Trailer

Maintenance

Manual

April 2004

Truck Trailer Manufacturers Association
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Trailer Maintenance Manual

GENERAL

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1.0 Preface:

1.1 No part of this document may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system without written permission from the Truck Trailer Manufacturers Association.

1.2 Recommended Practices and Technical Bulletins are furnished by the TTMA as a guide to general practices in the manufacture, use, and repair of truck trailers. However, the scope of the TTMA's Recommended Practices and Technical Bulletins is not exhaustive of all general practices in the manufacture, use, and repair of truck trailers and there may exist such general practices which do not appear in either the Recommended Practices or Technical Bulletins.

1.3 Recommended Practices and Technical Bulletins represent the state-of-the-art that existed at the time of its preparation. Users of Recommended Practices and Technical Bulletins should familiarize themselves with advancements in practices that have occurred subsequent to the Recommended Practice's or Technical Bulletin's publication date.

1.4 The TTMA has not undertaken any evaluation of all the conceivable ways in which Recommended Practices or Technical Bulletins may be used by manufacturers, users, or repairers of truck trailers nor the consequences of such uses. Everyone who uses Recommended Practices or Technical Bulletins must first satisfy himself or herself that his or her safety, the safety of others, or the safety of the truck trailer and any other equipment will not be jeopardized by their use of information contained within the Recommended Practices or Technical Bulletins.

1.5 The Recommended Practices and Technical Bulletins may contain terms or words with specialized meanings. Definitions for such terms or words may be found in TTMA RP No. 36 - Tank Trailer and Tank Container Nomenclature or TTMA RP No. 66 - Trailer Nomenclature.

1.6 Within the Recommended Practices and Technical Bulletins, "shall" is used wherever conformance with the TTMA publication requires that there be no deviation from the specific recommendation. "Should" is used wherever deviation from the specific recommendation is permissible in complying with the TTMA publication.

1.7 Conformity with TTMA publications by manufacturers, users and repairers of truck trailers is voluntary and any non-conformity with such publications is not indicative of the non-conforming practice being deficient.

1.8 Any inclusion of Recommended Practices or Technical Bulletins within any contract, document or standard is voluntary, and any such inclusion shall not imply any endorsement or approval by the TTMA due to the multitude of ways in which the Recommended Practices or Technical Bulletins may conceivably be used.

2.0 Scope:

While many of the maintenance recommendations apply to all types of trailer, this Trailer Maintenance Manual is directed to van, platform and dump trailers. Special maintenance recommendations as they may pertain to tank, lowbed, auto transporter, and other types of trailers are not included here.

Maintenance begins with the purchase and use of the correct trailer, properly designed for the hauling to be done, and must be followed by proper driver attitude and good driver training. Coupled with adequate regular service, shop preventive maintenance (PM), the life of a trailer can be increased manyfold. The length of the life of a trailer is limited only by possible accident and economic obsolescence.

A review of maintenance procedures, shop maintenance techniques, driver training, appearance maintenance, lubrication, and effects of weather and safety as related to the operation and useful life of a trailer is made in this manual.

2.1 Safety:

Safety in the Shop or anywhere else, for that matter is a vital issue that demands everyone's attention. Develop a shop safety and accident prevention policy and use all reasonable methods, procedures and equipment necessary to insure its success.

Knowledge and Vigilance are the best protection against safety hazards. A knowledge of proper work procedures and caution in trailer maintenance and repair and constant vigilance in their application will reduce accidents to a minimum. Complacency, especially in routine repetitive shop procedures, is one of the greatest underlying safety hazards.

Know the correct method of doing a specific job before attempting it. Review in your mind the possible safety hazards and take the necessary precautions before proceeding. If you lack knowledge, make due inquiry. All employees should know and observe the Federal Occupational Safety and Health Standards as published by the U.S. Department of Labor, all local and state regulations and any existing company safety policies which pertain to the specific job to be done.

Proper precaution is the element of safety that we must leave in your hands. Experience has proven that there is virtually no hazard or operation which cannot be overcome by practical safety measures. We can only offer the reminder that broken bones heal much more slowly than broker trailers.

2.2 Chemical Hazards:

An information file should be developed and maintained on all chemicals used in or near the shop. This file should contain information on the type of chemical, the fire and health hazards, MSDS, of each type and the proper safety measures necessary when using them. This file should also contain a copy of OSHA – 3084, Chemical Hazard

Communications, which explains what employers and employees should know about chemical hazards and how to protect themselves. A single free copy of this publication can be obtained from any OSHA field office.

2.3 Environmental Issues:

Federal, State and local regulations may have an impact on your ability to perform the work that needs to be done, or the manner and materials used to accomplish that work. These regulations change from time to time and obviously differ depending on the location involved. Before performing any work check with the appropriate sources to ensure compliance with existing or possibly pending regulations.

3.0 Nomenclature:

Nomenclature may be found in TTMA RP No. 66, *Trailer Nomenclature (enclosed)*. Tank related nomenclature can be found in TTMA RP No. 36 *Tank Trailer Nomenclature*, which may be purchased from TTMA, at www.ttmanet.org.

4.0 Highway Operation:

Maintenance, through good driving, can be summed up as being just plain, good commonsense.

4.1 Watch the Road:

Avoid low branches of trees, signs, roofs, fire escapes, protecting walls, low underpasses and other overhead obstructions that can be hit by the tractor trailer. Keep a sharp eye open for chuckholes and objects that can do damage to tires, wheels, and the tractor or trailer, such as large stone, brick, boards with nails, glass, wire, etc. By just plain, simple good piloting of the tractor or trailer considerable expense can be avoided by the driver.

4.2 Conservation of Brakes Through Driver Care:

Always:

- Check the performance of your brakes before starting your run.
- Maintain a safe road speed regardless of terrain or posted limits.
- Maintain one vehicle length behind the vehicle in front for each 10 mph of road speed.
- Apply brakes sufficiently in advance of stopping to prevent gradual, smooth deceleration.
- Endeavor to anticipate emergency stops. Watch traffic well down the road

- Take advantage of engine compression by downshifting when approaching a downgrade.

- Make several brake applications to dry out lining after running through water.

- Make yourself fully aware of the capabilities and limitations of the braking system on your tractor and trailer.

- Release brake just before crossing railroad tracks or hitting other rough road surfaces; let the wheels roll.

- Exercise extreme caution in making brake applications on icy or snowpacked roads. Make cautious, intermittent applications by fanning or pumping the brakes to reduce speed without skidding or locking the wheels.

- Put tractor in low gear and apply tractor parking brake to assist in holding unit when parking.

Remember:

- Severe braking overheats linings and drums, causing brake fade, and in severe cases complete brake loss. At the same time, drum and lining life are greatly reduced.

- When braked wheels bounce over uneven road surfaces, they lock up when they come down. Flat spots occur on tires and terrific impact stresses are imposed on tires, under construction and towing devices.

- For maximum safety, reduced maintenance costs and optimum braking efficiency, careful control of both speed and payload is most essential.

4.3 Conservation of Supports Through Driver Care:

Always:

- Engage crank handle with input shaft to ensure safe cranking conditions.

- Use chock blocks or lock trailer brakes when uncoupling or coupling tractor and trailer; on the road or in the terminal area. Chock as required for unusual loading conditions.

- Place landing gear wheels on a plank or smooth surface for flotation to prevent sinking into soil or soft asphalt when loaded trailers are uncoupled from tractor. Sand shoes may be suggested in some operations.

Never:

- Force landing gear beyond their normal retracted or extended position.
- Use excessive force to change gears.

4.4 Conservation of Coupler Through Driver Care:

Never:

- Assume coupling device is locked or unlocked. **Check!!!**
- Use excessive force to connect or disconnect. Damage may occur to fifth wheel, kingpin and front of trailer.
- Attempt to couple with the trailer at an improper height. This could result in a false or improper coupling and cause damage to the tractor or trailer.

Always:

- Position fifth wheel to kingpin before coupling. Reasonable straightaway alignment between tractor and trailer is necessary.
- Use chocks behind rear trailer axle or set trailer brakes before coupling.
- Be certain rear guide forks of fifth wheel are in the “down” position.
- Ease fifth wheel guide forks under front of trailer pickup plate – never use great force.
- After coupling, make a visual check to insure that the fifth wheel locking device is in the locked position. Apply pressure to locking device by locking trailer brakes and attempting to move trailer forward gently.

4.5 Conservation of Tires Through Driver Care:

Careless driving habits can result in serious and costly tire damage.

Always:

- Avoid speeding over rough roads which are full of large, sharp-edge chuckholes.
- Avoid driving over curbs by making too short a turn and do not back over curbs at loading docks.
- Avoid riding edge of pavement.

- Avoid improper load distribution.
- Avoid sudden and improper use of brakes due to not anticipating stops in time.
- Drive at moderate speeds, particularly with heavy loads during hot weather.
- Check for bubbles and flat spots.
- Report evidences of misaligned wheel or other abnormal conditions when driving vehicle.
- Check tires regularly and frequently for cuts, nail holes, glass and abrasions. Report and have them repaired permanently and immediately.
- Avoid running over glass, rocks, chuckholes, and other obstructions.

Never:

- Run a tire when it is flat or under-inflated as it can result in a fire.

4.6 Pulling the Insulated Trailer:

- Do not park loaded unit in sun if it can be avoided. To do so increases the refrigeration load.
- When unit is empty, leave doors open and unit in sun to dry out between loads.

INSPECTION

5.0 Inspection of Equipment by Driver:

This is the area in which the mechanic will learn that the driver can be a real partner in preventive maintenance. Encourage drivers to report anything unusual that they may notice in the inspection or operation of their outfit, such as:

Listen:

For thumps, bumps, rattles, squeaks, squeals, air leaks, or unusual equipment sounds.

Smell:

Odors like burning insulation, scorched fabric, burning rubber or wood, hot oil, etc.

Feel:

Difficulty in steering, braking, gear shifting, or other handling problems. Be sensitive to change in operation of equipment.

See:

Equipment defects in door locks, lights, light wiring cables, air lines, lower coupler, tires, splash guards, tarps and fasteners, accessories, fifth wheel, supports, brake gauge and operation, loading.

Report:

All symptoms of Unsafe, Defective, or Inoperable Equipment.

Impress on the driver that he is the first line of defense in preventive maintenance that will be less costly if he reports promptly all need for adjustment and repair.

6.0 Trailer Pre-Trip and Post-Trip Inspection:

6.1 While responsibility for checks and adjustments may belong to the shop or mechanical department in most operations, a driver for his own safety and comfort never takes the conditions of his tractor or trailer for granted. Therefore, it behooves the driver on his own best interest, as well as being a Federal Motor Carrier Safety Regulation requirement, to make thorough pre-trip inspections, on-the-road observation, and submit carefully prepared written reports on a regular basis.

Trailer Pre-Trip and Post-Trip Inspection Items

(1) **Doors Locked**:

Check rear and side door and all vent and cabinet doors. They must be secured either open or closed, as required. **Operating a trailer with the doors open is not recommended.**

(2) **Lamps**:

All lamps and reflectors should be clean. Check that all lights burn properly. All burned out bulbs and broken reflectors must be renewed.

(3) **Electrical Wiring**:

Inspect all visible wiring to see that it is not frayed and is properly supported and protected, and that all connections are tight.

(4) **Electrical Cable**:

It should be clean and long enough to permit jackknife parking. Cable should be supported so it cannot become pinched or entangled by lower and upper couplers. Electrical cable should securely connect to base connection on trailer. The driver should test the various circuits (turn signals, stop lamp, running lights, etc.), to make certain that they operate properly.

(5) **Air Lines**:

Jumper hoses, air lines and connections should be tight and well-supported. Hoses, lines, and seals should be free of chafing, and other evident wear and leaks.

(6) **Fifth Wheel and Kingpin Engagement**:

Inspect the kingpin and its structure on the trailer for damage or unusual wear. After coupling, make a direct visual inspection to assure proper coupling, then test the fifth wheel lock by pulling the tractor forward slightly with the trailer brakes locked.

(7) **Tires**:

DO NOT OVERLOAD! Check for proper inflation, with an accurate gauge, and when cold. Check spare for inflation. Inspect tires for nails, etc. and for stones and other objects lodged between duals. Look tires over to see that they are free of noticeable breaks and other defects. Watch new and retread tires for signs of failure during break-in period.

(8) **Splash Guards**:

Check that splash guards are in satisfactory condition and securely in place,

(9) **Ropes, Tarps, Straps, and Miscellaneous Securing Equipment**:

These should be checked for serviceable condition. When not being used for securing cargo, they should be properly stored or attached to prevent being blown about in the wind.

(10) **Accessory Items**:

Accessory items such as wheel chocks, emergency equipment, tire chains, etc., as provided should be inspected to determine presence and serviceability.

(11) **Landing Gear:**

Always raise landing gear legs completely before moving the trailer. Make sure crank handle is secured.

(12) **Check Brake Operation**:

Before entering traffic, check the operation of brakes to be sure that they are in good working order. Try floor pedal, emergency dash control valve (push, pull, or flip) and trailer brake lever to assure brake application and release in each instance. Listen for air leaks under each condition.

(13) **Loading**:

When possible, determine the amount and nature of the payload and its distribution and that it is properly braced and blocked to prevent shifting. If a load is a dangerous commodity, the driver should be informed of the nature of the commodity and what to do in case of accident or fire. Check to see that proper placards are displayed and special routing instructions received, if necessary.

If heating or refrigeration is required, obtain all necessary instructions relative to this equipment.

(14) **Sliders**:

If the trailer has a sliding tandem, be sure all four locking pins are securely locked in place through the upper slide rails and the manual stop bar immediately behind the slider unit is locked before moving the trailer.

(15) **Wheels**:

Check for loose wheel nuts or missing studs and check wheels and rims for cracks or distortions. Do not move the trailer when any of these conditions are present. Check hub gaskets and seals for oil leaks, and check the oil level in hubs before every trip.

(16) **Tire Carrier:**

Check tire carrier structure for possible damage and be sure the tire is properly secured.

(17) **Side Structure:**

Check trailer side for damage to the top and bottom rails as well as the side structure. Missing fasteners should be replaced and any damage corrected immediately to prevent further weakening of the side structure.

(18) **Tow Bars:**

If the trailer is equipped with a dolly, check both the tow bar eye and the hitch for unusual wear or damage.

(19) **Unsafe Equipment:**

Report all unsafe equipment when its physical condition is such as to make its operation hazardous. This procedure is mandated by the Federal Motor Carrier Safety Regulations Part 392.7 – **Equipment, Inspection and Use** (see next page) and 396.11 **– Driver Vehicle Inspection Reports**. (see Page 67)

49 CFR 392.7 **Equipment, inspection and use**. No motor vehicle shall be driven unless the driver thereof shall have satisfied himself that the following parts and accessories are in good working order, nor shall any driver fail to use or make use of such parts and accessories when and as needed.

Service brakes, including trailer brake connections.
Parking (hand) brake.
Steering mechanism
Lighting devices and reflectors.
Tires.
Horn.
Windshield wiper or wipers.
Rear-vision mirror or mirrors.
Coupling devices.

(20) **Freezing Weather**:

Here certain special inspection considerations should be made by the driver. See F. Freezing Weather Conditions.

7.0 Federal Requirements:

A commercial motor vehicle shall not be operated unless it is equipped in accordance with the Federal Motor Carrier Safety Regulations (FMCSR's) found in the Code of Federal Regulations (CFR) Title 49 parts 392, 393, and 396.

The Code of Federal Regulations can be found on the World Wide Web at the following address **http://www.access.gpo.gov/nara/** then scroll down to "Retrieve CFR sections by citation" and enter the title, part and section number that you want to read. TTMA suggests that you be familiar with all of the FMCSR's, but strongly encourages you to know the following parts of **Title 49**.

Part	Section	Subject
392	9	Inspection of cargo, cargo securement devices and systems.
393	1	Scope of the rules of this part.
393	3	Additional equipment and accessories.
393	5	Definitions.
393	11	Lighting devices and reflectors.
393	13	Retroreflective sheeting and reflex reflectors, requirements for semitrailers and trailers manufactured before December 1, 1993.
393	17	Lamps and reflectors-combinations in driveaway-towaway operation.
393	19	Requirements for turn signaling systems.
393	20	Clearance lamps to indicate extreme width and height.
393	22	Combination of lighting devices and reflectors.
393	23	Lighting devices to be electric.
393	25	Requirements for lamps other than head lamps.
393	26	Requirements for reflectors.
393	27	Wiring specifications.
393	28	Wiring to be protected.
393	29	Grounds.
393	30	Battery installation.
393	32	Detachable electrical connections.
393	33	Wiring, installation.
393	40	Required brake systems.
393	41	Parking brake system.
393	42	Brakes required on all wheels.
393	43	Breakaway and emergency braking.
393	45	Brake tubing and hose, adequacy.
393	46	Brake tubing and hose connections.
393	47	Brake lining.
393	48	Brakes to be operative.
393	49	Single valve to operate all brakes.
393	50	Reservoirs requirements.

393	55	Antilock Brake systems.
393	70	Coupling devices and towing methods, except for driveaway-towaway operations.
393	71	Coupling devices and towing methods, driveaway-towaway operations.
393	52	Brake performance.
393	75	Tires.
393	84	Floors.
393	86	Rear impact guards and rear end protection.
393	87	Flags on projecting loads.
393	100	Which types of commercial motor vehicles are subject to the cargo securement standards of this subpart, and what general requirements apply?
393	102	What are the minimum performance criteria for cargo securement devices and systems?
393	104	What standards must cargo securement and systems meet in order to satisfy the requirements of this subpart?
393	106	What are the general requirements for securing articles of cargo?
393	108	How is the working load limit of a tiedown determined?
393	110	What else do I have to do to determine the minimum number of tiedowns?
393	112	Must a tiedown be adjustable?
393	114	What are the requirements for front end structures used as part of a cargo securement system?
393	116	What are the rules for securing logs?
393	118	What are the rules for securing dressed lumber or similar building products?
393	120	What are the rules for securing metal coils?
393	122	What are the rules for securing paper coils?
393	124	What are the rules for securing concrete pipe?
393	126	What are the rules for securing intermodal container?
393	128	What are the rules for securing automobiles, light trucks and vans?
393	130	What are the rules for securing heavy vehicles, equipment and machinery?
393	132	What are the rules for securing flattened or crushed vehicles?
393	134	What are the rules for securing roll-on/roll-off or hook lift container?
393	136	What are the rules for securing large boulders?
393	201	Frames.
393	205	Wheels.
393	207	Suspension systems.

For Inspection, Repair and Maintenance the following CFR section will apply.

396	1	Scope.
396	3	Inspection, repair, and maintenance.
396	5	Lubrication.
396	9	Inspection of motor vehicles in operation.
396	11	Driver vehicle inspection reports.
396	13	Driver inspection.
396	17	Periodic inspection.
396	19	Inspector qualifications.
396	21	Periodic inspection record keeping requirements.
396	23	Equivalent to periodic inspection.
396	25	Qualification of brake inspectors.

MAINTENANCE AND REPAIR

8.0 Preventive Maintenance:

8.1 Introduction:

Preventive Maintenance is a general term and may best be defined as: all of the procedures necessary to secure maximum life, satisfactory service, and safe operation, at minimum cost, from a piece of equipment, short of completely rebuilding or replacing it.

Being cognizant of the variety of trailer PM plans used by some trailer operators and of the fact that other operators had no PM plan, it was felt that some degree of uniformity could be evolved. The TTMA recommended trailer preventive maintenance (TPM) Program is designed to meet the basic departments of all trailer operators and owners. This program is a simple and controlled plan of inspection and maintenance.

Records are few and easily maintained. Little follow-up is required for. The trailer carries a visible and, easily checked *TPM Due Date Record* which is the heart of the program.

TPM is so designed they can be used as a complete new plan or be integrated into systems presently used by trailer operators. No mileage or time-limit is specified for any of the inspections as these can be best determined by the operator to suit his particular operation, facilities, and type equipment.

Many problems arise on leased and interchange units and TPM with its uniform but simple and still flexible system of Inspection and Preventive Maintenance is designed to handle them.

Since the Preventive Maintenance Program, as explained here, is only a recommendation, suggestion for changing or improving the program will be welcomed by TTMA.

8.2 Recommended Preventive Maintenance Practices:

8.2.1 Shop Forms:

Three different but essential TPM inspections and inspection forms (See pages 105 and 108-113 for samples of the suggested forms) are recommended for this program. These are:

1. *Trip Safety TPM Inspection*:

(a) Except for “city” trailers, it is recommended that this inspection be performed before each trip in order to make this trailer as safe, legal, and roadworthy as possible. (Reported on form TPM 2)

2. *Minor TPM Inspection*:

(a) In a normal average over-the-road operations (approximately 50,000 miles per trailer per year), it is suggested that this TPM

Inspection be performed at 2,000 miles or semi-monthly intervals. (reported on form TPM 3)

(1) Where the mileage is higher than average or the operation harder on the equipment, a shorter time interval is suggested. The time interval can be lengthened where the reverse is true.
(2) Converter dollies and other types of vehicles regularly operated in areas where inspections are difficult must be brought into the maintenance shop for TPM inspections.

3. *Major TPM Inspection*:

(a) In a normal average over-the-road operation it is suggested that this TPM Inspection be performed at 50,000 miles or at yearly intervals, whichever occurs first. (Reported on Form TPM 4)

(1) It is recognized that the type of operation and equipment involved can vary the Major TPM interval considerably, so each user must determine what is best for his operation.

Both **Major** and **Minor** Inspections are to be made at a point where indicated repairs can be made, and the trailer scheduled accordingly. **Prompt Repair is Very Essential.**

8.2.2 Terminal Forms:

The forms used for the above inspections can be classified as field or shop forms. Two other forms for terminal control are also suggested.

1. Terminal TPM Control Record (Form TPM 1)

A copy is maintained for each trailer. It is designed for recording of inspections, to accumulate maintenance and repair cost if desired, and to provide TPM inspection follow-up as needed.

Suggested follow-up methods for Inspection Due Dates:

(a) Chronological file of unit numbers on 3 inch x 5inch cards.
(b) Date coded colored tabs on the Control Record Cards

2. TPM Inspection Past Due Follow-up:

(a) Option No. 1 (Form TPM 5) is a Master Notice Sheet of past due inspections for all trailers in a fleet. Suggested for fleets whose size or operation makes it impractical to know where each trailer is located each day.

(a) Option No. 2 (Form TPM 5A) is a single trailer notice of past due inspection. Suggested for operators that know exactly where each unit is each day. Also for trailers on interchange or lease.

Both Form TPM 5 and TPM 5A are compiled as often as necessary from the Terminal TPM Control Record, and sent to the attention of the person, terminal, or company as the case may be, that is responsible for seeing that the TPM inspections are made.

8.2.3 TPM Inspection Form Distribution:

Distribution of TPM Inspection Forms may be made as suggested below or can be varied to suit the operation:

1. To TPM Terminal Control for immediate posting on Control Record to eliminate all unnecessary past due inspection follow-up.
2. To TPM Terminal Control with cost record or invoice for posting to cost section of the TPM Control Terminal Record Car. (Optional)
3. To Servicing Shop File.

When the TPM Terminal Control Record Card is posted it is set up for follow-up on the next inspection Due Date according to the system adopted by the operator.

When either a **Minor** or **Major** inspection is past due, a follow-up is originated and mailed to the terminal or terminals where the trailer is in service.

No recording or follow-up is intended on Trip Safety Inspections, but should a periodic study of the Trip Safety Inspection form file disclose they are not being handled, then corrective action should be instituted.

