VALTIR

SS90™ HD

TRUCK MOUNTED ATTENUATOR

PRODUCT DESCRIPTION ASSEMBLY MANUAL

PN 618542
REVISION C NOVEMBER 2022

SS90™HD TMA

The SS90™HD TMA system has been tested pursuant to National Cooperative Highway Research Program ("NCHRP") Report 350 specifications. The SS90™HD TMA system has been deemed eligible for federal-aid reimbursement on the National Highway System ("NHS") by the Federal Highway Administration ("FHWA") as a TL-3 device.

Product Description
Assembly Manual

15601 Dallas Parkway
Suite 525
Addison, Texas 75001

Warning: The local highway authority, distributors, owners, contractors, lessors, and lessees are responsible for the assembly, maintenance, and repair of the SS90™HD TMA system. Failure to fulfill these RESPONSIBILITIES with respect to the assembly, maintenance, and repair of the SS90™HD TMA system could result in serious injury or death.

Important: These instructions are for standard assembly specified by the appropriate highway authority. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact a Valtir representative. This system has been deemed eligible by the FHWA for use on the national highway system under strict criteria utilized by that agency.

This manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Valtir directly at (888) 323-6374 or visit www.Valtir.com.

The instructions contained in this manual supersede all previous information and manuals. All information, illustrations, and specifications in this manual are based on the latest SS90™HD TMA information available to Valtir at the time of printing. Valtir reserves the right to make changes at any time. Please contact Valtir to confirm that you are referring to the most current instructions.

Part No. 618542

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Customer Service Contacts

Valtir is committed to the highest level of customer service. Feedback regarding the SS90™HD TMA, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from contact information below:

Valtir:

Telephone:	+1 (214) 589-8140 (USA) +44 (1473) 221105 (UK)
E-mail:	Valtir.com/Contact
Website:	www.Valtir.com

Important Introductory Notes

Proper assembly, deployment and future maintenance of the SS90™HD TMA are critical to achieve tested performance under accepted criteria. Take the time to review this manual thoroughly before performing all necessary work. These instructions should be read in their entirety and understood before assembling the SS90™HD TMA. These instructions are to be used only in conjunction with the assembly of the SS90™HD TMA system and are for standard assemblies only as specified by the applicable highway authority.

In the event your system assembly requires or involves deviation from standard parameters or, during the assembly process a question arises, please contact Valtir customer service. These instructions are intended for an individual who is qualified to both read and accurately interpret them as written. They are intended for the individual who is experienced and skilled in the assembly of highway products which are specified and selected by the highway authority.

If additional information is required about the SS90™HD TMA, please contact Valtir Customer Service. If there are deviations, alterations, or departures from the assembly protocol specified in this manual, the device many not perform as it was tested and accepted.

Important: It is the responsibility of the installer to maintain a safe work area including the use of standard work zone safety equipment & PPE: gloves, safety-toe shoes, and eye / ear protection.

Important: DO NOT use any component part that has not been specifically crash tested and/or approved for this system during the assembly or repair of this system.

Safety Symbols

This section describes safety symbols that may appear in the SS90™HD TMA manual. Read this manual for complete safety, assembly, operating, maintenance, repair, and service information.

Symbol	Meaning
	**Safety Alert Symbol:** Indicates Danger, Warning, or Caution. Failure to read and follow the Danger, Warning, Caution, or Important statements could result in serious injury or death to workers and bystanders.
	**Warning:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the SS90™HD TMA. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders.
	**Important:** Please keep up-to-date instructions for later use and reference by anyone involved with this product.

Safety Rules for Assembly

* Important Safety Instructions *

This manual must be kept in a location where it is readily available to persons who assemble, maintain, or repair the SS90™HD TMA. Additional copies of this manual are available from Valtir by calling +1 (214) 589-8140 or by e-mail at Valtir.com. Please contact Valtir if you have any questions concerning the information in this manual or about the SS90™HD TMA.

Important: It is the responsibility of the installer to use proper safety precautions when operating power equipment, mixing chemicals, and when moving heavy equipment or the SS90™HD TMA components. Hand, eye, foot, and back protection should be used.

Warning: Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while the TMA is in use. The traffic control plan established by the highway authority must always be observed when utilizing this product.

Limitations and Warnings

Valtir, in compliance with the NCHRP Report 350 “Recommended Procedures for the Safety Performance of Highway Safety Features”, contracts with FHWA approved testing facilities to perform crash tests, evaluation of tests, and submittal of results to the FHWA for review.

The SS90™HD TMA system was tested to meet the impact criteria, requirements, and guidelines of NCHRP Report 350. These tests, specifically set forth by FHWA, evaluate product performance by simulating those impacts outlined by NCHRP Report 350 involving a typical range of vehicles on our roadways, from lightweight cars (approx. 820kg [1800 lb.]) to full size pickup trucks (approx. 2000 kg [4400 lb.]) as specified by the FHWA. A product can be certified for multiple Test Levels. The SS90™HD TMA is certified to the Test Level(s) as shown below:

Test Level III: 100 km/h [62 mph].

These FHWA directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of NCHRP Report 350 as approved by FHWA.

Additionally, the SS90™HD TMA was tested to meet the impact criteria, requirements, and guidelines of TD 49. These tests are specifically set forth by The UK Highway Authority. The SS90™HD TMA is certified for various speed levels as shown in TL3.UK: 110 km/h [68 mph].

TL3.UK: 110 km/h [68 mph]

Highways Agency directed tests are not intended to represent the performance of systems when impacted by every vehicle type or every impact condition existing on the roadway. This system is tested only to the test matrix criteria of TD 49 as approved by the Highways Agency.

Valtir expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Valtir or by third parties.

The SS90™HD TMA system is intended to be assembled, delineated, and maintained within specific state and federal guidelines. It is important for the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. The customer should be careful to properly select, assemble, and maintain the product. Careful evaluation of the site lay out, vehicle population type; speed, traffic direction, and visibility are some of the elements that require evaluation in the selection of a highway product.

After an impact occurs, the debris from the impact should be removed from the area immediately and the product should be evaluated and restored to its original specified condition or replaced as soon as possible. All components and assemblies should be inspected and any parts that are damaged should be replaced with original Valtir replacement parts. Contact the Customer Service Department prior to repair if you have any questions (p. 3).

Warning: Ensure that the SS90™HD TMA and delineation used meet all federal, state, specifying agency, and local specifications.

Warning: Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards.

Safety Instructions

For maximum safety, the operator should stand at the rear of the truck on the curb side (Figure 2). When tilting the TMA, care should be taken to stay clear of all moving parts.

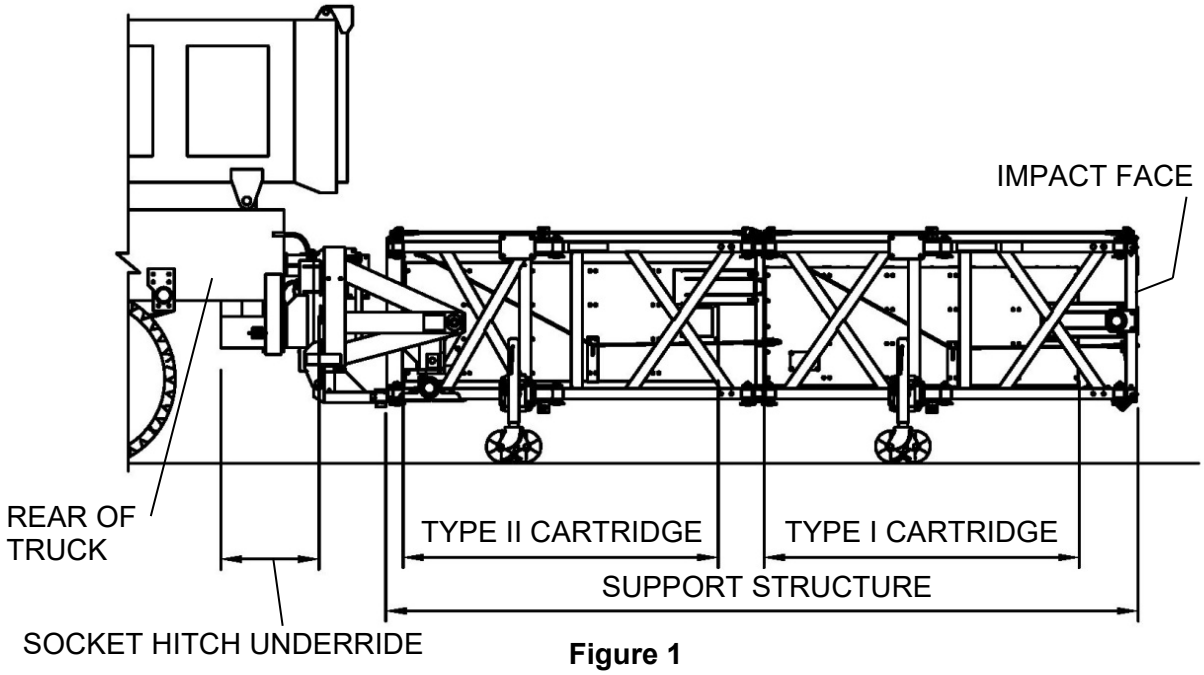


Figure 1

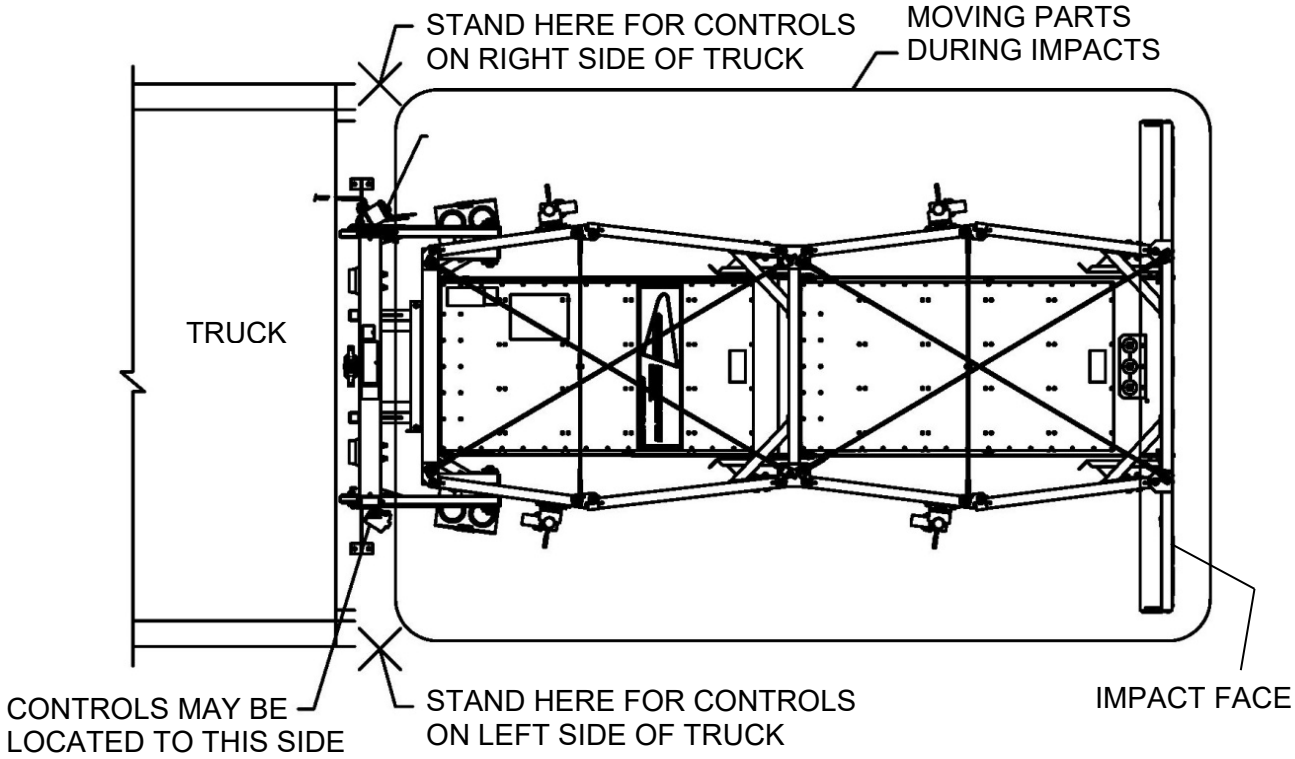


Figure 2

1. The TMA should be rigidly fastened to the truck. In the horizontal position, the bottom of the TMA should be 280 to 330 mm [11" to 13"] from the ground and level (Figure 3). The TMA must be left in the down position whenever possible. The TMA can only absorb the energy of an impacting vehicle within NCHRP Report 350 criteria in the down position.

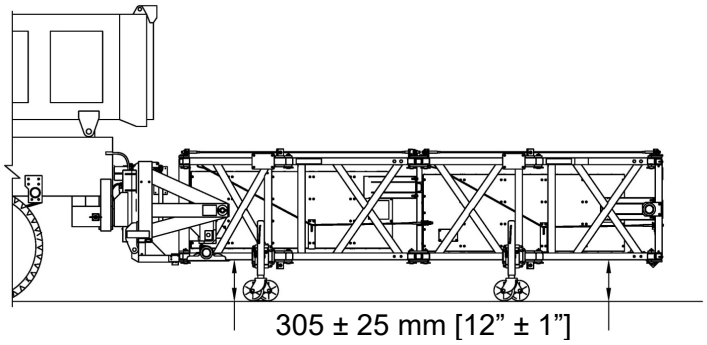


Figure 3

2. Jacks may be used to support the TMA when it is off the truck (Figure 3). The Jacks must be stored or removed while the TMA is attached to the truck (Figure 4).

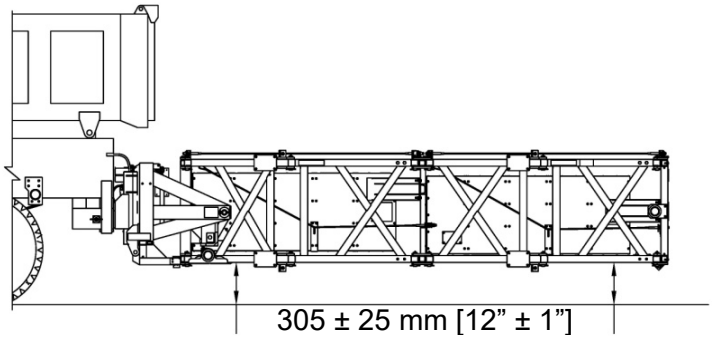


Figure 4

3. Make sure all pivot pins are in position and that all retaining pins are installed correctly (Figure 5).

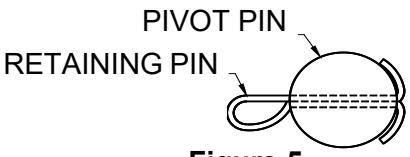


Figure 5

4. SS90™HD TMA has been shown to absorb an impact within the criteria of NCHRP Report 350 testing, and to support its own weight. **Do not drag the TMA or place anything on its top: damage may result (Figure 6). Do not sit, stand, or lean on any part of the TMA.**

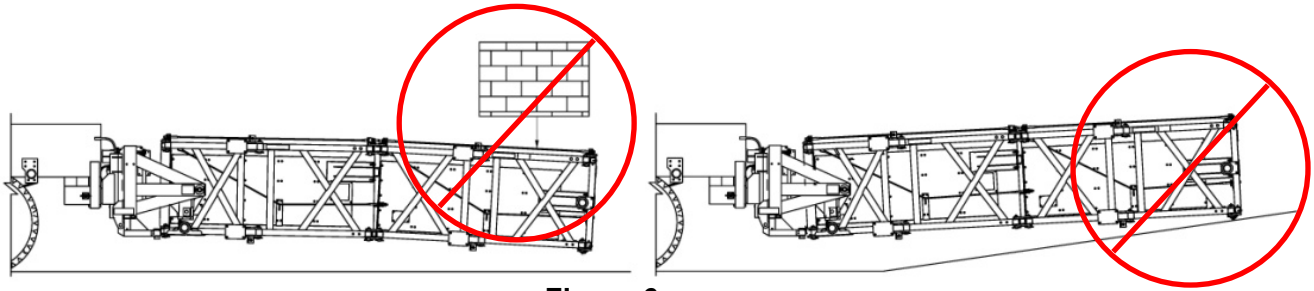
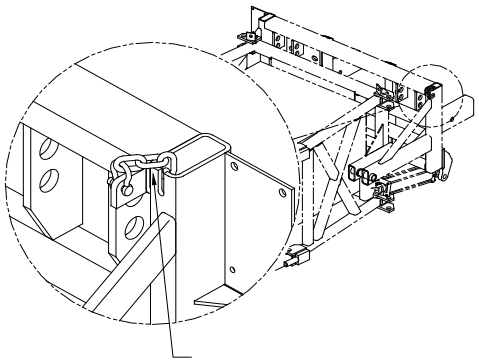


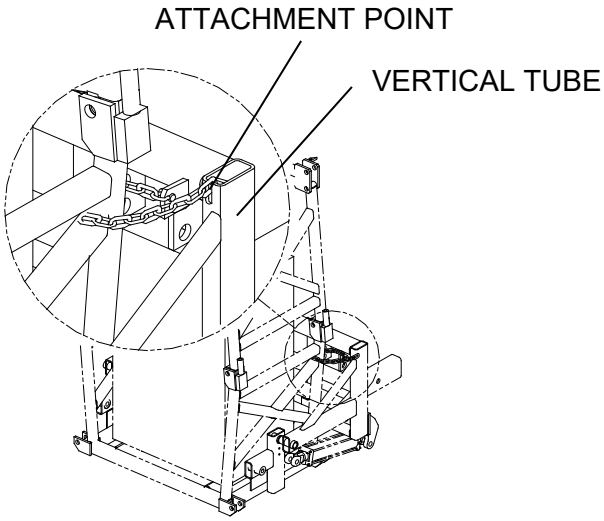
Figure 6

5. Before raising or lowering the TMA, the operator should be trained as to its proper operation. Refer to the Operation Instructions in this manual.
6. When traveling long distances or storing the TMA in the 90 degree (vertical) position, secure the Frame with the Retaining Chain to guard against hydraulic system bleed-down (see below).



PLACE THE RETAINING CHAIN INTO THE VERTICAL TUBE FOR STORAGE WITH THE TMA IN THE DOWN POSITION

Figure 7a



WHEN THE TMA IS IN THE UP POSITION, PULL THE RETAINING CHAIN OUT OF THE VERTICAL TUBE, WRAP THE CHAIN AROUND THE FRAME ARM AND SECURE IT TO THE ATTACHMENT POINT

Figure 7b

7. Be sure all persons are standing clear before raising or lowering the TMA. No one should be below the system when lowering it, or removing any retaining chain. Be sure the system is stopped and locked in full up position before allowing anyone directly behind the elevated system (Figures 7a, 7b & 8).

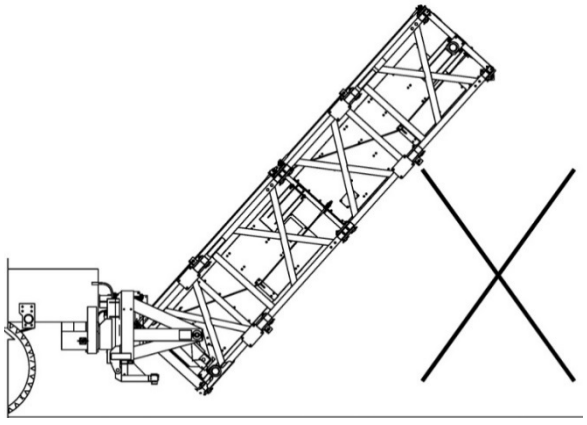


Figure 8

Warning: No one shall be allowed to stand behind or in the path of a moving or unlocked TMA. Failure to follow this warning could result in serious injury or death.

8. Ballast and other heavy objects **MUST BE ADEQUATELY ANCHORED** to the truck to prevent shifting during an impact as the force on the tie-down straps could be 20 times ballast weight (Figure 9).

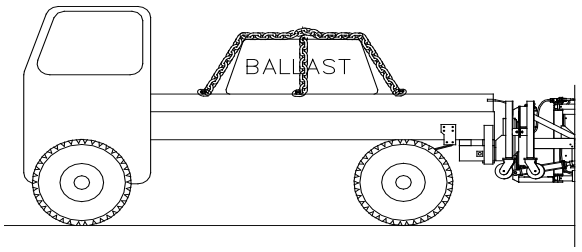


Figure 9

9. The agency or authority responsible for the truck should inspect it for adequate operator safety equipment (e.g., seat belts, head rests, etc.).
10. It is recommended that the SS90™HD TMA be mounted to trucks between 7300 kg [16,090 lbs.] and 9000 kg [19,845 lbs.] for tested impact performance.
11. Ensure that the performance and safety of the TMA is not impaired by damage or corrosion.

Caution: Failure to comply with these instructions can result in improper TMA performance and possible personal injury. This TMA is intended to be used as a crash attenuator on the rear of trucks which meet the design specifications for this system. The TMA should not be used for any other purpose.

12. Regular maintenance of the TMA is important for safe use. Refer to the Maintenance section of this manual for additional information.
    - Regular inspection of Frame members, Cartridges and pins is necessary to ensure proper system performance.
    - Regular maintenance of hoses is important. A broken or damaged hose may cause the system to lower at a faster and unsafe rate.
    - Keep electrical connections at the pump motor/solenoid clean to prevent arcing. Clean any hydraulic spills or leakage to prevent bodily injury, fire, etc.
13. The driver should be extra cautious while backing the truck with the TMA in the up or down position, so that injury and/or damage will not result.
14. The driver should be extra cautious while making turns with the TMA in the down position. The TMA extends beyond the end of the truck and will swing wide at corners.
15. When traveling long distances or storing the TMA in the 70-90° (vertical) position, secure the frame with the retaining chain to guard against hydraulic system bleed-down (p. 8).
16. This system is a crash cushion and is therefore used in high traffic risk areas. Stay clear of traffic whenever possible. If an accident is to occur, even during an impact, within NCHRP Report 350 criteria there may be fragments from the truck or impacting vehicle that could cause injury.

17. The hydraulic assembly was designed to lift and lower the TMA system as described. Any other use may be hazardous to people or equipment.
    - Do not use the system to push a load.
    - Do not use the raised end of the system to support any load.
    - Do not use any part of the TMA for towing or hauling a load. This could cause the lift mechanism to malfunction and may reduce the impact performance.
    - Do not use the TMA as a ladder.
18. The system must be in the horizontal position to perform properly during an impact. Do not leave the system raised, even slightly, when on the job.
19. Ensure the truck is appropriate for attaching a TMA (p. 13).

Definitions:

A **BARRIER VEHICLE** is a truck on which a TMA is mounted, while positioned upstream (towards the direction that traffic is approaching) of a work zone.

A **SHADOW VEHICLE** is a truck on which a TMA is mounted, which is following behind a moving operation such as striping, spraying, etc.

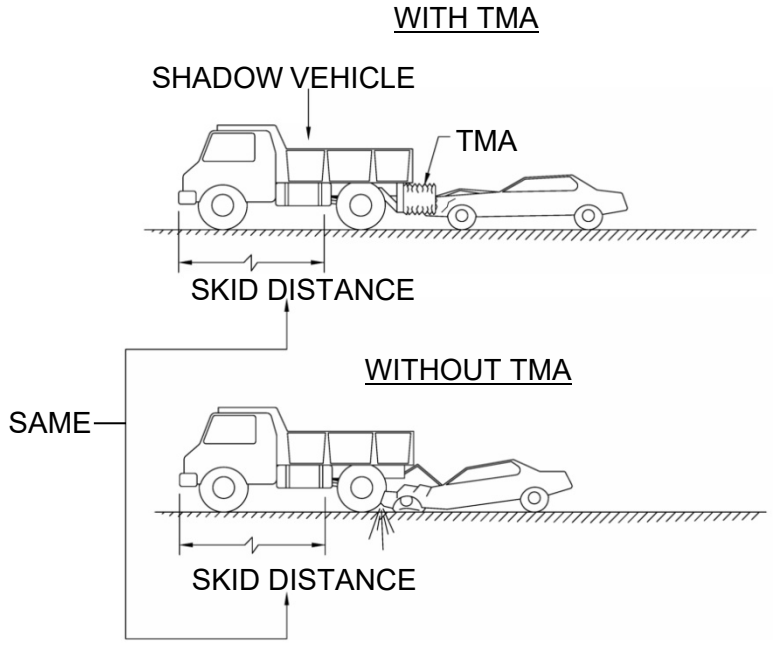


Figure 10

THE USE OF A TMA ON THE BACK OF A TRUCK, WHEN IMPACTED WITHIN NCHRP REPORT 350 CRITERIA, HAS BEEN SHOWN TO:

- Gradually stop the impacting vehicle*
- Protect the occupants of the impacting vehicle*
- Protect the shadow vehicle occupants*
- Reduce damage to the shadow vehicle*

WILL NOT:

- Affect the skid (roll ahead) distance of an impacted truck. **KEEP WORK CREWS CLEAR!**

REDUCING SKID DISTANCE (ROLL AHEAD):

- Skid distance is significantly increased and is less predictable for lightweight shadow vehicles
- Skid distance is reduced and is more consistent when heavier shadow vehicles are used.
- Preferred truck GVW rating is:
  7300 kg [16,090 lbs.] to 12 000 kg [26,460 lbs.]
- Recommended Curb Weight is:
  7300 kg [16,090 lbs.] to 9000 kg [19,845 lbs.]

***TMA'S HAVE BEEN TESTED UNDER THE FOLLOWING NCHRP REPORT 350 CRITERIA:**

- 100 km/h [62 mph] for 820 and 2000 kg [1808 and 4410 lbs.] vehicles.

***TMA'S HAVE ALSO BEEN TESTED UNDER THE FOLLOWING UK TD 49 CRITERIA:**

- 110 km/h for 900 and 1500 kg vehicles.

Attachment Instructions

Read and understand all instructions before beginning assembly.

Important: The truck rating (GVW) should be 7300 kg [16,090 lbs.] minimum. The weight of the vehicle should be between 7300 and 9000 kg [16,090 and 19,845 lbs.] to achieve impact performance under state and federal guidelines.

The system must be attached to the truck by welding parts to the frame. Do not weld forward of the rear leaf spring hangers to ensure structural integrity of frame. Use a qualified welding technician to ensure durable attachment of the TMA system.

Note: Disconnect the truck battery before any welding on truck or TMA.

The truck frame must be suitable and accessible for mounting a TMA system. If there are any questions regarding the suitability, contact the agency that specified this system. Valtir is available for consultation through that agency.

Shipping list

Check the shipping list against the actual parts to make sure all items were received. Review the drawing package and familiarize yourself with the assembly and part numbers.

Recommended Tools

- Welding equipment (for 1/2” plate) GMAW or SMAW
- Cutting torch
- Hammer
- Drift pin or alignment pin (12” long)
- Tape measure
- 1/2” drive socket wrench w/6” extension
- 1/2” drive sockets (9/16”, 1-1/8”, 1-1/2”, 9/16” deep well)
- Open end wrenches –(9/16”, 1-1/8”, 1-1/2”)
- 12” crescent wrenches – (2)
- Marking implement (pencil, soap stone)
- Floor jack
- Drill for 13/16" diameter bit
- 13/16" diameter bit and pilot drill bit for same
- Center punch
- Torque wrench - 120 Nm [90 ft-lb]
- Hydraulic fluid (use Dexron® III fluid only) - Shipped with system
- Forklift
- Work gloves, eye protection, safety-toe shoes and other personal protection equipment as required
- Bubble level

Note: The above list of tools is a general recommendation and should not be considered an extensive list. Depending on specific site conditions and the complexity of the assembly specified by the appropriate highway authority, the required tools may vary. Decisions as to what tools are needed to perform the job are entirely within the discretion of the specifying highway authority and the authority’s selected contractor performing the assembly of the system at the authority’s specified assembly site.

Preparation

Step 1 - Attachment Must Be Performed On a Level Surface

The system's framework is very heavy and pivots in several areas. Until the framework is secured with the alignment cables and release cables, it can swing out in an approximate 4 m [13'] radius from either side of the truck. A level surface is required to maintain control of the framework when it is being extended to its full length.

Step 2 - Truck Ballast

Use a bubble level to verify that the truck is parked on a level surface. The truck should be as close to the final driving weight as possible. If ballast must be added to achieve the 7300 kg [16,090 lbs] minimum weight, add it at this time. Ballast must be properly anchored to the truck to keep it in place during an impact. Ideally, an adequately sized truck, that requires no ballast, should be used. Because the 910 kg [2000 lbs] weight of the rearward protruding TMA is supported by the back of the shadow vehicle, care must be taken not to exceed the manufacturer's published maximum axle loads. To ensure that the driving characteristics of the vehicle are maintained, the manufacturer's recommended center-of-gravity zone should also be adhered to.

