

HR3100 SERIES B1
REAR UNIVERSAL HY-RAIL®
GUIDE WHEEL EQUIPMENT
HYDRAULICALLY OPERATED

OPERATOR'S SERVICE
AND PARTS MANUAL



ISSUED
REVISED

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REVISION A



- **THIS MANUAL CONTAINS VITAL INFORMATION FOR THE SAFE USE AND EFFICIENT OPERATION OF THE VEHICLE EQUIPPED WITH HY-RAIL® GUIDE WHEEL EQUIPMENT. CAREFULLY READ THIS OPERATOR'S MANUAL BEFORE USING THE VEHICLE. FAILURE TO ADHERE TO THE INSTRUCTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.**

HY-RAIL® is a registered trademark of Harsco Rail, Harsco Corporation.

When this manual is received, record the Guide Wheel Unit serial numbers in the spaces provided in the General Information and Parts Sections for future reference, in case the serial number tags ever become unreadable. A Manual must remain with the vehicle. Additional or replacement manuals may be obtained by calling or writing Harsco Rail, Harsco Corporation.

All information, illustrations and specifications in this manual are based on the latest information available at the time of publication. Harsco Rail, Harsco Corporation reserves the right to make changes at any time without notice.

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1.1 Operator and Maintenance Personnel Information

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The operators and maintenance personnel must be thoroughly familiar with the contents of this manual before operating the guide wheel equipped vehicle, making adjustments, or carrying out maintenance procedures. Use common sense and utilize practical safety practices when operating and working on or around the guide wheel equipped vehicle to help prevent injury and property damage.

The operator and maintenance personnel must have a working knowledge of railroad safety procedures and the specific rules and policies that are in effect in the work environment. Railroad, Government and/or local laws and regulations may also influence work decisions.

The illustrations, specifications, and other information in this publication are based on information in effect at the time of publication. Take care of your Operator's Service and Parts Manual. Ensure that the correct information is available to the operator and maintenance personnel at all times.

1.2 Safety Information



SAFETY IS A CRITICAL FACTOR IN THE DESIGN OF HARSCO RAIL EQUIPMENT. THE BEST SAFETY PROGRAM STARTS WITH A SAFETY CONSCIOUS OPERATOR. THE SAFETY INFORMATION HIGHLIGHTED IN THIS BULLETIN DESCRIBES SAFE OPERATING PRACTICES FOR THE BENEFIT OF THE WORKERS WHO WILL USE OUR EQUIPMENT IN THEIR DAILY JOBS.

1.2.1 Hazard Seriousness

Signal Words: DANGER, WARNING and CAUTION are used to identify levels of hazard seriousness.



DANGER - Immediate hazards which WILL result in severe bodily injury or death.



WARNING - Hazards or unsafe practices which COULD result in severe bodily injury or death.



CAUTION - Hazards or unsafe practices which COULD result in minor bodily injury and / or product or property damage.

1.2 Safety Information



- **APPLY THE VEHICLE PARKING BRAKE AND STOP THE ENGINE WHEN PERFORMING MAINTENANCE, MAKING ADJUSTMENTS, WORKING UNDER VEHICLE OR GUIDE WHEEL EQUIPMENT OR WHENEVER UNINTENDED MOVEMENT OF THE VEHICLE COULD OCCUR, UNLESS OTHERWISE INSTRUCTED IN THIS MANUAL.**
- **MAKE SURE ALL PERSONS ARE CLEAR OF VEHICLE BEFORE PERFORMING ANY OPERATING FUNCTIONS.**
- **KEEP ALL PARTS OF THE BODY AND LOOSE CLOTHING CLEAR OF ALL MOVING PARTS OF THE VEHICLE OR GUIDE WHEEL EQUIPMENT.**
- **UNDERSTAND EQUIPMENT OPERATION AND BE AWARE OF ALL PINCH POINTS BEFORE OPERATING OR MAKING ADJUSTMENTS TO GUIDE WHEEL EQUIPMENT.**
- **IF A DERAILMENT SHOULD OCCUR WHILE VEHICLE IS OPERATING IN ELECTRIFIED 3RD-RAIL TERRITORY, VEHICLE OR GUIDE WHEEL EQUIPMENT MIGHT BE IN ELECTRICAL CONTACT WITH ELECTRIFIED RAIL. DO NOT ATTEMPT TO EXIT FROM VEHICLE UNTIL ELECTRICAL POWER TO 3RD-RAIL HAS BEEN TURNED OFF.**
- **IF THE HY-RAIL® EQUIPPED VEHICLE IS INVOLVED IN A DERAILMENT OR HIGHWAY ACCIDENT, IT MUST BE INSPECTED AND NECESSARY REPAIRS OR ADJUSTMENTS MADE TO THE VEHICLE AND / OR HY-RAIL® EQUIPMENT PRIOR TO ITS NEXT OPERATION ON THE RAILROAD TRACK.**
- **DO NOT EXCEED 25 MPH (40 km/h) WHEN OPERATING VEHICLE ON TRACK. RAILROAD RULES GOVERNING SPEEDS SHOULD BE OBSERVED AT ALL TIMES. REDUCE SPEED WHEN PROPELLING VEHICLE THROUGH SWITCHES, CROSSINGS, BRANCH LINES AND ANY SPECIAL TRACK WORKS. OPERATING VEHICLE AT UNSAFE SPEEDS COULD RESULT IN DERAILMENT OF VEHICLE.**
- **CHECK AND CORRECT GUIDE WHEEL EQUIPMENT ALIGNMENT PROMPTLY IF MISALIGNMENT IS INDICATED.**

1.2 Safety Information

1



- **AT MAXIMUM LOADED GROSS VEHICLE WEIGHT ON TRACK (including driver, passengers, equipment, tools, payload, etc.) DO NOT EXCEED ANY OF THE FOLLOWING:**
 - **VEHICLE'S G.V.W.R. (Gross Vehicle Weight Rating).**
 - **VEHICLE'S FRONT G.A.W.R. (Gross Axle Weight Rating) OR THE FRONT GUIDE WHEEL UNIT RATED LOAD CAPACITY, WHICHEVER IS LOWER.**
 - **VEHICLE'S REAR G.A.W.R. (Gross Axle Weight Rating) OR THE SUM OF THE REAR GUIDE WHEEL UNIT RATED LOAD CAPACITY PLUS (+) VEHICLE'S REAR TIRE/WHEEL RATED LOAD CAPACITY, WHICHEVER IS LOWER.**
 - **COMPONENTS RATED LOAD CAPACITY:**
 - A. **TIRE MANUFACTURER'S RATED LOAD CAPACITY**
 - B. **VEHICLE'S WHEEL RATED LOAD CAPACITY**
 - C. **REAR GUIDE WHEEL UNIT RATED LOAD CAPACITY:**
 - 13,000 lbs (5,896 kg)
 - 6,500 lbs (2,948 kg) maximum per guide wheel

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.



- **OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.**
- **KNOW THE POSITIONS AND FUNCTIONS OF ALL CONTROLS BEFORE ATTEMPTING TO OPERATE VEHICLE.**
- **THIS GUIDE WHEEL EQUIPMENT IS DESIGNED WITH YOUR SAFETY IN MIND. NEVER DISCONNECT AND/OR ATTEMPT TO OVERRIDE SAFETY FEATURES.**

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

Note: To help ensure safe operation of this equipment, keep all safety decals clean and legible. Replace safety decals when necessary with new decals, listed in the Parts Section of this manual.

1.3 Description

The HR3100 Series B1 Rear HY-RAIL® guide wheel equipment can be applied to the rear of various cab chassis trucks with single or tandem rear axles and dual wheels. The vehicle's G.V.W.R. (gross vehicle weight rating) and/or G.A.W.R. (gross axle weight rating) must comply with specifications recommended by Harsco Rail. For information regarding special applications, contact Harsco Rail, Fairmont, Minnesota.

The guide wheel unit is raised and lowered hydraulically. Hydraulic power may be supplied from the vehicle system or from an optional power pack. The guide wheel unit is mounted on the vehicle frame. When the guide wheels are in the "highway" position, the weight of the guide wheel unit is carried on the vehicle frame, above the springs. When the guide wheels are in the "rail" position, load bearing guide wheels assemblies guide the vehicle. The guide wheel unit is lowered vertically with a "scissors" type mechanism. Dual control valves provide independent lowering of each side of the unit. This gives the unit "side shift" capabilities resulting in easier alignment of the vehicle with the rails when placing the vehicle in the "rail" position.

The vehicle's rear inner dual wheels are used for propulsion on the track. On track braking is provided by the vehicle's rear brakes, rear guide wheel unit's brakes and the front guide wheel unit's brakes, if so equipped. Since the guide wheel unit brakes are air actuated, the vehicle on which the guide wheel equipment is mounted should be equipped with air brakes. If not, an electric / air system is available to provide air for the guide wheel unit brakes.

A steering lock is used during on track operation. The steering lock holds the vehicle's steering wheel in place to ensure alignment of the vehicle's front wheels with the rail.

1.4 Vehicle Orientation

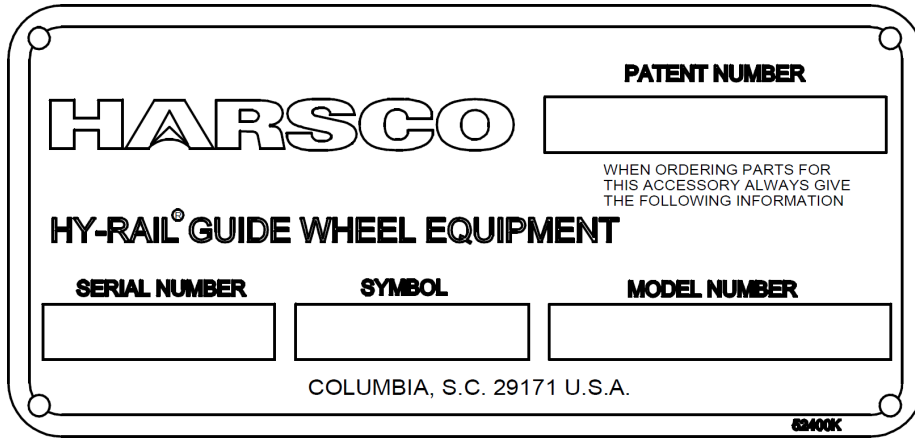
Front - rear and left - right are determined from the vehicle operator's seat.

1.5 Serial Numbers

1

When this bulletin is received, complete the following record from the serial number tag on the guide wheel unit. Always provide these factory serial numbers when calling or writing about the unit. The serial number tag is located on the frame assembly of the unit.

FIGURE 1-1
REAR GUIDE WHEEL UNIT SERIAL NUMBER



1.6 Specifications

1.6.1 Vehicle

The vehicle's G.V.W.R. (gross vehicle weight rating) and/or G.A.W.R. (gross axle weight rating) must comply with specifications recommended by Harsco Rail. For information regarding special applications, contact Harsco Rail, Fairmont, Minnesota.

1.6.2 Guide Wheel Unit

Track Gauge	56-1/2 in	(1435 mm)
Guide Wheels - Flange Diameter	14-3/4 in	(375 mm)
- Tread Diameter	12-1/2 in	(318 mm)
Weight	803 lbs	(364 kg)
Maximum Load Capacity	13,000 lbs	(5,896 kg)
Maximum Load Per Guide Wheel	6,500 lbs	(2,948 kg)

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2.1 Preparing Vehicle for Operation

Be sure the vehicle is in operating condition by checking the following:

- a. Engine oil level.
- b. Radiator fluid level.
- c. Fuel tank level.
- d. Hydraulic reservoir oil level.
- e. Brakes work properly.
- f. Parking brake works properly.
- g. Head, brake and signal lights work properly.
- h. Tires properly inflated to the manufacturer's recommended maximum pressure printed on the sidewall of the tires, or the wheel manufacturer's recommended maximum pressure stamped on the wheel, whichever is lower.
- i. Vehicle wheels: Lug nuts / bolts tightened to the proper torque, inspect vehicle wheels, lug bolts and lug nuts for wear or damage. For vehicle wheel, lug bolt and lug nut inspection information refer to the AMERICAN TRUCKING ASSOCIATION - TECHNOLOGY & MAINTENANCE COUNCIL - USER'S GUIDE TO WHEELS AND RIMS. To obtain this guide, contact:

AMERICAN TRUCKING ASSOCIATION
TECHNOLOGY & MAINTENANCE COUNCIL
950 N Glebe Rd., Suite 210
Arlington, VA 22203-4181
Phone: (703) 838-1763
Fax: (703) 838-1701
tmc@trucking.org

- j. Any other normal maintenance requirements.