8.2.4 TPM Due Date Record:

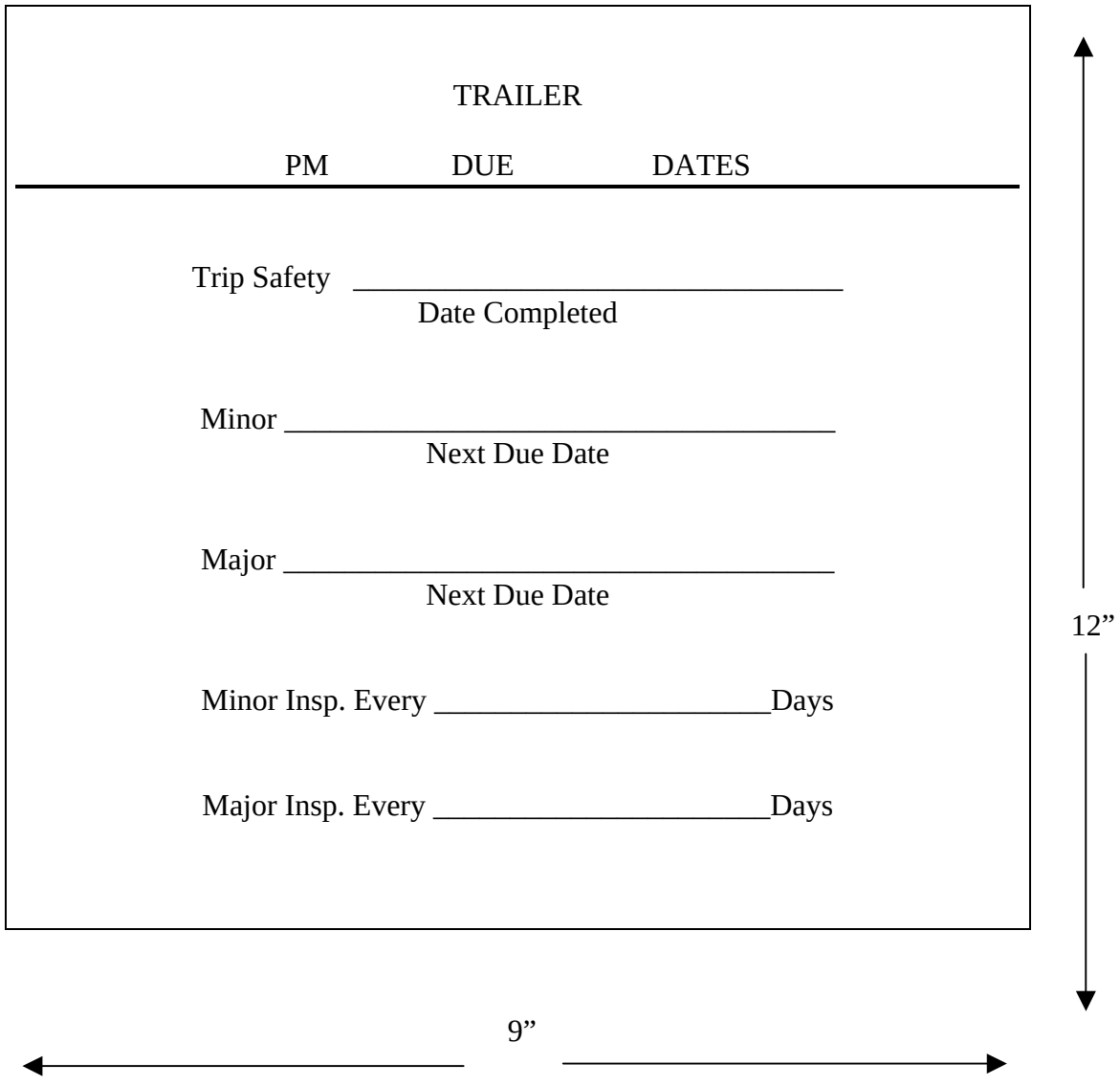
The TPM Due Date Record is a traveling record, always with the trailer and always immediately visible to point out:

1. When the last **Trip Safety Inspection** was completed.
2. When the next **Minor** and **Major** inspections are due.
3. Basis for establishing the next due dates.

This is a 9 inch X 12 inch metal panel applied to the lower front panel of trailer or lettered directly on the trailer front panel. Paint used for lettering must be of good quality, properly applied and remain unaffected by petroleum base solvents.

Inspection and due dates can be marked on the panel with a Black China Marking Pencil (Glaisdell 163T Paper Pencil or equal.) Old dates are easily removed with a cloth dampened with a petroleum base solvent. Record space should be clean and dry before marking in new dates.

The following is a suggested layout for the due date panel.



8.2.5 Determination of Due Dates:

To explain the determination of inspection due dates, we must assume certain conditions:

1. The operator has decided on a Minor Inspection each 2,000 miles and a Major Inspection each 50,000 miles. Assuming for instance, the average mileage is 4,000 miles per month and the initial TPM Inspection was a major which was completed on 8/6/88, the next Minor TPM due date would be 8/21 and the next Major TPM due date would be 8/6/89; in other words, (one year later).
2. On the other hand, assuming the average mileage per month is 3,000 miles and the initial TPM Inspection was a Major on 8/6, the next Minor TPM due date would be 8/26 (2,000 miles equals 20 days). The next Major would still be 8/26; i.e. (one year later), even though the annual mileage was less than 50,000 miles.

It shall be the responsibility of the mechanic performing the TPM inspection, the TPM Inspector, the shop foreman or whomever shall be designated to fill the correct TPM Inspection due dates on the Trailer Due Date Panel.

THIS MARKING OF THE TRAILER DUE DATE RECORD PANEL IS THE MOST IMPORTANT PHASE OF THE PROGRAM AND UNLESS PROPERLY HANDLED THE ENTIRE PLAN IS WORTHLESS

Here then is another example of the program's flexibility. Mileage and time limits can be established by the operator to suit his equipment and operation.

8.2.6 Putting "TPM" Into Operation:

In starting the TPM plan, the following procedure is suggested.

1. Originate an individual TPM Control Terminal Record Care (Form TPM 1) for every trailer to be covered by the plan. These Record Cards are to be maintained at the TPM Control Terminal designated by the owner and are to be filed by unit number in numerical sequence. For TPM Inspection follow-up they can be date coded with colored tabs or a separate 3 inch x 5 inch card file in chronological order can be set up.
2. Base on the previous maintenance operation and the physical condition of the trailer, perform the type of TPM Inspection that is due the trailer when it is received in the maintenance shop. Fill out the proper TPM Inspection form and handle as directed on that form.
3. Install TPM Due Date Record plate or lettered panel in the approved location on the lower front trailer panel.
4. Using an approved type marking pencil, insert the next due dates for all inspections on the plate or panel.
5. Return the trailer to operation.

In essence, the operation of TPM after originally started, is as follows:

Each day all company operated trailers including those on the interchange or lease, where there is a working agreement are to be checked for TPM Inspection Due Dates. This can be done quickly by a man walking through the yard or dock area. The number of times the yard is checked daily will depend entirely on the operation covered.

It can be seen from this how simple the program is and how **Very Important it is to Properly and Promptly** post the TPM Due Date Record Plate.

8.3 Summary:

The Trailer Preventive Maintenance Program as proposed here is simple to handle and administer. A check of how efficiently the plan is working is easily made by spot checking TPM Inspection Due Date Panels on trailers and by the number of past due inspections notices being mailed.

If assistance is desired by any company in setting up the TPM Plan, it is suggested that help be given by members of the Truck Trailer Manufacturers Association. The same holds true if the plan bogs down at any time, and the operator requires aid in straightening it out.

A well maintained trailer is safe and profitable – the Trailer Preventive Maintenance Program is designed to make trailers safe on the highway and to provide for trailer operation at a profit with a minimum of costly road failures.

* * * *

FORM TPM 1	**TERMINAL TPM CONTROL RECORD**									
ORIGINATE SEPARATE RECORD FOR EACH TRAILER			COMPANY NAME				TIRE SIZE	PLY	UNIT NO.	
FILE IN UNIT NUMBER SEQUENCE			PURCHASED DATE		MAKE		MODEL NO.		SERIAL NO.	
MILEAGE (OPTIONAL)	TPM INSPECTION DATES		COSTS (OPTIONAL)		TPM SCHEDULE DATES		TPM FOLLOW UP DATES			REMARKS
	MINOR	MAJOR	TPM	REPAIR	MINOR	MAJOR	1ST	2ND	3RD	

FORM TPM 2

COMPANY NAME

ALL OPERATIONS ARE TO BE PERFORMED BEFORE EACH TRIP DATE:_________

TRIP SAFETY TPM INSPECTION

REQUIRED SHOP REPAIRS ARE TO BE REPORTED TO THE SHOP FOREMAN

SHOP OR TERMINAL LOCATION___________________

OPERATIONS			
1.	LIGHTS AND REFLECTORS INSPECT FOR OPERATION AND DAMAGE OR MISSING PARTS. CLEAN LIGHTS AND REFLECTORS.	3.	TIRES – WHEELS AND MUD FLAPS INFLATE TIRES TO RECOMMENDED PRESSURE AND CHECK CONDITION. CHECK RIM CLAMPS OR WHEEL STUDS FOR LOOSENESS. CHECK SPLASH GUARDS.
2.	BRAKES DRAIN RESERVOIRS AND ADJUST BRAKES AT THE SLACK ADJUSTERS IF NECESSARY. INSPECT BRAKE SYSTEM FOR DAMAGE	4.	SLIDING TANDEM CHECK LOCK MECHANISM FOR PROPER OPERATION. INSPECT ALL PARTS VISUALLY FOR WEAR AND DAMAGE.
		5.	RECORD INSPECTION DATE FILL IN TODAY'S DATE ON DUE DATE PANEL

CODE EACH COLUMN AFTER TRAILER NO. AS INSPECTION IS COMPLETED
OK = INSPECTED AND OK R = MINOR REPAIRS MADE SE = SHOP REPAIRS REQUIRED; REPORT TO SHOP FOREMAN

TRAILER NUMBER	LIGHTS	REFLECTORS	BRAKES	TIRES AND WHEELS	SPLASH GUARDS	SLIDING TANDEM	RECORD INSP. DATE	MECH. NAME	REMARKS
	1	1	2	3	3	4	5		

FORM TPM 3

ALL OPERATIONS ARE TO BE PREFORMED ON THE DUE DATE INDICATED ON THE NOSE PANEL OF THE TRAILER	COMPANY NAME	DATE:
MAJOR REPAIRS ARE TO BE REPORTED TO THE SHOP FOREMAN	MINOR TPM INSPECTION	SHOP OR TERMINAL LOCATION

OPERATIONS

1.	**TRIP SAFETY INSPECTION USE FORM TPM 2**	5.	**FRAME** INSPECT SUBFRAME – BODY RAILS AND CROSSMEMBERS FOR DAMAGE OR CRACKS. INSPECT UPPER 5TH WHEEL PLATE AND KINGPIN FOR EXCESSIVE WEAR OR DAMAGE. INSPECT 45 WHEELER GEAR-HITCH-TOWBAR-CHAINS, ETC. FOR EXCESSIVE WEAR OR DAMAGE
2.	**SUPPORTS** INSPECT FOR BROKEN OR WORN PARTS (VISUAL CHECK)	6.	**BODY** INSPECT ROOF AND/OR TARPAULINS FOR LEAKS OR DAMAGE (LIGHT OR WATER TEST) INSPECT INTERIOR OR EXTERIOR PANELS FOR DAMAGE. INSPECT DOORS AND HARDWARE (INCLUDING HOLDBACKS) FOR OPERATION – FIT AND DAMAGE INSPECT FLOORS FOR DAMAGE AND/OR LEAKS.
3.	**UNDERCONSTRUCTION OR RUNNING GEAR** INSPECT FOR BROKEN SPRINGS. INSPECT HANGERS FOR EXCESSIVE WEAR-LOOSENESS OR DAMAGE. INSPECT ALL OTHER PARTS FOR EXCESSIVE WEAR-LOOSENESS OR DAMAGE	7.	**LUBRICATE** ALL HIGH PRESSURE FITTINGS AND FILL OIL RESERVOIRS.
4.	**BRAKES (DO NOT REMOVE WHEELS)** INSPECT BRAKE OPERATING PARTS FOR OPERATION, DAMAGE AND LEAKS.	8.	**CHANGE MINOR TPM DUE DATE** FILL IN NEXT DUE DATE ON NOSE PANEL.

CODE EACH COLUMN AFTER TRAILER NO. AS INSPECTION IS COMPLETED
OK = INSPECTED AND OK R = MINOR REPAIRS MADE SR = SHOP REPAIRS REQUIRED; REPORT TO SHOP FOREMAN

TRAILER NUMBER	TRIP INSP.	SUPPORTS	U C OR RUNNING GEAR	BRAKES	FRAME	BODY	LUBRICATION	NEXT DUE DATE	MECH. NAME	REMARKS
	1	2	3	4	5	6	7	8		

FORM TPM 4

COMPANY NAME

ALL OPERATIONS ARE TO BE PERFORMED ON THE DUE DATE INDICATED ON THE NOSE PANEL OF THE TRAILER

UNIT NUMBER_____

DATE_____

MAJOR TPM INSPECTION

MAJOR REPAIRS ARE TO REPORTED TO THE SHOP FOREMAN

_____
OWNER'S NAME IF INTERCHANGED OR LEASED

_____
SHOP OR TERMINAL LOCATION

_____
OWNER'S ADDRESS

_____
MECHANIC OR INSPECTOR

OPERATIONS	INSPECTED AND OK CHECK	REPAIRS NEEDED CHECK	ACTION TAKEN
TRIP SAFETY INSPECTION – USE FROM TPM 2			
MINOR TPM INSPECTION – USE FORM TPM 3			
AXLES AND BRAKES (WITH THE WHEELS REMOVED) CLEAN AND INSPECT BEARINGS – WHEELS & HUBS – REPACK BEARINGS – FOR OIL-SEAL EQUIPPED AXLES, CLEAN AND REFILL WITH OIL.			
CHECK AXLE SPINDLES FOR ALIGNMENT.			
TIGHTEN ALL U SPRING BOLTS.			
INSPECT ALL BRAKE PARTS – LININGS – DRUMS ETC., FOR WEAR AND DAMAGE.			
WIRING SYSTEM – CHECK FOR BROKEN OR DAMAGED CONDUIT CHECK FOR LOOSE OR FRAYED WIRE.			
MISC. – NOT COVERED ABOVE			

CHANGE INSPECTION DUE DATES ON NOSE OF TRAILER AND SHOW NEW DATES HERE
MINOR_____ MAJOR_____

ADDITIONAL REMARKS

FORM TPM 5

TRAILER PM SERVICE FOLLOW UP
MASTER SHEET

TO: All Branch/Terminal Managers
Garage Fireman

FROM: TPM Terminal Control ________________________________ DATE: _____________________________

According to existing records the following trailers are past due TPM inspections. They were due inspections as indicated on the date shown and to date no inspection forms have been received. Please arrange to perform the proper inspection at once if you receive a designated unit forward the inspection forms to this Control Terminal.

MAJOR INSPECTION

UNIT NO.	DATE DUE	UNIT NO.	DATE DUE	UNIT NO.	DATE DUE	UNIT NO.	DATE DUE

MINOR INSPECTION (Follow – up optional)

UNIT NO.	DATE DUE	UNIT NO.	DATE DUE	UNIT NO.	DATE DUE	UNIT NO.	DATE DUE

TPM INSPECTION FOLLOW UP CARD

The subject form is prepared from Form TPM 1 TPM Terminal Control Record

Card to be addressed on front side

<table>
<tr><td colspan="4">FORM TPM 5A</td></tr>
<tr><td colspan="4">TRAILER “PM” SERVICE FOLLOW UP</td></tr>
<tr><td rowspan="2">Owner’s Name</td><td colspan="3">Unit Number:</td></tr>
<tr><td colspan="3">License Number:</td></tr>
<tr><td colspan="4">IMPORTANT NOTICE</td></tr>
<tr><td rowspan="3">The above unit was last serviced as follows according to existing recodes on Date:</td><td></td><td>Minor (optional)</td><td></td></tr>
<tr><td></td><td>Major</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td colspan="4">To date no inspection forms have been received for the inspection due:</td></tr>
<tr><td colspan="4">Please arrange to perform the proper inspection at once and send the inspection forms to this control terminal</td></tr>
<tr><td colspan="2"></td><td colspan="2">Per: TPM Control Terminal</td></tr>
</table>

This is standard post card size

Suggest printing in eye catching colored stock.

Form to be printed – Standard post card size- No pre-stamping or pre-addressing included in standard forms.

9.0 Brakes:

Trailers equipped with ABS feature an amber warning lamp mounted to the driver's side of the trailer. The ABS warning lamp should illuminate during initial power application to the primary constant (blue) circuit or backup power (red) circuit, and then extinguish in a few seconds after a successful system self-check. If the warning lamp DOES NOT COME ON AT ALL, then replace the warning lamp. If the ABS warning lamp COMES ON and STAYS ON, even after pulling the trailer forward at greater than 4 mph, then a fault exists (or a intermittent fault has existed) somewhere within the ABS system. The procedures for diagnosing, repairing and clearing ABS faults vary by ABS manufacturer, but most involve the interpretation of blink codes which may be accessed and displayed on the ABS warning lamp in the side of the trailer. Some ABS valves may also display fault codes via small LED lamps on the valve itself. Contact the trailer of ABS manufacturer for procedures to a given trailer.

A schedule for the periodic cleaning, adjustment and lubrication of brakes equipment should be established by the operator based on past experience and severity of operation.

The three things of major importance to remember are to (1) institute and maintain a comprehensive preventive maintenance program, (2) train mechanics to replace questionable components and (3) use top quality materials throughout, retaining OEM specifications for linings, drums *and air brake systems components.*

Always:

LOOK AT BRAKE SHOE SPRINGS

Weak and unmated springs bring problems of pulling and dragging brakes. When time between brake adjustments is lengthened and the travels are extreme, the brake shoe springs are abnormally stretched. A condition of this kind with and frequency would damage the spring by the excessive stretch. The stretching and contracting of the spring is always taking place in the confined heat area of the drum.

Lubrication:

Nothing can be more damaging to brake performance than a hanging brake. Lubricate all brake linkages, camshaft, camshaft splines, and slack adjusters as well as any other brake components that call for grease. **Do Not Lubricate the Cam Face, Anchor Pins or the Outside of the Shoe Roller – They Must be Dry.**

A high-temperature resistant lubricant should be used and excessive lubrication must be avoided to prevent any getting on the lining. Grease soaked linings cannot be salvaged. Lubricate the shoe mechanism for a more responsive application and release of the brake. This will require less air in the application.

Brake Adjustment:

Always adjust brakes with the wheels off the floor.

This is the only true way of definitely knowing you have a free running brake.

During a major brake overhaul, the following parts should be carefully checked and replaced as required:

(1) Spiders for loose or sheared fasteners and for wear or damage.

(2) Anchor pins for wear misalignment.

(3) Cam Shafts and cam shaft bearings or bushings for wear.

(4) Shoe return springs should be replaced at time of overhaul.

(5) Brake shoes for wear, oversize fastener holes and for any signs of grease on the braking surface.

(6) Drums for cracks, scoring, or other damage.

All BRAKE LINING BLOCKS ON THE AXLE SHOULD BE REPLACED IN FULL SETS. DO NOT MIX NEW AND USED BLOCKS. ALWAYS USE OEM SPECIFICATION REPLACEMENT LININGS.

BRAKES:

At the time of relining brakes, the following procedure is recommended:

(1) *Measure* drums to be sure *that* both drums on the axle are the same diameter.

(2) *CAUTION. Some brake linings contain asbestos. Follow manufacturer's precautions when working on or about these materials.*

(3) Same manufacturer's drum design on each axle.

(4) Clean brake shoe tables thoroughly after removal of old lining.

(5) Replace all worn shoe parts. Replace the shoe if the anchor pin holes are oversize.

(6) Treat axle as a unit – identical repairs on both brakes.

(7) Disconnect slack adjuster lever to check cam shaft by hand.

(8) Be sure that proper lining is used – same specification as original equipment to

obtain uniform braking, and, when applicable, retain compliance with FMVSS 121 – Air Brake System.

(9) Be certain "S" cam is clean and free of grease to allow shoe roller to run free and turn freely on the cam face. All roller surfaces should be clean and free of any flat spots. Rollers with flat spots should be replaced.

(10) *Special precautions must be observed when servicing spring brake chambers. Use caution as these units contain large springs and improper handling can result in serious injury or death. Spring brake chambers should be replaced as a complete unit Consult with the manufacturer for proper handling techniques when replacing chambers.*

(11) Brake chambers, chamber springs and chamber diaphragms should be replaced in pairs.

(12) Camshafts should be rebushed and replaced in pairs.

(13) Replace manual slack adjusters if they will not adjust properly.

(14) *Many trailers are equipped with automatic slack adjusters. If the trailer brakes are maintaining adjustment outside the manufacturer's specified limits, the slacks must be adjusted or replaced as specified by the manufacturer. Do not mix manual and automatic slack adjusters, or automatics slack adjusters of different manufacture, on the same vehicle.*

(15) All brake shoe return springs should be replaced with every reline.

(16) Oil and grease seals should be replaced with every reline and their working surfaces checked.

(17) Push rods should be the same length and their travels identical on both sides.

(18) The initial adjustment should have a minimum clearance of .020 in. Subsequent adjustments should have a minimum clearance of .010 inches for a free brake and a cold drum. When adjustment is made by push rod travel, first establish the correct push rod travel for a free wheel travel.

IF WEDGE BRAKES:

(19) Should have the wedge assembly or adjusting mechanism removed for inspection and servicing.

(20) If a wedge assembly should need replacing, be sure to install the same angle wedge to mate with the others.

(21) Only approved lubricants should be used on the wedge brake.

(22) Use hot soapy water on seals in the wedge brake and a solvent on all metal parts.

IF DISC BRAKES:

(23) Follow the manufacturer's instructions in servicing and maintaining.

10.0 Axles, Wheels, and Drums:

Be aware that a variety of axle spindle nut types new exits, including two-piece, one-piece, castellated locking, snap-ring locking, set screw locking, etc. It is critical that the proper adjustment and locking procedure be used for a given type of spindle nut. Do not assume that specifications for torque and back-off (if any) on one type of spindle nut system will also work for another, as poor bearing end-play adjustment may result, along with seal leaks or bearing failure

In the interest of improved service life, axles, wheels, and drums should be inspected at regular intervals depending on vehicles speeds, loads and general operating conditions.

Rim clams and wheel stud nuts should be checked and tightened, if necessary, at the beginning or each trip. With spoke type wheels be sure rims are installed so that tires do not wobble. Run nuts up, uniformly using diagonally opposite tightening pattern, snugging up nuts gradually to recommended torque.

A check for loose wheels should be made at regular intervals to determine if there is play between bearing and the bearing race. Check wheel bearing cups and cones for wear or damage. When assembling the hub or wheel on the axle, do not force the hub or wheel over the bearings as damage may occur.

Accuracy of the wheel bearing adjustments cannot be overemphasized as it has a direct affect on the brake performance because the proper brake adjustment and bearing play are all interrelated.

You cannot properly adjust a brake if the wheel bearing has not been properly adjusted. It is therefore important that a torque wrench be used in the *wheel bearing adjustment* and that you adhere to the manufacturer's specification.

Oil or grease seals should be replaced each time a hub is removed to insure leak free operation. If the hub is removed it *could allow* contamination of the lubricant and possible bearing damage. Therefore, at any time a trailer hub is removed the seal should be replaced. Seals should be replaced each time brakes are relined rather than inspecting *and reusing* seals that do not show signs of leaking.

Brake drum life depends on the treatment it receives. Drum failure to heat checking is caused by overheating. This frequently happens when the trailer brakes are used independently of the tractor brakes. Trailer brakes are designed to be used in conjunction with tractor brakes.

Brake drums must not be rebored beyond the manufacturer's recommended maximum diameter.

REMEMBER – REBORE UP TO MAXIMUM LIMITS SET BY THE DRUM MANUFACTURER

11.0 Axle Alignment:

Poorly aligned axles cause vehicle dog tracking and excessive tire wear. That's why axle alignment is so important.

In aligning axles, the old adage "haste makes waste" is really true. Axle alignment **MUST** be done carefully and accurately to assure proper axle alignment.

Causes of misalignment include improper installation…damage from an accident…worn or broken suspension parts…replacing parts without rechecking axle alignment.

ALIGNING THE AXLE:

There are a number of axle alignment tools and systems available today, some of which detect camber and axle toe. Due to their cost however, they are not common in the field. The alignment method described below is the most common method used in the field and requires only basic and inexpensive tools. Questions on the acceptance of other methods should be directed to the trailer manufacturer.

