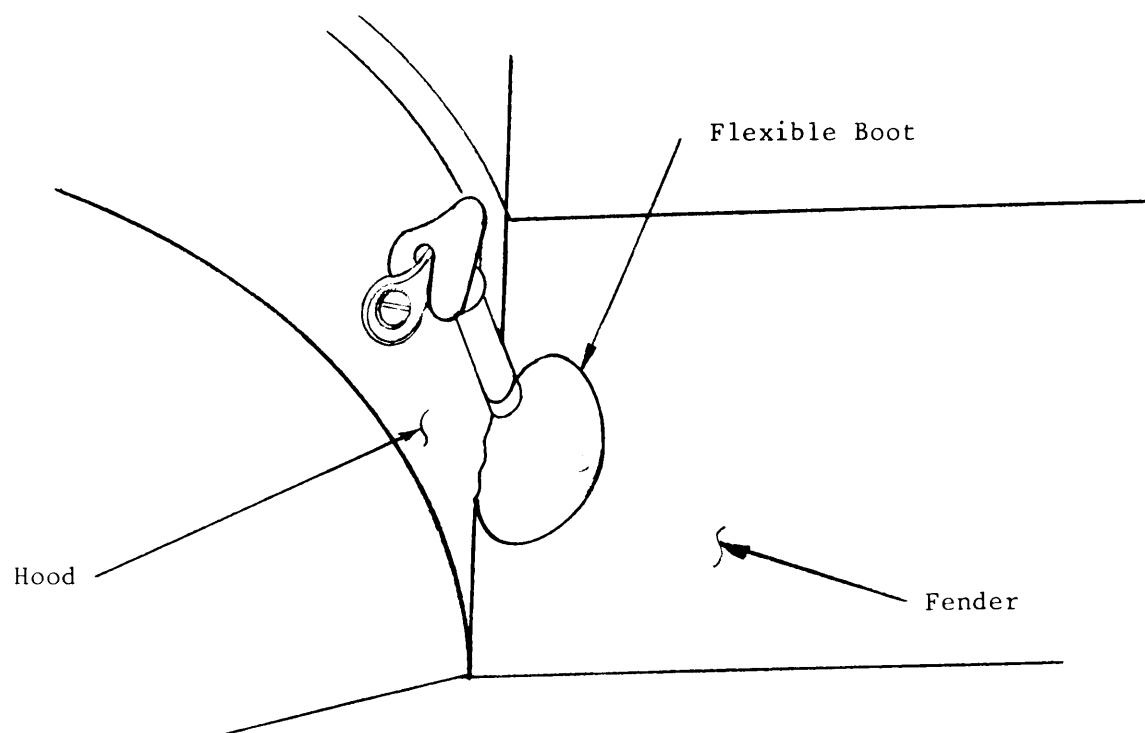


LATCHES

The grip of the hood latch does not trap contaminants and is easy to decontaminate. However, the ball joint in the fender mounting is a hard-to-decontaminate trap. Also, the wiping action of the latch barrel can carry contaminants from the latch rod into the interior of the latch.

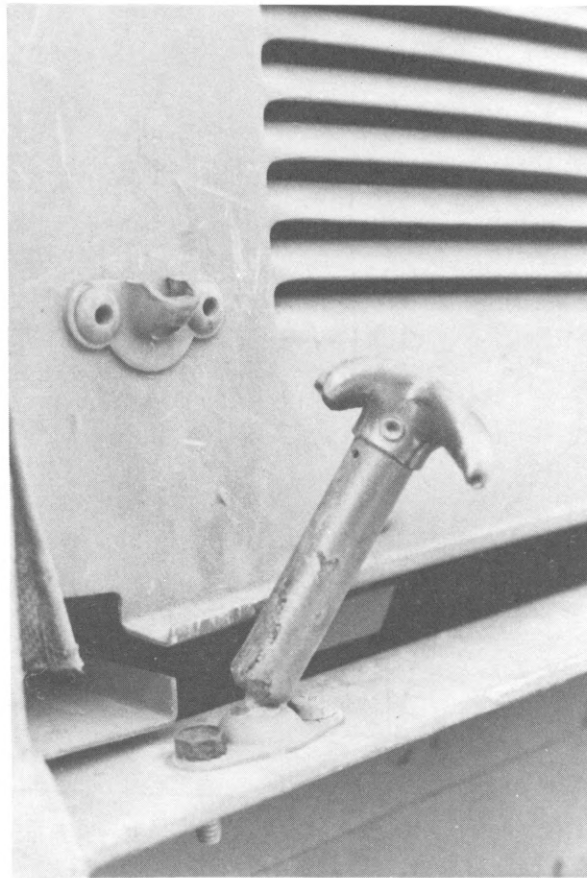
M151A1 Utility Truck

MIL-HDBK-784



LATCHES

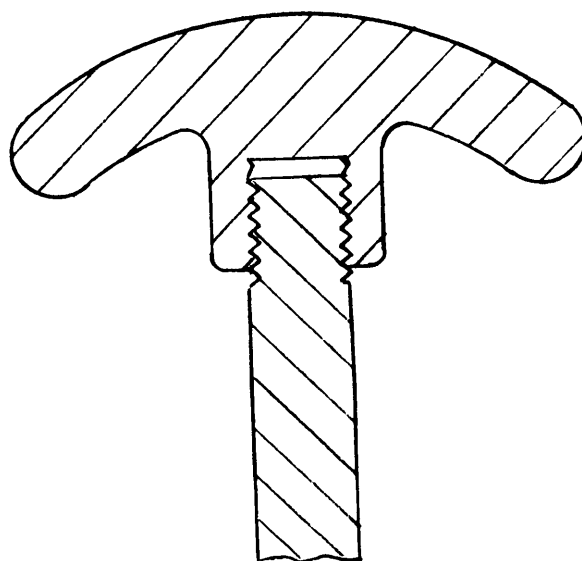
A flexible boot, clamped to the latch barrel and fastened to the fender around the ball joint, will keep contaminants out of hard-to-decontaminate recesses and openings.



LATCHES

The latch handle of the engine cover has been formed from sheet material, leaving crevices and hollows that can trap contaminants and that are difficult to decontaminate thoroughly. Contaminants retained in these spaces can be deposited on the fingers of personnel attempting to open the engine cover.

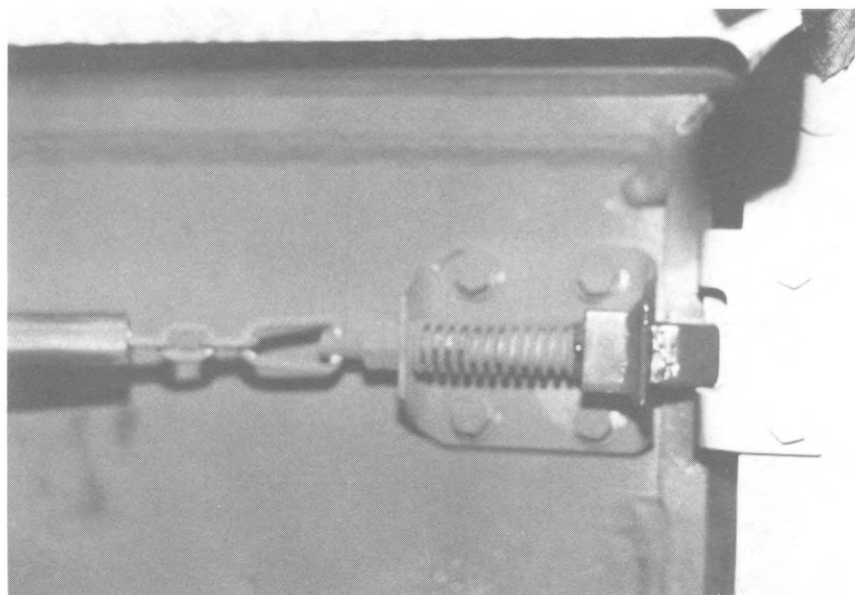
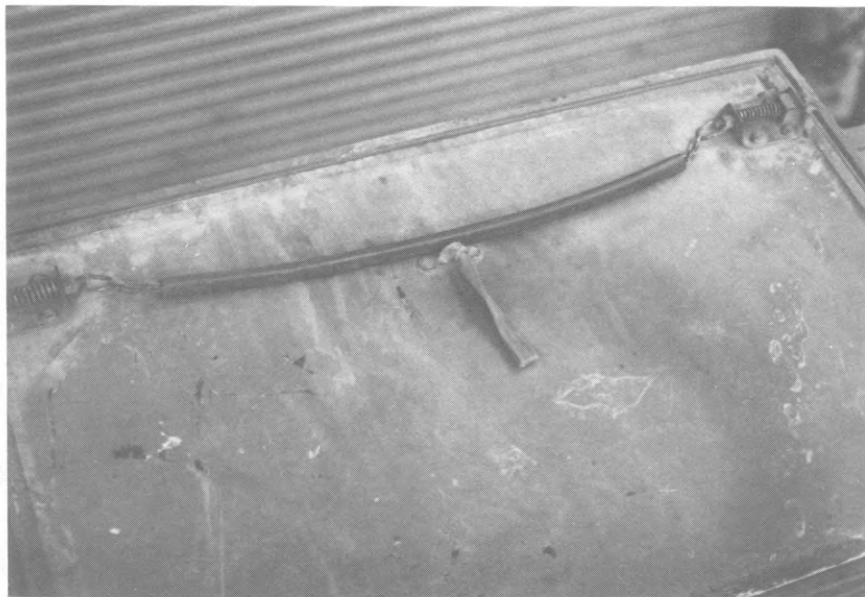
MIL-HDBK-784



LATCHES

Casting or forging the handle as a solid part and threading the handle onto the latch cylinder will eliminate hard-to-decontaminate contaminant traps.

MIL-HDBK-784

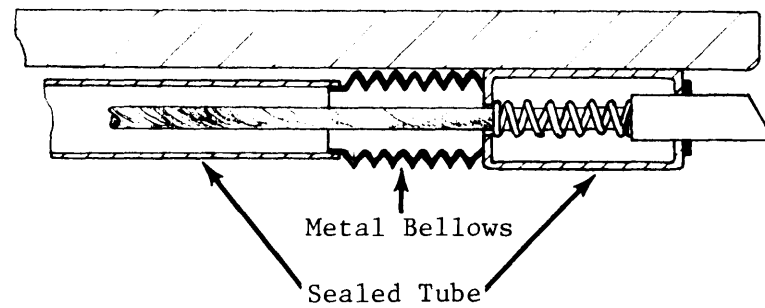


LATCHES

The chain and springs of the quick-release on the overhead door are exposed to contaminants and are difficult to decontaminate.

M113 Armored Personnel Carrier

MIL-HDBK-784



LATCHES

The spring is protected by a sealed tube and the cable (or chain) is protected by a metal bellows and the sealed tube.

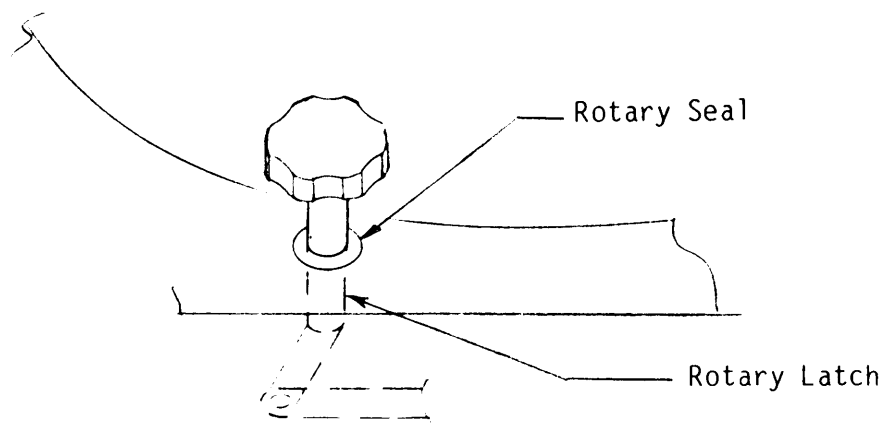


LATCHES

The latch cavity traps contaminants, which cannot be easily removed and which can transfer to the finger latch.

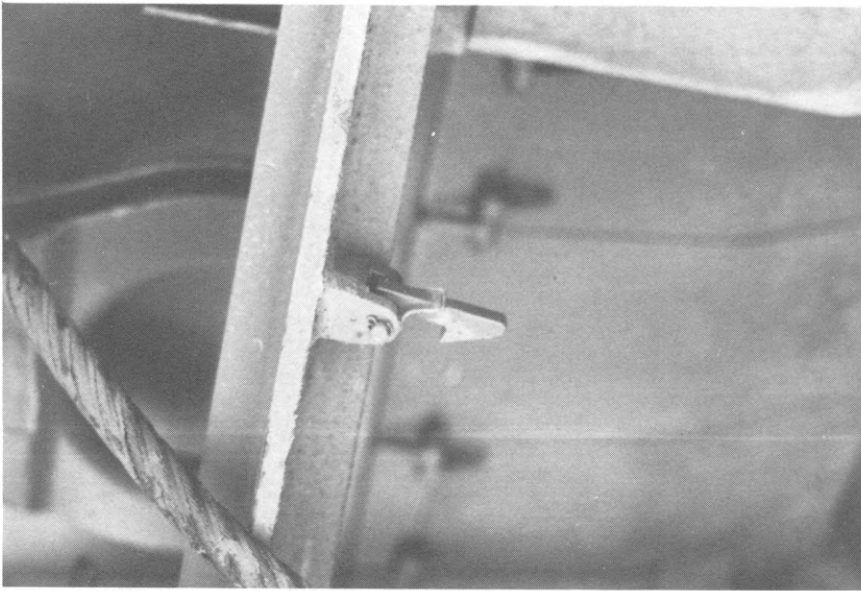
M886 Ambulance

MIL-HDBK-784



LATCHES

Replacing the pushbutton latch with a rotary latch having a rotary seal eliminates an entrapment cavity and prevents secondary contamination of the actuating rod.

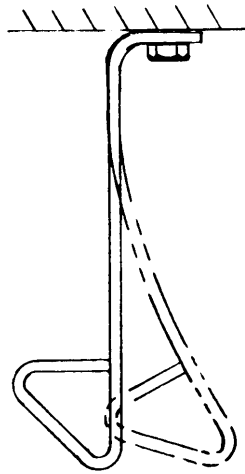


LATCHES

As the door is opened, the spring-loaded latch is deflected, then allowed to catch and hold the door in an open position. The crevices and interfaces make the latch difficult to decontaminate.

M88 Recovery Vehicle

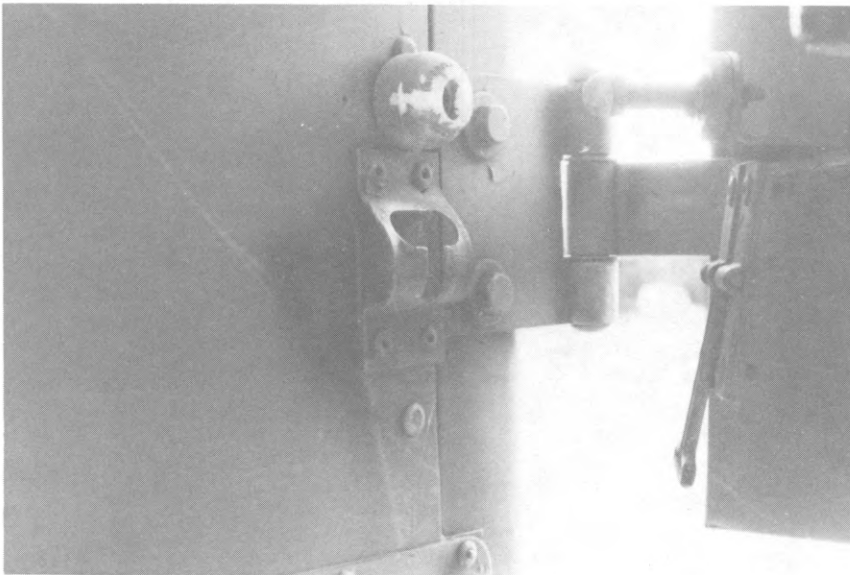
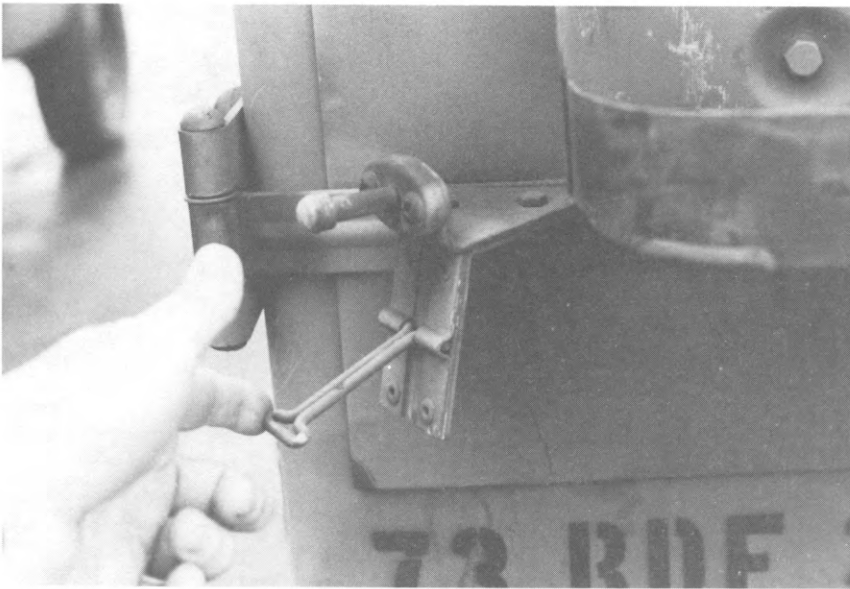
MIL-HDBK-784



LATCHES

Spring steel bolted to the support frame performs the same functions but is easier to decontaminate.

MIL-HDBK-784

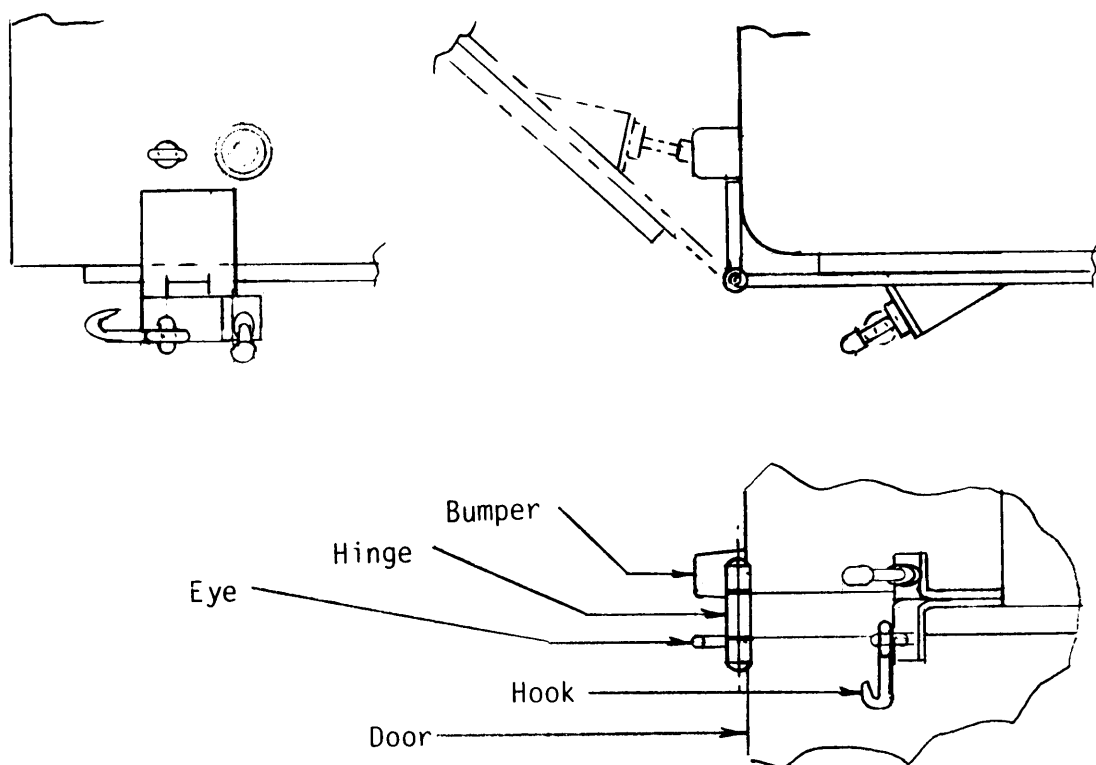


LATCHES

The rear-door hold-back latch has crevices and hidden surfaces that are inaccessible to decontaminants.

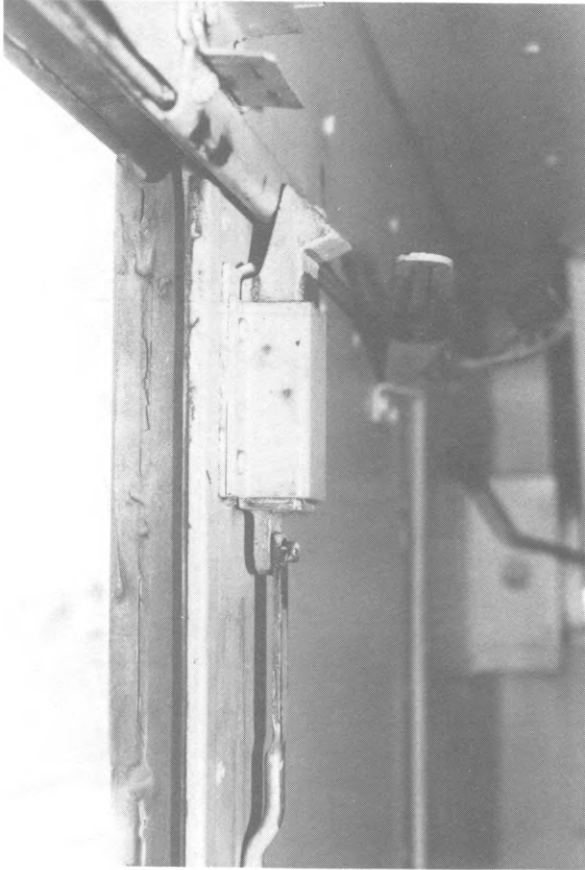
M886 Ambulance

MIL-HDBK-784



LATCHES

A simple J-hook and eye has no entrapment areas and is easier to decontaminate than the complex hook and plate.

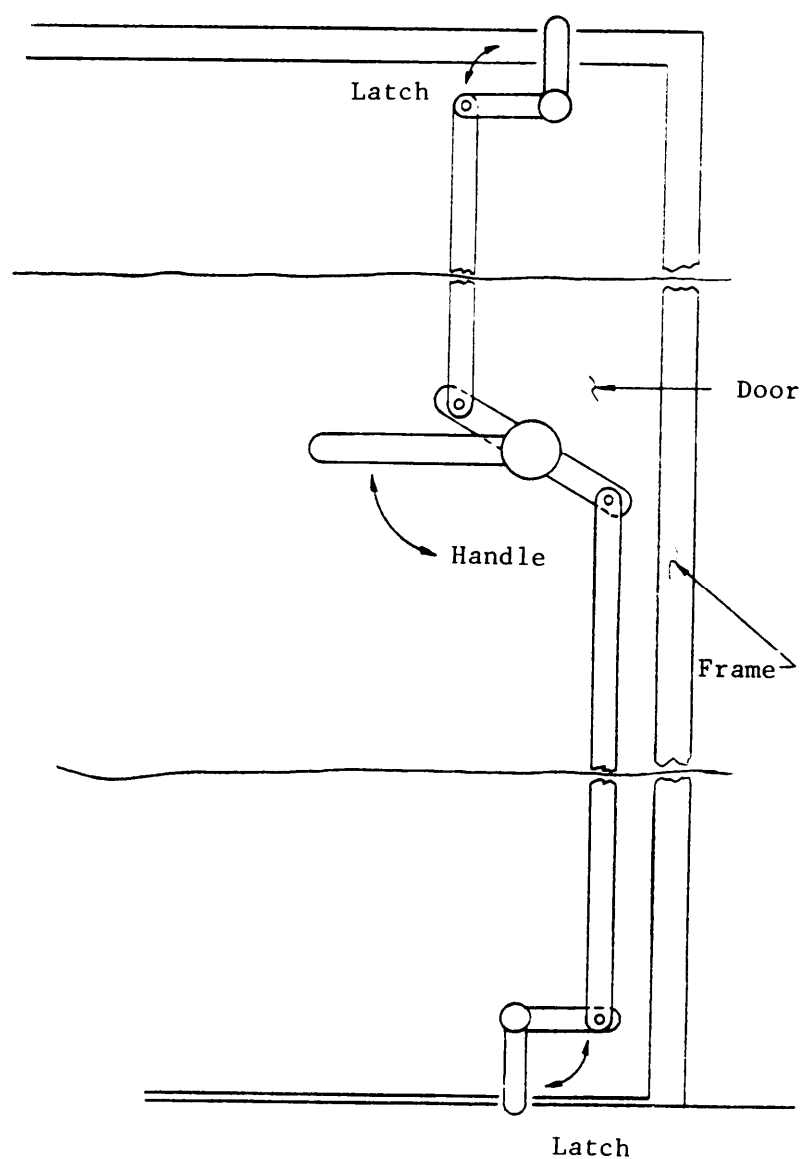


LATCHES

The spring-loaded internal mechanisms of the door catches can trap contaminants and are difficult to decontaminate.

M109 Shop Van Truck

MIL-HDBK-784



LATCHES

The alternative design eliminates the spring-loaded mechanism and is easier to decontaminate.

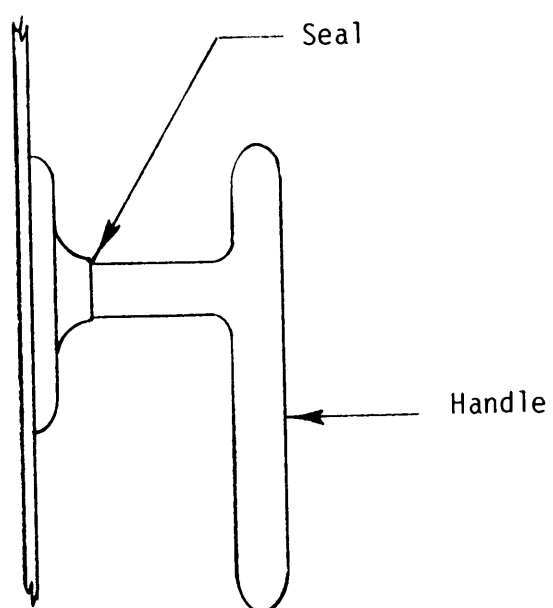


LATCHES

The door-catch release is close below the hand grip, making decontamination difficult.

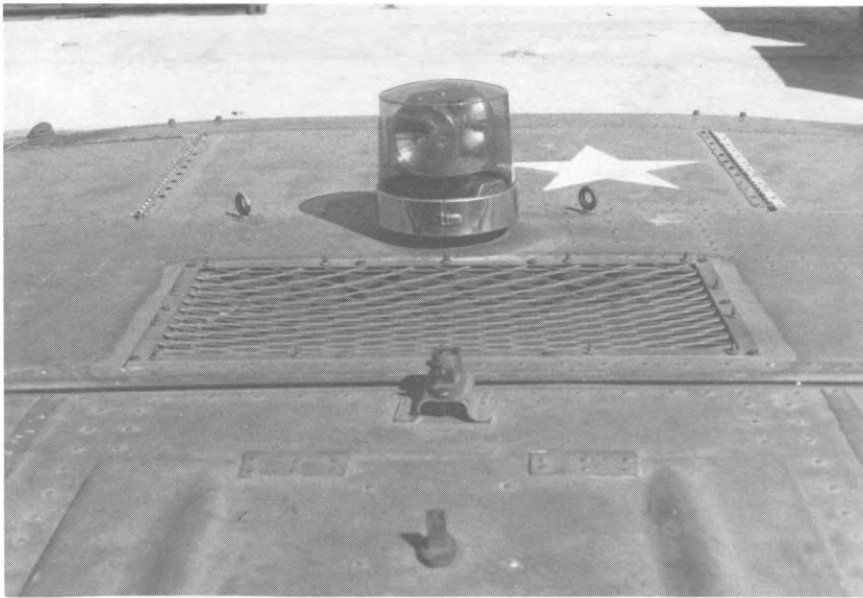
M886 Ambulance

MIL-HDBK-784



LATCHES

A simple handle-latch release is easy to decontaminate and, if installed with a rotary seal, does not trap contaminants.

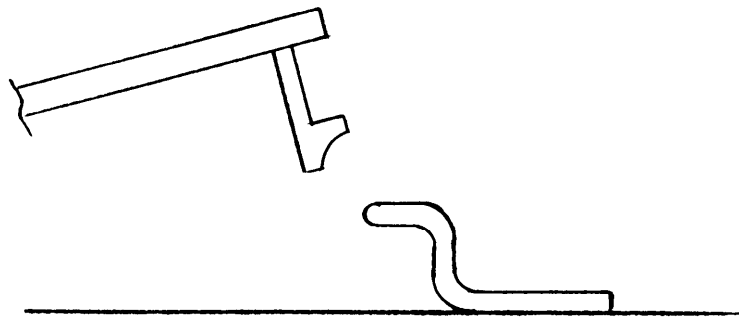


LATCHES

The latching mechanism may trap contaminants and is difficult to decontaminate.

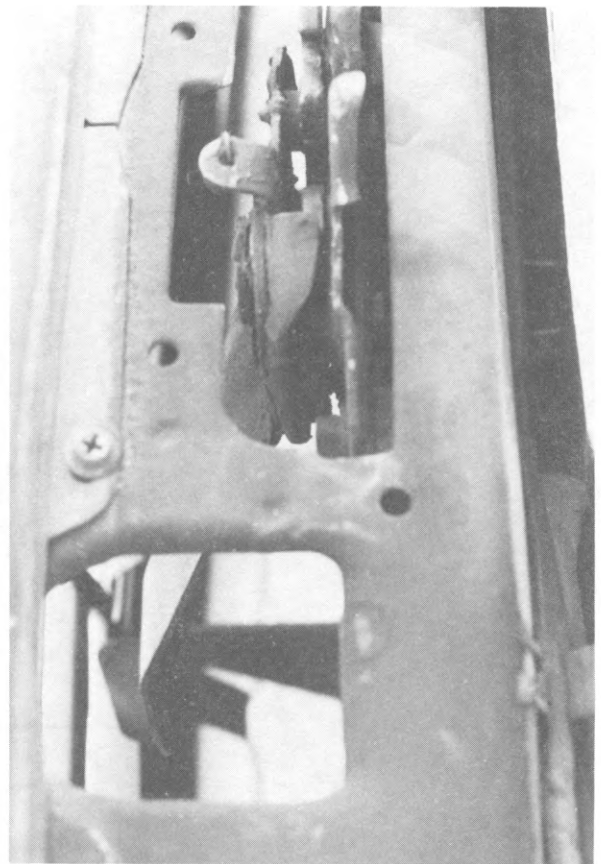
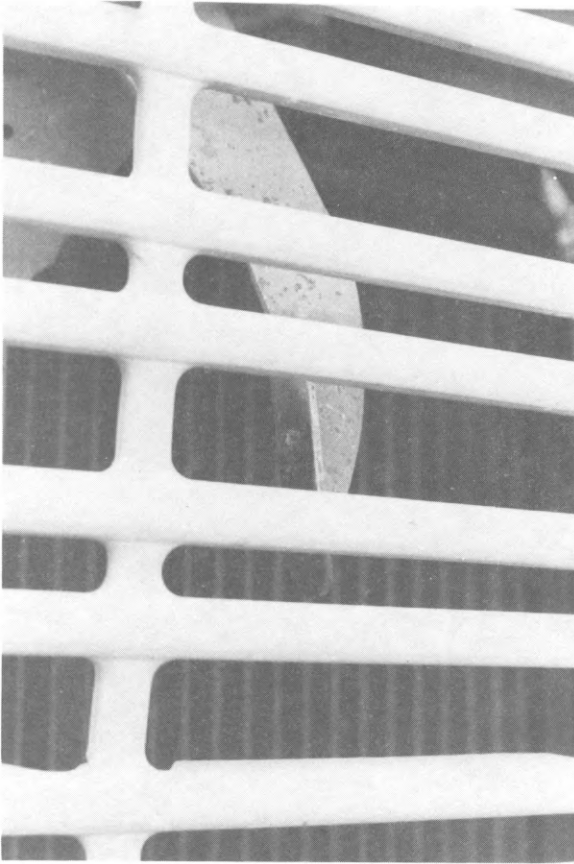
M116 Cargo Carrier

MIL-HDBK-784



LATCHES

A simpler latch will not trap contaminants and is easier to decontaminate.

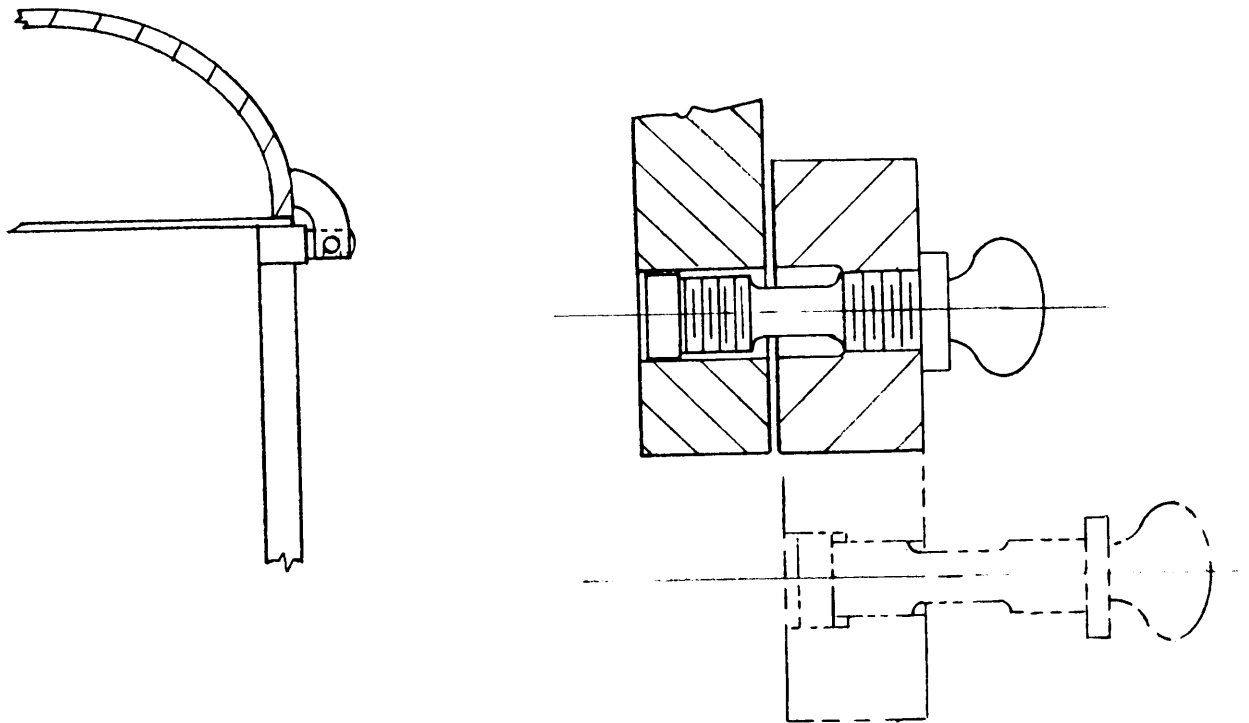


LATCHES

The manual hood-release lever and the spring-loaded release mechanism are exposed to airborne contaminants and are difficult to easily decontaminate.

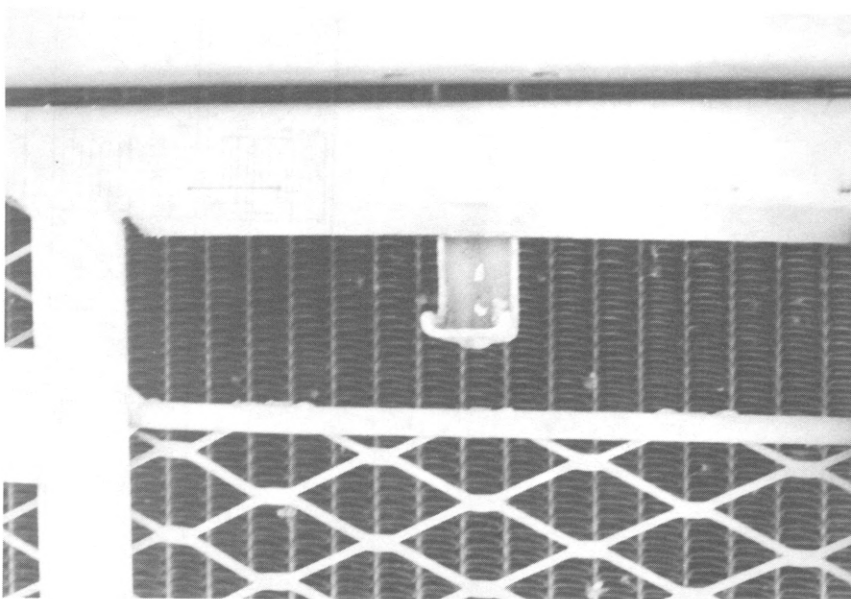
M886 Ambulance

MIL-HDBK-784



LATCHES

A remotely actuated hood release (left) or an external release (right) have no spring latches requiring lubricants, and are easier to decontaminate.

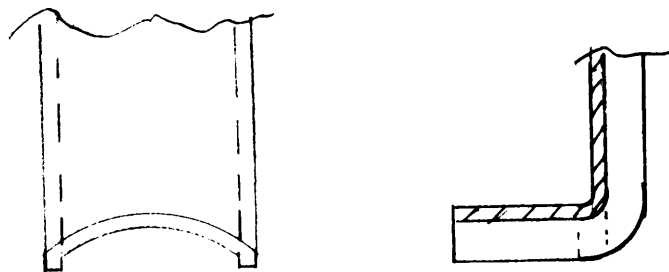


LATCHES

The release is formed as a cup that can trap airborne contaminants and contaminated dust.

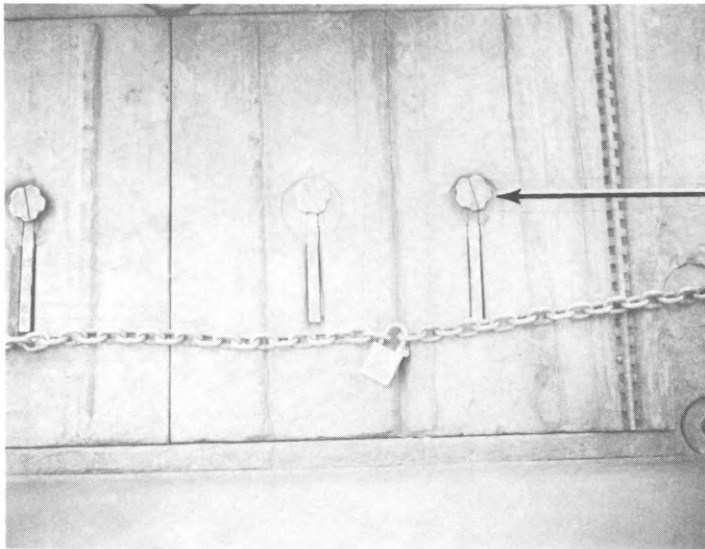
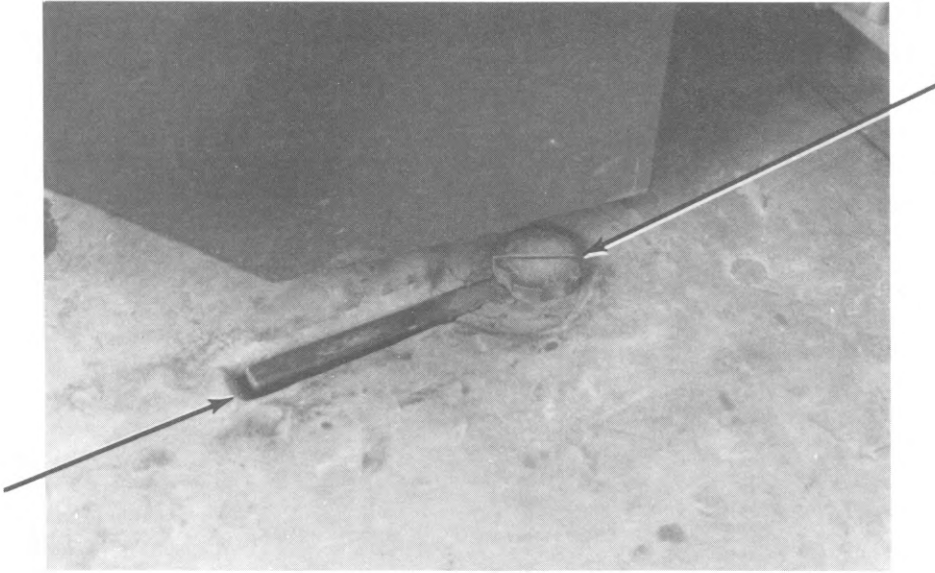
M820 Van Truck

MIL-HDBK-784



LATCHES

Reshaping the latch release will eliminate a contaminant trap and make the latch easier to decontaminate.

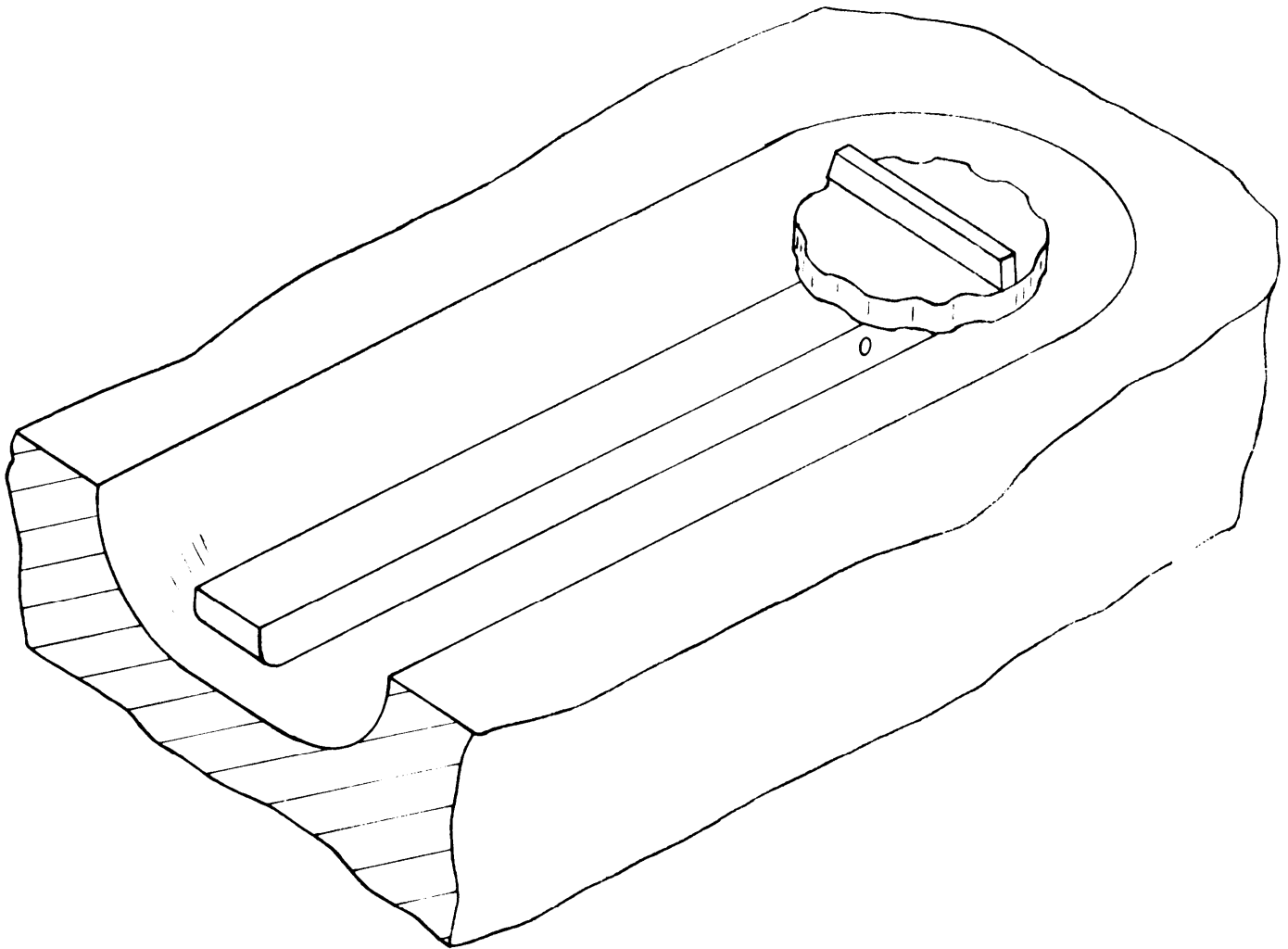


LATCHES

The restricted area around and under the deck compartment handle is difficult to decontaminate without touching contaminated surfaces. In addition, the screwdriver slot forms an entrapment area for solids and liquids.

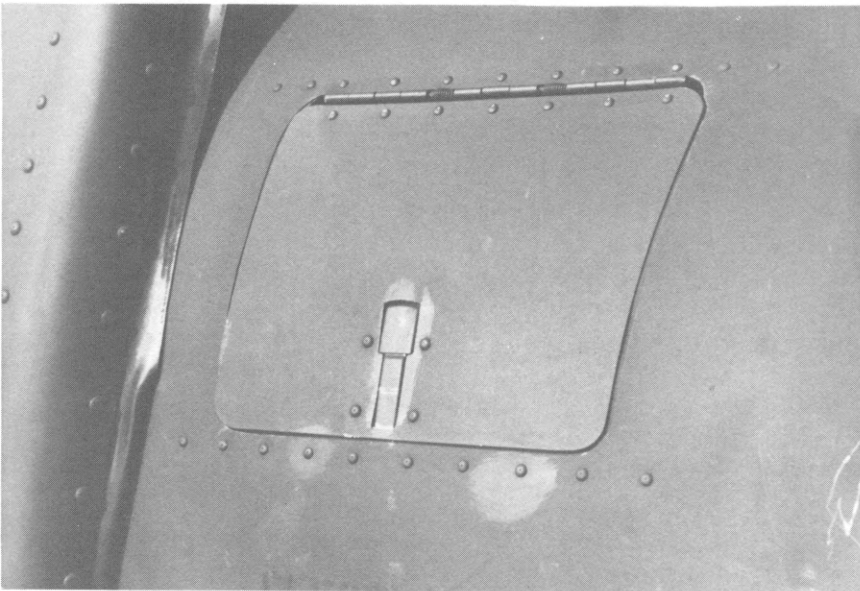
Chaparral Missile Launcher

MIL-HDBK-784



LATCHES

A wider cavity is easier to decontaminate. Also, eliminating the slot in the lock knob eliminates an entrapment area.

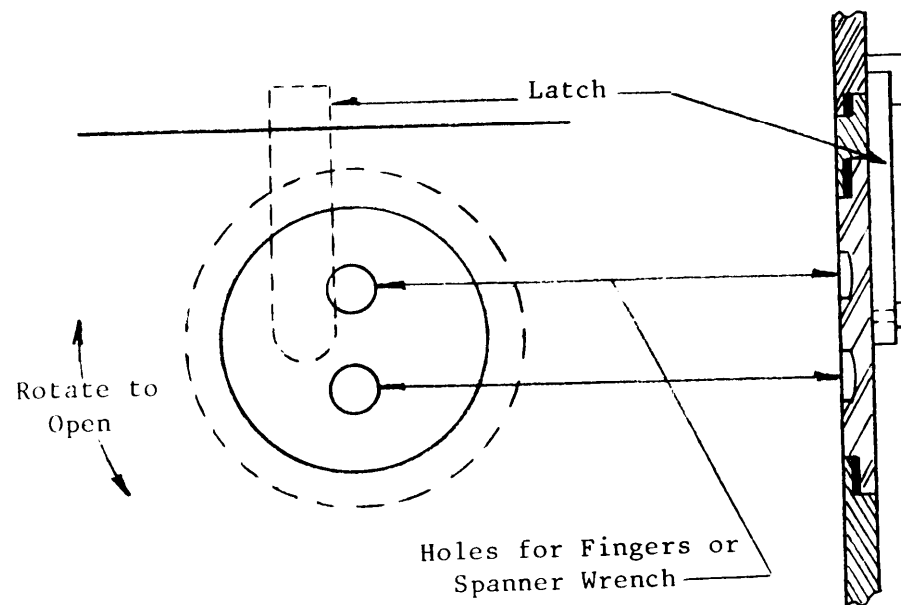


LATCHES

The spring-loaded latch mechanism is exposed to contaminants and is difficult to decontaminate.