2.2 Preparing Guide Wheel Equipment For Operation

Be sure the guide wheel equipment is in operating condition by checking the following:

- a. Air and hydraulic hoses and fittings for damage, wear or leaks.
- b. Overall for damaged or worn parts.
- c. Properly lubricated at the recommended operating mileage intervals.
- d. Brakes work properly.
- e. Hydraulic pressure properly adjusted.

2

2.3 Misalignment Indicators



- **BEFORE OPERATING A VEHICLE WITH NEWLY INSTALLED GUIDE WHEEL EQUIPMENT ON TRACK, VERIFY THAT THE GUIDE WHEEL EQUIPMENT ALIGNMENT PROCEDURE HAS BEEN COMPLETED. CHECK AND CORRECT ALIGNMENT PROMPTLY IF MISALIGNMENT IS INDICATED. MISALIGNMENT OF GUIDE WHEEL EQUIPMENT COULD RESULT IN DERAILMENT OF VEHICLE AND SEVERE BODILY INJURY.**

The following conditions may indicate that minor adjustments to the guide wheel equipment alignment are necessary. If any of these conditions occur during operation, perform the Track Test, see Adjustment Section - Vehicle Track Test and/or complete the Alignment Procedure, see Adjustment - Guide Wheel Equipment Alignment Procedure.

1. Excessive flange or tread wear on any of the rail guide wheels.
2. Vehicle pulls noticeably to the left or the right during on track operation.
3. Vibration felt throughout the vehicle at various speeds during on track operation.

2.4 Placing Vehicle On Track



- PLACE VEHICLE AUTOMATIC TRANSMISSION IN "PARK" OR MANUAL TRANSMISSION IN "NEUTRAL". APPLY THE PARKING BRAKE.
- UNDERSTAND EQUIPMENT OPERATION AND BE AWARE OF ALL PINCH POINTS BEFORE OPERATING OR MAKING ADJUSTMENTS TO GUIDE WHEEL EQUIPMENT.
- BEFORE PROPELLING VEHICLE ON THE TRACK, MAKE SURE:
 - FRONT AND REAR GUIDE WHEELS ARE LOWERED AND LOCKED IN RAIL POSITION, AND SECURED WITH LOCK PIN.
 - ALL RAIL GUIDE WHEEL FLANGES ARE ENGAGED ON INSIDE OF RAIL.
 - VEHICLE FRONT TIRES ARE A MINIMUM OF 1-1/2" (38 mm) ABOVE THE RAIL.
 - FRONT WHEELS ARE POINTED STRAIGHT AHEAD AND STEERING WHEEL LOCK IS ENGAGED.
 - IF EQUIPPED, BRAKE CONTROL VALVE IS IN THE "ON" POSITION AND GUIDE WHEEL BRAKE EQUIPMENT IS FUNCTIONAL.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN DERAILMENT OF VEHICLE AND SEVERE BODILY INJURY.



- WHEN USING VEHICLE MECHANICAL PTO HYDRAULIC PUMP TO LOWER/RAISE GUIDE WHEEL EQUIPMENT, DO NOT EXCEED HYDRAULIC SYSTEM FLOW OF 8 GPM (30 LPM) OR HYDRAULIC PRESSURE OF 2500 PSI (172 bar). EXCESSIVE FLOW AND / OR PRESSURE COULD DAMAGE HYDRAULIC SYSTEM COMPONENTS.
- OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.
- IF THE VEHICLE IS EQUIPPED WITH A STROBE LIGHT (BEACON) AND RAILROAD RULES AND REGULATIONS REQUIRE ITS USE, THE STROBE LIGHT (BEACON) MUST BE ILLUMINATED WHEN PLACING THE VEHICLE ON TRACK AND WHEN OPERATING THE VEHICLE ON TRACK.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

2.4 Placing Vehicle On Track

1. Ensure that highway vehicles are not approaching the grade crossing while placing the vehicle on track. Flag the crossing per railroad rules and regulations to ensure safety.
2. At a road crossing, drive the vehicle about 25 feet (7.6 m) past the track. Back the vehicle onto the rails so that the rear vehicle wheels are centered on the rails. On vehicles with dual rear wheels, the inner dual wheels must be centered on the rails. It may be necessary to move the vehicle back and forth several times to get the wheels centered on the rail properly.
3. Place the vehicle automatic transmission in "PARK" or manual transmission in "NEUTRAL". Apply the parking brake.
4. Engage the mechanical PTO hydraulic pump or start the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to direct hydraulic oil flow to the guide wheel equipment.
5. Lower and lock the rear guide wheels first. The rear guide wheels should be lowered first so the front tires of the vehicle can be maneuvered to align the front guide wheel unit with the rails.

2.4.1 Lowering Rear Guide Wheels

1. Raise the guide wheel unit slightly by moving both control valve handles to release pressure on the lock pins.
2. The unit may be equipped with manual locks or air cylinder actuated lock pins. Use the appropriate procedure to disengage the lock pins.
3. Move both control valve handles to lower the guide wheels. Watch the guide wheels as they lower to the rail. If the vehicle rear tires are not exactly aligned with the rails, it is possible to lower one guide wheel until its flange is engaged on the inside of the rail and then lower the other guide wheel until its flange is engaged on the inside of the rail. This action will shift the rear of the vehicle to align with the rails.
4. After both guide wheels are fully lowered, make sure the flanges on both guide wheels are engaged on the inside of the rails.
5. Use the appropriate procedure to engage the lock pins.
6. After lowering the rear guide wheels, maneuver the vehicle to align the front guide wheels with the rails. Lower the front guide wheels. See the Operator's Service and Parts manual provided with the front guide wheel unit.
7. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail.

2.4 Placing Vehicle On Track

2.4.2 Steering Locks - See Figures 2-1, 2-2, 2-3 and 2-4

Set the vehicle front wheels straight ahead and secure the steering wheel in that position by engaging the steering lock on the steering column. Steering locks may vary from vehicle to vehicle but will operate similarly.

Note: Do not place your hands or any pressure on the steering wheel after the steering lock is engaged.

FIGURE 2-1
VELCRO STEERING LOCK OFF

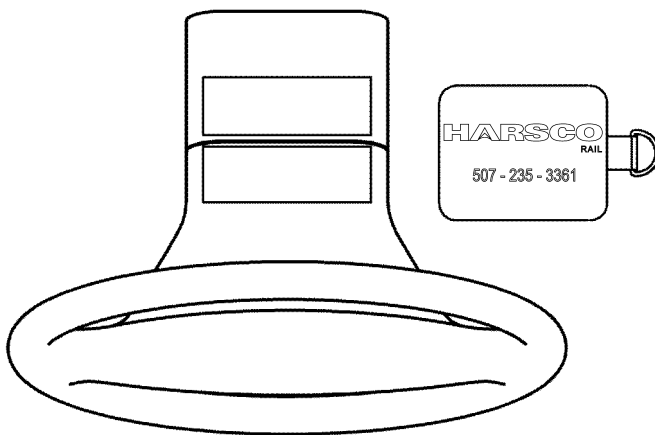


FIGURE 2-2
VELCRO STEERING LOCK ON

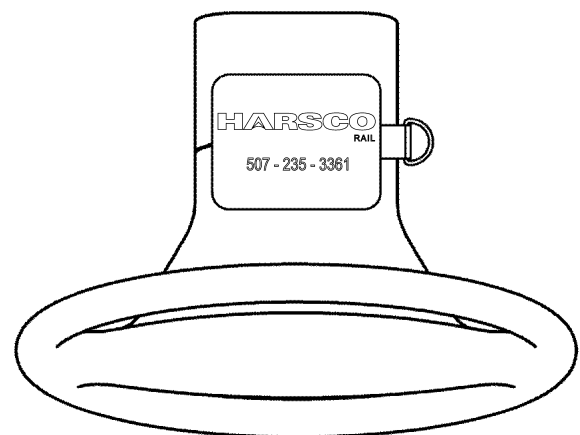


FIGURE 2-3
DEAD BOLT TYPE
STEERING LOCK DISENGAGED

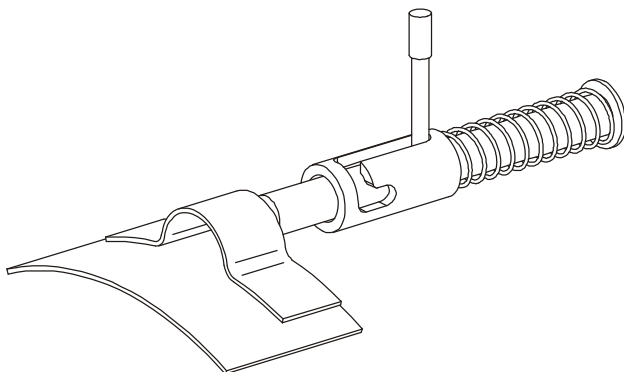
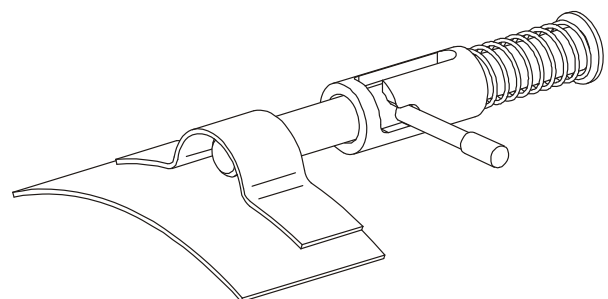


FIGURE 2-4
DEAD BOLT TYPE
STEERING LOCK ENGAGED



2.4 Placing Vehicle On Track

2.4.3 Rail Brakes

If so equipped, move the Rail Wheel Brake Control Valve to the ON position to activate the guide wheel equipment brakes whenever the vehicle is on track. The vehicle brake pedal will actuate the vehicle brakes and the guide wheel equipment brakes simultaneously.

2

2.4.4 Check Vehicle Front Tire Clearance Above Rail

If the vehicle's front tire clearance above the top of the rail is less than 1-1/2" (38 mm) see the Adjustment Section in the Operator's Service and Parts Manual provided with the front guide wheel unit. Never operate the vehicle on track when the front tire clearance above the top of the rail is less than 1-1/2" (38 mm).

2.5 Guide Wheel Load On Track



- **IMPROPER LOADING OF GUIDE WHEEL EQUIPMENT CAN CAUSE DERAILMENT OF VEHICLE.**
 - **ALWAYS CHECK THE GUIDE WHEEL LOAD BEFORE OPERATING THE VEHICLE ON TRACK.**
 - **NEVER OPERATE THE VEHICLE ON TRACK IF LOAD EXCEEDS THE MAXIMUM RATED LOAD OF THE FRONT AND/OR REAR GUIDE WHEEL UNITS. THE MAXIMUM RATED LOAD ON THE REAR GUIDE WHEEL UNIT IS 13,000 LBS (5,896 kg) OR 6,500 LBS (2,948 kg) MAXIMUM PER GUIDE WHEEL.**
 - **NEVER OPERATE THE VEHICLE ON TRACK IF CLEARANCE BETWEEN VEHICLE FRONT TIRES AND TOP OF RAIL IS LESS THAN 1-1/2" (38 mm).**
- FAILURE TO HEED THESE WARNINGS COULD RESULT IN DERAILMENT OF VEHICLE AND/OR SEVERE BODILY INJURY.**

2.5 Guide Wheel Load On Track

2.5.1 Checking Rear Guide Wheel Load

Note: The guide wheel unit is rigid (no suspension) when in the rail position. The mounting position (or height) was determined by the applicator when the unit was mounted on the vehicle. The guide wheel unit carries the majority of the vehicle's rear load when the vehicle is on rail. The guide wheel unit must be positioned so the vehicle's rear suspension carries enough of the vehicle's rear load to provide traction and braking on rail.

