REPAIR MANUAL FOR STEEL FREIGHT CONTAINERS

IICL

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REPAIR MANUAL

This manual describes the best procedures for the repair of containers known to the Institute and takes into account the need for safe, efficient and economical container performance. However, because any repair operation depends largely upon the skill of human beings, the machinery employed, the conditions under which the repair is performed and many other variables whose significance may not be apparent, the Institute and its members and personnel cannot and do not assume any liability for damage to persons or property or other consequences of any procedures referred to herein or of any omissions relating to repairs, practices and procedures.

CREDITS

The drawings and information on container dimensions in Appendices A, B and C is adapted and reprinted from ISO 668: 1988/Amd 1: 1993 and ISO 1496-1: 1990/Amd 1: 1993 with permission of the American National Standards Institute (ANSI) on behalf of the International Organization for Standardization. No part of these Standards may be copied or reproduced in any form, electronic retrieval system or otherwise, or made available on the Internet, a public network, by satellite or otherwise, without the prior written consent of the American National Standards Institute, 11 West 42nd Street, New York, NY 10036, USA. Copies of International Organization for Standardization (ISO) publications may be purchased from ANSI, fax 1-212-302-1286.

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SECTION 1 INTRODUCTION AND PURPOSE

The Institute of International Container Lessors, Ltd. (IICL) has issued this fifth edition of the *Repair Manual for Steel Freight Containers* in order to provide basic assistance in the repair of steel containers. The purpose of any repair is to restore structural integrity to the container, so that it may function safely in worldwide intermodal commerce as an instrument of international transportation. The *Repair Manual for Steel Freight Containers* recommends procedures for the repair of containers to permit their safe return to service.

The fifth edition uses a new and different approach from previous editions. To reduce the repetition of similar repair procedures throughout the manual, IICL has consolidated basic repair procedures applicable to many steel components into one introductory section of the manual, Section 2. Section 2 also includes information on replacement materials, surface preparation and painting, welding, non-conforming ("improper") repairs, general safety precautions and quality assurance. Subsequent sections of the manual (Sections 3 - 11) are devoted to specific container components and assemblies, and indicate which *types of repair* may be made to those components and assemblies and what restrictions and/or special considerations should be observed in each case.

If conditions require, the procedures described in this manual should be deviated from or supplemented accordingly, and owners may suggest alternative methods to those described in this manual. A basic understanding of containers and repair methods is assumed.

To determine if damage to containers requires repair, inspectors and repairers should consult the latest edition of the IICL/ICS *Guide for Container Equipment Inspection* and the IICL *Supplement on Container Inspection and Repair: Gray Areas* (as well as any pertinent Technical Bulletins) before undertaking any repairs. The Guide also includes container nomenclature and assembly details of general-purpose containers.

The Repair Manual is confined to the repair of steel containers and does not deal with other questions such as preventive maintenance or refurbishment (reconditioning). Preventive maintenance should be performed pursuant to the instructions of the individual owner, as requirements vary from owner to owner. IICL has issued a separate manual on refurbishment, *Specifications for Steel Container Refurbishing*.

Assistance in meeting the International Organization for Standardization (ISO) requirements is provided through illustration of certain ISO dimensions and tolerances in Appendices A, B, and C. A table converting metric (SI) dimensions to U.S. customary and sheet gage measurements is also included as Appendix D.

Metric references in this manual have been placed before references to inches and feet (U.S. customary), and some have been rounded off to the nearest whole number. Where changes have been made to round off metric references, no change in measurement is intended. If there is a conflict between metric and U.S. customary measurements, the metric measurement takes precedence.

IICL issues revisions of its publications from time to time, which are generally incorporated in new editions or Technical Bulletins. If a conflict should appear between criteria in different publications, those in the latest or more recent publication should prevail.

Readers' suggestions on this fifth edition of the Repair Manual are welcomed. Comments should be addressed to IICL at the postal address, fax number or e-mail address listed on the credits and copyright page (opposite page 1).

While the purpose of this manual is to assist in restoring containers to safe and structurally satisfactory condition, the IICL makes no representation that repairs carried out pursuant to this manual will meet any specific requirements of any particular government. Container repairers are reminded that they are responsible for complying with safety and other procedures described or approved by their applicable governments. Each repairer should carefully check the particular legal requirements of its government. Repair companies should ensure that their operations comply with all national and local laws regarding safety, the environment, the work place, repair and working conditions (*e.g.*, U.S.:29 Code of Federal Regulations, Parts 1910, 1917 and 1918).

SECTION 2 GENERAL REPAIR PROCEDURES

2.1 **Introduction**—The 5th edition of the *Repair Manual for Steel Freight Containers* sets forth step-by-step descriptions of repair procedures for steel components **once only**, in Section 2.8 on pages 7 - 13. Exceptions are repair methods recommended for *wood floors, door gaskets, door hardware and ventilators*, where complete procedures are provided in the sections of the manual pertaining to those components.

The repair method selected should be the most economical one possible within the limitations set forth in this manual. Whenever possible, damaged components or portions of components should be straightened, welded, or straightened *and* welded, rather than removed and replaced with inserts, sections or entire replacement components.

In some cases, undamaged or lightly damaged components may need repair if they are adjacent to damaged areas requiring repair. A proper repair should restore the profile of the damaged component and surrounding areas as close as possible to the original profile. Repaired containers should meet all applicable requirements of ISO standards, the International Convention for Safe Containers (CSC), the Customs Conventions on Containers and the Convention on the International Transport of Goods Under Cover of TIR Carnets.

2.2 **Safety Precautions**—IICL expects all repair personnel to observe appropriate safety precautions when repairing containers. Safety clothing and equipment should be worn, including hard hats, safety goggles, gloves, hearing protection, masks and any other devices that may be needed.

Some of the sealants, adhesives, solvents and lubricants used in container repair may pose environmental and personal safety risks if not handled and disposed of in a proper and responsible manner. Repairers should be well informed about these products and the recommended manner of application and disposal. In the United States, manufacturers of these products prepare and make available OSHA material safety and data sheets (MSDS) which indicate hazardous substances present and appropriate safety measures for handling them.

2.3 **General Principles Involved in Making Repairs**—In order to make satisfactory repairs, the following general principles should be observed:

- Determine if the damage requires repair, using criteria in the latest edition of the IICL/ICS *Guide for Container Equipment Inspection*.
- If the damage requires repair, determine the most economical type of repair that will correct the defect satisfactorily. Do not perform a repair more extensive or involved than is necessary to achieve a satisfactory result,

unless doing so will be more economical to perform than a simpler repair.

- Select the appropriate tools and arrange supports and other fixtures as necessary for the repair job.
- Temporarily remove, relocate or shield any nearby undamaged components that could become damaged in the repair process, particularly wooden flooring which is highly susceptible to burn damage.
- Proceed with the repair as described in the appropriate section below. Ensure that any new metal components that will not be exposed after repair is complete are cleaned and primed before covering them.
- Ensure that, once painted, the finished repair will be of satisfactory cosmetic appearance. If not, correct any flaws before painting.
- If the paintwork is broken on existing metal, or if a new metal piece is to be installed, prepare the surface of metal components for painting by cleaning and priming, as described below under "surface preparation".
- Apply top coating (including undercoating for the underside of replacement flooring) to exposed surfaces. (*EXCEPTION:* The *interior* side of panel patches and inserts do *not* need to be top coated, unless the owner so requires.) Once coating is dry, replace markings required by regulations, ISO standards and owners as necessary.
- Put back any temporarily removed or relocated components into place, and remove any shielding or other temporary fixtures.

2.4 **Replacement Quality**—After repair, the strength of the repaired area should be greater than or equal to the original. Materials and parts used should be equal to ("like-for-like") or of higher quality, strength and thickness than the original. If the original material is Corten (corrosive-resistant high-strength low-alloy steel conforming to Japanese Industrial Standard G3125 or its equivalent) or other material with special chemical properties, that material must be used in replacement. If there is any doubt as to the type of material used in a container, consult the owner. If the original type of steel is unknown, use Corten steel to repair panels, since it has both high-tensile and corrosion-resistant properties. Welding material must be at least as strong as the parent materials being welded (see Section 2.7, Welding).

Fasteners used for repair must have shear strength and material composition equivalent to the original fasteners replaced. If applicable, fasteners must also conform to customs (TIR) requirements. Dissimilar metals (*i.e.* aluminum/steel) should be avoided in attachments to minimize electrolysis; use barrier material to separate dissimilar metals if they must be placed together. In case of any doubt as to which fasteners to use, consult the owner.

2.5 **Surface Preparation**—Upon completion of any repair that damages the original surface coating, the repaired areas must be cleaned and prepared for painting.[1] All weld smoke, spatter, rust, burned and loose paint, grease and grit must be removed to allow proper adhesion of the coating material. Grease or oil should be removed with a cleaning solvent. Painting equipment and cans should be cleaned and cleaning agents and other residues disposed of in a manner consistent with local environmental regulations and painting equipment suppliers' recommendations.

[1] For more detailed information on surface preparation, see IICL's *Specifications for Steel Container Refurbishing,* latest edition.

A grinding disc, abrasive blasting, a chemical cleaner, or a combination of these should be used to remove other contaminants, and to provide a suitable "anchor profile" for proper adhesion of paint (consult owner or paint supplier for more detailed advice). Abrasive blasting to a minimum of Swedish Standard SA 2½ (or, on the underside, SA 2) is strongly recommended. Steel sheet that is pre-blasted and pre-primed by the steel supplier is recommended for large repairs (one panel sheet of 122 x 244 cm [4 x 8 ft] or greater in size). Handling of blasted panels must be minimized to prevent them from being exposed to skin oils and dirt.

Areas inaccessible to blasting should be cleaned before priming; use a needle gun or a mechanical wire brush. Burned paint edges should be feathered and the cleaned area marked off with masking tape in a square or rectangular pattern.

After surface preparation, repairs to steel components should be primed and painted as soon as possible. See Section 2.9 for further details regarding painting.

Photo 2.1 shows the result of proper abrasive blasting of a panel patch. Photo 2.2 shows how inadequate surface preparation during repair can eventually lead to corrosion. Photo 2.3 shows a panel patch prepared for painting by grinding and wire-brushing. Note that welds as well as parent metal must be properly cleaned and prepared.

2.6 **Tools**—Before beginning any repair work, ensure that the proper tools are at hand to perform the required job. Examples of tools commonly used are mechanical tools, such as hammers, chisels and hydraulic jacks; cutting tools, such as oxygen-acetylene torches, plasma cutters, disc cutters and circular wood saws; grinding tools; painting equipment, such as airless spray pumps and guns; and cleaning equipment, such as abrasive blasters, needle guns and wire brushes. Tools should always include measurement devices, such as measuring tapes and sticks and paint thickness gauges, which are needed to verify alignments and successful completion of repairs. Paint thickness gauges that measure dry-film thickness are always necessary, and gauges that measure wet-film thickness are also necessary if "wet-on-wet" paint applications are performed (see Photo 2.34). Properly aligned jigs and fixtures aid in ensuring maintenance of ISO and other required dimensions.

2.7 **Welding**—All welding must be done by qualified welders, using materials (welding rods, steel sheet, etc.) equal to those used in the manufacture of original equipment. If the weld materials are unknown, follow the recommendations in Table 2.1, making sure the welding wire or rod has a minimum yield point of 46 kg/mm² (65,000 psi) or greater. Welding should conform to requirements of recognized technical societies such as the American Welding Society, British Standards, etc. Reference to *Welding Inspection* (published by the American Welding Society) may be helpful.

Integrity of welds usually can be verified by visual inspection. A magnifier is useful. The inspection should determine that the weld is:

- watertight and free of porosity
- smooth in appearance (no roughness, weld spatter, etc.)
- free of craters
- dimensionally accurate (including warpage)
- free of undercutting

TABLE 2.1: WELDING DATA SHEET

STEEL GRADE	DIN NUMBER	AWS NUMBER	WELDING SYSTEM	ELECTRODE/WIRE OR ROD DIAMETER (MM)	GASES	ELECTRODES DIN	ELECTRODES AWS
Mild (MS)	1.0114		MIG	1.0 - 1.2	Argon 82% CO_2 18%	UNION K56	ER70-B6
High-Tensile (MTS)	1.0841		MIG	1.0 - 1.2	Argon 82% CO_2 18%	UNION K56	ER70-B6
Muffler-Grade (MG)	1.4512		MIG TIG	0.8 - 1.0 1.0/2.4	Argon 97.5% Argon 100%	1.4370 1.4370	E307 E307
Stainless (SS)	1.4301		MIG TIG	0.8 - 1.0 1.0/2.4	Argon 97.5% Argon 100%	1.4370 1.4316	E307 E308L
Corten A	8559	5.18	MIG	A) 1.0 - 1.2 mm wire (use with 4.5 mm & thicker steel) B) 0.9 mm wire (use with 1.9 mm - 4.5 mm steel) C) 0.6 mm wire (use with up to 1.9 mm steel)	Argon 80% CO_2 20%	1913	A5.1

Inspect to assure full weld penetration. If welding one side of the joint does not achieve full weld penetration, both sides of the joint must be welded. This visual inspection procedure should not supersede more sophisticated procedures, if needed, for the repairer to be satisfied with weld quality. Non-destructive testing techniques—based upon magnetic particle, liquid penetrant, radiographic or ultrasonic eddy current—may be used, although they may be beyond the capability of many repair facilities. All weld slag and spatter must be removed when using the arc welding electrode process.

Completed welds should *not* be ground smooth unless failure to grind the weld prevents proper mating of the repaired areas (for example, unground top rail section butt welds may obstruct mating of top rail to roof panel).

For additional recommendations about welding, see the Table 2.1, Welding Data Sheet. Also see the Glossary for definitions of welding terminology.

2.8 **General Repair Procedures**—Sections 2.8.1 - 2.8.5 describe step-by-step procedures for five different types of repairs common to all steel components of the container. When determining what type of repair is most appropriate for a component requiring repair, consult the section of the manual pertaining to that component to see which of these repair methods are recommended (*certain types of repair are not recommended by IICL for some components*).

Throughout this manual, the following terms will be used to designate types of repairs:

- ***Straightening:*** To mechanically or hydraulically restore a damaged component as close as possible to its original shape without removal of any portion of the component (although in certain cases adjacent components may have to be unfastened from the component being straightened).
- ***Welding:*** To fuse two separated pieces of metal together using heat and a third piece of metal.
- ***Straightening and Welding:*** A combination of straightening followed by welding.
- ***Inserting:*** To restore a damaged component to its original size, shape and strength by cutting out a portion of the component that is less than the full-profile section and welding or fastening replacement material of the original size, shape and strength in place. The replacement part itself is called an insert.
- ***Patching:*** The same as inserting, except that the replacement material is slightly larger than the material being removed, and its edges overlap the parent material. The replacement part itself is called a *patch*. NOTE: Patching is only allowed for *panels*, and may substitute for inserting those components. For all other components, patching is **not** permitted unless otherwise stated in this manual.
- ***Sectioning:*** To restore a damaged component to its original size, shape and strength by cutting out a portion of the component that extends through its full profile and welding or fastening replacement material of the original size, shape and strength in place. The replacement part itself is called a *section*.
- ***Replacement:*** To remove an entire damaged component and weld or attach a complete new component of the original size and strength. (In some cases, a different shape may be permitted).

All definitions above apply to components made up of a single-piece section, such as a pressed crossmember or a one-piece front corner post.

Because of the flat profile of side, roof and door panels, inserts and sections of these components generally mean the same thing. In the case of panels, therefore, the term *insert* will be used to cover both inserts and sections.

Composite components (like door headers and rear corner posts) are made by welding single-piece sections together to form the full profile. Inserts may be allowed in the constituent single pieces, but it is not recommended to attempt to place a single insert spanning more than one piece. *EXCEPTION*: A single insert that extends through more than one adjoining panel sheet is acceptable. While sections rarely, if ever, are allowed through the entire built-up profile of a component, they may be allowed through a constituent single-piece section. See details for each component in the corresponding section of this manual.

For additional definitions of repair terminology, refer to the Glossary.

2.8.1 **Straightening**—Whenever possible, straighten any dents or other distortions to the component by hydraulic or mechanical means without heat. If heat must be applied, the steel should only be heated in the damaged area and must not be heated beyond a dull cherry-red color, corresponding to approximately 650°C (1200°F). Use a former with the correct profile as a backing to straighten corrugated panels. Some components may require bracing for this procedure. ***Never*** *use a ball-peen or other round-head hammer to straighten components.* Whatever method used must not adversely affect the structural integrity of the component nor restrict its safe operation. The completed repair must be cosmetically acceptable. If the paint film of any component is damaged as a result of the repair, clean and coat the component according to the recommendations given in Sections 2.5 and 2.9.

When straightening **panels**, including side/front, roof and door panels, the following additional precautions should be observed:

2.8.1.1 ■ Tools used for straightening: Dents to panels may be straightened without heating by using a jack; a flat hammer or mallet and backing plate; or by a combination of these methods. For a backing plate, use a heavy flat object such as a dolly, former or mandrel which may be shaped to fit into the corrugation.

2.8.1.2 ■ Straightening with a jack: When using a jack on the side panels, the opposite side of the container is normally used to support the jack. The base of the jack should be placed on a board of sufficient size and thickness across several corrugations on the opposite side to spread the load and to reduce the pressure per unit of area. This will prevent damage to the opposite side during the repair process. A flat hammer also may be used on the exterior side to complete the straightening. See Photo 2.4.

2.8.1.3 ■ Straightening with a flat hammer: If a flat hammer and backing plate are used, the concave side of the dent should be supported by the backing plate. The convex side of the dent is forced back into the flat surface of the backing plate using the flat hammer. If a proper backing device is not used, multiple hammer marks may be left in the panel. This is unacceptable; it weakens the panel, does not restore the area as close as possible to its original profile, and results in an unacceptable cosmetic condition. See Photos 6.1 - 6.4.

2.8.2 **Welding or Straightening *and* Welding**—Fractures, cracks, cuts or tears in a component or a weld joining components can, in many cases, be repaired by welding or a combination of straightening and welding. Straighten the damaged area, if necessary, as described above in Section 2.8.1. The following limitations apply:

- The maximum length of any crack, fracture, cut or tear that may be welded is 200 mm (8 in), and the maximum width of separation is 5 mm (3/16 in).
- A crack, fracture, cut or tear may **not** be welded if it penetrates more than 50% of the height of a rail, crossmember or other horizontal structural component.

If the gap between the damaged edges is too great to meet the acceptable separation criterion, or if a crack is either too long or too wide as indicated above, even after straightening, then the damaged area must be removed and fitted with an insert, section or replacement component, as appropriate.

If welding up a crack, drill stop holes at each end of the crack to prevent it from propagating. Weld edges together using the correct welding material (see Table 5.1) for the parent metal being joined; if the parent metal is unknown, use welding material with a minimum yield point of 46 kg/mm^2 (65,000 psi).

2.8.3 **Inserting and Patching**—Damage to steel components that cannot be repaired by straightening, welding or straightening *and* welding can, in many cases, be repaired by installing an insert or, in the case of panels, an overlaying patch. All limitations or additional recommendations applying to the specific component requiring repair (shown in the section of this manual dealing with that component) must be observed.

The recommended general procedures for installing an insert or patch follow. When a procedure is applicable only to an insert or only to a patch, the term *insert* or *patch* is shown in *italics* below. Accompanying photos show how to perform *inserts* using the example of an insert in a side panel.

2.8.3.1 Determine the length of the original component to be removed. Mark where the cuts are to be made and shield or temporarily remove any nearby wooden components to protect against burning damage. Detach or free-up any adjoining components as necessary. Remove the damaged area by flame-cutting with an oxygen-acetylene torch or by disc grinding. When installing an *insert*, guide bars can be positioned and tack-welded to ensure straight cuts; this will avoid creating excessive gaps between the replacement insert and the remaining portion of the component.

Photo 2.5 shows marking and disc cutting of a panel.

2.8.3.2 Straighten the remaining edges of the adjoining area. Clean and smooth all cut edges with a grinding disc. When installing a *patch*, grind the existing panel to bare metal 20 mm (3/4 in) from the cut edges on the exterior side. This will provide a clean, smooth surface for the exterior patch weld.

2.8.3.3 Cut to size and clean the replacement insert/patch. The replacement material must have the same profile as the original and be of the same or higher quality, strength and thickness.

Inserts must be fitted flush with the existing component and should be fabricated to allow no more than 2 mm (5/64 in) clearance between adjoining

surfaces. If the insert will be lapped over by a panel (for instance, by a roof sheet in a top rail insert), it should be cleaned and primed before installation.

Patches should overlap the existing panel on the exterior by 13 mm (1/2 in). In the case of corrugated panels, they should be fabricated oversize to allow them to "nest" into the original corrugations. Installation of *patches* must not cause the component to fall outside ISO dimensions; this is particularly important for *roof* patches.

2.8.3.4 Fit the insert or patch into place. If installing an *insert*, ensure that the clearance between surfaces is no more than 2 mm (5/64 in), and that the insert is flush with the adjoining area. If installing a *patch*, fit over the cut-out area from the exterior side. Photo 2.6 shows proper fitting of a panel insert into place.

If repairing a frame component (rails and posts), bevel adjoining surfaces for components to a combined 60° angle (30° angle from the perpendicular on each side of the joint) to ensure complete weld penetration.
EXCEPTION: When an *insert* extends to a corner fitting, the edge of the insert should be beveled to a 45° angle from the perpendicular, and the corner fitting *should not be beveled at all*. NOTE: The perpendicular is the vertical for rails and the horizontal for posts.

2.8.3.5 Tack weld in position, check alignment (for frame components) and continuously weld the insert or patch on the exterior. Ensure that *insert* welds fully penetrate the panel to the interior side. It may be necessary to grind off sufficient weld bead to assure proper alignment.

Photo 2.7 shows an insert tack welded in position, and Photo 2.8 shows the insert continuously welded. Photo 2.9 shows complete penetration of the welds to the interior side.

If a *patch* is fitted, flatten down the interior cut-out edges of the panel against the patch.

Reinstall any temporarily detached components and remove any shielding used during the repair.

2.8.3.6 Clean, mask, prime and top coat the repaired area according to Sections 2.5 and 2.9. The interior side of panel inserts and patches does not require top coating (unless required by the owner), but must be cleaned and primed. After the paint dries fully, apply sealant around the entire perimeter of the cut-out hole covered by the patch on the interior side.

Photo 2.10 shows a properly masked and primed insert repair. Photo 2.11 shows the repair completed including top coating. Note the neat condition of the painting.

2.8.4 **Sectioning**—Damage to steel components that cannot be repaired by straightening, welding or straightening *and* welding, or inserting/patching can, in some cases, be repaired by installing a full-profile section. Consult the section of this manual pertaining to the specific component requiring repair to see if sectioning is permitted in that component. All limitations and additional recommendations applying to installing sections in specific components, which are listed in the sections of this manual dealing with those components, must be observed.

The recommended general procedures for installing sections follow.

Accompanying photos show how to perform sections using the example of a section in tube-type top side rail.

2.8.4.1 Determine the length of the area to be replaced. Mark where cuts are to be made. If necessary, support the area to avoid any distortion before cutting.

2.8.4.2 Detach or free-up any adjoining components. Shield or temporarily remove any nearby wooden components to protect against burning damage. Cut the damaged area from adjoining components and from the undamaged portion of the component with a torch or disc cutter. Grind all cut areas smooth and clean.

Photo 2.12 shows the damaged area removed in a top side rail section repair. Photo 2.13 shows jacking of the roof sheet to provide clearance for cutting and rewelding of the section.

2.8.4.3 Cut to size and clean the replacement section. Replacement material must have the same profile as the original and must be of the same or higher quality, strength and thickness. The replacement section must fit flush with the remaining rail profile. Allow no more than 2 mm (5/64 in) clearance between the adjoining edges to be butt welded. Bevel adjoining surfaces for components to a combined 60° angle (30° angle from the perpendicular on each side of the joint) to ensure complete weld penetration.
EXCEPTION: When a section extends to a corner fitting, the edges of the section that mate with the corner fitting should be beveled to a 45° angle from the perpendicular, and the corner fitting *should not be beveled.*

Photo 2.14 shows a tube-type top side rail section cut to size, cleaned and beveled, ready for installation.

2.8.4.4 *Before* installation, prepare the surface of the portion of any section to be overlapped when repairs are completed (for example, by a roof sheet or the floor) by cleaning and priming. Fit the replacement section into position. Ensure that the clearance between surfaces is no more than 2 mm (5/64 in), and that the section is flush with the adjoining area.

2.8.4.5 Tack weld and check alignment. Ensure that ISO dimensional tolerances are maintained (see Appendix A, ISO Dimensions and Tolerances). Photo 2.15 shows a tube-type top side rail section tack welded into place.

2.8.4.6 Continuously weld the section to the original component. Ensure full weld penetration making multiple passes as necessary, paying particular attention when sectioning flat-bar top rails. Photo 2.16 shows a tube-type top side rail section continuously welded in place. Photo 2.17 shows continuous welding of the same component on the interior side. Unless full penetration of welds from one side to the other can be achieved, both sides must be continuously welded. Additional photos showing proper welding of flat-bar top side rail sections are provided at the end of Section 5.

2.8.4.7 Grind off sufficient weld bead to assure proper alignment with adjoining components. Clean and prime any area that will be inaccessible after re-assembly of temporarily detached components. Reinstall the temporarily detached components and remove any shielding used during the repair.

2.8.4.8 Clean, mask, prime and top coat the repair according to Sections 2.5 and 2.9. Photos 2.18 and 2.19 show properly primed interior and exterior surfaces, respectively, of a tube-type top side rail section. Photo 2.20 shows the completed repair, including top-coating of the exterior. Note the neat, squared-off appearance of the top-coated area.

2.8.4.9 Apply sealant along interior seams if necessary.

2.8.5 **Replacement**—Steel components that cannot be repaired by straightening, welding or straightening *and* welding, inserting/patching or sectioning should be replaced.

Accompanying photos show how to replace a component, using as an example the replacement of a front corner post.

NOTE: The following section refers to replacement of *steel* components. For floor components or other non-steel component replacement, see the section of this manual relevant to the specific component to be replaced.

2.8.5.1 Detach or free-up any adjoining components. Remove and set aside any attached reusable components, such as roof bows, brackets, lashing rings, etc. Shield or remove any nearby wooden components to protect against burning damage. Using an oxygen-acetylene torch or disc cutter, cut out the damaged component. Take care not to damage any adjoining components; if repairing a component near the floor, shield or remove the floor before cutting to prevent damage from burning.

Photo 2.21 shows the use of an oxygen-acetylene torch to cut out a full-height corner post to be replaced. Note the workman pointing the tip of the cutting torch in the direction of travel so as to preheat the metal to be cut.

2.8.5.2 Remove the damaged component and grind all cut areas smooth. Clean and remove any old sealant or paint from areas to be welded.

Photo 2.22 shows the damaged post removed and the cut areas ground smooth.

2.8.5.3 Check alignments (if applicable) to ensure that ISO dimensional tolerances are maintained (see Appendix A, ISO Dimensions and Tolerances).

2.8.5.4 Measure and cut the replacement component to the proper length. Replacement material must have the same profile as the original and must be of the same or higher quality, strength and thickness.

2.8.5.5 Clean the replacement component. Bevel the edges to be welded to adjacent components to a 45° angle, in order to allow complete weld penetration. Do *not* bevel corner fitting surfaces.

Before installation, prime any areas which will be overlapped or covered by a panel or by the floor. Fit the replacement component in place. Allow no more than 2 mm (5/64 in) clearance between adjoining edges.

Photo 2.23 shows a replacement front corner post being fitted into place.

2.8.5.6 Tack weld the replacement component in position and check alignment. Ensure that ISO dimensional tolerances are maintained.

Photo 2.24 shows a replacement post tack welded in position.

2.8.5.7 Continuously weld into place the new component and any adjoining welded components previously detached. Any components which were detached, removed or freed-up by any means other than welding must be reinstalled as applicable, and any shielding must be removed.

Photo 2.25 shows a replacement corner post continuously welded into place. Photo 2.26 shows a detail of the welding in the critical area adjoining the corner fitting. Photo 2.27 shows skip welding of the interior side of the lap joint between a front corner post and the end of the side panel. Lap joints of corner posts must be skip welded on the interior side; lap joints of panel patches may be skip welded and caulked or simply caulked on the interior. Use the remaining post[s] to determine proper pitch and length of the skip welds.

2.8.5.8 Clean, mask, prime and top coat the interior and exterior of the repaired area according to Sections 2.5 and 2.9. *NOTE:* The interior side of a repaired panel does not have to be top coated unless required by the owner. See Section 2.9 for further details.

Photo 2.28 shows the priming of a replacement front corner post. Photos 2.29 and 2.30 show the completed, top-coated post on the exterior and interior, respectively.

2.8.5.9 Apply sealant (where applicable) along interior seams.

2.9 **Painting and Marking**—Areas that will be overlapped by another component when the repair is completed must receive surface preparation (see Section 2.5) and priming *before* the overlapping component is fitted. Such areas include the portion of a panel to be covered over by a patch, the uppermost flanges of roof bows, the inside of stiffening channels, etc.

For all other components, repairs must include surface preparation, priming and top coating of all new metal and the original metal whose paint film has been broken. Both prime and top coat the cleaned area with owner-approved paint or use an owner-approved one-coat combination coating that includes a rust inhibitor. *EXCEPTION:* The interior side of panel patches and inserts and new panels may be primed with rust-inhibitive primer designed for use *without a top coat.* Such a primer must be able to withstand contact with, and not contaminate, cargo (compliance with U.S. Food and Drug Administration [FDA] requirements recommended). Alternatively, the interior side of panels may be primed and top coated with an FDA-compliant top coat. Note that certain primers, such as zinc-rich epoxy primer, must be top-coated or they will oxidize and deteriorate.

Top-coat color must match owner's specifications; primer should have a contrasting color. The primer and top coat used must be compatible with that originally applied to the container and with each other. Follow the paint manufacturers' recommendations for coating application and dry-film thickness.

Completed and painted repairs should have a neat appearance. To achieve this condition, it is recommended to square off and mask areas to be painted. Photo 2.31 shows application of masking. Photo 2.32 shows completion of priming within the masked area. Photo 2.33 shows the neat appearance of the repair after painting and removal of masking.

Ensure that film thickness of each coat meets requirements by measuring

dry-film thicknesses (wet-film thickness of any coat that will be overcoated before drying is complete). Photo 2.34 shows the use of an electronic dry-film thickness gauge. This is especially important for panels, because the corrugation profile may make paint application more difficult than on flat surfaces.

Lastly, decals and other markings must be replaced as required by the owner and applicable standards and regulations. Legible marking plates should be reused unless the owner specifies otherwise. Do not apply decals and plates until the paint is fully dry to the touch.

Due to tightening environmental regulations, water-borne paints may be in use in some repair shops, and may be required by some container owners. Use only paints which meet local environmental requirements, such as regulations specifying the maximum permitted amount of volatile organic compounds (VOC's).

2.10 **Non-Conforming ("Improper") Repairs**—*Non-conforming repair* is a condition resulting from a repair not being performed in accordance with IICL recommendations. This condition is often called "improper repair". Depending upon the condition observed, the non-conforming repair may be considered unacceptable, requiring correction, or acceptable, requiring no corrective action. Individual owners should be consulted for guidance with respect to correction of these conditions.

Leased containers present special problems in regard to non-conforming repairs. Non-conforming repairs performed after delivery of the container to the user may have to be corrected, at owner's discretion, upon redelivery of the container by the user to the owner's depot. Sometimes a non-conforming repair that is discovered upon redelivery was performed before delivery of the container to that user. On-hire documentation or obviously advanced age of the repair may indicate that a non-conforming repair preceded the present use of the container. Depending upon the nature of the non-conformance, whether the repair presents a safety hazard and owner's policies, some non-conforming repairs must be corrected by repairing again, while others may require no action. Consult the owner in order to find out whether a particular non-conforming repair must be corrected. Further guidance on the correction of improper repairs may be found in the *IICL Supplement on Container Inspection and Repair: Gray Areas.*

2.11 **Quality Assurance and Management**—A quality assurance program assists depot management to ensure consistently satisfactory repair quality. Such a program may include checking materials received for use in repairing containers, verifying that proper preparation, authorization and repair activities take place, and ensuring proper completion of repair orders before the container is returned to service. The need for repairers' own quality assurance programs is not superseded by audit programs conducted by container owners and/or users.

The adequacy of quality assurance procedures may be demonstrated by obtaining registration by an accredited registrar for ISO 9000 process control standards. These standards have been published by the International Organization for Standardization (ISO). Even if ISO 9000 registration is not obtained, voluntary conformance with ISO 9000 procedures may aid the repairer in simplifying operations, minimizing correction of non-conforming repairs, and winning owner and user confidence.