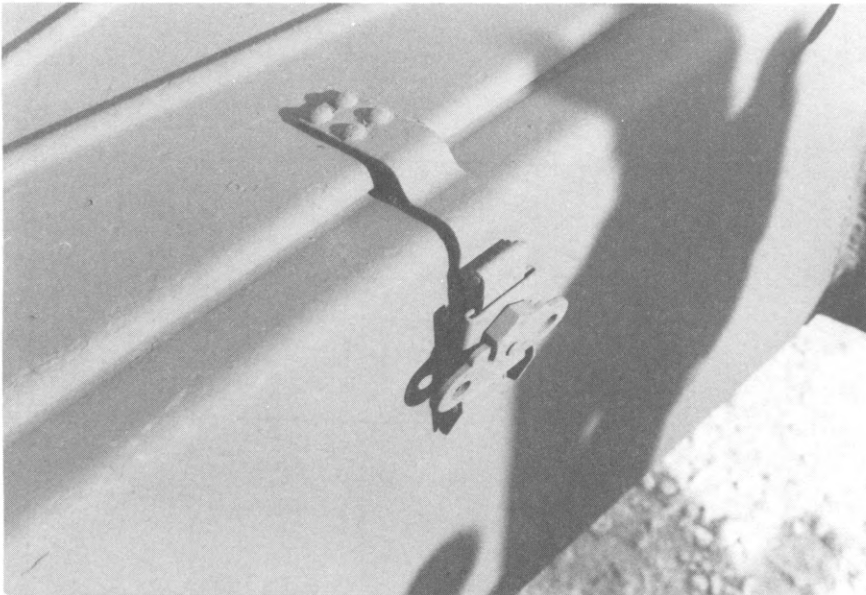
UH-1M Helicopter (Huey)

MIL-HDBK-784



LATCHES

The alternative design eliminates the spring-loaded latch mechanism.

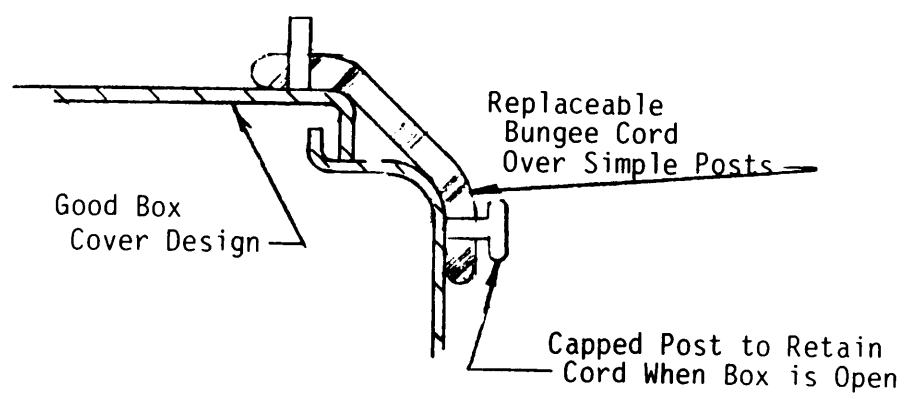


LATCHES

The toolbox cover, closing over a vertical lip, protects the interior of the box and is easy to decontaminate. The complicated latch, however, has several hard-to-decontaminate traps.

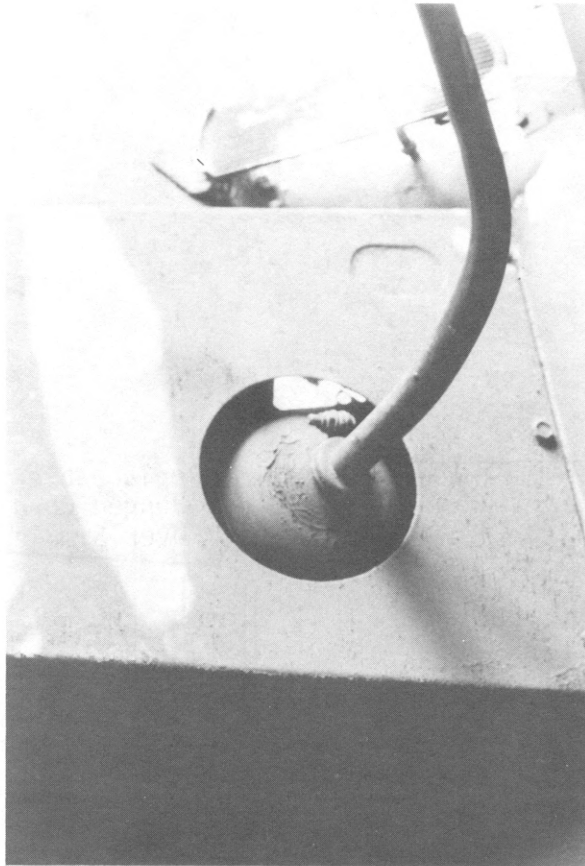
M102 Howitzer

MIL-HDBK-784



LATCHES

Replacing the complicated latch with a simple, replaceable, flexible cord reduces the problem of decontamination.

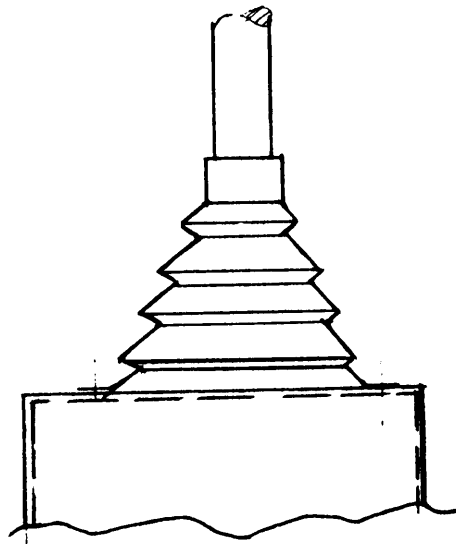


LEVERS

Contaminated dust can enter the truck cab through the opening for the shift lever.

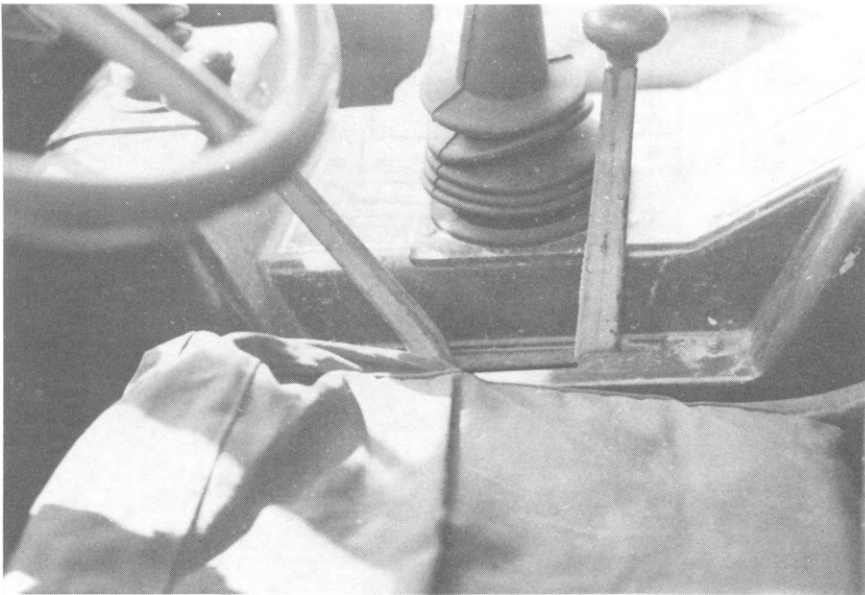
M820 Van Truck

MIL-HDBK-784



LEVERS

Installing a boot on the gear shift lever will prevent contaminated dust from entering the cab through the opening in the deck.

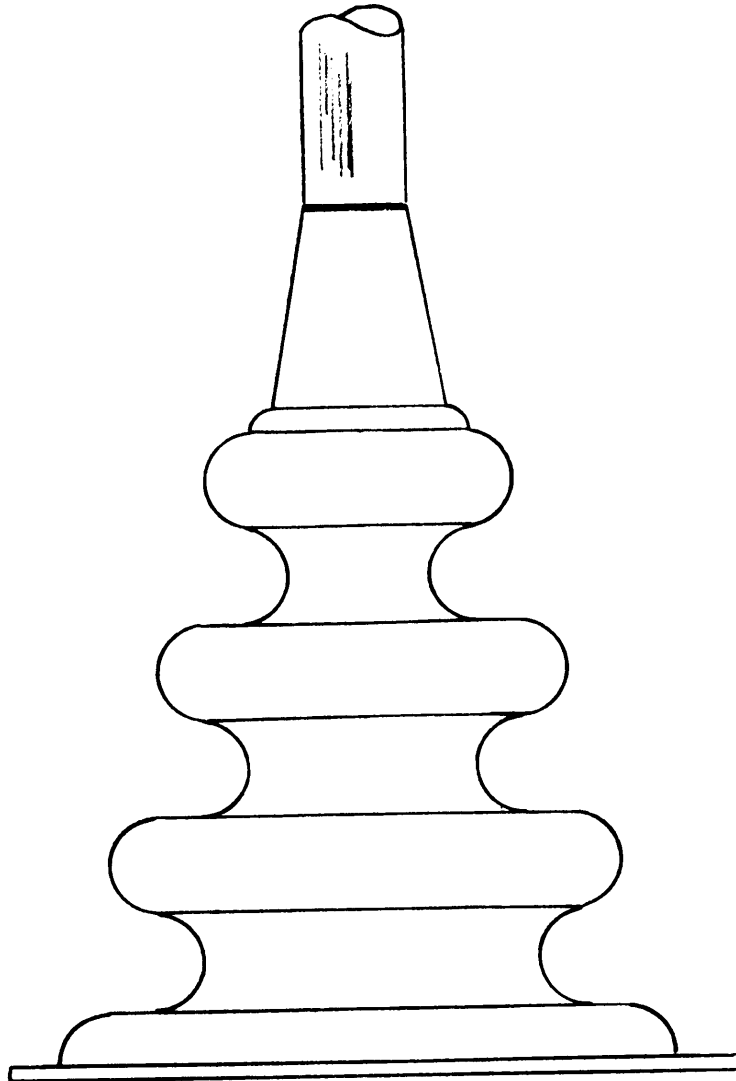


LEVERS

The many and deep corrugations of the control stick boot can trap contaminants and are difficult to decontaminate.

M561 Cargo Truck

MIL-HDBK-784



LEVERS

A boot with fewer and less acute corrugations is easier to decontaminate.

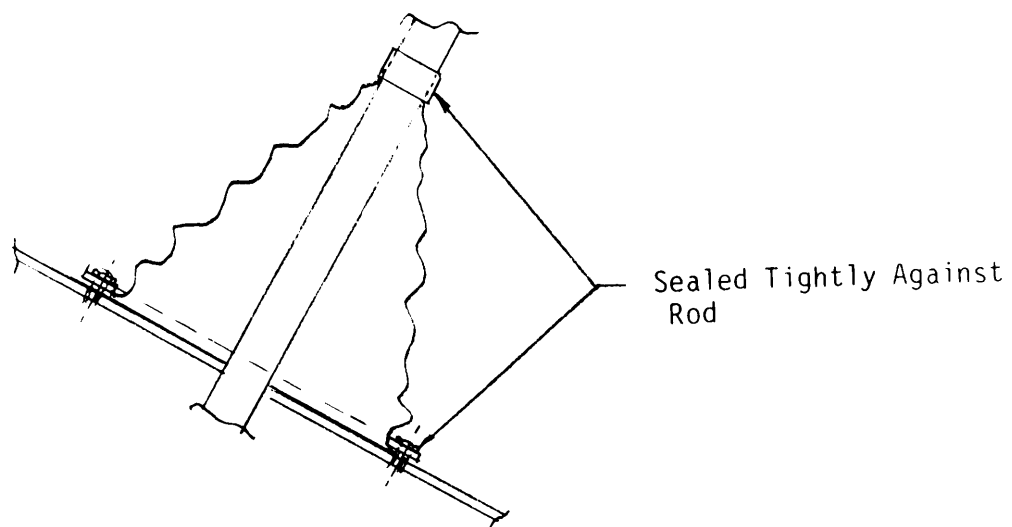


LEVERS

Contaminants can be trapped inside the ill-fitting boots, trapped in the cracks and crevices, and absorbed by the boot fabric.

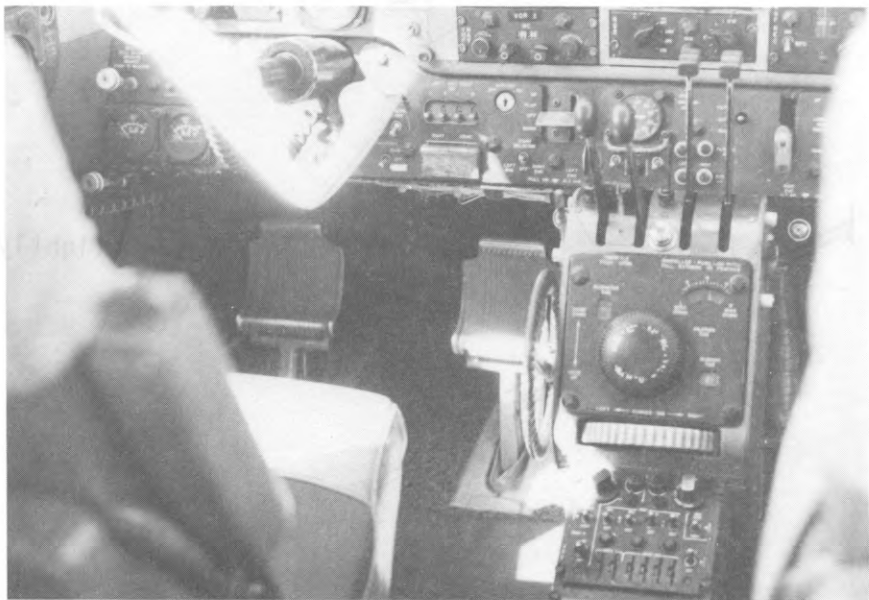
UH-1M Helicopter (Huey)

MIL-HDBK-784



LEVERS

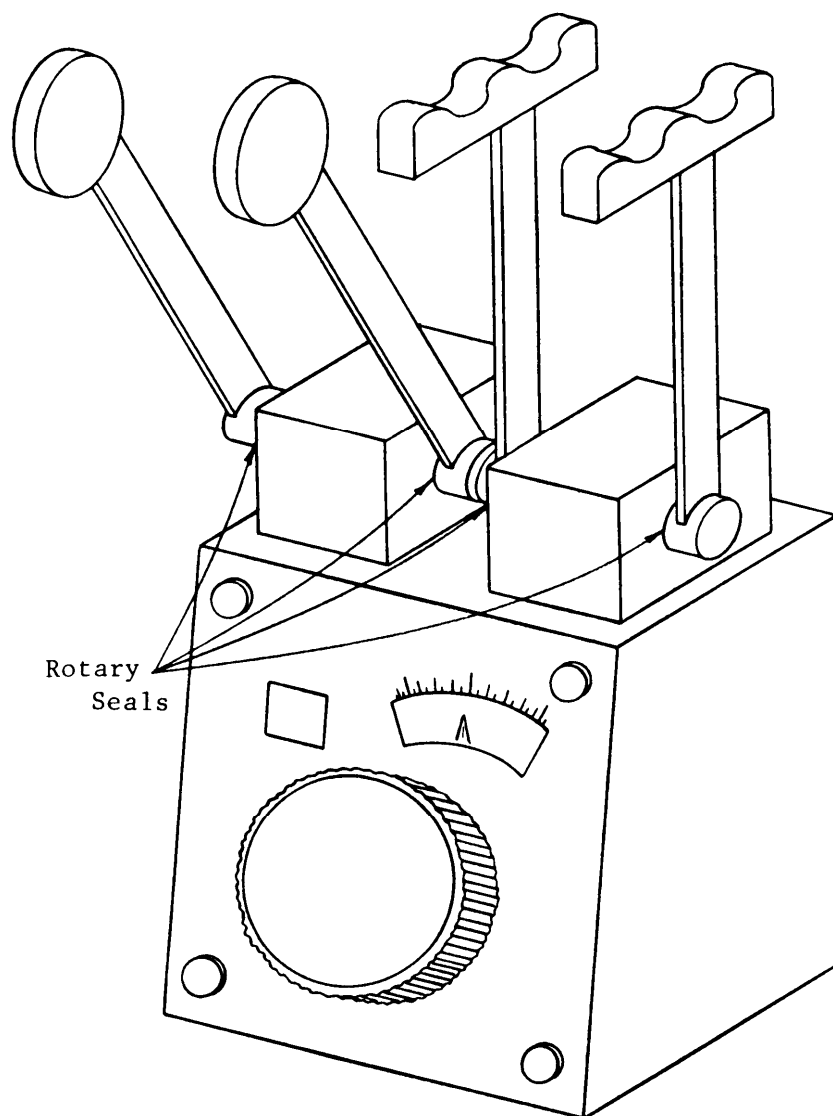
Boots designed without sharp angles, clamped tightly to the control sticks, and made of nonabsorbent, nonreactive material will not trap contaminants and will be easy to decontaminate.



LEVERS

The toggle switches and control sticks allow the drawing in and entrapment of contaminants and are difficult to decontaminate.

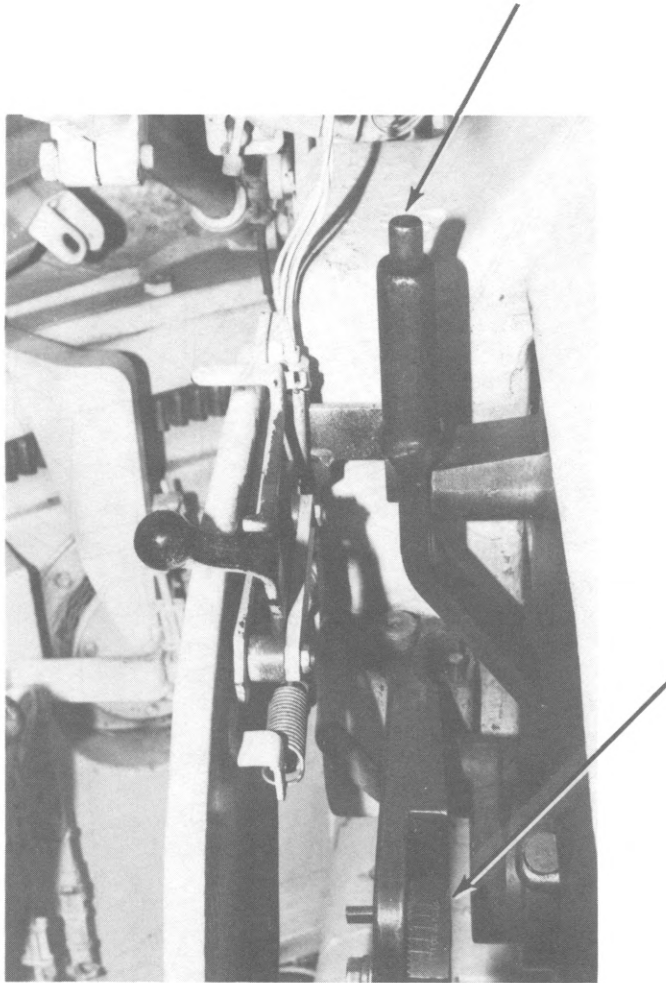
MIL-HDBK-784



Rotary
Seals

LEVERS

Housings and rotating seals prevent contaminant entrapment and facilitate decontamination.

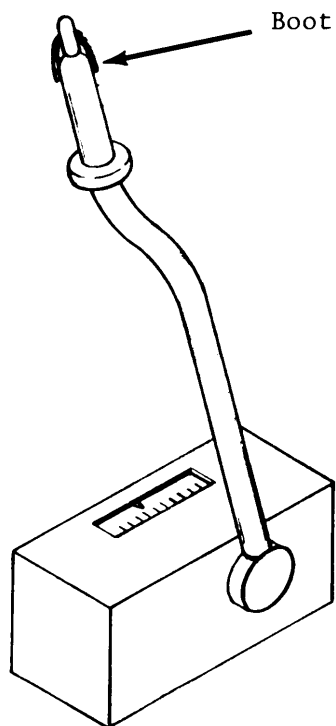


LEVERS

The downward movement of the pushbutton can draw in contaminants. In addition, the pivot area of the indicator can trap contaminants and is difficult to decontaminate.

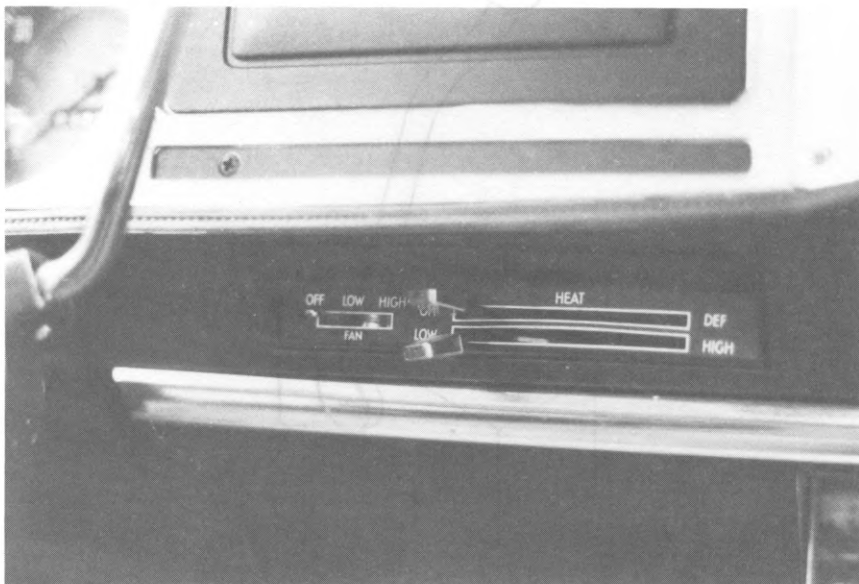
M60 Tank

MIL-HDBK-784



LEVERS

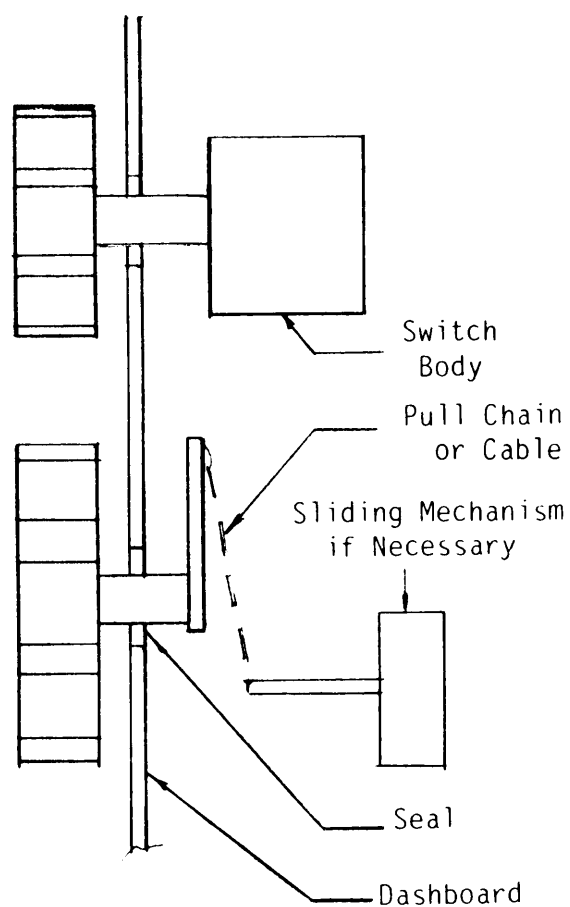
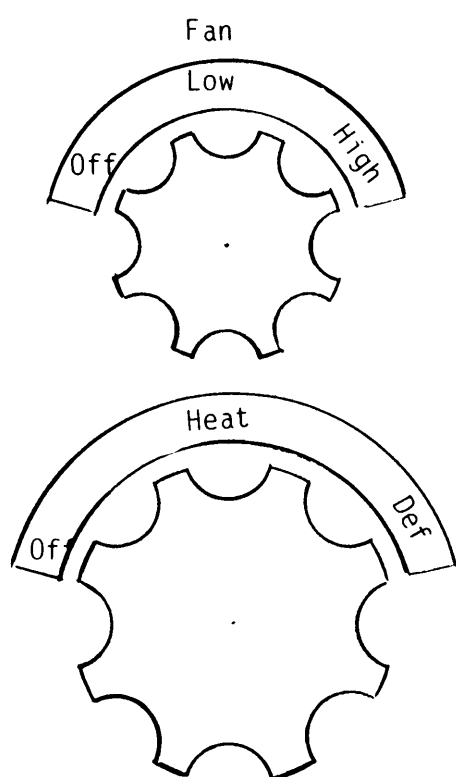
A nonporous boot around the pushbutton prevents the drawing in of contaminants, and a sealed box protects the indicator and linkages from contaminants .



LEVERS

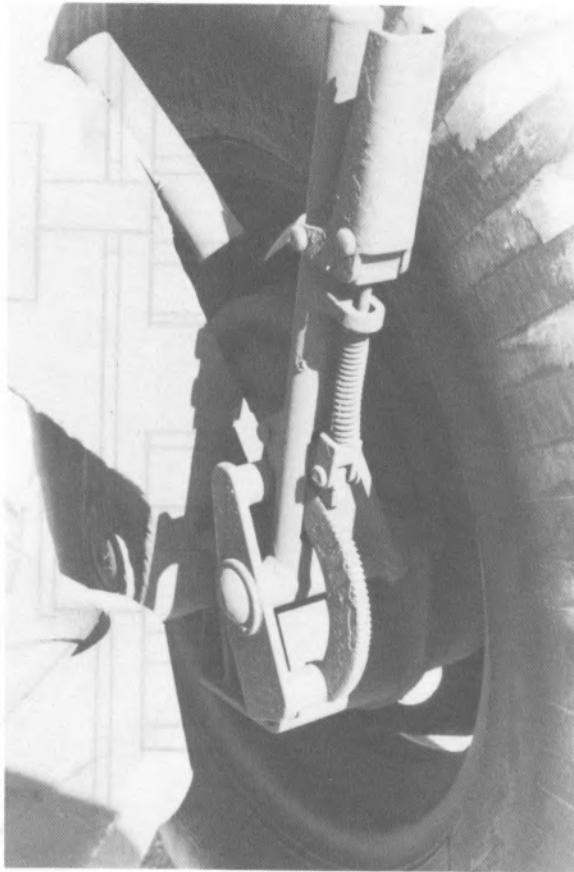
The slide controls allow contaminants into the space behind the dashboard, where they are difficult to remove. The trapped contaminants can recontaminate cleaned control levers or be entrained in the compartment atmosphere.

MIL-HDBK-784



LEVERS

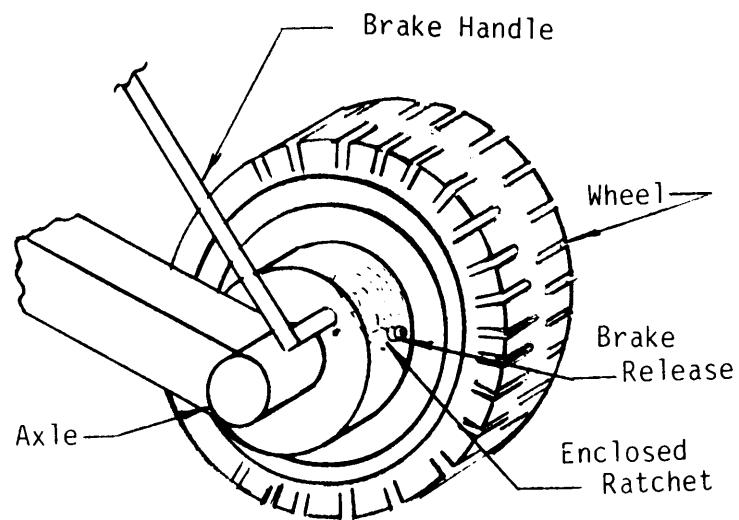
Replacing the slide controls with rotary controls allows the control shaft to be sealed, protecting the area behind the dashboard from contamination.



LEVERS

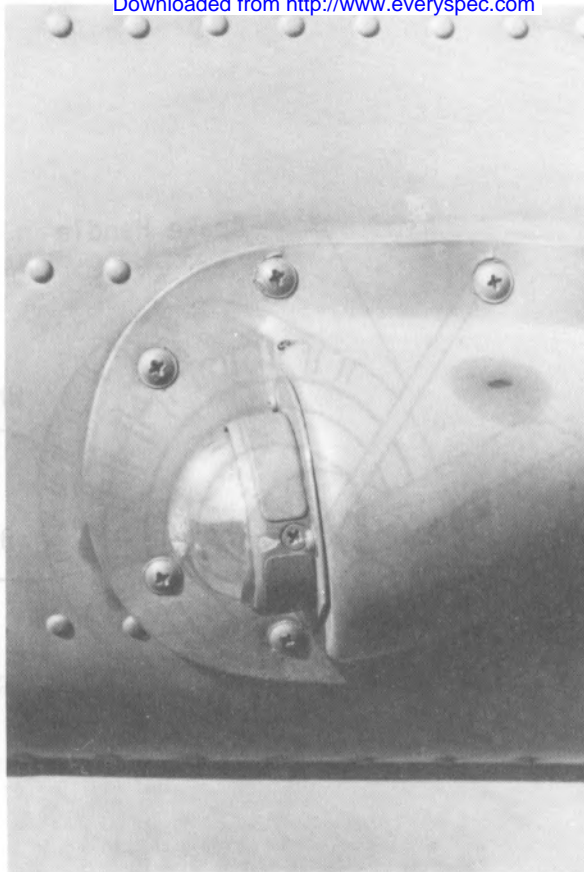
The wheel locking mechanism, exposed to contaminants and contaminated dust, has several entrapment spaces that are difficult to decontaminate.

MIL-HDBK-784



LEVERS

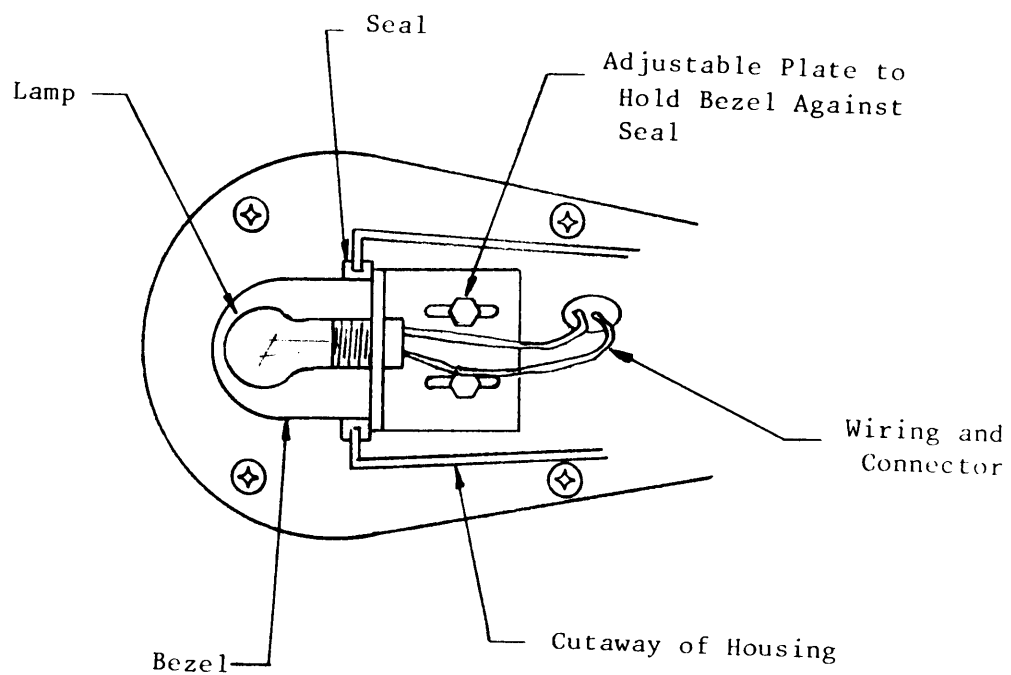
Enclosing the more intricate parts of the wheel lock mechanism protects them from contamination.



LIGHTING FIXTURES

The light housing design is generally good from a contamination/decontamination viewpoint, but the lack of tight seals allows contaminants to be drawn in.

MIL-HDBK-784



LIGHTING FIXTURES

Improved seals prevent the drawing in of contaminants.

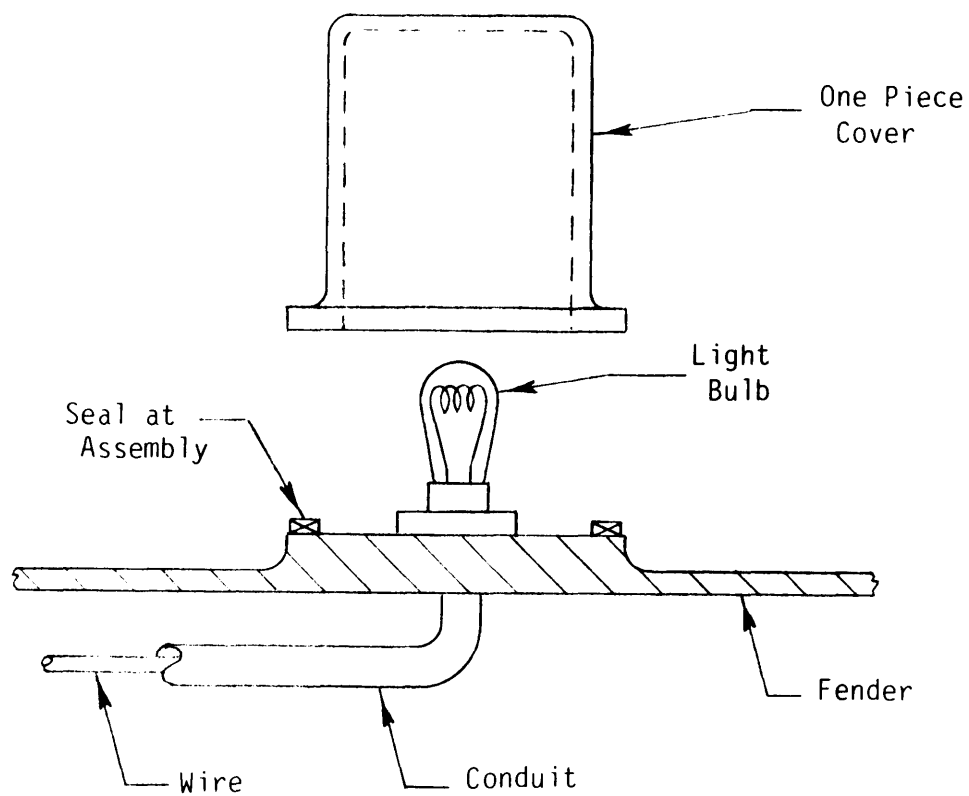


LIGHTING FIXTURES

Gaps at the attachment and mounting interfaces can trap contaminants and are difficult to decontaminate.

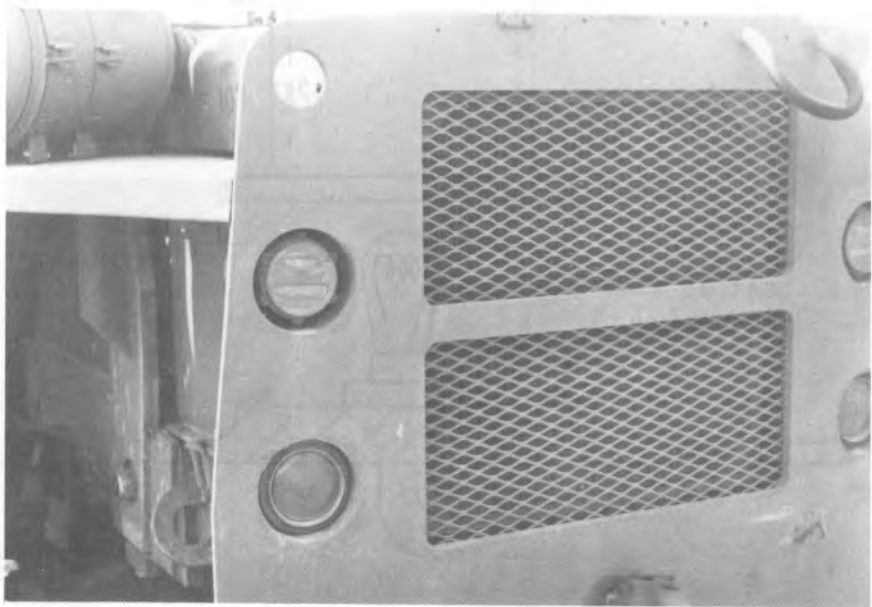
Stake Truck (Loadstar)

MIL-HDBK-784



LIGHTING FIXTURES

A one-piece cover protects the lights and reduces the number of gaps.

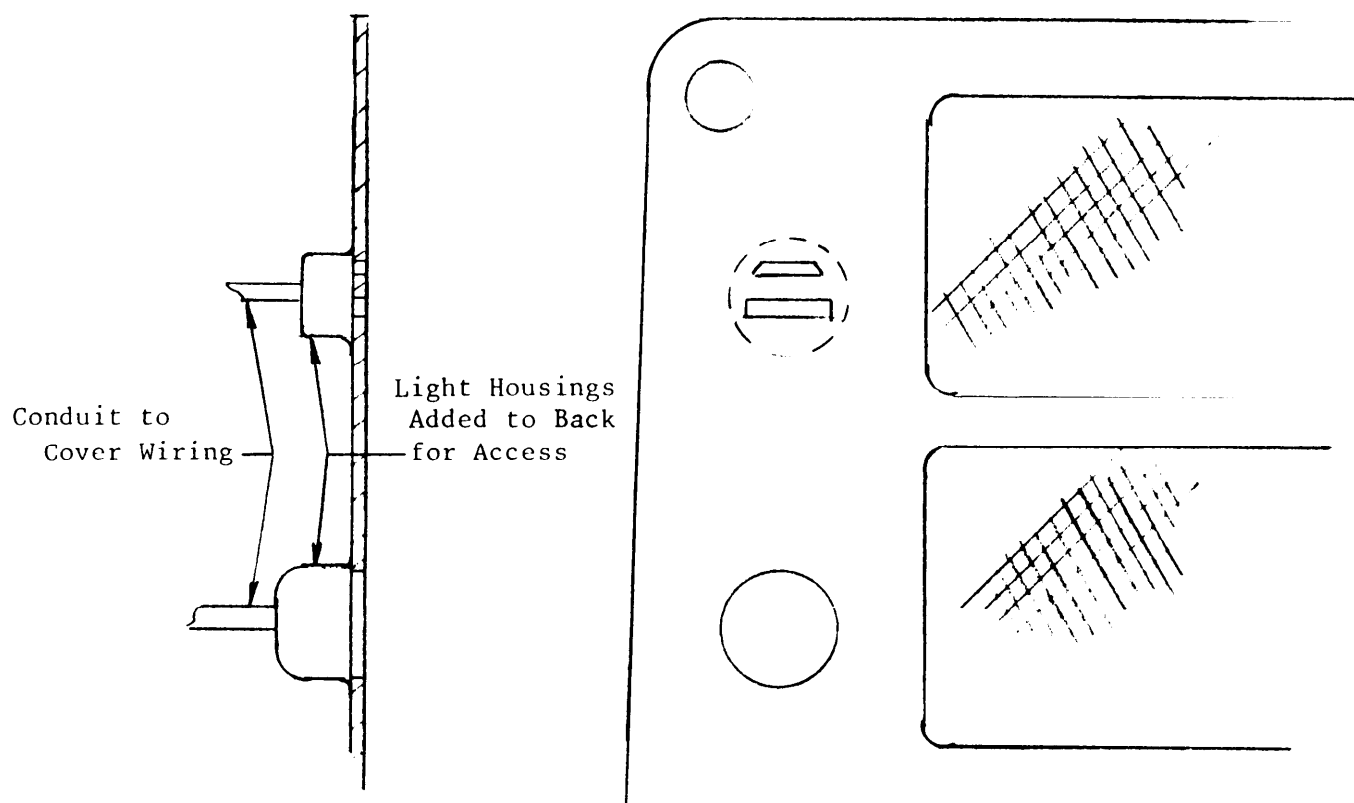


LIGHTING FIXTURES

The recesses and gaps around the light are difficult to decontaminate.

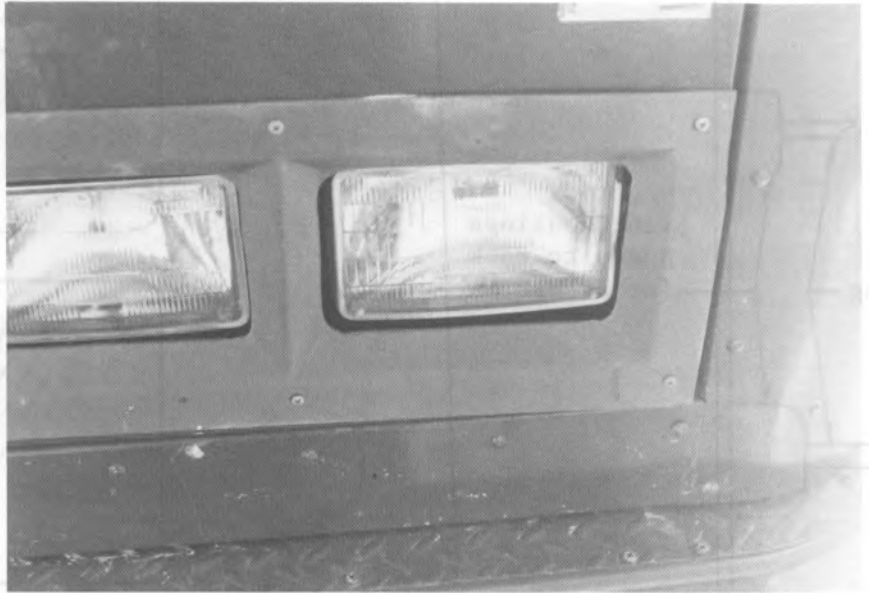
Forklift (6,000-lb capacity)

MIL-HDBK-784



LIGHTING FIXTURES

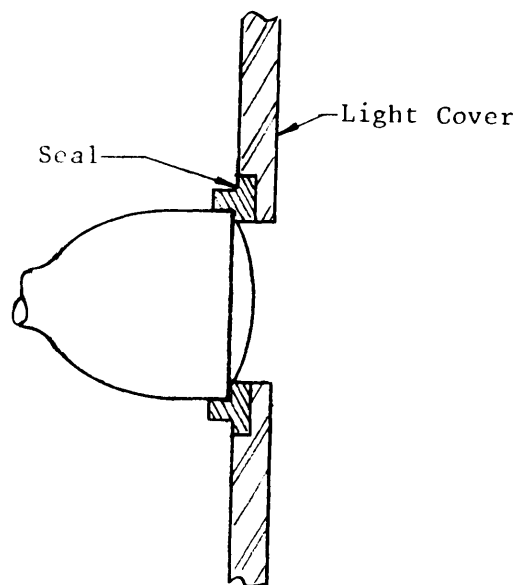
Building the light covers into the plate eliminates deep recesses.



LIGHTING FIXTURES

The gaps around the headlights allow the entry of contaminants.

School Bus



LIGHTING FIXTURES

A tight cover and seal around the headlights will prevent the entry of contaminants .

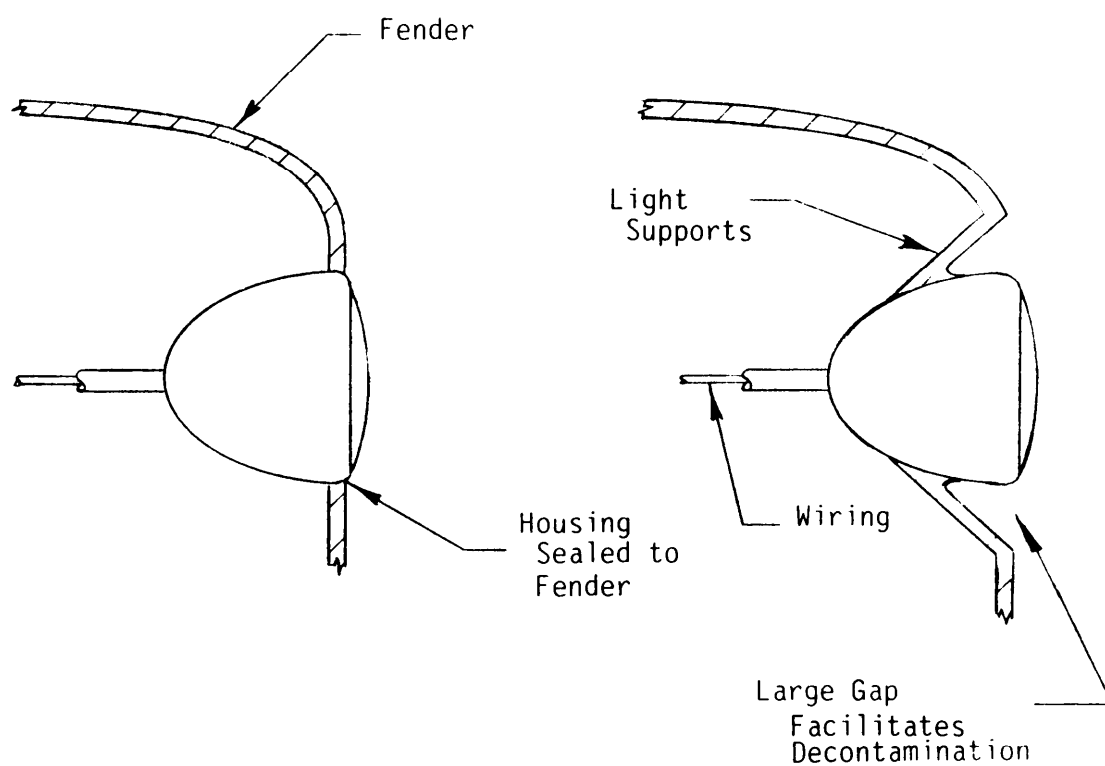


LIGHTING FIXTURES

The headlights, housed in the fender, are not sealed, and the gaps around the housing are difficult to decontaminate.

Stake Truck (Loadstar)

MIL-HDBK-784



LIGHTING FIXTURES

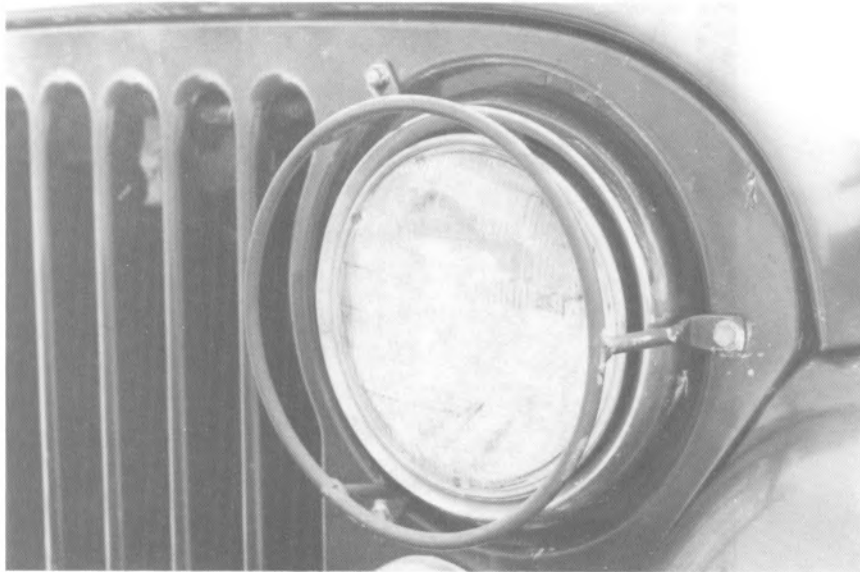
Sealed gaps (left) prevent the entry of contaminants. Alternatively, widened gaps (right) facilitate decontamination.



LIGHTING FIXTURES

The beam adjustment openings and the gap between the light mounting and grill can trap airborne contaminants and contaminated dust. The flange must be removed for thorough decontamination.

M151A1 Utility Truck



LIGHTING FIXTURES

An integral mounting flange is easier to decontaminate. The beam adjustment brackets, in the groove between the lamp and flange, are open to both contaminants and decontaminants. (M151A1 Utility Truck)

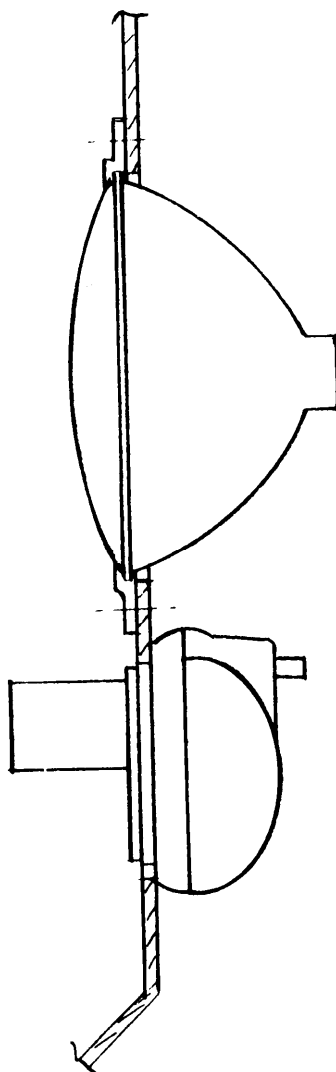


LIGHTING FIXTURES

The headlight-mounting area on the vehicle is difficult to decontaminate.