Once positioned, the unit was permanently attached (by welding) and can not be repositioned unless the welds are ground off. See the Adjustments Section for instructions on setting the guide wheel unit position.

1. Whenever the vehicle is loaded or additional load is added to the existing vehicle load on track, check the load on the rear guide wheels. The maximum load on the rear guide wheel unit is 13,000 LBS (5,896 kg) or 6,500 LBS (2,948 kg) maximum per guide wheel.
2. To check the load on the rear guide wheels, the guide wheels must be located on a scale. Check the load on the guide wheel unit and on both guide wheels individually. The load on the guide wheel unit or either guide wheel must not exceed the maximum limits.
3. If the load exceeds the maximum allowable limits, some of the load on the vehicle must be removed or repositioned until the load on the guide wheel unit and both guide wheels is within the allowable limits.
4. Also, check the load on the front guide wheel unit. See the Operator's Service And Parts Manual provided with the front guide wheel unit for information on checking the load on the front guide wheel unit.

2.6 Propelling On Track



2

- **IMPROPER LOADING OF HY-RAIL® EQUIPPED VEHICLE CAN CAUSE DERAILMENT OF VEHICLE.**
- **ALWAYS CHECK GUIDE WHEEL LOAD BEFORE OPERATING THE VEHICLE ON TRACK.**
- **NEVER OPERATE VEHICLE ON TRACK IF LOAD EXCEEDS MAXIMUM RATED LOAD OF FRONT AND/OR REAR GUIDE WHEEL UNITS.**
- **NEVER OPERATE VEHICLE ON TRACK IF CLEARANCE BETWEEN VEHICLE FRONT TIRE AND RAIL IS LESS THAN 1-1/2" (38 mm).**

FAILURE TO HEED THESE WARNINGS COULD RESULT IN DERAILMENT OF VEHICLE AND/OR SEVERE BODILY INJURY.



- **BEFORE OR WHEN PROPELLING ON TRACK:**
 - **OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.**
 - **OPERATOR MUST LOOK IN ALL DIRECTIONS FOR PERSONS OR OBJECTS ON OR ADJACENT TO THE TRACK.**
 - **DO NOT ACCELERATE SUDDENLY. TRACTION IS REDUCED ON TRACK, SPINNING VEHICLE TIRES COULD DAMAGE THEM.**
 - **DO NOT EXCEED 25 MPH (40 km/h) WHEN OPERATING VEHICLE ON TRACK. RAILROAD RULES GOVERNING SPEEDS SHOULD BE OBSERVED AT ALL TIMES. REDUCE SPEED WHEN PROPELLING VEHICLE THROUGH SWITCHES, ROAD CROSSINGS, BRANCH LINES AND ANY SPECIAL TRACK WORKS. OPERATING VEHICLE AT UNSAFE SPEEDS COULD RESULT IN DERAILMENT OF THE VEHICLE.**
 - **STEERING LOCK MUST BE ENGAGED AT ALL TIMES WHEN OPERATING VEHICLE ON TRACK.**
 - **IF THE VEHICLE IS EQUIPPED WITH A STROBE LIGHT (BEACON) AND RAILROAD RULES AND REGULATIONS REQUIRE ITS USE, THE STROBE LIGHT (BEACON) MUST BE ILLUMINATED WHEN OPERATING THE VEHICLE ON TRACK.**

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

Vehicles equipped with the HR3100 Series B1 HY-RAIL® Guide Wheel Equipment use the vehicle propulsion system to propel on track. Do not accelerate suddenly. Traction is reduced on track. Spinning the vehicle tires could damage them.

2.7 Braking On Track



- PERSONS WHO OPERATE THE VEHICLE MUST BE FAMILIAR WITH TRACK AND WEATHER CONDITIONS THAT MAY AFFECT STOPPING DISTANCE. BE ALERT TO THESE CONDITIONS AND ALLOW ADEQUATE STOPPING DISTANCE.
- BE PREPARED TO BRAKE AT ALL HIGHWAY CROSSINGS. THIS VEHICLE MAY NOT OPERATE TRACK SIGNAL CIRCUITS, AND ONCOMING VEHICLES OR PEDESTRIANS MAY NOT YIELD THE RIGHT OF WAY.
- IF EQUIPPED, RAIL WHEEL BRAKE CONTROL VALVE MUST BE IN THE "ON" POSITION WHENEVER VEHICLE IS ON TRACK.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

The HR3100 Series B1 HY-RAIL® Guide Wheel Equipment may be equipped with brakes. If the guide wheel unit is equipped with brakes, the vehicle uses a combination of the front guide wheel unit brakes and the vehicle's rear axle brake system for braking on track. The front guide wheel unit brakes will apply simultaneously when the vehicle brakes are applied. Stopping distance is greater on track than on typical road surfaces. Apply the brakes gradually to avoid sliding the vehicle tires and rail guide wheels.

2.8 Vehicles Equipped With Crane Or Aerial Lift Device



2

- **WHEN OPERATING CRANE, AERIAL LIFT DEVICE, ETC., WHILE THE VEHICLE'S GUIDE WHEELS ARE ON THE RAILS, DO NOT OVERLOAD THE GUIDE WHEEL EQUIPMENT OR EXCEED THE CAPACITY OF ANY OF THE EQUIPMENT BEING USED.**
- **THE UNIT SHOULD BE EQUIPPED WITH OUTRIGGERS TO HELP PREVENT ACCIDENTS AND THE POSSIBILITY OF DAMAGE TO THE GUIDE WHEEL EQUIPMENT. WHEN USING THE EQUIPMENT TO TRANSFER ANY LOAD, SET THE OUTRIGGERS ON A STABLE BASE TO PREVENT SETTLING OF THE OUTRIGGERS AND SHIFTING OF THE VEHICLE.**
- **IF OPERATING CONDITIONS REQUIRE LIFTING A LOAD WITH THE CRANE WHILE ON RAIL, BUT WITHOUT THE OUTRIGGERS BEING USED, THE LOAD APPLIED BY LIFTING WITH THE CRANE MUST NOT OVERLOAD ANY COMPONENT OF THE GUIDE WHEEL EQUIPMENT.**
- **CAREFULLY READ THE CRANE OR AERIAL LIFT DEVICE OPERATOR'S MANUAL FOR THE SAFE USE AND EFFICIENT OPERATION OF THE EQUIPMENT.**

FAILURE TO HEED THESE WARNINGS COULD CAUSE DERAILMENT OF THE VEHICLE RESULTING IN SEVERE BODILY INJURY AND/OR DEATH.

1. When operating a crane, aerial lift device, etc., while the vehicle's guide wheels are on the rails, do not overload the guide wheel equipment or exceed the capacity of any of the equipment being used.
2. The crane, aerial lift device, etc. should be equipped with outriggers to help prevent accidents and the possibility of damage to the guide wheel equipment. When using the crane, aerial lift device, etc. to transfer any load, set the outriggers on a stable base to prevent settling of the outriggers and shifting of the vehicle. Carefully read the crane or aerial lift equipment operator's manual for the safe use and efficient operation of the equipment.
3. If operating conditions require lifting a load with the crane while on rail, but without the outriggers being used, the load applied by lifting with the crane must not overload any component of the guide wheel equipment.

2.9 Removing Vehicle From Track



- PLACE VEHICLE AUTOMATIC TRANSMISSION IN "PARK" OR MANUAL TRANSMISSION IN "NEUTRAL". APPLY THE PARKING BRAKE.
- UNDERSTAND EQUIPMENT OPERATION AND BE AWARE OF ALL PINCH POINTS BEFORE OPERATING OR MAKING ADJUSTMENTS TO GUIDE WHEEL EQUIPMENT.
- BEFORE PROPELLING VEHICLE OFF TRACK, MAKE SURE:
 - FRONT AND REAR GUIDE WHEELS ARE RAISED, LOCKED IN THE HIGHWAY POSITION, AND SECURED WITH THE LOCK PINS.
 - STEERING WHEEL LOCK IS DISENGAGED.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.



- WHEN USING VEHICLE MECHANICAL PTO HYDRAULIC PUMP TO LOWER/RAISE GUIDE WHEEL EQUIPMENT, DO NOT EXCEED HYDRAULIC SYSTEM FLOW OF 8 GPM (30 LPM) OR HYDRAULIC PRESSURE OF 2500 PSI (172 bar). EXCESSIVE FLOW AND / OR PRESSURE COULD DAMAGE HYDRAULIC SYSTEM COMPONENTS.
- OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.
- IF THE VEHICLE IS EQUIPPED WITH A STROBE LIGHT (BEACON) AND RAILROAD RULES AND REGULATIONS REQUIRE ITS USE, THE STROBE LIGHT (BEACON) MUST BE ILLUMINATED WHEN OPERATING AND REMOVING THE VEHICLE FROM TRACK.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

1. Ensure that highway vehicles are not approaching the grade crossing while placing the vehicle on track. Flag the crossing per railroad rules and regulations to ensure safety.
2. Approach the crossing and stop with the vehicle front wheels on the crossing.
3. Place the vehicle automatic transmission in "PARK" or manual transmission in "NEUTRAL". Apply the parking brake.
4. If so equipped, move the Rail Wheel Brake Control Valve to the OFF position, whenever the vehicle is removed from the track for highway use.
5. Engage the mechanical PTO hydraulic pump or start the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to direct hydraulic oil flow to the guide wheel equipment.

2.9 Removing Vehicle From Track

6. Raise the front guide wheels first. See the Operator's Service and Parts Manual provided with the front guide wheel unit.

2.9.1 Raising Rear Guide Wheels

2

1. Lower the guide wheel unit slightly by moving both control valve handles to release pressure on the lock pins.
2. The unit may be equipped with manual locks or air cylinder actuated lock pins. Use the appropriate procedure to disengage the lock pins.
3. Move both control valve handles to raise the guide wheels. After both guide wheels are fully raised, use the appropriate procedure to engage the lock pins.
4. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment.

2.9.2 Steering Locks - See Figures 2-7, 2-8, 2-9 and 2-10

1. See Figures 2-5, 2-6, 2-7 and 2-8. Disengage the vehicle steering lock located on the steering column. Steering locks may vary from vehicle to vehicle but will operate similarly.