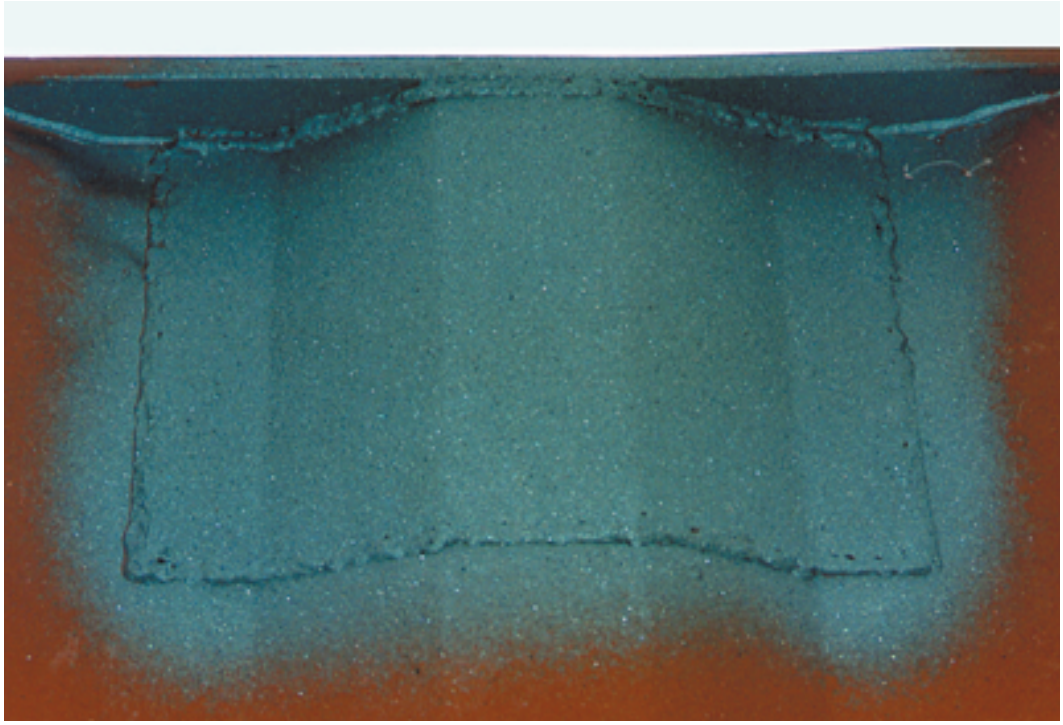


Photo 2.1 / Abrasive blasting of panel patch before priming

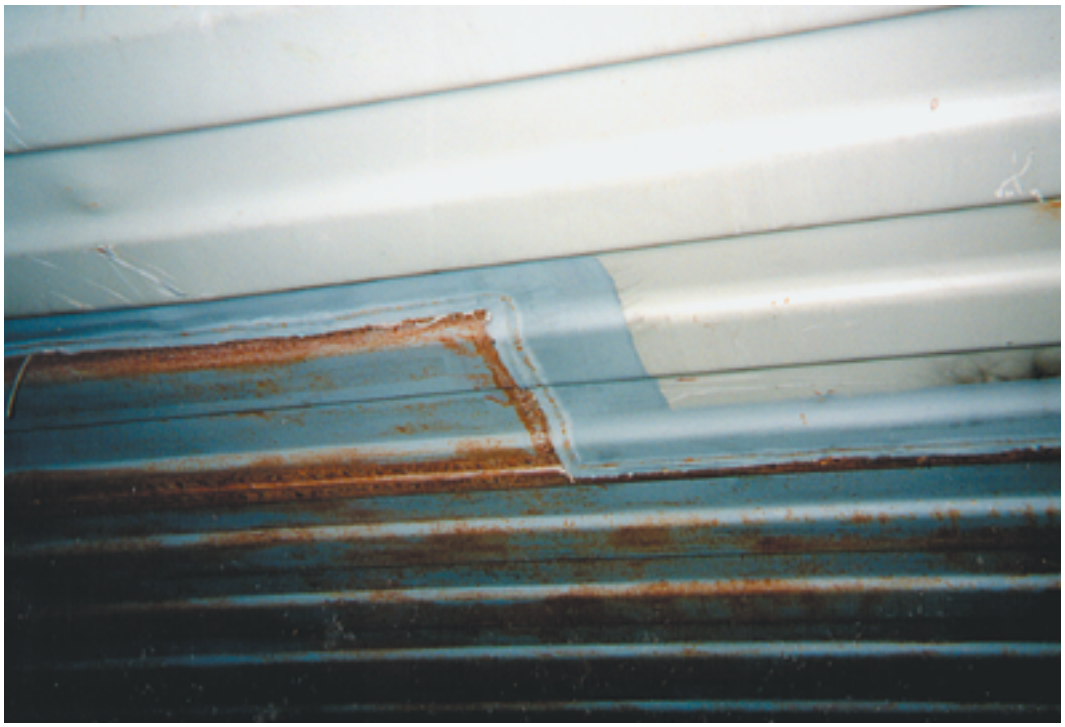


Photo 2.2 / Corrosion due to improper surface preparation of roof panel patch

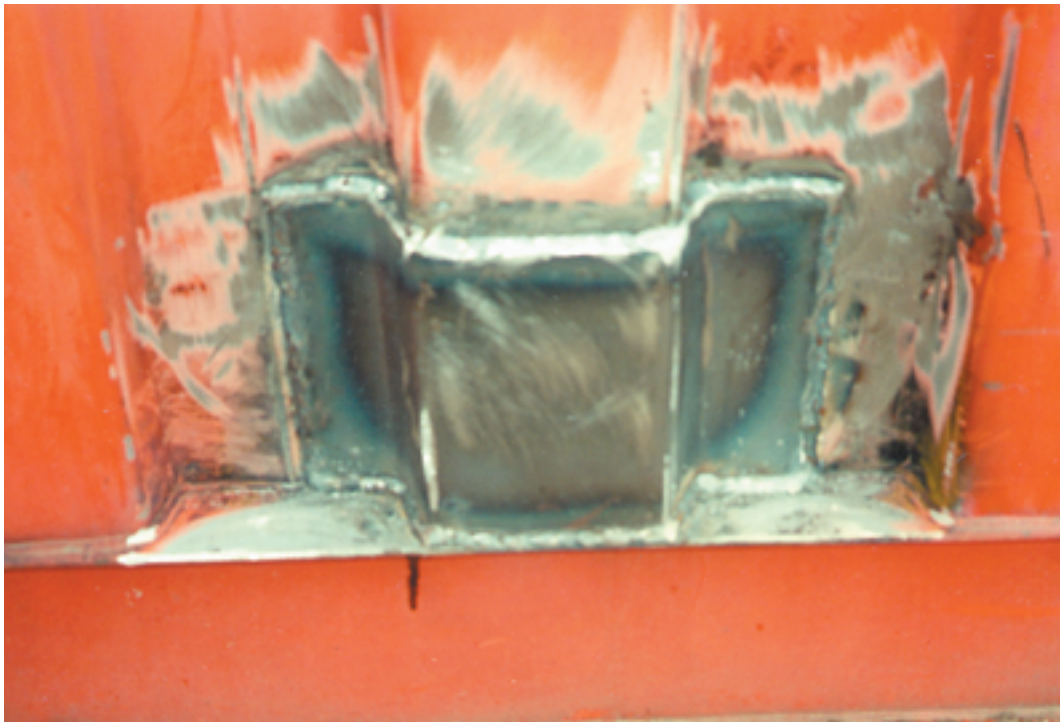


Photo 2.3 / Preparation of a panel patch by grinding and wire-brushing (note clean, bright weld condition)

Photo 2.4 / Using a jack with a backing plate to straighten a side panel

Photo 2.5 / Removing a portion of panel using a disc cutter (disc grinder)

Photo 2.6 / Panel insert fitted into place (before welding)

Photo 2.7 / Panel insert tack welded in position

Photo 2.8 / Panel insert continuously welded

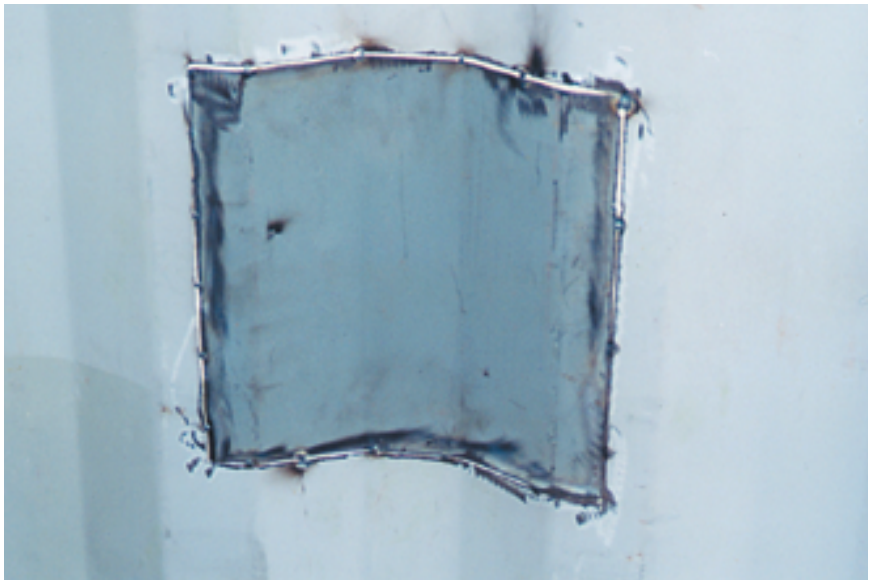


Photo 2.9 (to left) / Full penetration of continuous panel insert weld to interior side

Photo 2.10 (to right) / Masking and priming of panel insert repair

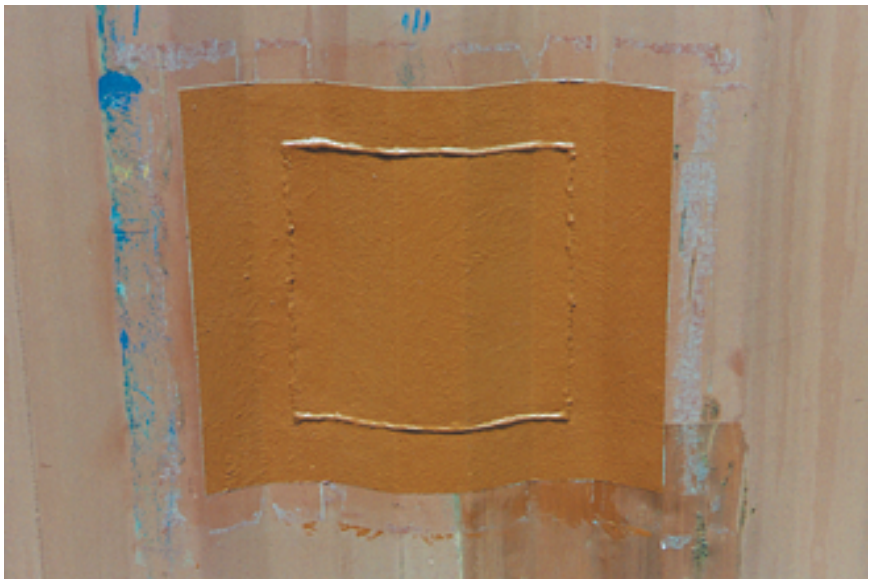


Photo 2.11 (to left) / Completed panel insert repair, fully top coated

Photo 2.12 (to right) / Damaged top side rail area removed before installing a new section. Note that the roof panel has been detached beyond the edges of the removed area, and the edges of rail have been beveled.

Photo 2.13 (above) / Jacking up of roof sheet to provide clearance for removal of damaged material and rewelding of top side rail section

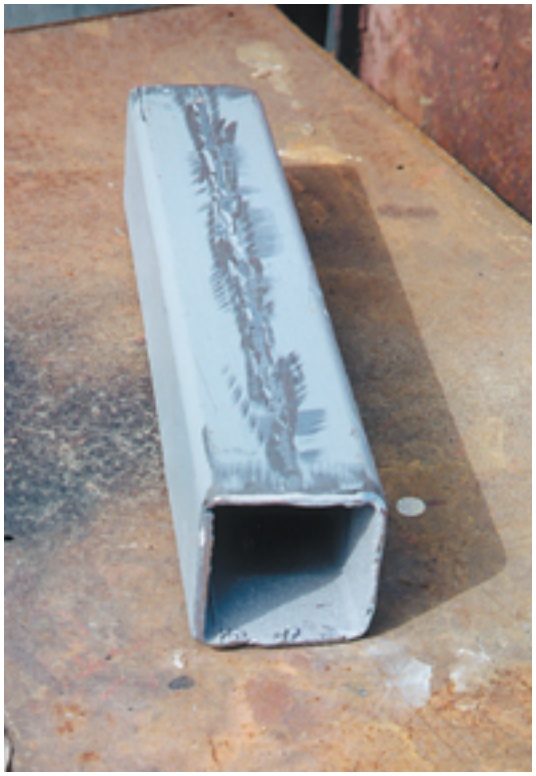


Photo 2.14 (to right) / Tube-type top side rail section cut to size, cleaned and beveled

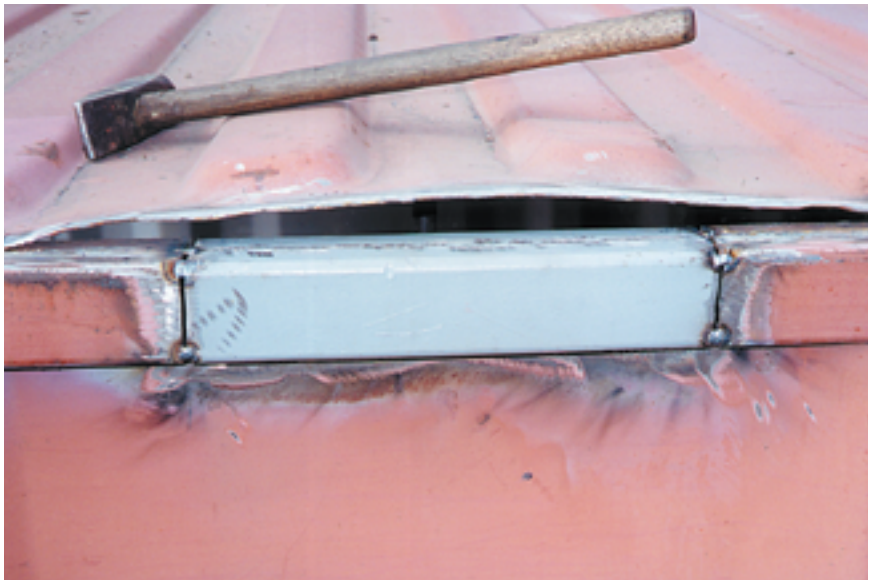


Photo 2.15 (to left) / Tube-type top side rail section tack-welded into position

Photo 2.16 (below) / Tube-type top side rail section continuously welded (exterior view)

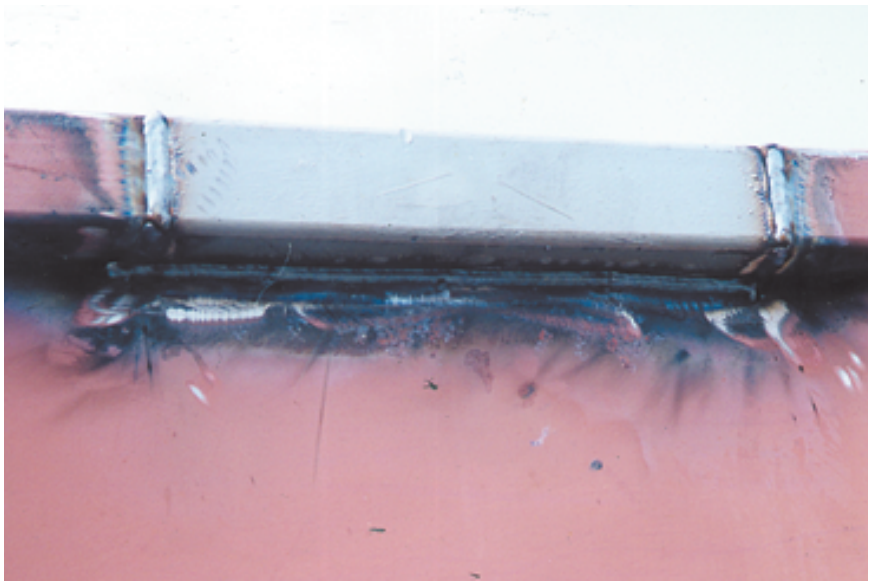


Photo 2.17 (to right) / Tube-type top side rail section continuously welded (interior view)

Photo 2.18 (to right) / Priming of tube-type top side rail section and adjacent surfaces on the interior. NOTE: For a neater finished appearance after painting, mask a rectangle around the area to be primed and top coated before paint is applied.

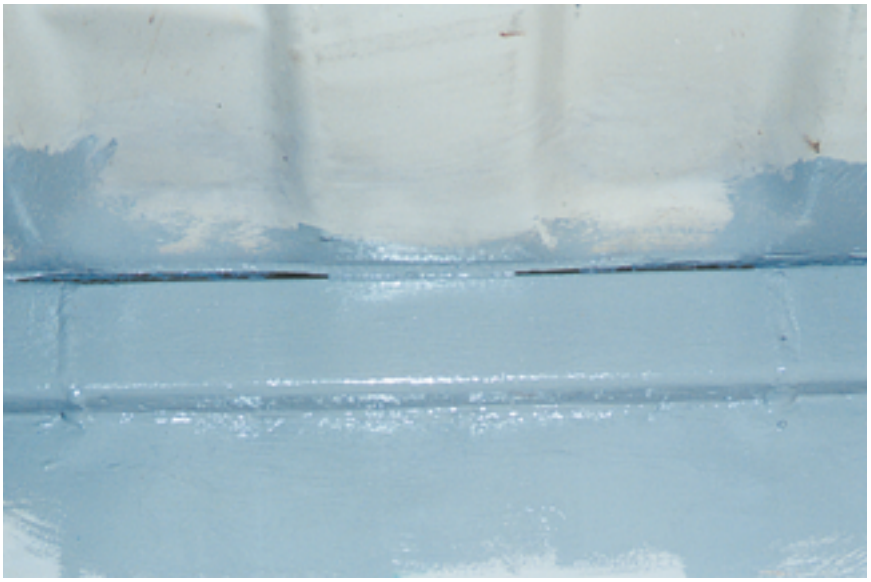


Photo 2.19 (below) / Priming of tube-type top side rail section and adjacent surfaces on the exterior. See note above for Photo 2.18.

Photo 2.20 (to left) / Top-coating of tube-type top side rail section and adjacent surfaces on the exterior. See note above for Photo 2.18.

Photo 2.21 / Cutting out a front corner post using an oxygen-acetylene torch. Note that the torch is being pointed in the direction of travel, to preheat the metal to be cut.

Photo 2.22 / Removal of corner post showing cut edges ground smooth

Photo 2.23 / Fitting a replacement corner post into place

Photo 2.24 / Tack welding replacement front corner post in position

Photo 2.25 (to right) / Front corner post continuously welded in place

Photo 2.26 (below) / Detail of front corner post welding adjacent to corner fitting

Photo 2.27 (to right) / Skip welding of interior of corner post/ panel lap joint

Photo 2.28 / Priming of replacement front corner post

Photo 2.29 / Top coating of replacement front corner post (exterior)

Photo 2.30 / Top coating of replacement front corner post (interior)

Photo 2.31 / A section repair to a bottom rail has been squared off with masking tape and priming has begun.

Photo 2.32 / The same repair, with priming completed within the masked-off area.

Photo 2.33 (to left) / Top coating of bottom rail section completed.

Photo 2.34 (to right) / Use of an electronic dry-film paint thickness gauge

SECTION 3 CORNER FITTINGS

3.1 **General**—Corner fittings are the key components through which the container is handled. Since each fitting may have to handle up to one-half the container maximum gross weight in the lifting mode, filling of cracks, etc., is **not** permitted. *Corner fittings may be repaired **only** by replacement.* Extra care must be taken to ensure proper placement of fittings to ISO specifications; *no allowance beyond the dimensions defined by ISO standards is allowed.* See Appendix A, ISO Dimensions and Tolerances.

Before undertaking any repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

3.2 **Corner Fitting Replacement**—To replace a corner fitting, cut out the damaged fitting with an oxygen acetylene torch as described in Section 2.8.5. Carefully grind all existing welds back to base metal with a disc grinder. To ensure complete penetration of welds, parts adjacent to connections should have their edges ground to a 45° bevel and be positioned with gaps of no more than 2 mm (5/64 in) before welding. *Do not bevel the corner fitting itself.* When possible, connections to the fitting should be fully welded on both sides of the joint. Welds must be uniform, free of scale, pin and blow holes, and with full penetration.

All welds to corner fittings should be made with low-hydrogen welding rods or wire in order to minimize any chances of hydrogen embrittlement in the weld. Embrittlement may lead to failure in time. Low-hydrogen welding rods and wire must be kept dry and stored in a dry place in order to keep the protective flux coating intact, and, if exposed to moisture, carefully dried with heat before use. Typical low-hydrogen material in use for corner fitting welding includes AWS E7016 and E7018 electrodes.

Upon completing installation of replacement corner fittings, clean, prime and top coat the fittings in a color that matches that of adjoining components. See Sections 2.5 and 2.9 for recommendations on surface preparation and painting.

To ensure proper engagement of container handling devices, it is important that the distance between aperture centers be maintained within the tolerances recommended by ISO. Care must also be taken to assure that the fitting height, measured between the top and bottom corner fittings, is within ISO dimensional tolerances and that the fitting is properly positioned horizontally.

SECTION 4 CORNER POSTS

4.1 **General**—Corner posts are vertical structural members at either side of the end frame of a container extending between top and bottom corner fittings. In order to maximize cubic capacity of the container and the width of the door opening, the front corner posts (opposite from the door end) are shaped differently from the rear corner posts (at the door end).

Commonly, front posts are made of a single piece of steel in a flat-square or corrugated-square ("serpentine") profile. Less commonly, a flat-square front corner post may be reinforced on the inside of the profile with a second inner post.

Rear corner posts, on the other hand, are nearly always made of at least two pieces: an outer sheet and a pressed or rolled channel reinforcement. The channel itself and/or the outer sheet may be further reinforced with one or more flat bars. An extension of the outer sheet lies rearward of the edge of the channel to encircle the door hinges; the extension is called a J-bar because its section resembles the letter "J".

Because of their different profiles, front and rear posts are subject to different repair requirements:

Inserting is permitted on the outer and inner profiles of a front corner post and the outer profile and J-bar portion of the rear corner post. Sectioning is permitted **only** on the outer profile of a rear corner post, including the J-bar portion. *Neither inserting nor sectioning is allowed on the **inner** profile of the rear corner post. No full-profile sectioning of any kind is allowed on front corner posts, in order to maintain structural integrity.*

Before undertaking any repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

4.2 **Straightening Front and Rear Posts (Including J-Bars)**—To straighten corner posts, follow the procedures recommended in Section 2.8.1 on page 8. In a rear corner post, or a double-skin front post, straighten all parts of the assembly together without disassembly. If that is not possible, disassemble the post, straighten the components and reweld.

4.3 **Inserting in *Front* Corner Posts**—Damage to a front corner post that cannot be repaired by straightening may be repaired by replacing the damaged area with an insert, *provided* it can be accomplished within the limitations listed below in Section 4.3.1. Otherwise, the post must be replaced.

Photos 4.1, 4.2 and 4.3 all show acceptable front corner post inserts. It is

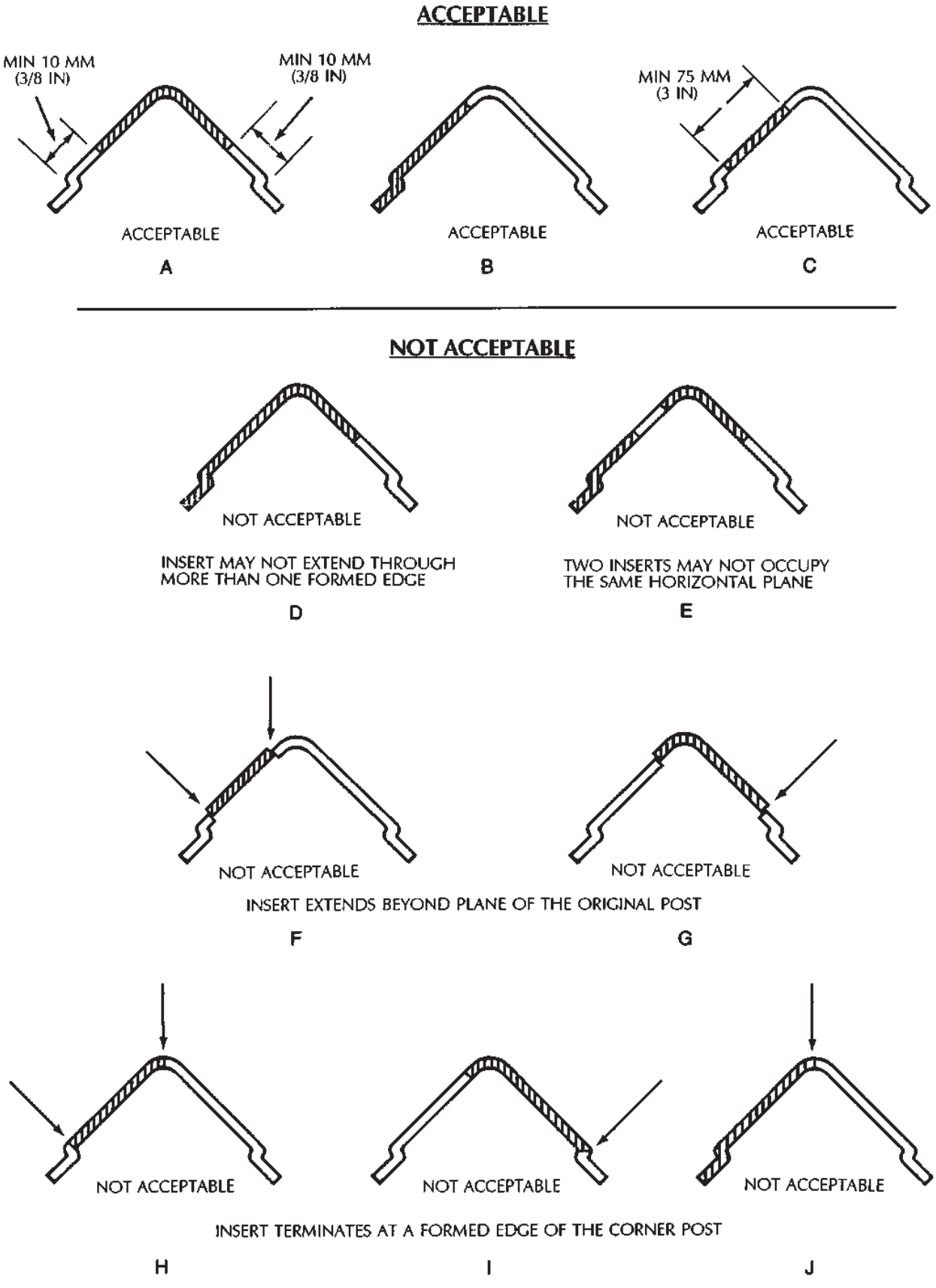


Fig. 4.1/Cross sections of inserts on square-profile corner points

assumed that these inserts meet the limitations described in Section 4.3.1 below.

4.3.1 Limitations on Front Corner Post Inserts—The following limitations apply to inserts in the front posts, including both the serpentine and square-profile front corner posts. See Figures 4.1, 4.2 and 4.3 as indicated for illustration of acceptable and unacceptable repairs.

- *Full-profile* sections through the complete cross-sectional profile of a front corner post are **not** allowed.
- There is no limit to the number of inserts allowed in a front corner post provided all other limitations listed herein are observed (see Figure 4.2). (Nevertheless, the number of inserts may be limited in practice if combining inserts or performing another acceptable type of repair would be more economical to perform.)
- Inserts must be fitted flush with the original material and butt-welded (compare Figure 4.1 A, B and C with F and G).
- A front corner post insert must be at least 150 mm (6 in) in length, unless it terminates at a corner fitting (see Figure 4.2 B and D).
- A front corner post insert that would terminate within 300 mm (12 in) of a corner fitting must be extended to the fitting, and must be at least 300 mm (12 in) in length (compare Figure 4.2 A, C and D with Figure 4.3 A).
- There are no *maximum* height limitations for front corner post inserts. Full-height front corner post inserts are acceptable (see Figure 4.2 F).
- No insert to a front post shall share the same horizontal plane as another insert (see Figure 4.1 E and 4.3 D).
- An insert in a *square-profile front corner post* may extend through only *one* formed edge (see Figure 4.1 D). An insert may not terminate within 10 mm (3/8 in) of any formed edge (see Figure 4.1 A). In addition, the insert must extend through at least 75 mm (3 in) of the cross-sectional profile of the post (see Figure 4.1 C).
- An insert in a *serpentine front corner post* must not extend through more than 50% of the cross-sectional area of the post, nor may it terminate vertically within 10 mm (3/8 in) of any formed edge. In addition, the insert must extend through at least 75 mm (3 in) of the cross-sectional profile of the post.
- Front corner post inserts may be rectangular, oval, or diamond in shape.
- Horizontal insert welds of rectangular front corner post inserts or extremity welds of diamond- or oval-shaped inserts must be a minimum of 150 mm (6 in) apart (compare Figure 4.2 D with 4.3 C).
- A front corner post insert that would terminate within 150 mm (6 in) of an existing insert must be extended to the existing insert to form a common weld (see Figure 4.2 E).

  NOTE: The common weld must extend horizontally through the profile of the post. When diamond- or oval-shaped inserts are involved, they must, therefore, be cut to provide a horizontal edge that will butt against and be welded to the adjacent insert.
- When two inserts share a common weld, the total length of the horizontal plane of the common weld must not extend through more than half of the external cross-sectional profile of the post.

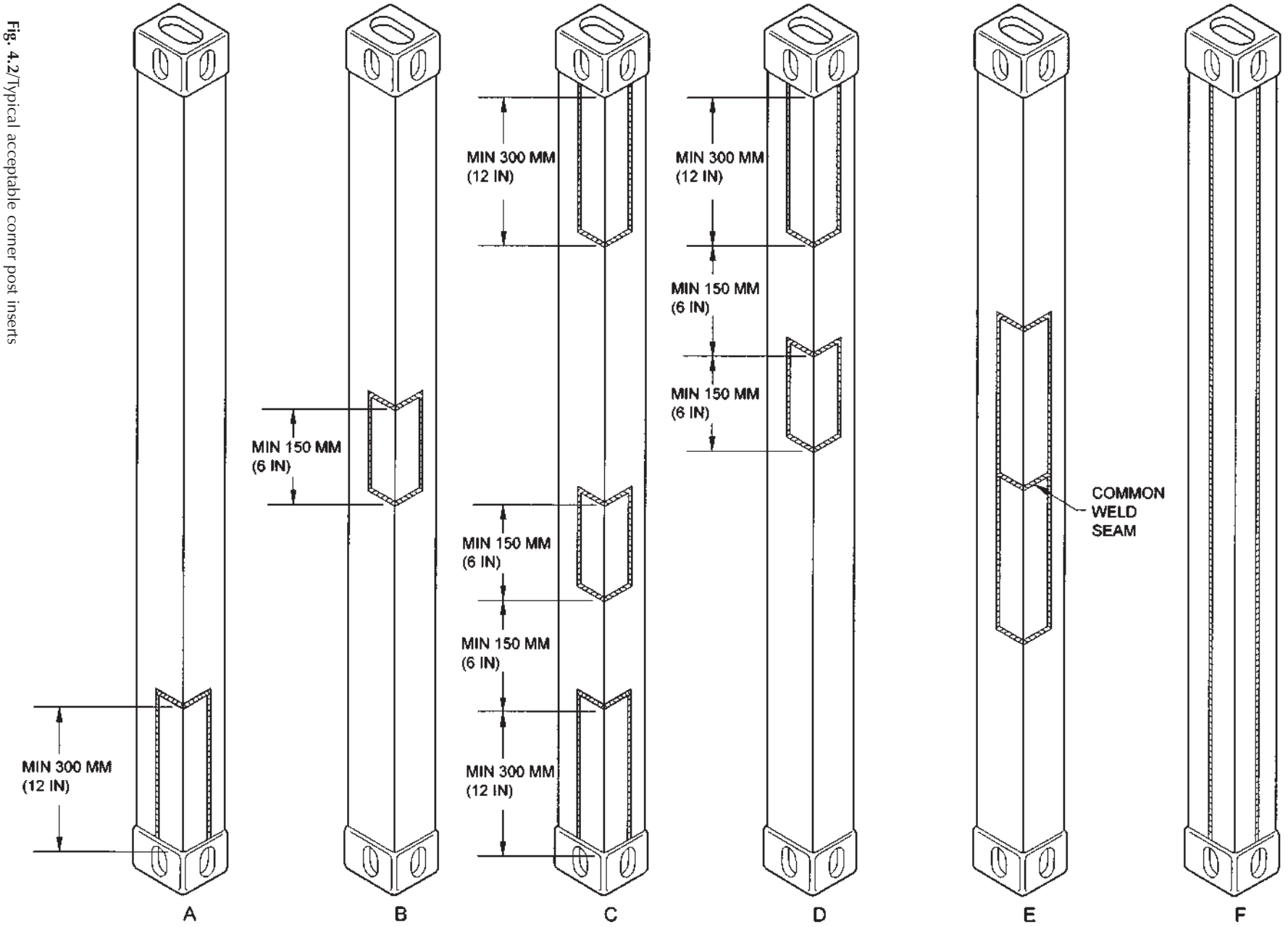


Fig. 4.2/Typical acceptable corner post inserts

4.4 **Inserting in the *Outer Profile of a Rear* Corner Post**—Damage to the outer profile portion of a rear corner post that cannot be repaired by straightening, may be repaired with an insert. Inserting is **not** permitted in the *inner* profile of a rear corner post.

4.4.1 **Limitations on Inserts in the Outer Profile of a Rear Corner Post**

- An insert in the outer profile of a rear corner post (except in the J-bar portion) must be at least 150 mm (6 in) in length, or 75 mm (3 in) in the J-bar portion, unless it terminates at a corner fitting.
- An insert, whether in the J-bar portion or not, that would terminate within 300 mm (12 in) of a corner fitting must be extended to the fitting.
- No insert in the outer profile section of a rear corner post can share the same horizontal plane as another insert.
- There are no maximum height limits for outer profile rear corner post inserts.
- No insert shall terminate on a formed edge.
- The inserted material must be shaped to conform with the original radii of the post.

4.5 **Corner Post Inserting: Procedures and Special Considerations**—To install an insert in a corner post, follow the procedures recommended in Section 2.8.3 on pages 9 - 10.

If the type of material in the corner post is not known, the replacement steel must be high-tensile carbon or Corten steel of the same or greater thickness with a minimum yield point of 34 kg/mm^2 or 50,000 psi. The radii of the formed edges of the insert must be identical to the radii of the original post so that the surfaces of the insert and corner post can be properly aligned.

4.6 **Sectioning of Rear Corner Post Outer Profile**—Damage to the outer profile portion of a rear corner post that cannot be repaired by straightening or inserting can be repaired by installing a section, provided it can be accomplished within the limitations listed below in Section 4.6.1. To install a section, follow the procedures recommended in Section 2.8.4 on pages 10 - 12. The inner profile(s) must be detached from the outer profile before sectioning, and reattached afterwards. If the paint on the detached inner profile is damaged, the surface must be prepared, primed and top coated according to Sections 2.5 and 2.9 after repair is completed.

4.6.1 **Limitations on Sectioning of Rear Corner Post Outer Profile**—Sections to the outer profile of rear corner posts is subject to the following limitations:

- A full-profile section must be at least 150 mm (6 in) in length, unless it terminates at a corner fitting.
- If a section would terminate within 300 mm (12 in) of the corner fitting, it must be extended to the fitting.
- There are no maximum height limits for sections in the outer profile of a rear corner post.
- A maximum of three (3) sections are allowed in the outer profile of the rear corner post.
- Sections must be fitted flush with the original post material and butt-welded.