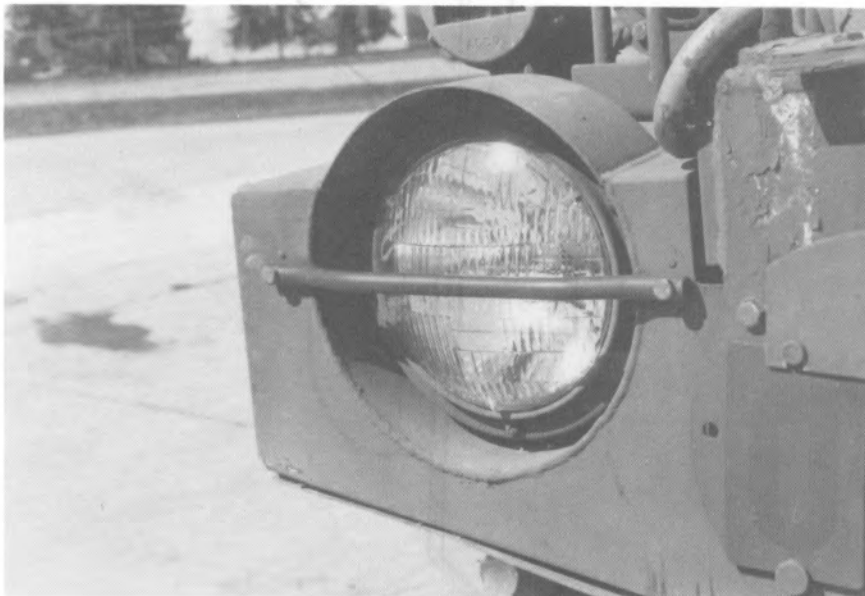
M819 Tractor Truck

MIL-HDBK-784



LIGHTING FIXTURES

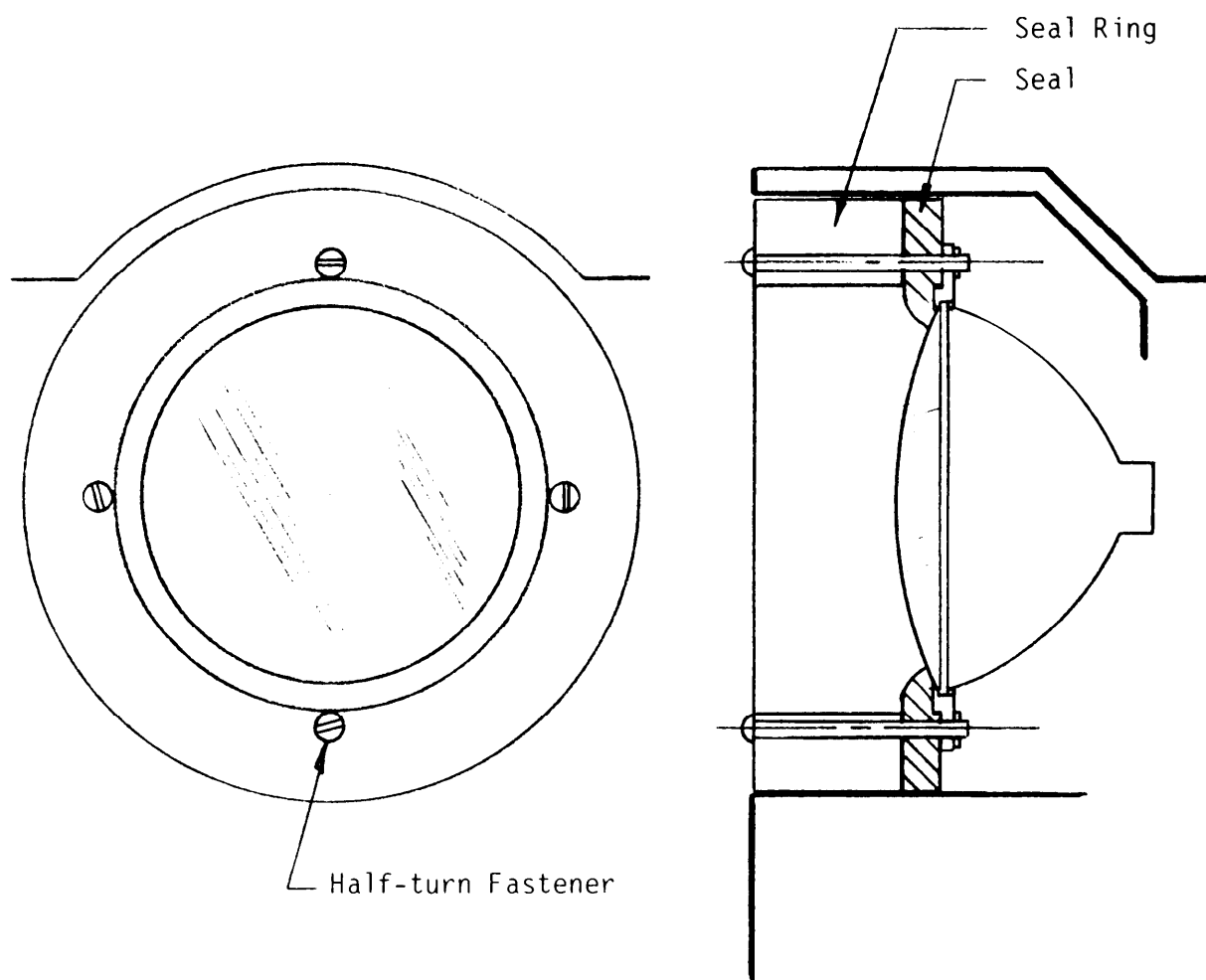
Mounting the headlight and horn flush with the wall of the engine compartment allows access behind the reinforcing beam beside the grill and makes decontamination easier.



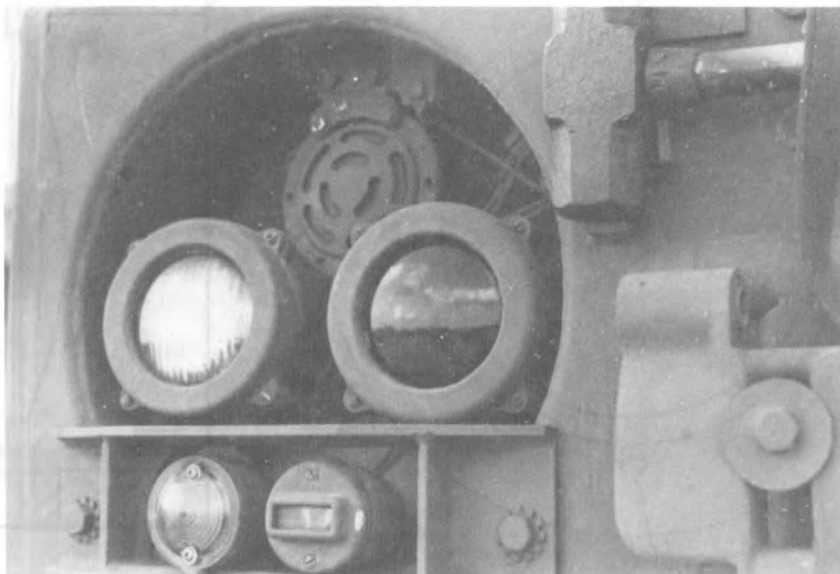
LIGHTING FIXTURES

Contaminants and contaminated dust can be trapped behind the mounting ring and between the ring and the lamp. These areas, inaccessible to cleaning instruments, are difficult to decontaminate.

MIL-HDBK-784

LIGHTING FIXTURES

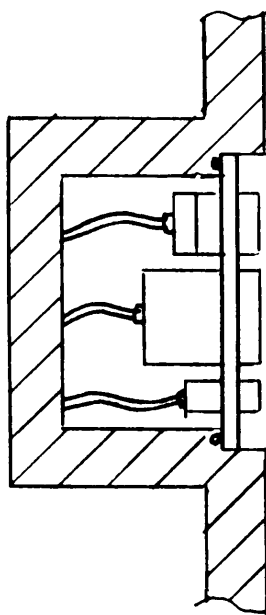
Installing a seal will prevent contaminants from being trapped within the headlight mounting cavity. In addition, quick-release screws make replacement of the seal easy and allow adjustment of the lamp.



LIGHTING FIXTURES

The lights and horn are mounted in a cavity that is difficult to decontaminate without removing hardware. Also, the electrical wiring within the cavity can absorb some contaminants.

MIL-HDBK-784

LIGHTING FIXTURES

The lights and horn are mounted and sealed around the edges in a one-piece panel that is sealed into the cavity. The cavity, rear surfaces of lights and horn, and wiring are protected from contamination. To repair or replace an item, the panel with items attached is removed; the specific item is removed from the rear of the panel.

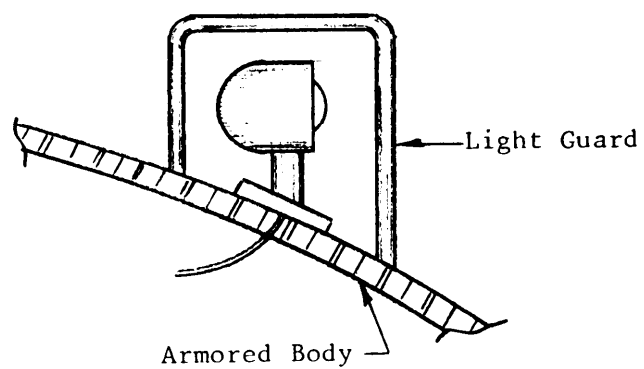


LIGHTING FIXTURES

The depression under the lights allows liquid contaminants to pool and be drawn under the fasteners. This area is difficult to decontaminate.

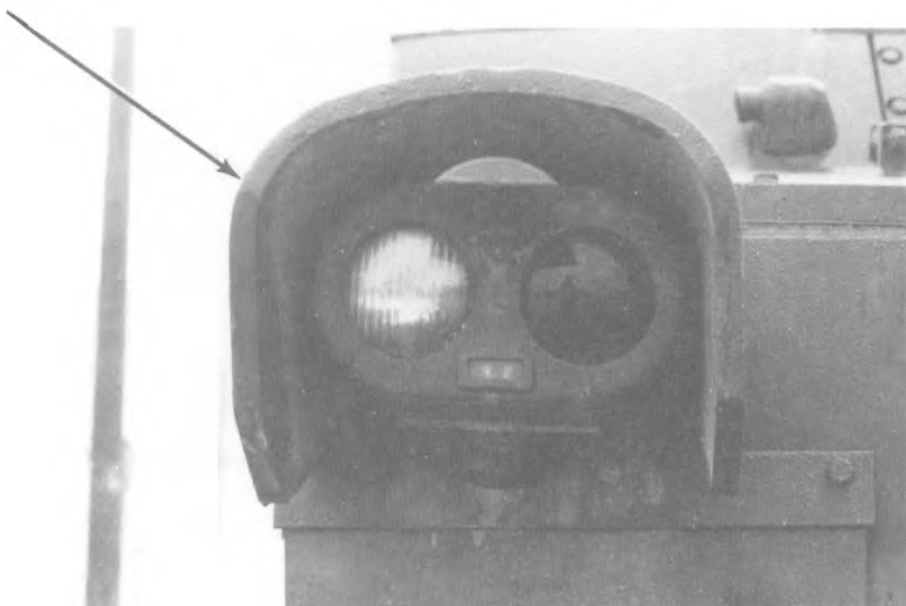
M551 Tank (Sheridan)

MIL-HDBK-784



LIGHTING FIXTURES

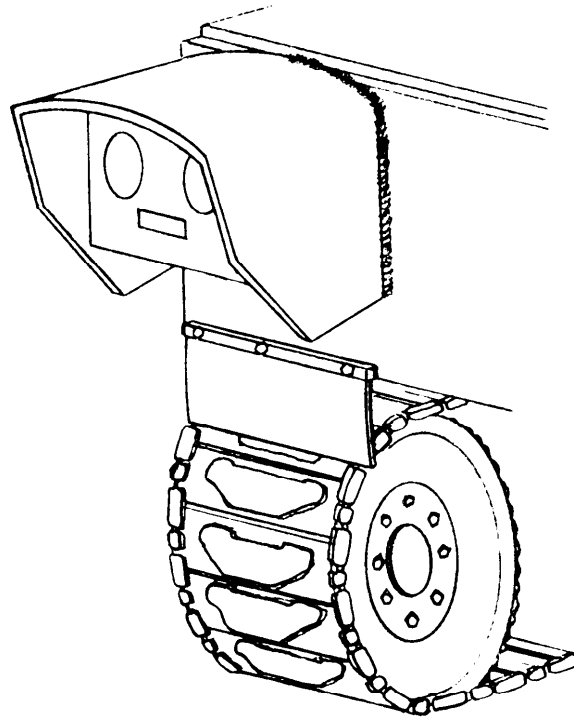
Eliminating the depression prevents the pooling of liquid contaminants and facilitates decontamination.



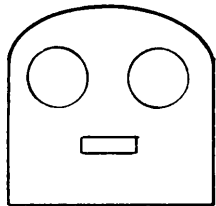
LIGHTING FIXTURES

The light guard exposes the bulbs and wiring to contaminants and makes the shielded area behind the lights difficult to decontaminate. In addition, the wiring can absorb some contaminants.

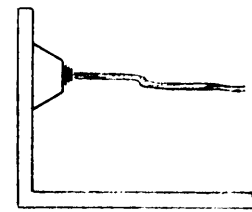
MIL-HDBK-784



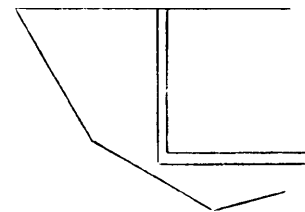
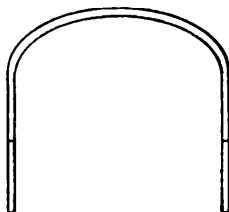
(a)



(b)



(c)



LIGHTING FIXTURES

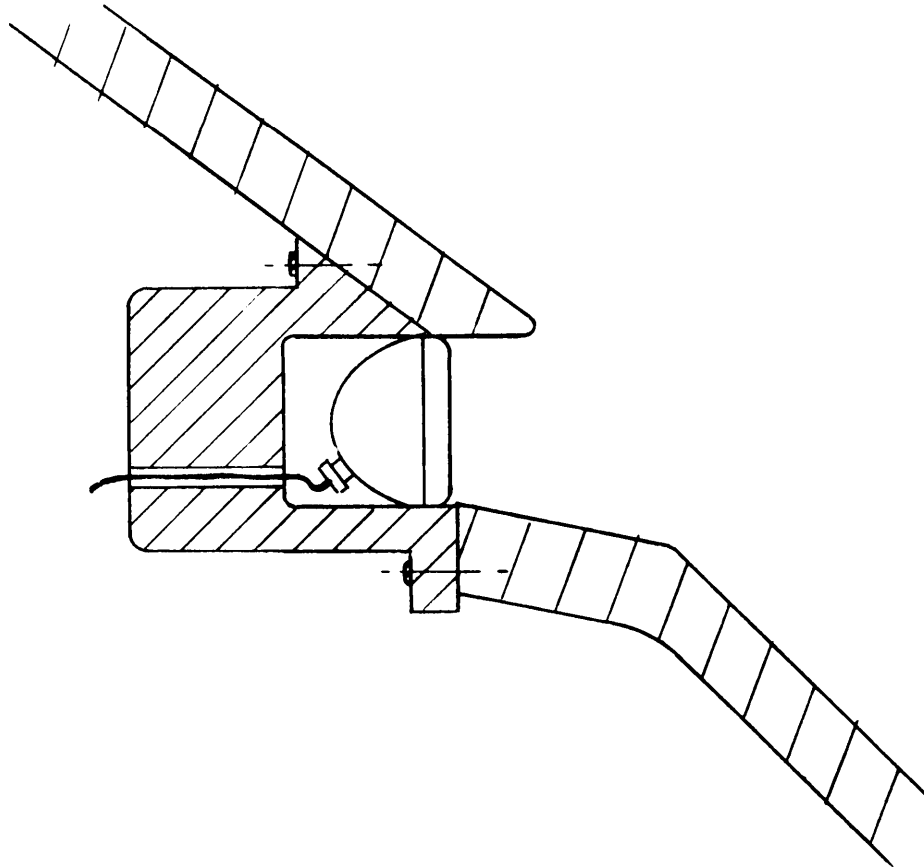
The lights are mounted in a panel (b), which is sealed in a solid guard (c). The guard is welded completely around to the hull (a). The panel seals the area behind the bulbs.



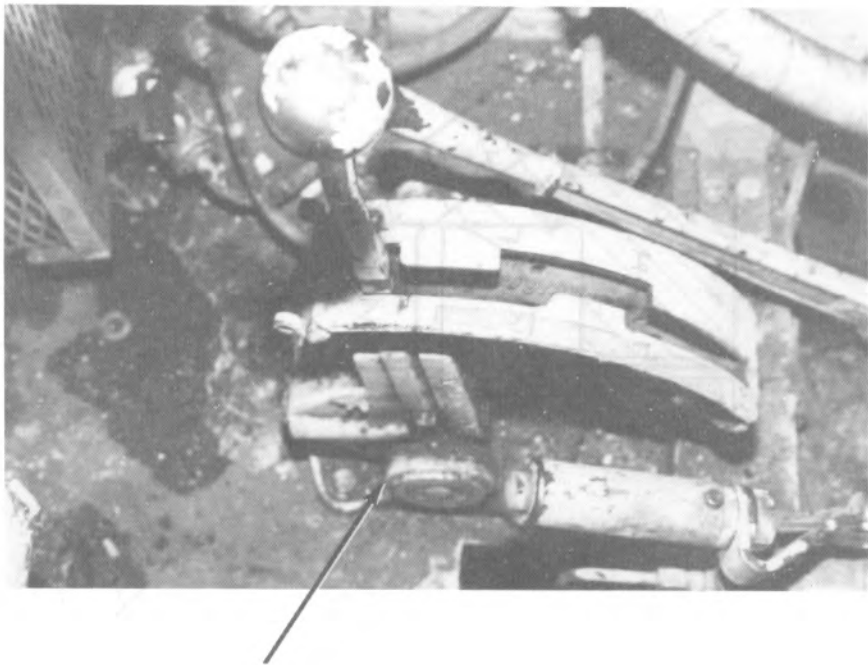
LIGHTING FIXTURES

The body of the light, support, and protective frame are all exposed to the contaminating atmosphere. In addition, the channels, wiring, and fasteners are difficult to decontaminate.

MIL-HDBK-784

LIGHTING FIXTURES

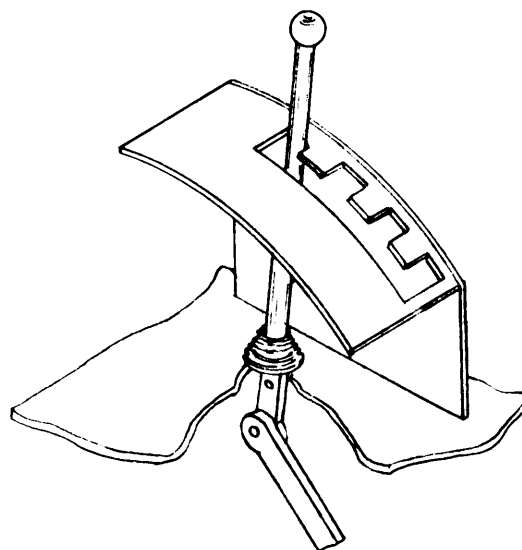
An inset, sealed headlight has less surface exposed to contamination and is easier to decontaminate. The armor behind the light protects the interior of the vehicle.



LINKAGES

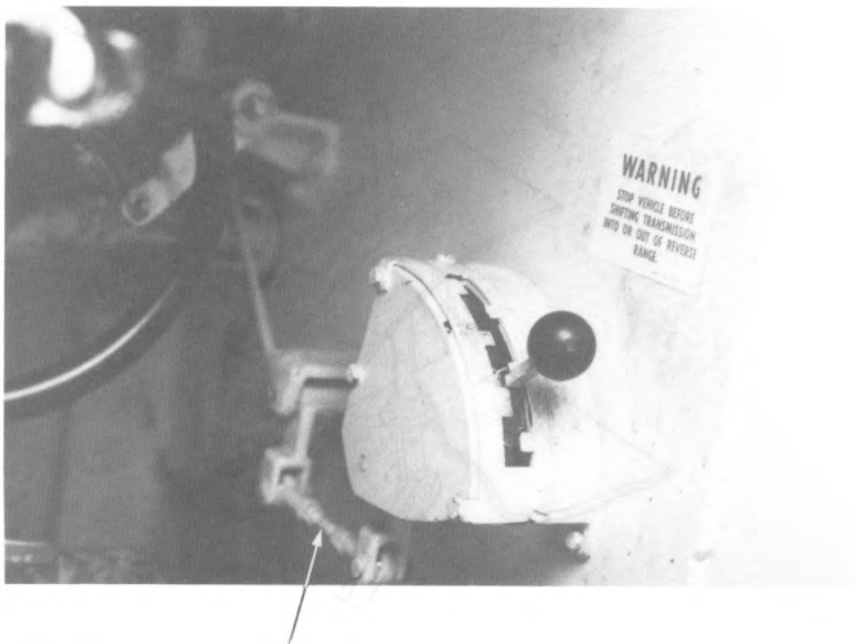
The complex pivot area can trap contaminants and makes application and removal of chemical decontaminants difficult.

NIL-HDBK-784



LINKAGES

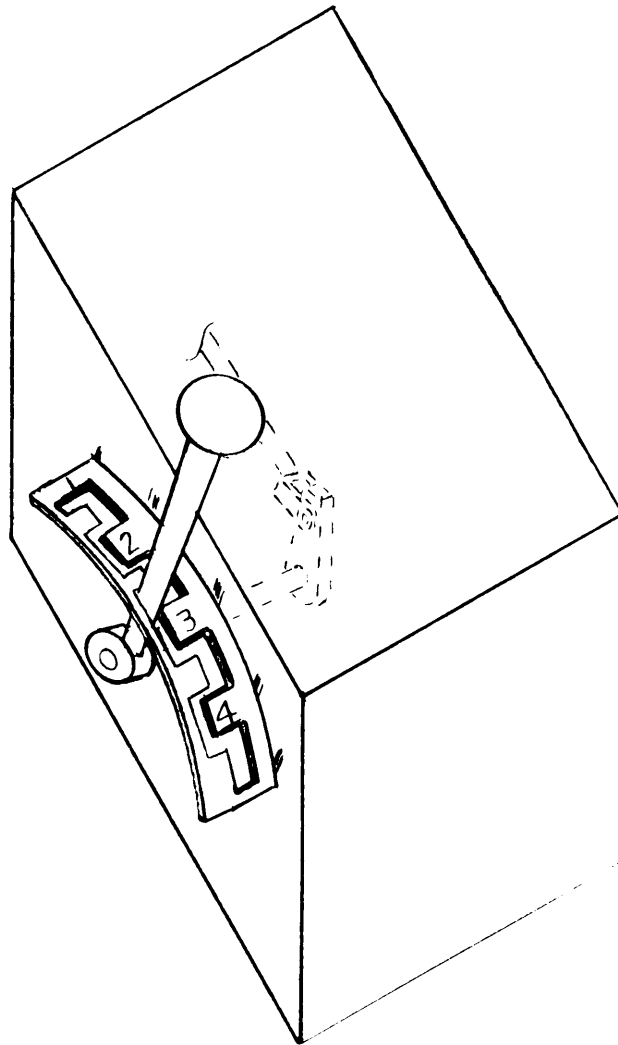
A floor panel shields the linkage pivot areas and a metal bellows seals the lever opening in the floor.



LINKAGES

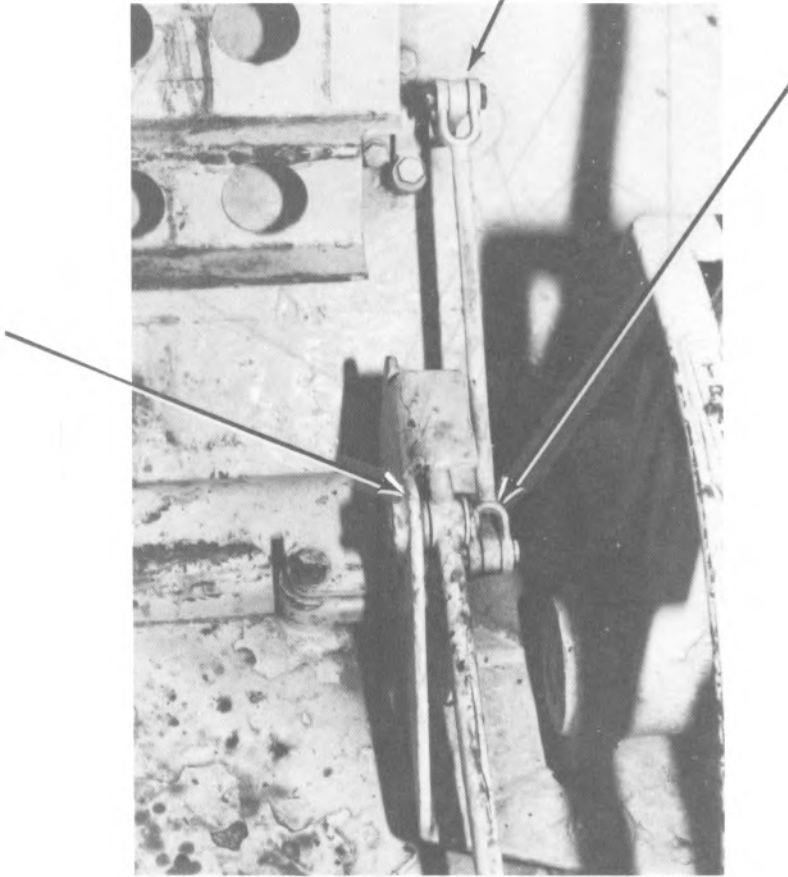
The transmission shift lever and linkages are exposed to contaminants and are difficult to decontaminate. In addition, the shift guide hinders decontamination.

MIL-HDBK-784



LINKAGES

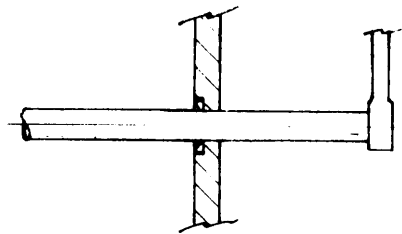
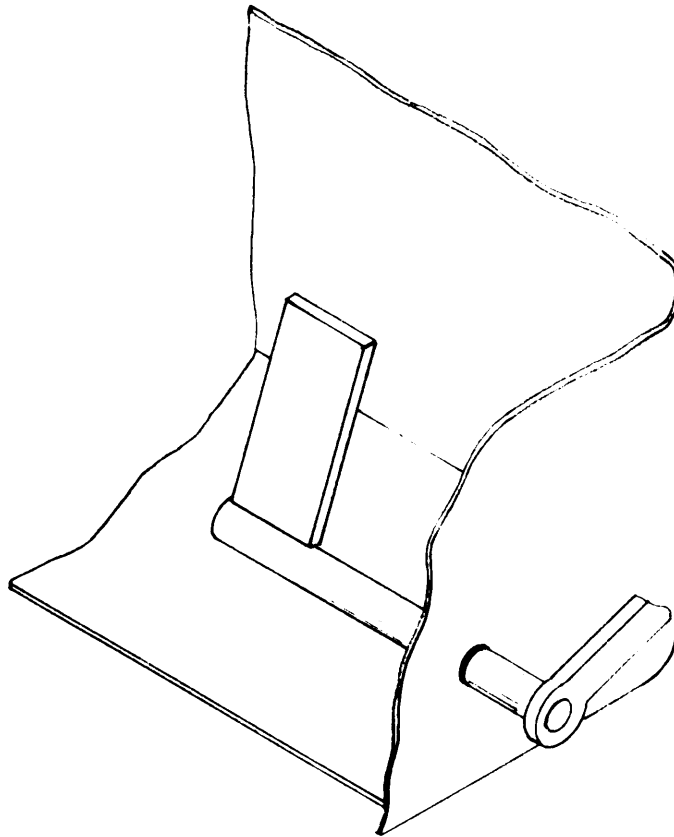
A sealed box or wall panel protects the linkages and a simplified shift guide facilitates decontamination.



LINKAGES

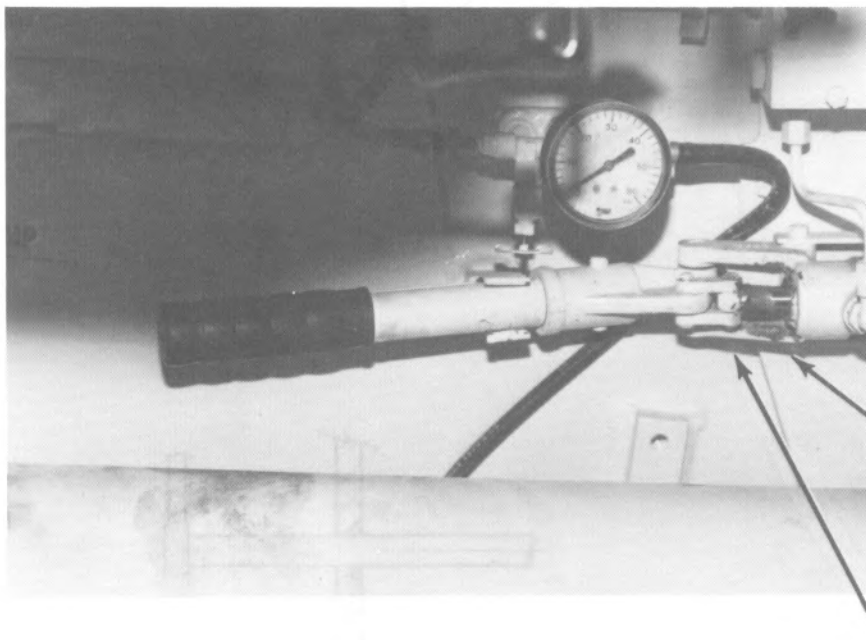
The pivot areas can trap contaminants and make application and removal of chemical decontaminants difficult.

MIL-HDBK-784



LINKAGES

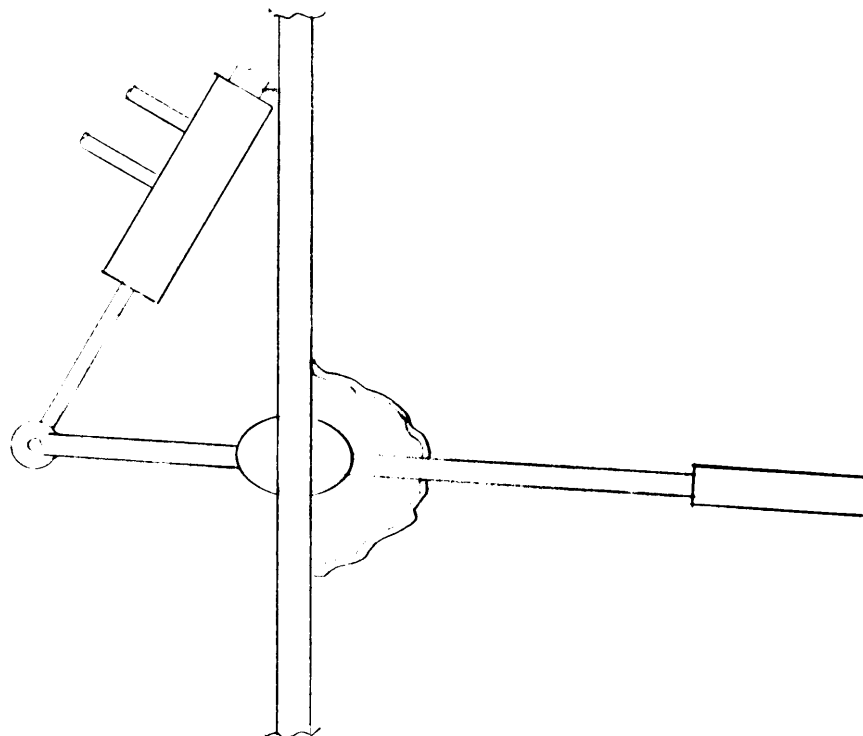
A sealed wall panel protects the pivot areas from contaminants. The rotating rod is easier to seal than a sliding rod.



LINKAGES

The linkage of the hydraulic pump handle is exposed to contaminants and is difficult to decontaminate.

MIL-HDBK-784



LINKAGES

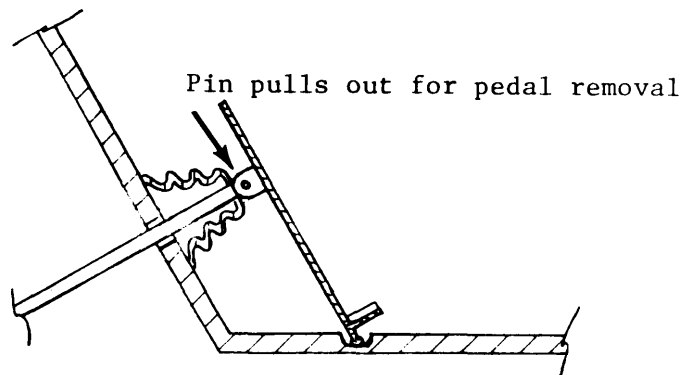
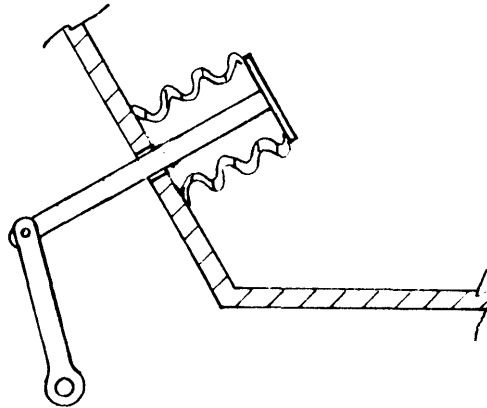
A panel protects the linkage and pump from contaminants, and a metal bellows seals the handle.



LINKAGES

The complicated pivot areas of the pedal linkages are difficult to decontaminate by chemical means.

MIL-HDBK-784



LINKAGES

(Top) A floor panel shields the linkage pivot areas and a metal bellows prevents the drawing in of contaminants.

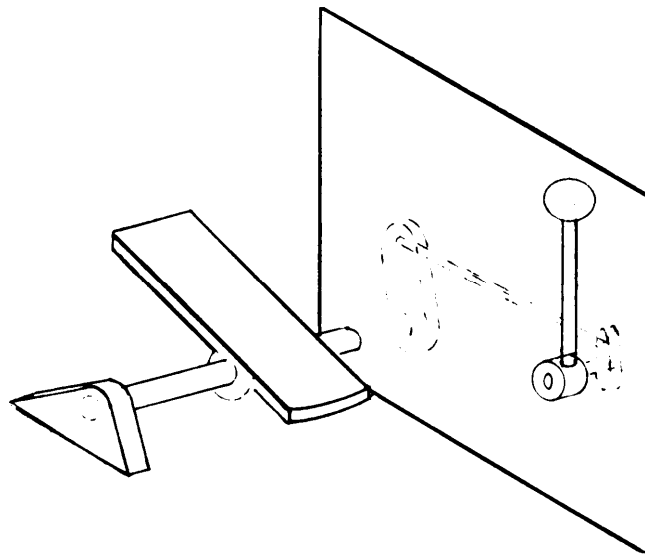
(Bottom) A floor panel shields the linkage pivot areas. A pull-out pin allows easy removal of the pedal for decontamination, and a hinge notch in the floor is wide enough for effective decontamination. A metal bellows prevents the drawing in of contaminants.



LINKAGES

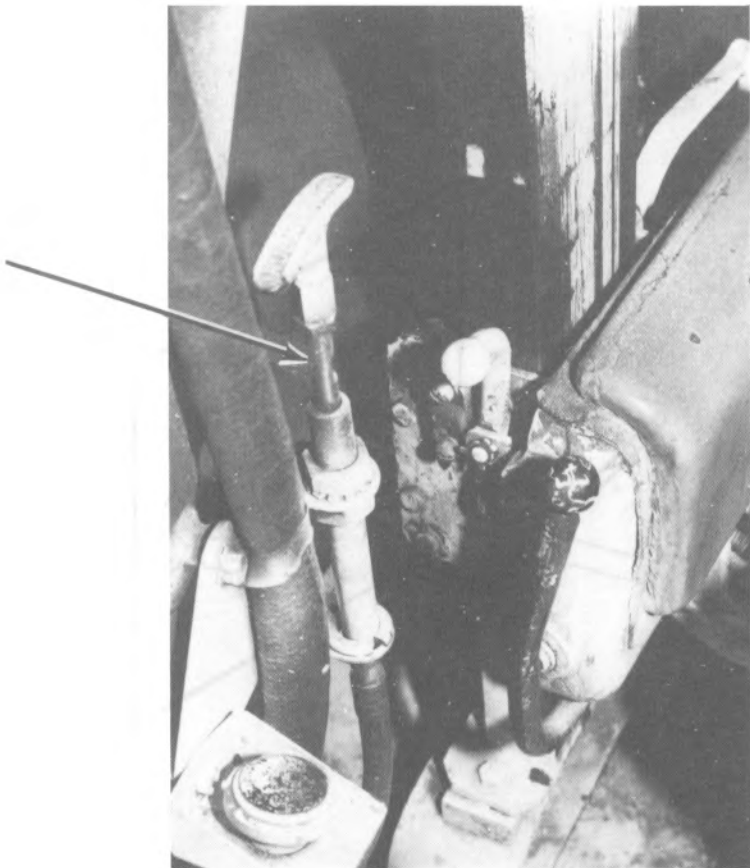
The linkages and joints are exposed to contaminants and are difficult to decontaminate.

MIL-HDBK-784



LINKAGES

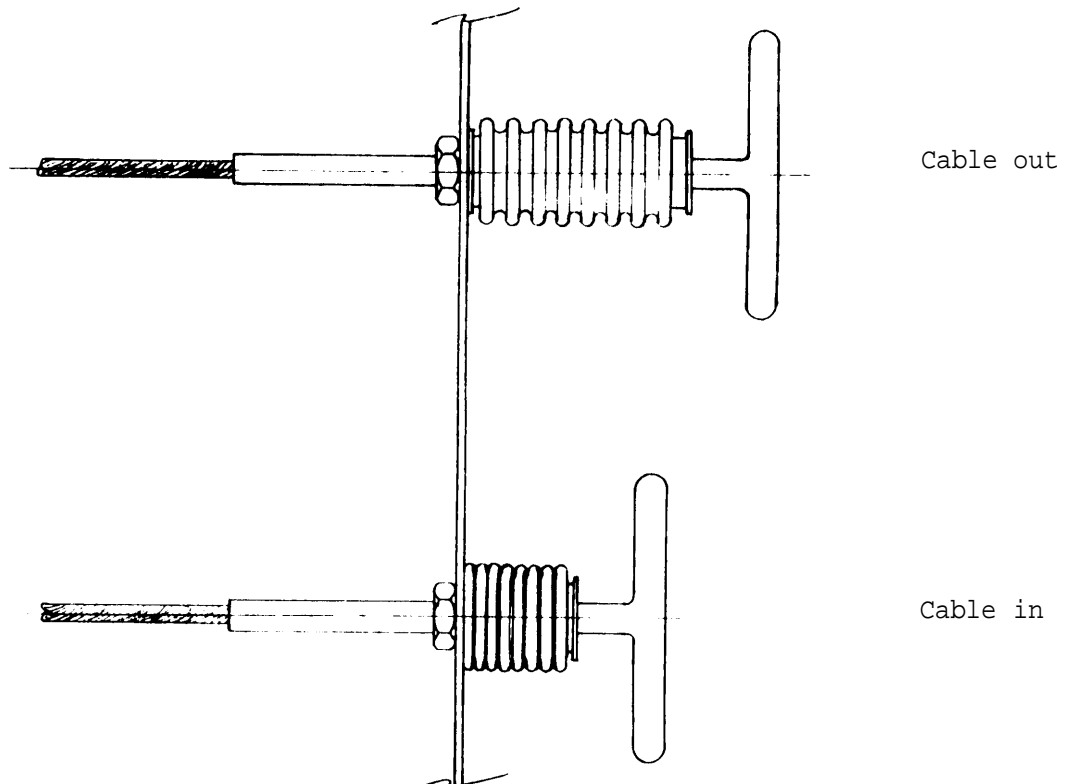
A wall panel protects the linkages in this design, which makes use of rotating rods.



LINKAGES

The sliding rod tends to draw contaminants into the cylinder.

MIL-HDBK-784



LINKAGES

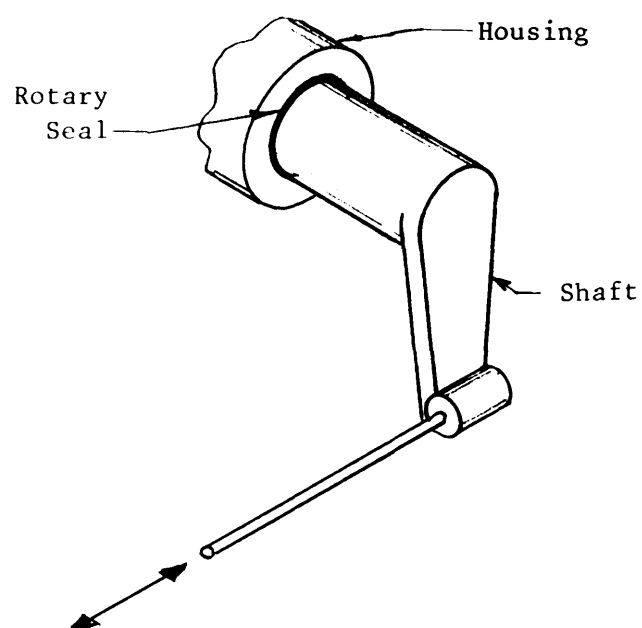
A panel protects the cables from contaminants, and a metal bellows prevents the drawing in of contaminants.



LINKAGES

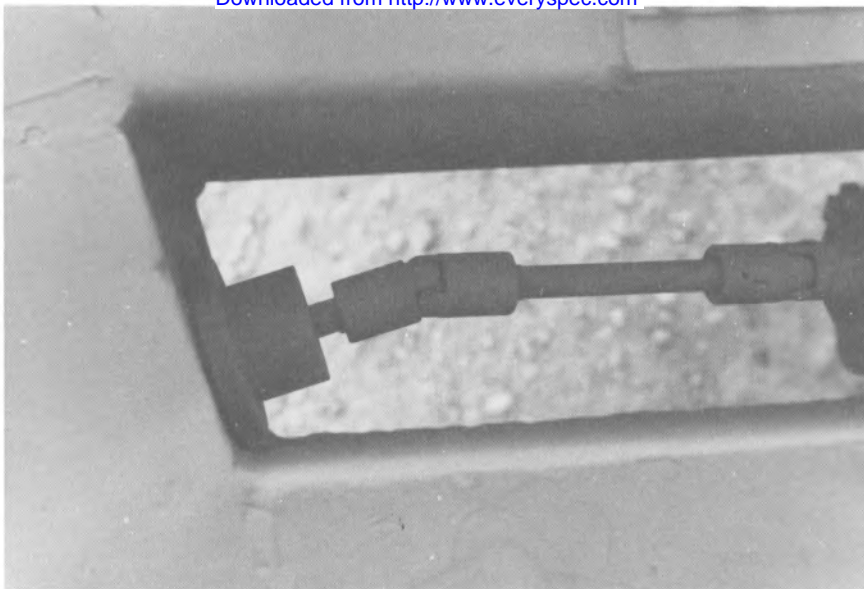
The sliding rods are difficult to seal and tend to draw contaminants into the cylinders.

MIL-HDBK-784



LINKAGES

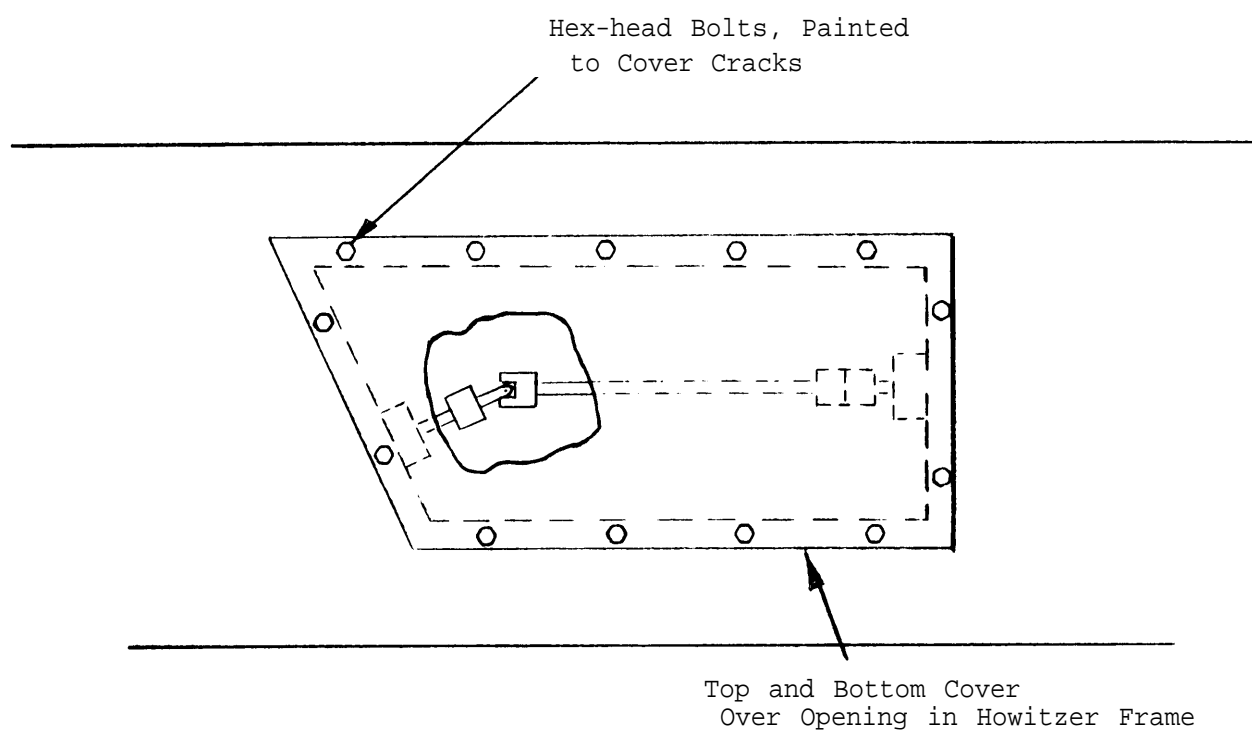
Cantilevered shafts with cranks attached to the end are easier to seal. Nonporous boots can be placed over the thrust rods connected to the crank.



LINKAGES

Exposed universal joints and shafts are difficult to decontaminate because of crevices and limited access.

MIL-HDBK-784



LINKAGES

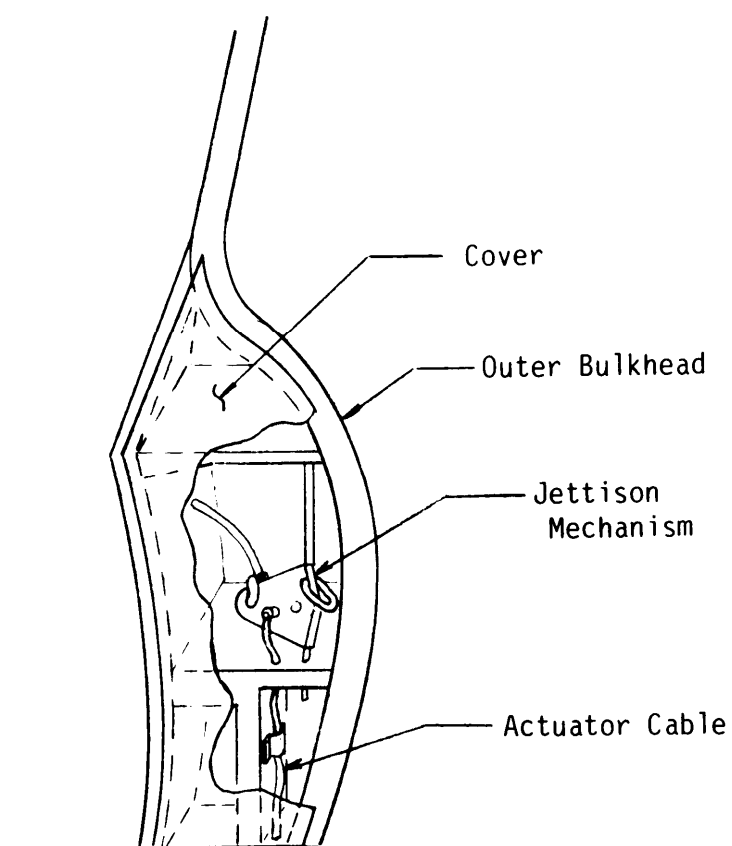
Covering the opening in the caisson frame protects the joints and shafts from contaminants. A different housing could be used for the same purpose.



LINKAGES

Door jettison mechanism can trap airborne contaminants and contaminated dust in spaces inaccessible to decontaminants. Also, the interior and blind areas behind the mechanism mounting and the corrugations of the armor on the actuating cables are difficult to decontaminate.

MIL-HDBK-784



LINKAGES

A cover over the bulkhead access protects the jettison mechanism from contamination.