FIGURE 2-5
VELCRO STEERING LOCK OFF

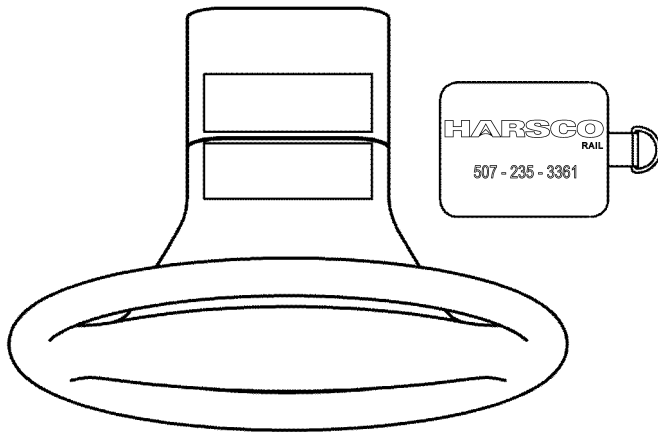
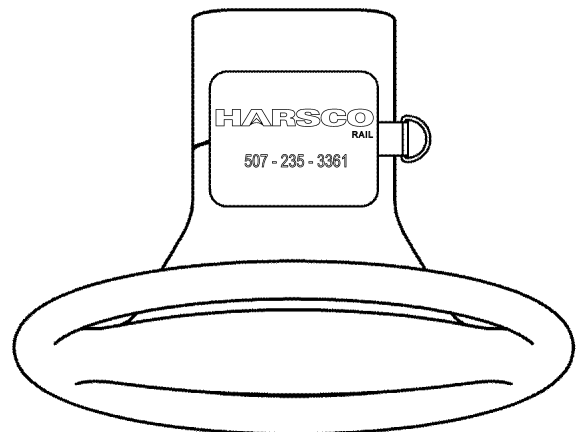


FIGURE 2-6
VELCRO STEERING LOCK ON



2.9 Removing Vehicle From Track

2.9.2 Steering Locks

FIGURE 2-7
DEAD BOLT TYPE
STEERING LOCK DISENGAGED

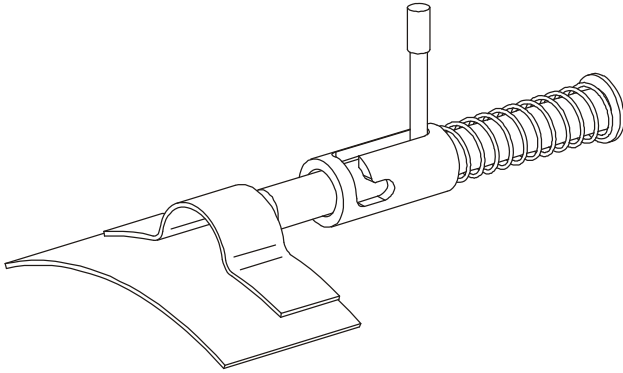
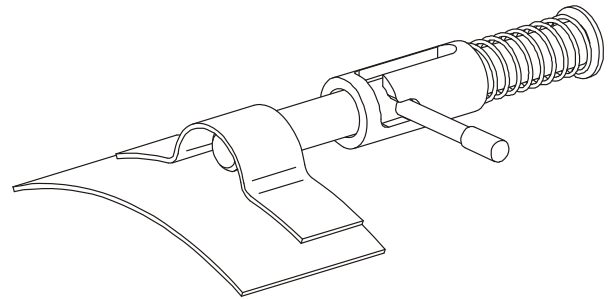


FIGURE 2-8
DEAD BOLT TYPE
STEERING LOCK ENGAGED



2

2.10 Highway Operation



- **THIS MULTIPURPOSE VEHICLE HAS SPECIAL DESIGN AND EQUIPMENT FEATURES FOR OFF-ROAD USE. IT HANDLES DIFFERENTLY FROM AN ORDINARY PASSENGER CAR IN DRIVING CONDITIONS WHICH MAY OCCUR ON STREETS, HIGHWAYS AND OFF-ROAD. WEIGHT AND LOCATION OF AVAILABLE PAYLOAD MAY ALSO AFFECT THE HANDLING OF THIS VEHICLE. DRIVE WITH CARE AND WEAR SAFETY BELTS AT ALL TIMES. READ VEHICLE OWNER'S MANUAL FOR ADDITIONAL PRECAUTIONS.**

2.11 Towing Trailer / Equipment With Vehicle On Track



2

- VEHICLE USED FOR TOWING MUST BE RATED BY VEHICLE MANUFACTURER FOR WEIGHT OF TRAILER / EQUIPMENT TO BE TOWED. DO NOT EXCEED VEHICLE MANUFACTURER'S MAXIMUM RATED TOWING CAPACITY.
- TOWING VEHICLE MUST WEIGH AS MUCH OR MORE THAN TRAILER / EQUIPMENT BEING TOWED.
- VEHICLE USED FOR TOWING MUST HAVE AN ADEQUATE BRAKE SYSTEM TO SAFELY DECELERATE AND STOP TOWING VEHICLE AND TRAILER / EQUIPMENT BEING TOWED.
- TOWING TRAILER / EQUIPMENT LENGTHENS STOPPING DISTANCES. ALLOW ADEQUATE DISTANCE FOR STOPPING. ANTICIPATE STOPS SO YOU CAN BRAKE GRADUALLY.
- STOPPING DISTANCE IS GREATER ON TRACK THAN ON TYPICAL ROAD SURFACES. APPLY BRAKES GRADUALLY TO AVOID SLIDING VEHICLE TIRES AND GUIDE WHEELS.
- TOW TRAILER / EQUIPMENT AT A REASONABLE SPEED (20 MPH MAXIMUM) TAKING INTO ACCOUNT TRACK CONDITIONS, TRACK GRADE, WEATHER, VISIBILITY AND STOPPING DISTANCE TO ASSURE SAFE OPERATION. RAILROAD RULES GOVERNING SPEEDS AND RIGHT OF WAY SHOULD BE OBSERVED AT ALL TIMES.
- TRAILER / EQUIPMENT BEING TOWED MUST BE IN A SAFE, USABLE CONDITION TO BE TOWED.
- MAKE SURE THAT VEHICLE'S:
 - FRONT AND REAR GUIDE WHEEL ARE LOWERED AND LOCKED IN THE RAIL POSITION.
 - ALL GUIDE WHEEL FLANGES ARE ENGAGED ON INSIDE OF RAILS.
 - FRONT TIRES ARE A MINIMUM OF 1-1/2" (38 mm) ABOVE RAIL.
 - VEHICLE STEERING WHEEL LOCK ENGAGED WITH FRONT WHEELS STRAIGHT AHEAD.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.

2.11 Towing Trailer / Equipment With Vehicle On Track



- CAREFULLY AND THOROUGHLY PREPARE VEHICLE FOR TOWING, MAKING SURE TO USE THE RIGHT TOWING EQUIPMENT AND TO ATTACH IT PROPERLY.
- TOWING EQUIPMENT (HITCHES, TOW BARS, ETC.) MUST BE ATTACHED TO VEHICLE FRAME. DO NOT MOUNT OR ATTACH TOWING EQUIPMENT TO VEHICLE'S GUIDE WHEEL EQUIPMENT.
- TOWING EQUIPMENT (HITCHES, TOW BARS, ETC.) MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN WEIGHT OF TRAILER / EQUIPMENT BEING TOWED.
- USE A RIGID TYPE TOW BAR WITH SAFETY LOCKING COUPLERS. DO NOT USE CHAIN, WIRE ROPE ETC.
- OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.
- DO NOT ACCELERATE SUDDENLY. TRACTION IS REDUCED ON RAIL, SPINNING VEHICLE TIRES COULD DAMAGE THEM.
- ALWAYS CHOCK TRAILER WHEELS BEFORE UNHOOKING TRAILER FROM TOWING VEHICLE.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

2.11 Towing Trailer / Equipment With Vehicle On Track

1. See your vehicle's operators manual for towing information.
2. Use the vehicle manufacturer's recommendations to determine the maximum weight the towing vehicle can tow. Do not exceed vehicle manufacturer's maximum rated towing capacity.
3. The towing vehicle must have an adequate brake system to safely decelerate and stop the towing vehicle and the trailer / equipment being towed. The towing vehicle must weigh as much or more than the trailer / equipment being towed.
4. Make sure that the vehicle's:
 - a. Front and rear guide wheels are lowered and locked in the rail position.
 - b. All guide wheel flanges are engaged on the inside of the rails.
 - c. Front tires are a minimum of 1-1/2" (38 mm) above the rail.
 - d. Vehicle front wheels are set straight ahead and the steering wheel lock is engaged on the steering column.
5. Make sure the towing vehicle and the trailer / equipment are in good working condition (tires, brakes, lights, etc.) and that current maintenance has been performed on the vehicle and trailer / equipment.
6. The towing equipment (hitches, tow bars, etc.) on the towing vehicle must have a rating equal to or greater than the weight of the trailer / equipment being towed.
7. The towing equipment (hitches, tow bars, etc.) must be attached to the towing vehicle frame. Do not mount or attach the towing equipment to the vehicle's guide wheel equipment.
8. Observe and follow all railroad safety rules and regulations.
9. Do not accelerate suddenly. Traction is reduced on rail. Spinning the vehicle tires could damage them.
10. Stopping distance is greater on rail than on typical road surfaces. Apply the vehicle brakes gradually to avoid sliding the vehicle tires and the guide wheels. Towing trailer / equipment lengthens stopping distances. Allow adequate distance for stopping. Anticipate stops so that you can brake gradually.
11. Tow the trailer / equipment on the track at a reasonable speed (20 MPH maximum) taking into account track conditions, track grade, weather, visibility and stopping distance to assure safe operation. Railroad rules and regulations governing speed limits and right of way should be observed at all times.
12. Always chock the trailer wheels before unhooking the trailer from the towing vehicle.

2.12 Towing Trailer / Equipment With Vehicle On Road



- VEHICLE USED FOR TOWING MUST BE RATED BY VEHICLE MANUFACTURER FOR WEIGHT OF TRAILER / EQUIPMENT TO BE TOWED. DO NOT EXCEED VEHICLE MANUFACTURER'S MAXIMUM RATED TOWING CAPACITY.
- VEHICLE USED FOR TOWING MUST HAVE AN ADEQUATE BRAKE SYSTEM TO SAFELY DECELERATE AND STOP TOWING VEHICLE AND TRAILER / EQUIPMENT BEING TOWED.
- TOWING TRAILER / EQUIPMENT LENGTHENS STOPPING DISTANCES. ALLOW ADEQUATE DISTANCE FOR STOPPING. ANTICIPATE STOPS SO YOU CAN BRAKE GRADUALLY.
- TOW TRAILER / EQUIPMENT AT A REASONABLE SPEED TAKING INTO ACCOUNT ROAD CONDITIONS, ROAD GRADE, WEATHER, VISIBILITY AND STOPPING DISTANCE TO ASSURE SAFE OPERATION. POSTED SPEED LIMITS SHOULD BE OBSERVED AT ALL TIMES.
- TRAILER / EQUIPMENT BEING TOWED MUST BE IN A SAFE, USABLE CONDITION TO BE TOWED.
- MAKE SURE THAT VEHICLE'S:
 - FRONT AND REAR GUIDE WHEELS ARE RAISED AND LOCKED IN HIGHWAY POSITION.
 - VEHICLE STEERING WHEEL LOCK DISENGAGED.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.