Step 3 - Check for Interference

Before attempting to attach the Underride, check for interference problems.

The system rotates very close to the mounting location (Figure 37 on p. 33). If you are using something other than a standard socket receiver hitch underride, refer to special instructions supplied with your assembly, then skip to step 8.

Temporarily position the Underride Socket Receiver under truck frame as shown (Figure 12) and check for interference problems. Interference problems with tail lights, springs, dump bodies (in the up or down positions), etc., should be corrected before proceeding.

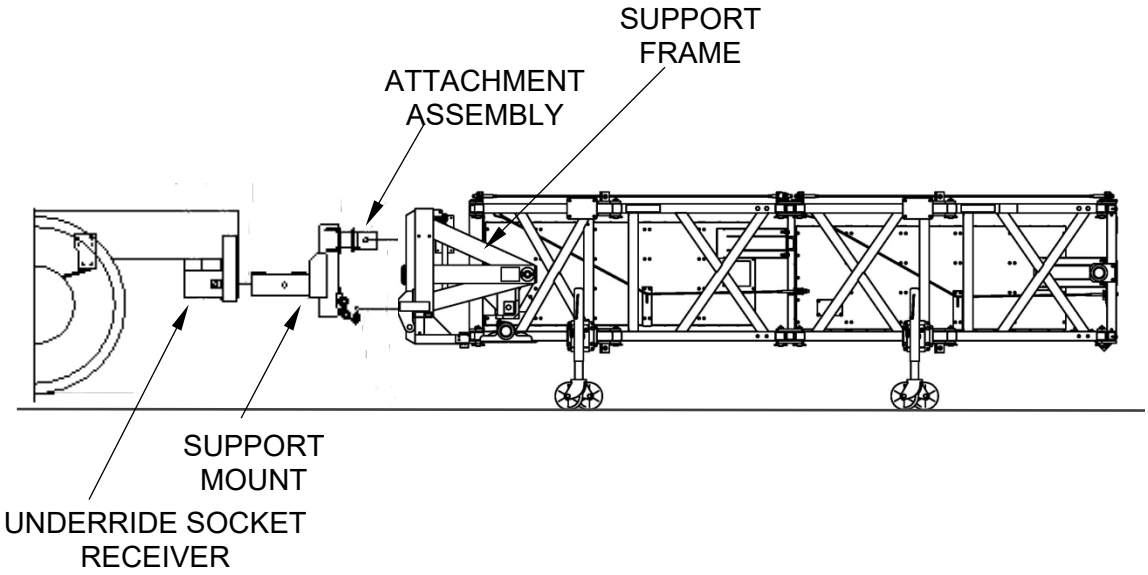


Figure 11

Step 4 - Underride Assembly

Park the truck on a level surface. Make sure the truck is at its actual driving weight. Measure the distance from the ground to the bottom of the truck frame. A distance of 711±25 mm [28±1"] is required. Spacers may be added to the bottom of the frame to achieve this height (Underride Assembly drawing).

Important: The truck's springs may settle with the weight of the TMA, sometimes, as much as 50 mm [2"]. Adjust the height to compensate for anticipated settling.

Measure the distance from the back-end of the frame to the rear-most leaf spring hanger (or any other obstruction on the bottom of the frame that may interfere with the Socket Receiver). A minimum of 305 mm [12"] is required (p. 37).

Position the Socket Receiver at the rear end of the frame so that the 76 x 387 mm [3" x 15 1/4"] flat bar is along the outside of the frame member and the Socket Receiver Tube is flush with the end of frame. If Spacers are required, weld them to the Receiver Tube and lap the Spacer Splices (pieces of 10 x 51 x 103 mm [3/8 x 2 x 4"] flat bar) across the Socket Receiver Tube and Spacer at the rear-most location (p. 48). The top of the Socket Receiver Tubes to be 711 ± 25 mm [28 ± 1"] from the level ground for proper system height (Figure 13).

Weld the Socket Receiver Tube to the bottom of the truck frame with the 76 x 387 mm [3 x 15 1/4"] flat bar on the outer side of the frame (Figure 12).

Important: Welding must be performed by professional or certified welder.

Caution: The truck frame is high carbon steel. To avoid cracking, do not weld or apply excessive heat to the bottom flange, forward of rear-most leaf spring hangers.

Prime and paint all welded areas.

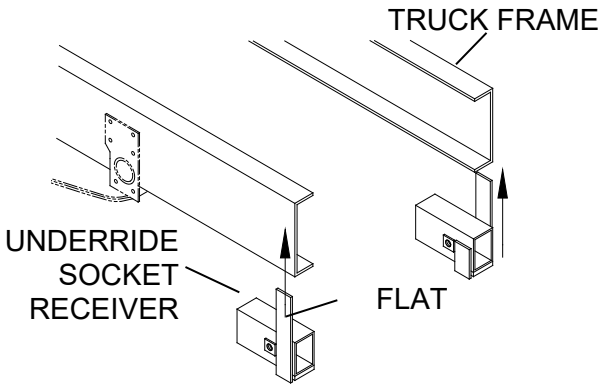


Figure 12

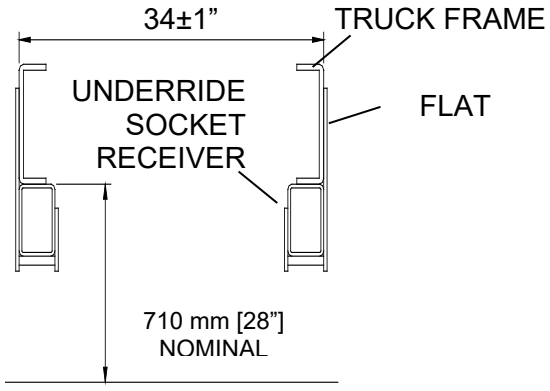


Figure 13

Important: Left and right Underride Socket Receivers must be parallel and level with each other.

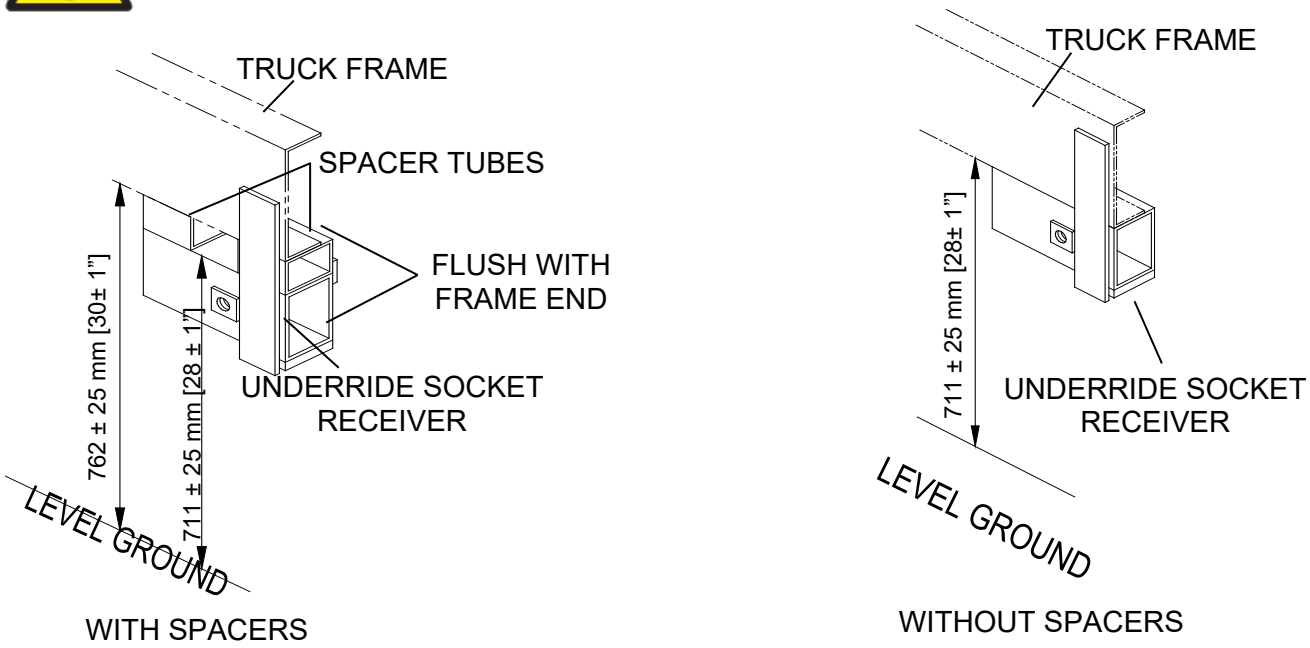


Figure 12 – Socket Hitch
Left Side Shown

Step 5 - Socket Hitch Assembly

Inset the Socket Hitches and pin them into place using the 1 x 6 1/4" Hitch Pins and Retainer Pins shipped with the system.

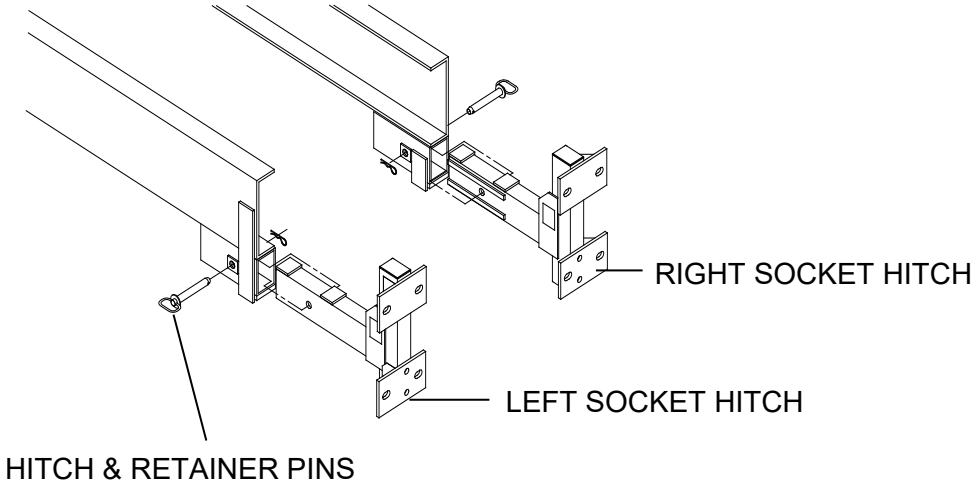


Figure 15

Step 6 - Mount the Attachment Assembly to Socket Receivers

Mount the Attachment Assembly to the Socket Hitches as shown in Figure 16. Shims are used to level the system. It is recommended that 1/2" Shims be used initially. This may be adjusted once the system is assembled.

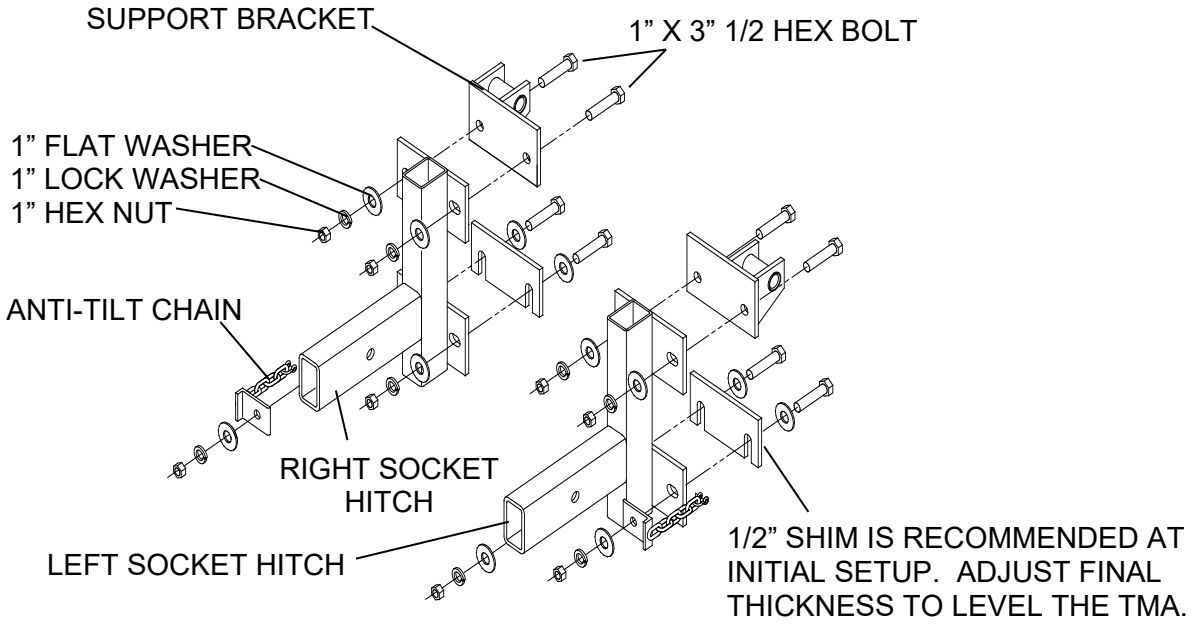


Figure 16

Step 7 - Attach the Support Frame/Backup to the Attachment Assembly

Move the Support Frame/Backup Assembly to the truck and pin it to the Attachment Assembly, as shown in Figure 17. The Support Frame/Backup Assembly is to be attached while frame is still collapsed, with forklift slings supporting the system. Use the upper set of mounting holes for the attachment. Electrical Box is temporarily held by zip ties and may need to be removed for clearance issues.

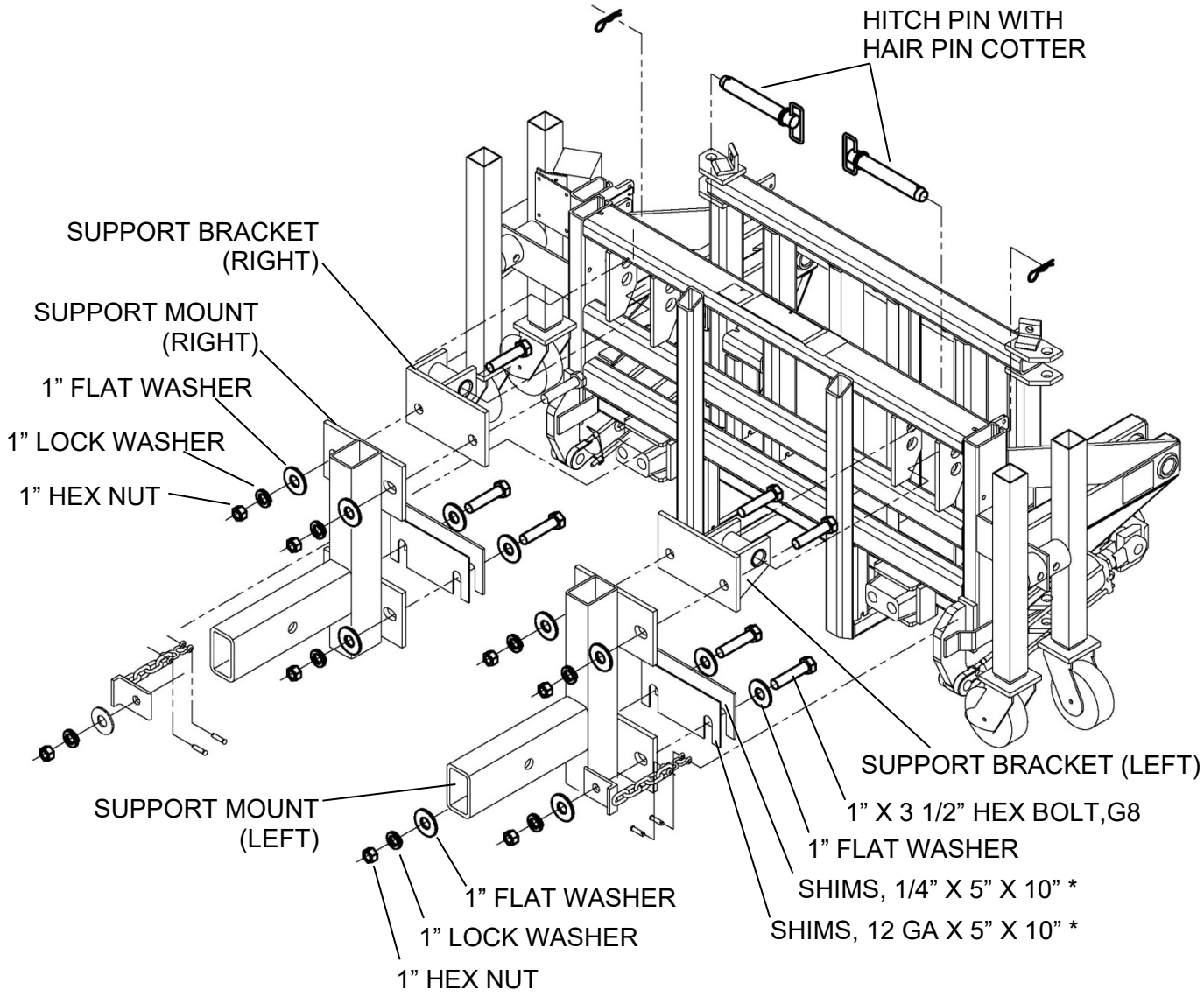


Figure 17

Step 8 - Extend the Support Frame

With the TMA pinned to the Attachment Assembly, slowly and evenly pull the Frame Assembly out to its full extent.

Warning: Use extreme care when handling the frame as it can be unwieldy. Failure to heed this warning could cause serious injury or death.

Warning: Until the cables are attached, the system could shift to one side.

Step 9 - Attach Corner Gussets

Using 1/2” bolts, nuts, flat washers and lock washers, attach Corner Gussets four places as shown in Figure 18.

Warning: Pinch point hazards exist when attaching Corner Gussets.

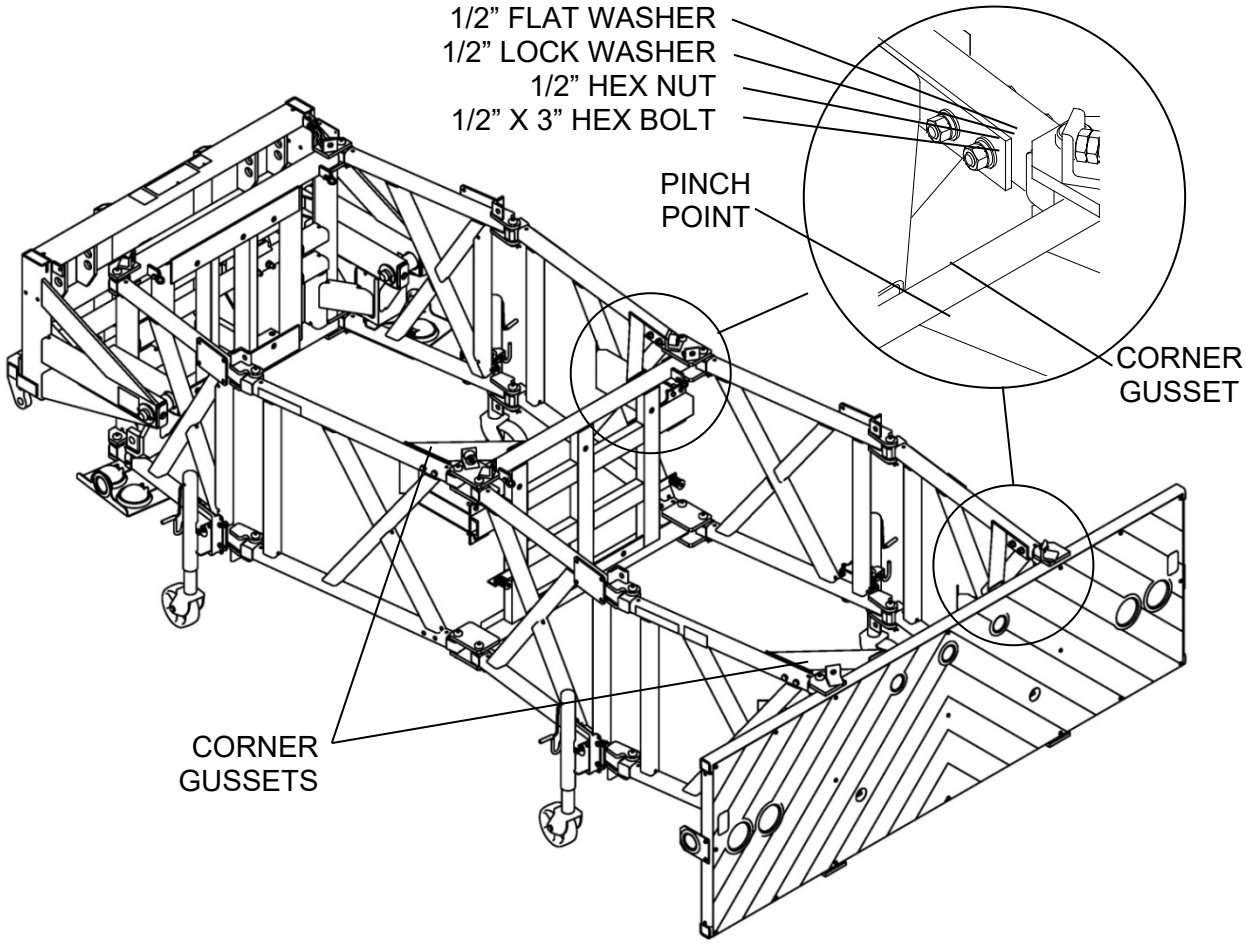


Figure 18

Step 10 - Attach the Bottom Release Cables across the Arm Assemblies.

Warning: For proper system performance, use only Release Cables supplied by Valtir. Failure to use the correct equipment could result in unpredictable system performance.

Verify that the Frame is extended as far as it will go. Attach the Bottom Release Cables across Arm Assemblies (Figure 19). Torque the nuts to 34 -0/+3 Nm [25 -0/+2 ft-lb], making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using remaining fasteners as "jam" nuts.

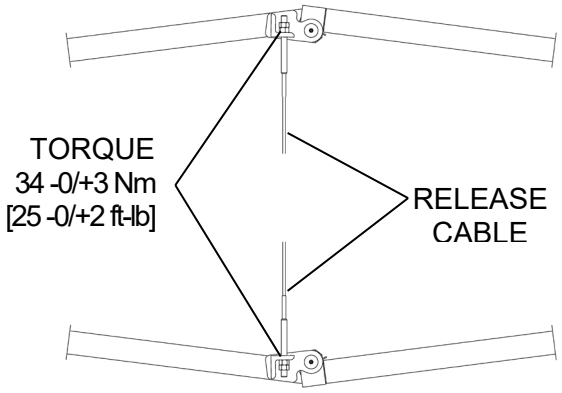


Figure 19

Step 11 - Attach Cartridges (Figure 20)

(If Alignment Cables are already attached, remove one end of each Alignment Cable from the TMA and set aside to clear the top side of each bay.) Using a forklift and sling, place Cartridge I (PN 606002B) in position and secure it using the flat washers, lock washers, and nuts provided. Torque the nuts to 120 ± 7 Nm [90 ± 5ft-lb] and repeat same procedure for Cartridge II (PN 606008B).

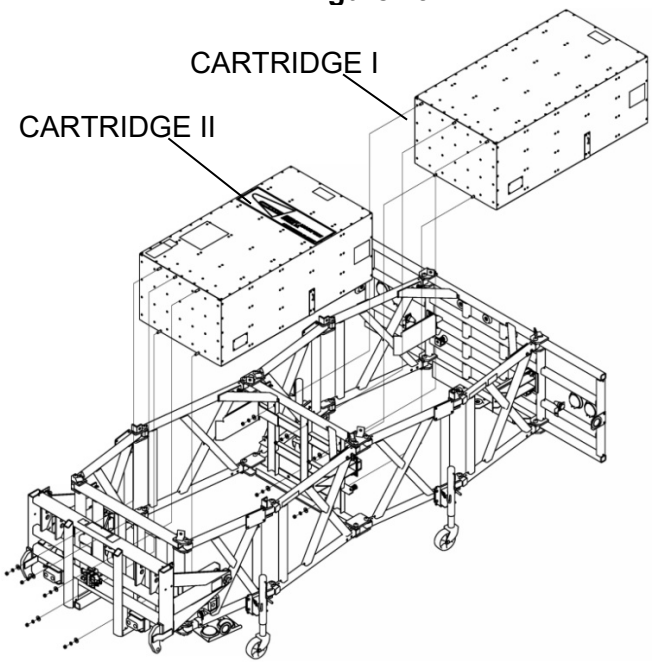


Figure 20

Step 12 - Attach the Top Release Cables across the Arm Assemblies

Attach the Top Release Cables across the Arm Assemblies (Figure 19). Torque the nuts to 34 Nm (25 ft-lb), making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock Release Cables in place using the remaining fasteners as "jam" nuts.

Step 13 - Attach and adjust Alignment Cables.

There are four Alignment Cables (two for each bay). Attach the Alignment Cables as shown in Figure 21. Measure the diagonals of each bay and adjust the cables so that the diagonal measurements in each bay are the same within the given tolerance (A = B ± 5 mm [3/16"], C = D ± 5 mm [3/16"]) and taut. Cables are "taut" when they deflect 38 mm - 50mm [1 1/2" - 2"] when pressed by hand at the center.

Important: The Die Springs, Spring Spacers, and flat washers (Figure 21 and Detail B) are only used at mid-frame, on the front two Top Cables, i.e. the two cables closest to the truck.

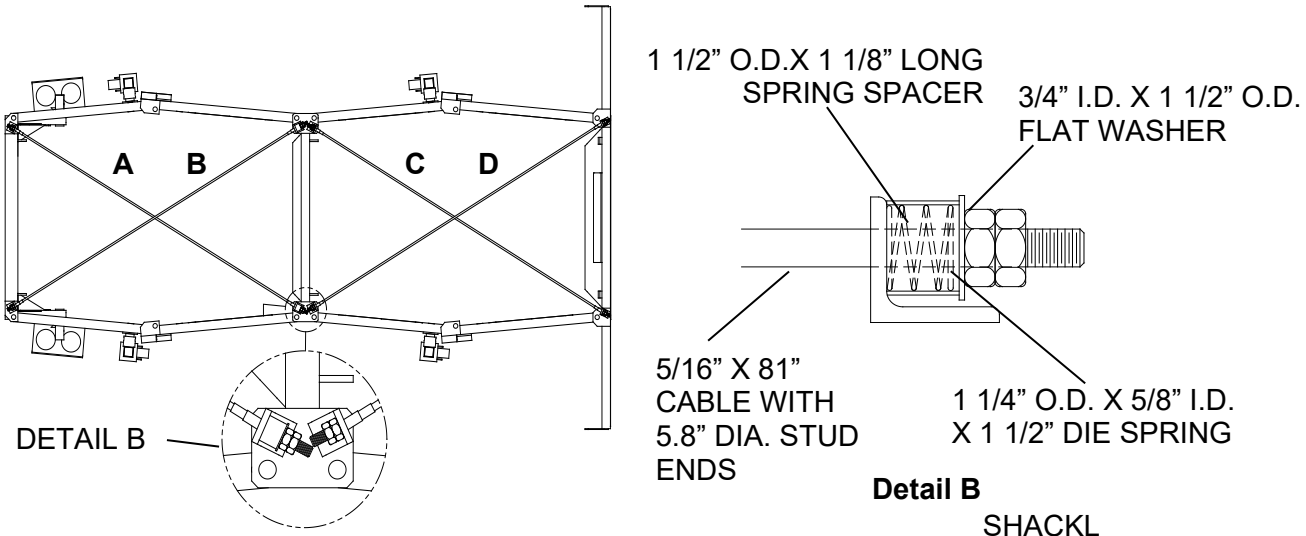


Figure 21 (Support Frame not shown for clarity)

Step 14 - Attach and adjust Cartridge Support Cables.

There are four Cartridge Support Cables. Attach thimble end of all Cartridge Support Cables to the Frame as shown using the provided shackles. Pass the stud end of the cable through the corresponding cartridge chain loop and attach as shown in Figure 22 using a die spring, washer, and nuts.

To properly tension the Cartridge Support Cables, tighten the first nut on one cable until all slack is removed, then tighten it until the Tensioning Spring has been compressed to 32±2 mm [1 1/4±1/16"]. Lock this nut in place with the second "jam" nut. Repeat this procedure with other cables.