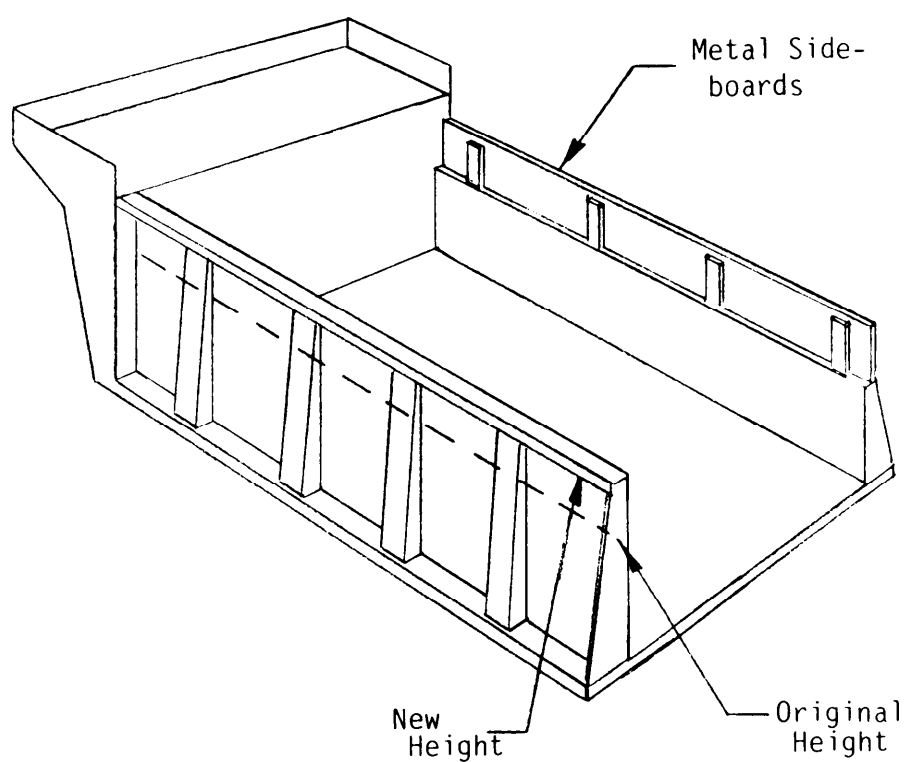


PANELS

The wood sideboards may absorb contaminants.

M51A2 Dump Truck

MIL-HDBK-784



PANELS

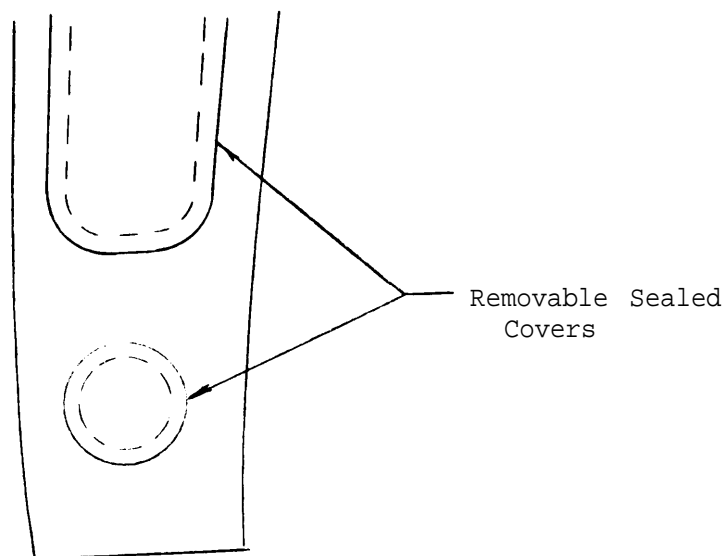
Using higher sides on the truck bed (left side) or metal sideboards (right side) will reduce or eliminate the absorption problem.



PANELS

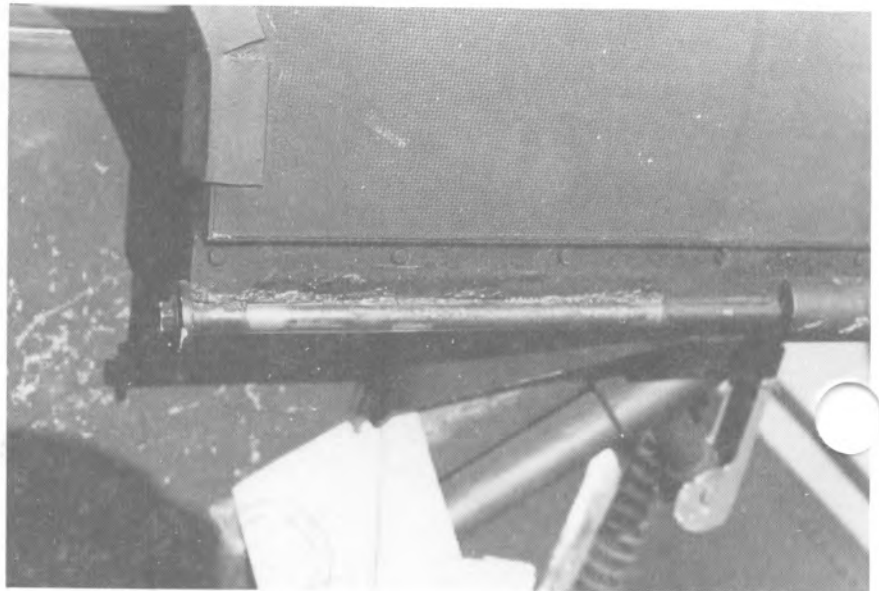
The openings in the panel allow contaminated material to be trapped between the wiring and cables, the coatings of which may be incompatible with decontaminating solutions.

MIL-HDBK-784



PANELS

Removable, sealed covers over the access openings protect the wiring inside the bulkheads from contaminants and decontaminants.

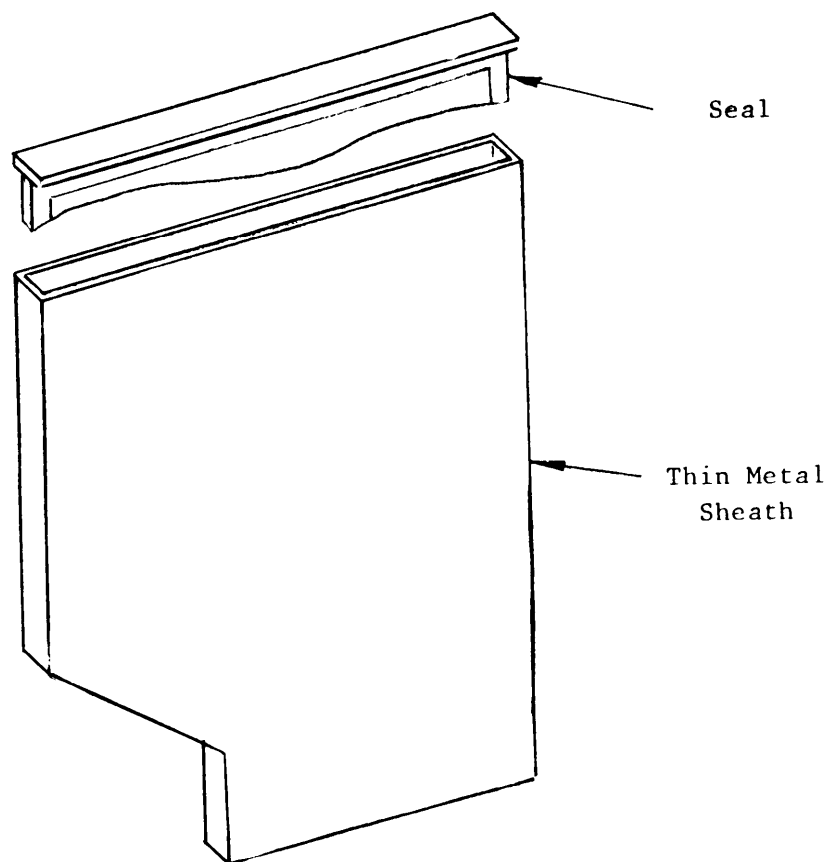


PANELS

The cover material on the armor plate may absorb contaminants and may be incompatible with decontaminants.

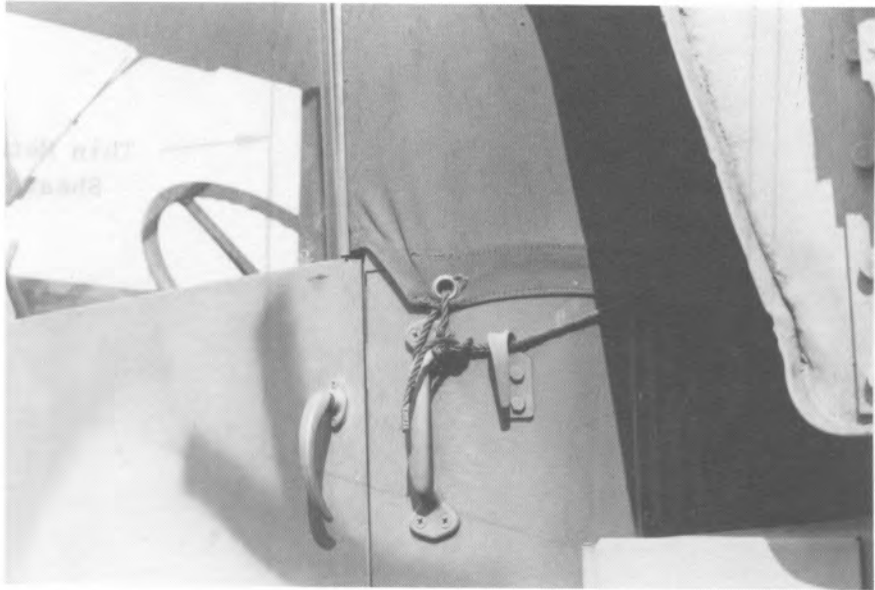
UH-1M Helicopter (Huey)

MIL-HDBK-784



PANELS

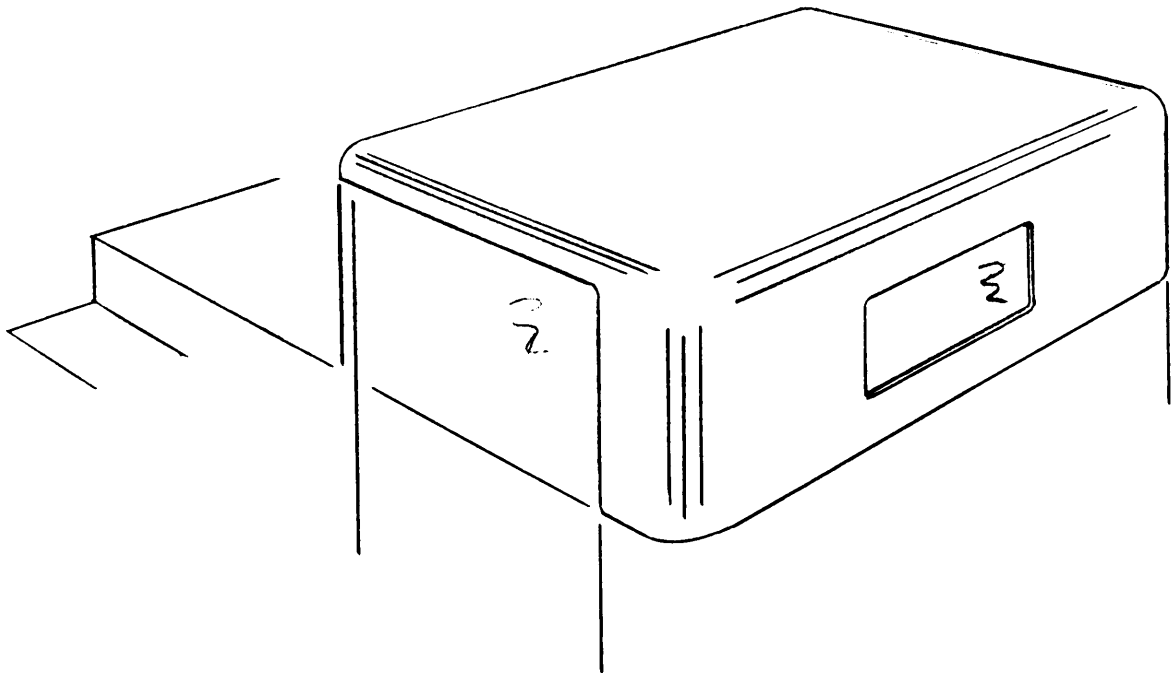
Covering the armor with a thin metal sheath eliminates the absorption problem.



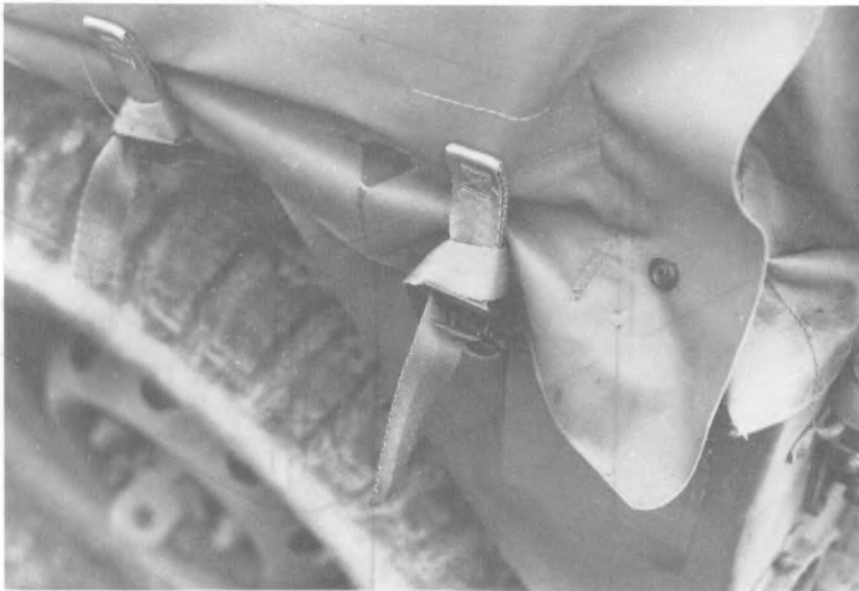
PANELS

The canvas cover and the attachment ropes may absorb contaminants. The ropes must be untied to remove or replace the cover.

MIL-HDBK-784

PANELS

A solid cover (perhaps painted fiber glass and epoxy) reduces the absorption problem. Alternatively, different attachments (such as spring hooks) would facilitate replacement of the canvas cover.



PANELS

The ill-fitting canvas allows airborne contaminants to enter the vehicle. In addition, the canvas traps and absorbs contaminants and is difficult to remove for cleaning.



PANELS

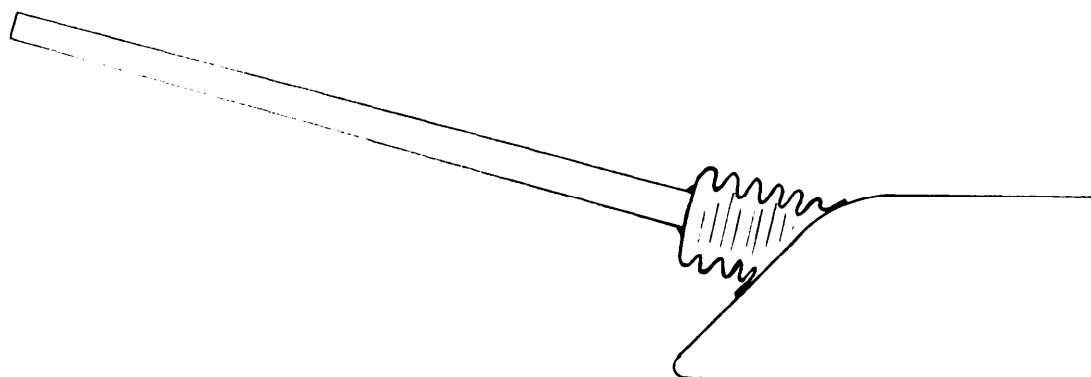
A metal body can be sealed more effectively than the canvas body to prevent contaminants from entering the crew compartment. The smooth surface does not trap contaminants and can be decontaminated in place (M151A1 Utility Truck).



PANELS

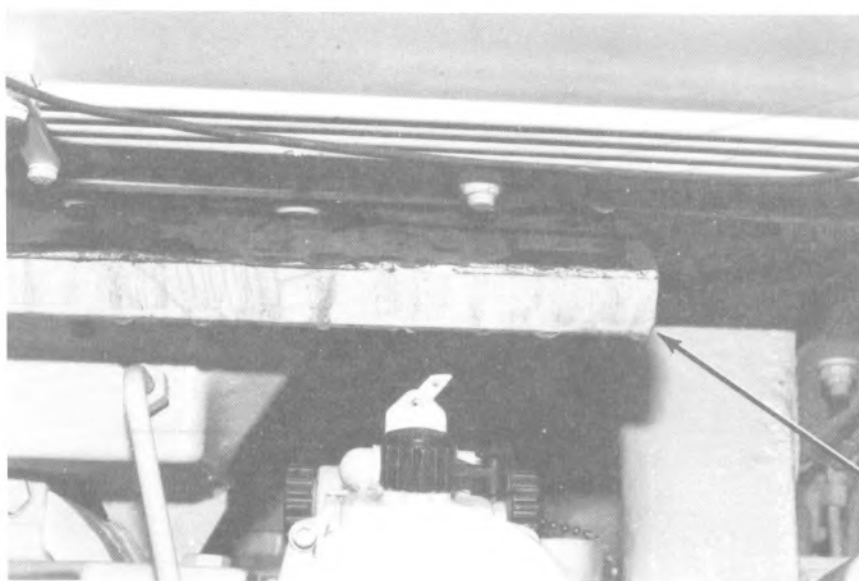
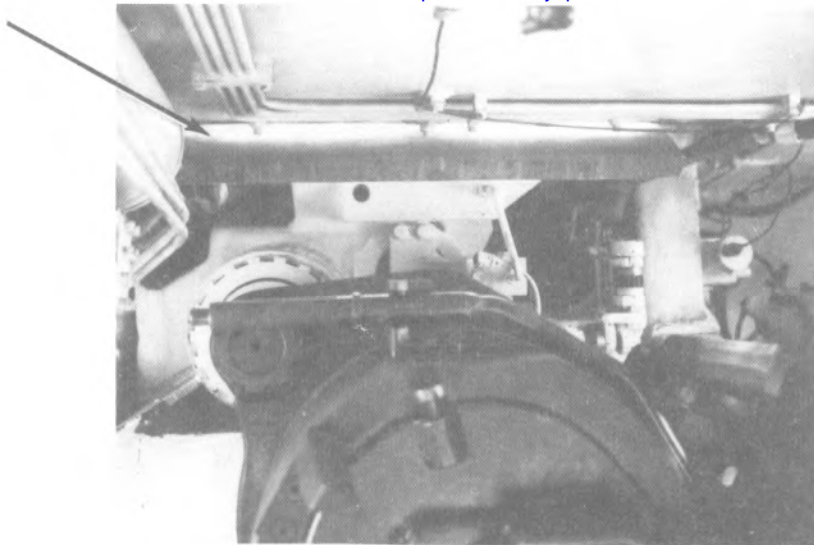
The gun shroud seals the gun-turret interface against the normal environment and allows vertical movement of the gun with respect to the turret. However, the present shroud material is canvas, which can absorb certain chemical contaminants and decontaminants. Canvas is nearly impossible to decontaminate in place, and removal requires extensive handling by personnel, exposing them to contamination from absorbed contaminants.

MIL-HDBK-734



PANELS

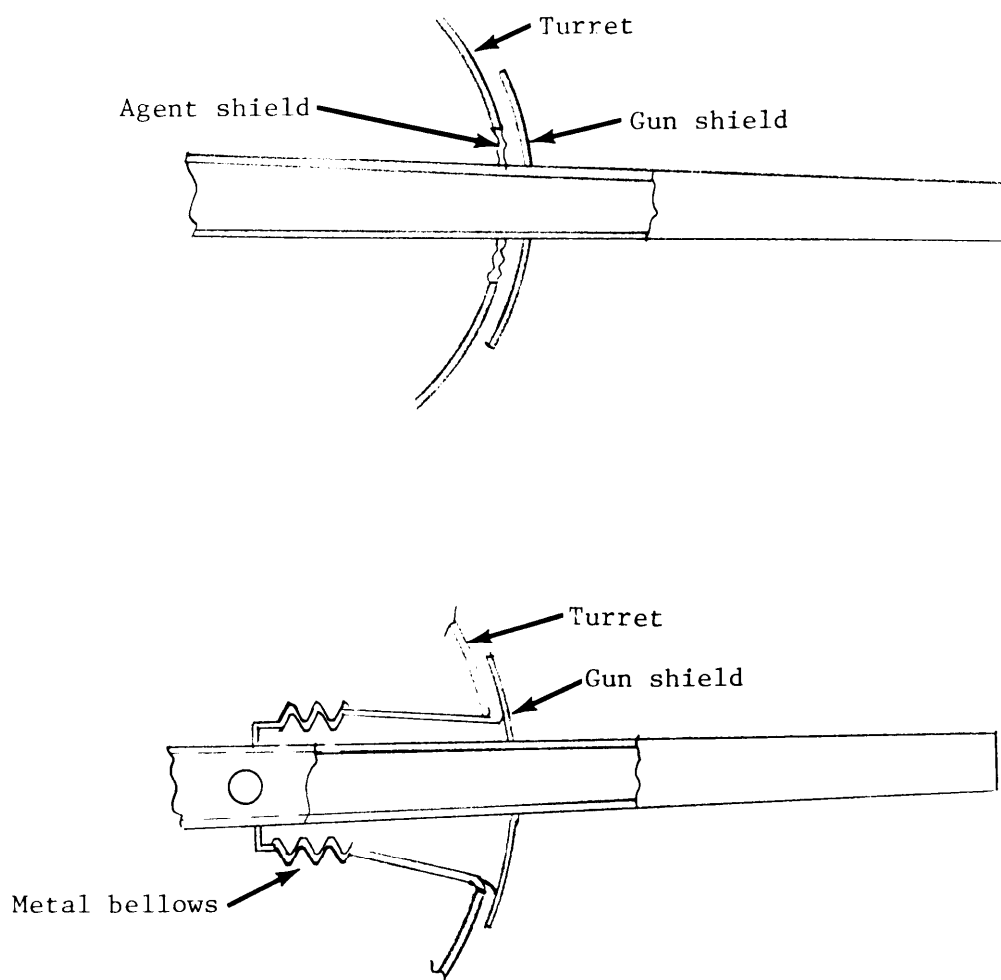
A metal, bellows type shroud performs the same function as the canvas shroud, but is nonabsorbent and does not require removal for decontamination.



PANELS

The gun shield on the elevating main gun allows contaminant entry and is difficult to decontaminate.

MIL-HDBK-784

PANELS

(Top) A corrugated metal shield prevents contaminant entry, and the outer gun shield prevents damage to the agent shield. The area behind the gun shield may be flushed with decontaminant.

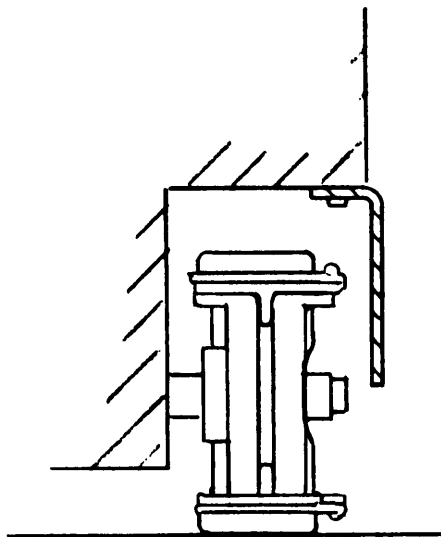
(Bottom) A metal bellows surrounds the barrel, preventing contaminant entry. The area behind the gun shield may be flushed with decontaminant.



PANELS

The attaching member of the flotation skirt attachment is an angle strip mounted on the side of the vehicle. Dust and mud can collect on the angle and between the angle and hull, and the strip is susceptible to damage. In addition, contaminants can be absorbed by dirt and held in damaged areas. The skirt currently used is an elastomer that can absorb some contaminants.

MIL-HDBK-784



PANELS

Mounting the skirt under the fender eliminates the angle and the collecting surface, and replacing the elastomeric skirt with a flexible metal eliminates the absorption problem.

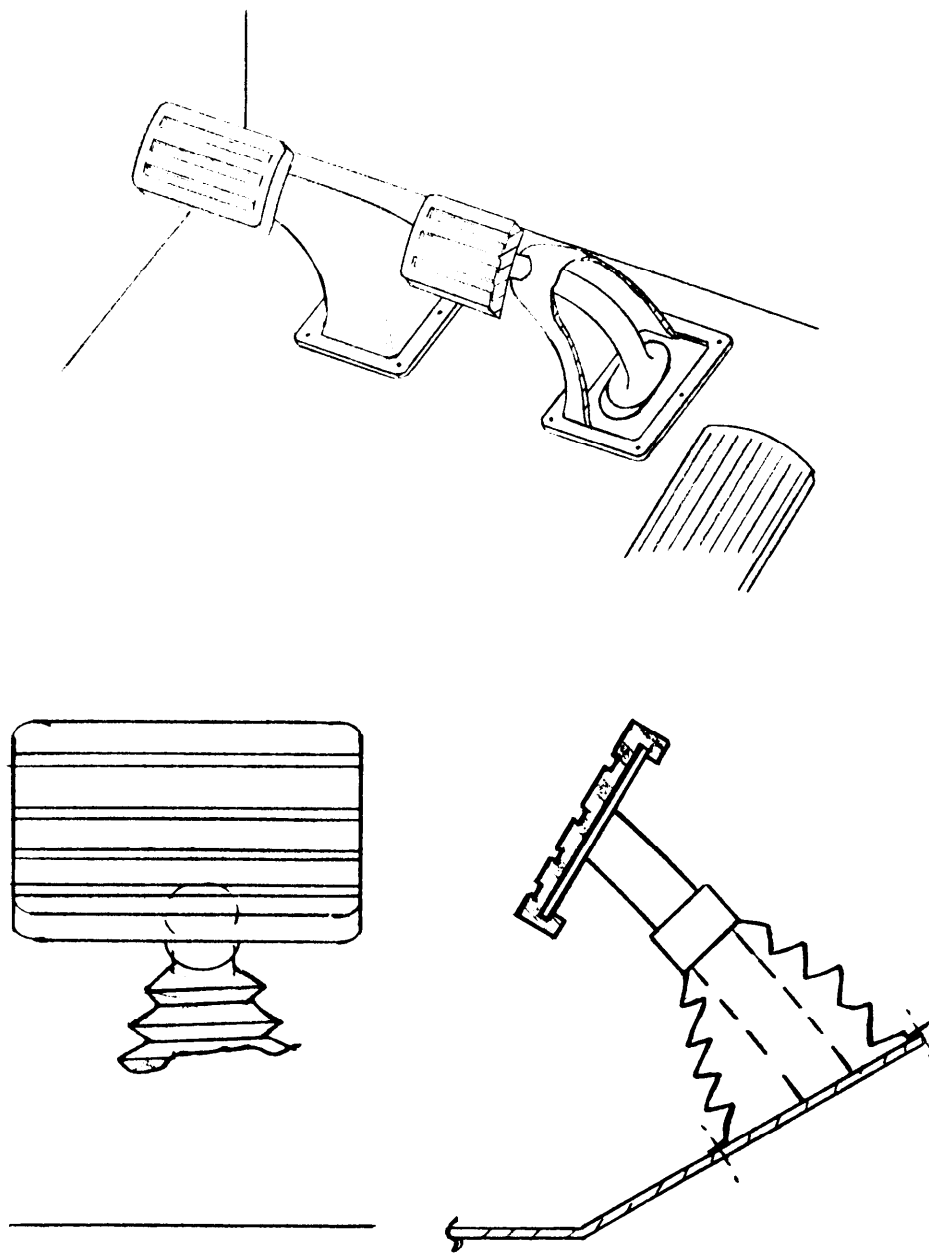


PEDALS

The openings for the pedals allow contaminated dust to enter the truck cab.

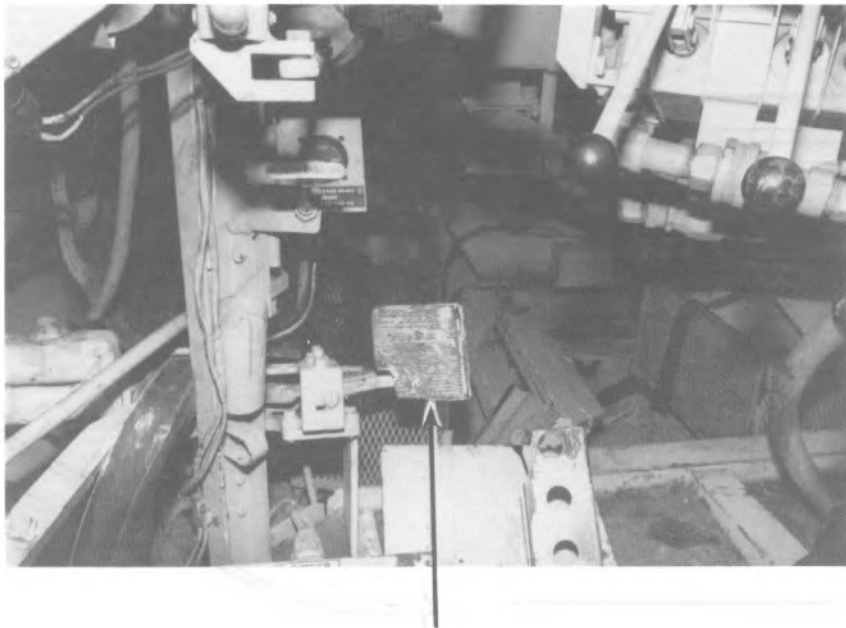
M818 Tractor Truck

MIL-HDBK-784



PEDALS

Nonabsorbent boots or other compressible seals prevent the entry of contaminated dust into the vehicle.

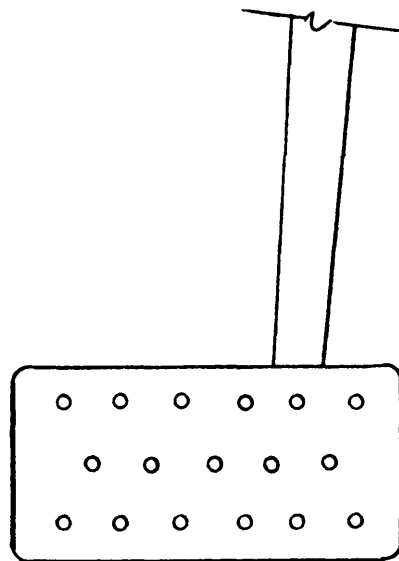


PEDALS

The treads on the brake pedal can trap contaminants and dirt.

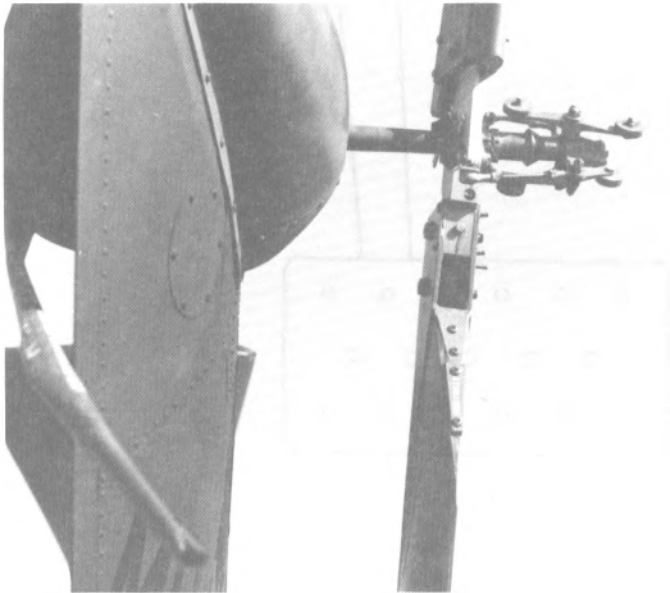
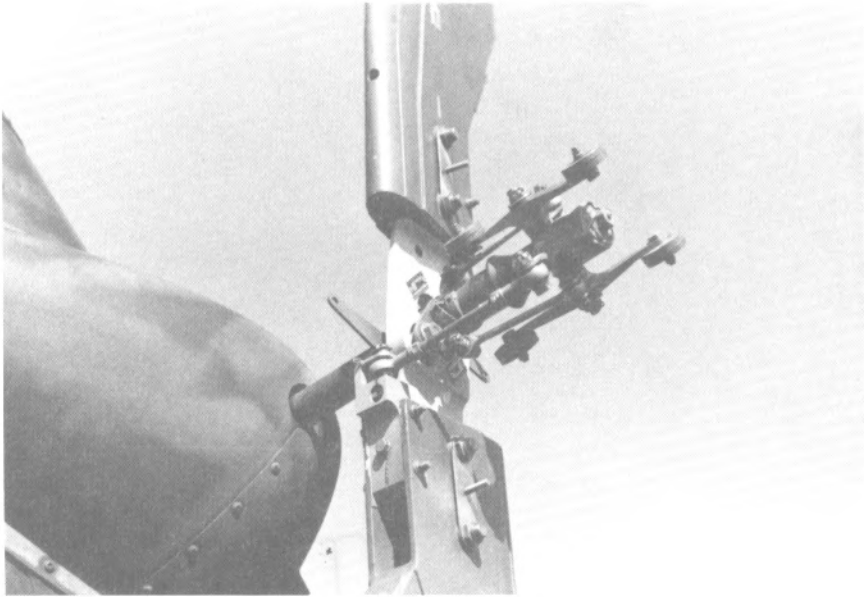
AVLB Bridge-Launching Vehicle

MIL-HDBK-784



PEDALS

Convex dimples on the pedal surface are less likely to trap contaminants and will make the pedal easier to decontaminate.

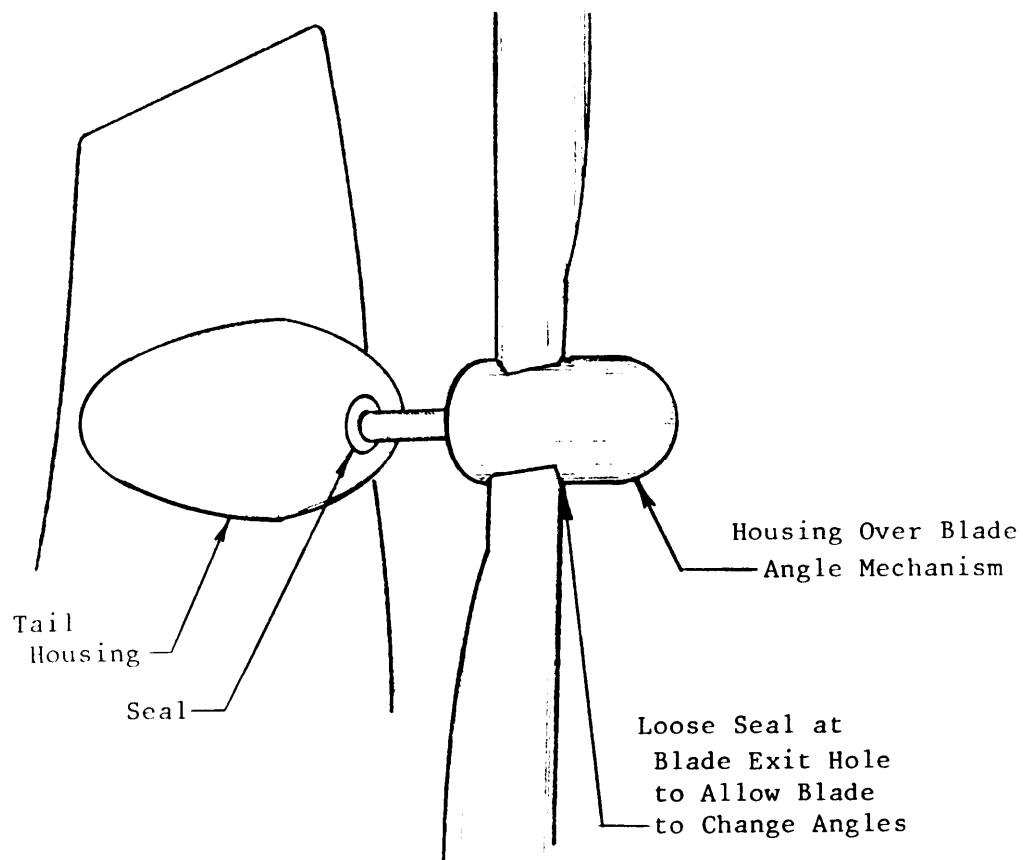


ROTORS, HELICOPTER

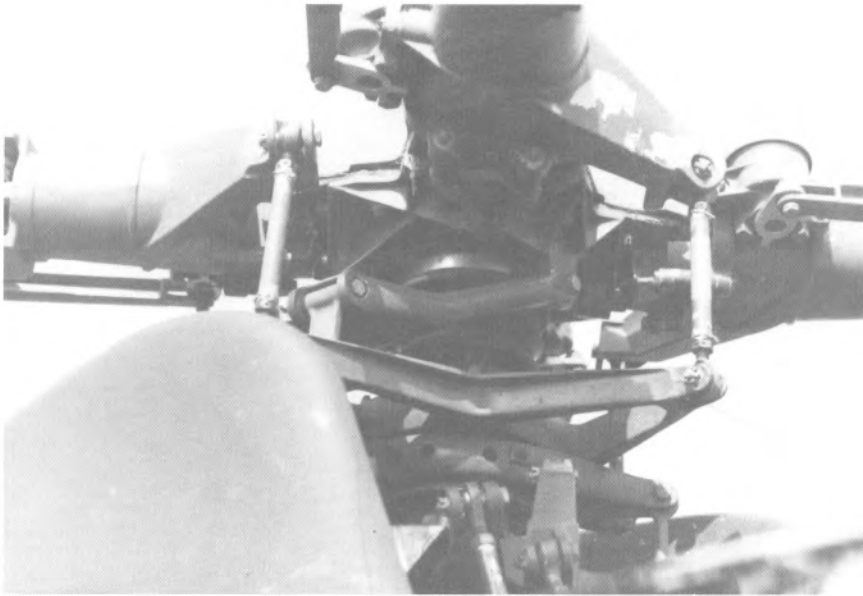
The multiple joints and interfacial crevices in the rotor assembly can trap contaminants, particularly when the rotor is stationary. If lubricants are present to absorb contaminants or to combine with contaminated dust, decontamination will be particularly difficult.

AH-1 Helicopter (Cobra)

MIL-HDBK-784

ROTORS, HELICOPTER

Enclosing the mechanism in a sealed housing will prevent the entrapment and absorption of contaminants.

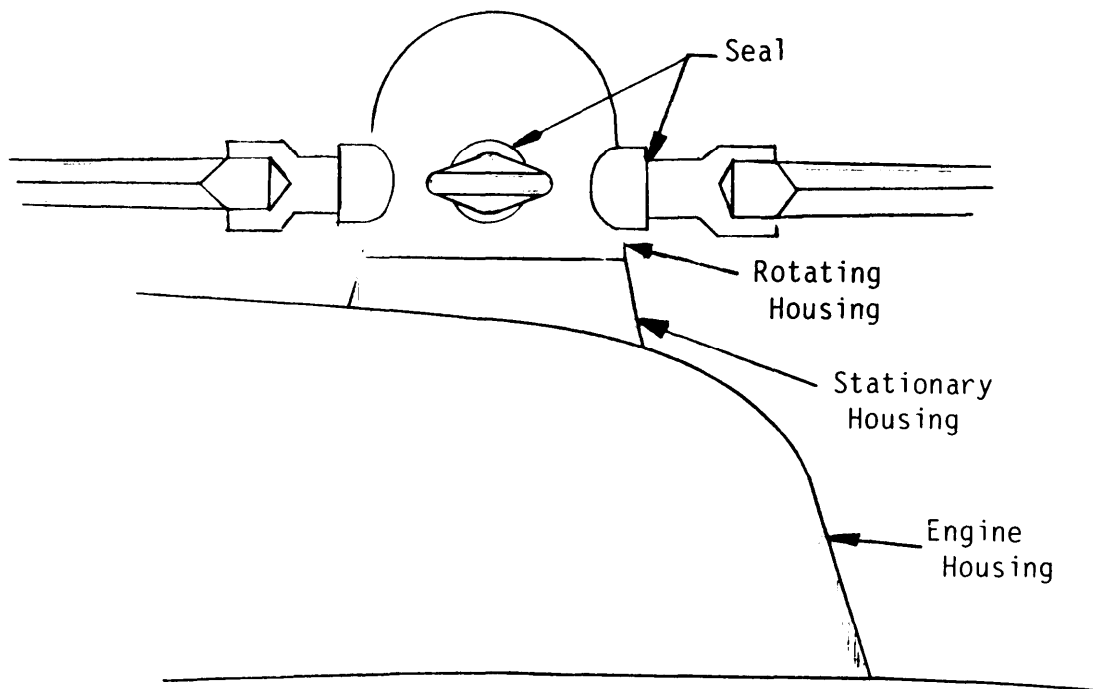


ROTORS, HELICOPTER

The rotor angle-control components can trap contaminants, particularly when the rotor is stationary.

OH-6 Helicopter (Cayuse)

MIL-HDBK-784



ROTORS, HELICOPTER

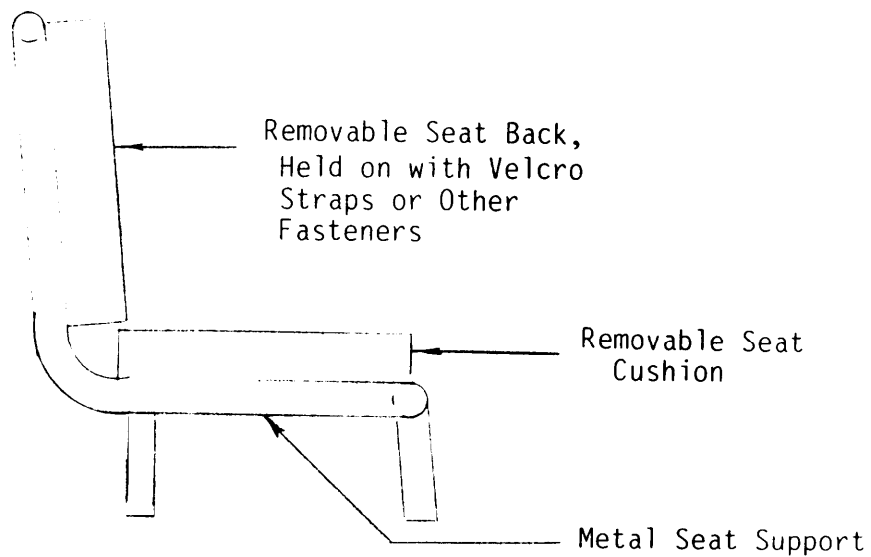
Enclosing the components in rotating and stationary housings will prevent contaminant entrapment.



SEATS

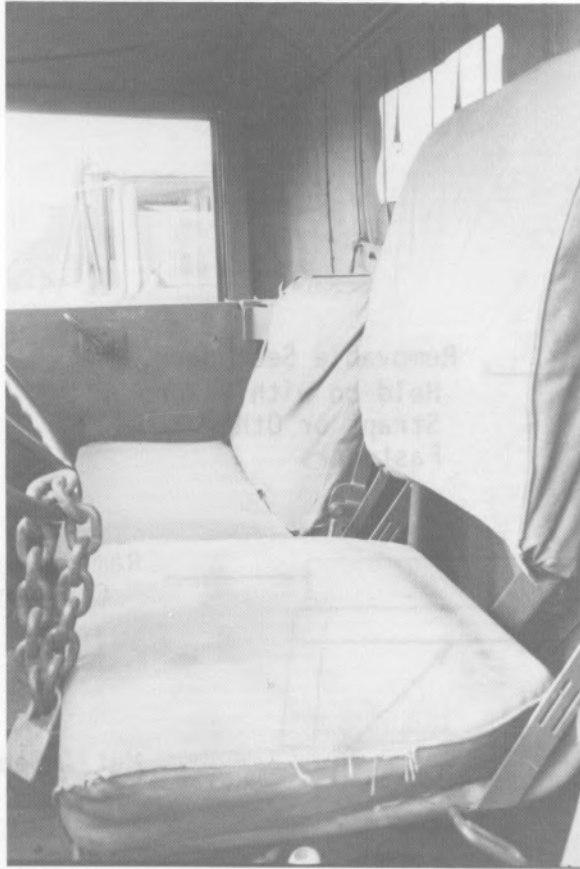
The two-part seats can trap contaminated dirt between the back and bottom cushions, the cushion fabric absorbs contaminants and cannot be cleaned in place, and the cushions cannot be easily removed for decontamination or replacement.

MIL-HDBK-784



SEATS

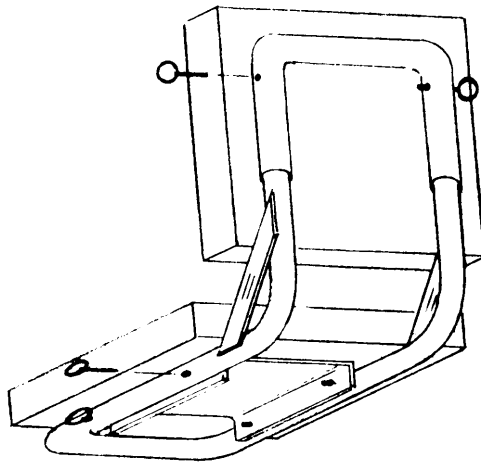
Making the area under the seat more accessible and making the back and bottom cushions more easily removable will facilitate the decontamination of the driver's compartment.



SEATS

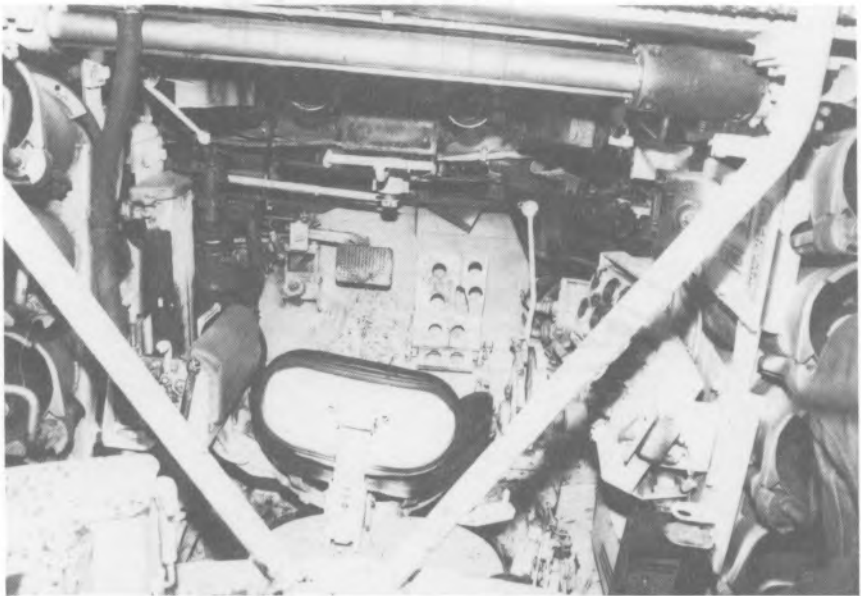
Contaminants/decontaminants can be absorbed by the seat cushion material or can gain entry through holes and tears in the material.

MIL-HDBK-784



SEATS

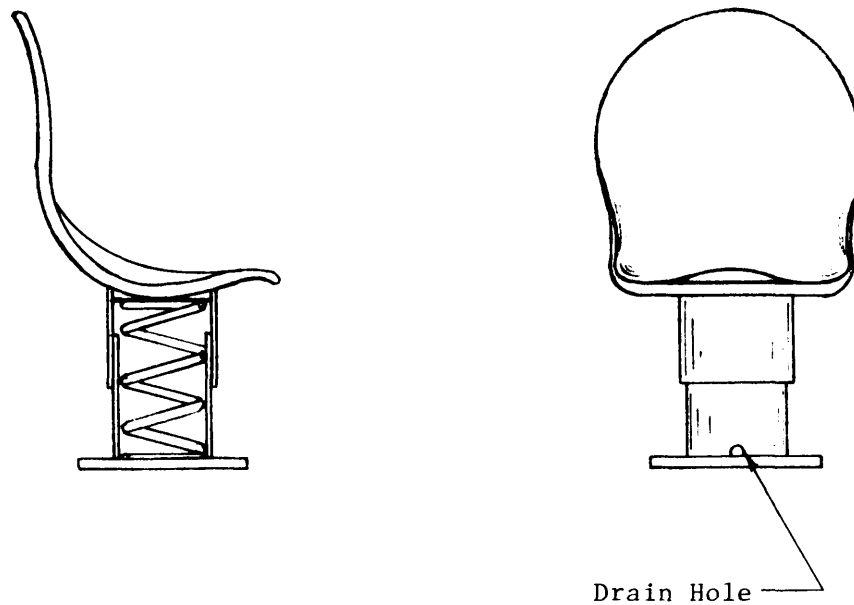
Pull-pin attachment allows easy removal of seat cushions for replacement.



SEATS

The seat material can absorb contaminants/decontaminants, and the seat support may trap contaminants and be difficult to decontaminate.

MIL-HDBK-784

SEATS

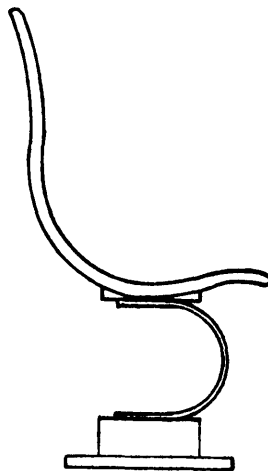
A molded metal seat prevents contaminant/decontaminant absorption. The internal spring is protected by a casing with a sliding post, and the support may be removed from the base to allow decontamination of the spring and interior.