2.12 Towing Trailer / Equipment With Vehicle On Road



2

- THIS MULTIPURPOSE VEHICLE HAS SPECIAL DESIGN AND EQUIPMENT FEATURES FOR OFF-ROAD USE. IT HANDLES DIFFERENTLY FROM AN ORDINARY PASSENGER CAR IN DRIVING CONDITIONS WHICH MAY OCCUR ON STREETS, HIGHWAYS AND OFF-ROAD. WEIGHT AND LOCATION OF AVAILABLE PAYLOAD MAY ALSO AFFECT THE HANDLING OF THIS VEHICLE. DRIVE WITH CARE AND WEAR SAFETY BELTS AT ALL TIMES. READ VEHICLE OWNER'S MANUAL FOR ADDITIONAL PRECAUTIONS.
- OBSERVE AND FOLLOW ALL FEDERAL, STATE AND LOCAL DRIVING RULES AND REGULATIONS.
- STATE LAWS MAY REQUIRE TOWING VEHICLE AND TRAILER / EQUIPMENT BEING TOWED TO BE EQUIPPED WITH SPECIAL SAFETY EQUIPMENT (MIRRORS ON BOTH SIDES OF TOWING VEHICLE, TRAILER BRAKES, TRAILER LIGHTS, ETC.).
- CAREFULLY AND THOROUGHLY PREPARE YOUR VEHICLE FOR TOWING, MAKING SURE TO USE THE RIGHT TOWING EQUIPMENT AND TO ATTACH IT PROPERLY.
- TOWING EQUIPMENT (HITCHES, TOW BARS, ETC.) MUST BE ATTACHED TO VEHICLE FRAME. DO NOT MOUNT OR ATTACH TOWING EQUIPMENT TO VEHICLE'S GUIDE WHEEL EQUIPMENT.
- TOWING EQUIPMENT (HITCH, TOW BAR, ETC.) MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN WEIGHT OF TRAILER / EQUIPMENT BEING TOWED.
- ALWAYS CHOCK TRAILER WHEELS BEFORE UNHOOKING TRAILER FROM TOWING VEHICLE.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

2.12 Towing Trailer / Equipment With Vehicle On Road

1. See your vehicle's operators manual for towing information.
2. Use the vehicle manufacturer's recommendations to determine the maximum weight the towing vehicle can tow. Do not exceed vehicle manufacturer's maximum rated towing capacity.
3. The towing vehicle must have an adequate brake system to safely decelerate and stop the towing vehicle and the trailer / equipment being towed. Towing trailer / equipment lengthens stopping distances. Allow adequate distance for stopping. Anticipate stops so that you can brake gradually.
4. Make sure that the vehicle's:
 - a. Front and rear guide wheels are raised and locked in the highway position.
 - b. Vehicle steering wheel lock is disengaged on the steering column.
5. Make sure the towing vehicle and the trailer / equipment are in good working condition (tires, brakes, lights, etc.) and that current maintenance has been performed on the vehicle and trailer / equipment.
6. The towing equipment (hitches, tow bars, etc.) on the towing vehicle must have a rating equal to or greater than the weight of the trailer / equipment being towed.
7. The towing equipment (hitches, tow bars, etc.) must be attached to the towing vehicle frame. Do not mount or attach the towing equipment to the vehicle's guide wheel equipment.
8. Observe and follow all federal, state and local driving rules, regulations and laws.
9. State laws may require the towing vehicle and/or the trailer / equipment being towed to be equipped with special safety equipment (mirrors on both sides of the towing vehicle, trailer brakes, trailer lights, etc.).
10. Tow the trailer / equipment on the road at a reasonable speed taking into account road conditions, road grade, weather, visibility and stopping distance to assure safe operation. Always observe posted speed limits.
11. Always chock the trailer wheels before unhooking the trailer from the towing vehicle.

2.13 Towing Disabled Vehicle On Track



2

- TOWING VEHICLE / MACHINE MUST WEIGH AS MUCH OR MORE THAN DISABLED VEHICLE BEING TOWED.
- VEHICLE / MACHINE USED FOR TOWING MUST HAVE AN ADEQUATE BRAKE SYSTEM TO SAFELY DECELERATE AND STOP TOWING VEHICLE / MACHINE AND DISABLED VEHICLE BEING TOWED.
- TOWING DISABLED VEHICLE LENGTHENS STOPPING DISTANCES. ALLOW ADEQUATE DISTANCE FOR STOPPING. ANTICIPATE STOPS SO YOU CAN BRAKE GRADUALLY.
- TOW DISABLED VEHICLE AT A REASONABLE SPEED (10 MPH MAXIMUM) TAKING INTO ACCOUNT TRACK CONDITIONS, TRACK GRADE, WEATHER, VISIBILITY AND STOPPING DISTANCE TO ASSURE SAFE OPERATION. RAILROAD RULES GOVERNING SPEED LIMITS AND RIGHT OF WAY SHOULD BE OBSERVED AT ALL TIMES.
- STOPPING DISTANCE IS GREATER ON TRACK THAN ON TYPICAL ROAD SURFACES. APPLY BRAKES GRADUALLY TO AVOID SLIDING TOWING VEHICLE / MACHINE WHEELS.
- MAKE SURE THAT DISABLED VEHICLE'S:
 - FRONT AND REAR GUIDE WHEELS ARE LOWERED AND LOCKED IN RAIL POSITION.
 - ALL GUIDE WHEEL FLANGES ARE ENGAGED ON INSIDE OF RAILS.
 - FRONT TIRES ARE A MINIMUM OF 1-1/2" (38 mm) ABOVE RAIL.
 - VEHICLE STEERING WHEEL LOCK ENGAGED WITH FRONT WHEELS STRAIGHT AHEAD.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.

2.13 Towing Disabled Vehicle On Track



- TOW BAR MUST BE ATTACHED TO DISABLED VEHICLE'S FRAME. DO NOT MOUNT OR ATTACH TOW BAR TO DISABLED VEHICLE'S GUIDE WHEEL EQUIPMENT.
- TOW BAR MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN WEIGHT OF DISABLED VEHICLE BEING TOWED.
- USE A RIGID TYPE TOW BAR WITH SAFETY LOCKING COUPLERS. DO NOT USE CHAIN, WIRE ROPE ETC.
- OBSERVE AND FOLLOW ALL RAILROAD SAFETY RULES AND REGULATIONS.
- DO NOT ACCELERATE SUDDENLY. TRACTION IS REDUCED ON RAIL, SPINNING TOWING VEHICLE / MACHINE WHEELS COULD DAMAGE THEM.
- TOW DISABLED VEHICLE TO NEAREST ROAD CROSSING AND REMOVE FROM TRACK.

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

2.13 Towing Disabled Vehicle On Track

1. See your vehicle's operators manual for towing information.
2. The towing vehicle / machine must have an adequate brake system to safely decelerate and stop the towing vehicle / machine and the disabled vehicle being towed. The towing vehicle / machine must weigh as much or more than the disabled vehicle towed.
3. Make sure that the disabled vehicle's:
 - a. Front and rear guide wheels are lowered and locked in the rail position.
 - b. All guide wheel flanges are engaged on the inside of the rails.
 - c. Front tires are a minimum of 1-1/2" (38 mm) above the rail.
 - d. Vehicle front wheels are set straight ahead and the steering wheel lock is engaged on the steering column.
4. Make sure the towing vehicle / machine is in good working condition (tires, brakes, lights, etc.) and that current maintenance has been performed on the vehicle / machine.
5. The towing equipment (hitches, tow bars, etc.) on the towing vehicle / machine must have a rating equal to or greater than the weight of the disabled vehicle being towed.
6. The tow bar must be mounted or attached to the disabled vehicle's frame. Do not mount or attach the tow bar to the disabled vehicle's guide wheel equipment. Use a rigid type tow bar with safety locking couplers.
7. Observe and follow all railroad safety rules and regulations.
8. Do not accelerate suddenly. Traction is reduced on rail. Spinning the towing vehicle tires / machine wheels could damage them.
9. Stopping distance is greater on rail than on typical road surfaces. Apply the towing vehicle / machine brakes gradually to avoid sliding the vehicle tires / machine wheels. Towing disabled vehicle lengthens stopping distances. Allow adequate distance for stopping. Anticipate stops so that you can brake gradually.
10. Tow the disabled vehicle on the track at a reasonable speed (10 MPH maximum) taking into account track conditions, track grade, weather, visibility and stopping distance to assure safe operation. Railroad rules and regulations governing speed limits and right of way should be observed at all times.
11. Tow the disabled vehicle to the nearest road crossing and remove the vehicle from the track.

2.14 Towing Disabled Vehicle On Road



- TOW DISABLED VEHICLE PER VEHICLE MANUFACTURER'S TOWING SPECIFICATIONS LISTED IN YOUR VEHICLE'S OPERATORS MANUAL.
- VEHICLE USED FOR TOWING MUST HAVE AN ADEQUATE BRAKE SYSTEM TO SAFELY DECELERATE AND STOP TOWING VEHICLE AND DISABLED VEHICLE BEING TOWED.
- TOW DISABLED VEHICLE AT A REASONABLE SPEED TAKING INTO ACCOUNT ROAD CONDITIONS, ROAD GRADE, WEATHER, VISIBILITY AND STOPPING DISTANCE TO ASSURE SAFE OPERATION. POSTED SPEED LIMITS SHOULD BE OBSERVED AT ALL TIMES.
- MAKE SURE DISABLED VEHICLE'S:
 - FRONT AND REAR GUIDE WHEELS ARE RAISED AND LOCKED IN HIGHWAY POSITION.
 - VEHICLE STEERING WHEEL LOCK DISENGAGED.

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.



- TOWING EQUIPMENT (TOW TRUCK, TOW BARS, ETC.) MUST BE ATTACHED TO DISABLED VEHICLE'S FRAME. DO NOT MOUNT OR ATTACH TOWING EQUIPMENT TO DISABLED VEHICLE'S GUIDE WHEEL EQUIPMENT.
- TOWING EQUIPMENT (TOW TRUCK, TOW BARS, ETC.) MUST HAVE A RATED TOWING CAPACITY EQUAL TO OR GREATER THAN WEIGHT OF DISABLED VEHICLE BEING TOWED.
- OBSERVE AND FOLLOW ALL FEDERAL, STATE AND LOCAL DRIVING RULES AND REGULATIONS.
- STATE LAWS MAY REQUIRE TOWING VEHICLE AND DISABLED VEHICLE TO BE EQUIPPED WITH SPECIAL SAFETY EQUIPMENT (LIGHTS, ETC.).

FAILURE TO HEED THESE PRECAUTIONS COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.

2.14 Towing Disabled Vehicle On Road

1. See your vehicle's operators manual for towing information.
2. The towing vehicle must have an adequate brake system to safely decelerate and stop the towing vehicle and the disabled vehicle being towed.
2. Make sure that the disabled vehicle's:
 - a. Front and rear guide wheels are raised and locked in the highway position.
 - b. Vehicle steering wheel lock is disengaged on the steering column.
4. Make sure the towing vehicle is in good working condition (tires, brakes, lights, etc.) and that current maintenance has been performed on the vehicle.
5. The towing equipment (tow truck, tow bars, etc.) on the towing vehicle must have a rating equal to or greater than the weight of the disabled vehicle being towed.
6. The towing equipment (tow truck, tow bars, etc.) must be mounted or attached to the disabled vehicle's frame. Do not mount or attach the towing equipment to the disabled vehicle's guide wheel equipment.
7. Observe and follow all federal, state and local driving rules, regulations and laws.
8. State laws may require the towing vehicle and disabled vehicle being towed to be equipped with special safety equipment (lights, etc.).
9. Tow the disabled vehicle on the road at a reasonable speed taking into account road conditions, road grade, weather, visibility and stopping distance to assure safe operation. Always observe posted speed limits.

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3.1 Guide Wheel Equipment Alignment Procedure



- **ENGINE MUST BE RUNNING TO OPERATE MECHANICAL PTO HYDRAULIC PUMP TO RAISE / LOWER THE GUIDE WHEELS. BEFORE PERFORMING ANY ADJUSTMENTS TO GUIDE WHEEL EQUIPMENT OR VEHICLE, ALWAYS PLACE AUTOMATIC TRANSMISSION IN "PARK" OR MANUAL TRANSMISSION IN "NEUTRAL". APPLY THE PARKING BRAKE.**
- **UNDERSTAND EQUIPMENT OPERATION AND BE AWARE OF ALL PINCH POINTS BEFORE OPERATING OR MAKING ADJUSTMENTS TO THE GUIDE WHEEL EQUIPMENT.**

FAILURE TO HEED THESE WARNINGS COULD RESULT IN SEVERE BODILY INJURY.

3

The Guide Wheel Alignment Check must be completed when any of the misalignment indicators occur. See Operation - Misalignment Indicators.

See The Operator's Service and Parts Manual provided with the front guide wheel unit for the proper alignment procedure for the front guide wheel unit.