When aligning axles, suspension should be in a normal, relaxed state, free of any "binds." Before taking measurements and to achieve the relaxed condition, make sure the vehicle is unloaded. All trailers should be pushed backwards and pulled forwards with the service brakes applied on a level floor. On trailers with an adjustable undercarriage, this will assure that the locking pins rest against the rear of their positioning holes. Trailer with air ride suspensions shall be aligned with the suspension at its nominal ride height. Vehicle **MUST** be level from side to side as well as from front to rear.

Use screw-on axle end extenders or remove outer wheels and anything else that may be in the way of the measuring tape to achieve a straight line from kingpin to the axle ends.

Proper tools for axle alignment inspections are:

A. Spring loaded, kingpin extender with buffle level.

B. Axle end extenders.

C. 50 ft. steel tape (a tape tensioner should be used with the tape to ensure equal tape tension at measurement A and B – Figure 1).

D. Adjuster tram.

E. Gauge for measuring axle center to axle center.

Refer to Figure 1 (below). Measure distance A and B from the kingpin to the front axle. These must be equal within 1/8 inch of each other. Measure distances C and D between axles using gauge as shown in Figure 2 (below). Note that all currently available trailer axles have dimples or recesses at the center of the axle spindle ends. These also must be equal within 1/16 inch of each other. Determine lateral centerline of trailer body and axles. Distance E should not exceed 1/4 inch for either axle.

PRECAUTIONS:

(1) Always measure to the front axle for accurate alignment.

(2) Avoid measuring to rims, suspension brackets, hub cap vent holes, brake drums and the like. This can result in improper alignment.

(3) If difficulty is encountered in obtaining true alignment, check and repair or replace problem suspension parts.

(4) Always align any succeeding axles with the front axle, not the kingpin.

Additional recommendations on trailer axle alignment may be found in the TMC Recommended Practice 708, “Trailer Axle Alignment,” available from the Technology and Maintenance Council, 2200 Mill Road Alexandria, VA 22314-4677, 703-838-1763.

AXLE ALIGNMENT MEASUREMENT

FIGURE 1

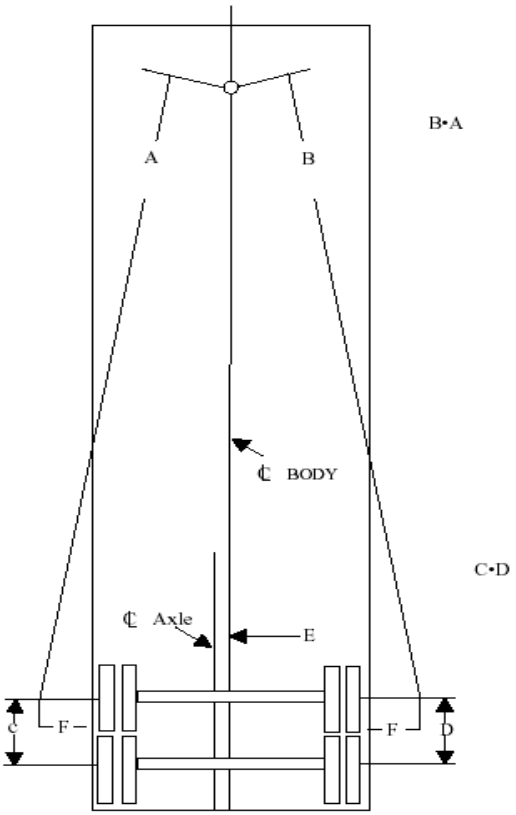
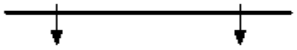


FIGURE 2
GAUGE FOR MEASURING AXLE CENTERS



The gauge can be made of drill rod and must be rigid and true. The pointer arms of the gauge must be parallel and held at the same height

12.0 Electrical System:

12.1 Definitions:

Short Circuit – a wire or portion of the energized circuit comes in contact with a "ground circuit or grounded portion of the trailer".

Open Circuit – a break that interrupts the electrical path and does not allow electric current to return to the grounded side of the power source.

Ground Circuit – the wire circuit (or metal structure) attached to the ground side of the power source (normally the negative "-" side of the battery).

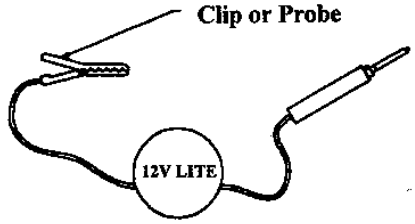
Crossover – a direct contact between two "hot" wires ("+" side of a battery) such that energizing either of the circuits will activate all the devices in both circuits.

One Wire System – systems where the trailer frame (body) serves as the return (ground) wire. Lamps have a single (hot) wire lead and are grounded to the frame by a mounting screw or short pigtail. The trailer frame is grounded to the tractor.

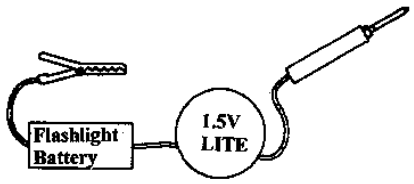
Two Wire System – two wires are provided for each lamp. Lamps are not grounded to the frame (but may be). The trailer frame may of may not be grounded to the tractor.

Waterproof Sealant – any non-conductive waterproof liquid or paste that can be brushed or sprayed onto a terminal or a metal surface. (Automotive gasket sealing compound).

Continuity Tester –



NON-POWERED



POWERED

NOTE: 12V Circuit must not be powered when using this battery powered continuity tester.

Non-Conductive Grease – any of several commercially available greases made to inhibit corrosion in electrical systems.

12.1.1 Trouble Shooting Trailer Electrical System:

PROBLEMS	CAUSES	FIXES
A. Open Circuits		
One Lamp Inoperative	Bulb burned out	Replace bulb.
	Corrosion in lamp socket	Clean out the corrosion. Reinstall bulb with non-conductive grease
	Broken or corroded hot (or ground) wire	Replace pigtail if possible. Replace lamp assembly.
	Corroded mounting screw or rivet. (one wire system only)	Clean the metal. Replace with new self tapping screw or a bolt and nut with a star washer. Brush primer or sealant over bare metal. If serious corrosion, rotate or relocate lamp using new holes and screw.
One circuit inoperative	Open circuit is system	Locate the open circuit with continuity test. Replace the harness or the wire containing the open circuit
	Circuit breaker malfunction	Use jumper to determine if this is the problem. Clean the contacts and replace breaker with same amperage.
	Prong in receptacle corroded or not expanded (split pin)	Clean and/or expand the pin
	Pin socket in plug corroded	Same as above. Clean out socket and reassemble with non-conductive grease.
B. Short Circuits		
General	Hot wire grounded to frame by: 1. Screw into wire 2. Wire insulation chafed	Locate the short. Replace the harness or wire. (Insulation may have melted or charred and will develop shorts in other locations if not replaced).

C. Crossover – Two circuits operating when one wire is energized		
Two hot wires in contact (accidental or deliberate)	A jumper is installed between two circuit breakers or behind the receptacle	Check circuit breakers and front receptacle for jumper. Remove if not wanted)
	Contact between conductors in a dual filament light or lamp base	Isolate problem by alternately disconnecting dual filament lights where both filaments are burning and only one wire is energized. Clean or replace the lamp with the crossover problem.
	Shorts in a molded plug or a screw piecing the insulation of two wires	If a. and b. do not solve the problem, the crossover is probably in the wiring, or more commonly in a molded plug connector. Energize one of the circuits – starting at the rear, disconnect sub harness(es) from the main harness. Use powered continunity tester to check pairs of leads. When continunity between two circuits is found, replace that section of the harness.
Cross over – Stop/tail or turn/tail	In certain instances, one tail lamp may be dimmer than the other. When the stop lamp is actuated, only on stop lamp illuminates and the tail lamp on the other side (dim lamp) becomes dimmer or goes out.	
	Absence of ground or dim light	Clean and/or repair the ground as described above.

12.2 Repairs:

12.2.1 *Repairs to sealed wire systems.*

Sealed wire systems are normally in segments with moisture barriers in the molded plugs at the ends of each segment to localize the migration of water. If corrosion is found in the one segment, it should be replaced since the corrosion will proceed through the conductor and the failure will recur.

Temporary splices should use crimp (butt) connectors. Do not use the insulation - piercing type. The splice should be coated with a waterproofing compound and sealed with an overlaid gum-type shrink tube.

12.2.2 *Metal Surfaces.*

Should be cleaned to remove all corrosion and, after repair are complete, coated with a waterproofing compound.

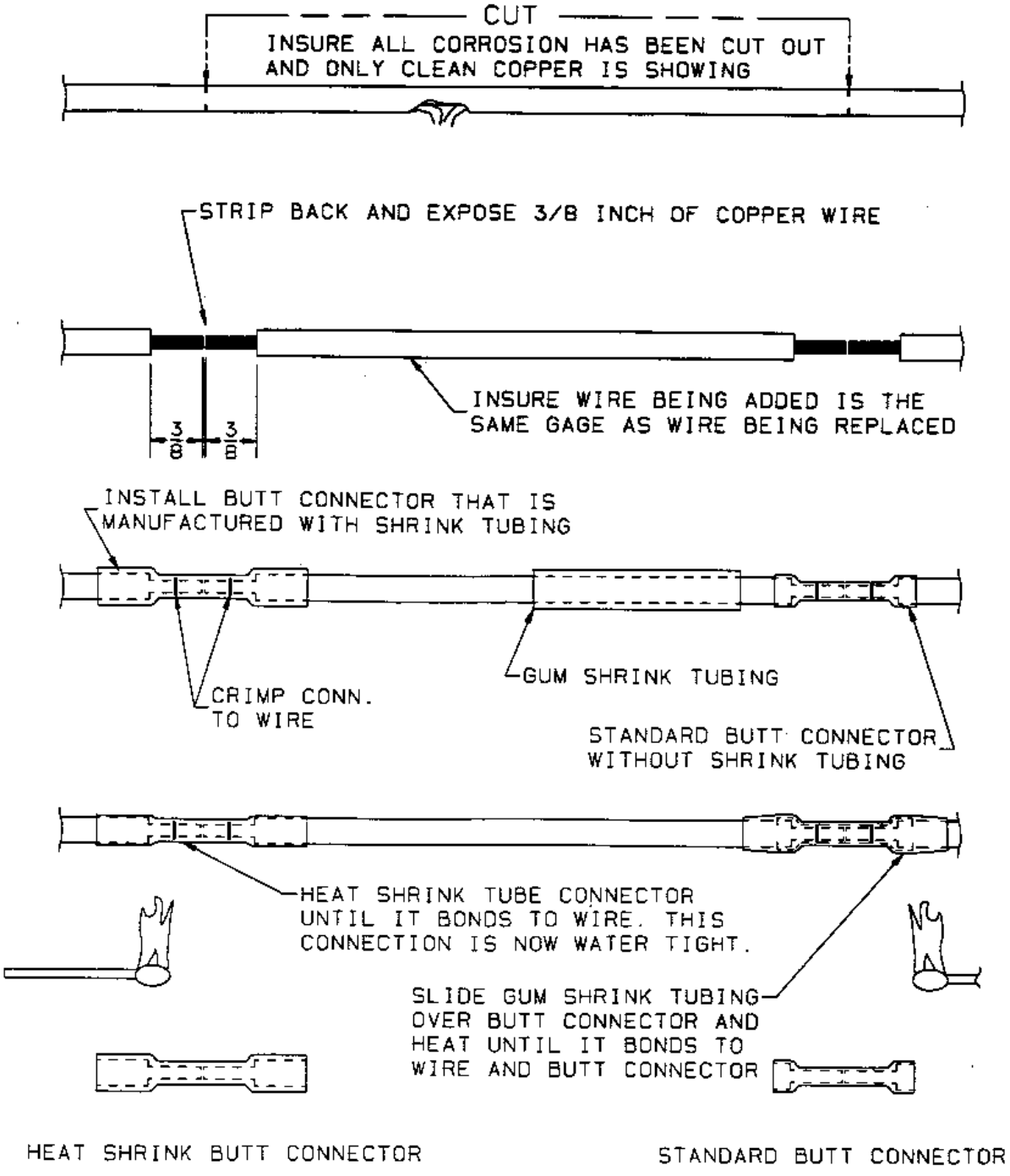
Always apply conductive grease in receptacles and in bulb sockets prior to re-assembly.

12.2.3 Wire Splicing:

13.2.3.1 7-Way Receptacles:

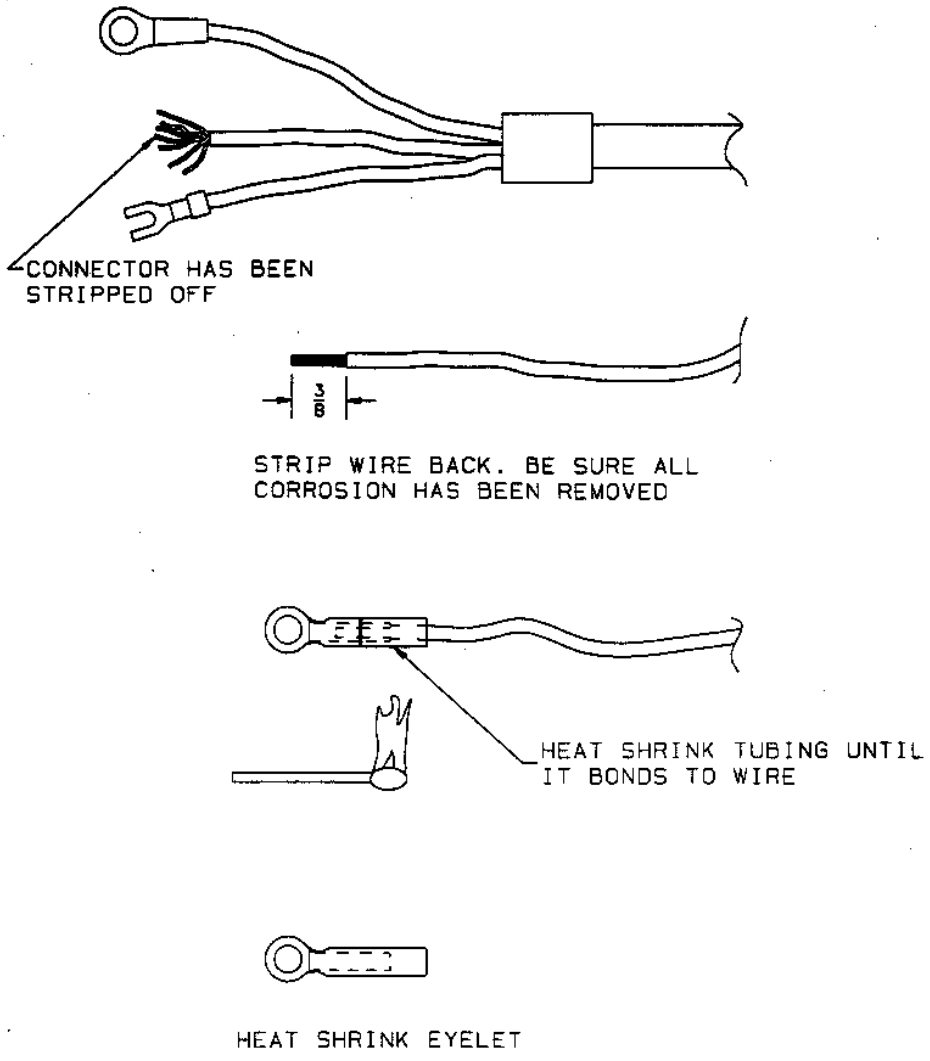
Worn or corroded SAE J560 7-way receptacles should be replaced, in order to ensure that adequate power is supplied to the ABS valve, especially in the case of trailers designed to tow another trailer (doubles or triples). Trailer ABS systems now draw constant power from the blue center pun of the standard SAE J560 7-way receptacle, which leaves no available circuit for auxiliary "switched power" devices such as air suspension dump valves. When additional circuits are required for auxiliary equipment, the ISO 3731 receptacle is added (see page 105). This additional 7-way connector features a "sex-change" on the ground pin that prevents a standard J560 plug from fitting, to prevent inadvertent swapping of the two plugs coming from the tractor. Be sure to use the proper receptacle (j560 or ISO 3731 when replacement becomes necessary.

Splices should be made as shown in the following sketches.


CUT
INSURE ALL CORROSION HAS BEEN CUT OUT
AND ONLY CLEAN COPPER IS SHOWING
STRIP BACK AND EXPOSE 3/8 INCH OF COPPER WIRE
INSURE WIRE BEING ADDED IS THE
SAME GAGE AS WIRE BEING REPLACED
3/8
3/8
INSTALL BUTT CONNECTOR THAT IS
MANUFACTURED WITH SHRINK TUBING
CRIMP CONN.
TO WIRE
GUM SHRINK TUBING
STANDARD BUTT CONNECTOR
WITHOUT SHRINK TUBING
HEAT SHRINK TUBE CONNECTOR
UNTIL IT BONDS TO WIRE. THIS
CONNECTION IS NOW WATER TIGHT.
SLIDE GUM SHRINK TUBING
OVER BUTT CONNECTOR AND
HEAT UNTIL IT BONDS TO
WIRE AND BUTT CONNECTOR
HEAT SHRINK BUTT CONNECTOR
STANDARD BUTT CONNECTOR

12.2.4 Replacing Eyelets or Fork Connectors:

Replace as shown in the following sketches.



12.2.5 Instant Auto Connectors – *DO NOT USE* -

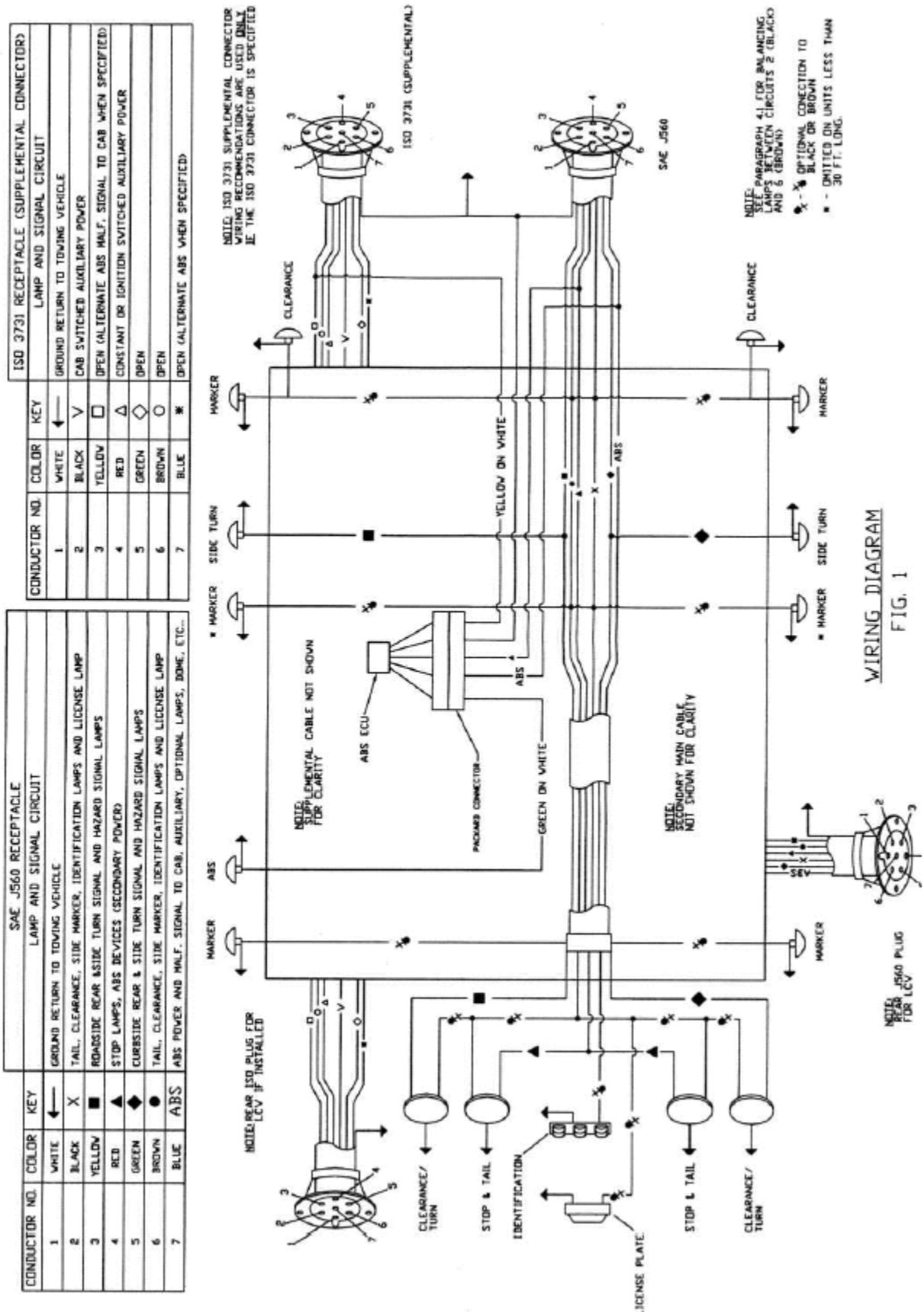
These type of wire connectors are to be considered temporary connectors which are used in the rental industry. The jacket is split open when the connector is closed onto the wire. The copper is exposed and will corrode. Also a wick effect takes place and if left open long enough will pull moisture as far as 3 feet into the jacket. (which is corroded)

12.3 Wiring Diagram:

The trailer wiring and jumper cable connector wiring are shown in the following diagram and sketch.

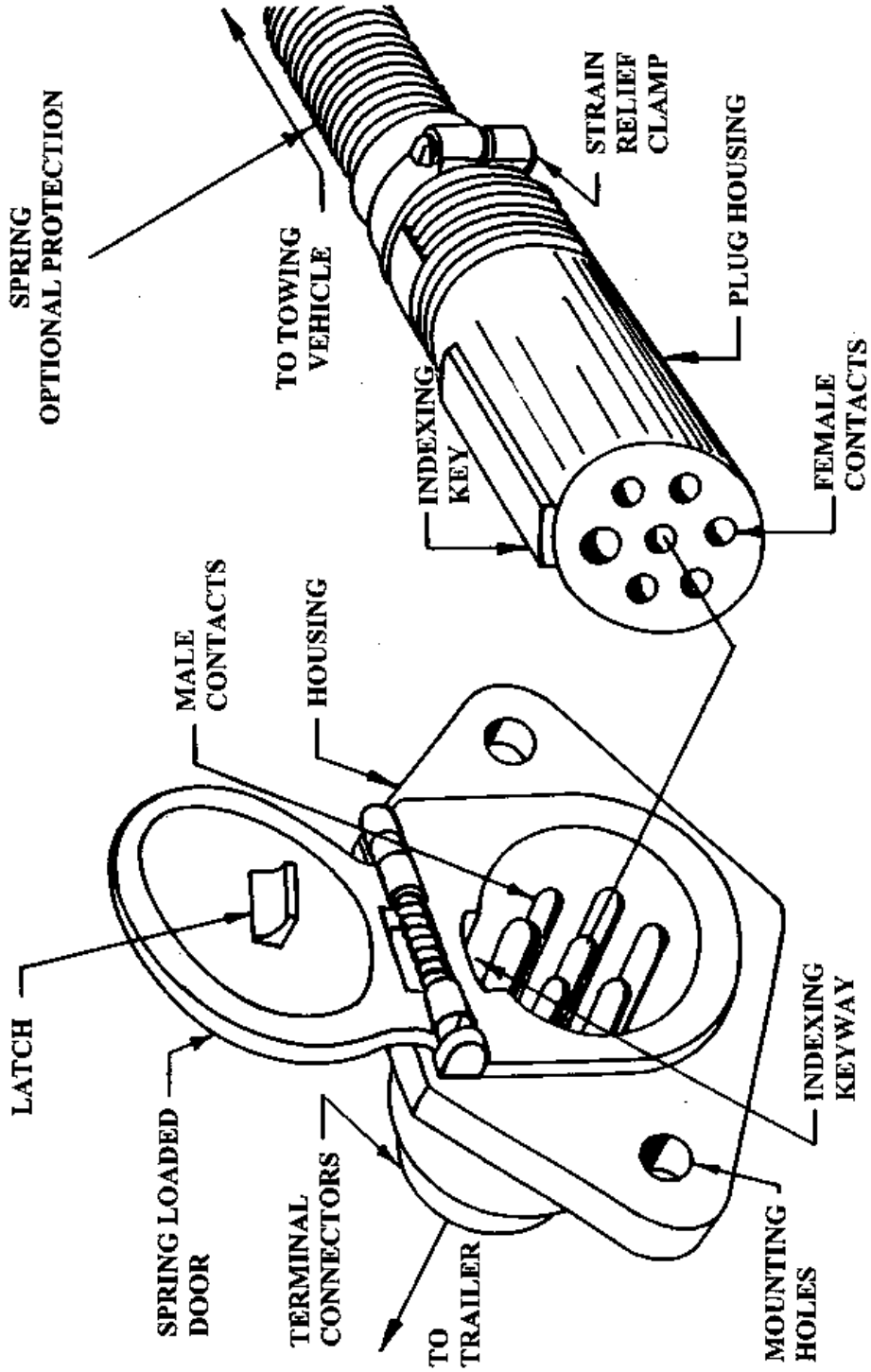
12.4 Component and Systems Grounds

Pay particular attention to maintaining ground circuits of both types (chassis ground and ground return types) as the effects on available voltage to components may affect component performance. In particular be aware that trailer ABS braking performance for Long Combination Vehicles (LCV's) may be affected by the condition of the ground circuit.