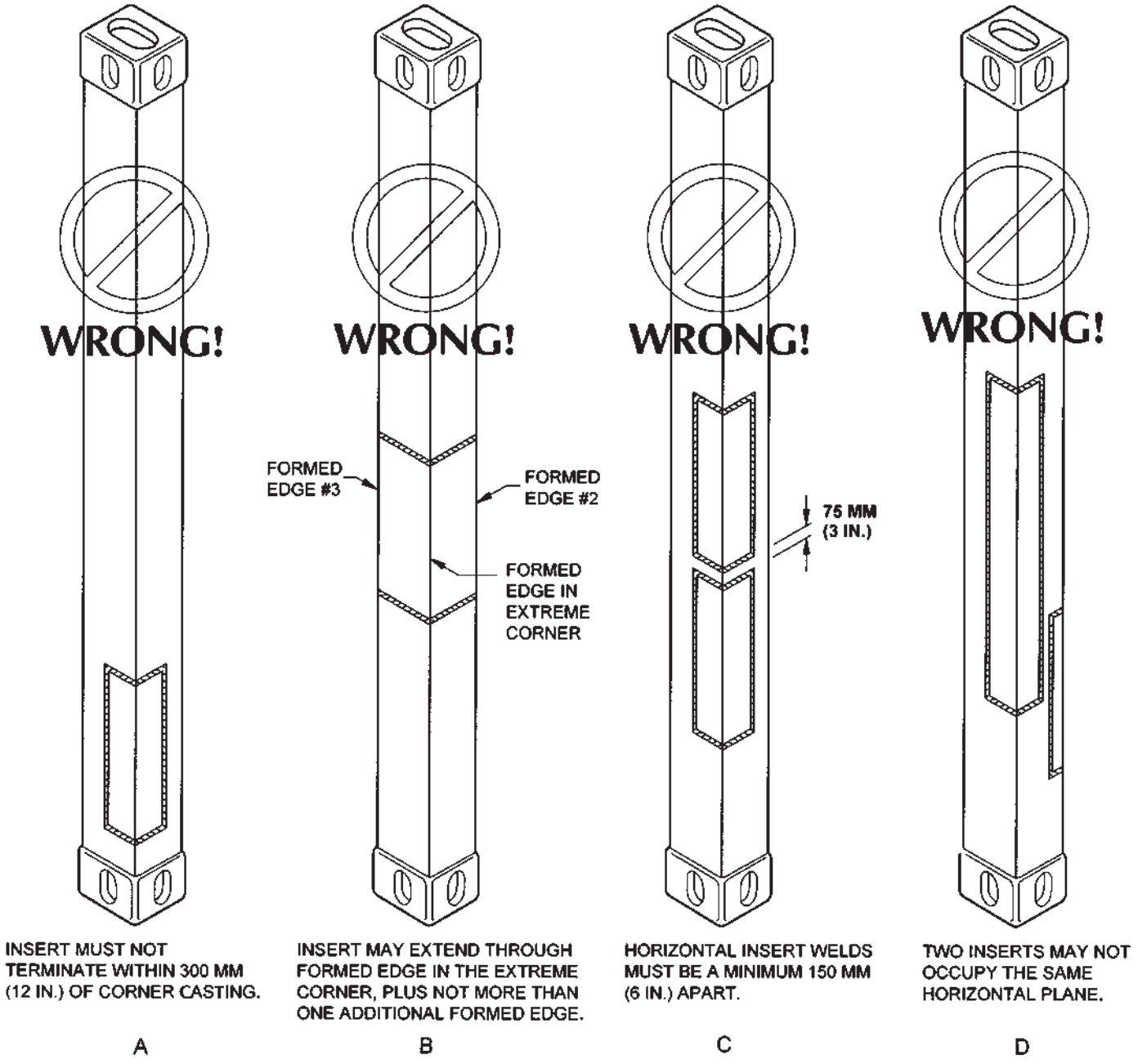


Fig. 4.3/UNACCEPTABLE corner post inserts

- Sections that would terminate within 150 mm (6 in) of an existing section must be extended to form a common weld.
- No inserting or sectioning of the inner post or stiffeners is permitted.

4.7 **Corner Post Replacement**—When damage to a corner post cannot be repaired by one of the repair methods listed above, the entire post must be replaced. However, if a rear post or a double-skin front post has one part damaged and the other part intact, the intact part may be salvaged for reuse if possible. Serpentine types of corner posts may be replaced by square-profile posts, providing that the cross-sectional area of the replacement post is equal to or greater than that of the original *and* the replacement post material is the same or greater in strength (yield point and tensile strength) than the original.

If the type of material in the corner post is not known, the replacement steel should be high tensile carbon or Corten steel of the same or greater thickness with a minimum yield point of 34 kg/mm^2 or 50,000 psi.

To replace a corner post, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. Photos showing a front corner post replacement appear at the end of Section 4. Special considerations for corner post replacement follow:

4.7.1 ■ Flame-cutting out the post: If the post is at the door end, cut the hinge lugs from the post and remove the door. Remove any adjacent sections of flooring that could be burned or otherwise damaged. If the corner post has both an inner and an outer profile, first remove the inner profile. Remove any corner fitting reinforcement gussets from the post. Direct the torch flame away from the corner fittings, rails and side panels to prevent damaging any of these adjacent parts.

4.7.2 ■ Reinstalling door and fittings: When replacing a rear corner post, reinstall the door by fully welding the hinge lugs to the corner post while supporting the door. Fabricate or reuse any lashing bars or other fittings present in the post being replaced. Weld these bars or fittings in the same locations as they were in the old post.

4.7.3 ■ Completing the repair: When the post has an inner and outer post, or an outer skin and an inner reinforcing channel, prepare the surface and prime the interior of both the outer and inner corner post or reinforcement replacement before welding the inner post or reinforcement in position. The surfaces of the other portions of the post must be prepared, primed and top coated according to Sections 2.5 and 2.9. Replace flooring if required.

Photo 4.1 / Front corner post insert adjacent to corner fitting

Photo 4.2 / Front corner post insert not adjacent to corner fitting (exterior view)

Photo 4.3 / Front corner post insert not adjacent to corner fitting (interior view)

SECTION 5 RAILS

5.1 **General**—Rails are major structural components and damage to them can affect the strength and dimensional requirements of the container. Before undertaking rail repairs, it should be recognized that corner fitting alignment may be affected. Dimensional alignment checks must be made before, during and after the repair operation to confirm that alignments conform to ISO specified dimensions (See Appendix A, ISO Dimensions and Tolerances).

Damage to rails can be repaired by straightening, welding or straightening *and* welding, inserting (except in flat-bar top rails), sectioning and replacement.

Before undertaking any rail repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

5.1.1 **Limitations on Rail Inserts and Sections**—Damage that cannot be repaired by straightening, welding or straightening *and* welding may be repaired by replacing the damaged area with an insert, except in the case of flat-bar top rails (inserts may *not* be fitted to flat-bar top rails). Inserts must be long enough to replace the entire damaged area, but may have to be lengthened still further under certain conditions. If the rail cannot be repaired by inserting, a section may be installed. The following limitations apply to rail inserting and sectioning:

- Inserts and sections must be fitted flush with and butt-welded to the original rail.
- Inserts and sections must be at least 150 mm (6 in) in length.
- If an insert or section would end within 150 mm (6 in) of another insert, section or vertical rail weld (other than a full-profile weld to a corner fitting), it must be extended to that weld.
- If an insert or section in a side rail (top or bottom) would end within 300 mm (12 in) of a corner fitting, it must be extended and welded to the fitting. This also means that any side rail insert or section that *begins* at a corner fitting and is welded to the fitting must be at least 300 mm (12 in) in length.
- If an insert or section in an end rail (header or sill) would end within 150 mm (6 in) of a corner fitting, it must be extended and welded to the fitting. This also means that any end rail insert or section that *begins* at a corner fitting and is welded to the fitting must be at least 150 mm (6 in) in length.

NOTE: See Figures 5.1 and 5.2 for illustration of limitations on top rail inserts and sections, and Figure 5.4 for illustration of limitations on bottom rail inserts.

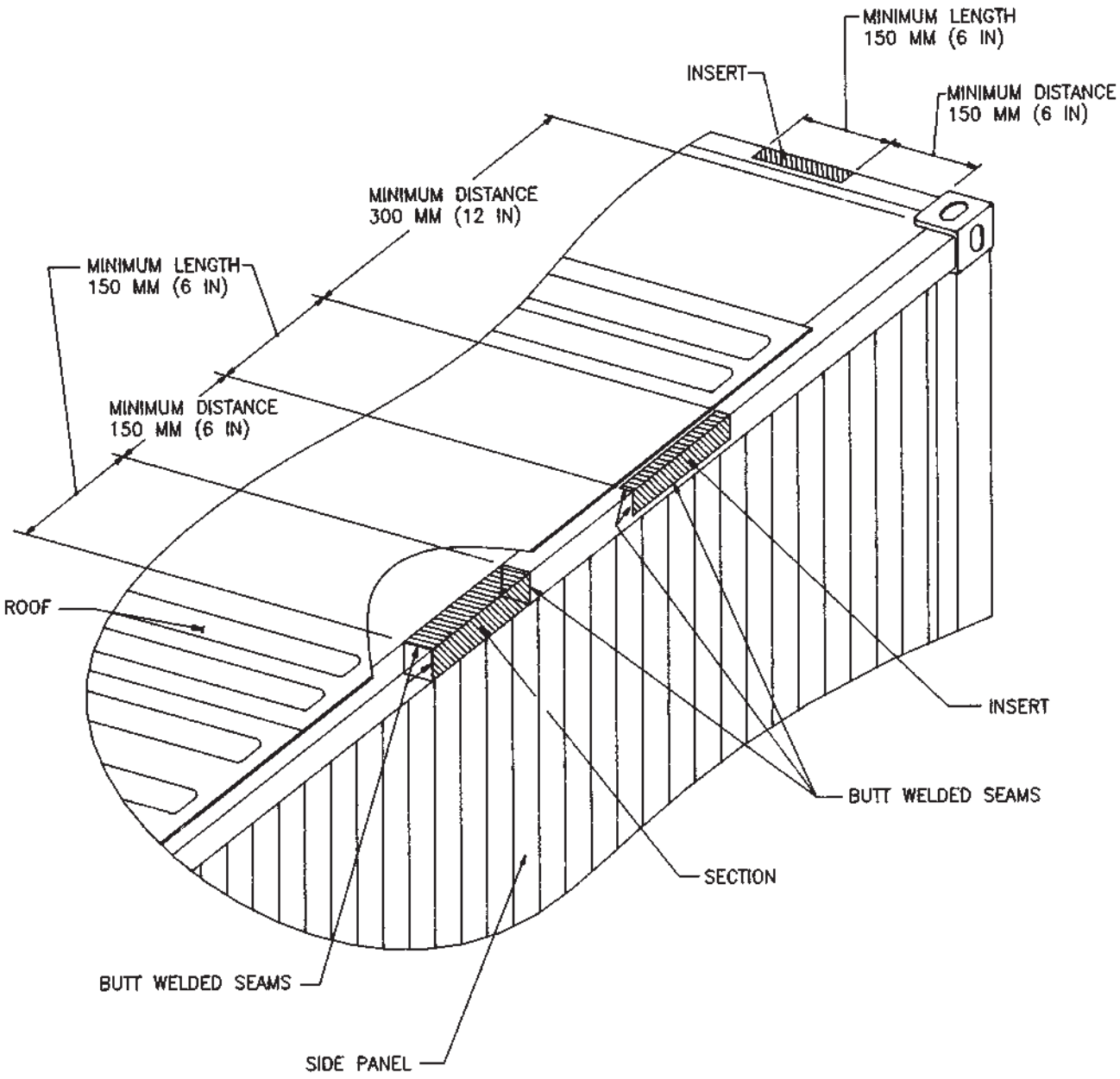


Fig. 5.1/Top rail insert and section limitations

5.2 Top Rails

5.2.1 **Top Rail Straightening**—To straighten top rails, follow the procedures recommended in Section 2.9.1 on page 8. If the attached panel is damaged, cutting the welds attaching the panel to the rail will sometimes allow the rail to spring back into proper position, which will be retained when the panel is repaired.

5.2.2 **Top Rail Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts or pin holes in top rails, follow the procedures and limitations recommended in Sections 2.8.2 on page 9.

5.2.3 **Top Rail Inserting**—Damage to a tubular-type top rail that cannot be repaired by one of the methods listed above may be repaired by installing an insert, providing the limitations listed in Section 5.1.1 are observed. *Inserting into a flat-bar top rail and patching of any rail are **not** permitted.* To install an insert in a tubular-type rail, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. Special considerations for top-rail inserting follow:

5.2.3.1 ■ Back-up plate: Back-up plates are temporary fittings on which an insert in a tube-type rail can be rested to ensure easy and accurate positioning of the insert as it is continuously welded into place. When installing the insert, a backing strip or two small back-up plates may be tack-welded to the inside of the face of the opening in the original rail.

5.2.3.2 ■ Completing the repair: After continuously welding an insert in place, it may be necessary to grind off sufficient weld bead on the top side of the top rail to assure proper alignment with the roof sheet.

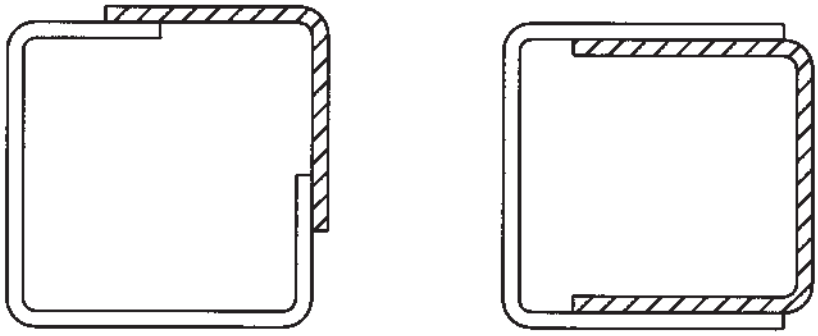
5.2.4 **Top Rail Sectioning**—To install a full-profile section in a top rail, follow the procedures recommended in Section 2.8.4 on pages 10 - 12 and the limitations listed in Section 5.1.1. Special considerations for top rail sectioning follow:

5.2.4.1 ■ Before cutting out the rail: Support the container so that it does not distort when the rail section is cut out.

5.2.4.2 ■ Cutting out the damage: The cut should extend beyond the damaged area to allow insertion of wedges between top rail and roof panel. This will permit welding of the top rail butt joints under the roof panel. Take care to preserve intact the roof sheet and side/front panels where possible.

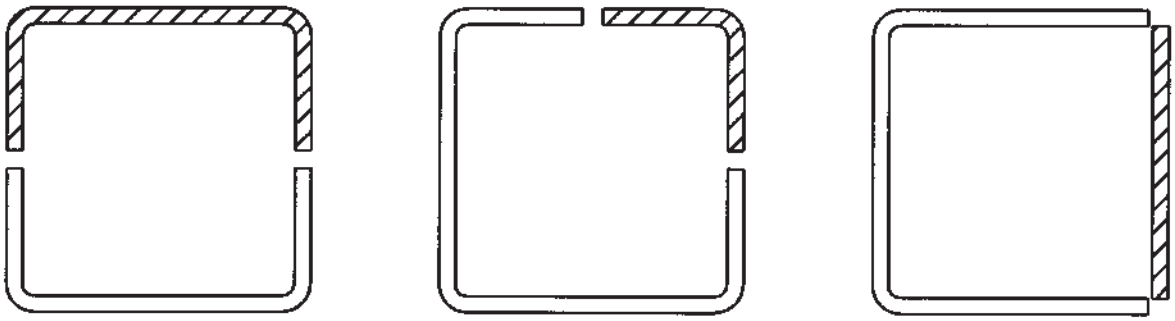
Photo 5.1 shows the removal of a flat-bar top side rail portion beyond the damaged area, with an additional area of roof panel detached to allow for the insertion of wedges as needed.

5.2.4.3 ■ Beveling and welding: The thickness of flat-bar top rail sections (12 mm [15/32 in] or more) make welding penetration more difficult. Ensure that top mating surfaces of a flat-bar section and original rail are beveled to a combined 60° angle to a sufficient depth to ensure full penetration of the initial welding pass. If the flat-bar section is joined directly to a corner fitting, bevel to a 45° angle. After beveling, make multiple welding passes as



INSERTS NOT FLUSH WITH REMAINING RAIL

NOT ACCEPTABLE



ACCEPTABLE

Fig. 5.2/Cross sections of top rail inserts (before welding)

necessary to ensure complete filling of the gap. See Figure 5.3 and Photo 5.2.

Photos 5.3, 5.4 and 5.5 show the appearance of the joint between the flat-bar top side rail section and the original rail after the first, second and third welding passes, respectively. Three or more passes of welding may be needed to fill the gap in the beveled joint completely.

5.2.4.4 ■ Completing the repair: After welding the section into place, it may be necessary to grind off sufficient weld bead from the top and bottom of the original top rail to assure proper alignment with the roof sheet and side panel. If necessary, reattach roof bows to the top rail section. Apply sealant along the interior seam between the roof panel and top rail.

Photo 5.6 shows a fully welded flat-bar top side rail section. The rearmost portion of the welds between the section and the original rail have been ground down to permit proper reattachment of the roof sheet.

5.2.5 **Top Rail Replacement**—To replace a top rail, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. Special considerations for top rail replacement follow:

5.2.5.1 ■ Cutting out the rail: When cutting the top rail from the corner fittings, take care not to damage the fittings. When replacing top *side* rails, take care not to damage the roof bows, if any. Remove any old sealant adhering to the header or roof panel.

5.2.5.2 ■ Completing the repair: After welding the rail in place, reattach roof bows (if any) to top rail by the original attachment method. If clips and fasteners are used, clips must first be welded onto the interior face of the replacement rail. Reinstall any cargo lashing rings attached to the original top rail. If the rail has an open-type profile, as many end rails do, ensure that gussets are installed as required, reusing any intact gussets that were previously removed, if feasible.

5.3 **Rain Gutters**

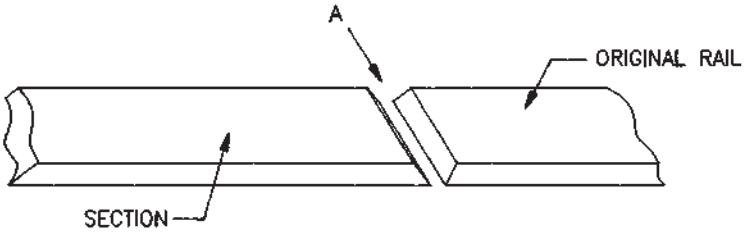
5.3.1 **Rain Gutter Straightening**—Rain gutter distortion should be straightened according to the recommendations in Section 2.8.1 on page 8. If the weld connecting the rain gutter to the corner fitting is broken, the rain gutter should be re-welded or, if the owner requires, removed.

5.3.2 **Rain Gutter Removal**—If the rain gutter cannot be returned to its original profile by straightening, it should be removed as described below.

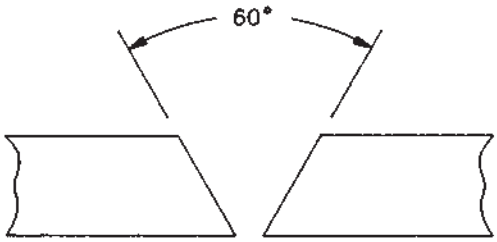
5.3.2.1 Open the doors to their fullest extent so that the door gasket is not in the area under repair.

5.3.2.2 Mark the rain gutter at a point at least 6 mm (1/4 in) but no more than 10 mm (3/8 in) from the rear vertical face of the door header. Remove the rain gutter by cutting along this line.

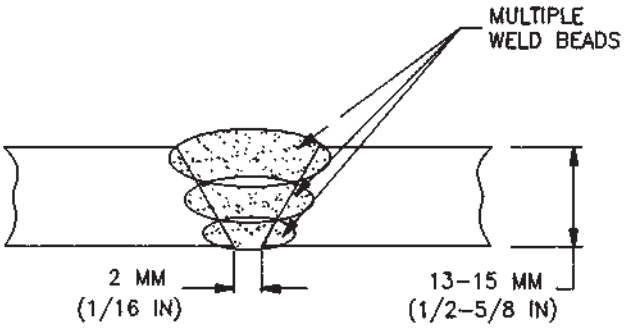
5.3.2.3 Grind the cut edges of the door header smooth. Prepare the surface and coat according to Sections 2.5 and 2.9.



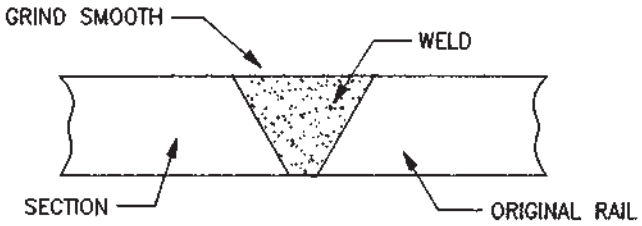
FLAT BAR TOP RAIL SECTION AND ORIGINAL RAIL



VIEW A: FLAT BAR TOP RAIL SECTION AND ORIGINAL RAIL BEVELLED TO COMBINED 60 DEGREE ANGLE



ARRANGEMENT OF MULTIPLE WELDING BEADS



COMPLETED FLAT BAR TOP RAIL SECTION REPAIR

Fig. 5.3/Flat-bar top rail section

5.4 Bottom Rails

5.4.1 **Bottom Rail Straightening**—To straighten a bottom rail, follow the procedures recommended in Section 2.8.1 on page 8.

5.4.2 **Bottom Rail Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts or pin holes in crossmembers, follow the procedures and limitations recommended in Sections 2.8.2 on page 9.

5.4.3 **Bottom Rail Inserting**—To install an insert in a bottom rail, follow the recommendations in Section 2.8.3 on pages 9 - 10. Please note that overlapping angles should **not** be installed on bottom rails.

5.4.4 **Bottom Rail Sectioning**—To install a full-profile section in a bottom rail, follow the procedures recommended in Section 2.8.4 on pages 10 - 12. Special considerations for bottom rail sectioning follow:

5.4.4.1 ■ Before cutting out the rail: Support the container so that it does not distort when the rail section is cut out. Also, remove flooring (and, if installed, any plywood lining) adjacent to the damaged rail. Cut any welds attaching crossmembers, outriggers, forklift pocket assemblies, gooseneck tunnel assembly and panels to the damaged portion of rails. If repairing a door sill, remove any screws retaining the floor or threshold plate adjacent to the area of the sill to be removed.

5.4.4.2 ■ Cutting out the rail: The rail cut should extend beyond the damaged area to permit welding of the bottom rail butt joints. The weld between the rail and the adjacent panel should also be cut beyond the extent of the damaged area to permit welding of the bottom rail butt joints.

Photo 5.7 shows the cutting of rail and adjacent welds between the damaged rail and the original rail, crossmember(s) and adjacent panel.

5.4.4.3 ■ Completing the repair: Reweld any crossmembers detached and reinstall and resecure any removed or loosened flooring. Photo 5.8 shows welding of bottom rail section to original rail, panel and crossmember. Reinstall or replace (if necessary) any cargo lashing rings, corner reinforcement gussets, certification plates and locking bar cam retainers (keepers) that were attached to the original rail. Apply sealant along the interior seam between the bottom rail and the flooring, and apply primer and undercoating or other owner-specified coating to the inside surfaces of the new section.

Photo 5.9 shows application of undercoating to the inside surface of rail. Primer was also applied to this rail before undercoating was applied.

5.4.5 **Bottom Rail Replacement**—To replace a bottom rail, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. When replacing a front or rear bottom rail (*i.e.,* front or door sill), a closed type of rail design may be replaced by an open type of design, providing that the type and size of material used will restore the structural integrity of the container. When installing a replacement open-type bottom end rail, it must be fitted with vertical reinforcing gussets: a minimum of three (spaced equidistantly) on front sills and four (one behind each cam keeper) on door sills. Owner

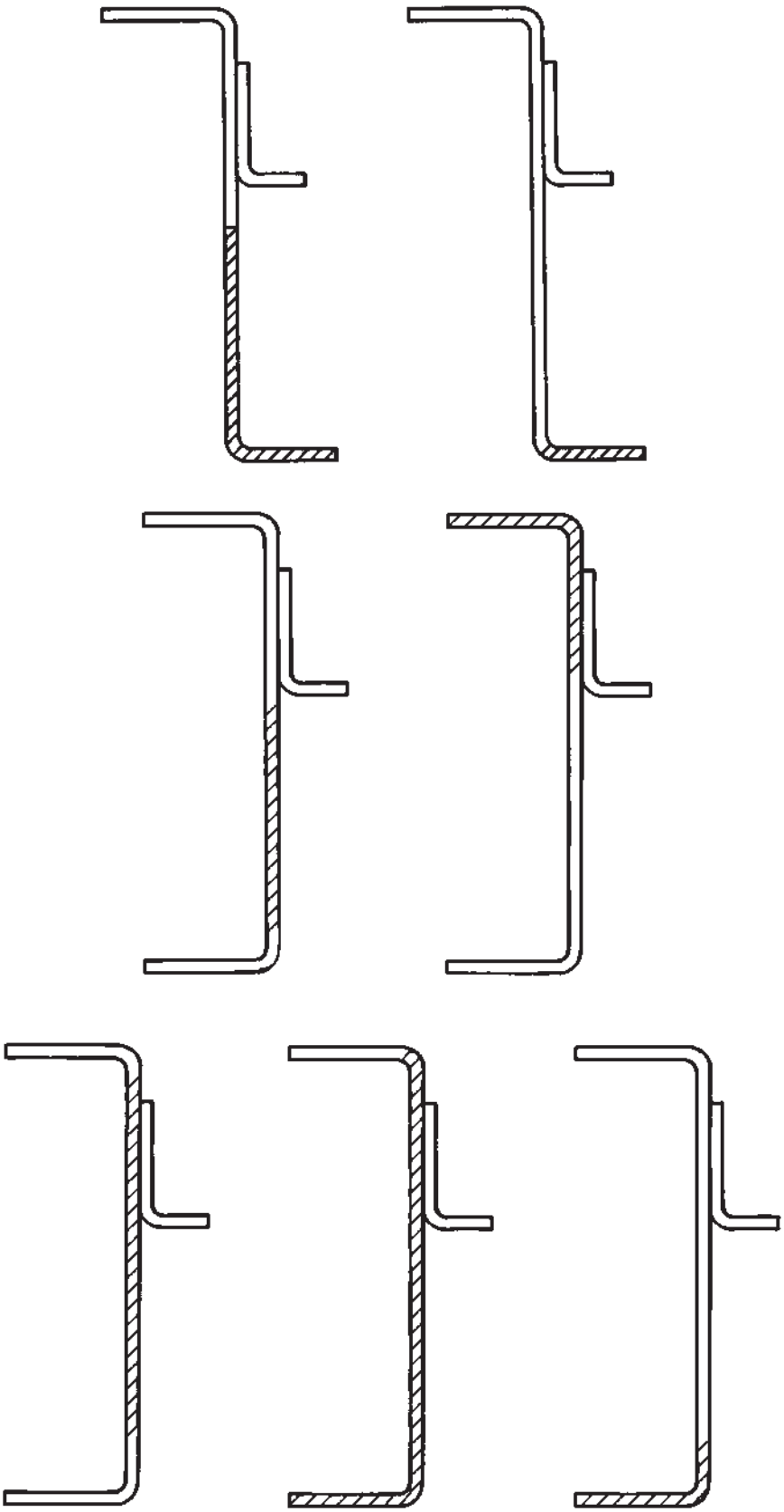


Fig. 5.4/Examples of acceptable bottom rail inserts (shown as cross sections through the rail profile)

approval is required for such substitution. Other special considerations for bottom rail replacement follow:

5.4.5.1 ■ Before cutting out rail: Support the container so that it does not distort when the bottom rail is removed. Also, remove flooring (and, if installed, any plywood lining) adjacent to the damaged rail. Cut any welds attaching the rail to crossmembers, outriggers, forklift pocket assemblies, gooseneck tunnel assembly, and panels before cutting through the welds between corner fittings and the rail. If repairing a door sill, remove any screws retaining the floor or threshold plate adjacent to the area of the sill to be removed.

5.4.5.2 ■ Completing the repair: Reweld all previously detached understructure members and reinstall and resecure any removed or loosened flooring. Reinstall or replace any cargo lashing rings, corner reinforcement gussets, certification plates and locking bar cam retainers (keepers) that were attached to the original rail. Apply sealant along the interior seam between the bottom rail and the flooring.

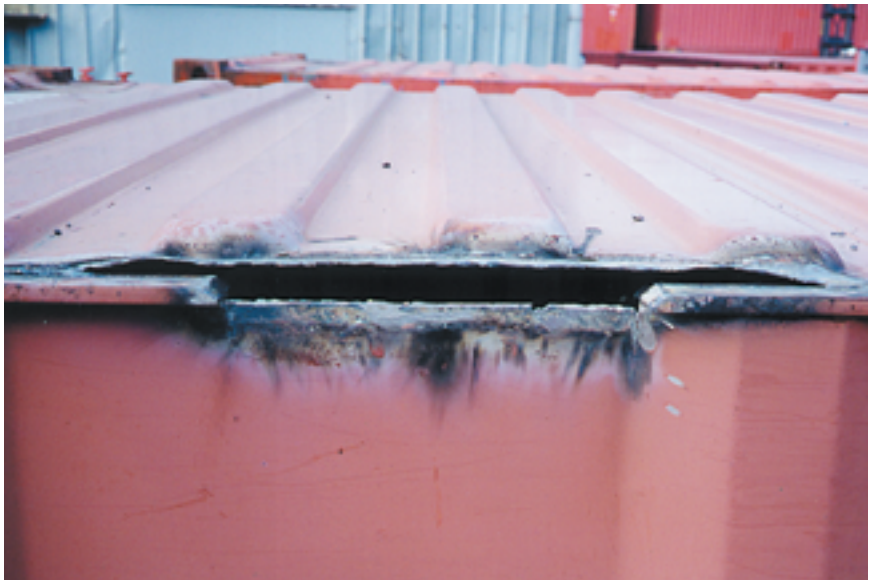


Photo 5.1 (to left) / Removal of damaged flat-bar top side rail section and extra cutting of welds to roof sheet to allow placement of wedges as needed

Photo 5.2 (to right) / Flat-bar top side rail section installed before welding, showing beveling of section and original rail to a combined 60 angle

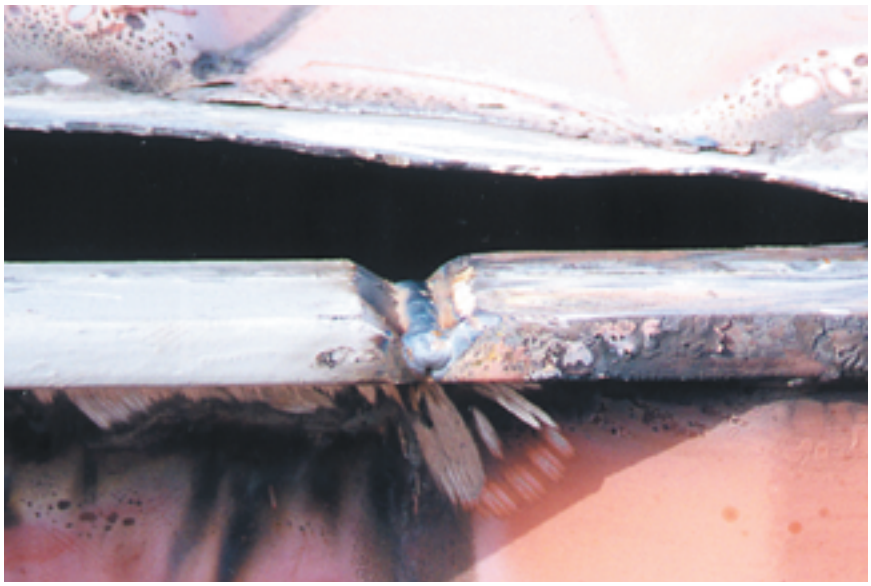


Photo 5.3 (to left) / Welding of flat-bar top side rail section to original rail (first pass)

Photo 5.4 (to right) / Welding of flat-bar top side rail section to original rail (second pass)

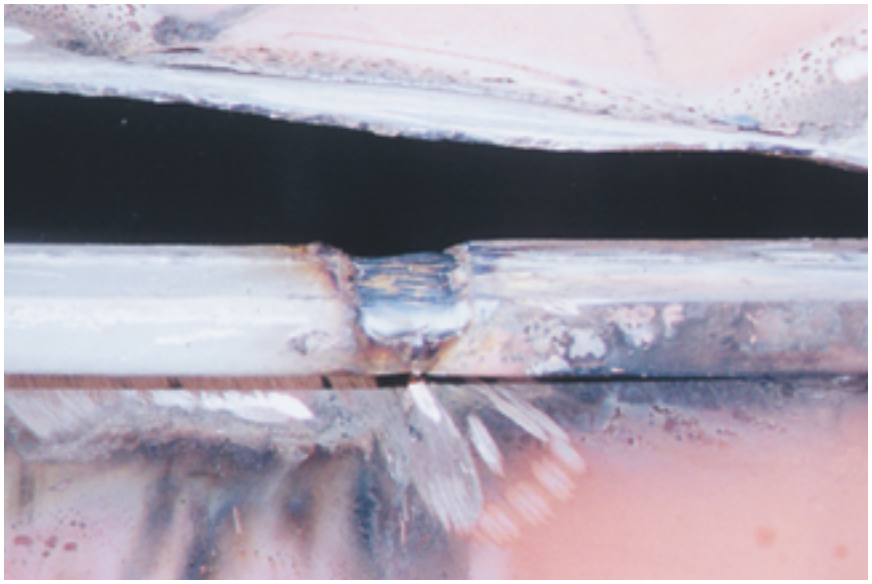


Photo 5.5 (to left) / Welding of flat-bar top side rail section to original rail (third pass)

Photo 5.6 (to right) / Completed welding of flat-bar top side rail section. A portion of the welds between the section and the original rail has been ground down to permit proper reattachment of the roof sheet.

Photo 5.7 (to left) / Removal of damaged portion of bottom side rail. Note cutting of welds to side panel beyond the removed area of rail.