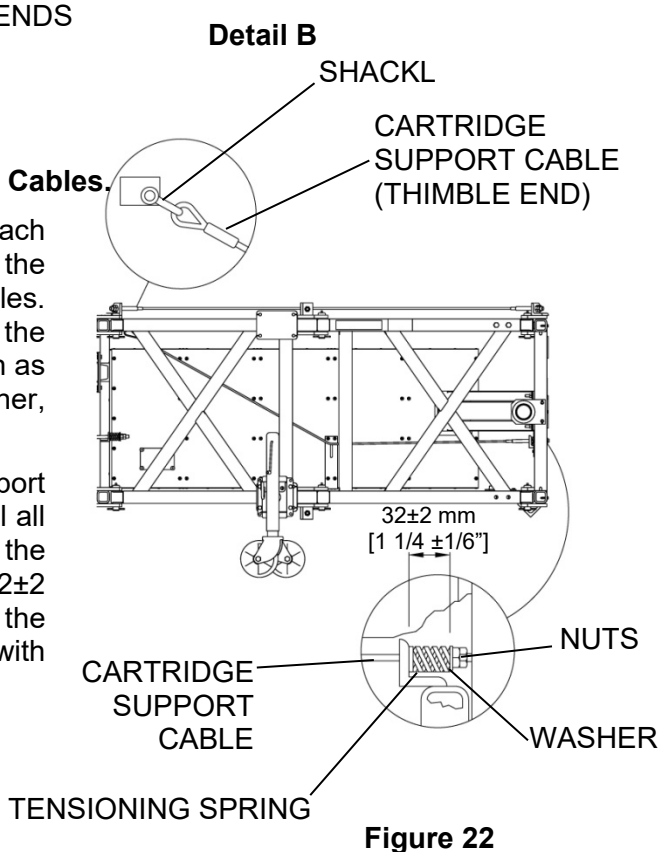


Figure 22

Step 15 - Attach Side Guides.

There are four Side Guides, two for Bay 1 and two for Bay 2. Attach Side Guides as shown in Figure 23 and tighten bolts.

Step 16 - Adjust height and levelness of the System Frame.

Verify that the system Frame is 305 ± 25 mm [12 ± 1"] from the ground at the front and rear of the system. It may be necessary to add or remove Shims from the Socket Hitch in order to adjust the levelness of the cartridge (Figure 24 & Detail 24a).

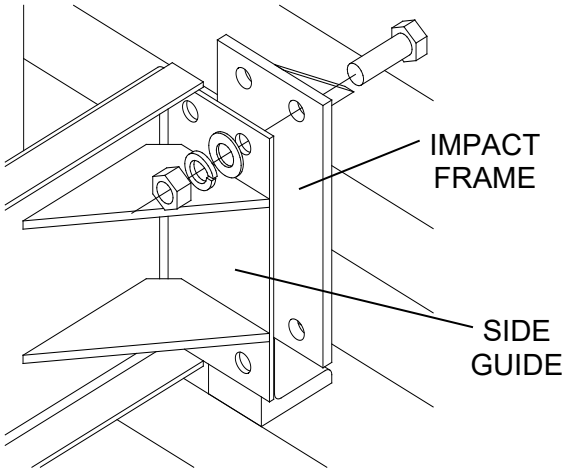
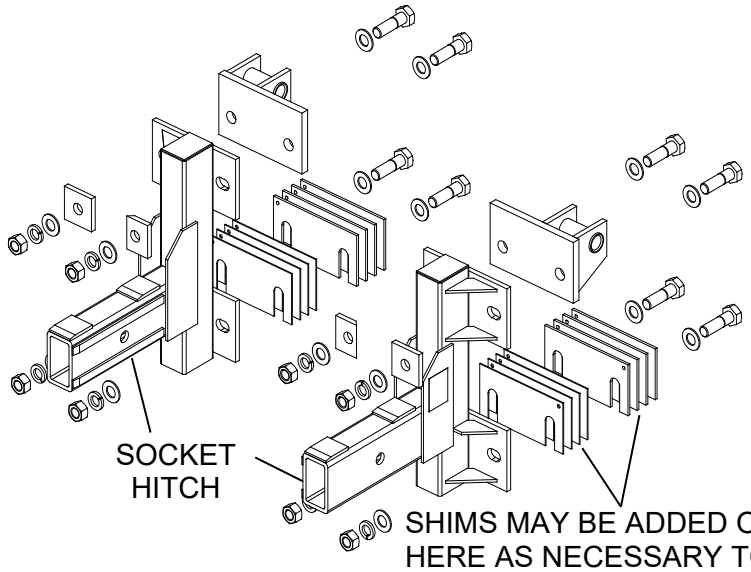


Figure 23



Detail 24a

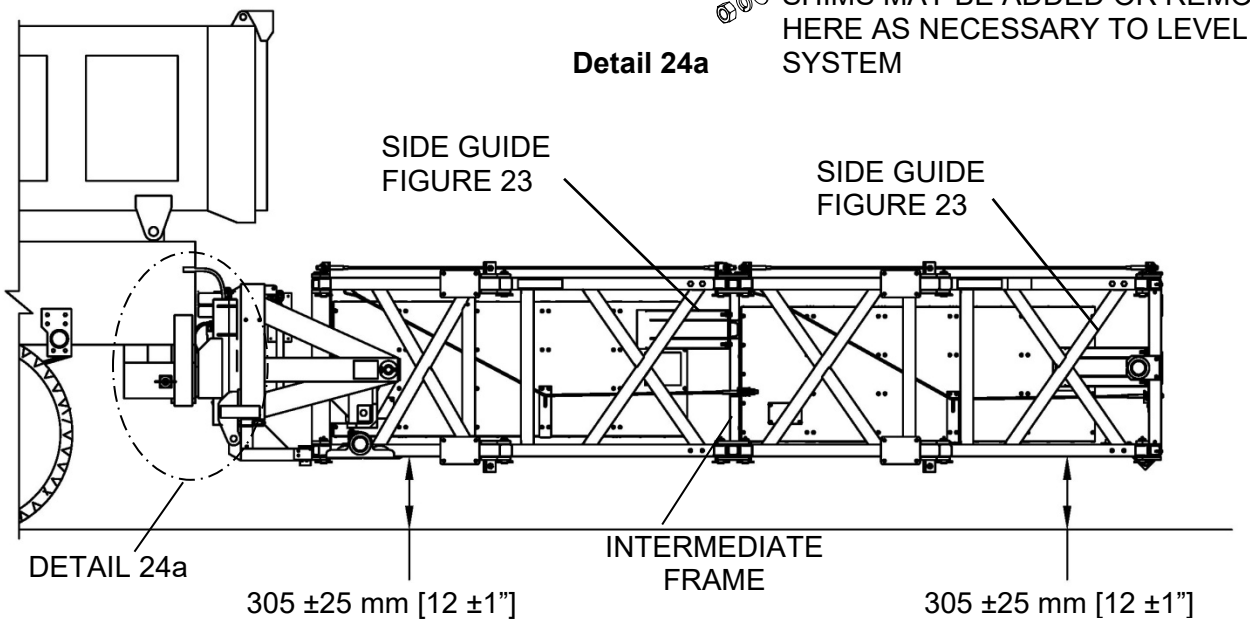


Figure 24

Step 17 - Connect the Lights and Controls.

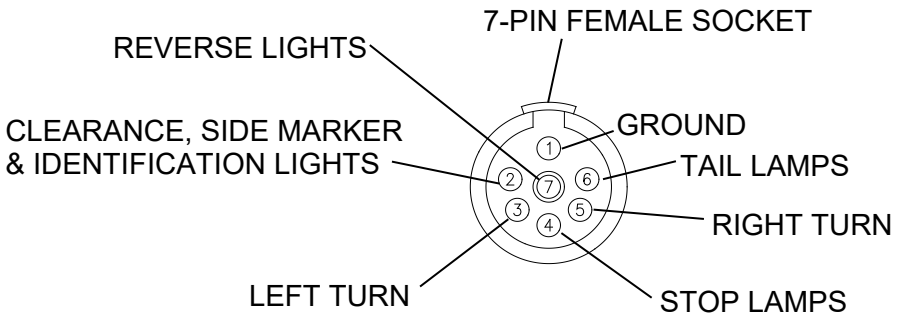
Locate the female TMA socket connector in a convenient location on the truck, so that lifting or lowering the TMA will not damage the electrical cable. Make sure that the electrical cord on the TMA can reach this location.

For support vehicles with combined tail and clearance lights, connect a jumper between pins 2 and 6 on the backside of the male TMA plug (View A-A & Figure 25.)

Install the Electrical Box to Plate mounted next to Pump (p. 54) with the 4 bolts, washers and nuts on the Electrical Box. The truck battery must be of the proper voltage. The SS90™HD is available in 12 and 24 volt systems. Be sure the system and truck are compatible. Use standard safety practices when attaching the battery cables (e.g. do not let the ends of the cables touch, etc.) Do not run the battery cables around sharp corners, metal work, or in areas that would pinch or cut the cables. Connect the battery cable to the pump motor (p. 54).

Important: A 2 gauge battery cable (PN 618356B) is good up to 7.6 m [25'] for a 12V system. If longer cable is needed use 1/0 gauge up to 12.5 m [44']. Both Power and Ground Cables should be connected directly to the battery.

The controls at the rear of the truck should be mounted to the Support Frame, on the non-traffic side (side closest to the curb). If they are not, remove the fasteners and move the controls to the other side. Securely fasten the controls to the existing mounting bracket. Mount the cab switch box inside the cab within easy reach of the driver.



View A-A – Back side of Socket Connector

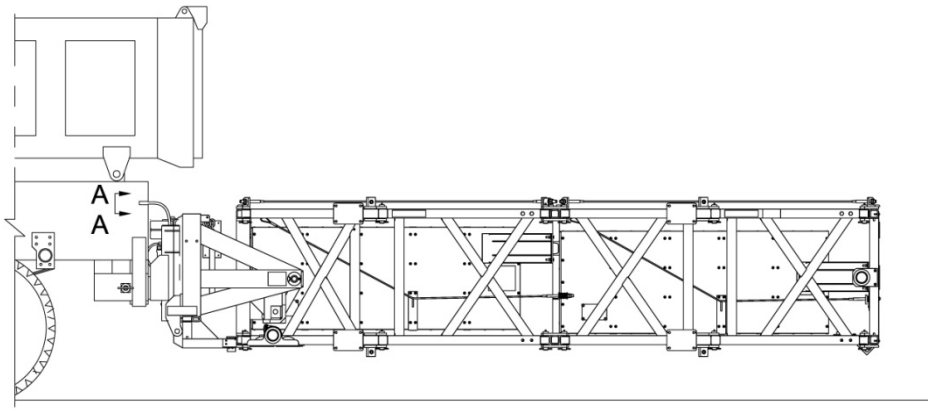


Figure 25

Step 18 - Check the Hydraulic System

The Hydraulic System is pre-assembled and tested for operation and leaks before shipping. The pump is wired as shown on the Hydraulic Assembly drawing (p. 54). Before operating the system, remove the cap from the fill port of the hydraulic reservoir and check to see if the reservoir is full. Add only Dexron® III fluid if it is not. Do not overfill. Replace the vent plug in the filler port.

Read Operation Instructions. Making sure all electrical and hydraulic lines will not be damaged, use the switch at the rear of the truck, power the system up and down twice. This purges air from the system. Also cycle the system using the Cab Switches to verify proper operation.

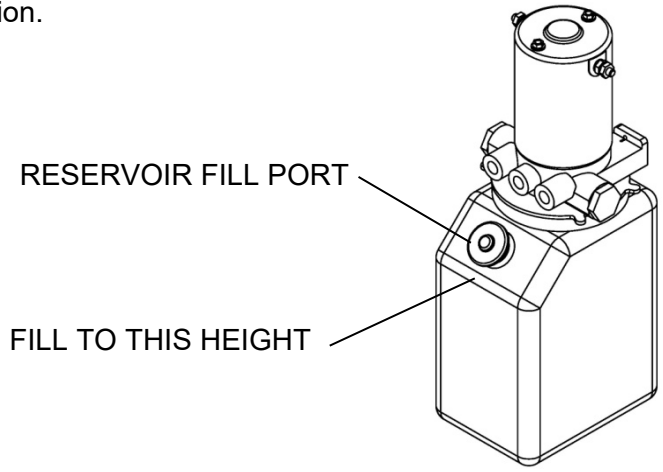


Figure 26

Important: Continuous operation may run down truck battery.

Step 19 - Remove and store Jacks

The Jacks are provided to facilitate attachment and removal of the system from the truck. Remove all four jacks and place them in storage.

Step 20 - Verify Turn-Stop-Tail Light Operation

Plug in the light cable. Verify that all the turn/stop/tail lights are working properly.

Step 21 - Check position of the Hydraulic/Electrical lines

Check the location of all the hydraulic and electrical lines to be sure they will not be damaged during turning or tilting of the system up or down.

Step 22 - Verify Hydraulic Locking in the Up Position

If the system is tilted from horizontal, the TMA's Hydraulic system will automatically lock when the switch is released. The pump is used to raise and lower the system.

Caution: Each time the TMA is raised, the operator should verify that the system is hydraulically locked and chained before allowing anyone behind the system.

Step 23 - Grease Friction Points

Follow directions in the Maintenance section IV (Lubrication) parts 2 & 3 before first use of TMA (p. 31).

Step 24 - Final Check of System

Check the tightness of all of the fasteners. Double check the height and levelness of the system.

Step 25 - Ready for Use

The TMA system is now ready for use. To ensure proper and safe operation, all TMA users should be given operating and safety training, as given in this manual and as specified by the owner and local regulations.

Warning: Do NOT modify the SS90™HD TMA in any way.

Operation Instructions

Before operating the SS90™HD TMA, thoroughly read and understand these instructions and the safety section of this manual. Verify that the system is properly attached and in working order.

For impact performance per NCHRP Report 350 crash testing, the TMA must be equipped with one Cartridge I (PN 606002B) and one Cartridge II (PN 606008B), in their proper positions as shown in Figure 20 (p. 19).

The SS90™HD TMA has been equipped with a Hydraulic Pump that can be used to tilt the TMA up from its horizontal position. The "tilting" feature may be used to prevent possible scraping of the rear end of the system as the truck travels in and out of sloped driveways. The operator simply activates the "up" button to tilt the TMA up. When he removes his finger from the button, the TMA will hydraulically lock. To lower the TMA, the operator simply activates the “Down” button. The Buzzer will continue to buzz (and rocker switch with flash on optional Cab Controller) until the TMA is either all the way up or down. Optional In-Cab Controller is available (PN 618504B).

The complete vertical "up" position allows the TMA equipped truck to be more easily driven and parked in congested areas. The driver must make sure everything is clear before lowering the TMA from the vertical (up) position.

The system can only perform as a crash cushion when the system is in the down position.

While raising or lowering the TMA from outside the cab, the operator is to stand on the non-traffic side of the truck. Always stay clear of moving parts. Never stand behind or below a lowering TMA, or allow others to be positioned there.

The controls are located on one side of the Support Frame. An optional set of controls can be located in the truck cab (Cab Controller PN 618504B).

Raise and Lower the System

Warning: Make sure the top of the system is clear of all objects before proceeding. **Under no circumstances should anyone be allowed behind or in the path of the system when it is being raised or lowered.**

When operating from the cab, always be aware of objects behind or below the TMA.

Raising the system

To tilt the system up: Press and hold the "Raise" side of the Rocker Switch until the system reaches the 90-degree position. The hydraulics automatically locks the system when the Rocker Switch is released. In the 90 degree position, the Restraining Chain should be used to ensure that the system stays in the 90 degree position for long term storage and for maintenance.

Caution: If someone will be doing maintenance behind the raised system, or if the system is to be stored in the "up" position, be sure to secure the system with the Retaining Chain as shown in Figure 27.

Warning: **NEVER REMOVE RETAINING CHAINS WHILE WORK IS BEING PERFORMED.**

WHEN THE TMA IS IN THE “UP” POSITION, STAND TO THE SIDE AND PULL THE RETAINING CHAIN OUT OF THE VERTICAL TUBE, WRAP THE CHAIN AROUND THE FRAME ARM AND SECURE IT INTO THE SLOT.

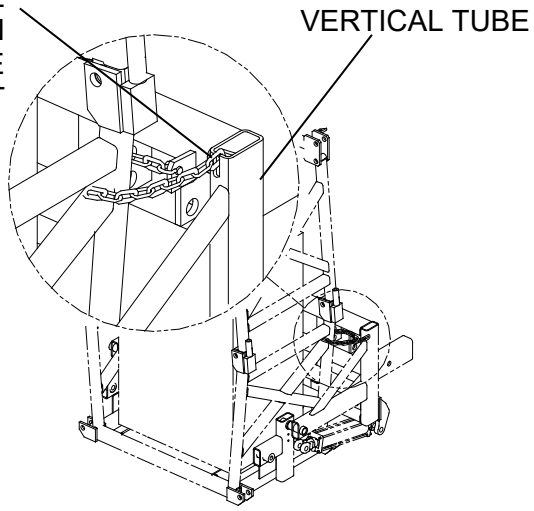


Figure 27

Lowering the system

When lowering the system, be sure that the Restraining Chain is placed in the “unlocked” position and that no person is behind the system. Then, press and hold the "Lower" side of the Rocker Switch.

Maintenance

Before performing any Maintenance on the SS90™HD TMA, thoroughly read and understand the Maintenance Section and the Safety Section of this manual. If maintenance is to be performed with the system in the vertical ("up") position, be sure to secure the system with the Retaining Chain.

I. Routine Maintenance

Description	Interval
1. Height and Levelness - The height and levelness of the system is important to its impact performance. Check regularly and adjust as necessary (see below).	A/R*

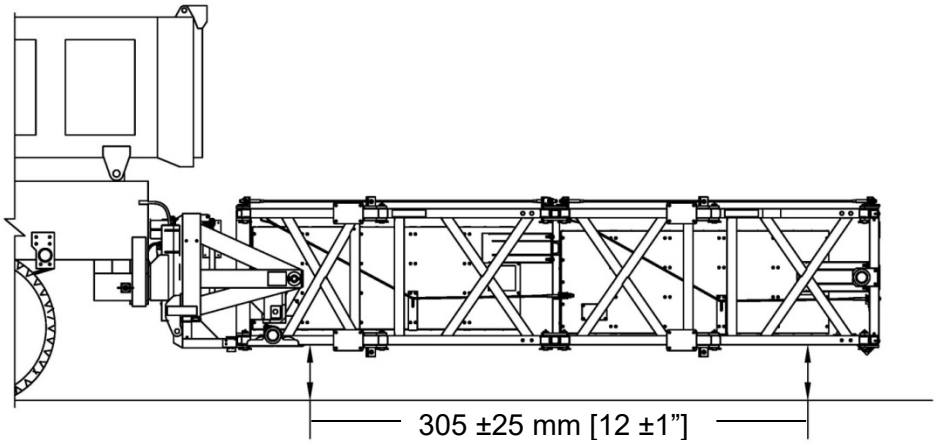


Figure 28

2. Fasteners - Check the tightness of the fasteners monthly. See drawings in back for all fastener locations. Be sure to check bolts attaching the Cartridges to the Support Structure. Lock washers should be fully compressed.	1 Month
3. Hydraulic Cylinders, Hoses and Fittings - Inspect all hydraulic lines and connections for leaks. If the TMA sits overnight, check the ground underneath for fluid drip spots.	Each use
4. Cables - Check the tension in the Cartridge Support Cables. With the system in the horizontal position, tighten the first nut on one cable until all the slack has been removed. Then tighten until the tension springs have been compressed to 1 1/4± 1/16 " in height. Lock tension nut in place with the second jam nut. Repeat this procedure each Alignment Cable. Check and adjust monthly or when loose (p. 20).	1 Month or when loose
5. Swivel Jacks – Inspect Jack wheel condition monthly or as required.	1 Month
6. Light Bulbs - Replace the light bulbs as required.	A/R*

*A/R = as required

Description	Interval
7. Pivot Pins - Prior to each use, ensure all Pins are held in position with a Retaining Pin as required (Figure 29).	Each use

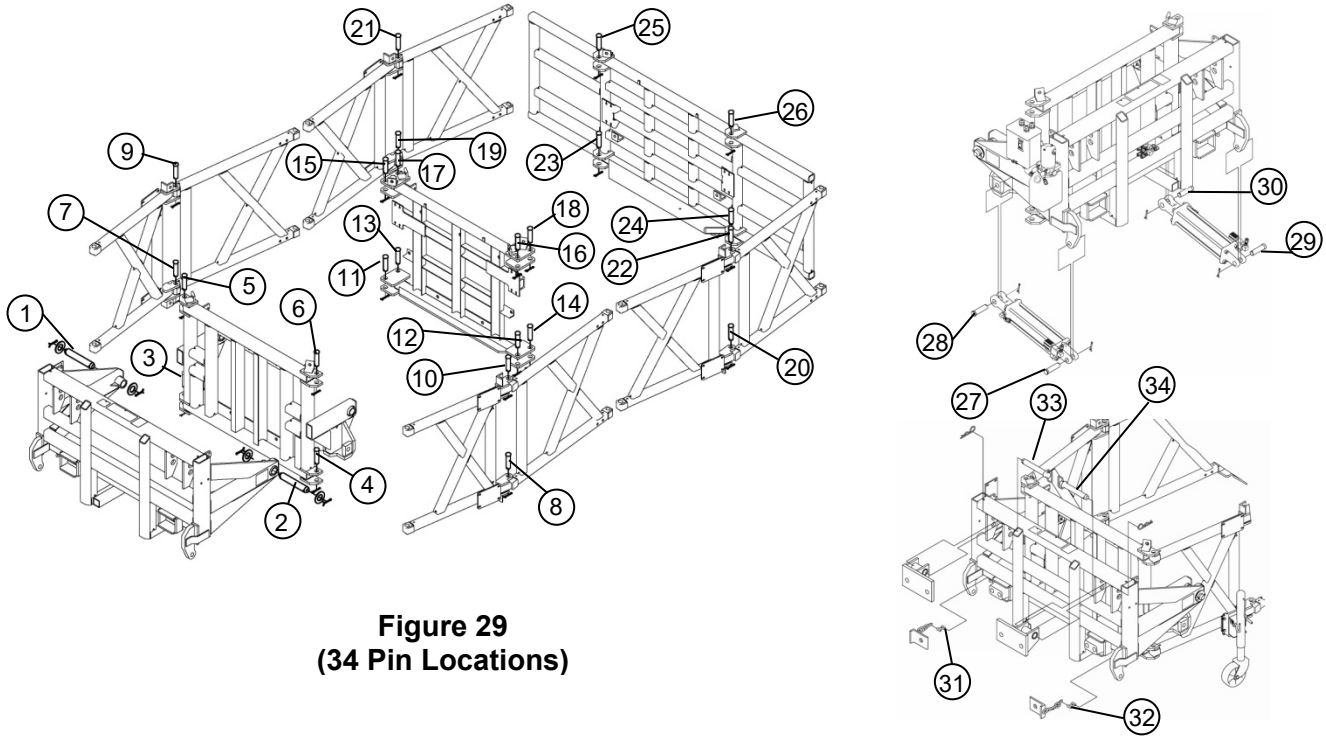


Figure 29
(34 Pin Locations)

8. Clean System - Clean the Frame Assembly, Cartridges and Support Structure and Impact Face from dirt and salt as required. Check monthly. The system can be cleaned with mild soap solution. Always check lubrication after cleaning.	Varies– Section IV (p. 31)
9. Hydraulic Pump - Clean the Hydraulic Pump as required. Check fluid level and electrical connections monthly. Remove all residue or debris on or around the Pump.	1 Month
10. Hydraulic Rams - Clean the Hydraulic Rams as required. Check monthly. Remove all residue or debris on or around the Rams.	1 Month
11. Lubrication - Lubricate as described in the Lubrication Section (Maintenance Section - IV) of this manual (p. 31).	1 Month
12. Grease Pins – Grease as described in the Grease Section (Maintenance Section – IV) of this manual (p. 31).	6 Months
13. System Check – Run the Hydraulic System up and down to make sure the Cylinder locks and buzzer are working.	Each Use

II. Hydraulic System Operation

Introduction

The SS90™HD TMA is equipped with a Hydraulic Locking system to allow the TMA to be locked in any position. The system works via two Hydraulic Solenoid Valves, one on each of the two Hydraulic Cylinders. These Solenoid Valves are electrically operated. When the TMA system is raised or lowered, these Valves are opened, allowing the hydraulic fluid to flow. At all other times, these Valves are closed, locking the TMA in place.

Warning: Never use the TMA as a crash cushion in any orientation that is not fully down. This can be dangerous because an errant vehicle may not properly engage the TMA. The system can only perform as a crash cushion when the system is in the all-the-way-down position. The SS90™HD TMA has an alarm which sounds when the TMA is not fully raised or lowered. Failure to follow this warning may result in damage, injury, or death.

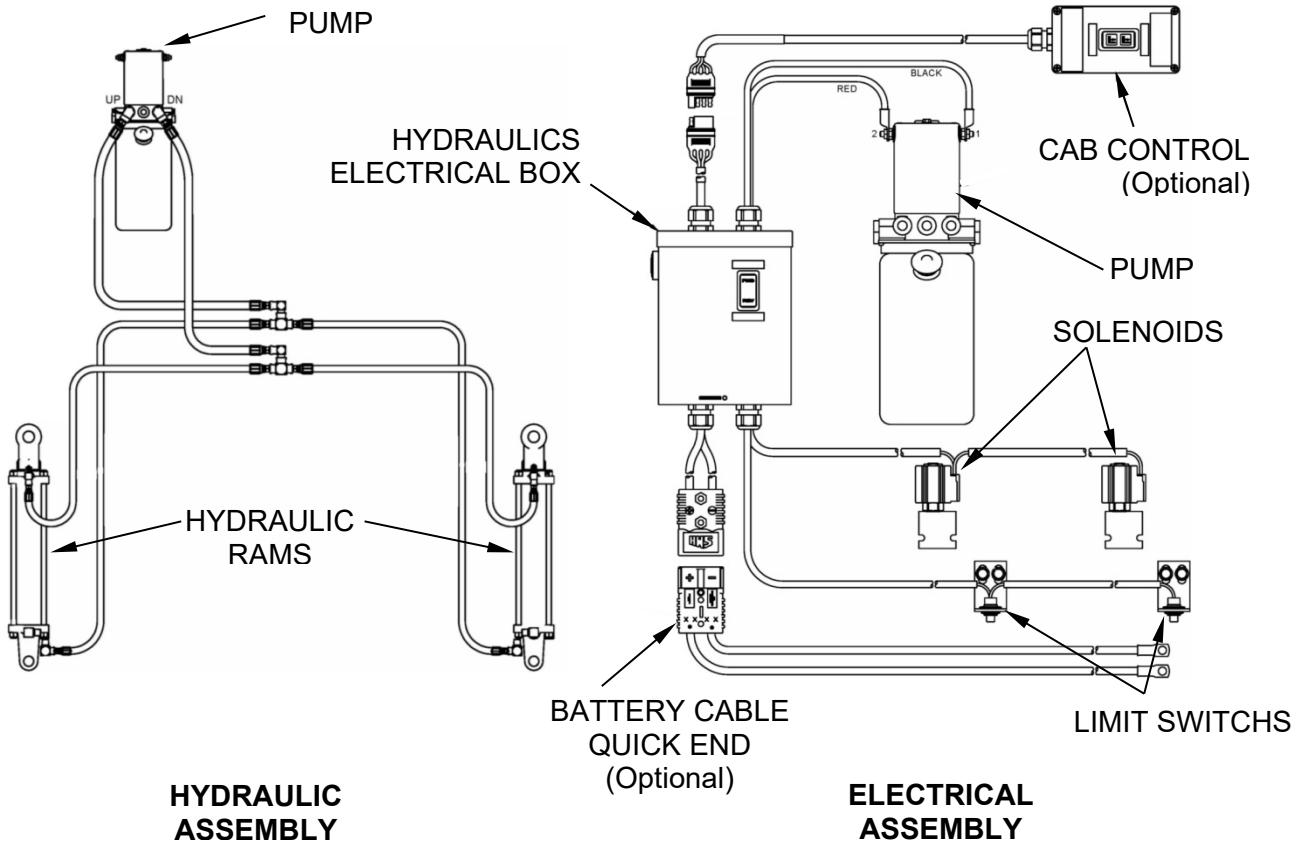


Figure 30

III. Detaching and Attaching the System to the Truck

1. **Detaching the system from the truck**
   A. Lower the system to the horizontal position.
   B. Remove the Jacks from the storage location and attach them to the system as shown in Figure 31.

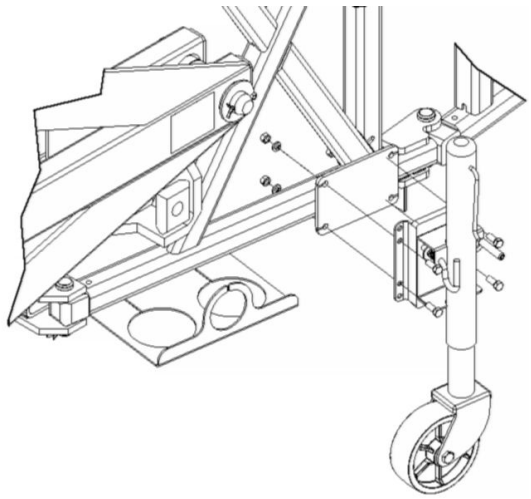


Figure 31

   C. Extend the Jacks until the system is supported.
   D. Unplug the Light Harness and disconnect the Positive Power and Ground Cables from the Pump. Remove the Cab Switch wires (optional) from the Control Box.
   E. Remove the Socket Hitches from the Underride Socket Receivers by removing 1 x 6 1/4" Hitch Pins and Retainer Pins*(Figure 32).