WIRING DIAGRAM

FIG. 1



SEVEN CONDUCTOR ELECTRICAL CONNECTOR

13.0 Lubrication:

13.1 Purpose:

Proper lubrication is essential to all types of bearings, gearing, and friction producing mechanical devices. Lack of adequate and proper lubrication results in premature wear of components due to increased abrasion or excessive heat.

Experience has shown that a large percentage of all service problems with mechanical equipment can be traced to use of the wrong lubricant or to improper application or to complete neglect.

Lubricants properly selected and applied reduce friction, protect against corrosion, carry heat away and prevent foreign matter from entering lubricated areas.

13.2 Selection and Types:

Careful selection of the proper lubricant is essential for best results. This is because not all lubricants are equally effective in a given application. The selection of lubricant and its application technique are governed by the design and operating conditions of the parts requiring lubrication. The service temperature range, pressures, flash points, viscosity, sensitivity to moisture, type of materials – all go into selecting the proper lubricant. The wrong lubricant may thin out in normal temperatures caused by friction, while the same lubricant may congeal in cold weather or may emulsify with only limited service in the presence of slight moisture.

Lubricant makers have been progressive, in that many synthetic, more stable products have been developed for standard and special applications. New greases with special properties have been developed and are on the market. Lithium soap and barium soap greases are becoming quite common, although because of high cost are used mainly for special uses where their unique properties justify the expense. The silicone and silicone greases have been used particularly for high temperature applications. Most applications, however, are taken care of by the standard, well refined mineral oils and standard lime soap and sodium soap greases.

Do not mix different types of hub lubricants, or top off an existing lubricant with another lubricant of a different type. Note that some semi-fluid greases will separate after settling, giving the appearance that grease has be topped off with oil when this is not the case. Note that hubs lubricated with semi-fluid grease should provide some means of venting pressure at high temperatures. Normally this is accomplished via a vented hub cap, although some manufacturers permit venting into the axle tube itself. Also, hubcaps for semi-fluid grease applications are often “solid” and void of a center fill plug to discourage topping off with oil. A hub for a semi-fluid grease application often features a fill plug in the radial surface of the hub itself, to permit the addition of lubricant given a solid hub cap.

13.3 Amount:

Use of the proper amount of lubricant! Excessive lubricant or too heavy a lubricant may result in an increase in operating temperatures and possible leakage. This usually is followed by the tightening of closures and a resultant further increase in friction until, in extreme cases, failure occurs.

13.4 Cleanliness:

Lubricants should be clean and free of dust, dirt, and moisture and clear of other contaminants. Further, all lubricants subject to such contamination should be changed at more frequent intervals. Dirty lubricants often result in galling of metal and premature wear. Lubricants of different grades or manufacture should, in general, not be mixed together.

13.5 Manufacture:

It is advisable to consider the reputation of the refiner or vendor when selecting a lubricant. He is responsible to a great extent for the quality of and instructions regarding the correct application of this product. A high grade lubricant incorrectly applied may greatly reduce the maximum service life built into a trailer.

14.0 Freezing Weather Conditions:

Winter cold weather and its slush, sleet, and snow present many special problems to the truck trailer driver and maintenance man. The trailer maintenance mechanic has many special little things that he should do to get and keep units ready for cold weather operation.

For the maintenance man, low temperatures can mean frozen and sluggish or inoperative brakes, sagging electrical and brake lines, broken connections, increased corrosion and installation of winter equipment. Enclosed air pressure systems of brakes and air operated equipment should be drained daily of accumulated moisture.

The air system should never be treated through either tractor equipment or direct into air lines, with any type of additive of de-icer. Make sure electrical and brake lines are adequately supported.

Ice and mud accumulations on brake lines and chambers should be removed regularly, as any air leaks which may exist would be most difficult to detect when they are encased in such deposits.

Trailers should be washed regularly with a solution of mild soap and water, and rinsed thoroughly with plain water. This is particularly important during the colder months when road de-icing agents are in use. It is also advisable during those months to pay close attention to periodic cleaning and inspection of the underside and undercarriage of the trailer.

15.0 Appearance Maintenance:

Important direct and indirect time and cost-saving benefits are realized along with larger profits by truck trailer operators who properly maintain the exterior appearance of their truck trailer equipment. Proper and adequate cleaning of equipment with the correct materials is a profit-producing function. *Clean, Bright Tractors and Trailers Please Customers, Attract and Impress New Prospects*. This, in some degree, provides improved public relations, advertising, and additional earnings and reduced insurance rates, better resale values and higher trade-in allowances on use equipment.

Appearance maintenance includes cleaning, brightening or polishing, corrosion prevention and removal, and protective coating. A working knowledge of each of these areas of appearance maintenance is essential to the complete and proper maintenance of trailers. Many chemical firms compound materials for these purposes. Always follow label directions carefully when using any type of cleaning compound (do not use aluminum brightener. Pay particular attention to instructions regarding dilution ratios and rinsing instructions.

Protective films, such as paint and clear coats, are necessary to the prevention of corrosion and the preservation of metal and wood surfaces. They add color, beauty, and distinction of appearance to all trailer equipment.

While specific preparation and application techniques for various coatings will vary with different products, certain considerations are basic. Always follow manufacturers instructions regarding substrate compatibility and proper installation to achieve desired coating performance.

16.0 Van Trailer Repairs:

16.1 General Considerations:

Prior to making major modifications or repairs to the original design or structure, consult the manufacturer for recommendations, drawings, and technical assistance.

Compatible materials, original replacement parts, and recommended repairs are suggested to provide the best performance. Genuine original equipment as manufactured, approved, and recommended by the builder of the trailer, are always selected for their compatibility with each of the other elements of the unit. Such replacements are a key to satisfactory service work.

16.2 Dissimilar Metals in Joint Assembly:

Joining of dissimilar metals and other materials involves tried and proved procedures that prevent or control corrosion which may occur in certain atmospheric or moisture conditions. When carefully followed, the procedures suggested herein will, within practical limits, prevent such corrosion.

Improper application of protective coatings between surfaces of dissimilar metals can leave the materials open to a severe galvanic corrosion. (When the space between two different metals is filled by a fluid that can conduct electricity, one of the metals will gradually decompose.) Corrosion also occurs when wood parts are not protected adequately prior to their assembly to an aluminum surface.

16.2.1 Joining Aluminum to Unfinished Steel or Stainless Steel (Fig.1)

16.2.1.1 Before assembling aluminum to steel, clean the surface of the steel of all rust, scale, weld flux, metal expulsion, and other foreign materials. Steel surfaces can be cleaned by sandblasting, disc sanding, and other methods.

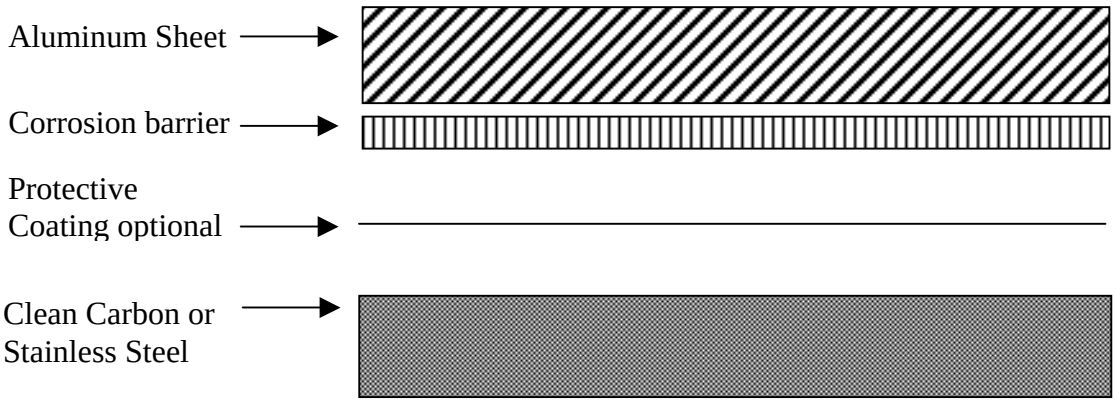


Figure 1: Joining Aluminum to Steel or Stainless Steel

16.2.1.2 Immediately after cleaning the steel surface, application of a protective primer is recommended.

16.2.1.3 After primer is applied, coat the steel areas with aluminum paint.

16.2.1.4 An additional insulating tape should be installed between the aluminum and steel surfaces for added protection against corrosion. Tape of a flexible plastic material will provide the desired protection.

16.2.1.5 All escutcheon plates, steel name plates, and similar exposed items, should receive one heavy coat of aluminum paint before they are assembled to aluminum surfaces.

16.3 Aluminum and Steel Rivet Techniques (Fig.4)

16.3.1 For repairs on trailers, which require the use of rivets, the Rivet Chart (Fig.4) will give an idea of the right and wrong way to attach rivets.

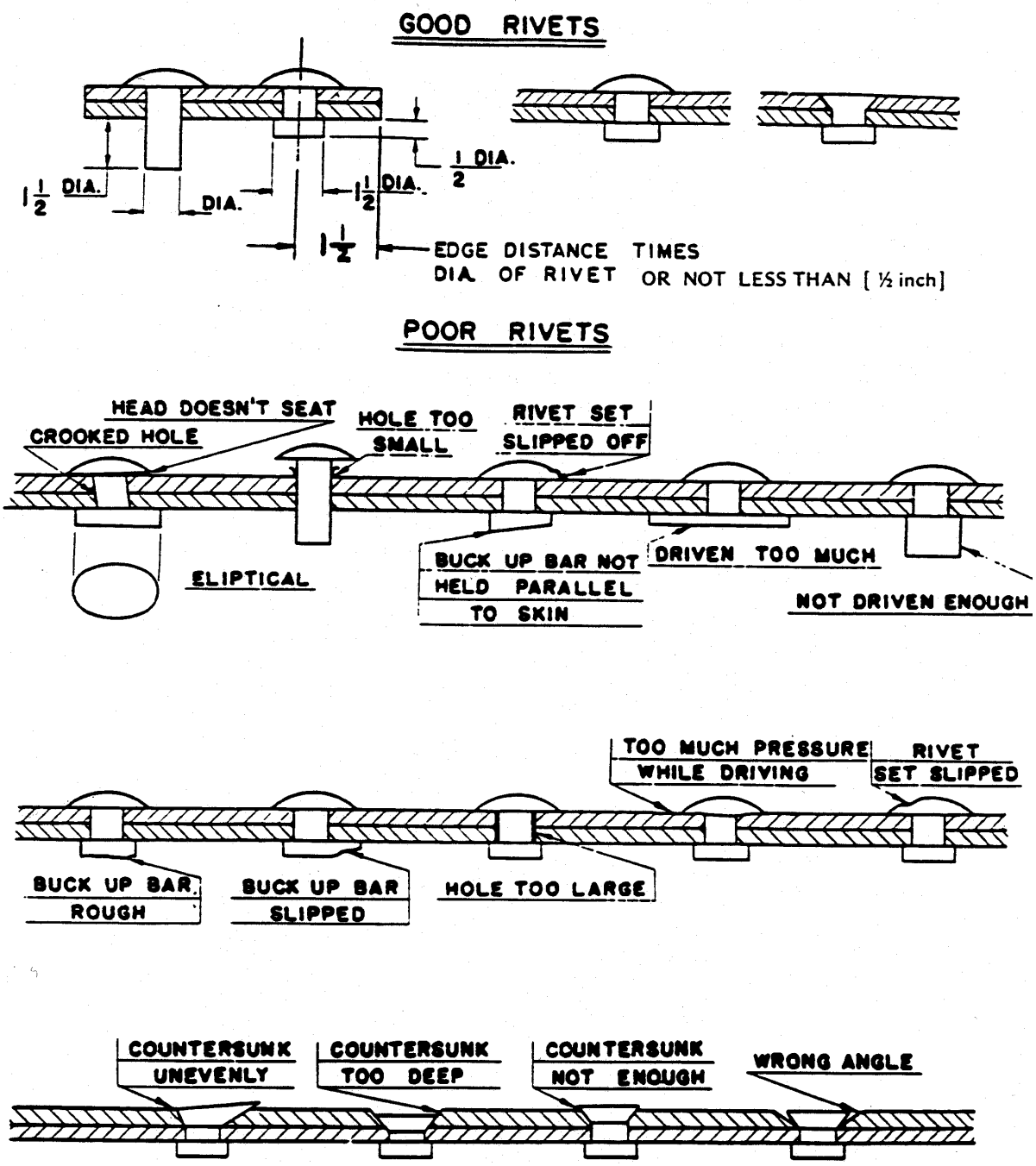


Figure 4: GOOD AND BAD RIVET HEADS

16.3.2 Solid Riveting

16.3.2.1 A large portion of components on trailers and containers are engineered to be permanently fastened together by a reliable technique called RIVETING.

The importance of using correct riveting techniques is not covered in the contents of the Solid Rivet Chart shown in this section but is a guide to sizes and ratings of various types of solid rivets, aluminum and steel used in the production and servicing of trailers and containers.

The Solid Rivet Chart lists grip ranges (minimum and maximum) hole preparation (drill sizes and hole limits) for the solid aluminum and steel rivets.

(See Page 90 for Solid Rivet Chart)

Listed below are some solid riveting techniques.

16.3.2.2 Inspection Procedures for Locating Defective or Loose Solid Rivets:

There are several methods of detecting a loose or defective rivet. Obviously, if a rivet can be turned or shaken with the fingers, it should be replaced.

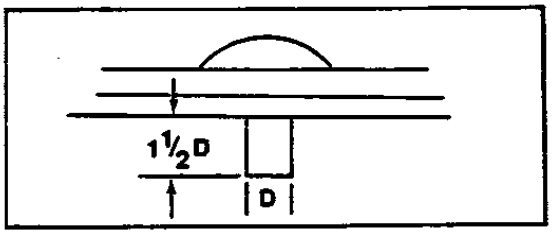
If looseness is suspected but cannot be assured by turning it, a sharp rap with a hammer will produce a dull sound in a loose rivet.

A further check is to coat the rivet head with light oil, wait a few seconds for the oil to penetrate, wipe it clean, and rap it again with a hammer. If oil appears around the edges again the rivet should be replaced.

Finally, the appearance of evidence of movement or shifting between riveted parts, such as bare or shiny areas, is a good indication of the need for replacement.

Rust or corrosion around or "oozing" of a corrosion product from underneath the rivet head does not necessarily indicate looseness, however, it could be a good reason to suspect it.

Select a rivet length so that the shank before riveting protrudes through the material 1 ½ times the diameter of the shank.



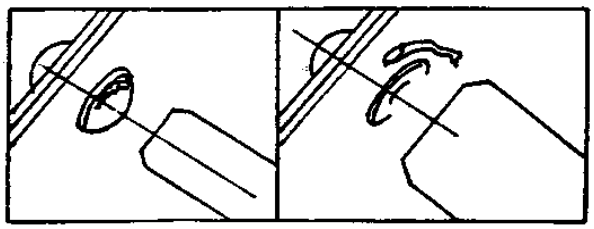
16.3.2.3 Riveting Tools:

The rule of using the proper tool for doing a good job as it applies in normal manufacturing process, applies equally as well in riveting.

The two most important tools for producing a good rivet "upset" are the Rivet Set and the Bucking Bar.

(a) The Solid Rivet Set:
It is very important to select and use the correct rivet set which will match the head of the rivet being used. For example, a Universal Head Rivet Set should not be used on a Round head rivet.

Likewise, having the correct size of rivet set is important. An oversized set will flatten the rivet head and damage the adjacent material while an undersized set will damage the rivet head.



There are many types and sizes of rivet sets, therefore, care must be used in selecting the proper set for the rivet. The most common type is the Straight Rivet Set.

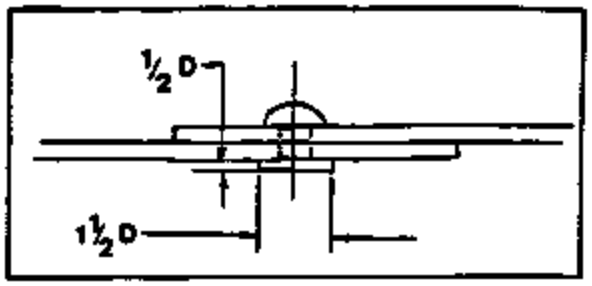
Another type is the Offset used for riveting in limited access areas.

The Mushroom type is used for flat head or countersunk rivets. It is important that the Mushroom Rivet Set is held flat against the rivet to avoid damaging the material.

The rivet set is held in the gun by retaining spring. Always be sure that the spring is securely in place prior to starting. The strike of the rivet gun is adjustable and should be tested against a block of wood to insure proper strike.

(b) A good riveting job requires not only the selection of the right rivet set, but the use of the proper Bucking Bar.

The Bucking Bar is used to produce the flat head (Bucked Head) on the opposite end of the rivet from the manufactured Head. By using the correct bar properly, a Bucked Head should be produced which is 1 ½ times the diameter of the rivet shank and ½ the diameter in thickness.



Bucking bars are produced in many sizes, shapes, and weights ranging from one to fifteen pounds.

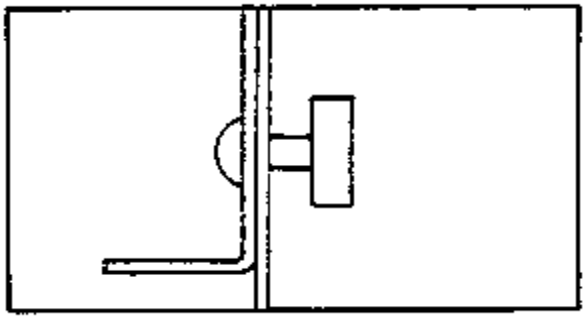
The weight of the bar being used has an effect on the riveting job. If the bar is too light, it will require more action from the riveting gun and will consequently cause damage to the material. A heavy Bucking bar will work faster and will keep the vibration of the gun from being transmitted to the “bucker’s” hand.

One surface or side of the Bucking bar is polished. This is known as the “face” and must be positioned and held correctly to create a proper Bucked Head.

These are some of the basic rules to follow in the use of the Bucking bar.

Keep the face of the bar parallel to the material. If the bar is canted, the Bucked Head will be improperly formed and the material will be damaged.

Use the size bar suited for the riveting job.



The face of the Bucking bar must cover the entire rivet end.

A firm hold on the bar will result in a smoother and faster job and will prevent “chatter.”

Improperly used tools and techniques will result in unsatisfactory riveting.

Solid Rivet Chart

Sizes and Ratings

Solid Aluminum Universal Head Rivet					
Size		Grip Range		Hole Preparation	
Dia.	Length	Min.	Max.	Drill Size	Hole Limits
3/16	3/8	.057	.150	#7	.200/.204
3/16	7/16	.119	.212	#7	.200/.204
3/16	1/2	.181	.274	#7	.200/.204
3/16	9/15	.243	.336	#7	.200/.204
3/16	5/8	.305	.398	#7	.200/.204
3/16	11/16	.367	.460	#7	.200/.204
1/4	1/2	.075	.200	“I”	.270/.277
1/4	5/8	.199	.324	“I”	.270/.277
1/4	3/4	.323	.448	“I”	.270/.277
1/4	7/8	.441	.572	“I”	.270/.277
1/4	1	.571	.697	“I”	.270/.277
5/16	3/4	.219	.375	“Q”	.328/.336
5/16	13/16	.281	.437	“Q”	.328/.336
5/16	7/8	.343	.500	“Q”	.328/.336
5/16	1	.360	.548	“Q”	.328/.336
3/8	5/8	.062	.250	“X”	.395/.404
3/8	13/16	.173	.361	“X”	.395/.404
3/8	1	.360	.548	“X”	.395/.404
3/8	1 1/8	.485	.673	“X”	.395/.404
3/8	3/4	.111	.300	“X”	.395/.404
1/4	1 1/4	.812	1.000	“I”	.270/.277
1/4	1 7/16	1.062	1.187	“I”	.270/.277

Solid Aluminum Countersunk Rivet					
Size		Grip Range		Hole Preparation	
Dia.	Length	Min.	Max.	Drill Size	Hole Limits
1/4	5/8	.200	.325	“F”	.256/.261
3/8	7/8	.235	.425	“W”	.386/.391
3/8	1 1/4	.610	.600	“W”	.386/.391
3/16	7/16	.119	.212	#9	.193/.196

Solid Aluminum Button Head Rivet					
Size		Grip Range		Hole Preparation	
Dia.	Length	Min.	Max.	Drill Size	Hole Limits
3/8	3/4	.111	.300	“X”	.395/.404
3/8	13/16	.173	.361	“X”	.395/.404
3/8	1	.360	.548	“X”	.395/.404

16.4 Body Repairs:

Methods for making repairs ranging from the installation of a small patch to the replacement of a panel are explained herein. The materials selected and the methods used in making the repair will govern the quality of the finished job.

16.4.1 Patching Small Breaks and Openings in Body Panels:

On units of riveted type construction, repairs should be handled in a manner similar to the procedures given below.

16.4.1.1 Smooth and Beaded Panel Units:
For smooth wall or beaded units, a patch panel should be made to overlap the existing panel break an inch on all sides. The patch may be installed from either the inside or outside of the trailers. (see Fig. 5)

16.4.1.2 Exposed Post Units:
On exposed post units the patch should be installed to the outside of the trailer with its edges overlapping panel break by at least one inch. (see figure 5)

16.4.1.3 Aluminum panel patches should be the same thickness as original panel, but not less the .038 inch. 5052-H291 or alloy of similar strength such as, 5154-H38 or 3004-H291 aluminum.

16.4.1.4 Steel panel patches should be the same material and same thickness as original panel. If that material is not available 18 gauge (0.047 inch), cold rolled steel, SAE 1010-1020 may be substituted.

16.4.1.5 It is also acceptable to use the fiberglass type of material that is sun cured or thermo setting. Follow the manufacturer's recommendations for application.