Photo 5.8 to right) / Welding of bottom rail section to original rail, panel and crossmember

Photo 5.9 (to left) / Undercoating bottom rail section (primer was applied beforehand)

SECTION 6 SIDE AND FRONT PANELS

6.1 **General**—Side and front panels are the thinnest components of the container, yet they must be able to withstand forces of 60% and 40% of payload, respectively. Therefore, careful attention to repair technique is important. In addition, the thinness of the panels makes them very susceptible to loss of strength due to corrosion. Pre-primed Corten high-strength low-alloy corrosion-resistant material or an equivalent should be used. Proper surface preparation and painting methods are essential. Consult the owner or paint supplier for additional guidance.

Before undertaking any panel repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

6.1.1 **Before and After Panel Repairs**—Before cutting out a damaged portion from a panel, an individual panel, or an entire panel assembly, remove any attachments (ventilators, marking plates, etc.) that are within the damaged area, or near enough that they may be damaged during repair. Shield the floor before cutting the weld attaching any damaged areas to the bottom rails.

To complete the repair, replace markings removed during repair that are required by regulation, ISO standards or as directed by the owner. Reattach any other components that were removed during the repair. If a ventilator needs replacement, use a plastic type of replacement ventilator whenever possible (see Section 11 for ventilator replacement recommendations).

6.2 **Panel Straightening**—Straighten dents according to the procedures recommended in Section 2.8.1 on page 8. See Photo 2.4 for an illustration of panel straightening with a jack. If the damage has stretched the panel to such an extent that the original profile cannot be restored, repair by straightening should not be attempted; an insert or replacement is necessary.

Since straightening rarely results in a perfect match to the original panel profile, some judgment must be exercised when determining whether the finished repair is of acceptable quality. Photo 6.1 shows an example of good straightening, with good corrugation profile but less-than-perfect hammer marks. Photo 6.2 shows fair straightening, with hammer marks and fair corrugation profile. Photo 6.3 shows poor straightening, with numerous hammer marks and poor corrugation profile. Repainting is obviously *not* a substitute for straightening: Photo 6.4 shows a neatly repainted area which nevertheless was not straightened.

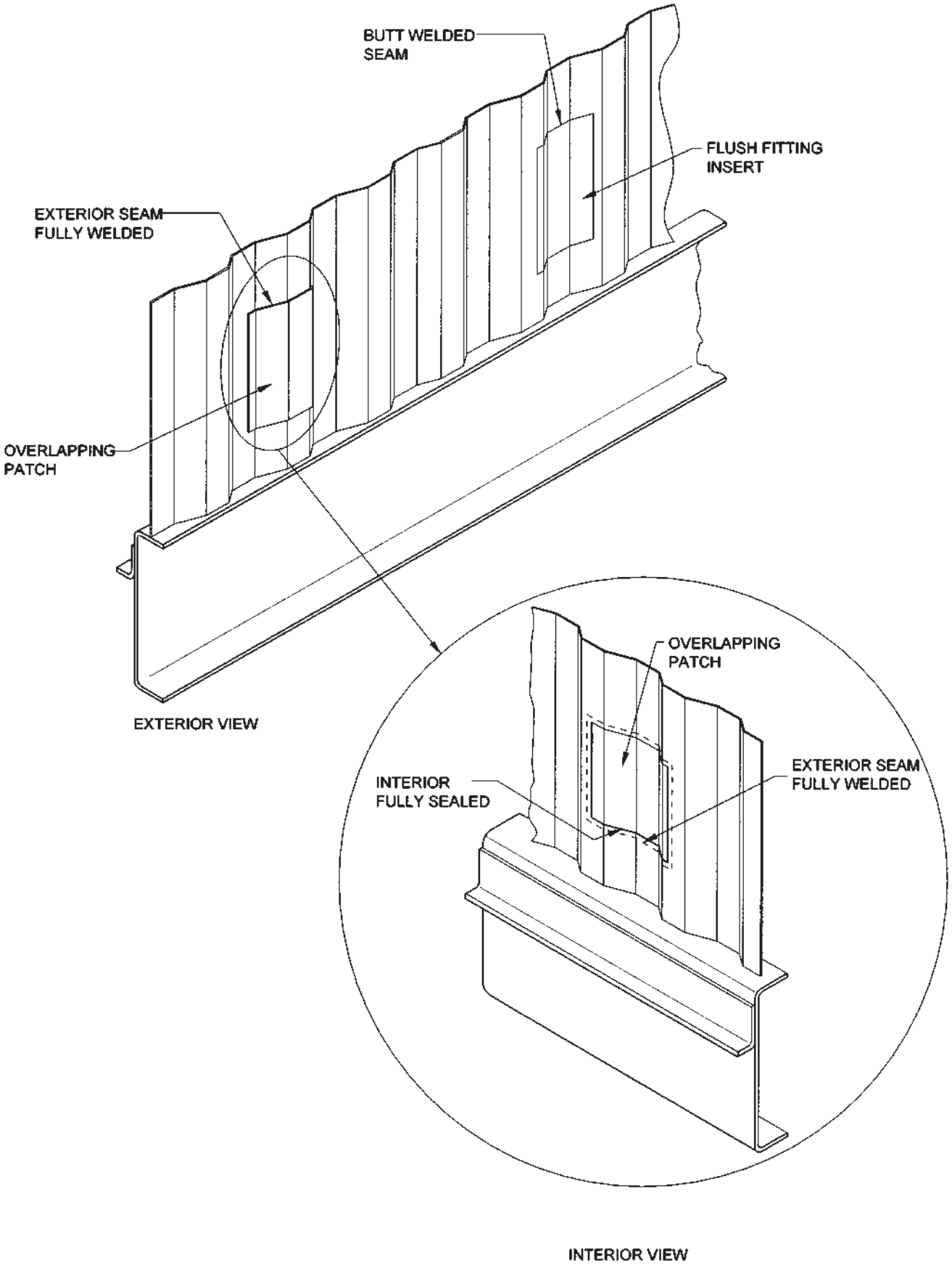


Fig. 6.1/Panel patch and insert

6.3 **Panel Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts or pin holes in panels, follow the procedures and limitations recommended in Sections 2.8.2 on page 9. Also see Section 2.8.1 on page 8 and Section 6.2 above for special considerations on straightening.

6.4 **Panel Inserting or Patching**—To install a butt-welded insert or overlapping exterior patch in a side or end panel, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. See Figure 6.1 and Photos 2.5 - 2.11 illustrating each step in the installation of a side panel insert. Also consult Section 6.1 above for recommendations on cutting out damage and completing repairs.

Inserts or patches may straddle an existing panel weld seam if the damaged area is on or near such a seam. Inserts or patches may not be suitable if the damage covers a large area adjacent to a rail or post, or if nearby inserts are corroded or improperly installed and must be corrected. In such cases, especially if it would be less expensive to perform, a full panel replacement may be more appropriate. See Section 6.5 for more information on replacements.

6.5 **Panel Replacement**—A panel should be replaced if it cannot be repaired by one of the methods listed above; if inserting or patching would leave non-conforming repairs nearby; or if replacement would be the least expensive method. To install a replacement panel, follow the procedures recommended in Section 2.8.5 on pages 12 - 13.

Butt-welded joints between the replacement and existing panels are preferred, but lap joints are acceptable.

NOTE: It is customary to use butt joints when replacing a panel, except that lap joints are used when a replaced panel is attached to a corner post.

Special considerations for panel replacement follow:

6.5.1 ■ Replacement material: Minor variations in the shape of the corrugations from the original are permitted, providing that the number of corrugations is the same as the original panel and the interior width of the container is not reduced.

6.5.2 ■ Welding a panel to a corner post: Where a lap joint is used to attach the replacement panel to a corner post, the lap must be at least 13 mm (1/2 in) and continuously welded on the exterior seam. The interior seam of a corner-post-to-panel lap joint should be skip welded and sealed with a polyurethane or chloroprene sealant after welding and painting. Do **not** use butyl sealant on panels.

6.6 **Panel Assembly Replacement**—If damage to a side or front panel assembly cannot be repaired by one of the methods listed above, or if replacement of individual panels is inadequate, the complete panel assembly must be removed and replaced. Replacement of a panel assembly may also be performed if it is more economical than a series of lesser repairs to the individual panels. To install a replacement panel assembly, follow the recommendations in Section 2.8.5 on pages 12 - 13.

It is important to note that ISO dimensions and tolerances can be affected

when a complete side or front panel assembly requires replacement. When performing this repair, dimensions and tolerances should be checked before, during and after the repair operation (see Appendix A, ISO Dimensions and Tolerances).

To guard against corrosion, the replacement assembly should be abrasive-blasted to Swedish Standard SA 2½ or equivalent ("near-white cleaning"), primed and (on the exterior) top coated. See Sections 2.5 and 2.9 for additional details regarding surface preparation and painting.

See Sections 6.5.1 on replacement material and 6.5.2 on welding a panel to a corner post. Additional special considerations for panel assembly replacement follow:

6.6.1 ■ Cutting out the panel assembly: It may be necessary to cut the panels to be removed into smaller pieces for ease of handling.

6.6.2 ■ Completing the repair: In addition to replacing markings, etc., per Section 6.1.1, light-leak test to ensure that there are no pin holes in the welds. Ensure that butt welding penetrates through the entire panel thickness to the interior.

Photo 6.1 (to right)/ Example of good panel straightening, with well-formed corrugation profile (although with a few hammer marks)

Photo 6.2 / Example of fair panel straightening, with fair corrugation profile and more serious hammer marks

Photo 6.3 / Example of poor panel straightening, with numerous deep hammer marks and poor corrugation profile

Photo 6.4 / Example of poor panel straightening. The damaged area has been painted, but no attempt has been made to straighten the dents.

SECTION 7 ROOF ASSEMBLY

7.1 **General**—Container roofs are made of either self-supporting corrugated panels or flat panels supported by roof bows. Both kinds of roof are fitted with either corner protection plates or header extension plates near the corner fittings. Open-top containers are fitted with tarpaulins. This section describes repairs to corrugated and flat-panel roofs, roof bows, corner protection and header extension plates, tarpaulins and TIR cords.

Before undertaking any panel repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

7.2 **Roof Panels**—Roof panels may be either corrugated or flat, but many of the repair procedures apply to both types of roof. The procedures outlined below apply to either corrugated or flat roofs, unless otherwise indicated.

7.2.1 **Material and Profile of Roof Panel Repairs**—Roof panel insert, patch and replacement material should be of Corten steel unless the original material is known to be different and the owner consents to use other material. If Corten steel is not used, use 2 mm (14 gauge) thick replacement material.

When replacing corrugated steel panels, minor variations in the shape of the corrugations from the original are permitted, providing that (1) the number of corrugations is the same as in the original panel, (2) the interior height of the container is not reduced and (3) structural integrity and water-tightness are maintained. Note that all portions of both corrugated and flat roofs must allow a minimum of 6 mm (1/4 in) clearance between the highest point on the roof (not including corner protection plates) and the plane of the upper faces of the top corner fittings, as required by ISO standards; corrugated profiles must fit accordingly.

An insert at the edge of a corrugated roof panel may have a different corrugation profile than that of the adjacent panel.

Do not replace flat roofs with corrugated roofs, or vice-versa, without owner's consent. Generally, differences in height clearances of the roof between corrugated and flat designs do not permit such substitution.

7.2.2 **Roof Panel Straightening**—To straighten roof panels, follow the procedures recommended in Section 2.8.1 on page 8. Use a backing plate or former appropriate to the design of the roof sheet (flat for flat roofs, shaped to fit the corrugations of corrugated roofs). Flat roofs can sometimes be straightened merely by straightening the underlying roof bows; this procedure should be considered before straightening a flat roof panel directly.

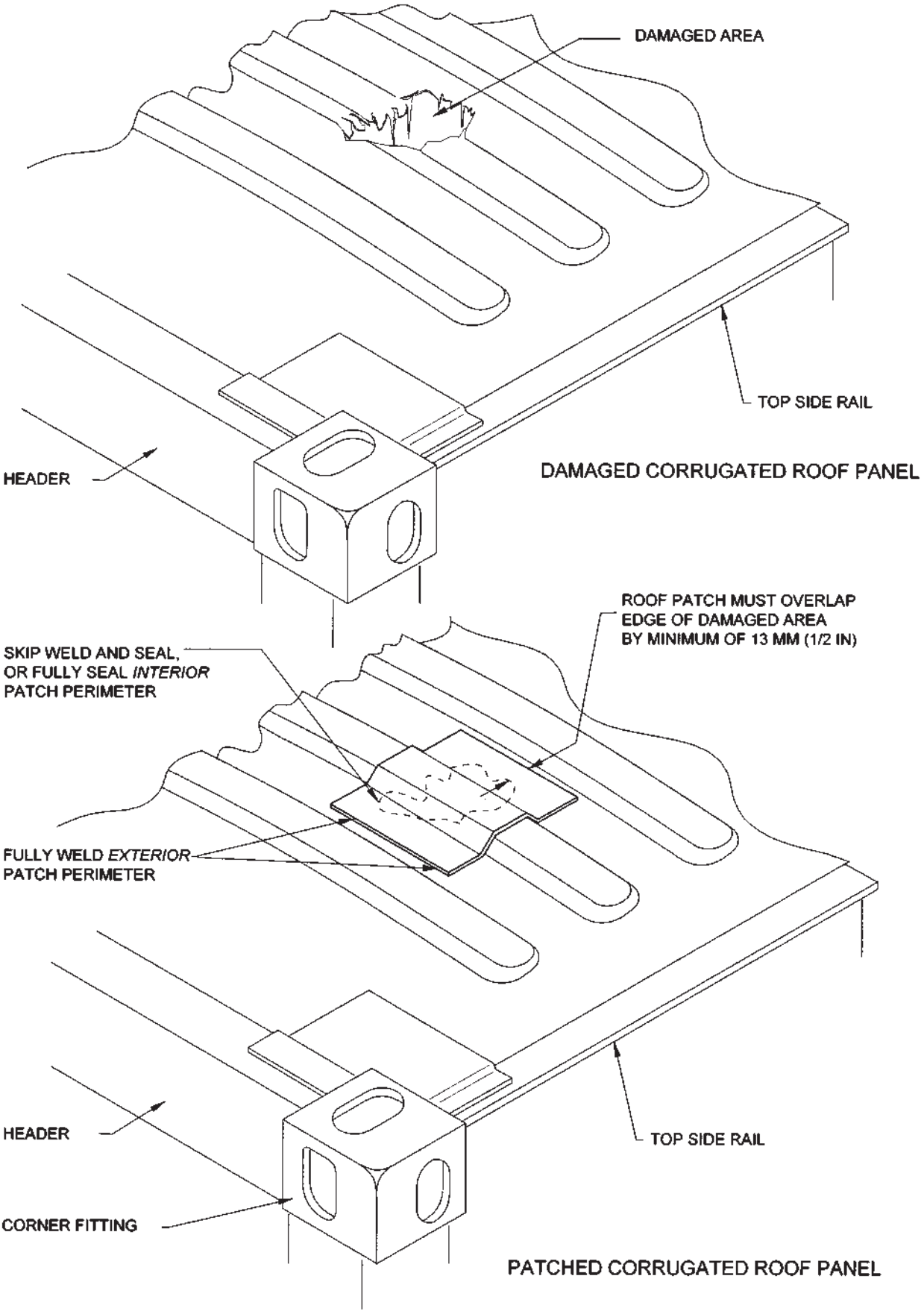


Fig. 7.1/Corrugated roof panel patch

7.2.3 **Roof Panel Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts, tears or pin holes in roof panels, follow the procedures and recommendations in Sections 2.8.2 on page 9 and 7.2.2 above.

7.2.4 **Roof Panel Inserting or Patching**—To install a butt-welded insert or an overlapping exterior patch in a roof panel, follow the recommendations in Sections 2.8.3 on pages 9 - 10 and 7.2.1 above. See Figures 7.1 and 7.2.

7.2.5 **Roof Panel Replacement**—To replace a roof panel, follow the recommendations in Section 2.8.5 on pages 12 - 13 and Section 7.2.1 above. Special considerations for roof panel replacement follow:

7.2.5.1 ■ Alternate method of removing roof panels: An alternative to cutting the panel directly from the top rail is to leave a strip of panel attached to the rail and to remove the strip by grinding away the weld seam using a disc grinder.

7.2.5.2 ■ Replacement material: When replacing pressed steel panels, minor variations in the shape of the corrugations from the original are permitted, providing that the number of corrugations is the same as the original panel, the interior height of the container is not reduced and the corrugation allows a minimum of 6 mm (1/4 in) clearance between the top of the corrugation and the upper face of the top corner fittings (as required by ISO standards). Replacement panels for flat-panel roofs should be fabricated with a slight upward camber (6 - 8 mm or 1/4 - 5/16 in).

7.2.5.3 ■ Flat panels and roof bows: Do **not** weld a replacement flat panel to the roof bows, unless the owner so requires. Corrugated roofs do not use roof bows.

7.3 **Roof Assembly Replacement**—If the *entire* roof requires replacement, follow the procedures recommended in Section 2.8.5 on pages 12-13. It is important to note that ISO dimensional tolerances can be affected when replacing the complete roof assembly. Dimensions must be checked before, during and after the repair operation to ensure that ISO tolerances are maintained. See Appendix A, ISO Dimensions and Tolerances. Also see Sections 7.2.1 and 7.2.5.2 for recommended replacement materials and profiles, and Section 7.2.5.1 for an alternate method of removing roof panels.

7.3.1 **Corrugated Roof Assembly Replacement: Special Considerations**—Butt-welded joints between the replacement panels are preferred, but lap joints are acceptable. Butt-welded joints are subject to the requirements in Section 2.8.5, Replacement; lap joints are subject to the requirements for patching in Section 2.8.3, Inserting and Patching.

7.3.2 **Flat Roof Assembly Replacement: Special Considerations**—Undamaged corner protection plates should be left intact. Undamaged roof bows should be separated from the roof sheet and left in place, unless their removal and replacement would be less expensive to perform. If required, remove the roof bows according to Section 7.4.4.3, reusing intact bows wherever possible. Do not weld roof bows to roof panel unless the owner so requires.

If possible, the replacement panels should be welded together *before* being placed on the container.

7.4 **Roof Bows**—Roof bows can be repaired by straightening, welding or straightening *and* welding, inserting, sectioning or replacement.

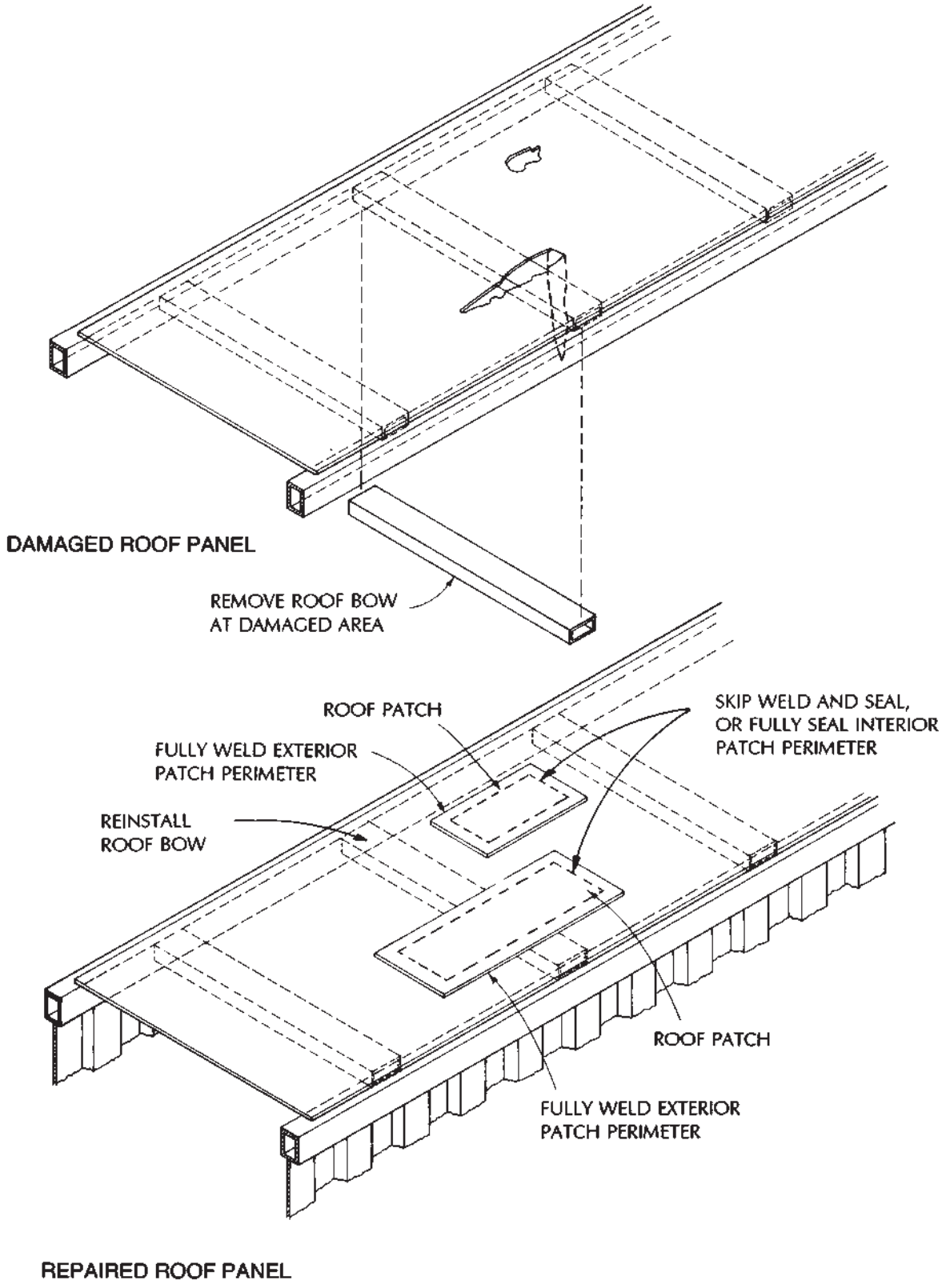


Fig. 7.2/Roof panel patches

7.4.1 **Roof Bow Straightening**—Depressed roof bows on closed dry-van containers can be straightened by following the procedures recommended in Section 2.8.1 on page 8 and 7.4.1.1 - 2 below . This method does **not** apply to roof bows in *open-top* containers; to straighten an open-top roof bow, consult the owner.

7.4.1.1 Position a T-beam or cross beam beneath the roof bow. Use a support under the jack to avoid floor damage. Jack the roof bow beyond the final position required to allow it to spring back to the desired position when pressure is released. This procedure can be used to give the roof a slight upward camber of 6 - 8 mm (1/4 - 5/16 in) at the center line of the roof, thereby improving drainage. See Figure 7.3.

7.4.1.2 If the roof bow becomes detached from the side rail, it may be straightened, jacked into position to provide the required camber, and then re-welded.

The roof bows on some containers are attached by a blind fastener to a clip welded to the top side rail. When replacing roof bows with this design, secure the bow to the clip with a blind fastener; do not weld the bow to the clip. Other container designs have *floating* roof bows that either are attached to the side rails but not the roof sheet, or are attached to the roof sheet but not the side rails. Before commencing a roof bow repair, examine the bows to determine the original configuration.

7.4.2 **Roof Bow Welding or Straightening *and* Welding**—Cracks or cuts in a roof bow may be repaired by welding or straightening *and* welding according to the procedures recommended in Section 2.8.2 on page 9 and 7.1 above. If necessary, reweld roof bows either to roof panels or side rails, according to the original configuration. If rewelding is required, follow the instructions in Section 7.4.4.2.

7.4.3 **Roof Bow Inserting and Sectioning**—To install a roof bow insert or section, follow the procedures recommended for inserting in Section 2.8.3 on pages 9 - 10 or for sectioning in Section 2.8.4 on pages 10 - 12. The following restrictions apply:

- Inserts should be limited to any bow face not in contact with a roof panel.
- Inserts and sections must be at least 150 mm (6 in) in length. There is no maximum length limit for roof bow inserts or sections.
- Any insert or section that would terminate within 150 mm (6 in) of a top rail must be extended to the rail.
- Sectioning should be undertaken only if there is adjacent roof panel damage which requires repair; removal of the damaged portion of the roof panel will allow access to the top face of the bow for installation of the section. The roof panel repair should be completed after the roof bow section has been installed.
- A damaged roof bow may be removed to facilitate installation of a section and replaced after the repair is complete, *provided* the total cost of repair would be less than the cost of a full roof bow replacement.

7.4.4 **Roof Bow Replacement**—Full roof bow replacement should be undertaken **only** if the cost will be less than any other form of repair. To replace a roof bow, follow the procedures recommended for replacement in Section 2.8.5 on pages 12 - 13 with the following special considerations:

7.4.4.1 ■ Replacement material: In closed dry-van containers, use rectangular steel

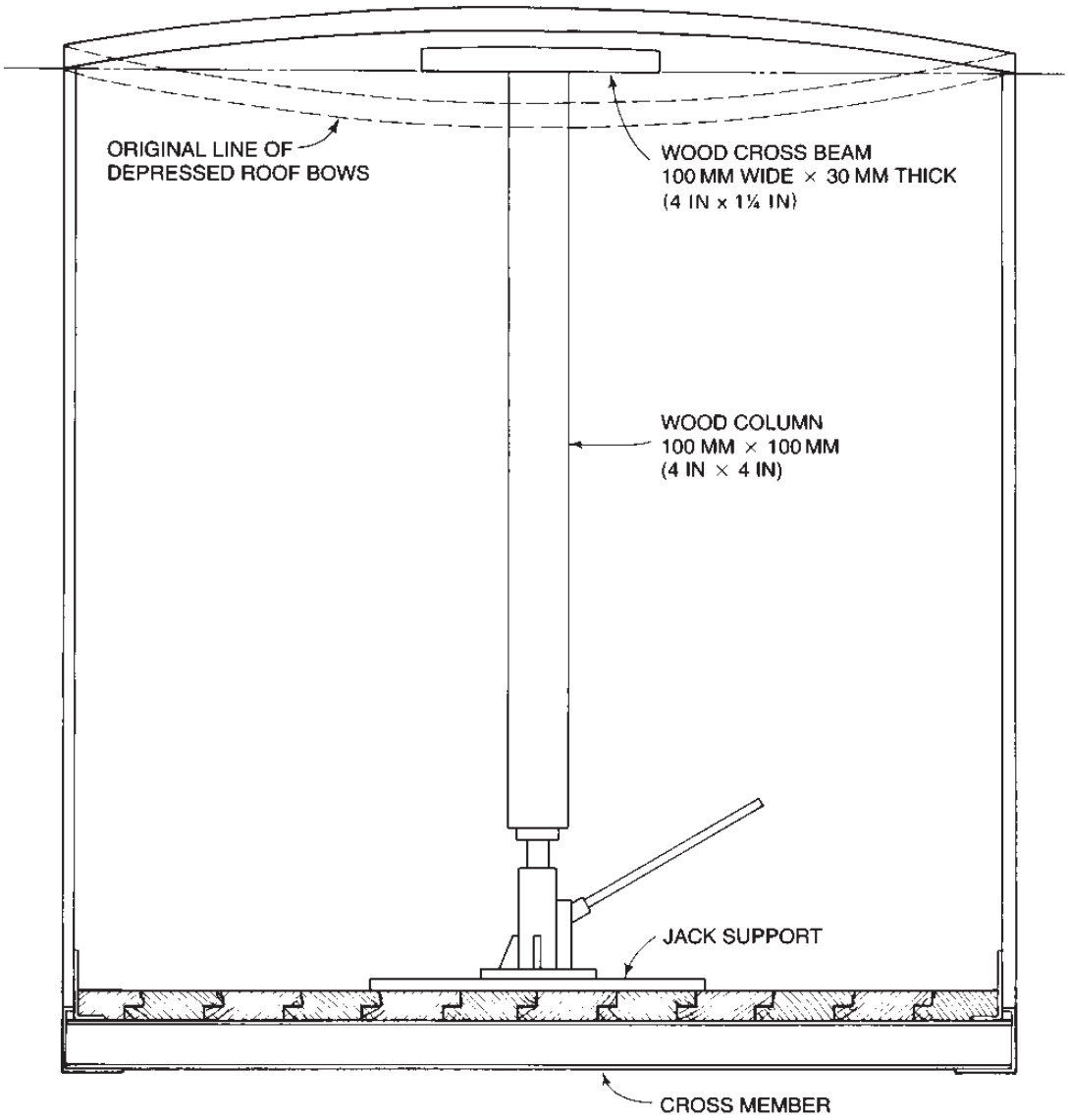


Fig. 7.3/Roof bow straightening

tubing 25 mm x 50 mm (1 in x 2 in) or 30 mm x 60 mm (1¼ in x 2½ in) with a wall thickness of 2 mm (14 gauge) or hat sections 60 mm x 25 mm (2½ in x 1 in) with 30 mm (1¼ in) wide flanges and 1.6 mm (16 gauge) thick. Hat sections should have a 6 mm (¼ in) drain hole in each end. Bows should be fabricated with a camber similar to the original bows.

In open-top containers, like-for-like replacement (compared with remaining bows) is recommended. If such replacement is not possible, replacement bows should be round with a minimum diameter of 30 mm (1-3/16 in) and a minimum wall thickness of 2.5 mm (3/32 in). Hot-dipped galvanized replacement bows having a smooth surface are highly recommended to prevent damage to the tarpaulin.

Substitution of roof bows with the profiles above is permitted, providing the interior height of the container is not reduced, minimum wall thickness requirements are met and the owner so permits.

7.4.4.2 ■ Attachment: Replacement roof bows should be attached to the top side rails in the same manner as are the original roof bows. Check with the owner to verify how bows should be reattached (if at all) to the roof panel. If the owner requires securing the roof bow to the roof panel by welding, use seven skip welds, spaced at equidistant intervals from each other and staggered along either side of the roof bow. Apply adhesive or non-drumming material as the owner requires.

7.4.4.3 ■ Replacement of multiple bows: If many roof bows need to be replaced, such as when replacing an entire roof, do not remove all the old bows at once. Rather, leave every *third* roof bow on 20 ft containers and every *fourth* bow on 40 ft containers attached to the top side rails, until the removed bows have been replaced. Then, the remaining damaged bows can be removed and replaced.

When *all* roof bows require replacement, the original number of bows should be reinstalled or a minimum of 9 bows for a 20 ft container and 17 bows for a 40 ft container. Replacement bows should be evenly spaced along the length of the container.

7.5 Corner Protection and Header Extension Plates

7.5.1 **General: Corner Protection Plates**—Corner protection plates may be straightened and welded according to the procedures recommended in Section 2.8.2 on page 9, provided the upper face of the repair plate is at least 6 mm (¼ in) below the level of the upper face of the top corner fittings. If this is not possible, replace the plate according to the procedures recommended for replacement in Section 2.8.5 on pages 12 - 13.

7.5.2 **General: Header Extension Plates**—Header extension plates may be straightened and welded. They may also be patched if the highest point on the installed patch is at least 6 mm (¼ in) below the level of the upper face of the top corner fittings. To install a patch, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. The interior lapped seam may be skip welded or fully caulked, according to the owner's policy. If these methods are not possible, or if economics so dictate, the plate must be replaced.

7.5.3 **Corner Protection and Header Extension Plate Replacement**—To replace these plates, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. Special considerations for these replacements follow:

7.5.3.1 ■ Replacement material: The replacement plate must be a minimum of 3.2 mm (10 gauge) thick and of the same material as the original (or Corten steel if unknown).

7.5.3.2 ■ Fitting the replacement plate: The plate should be fitted around the corner fitting and extend at least 38 cm (15 in) along the top side and header rails. Replacement plates should overlap the existing roof panel in the same manner as in the original roof or by at least 13 mm (1/2 in).

7.5.3.3 ■ Completing the repair: The interior seam between the top side rails and the plate must be skip-welded and caulked between the seams, or fully caulked.

7.6 Tarpaulin Repair (Open-Top Containers)

7.6.1 **Patching of Tarpaulins**—Holes or cuts in tarpaulins may be patched unless it would be less expensive to replace the tarpaulin and/or the owner requires replacement for other reasons. Patches must have the same properties, characteristics, material and specifications as the tarpaulin to which they are to be attached. Use of pre-cut patches with attached customs tape, available from suppliers of tarpaulins in various sizes, may reduce expense. Do **not** repair a tarpaulin by sewing on a patch. The correct procedure for patching tarpaulins follows:

7.6.1.1 Select a patch that completely covers the area to be repaired plus a minimum of 15 mm (9/16 in) on all sides of the repaired area.

7.6.1.2 Clean the area to be covered with acetone or other mineral spirit that is compatible with the tarpaulin and patch.

7.6.1.3 Apply the patch and use a heat gun to fuse the patch to the tarpaulin. Follow the recommendations of the tarpaulin supplier.

7.6.1.4 Roll the patch with a heavy weight while the surfaces are heated to ensure proper, flat adhesion. Cover the joint with a band of plastic material (customs tape). Roll over the taped area with a pattern wheel while it is hot, in order to create a relief pattern as required by TIR regulations.

7.6.1.5 If the owner and local environmental regulations so permit, pin holes no greater than 6 mm (1/4 in) in diameter may be repaired using epoxy compounds. Clean the repaired area as indicated above and apply the compound to cover the hole as per manufacturer's requirements.

7.6.2 **Replacement of Tarpaulins**—If a tarpaulin is too heavily damaged to be repaired economically by patching, it should be replaced. Like-for-like replacement is recommended. If like material is not available, or if the tarpaulin is entirely missing and needs replacement, consult the owner for guidance as to requirements.

NOTE: If there is delay in obtaining replacement tarpaulin material, the top of the container should be temporarily covered to protect the floor until the replacement tarpaulin can be fitted. Unless the top structure is heavily damaged, covering with a container stacked on top is suggested.

7.7 **TIR Cord**—If the existing cord is repairworthy or missing, replacement of the cord is the only type of repair allowed. Cable thickness should be between 6-8 mm (1/4 - 5/16 in). Note that if there are only cut or frayed portions of the PVC cable coating with no other damage, repair is not required.

SECTION 8 UNDERSTRUCTURE (OR UNDERFRAME)

8.1 **General**—The understructure of the container is composed of crossmembers which support the floor. Many 20 ft containers have forklift pockets that mate with handling equipment; most 40 ft containers have gooseneck tunnels that mate with recesses in the chassis and are supported by short cross-members called *outriggers*. (NOTE: Whatever applies to *crossmembers* in the text below also applies to *outriggers* unless otherwise specified.) Because these components support the structure of the container and because the forklift pockets and gooseneck tunnels must mate with a variety of other equipment, careful attention to material specification and dimensions is crucial.