SEATS

The seat pad material can absorb contaminants/decontaminants.

MIL-HDBK-784



SEATS

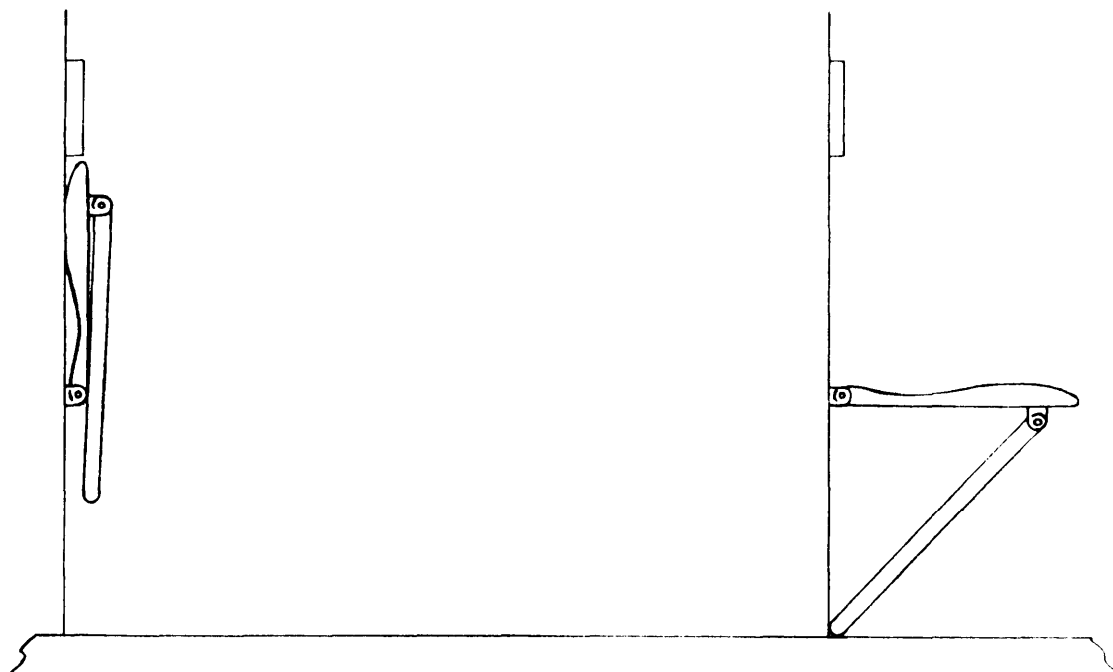
A one-piece molded steel seat eliminates the absorption problem.



SEATS

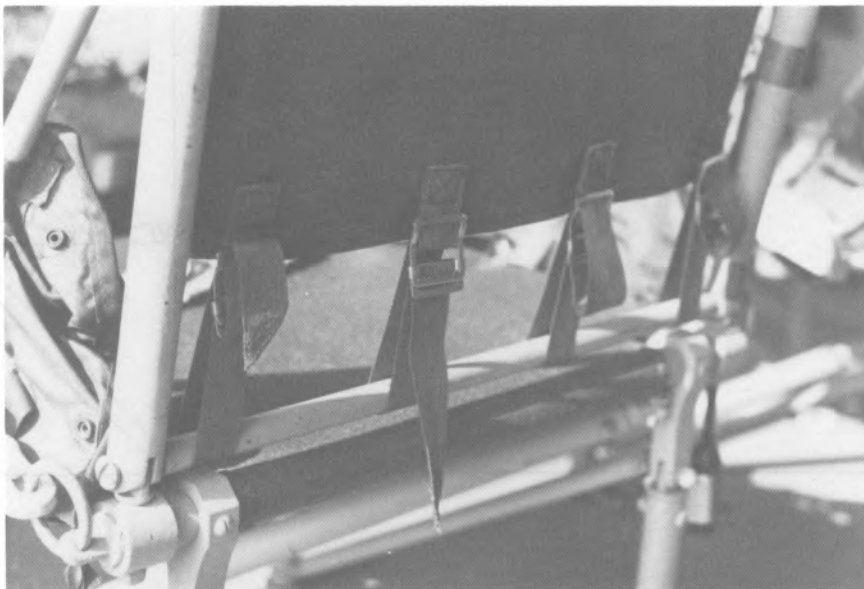
The wooden seats, supports, and sideboards of the truck bed can absorb contaminants/decontaminants.

MIL-HDBK-784



SEATS

Molded metal seats, metal supports and sideboards eliminate the absorption problem.

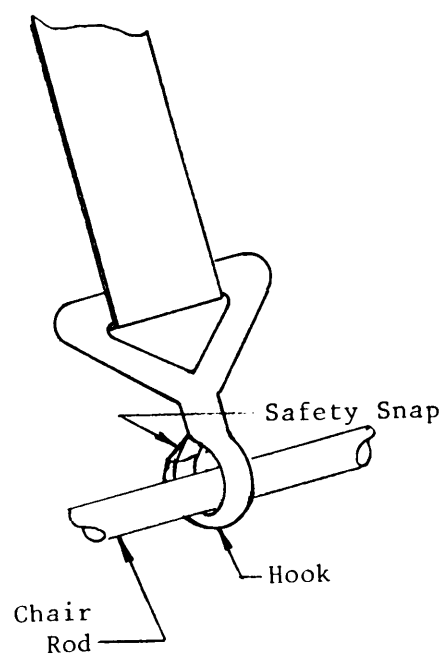


SEATS

The canvas seat backs can be removed, but the buckles may be hard to loosen if gloves are worn by the decontamination personnel.

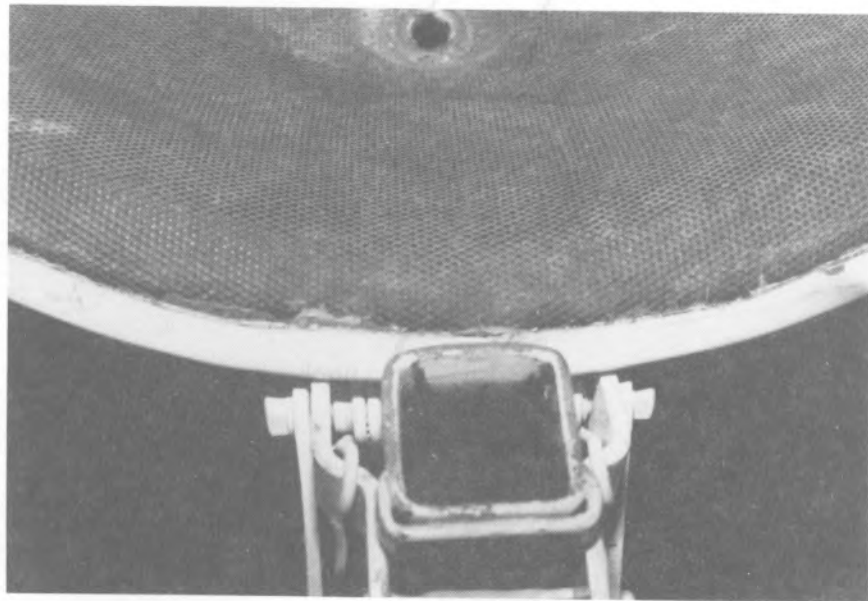
UH-1M Helicopter (Huey)

MIL-HDBK-784



SEATS

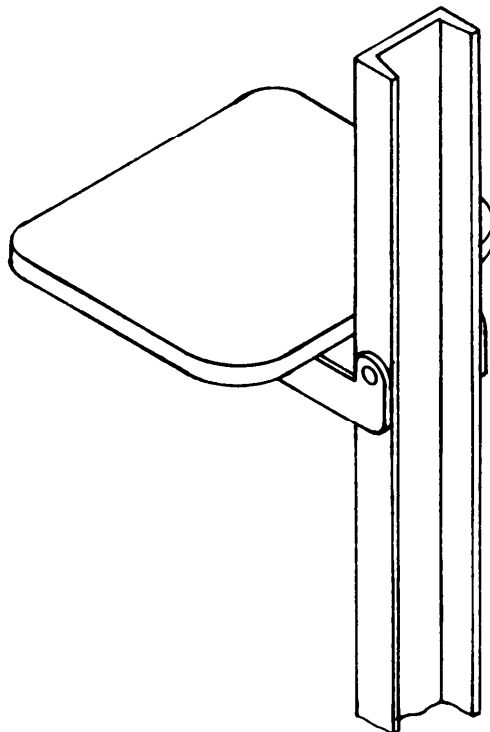
Snap-type hooks make seat removal easier.



SEATS

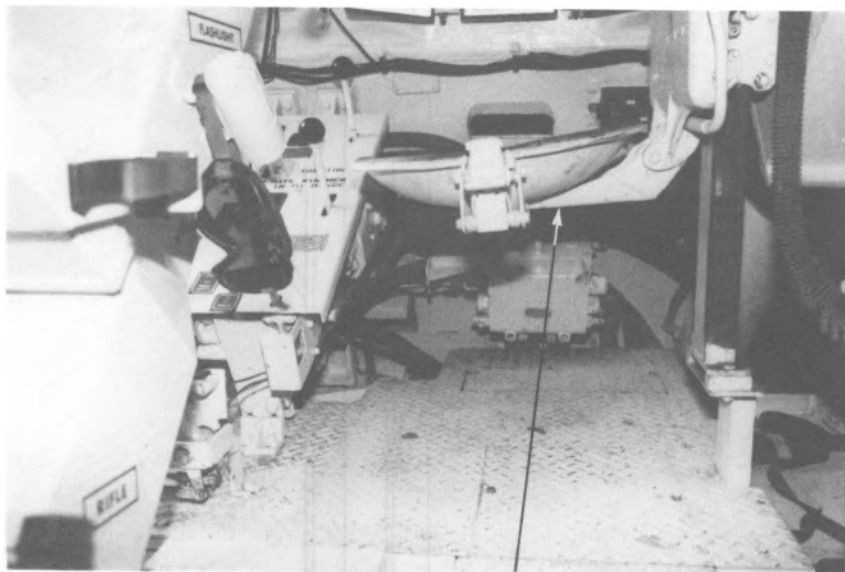
The openings in the structural components trap contaminants and are difficult to decontaminate by chemical means.

MIL-HDBK-784



SEATS

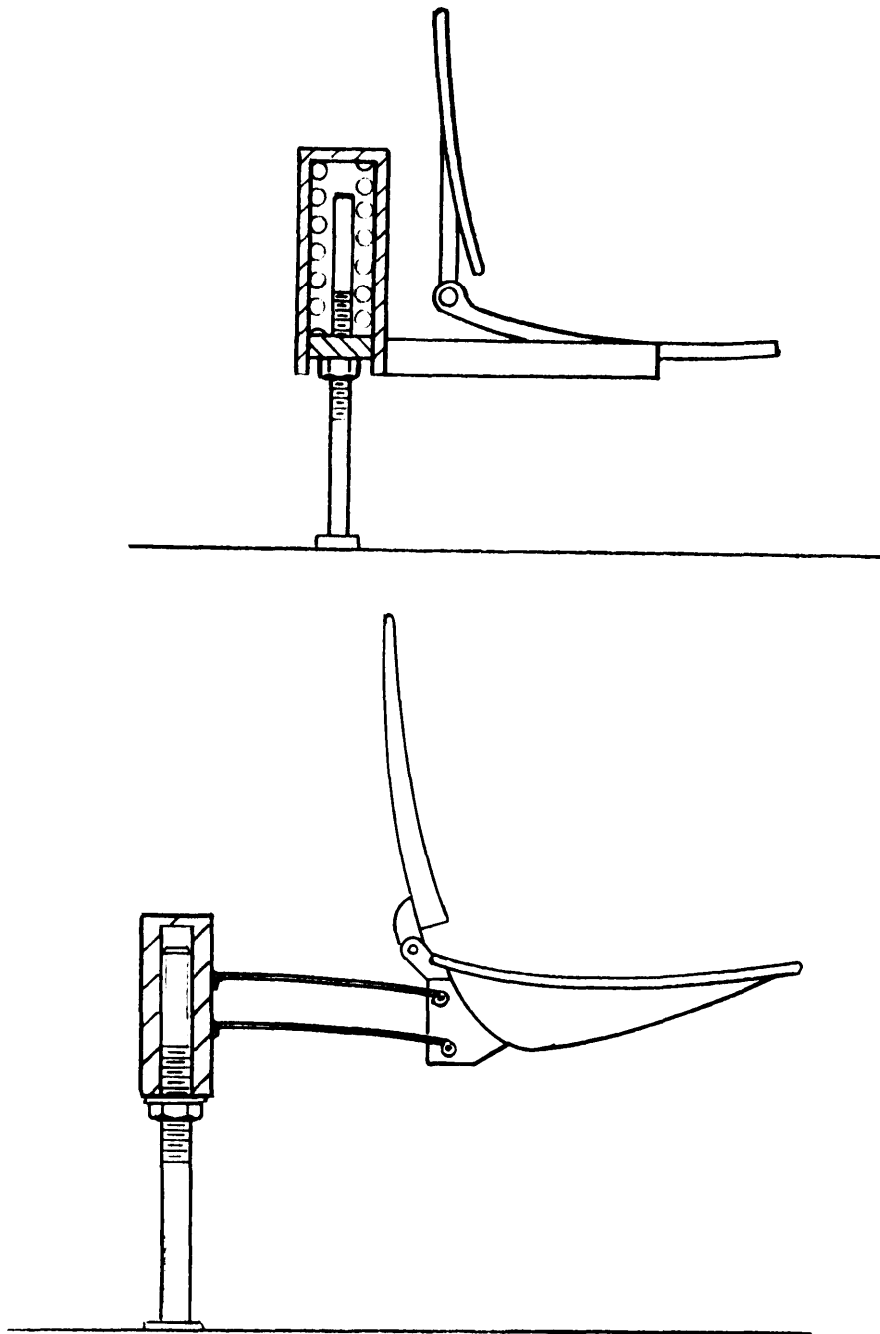
The channels and angles used in this design eliminate structural openings and contaminant traps.



SEATS

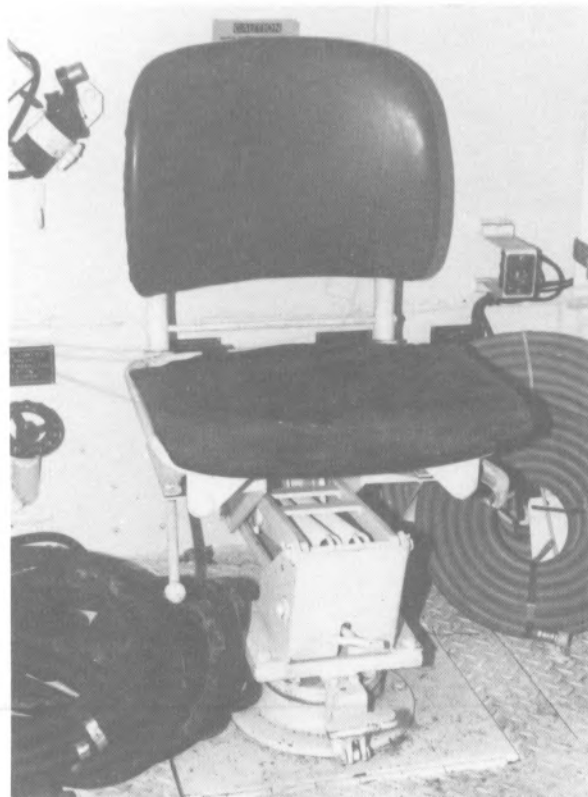
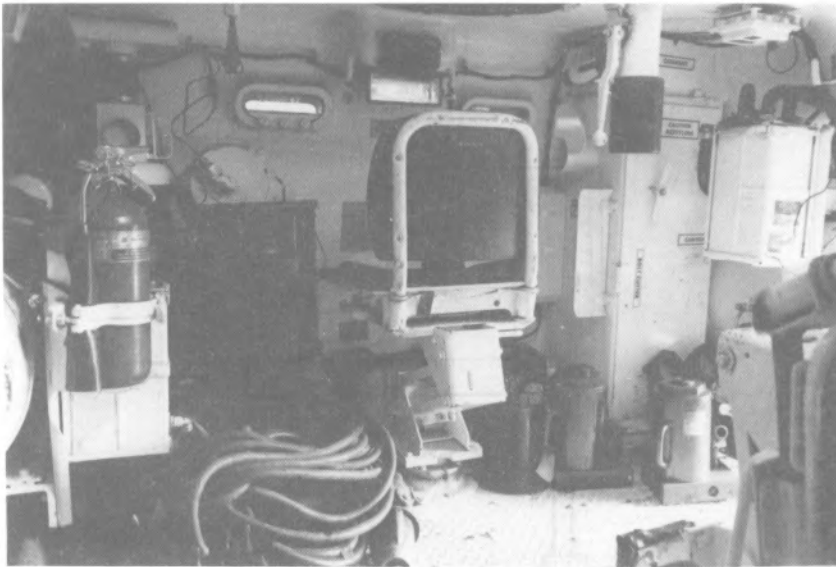
The complicated seat suspension is exposed to contaminants and is difficult to decontaminate. In addition, the canvas cover can absorb contaminants/decontaminants.

MIL-HDBK-784

SEATS

(Top) A metal casing protects the spring-loaded support. A stop-nut moves the casing along the threaded shaft, the seat back folds at the hinge, and the seat can swing out of the way. Molded metal replaces the canvas.

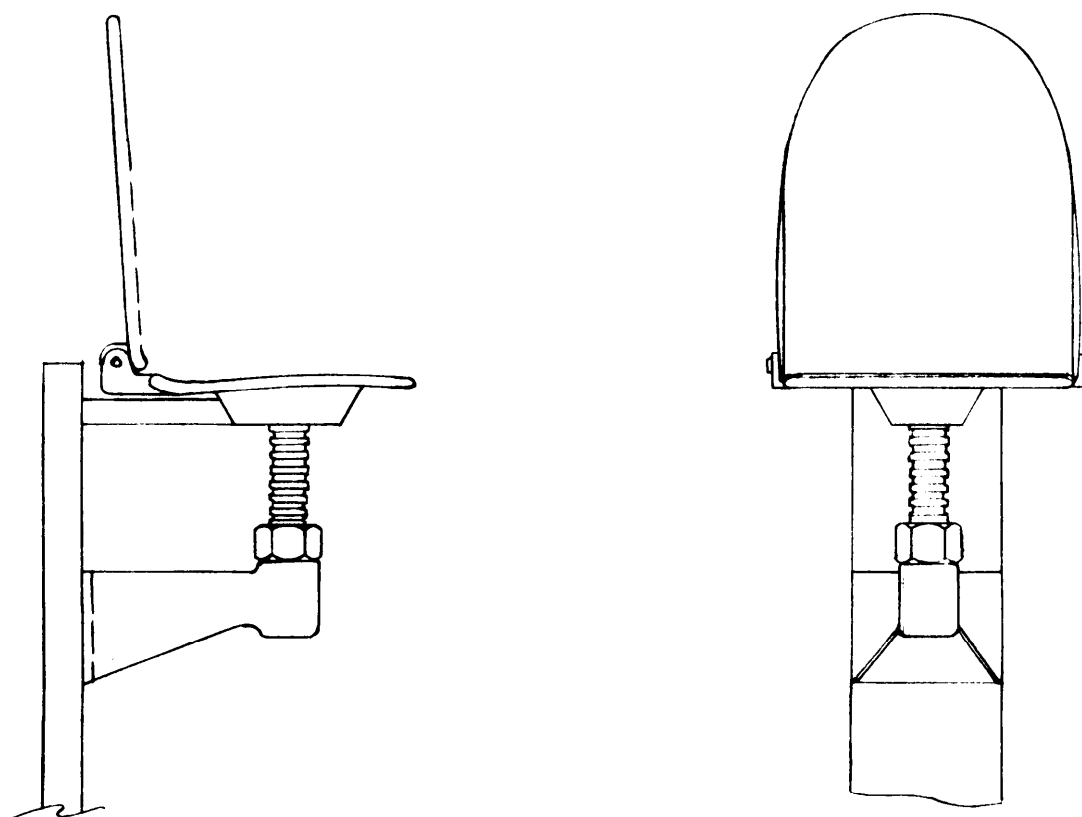
(Bottom) Two cantilever springs support the seat. A stop-nut moves along the threaded shaft, the seat back folds at the hinge, and the seat can swing out of the way. Molded metal replaces the canvas.



SEATS

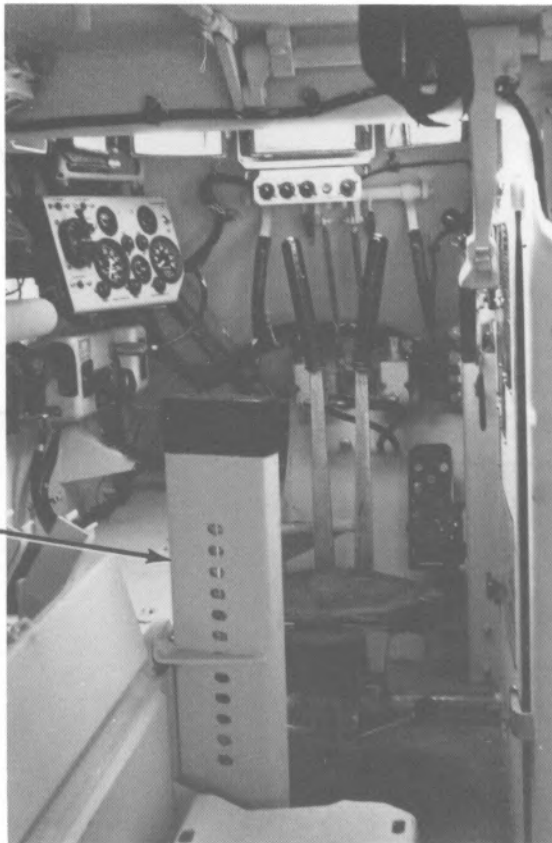
The complicated seat support is exposed to contaminants and is difficult to decontaminate.

MIL-HDBK-784



SEATS

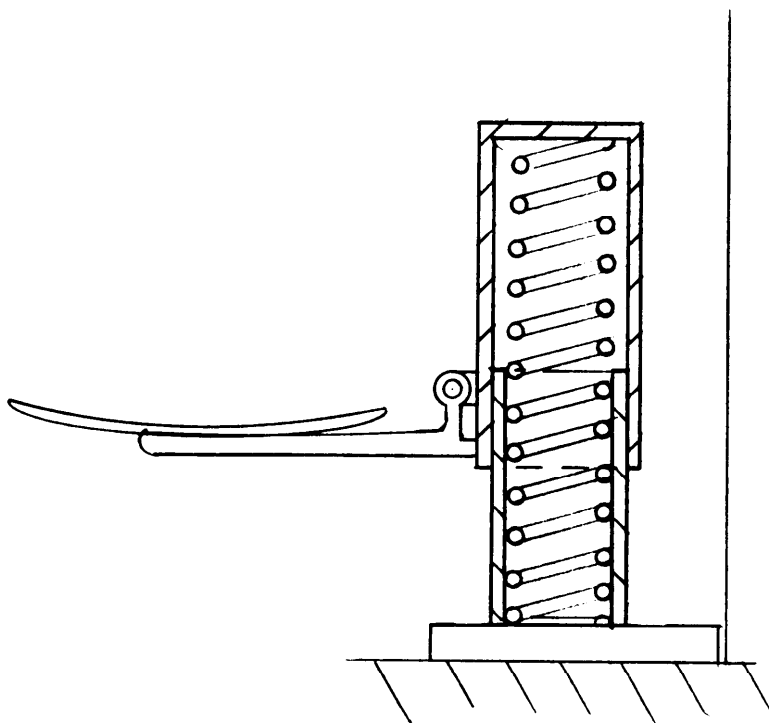
A simpler, easier-to-decontaminate support allows height adjustment by a stop-nut on a threaded shaft. The seat back folds at the hinge.



SEATS

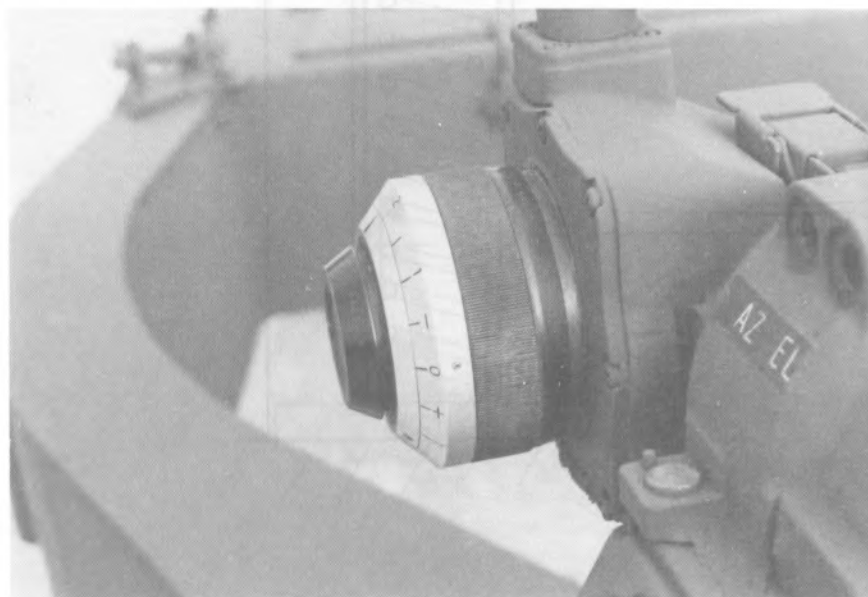
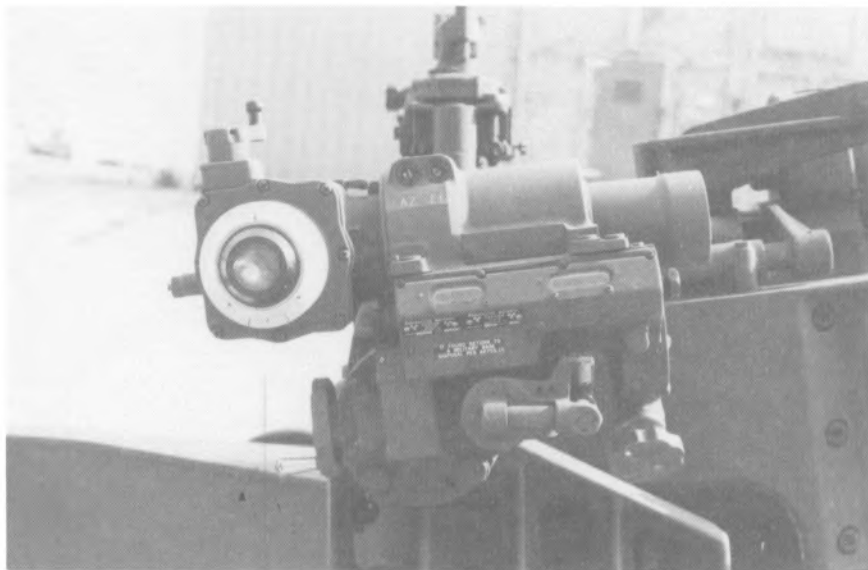
The seat support is exposed to contaminants and is difficult to decontaminate.

MIL-HDBK-784



SEATS

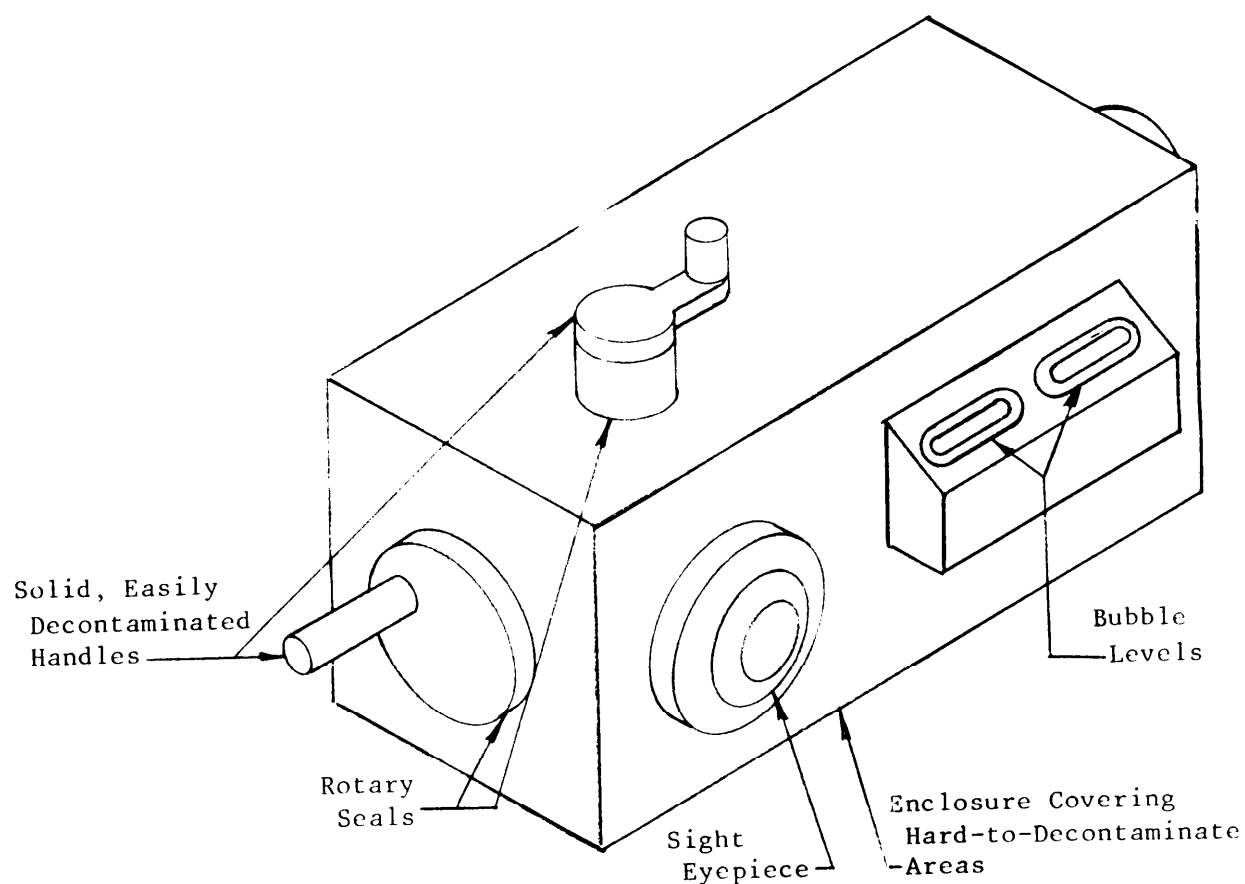
A metal casing protects the spring. The base is welded to the floor, preventing the drawing in of contaminants.



SIGHTING DEVICES

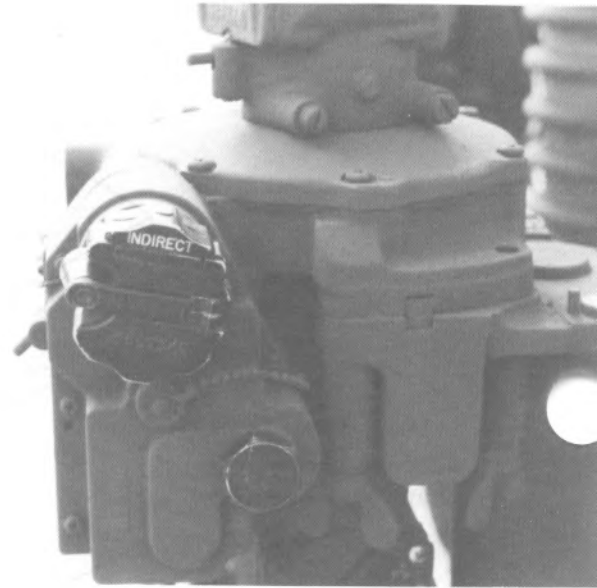
The sighting system has numerous traps that are difficult to decontaminate thoroughly without disassembly.

MIL-HDBK-784



SIGHTING DEVICES

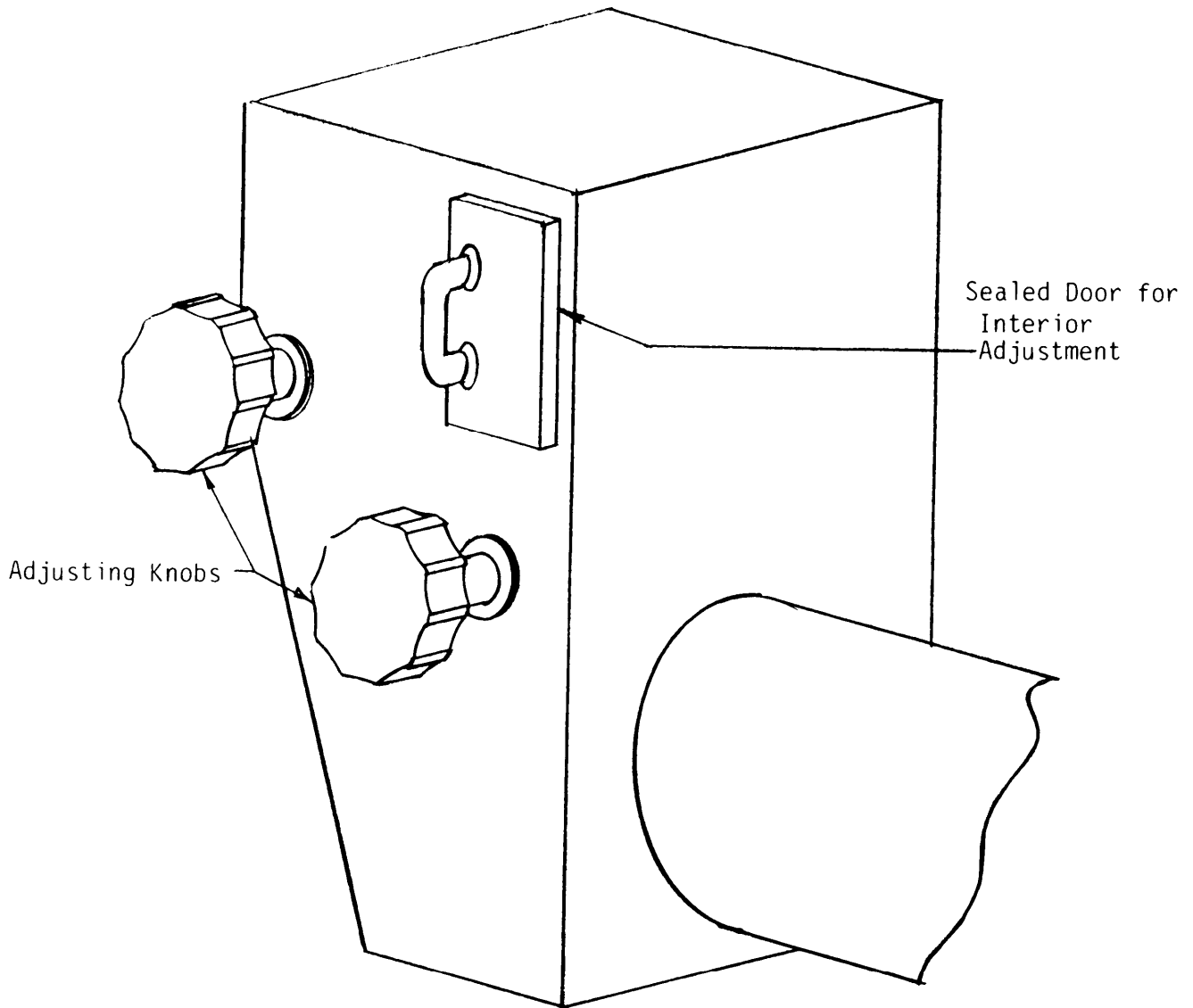
Enclosing the entire sighting system, except for the sealed adjustment handles, and capping the eyepiece will eliminate hard-to-decontaminate spaces between the components and will exclude contaminants from potential traps in the components.



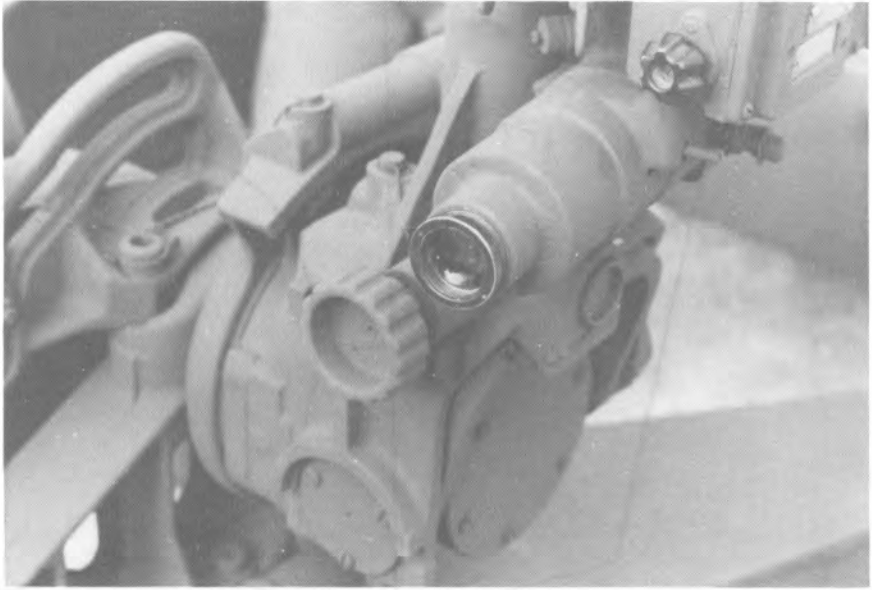
SIGHTING DEVICES

The telescope system is an assembly of separate components that has many inaccessible spaces in which contaminants can lodge. Thorough decontamination is difficult without disassembly.

MIL-HDBK-784

SIGHTING DEVICES

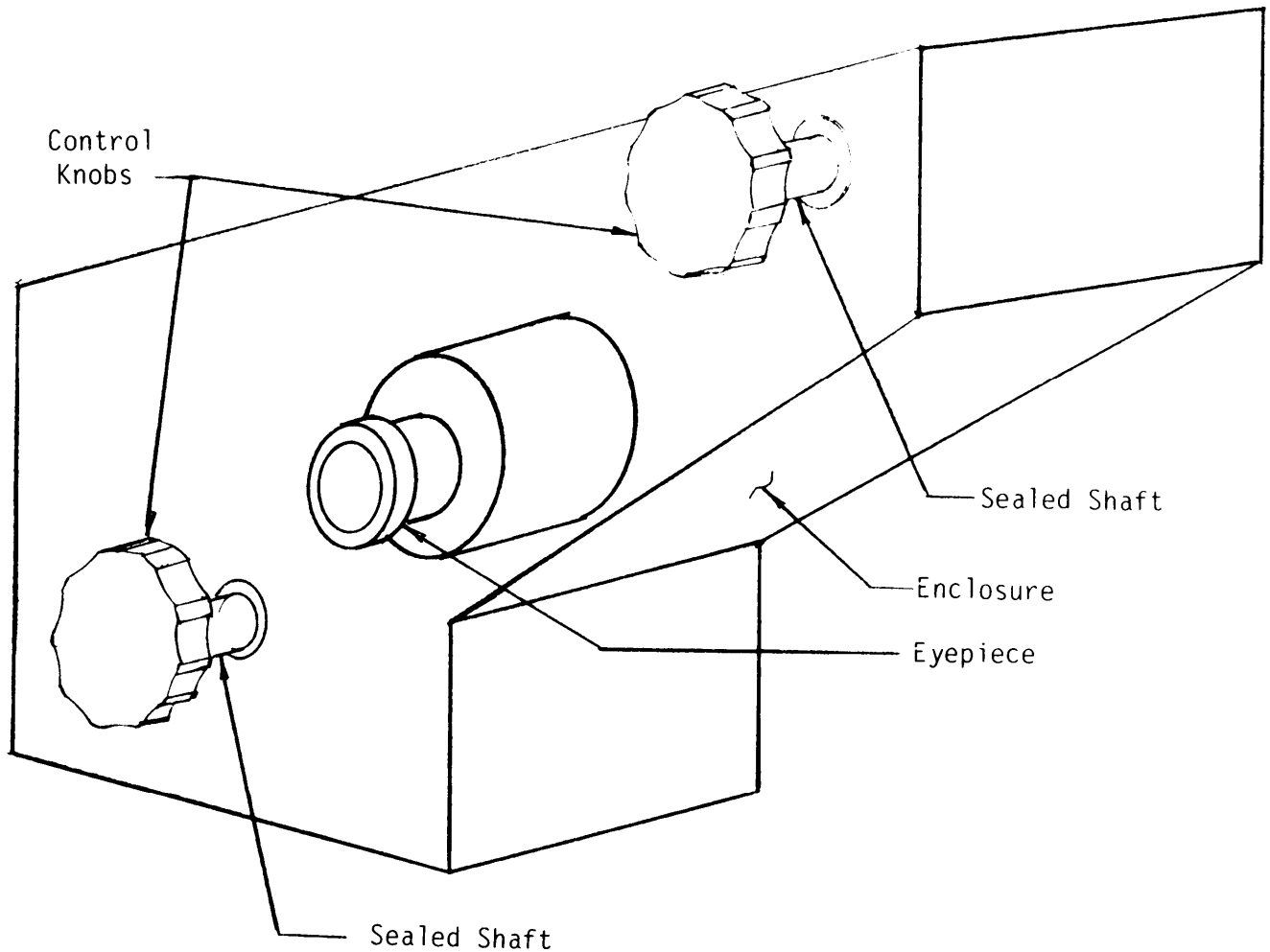
Unitizing the assembly by installing the separate components within a single housing or rigid cover will greatly reduce the number of entrapment spaces and minimize the entrapment area.



SIGHTING DEVICES

The one-piece telescope housing has a smooth surface without crevices to trap contaminants and is easy to decontaminate. However, the spaces between the telescope housing and the instrument housings, the control knob surfaces, and the shafts are all difficult to decontaminate thoroughly.

MIL-HDBK-784



SIGHTING DEVICES

The entrapment areas are minimized by enclosing the intra-component areas and by installing rotary seals on the control shafts.

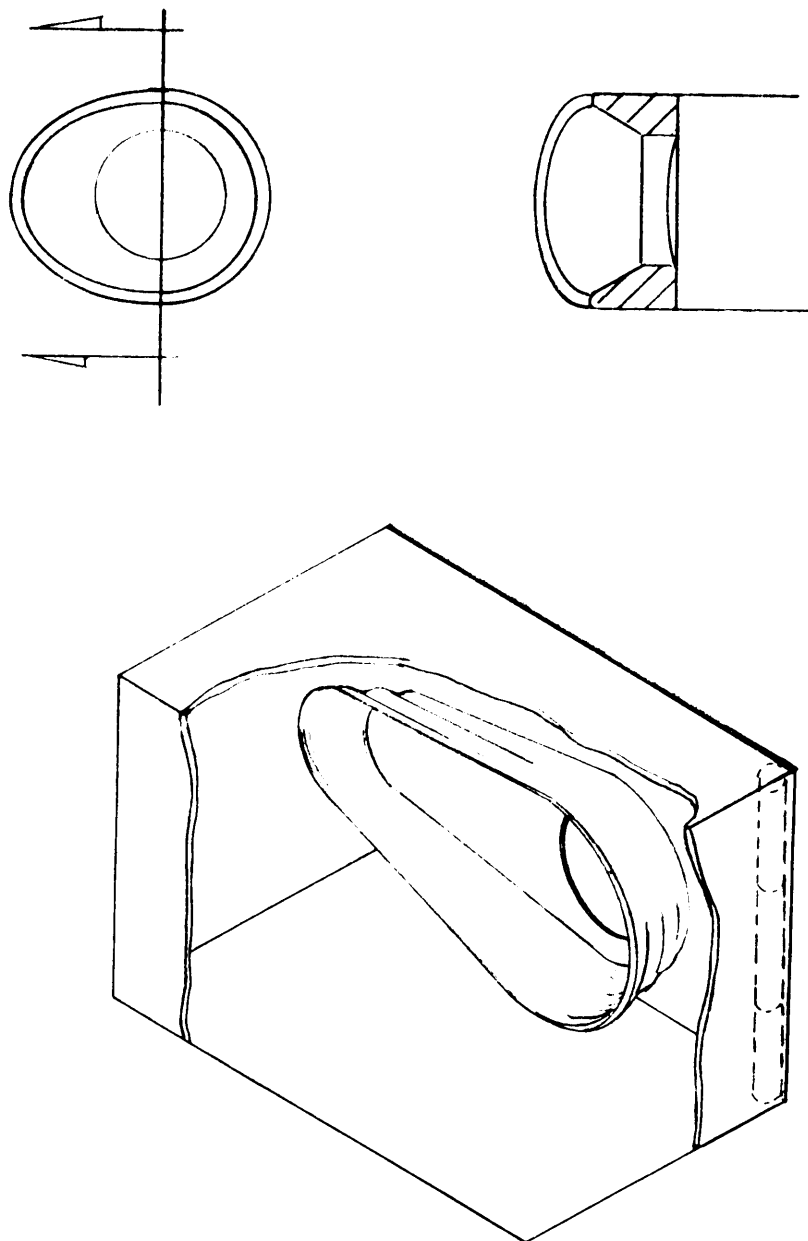


SIGHTING DEVICES

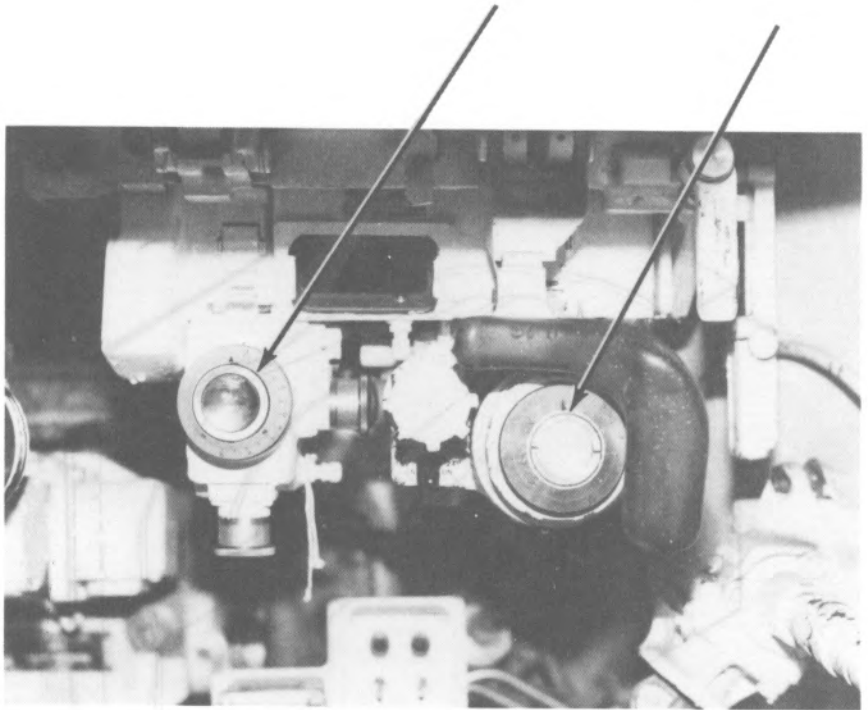
The cavity inside the eyepiece hood can trap contaminants and is difficult to decontaminate without removing the hood. Also, the elastomeric hood can absorb some contaminants.

TOW Missile Launcher

MIL-HDBK-784

SIGHTING DEVICES

The hood is molded without an entrapment cavity. Nonabsorbent material should be used or the hood should be covered when the launcher is not in use. The box built onto the rear sight covers and protects the hood and lenses; it can be folded back to the side to use the sight.

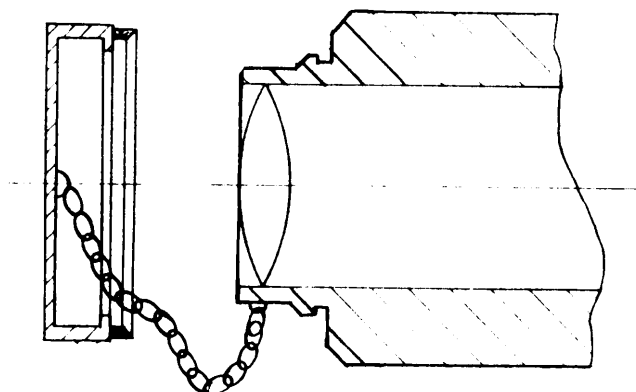


SIGHTING DEVICES

The gunsight lens is exposed to contaminants.