16.4.1.6 Clean and deburr both panel and patch**.**

16.4.1.7 Place the panel patch over the hole to be patched and drill 3/16 inch rivet holes all around the perimeter of the patch, spacing holes on about 1" to 1 ½" inch centers. The rivet holes should be located from the edge of the patch, a distance of ½ inch to hole centerline. (See fig. 5)

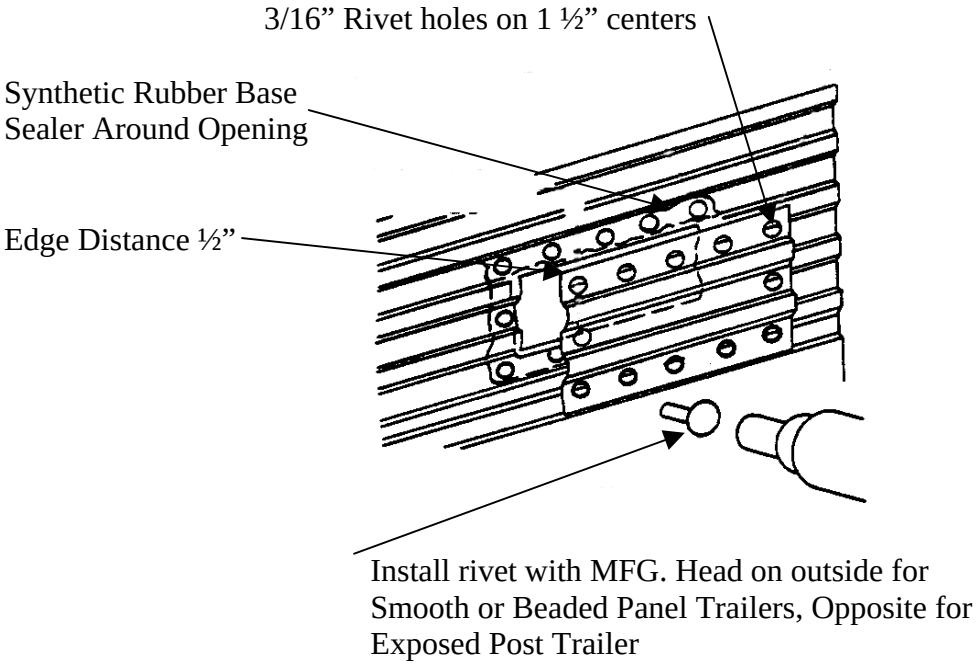


Figure 5: Typical Small Break or Hole Patches

Apply a sealer all around the edges of the hole prior to installing the patch.

16.4.1.8 Install the Patch:

16.4.1.8.1 Seal:
Apply a sealer all around the edges of the patch. (see Fig. 5)

16.4.1.8.2 Position Driven Head of Rivets Correctly (see Fig. 5)

(a) On smooth or beaded panel trailers, the manufactured rivet head should be on the outside of the unit, and the driven head on the inside.

(b) On exposed post panel trailers in a cargo area, the manufactured rivet head should be on the inside of the unit and the driven head on the outside.

16.4.1.8.3 Rivet Materials:

(a) Use 3/16 inch diameter 2117-T4 aluminum alloy rivets on aluminum constructed units.

(b) Use 3/16 inch diameter type 302 HQ stainless 302 HQ Stainless steel rivets on steel constructed units.

16.4.2 Overlay Repair Panel:

An overlay plate should be installed on trailers with badly corroded side panels in the lower side rail area. (See Fig. 6)

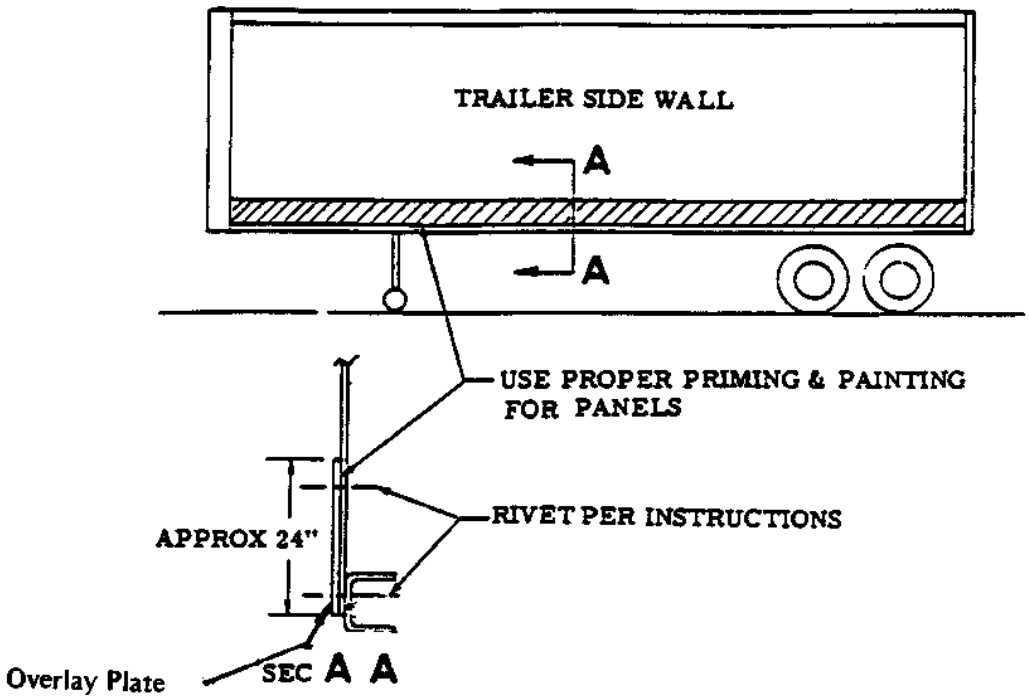


Figure 6: Overlay Repair Panel Installation

Make sure the trailer is empty and properly supported and leveled before beginning this type of repair.

16.4.2.1 Loosen the side panels at the lower side rail in the area where overlap panel is to be applied.

16.4.2.2 Remove all rust, scale, dirt, etc. by means of sandblasting, disc sanding, etc.

16.4.2.3 Immediately after removing the rust, scale, or dirt, the area is to be covered with a red or gray metal primer. The overlay repair panel should also be primed prior to installation.

16.4.2.4 Install the overlay panel over the existing panel (See fig. 6**)**

(a) On aluminum panel units, a 0.063 inch No. 5052-H291 or alloy of similar strength, such as 5154-H38 or 3004-H291 aluminum is recommended.

(b) On steel panel units cold rolled 18 gauge (0.047 inch) SAE 1010-1020 steel is recommended.

16.4.2.5 Rivet materials:

Use OEM specified rivet material.

16.4.3 Complete Panel Replacement:

16.4.3.1 Select Proper Panel Material:

Proper material should be selected when replacing side wall panels to agree with manufacturer's recommendations.

(a) Unless recommended otherwise by manufacturers, for aluminum trailers a 0.050 inch nominal 5052-H291 or alloy of similar strength such as, 5154-H38 or 3004-H291 aluminum material is recommended.

(b) Unless recommended otherwise by manufacturers, for steel trailers an 18-gauge (0.047inch) cold rolled, SAE 1010-1020 steel is recommended.

16.4.3.2 Adequate Panel Lap: (See Fig. 7)

Sufficient panel lap is required to provide a good seal and proper installation by riveting or welding as recommended by manufacturer (Fig. 7). Underlap the forward edge of panels and overlap the rear edge to discourage leakage.

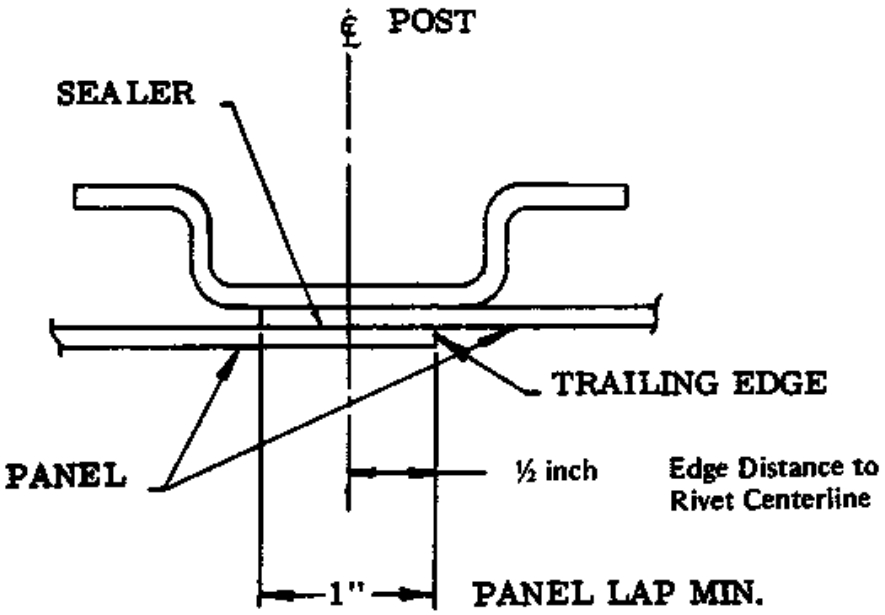


Figure 7: Typical Panel Lap

(a) The recommended rivet edge distance at the panel lap is ½ inch. (see Fig. 7)

(b) The exposed edge of the panel must be on the trailing edge and it must be toward the rear of the trailer.

16.4.3.3 Installation of Panel:

(a) Place the panel over the opening and drill 3/16 inch rivet holes around its perimeter to match the original manufacturers rivet centers, using the existing body posts or panels as a template. If an old rivet hole is used, it must be reamed to provide a tight fit by use of ~~a~~ the next larger diameter rivet.

(b) The replacement panel and old panels should be cleaned and deburred where they will lap.

(c) Use 3/16 inch diameter rivets for the vertical seams of the panel to upright posts, and ¼ inch diameter rivets at upper and lower side rails. For oversize rivets holes, use rivets which will provide a good tight fit.

(d) Use 2117-T4 aluminum rivets on aluminum construction units. On steel construction units, use type 302HQ (full annealed) stainless steel rivets.

IMPORTANT: DO NOT USE DRIVE PIN OR PULL RIVETS IN THIS STRUCTURAL APPLICATION.

16.4.4 Upper and Lower Side Rail Splices:

It is most important that sufficient sectional reinforcement is added to the rail at all rail repair splices, thus maintaining the original strength and load-supporting ability of the unit.

16.4.4.1 Recommended Splice Methods:

(a) USE A SPLICE WITH THE SAME SHAPE AND SIZE (SQUARE INCH AREA) EQUAL TO OR GREATER THAN THE CROSS SECTION OF THE RAIL BEING REPAIRED (SEE FIG.. 8) PHYSICAL PROPERTIES OF SPLICE MATERIAL MUST BE AT LEAST EQUAL TO THE PROPERTIES OF THE RAIL BEING REPAIRED.

(b) For splicing of steel rails, the cross section of the splice material is to be equal to or greater than the rail cross section. The splice should be long enough so that the amount of weld on each side of splice will equal the cross section (size and shape) strength of the rail.

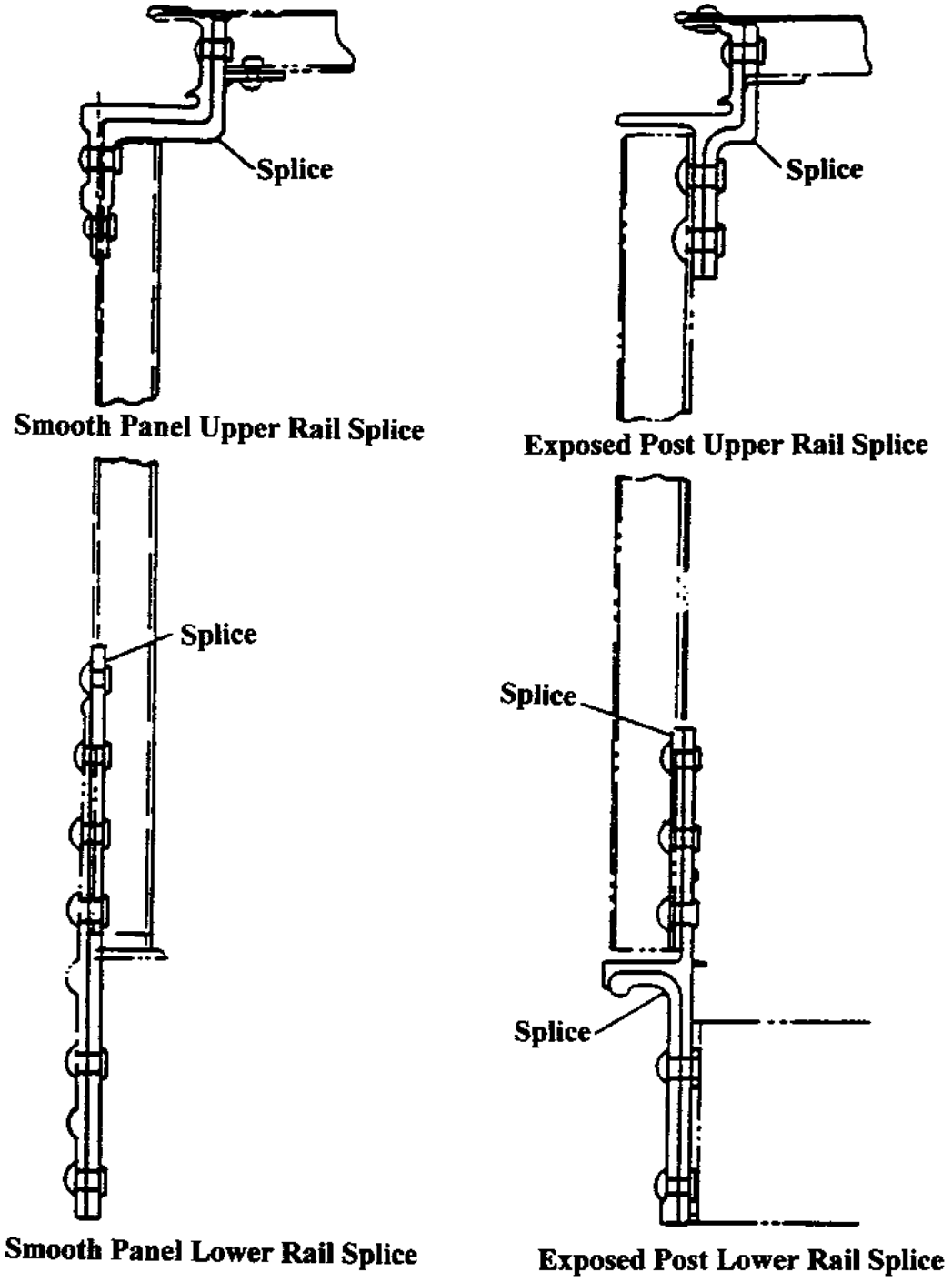


Figure 8: Typical Splices for Upper and Lower Rails

(c) The length of the splice plate should be approximately equal to the spacing between posts for upper rails and approximately twice the spacing between crossmembers for the lower rail. (See Fig. 9)

(d) The fasteners used on each side of a centerline of splice should be equal in size and quantity to provide a splice of equal or greater strength than the original rail design. If a rivet is to be installed in an old distorted rivet hole, the old rivet hole should be reamed and a rivet of the next larger size be used. Lock bolts or blind fasteners if used must be in proper size and grip range. Contact original vehicle manufacturer for approval of fastener substitution.

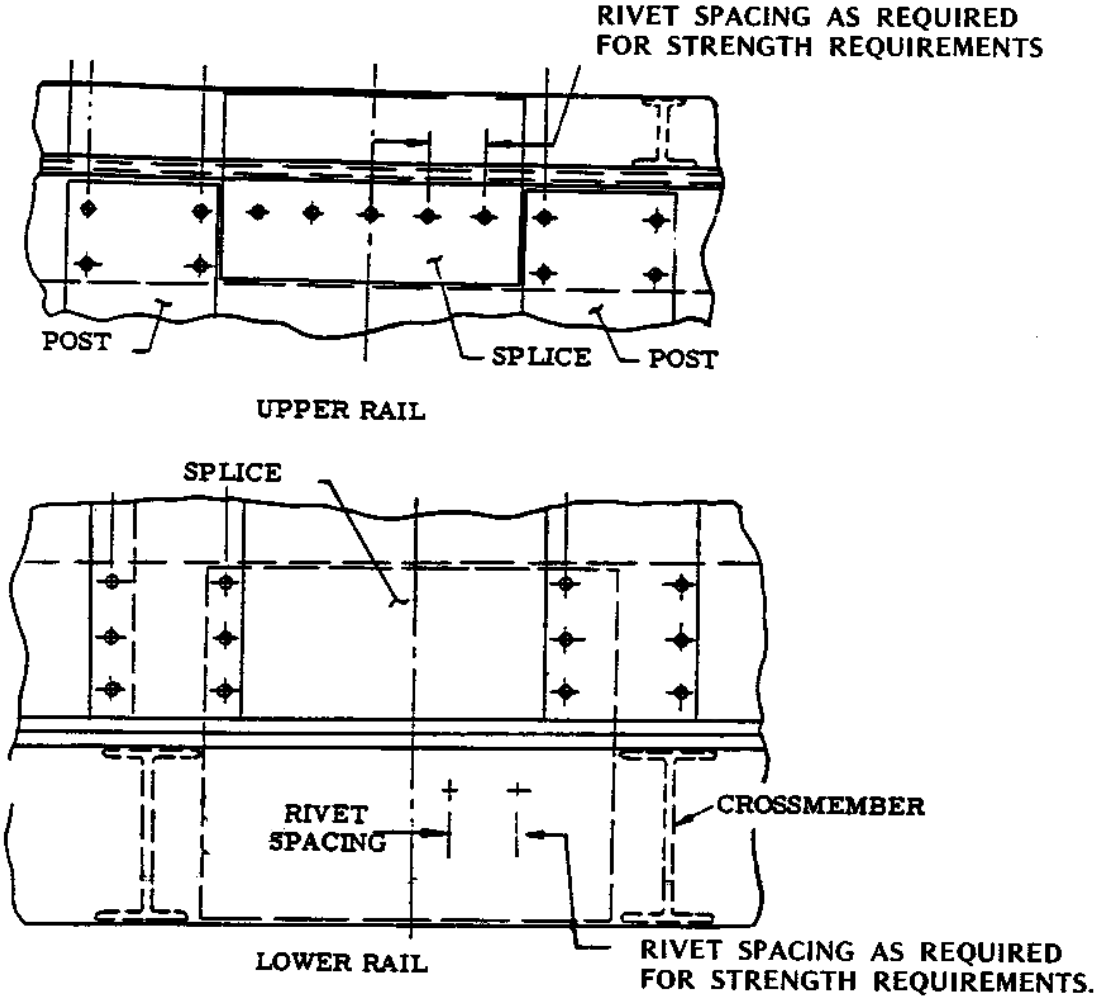


Figure 9: Typical Splice Locations for Upper and Lower Rails

16.5 Roof Repairs:

Roof repairs are equally as important as repairs to front or side walls. Correct materials and good workmanship can reflect the difference between a job of superior or inferior quality. Outlined herein are repairs ranging from a small break in the roof skin to the replacement of a complete roof panel section.

16.5.1 Small breaks and Openings: (See Fig. 10)

(a) Clean the surface around the damage area.

(b) Coat the damaged area with cement and an adhesive compound.

(c) Cover the damaged area with a patch such as fiberglass cloth.

(d) Apply a liquid roof coating (a plasticizer that will keep the fiberglass adhesive tacky) over the repaired area.

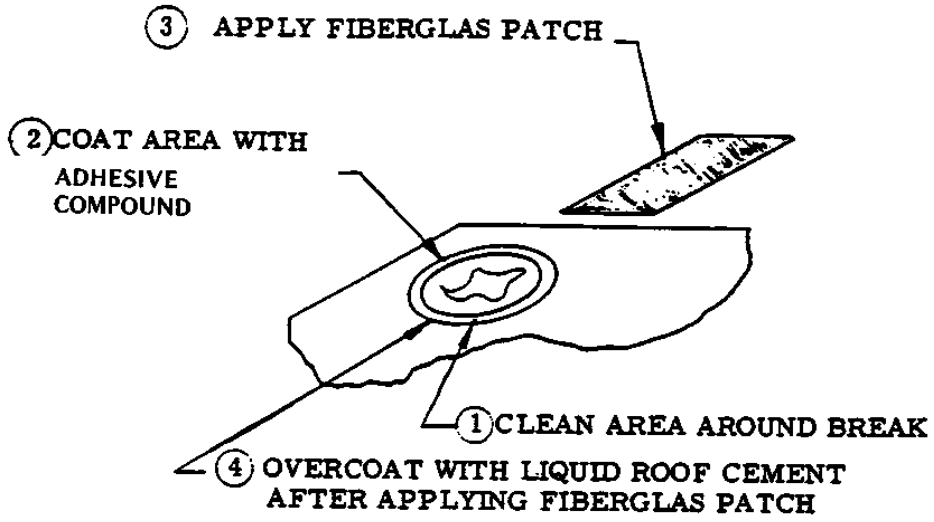


Figure 10: Typical Repair for Small Roof and Openings

16.5.2 Small Patches:

Small patches can also be applied by using the fiberglass material that is sun cured or thermo setting. Follow the manufacturer's recommendations for application.

16.5.3 Large Breaks (See Fig. 11)

(a) Cut out the damaged portion to produce an oblong or round opening and deburr the edges.

(b) Make a patch large enough to overlap a minimum of one inch on all sides of the opening.

(c) Patch Material

(1) On aluminum panel trailers use 0.040 inch thick 3003-H16 aluminum alloy.

(2) On steel panel trailer use 26 gage (0.022 inch) thick hot rolled steel galvannealed or equal.

(d) Clean the surfaces around the panel opening and the patch panel.

(e) Installing patch panel using rivets

When rivets are used to install the patch panel, drill 3/16 inch diameter holes on 1 ½ inch centers around the patch panel and opening. The rivet holes should be located from the edge of the patch, a distance of ½ inch.

(1) On aluminum paneled units use aluminum rivets 3/16 inch diameter of 2117-T4 aluminum alloy.

(2) On steel paneled units, use 3/16 inch diameter type 302 HQ (full annealed) stainless steel rivets.

(f) Seal patch panel edges

When rivets are used to install patch panels, apply a sealer urethane or elastomer over the rivet and panel edges to insure a good water tight seal.

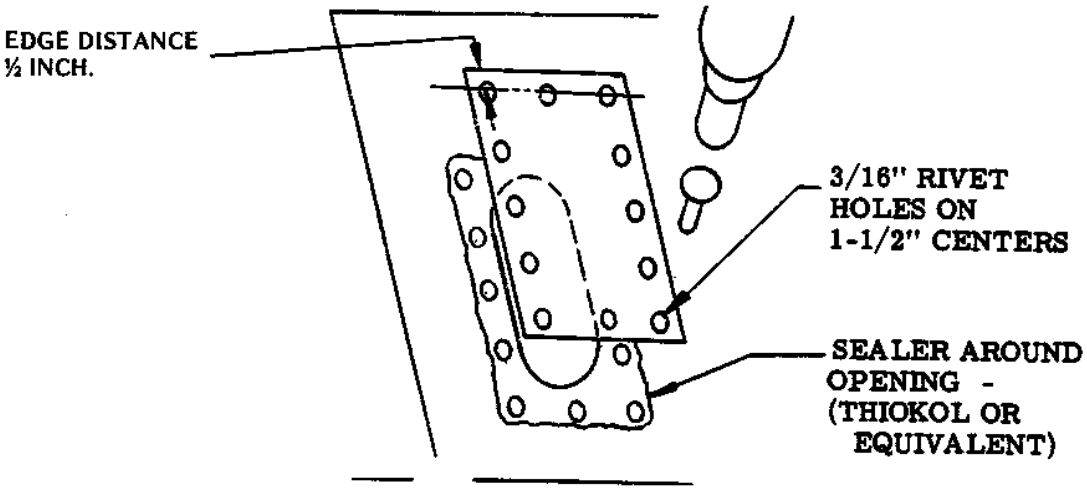


Figure 11: Typical Repair for Large Roof Breaks and Openings

16.5.4 Full Width Panel Replacement: (See Fig. 12)

16.5.4.1 Make sure the trailer is empty, properly supported, and leveled before beginning this type of repair. Remove damaged panel:

To replace a full width roof panel, begin by cutting and removing the damaged panel for the full width of the roof as illustrated in Figure 12. Deburr the panel edges.

16.5.4.2 If the roof is constructed of panel sections tied together with clincher strips, it is necessary to flatten the panel edges and remove all distortion before satisfactory reinstallation can be made of the clincher strips.

16.5.4.3 Remove damaged roof bows and install new bows as required.

16.5.4.4 Clean and deburr the panel edges on existing roof panels and the replacement panel.

16.5.4.5 Panel material:

(a) On aluminum panel trailers, use 0.040 inch thick 3003-H16 aluminum alloy.

(b) On steel panel trailers, use 26 gage (0.022 inch) thick hot rolled steel galvannealed or equal.