Before undertaking any understructure repairs, refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

8.1.1 **Replacement Materials**—When installing screws in a replacement understructure component, use zinc-plated or other similarly treated self-tapping screws with the same diameter of screw head and shank as the original. If this size is unavailable, use a screw with a minimum shank diameter of 6 mm (1/4 in). Screws should be countersunk to a depth of 2 mm (5/64), and should be of sufficient length to penetrate the top flanges of crossmembers and forklift pocket sides completely. Pre-lubricated screws will be easier to install.

8.1.2 **Attachment to Floor**—When installing a replacement understructure component or portion of such a component, any floor screws that are in the area of the component to be removed must be backed out and removed before removing the component. If the screws cannot be backed out, they should be cut from the crossmember. Using a cutting torch, flame-cut the screws from the crossmember while shielding the underside of the floor to prevent damage by burning.

When reattaching the replacement understructure component or portion of the component, drill holes into the new crossmember from inside the container through any existing holes in the floor. If the existing holes are enlarged or distorted, or if new flooring is installed above the new understructure component, carefully measure the location of new holes and drill them through the floor. New holes in existing flooring should be adjacent to existing holes, which should be filled with wooden dowels glued in place.

Loose floor screws should be tightened if intact. If the screws are not intact or cannot be tightened, they should be removed and replaced.

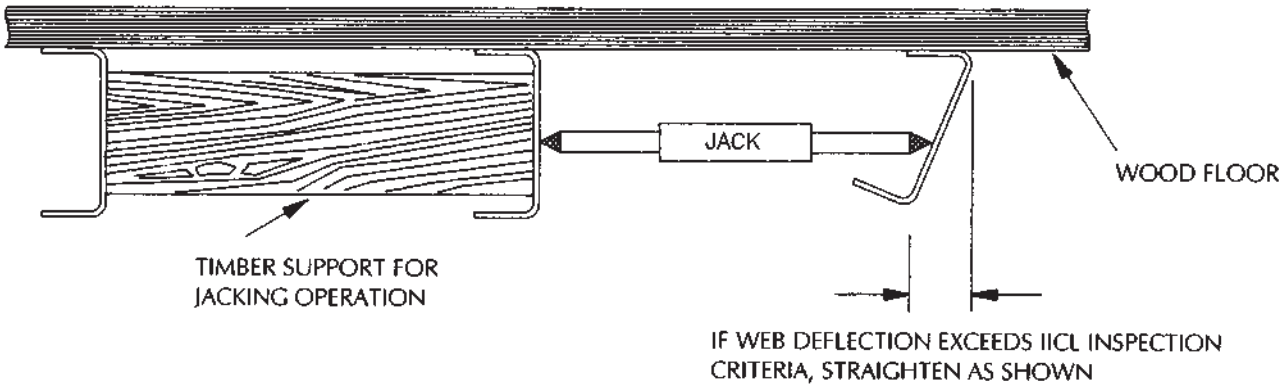


Fig. 8.1/Timber bracing for crossmember straightening

8.1.3 Welding of Cracks, Etc.—Cracks, cuts, tears or fractures in understructure components can be repaired by welding or straightening *and* welding, *provided* the length of the cut, crack or other damage is not greater than any of the maximum limitations provided in Section 2.8.2 on page 9. (If *any* of these dimensions is exceeded, inserting or replacement is required.)

8.1.4 Coating of Understructure Repairs—Understructure components are usually covered with different coatings (*undercoating or underseal*) than those applied to other steel components. Undercoatings are usually bituminous- or wax-based materials designed to resist corrosion by barrier action rather than rust-inhibitive chemicals. Thus, it is important to cover the components completely (including the underside of the floor boards, if originally coated) and in adequate thickness to resist moisture and contaminant contact with bare materials.

The surface must be prepared for coating, preferably by abrasive blasting to a minimum of Swedish Standard SA 2 (commercial cleaning). Coatings must be the same type as covered the original component, and must be applied to the repair in the same manner (*ie.*, if the original components were primed prior to being undercoated, replacement material must also be primed in the same or an equivalent manner).

8.2 Crossmembers (Including Outriggers)—Damaged crossmembers may be repaired by straightening, welding or straightening *and* welding, inserting (including installation of a full-length overlapping angle if warranted and economically feasible) or full replacement. Hot-rolled crossmembers (**not** pressed or formed crossmembers or outriggers) also may be sectioned.

8.2.1 Crossmember Straightening—To straighten a crossmember, follow the procedures recommended in Section 2.8.1 on page 8. Special considerations for crossmember straightening follow:

8.2.1.1 ■ Straightening with a jack: When using a jack to straighten the web of a crossmember, the jack should be braced against adjacent crossmembers using suitable timber to spread the load from the jack over a larger area, as shown in Figure 8.1. The wood will prevent damage to the braced crossmember. Care should be taken to ensure that the crossmembers are not pulled away from the floor. Photo 8.1 shows the use of a hydraulic jack to straighten a crossmember web.

8.2.1.2 ■ Straightening the flange: Crossmember flanges usually do not require straightening except when necessary in conjunction with straightening the web and when ISO+IICL minimum ground clearances are violated. When straightening is necessary, use a long-handled wrench and straighten as close as possible to the original profile.

8.2.1.3 ■ Resecuring the crossmember: When straightening understructure components, ensure that the floor remains tightly secured by floor screws.

8.2.2 Crossmember Welding or Straightening *and* Welding—To weld or straighten *and* weld cracks, cuts or tears in crossmembers, follow the procedures and limitations recommended in Sections 2.8.2 on page 9 and

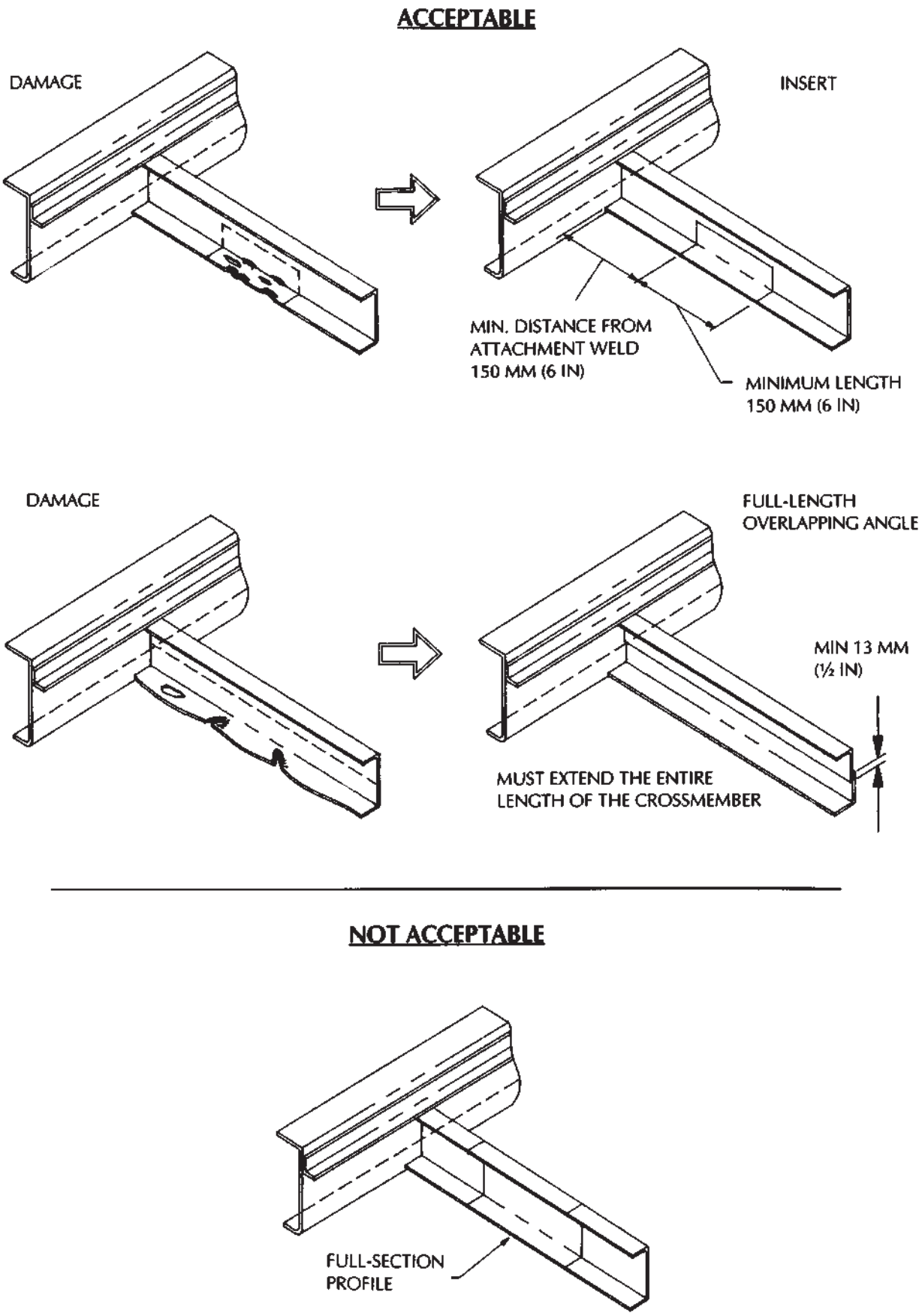


Fig. 8.2/Acceptable and unacceptable crossmember repairs

8.2.1.1 - 8.2.1.3 above. If the limitations cannot be observed, an insert should be installed.

8.2.3 **Crossmember Inserting**—To install an insert in a crossmember, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. Crossmember inserts are subject to the following limitations:

- Sections through the complete profile of the crossmember are **not** permitted *except* for hot rolled profiles, such as I-beams.
- An insert must be at least 150 mm (6 in) in length.
- Inserts must be flush with the crossmember (overlapping patches are *not* acceptable).
- The top flange of the crossmember securing it to the floor must be left intact.
- Welding an insert to the radius of the crossmember is not recommended; it is good practice to leave a minimum of 13 mm (1/2 in) of the original vertical web intact, if possible, to attach the insert.
- If an insert would end within 150 mm (6 in) of another vertical weld in the crossmember, the insert must be extended to the existing weld.
- If an insert would end within 150 mm (6 in) of a weld attaching the bottom side rail to crossmember, the insert must be extended to the bottom rail. Similarly, if an insert *begins* at the bottom rail, it must be at least 150 mm (6 in) in length.

See Figure 8.2 for illustration of acceptable and unacceptable crossmember repairs. Photo 8.2 shows a crossmember insert continuously welded in place, before undercoating. Photo 8.3 shows a completed and coated crossmember insert.

8.2.4 **Full-Length Overlapping Angle Installation (Crossmember)**—If damage to the crossmember extends along its entire length but the top flange is undamaged and the crossmember is properly secured, it may be possible to repair the crossmember by installing a full-length overlapping angle (see Figure 8.2). This repair is actually a web patch which overlaps the crossmember web on one side and provides a new flange on the other side. To perform this repair, follow the procedures recommended for *patching* in Sections 2.8.3 on pages 9 - 10 and 8.2.4.2 below. Note that only one side of the angle overlaps and is welded to original material, and that the angle must extend the *full length* of the crossmember.

Note that if it is more economical and practical to replace the crossmember than to fit a full-length overlapping angle, the crossmember should be replaced.

8.2.4.1 Overlapping-angle repair is subject to the following limitations:

- The angle must extend across the entire length of the crossmember.
- A minimum of 25 mm (1 in) of the original vertical web of the crossmember must be left intact along its entire length to ensure satisfactory attachment of the angle.

8.2.4.2 Overlapping-angle repair is subject to the following special considerations:

■ Preparation for welding: After removing the damaged area, remove any residual coating from the remaining portion of vertical web. Grind the cut areas along at least 20 mm (3/4 in) of the vertical web clean and smooth. Bevel the edge of the replacement angle along the ends to be joined to the bottom

side rails. The replacement angle must overlap the remaining portion of the vertical web by at least 13 mm (1/2 in) and butt against the bottom side rails.

8.2.5 **Crossmember Sectioning (Hot-Rolled Profiles ONLY)**—If damage to a *hot rolled* I-beam crossmember cannot be repaired by one of the methods listed above for crossmember repair, a full-profile section is permitted with the following limitations:

- Sections may **only** be fitted to hot-rolled profiles such as I-beams. **No** full-profile sections are permitted in pressed or formed channel-type or box-section crossmembers.
- Sections must be at least 150 mm (6 in) in length.
- If a section would end within 150 mm (6 in) of another full profile vertical weld, the section must be extended to that weld.
- If a section would start or end within 150 mm (6 in) of a weld attaching the bottom side rail to crossmember, the section must be extended to the bottom rail.
- Full-profile sectioning should be avoided if crossmember replacement would be less expensive.

To install a section in a hot-rolled I-beam crossmember, follow the procedures recommended in Section 2.8.4 on pages 10 - 12. All floor screws in the sectioned area must be removed and the floor shielded (if flame-cutting is employed). The portion of the top flange of the section that butts against the floor must be primed and/or undercoated *before* the section is fitted.

8.2.6 **Crossmember Replacement**—To replace a crossmember, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. All floor screws in the crossmember must be removed and the floor shielded (if flame-cutting is employed). The portion of the top flange of the new crossmember that butts against the floor must be primed and/or undercoated before the new crossmember is fitted.

8.3 **Forklift Pocket Straps (Fork Pocket Straps)**—Damage to forklift pocket straps can be repaired by straightening, welding or straightening *and* welding or replacement. Inserts and sections are not permitted. ISO and IICL tolerances for minimum forklift pocket opening and minimum ground clearance of the strap must be maintained when repairing damaged forklift pocket straps.

8.3.1 **Forklift Pocket Strap Straightening**—To straighten a forklift pocket strap, follow the procedures recommended in Section 2.8.1 on page 8.

8.3.2 **Forklift Pocket Strap Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, cuts or tears attaching a forklift pocket strap or in the strap itself, follow the procedures and limitations recommended in Sections 2.8.2 on page 9 and 8.2.1.1 - 8.2.1.3 above. If the limitations cannot be observed, the strap must be replaced.

8.3.3 **Forklift Pocket Strap Replacement**—To replace a forklift pocket strap, follow the procedures recommended in Section 2.8.5 on pages 12 - 13. Special considerations follow:

8.3.3.1 ■ The replacement strap: Measure the inside dimensions between the forklift

pocket sides and cut a replacement strap to size. Replacement straps should be at least 6 mm (1/4 in) in thickness and must extend a minimum of 200 mm (8 in) into the forklift pocket tunnel. Ensure that the same coating is applied to the replacement strap as was present on the original. The top of the strap may have one coating and the bottom another coating.

8.4 **Forklift Pocket Sides (Fork Pocket Sides)**—Forklift pocket sides may be repaired by straightening, welding or straightening *and* welding, inserting or replacement. Overlapping angles may be installed, *providing* they are welded as described below in 8.4.3 and in Fig. 8.3. However, overlapping patches may **not** be used on forklift pocket sides; they present an obstruction in the pocket side that can lead to damage by forklift pocket tines.

8.4.1 **Forklift Pocket Side Straightening**—To straighten forklift pocket sides, follow the procedures recommended in Section 2.8.1 on page 8. Use of a jack, as in crossmember straightening (described in Section 8.2.1.1) is recommended.

8.4.2 **Forklift Pocket Side Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, cuts, tears or fractures in forklift pocket sides, follow the procedures and limitations recommended in Section 2.8.2 on page 9. If the limitations cannot be observed, an insert should be installed.

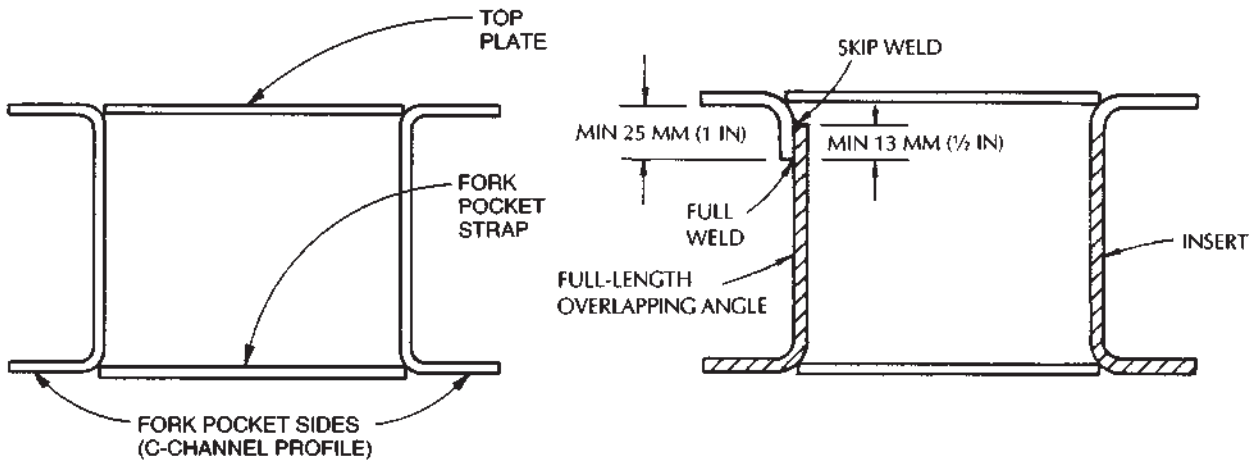
8.4.3 **Forklift Pocket Side Inserting**—To install an insert in a forklift pocket side, follow the procedures recommended in Section 2.8.3 on pages 9 - 10.

Crossmember inserts are subject to the following limitations:

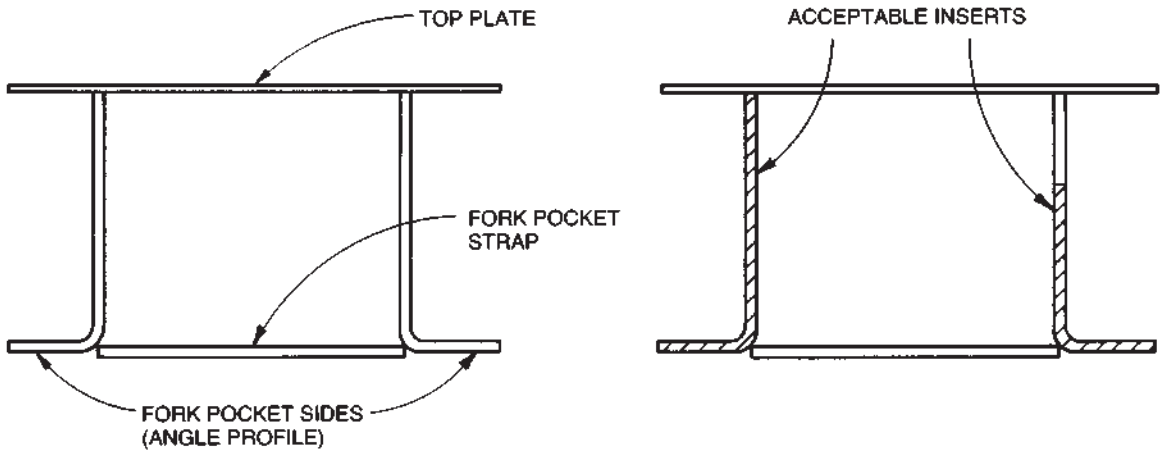
- Sections through the complete profile of the C-channel forklift pocket side are **not** permitted.
- Inserts must be flush with and butt welded to a forklift pocket side. Exception: a lapped, full-length overlapping angle is an acceptable repair to a forklift pocket side. See Fig. 8.3.
- If a forklift pocket side is constructed from a C-channel profile, the top flange of the pocket side securing it to the floor must be left intact.
- If the forklift pocket side is constructed from an angle welded to a top plate, the top plate must be left intact. See Figure 8.3.
- An insert must be at least 150 mm (6 in) in length.
- If an insert would end within 150 mm (6 in) of another vertical weld in the forklift pocket side, the insert must be extended to the existing weld.
- If an insert would end within 150 mm (6 in) of a weld attaching bottom side rail to forklift pocket side, the insert must be extended to the bottom rail. Similarly, if an insert begins at the bottom rail, it must be at least 150 mm (6 in) in length.

8.4.4 **Full-Length Overlapping Angle Installation (Forklift Pocket Sides)**—If damage to the forklift pocket side extends along its entire length, but the top flange or plate is undamaged and is properly secured to the floor, it may be possible to repair the forklift pocket side by installing a full-length overlapping angle (see Figure 8.3). *This repair should not be performed if it would be less expensive to replace the entire forklift pocket side.*

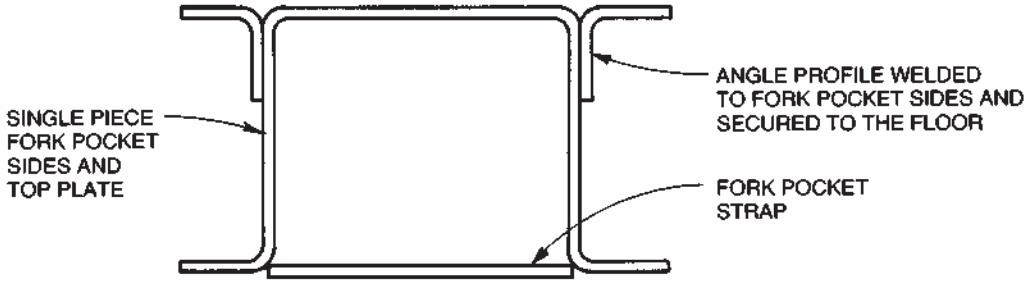
To install a full-length overlapping angle in a forklift pocket side, follow the procedures recommended for patching in Section 2.8.3 on pages 9 - 10, as well as the recommendations for installing a full-length overlapping angle in a



ORIGINAL DESIGN WITH TOP PLATE FULLY WELDED TO C-CHANNEL PROFILE FORK POCKET SIDES.



ORIGINAL DESIGN WITH TOP PLATE WELDED TO ANGLE PROFILE FORK POCKET SIDES.



ACCEPTABLE REPLACEMENT FORK POCKET ASSEMBLY.

Fig. 8.3/Forklift pocket (fork pocket) repairs

crossmember in Section 8.2.4 above (including the limitations in Section 8.2.4.1).

8.5 **Forklift Pocket Assembly Replacement**—To install a replacement forklift pocket assembly, follow the procedures recommended in Section 2.8.5 on pages 12-13, as well as Sections 8.1.1 - 8.1.4 and 8.3.3.1 above.

Special considerations follow:

8.5.1 ■ Replacement material: If a closed type of forklift pocket requires replacement, an open type of forklift pocket assembly may be substituted, *providing* the type and size of material used will restore the structural integrity of the container.

Replacements for open types of forklift pocket assemblies may be fabricated using C-channel or angle sections for the forklift pocket sides, welded to a flat top plate. Alternatively, a single piece of steel may be folded to fabricate the forklift pocket sides and the top plate. An angle profile is then continuously welded to each of the forklift pocket sides to form a C-channel profile (see Figure 8.3).

8.5.2 ■ Fabricating the replacement forklift pocket: If the assembly is fabricated from C-channel forklift pocket sides or angles and a top plate, the forklift pocket sides and top plate should first be continuously welded together to form a single forklift pocket assembly before installing on the container. Similarly, if using a folded piece of steel, weld the angle profiles to the sides before proceeding.

8.5.3 ■ Preservation of ISO dimensions: Minimum dimensions of the pocket and forklift pocket strap as well as ground clearance of all components of the assembly specified in ISO standards must be preserved.

8.6 **Gooseneck Tunnel Components**—When repairing, it is important to preserve the dimensions of the gooseneck tunnel so that it will mate with chassis properly and so that there will not be intrusion into the cube of the container.

8.6.1 **Gooseneck Tunnel Longitudinal Rail**—If the gooseneck tunnel rail is deflected in such a manner as to impede loading the unit to a gooseneck chassis or the damage extends beyond the ISO tolerance by 10 mm (3/8 in) or more, it may be repaired by straightening, welding or straightening *and* welding, inserting or replacement. Full-profile sections may be fitted to open-section rails only; sections are **not** permitted in box- or other closed-section rails.

8.6.1.1 **Gooseneck Tunnel Rail Straightening**—To straighten a gooseneck tunnel rail, follow the procedures recommended in Section 2.8.1 on page 8.

8.6.1.2 **Welding or Straightening and Welding**—To weld or straighten *and* weld cracks, cuts, tears or fractures in gooseneck tunnel rails, follow the procedures and limitations recommended in Sections 2.8.2 on page 9.

8.6.1.3 **Gooseneck Tunnel Rail Inserting**—To install an insert in a gooseneck tunnel rail, follow the procedures recommended in Section 2.8.3 on pages 9 - 10.

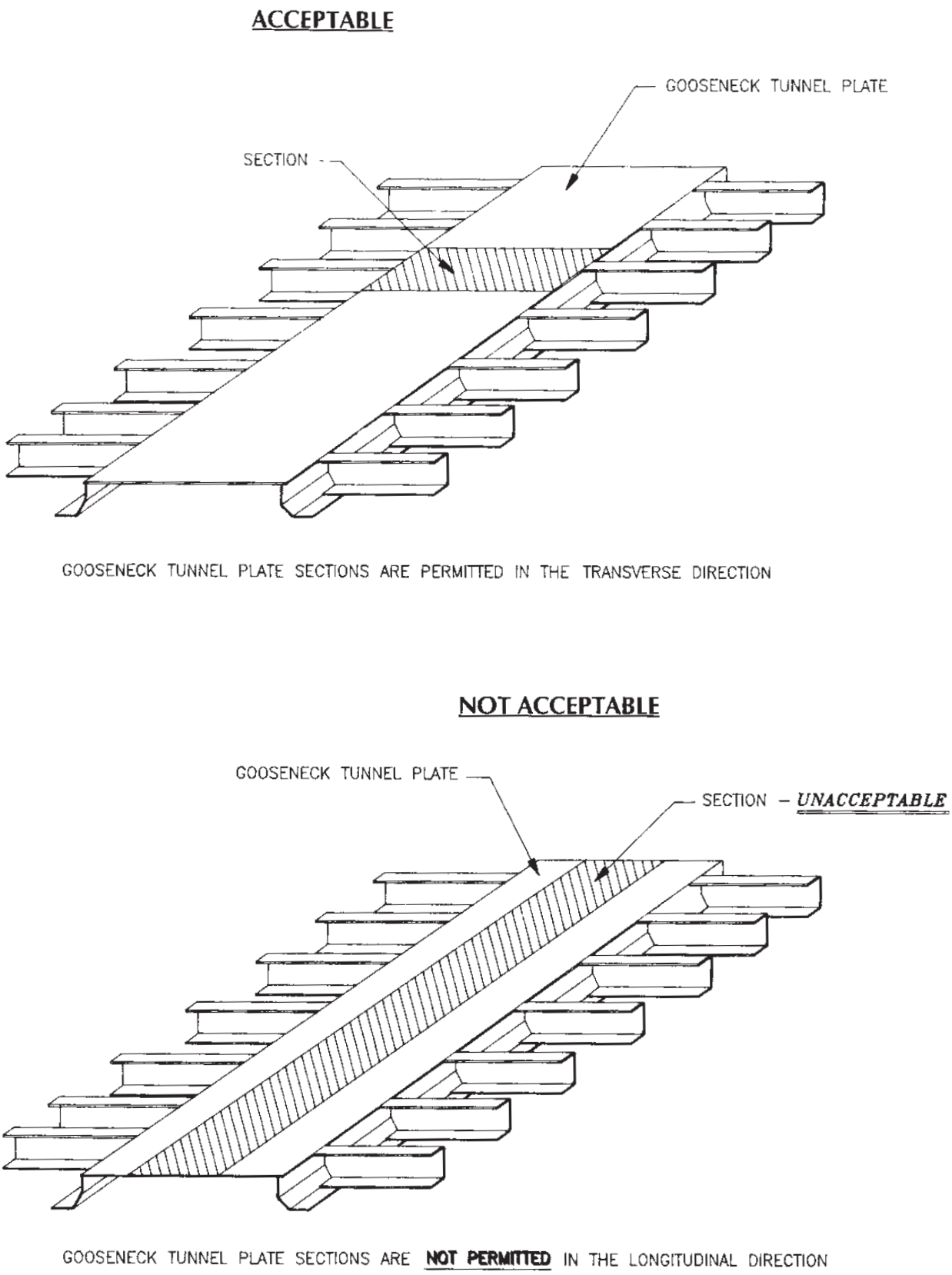


Fig. 8.4/Acceptable and unacceptable gooseneck tunnel plate sections

Gooseneck tunnel rail inserts are subject to the following limitations:

- Inserts can be of any profile that does not extend through the entire cross sectional profile of the rail.
- Inserts must be fitted flush with the original rail.
- An insert must be at least 150 mm (6 in) in length.
- If an insert would end within 150 mm (6 in) of another vertical rail weld, the insert must be extended to that weld. This also means that if an insert would *start or end* within 150 mm (6 in) of the tunnel bolster or the front sill, the insert should be extended to the bolster or sill.

Special considerations follow:

■ Cutting out the damaged area: When installing an insert in the longitudinal rail, it may be necessary to cut the weld attaching the rail to the outriggers, tunnel plate, tunnel stiffeners, bolster rail and front bottom rail.

■ Stiffening plates and back-up plates: If any stiffening gussets were removed from the damaged area, refit or replace these gussets in the rail profile before fitting insert. NOTE: A back-up plate may be welded on the inside edge of the original rail to allow the insert to be firmly positioned during welding.

■ Rewelding: All rewelding of adjacent components that are to be re-attached to the rail must be completed before recoating begins.

8.6.1.4 Open-Section Gooseneck Tunnel Rail Sectioning—To install a full-profile section in a gooseneck tunnel rail, follow the recommendations in Section 2.8.4 on pages 10 - 12. The following limitations apply:

- Sections may *only* be fitted to **open-section** types of rails. No full-profile sections may be fitted to box- or other closed-section rails.
- A section must be at least 150 mm (6 in) in length.
- If a section would end within 150 mm (6 in) of another full-profile vertical weld, the section must be extended to that weld. This also means that if a section would end within 150 mm (6 in) of the tunnel bolster or the front sill, the section should be extended to the bolster or sill.

The following special consideration applies:

■ Stiffening plates and back-up plates: If any stiffening gussets were removed from the damaged area, refit or replace these gussets in the rail profile before fitting the section to the rail.

8.6.2 Gooseneck Tunnel Plate and Bolster—Damage to a gooseneck tunnel plate or bolster can be repaired by straightening, welding or welding *and* straightening, installing an insert or a *transverse* full-profile section (tunnel *plate* only), or by replacement. *Longitudinal* full-length tunnel plate sections are **not** acceptable as they can damage tunnel stiffeners. See Fig. 8.4.

8.6.2.1 Gooseneck Tunnel Plate or Bolster Straightening—To straighten a damaged gooseneck tunnel plate or bolster, follow the procedures recommended in Section 2.8.1 on page 8.

8.6.2.2 Gooseneck Tunnel Plate or Bolster Welding or Straightening *and* Welding—To weld or straighten *and* weld cracks, cuts, tears or fractures in gooseneck tunnel plates, follow the procedures and limitations recommended in Sections 2.8.2 on page 9.

8.6.2.3 Gooseneck Tunnel Plate Inserting/Sectioning or Bolster Inserting—To

install an insert in a gooseneck tunnel plate or bolster, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. The limitations listed in 8.6.1.1 for gooseneck tunnel *rail* inserts are also applicable for gooseneck tunnel *plate and bolster* inserting, with the following additions:

- Inserts may not exceed 450 mm (18 in) in the longitudinal direction.
- An insert may not terminate on any formed edge.
- Inserts terminating within 150 mm (6 in) of each other in any direction must be extended to encompass the earlier repair or to provide a common weld.
- If an insert in a bolster would terminate within 150 mm (6 in) of a bottom side rail, it must be extended to the side rail.
- If an insert in a bolster would terminate within 150 mm (6 in) of a weld joining the longitudinal rail to the bolster, it must be extended to that longitudinal rail.
- An insert in a tunnel bolster may not extend into the uppermost surface of the bolster. An insert that extends into any or all of the remaining surfaces is acceptable, except as provided below.

The following special consideration applies:

■ Tunnel stiffeners: Cut out the tunnel stiffeners on either side of the area where the insert will be placed by disc cutting or burning. After welding the insert in place, reweld or replace any removed tunnel stiffeners.

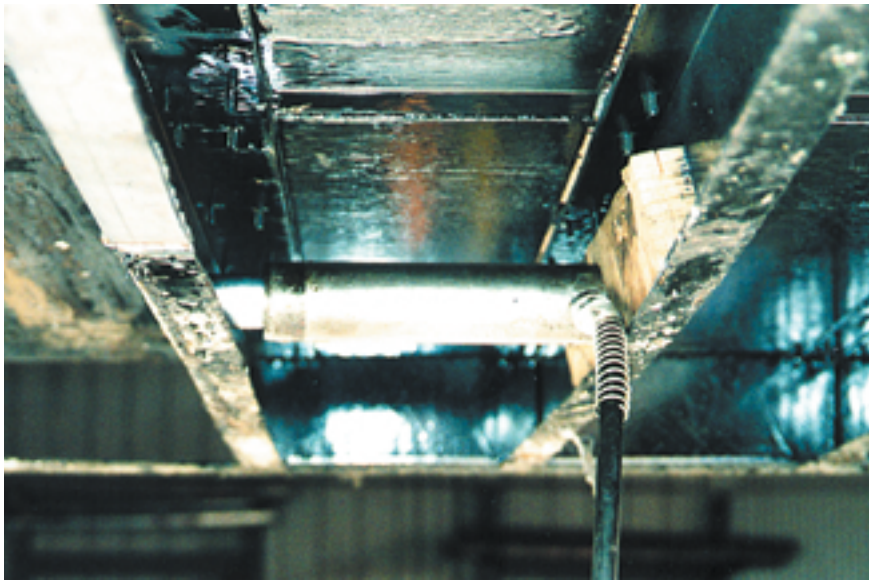
Sections to tunnel plates are identical to inserts, and the same procedures and limitations apply. *Sections to tunnel bolsters are **not** permitted*; if bolsters cannot be repaired by straightening, welding or straightening *and* welding or inserting, they must be replaced.

8.6.3 Gooseneck Tunnel Component and Assembly Replacement—If tunnel components cannot be repaired economically or practically by inserting (or sectioning, if permitted), replace components or the entire assembly according to the procedures recommended in Section 2.8.5 on pages 12 - 13.

Check ISO dimensions to ensure that the minimum tunnel opening and prescribed length, width and height are maintained (see Appendix A, ISO Dimensions and Tolerances).