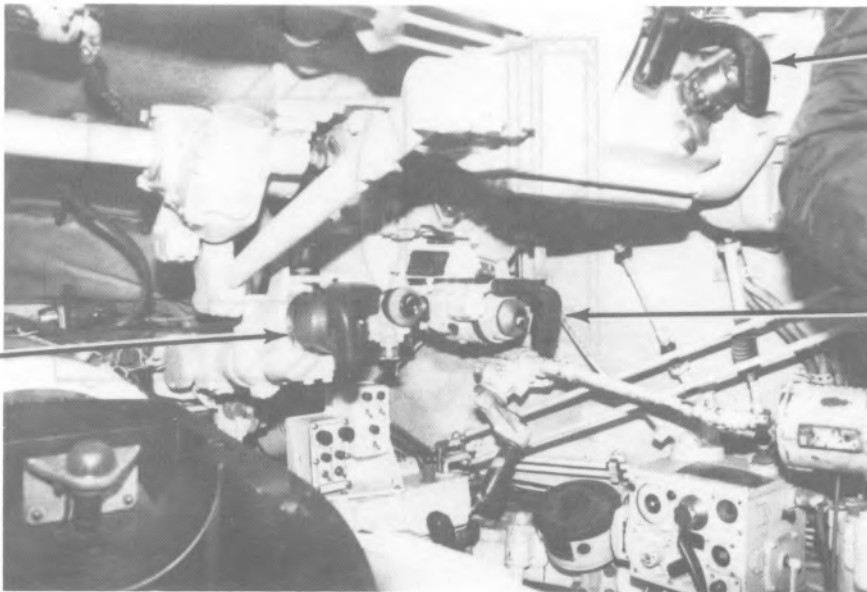
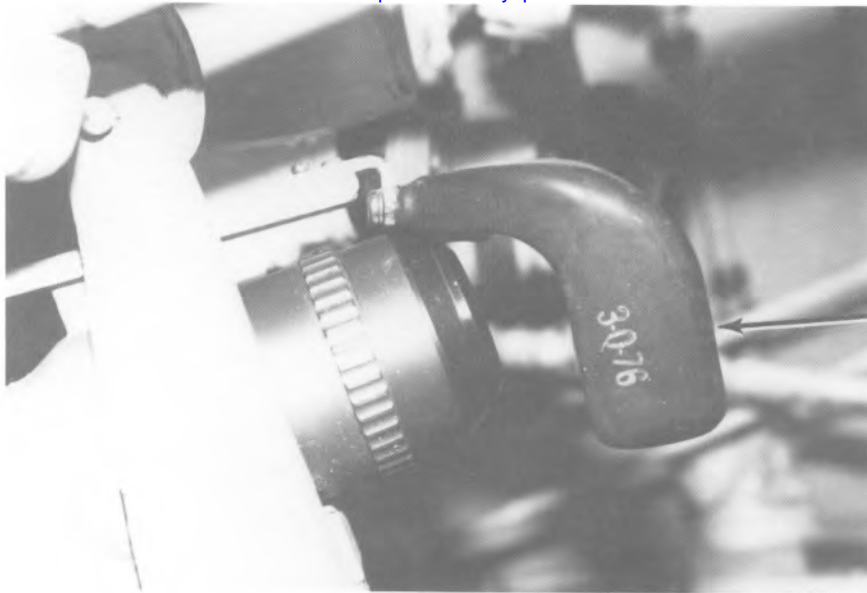
M60 Tank

MIL-HDBK-784



SIGHTING DEVICES

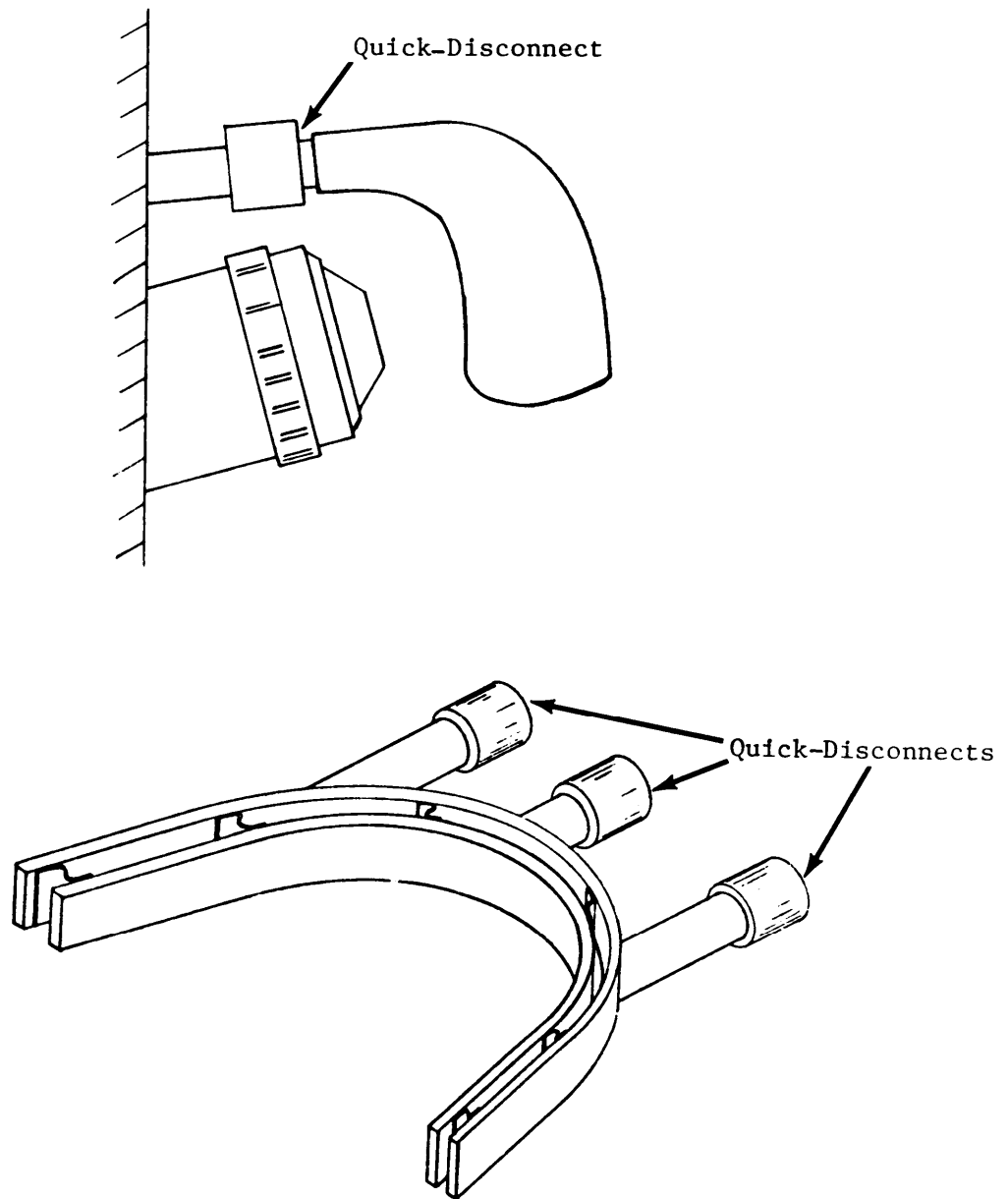
A cover attaches to the slots on the lens housing when the lens is not in use, protecting the lens as well as the attachment chain.



SIGHTING DEVICES

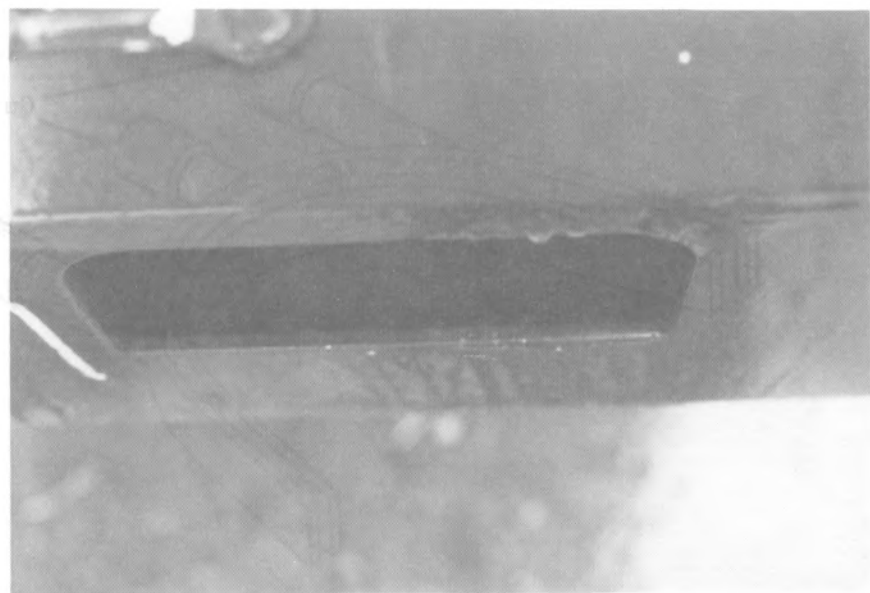
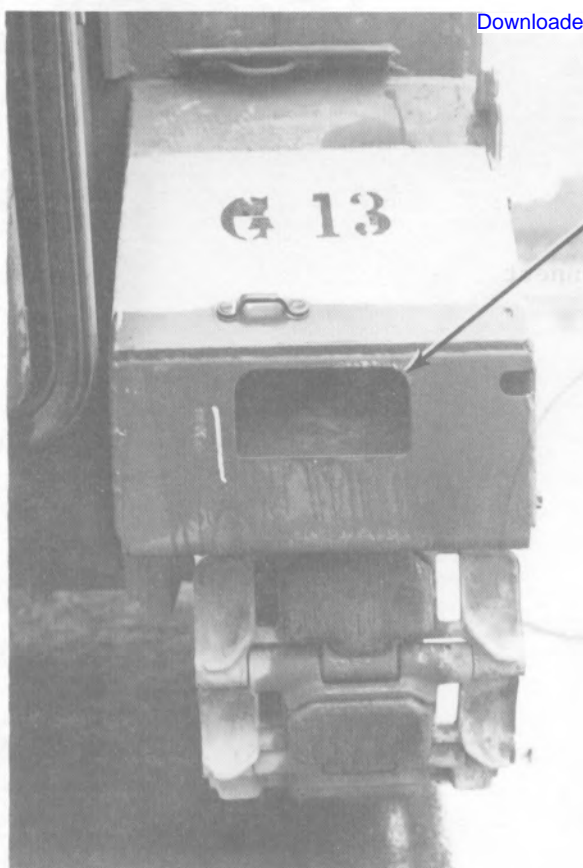
The connection for the gunsight headpad makes decontaminant application and removal difficult. In addition, the rubber headpad may absorb contaminants/decontaminants.

MIL-HDBK-784

SIGHTING DEVICES

(Top) A quick-disconnect facilitates decontamination or disposal of the rubber headpad.

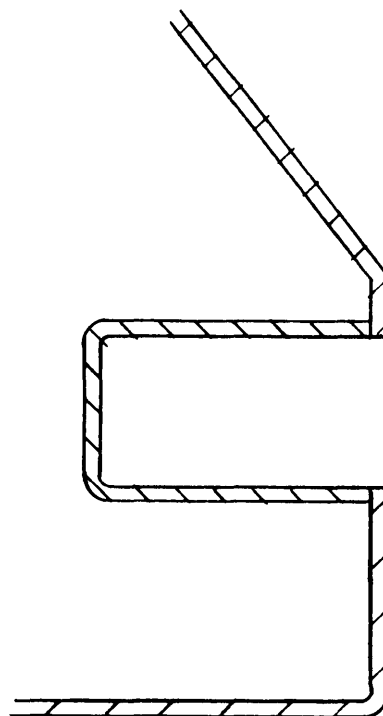
(Bottom) A metal headrest with steel springs has quick-disconnects that allow easy removal for decontamination. The metal eliminates the absorption problem.



STEPS

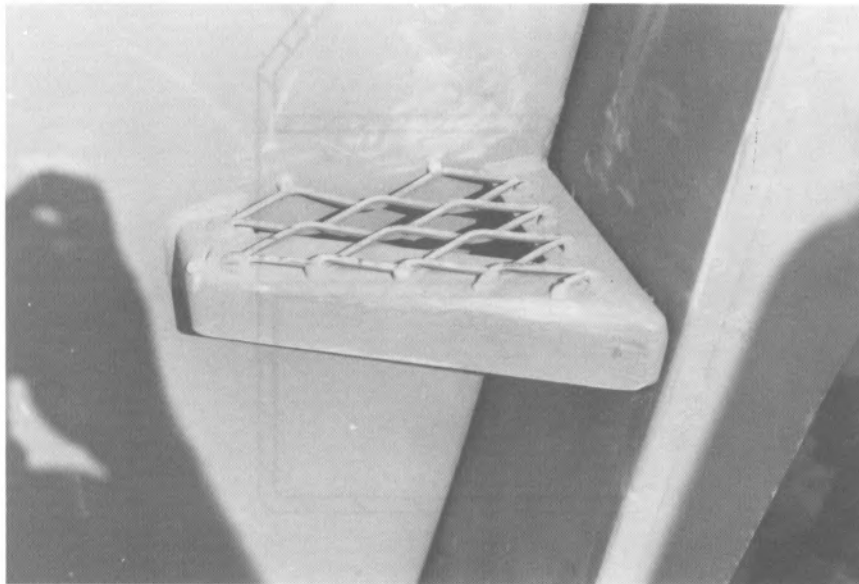
The interior walls and corners of the cavity of the rearguard steps cannot be exposed to a decontaminating stream.

MIL-HDBK-784



STEPS

A box built into the guard cavity eliminates the hidden areas, is easy to decontaminate, and can be used as a step to mount to the upper surface of the vehicle.

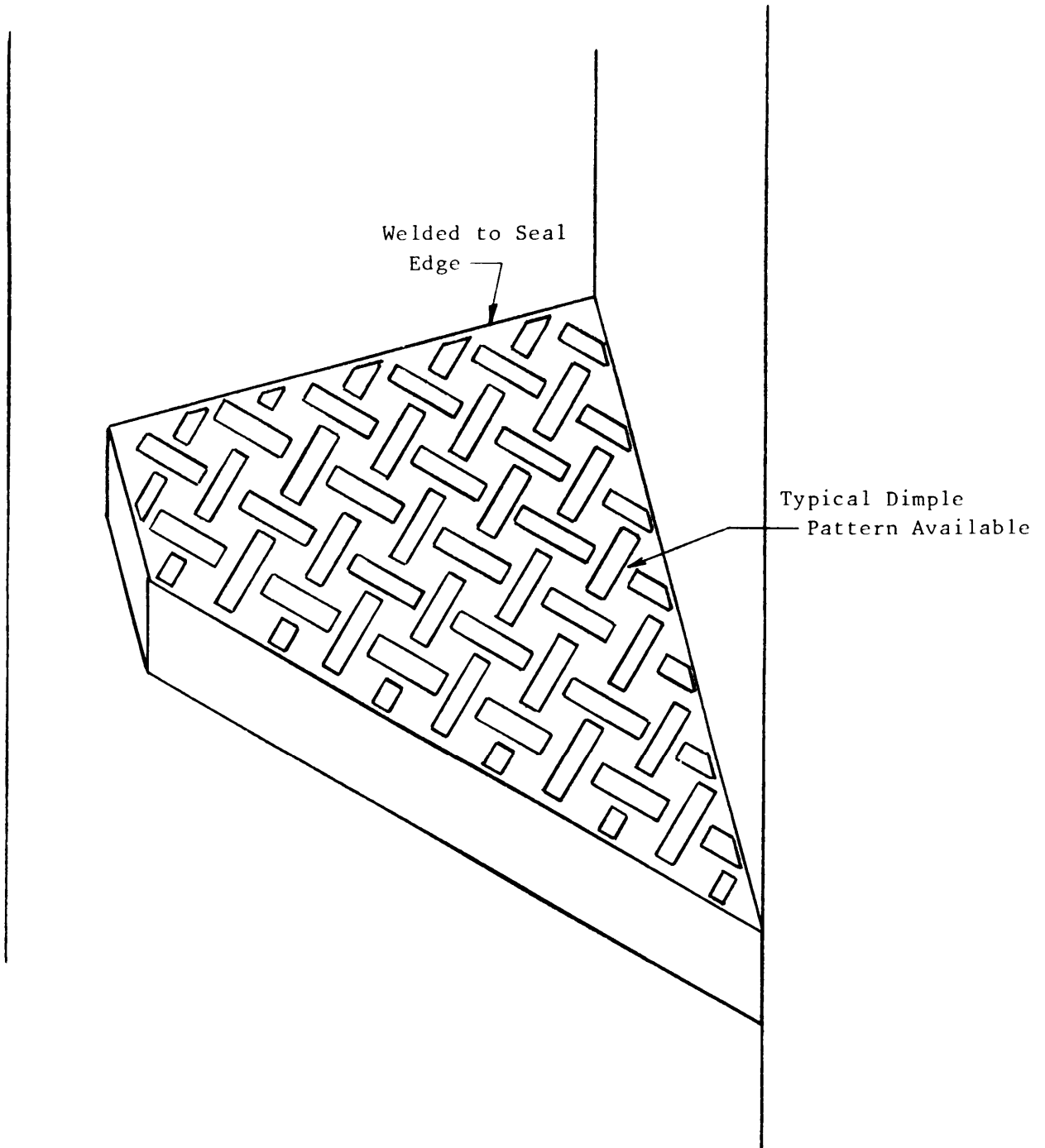


STEPS

The open tread patterns and the crevices along the edges of the steps trap contaminants and are difficult to decontaminate. The open tread pattern also allows contaminated dirt to collect on the underside of the steps.

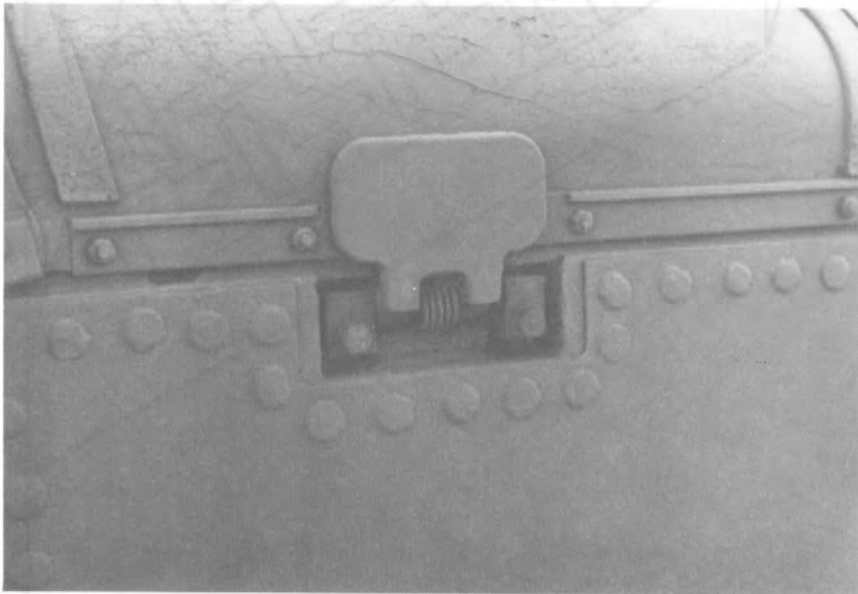
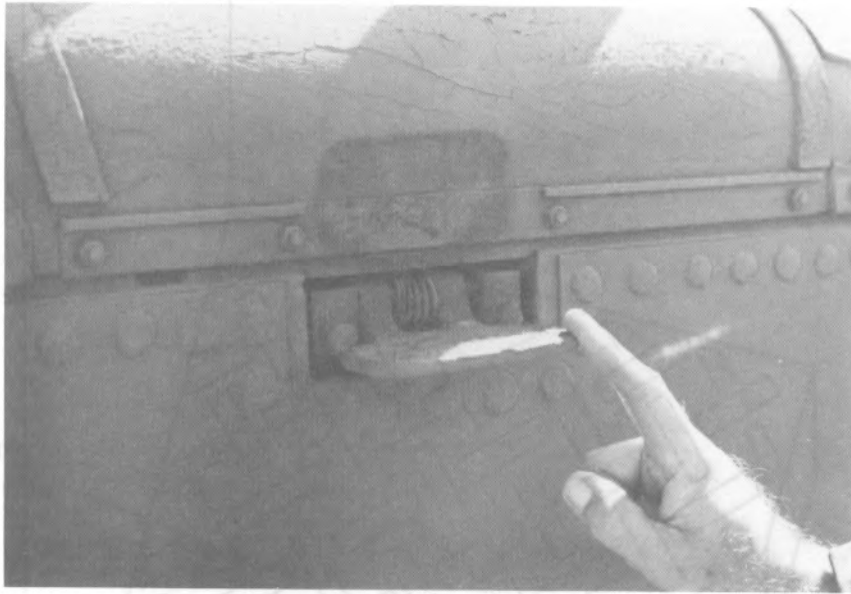
Forklift (6,000-lb capacity)

MIL-HDBK-784



STEPS

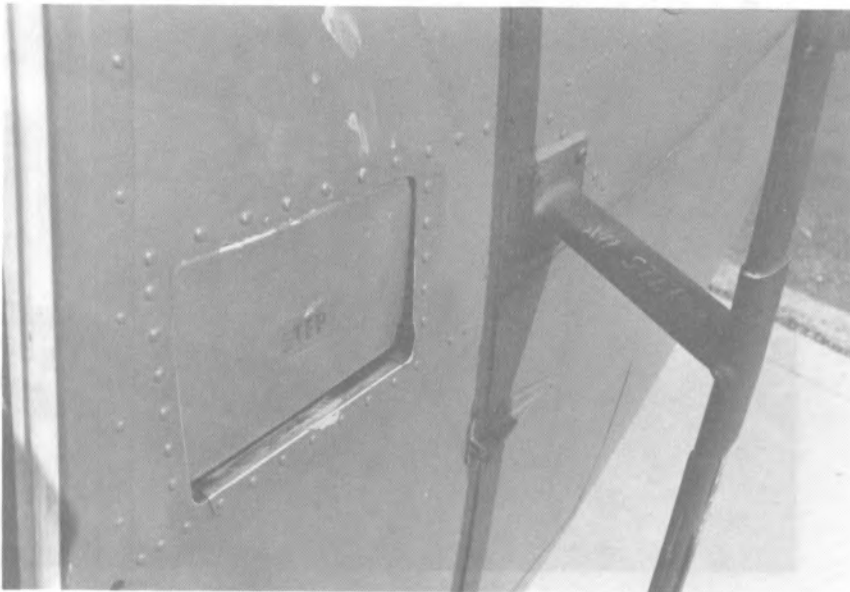
A step with a solid dimple pattern, and welded at the edges, is easier to decontaminate.



STEPS

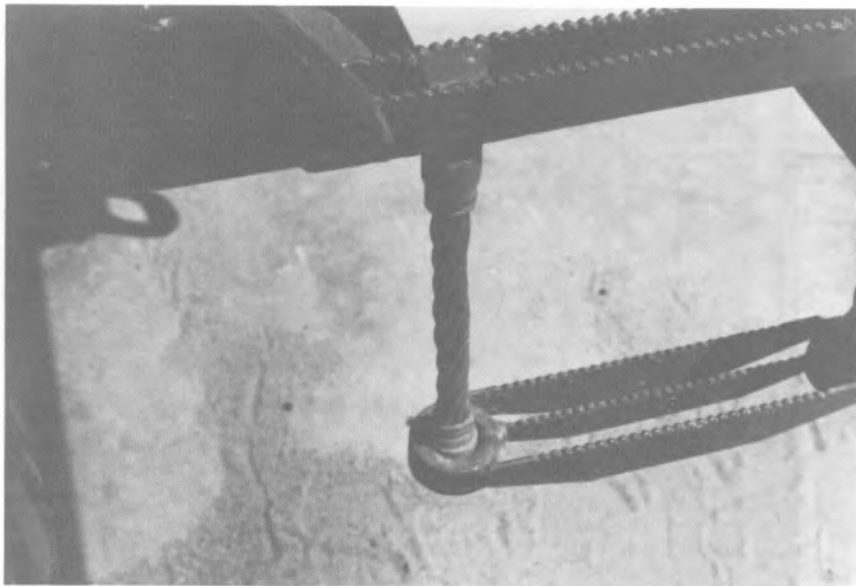
The hinge, spring, and attaching hardware of the step have gaps and crevices that can trap contaminants and that are difficult to decontaminate.

M551 Tank (Sheridan)



STEPS

A simpler step, either uncovered (top -- from Forklift) or covered (bottom -- from UH-1M Helicopter) is easier to decontaminate. The step should be sloped slightly downward to promote drainage.

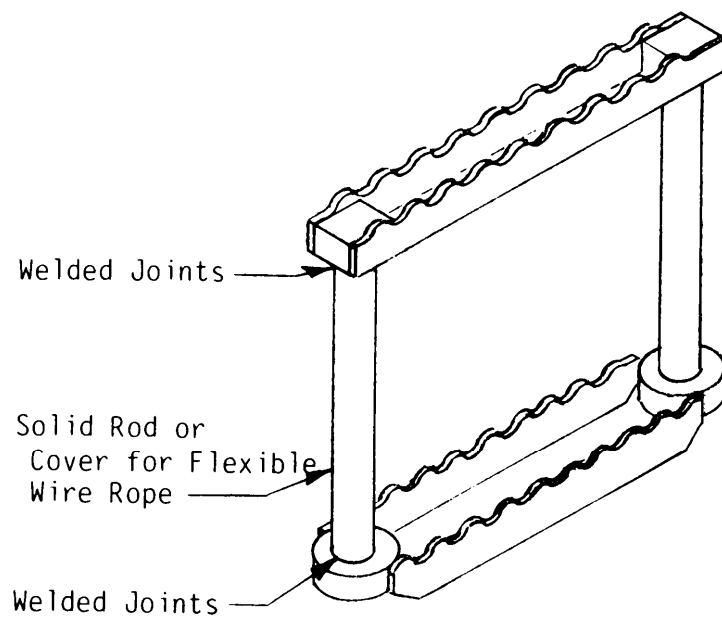


STEPS

The cab step is easy to decontaminate except for the wire-rope supports. The wire rope, its fittings, and the crevice where the step connects to the rope can trap contaminants in spaces inaccessible to decontamination procedures.

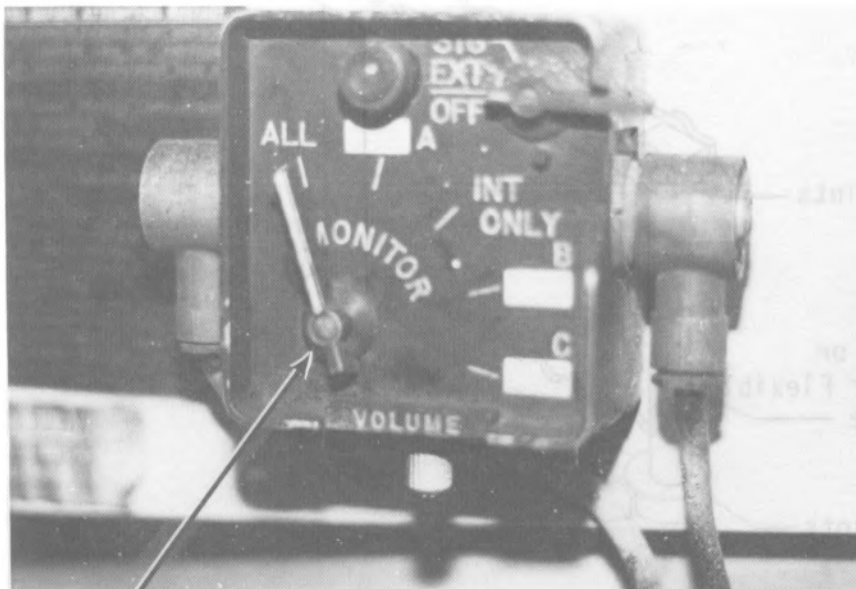
Tractor Truck (10-Ton, 8x8)

MIL-HDBK-784



STEPS

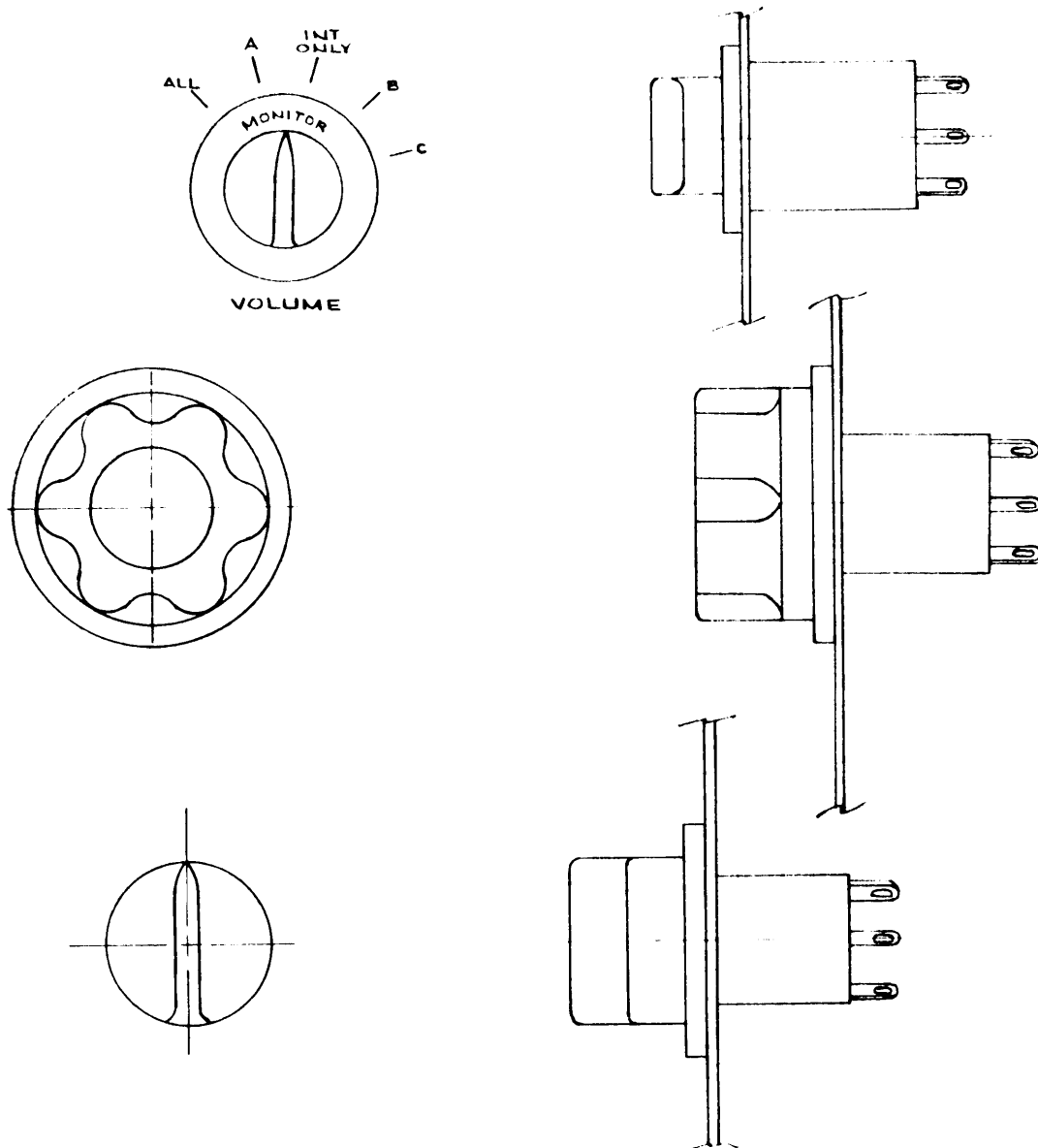
Replacing the wire-rope supports with solid rods or covering the rope with metal tubing and welding the rods or tubing in place will eliminate entrapment crevices.



SWITCHES

Capillary action under the knob fastener tends to draw in contaminants. In addition, the sweeping knob stem can smear contaminants.

MIL-HDBK-784

SWITCHES

All three knob designs are sealed against capillary entrapment and eliminate the sweeping knob stem.

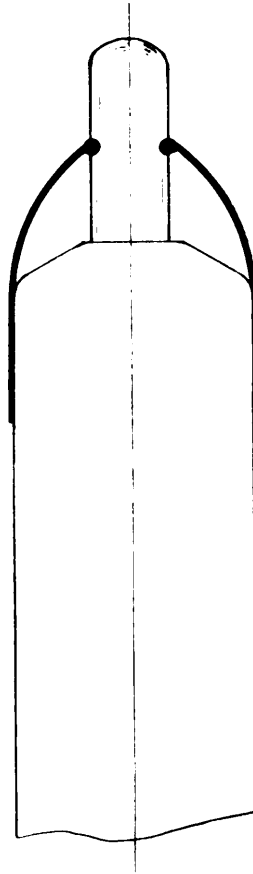


SWITCHES

Pushbuttons can draw contaminants into the cylindrical handgrip, making decontamination difficult.

TOW Missile Launcher

NIL-HDBK-784



SWITCHES

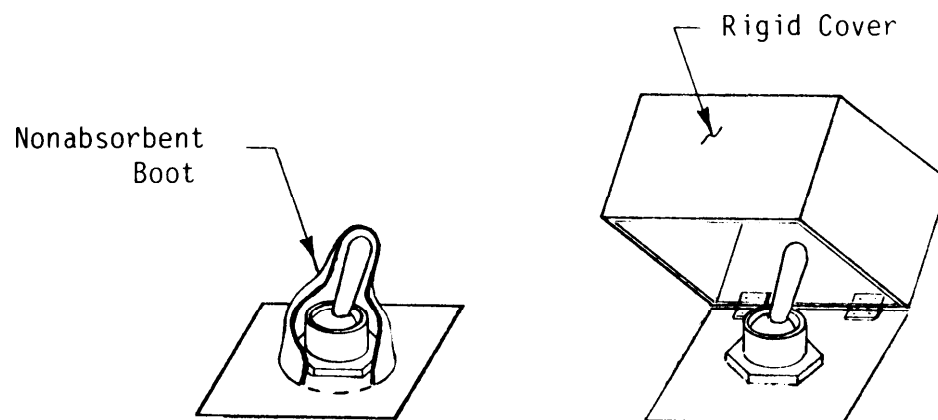
A nonporous boot around the button eliminates the gap, preventing the drawing-in of contaminants.



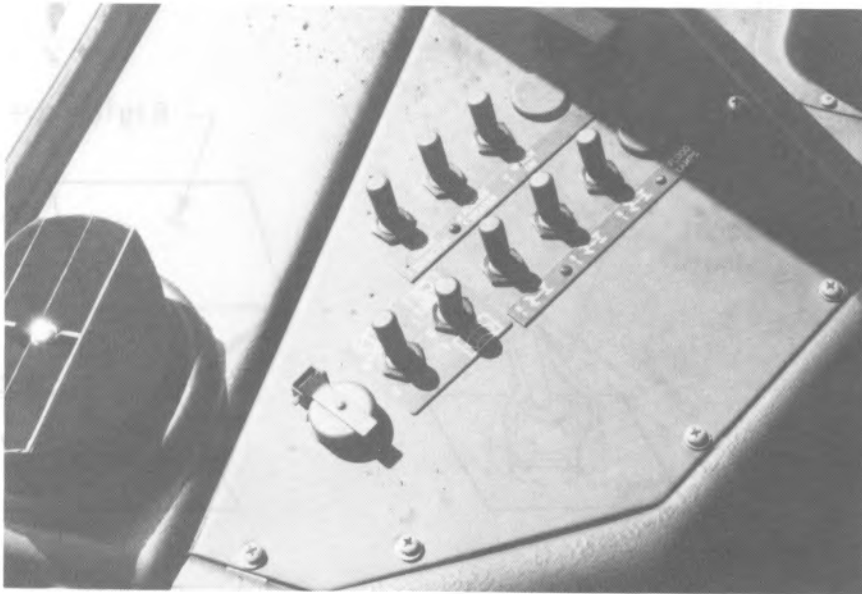
SWITCHES

The threaded attachment stud of the domelight switch has a deep cavity than can trap airborne contaminants and is difficult to decontaminate.

MIL-HDBK-784

SWITCHES

Replacing the present domelight switch with an item not having an entrapment cavity (preferred), or enclosing it with a nonabsorbent or a rigid protective cover, will prevent contamination.

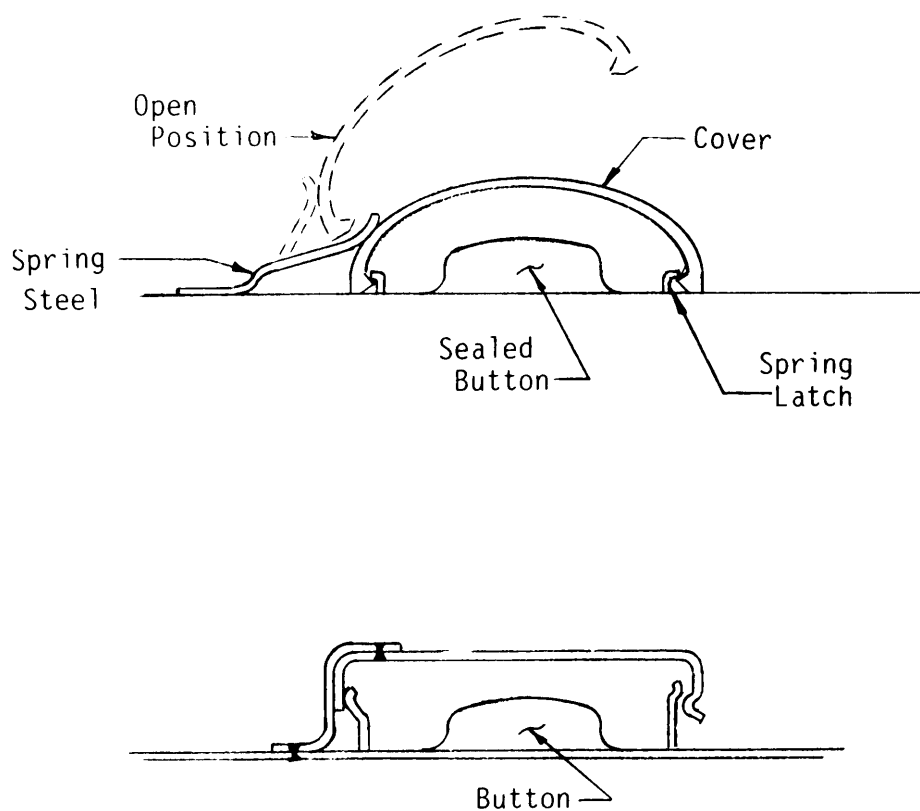


SWITCHES

The switch toggles have a simple shape and are easy to decontaminate. In addition, the mounting threads are well-covered to eliminate contaminant traps. However, the hinges and hinge mountings for the covers contain entrapment spaces that are difficult to decontaminate.

Tractor Truck (10-Ton, 8x8)

MIL-HDBK-784



SWITCHES

The simplified design of the switch cover as a press closure with a spring-steel attachment to the panel surface eliminates pivot-pin hinges and their entrapment spaces and makes the cover assembly easy to decontaminate.

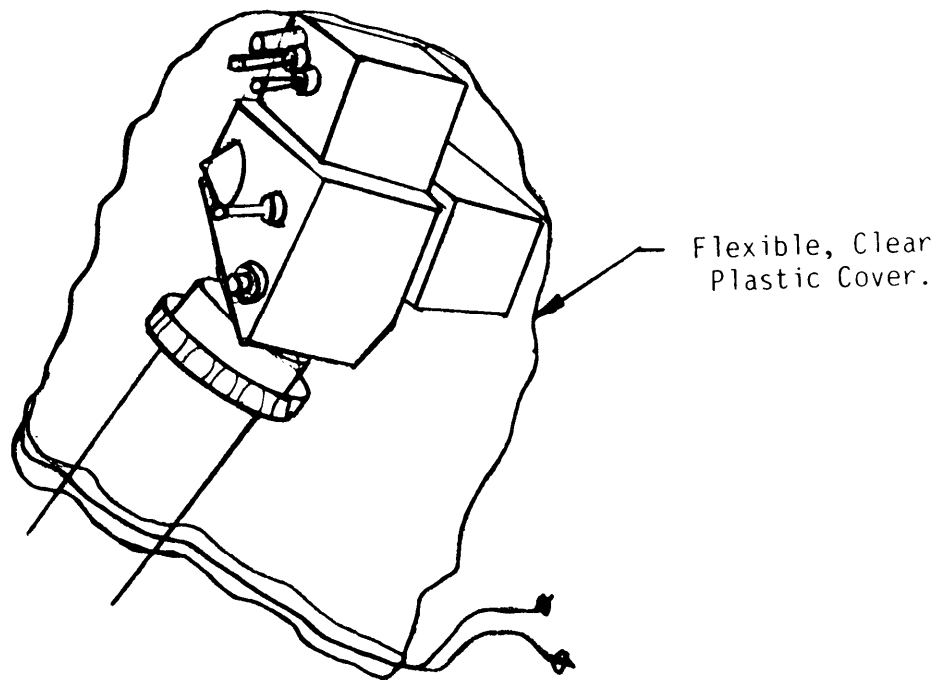


SWITCHES

Contaminants can be trapped in the switch cavities of the control stick and cannot be removed or neutralized easily. The trapped material can recontaminate cleaned actuators.

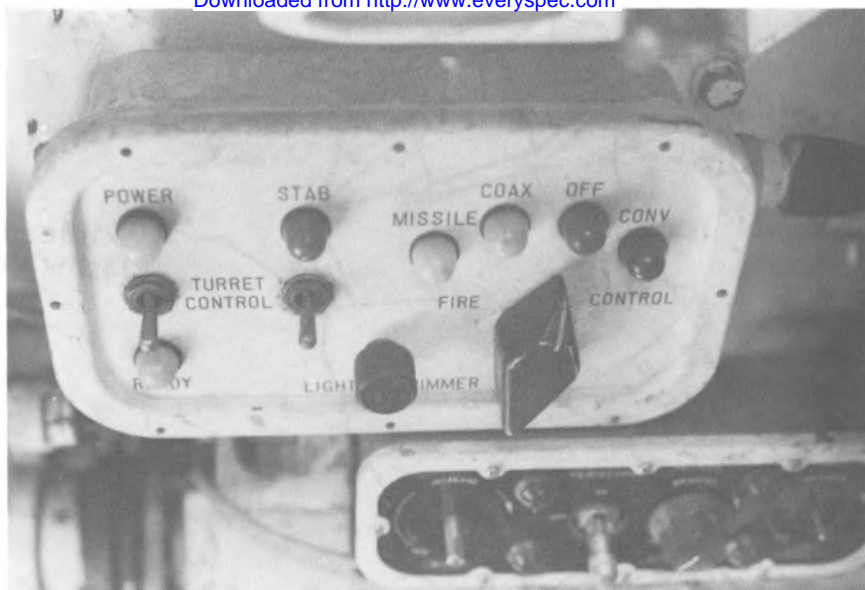
UH-1M Helicopter (Huey)

MIL-HDBK-784



SWITCHES

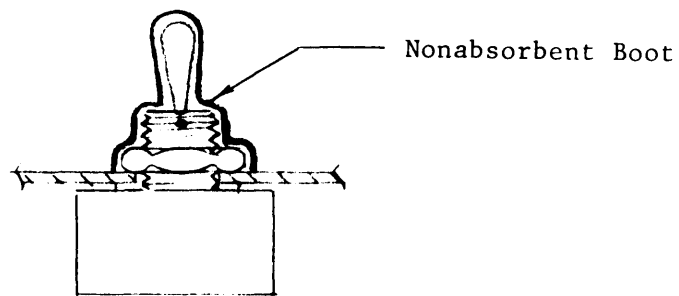
Covering the head of the control stick with a disposable, transparent shield will prevent contaminants from being trapped in the switch cavities. If the flexible cover is large enough, the pilot can insert his hand to operate the switches; otherwise, the switches can be operated through the cover.



SWITCHES

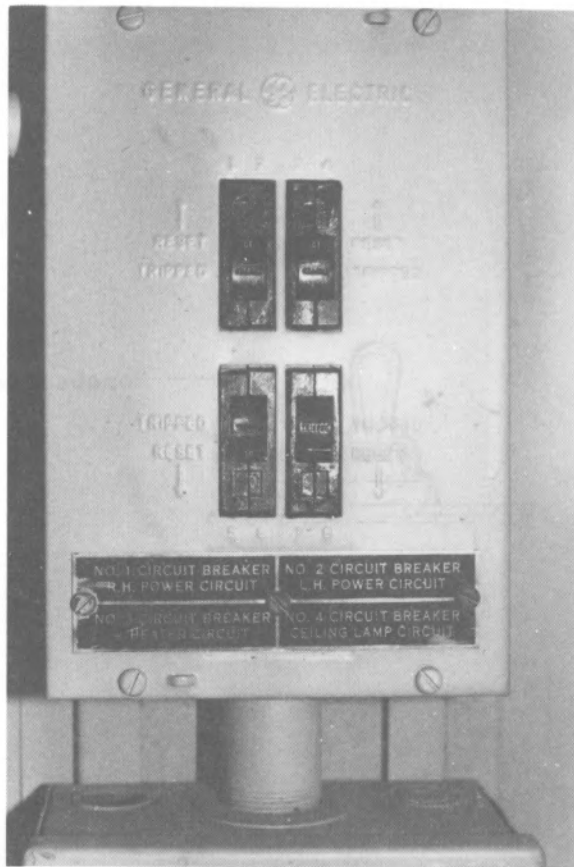
The light bezels are sealed to the control box and are smooth and easy to decontaminate. However, the turret control switches allow contaminants to pool and be drawn in.

MIL-HDBK-784



SWITCHES

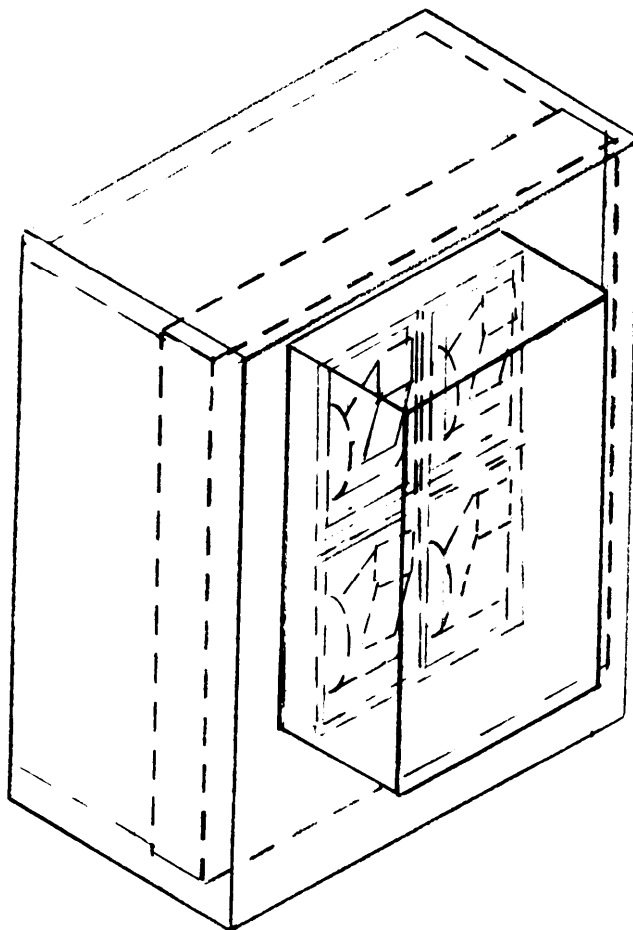
A nonabsorbent boot prevents the pooling and drawing in of contaminants.



SWITCHES

The circuit breaker switches are exposed to contaminants and are difficult to decontaminate.

MIL-HDBK-784

SWITCHES

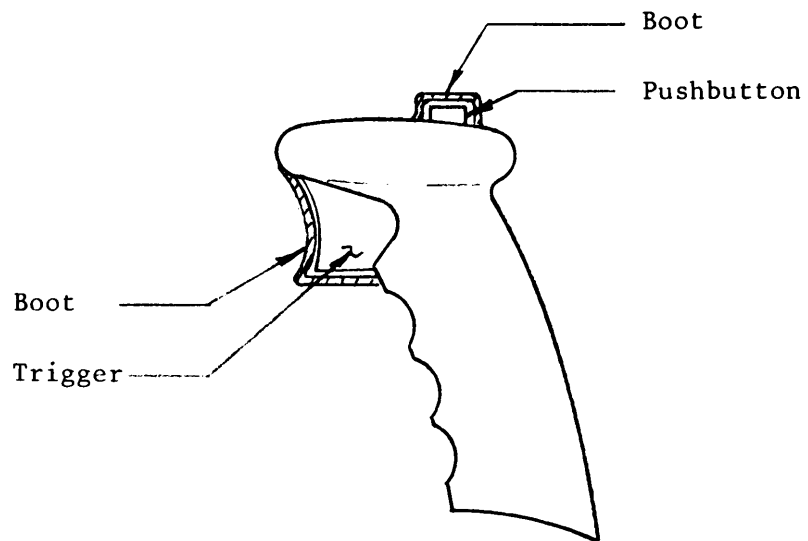
An enclosure protects the switches from contaminants. Non-mechanical pushbutton switches may also alleviate the entrapment/decontamination problem.



SWITCHES

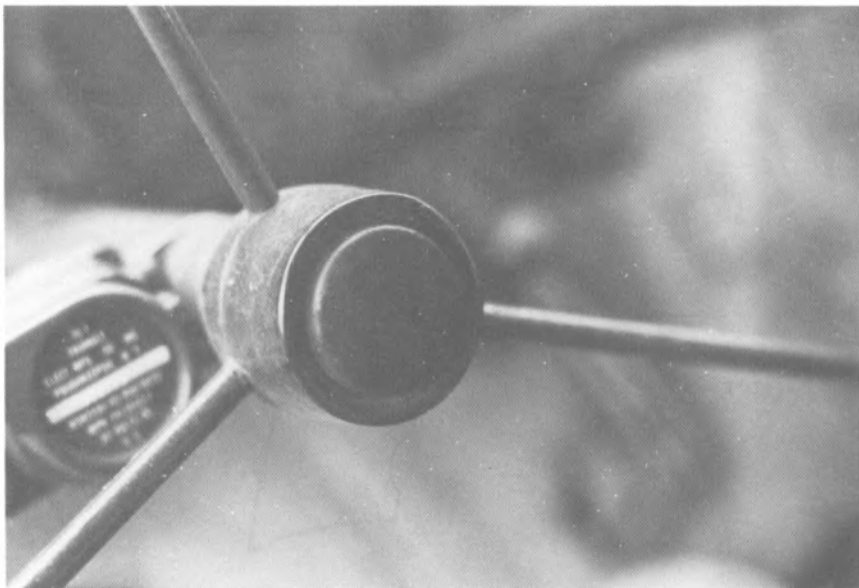
The gun control is of good design from a contamination/decontamination viewpoint, except the trigger buttons can draw in contaminants.