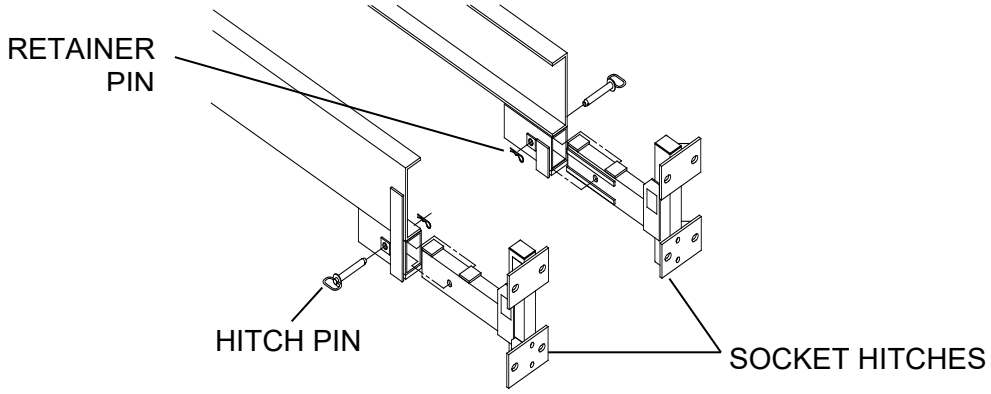


Figure 32

Note: If the alignment is off, making removal difficult, it may be necessary to adjust Jacks or temporarily disassemble the Attachment Brackets from the Socket Hitches. This can be done by removing the two 1 1/4 x 7” Hitch Pins and Retainer Pins and removing Anti-tilt Chains as shown in Figure 33 and 27.

***Reinsert Pins with Retainer Pins in Socket Hitches so they will not be lost.**

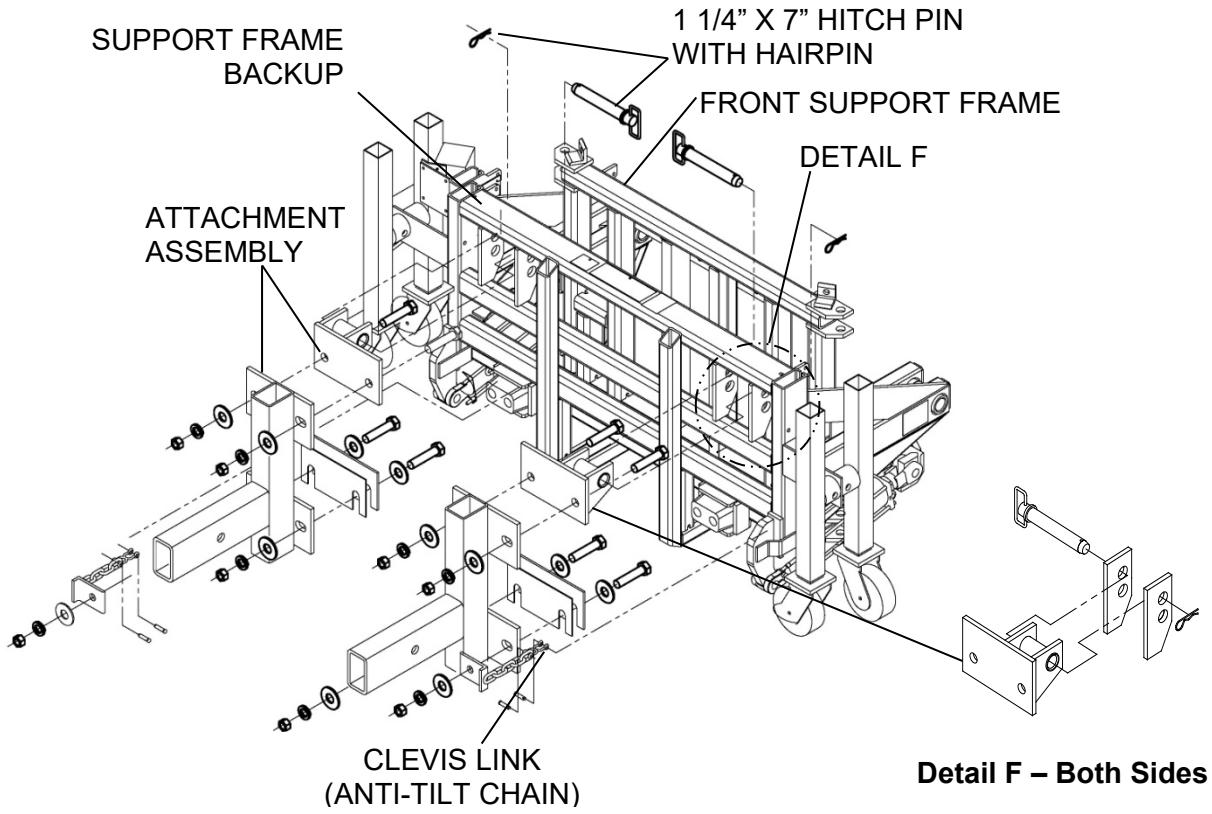


Figure 33

F. Move the TMA away from the truck.

2. Attaching the system to the truck

A. Move the TMA to the truck.

B. Insert the Socket Hitches into the Underride Socket Receivers and pin them into place using 1 X 6 1/4” Pin and Retainer Pin. If alignment is off, making the assembly difficult, it may be necessary to adjust Jacks or temporarily disassemble the Attachment Brackets from the Support Frame. Be sure the Retainer Pins are inserted correctly and cannot fall out.

C. Plug in the Light Harness and connect the Positive Power and Ground Cables to the Pump, and the Cab Switch wires (optional) to the Control Box.

D. Retract the Jacks completely and remove them to the storage position.

E. Check the Hydraulic/Electrical system for proper operation.

F. Verify that the system is level and 280-330 mm [11-13”] above the ground.

IV. Lubrication

1. Add Hydraulic Fluid

Add hydraulic fluid as required and check the fluid level monthly. The reservoir is full when the fluid level is close to the fill port. Use only Dexron® III Hydraulic fluid. Figure 34 shows the location of the hydraulic fluid fill port.

Caution: It is the responsibility of the installer to use appropriate measures while handling hydraulic fluid to prevent spillage. Clean up spillage immediately.

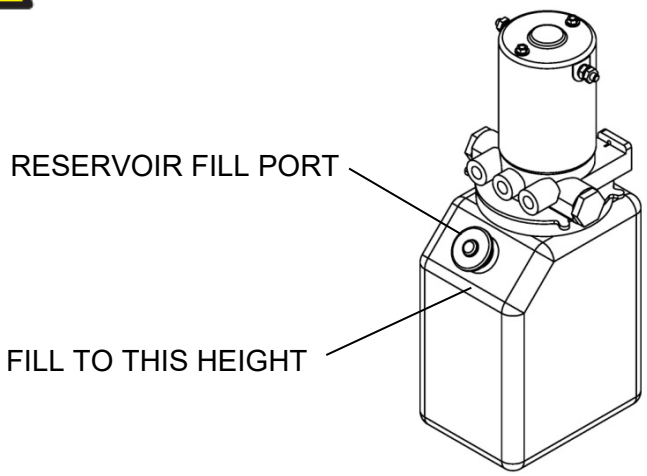
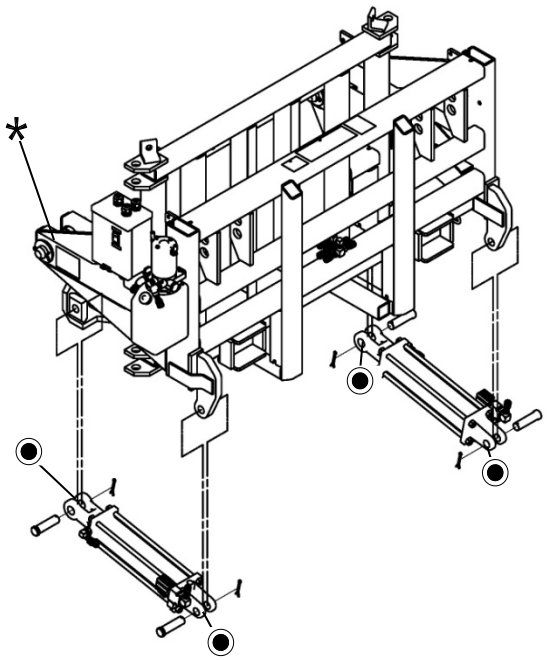


Figure 34

2. Lubricate Friction Points

Apply lubricant to moving steel parts every 6 months (Figure 35).



* **FRICTION POINT USING BEARING GREASE**

◉ **FRICTION POINTS USING LIGHT MACHINE OIL**

Figure 35

3. **Lubricate Swivel Jacks**
   Use oil and grease to lubricate each Swivel Jack every six months (Figure 36).

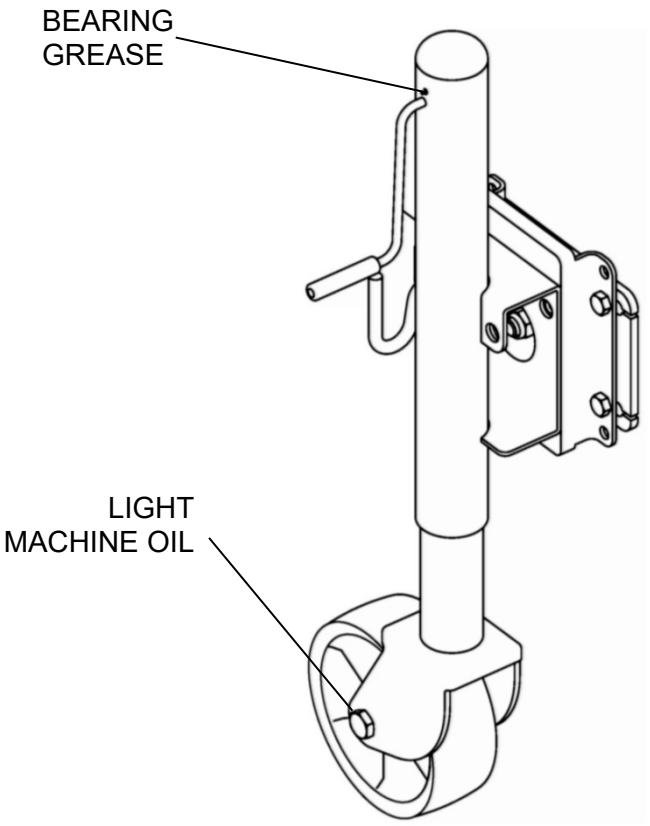


Figure 36 – Swivel Jack

4. **Change the Hydraulic Fluid**
   Change the hydraulic fluid every 2 years. Use only Dexron® III fluid. The Pump Reservoir capacity is 2 quarts.

   The Pump Reservoir and system may need to be filled and cycled several times to remove air that may be trapped in the system. As the TMA is raised, the Pump will cavitate when the Reservoir is emptied. Add fluid until system rises to 90 degrees without cavitating. If this procedure is not followed, the Reservoir will overflow at the end of the bleed-down cycle.

V. Technical Specifications

1. Weight

Cartridge I	109 lbs	49 kg
Cartridge II	162 lbs	73 kg
Frame Components	1704 lbs	773 kg
Hardware	214 lbs	97 kg
Total	2189 lbs	992 kg

2. Dimensions (Figures 37 & 38)

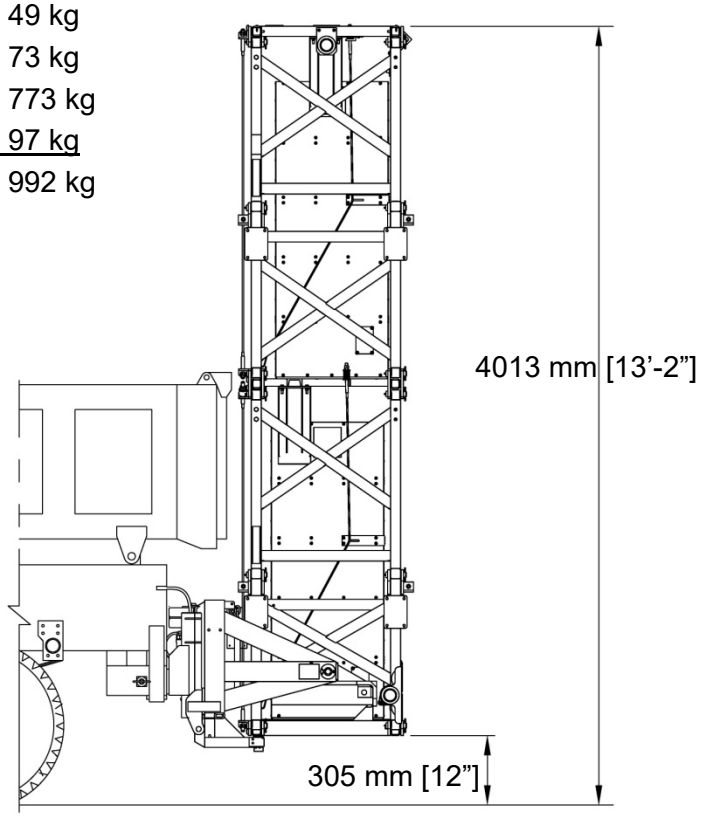


Figure 37

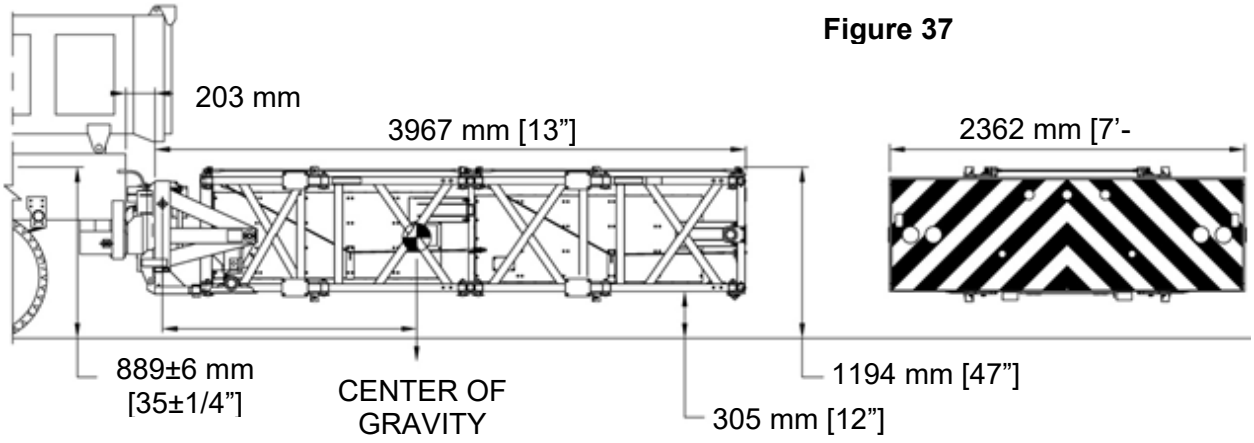


Figure 38

3. Replacement parts

For details on replacement parts, refer to the drawings at the end of the manual. The drawings include the part numbers and descriptions. Call Valtir customer service for replacement parts (p. 3).

4. Operating Rates

The system may be raised from the down to the up position in approximately 20 seconds. Lowering the system from the up position also takes about 20 seconds.

Repair Instructions

IV. Post Impact

Important: Only the correct parts manufactured specifically for this product by Valtir may be used to repair a damaged system. Failure to comply may result in damage to the system and/or an untested effect on the impacting vehicle, to and including injury or death.

Caution: Be sure to use the Retaining Chain to lock the system while working behind or under the system in the raised position. Disconnect the power while work is being performed. Failure to use the Retaining Chain could result in damage to the system, personal injury, or death.

1. **Inspect the Frame for Bent Parts**
   Replace any Frame members that have been damaged. Do not attempt to weld or straighten parts. Replace the arms in pairs to ensure that the system collapses properly. Refer to the system drawings for the part numbers and descriptions of the parts.

2. **Inspect Pins and Bolts for Damage**

   Replace all bolts and pins that have been damaged. Refer to the drawings at the end of the manual for the part numbers and descriptions of the parts.

3. **Expand the System and Loosen One End of the Top Cables**

   Extend the Frame and loosen one end of each of the four Top Cables.

Caution: Frames may swing side to side.

4. **Remove Cartridges and Spent Release Cables**

Important: Do not attempt to repair a damaged Cartridge. For full tested capacity, the Cartridges will need to be replaced even if they were only crushed slightly.

5. **Inspect Corner Gussets for Damage**

6. **Attach the Bottom Release Cables Across the Arm Assemblies**

Warning: For proper system performance, only use Release Cables supplied by Valtir. Failure to use the correct equipment could lead to fatigue or result in untested system performance.

Warning: Until the cables are inserted, the system may shift side to side.

Verify that the Frame is extended as far as it will go. Attach the Bottom Release Cable across Arm Assemblies (Figure 39). Torque the nuts to 34 -0/+3 Nm (25 -0/+2 ft-lb) making sure that roughly an equal amount of threads protrude from nuts on both ends of Cable. Lock Cable in place using remaining fasteners as "jam" nuts.

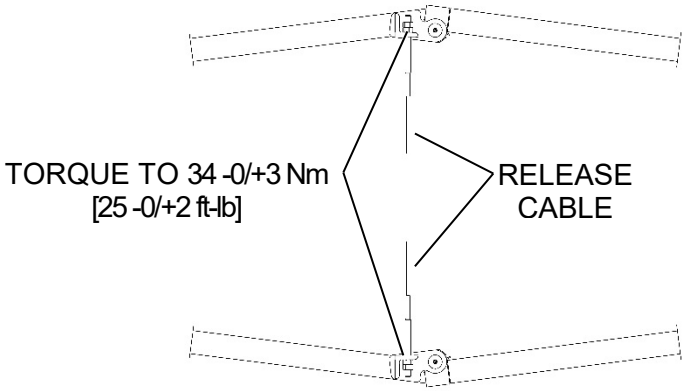


Figure 39

7. **Attach Cartridges**

Remove one end of each Alignment Cable from the TMA and set aside to clear the top side of each bay. Using a forklift and sling, place Cartridge I in position and secure it using the flat washers, lock washers, and nuts provided. Torque the nuts to 120 ± 7 Nm [90 ± 5ft-lb]. Repeat procedure for Cartridge II (Figure 40).

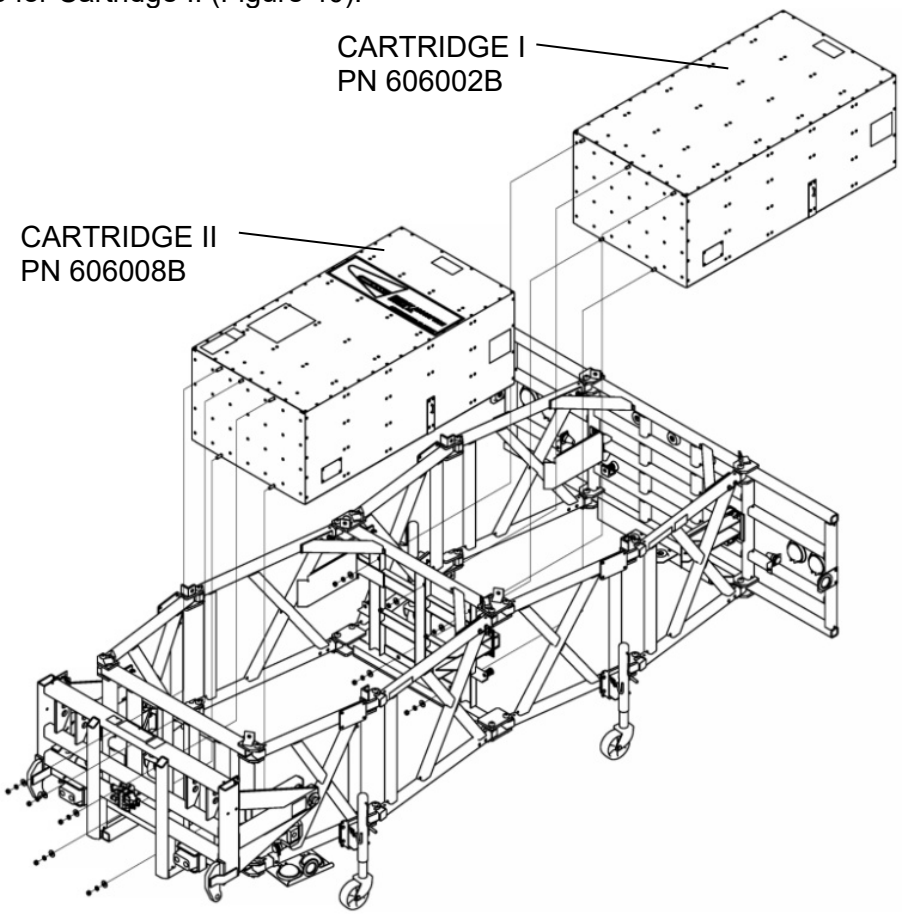


Figure 40

8. **Attach the Top Release Cables across the Arm Assemblies**

Attach the Top Release Cable across the Arm Assemblies (Figure 39). Torque the nuts to 34 -0/+3 Nm (25 -0/+2 ft-lb), making sure that roughly an equal amount of threads protrude from nuts on both ends of cable. Lock cable in place using remaining fasteners as "jam" nuts.

9. **Reattach and Adjust the Alignment Cables**

Reattach the four Alignment Cables (two for each bay) as shown in Figure 41. Measure the diagonals of both Bays and adjust the Cable pair in each bay to the same length. After adjusting the length, lock each Cable in place using the second nut as a “jam nut” (Detail 41A).

Important: Ensure both sets of Alignment Cables for each Bay are equal in length to ± 5 mm [3/16"].

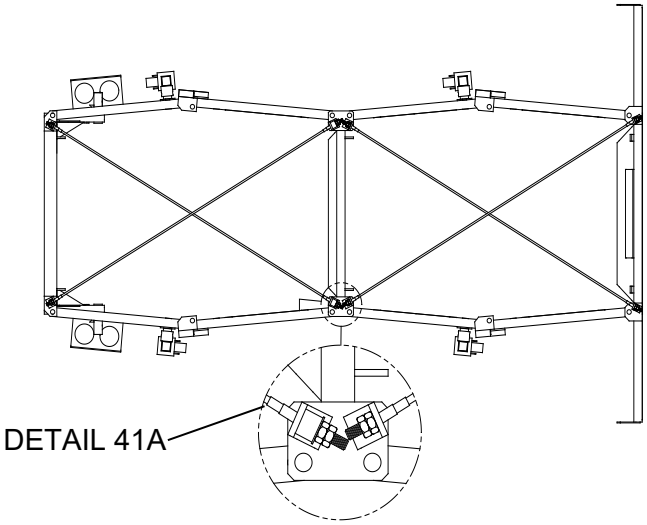
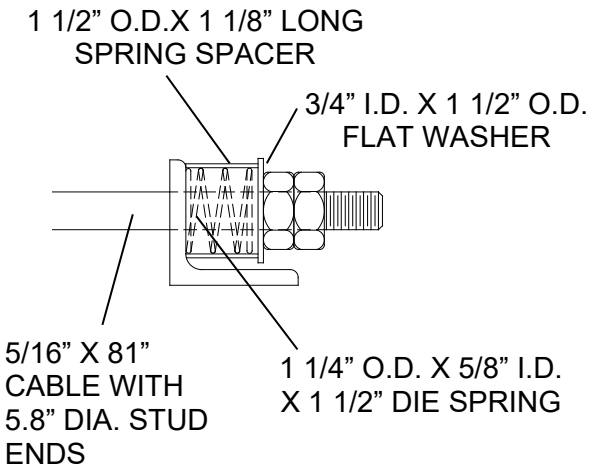


Figure 41 (Support Frame not shown for clarity)



Detail 41A

10. **Replace Side Guides**

The Side-Guides must be inspected and replaced if damaged. The Side-Guides are sacrificial and can be easily attached to their respective mounts. Side-Guides are necessary for proper system alignment during an impact and must be in place to ensure tested performance characteristics during system operation in an impact.

11. **Attach and Tension the Cartridge Support Cables**

There are four Cartridge Support Cables. Attach thimble end of all Cartridge Support Cables to the Frame as shown using the provided shackles. Pass the stud end of the cable through the corresponding Cartridge chain loop and attach as shown in Figure 42 using a die spring, washer, and nuts.

To properly tension the Cartridge Support Cables, lower the SS90™HD TMA to the horizontal position. Tighten the first nut on one Cable until all slack is removed, then tighten it until the Tensioning Springs have been compressed to 32±2 mm [1-1/4±1/16"]. Lock this nut in place with the second "jam" nut. Repeat this procedure with other Cables.

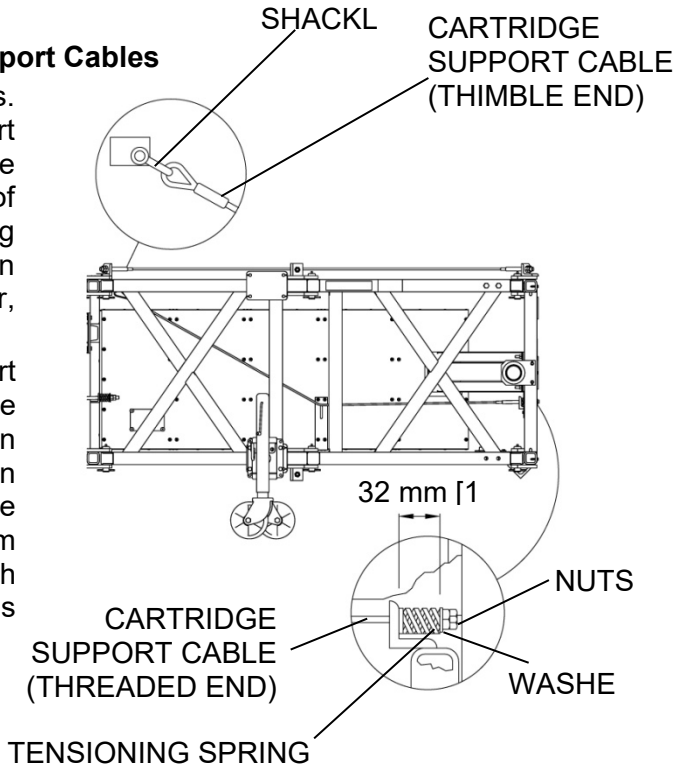


Figure 42

12. **Adjust the Height and Levelness of the System Frame**

Retract Jacks slightly off ground. Verify that the System Frame is 305 ± 25 mm [12" ± 1"] from the ground at the front and rear of the system. It may be necessary to place Shims under the Lower Attachment Bracket on the Frame Support in order to adjust the levelness of the Cartridge (Figure 43).