Shield the underside of the floor before removing any components by burning. If the entire tunnel assembly requires replacement, the floor boards and outriggers surrounding the tunnel area may have to be removed to prevent collapse and burning during the repair.

Photo 8.1 (to right) / Using a hydraulic jack to straighten a crossmember web



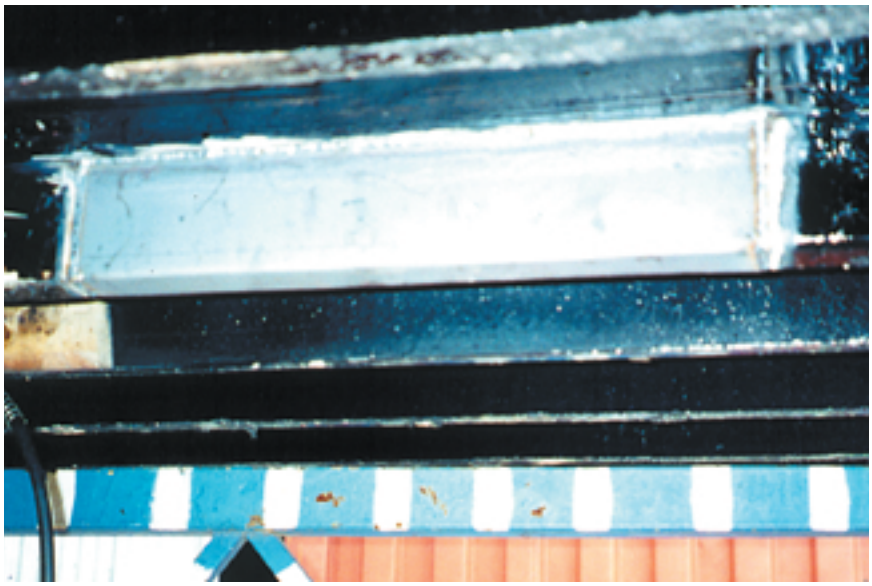


Photo 8.2 (to left) / Crossmember insert continuously welded in place, before painting and undercoating

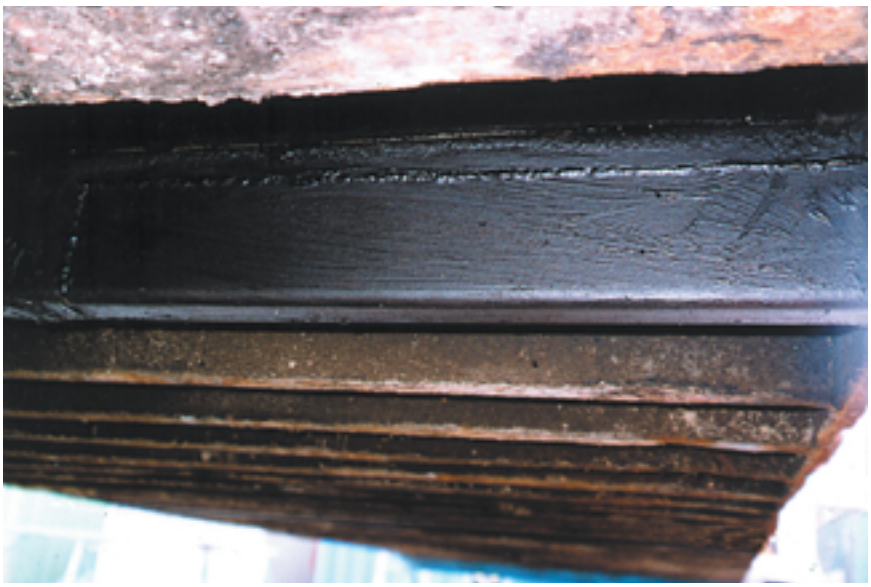


Photo 8.3 (to right) / Completed crossmember insert including undercoating

SECTION 9 FLOORING

9.1 **General**—Floor repair is different from most container repairs because floors are made of wood instead of steel. Wood burns, discolors and absorbs odors and stains more readily than steel. When repairing nearby steel components, care must be taken to protect flooring. If flooring requires repair, the method of repair should be the least aggressive necessary to correct the damage. The general order of aggressiveness, from least to most, is:

- Cleaning
- Dowel repair
- Sectioning or partial replacement
- Complete replacement of floor

The use of wood filler is not recommended by IICL as a method of repair.

The type of repair required depends upon the extent of damage and the type of floor material, as follows:

- Small holes up to 13 mm (1/2 in) in diameter may be repaired using dowels.
- Floors may be repaired by replacing part of the floor or by installing a complete new floor. At the owner's option, a container requiring replacement of an entire plank floor can be refitted with a plywood floor.
- Plywood floors that do not have a center support and that require partial replacement must be fitted with a steel center support.

9.1.1 **Environmentally Friendly Flooring**—In addition to wood, new environmentally friendly floor materials are under consideration for container flooring. These materials, which range from carpet fibers to plastic to cement, are being developed as alternatives to tropical hardwoods. IICL has developed criteria for evaluating new floor materials, both to ensure that container users' technical requirements are met and to minimize adverse effects on the environment of raw material supply, manufacture, distribution and disposal.

In the event that new floor materials come into general use while this fifth edition of the Repair Manual is in effect, IICL will consider amending the manual to include any new procedures that may be necessary for the repair of such new materials.

Repairers are urged to use environmentally friendly floor replacement materials whenever possible. Consult owners for approved materials.

9.1.2 **Wood Material**—Materials used in container floors include solid or laminated hardwood planks, solid or laminated softwood planks, or plywood panels. Planks are milled with ship-lap or tongue-and-groove edges, while plywood panels have flat square edges. When repairing floors, replacement material

should be the same as the material removed ("like-for-like"). However, laminated hardwood plank may be substituted for solid hardwood plank, and vice-versa, if like material is not available. Similarly, laminated softwood plank may be substituted for solid softwood plank, and vice-versa. *Substitution of plank for plywood, softwood for hardwood, or vice-versa is **not** permitted without owner's consent.*

All timber must be seasoned, with a moisture content of less than 15% at time of installation. All replacement timber flooring material must be free of splits and cracks. Solid and laminated hardwood flooring must also be free of knots. Tightly secured knots are permissible in solid and laminated softwood timber boards. Ship-lapped planks should have a minimum 2 mm (5/64 in) crusher bead to prevent later expansion damage. Wood used for replacement in Australian-approved treated floors (TCT) must be treated to conform to Australian Quarantine Requirements. Since most wood floors have been chemically treated to comply with Australian Quarantine requirements, repair depots should make sure to dispose of discarded flooring in an environmentally responsible manner.

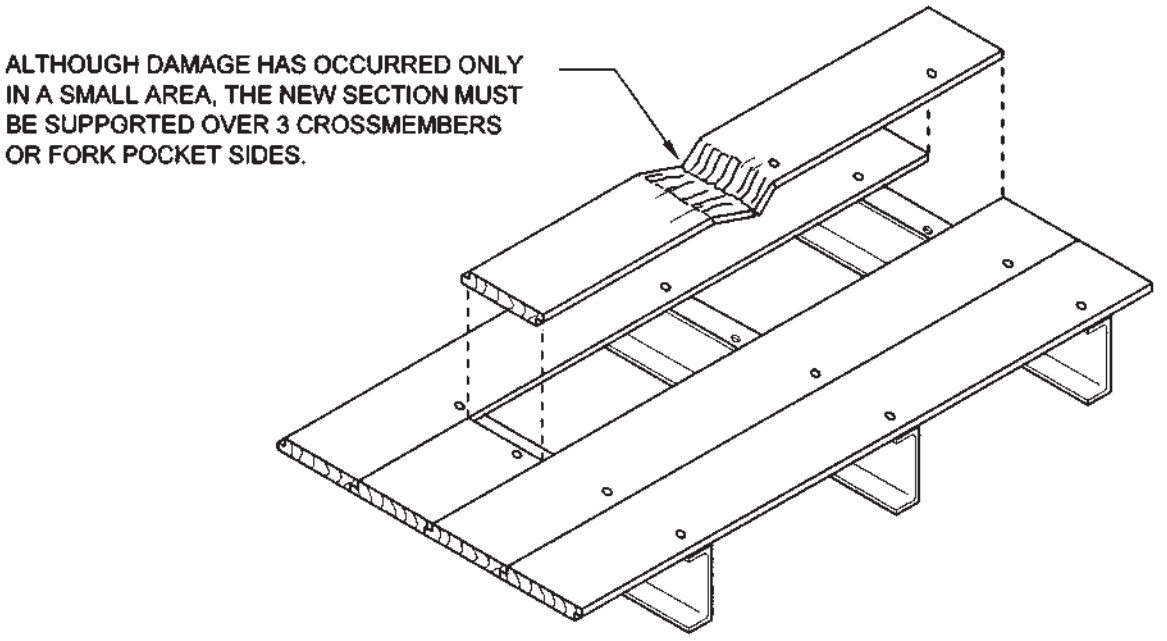
9.1.3 **Floor Screws**—When repairing floors or replacing screws, install zinc-plated or other similarly treated self-tapping screws with a minimum diameter of 6 mm (1/4 in). Screws should be countersunk to a depth of 2 mm (5/64 in) below the floor surface. Use the same number of screws as in the original planks or boards. Butt joints of repaired sections require at least two screws per plank, or three if the plank is over 150 mm (6 in) wide. Floor screws must be of sufficient length to engage the understructure properly.

9.1.4 **Sealant**—Sealant is normally applied to the understructure surfaces that mate with the replacement board and at the butt joints of the replacement board (including rail and tunnel joints). Sealant exposed to cargo-carrying surfaces should not be of butyl material, but rather of urethane or chloroprene material suitable for contact with cargo.

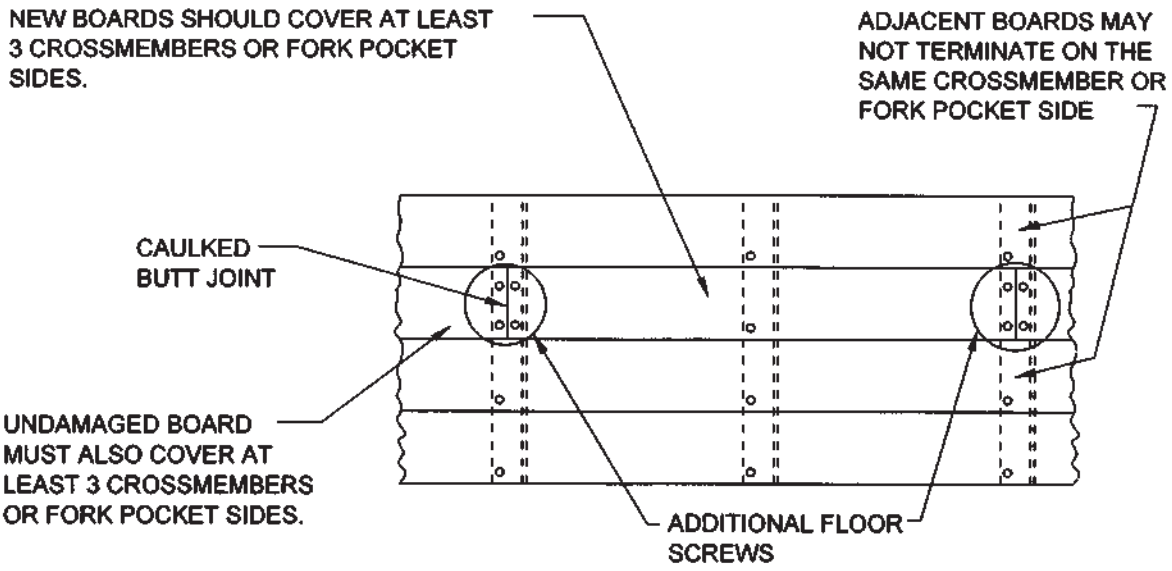
9.1.5 **Coatings**—If the original floor was coated by the manufacturer, apply coating to the replacement flooring on the underside and topside, using the same type of material as in the original (bitumen, polyurethane, wax-based or other type of top or underside coating). Don't forget to apply primer under the main coating if the original floor was primed and/or if the owner requires it.

9.2 **Cleaning**—Depending upon floor conditions, wooden flooring may be cleaned by the following methods listed in order of increasing aggressiveness: sweeping; washing with water, detergent or other cleaning agent; steam cleaning; or sanding. The least aggressive method necessary to clean the container should always be employed. Readers should refer to the latest edition of the ICS/IICL *General Guide for Container Cleaning* for cleaning recommendations for each type of condition likely to be encountered.

9.2.1 **Contamination (Hazardous or Potentially Hazardous)**—It is extremely important to ascertain the types of substances that are to be cleaned out. In some cases, certain substances may produce toxic gases or even explosions when they come in contact with water or steam. A container that has been accepted by the depot with any conditions that may be harmful to human life



REMOVAL OF DAMAGED BOARD



FINISHED REPAIR

Fig. 9.1/Plank board repair

or health must be segregated until the condition has been established and appropriate treatment advice provided. If the substance is unknown, contact the redelivery agent to establish the type of contaminant present and the appropriate treatment. If the contamination is identified as hazardous, the cleaning depot must seek specialist advice on the correct method of cleaning. *Do not attempt to clean until the substance has been identified and appropriate cleaning instructions have been received.*

9.3 **Dowel Repairs**—Holes up to 13 mm (1/2 in) in diameter may be repaired by inserting a round hardwood dowel into the hole and securing it into place with glue. The following limitations apply to the use of dowels:

- Dowels must be round and made of hardwood.
- Dowels cannot exceed 13 mm (1/2 in) in diameter.
- The minimum distance between the end of any floor board, plank or screw and any part of a dowel is 50 mm (2 in).
- The minimum distance from the side of a floor board and any part of a dowel is one (1) times the dowel diameter.
- The minimum distance from any part of a dowel to any part of another dowel is four (4) times the larger dowel diameter.

Holes up to 13 mm (1/2 in) that cannot be repaired using dowels that meet the minimum distance requirements above, and *all* holes greater than 13 mm (1/2 in) in diameter, must be repaired by sectioning or replacement of the wood.

9.3.1 To repair a hole by inserting a dowel, remove protruding nails. The hole must be smoothed and rounded for a close fit of the dowel. Coat the hole and dowel with exterior-grade wood glue and insert the dowel gently into the hole. Cut the dowel so that its length is the same as the thickness of the floor board (generally, 28 mm [1-1/8 in]), and smooth the cut surfaces. Allow glue to dry thoroughly before using the container.

9.4 **Limitations Applying to Floor Repairs (Partial or Complete Replacement)**—Repairs involving partial or complete replacement are subject to the following limitations:

- Replacement planks and plywood boards, as well as undamaged remaining planks or boards, must cover at least three (3) crossmembers or forklift pocket sides.
- Adjacent floor planks must not terminate on the same crossmember or forklift pocket side.

See Figure 9.1 for illustration of these limitations.
NOTE: If an inspection reveals that the floor has been previously repaired improperly in respect to this limitation, consult owner to determine if correction is required.

9.5 **Partial Replacement (Sectioning) of a Wood Floor (General)**—Following are recommendations for replacing a *portion* of a plank floor or plywood floor. Also see Section 9.1 for basic information required for floor repair.

9.5.1 **Considerations in Partial Replacement of *Plank* Floors**—A single damaged plank need not be replaced in its entirety if both the damaged and the undamaged portion of the plank each cover at least three (3) crossmembers.

Planks should, if possible, be replaced with wood of the same thickness and type of joint (half- or ship-lap, or tongue-and-groove) as originally installed. If tongue-and-groove planks are used, the last board installed must be without a joint to permit assembly.

9.5.2 Considerations in Partial Replacement of *Plywood* Floors—Individual plywood boards (panels) may originally have been installed with their longest dimension either longitudinally or transversely aligned (*i.e.*, with the longer dimensions parallel to the sides or to the ends of the container, respectively). Modern design generally uses a longitudinal alignment of floor boards, with a longitudinal steel center spacer supporting the board edges midway across the container. This support is usually a hat-section or flat-bar profile.

The following considerations apply to repair of plywood floors:

- Replacement plywood sections must extend from the side bottom rail to the steel center support, even if a center support must be installed.
- For transversely laid boards, replacement sections must be as wide (in the longitudinal direction) as the original board.
- Longitudinally laid replacement boards must be cut so as to ensure that joints with existing adjacent boards lie over the center of the top flange of a crossmember, forklift pocket side or outrigger, as appropriate.
- Unless the entire original board is damaged and depending on the size of the damage and of the remaining undamaged board, the replacement panel may span as few as three (3) crossmembers.

9.5.2.1 Considerations in Partial Replacement of Plywood Floors (*without* a Center Support)—In containers manufactured without a center support where the panels run from bottom side rail to bottom side rail, a half-panel may be replaced upon installation of a center support. The center support holds up the edge of both the new and remaining original half-panels. Recommendations for fabricating and installing a center support are provided in Section 9.7. The replacement panel must run from center support to bottom side rail. When performing this type of repair, the following additional limitations apply:

- Half of the original panel, approximately 120 cm x 120 cm (4 ft x 4 ft), must be replaced.
- The longitudinal butt joint between the original and replacement panel must be along the center line of the container.

9.5.3 Procedures for Partial Replacement of Wood Floors—Determine the area of flooring to be replaced and mark where to cut the wood. Photo 9.1 shows marking of a portion of plywood panel to be removed.

9.5.3.1 If necessary, remove or loosen the threshold plate by backing out the screws securing it to the rear bottom rail and the first crossmember. If the screws cannot be backed out, remove screws as described in Section 9.5.3.2 below, taking care not to damage the threshold plate.

9.5.3.2 Back out and remove floor screws in the damaged board and loosen the screws in adjacent planks or boards. If screws cannot be backed out of the damaged wood, shield the floor from possible burn damage and burn off the screw heads, then punch out or, if necessary, drill out the rest of the screws.

NOTE (plywood floors): After removing the screws in the damaged portion of the panel, screws in the remaining, undamaged portion of the panel should be loosened to permit removal of the damaged area.

9.5.3.3 Wedge up the floor wood above the crossmember to allow saw-blade clearance. Set the rotary blade to floor-board depth plus 3 mm (1/8 in) and cut through the damaged wood. Cuts must be made along the center line of crossmember flanges.

NOTE (*Plank* floors): When cutting out the damaged flooring, take care not to cut adjacent planks. For tongue-in-groove planks, an additional longitudinal cut in the damaged plank must be made to allow the damaged flooring to be removed without damage to adjoining planks. Photo 9.2 shows the proper removal of damaged plank flooring. Photo 9.3 shows plank joints lying over the center line of a crossmember flange.

NOTE (*Plywood* floors): Cut out the damaged panel so as to leave an undamaged portion of panel approximately 120 cm x 120 cm (4 ft x 4 ft).

- For transversely laid boards, the cut should be made so that the edges of both the new and undamaged portion of the original panel will lie along the center line of the center support. If a center support is not present and needs to be fitted, remove *both halves* of the panel, both the damaged section and the reusable remaining section. The reusable section will require routing at the center line to allow the board to fit flush against the center support once the section is refitted. Photo 9.4 shows the removal of a plywood panel section, with the joint lying above the center line of the crossmember flanges.
- For longitudinally laid boards, the cut to remove the damaged section must be over the centerline of the top flange of a crossmember or forklift pocket side. Both the replacement section and the reused remaining section must span a minimum of 3 crossmembers and/or forklift pocket sides.

9.5.3.4 Use a hammer and chisel to cut the remaining portion of the damaged wood loose and remove the damaged flooring. Remove any old sealant from the exposed understructure and break off any remaining screws.

9.5.3.5 For plywood floors without a center support: Install a center support as described in Section 9.7.

9.5.3.6 Measure and cut replacement planks or a plywood panel to fit the damaged area. Gaps between adjacent flooring should not exceed 2 mm (5/64 in). Photo 9.5 shows cutting of plank material to fit the damaged area.

When placing a board or panel adjacent to a bottom side rail, the underside of the board may have to be shaped to fit the bottom side rail flange (See Figure 9.2).

NOTE (*Plywood floors without a center support*): Shape the underside of the cut edge of the undamaged, remaining portion of panel in order to fit the center support (See Figure 9.3). After applying sealant according to Section 9.1.4, refit the undamaged panel back into place. The replacement panel must be fitted so that it butts against the original panel along the center line of the center support.

9.5.3.7 If the original floor was coated by the manufacturer, apply coating to the new

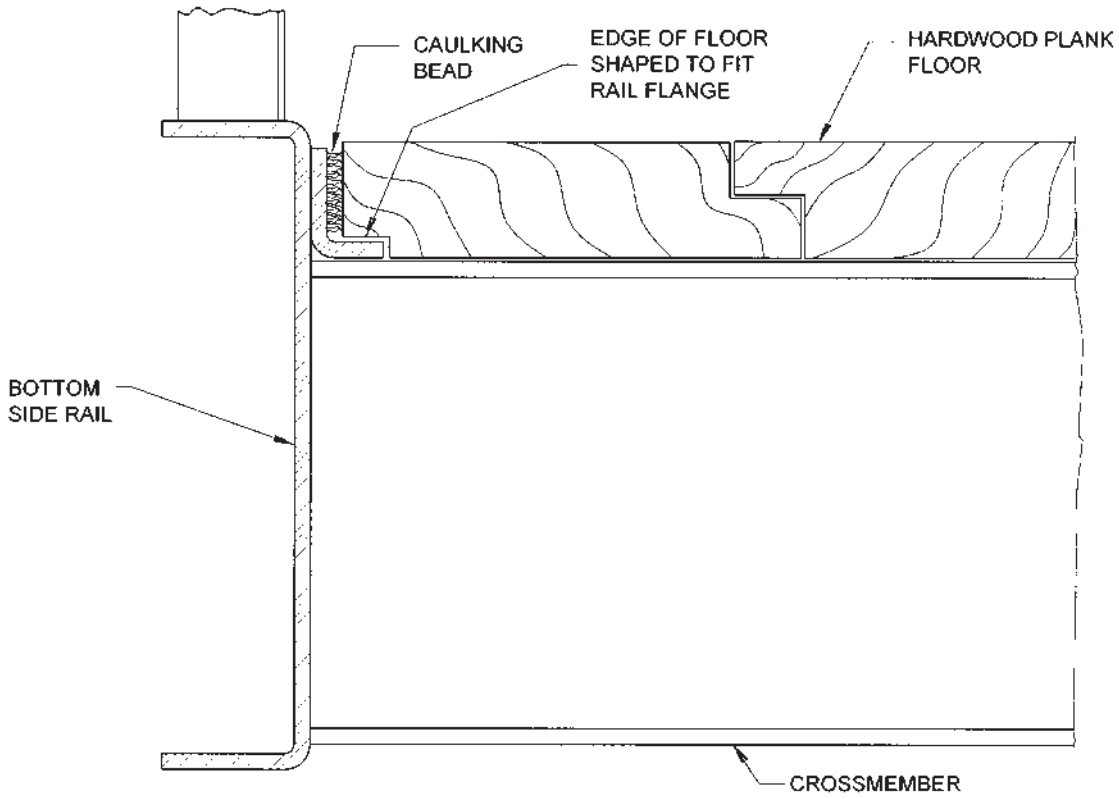


Fig. 9.2/Floor-bottom side rail joint

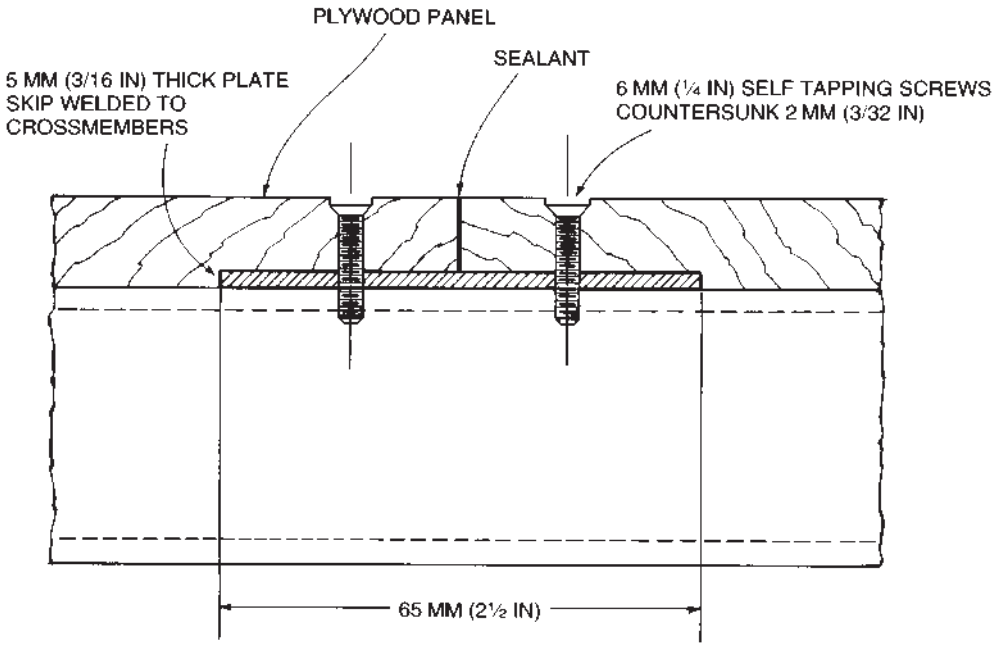


Fig. 9.3/Plywood floor installation of center support

wood and to adjacent areas where the coating was disturbed when the damaged wood was removed, according to Section 9.1.5.

Apply sealant according to the recommendations in Section 9.1.4. Photo 9.6 shows application of sealant along the shiplap of the adjacent plank. Photo 9.7 shows application of sealant along the shiplap of the new plank section. Photo 9.8 shows the completed application of sealant along mating edges of new plywood section with the center support and bottom side rail.

9.5.3.8 Fit the replacement planks or panel section into place. Mark original screw-hole spacing by drawing guide lines across the replacement planks, projecting from the line of screws in the adjacent original flooring. Drill screw holes through replacement flooring and understructure. Photo 9.9 shows the replacement plank fitted into place, and new screw holes being drilled in line with the screws in adjacent planks following the original floor screw pattern.

9.5.3.9 Install new screws as according to the recommendations in Section 9.1.3. If repairing a plywood floor, reinstall and tighten the screws in the original portion of the panel, if previously removed. Photo 9.10 shows screws installed into the new plank section. Ensure that screws fully penetrate crossmember flanges, as illustrated in Photo 9.11. Photo 9.12 shows a plywood panel section properly fitted and screwed to crossmembers.

9.5.3.10 If necessary, sand the edges of the repaired section so that they are flush with the rest of the floor. Reinstall threshold plate, if previously removed, or re-secure the loosened threshold plate to the floor.

9.6 Complete Replacement of a Wood Floor (Including One or More Complete Panels of a Plywood Floor)—Following are procedures for replacing a complete wood floor or one or more complete panels in a plywood floor.

9.6.1 Considerations in Complete Replacement of a *Plank* Floor—If the entire plank floor needs replacement, the floor may be replaced either with planks or with plywood at owner's option.

9.6.2 Considerations in Complete Replacement of a *Plywood* Floor—If the entire plywood floor needs replacement, and no suitable "like-for-like" replacement material is available, the owner should be consulted for guidance. If a plywood floor without a center support is being replaced, or if the owner confirms that an entirely new plywood floor may be substituted for a plank floor, a center support must be installed before the flooring is fitted.

9.6.3 Procedures for Complete Replacement of a Wood Floor (General) (or of One or More Complete Panels of a Plywood Floor)—Follow the procedures described in Section 9.5.3 for Partial Replacement. Note the following special considerations for *complete* replacement:

9.6.3.1 ■ Fitting *plank* floors: When fitting the planks into place, insert wedges between the bottom side rail and the adjacent floor plank to ensure that the planks fit tightly.

9.6.3.2 ■ Installing screws: Mark the centerline of the crossmember flanges on each

side of the bottom rail, in order to locate the screw-hole line once the new flooring is installed. Fit the replacement planks or panels into place. Using the bottom rail marks as a guide, draw a line across the replacement floor to determine the position of the screws. Drill screw holes through the panels or planks and understructure using the original screw hole spacing as a guide. Ensure that the same number of screws per crossmember is reinstalled in the new floor.

9.7 **Installation of a Center Support**—The procedures below describe how to fabricate and install a center support for a plywood floor.

9.7.1 Cut to length a steel center support plate 5 mm (3/16 in) thick and 64 mm (2-1/2 in) wide. For a complete floor in a 40 ft container with a gooseneck tunnel, the support should extend from the tunnel bolster to the doors.

9.7.2 If installing a complete replacement floor, remove all wood. If installing a partial floor replacement, remove the panel where the damage is located. Remove the coating from the understructure in the areas where a skip weld to the center support will be made. Grind smooth and clean the center support strip and the understructure in the areas to be welded.

9.7.3 Fit the center support plate into position longitudinally along the center line of the container on top of the understructure. The center support must terminate on the flange of a crossmember.

9.7.4 Tack weld into position and check alignment. Skip weld the underside of the center support strip to the understructure. Prepare the surface, prime and top coat the center support according to Sections 2.5 and 2.9. Prepare the surface of the understructure where the coating has been damaged by the repair and coat according to Sections 2.5, 2.9 and 8.1.4.

Photo 9.1 (to right) / Marking of a portion of a plywood panel to be removed

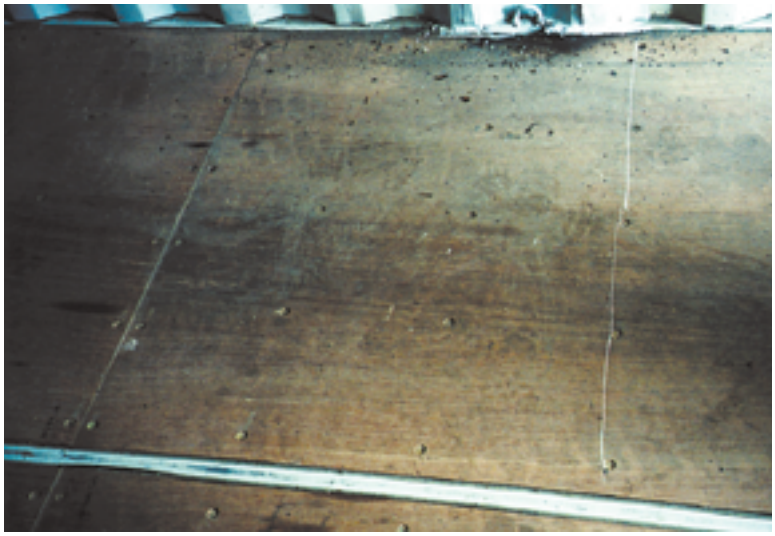


Photo 9.2 (above) / Removal of damaged section from a plank floor

Photo 9.3 (below) / Plank floor joint lying above center line of crossmember flange

Photo 9.4 (to left) / Removal of plywood panel section, showing joint lying above center line of crossmember flanges

Photo 9.5 (above) / Cutting a plank to fit damaged area

Photo 9.7 (above) / Application of sealant along shiplap of new plank section

Photo 9.6 (above) / Application of sealant along shiplap of adjacent plank

Photo 9.8 (to right) / New plywood panel section in place with sealant applied along edges

Photo 9.9 (to left) / Drilling new screw holes aligning with line of screws in adjacent planks, following the original floor screw pattern

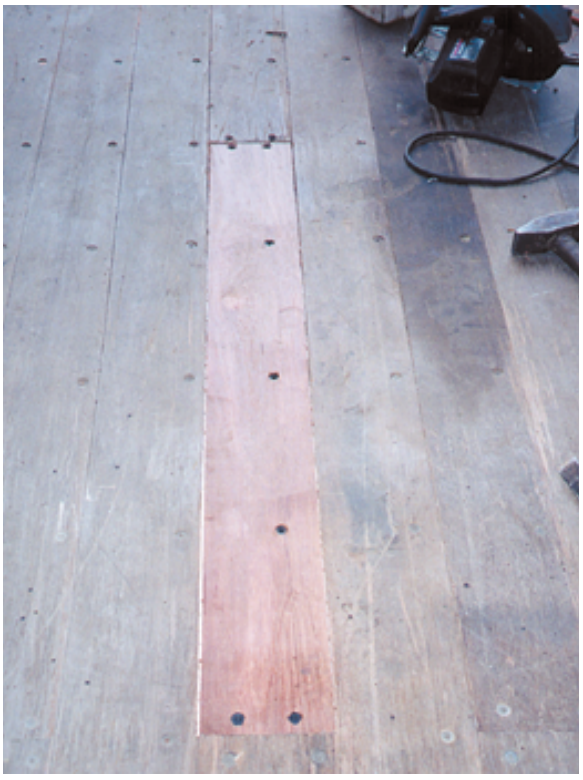


Photo 9.10 (above) / Screws installed into new plank section (interior view)

Photo 9.11 (above) / Screws installed into new plank section, fully engaging flange of crossmember (underside view)

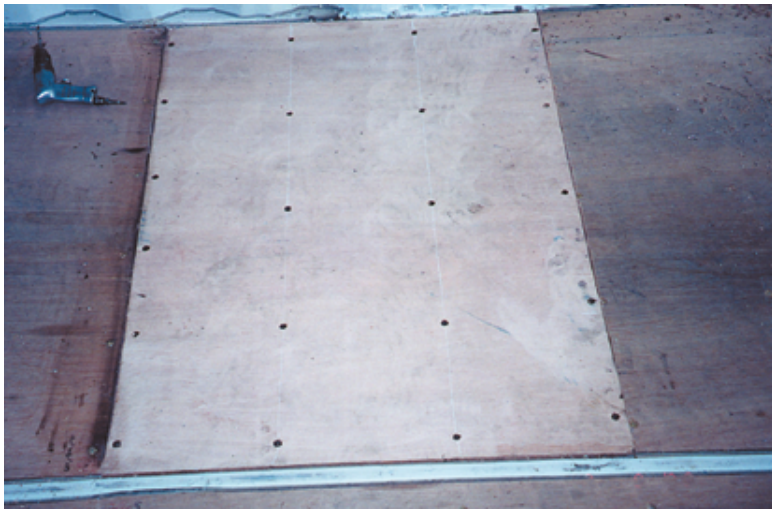


Photo 9.12 (to right) / Plywood panel section fitted and screwed to crossmembers.

SECTION 10 DOOR ASSEMBLY

10.1 **General**—Rules and procedures pertaining to steel doors apply to both corrugated and flat doors, unless otherwise indicated below.

Door repairs often involve repair of several adjacent components at one time. Damage to door frames at the door bottom, for instance, is often accompanied by damage to adjacent door panels, gaskets and hardware. Before beginning a door frame repair, therefore, determine if repair to other components is required. If so, carefully plan out the entire repair so that each component is repaired in logical sequence. When following the instructions for repairing the frame, refer to and incorporate subsections pertaining to repair of other damaged door components at the appropriate time and before completing the frame repair.