MIL-HDBK-784



SWITCHES

A nonabsorbent, flexible boot on the trigger buttons prevents the drawing in of contaminants.

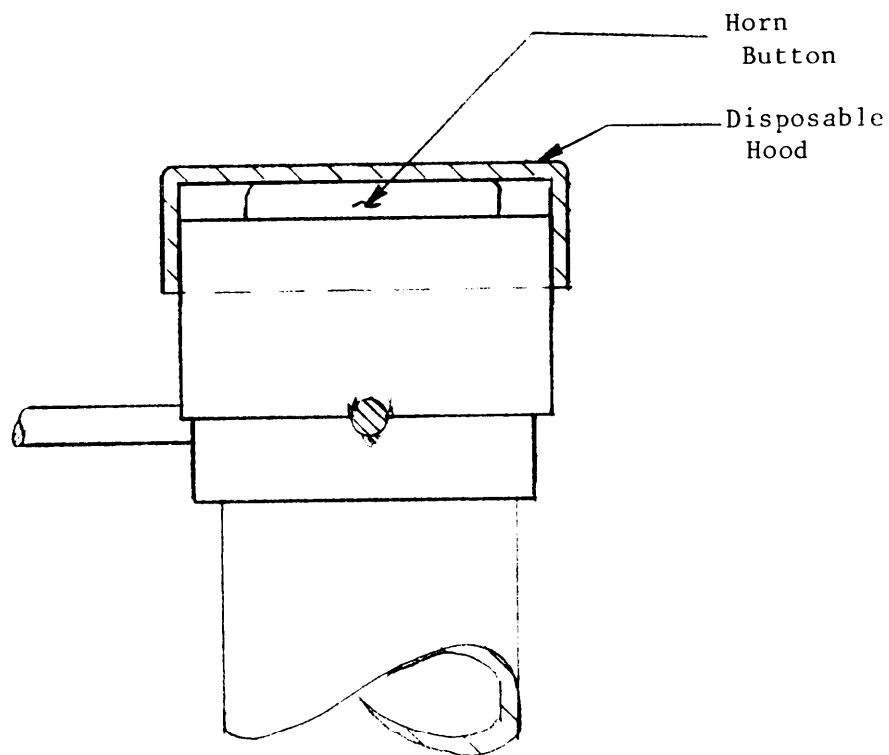


SWITCHES

The channel around the horn button allows contaminants to be drawn in, and the button materials may be incompatible with decontaminants.

M819 Tractor Truck

MIL-HDBK-784

SWITCHES

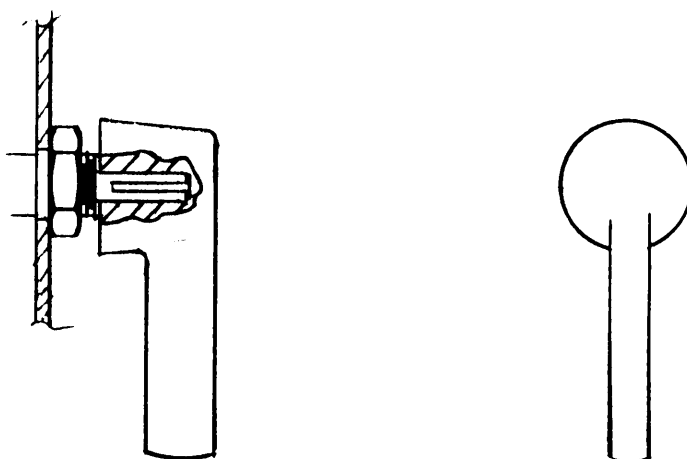
A disposable, nonabsorbent hood protects the button from contaminants. Alternatively, the button could be fabricated from materials that are compatible with decontaminants.



SWITCHES

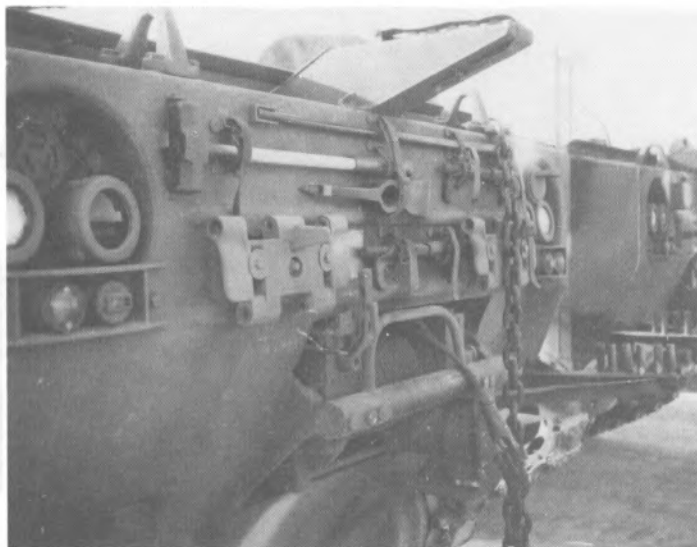
The areas around the screws in the rotary-switch handles are difficult to decontaminate. Removing the screws requires contact with possibly contaminated surfaces.

MIL-HDBK-784



SWITCHES

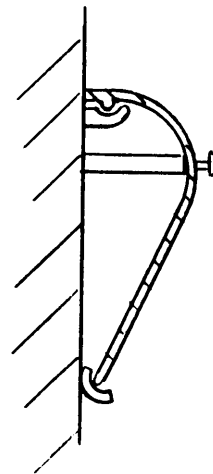
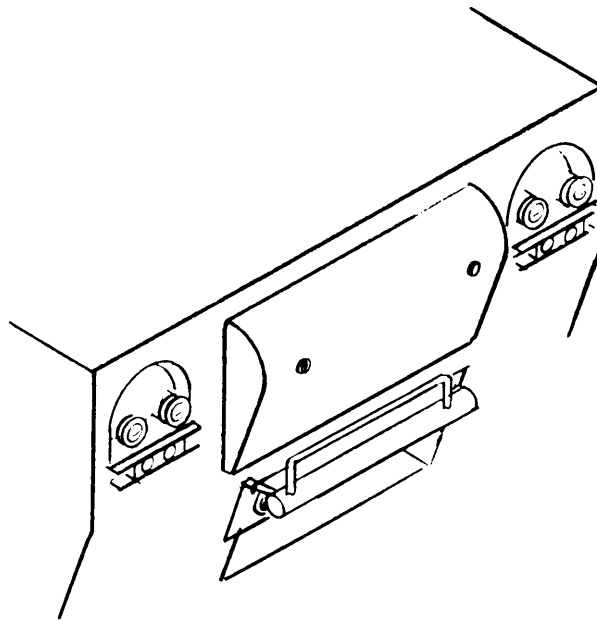
Securing the switch handles by internal detents or keys results in simpler, more easily decontaminated exterior surfaces. The handles can be removed by pulling them off of the switch shafts with minimal contact with contaminated surfaces.



TOOLS

The wooden handles on the tools can absorb contaminants/decontaminants. In addition, the tool sockets and the area behind the tools can trap contaminants and are difficult to decontaminate without removing the tools.

MIL-HDBK-784



TOOLS

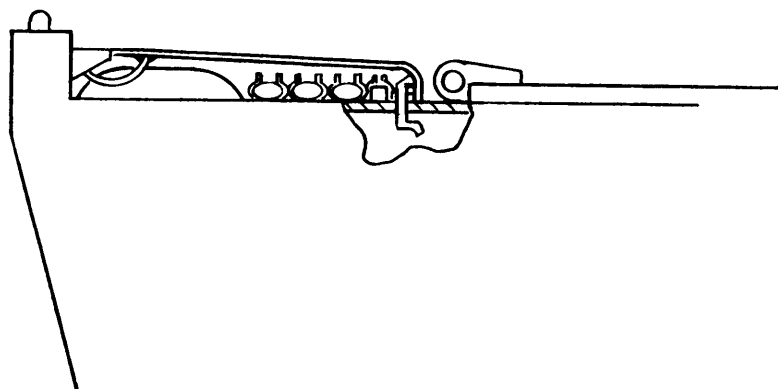
A formed cover over the tools fits into the sealed brackets on the front of the vehicle, protecting the tools from the contaminating atmosphere. The cover could be thin sheet metal or fiber glass painted with non-absorbent paint (see Appendix B).



TOOLS

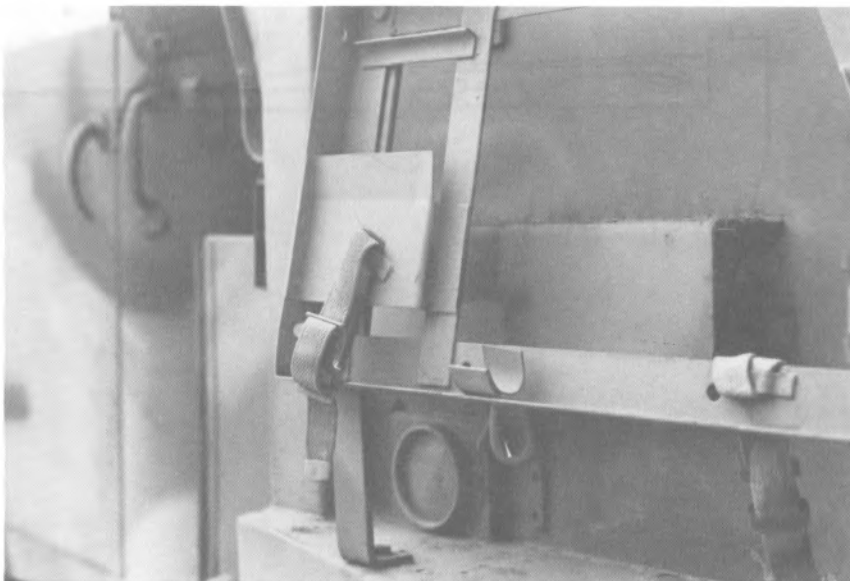
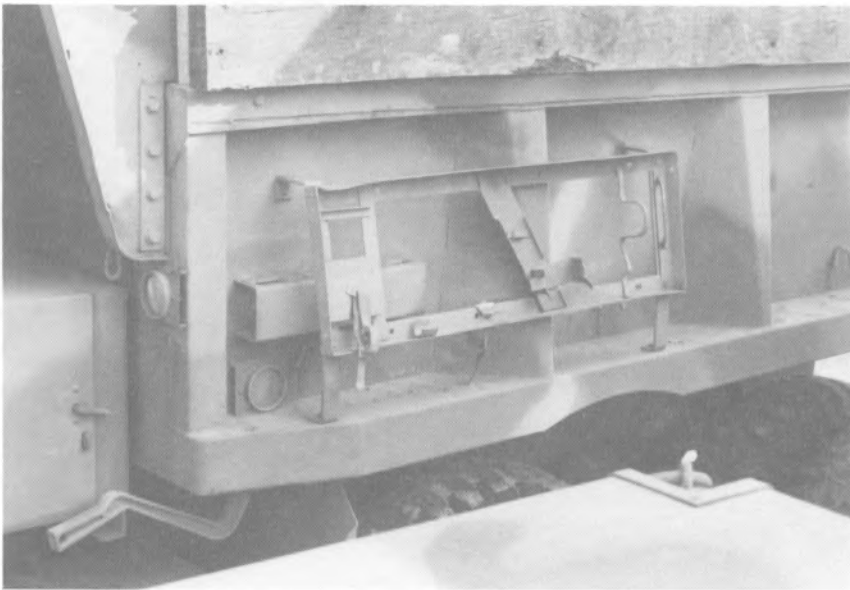
The wooden handles on the tools and the canvas tie-downs can absorb contaminants/decontaminants and must be handled to be removed from the exposed surface of the vehicle.

MIL-HDBK-784



TOOLS

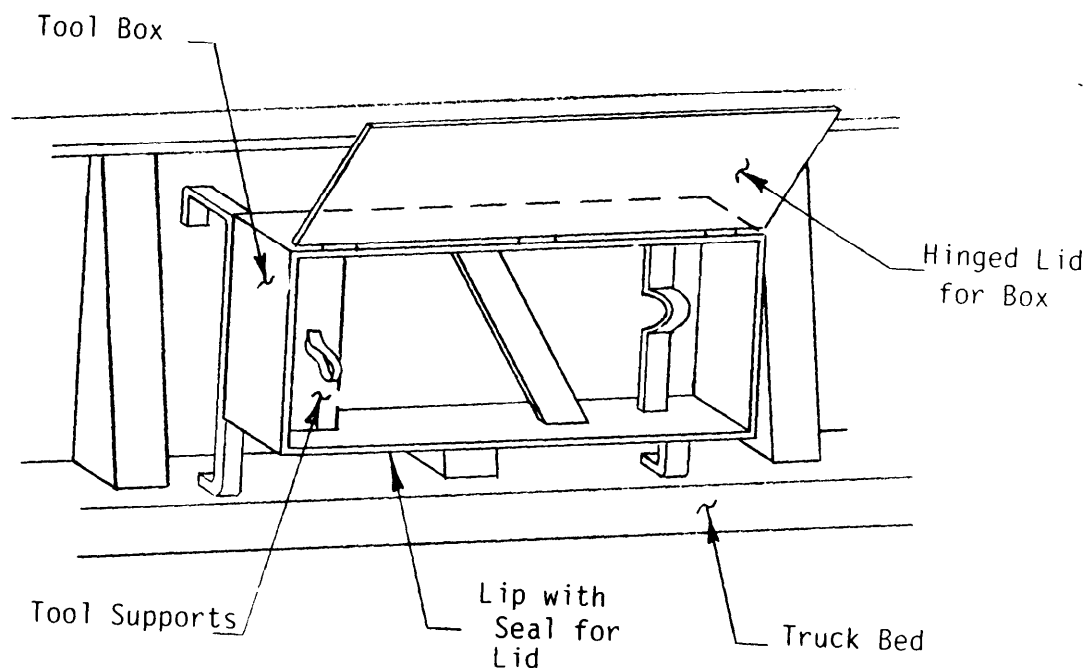
Metal clips welded to the roof eliminate the need for canvas tie-downs. In addition, a formed sheet metal cover protects the tools from exposure; the hinge under the cover is not exposed to contaminants. The cover latch can be released from inside the vehicle. A formed fiber-glass cover can be substituted for metal if it is painted with nonabsorbent paint (see Appendix B). Either type of cover must have an integral seal to close the cover-roof interface.



TOOLS

The canvas straps and wooden handles of the tools can absorb contaminants/decontaminants.

MIL-HDBK-784



TOOLS

An enclosure protects the tools and straps while permitting quick access.

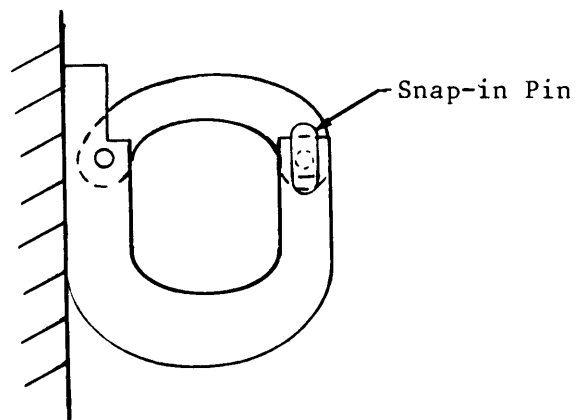
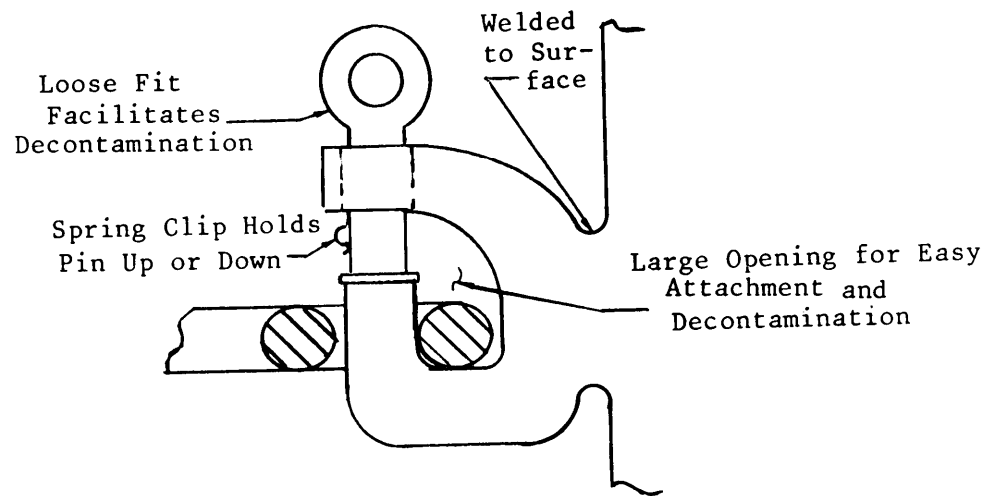


TRAILER HITCHES

The fasteners and locking catch of the hitch can trap contaminants and are difficult to decontaminate. The opening behind the hitch allows the entry of contaminants.

Forklift (6,000-lb capacity)

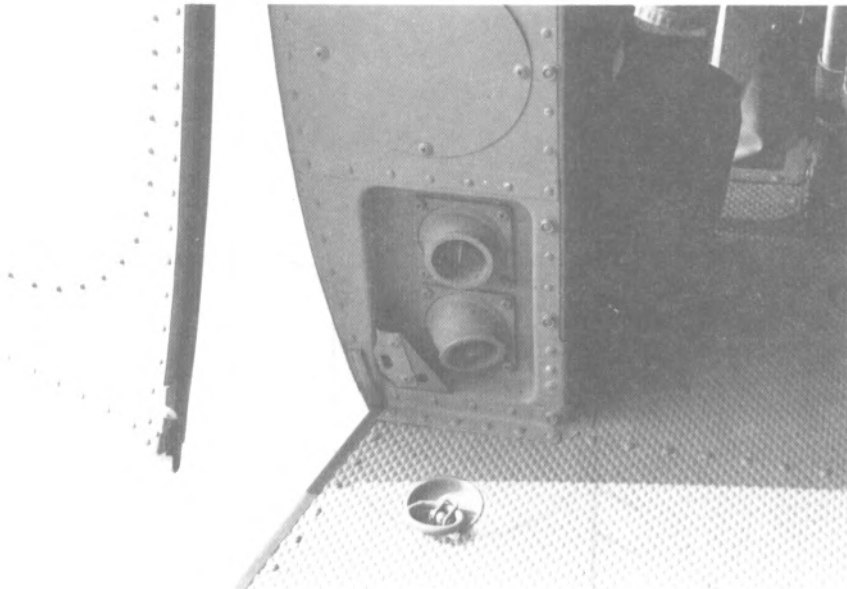
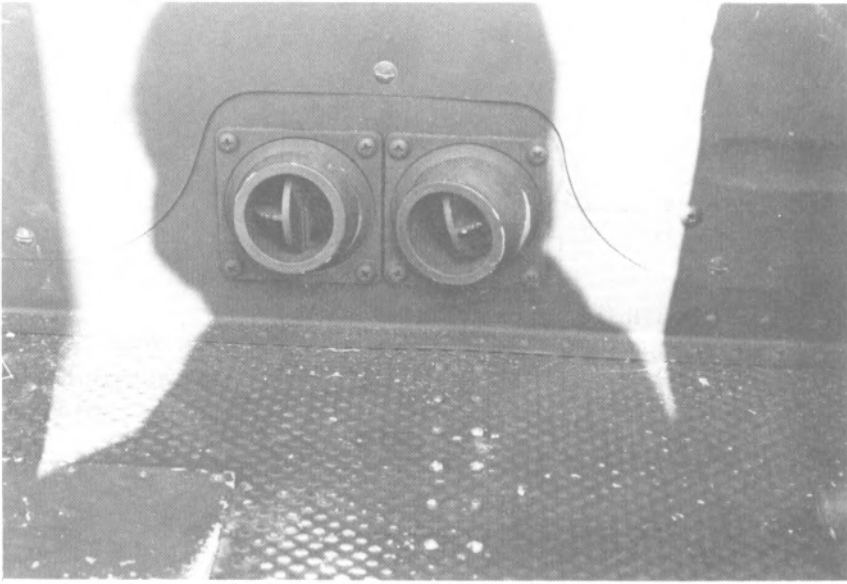
MIL-HDBK-784



TRAILER HITCH

(Top) The hitch is welded to the vehicle, and an easily removable pin facilitates decontamination.

(Bottom) Replacing the locking catch with a snap-in pin arrangement decreases the contamination problem.

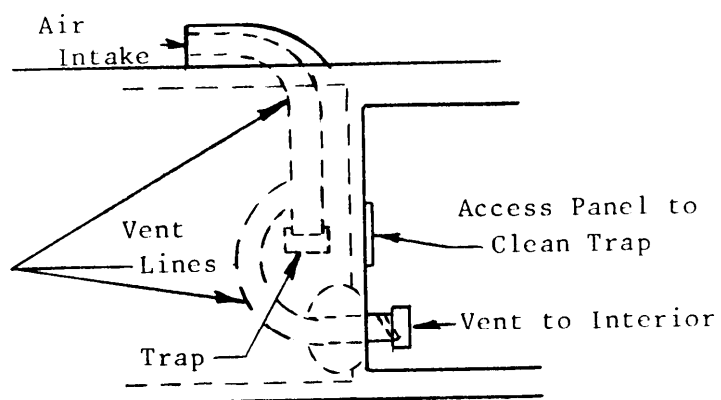


VENTS

Contaminants can enter the interior atmosphere through the air passageways.

UH-1M Helicopter (Huey)

MIL-HDBK-784



VENTS

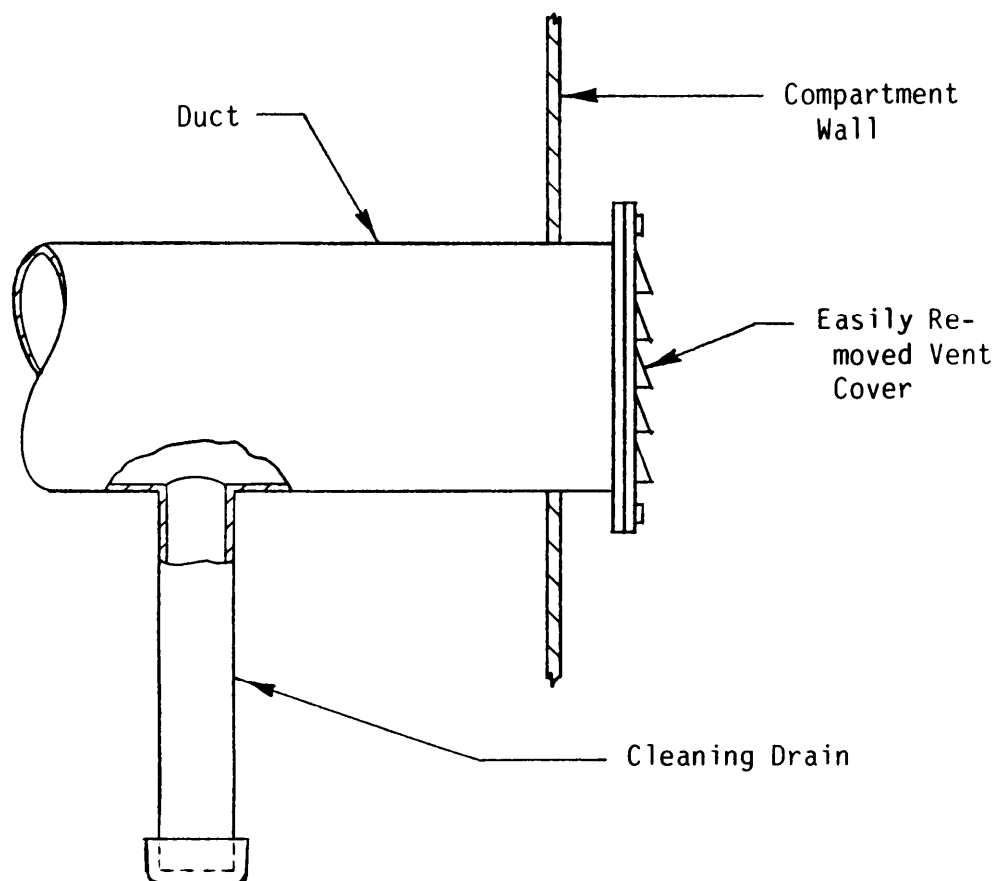
A trap collects the contaminating particles, and can be replaced via an access panel.



VENTS

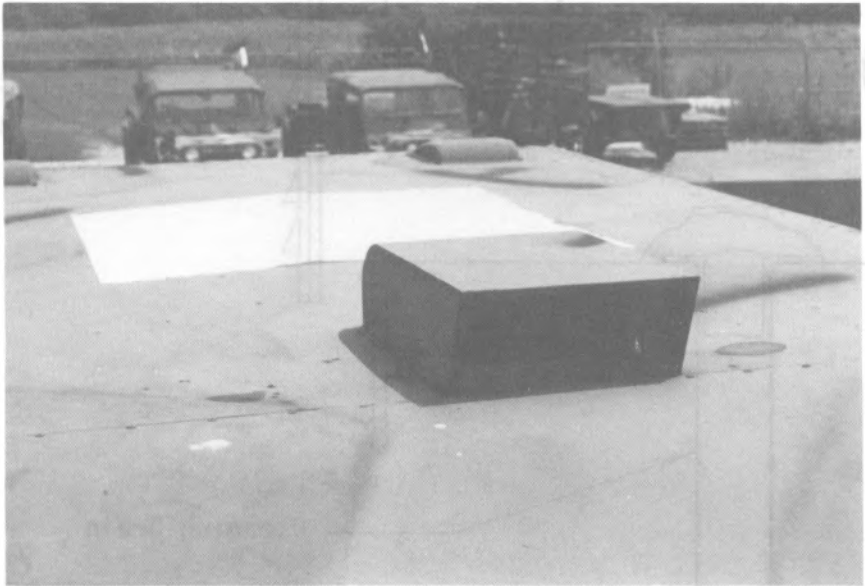
The heater outlet grill in the rear compartment allows contaminants into the ducting behind the wall. The grill, fastened through the wall, cannot be removed easily for decontamination.

MIL-HDBK-784



VENTS

Extending the heater duct through the wall and fastening the grill directly to the duct allows easy removal of the grill for decontamination.

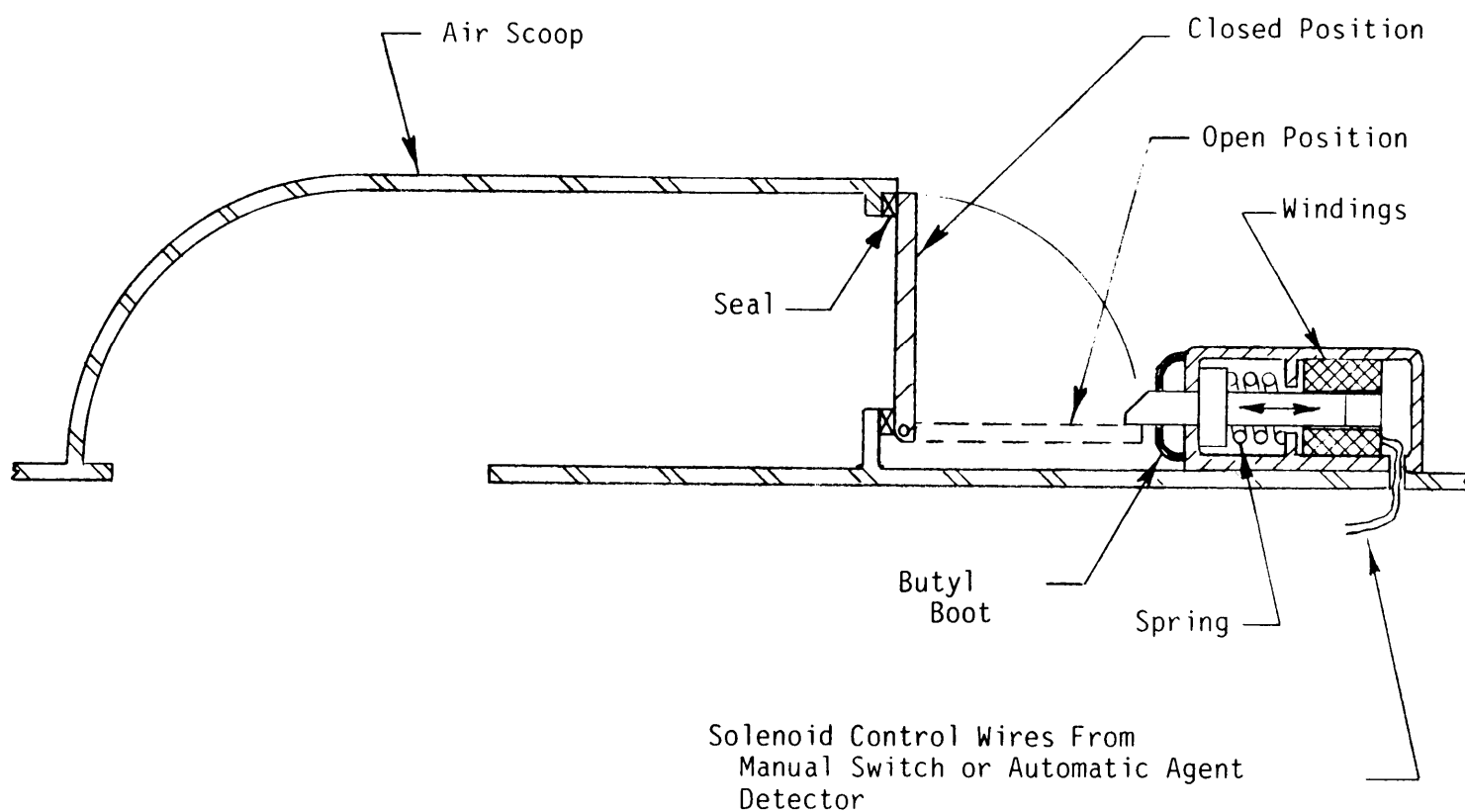


VENTS

The roof-mounted air scoop is permanently open to entrain contaminants into the vehicle atmosphere.

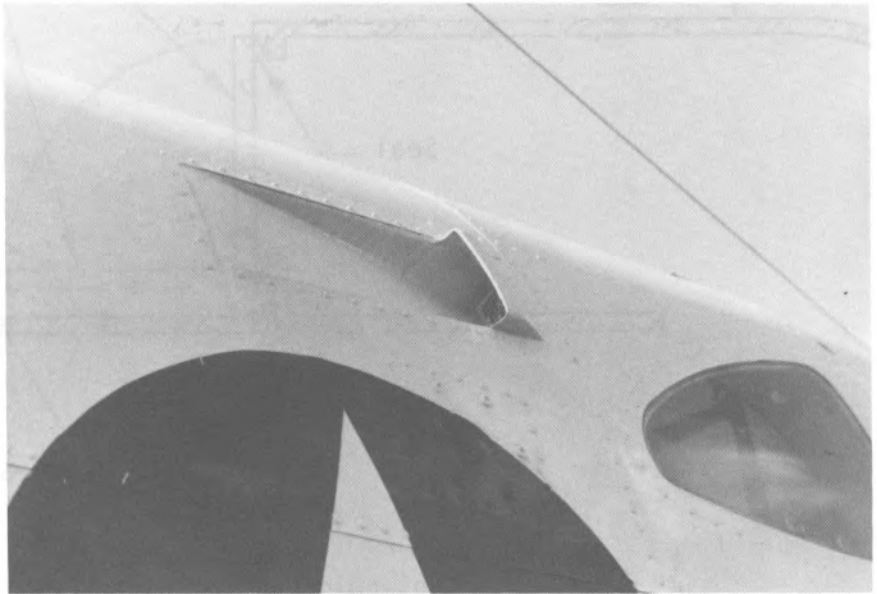
M886 Ambulance

MIL-HDBK-784



VENTS

A solenoid-operated, spring-loaded door latch can be controlled from inside the cab to close the air scoop when the danger of contamination is present.

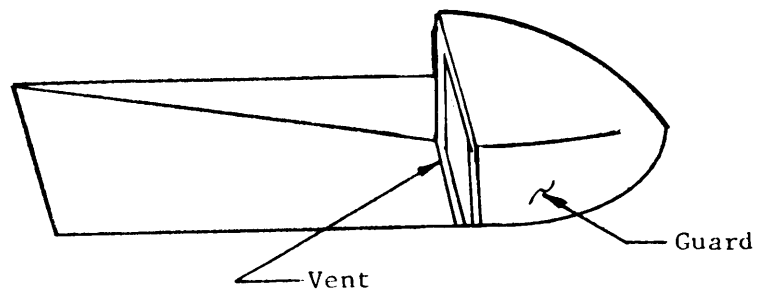


VENTS

The limited access to the vent hinders decontamination procedures.

L23F Airplane

MIL-HDBK-784



VENTS

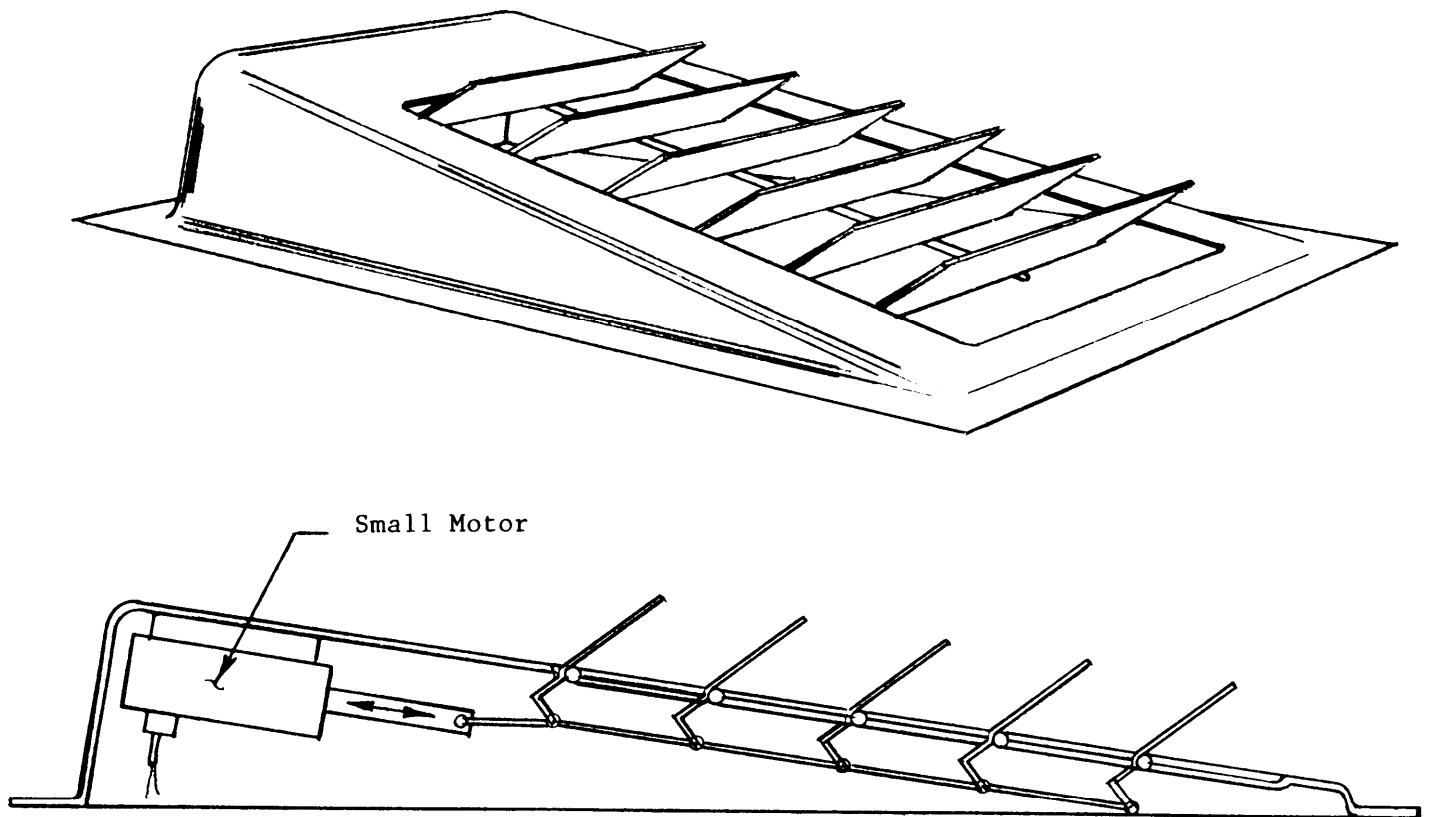
Easier access to the vent facilitates decontamination.



VENTS

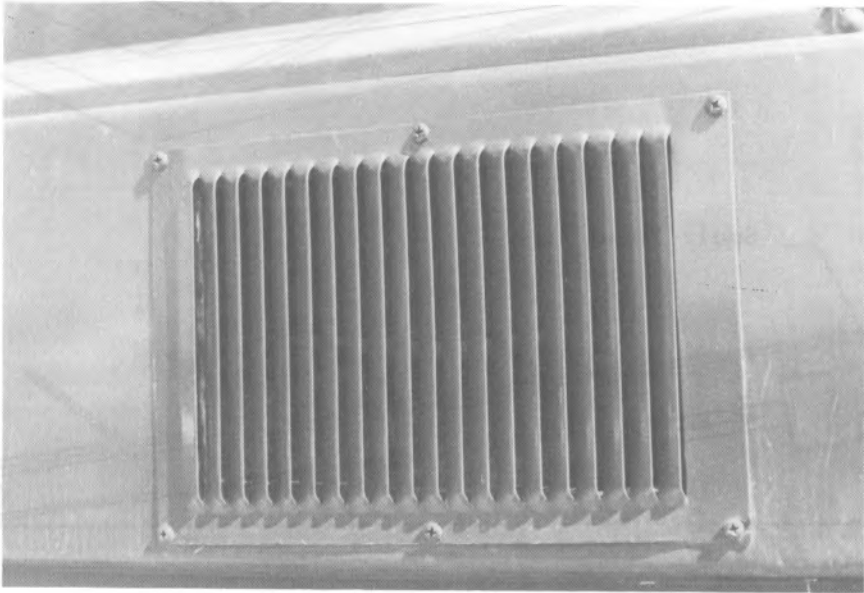
The roof-mounted vent is exposed to contaminants, and the permanently open grill allows contaminants to enter the vehicle. The interior of the vent cannot be decontaminated unless it is removed.

MIL-HDBK-784



VENTS

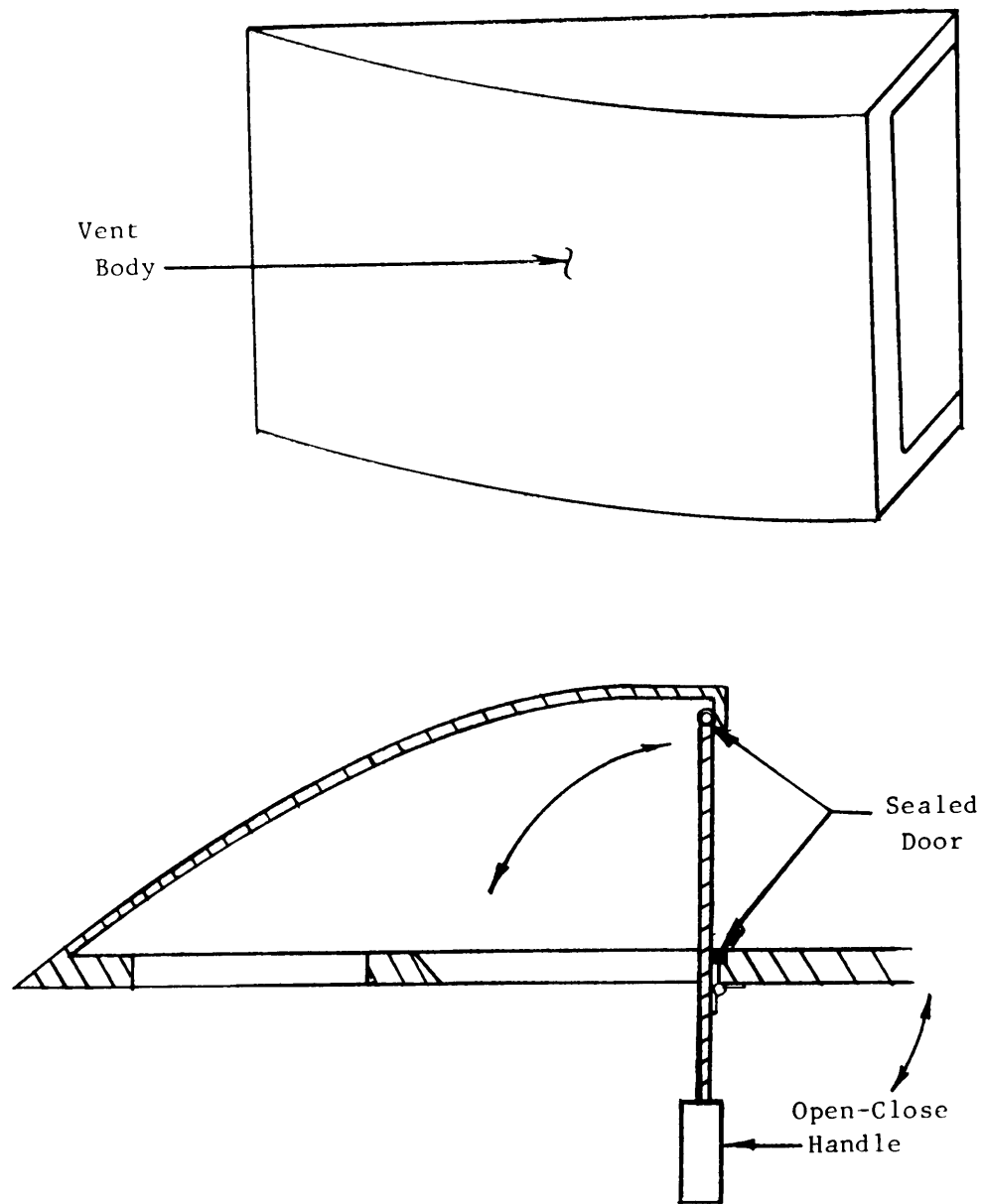
Motor-controlled louver fins prevent contaminants from entering the vehicle.



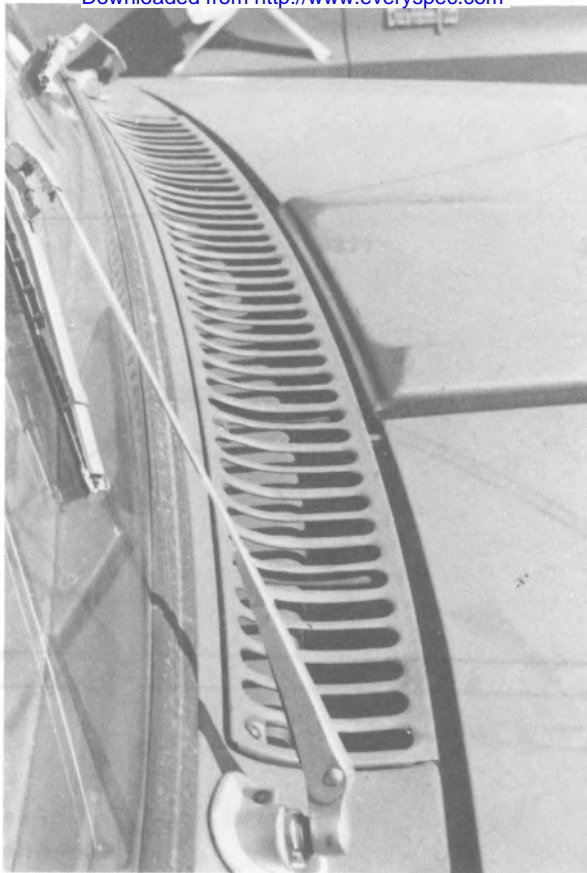
VENTS

The louvers are difficult to decontaminate.

MIL-HDBK-784

VENTS

A single vent with a door is easier to decontaminate.

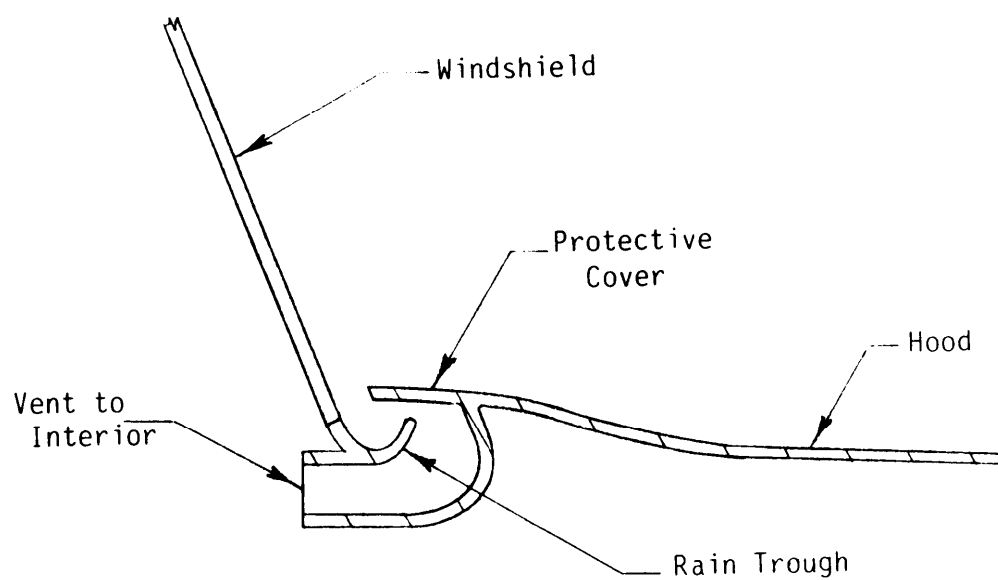


VENTS

The vent intake grill and surrounding area are difficult to decontaminate.

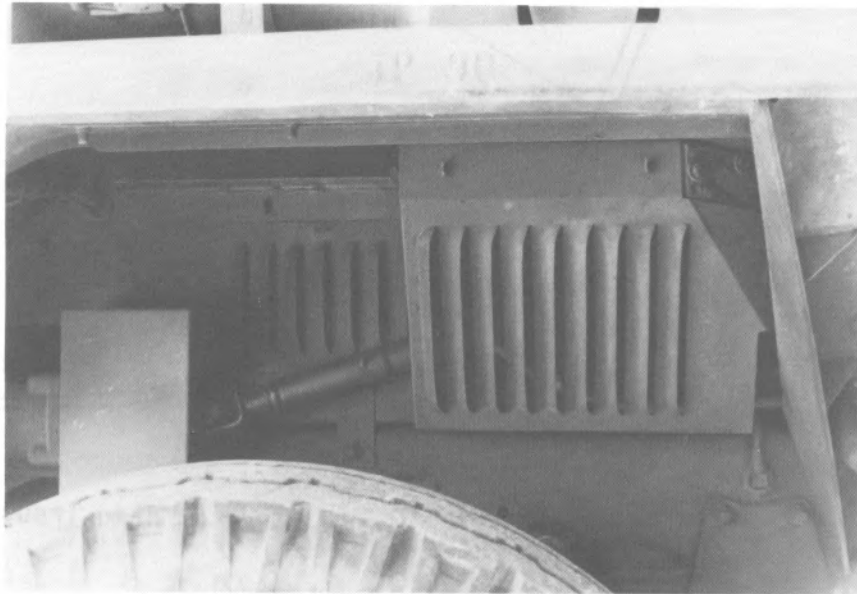
Stake Truck (Loadstar)

MIL-HDBK-784



VENTS

A protective cover limits exposure to contaminants, and a trough facilitates decontamination.