3.1.1 Vehicle Check

1. The vehicle must be at curb weight with permanent attachments: spare tire, tool box less tools, utility box, crane, aerial lift boom, etc. and without: passengers, baggage, load, etc.
2. Weigh the entire vehicle and record this weight. Weigh both the front and rear axles of the vehicle separately and record these weights.
3. The weight of the vehicle should not exceed the GVWR (Gross Vehicle Weight Rating) and the weight on the front and rear axles should not exceed their respective GAWR (Gross Axle Weight Rating).
4. Permanent attachments to the vehicle such as a tool box, utility box, crane, aerial lift boom, etc. which could cause uneven loading on the guide wheels should be compensated for by adjusting the vehicle suspension (adding leaf springs, coil springs, etc).
5. Tires must be inflated to the tire manufacturer's recommended maximum pressure printed on the sidewalls of the tires or wheel manufacturer's recommended maximum pressure, stamped on the wheel, whichever is lower.
6. Visually inspect the entire vehicle, especially the guide wheel equipment, for loose or missing bolts, and bent or damaged components. Tighten, repair, or replace as necessary.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.1 Vehicle Check

7. Verify that the vehicle the guide wheel equipment is to be mounted to is equipped correctly (springs, tires, wheels, etc.).
8. Check the following measurements on the vehicle.
 - a. Frame must be square. Diagonal measurements of the frame should be equal within 1/8 inch (3.2 mm).
 - b. Wheelbase (as measured on each side) must be equal within 1/16 inch (1.8 mm).
 - c. Vehicle axles must be square with the frame within 1/64 inch per foot (.4 mm per 304 mm). Harsco Rail recommends that this be checked by a reputable alignment shop.
9. Follow the mounting instructions on the application drawings which are supplied with each Guide Wheel Equipment Group.

Note: The applicator of the guide wheel equipment must make sure the application drawings remain with the vehicle for further reference. If the application drawings are not with the vehicle, contact Harsco Rail, Fairmont Minnesota Facility to obtain these drawings.

10. Make sure that the applicator of the guide wheel equipment performed a four point alignment on the vehicle including checking the caster, camber, toe-in on the front wheels and thrust angle of the rear axle. The thrust angle of the rear axle should be set as close to zero as possible. If necessary, adjust to vehicle manufacturer's recommendations.
11. Make sure the headlight aim is checked and adjusted.

3.1.2 Placing Vehicle On Track

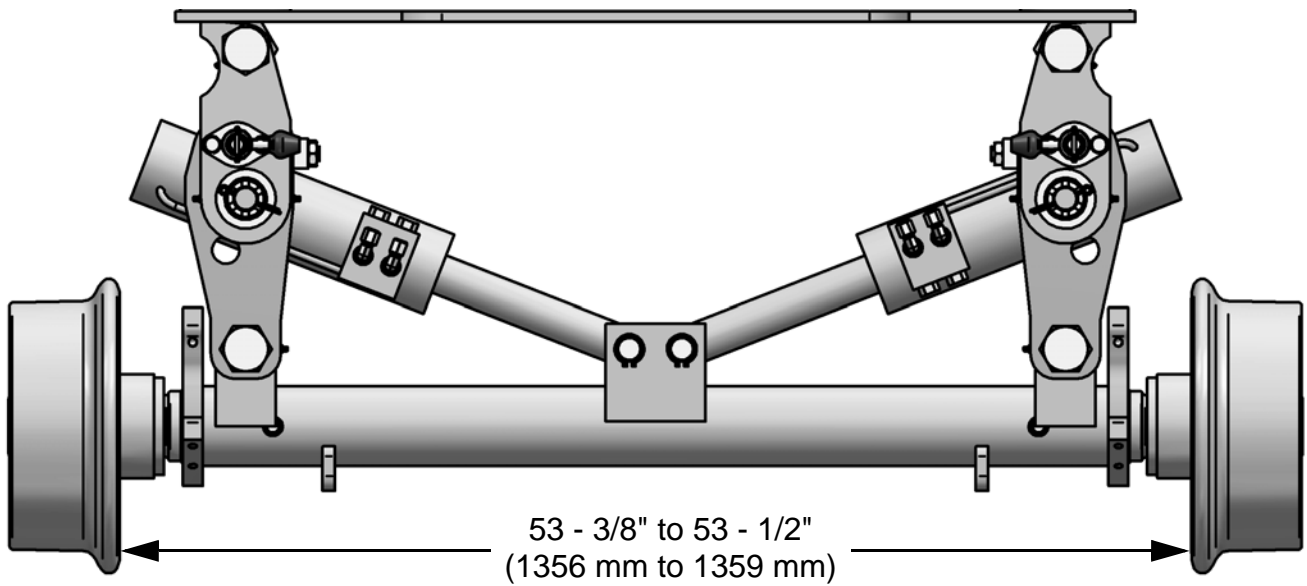
1. Place the vehicle on straight, level, tangent track or an alignment rack constructed for guide wheel equipment alignment. If track or an alignment rack is not available, use 2 x 4 inch lumber on a level floor to simulate track. Space the lumber so it measures 57-1/2 inches (1461 mm) between the inside edges.
2. Place the vehicle automatic transmission in "Park" or manual transmission in "Neutral". Apply the parking brake. Lower and lock the guide wheels in the rail position. See Operation - Placing Vehicle On Track.
3. Set the vehicle's front wheels straight ahead. Secure the steering wheel using the steering lock. Stop the engine.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.3 Guide Wheel Back Flange Gauge - See Figure 3-1

1. Measure the back flange gauge on the front guide wheel unit. Measure from the back of the left wheel flange, directly below the center line of the wheel spindle, to the same point on the right wheel flange. This dimension must be 53-3/8 to 53-1/2 inches (1356 mm to 1359 mm). The back flange gauge is preset at the factory and is non-adjustable.

FIGURE 3-1
GUIDE WHEEL BACK FLANGE GAUGE



3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load



- **IMPROPER LOADING OF GUIDE WHEEL EQUIPMENT CAN CAUSE DERAILMENT OF VEHICLE.**
- **ALWAYS CHECK THE GUIDE WHEEL LOAD BEFORE OPERATING THE VEHICLE ON TRACK.**
- **NEVER OPERATE THE VEHICLE ON TRACK IF LOAD EXCEEDS THE MAXIMUM RATED LOAD OF THE FRONT AND/OR REAR GUIDE WHEEL UNITS. THE MAXIMUM LOAD ON THE REAR GUIDE WHEEL UNIT IS 13,000 LBS (5,896 kg) OR 6,500 LBS (2,948 kg) MAXIMUM PER GUIDE WHEEL.**
- **NEVER OPERATE THE VEHICLE ON TRACK IF CLEARANCE BETWEEN VEHICLE FRONT TIRES AND RAIL IS LESS THAN 1-1/2" (38 mm).**

FAILURE TO HEED THESE WARNINGS COULD RESULT IN DERAILMENT OF VEHICLE AND/OR SEVERE BODILY INJURY.

3.1.4.1 Checking Rear Guide Wheel Load

Note: The guide wheel unit is rigid (no suspension) when in the rail position. The mounting position (or height) was determined by the applicator when the unit was mounted on the vehicle. The guide wheel unit carries the majority of the vehicle's rear load when the vehicle is on rail. The guide wheel unit must be positioned so the vehicle's rear suspension carries enough of the vehicle's rear load to provide traction and braking on rail. Tire wear and weakening of the vehicle springs may result in loss of traction on rail. If this occurs, it may be necessary to replace the vehicle tires and / or replace or add suspension components to correct vehicle frame height. If this does not correct the problem, it may be necessary to reposition the guide wheel unit.

See the Guide Wheel Unit Height Setup instructions for setting the guide wheel unit position.

1. Whenever the vehicle is loaded or additional load is added to the existing vehicle load on track, check the load on the rear guide wheels. The maximum load on the rear guide wheel unit is 13,000 LBS (5,896 kg) or 6,500 LBS (2,948 kg) maximum per guide wheel.
2. To check the load on the rear guide wheels, the guide wheels must be located on a scale. Check the load on the guide wheel unit and on both guide wheels individually. The load on the guide wheel unit or either guide wheel must not exceed the maximum limits.
3. If the load exceeds the maximum allowable limits, some of the load on the vehicle must be removed or repositioned until the load on the guide wheel unit and both guide wheels is within the allowable limits.
4. Also, check the load on the front guide wheel unit. See the Operator's Service And Parts Manual provided with the front guide wheel unit for information on checking the load on the front guide wheel unit.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load

3.1.4.2 Guide Wheel Unit Height Setup - See Figure 3-2

Note: This procedure will be applicable when initially applying the guide wheel unit or repositioning the height of the guide wheel unit. Refer to the application drawings supplied with the guide wheel unit.

1. Make sure the vehicle tires are inflated to the manufacturers recommended specifications.
2. Locate the vehicle inner rear tires, single and / or tandem axle, on installation rails (1). The installation rails should be made of solid steel, heavy wall rectangular tubing or "C" channel. These rails should be approximately 2" high and as wide as the head of a rail.
3. The guide wheel unit must not be attached to the vehicle frame. Plate (2) and any spacers that are welded to the upper structure (3) must be removed (grind welds off). If the guide wheel unit height is being adjusted, make sure the spacers (4) between the upper structure and the vehicle frame are saved so they can be replaced in their original positions to help re-align the guide wheel unit.
4. Place a temporary 6" x 6" x 3/8" wall steel tube spacer (5) between the vehicle frame and guide wheel unit upper structure (3).
5. Using the hydraulic control valves, lower the guide wheels. This will cause the upper structure and 6" spacers to raise up against the vehicle frame. Continue to lower the guide wheels (raise upper structure) until the guide wheels are fully lowered. The vehicle tires will be raised from installation rails. For safety purposes, clamp the upper structure to the vehicle frame.
6. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail.
7. Measure the gap from the top of the installation rails (1) to the bottom of the tire, both left and right sides. If the measured gap is different on the left and right sides, add the two dimensions together and then divide by two. This will be the measured gap that is used to calculate the actual spacer thickness.
8. To calculate the spacer thickness, subtract the measured gap from 6 inches (temporary spacer thickness) and then multiply the resulting figure by 60%. As an example, if the gap is 3 inches the calculation will be as follows: $6" - 3" = 3" \times 60\% = 1.8"$. Using the calculations, the spacers need to be 1.8". For practical purposes, 1-3/4" spacers should be acceptable.

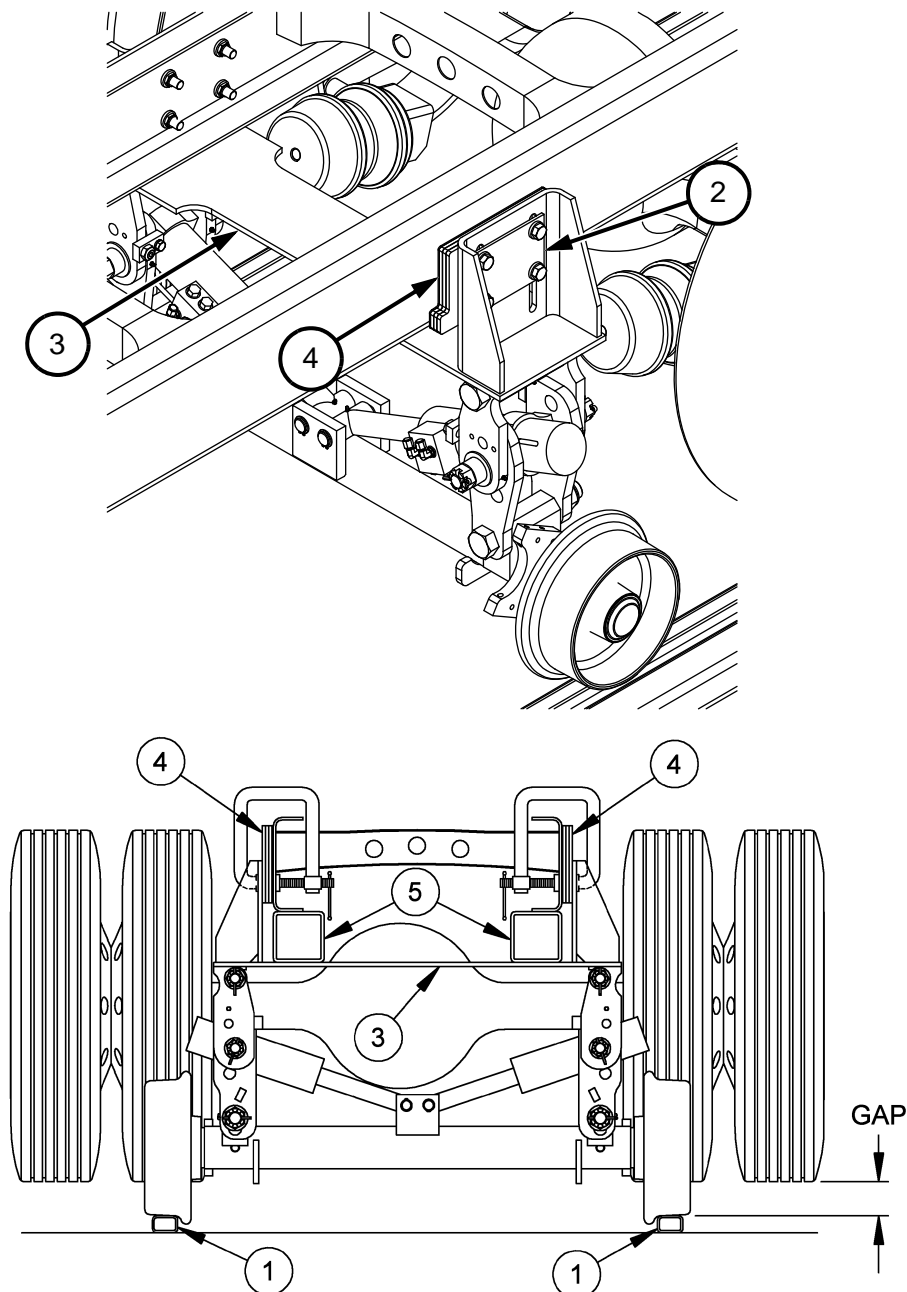
3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load