16.5.4.6 Installing full width panel: (See Fig 12)

(a) Position the replacement panel over opening to be covered and drill 3/16 inch holes around perimeter on 1 ½ inch centers. Maintain the proper rivet edge distance of ½ inch to rivet centerline. If a rivet is to be installed in an old rivet hole, the old rivet hole should be reamed and a rivet of the next larger size be used. Use a “hole finder” to locate existing holes.

(b) Apply a sealer around edges of damaged panel opening.

(c) Install the replacement panel.

(d) Secure the replacement panel into position with rivets.
  (1) On aluminum roofs use a 2117-T4 aluminum rivet.
  (2) On steel roofs use an A type 302 HQ (full annealed) stainless steel rivet.

(e) Apply additional sealer over the rivet heads and all joints of repaired area.

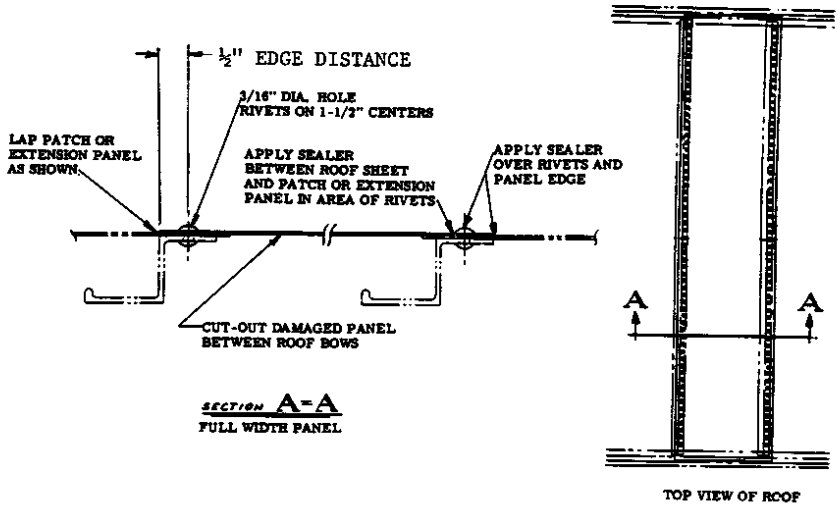


Figure 12: Typical Replacement of Full Width Panel

16.5.5 Complete Aluminum Roof Replacement: (See Fig. 13)

When replacing a complete roof, an .040 inch 3003-H16 aluminum material is recommended.

16.5.5.1 Make sure the trailer is empty, properly supported and leveled before beginning this type of repair. Remove damaged panel. (See Fig. 13).

To replace a complete roof, begin by removing the old roof.

16.5.5.2 Damaged roof bows:

All damaged roof bows are to be removed and replaced with new roof bows. The new bows are to be attached at each end to the top roof rail by use of rivets matching the original design.

16.5.5.3 Cleaning:

All roof bows and rail gutters are to be cleaned and deburred.

16.5.5.4 Before installing new roof panel, apply a sealer on the roof rail or in the roof rail gutter around the complete trailer. (see Fig. 13)

16.5.5.5 Installation of Panel:

(a) Place the panel in position on the front rail. If the original roof design requires the use of a retainer strip, install at this time. A suggested roof edge depressing tool is illustrated in figure 14 for this type of design.

Use a “hole finder” to locate and reuse existing rivet holes in the top rails.

(b) Use 3/16 inch diameter aluminum rivets of 2117-T4 aluminum alloy to secure roof panel to front rail. Rivets are to be spaced on 1 ½ inch centers or as recommended by the manufacturer.

(c) The new roof sheet should be stretched in place by using clamps or roof stretchers at the rear header of the trailer. Stretching is important to reduce unnecessary flapping which could cause cracking.

(d) The new roof panel should be attached to the roof bows using a polysulfide adhesive, caulk, or tape.

(e) The sides of the roof panel are now depressed into the roof rail gutter and a retainer strip is added or attached to the upper side rails as originally manufactured. Rivet the panel in place on 1 ½ inch centers.

(f) The roof panel is finally attached at the rear by means of a retainer band and ¼ inch X ¾ inch S. T. “D” P.H. screws or as originally manufactured. Fig 13 Sec. E-E). Insulating tape should be installed between steel and aluminum material for corrosion protection.

(g) Apply a sealer over rivet heads at front and sides and over screw or rivet heads at rear.

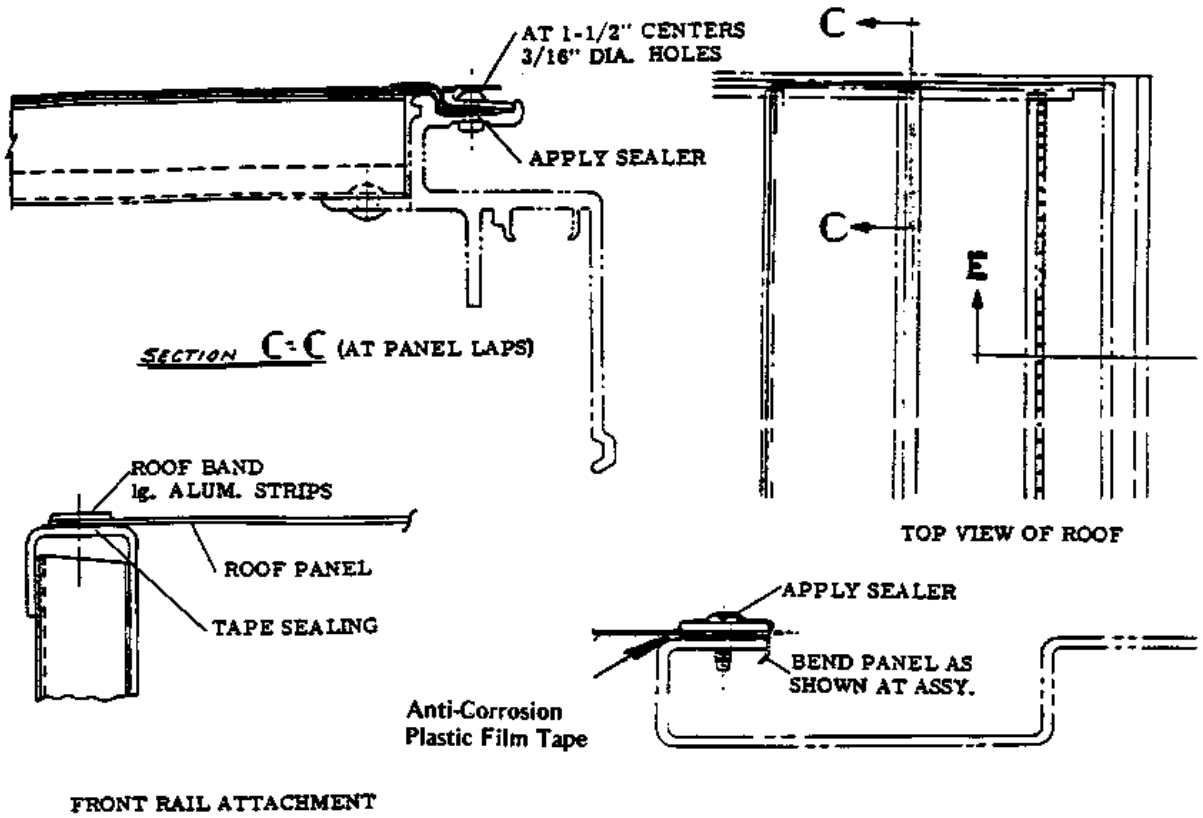
16.5.6 Insulated Roofs:

16.5.6.1 In most instances, the fiberglass material for repair will be fastest and most permanent.

16.5.6.2 Patch Panel:
If only a small patch panel is required on insulated roofs and can be installed from the outside of the trailer, the instructions as provided above will, in general, prevail except for the following special considerations.

16.5.6.2.1 Use Blind Fasteners:
Structural blind fasteners to attach panel to existing roof are suggested.

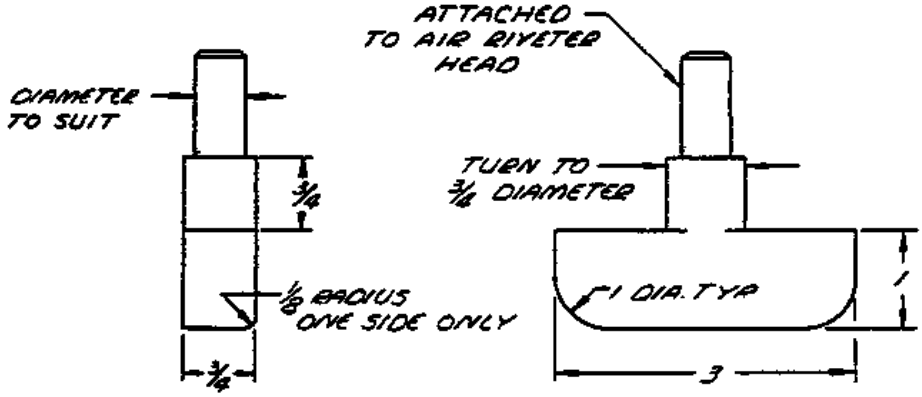
16.5.6.2.2 Flammable Insulations:
If insulation in the unit is flammable, do not employ welding equipment. When in doubt as to the type of insulation or its flammability, check with the original trailer manufacturer.



NOTE:
RETAINER STRIP AND ROOF PANELS MUST BE SECURELY CLAMPED TO THE ROOF RAIL BEFORE DRILLING & RIVETING

[FIG. 13 – TYPICAL COMPLETE ROOF REPLACEMENT]

SUGGESTED - ROOF EDGE DEPRESSING TOOL



NOTE: Make from H.R. S. SAE 1010-1020

16.5.6.3 Panel Replacement:

Replacement of larger panel sections in the roof may involve removing the interior lining of the ceiling and the insulation.

(a) Repair the panel as outlined in the preceding instructions.

(b) When replacing the insulation, use insulation of the same types as removed. Most insulation can be purchased through the trailer manufacturer or locally.

16.5.6.4 Complete roof replacement on an insulated trailer may be more practical by installing a full floating roof sheet of a heavier gauge material. Contact the manufacturer for a recommendation.

16.6 Other Damages:

Damaged components of a side wall, front wall or a roof assemblies must be replaced or repaired whenever they are cracked, bent, broken, or buckled.

The walls and roofs on typical trailer may be highly stressed and slight fractures, cuts, and holes can occur. If the damage is not taken care of immediately a serious structural problem could occur resulting in property damage, personal injury or even death.

16.7 Specific Problems:

Contact the original trailer manufacturer for information on specific repair problems. The selection of incorrect replacement materials is one of the service difficulties encountered in repairing walls or roofs. Because of modern trailer designs, the strength in the walls and roof depends largely on the material used.
If the replacement materials differ from those recommended by the manufacturer, serious problems are likely to result. Correct materials, and good workmanship will provide proper repairs necessary to provide the strength and load carrying ability of a trailer.

16.8 Painting and Finishing:

Painting of all surfaces, including aluminum and steel, must be preceded by a good, thorough cleaning, including, the removal of corrosion and oxidation and by washing off traffic film, dust, grease, and oil.
Surface cleaning and removal of foreign residues in preparation for painting should be followed by an etching of all surfaces, steel, and aluminum, for application of surface coatings. This etching is necessary to provide good adhesion of the coatings.
Nearly all paints require the use of a primer material on the surface first. This is also necessary for good adhesion and life of the paint itself. On aluminum parts, surface should be primed and followed with a finish coat of paint as per paint manufacturers'

instructions. All parts in non-weld assemblies should be cleaned and primed before installation. Welded parts and assemblies should be cleaned and primed after welding.

(a) Remove all rust, scale, weld, flux, and any loose material which may prevent primer and paint form binding to the base material.

(b) Before priming, acid-etch all surfaces with an etching solution, following the manufacturer's instructions. Do not sand surface after etching.

(c) Immediately after etching, apply a primer coat. A good primer designed for this purpose and applied per the manufacturer's instructions will do.

(d) When the aluminum and steel parts are joined, either an insulating tape should be used in the joints between dissimilar metals, or a coat of aluminum paint should be applied to all steel surfaces that will come in contact with aluminum surfaces. Aluminum surfaces that come in contact with stainless steel need not be coated.

17.0 Insulated Trailer Maintenance:

Cleanliness, sanitation, and maintenance of refrigerated trailer exteriors and interiors, lining, finishes and insulation efficiency, including the operation of doors, running gear, and mechanical refrigeration units, are problems best met through proper education of the people using and maintaining such equipment. Safety and profitable operation are closely related and highly dependent on the effectiveness of such education and the resultant care and thoroughness of the maintenance provided.

17.1 Cleaning:

17.1.1 Interior:

17.1.1.1 Steam or Hot Water Method:

Either method with a USDA approved detergent is an acceptable means of cleaning and deodorizing. Both methods are detrimental to sealants and exposed wooden surfaces.

(a) Exposed wooden surfaces such as liners, floors, scuffbands, bulkheads, etc. should be coated with a USDA approved moisture protectant.

(b) Body and sealants and other exposed vapor barriers need to be maintained to assure a watertight seal.

17.1.1.2 Odors:

A frequent source of odors which may persist in otherwise clean units are maggots, mold spores, and bacteria on interior surfaces or within the insulation space.

(a) If after thoroughly cleaning by either of the above methods, an odor still exists, 3 or 4 pounds of ground coffee can be spread on the floor. The unit can be closed up with the exception of one vent for approximately 24 hours. This procedure has proven effective in some cases. Coffee will absorb some odors.

(b) If contamination is in the insulation cavity, the only positive solution to this problem is to take up the floor or remove the lining, or both and replace the contaminated material.

(c) Application if USDA approved spray pesticides and bactericide designed for use with or in contact with edible food products may be desirable.

(d) Prevent re-infestation by carefully and thoroughly sealing all openings.

17.1.1.3 USDA Approval:

Approval of materials and cleaning agent coming in contact with food can be obtained through the United States Department of Agriculture's Food Safety and Inspection Service. A listing of authorized products is published annually as Miscellaneous Publications Number 1419 entitled "List of Proprietary Substances and Nonfood Compounds – Authorized for use under USDA Inspection and Grading Programs." This document is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 2002. The telephone number is 202-512-1800 or 866-512-1800.

17.1.2 Exterior:

Cleaning the outside of refrigerated trailers is handled in the same manner as dry freight van units. Complete instructions for cleaning, brightening, and protecting the exterior surfaces of all van type trailer may be obtained from the manufacturer of the cleaning product.

17.1.2.1 Application of a protective transparent coating is suggested after cleaning and brightening to protect the surface from further oxidation.

17.1.2.2 Do not use aluminum brightener (corrosive compound) on any surface.

17.2 Insulating Efficiency Check:

17.2.1 Weigh the trailer at regular intervals to determine if there is any moisture or water pickup through condensation or leakage in the insulation.

17.2.1 Observe points from which water may leak out during cleaning process other than from regular drain holes. This would indicate wet insulation in the area behind the leakage.

17.2.2 Record the duration of the mechanical refrigeration unit cycles (including ambient temperature) and their frequency. An increase in frequency and in duration of the cycles, or both, of an appreciable degree could indicate either a general deterioration in the trailer insulation or refrigeration unit. Moderate amounts of condensation on the exterior surface under certain climatic conditions is normal. This will usually occur near internal reinforcements.

17.2.3 Air pressure test a trailer to determine overall efficiency of trailer and to spot developing problems. With all doors closed, and all drains sealed, test air leakage with suitable instruments to record amount of air flow and pressure. For normal foam-in-place trailers, air leakage should not exceed manufacturer's specification. Excessive air leakage indicates problems, such as a perforated walls, worn out areas on door seals or door locks and around vents, side doors and refrigeration units. These areas should be repaired and retested. For details, on air leakage testing refer to the latest editions of TTMA's Recommended Practice RP No. 38, entitled "Method for Rating Heat Transmission of Refrigerated Vehicles."

17.3 Techniques for Maintaining Insulation Efficiency:

17.3.1 Moisture Pickup:

17.3.1.1 Open the unit doors and park it in the sun. It takes several days of good sunny weather to equalize water vapors trapped in the body with that of the outside air.

17.3.1.2 Place a trailer in a controlled heat paint drying oven to speed up the process of dehydration. Do not exceed 150˚F.

17.3.1.3 How effective both of the above methods are is dependent on the type of insulation used and the amount of moisture that has been absorbed. Fiberglass insulation tends to dry out more readily than plastic foams. If the moisture pickup is excessive, insulation may have to be replaced.

17.3.2 Rain Water Leakage:

17.3.2.1 Check complete outside and inside of unit for holes and loose joints or seams through which moisture may seep.

17.3.2.2 Waterproof all openings immediately by patching and sealing, or both especially after accidents in which body and roof skin may have been cut.

17.3.2.3 An appropriate type sealer should be used for closing all minor openings.

17.3.3 Excessive Cycling of Refrigeration Unit:

If the unit is operating properly, the excessive cycling could be caused by:

(a) Air transfer through leaking door seals.

(b) Deterioration of insulation efficiency.

(c) Excessive ambient temperature.

(d) Commodity temperature in excess of refrigeration unit capacity. All commodities should be pre-cooled.

17.3.4 Frost or Cold Spots:

If examination of the outside panels has indicated the presence of excessive condensation or “cold spots” remove the inside lining at these locations and check insulation for density, sagging, or other general deterioration. Replace the insulation as required, follow current techniques.

17.3.5 Floor:

17.3.5.1 If insulation or damage to the floor is a problem take the floor out. In replacing the insulation use a foamed-in-place urethane or exposed polystyrene block type insulation. The foamed-in-place type of insulation picks up very little moisture and is generally superior to block type insulations.

17.3.5.2 Thoroughly rinse aluminum floors after hauls of corrosive or caustic materials, by flushing thoroughly with water.

17.3.5.3 Corrosion at screw heads and joints.

(a) Remove all corrosion, using a mild cleaner and flush thoroughly with water. Follow safety procedures as recommended by cleaner manufacturer.

(b) Coat screw heads and joints with a urethane or elastomeric based sealer.

17.3.6 Subfloors:

Subfloors being enclosed on the top side and open at the bottom are subject to considerable road splash and corrosion. Where they have deteriorated to a point so that they no longer function as effective vapor barriers and water seals, they should be replaced. Subfloors in good condition should be protected with a coating as a barrier against corrosion as required .

17.3.7 Refrigeration Interface:

17.3.7.1 Unit mounting bolts, battery box bolts, and fuel tank mounting bolts torques should be check periodically.

17.3.7.2 Inspect fuel lines at least on an annual basis.

17.3.7.3 Inspect and clean trailer drain kazoos regularly.

17.3.7.4 Inspect air duct installation, if equipped, for obstructions and attachments to a unit and trailer.

17.3.7.5 Inspect bulkhead, if equipped, for any obstructions to unit air return openings. Debris is frequently drawn into the suction side of the unit.

17.3.7.6 Cleaning materials used for the trailer exterior are not necessarily acceptable for the unit. Only non-corrosive agents are acceptable. After cleaning, the unit must be flushed with clean, fresh water until all cleaning residues are removed.

17.3.8 Doors – Vents – Hatches:

17.3.8.1 Worn seals should be replaced; they do not last forever.

17.3.8.2 As required, check and correct the alignment of door hinges and locks.

17.3.9 Scheduling Insulated Unit Operations:

17.3.9.1 Allow as much time as possible between low temperature runs so that the unit has an opportunity to dry out. This should only be necessary on fiberglass insulated units or those with wood linings on floors.

Always Open the Doors When Parked Empty:

17.3.9.2 Have sufficient equipment to allow units to remain idle so as to dehydrate as required.

17.3.10 User Education:

Insulated unit operators must become informed of the refrigeration limitations of this type equipment in winter as well as summer.

(a) Do not haul frozen foods in a trailer designed to haul only chilled products.

(b) Do not expect the trailer to lower inadequately chilled product temperatures. Products hauled should be loaded at a temperature as cold or slightly colder than the temperature required at time of delivery.

17.3.11 Safety:

Insulated trailers will burn. See RP No. 68 and TB No. 97 for proper fire protection procedures when repairing refrigerated trailers.

17.3.12 Specific Problems:

On problems of maintenance for reefer trailers not covered herein, consult with the trailer manufacturer.

17.3.13 TPM (Trailer Preventive Maintenance):

For assistance in planning a program of truck trailer maintenance, refer to Section 9.

18.0 Insulated Trailer Repair:

18.1 Insulation Types:

Determine the type of insulation material in the area of the unit to be repaired. Insulation in use today can be divided into two basic types fiberglass batts and rigid and non-rigid plastic foams such as polyurethane, polystyrene, etc.

Listed below are some rules, which should govern (prior to and during) repair operations on refrigerated trailers when torches or welders are to be used in close proximity to these two types of insulation.

18.1.1 Fiberglass wool batts – Fiberglass itself is not flammable. If the fiberglass has a backing, the backing may burn and produce toxic gases. Fiberglass is an irritant to the upper respiratory system, eyes, and skin. Proper Personal Protective

Equipment (PPE) shall be employed when working with fiberglass insulation materials.

Rigid and Non-Rigid Plastics Foams – All plastic foam will burn whether they are “fire retardant” or not. Rigid urethane foam is combustible like cork, wood or other organic materials. When urethane is exposed to intensive heat of welding, flame cutting or other hot work wherein a high intensity heat source is used in repairing an insulated trailer, certain precautions must be observed. Urethane and other plastic foams burn readily, often with dense clouds of toxic black smoke. Minimum precautionary measures are listed below

- Personal performing insulated trailer repair shall utilize proper Personal Protective Equipment at all times when working around or with plastic foam insulations.
- Clean the work area. Never allow plastic foam scrapes or other organic material to be in the work area inside or around the trailer or allow foam materials to accumulate on the job site.
- Under no circumstances shall a direct flame be allowed to contact plastic foam. The foam must be mechanically cut away and totally removed from around the repair area at least two feet or an obvious safe distance to prevent any flame from coming in contact with the foam.
- All other combustible materials below the work site must be removed to prevent ignition from hot sparks or slag.
- Should the plastic foam begin to visibly smoke, hot work must be stopped immediately. All flames must be extinguished and additional plastic foam must be removed from the work site before hot work is continued.
- A fire watcher equipped with at least a 150 pound CO_2 or dry chemical extinguisher must be posted at the job site during all hot work operations and must remain for at least 30 minutes after such operations have been completed
- Interrupt burning and welding occasionally to prevent a build-up of heat.
- In the event a fire is encountered, immediate steps should be taken to avoid breathing the toxic fumes associated with such fires.

18.1.2 Paper vapor-barriers, cements, sealers and other materials used in assembling insulated trailers can also be highly flammable.

18.1.3 Prior to any welding repairs to trailer, disconnect refrigeration unit battery cables to prevent any possible damage to refrigeration unit's electrical control system components. If the refrigeration unit is equipped with an fuel pump, it should also be disconnected prior to any welding.

18.1.4 Use fire resistant shields to prevent direct flame contact with combustible materials even if the shield must be left in the trailer or container.

19.0 Platform Trailer Repair:

19.1 General Considerations:

This section of the Maintenance Manual discusses the more common repairs to platform and chassis trailer frames. The frames can be made from a wide variety of materials (various steel or aluminum alloys) using perimeter beam or inner beam construction.

It is necessary that any repair work be done by experienced personnel with proper equipment. The repair facility must know the type of material used in the construction of the trailer before attempting any corrective action. Any substitution in material could drastically affect the load carrying ability of the trailer. Steel trailers use mild steel, high strength low alloy (HSLA) steel and/or heat treated T1-type steels. The weld procedure includes pre-heat and post-heat requirements as well as maximum heat input and specifications for the type material being repaired. The area surrounding the repair should be cleaned to remove paint, grease, dirt, etc. The same logic applies to aluminum trailers.

Do not weld across flanges of main beams. Any rough edges should be ground smooth and free of notches. Reinforcement should be added per the trailer manufacturer's recommendations. The upper and lower flanges of many trailer main beams are heat treated T1 steel, and should not be flame straightened. Heating can destroy the desirable properties of the material.

If there are any questions concerning the material being repaired, it is recommended that the trailer manufacturer be contacted before any work is accomplished.