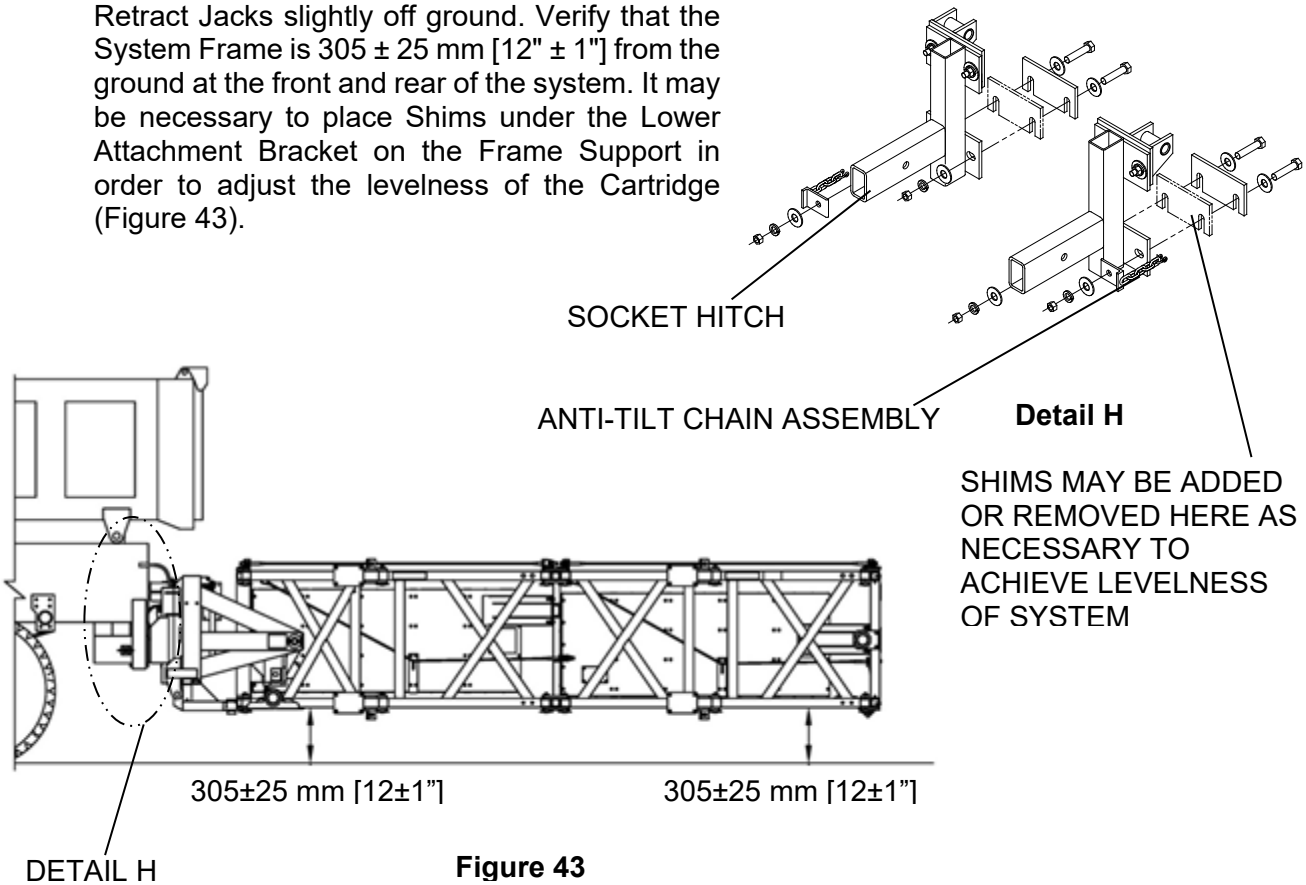


Figure 43

13. **Reconnect Power Connections**

    Reconnect power and ground cables from battery.

14. **Check System Lights for Proper Operation**

    Verify that all the turn/stop/tail lights are working properly. Replace any bulbs that are out.

15. **Verify Position of Hydraulic/Electric Lines**

    Check the location of all the hydraulic and electrical lines to make sure they will not be damaged during the tilting of the system up or down.

16. **Final Check**

    Check the tightness of all the fasteners. Check all steel cables to verify that they are properly attached and tightened.

17. **Ready to Use**

    The system is now ready for use.

Warning: Use only Valtir parts that are specified herein for the SS90™HD TMA for assembling, maintaining, or repairing the SS90™HD TMA system. **Do not utilize or otherwise comingle parts from other systems even if those systems are other Valtir systems.** Such configurations have not been tested, nor have they been deemed eligible for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with an UNACCEPTED system.

Troubleshooting Guide

Caution: Always wear eye protection when working on or around machinery or power tools, and while working with hydraulics. Failure to follow these warnings and cautions could result in serious injury or death.

Danger: Do not attempt to control a hydraulic leak with your hand. High-pressure hydraulic fluid can puncture the skin and cause severe injury or death. Use extreme caution when working on hydraulic systems.

In general, consult Valtir Customer Service Department if problems associated with operating or repairing the TMA should arise. This guide is meant to be an aid for performing system maintenance, not a detailed repair manual. **NOTE:** For any problems not listed here, contact Valtir. If you suspect problems, **do not operate the system**. Diagnose and repair, or contact Valtir Customer Service Department for assistance (p. 3).

Test Equipment

The following is a recommended list of test equipment required to troubleshoot D.C. powered hydraulic systems.

1. **Pressure Gauge**
   A 34,450 kPa [5000 psi] pressure gage, preferably glycerin filled, is a valuable and relatively inexpensive tool for checking pressure in the various sections of the circuit.
2. **D.C. Test Light**
   A test light is a light bulb with one lead wired to an alligator clip and the other lead connected to a metal probe. It is used to check for the presence of a voltage in the electrical circuit. With the alligator clip grounded, the light glows when the probe comes into contact with a hot electrical component.
3. **Continuity Light**
   A continuity light is like a test light but contains its own battery. It is used for testing electrical circuits when the components are not connected to a power source.
4. **Volt Meter**
   A D.C. voltmeter can be used to troubleshoot voltage problems. Two common uses are: 1) Ground one probe while using the other to probe hot leads in search of the available voltage at the point where the second probe is connected. 2) Measure a voltage drop in a wire or component by connecting one probe to one end and the remaining probe to the other end of the item in question.
5. **Ohmmeter**
   An ohmmeter is used to measure resistance and is useful when working with solenoid coils. On some coils the wire resistance is large enough that a D.C. test light might not illuminate, falsely indicating an open circuit (infinite resistance). A successful coil test, however, should always show some non-infinite value of resistance.

Caution: All tests conducted with an Ohmmeter must be done with the power source disconnected from the system.

6. **Assorted Hoses and Pressure Fittings**

   These can be used to connect and/or isolate certain parts of a hydraulic circuit for diagnosing hydraulic problems.

7. **High Pressure Shutoff Valve**

   A shutoff valve can be used to choke off fluid flow so that a "false" load can be put on the pump and other components. With the valve attached, it can be slowly shut off while the equipment listed above records the data for making a proper diagnosis.

Hydraulic Fluid

1. THE PURPOSE OF HYDRAULIC FLUID

The main purpose of hydraulic fluid is to transfer power from the pump to the actuators but it must also perform many other tasks which are critical to a well-designed system.

First, the fluid must have good lubricity or be "slippery" so that the friction will be as low as possible to keep metal to metal wearing at a minimum. Second, the viscosity or "thickness" must be in the proper range at the operating temperature so that unwanted leakage will be at a minimum but will still allow the fluid to lubricate the close fitting parts in the system. (Fluid that is too thin will leak past seals, valve spools, and the gears; fluid that is too thick will not flow properly and cause the pump to cavitate or starve.) Third, the fluid must be compatible with the seals used in the system. Fourth, there should also be additives in the fluid to slow down the effects of rust, oxidation (oxygen in the air combining with the fluid to form sludge) foaming, and water settling to the bottom of the reservoir. Fifth, the fluid must be able to pour or flow at the lowest expected temperature so that the fluid can reach or get into the pump.

For all of the reasons listed above, automatic transmission fluid (ATF, Dexron® III) was found in most cases to be the best readily available fluid for the job in most climate conditions.

2. SELECTING FLUIDS FOR APPLICATIONS OUTSIDE ATF'S TEMPERATURE RANGE

When looking for fluids that can be used in place of ATF or for applications where the operating temperature is outside the range of ATF, the following specs should be discussed with your local oil distributor:

A. Fluid must be compatible with Buna-N sealing compounds.

B. The Pour Point must be below the lowest anticipated temperature that will be encountered.

C. It should contain Rust or Oxidation inhibitors as well as other detergent type inhibitors.

D. The viscosity (SUS) should lie between 80 and 375 in the operating range, with the ideal viscosity near 200 SUS.

E. The viscosity index should be as high as possible. As an example, ATF has the following specs as listed by most oil manufacturers:

[1] Viscosity (SUS)

37 deg. C [100 deg. F]	185 to 205
99 deg. C [210 deg. F]	45 to 55

[2] Pour Point

-44 deg. C [-45 deg. F] to -37 deg. C [-35 deg. F]

[3] Viscosity Index 145 to 165

NOTE: In an emergency, for cold weather applications, it is permissible to use SAE 10 W non-detergent oil mixed by volume with no more than 30% #1 fuel oil or kerosene. Afterward, flush system and add fluid as outlined above.

Pump Priming

1. New Assemblies

   New system assemblies, as well as those that are disassembled for repair, require proper priming to avoid possible pump failure. A pump is said to be "primed" when the internal cavity is full of fluid and the air has been expelled.

   A. Prime a pump as follows:

      1. "Crack" or remove the high pressure line at or near the cylinder.
      2. "Jog" the unit until fluid flow is clear.
      3. Retighten or replace hose.

2. If a system fails to prime or loses its prime, check for the following:

   A. Partially clogged suction filter (Filter section).

   B. A loose or improperly installed suction hose or pickup tube.

   C. Bad front pump seal (Pump section).

   D. A solid fill plug in reservoir with no vent (Reservoir section)

   E. Fluid that is too thick (Hydraulic fluid section) or contaminated with water (Reservoir section).

   F. Occasionally a pump will not prime itself because a check valve spring in the high pressure port is too "stiff" or the spring retainer is turned down too far. If this condition is suspected, loosen the spring retainer (found in the high pressure outlet port), energize the pump to prime it, and then turn the retainer back to the correct depth (Check Valves).

Reservoirs

1. **Use Recommended Fluid**

   Fill Reservoir with Dexron III ATF (p. 41).

2. **Filling and Operation**

   A. Fill reservoir to within 12.5 mm [1/2"] with all the cylinders in the fully retracted position.

   B. Operate system several times starting with short cylinder strokes and increasing length of each successive stroke.

   C. Recheck fluid level often and add fluid as necessary to keep pump from picking up air.

   D. After system is completely "bled", collapse all cylinders, check fluid level in reservoir, and attach the filter/breather plug provided.

Caution: Do not use a solid plug or fill cap without a filter/breather element as this will cause damage to the pump and/or reservoir.

3. Reservoir Problems

A. Clear fluid flowing out of fill hole usually means Cylinders were not fully collapsed when reservoir was filled.

B. Foamy fluid flowing out of the fill hole points to the following:

1. Air is present in the system; that is, cylinders and fluid lines. The response usually is "spongy" and the cylinder moves with a "jerking" motion.
2. There is no drop tube or "down spout" on the return line so that the fluid is not returning to the bottom of the reservoir.
3. Damage to pump seal.

C. Water in the fluid.

Water can enter the reservoir through the fill hole if the unit is left outdoors or washed with high pressure washers. Protect the unit, whenever possible, and change fluid regularly to minimize problems. In cold weather the water will freeze and the pump will not work until the ice melts.

Filters

Most pump systems have filters which must be cleaned periodically or whenever flow is slow or sluggish. Some filters may be washed in cleaning solvent and blown dry with compressed air. Those which cannot be cleaned sufficiently should be replaced. External high pressure filters may be added to the system for added protection and ease of cleaning.

Hydraulic Cylinders

1. DIAGNOSING AND TROUBLESHOOTING HYDRAULIC CYLINDERS

A. Most ram type failures are caused by one of the following reasons:
1. Excessive side load.
2. Stroking the rod to full extension.

B. Excessive side load can be diagnosed by observing the following:
1. Cracked gland nut.
2. Gouged rod.
3. A cracked or bent rod that will not retract back into the tube.

C. Over-stroking can be diagnosed by observing the following:
1. Premature leakage past the V-rings.
2. System filters that become prematurely clogged with pieces of rubber due to v-ring crushing (Filters above).

D. It is also possible to have a piston seat failure. This feature will show up as a cylinder drift in the hold position. Troubleshoot in the following manner:
1. Put the cylinder in the hold position.
2. Place a jack under the load.
3. Remove the high pressure hose from the cylinder port on the side opposite the holding end.
4. Let the jack down slowly: If the piston seal is bad, fluid will escape from the port.

Warning: Do not use a solid plug or fill cap without a filter/breather element as this will cause damage to the pump and/or reservoir.

2. REPAIRING HYDRAULIC CYLINDERS

A. Remove cylinder from the assembly, disconnect hose line(s), and drain fluid.
B. Remove gland nut, rod, spreader, and packing assembly from the tube assembly.
C. Clean internal tube and inspect chrome rod for gouges, scratches, or wear. Replace if necessary.
D. Replace chrome rod back into tube assembly.
E. Insert steel spreader.
F. Grease the v-ring set on the inside and outside diameters.
G. Reattach one V-ring at a time, making sure each V-ring lies flat on the ring prior to it.
H. Replace the gland nut complete with a new wiper ring if worn. Thread it down until it makes contact with the V-rings, then tighten an additional 1 to 1 1/2 turns. The distance between the top of the threaded collar and the bottom of the large section on gland nut should be 6.35 to 7.94 mm [1/4" to 5/16"]. Do not over tighten.

Important: If it is possible to stroke the cylinder after repairing, turn gland nut until it contacts the V-rings and stroke the cylinder to allow the rings to seat and align, then retighten as described above.

I. Double acting cylinders have two piston cups on the internal threaded end of the chrome rod. If these cups are worn they must be replaced to ensure a proper seal. It is also advisable to check the piston "O" ring and the stuffing box "O" ring and replace if signs of wear exist.

Important: When replacing pistons on the rod, have the "O" ring well-greased and screw the piston past the threads to prevent damage to the new "O" ring.

J. Replace the V-rings, spreader, and gland nut as described in E, F, G, and H above.

Electrical Problems

Caution: Remove all rings, watches, etc. prior to doing any electrical work.

1. Operating D.C. Power Systems

Operating D.C. (direct current) power systems efficiently requires proper voltage. Any attempt to operate below the minimum required voltage could cause system failure.

A. Signals which point to low voltages are:
   1. Motor running at reduced speed.
   2. Solenoid valves not shifting.

B. Minimum voltage readings are as follows:
   1. The minimum voltage required for the Pump Motor to operate is 9.5 volts.
   2. The minimum voltage required for the solenoid valves to work is 9.5 volts.

C. Causes for low voltage are:
   1. Battery capacity is too small.
   2. Cable ends not electrically secure to battery cable. (Solder them if necessary)
   3. Battery cable size too small for load and length of run. Copper #2 automotive battery cable is the recommended minimum size. Larger copper battery cable (#1, #0, or #00) may be required for cable lengths over 25 feet to keep performance from deteriorating.
   4. Bad joints where cable ends are bolted to battery, motor solenoid, start switch, ground, etc.
   5. Burnt contacts on motor solenoid or start switch.

D. Check for low voltage as follows: (A volt meter will be required.)
   1. On vehicles equipped with an alternator, the voltage should be approximately 13.5 volts with no electrical accessories operating and the engine running - Check it.
   2. Operate pump under maximum conditions. Use the volt meter to probe each connection, cable end, and cable from the battery all the way back to the motor stud and note the voltage losses. Make necessary repairs. Increase the voltage above the minimum required.

Important: Check the ground side as well: paint, rust, and dirt are insulators - remove them.

2. D.C. Motors

Motors should be serviced periodically to ensure good performance. Service as follows:

A. Remove head assembly from motor.
B. Check sleeve bearing in head assembly for wear.
C. Place a few drops of fluid on felt liner in head assembly
D. Check brushes for wear, and replace if necessary.
E. Blow dirt and dust out of motor housing and check for shorts, burnt wires, or open circuits in the field coil assembly.
F. Check armature and commutator for shorts or open circuits.
G. Check ball bearing on motor shaft: A “growling” motor can be caused by bad bearings.
H. Check for excessive "end play" of armature and add thrust washers as necessary.
I. If there is an excessive amount of water, condensation, or rust in the motor, a small drain hole may be drilled in the motor case on the low side of the motor depending on the mounting - consult with pump manufacturer for additional information.

Important: A motor which does not turn in freezing weather could be caused by water that has frozen inside the housing.

J. Be sure to check orientation of motor before replacing.
K. If motor fails to turn the pump, check the pump by turning drive shaft by hand – the motor or the pump may be "seized up".

3. Electrical Circuits

A. Push button, toggle, rocker, or manual motor start switches: Defective switches are a common cause of electrical malfunction. What SEEMS to be a serious system defect can often be caused simply by a faulty switch, especially where the switch controls two functions (e.g. start the motor, and shift a valve). In those cases, one half of the switch might be defective, while the other half operates correctly and the fault appears to be with some other component.

Troubleshooting can be done by any one of three methods.

1. Use continuity light to test switch (Test Equipment section).
2. Use a circuit test light to test switch (Test Equipment section).
3. Remove the wires from the switch and touch them together in the proper order to operate them.

Important: Even though external switch is "waterproof", any switch controls subject to the weather should be mounted so that the cord exits from the bottom to prevent water from entering the box.

B. Motor start solenoid switches:

Although there may be exceptions, most solenoid switches found on TMA pumps are the following type: Three Post Solenoid Switch (Figure 44).

1. This three post solenoid switch is wired and constructed as follows:
   a. The large post marked "Bat" must be attached to the cable leading from the battery.
   b. The small post connects to the control circuit. (Push button, rocker, or toggle, etc.)
   c. The shared "hot" lead from the control circuit must also be attached to the large post marked "Bat".
   d. The remaining large post attaches to the cable leading to the motor.

4. Shorts, “Grounding Faults” and “Open Circuits”

In control wiring, shorts can only occur when "hot" lines (lines connected directly to the battery) come in contact with a ground. A short will either cause a fuse to blow, if there is a fuse, or burn the wire off at its weakest point. Likely spots for shorts are switches, electrical strain reliefs, electrical junction boxes, and a control cord which has been pinched or cut.

Grounding faults are much like shorts except they occur on the opposite side of the electrical component. A "ground fault" will cause the coil in the motor solenoid switch to remain energized. This type of failure can happen because switching is done in the ground wire due to the construction of the motor solenoid switch (see "3 - Electrical Switches, C - 1). Likely spots for "faults" are the same as for shorts (see above).

An "open" circuit is simply a break which prohibits current flow. Likely spots for "open" circuits are the same as shorts (see above).

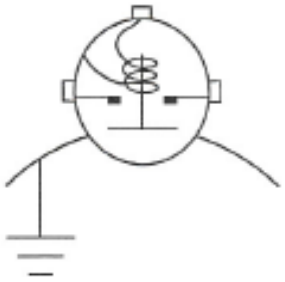


Figure 44

5. **Solenoid Coils**

   Coils are used in solenoid operated valves and start switches. Failures can be caused by vibration, water, improper voltage, or corrosion. The best way to test a coil is with an ohmmeter. The meter should read some value of ohms. An infinite reading means that the coil has an open circuit. The reading between any lead on the coil and the "can" should be infinite unless there is only one lead wire and the coil is grounded to the "can".

6. **Electrical Polarity**

   Pump motors supplied with TMA's can be used on either positive or negative ground systems.

Hydraulic Quick Troubleshooting Guide

Finding and Solving Problems:

Hydraulic system failures usually follow a similar pattern: A gradual or sudden loss of pressure or flow, followed by a loss of cylinder or motor power. Any of the systems components could be the cause. The problem may be solved by following a step by step procedure.

1. MOTOR FAILS TO START:

Failed motor starter solenoid: Replace if necessary.

Electrical switch inoperative: Repair or replace.

"Open" circuit/Insufficient grounding: Check and correct.

Motor inoperative: Repair or replace.

2. SYSTEM IS INOPERATIVE:

No fluid in system; insufficient fluid in system; pump losing prime: Fill system; Check for leaks.

Wrong fluid in system (Should be Dexron® III): Change fluid.

Clogged or dirty filter: Drain fluid and replace filter or element.

Fluid line restricted: Line dirty or collapsed - Clean or replace fluid line.

Air leaks in pump suction line: Repair or replace as needed.

Worn or dirty pump: Clean, repair or replace; check alignment; check for contaminated fluid - drain, flush, and refill system with approved fluid

Badly worn components (valves, cylinders, etc.): Examine and test for internal or external leakage. Replace faulty components. Check for cause of wear.

Leakage: Check all components, especially the relief valve, for proper settings.

Excessive load: Check for binding. Do not allow extra weight on lowered Cartridge.

Broken pump drive: Repair or replace couplings, etc. Check for "Ground" fault.

3. SYSTEM OPERATES ERRATICALLY

Air in system: Check suction side for leaks. Repair.

Cold fluid: Allow system to warm up.

Damaged or dirty components: Clean or repair as needed.

Restricted lines or filters: Clean and /or replace lines or elements as necessary.

4. SYSTEM OPERATES SLOWLY

Fluid viscosity too high or cold fluid: Allow fluid to warm up before operating or replace fluid with proper specified fluid.

Low fluid level: Check reservoir & add fluid as necessary.

Air in system: Check suction side for leaks - repair; cycle system several times to relieve air from system.

Worn pump, valves, cylinders, etc... Replace or repair as necessary.

Restriction in lines or filters: Clean or replace elements or lines.

Improperly adjusted flow control valve: Replace or adjust as necessary.

Oil leaks: Tighten fittings; replace seals or damaged lines.

Low Voltage: Using volt meter and/or ohmmeter to check system voltage (Electrical Problems section on p. 43). Check alternator; check connections.

5. FLUID IN SYSTEM OVERHEATS

Incorrect, low, or dirty fluid: Add or change fluid as necessary.

Excessive component internal leakage: Repair or replace as necessary.

Restriction in lines or filters: Clean or replace as needed.

Insufficient heat radiation: Clean dirt and mud from reservoir and components.

Malfunctioning component: Replace or repair.

6. FOAMING OF FLUID

Incorrect, low or dirty fluid: Replace or add fluid as needed.

Air leaks: Check suction lines & component seals for leaks. Replace.

7. NOISY PUMP

Low fluid level, incorrect or foamy fluid: Replace or add fluid as necessary.

Suction line or inlet screen plugged: Clean or replace.

Worn or damaged pump: Repair or replace.

8. LEAKY PUMP OR MOTOR

Damaged or worn shaft seal: Replace. Check for misalignment.

Loose or broken parts: Tighten or replace.

Incorrectly adjusted relief valve: Adjust valve.

9. SYSTEM BLEEDS DOWN WHEN SYSTEM "LOCKED"

Leaking cylinder seals or fittings: Replace worn or damaged parts.

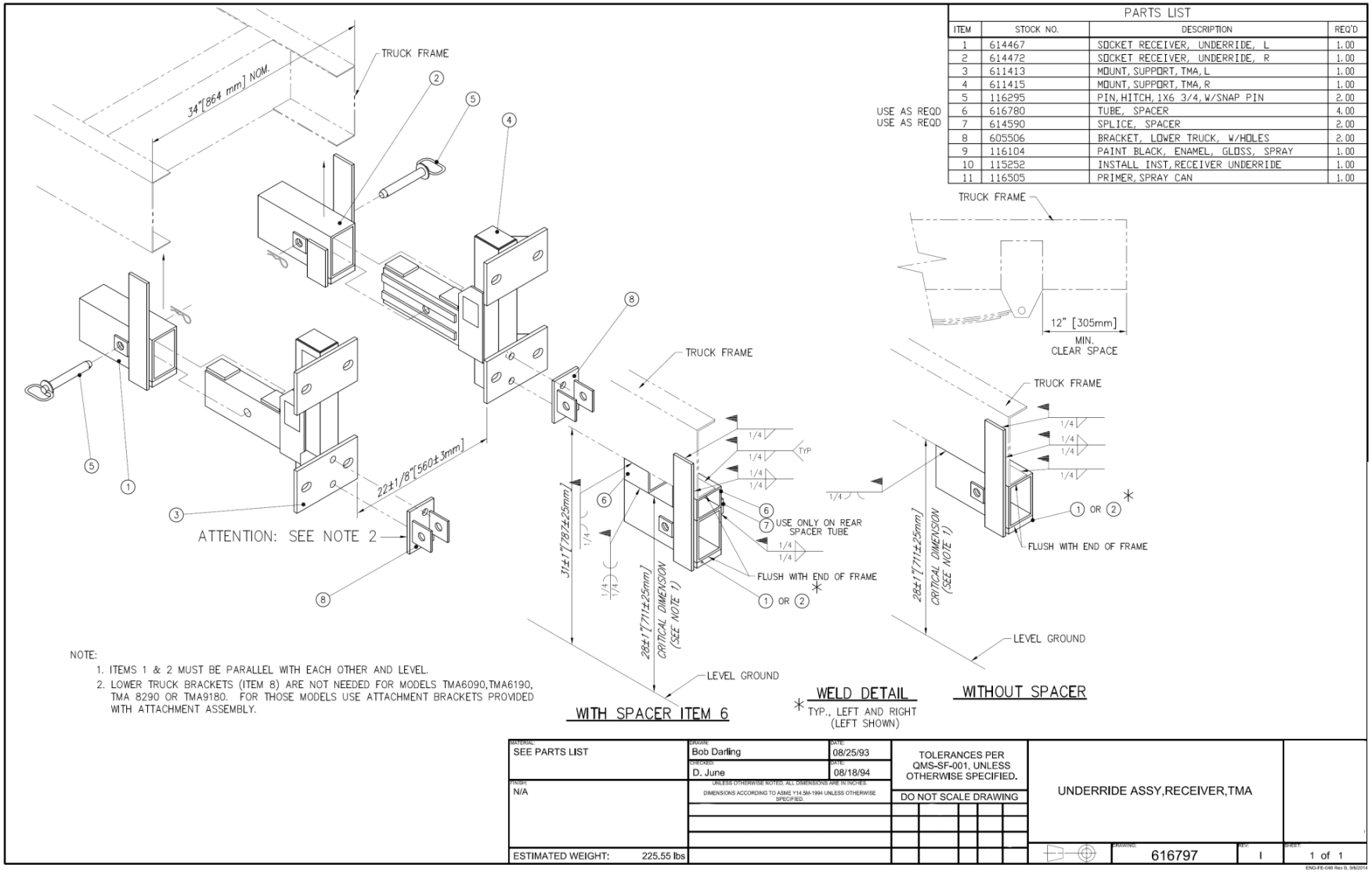
10. LEAKY CYLINDER(S)

Seals worn or damaged: Replace.

Rod damaged: Replace.

Warning: Never stand behind or in the path of the TMA when it is being raised, lowered, or someone is at the controls.

616797



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	REQ'D
1	614467	SOCKET RECEIVER, UNDERRIDE, L	1.00
2	614472	SOCKET RECEIVER, UNDERRIDE, R	1.00
3	611413	MOUNT, SUPPORT, TMA, L	1.00
4	611415	MOUNT, SUPPORT, TMA, R	1.00
5	116295	PIN, HITCH, 1X6 3/4, W/SNAP PIN	2.00
6	616780	TUBE, SPACER	4.00
7	614590	SPLICE, SPACER	2.00
8	605506	BRACKET, LOWER TRUCK, W/HOLES	2.00
9	116104	PAINT BLACK, ENAMEL, GLOSS, SPRAY	1.00
10	115252	INSTALL INST, RECEIVER UNDERRIDE	1.00
11	116505	PRIMER, SPRAY CAN	1.00

USE AS REQD
USE AS REQD

NOTE:
1. ITEMS 1 & 2 MUST BE PARALLEL WITH EACH OTHER AND LEVEL.
2. LOWER TRUCK BRACKETS (ITEM 8) ARE NOT NEEDED FOR MODELS TMA6090,TMA6190, TMA 8290 OR TMA9180. FOR THOSE MODELS USE ATTACHMENT BRACKETS PROVIDED WITH ATTACHMENT ASSEMBLY.