3.1.4.2 Guide Wheel Unit Height Setup - See Figure 3-2

9. Remove the clamps from the upper structure and vehicle frame. Using the hydraulic control valves, raise the guide wheels (lower the upper structure) enough to remove the 6" spacer (5). Install the permanent calculated thickness spacers between the upper structure (3) and the vehicle frame. These spacers must be made of solid steel because they will be positioned to carry and transfer the full load on the rear of the vehicle to the guide wheel unit, less the load that is carried on the vehicle rear tires.

FIGURE 3-2
GUIDE WHEEL UNIT HEIGHT SETUP



3.1 Guide Wheel Equipment Alignment Procedure

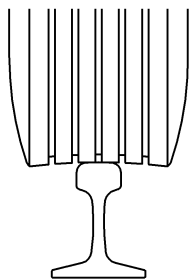
3.1.4 Guide Wheel Load

3.1.4.2 Guide Wheel Unit Height Setup - See Figures 3-3, 3-4, 3-5 and 3-6

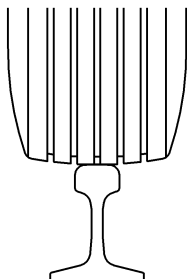
9. Using the hydraulic control valves, lower the guide wheels (raise upper structure) until the guide wheels are fully lowered. The upper structure with the permanent spacers will be tight against the vehicle frame. For safety purposes, clamp the upper structure to the vehicle frame.
10. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail.
11. Check the tire profile over the installation rails. If this is not a new installation, the tire profile can be checked on track rails.
12. The truck inner dual tires should be flat to slightly cupping the rails. Not enough weight (guide wheel unit positioned too low) will cause wheel spin and poor braking. Too much weight on the tires (guide wheel unit positioned too high) will cause rapid tire wear and possible derauling at crossings.

FIGURE 3-3
TIRE PROFILE OVER THE RAIL

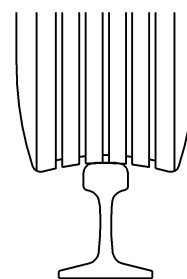
UNIT HEIGHT
ACCEPTABLE



UNIT HEIGHT
SET TOO LOW



UNIT HEIGHT
SET TOO HIGH



13. If necessary, adjust the spacer thickness to achieve the proper tire profile over the rails. Tack weld the spacer in place, welding on the guide wheel unit upper structure only, not on the vehicle frame.
14. Once the proper tire profile over the rail has been achieved, the guide wheel unit needs to be squared with the vehicle rear axle.
Dimension "A" must be equal to dimension "B" within 1/16".
Dimension "C" must be equal to dimension "D" within 1/8".
15. Referring to the application drawings supplied with the guide wheel unit, secure the unit to the vehicle frame using the correct plates, spacers and fasteners.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load

3.1.4.2 Guide Wheel Unit Height Setup

16. Complete the String Lining and Rear Guide Wheel Alignment Procedures in this manual.
17. Once all of the procedures are completed, weld mounting plate (2) in place as shown.
18. Complete the Vehicle Track Test Procedure to ensure the vehicle tracks properly. Make adjustments as necessary for proper vehicle tracking.

FIGURE 3-4
GUIDE WHEEL UNIT SQUARING

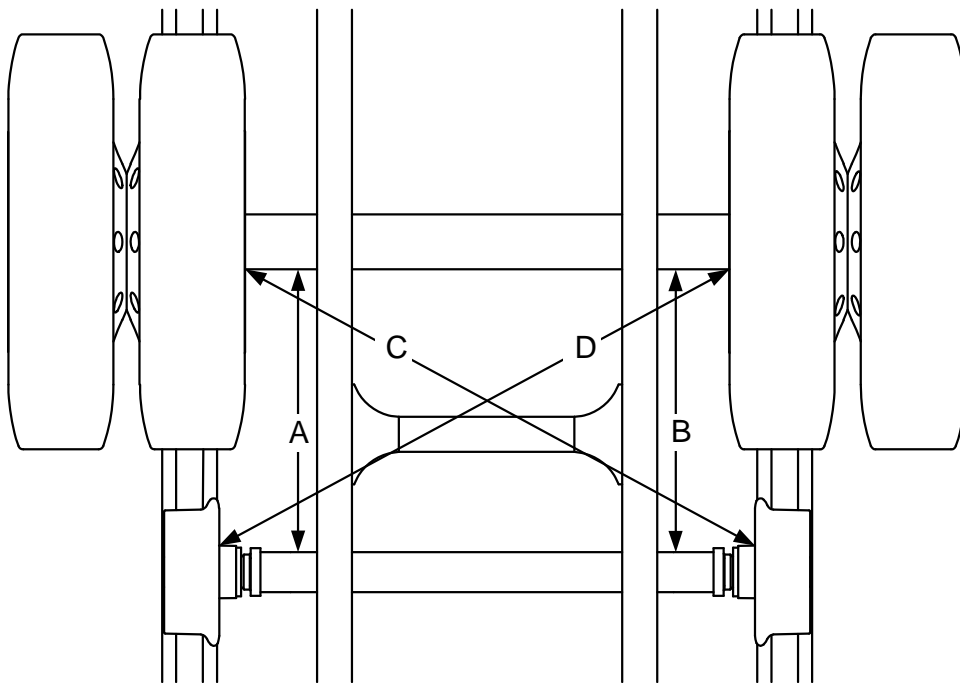


FIGURE 3-5
TACK WELD SPACER IN PLACE

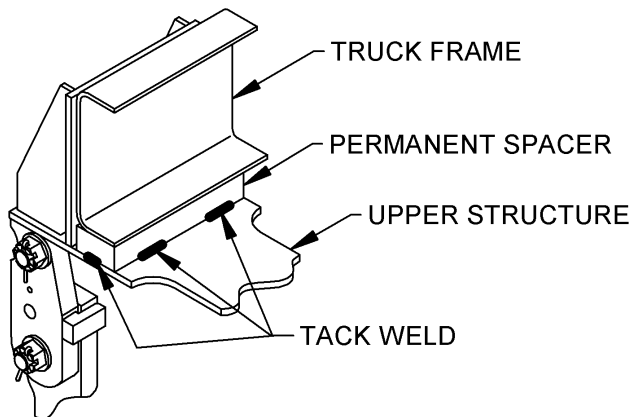
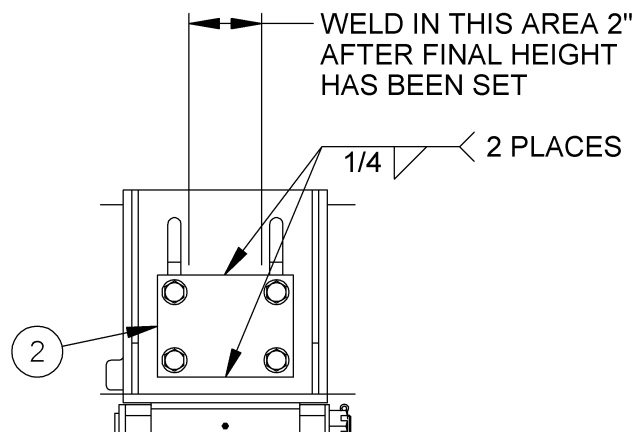
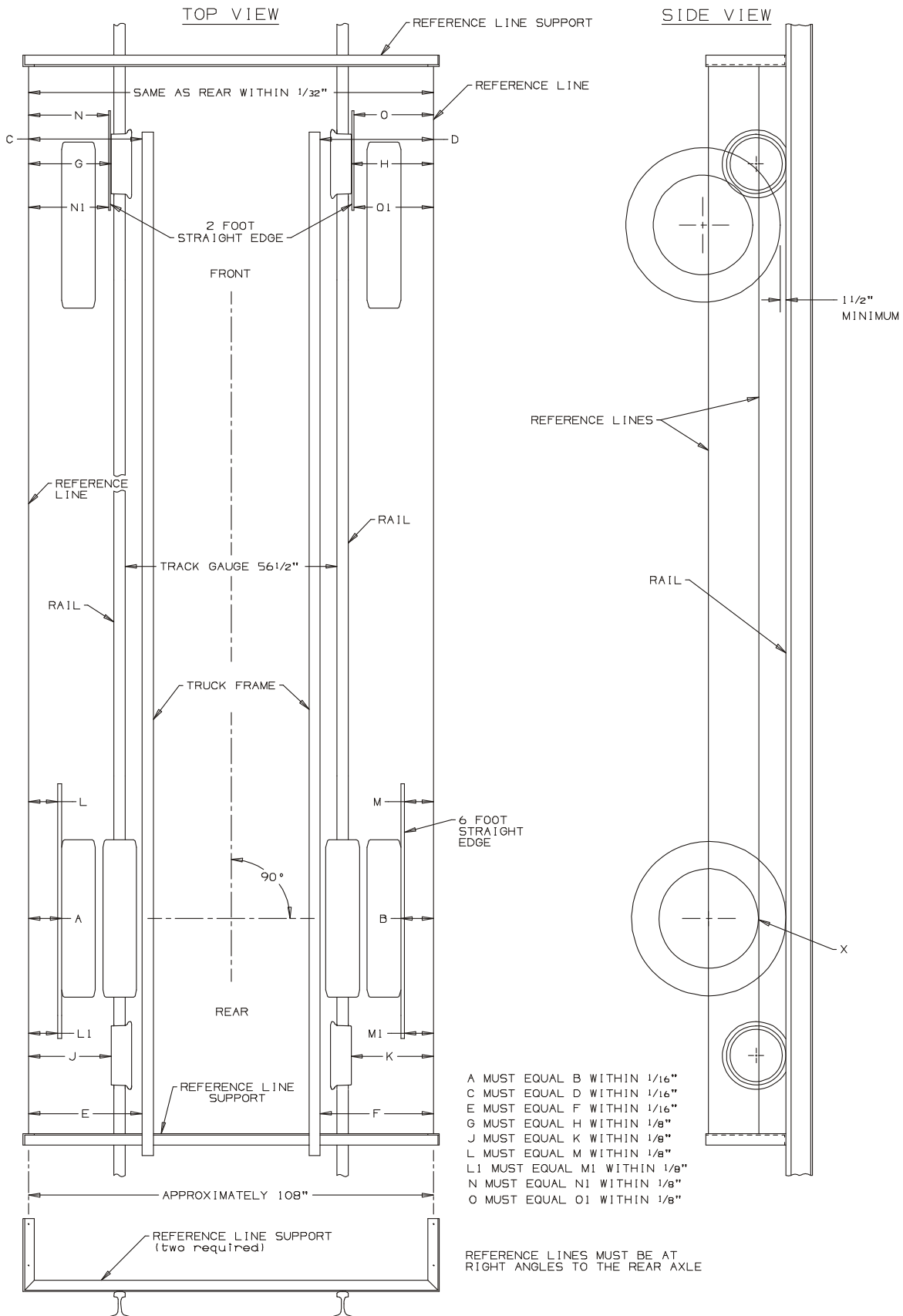