Lengthening trailers should be done only in areas and using methods approved by the trailer manufacturer. Generally, the area from behind the kingpin plate to behind the landing gear is a critical area in most platform trailers and no modifications should be made in this area without the manufacturer's approval. The center of the trailer is also a critical area in platform trailers and should be avoided.

Purchase replacement parts from the trailer manufacturer whenever possible. This will reduce the possibility of incompatible materials.

19.2 Main Beam Repairs:

The main beams are the most important load carrying element in the trailer frame. Improper repair can result in catastrophic failure under load. Repairing a crack consists of welding up the failed area plus adding additional reinforcement to lower the working stress in the surrounding area.

19.3 Crossmember Repair:

If a crossmember is severely damaged, it is best to replace it. Remove the damaged component and replace it with an identical piece. Depending upon the cause of failure, it is usually NOT good practice to replace a part with a much stronger or weaker component. When in doubt, consult the trailer manufacturer.

Small cracks in a crossmember can be welded and reinforced with a stiffener or gusset depending on type of failure.

19.4 Front or Rear Crossmember (Skirt) Repair:

The forward or rear closure crossmember (skirt) is a critical member also. Repair to this area is difficult due to the confined areas. Like other crossmembers, it acts as a beam transmitting load from the side rails into the main beams and should be repaired accordingly.

19.5 Side Rail Repair:

Material and design of side rails varies greatly among manufacturers. Many side rails are hot rolled structural steel shapes with yield strengths ranging from 36,000 to 50,000 psi. These rails are very weldable and can be straightened easily using common shop methods.

Some side rails are roll formed from multiple pieces. Again, the manufacturers should supply the appropriate repair procedures.

20.0 Dump Trailer Repair :

20.1 Introduction:

The repair of any type of heavy equipment can be hazardous if precautions are not taken to avoid potential problems. Repair to dump trailers should only be done by experienced personnel and with top quality equipment.

Dump trailer are manufactured in various configurations. There are both bottom dumps and hydraulically lifted end dumps. Various types of dump trailers are shown on the following sketches.

When servicing or repairing a hydraulic hoist-type, end dump trailer, it may be necessary for personnel to work under the trailer box with the cylinder extended. If the structure were to lower accidentally, these people could be injured or killed.

To avoid injury to maintenance workers, a safety device or structure should be installed to prevent the accidental lowering of the dump body. Take precautions to insure that movement of the vehicle or upward movement of the dump body will not accidentally dislodge or disengage the device. Its placement should be made based on recommendations form the trailer manufacturer.

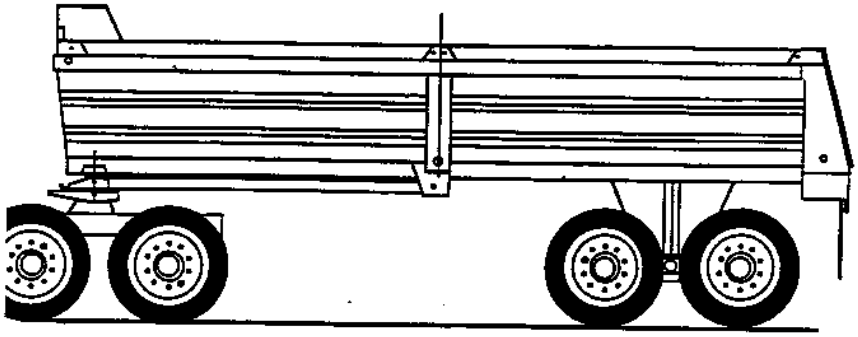
If the dump trailer is being repaired in a way that the tail gate must be raised during repair, make certain that the tail gate is properly supported. If the gate were to fall while a worker was under the gate, personal injury or loss of life may occur.

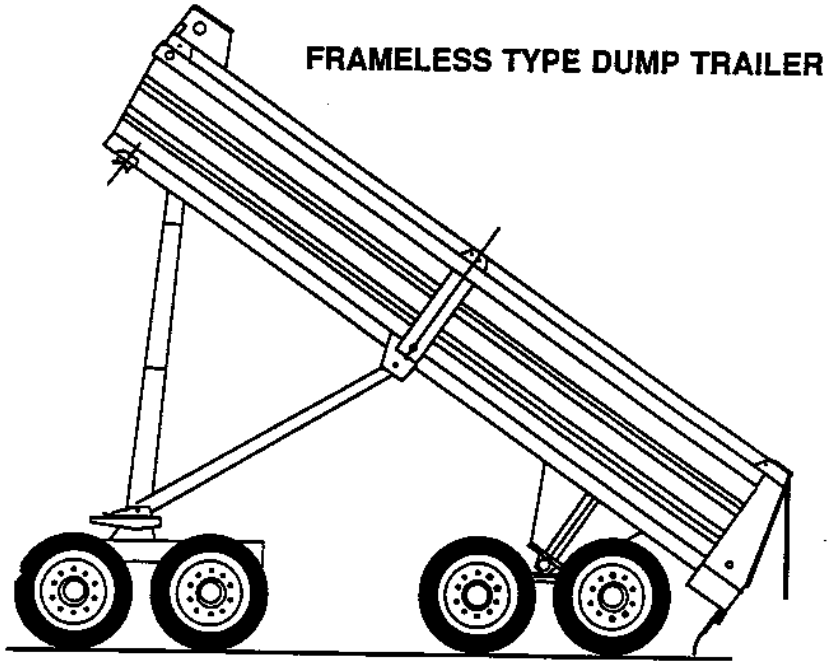
In recent years dump trailers have been manufactured using high strength low alloy steel or aluminum sheets and plates. Both of these materials can be welded, but a clear understanding of what materials are used by the trailer manufacturer before repair begins is essential.

Contact the trailer manufacturer before beginning to repair any trailers, to determine the materials used in the structure and what electrode and welding procedure should be followed.

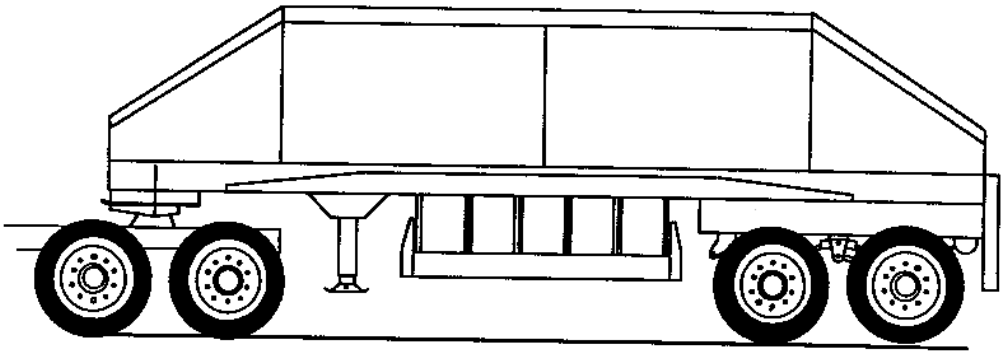
20.2 Sketches:

The following sketches represent dump trailer construction.

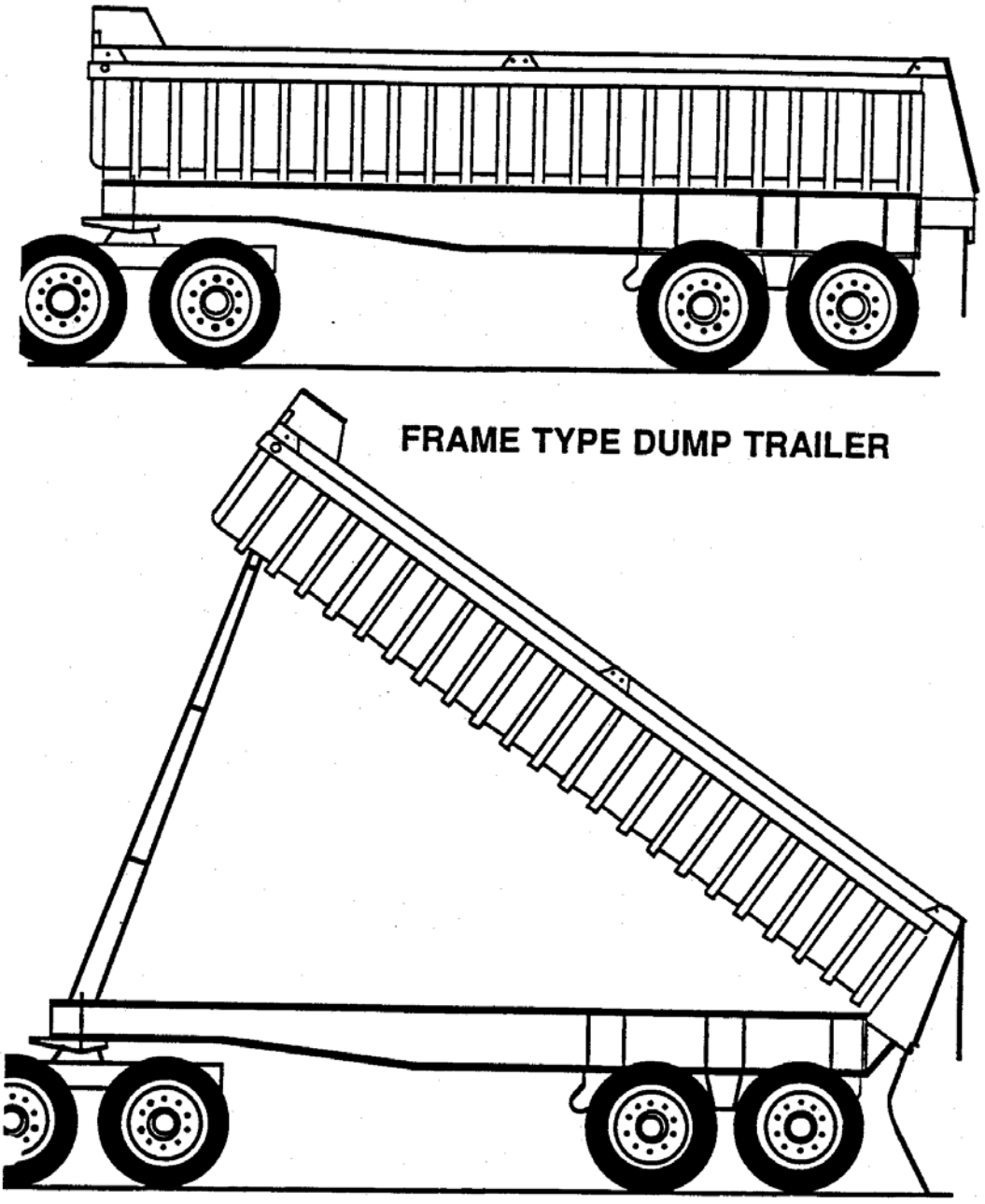




FRAMELESS TYPE DUMP TRAILER



BOTTOM DUMP TRAILER



FRAME TYPE DUMP TRAILER

There are various designs of both hydraulic and dumps. In general, they are broken into the frame type and frameless type. Since each make and model of trailer has areas that are critical, then the proper repair must be done to eliminate the chance of a later failure. Contact the trailer manufacturer to determine proper repair procedures and fixes for problems encountered.

20.3 Welded Procedures – Aluminum, Trailers:

There are two procedures which are used in the welding of aluminum. One of these processes is called Gas Tungsten Arc Welding (TIG) and is used for thicknesses up to 1/8 inch and the other process is Gas Metal Arc Welding (MIG) and is used for thicker material. While this is a good rule to follow, it is not necessarily a hard and fast rule.

Once the material of the trailer has been determined, a welding procedure must be established for making the necessary repair. The trailer manufacturer should be able to assist in developing this procedure, however, if they are not, a welding engineer should be contacted for assistance. If a welding engineer is not available, the following information can be used to develop a suitable procedure.

The metal produced in the weld pool is a combination of metals that must have the strength, ductility, crack resistance, and corrosion resistance required. The correct choice of a filler material will insure that the welded joint is adequate. A relatively small number of filler alloys can be used to weld a wide range of aluminum alloys. Refer to Appendix A for information on correct filler materials.

Cleanliness is of prime importance in welding aluminum. Both the filler wire and the base metal must be free of oil, dirt, and surface oxides.

A good quality weld can only be attained if the filler wire is clean and of high quality. If the wire is not clean, a large amount of contaminant may be introduced into the weld pool. This is especially true in Gas Metal Arc Welding because of the larger surface area of the weld with respect to the amount of filler wire used.

Contaminants of the filler wire are most often an oil or hydrated oxide. The best quality welds can be attained by using the wire as soon as possible after it has been unpackaged. Even high quality wire can produce inferior welds if the wire is contaminated by oil, dust, or other foreign material. Therefore, spools of wire should be protected by a cover after they are unpackaged. If components of the wire drive system are not clean, they too can contaminant the wire.

Due to the operating environment of a dump trailer, care must be taken to thoroughly clean all areas to be repaired by welding. In addition, replacement parts which have been formed, sheared, or sawed must be thoroughly cleaned prior to installation. The complete removal of all foreign materials which may have gotten on replacement pieces in their manufacture is a necessity. In particularly, care must be taken to remove all oil, other hydrocarbons and loose particles from sawed or sheared edges prior to welding. Sheared edges should be clean and smooth and not ragged.

To reduce the possibility of porosity in welds, cleanliness of the welding surfaces cannot be overemphasized.

Cleaning should be done immediately prior to welding. Oil or grease films can usually be removed chemically by dipping, spraying, or wiping the contaminated parts with a solvent. Mildly alkaline solutions and commercial degreasers that do not emit toxic fumes during welding may be used. All welding surfaces should be thoroughly dried before welding. It is necessary to remove surface oxides and other foreign substances, especially the original parts of the trailer, just prior to welding. If the trailer has been painted, the paint must be removed. Wire brushing, scraping, filing, and grinding are common mechanical cleaning methods used on aluminum plate. In wire brushing, a stainless steel brush is preferred.

Chemical deoxidation of parts should be done less than 24 hours prior to welding. An excessively black or dirty appearing inert gas weld may be an indication of excessive plate oxide.

While a limited amount of porosity and dross can be tolerated in some weld joints, ductility, fatigue strength, and tensile strength are adversely affected by porosity in the weld metal. The main cause of porosity in aluminum welds is entrapped gas in the weld puddle. These gases originate from contaminants in the shielding gas, from air and water, and from contaminants that get into the puddle from dirty base metal or filler metal. They can also originate from having too long an arc or as a result of violent arc action. Once the correct filler metal has been established and the weld joints have been properly prepared, good welding practice should be used to make the weld.

20.4 Welding Procedures – Steel Trailer:

Before beginning the repair of any trailer, contact the manufacturer to determine the materials used in manufacturing the trailer. They will be able to help in providing welding procedure and repair methods for the trailer. Since many trailer manufacturers use high strength, low alloy steels such as 80 ksi and 100 ksi yield material, good welding procedures are essential to minimize the loss of strength which occurs in the heat affected zone. Once this is established, a welding engineer should be contacted for help in finalizing the welding process. If no welding engineer is available, the following information may be used to help the welder repair a steel dump trailer.

The materials used in the manufacturer of modern steel dump trailers varies from mild steel to high strength, low alloy steels to high strength, alloy steels. When trailers are designed using high strength, low alloy steels, the integrity of the material is absolutely necessary to insure that the trailer performs in the way expected. The integrity of the material must also be maintained after a repair has been made to the structure. This requires that good welding procedures be used in repairing a fracture in the trailer body.

When welding any steel trailer, three factors must be considered:

1. The use of correct filler materials.

2. The use of correct heat input.

3. The use of accepted welding procedures.

Refer to Appendix B for information about the proper selection of Gas Metal Arc Welding and flux-cored wires and Appendix C for information on the correct filler rod materials for welding steels. It should be emphasized that Gas Metal Arc Welding is the preferred welding method for all high strength, low alloy steels.

The second factor is to maintain proper heat input. This is important in both the cutting process and the welding process. An oxyacetylene torch may be used to cut plate and bevel edges to be welded. Care should be taken to maintain normal cutting speeds and to avoid overheating the steel, particularly in localized areas such as starting points.

In welding high strength alloy steel, the maximum heat input should not exceed the following:

SUGGESTED MAXIMUM HEAT INPUT LIMITS

PLATE THICKNESS INCHES	PRE-HEAT AND INTERPASS TEMPERATURE °F			
	70	200	300	400
3/16	17,500	14,000	11,500	9.000
1/4	23,700	19,200	15,800	12,300
1/2	47,400	35,500	31,900	25,900
3/4	88,600	69,900	55,700	41,900

The allowable heat input is based on the joules per inch of weld joint given by the following formula: $\text{Heat Input} = \frac{\text{ARC Voltage X Current X 60}}{\text{Travel Speed (inch / min)}}$ The third factor is the use of correct welding procedures. This included both joint preparation and weld procedure.

Oxyacetylene torch gouging is not a satisfactory method of preparing joints because the slow travel speed and the occasional stops and restarts easily results in excessive heat input. Plasma torch cutting and gouging or air carbon-arc gouging is a more satisfactory procedure providing precautions against carburization are followed. The surface should be ground after air carbon-arc gouging to provide a clean surface for welding.

Defects in welds made on high strength, low alloy steel can be very serious. It is very important that the weld surface be smooth with contours that are well blended into the pieces being joined. Each weld should be made so that there is a good penetration into the parent metal or previous weld and that no undercut exists. Complete penetration is essential to utilize the full strength of high strength steel.

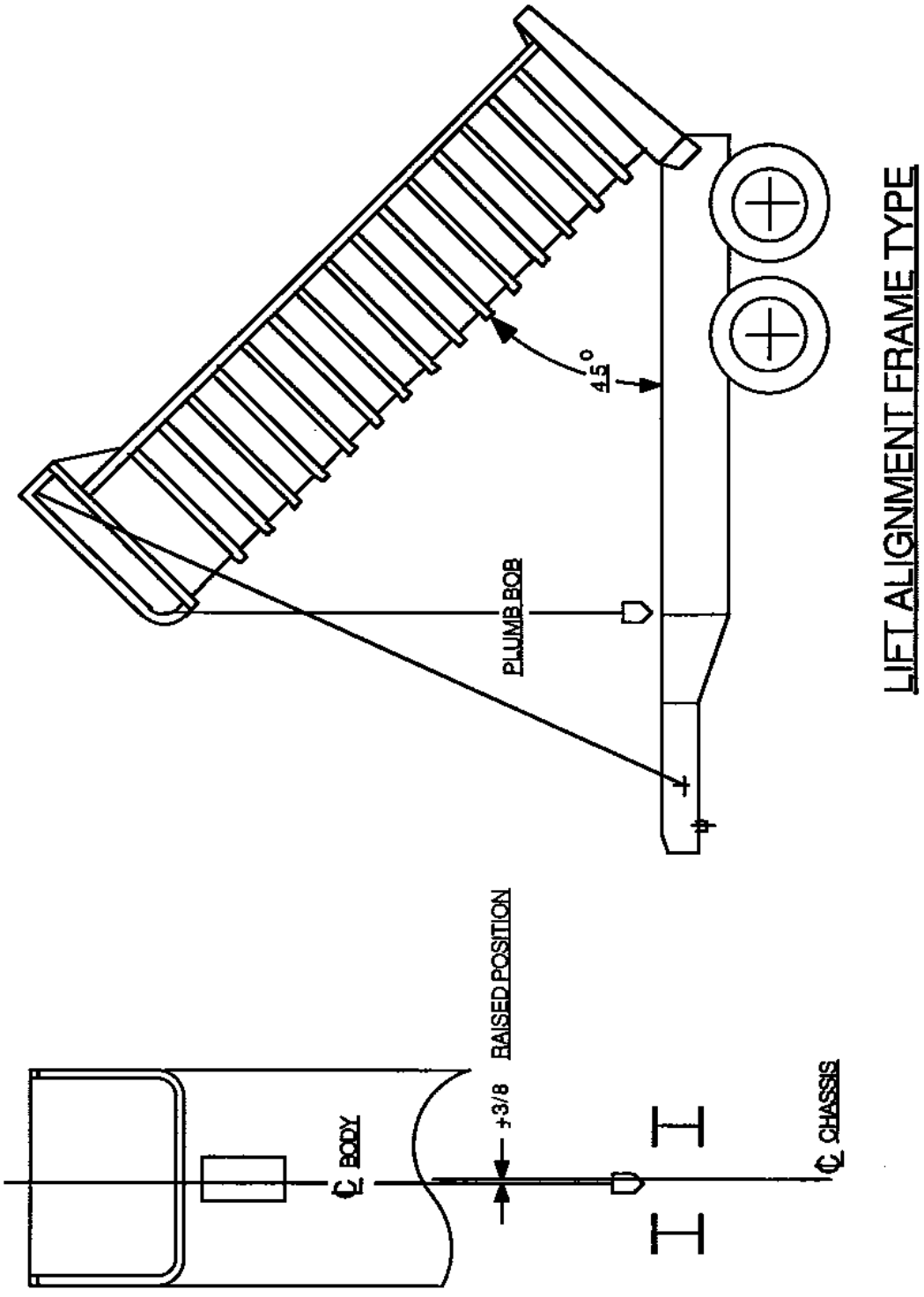
20.5 Hoist Cylinder Maintenance:

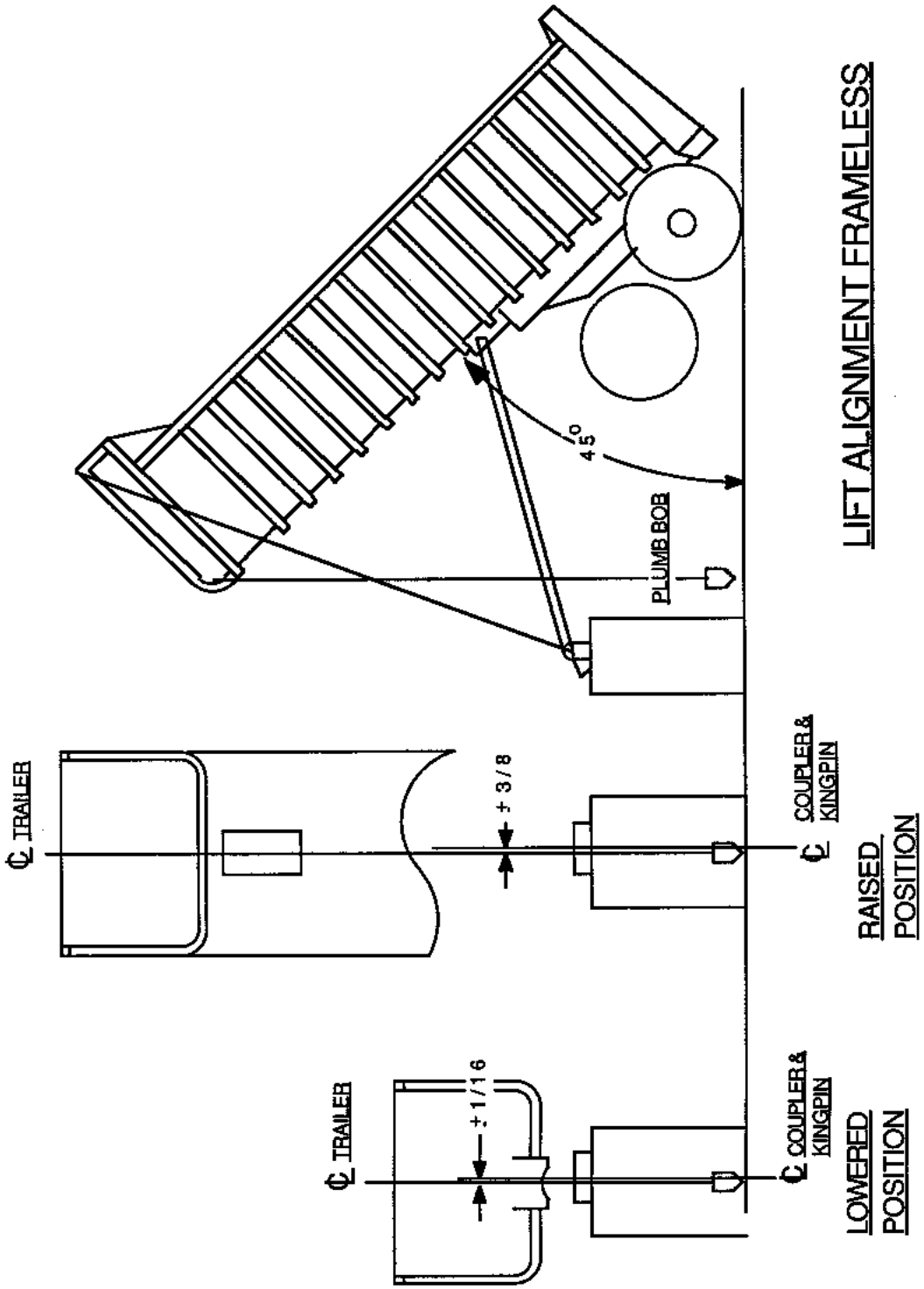
Hoist cylinder repair should be done based on the recommendation of the hoist manufacturer. Contact hoist manufacturers or their representatives for maintenance information before doing any repair. Consult Appendix D for a list of various hoist manufacturers.