MATERIAL: SEE PARTS LIST	DRAWN: Bob Darling	DATE: 08/25/93	TOLERANCES PER QMS-SF-001, UNLESS OTHERWISE SPECIFIED.
FINISH: N/A	CHECKED: D. June	DATE: 08/18/94	DO NOT SCALE DRAWING
ESTIMATED WEIGHT: 225.55 lbs	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.		UNDERRIDE ASSY,RECEIVER,TMA
			DRAWING: 616797 REV: I SHEET: 1 of 1

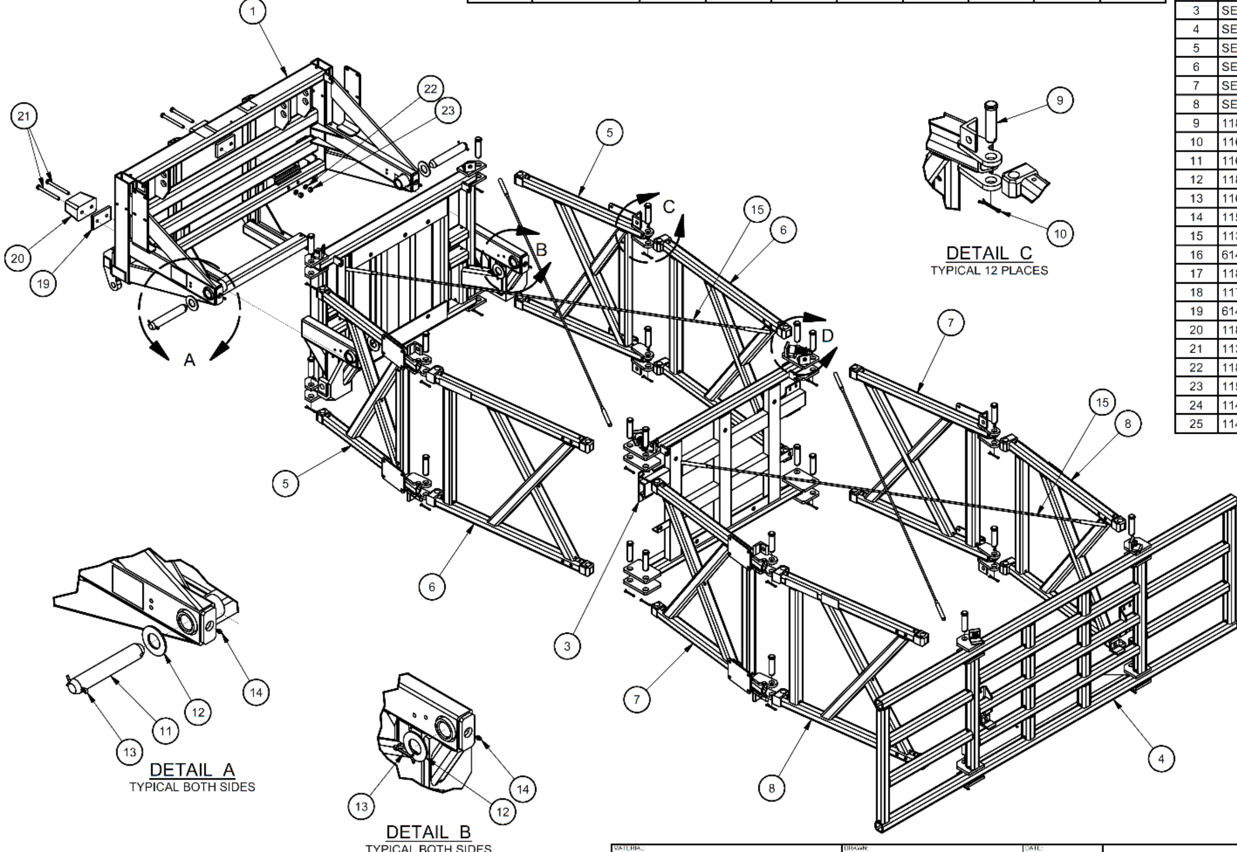
ENG-FR-048 Rev B, 9/8/2014

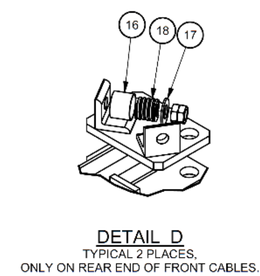
Underride Assembly, Receiver, TMA

COLOR	ASSY NO.	ITEM 1	ITEM 2	ITEM 3	ITEM 4	ITEM 5	ITEM 6	ITEM 7	ITEM 8
GALV	618268	618238	618247	618967	618245	618254	618255	618262	618264
BLACK	618269	618242	618248W	618244W	618246W	618256W	618257W	618263W	618265W
YELLOW	618270	618243	618248Y	618244Y	618246Y	618256Y	618257Y	618263Y	618265Y

PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	FRAME,HD BACKUP,SUPPORT,8292,W/DECALS	1
2	SEE TABLE	FRAME,FRONT,8292,HD	1
3	SEE TABLE	FRAME,MIDDLE,8292	1
4	SEE TABLE	FRAME,REAR,8292	1
5	SEE TABLE	ARM,FRONT W/SUPPORT,8292	2
6	SEE TABLE	ARM,FRONT,8292	2
7	SEE TABLE	ARM,REAR W/SUPPORT,8292	2
8	SEE TABLE	ARM,REAR,8292	2
9	118386	PIN,CLEVIS,1X3 3/4,P	24
10	116276	PIN,COTTER,3/16X1 1/2,P	24
11	116249	PIN,AXLE,1 1/2X9,P	2
12	118000	WASHER,FLAT,1 1/2 SAE,P	4
13	116270	PIN,COTTER,1/4x2 1/2,S	4
14	115067	GREASE FITTING,1/4-28,STR	4
15	113943	CABLE,5/16X81 1/2,5/8 STUD ENDS	4
16	614548	SPACER,SPRING,1 1/2 ODX1 1/8,B	2
17	118026	WASHER,FLAT,3/4 X 1 1/2,G	2
18	117459	SPRING,DIE,1 1/4 OD X5/8X1 1/2,G	2
19	614493	SPACER 1/2X3X4 1/2,W/HOLES,B	2
20	118458	BUMPER,POLYURETHANE,3 1/8X5X3 1/2H,2 HOLES	2
21	113486	BOLT,HX,1/2X5 1/4,P	4
22	118083	WASHER,LOCK,1/2,P	4
23	115941	NUT,HX,1/2,P	4
24	114459	DECAL,CAUTION,STAY CLEAR	2
25	114674	DECAL,WARNING,RELEASE CABLE TORQUE	4





NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER CEMC-THP-SF-004, UNLESS OTHERWISE SPECIFIED.

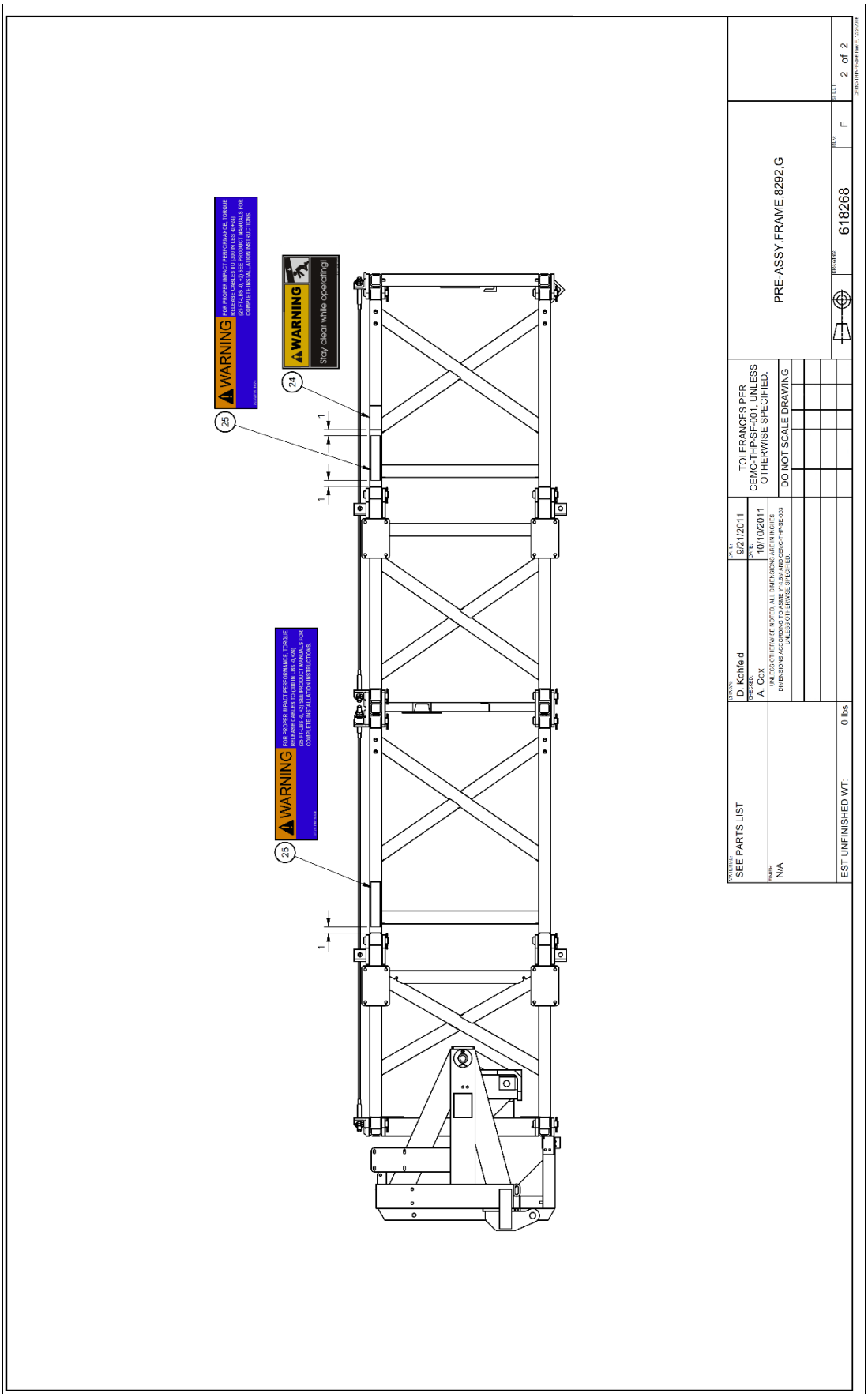
MATERIAL: SEE PARTS LIST	DRAWN: D. Kohfeld	DATE: 9/21/2011	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.
FINISH: N/A	CHECKED: A. Cox	DATE: 10/10/2011	DO NOT SCALE DRAWING
	UNLESS OTHERWISE NOTED: ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M AND CEMC-THP-SF-003 UNLESS OTHERWISE SPECIFIED.		
EST UNFINISHED WT: 0 lbs			

PRE-ASSY,FRAME,8292,G

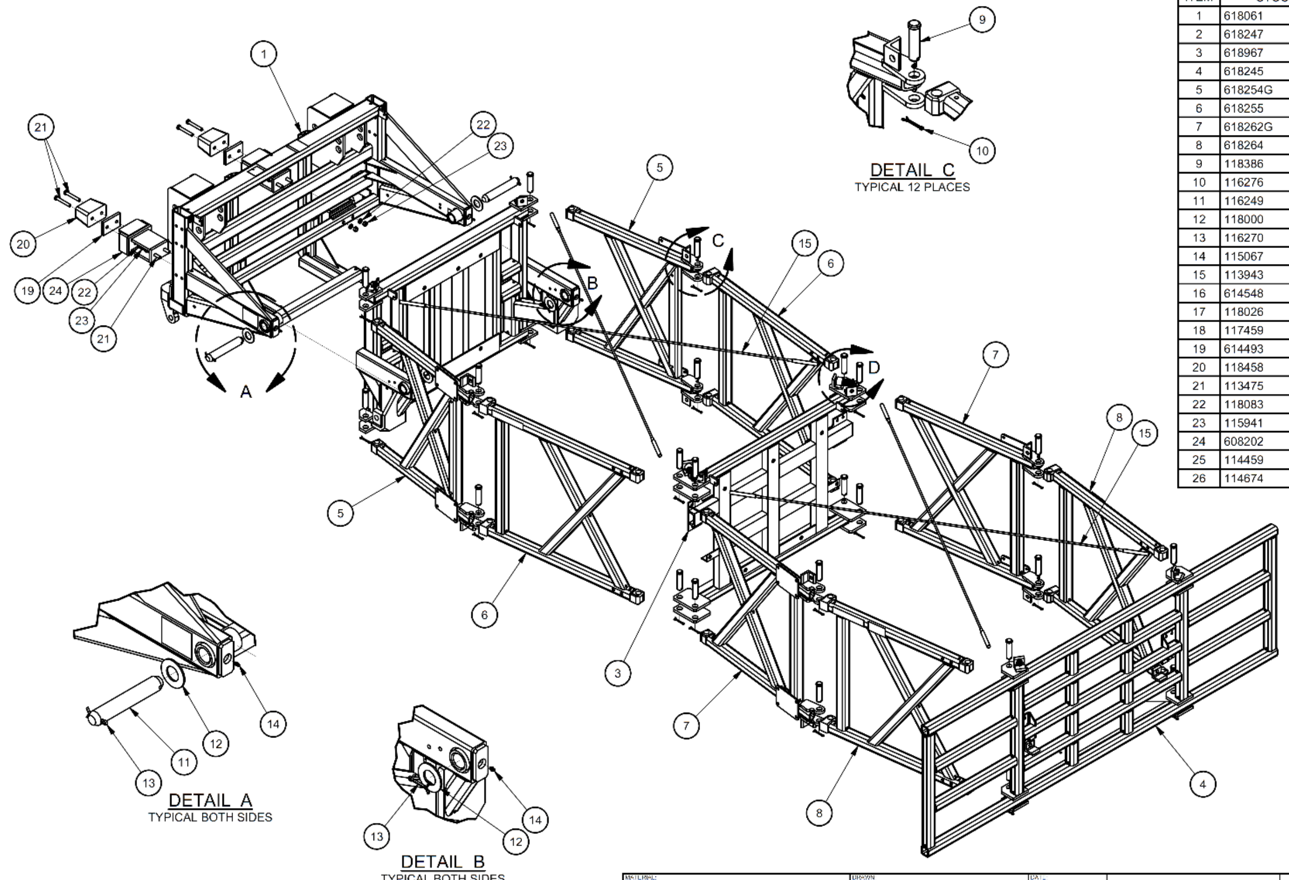
DRAWING: 618268 | REV: F | SHEET: 1 of 2

Pre-Assembly, Frame, 8292

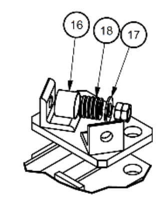
618268 - 2 of 2


WARNING
FOR PROPER IMPACT PERFORMANCE, TORQUE RELEASE CABLER TO 200 IN LBS -0 +20 (23 FT LBS -0 +2) SEE PRODUCT MANUALS FOR COMPLETE INSTALLATION INSTRUCTIONS.
WARNING
Stay clear while operating!
24
25
1
SEE PARTS LIST
N/A
EST UNFINISHED WT:
0 lbs
D. Kohfeld
A. Cox
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M AND CEMC-THP-SE-003 UNLESS OTHERWISE SPECIFIED.
9/21/2011
10/10/2011
TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING
PRE-ASSY,FRAME,8292,G
618268
F
2 of 2

618271 - 1 of 2



PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	618061	FRAME,HD BACKUP,SUPPORT,8291*EUG,W/DCLS	1
2	618247	FRAME,FRONT,8292,HD	1
3	618967	FRAME,MIDDLE,8292,G	1
4	618245	FRAME,REAR,8292,G	1
5	618254G	ARM,FRONT W/SUPPORT,8292,G	2
6	618255	ARM,FRONT,8292,G	2
7	618262G	ARM,REAR W/SUPPORT,8292,G	2
8	618264	ARM,REAR,8292,G	2
9	118386	PIN,CLEVIS,1X3 3/4,P	24
10	116276	PIN,COTTER,3/16X1 1/2,P	24
11	116249	PIN,AXLE,1 1/2X9,P	2
12	118000	WASHER,FLAT,1 1/2 SAE,P	4
13	116270	PIN,COTTER,1/4x2 1/2,S	4
14	115067	GREASE FITTING,1/4-28,STR	4
15	113943	CABLE,5/16X81 1/2,5/8 STUD ENDS	4
16	614548	SPACER,SPRING,1 1/2 ODX1 1/8,B	2
17	118026	WASHER,FLAT,3/4 X 1 1/2,G	2
18	117459	SPRING,DIE,1 1/4 OD X5/8X1 1/2,G	2
19	614493	SPACER 1/2X3X4 1/2,W/HOLES,B	2
20	118458	BUMPER,POLYURETHANE,3 1/8X5X3 1/2H,2 HOLES	2
21	113475	BOLT,HX,1/2X3 1/2,G5,P	8
22	118083	WASHER,LOCK,1/2,P	8
23	115941	NUT,HX,1/2,P	8
24	608202	EXTENSION,BUMPSTOP,TMA 8291EU,G	2
25	114459	DECAL,CAUTION,STAY CLEAR	2
26	114674	DECAL,WARNING,RELEASE CABLE TORQUE	4



DETAIL D
TYPICAL 2 PLACES,
ONLY ON REAR END OF FRONT CABLES.

NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER CEMC-THP-SF-004, UNLESS OTHERWISE SPECIFIED.

MATERIAL: SEE PARTS LIST	DRAWN: D. Kohfeld	DATE: 9/22/2011	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.
	CHECKED: A. Cox	DATE: 10/10/2011	
FINISH: N/A	UNLESS OTHERWISE NOTED: ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M AND CEMC-THP-SF-003 UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DRAWING
EST UNFINISHED WT: 1728.25 lbs			

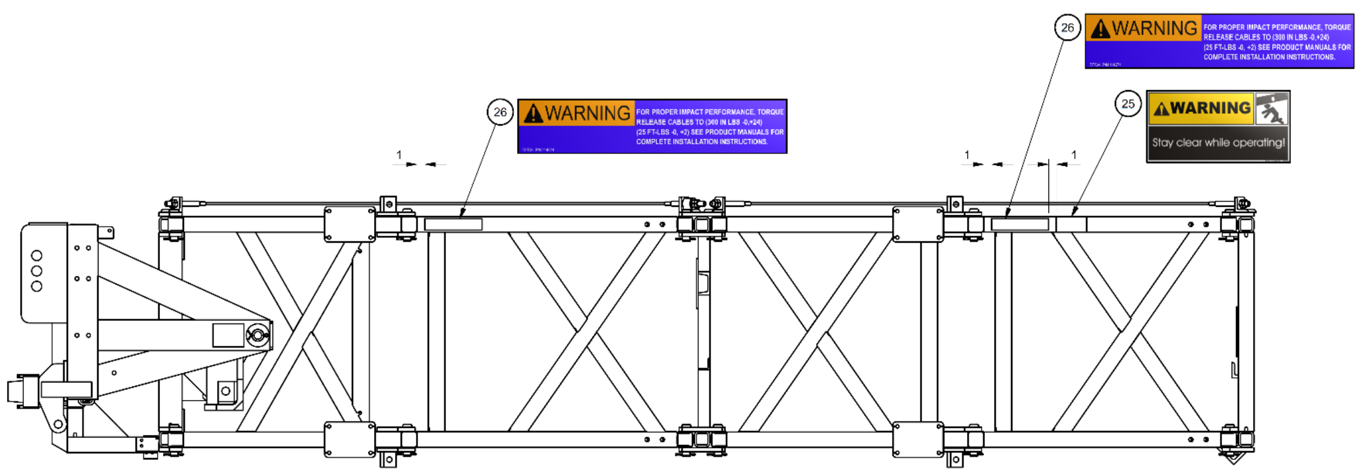
PRE-ASSY,FRAME,8292,EUG

DRAWING: 618271 | REV: D | SHEET: 1 of 2

CEMC THP FS 040 Rev 2, 12/2016

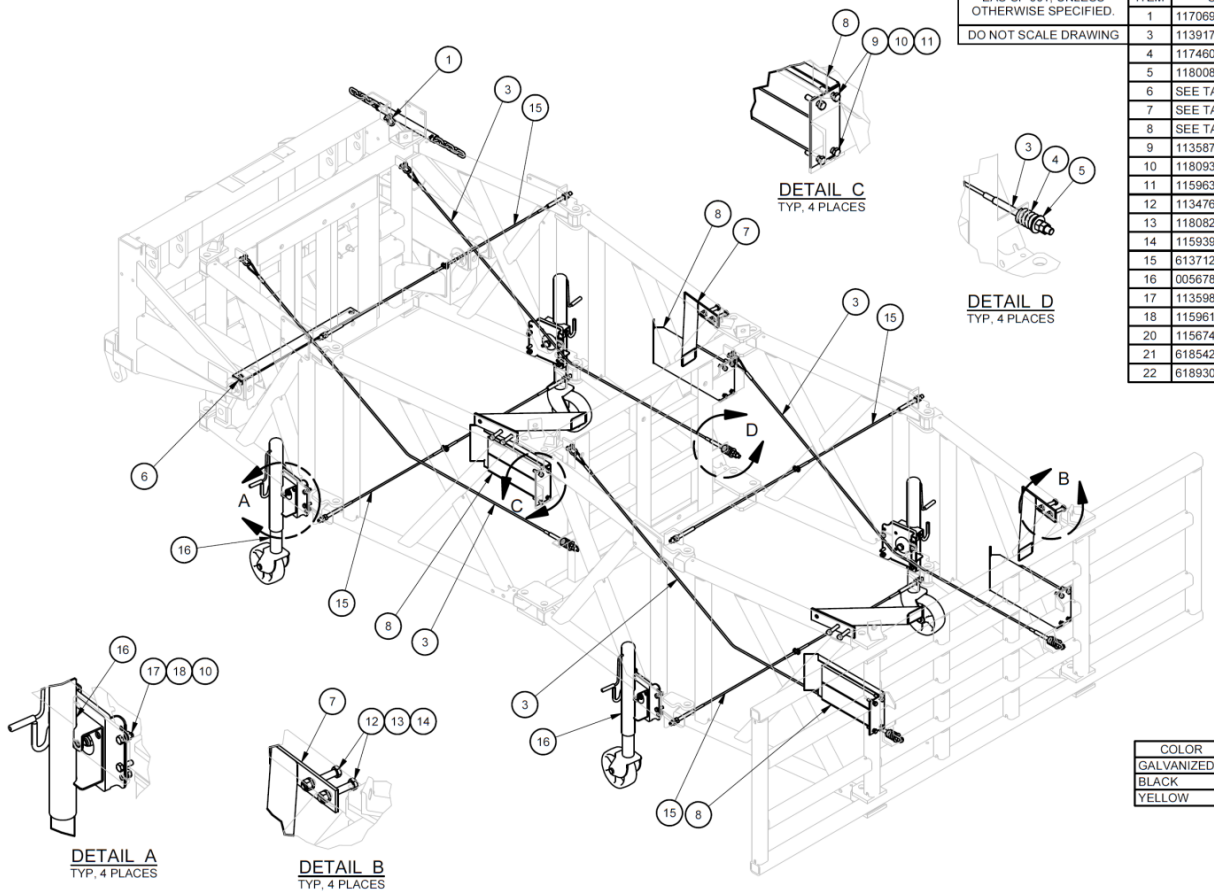
Pre-Assembly, Frame, 8292, EUG

618271 - 2 of 2



MATERIAL: SEE PARTS LIST	DRAWN: D. Kohfeld	DATE: 9/22/2011	TOLERANCES PER CEMC-THP-SF-001, UNLESS OTHERWISE SPECIFIED.	PRE-ASSY,FRAME,8292,EUG	
	CHECKED: A. Cox	DATE: 10/10/2011			
FINISH: N/A	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M AND CEMC-THP-SF-003 UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DRAWING		
			Chk.		
EST UNFINISHED WT: 1728.25 lbs				DRAWING: 618271	REV: D	SHEET: 2 of 2

618266



TOLERANCES PER EAS-SF-001, UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	117069G	SHACKLE,ANCHOR,1/4	5
3	113917B	CABLE,1/4X73,STUD W/THIMBLE	4
4	117460B	SPRING,DIE,1 1/4 ODX9/16X1 1/2,Y	4
5	118008G	WASHER,FLAT,1/2X1 3/8,P	4
6	SEE TABLE	SHIM KIT,TMA8291	1
7	SEE TABLE	GUSSET,CORNER,8291	4
8	SEE TABLE	GUIDE,FRAME,8291	4
9	113587G	BOLT,HX,3/8X1 1/2,G5,P	16
10	118093G	WASHER,LOCK,3/8,P	32
11	115963G	NUT,HX,3/8,P	16
12	113476G	BOLT,HX,1/2X3,G2,G	8
13	118082G	WASHER,LOCK,1/2,G	8
14	115939G	NUT,HX,1/2,G	8
15	613712B	RELEASE CABLE ASSEMBLY,8291	4
16	005678B	TMA-JACK (1200#,XP10)	4
17	113598G	BOLT,HX,3/8X1,G5,P	16
18	115961G	NUT,HX,3/8,G5,P	16
20	115674B	MATERIAL SAFETY INFORMATION NOTICE	1
21	618542B	INSTALLATION INSTRUCTIONS,TMA8292	1
22	618930B	SS90HD OPTIONS DRAWING	1

COLOR	ASSEMBLY	ITEM 6	ITEM 7	ITEM 8
GALVANIZED	618266B	614052B	610100G	610025G
BLACK	618267B	614051B	610101W	610026W
YELLOW	618275B	618274B	610101Y	610026Y

NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER EAS-SF-002, UNLESS OTHERWISE SPECIFIED.

ASSEMBLY NO. SEE TABLE 260.03 lbmass

DRAWN: D. Kohfeld	DATE: 9/27/2011	
DESIGNED: A. Cox	DATE: 8/7/2011	
CHECKED: KRM	DATE: 10/7/2011	MISC. HARDWARE,8292
APPROVED: A. Cox	DATE: 10/11/2011	
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.		DRAWING: 618266 SHEET: 1 of 1 REV: C

FM0036 Rev A, 5/8/11

Miscellaneous Hardware, 8292

TOLERANCES PER EAS-SF-001, UNLESS OTHERWISE SPECIFIED.

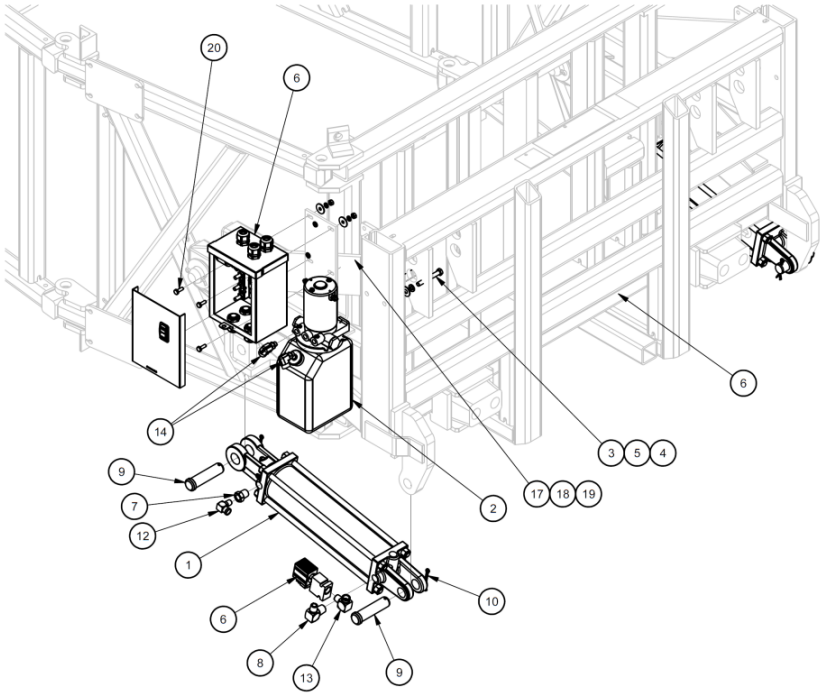
DO NOT SCALE DRAWING

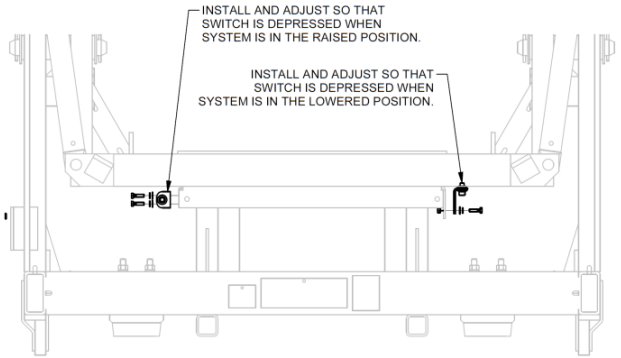
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	114413B	CYLINDER,3B,12S	2
2	118320B	PUMP,SEAL MOTOR,VERT,12V,HEAVY DUTY	1
3	118511G	BOLT,HX,3/8X2 3/4,G5,P	2
4	118037G	WASHER,FLAT,3/8X1,P	2
5	118093G	WASHER,LOCK,3/8,P	2
6	618277B	ELECTRICAL BOX,HYDRAULIC PUMP,12V,8292	1
7	116620B	REDUCER,BUSHING,1/2X1/4 NPT,P	2
8	114825G	ELBOW,MALE,1/2X3/8,P	2
9	118386G	PIN,CLEVIS,1X3 3/4,P	4
10	116276G	PIN,COTTER,3/16X1 1/2,P	4
11	117709G	TEE,BRANCH,1/4,FEMALE,P	2
12	114838G	ELBOW,STREET,4MP-4FP,P	4
13	114836G	ELBOW,STREET,3/8MALE X 1/4FEM,P	2
14	114784G	ELBOW,#4M-ORB X #4-NPT,P	2
15	115174B	HOSE ASSY,HYDRAULIC,36"	4
16	115176B	HOSE ASSY,HYDRAULIC,44"	2
17	115946G	NUT,HX,1/4,G	4
18	118086G	WASHER,LOCK,1/4,P	4
19	118016G	WASHER,FLAT,1/4X1,P	4
20	113518G	BOLT,HX,1/4X3/4,G5,G	4
23	117783B	TIE,NYLON,14,BLACK	10

OPTIONAL ITEMS

ITEM	STOCK NO.	DESCRIPTION	QTY.
21	618504B	CONTROL BOX ASSY,CAB,8292	1
22	618356B	CABLE,BATTERY,2GA,25FT,QUICK END	1





NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER EAS-SF-002, UNLESS OTHERWISE SPECIFIED.
2. SECURE LOOSE CABLES AND HOSES WITH ITEM 23.