Because the interior surfaces of doors may be exposed to weather when the doors are open, door repairs on the interior side *should be top coated as well as primed*. However, if a combination primer/top coat paint has been used on the interior previously, and such paint is suitable for exposure to weather, a separate top coat may not be required; consult owner for applicable policy.

Before undertaking any panel repairs, the repairer should refer to Section 2 for general repair principles and step-by-step repair procedures, as well as recommendations on replacement materials, surface preparation, tools, welding, painting and marking.

10.2 **Steel Door Stiffeners and Frame**—Steel door frames may be repaired by straightening, welding or straightening *and* welding, inserting, sectioning or replacement.

10.2.1 **Door Frame Straightening**—To straighten door frames, follow the procedures recommended in Section 2.8.1 on page 8. If it is necessary to apply heat to assist in straightening, the steel should be heated only in the damaged area, taking care not to burn the door gasket or locking rod bushings.

10.2.2 **Door Frame Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts or pin holes, follow the procedures and limitations recommended in Section 2.8.2 on page 9. Also see Sections 2.8.1 on page 8 and 10.2.1 above.

10.2.3 **Door Frame Inserting**—To install an insert, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. If repair to the door panel, gasket and/or hardware is required, those repairs should be performed at the appropriate time in conjunction with the repair of the frame. Special considerations for inserting into door frames or stiffeners follow:

10.2.3.1 ■ Cutting out the damage: Remove any door hardware or gaskets in the area to be repaired. Cuts should extend beyond both ends of the damaged area. Insert wedges between the frame and the door panel to separate the panel from these components in the damaged area (the wedges should be removed after tack welding the insert into place and before continuously welding).

10.2.3.2 ■ Replacement material: Door stiffeners or frames are normally rectangular or C-channel profiles. If the required profile size is not available, it can be fabricated by continuously welding two channel or angle profiles together.

10.2.3.3 ■ After the repair: Reinstall any door gaskets or hardware previously removed. If damaged, gaskets and hardware should be repaired or replaced as required and installed according to the appropriate procedures recommended below.

10.2.4 **Door Frame Sectioning**—To install a full-profile section in a door frame, follow the procedures recommended in Sections 2.8.4 on pages 10 - 12 and 10.2.3 above. If repair to adjacent door components is required, those repairs should be performed at the appropriate time in conjunction with the repair of the frame. Door-frame sections are subject to the following limitations:

- Sections must be at least 150 mm (6 in) in length.
- Sections must be at least 150 mm (6 in) apart.
- Welds should not be made within 150 mm (6 in) of the corners of the frame or the ends of the stiffeners.
- If a section begins at a corner of the frame or end of the stiffener, it must extend at least 150 mm (6 in).

10.2.5 **Door Frame Replacement**—If the entire door stiffener or frame needs to be replaced, choose a replacement component that matches the size and profile of the original. In the case of a flat door, and only with owner's approval, box-section door frame members may be replaced with open-section profiles with a minimum thickness of 4.5 mm (7 gauge). *Open sections may **not** be used to substitute for box sections on corrugated doors.*

To replace a door frame, follow the procedures recommended in Section 2.8.5 on pages 12 - 13.

10.3 Steel Door Panels (Corrugated or Flat)

10.3.1 **Door Panel Straightening**—To straighten a door panel, follow the procedures recommended in Section 2.8.1 on page 8. Be sure to read the special considerations for panel straightening in 2.8.1.1 - 3. If the damage has stretched the panel so that the original profile cannot be restored, repair by straightening should not be attempted; an insert or replacement is necessary.

10.3.2 **Door Panel Welding or Straightening *and* Welding**—To weld or straighten *and* weld cracks, splits, cuts or pin holes, follow the procedures recommended in Section 2.8.2 on page 9. Also see Sections 2.8.1 on page 8 and 10.3.1 above.

10.3.3 **Door Panel Patching or Inserting**—To install an overlapping exterior patch or a butt-welded insert, follow the procedures recommended in Section 2.8.3 on pages 9 - 10. When the repair is adjacent to another component attached to the door panel, an insert (not a patch) should be used. One or more of the components attached to the door panel may have to be removed to allow an insert to be installed.

10.3.3.1 ■ Preparing for the repair: Remove any certification plates, the cargo label plate, door hardware, door hinges and door gaskets that may be damaged during the repair or may interfere with the repair operation. In some instances it may be possible to leave these components attached to the door panel if they are shielded to prevent damage by burning.

Also, if necessary, detach the panel from any part of the door frame, stiffeners and reinforcement plate that may be damaged during, or may interfere with, the repair operation. Insert wedges between these components and the door panel to prevent damage by burning.

10.3.3.2 ■ After the repair: Reinstall any door gaskets or hardware previously removed. If damaged, gaskets and hardware should be repaired or replaced as required and installed according to the appropriate procedures recommended below. Replace any removed or missing markings required by regulation, ISO standards or the owner.

10.4 **Steel Door Assembly Replacement (Corrugated or Flat)**—If an entire door requires replacement, consult Section 2.8.5 on pages 12 - 13 for general recommendations on replacement. Specific procedures for replacing a flat or corrugated door panel assembly follow:

10.4.1 If damaged, the door hinges should be left attached to the door. Support the door and remove any weld attaching the hinge pins to the hinge lugs. Apply penetrating oil and drive the pin out of the lug with a hammer and punch. When the pin cannot be driven out of the hinge lug, cut the hinge pin above and below the hinge blade using a hacksaw or thin grinding disc.

If the hinges are not damaged, support the door and remove hinges from door panel by cutting the attachment welds. Remove the damaged door.

10.4.2 Remove and retain all undamaged door hardware, gaskets and plates from the original door by cutting through or backing out the fasteners.

10.4.3 Measure the dimensions of the original door. If the door is missing or so badly damaged that its dimensions cannot be determined, measure the door opening of the container. The replacement door should be fabricated to dimensions that will allow sufficient clearance between the door panel and the rear end frame for installation of the door gasket, approximately 15 mm (5/8 in).

10.4.4 The replacement door must conform to the design of the original door. Fabricate, fit and weld the replacement door as described in 10.4.4.1 (corrugated panels) or 10.4.4.2 (flat panels). If the owner approves, open-channel stiffeners may be substituted for closed sections (flat doors only).

10.4.4.1 *Corrugated* doors: Cut and press replacement panel (or obtain prefabricated panel) and frame to size and to match original door in profile and clearances. Place on a flat surface and assemble replacement door.

10.4.4.2 *Flat panel* doors: Cut replacement panel, frame and stiffeners to size. Place on a flat surface and assemble replacement door. Clamp the panel to the frame and stiffeners. Check the alignment ensuring that the stiffeners remain clear of the locking rod attachment bolts. The door frame around the perimeter of the panel is normally positioned 15 mm (5/8 in) inboard from the panel edge to allow for proper gasket fit. Reinforcement plates at least 3.2 mm (1/8 in) thick should be positioned on the inside of the door panel in the area where the hardware will be attached. Continuously weld all butt joints

and the reinforcement plate to the door panel seam on the exterior face. Skip weld the door frame and stiffeners to the door panel on the *interior* only.

10.4.5 Prepare the surface and prime the door assembly according to Sections 2.5 and 2.9.

10.4.6 Install door gaskets as described in Section 10.7.5.

10.4.7 If damaged door hinges were removed with the damaged door, install replacement hinges on the appropriate rear corner post. Lubricate the hinge pin hole in the blade and lug and install a replacement bushing in the hinge blade. Fit the hinge blade into the lug and insert a replacement pin. Weld the hinge pin to the hinge lug as in the original design.

10.4.8 Position and support the replacement door on the container ensuring that proper clearance between the door and the rear end frame is maintained. Tack weld the door hinges to the door. Check the proper operation of the door. Continuously weld the hinges to the door. Take care not to melt any bushings in the hinge blades.
NOTE: Protect the door gasket from weld spatter while welding door hinges.

10.4.9 Install door hardware removed at the beginning of the repair.
NOTE: The tack welding of certain fasteners or use of non-removable fasteners on the right hand door is required to comply with customs (TIR) regulations (See Figure 10.1). When the door design does not provide for a metal overlap of the right hand over the left hand door, the left door must be fitted with a metal customs catch continuously welded to the interior frame which prevents the left door from being opened before the right.

10.4.10 After priming and coating, check the door again for proper operation. Replace plates and markings as originally installed and as required by regulation, ISO standards and owner. Light- and water-test the door for leakage.

10.5 **Door Hinges**—Frozen door hinges can be freed as described in Section 10.5.1. If a door hinge cannot be freed or is damaged, the hinge pin or the blade can be replaced according to Sections 10.5.2 and 10.5.3 below.

10.5.1 **Freeing Hinges**—Free hinge pins by lubricating the hinge with penetrating oil. ***Never*** *use heat to free hinges fitted with plastic bushings*. As a last resort, limited heating may be used at owner's discretion to free hinges fitted with *metallic* (not plastic) bushings. If a door hinge is so heated, protect the door gasket to prevent damage by burning.
After heating, prepare the surface, mask, prime and top coat the repaired area according to Sections 2.5 and 2.9.

10.5.2 **Replacement of Hinge Pin**—Ensure that the door is adequately supported before proceeding.

10.5.2.1 Remove any welding attaching the hinge pin to the hinge lug. Apply penetrating oil and drive the pin out of the lug with a hammer and punch. Clean and lubricate the pin hole. If the pin has been successfully removed, proceed to Section 10.5.2.3.

10.5.2.2 When the pin cannot be driven out of the hinge lug, or where stainless steel pins and plastic bushings are used, proceed as follows:

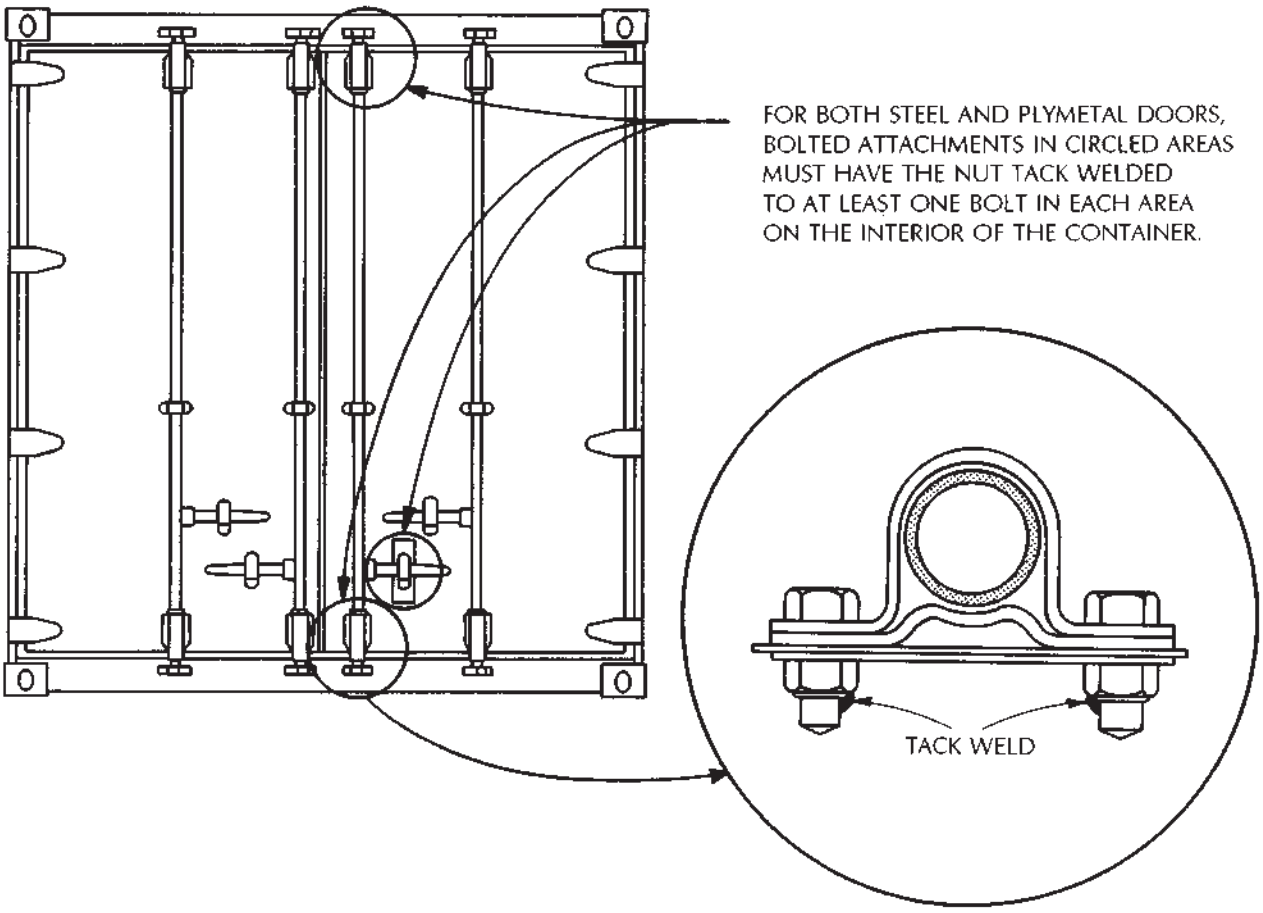


Fig. 10.1/Tack welded door hardware fasteners

Remove the hinge blade from the door by cutting the attachment weld. Using a hacksaw or thin grinding disc, cut the hinge pin above and below the hinge blade. Remove any weld attaching the hinge pin to the hinge lug. Reapply penetrating oil and drive the hinge pin out of the blade with a hammer and punch.

Remove any remains of the hinge pin from the hinge lug and blade with a hammer and punch. Remove the damaged bushing from the hinge blade.

10.5.2.3 Clean and lubricate the hinge pin hole in the blade and lug, and install a replacement bushing in the hinge blade.

10.5.2.4 Fit the hinge blade into the lug and insert the replacement pin. The new pin should be made of SUS 304 or equivalent stainless steel. Weld the hinge pin to the hinge lug as in original.

10.5.2.5 Refasten the hinge blade to the door. If welding is necessary, care should be taken not to melt the nylon bushing in the hinge blade. Prepare the surface and coat the repaired area according to Sections 2.5 and 2.9.

10.5.3 **Replacement of Hinge Blade**—Ensure that the door is adequately supported before proceeding. Follow the recommendations above for hinge pin replacement, replacing the damaged hinge blade with a replacement blade.

10.6 **Locking Bars (Locking Rods)**—Damaged locking bars can be freed, straightened, sectioned or replaced, depending upon the type and extent of damage.

10.6.1 **Freeing Locking Bars**—Apply penetrating oil to the seized locking bar. Wait for a few minutes and then work the locking bar with the door handle until it moves freely. Do not apply heat if the locking bar guides or brackets have plastic bushings.

10.6.2 **Straightening Locking Bars**—To straighten locking bars, follow the procedures recommended in Section 2.8.1 on page 8. Do not use heat if the locking bar guides or brackets have plastic bushings. Shield the door panel when heating the locking rod. After straightening the locking rod, prepare the surface, prime and top coat areas of damaged coating.

10.6.3 **Sectioning Locking Bars**—Locking bars extend from top to bottom locking cams. Anti-rack rings are normally welded to either end of the rod where it enters the bearing brackets. Damage to a locking bar usually occurs between the inner pair of anti-rack rings.

Section repairs to locking bars are subject to the following limitations:

- Sections must be at least 150 mm (6 in) in length.
- Sections are not permitted within 150 mm (6 in) of another full-profile weld in the locking rod.

10.6.3.1 If possible, close and lock the door containing the damaged locking bar. Mark where the bar is to be cut. If the damage extends to an anti-rack ring, the rod should be cut 10 mm (3/8 in) from the anti-rack ring.

10.6.3.2 Cut through the locking bar and remove the damaged section. Photo 10.1 shows cutting of the bar with a disc cutter. If a cutting torch is used, shield the door panel to prevent damage by burning.

If the damaged section of rod extends through or ends near a guide, the guide must be removed before removing the damaged rod. If the damaged

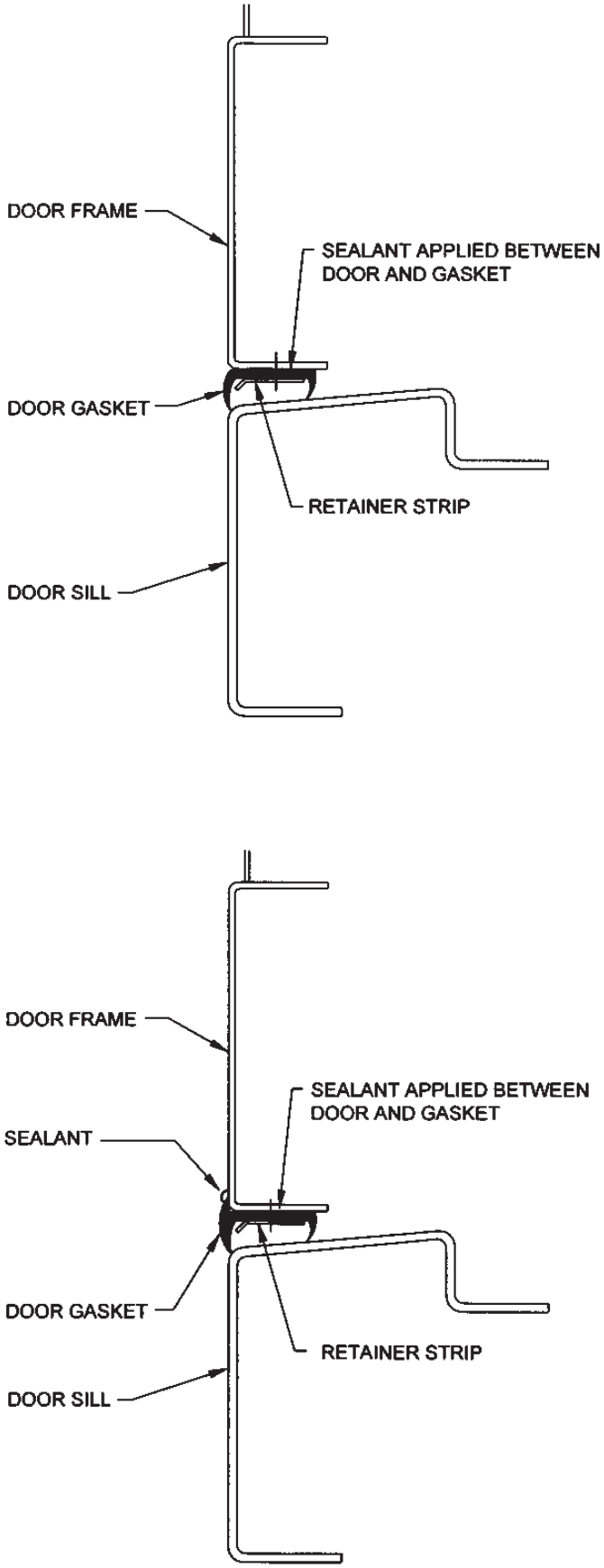


Fig. 10.2/Two different types of wipe and lap type gaskets on a steel door

section of bar is attached to the door handle, remove the handle by cutting the weld joining the door handle hub to the locking bar. If the entire section of rod between the bearing brackets requires replacement, all guides must be removed before removing the damaged rod.

Clean and smooth the cut areas and end of the remaining rod and bevel the edges. Photo 10.2 shows the proper condition of the remaining rod end.

10.6.3.3 Measure and cut the replacement section. As for other component sections, allow a gap of no greater than 2 mm (5/64 in) between the section and the remaining locking bar. The replacement material should be galvanized steel tubing of the same diameter, thickness and strength as the original.

Grind the cut ends of the replacement section clean and smooth, and bevel the edges for good weld penetration.

10.6.3.4 If necessary, reattach the door handle to the locking rod by welding the door handle hub to the replacement section of locking rod.

10.6.3.5 Position the replacement section (if necessary slipping the section through the locking rod guides) with the door handle and the locking rod cams in the locked position.

10.6.3.6 Tack weld the replacement section in position and check alignment. The locking rod cams must be fully engaged when the door is closed and locked.

10.6.3.7 Open the door. Continuously weld one side of both ends of the locking rod section to the remaining bar. Turn the locking rod 180° and continuously weld the other side to obtain a 360° weld seam. Photo 10.3 shows the replacement rod section continuously welded in place.

10.6.3.8 If necessary, reinstall the locking rod guides previously removed. Check the locking rod for proper operation by rotating it though its full 180° arc.

Prepare the surface, prime and top coat according to Sections 2.5 and 2.9. Photo 10.4 shows the replacement section completed, including top coating.

10.6.4 **Replacing Locking Bars**—If a locking bar cannot be repaired by one of the methods listed above, it should be replaced. Follow the procedures described above for sectioning, removing and replacing the entire rod.

10.7 **Door Gaskets**—Torn, cut or otherwise damaged door gaskets can be repaired by bonding, patching, inserting, sectioning or replacement, depending upon the type and extent of damage. See Figure 10.2.

The repair methods described in this manual for door gaskets require the use of an adhesive. Cyanoacrylate adhesives are recommended for bonding door gasket material. Other types of adhesive may also be acceptable but should not be used without the prior approval of the owner.

10.7.1 **Door Gasket Bonding**—Door gaskets that are cut may be repaired by bonding together the cut edges of the gasket providing that no gasket material is missing and the cut edges mate together.
NOTE: Cyanoacrylate adhesives will not fill a void.

10.7.1.1 Roughen the cut edges of the gasket and wipe clean with acetone. Apply a very thin film of the adhesive to one cut edge of the gasket and immediately mate to the other cut edge, spreading the adhesive by slightly rubbing the two surfaces together. NOTE: Since adhesive can set in 2 - 3 seconds, rubbing time must be minimal.

10.7.1.2 Apply light pressure for a few seconds until the bond cures sufficiently to hold the cut gasket edges together. NOTE: On rubber or synthetic rubber gasket material, a bond of handling strength will usually be obtained in less than 10 seconds. A bond of 80% strength will be obtained in one hour, and maximum strength (chemical and water resistant) will be obtained after 12 to 24 hours' cure.

Cured cyanoacrylate adhesive is extremely difficult to remove but is gradually soluble in Nitromethane, Methyl Ethyl Ketone (MEK) or Acetone. *CAUTION: Cyanoacrylate adhesives will bond skin or clothing upon contact. Read and observe all manufacturer's cautionary information and instructions.*

10.7.1.3 Light-leak test the door gasket.

10.7.2 **Door Gasket Patching**—The cut or torn exterior face of a gasket can be repaired by patching, provided there is no serious loss of gasket material, and that the damaged part is not missing, but hanging free. If the damaged area is missing, the gasket should be repaired with an insert or a section.

To repair a gasket using a patch, a piece of material equivalent to the original (or EPDM, if original material is unknown) cut to width and length may be overlaid and bonded to the gasket, following the procedures recommended for bonding above. The repair should extend over both the torn gasket area and beyond each side of the damage by a minimum of 50 mm (2 in).

10.7.3 **Door Gasket Inserting**—Damage to door gaskets that cannot be repaired by bonding or patching may be repaired by installing an insert. A door gasket insert may be of any profile that does not extend through the entire cross-sectional profile of the gasket.

10.7.3.1 If the insert extends beneath the retaining strip, remove the fasteners holding the damaged gasket in place. The fasteners along the entire length of the door edge containing the damaged gasket should be removed. Remove screw-type fasteners by backing out the screws and rivet-type fasteners by drilling out the rivet heads.

Remove the gasket retaining strip. If undamaged, keep the retaining strip and fastening screws for reinstallation.

10.7.3.2 Cut and remove the damaged portion of the gasket. The cut area should have straight edges and square corners. If the door edge is exposed, remove any old sealant from the edge and check for corrosion. If necessary, clean the door edge with a grinding disc and then prime and top coat according to Section 2.9.

10.7.3.3 Measure and cut to size a replacement insert from material with the same profile and thickness as the original. The insert must mate exactly with the remaining gasket *without any gaps*. NOTE: Cyanoacrylate adhesives will not fill a void.

10.7.3.4 To apply adhesive and bond edges, follow the instructions in 10.7.1.1 - 3, bonding one edge of the insert at a time. If the door edge is exposed, apply sealant to the mating area.

10.7.3.5 If the retainer strip was removed, it must be reinstalled. Place the retaining strip along the door edge ensuring that the holes in the door edge are aligned with those in the gasket and retainer strip. If necessary, drill holes through the

gasket insert using the holes in the retainer strip as a guide. If a new retaining strip is needed, drill holes using the same spacing as in the original installation. Use a stainless-steel retaining strip, unless the owner specifies galvanized steel or other material.

Secure the retainer strip and gasket to the door using 4.5 mm (3/16 in) diameter stainless-steel sheet metal screws or other appropriate fasteners. If the original holes are enlarged, use the next larger size fastener.

10.7.3.6 Light-leak test the door gasket.

10.7.4 **Door Gasket Sectioning**—Damage to the door gasket that cannot be repaired by one of the methods described above may be repaired by installing a section. A door gasket section extends through the complete cross-sectional profile of the gasket. Photos 10.5 - 10.10 document the progress of a typical gasket section repair.

To install a section in a door gasket, follow the procedures described above in Sections 10.7.3.1 - 10.7.3.6, with the following additional considerations.

10.7.4.1 ■ Cutting out the damage: If the damage extends along the door edge to the corner of the door, cut along the 45° angle seam fused by the manufacturer.

10.7.4.2 ■ Replacement gasket section: If the replacement section extends to a corner of the door, cut that end of the gasket at a 45° angle.

10.7.5 **Door Gasket Replacement**—If possible, the replacement gasket should be obtained as a one-piece assembly around the entire periphery of the door, with mitered corners fused by the manufacturer. If this cannot be obtained, the replacement gasket material should be mitered and joined at the corners using a cyanoacrylate or other owner-approved adhesive.

The complete door gasket may fit along three or four sides of the door depending on whether the left or right door gasket requires replacement.

To replace a gasket, follow the procedures above in Sections 10.7.3.1 - 6, with the following additional considerations:

10.7.5.1 ■ Removing retaining strip: After removing the damaged gasket retaining strip according to Section 10.7.3.1, remove the gasket from the door.

10.7.5.2 ■ Drilling holes in the gasket: After preparing the door edge according to Section 10.7.3.2, fit the replacement gasket into position. Align the gasket and retainer strip with the door edge. The holes in the door edge should be aligned with those in the retainer strip. Using the holes in the retainer strip as a guide, drill through the replacement gasket.

10.7.5.3 Installing the gasket: Remove the retainer strip and replacement gasket. Apply sealant to the mating areas of the door, and fit the replacement gasket into position. Place the retainer strip along the door edge ensuring that the holes in the door edge are aligned with those in the gasket and the retainer strip. Complete the repair following the instructions in Section 10.7.3.5 - 6.

Photo 10.1 / Cutting locking bar with a disc cutter

Photo 10.2 / Cleaned, smooth, beveled cut edge of locking bar

Photo 10.3 / Replacement locking bar section continuously welded in place

Photo 10.4 / Replacement locking bar section completed, including top coating

Photo 10.5 (to right) / Damage to top edge of door gasket that may be repaired by sectioning

Photo 10.6 (to left) / Removed gasket retaining strip

Photo 10.7 (to left) / Primed area of door under gasket

Photo 10.8 (to left) / Top coated area of door under gasket

Photo 10.9 (to right) / Gasket section installed (exterior view)

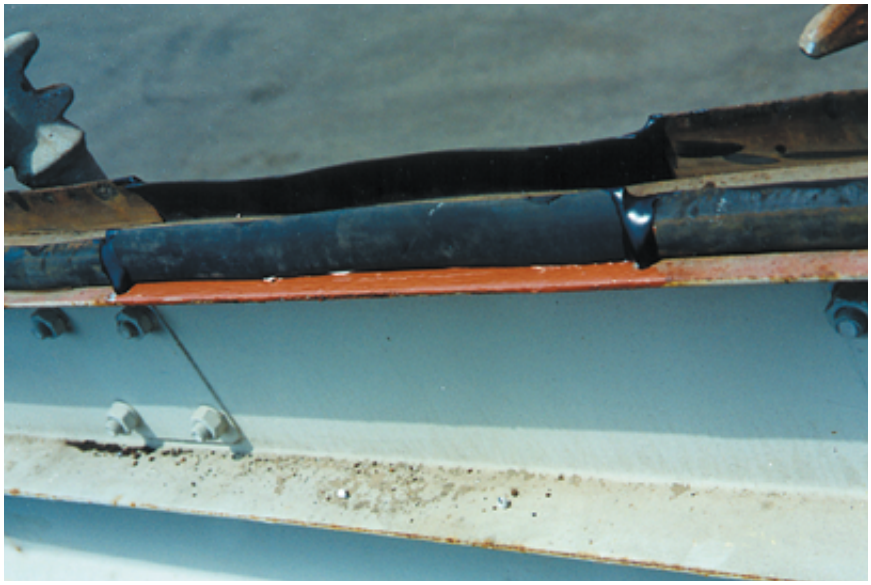


Photo 10.10 (to left) / Gasket section installed (interior view)

SECTION 11 VENTILATORS

11.1 **General**—Steel containers are generally equipped with ventilators to prevent condensation from forming inside the container. A container ventilator consists of a plastic or steel cover approximately 25 mm (1 in) in depth which is fitted over an area of the container side panel in which holes have been drilled. A set of holes on the bottom portion of the ventilator allows air to circulate between inside and outside the container. The inside of the cover is fitted with horizontal projections called "baffles" to permit air interchange while preventing the entrance of water. The terms "ventilator" and "ventilator cover" will be used interchangeably in this section.

Newer containers are generally equipped with plastic, rather than steel, ventilators. Steel covers may be welded on or attached with fasteners; plastic covers are always attached with fasteners. Damaged ventilators should be repaired *only* by replacement.

Damaged ventilators are usually replaced with plastic covers, regardless of the original material. Plastic covers come in two principal sizes: wide ventilators (approximately 350 x 150 mm [13¾ x 6 in]), attached with eight fasteners, and *narrow* ventilators (approximately 200 x 50 mm [8 x 2 in]), attached with three fasteners. Consult owner for the appropriate type of replacement cover to be fitted. Do not replace a damaged ventilator with a *steel* cover unless specifically directed by the owner; even then, the new cover must be attached with fasteners. *Do not attach any type of replacement ventilator cover by welding*; doing so contributes to rusting of the cover and/or the underlying panel.

Whether or not the ventilator is damaged, the underlying portion of the side panel may be damaged or corroded and may need repair. To perform this type of repair, the damaged portion of side panel under the ventilator must be replaced with a side panel insert into which holes have been drilled (see Section 11.4).

11.2 **Replacement of Steel Ventilator with Plastic Ventilator**

11.2.1 If removing a welded ventilator, cut from the panel with an oxygen acetylene torch. If the ventilator is attached with fasteners, remove fasteners. Grind off fastener heads of blind fasteners on the interior of the container; remove locking bolts by cutting and removing the collars on the exterior of the container. Care should be taken to avoid damage to the side panel.

11.2.2 Plug weld and/or prepare attachment and ventilation holes as follows:

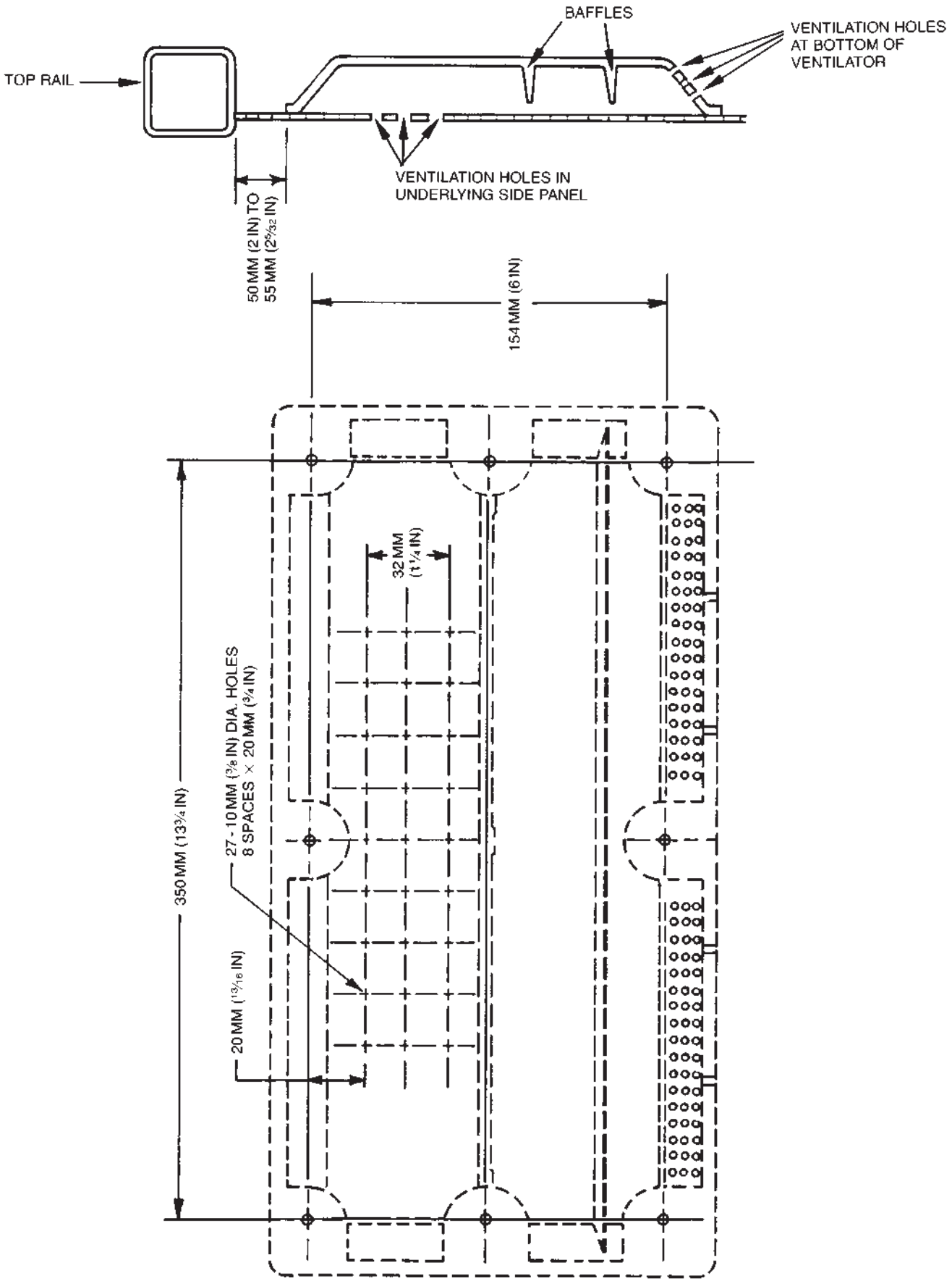


Fig. 11.1/Wide ventilator structure and hole patterns

11.2.2.1 If installing a ***wide*** plastic ventilator: Plug weld any ventilator holes in the side panel that are above or below the replacement ventilator or below the baffles. To determine what holes, if any, require plug welding, position the ventilator 50 to 55 mm (2 to 2¼ in) below the top side rail. Mark the top and bottom perimeter and pilot attachment hole. Determine the location of the baffles. All ventilator holes on the underlying panel should be *above* the baffles on the replacement ventilator to prevent water entry into the container interior.