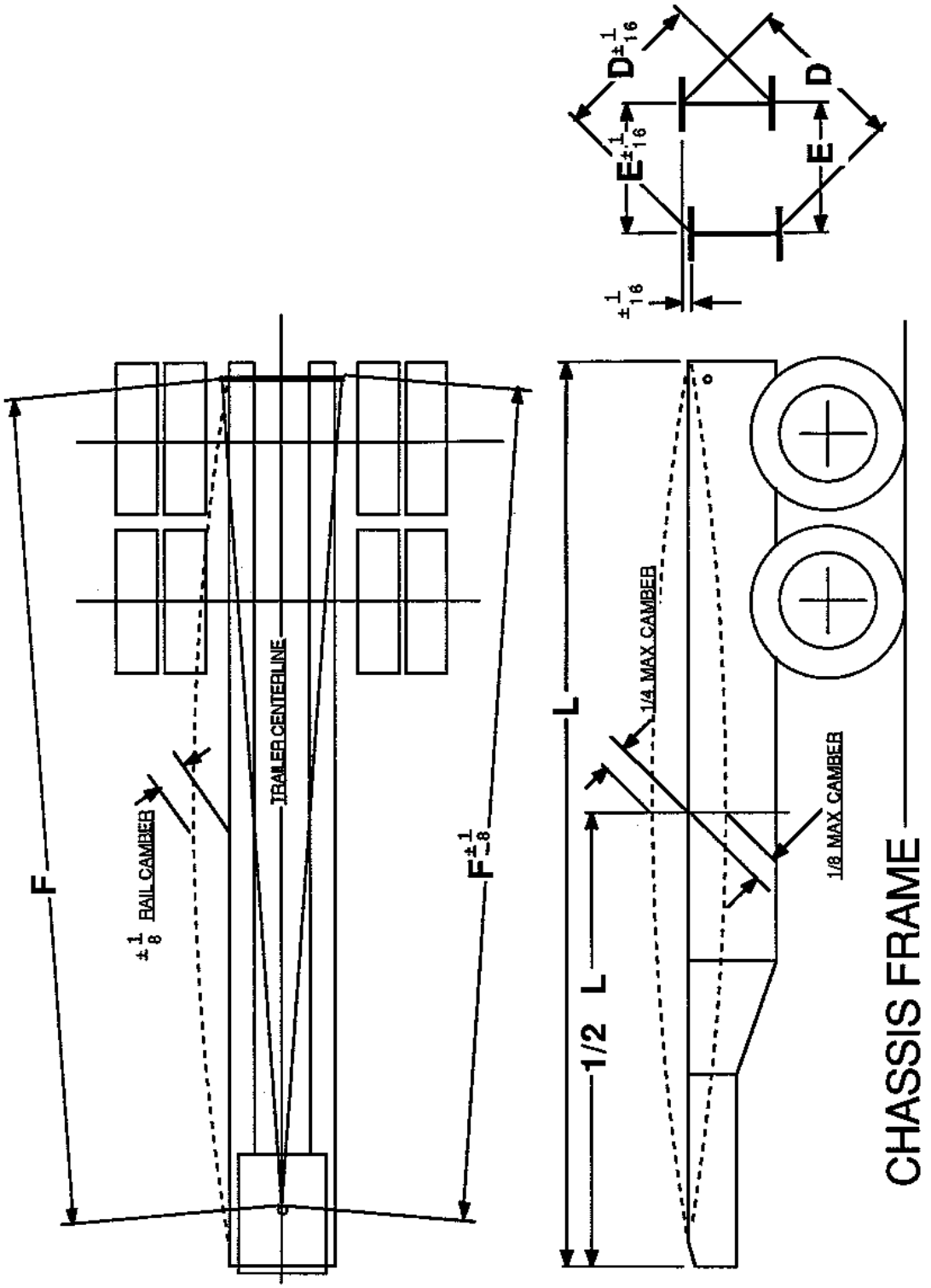
20.6 Alignment:

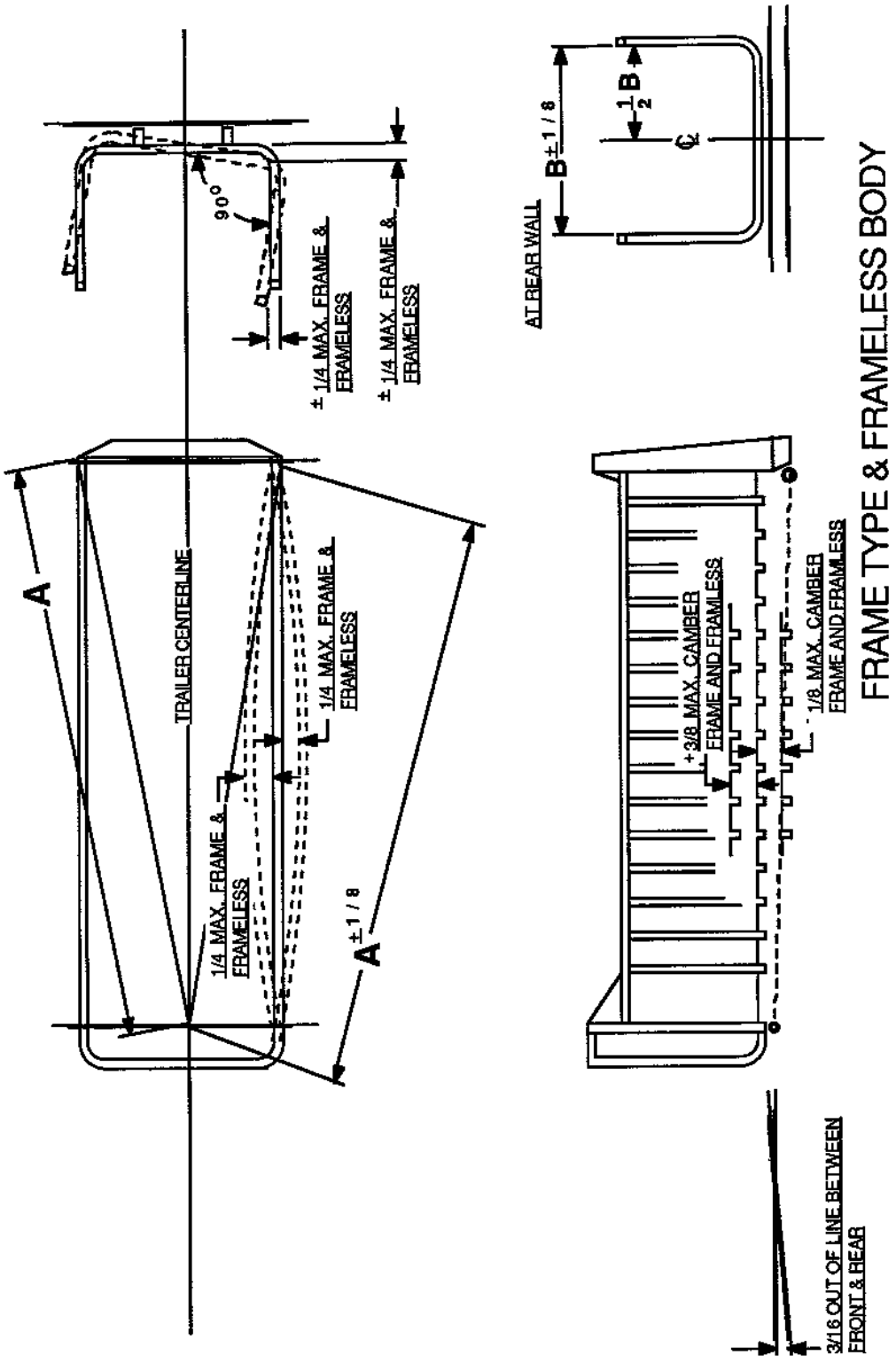
Refer to the following sketches to insure the proper alignment between the box and the centerline of the kingpin and tandem.

Note: Sketches are shown on pages 87 through 90


45°
PLUMB BOB
LIFT ALIGNMENT FRAME TYPE
RAISED POSITION
±3/8
℄ BODY
℄ CHASSIS


LIFT ALIGNMENT FRAMELESS
45°
PLUMB BOB
℄ TRAILER
± 3/8
℄ COUPLER & KINGPIN
RAISED POSITION
℄ TRAILER
± 1/16
℄ COUPLER & KINGPIN
LOWERED POSITION


D ±1/16
D
E ±1/16
E
±1/16
F
±1/8 RAIL CAMBER
TRAILER CENTERLINE
F ±1/8
L
1/4 MAX CAMBER
1/8 MAX CAMBER
1/2 L
CHASSIS FRAME



FRAME TYPE & FRAMELESS BODY

20.7 Bibliography:

Cary, Howard B., *Modern Welding Technology*, Prentice-Hall, Inc., New Jersey, 1979

Kearns, W. H., *Welding Handbook*, Seventh Edition, Volume 4, American Welding Society, New York, 1982

Linnert, George E., *Welding Metallurgy*, Third Edition, Volume 2, American Welding Society, New York, 1967

The Procedure Handbook of Arc Welding, The Lincoln Electric Company, Cleveland, Ohio, 1973

Appendix A

Guide to the Choice of Filler Metal for General Purpose Trailers

Welding Aluminum and Aluminum Alloys

Base Metal	319,333,354 55,C355	13,43,344, 356A356, A357,359	214,A214, B214,F214	7039,A612, C612,D612	6070, 6071	6061,6063, 6101,6151, 6201,6951	5456	5454	5154a 5254a
1060,EC	4145[c]	ER4043	ER5356 [e]	ER4043	ER4043	ER 4043	ER5356 [c]	ER5356 [e,c]	ER5356 [e,c]
1100, 3003 Alclad 3003	4145[c]	ER4043	ER5356 [c]	ER4043	ER4043	ER 4043	ER5356 [c]	ER4043 [e]	ER4043 [e]
2014, 2024	4145[g]	4145	….	….	4145	4145	….	….	….
2219	4145[g]	4145 [c]	….	ER4043	ER4043 [f]	ER4043 [f]	ER4043	ER4043	ER4043
3004 Alclad 3004	ER4043	ER4043	ER5356 [e]	ER4043 [e]	ER4043	ER4043 [b]	ER5356 [e]	ER5356 [c,e]	ER5356 [e]
5005, 5050	ER4043	ER4043	ER5356 [e]	ER5356 [e]	ER4043 [e]	ER4043 [b]	ER5356 [e]	ER5356 [c,e]	ER5356 [c,e]
5052, 5652[a]	ER4043	ER4043 [e]	ER5356 [e]	ER5356 [e,h]	ER4043 [e]	ER5356 [b,c]	ER5356 [e]	ER5356 [b,c]	ER5356 [b]
5083	….	ER5356 [c,e]	ER5356 [e]	ER5183 [e,h]	ER5356 [e]	ER5356 [e]	ER5183 [e]	ER5356 [e]	ER5356 [e]
5086	….	ER5356 [c,e]	ER5356 [e]	ER5356 [e,h]	ER5356 [e]	ER5356 [e]	ER5356 [e]	ER5356 [b]	ER5356 [b]
5154, 5254[a]	….	ER4043 [e]	ER5356 [b]	ER5356 [b,h]	ER5356 [b,c]	ER5356 [b,c]	ER5356 [b]	ER5356 [b]	ER5356 [a,b]
5454	…..	ER4043 [b]	ER5356 [e]	ER5356 [b,h]	ER5554 [c,e]	ER5356 [b,c]	ER5356	ER5554 [c,e]	
5456	….	ER5356 [c,e]	ER5356 [e]	ER5556 [h]	ER5356 [e]	ER5356 [e]	ER5556 [e]		
6061, 6063, 6101, 6201, 6151, 6931	ER4043 [f,i]	ER4043 [e,l]	ER5356 [b,c]	ER5356 [b,c,h]	ER4043 [b,i]	ER4043 [b,i]			
6070, 6071	ER4043 [f,i]	ER4043 [e,l]	ER5356 [c,e]	ER5356 [c,h]	4643 [c,e]				
7039, A612, C612,D612	ER4043	ER4043 [e,h]	ER5356 [e,h]	5039 [e]					
214, A214, B214, F214	….	ER4043 [e]	ER5356 [e,d]						
13, 43, 344, 355, C355, 356, A356, A357, 359	ER4043 [d,f]	ER4043 [d,i]							
319, 333, 354	4145 [d,f]								

5086	5083	5052 5652 [a]	5005 5050	3004 Alc. 3004	2219	2014 2024	1100 3003 Alc. 3003	```	Base Metal
ER5356[c]	ER5356 [c]	ER4043	ER1100	ER4043	4145	4115	ER1100 [c]	ER1260	1060, EC
ER5356[c]	ER5356 [c]	ER4043 [e]	ER4043 [e]	ER4043 [e]	4145	4145	ER1100 [c]		1100,3003 Alclad 3003
….	….	….	….	….	4145 [g]	4145 [g]			2014,2024
ER4043	ER4043	ER4043	ER4043	4043	2319 [c,f]				2219
ER5356[e]	ER5356 [e]	ER5356 [c,e]	ER4043 [e]	ER4043 [e]					3004 Alclad 3004
ER5356[e]	ER5356 [e]	ER4043 [e]	ER4043 [d,e]						5005,5050
ER5356[e]	ER5356 [e]	ER5353 [a,b,c]							5052,5652 [a]
ER5356[e]	ER5183 [e]								5083
ER5356[e]									5086

Note: 1 – Service conditions such as immersion in fresh salt water, exposure to specific chemicals or a sustained high temperature (over 150°F) may limit the choice of filler metals.

Note: 2 – Recommendations in this table apply to gas shielded-arc welding process. For gas welding, only R1100, R1260 and R4043 filler metals are ordinarily used.

Note: 3 – Filler alloys designated with ER prefix are listed in AWS specification A5.10. Alloys not possessing the prefix letters are not included in the AWS specification.

[a] Base metal alloys 5652 and 5254 are used for hydrogen peroxide service. ER 5254 filler metal is used for welding both alloys for low-temperature service (150°F and below). ER5652 filler metal can be used for welding 5652 for high-temperature service (150°F and above).

[b] ER 5154, ER5254, ER5183, ER5356 and ER5556 may be used. In some cases they provide: (1) improved color match after anodizing treatment.
(2) highest weld ductility, and (3) higher weld strength. ER5554 is suitable for elevated temperature service.

[c] ER 4043 may be used for some applications.

[d] Filler metal with the same analysis as the base metal is sometimes used.

[e] ER 5356, ER5183, or ER5556 may be used.

[f] 4145 may be used for some applications.

[g] 2319 may be used for some applications.

[h] 5039 may be used for some applications.

[i] 4643 may be used and is often desirable to provide highest strength in postweld heat-treated assemblies.

Note: 4 – Where no filler metal is listed, the parent alloy combination is not recommended for welding.

Appendix B

Guide to the Selection of Carbon Steel Filler Metals for Gas Metal Arc Welding

(1) Gas Metal Arc Welding

The AWS classification system for GMAW is defined as follows:

Prefix R: Indicates a welding rod.
Prefix E: Indicates a welding electrode.

Number 60 or 70: Indicates the required minimum as-welded tensile strength in thousands of pounds per square inch.

Letter S: Indicates solid electrode or rod.
Letter T: Indicates tubular electrode.

Suffix Number: Indicates a particular chemical composition or shielding gas.

The following chart shows some typical examples of GMAW electrodes.

Identification	Welding Conditions			Test Requirements (as welded)				Chemical Composition					
AWS Classification	Current Electrode Polarity	External Gas Shield	Radiographic Test	All Tensile min psi	Weld Yield min psi	Metal El. % min 2"	Impact test Charpy V	C	Mn	Si	Other		
E-70S-1	DCEP	AO	Rqd.	72,000	60,000	22	Not Rqd.	0.07 to 0.19		0.30 to 0.50			
E-70S-2	DCEP	AO&CO_2	Rqd.	72,000	60,000	22	20@ -20°F	0.6		0.40 to 0.70	Ti – 0.05 to 0.15	Zi- 0.02 to 0.12	Al-0.05 to 0.15
E-70S-3	DCEP	AO&CO_2	Rqd.	72,000	60,000	22	20@ 0°F	0.06 to 0.15	0.90 to 1.40	0.45 to 0.70			
E-70S-4	DCEP	CO_2	Rqd.	72,000	60,000	22	Not Rqd.	0.07 to 0.15		0.65 to 0.85			
E-70S-5	DCEP	CO_2	Rqd.	72,000	60,000	22	Not Rqd.	0.07 to 0.19		0.30 to 0.60	Al- 0.05 to 0.90		
E-70S-6	DCEP	CO_2	Rqd.	72,000	60,000	22	20@ -20°F	0.07 to 0.15	1.40 to 1.85	0.80 to 1.15			
E-70S-G	Not specified	Not Specified	Rqd.	72,000	60,000	22	Not Rqd.	No Chemical Requirements					
E-70S-1B	DCEP	Co_2	Rqd.	72,000	60,000	17	20@ -20°F	0.07 to 0.12	1.60 to 2.10	0.50 to 0.80	Ni- 0.15	Mo 0.40 to 0.60	
E-70S-GB	Not Specified	Not Specified	Rqd.	72,000	60,000	22	Not Rqd.	No Chemical Requirements					

Note: P-0.025 Max S-0.035 Max.

(2) Flux Cored Arc Welding

A common method of welding low alloy steels is the use of flux-cored-arc welding. The following table shows the chemical composition of some of these.

AWS Classification	Chemical Composition Requirements % (1) (2) (3)						
	Mengeness	Silicon	Nickel	Chromium	Molybdenum	Vanadium	Aluminum
E60T-7	1.50	0.90	0.50	0.20 (4)	0.30 (4)	0.08 (4)	1.8
E60T-8	1.50	0.90	0.50	0.20 (4)	0.30 (4)	0.08 (4)	1.0
E70T-1	1.75	0.90	.030 (4)	0.30 (4)	0.30 (4)	0.08 (4)	-
E70T-2	No Chemical Requirements						
E70T-3							
E70T-4	1.50	0.90	0.50	0.20 (4)	0.30 (4)	0.08 (4)	1.8
E70T-5	1.50	0.90	0.30 (4)	0.20 (4)	0.30 (4)	0.08 (4)	-
E70T-6	1.60	0.90	0.80	0.20 (4)	0.30 (4)	0.08 (4)	-
E70T-G	No Chemical Requirements						

Note (1) Carbon, phosphorus, and sulphur not specified.
Note (2) Single values shown are maximum.
Note (3) Chemical composition requirements for electrodes are based on the analysis of deposited weld metal.
Note (4) The elements may be present but are not intentionally added.

E60T-7 Electrode Classification:

Electrodes of this classification are used without externally applied gas shielding and may be used for single and multiple-pass applications in the flat and horizontal positions. Due to low penetration and other properties, the weld deposits have a low sensitivity to cracking.

E60T-8 Electrode Classification:

Electrodes of this classification are used without externally applied gas shielding and may be used for single and multiple-pass applications in the flat and horizontal positions. Due to low penetration and other properties, the weld deposits have a low sensitivity to cracking.

E70T-1 Electrode Classification:

Electrodes of this classification are designed to be used with carbon dioxide shielding gas for single and multiple-pass welding in the flat position and for horizontal fillets. A quiet arc, high deposition rate, low spatter loss, flat-to-slightly convex bead configuration, and easily controlled and removed slag are characteristics of this class.

E70T-2 Electrode Classification:

Electrodes of this classifications are used with carbon dioxide shielding gas and are designed primarily for single-pass welding in the flat position and for horizontal fillets. However, multiple-pass welds can be made when the weld beads are heavy and an appreciable amount of admixture of the base and filler metals occurs.

E70T-3 Electrode Classification:

Electrodes of this classification are used without externally applied gas shielding and are intended primarily for depositing single-pass, high speed welds in the flat and horizontal position on light plate and gage thickness base metals. They should not be used on heavy sections or for multiple-pass applications.

E70T-4 Electrode Classification:

Electrodes of this classification are used without externally applied gas shielding and may be used for single and multi-pass applications in the flat and horizontal positions. Due to low penetration and other properties, the weld deposits have a low sensitivity to cracking.

E70T-5 Electrode Classification:

This classifications covers electrodes primarily designed for flat fillet or groove welds with or without externally applied shielding gas. Welds made using carbon dioxide shielding gas have better quality then those with no shielding gas. These electrodes have a globular transfer, low penetration, slightly convex bead configuration, and a thin, easily removed slag.

E70T-6 Electrode Classification:

Electrodes of this classification are similar to those of the E70T-5 classification, but are designed for use without an externally applied shielding gas.

E70T-G Electrode Classification:

This classification included those composite electrodes that are not included in the preceding classes. They may be used with or without gas shielding and may be used for multiple-pass work or may be limited to single-pass applications.

E70T-G electrodes are not required to meet chemical, radiographic, bend test, or impact requirements, however, they are required to meet tension test requirements. Welding current type is not specified.

The flux-cored electrode wires are considered to be low hydrogen, since the materials used in the core do not contain hydrogen. However, certain of these materials are hygroscopic and thus tend to absorb moisture when exposed to high-humidity atmosphere. Electrode wires are therefore packaged in special containers to prevent this. It is recommended that these electrodes wire be stored in a dry room.

Welding Rod Designation

Type of Weld	Horizontal			Vertical Down			Flat or Down Hand		
Gage	Mild	Hi- Ten	T_1 - Naxtra	Mild	Gives Best Rod		Mild	Hi-Ten	T_1- Naxtra
					Hi-Ten	T_1 - Naxtra			
.060 – Under	3/32 In. E4510	_____	_____	3/32 In. E4510	_____	_____	3/32 In. E4510	_____	_____
.060- .090	3/32 In. E6012	3/32 In. E7018	_____	3/32 In. E6012	3/32 In. E6012	_____	3/32 In. E6012	3/32 In. E7018	_____
.091- .125	1/8 In. E6012	1/8 In. E7018	1/8 In. E11018	1/8 In. E6012	1/8 In. E7018	1/8 In. E11018	1/8 In. E6024	1/8 In. E7018	1/8 In. E11018
.126- .187	1/8In. E6012 E6024	1/8 In. E7018	1/8 In. E11018	1/8 In. E6012	1/8 In. E7018	1/8 In. E11018	1/8 In. E6024	1/8 In. E7018	1/8 In. E11018
.187- Above	3/16 In. E6012 E6024	3/16 In. E7018	3/16 In. E11018	3/16 In. E6012	3/16 In. E7018	3/16 In. E11018	3/16” In. E6024	3/16 In. E7018	3/16 In. E11018

(1) Rod size may vary one size with approval of welding engineer.

(2) On combination of steels, use electrode for lowest steel (i.e. mild steel to NAXTRA, use mild steel chart). Welding engineer should approve.

(3) On gage combination, use lightest gage chart.

Appendix D

The following are manufacturers of hydraulic cylinders for dump trailers. Maintenance information for cylinders manufactured by these companies can be obtained by writing the respective manufacturers at the address shown.

Custom Hoists
P.O. Box 98
Hayesville, OH 44838

Harsh Hoists
600 Oak Street
Eaton, CO 80615

Johnson Hydraulics
6315 W. Fauber Road
Peoria, IL 61607

Marion MFG. Co.
6501 Barberton Ave.
Cleveland, OH 44102

Dana/Hyco
5810 Southwyck Blvd.
Toledo, OH 43699

THE END