ASSEMBLY NO. 618586B 97.17 lbmass

DRAWN: D. Kohfeld DATE: 11/30/2011
DESIGNED: R. Brougher DATE:
CHECKED: KRM DATE: 12/27/2011
APPROVED: R. Brougher DATE: 12/21/2011

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

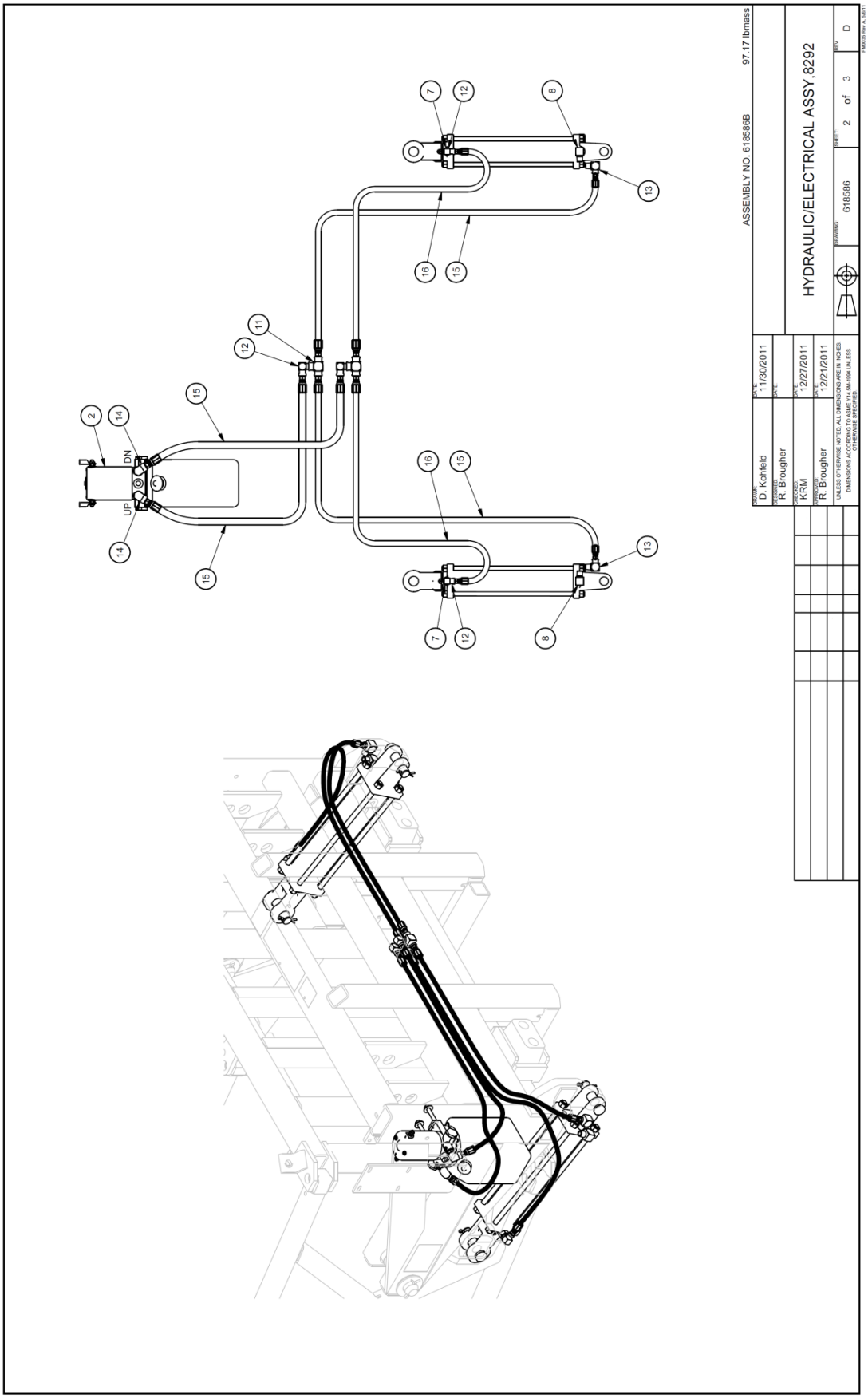
HYDRAULIC/ELECTRICAL ASSY,8292

DRAWING: 618586 SHEET: 1 of 3 REV: D

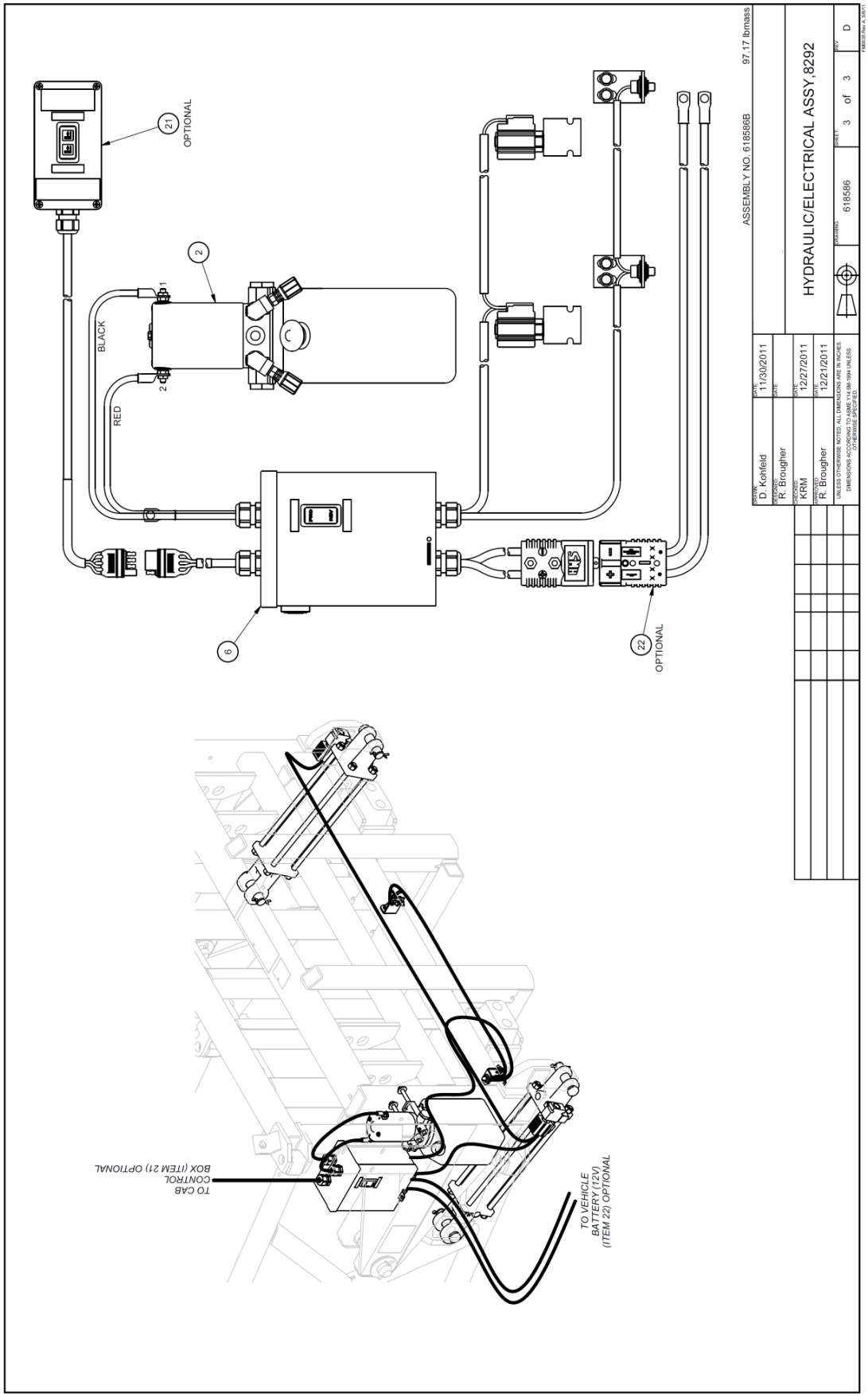
FM0036 Rev A, 5/6/11

Hydraulic/Electrical Assembly, 8292

618586 - 2 of 3


ASSEMBLY NO. 618586B
97.17 lbmass
DRAWN
D. Kohfeld
11/30/2011
ENGINEER
R. Brougher
CHECKED
KRM
12/27/2011
APPROVED
R. Brougher
12/21/2011
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED
HYDRAULIC/ELECTRICAL ASSY,8292
DRAWING
618586
SHEET
2 of 3
REV
D
UP
DN

618586 - 3 of 3


21
OPTIONAL
2
BLACK
RED
6
22
OPTIONAL
TO CAB CONTROL BOX (ITEM 21) OPTIONAL
TO VEHICLE BATTERY (12V) (ITEM 22) OPTIONAL
ASSEMBLY NO. 618586B
97.17 lbmass
HYDRAULIC/ELECTRICAL ASSY,8292
DRAWN D. Kohfeld 11/30/2011
REVISED R. Brougher
CHECKED KRM 12/27/2011
APPROVED R. Brougher 12/21/2011
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED
DRAWING 618586
SHEET 3 of 3
REV D

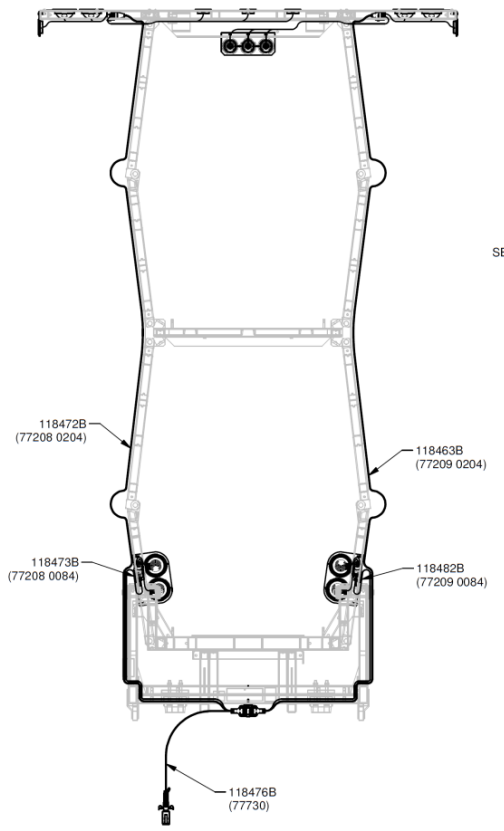
TOLERANCES PER EAS-SF-001, UNLESS OTHERWISE SPECIFIED.
DO NOT SCALE DRAWING

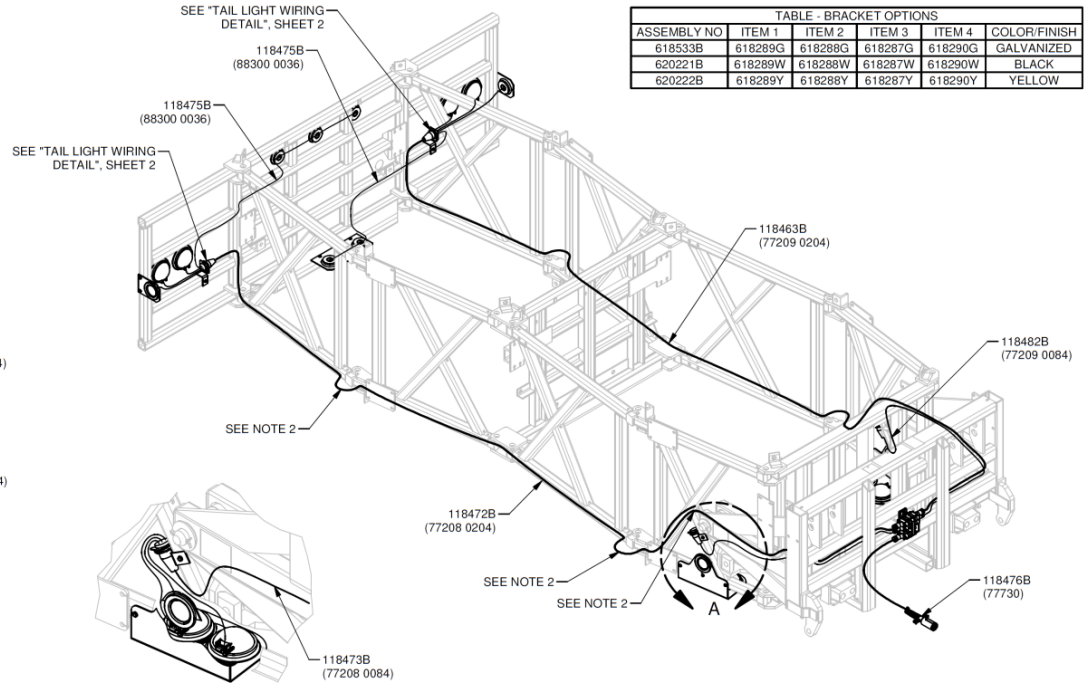
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BRACKET,LIGHT,FRONT	2
2	SEE TABLE	BRACKET,LIGHT,ICC	1
3	SEE TABLE	BRACKET,LAMP,MARKER	2
4	SEE TABLE	BRACKET,HARNESS	4
5	116888G	SCREW,HWH,1/4X1 1/4,SELF DRILL/TAP,P	19
6	118478B	LIGHT AND HARNESS KIT,12V,LED,8292	1
7	117783B	TIE,NYLON,14,BLACK	42

TABLE - BRACKET OPTIONS

ASSEMBLY NO	ITEM 1	ITEM 2	ITEM 3	ITEM 4	COLOR/FINISH
618533B	618289G	618288G	618287G	618290G	GALVANIZED
620221B	618289W	618288W	618287W	618290W	BLACK
620222B	618289Y	618288Y	618287Y	618290Y	YELLOW





DETAIL A

NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER EAS-SF-002, UNLESS OTHERWISE SPECIFIED.
2. USE ITEM 7 TO SECURE ALL CABLES. PROVIDE SLACK AT ARM AND BACKUP PIVOTS.

ASSEMBLY NO. SEE TABLE 28.75 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011
DESIGNED: P. Kruse	DATE: 8/24/2011
CHECKED: KRM	DATE: 10/19/2011
APPROVED: P. Kruse	DATE: 10/20/2011

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

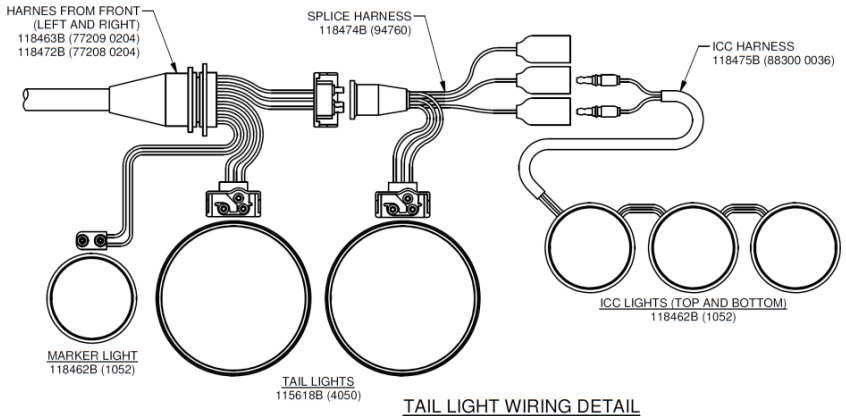
LIGHTING ASSY,LED,12V,8292

DRAWING: 618533 | SHEET: 1 of 3 | REV: B

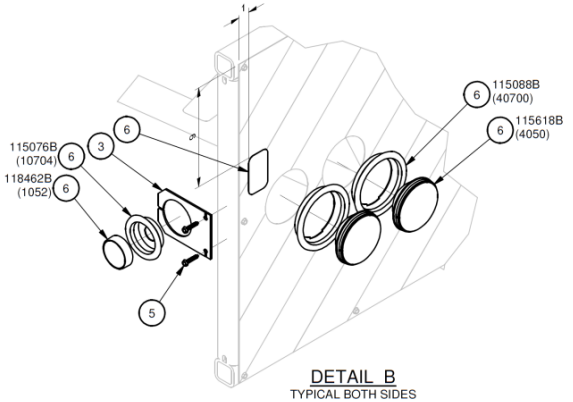
FM0035 Rev A, 5/0/11

Lighting Assembly, LED, 12V, 8292

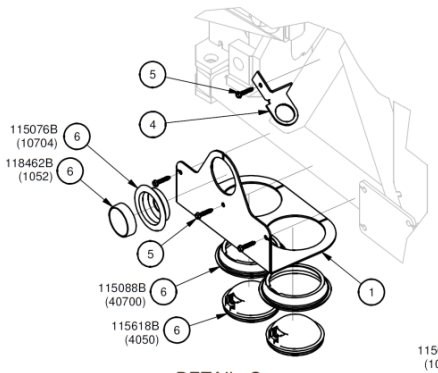
618533 - 2 of 3



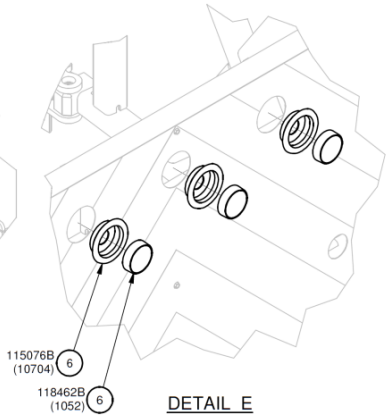
TAIL LIGHT WIRING DETAIL
TYPICAL LEFT AND RIGHT, UPPER AND LOWER ICC LIGHTS.



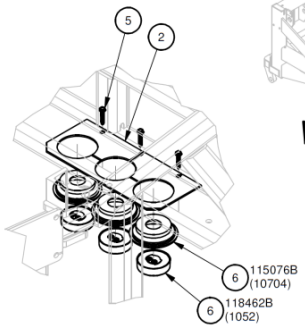
DETAIL B
TYPICAL BOTH SIDES



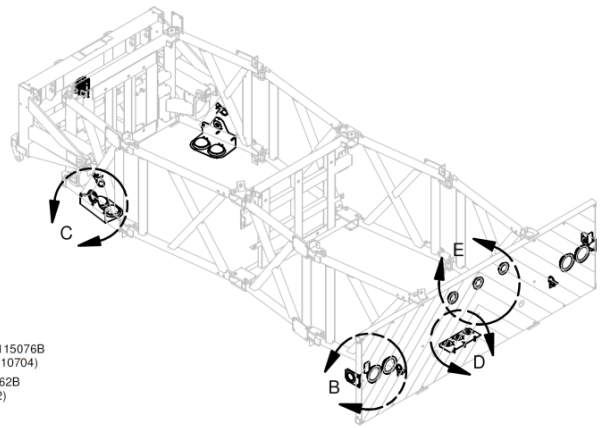
DETAIL C
TYPICAL BOTH SIDES



DETAIL E



DETAIL D



ASSEMBLY NO. SEE TABLE 28.75 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011
DESIGNED: P. Kruse	DATE: 8/24/2011
CHECKED: KRM	DATE: 10/19/2011
APPROVED: P. Kruse	DATE: 10/20/2011

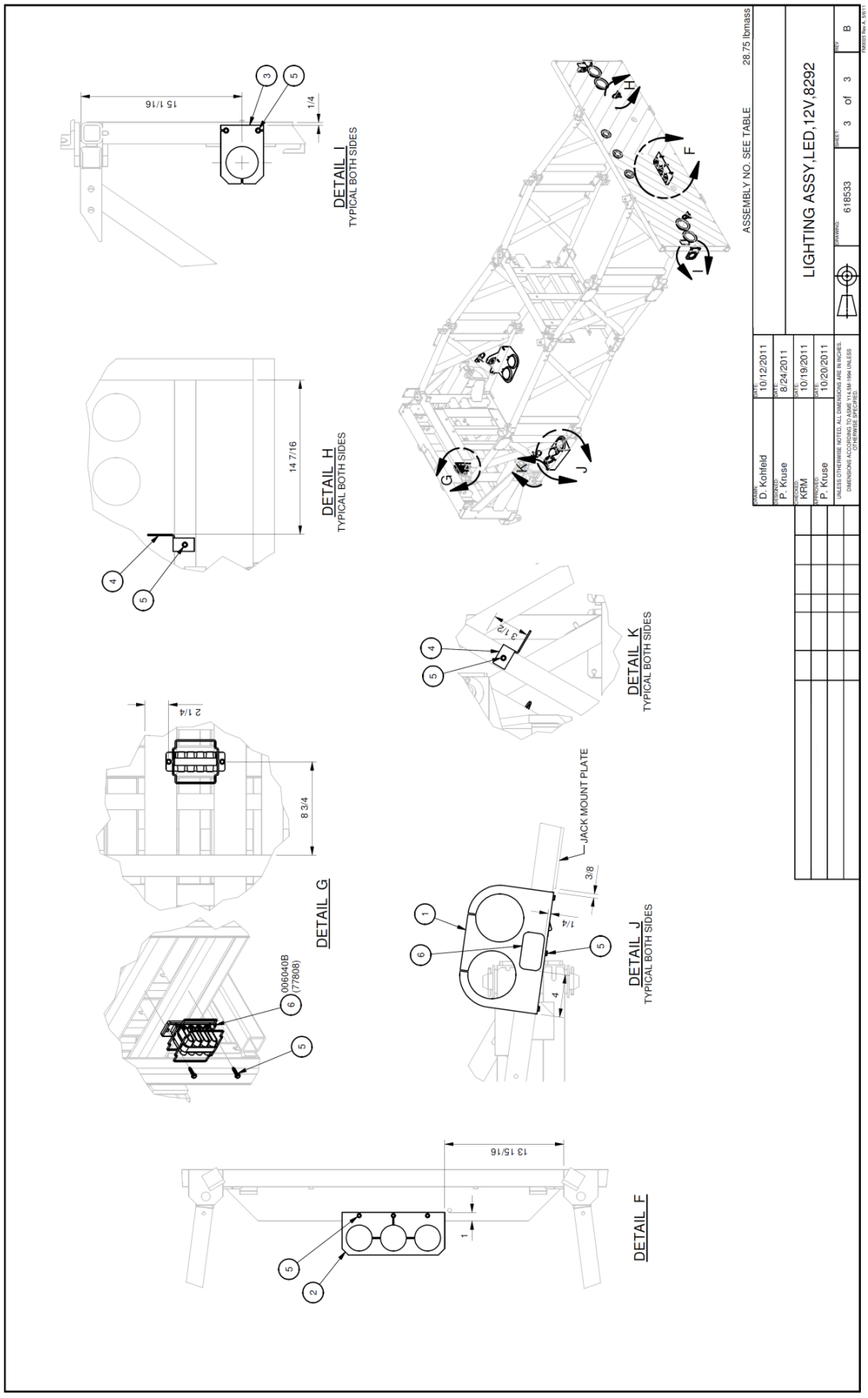
LIGHTING ASSY,LED,12V,8292

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

DRAWING: 618533 | SHEET: 2 of 3 | REV: B

FM0035 Rev A. 5/8/11

618533 - 3 of 3


DETAIL I
TYPICAL BOTH SIDES
15 1/16
1/4
DETAIL H
TYPICAL BOTH SIDES
14 7/16
DETAIL G
2 1/4
8 3/4
006040B (77808)
DETAIL K
TYPICAL BOTH SIDES
3 1/2
DETAIL J
TYPICAL BOTH SIDES
JACK MOUNT PLATE
3/8
1/4
4
DETAIL F
13 15/16
1
ASSEMBLY NO. SEE TABLE
28.75 lbmass
LIGHTING ASSY,LED,12V,8292
DRAWING 618533
SHEET 3 of 3
REV B
D. Kohfeld 10/12/2011
P. Kruse 8/24/2011
KRM 10/19/2011
P. Kruse 10/20/2011

TOLERANCES PER EAS-SF-001, UNLESS OTHERWISE SPECIFIED.

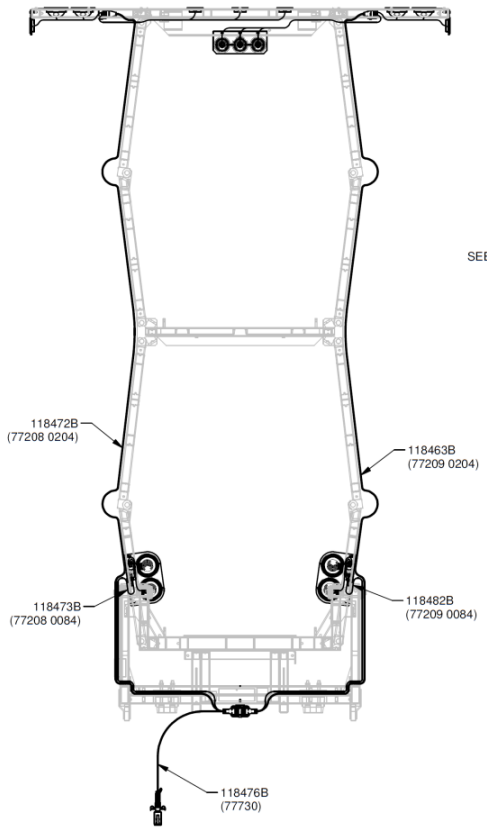
DO NOT SCALE DRAWING

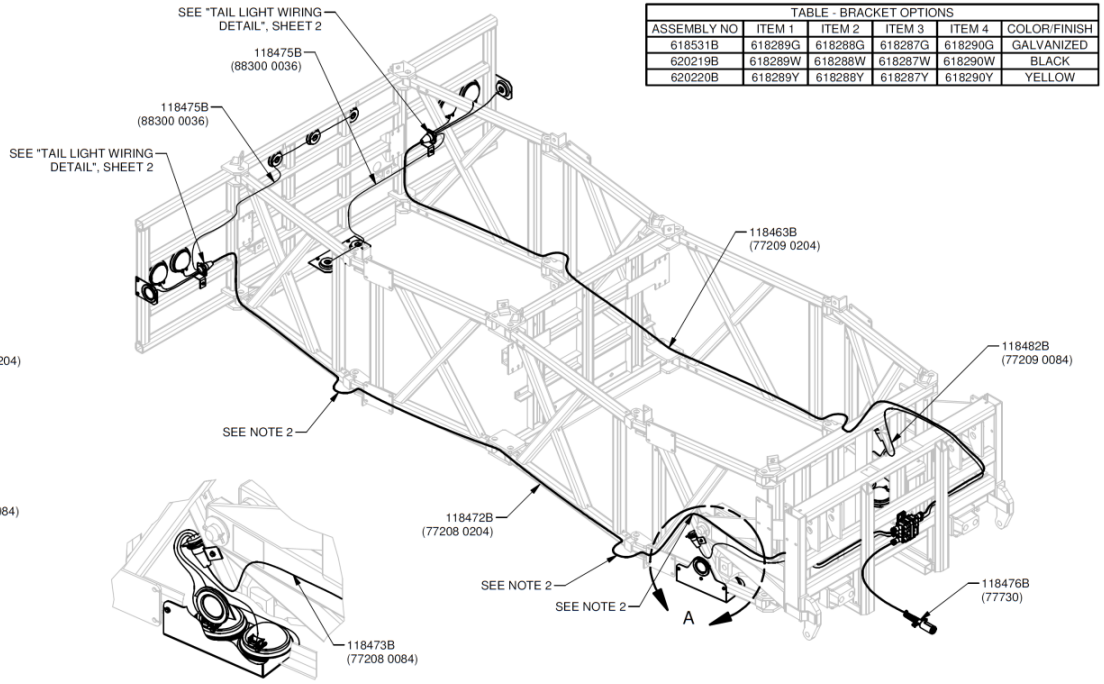
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BRACKET,LIGHT,FRONT	2
2	SEE TABLE	BRACKET,LIGHT,ICC	1
3	SEE TABLE	BRACKET,LAMP,MARKER	2
4	SEE TABLE	BRACKET,HARNESS	4
5	116888G	SCREW,HWH,1/4X1 1/4,SELF DRILL/TAP,P	19
6	118477B	LIGHT AND HARNESS KIT,12V,STD,8292	1
7	117783B	TIE,NYLON,14,BLACK	42

TABLE - BRACKET OPTIONS

ASSEMBLY NO	ITEM 1	ITEM 2	ITEM 3	ITEM 4	COLOR/FINISH
618531B	618289G	618288G	618287G	618290G	GALVANIZED
620219B	618289W	618288W	618287W	618290W	BLACK
620220B	618289Y	618288Y	618287Y	618290Y	YELLOW





DETAIL A

NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER EAS-SF-002, UNLESS OTHERWISE SPECIFIED.
2. USE ITEM 7 TO SECURE ALL CABLES. PROVIDE SLACK AT ARM AND BACKUP PIVOTS.