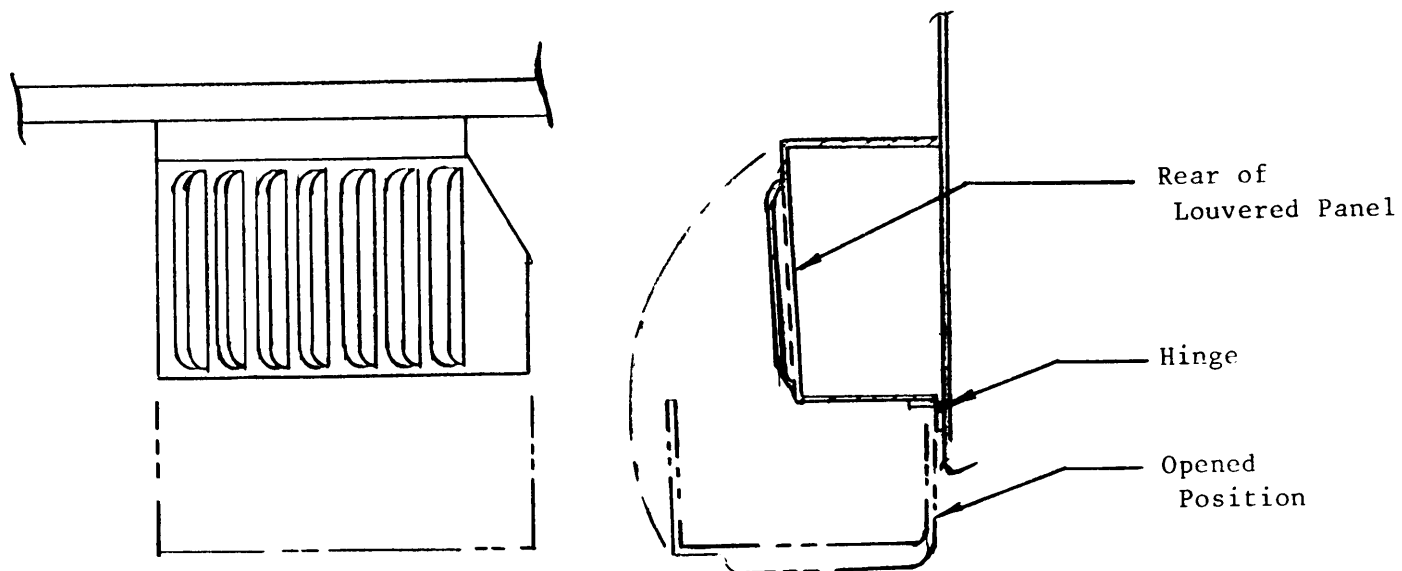


VENTS

Decontamination is hindered by the limited access to the rear and shielded surfaces of the louvered panels.

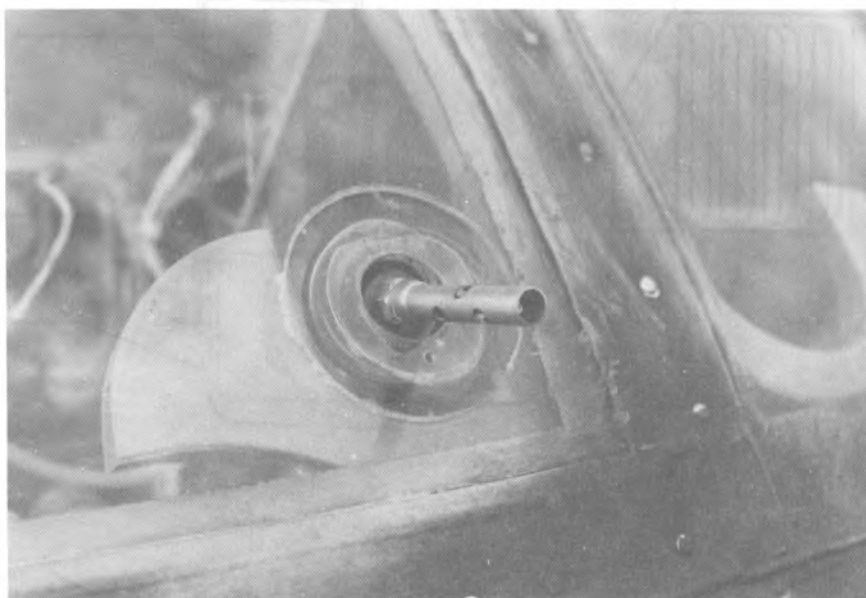
M819 Tractor Truck

MIL-HDBK-784



VENTS

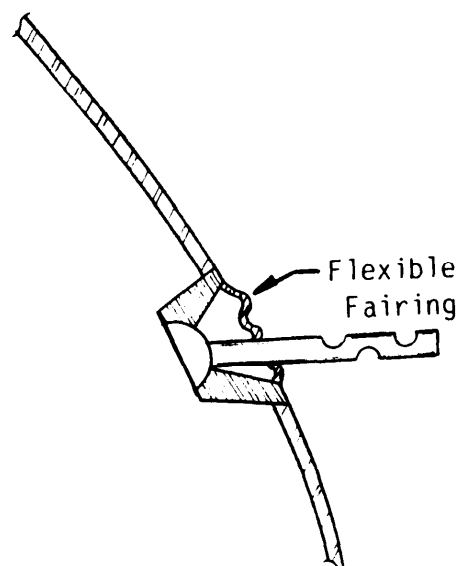
Using a drop-down hinge on the outer vent will allow greater access to the rear and shielded surfaces.



VENTS

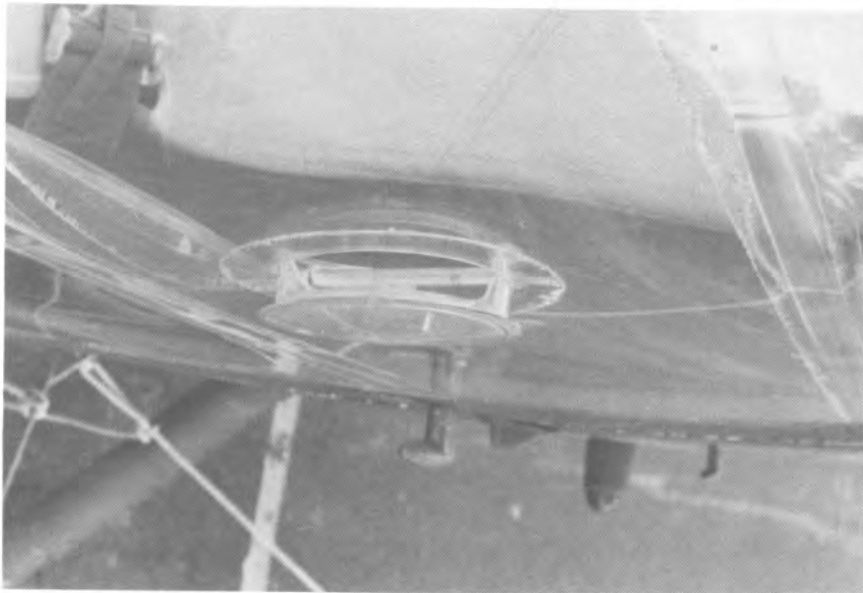
The area around the intake tube can trap contaminants and is difficult to decontaminate.

OH-6 Helicopter (Cayuse)



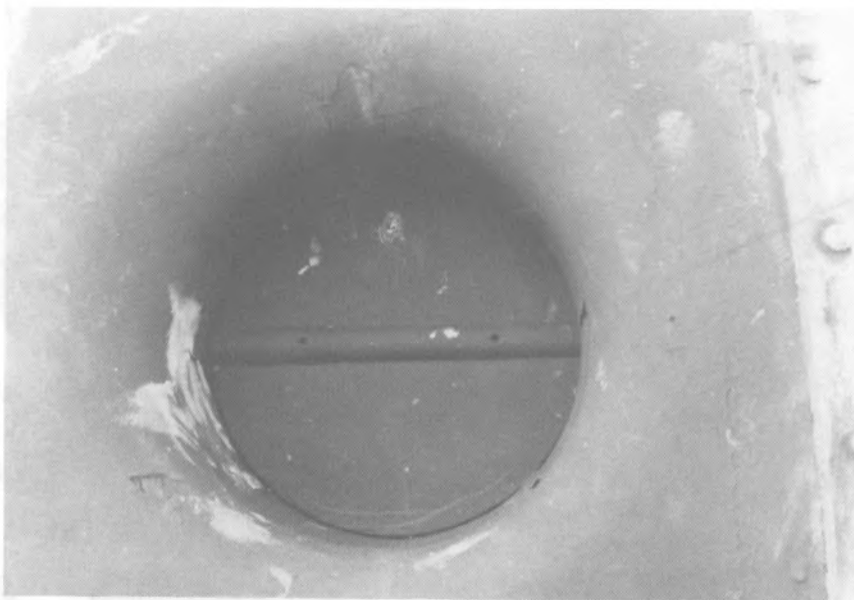
VENTS

A flexible fairing around the tube prevents contaminant entry and entrapment. Where possible, the entering air should be routed through a filter or agent-removal system.



VENTS

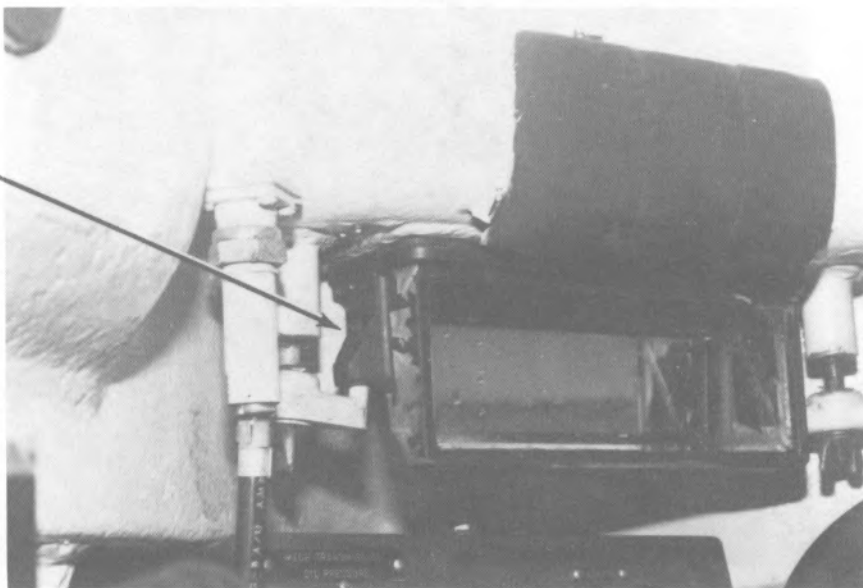
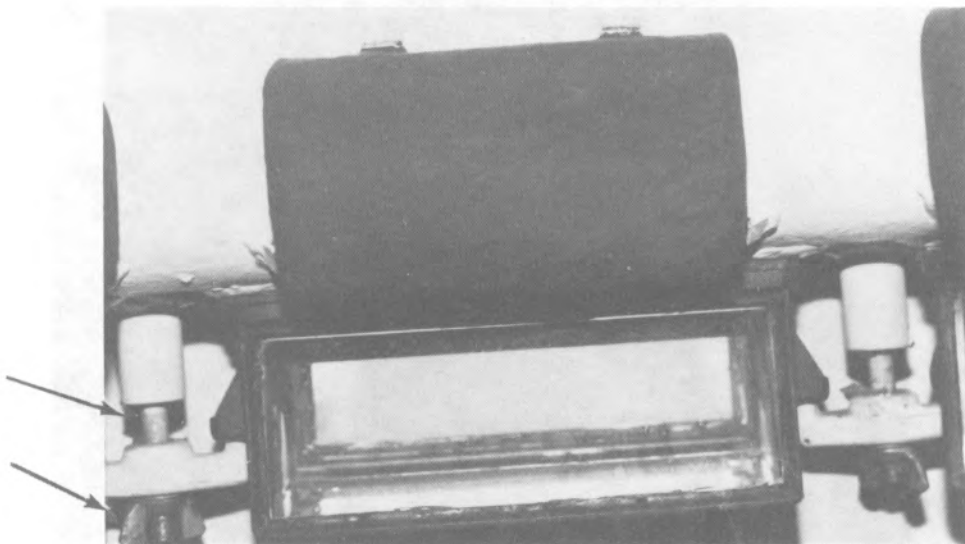
The window vent is of good design from a contamination/decontamination viewpoint: it seals well, is easy to decontaminate, and is easy to remove for replacement. Where possible, the air through the vents should be routed through a filter or agent-removal system.



VENTS

The air intake port also is of good design from a contamination/decontamination viewpoint. The shut-off should be tight to prevent contaminant entry.

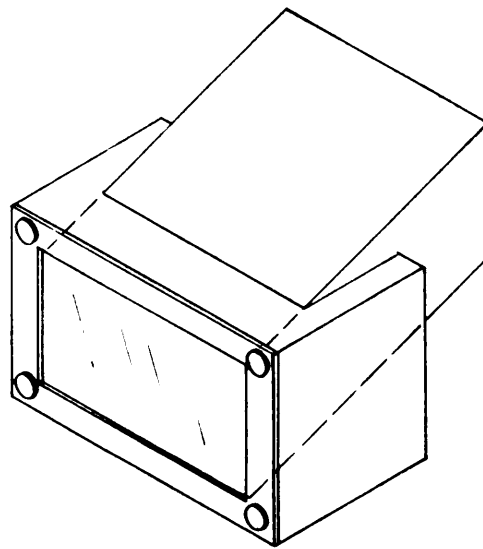
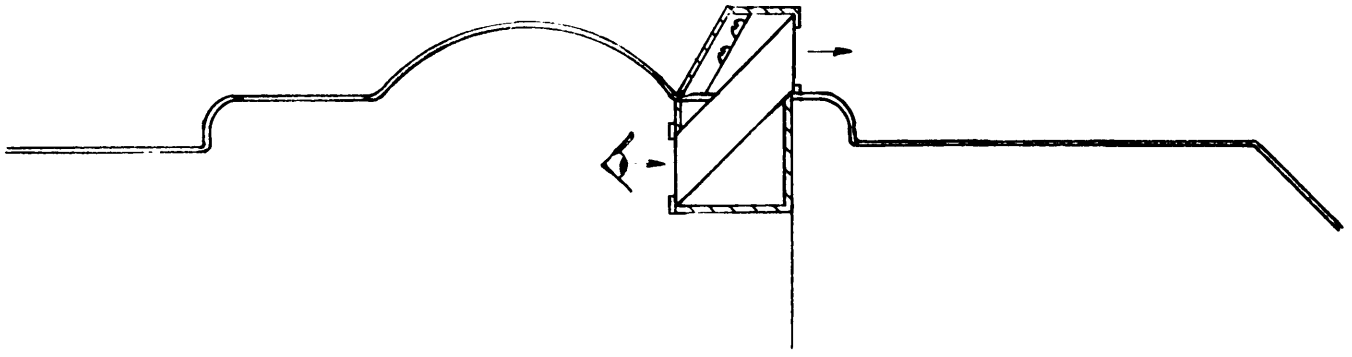
OH-6 Helicopter (Cayuse)



VISION BLOCKS

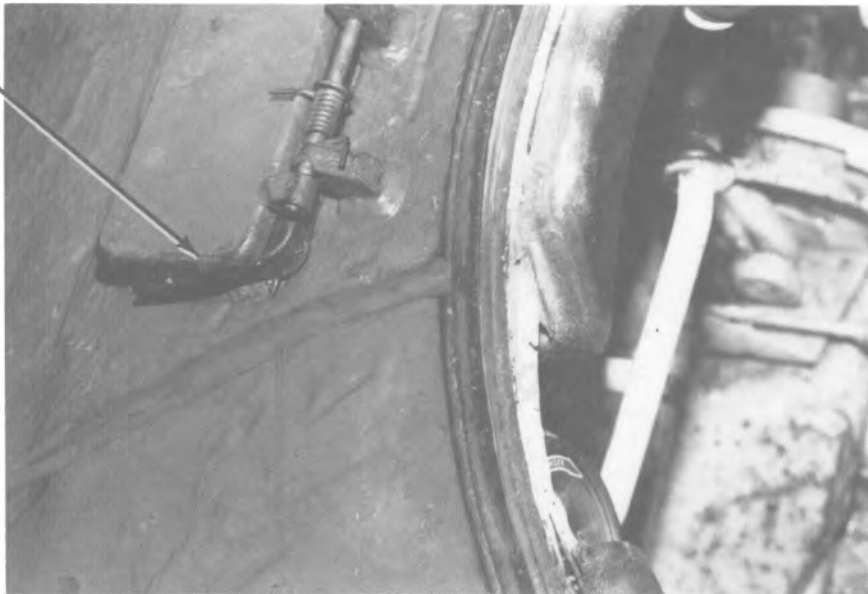
The vision block protrudes from the wall, exposing poor-access areas to contaminants. The wing nuts are also exposed to contaminants and are difficult to decontaminate.

MIL-HDBK-784



VISION BLOCKS

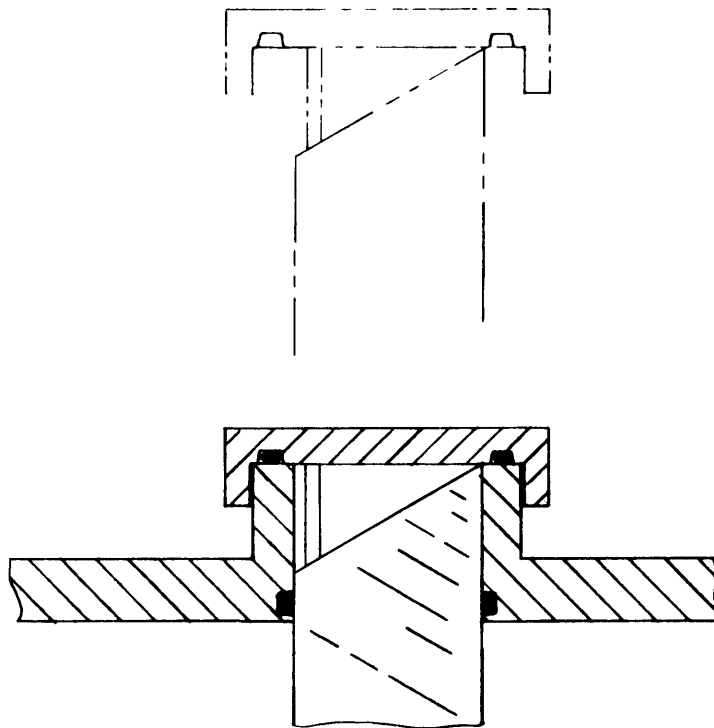
The vision block is sealed against the wall, eliminating poor-access areas. Support bolts replace the wing nuts.



VISION BLOCKS

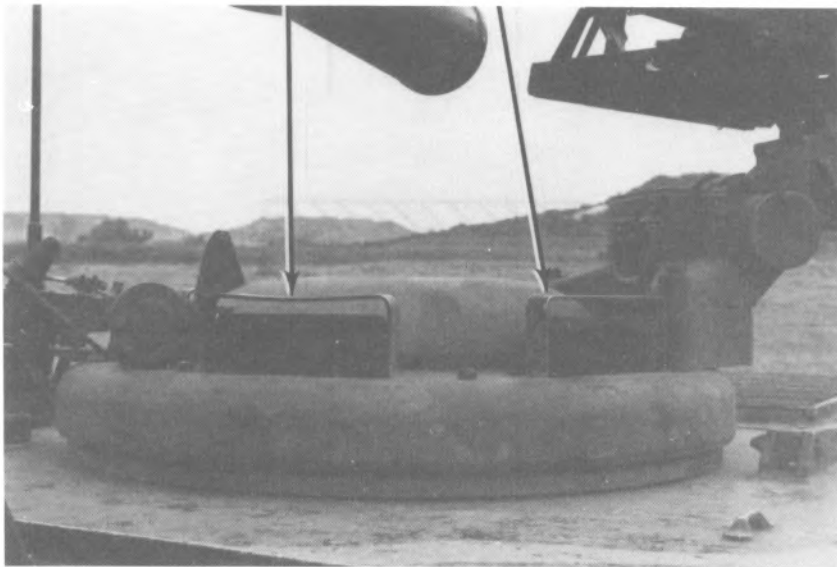
The vision block cover is frequently kicked and stepped on, and the exposed spring and pin-flange hinge can trap contaminants and are difficult to clean. In addition, the exposed seal is easily damaged, and the recess of the seal around the block forms a channel which holds contaminants/decontaminants; the loose seal allows material to seep from the channel into the interior of the vehicle.

MIL-HDBK-784



VISION BLOCKS

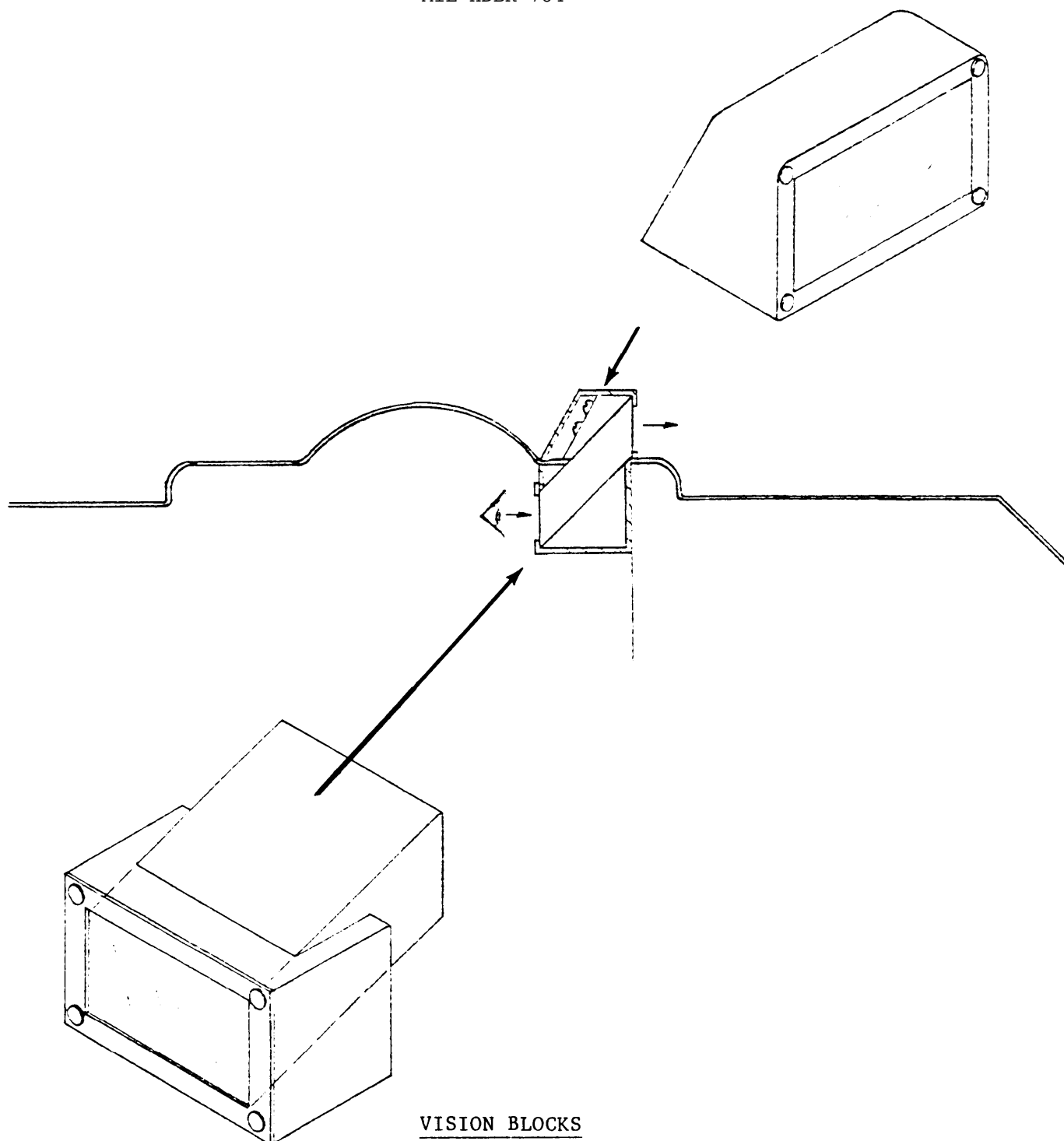
A heavier mounting for a pop-up vision block is less susceptible to damage than is the present configuration; the seals are better protected and stay intact longer. The hinge and spring are eliminated along with their high susceptibility to contamination, and the channel around the block is unnecessary.



VISION BLOCKS

The guard is too close to the block to allow thorough decontamination around the block. Contaminants/decontaminants are difficult to remove from the seal area where the block penetrates the hatch surface.

MIL-HDBK-784



The enclosed guard has removable front and back plates for access to the block. The block inserted from inside the vehicle is sealed against the flange of the front plate on the guard. Adjustment screws behind the back panel hold the block firmly against the front plate. Both plates have seals to prevent the entrance of contaminants and decontaminants.



WHEELS

Contaminants and contaminated dirt can be trapped in the crevices in the wheel and absorbed by grease from the axle.



WHEELS

A wheel cover prevents contaminant entrapment in and on the items most likely to be contacted by personnel. The wheel cover shown is relatively well-designed to limit contamination, presenting few gaps and crevices that can trap contaminants. The lugs, nuts, and flange are readily accessible to decontaminants (Tractor Truck, 10-Ton, 8x8).

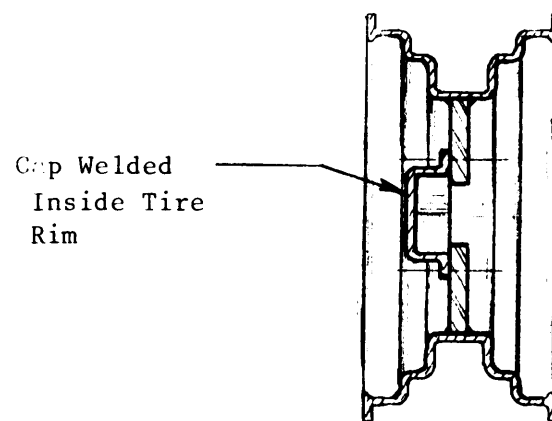


WHEELS

The crevices between the two formed pieces can draw in contaminants and allow contaminants/decontaminants to be absorbed into packing grease. The clips can also trap contaminants.

Generator (7.5 kW)

MIL-HDBK-784



WHEELS

A single-piece center hub welded to the inside of the rim alleviates the contamination problem.

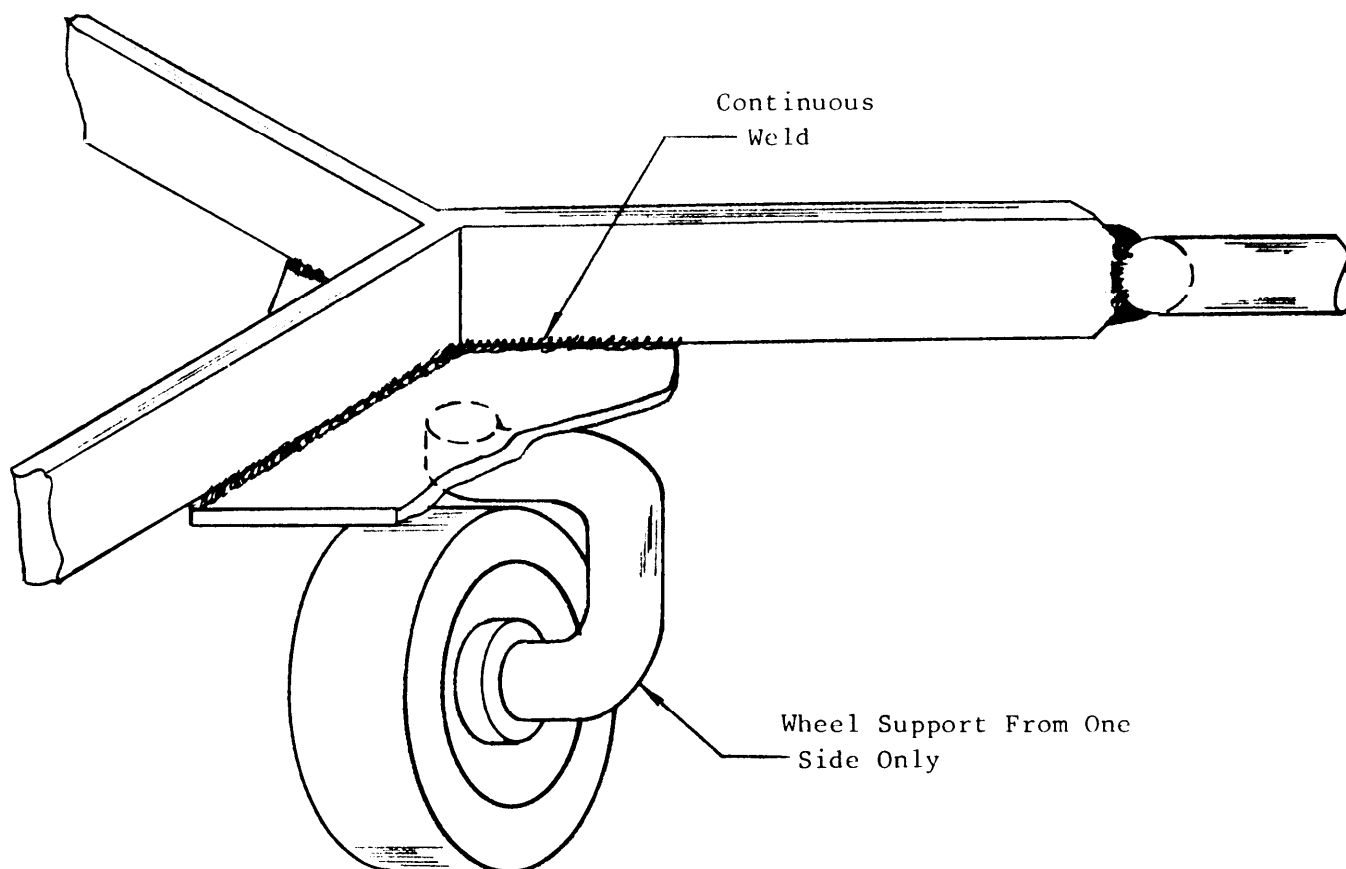


WHEELS

Contaminants/decontaminants can become trapped between the bar and the plate. Also, decontamination is hindered by the limited access between the wheel support and the wheel.

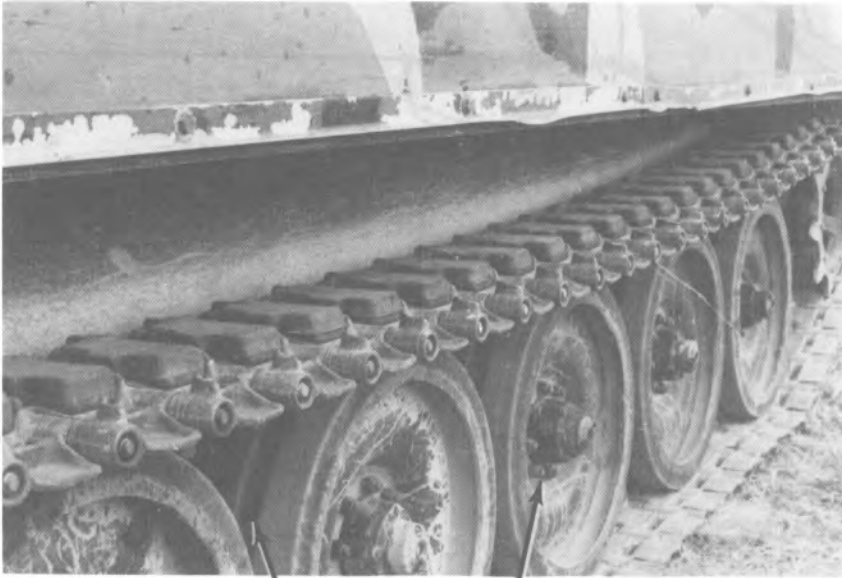
Generator (7.5 kW)

MIL-HDBK-784



WHEELS

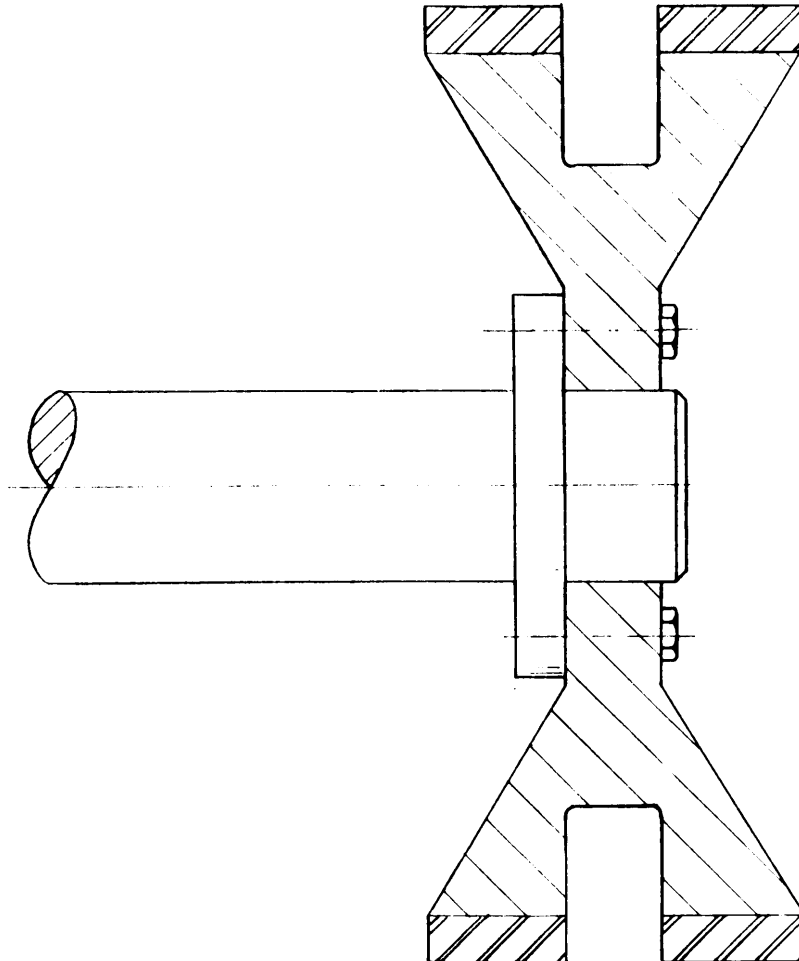
Welding along the sides of the bar will prevent contaminant entrapment. The additional space between the wheel and wheel support facilitates decontamination.



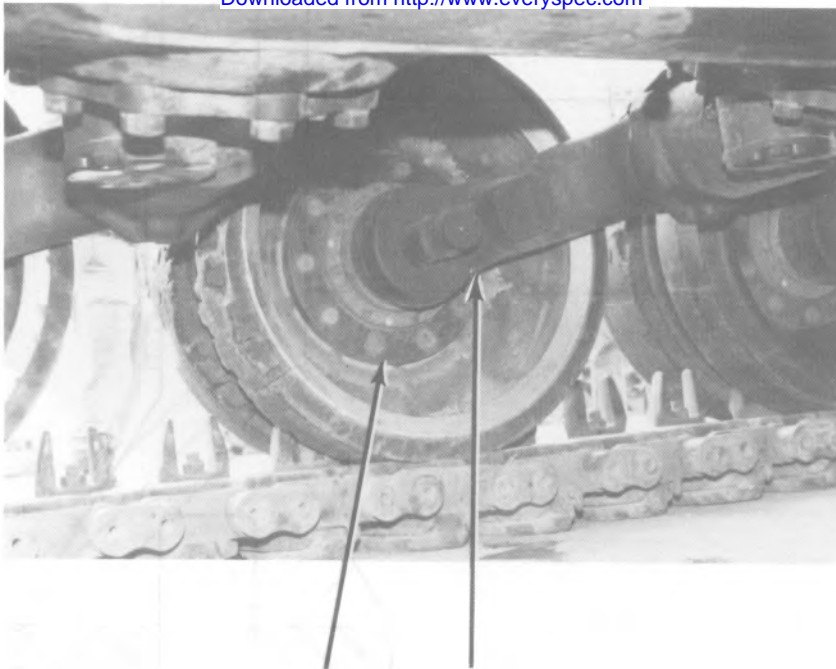
WHEELS

The area between the wheels is deep and difficult to decontaminate. In addition, the complex surfaces inside the rim can hold dirt and mud that can absorb contaminants.

MIL-HDBK-784

WHEELS

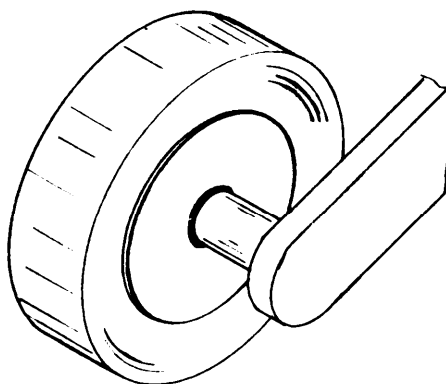
A single-piece wheel decreases the surface area for contamination. The shorter axle hub is easier to decontaminate.



WHEELS

Mud and dust adhering to the wheels can absorb contaminants and are difficult to remove without manual effort. Mounting and support hardware, including fasteners, are especially difficult to decontaminate.

MIL-HDBK-784



WHEELS

A smooth cap inside the rim of the wheel protects the surfaces from contamination. A rotary seal on the axle prevents the entrance of solid and liquid materials, and a smooth fairing on the axle support covers the complex surface configuration and is easy to decontaminate.

6. NOTES

6.1 Subject term (key word) listing.

- Ammunitions holders
- Aircraft
- Chemical agents
- Contaminants
- Decontaminants
- Fittings
- Hatches
- Latches
- Rotors, helicopter
- Trailer hitches
- Wheels

6.2 Abbreviations. The use of abbreviations in this military standard are in accordance with MIL-STD-12 where applicable. Metric system abbreviations and symbols are in accordance with ASTM E 380.

TABLE A-1 • CHEMICAL AGENTS AND THEIR EFFECTS¹

Agent Category	Agent Designation	Maximum	Effects	
			Systemic	Local
Nerve	GB ² GD ³ VX ⁴	Death	Vomiting, cramps, coma, convulsions, asphyxia	Tightness in chest, contraction of pupils, sweating, muscle spasms
Choking	CG	Death	Fluid fills lungs	Irritation and lesions in lungs
Blood	CK	Death	Tissues cease to take oxygen	Eye irritation, tears; irritation of lungs
Blister	HD HN HL	Incapacitation for weeks; death	Diarrhea, internal lesions	Blisters, irritation, pain on skin; tears; inflammation and lesions in lungs
Incapacitating	BZ ⁵	Incapacitation for days	Interference with nerve impulses; mental aberrations, physical disability	Behavior, activity altered
Vomiting	DM	Incapacitation for minutes	Headache, nausea, vomiting	Irritation of eyes and skin, pain and tightening in chest
Riot-control	CS ⁶ CR ⁷	Incapacitation for minutes	Headache, nausea, vomiting	Irritation and inflammation of lungs, eyes, and skin; tears; tightness in chest

¹These agents typify those available to U. S. military forces. It can be presumed that foreign forces possess equivalent agents having similar effects.

²Sarin; O-isopropyl methylphosphonofluoridate; nearly as volatile as water; lethal dose ~ 1 mg

³Soman; O-1, 2, 2-trimethylpropyl methylphosphonofluoridate; volatility near that of sarin (lethality between GB and VX), can be thickened (standard Russian nerve agent - VR55)

⁴O-ethyl S-2-diisopropylaminoethyl methylphosphonothiolate; volatility close to heavy lubricating oil; lethal dose ~ 0.4 mg

⁵3-quinuclidinyl benzilate

⁶Orthochlorobenzylidene malononitrile

⁷Dibenz [bf] [1,4] oxazepine

TABLE A-2 • DECONTAMINANTS FOR NBC AGENTS¹

Decontaminant	Composition	Remarks
Acetylene tetrachloride		Attacks metals in presence of moisture
Air/Heat		Evaporates, dissipates agent
Alcohol		Removes, does not neutralize
Ammonia		
ASH (Activated Solution of Hypochlorite)	0.5% calcium hypochlorite in buffered water	
Baking soda	Sodium bicarbonate	
Bleach	Sodium hypochlorite	Corrosive to metals
BPL	Beta propiolactone	
Carbon tetrachloride		Removes, does not neutralize
Caustic potash		
Caustic potash, alcoholic		
Caustic soda	Sodium hydroxide	Corrosive to metal; damages cotton, wool
Caustic soda, alcoholic		
Charcoal slurry		Absorbs, does not destroy
Chlormide powder		

TABLE A-2 • (Continued)

Decontaminant	Composition	Remarks
Chloramine-B	Sodium N-chlorobenzene sulfonamide	Used in M258 Personal Decon Kit
Chloramine-T	Sodium-N-chlorotoluene sulfonamide	
Chlorine		
Detergent solution	Any liquid detergent and water	
Detrochlorite	19.3% diatomaceous earth, 0.5% wetting agent, 2.9% calcium hypochlorite, 77.3% water	Very corrosive to metals
Dichloramine-T	N, N-dichlorotoluene sulfonamide	
Diesel fuel		Removes, does not neutralize
Dry-cleaning fluid		Removes, does not neutralize
DS2 (Standard Vehicle Decontaminant)	70% diethylenetriamine, 28% ethylene glycol monoethyl ether, 2% sodium hydroxide	Promotes corrosion of metals, removes most acrylic or alkyd paint, deteriorates most organic material, optical lenses.
Ethylene oxide-fluorinated	12% ethylene oxide, 88% fluorinated hydrocarbon	
Formaldehyde	Formalin	
Formalin-methanol		
Fuller's earth		Absorbs, does not destroy
Gunk	Gunk in kerosene, added to water	Removes, does not neutralize
HTH (high-test bleach)	Calcium hypochlorite	Highly corrosive to metals
Kerosene		Removes, does not neutralize
Lime	Calcium hydroxide	

TABLE A-2 • (Continued)

Decontaminant	Composition	Remarks
MEA	10% monoethanolamine, 1% surfactant, water	
Naphtha		Removes, does not neutralize
PCE	Perchloroethylene	Removes, does not neutralize
Peracetic acid		Damages most materials with time
Soap solution	Preferably lye soap and water	
Sodium bisulfite solution		
Sodium hydrochloride		Corrosive
Sodium sulfite		
STB (super-tropical bleach: standard decontaminant for terrain, facilities)	Calcium hypochlorite and calcium oxide	Caustic/corrosive to metals
Steam		Hydrolyzes some agents
Washing soda	Sodium carbonate	
Water		Removes, does not neutralize

These decontaminants may be used against chemical and/or biological agents, as appropriate. They do not reduce the radiation hazard of nuclear agents. Such agents must be removed and disposed of or shielded until natural decay reduces the hazard level.

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APPENDIX B

COMPATIBILITY OF CONTAMINANTS AND
DECONTAMINANTS WITH MATERIALS

Information is currently available on the compatibility of materials used in military equipment with the various contaminants and decontaminants. Investigations in this area have been conducted for the U.S. Army Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD 21010-5423, The results of these investigations are compiled in the NBC Materials Handbook, Jan 1983 (DTIC #B079397).

Chemical-agent-resistant paints are as follows:

Exterior surfaces -- "Coating, Aliphatic Polyurethane, Camouflage, Chemical Agent Resistant" in conformance with MIL-C-46168(ME).

"Coating, Aliphatic Polyurethane, Single Component, Chemical Agent Resistant" in conformance with MIL-C-53039(ME).

Interior surfaces -- "Coating, Epoxy-Polyamide", in conformance with MIL-C-22750.

At present, a nonabsorbent sealant cannot be recommended.

APPENDIX C
EQUIPMENT EXAMINED FOR GUIDELINES



L23F AIRPLANE



AH-1 HELICOPTER (COBRA)



OH-58A HELICOPTER (KIOWA)



UH-1H HELICOPTER (HUEY)



UH-1M HELICOPTER (HUEY)



OH-6 HELICOPTER (CAYUSE)



AVLB BRIDGE-LAUNCHING VEHICLE



M578 LIGHT RECOVERY VEHICLE



M88 RECOVERY VEHICLE



M102 105-MM HOWITZER



M109 HOWITZER



TOW MISSILE LAUNCHER



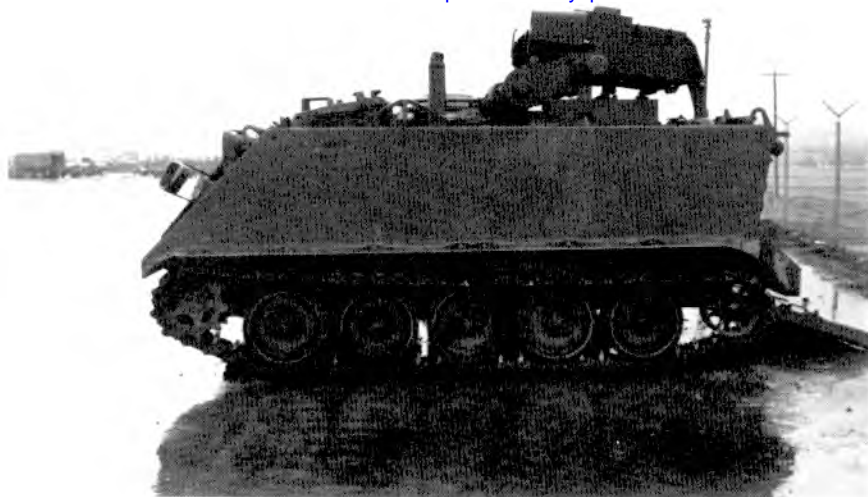
CHAPARRAL MISSILE LAUNCHER



M551 TANK (SHERIDAN)



M60 TANK



M113 ARMORED PERSONNEL CARRIER



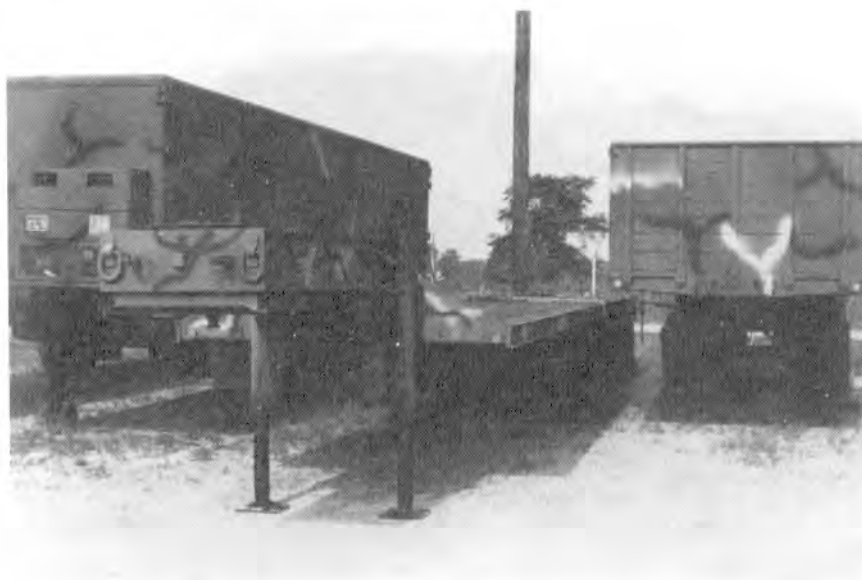
M416 CARGO TRAILER



M105A2 CARGO TRAILER



M129A2C VAN SEMITRAILER



M270A1 WRECKER SEMITRAILER



FLATBED SEMITRAILER



DIESEL GENERATOR



GENERATOR (7.5 kW)



RECIPROCATING COMPRESSOR (COVERED)



RECIPROCATING COMPRESSOR (UNCOVERED)



XM107 WATER TANK



M886 AMBULANCE



M561 CARGO TRUCK (GAMMA GOAT)



M35 TRUCK



M109 SHOP VAN TRUCK



M51A2 DUMP TRUCK



STAKE TRUCK (LOADSTAR)



M820 VAN TRUCK



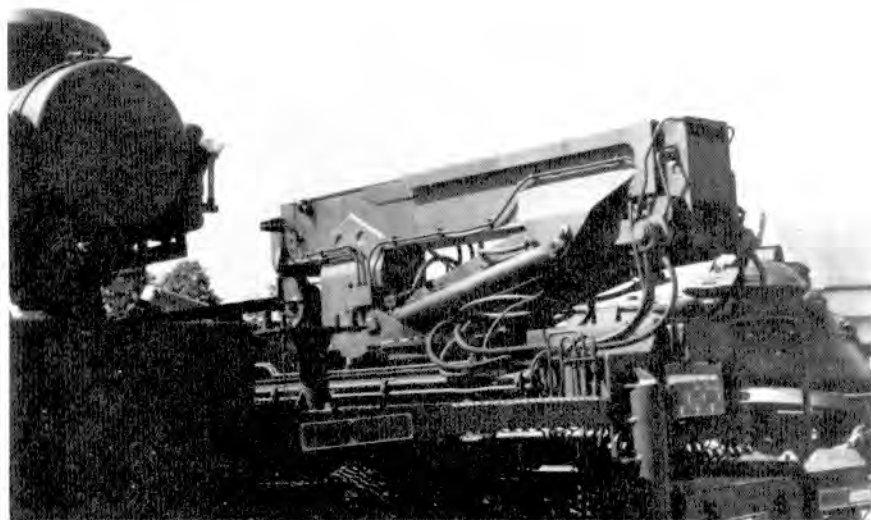
M818 TRACTOR TRUCK



M151 UTILITY TRUCK (JEEP)



M819 TRACTOR TRUCK (WRECKER)



TRACTOR TRUCK (10-TON, 8x8)



M116 CARGO CARRIER



FORKLIFT (6,000-LB CAPACITY)



FORKLIFT (10,000-LB CAPACITY)



ROAD GRADER



CITY BUS



SCHOOL BUS

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Preparing Activity: Army - EA

Custodians:

Project Number 4230-0090

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Navy - YD

Air Force - 99

Review Activities:

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User Activity:

Navy-MC

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions – Reverse Side)*

1. DOCUMENT NUMBER MIL-HDBK-784		2. DOCUMENT TITLE Guidelines-Design to Minimize Contamination & to Facilitate Decon of Mil Vehicles & Other Equip: Int & Ext	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one) <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
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5. PROBLEM AREAS			
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b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) – Optional		b. WORK TELEPHONE NUMBER (Include Area Code) – Optional	
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