If necessary, drill additional ventilator holes for a minimum of 27 holes, each 10 mm (⅜ in) in diameter, ensuring that the holes remain within the perimeter of the ventilator cover. Use the hole pattern shown in Figure 11.1.

11.2.2.2 If installing a ***narrow*** plastic ventilator: Plug weld *all* ventilation and attachment holes (new holes will be drilled later in the procedure). Alternatively, fully weld a lapped patch to the exterior of the panel covering all ventilation and attachment holes. Grind all cut and burned areas and any plug welds smooth and clean.

11.2.3 Check the panel beneath the ventilator for corrosion. Prepare the surface, mask, prime and top coat both the interior and exterior panel repair area according to Sections 2.5 and 2.9.

11.2.4 Position the replacement ventilator 50 to 55 mm (2 to 2¼ in) below the top rail. Narrow ventilators should be positioned in the inboard corrugation immediately adjacent to the large flat marking panel area, or in the *second* corrugation from the corner post if there is no marking panel. Ensure that baffles are below the inner panel ventilator holes.

Drill additional holes and/or install fasteners as described in 11.2.5 (wide ventilators) and 11.2.6 (narrow ventilators).

11.2.5 If installing a ***wide*** ventilator, proceed as described below:

11.2.5.1 Using the pilot hole in the ventilator as a guide, drill through the side panel. Remove the ventilator. Insert a locking bolt pin in the pilot hole from the inside of the container, and set by tapping with a hammer (an example of a suitable fastener is shown in Figure 11.3).

11.2.5.2 If a sealing gasket is not provided with the ventilator, apply a bead of sealant to the back of the ventilator flange on the top and sides. To allow drainage of moisture and condensation and to prevent clogging of drain holes, *do not apply sealant to the bottom flange.*

11.2.5.3 Reposition the ventilator, install locking bolt collar and secure. Drill the hole for the center locking bolt through the bottom flange of the ventilator and the steel panel. Insert and hammer in the pin. Install and secure the collar.

11.2.5.4 Using the ventilator as a template, drill the remaining 6 mm (¼ in) diameter attachment holes through the ventilator flange and underlying panel. Insert and hammer in the pins from the inside of the container.

11.2.6 If installing a ***narrow*** ventilator, proceed as described below:

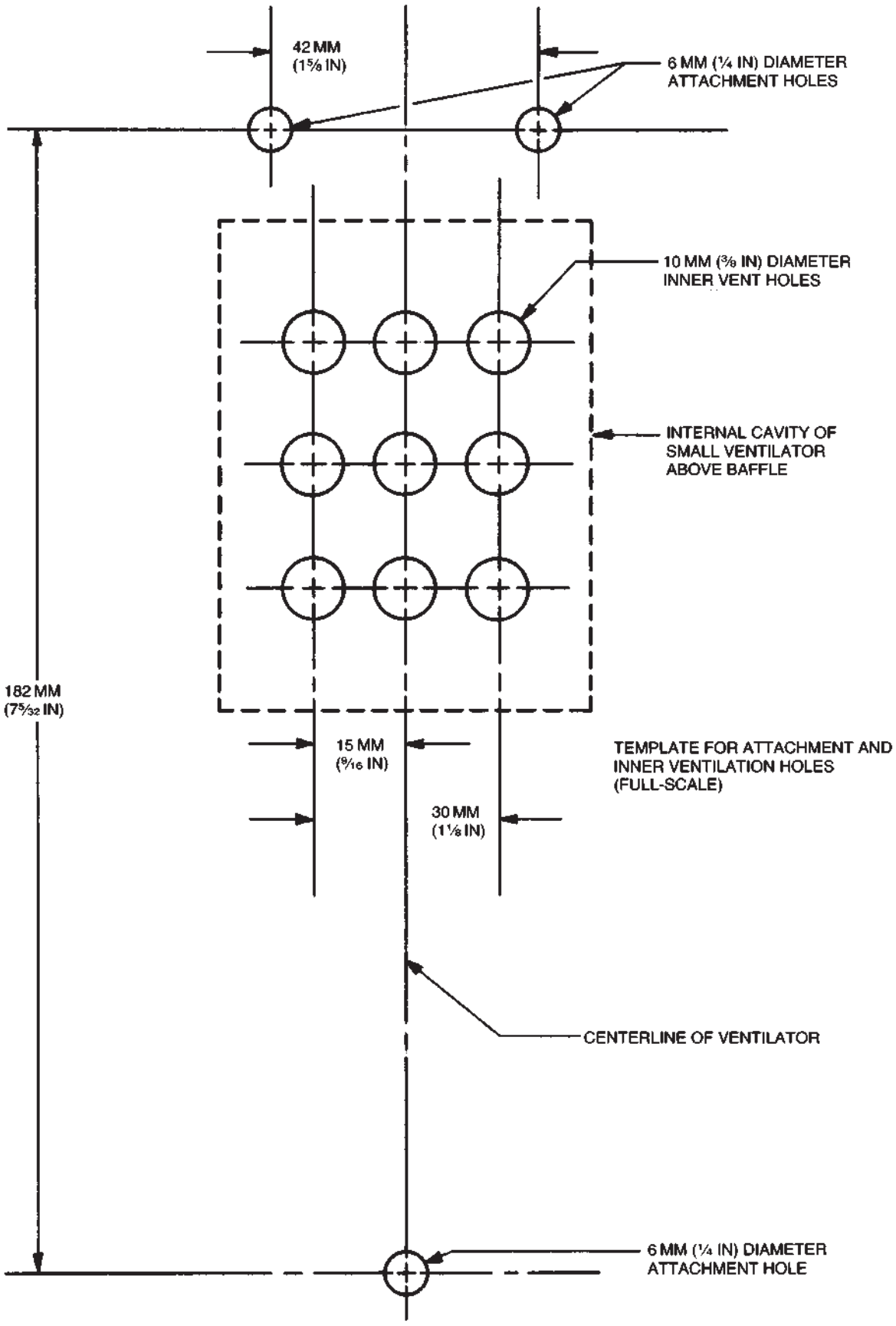


Fig. 11.2/Hole pattern on panel under narrow plastic ventilator

11.2.6.1 Drill three 6 mm (1/4 in) diameter attachment holes through the ventilator flange and underlying panel using the pilot hole and the attachment location marks on the ventilator as a guide. Using a metal template (corresponding to the dimensions shown in Figure 11.2), align the holes in the side panel with those in the template.

11.2.6.2 Punch the centers of nine ventilation holes in the panel. Drill nine holes, each 10 mm (3/8 in) in diameter, at the center punch marks.

11.2.6.3 Insert and hammer the three TIR-approved lock bolts into the three attachment holes with the head of the bolt to the interior of the container (an example of a suitable fastener is shown in Figure 11.3).

11.2.7 For both wide and narrow ventilators, install fastener collars and secure with a hydraulic, pneumatic or manual tool. Care should be taken not to use an oversize tool as excess impact from the tool may crack the plastic flange of the ventilator cover. When installed, all fasteners will have the bolt heads to the inside and the collars to the outside of the container.

11.2.8 If installing a wide ventilator, apply a 6 mm (1/4 in) bead of sealant across the top and two vertical edges of the ventilator to prevent water entry. No sealant is required for narrow plastic ventilators.

11.3 **Replacement of Steel Ventilator with Steel Ventilator**—*This repair should be performed **only** if specifically authorized by the owner.* Normally, steel ventilators are replaced with plastic covers. Follow the instructions for installing a wide plastic ventilator in Section 11.2.

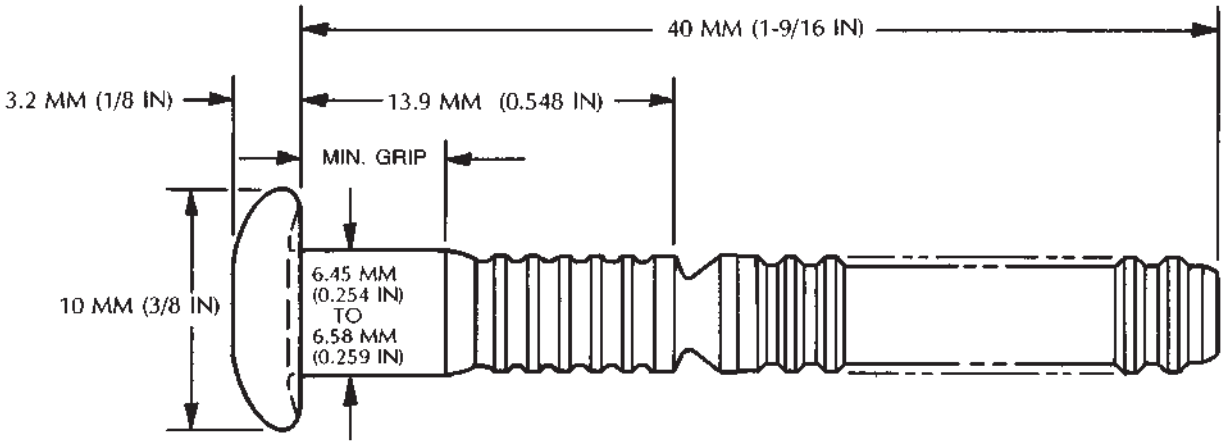
11.4 **Replacement of Ventilator *and* Underlying Portion of Panel**—If damage to a ventilator extends to the side panel underneath, then both the ventilator and the portion of side panel beneath the cover must be removed and replaced.

11.4.1 The ventilator and underlying area of side panel can be removed separately (Section 11.2.1) or together (Section 11.4.3).

11.4.2 Determine the area of side panel to be removed. The replacement panel insert should terminate at the vertical center line of each corrugation immediately adjacent to the large flat marking panel area. If there is no marking panel, the panel insert should terminate at least one full corrugation beyond the damaged area. Mark the area of side panel to be removed on the *interior* of the container.

11.4.3 Cut the portion of side panel to be removed along the marked line and along the side panel to top rail weld. Remove the damaged area of panel. For welded ventilators, this will also allow removal of the ventilator cover.

11.4.4 Prepare a panel insert from material equal to or greater in strength and thickness than the original panel. The insert must be fitted flush with the existing panel with no more than 2 mm (5/64 in) clearance between adjoining surfaces. Grind the cut areas of the remaining panel and the edges of the insert clean and smooth.



EXAMPLES OF TYPICAL FASTENERS SUITABLE FOR USE:

AVELOCK™: 2801-08-03 PIN AND 2659-08 COLLAR
HUCKBOLT™: C6LB-C8-3 PIN AND 3LC-I-8 COLLAR

NOTE: EQUIVALENT FASTENERS THAT ARE APPROVED BY CUSTOMS FOR INTERNATIONAL TRANSPORT OF GOODS UNDER CUSTOMS SEAL MAY BE USED IF APPROVED BY THE OWNER.

THESE TYPES OF FASTENER SHOULD FIT IN A HOLE MADE BY A 6 MM (1/4 IN) DIAMETER DRILL BIT. INSTALL THE FASTENER AND SET BY TAPPING WITH A HAMMER. USE A HYDRAULIC, PNEUMATIC OR MANUAL TOOL TO FASTEN THE COLLAR.

Fig. 11.3/A typical plastic ventilator fastener

11.4.5 When installing a ***wide*** plastic ventilator, drill 27 holes, each 10 mm (3/8 in) in diameter in the panel insert according to the dimensions shown in Figure 11.3. Position holes above plastic ventilator baffles and below the ventilator top, which is approximately 50 to 55 mm (2 to 2 1/4 in) below the top side rail.

When installing a ***narrow*** ventilator, no holes should be drilled; the panel insert must be left blank. If the narrow ventilator is not to be installed on the panel insert, it should be installed in the inboard corrugation immediately adjacent to the large flat marking panel area, with ventilation holes to be drilled in the inboard corrugation according to Section 11.2.6.

11.4.6 Fit the panel insert into position flush with the original side panel. Tack weld into place and check alignment. A clearance of no more than 2 mm (5/64 in) should be allowed between the insert and original panel.

11.4.7 Continuously weld the insert to the original panel.

11.4.8 Clean, mask and prime the interior and exterior surfaces and top coat the exterior surface of the insert according to Sections 2.5 and 2.9.

11.4.9 Install the ventilator cover over the insert according to Section 11.2.

SECTION 12 GLOSSARY OF REPAIR TERMS

Following is a glossary of terms, presented in alphabetical order, as they may be used in the repair of containers. For more general container terminology, see the Glossary in the *Guide for Container Equipment Inspection*, latest edition.

Aggressive (as applied to repair procedures such as cleaning)—More extensive; strongly chemically reactive or intrusive to surfaces of the container to which treatment is applied.

Anchor Profile—A term used to describe the arrangement of tiny peaks and valleys on an abrasive-blasted surface to which paint will be applied.

AWS—American Welding Society, a maker of rules governing welding.

Baffles—Projections on the inside of a ventilator cover designed to prevent the entry of water into the container, while allowing air to enter and escape.

Bevel—Cut at an angle other than a right angle.

Bituminous—Containing hydrocarbons derived from coal or petroleum distillates (similar to asphalt, tar, etc.), usually used in this manual with respect to coatings used for the understructure.

Camber—Change in profile along the length or width of a component, *e.g.* increase in height of a roof along the longitudinal center line compared to the roof edges.

Channels—Formed, folded or rolled metal bars with bracket-shaped (e.g. C- or Z-shaped) sections.

Common Weld—A single weld joining together two adjacent inserts or sections on one side of each.

Continuous Weld—A single, unbroken bead of weld used to join and seal two steel components together completely.

Corten—Generic term for any of a family of high-strength, atmospheric corrosion-resistant steels that conforms to Japanese Industrial Standard (JIS) G3125, e.g. U.S. Steel “Cor-Ten A”.

Countersunk (as applied to floor screws)—Driven into a hole such that the fastener head will lie flush with or below the floor surface.

Craters—Pits in the surface of a weld.

DIN—Deutsches Institut für Normung, the German national standards organization.

Disc Cutter (Abrasive Cut-Off Saw)—A saw that uses the edge of an abrasive disc to cut metal.

Disc Grinder—A flat abrasive disc whose rotating face is used for smoothing metal surfaces.

Dowels—Round wooden pins that fit tightly into holes in wooden boards.

Electrode—Flux-coated metal rod or wire used as filler metal in manual arc welding.

Embrittlement—Making a weld overly susceptible to breakage or cracks (*e.g.* by the introduction of hydrogen into the weld).

Flame Cutter—Torch which concentrates an open flame to a narrow point suitable for cutting metals. See Oxygen-Acetylene Torch.

Formed Edge—Outside radius of fabricated fold or bend in a component (not a bend due to damage).

Gusset—A flat insert used to strengthen steel components.

Hat Sections—Steel profiles in the shape of a hat or the letter "Omega" (Ω)

High-Tensile Steel—Steel having a yield point greater than approximately 30 kg/mm^2 (42,600 psi).

Hydraulic—Producing force by means of fluid motion and/or pressure.

Keepers—See "Locking Bar Cam Retainer".

Knot—A circular, darker cross-section of wood with a grain running differently from that of the wood in which it is imbedded.

"**Like-for-Like**"—Substitution of an exact duplicate component (same profile, material, thickness, strength, etc.) for one being replaced.

Locking Bar (Rod)—The vertical shaft or rod to which the cam locks are fitted. When rotated, the cams may be locked in the cam retainer, forming an integral part of the door frame assembly.

Locking Bar Bracket—A device attaching the locking bar to the top and bottom of a door, usually containing a bushing.

Locking Bar Cam—The part of the door securing device (locking bar) that engages the retainer which, by lever action, forms the cam lock.

Locking Bar Cam Retainer—The component which retains the cam locking device when the door is locked. This component is often called a "keeper" or "cam keeper."

Longitudinal—Placed or running lengthwise; aligned along the length of the container.

Magnetic Particle—A type of welding fault-detection apparatus using magnetic currents.

Mechanical—Producing force by means of machines, tools or manual energy, as opposed to chemical action or the application of heat.

MIG—Metal inert gas, a method of welding.

Mild Steel—Steel having a yield point less than approximately 30 kg/mm^2 (42,600 psi).

Muffler-Grade Steel—Corrosion-resistant steel with a chromium content of approximately 10% (more corrosion-resistant than Corten, but less than stainless steel).

Oxygen Acetylene Torch—A flame cutter using a combination of oxygen and acetylene fuel.

Porosity—Welding defect composed of voids, holes, pin holes, pores, etc., caused by contaminants at the time of welding.

Self-Tapping Screws—Screws that create their own thread as they are driven into the material being fastened.

Serpentine—Wavy (not angular) component profile, *e.g.* on certain types of corner posts.

Stainless Steel—Corrosion-resistant steel with a chromium content of approximately 18% (more corrosion-resistant than muffler-grade steel).

Stitch (or Skip) Weld—A linear series of weld beads, each of which is approximately 25 mm (1 in) or more in length and separated from the next bead by an unwelded length. The sum of the length of one bead plus the unwelded distance to the next bead is called *pitch*; both the weld length and pitch are specified in welding diagrams for this type of weld.

Tack Weld—A bead of weld less than 25 mm (1 in) in length, usually used singly or in combination with other tack welds to hold components in position temporarily prior to permanent welding. Tack welding is also used to comply with certain TIR requirements (e.g., to weld nuts to bolts on doors).

TIG—Tungsten inert gas, a method of welding.

Tongue-and-Groove—A joint where a milled-in central semi-circular edge protrusion on a board ("tongue") mates with a routed-out semi-circular cavity on another board ("groove").

Transverse—Placed or running crosswise, *i.e.* perpendicular to longitudinal; aligned across the width of a container.

Ultrasonic Eddy Current—A type of welding fault-detection apparatus using ultra-high frequency sound waves.

Undercutting—Welding fault involving excessive reduction in parent-metal thickness at the edge of a weld.

Vented Container—A container with passive (ie., non-mechanical) vents, also called ventilators, at the upper part of the cargo space. Section 11 of this manual describes repairs to this type of ventilator. A vented container should not be confused with a *ventilated* container (See VENTILATED CONTAINER).

Ventilated Container—A container with a mechanical ventilation system (*ie.*, fans) or with passive vents located both at the upper *and* lower part of the cargo space. A ventilated container should not be confused with a *vented* container (See VENTED CONTAINER).

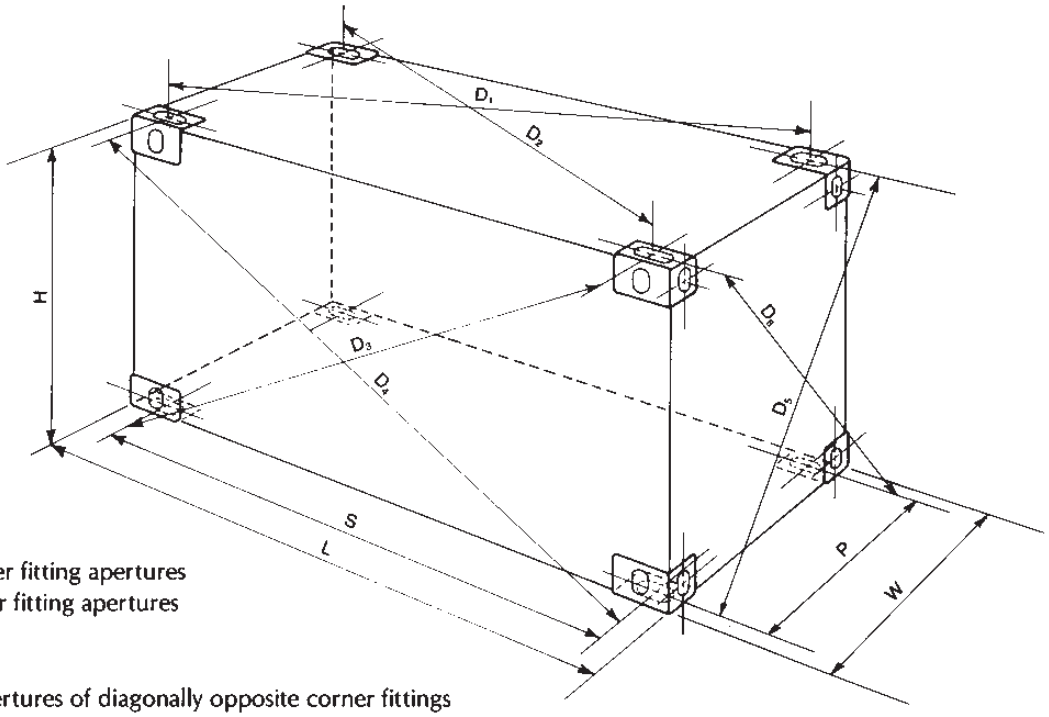
Volatile Organic Compounds (VOC)—Solvents and other compounds in paints that can escape into the atmosphere during paint application or curing, which may be harmful to atmospheric air quality.

Warpage—Curvature of wood out of shape due to uneven expansion and contraction throughout the thickness of the wood, often the result of exposure to moisture.

Weld Slag—A solid vitreous residue of the welding process that does not contribute to joining of metals together.

APPENDIX A ISO DIMENSIONS AND TOLERANCES

(Adapted from International Standard ISO 668: 1988/Ams 1: 1993)



S = Length between centers in corner fitting apertures
P = Width between centers in corner fitting apertures
L = External length of the container
W = External width of the container
D = Distance between centers of apertures of diagonally opposite corner fittings
K_1 = Difference between D_1 and D_2 or D_3 and D_4
K_2 = Difference between D_5 and D_6
H = Overall height

EXTERNAL DIMENSIONS AND TOLERANCES IN MILLIMETERS AND IN FEET AND INCHES

Height - 8 ft. high: 2 438 $^{+0}_{-5}$ mm (8 ft 0 in. $^{+0}_{-3/16}$ in.) Height - 8 1/2 ft. high: 2 591 $^{+0}_{-5}$ mm (8 ft 6 in. $^{+0}_{-3/16}$ in.)

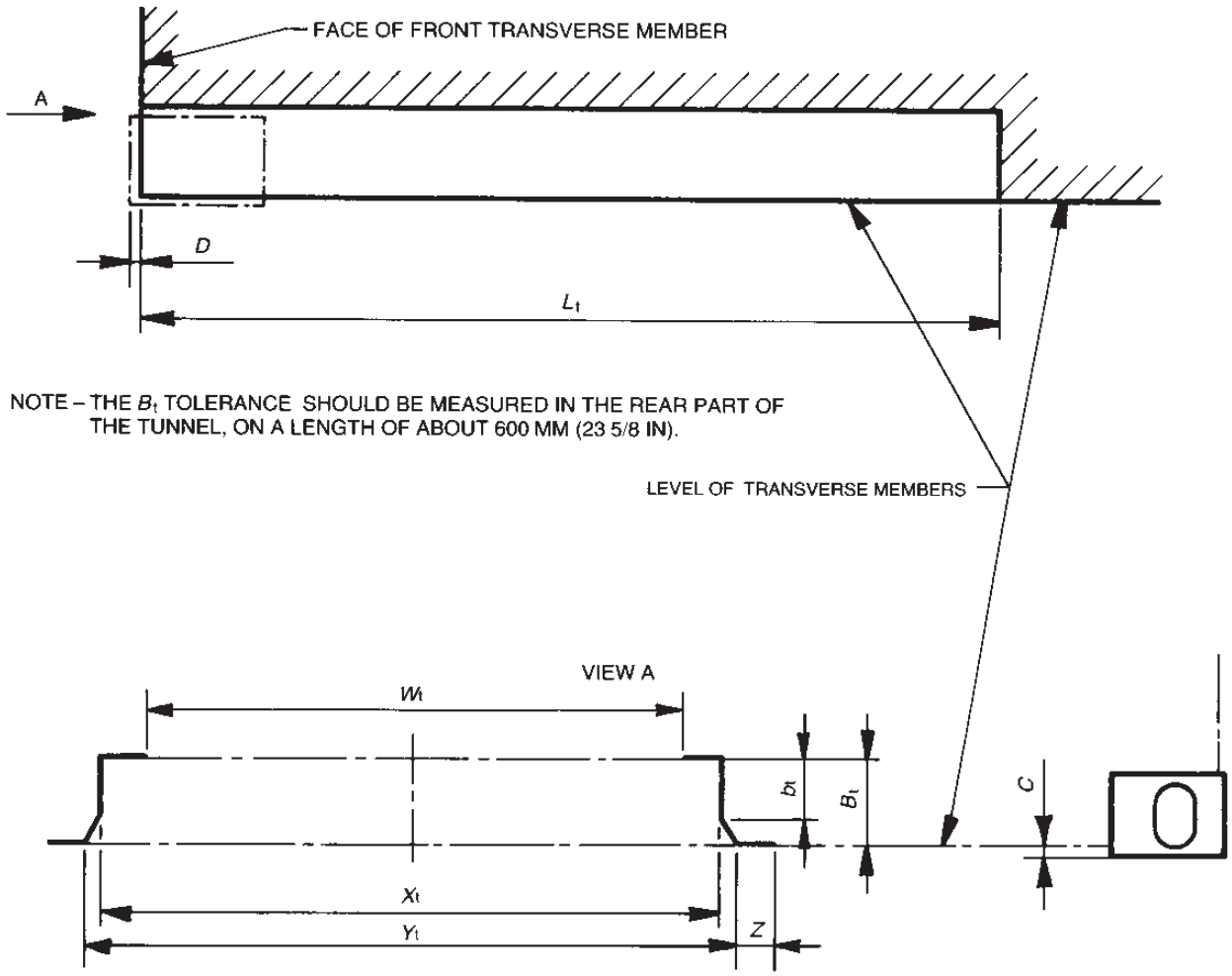
Height (external) - 9½ ft. high: 2 896 $^{+0}_{-5}$ mm (9 ft 6 in. $^{+0}_{-3/16}$ in.) Width - All containers: 2 438 $^{+0}_{-5}$ mm (8 ft 0 in. $^{+0}_{-3/16}$ in.)

Freight container designation	Length (external)			S			P			K_1 max.		K_2 max.	
	mm	ft	in	mm	ft	in	mm	ft	in	mm	in	mm	in
40′	12 192 $^{+0}_{-10}$	40	0 $^{+0}_{-3/8}$	11 985	39	3-7/8	2 259	7	4-31/32	19	3/4	10	3/8
30′	9 125 $^{+0}_{-10}$	29	11-1/4 $^{+0}_{-3/8}$	8 918	29	3-1/8	2 259	7	4-31/32	16	5/8	10	3/8
20′	6 058 $^{+0}_{-6}$	19	10-1/2 $^{+0}_{-1/4}$	5 853	19	2-7/16	2 259	7	4-31/32	13	1/2	10	3/8

MINIMUM INTERNAL DIMENSIONS

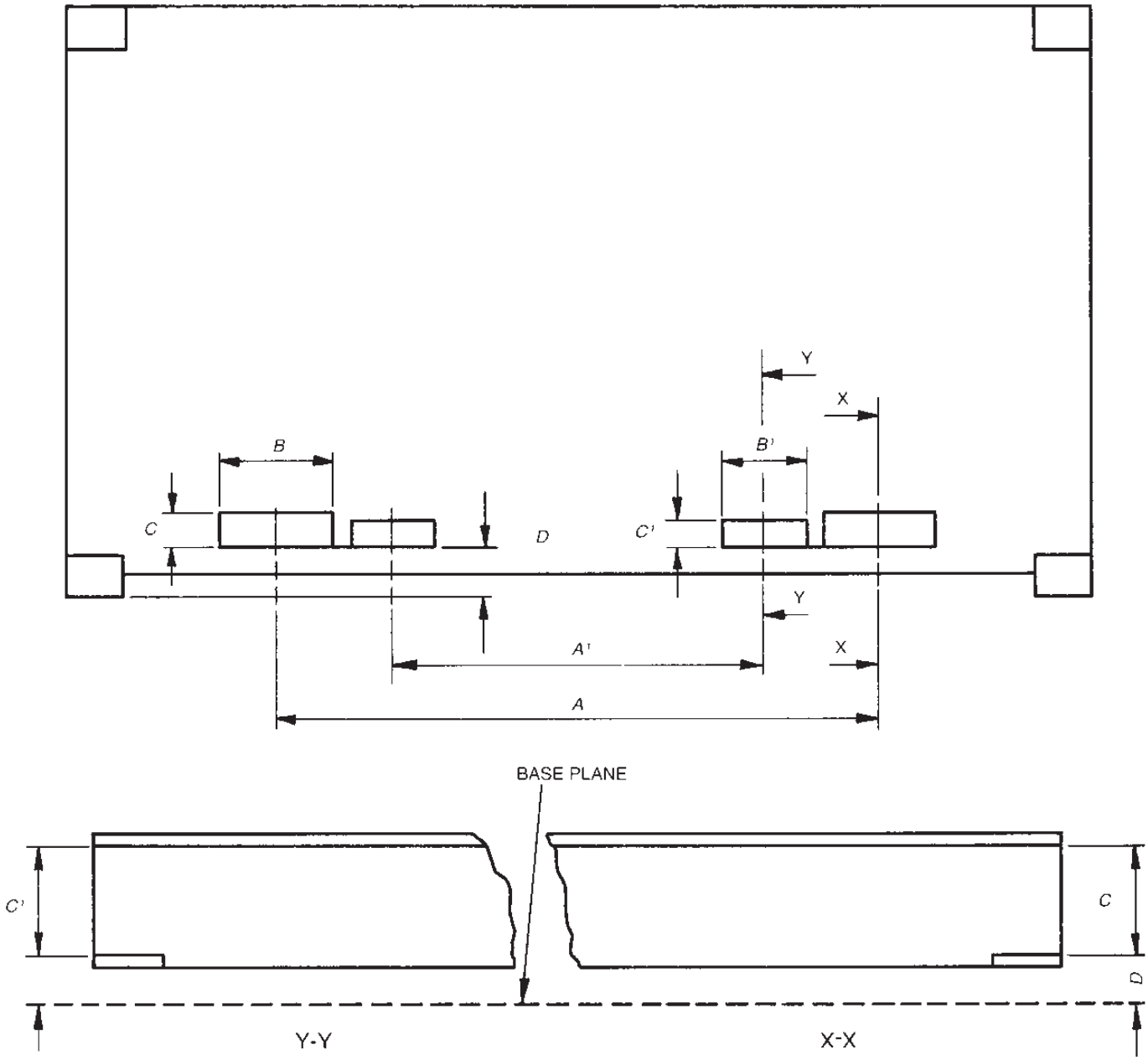
Freight container designation	Minimum height	Minimum width		Minimum length		
		mm	in	mm	ft	in
20'	Nominalcontainer external height minus 241 mm (9-1/2 in)	2,330	91-3/4	5,867	19	3
30'				8,931	29	3-5/8
40'				11,998	39	4-3/8

APPENDIX B DIMENSIONS OF GOOSENECK TUNNELS



		Dimensions	
		mm	in
Length	L_t	3150 to 3500	124 1/4 to 137 7/8
	D	6^{+1}_{-2}	$1/4^{+3/64}_{-3/32}$
Width	W_t	930 max.	36 5/8 max.
	X_t	1029^{+3}_{0}	$40\ 1/2^{+1/8}_{0}$
	Y_t	1070 min.	42 1/8 min.
		1130 max.	44 1/2 max.
	Z	25 min.	1 min.
Height	B_t	120^{0}_{-3}	$4\ 23/32^{0}_{-1/8}$
	b_t	35 min.	1 3/8 min.
		70 max.	2 3/4 max.
	C	$12.5^{+5}_{-1.5}$	$1/2^{+3/16}_{-1/16}$

APPENDIX C DIMENSIONS OF FORKLIFT POCKETS



Container	Dimensions													
	Fork pockets for loaded and unloaded containers								Fork pockets for unloaded containers only					
	mm				in				mm			in		
	A	*B*	*C*	*D*	*A*	*B*	*C*	*D*	*A'*	*B'*	*C'*	*A'*	*B'*	*C'*
1CC 1C, 1CX	2050 ±50	355 min.	115 min.	20 min.	81 ±2	14 min.	4½ min.	0.8 min.	900 ±50	305 min.	102 min.	35½ ±2	12 min.	4 min.
1D 1DX	900 ±50	305 min.	102 min.	20 min.	35½ ±2	12 min.	4 min.	0.8 min.						

Note – *C* = Clear opening.

APPENDIX D TABLE OF EQUIVALENTS

APPROXIMATE EQUIVALENT INTERNATIONAL SYSTEM (METRIC) DIMENSIONS, U.S. CUSTOMARY DIMENSIONS AND SHEET METAL THICKNESS IN MANUFACTURER'S GAGE NUMBER

METRIC DIMENSION MILLIMETERS	APPROX. U.S. CUSTOMARY DIMENSION INCHES	APPROX. MANUFACTURER'S GAGE
1	1/32	19
1.6	1/16	16
2	3/32	14
2.5	3/32	12
3	1/8	11
3.2	1/8	10
4.5	3/16	7
6	1/4	3
10	3/8	
13	1/2	
19	3/4	
25	1	
150	6	
300	12	
380	15	
1200	48	
2400	96	
6000*	240 (20 ft.)	
12000**	480 (40 ft.)	

*6000 mm is the nominal metric length for 20 foot container.
**12,000 mm is the nominal metric length of 40 foot container.
Note: One millimeter is approximately equal to 0.040 inches.

Carlisle Leasing International LLC
Container Applications International, Inc.
Cronos Containers Limited
Flexi-Van Leasing, Inc.
Florens Container Services (U.S.) Ltd.
GE SeaCo SRL
Interpool Limited
Textainer Equipment Management (U.S.) Ltd.
Trac Lease, Inc.
Transamerica Leasing Inc.
Triton Container International Ltd.
XTRA International