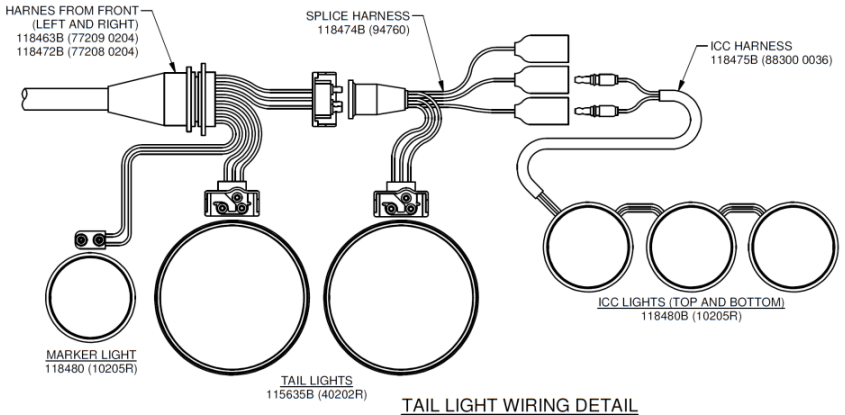
ASSEMBLY NO. SEE TABLE 28.75 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011		
DESIGNED: P. Kruse	DATE: 8/24/2011		
CHECKED: KRM	DATE: 10/19/2011	LIGHTING ASSY,INCANDESCENT,12V,8292	
APPROVED: P. Kruse	DATE: 10/20/2011		
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.		DRAWING: 618531	SHEET: 1 of 3 REV: B

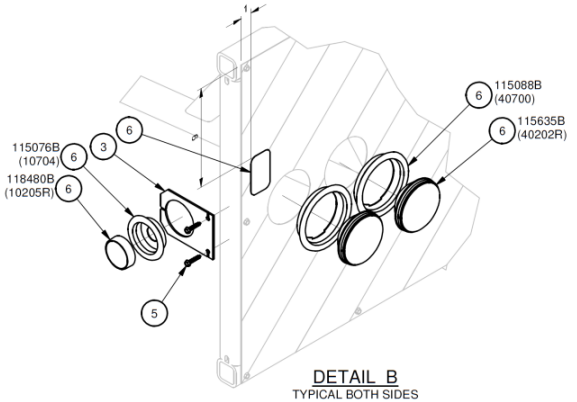
FM0035 Rev A, 5/6/11

Lighting Assembly, Incandescent, 12V, 8292

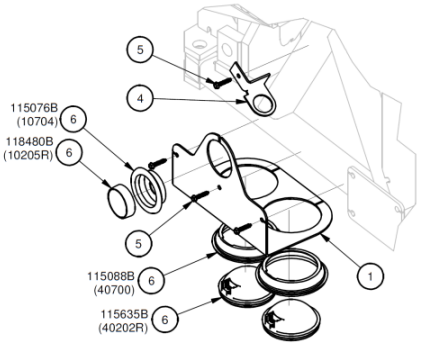
618531 - 2 of 3



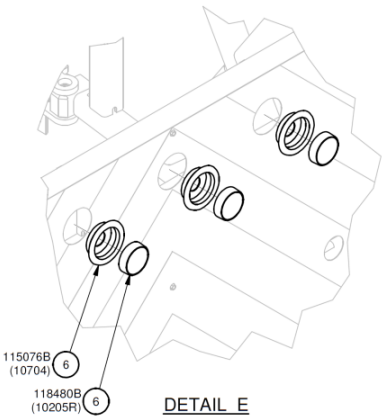
TAIL LIGHT WIRING DETAIL
TYPICAL LEFT AND RIGHT, UPPER AND LOWER ICC LIGHTS.



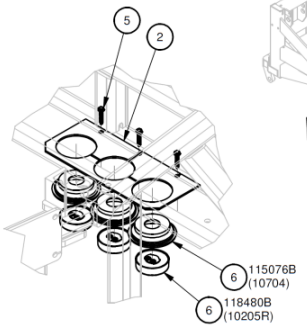
DETAIL B
TYPICAL BOTH SIDES



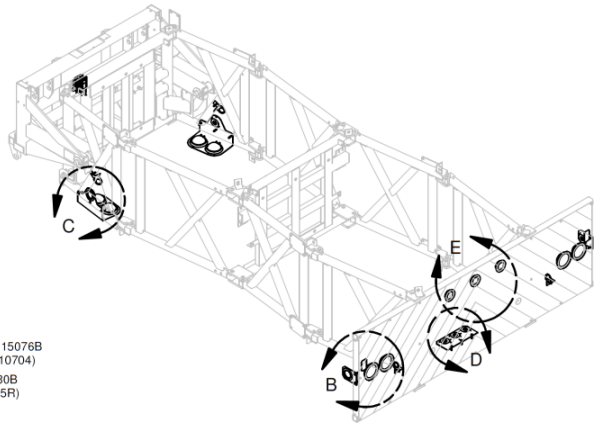
DETAIL C
TYPICAL BOTH SIDES



DETAIL E



DETAIL D



ASSEMBLY NO. SEE TABLE 28.75 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011
DESIGNED: P. Kruse	DATE: 8/24/2011
CHECKED: KRM	DATE: 10/19/2011
APPROVED: P. Kruse	DATE: 10/20/2011

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

LIGHTING ASSY,INCANDESCENT,12V,8292

DRAWING: 618531 | SHEET: 2 of 3 | REV: B

FM0035 Rev A, 5/2/11

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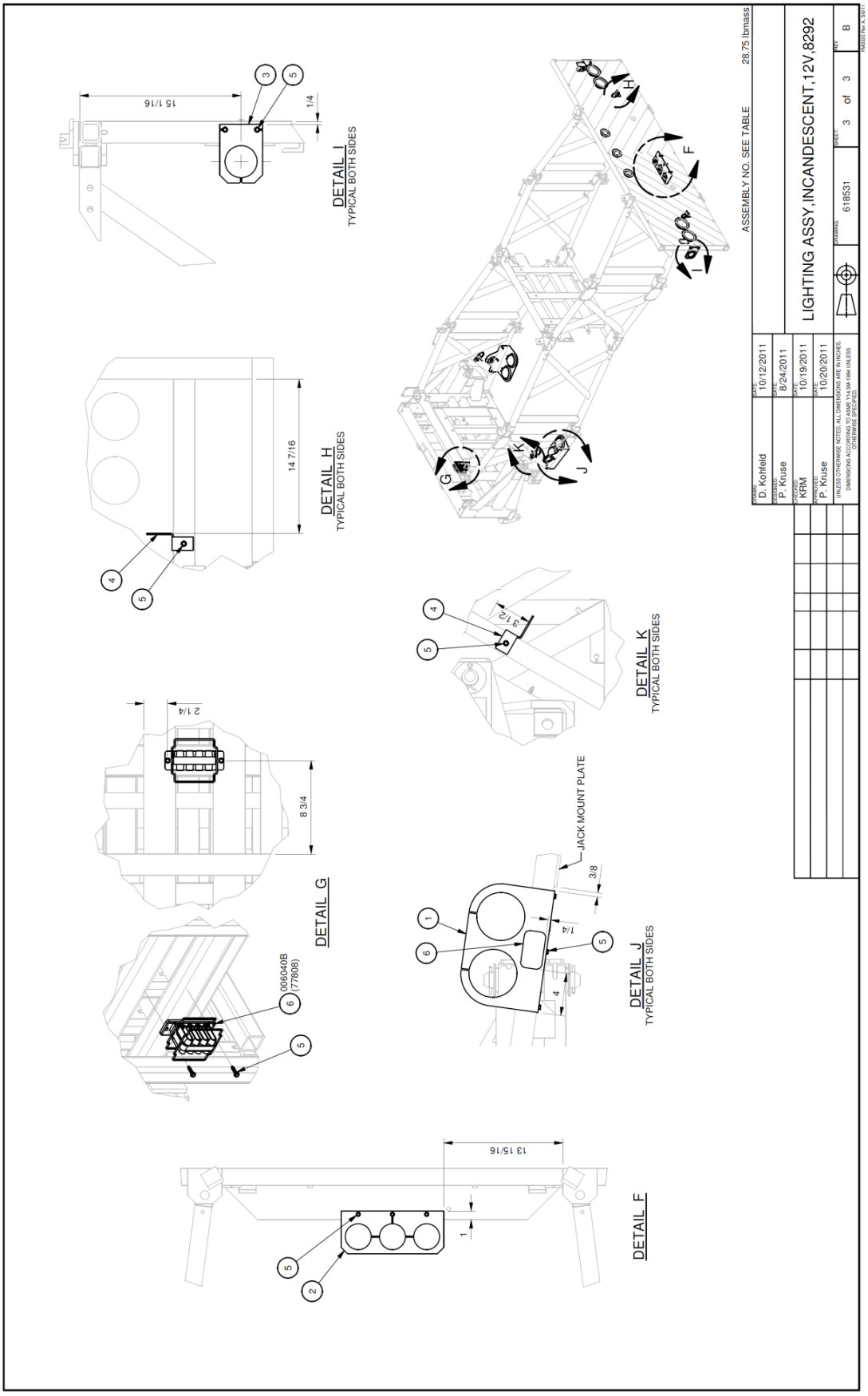

DETAIL I
TYPICAL BOTH SIDES
15 1/16
1/4
DETAIL H
TYPICAL BOTH SIDES
14 7/16
DETAIL K
TYPICAL BOTH SIDES
3 1/2
DETAIL G
2 1/4
8 3/4
006040B (77808)
DETAIL J
TYPICAL BOTH SIDES
JACK MOUNT PLATE
3/8
1/4
4
DETAIL F
13 15/16
1
ASSEMBLY NO. SEE TABLE
28.75 lbmass
LIGHTING ASSY,INCANDESCENT,12V,8292
DRAWING 618531
SHEET 3 of 3
REV B
D. Kohfeld 10/12/2011
P. Kruse 8/24/2011
KRM 10/19/2011
P. Kruse 10/20/2011
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

618534 - 1 of 3

TOLERANCES PER EAS-SF-001, UNLESS OTHERWISE SPECIFIED.

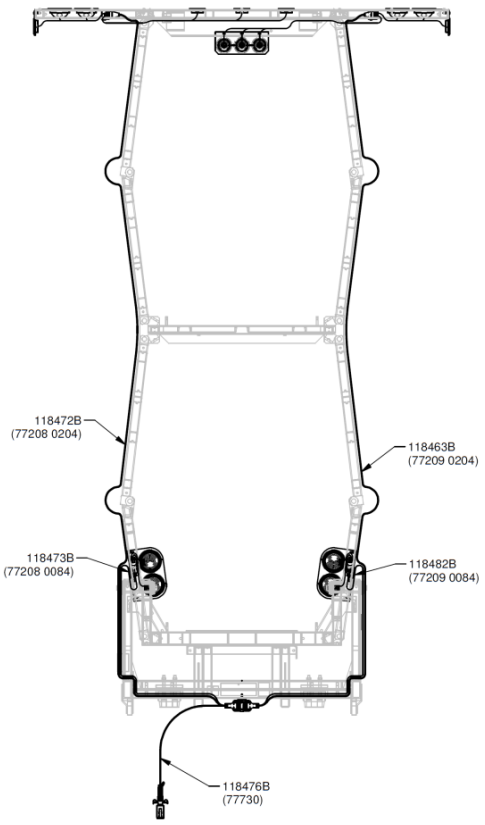
DO NOT SCALE DRAWING

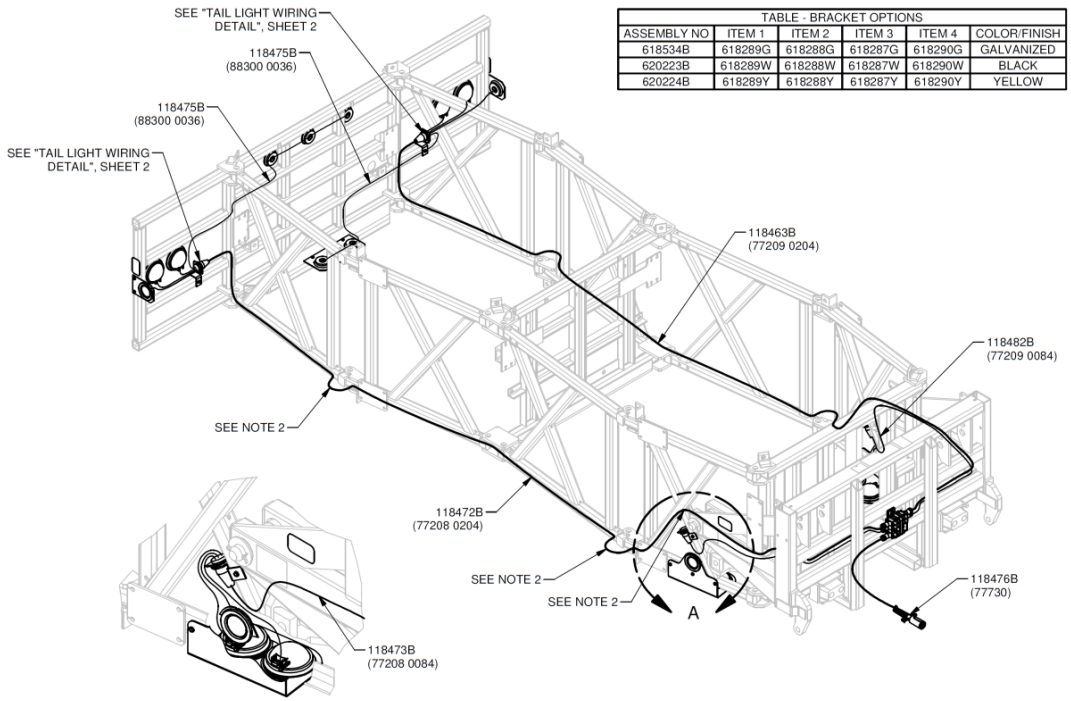
PARTS LIST

ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	BRACKET,LIGHT,FRONT	2
2	SEE TABLE	BRACKET,LIGHT,ICC	1
3	SEE TABLE	BRACKET,LAMP,MARKER	2
4	SEE TABLE	BRACKET,HARNESS	4
5	116888G	SCREW,HWH,1/4X1 1/4,SELF DRILL/TAP,P	19
6	118479B	LIGHT AND HARNESS KIT,24V,STD,8292	1
7	117783B	TIE,NYLON,14,BLACK	42

TABLE - BRACKET OPTIONS

ASSEMBLY NO	ITEM 1	ITEM 2	ITEM 3	ITEM 4	COLOR/FINISH
618534B	618289G	618288G	618287G	618290G	GALVANIZED
620223B	618289W	618288W	618287W	618290W	BLACK
620224B	618289Y	618288Y	618287Y	618290Y	YELLOW





DETAIL A

NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER EAS-SF-002, UNLESS OTHERWISE SPECIFIED.
2. USE ITEM 7 TO SECURE ALL CABLES. PROVIDE SLACK AT ARM AND BACKUP PIVOTS.

ASSEMBLY NO. SEE TABLE 28.76 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011	
DESIGNED: P. Kruse	DATE: 8/24/2011	
CHECKED: KRM	DATE: 10/19/2011	LIGHTING ASSY,INCANDESCENT,24V,8292
APPROVED: P. Kruse	DATE: 10/20/2011	

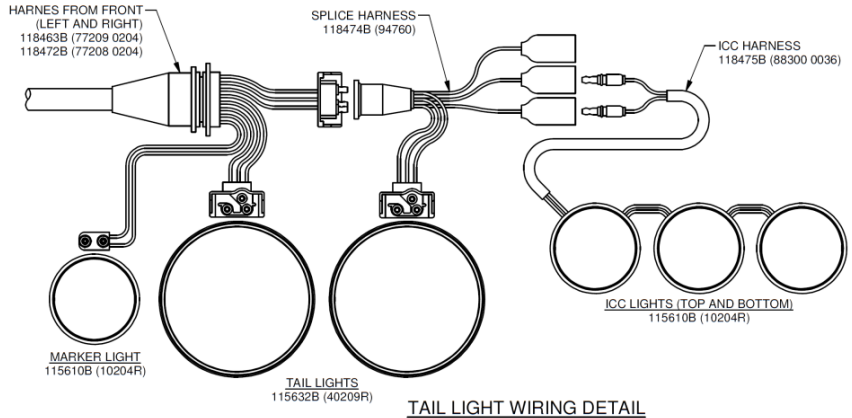
UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES.
DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

DRAWING: 618534 | SHEET: 1 of 3 | REV: B

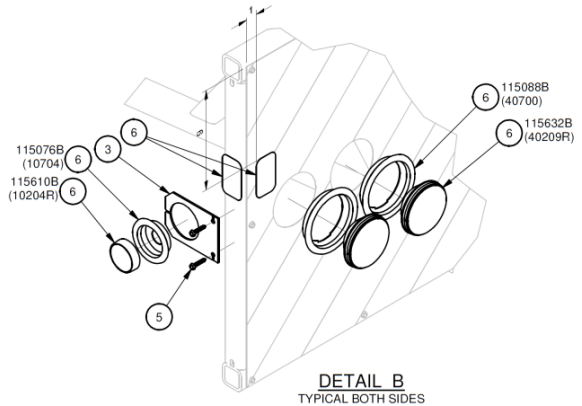
RM005 Rev A, 5/9/11

Lighting Assembly, Incandescent, 24V, 8292

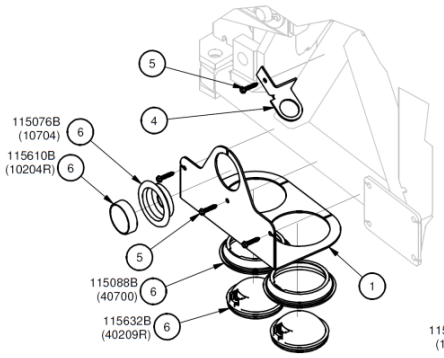
618534 - 2 of 3



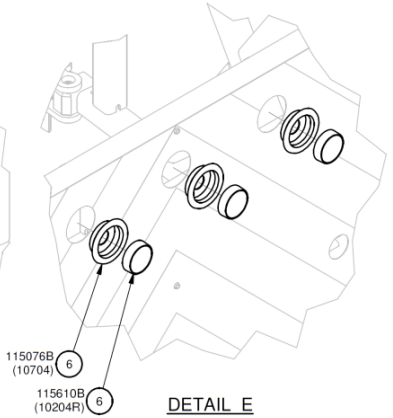
TAIL LIGHT WIRING DETAIL
TYPICAL LEFT AND RIGHT, UPPER
AND LOWER ICC LIGHTS.



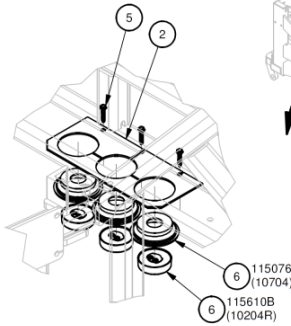
DETAIL B
TYPICAL BOTH SIDES



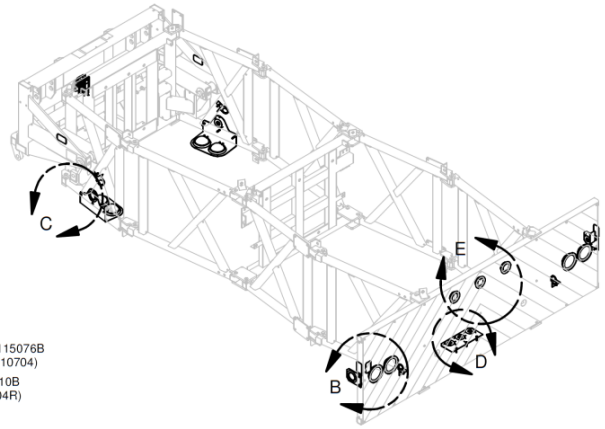
DETAIL C
TYPICAL BOTH SIDES



DETAIL E



DETAIL D



ASSEMBLY NO. SEE TABLE 28.76 lbmass

DRAWN: D. Kohfeld	DATE: 10/12/2011
DESIGNED: P. Kruse	DATE: 8/24/2011
CHECKED: KRM	DATE: 10/19/2011
APPROVED: P. Kruse	DATE: 10/20/2011

LIGHTING ASSY,INCANDESCENT,24V,8292

UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M-1994 UNLESS OTHERWISE SPECIFIED.

DRAWING: 618534 | SHEET: 2 of 3 | REV: B

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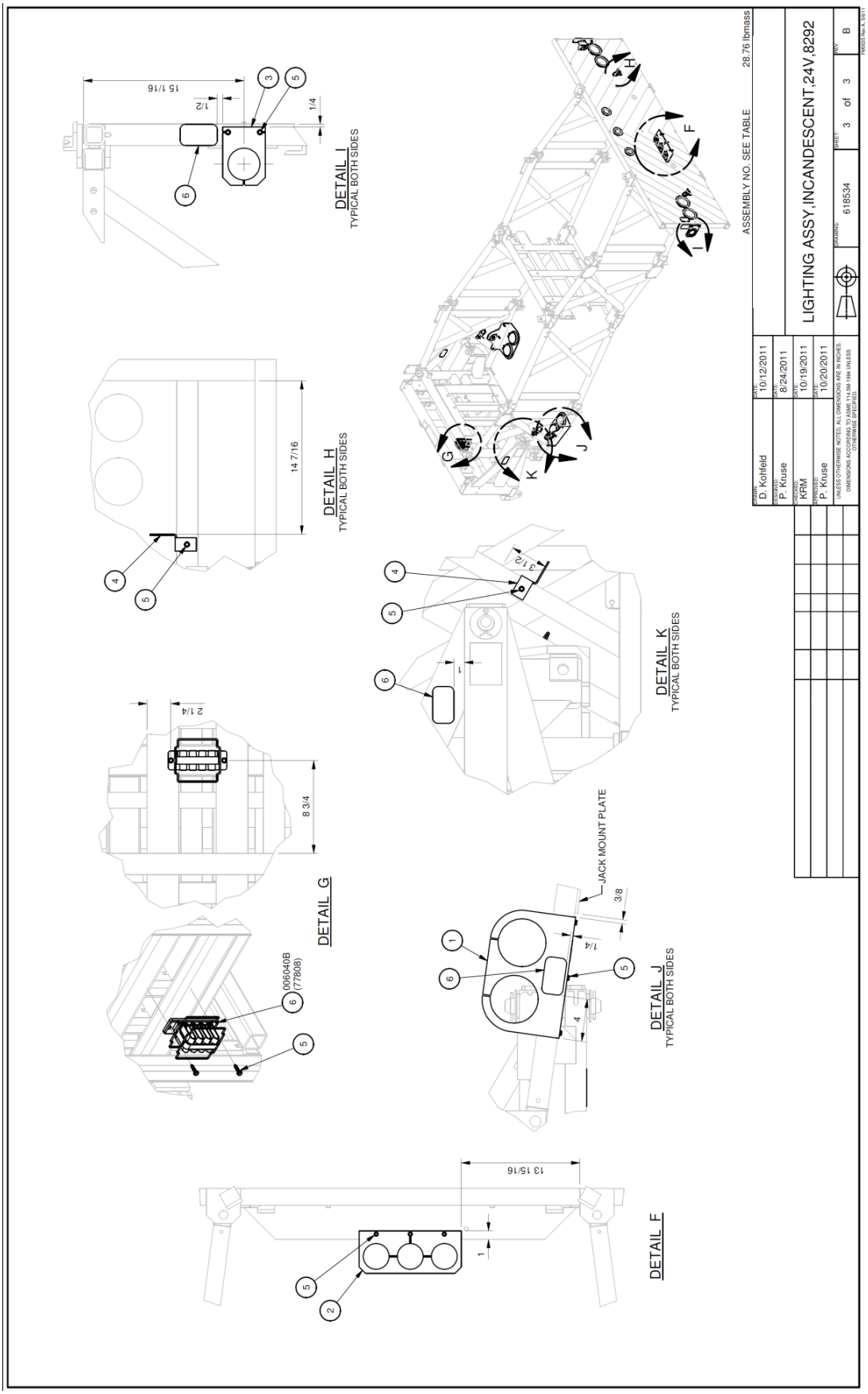
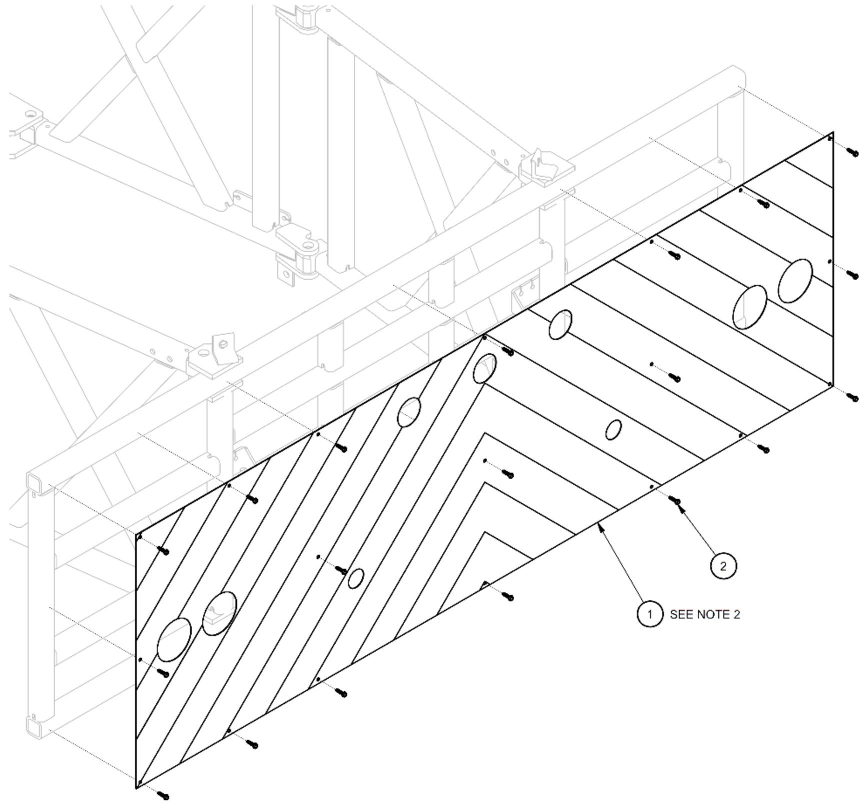
618534 - 3 of 3


DETAIL I
TYPICAL BOTH SIDES
DETAIL H
TYPICAL BOTH SIDES
DETAIL K
TYPICAL BOTH SIDES
DETAIL G
DETAIL J
TYPICAL BOTH SIDES
JACK MOUNT PLATE
DETAIL F
ASSEMBLY NO. SEE TABLE
28.76 lbmass
LIGHTING ASSY,INCANDESCENT,24V,8292
618534
3 of 3
B

618505

PARTS LIST			
ITEM	STOCK NO.	DESCRIPTION	QTY.
1	SEE TABLE	STRIPING ASSY,8292	1
2	116890	SCREW,HWH,1/4X1,SELF DRILL/TAP,P	19

STRIPING ASSEMBLY TABLE		
ASSEMBLY NO.	ITEM 1 NO.	DESCRIPTION
618505	618485	4" BLACK
618506	618486	4" ORANGE/BLACK, VA
618509	618489	8" RED/WHITE
618511	618491	6" ORANGE/WHITE, FL
618512	618492	4" YELLOW REFL/BLACK
618513	618493	4" BLUE, NY
618516	618496	4" ORANGE, MD
618517	618497	6" BLACK REFL, PA
618518	618498	8" BLACK REFL, MO
618519	618499	6" BLACK/ORANGE, PA TPK
618520	618500	6" ORANGE/BLACK, VA2
618521	618501	12" RED/WHITE, MO
620087	620086	4" RED REFL, HK
626362	626361	6" FL YELLOW GREEN/RED, AL
626377	626376	8" YELLOW-GREEN/ORANGE, TX



NOTES:
1. FINISH AND GENERAL WORKMANSHIP PER THP-SF-004, UNLESS OTHERWISE SPECIFIED.
2. STRIPING PATTERN SHOWN IS GENERIC. SEE STRIPING ASSEMBLY TABLE ITEM DRAWING FOR SPECIFIC STRIPING PATTERN.

MATERIAL: SEE PARTS LIST	DRAWN: D. Kohfeld	DATE: 10/5/2011	TOLERANCES PER THP-SF-001, UNLESS OTHERWISE SPECIFIED.
	CHECKED: P. Kruse	DATE: 10/20/2011	
FINISH: N/A	UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN INCHES. DIMENSIONS ACCORDING TO ASME Y14.5M AND THP-SF-003 UNLESS OTHERWISE SPECIFIED.		DO NOT SCALE DRAWING
EST UNFINISHED WT: 10.5 lbs			

REAR PLATE ASSY,W/STRIPING,8292

DRAWING NO.: 618505 | REV: C | SHEET: 1 of 1

Rear Plate Assembly, w/Striping, 8292

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