FIGURE 3-6
WELD PLATE IN PLACE



3.1 Guide Wheel Equipment Alignment Procedure

FIGURE 3-7
GUIDE WHEEL EQUIPMENT ALIGNMENT



3.1 Guide Wheel Equipment Alignment Procedure

3.1.5 String Lining Set-Up - See Figure 3-7

1. The string lining procedure is only a guide to check and make alignment adjustments to the guide wheel equipment. String lining the vehicle and guide wheel equipment will not guarantee that the guide wheel equipped vehicle will track properly. Harsco Rail recommends that all HY-RAIL® equipped vehicles be track tested. The vehicle should be at its normal operating load for track testing. The vehicle should be track tested when:
 - a. The guide wheel equipment is installed on the vehicle.
 - b. Any adjustments are made to the guide wheel equipment.
 - c. The load on the vehicle is changed.
 - d. Periodically to ensure that the vehicle is tracking properly.
2. Lower and lock both the front and rear guide wheel units in the "rail" position. See Operation Section - Placing Vehicle On Track. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail. Set the vehicle wheels straight ahead. Secure the vehicle steering wheel using the steering lock.
3. Establish parallel reference lines on each side of the vehicle as shown in Figure 3-7. Parallel reference lines can be established by building two supports or brackets. These can be built out of scrap angle iron or other material. The supports must be high enough so the top reference line is through the center of the rear axle. The supports need to be a few inches longer than the width of the vehicle. Wires or cords stretched between the front and rear supports will be the reference lines. The wires or cords should be spaced approximately 108 inches (2743 mm) apart. The distance between the wires or cords must be equal or within 1/32 inch (.8 mm) at each support.
4. Clamp the supports to the rail in front of and behind the vehicle. The supports should be at right angles to the rail. Stretch the wires or cords between the supports, so the lower reference line is level with the bottom edge of the rear vehicle wheel rim(s) (point X) and the upper reference line is through the center of the rear axle(s). The reference lines must be level.
5. Shift the supports on the rail until dimension A equals (=) B and dimension C equals (=) D or within 1/16 inch (1.6 mm). Measurements A and B should be taken from the edge of the rear vehicle rim(s) directly below the axle (point X) to the reference lines. Measurements C and D are taken from the front of the vehicle frame. When shifting the supports, keep them at right angles to the rail so the reference lines stay level and parallel to each other.
6. Hold a six (6) foot straight edge against the outer edge of the rear, outside tires with the straight edge centered on the tires. Record dimensions L, L1, M and M1 to the reference line. Rotate the rear tires 180 degrees and record a second set of dimensions at L, L1, M and M1. Average the two dimensions taken at L, L1, M and M1.

Example: [L (first dimension) + L (second dimension)] ÷ 2 = L (average dimension)

3.1 Guide Wheel Equipment Alignment Procedure

3.1.5 String Lining Set-Up - See Figure 3-7

7. Shift the supports on the rail until dimension L (average) equals (=) M (average) and dimension L1 (average) equals (=) M1 (average) or within 1/8 inch (3.2 mm). When shifting the supports, keep them at right angles to the rail so the reference lines stay level and parallel to each other. The reference lines will be parallel only when the rear axle is straight.
8. After the reference lines have been established, measurements can be taken from these lines to the guide wheels to help ensure correct alignment when applying the unit and / or checking the front and rear guide wheel unit alignment to the vehicle.

3

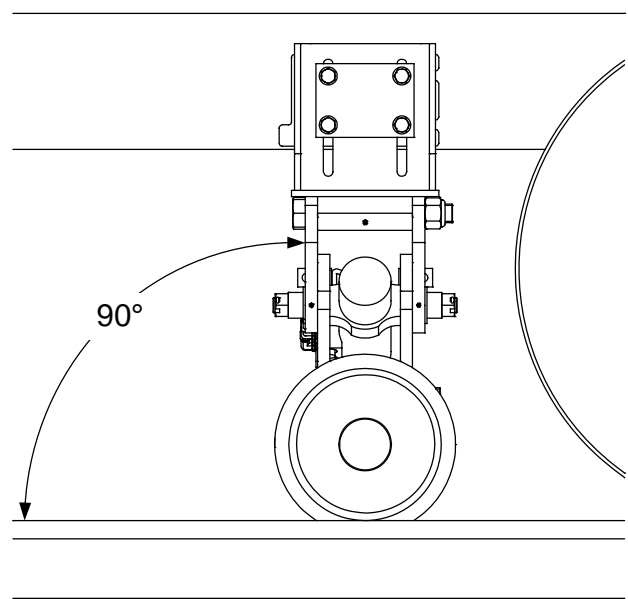
3.1.6 Rear Guide Wheel Alignment - See Figure 3-7

1. Lower and lock the rear guide wheel units in the "rail" position. Take measurements J and K. Measure from the outer edge of the guide wheel, directly below the center line of the wheel spindle, to the reference lines. Check that dimension J equals (=) dimension K or is within 1/8 inch (3.2 mm). If not, see Adjustment.

3.1.6.1 Rear Guide Wheel Adjustment - See Figures 3-7, 3-8 and 3-9

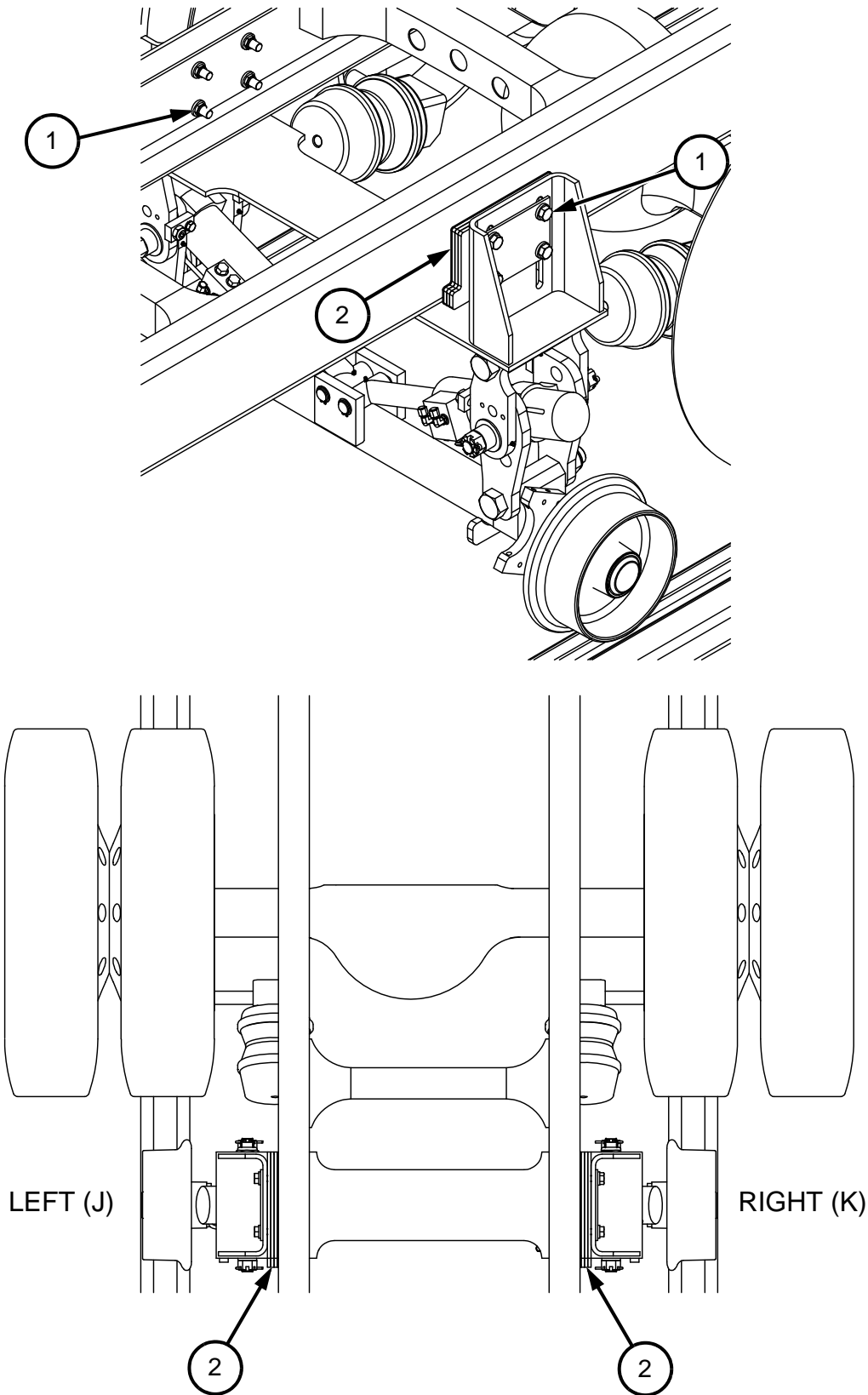
1. Unlock and raise the guide wheel unit from the "rail" position. Let the guide wheels rest on the rails.
2. Loosen eight fasteners (1) that bolt the guide wheel unit to the vehicle frame. Move the appropriate number of 1/8 inch or 3/8 inch shims (2) from one side to the other side. As an example, if dimension K is less than dimension J, remove shims from the right side (K) and install on the left side (J). Move 1/2 the thickness of shims that K is less than J. Torque the mounting fasteners (1) to 282 lb-ft.
3. Lower and lock the guide wheel in the "rail" position. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail.
4. Repeat Steps 1 through 3 until dimension J equals (=) dimension K or is within 1/8 inch (3.2 mm).
5. The guide wheel unit must also be positioned as close as possible to 90° to the rail.

FIGURE 3-8
GUIDE WHEEL UNIT 90° TO THE RAIL



3.1 Guide Wheel Equipment Alignment Procedure

FIGURE 3-9
REAR GUIDE WHEEL ALIGNMENT



3.1 Guide Wheel Equipment Alignment Procedure

3.1.7 Vehicle Track Test



■ **CHECK AND CORRECT ALIGNMENT PROMPTLY IF MISALIGNMENT IS INDICATED. MISALIGNMENT OF GUIDE WHEEL EQUIPMENT COULD RESULT IN DERAILMENT OF THE VEHICLE AND SEVERE BODILY INJURY.**

1. Harsco Rail recommends that all HY-RAIL® equipped vehicles be track tested. The vehicle should be at its normal operating load for track testing. The vehicle should be track tested when:
 - a. The guide wheel equipment is installed on the vehicle.
 - b. Any adjustments are made to the guide wheel equipment.
 - c. The load on the vehicle is changed.
 - d. Periodically to ensure that the vehicle is tracking properly.
2. The vehicle must be placed on straight, level, tangent track. See Operation Section - Placing Vehicle On Track.
3. Apply spray paint to the flanges and treads of all guide wheels.
4. Lower and lock both guide wheel units in the "rail" position. Disengage the mechanical PTO hydraulic pump or stop the auxiliary hydraulic power source. If the vehicle is equipped with an auxiliary control valve, place the valve in the proper position to shut off hydraulic oil flow to the guide wheel equipment. Move valve handles back and forth to bleed off hydraulic pressure to the guide wheel unit hydraulic cylinders. This will ensure that slack is removed from the unit's linkage so the unit will be properly positioned on the rail.
5. Operate the vehicle a minimum of 1/4 mile at a normal operating speed.
6. The paint should wear evenly around the flanges and treads of all guide wheels. If the paint is worn evenly on all guide wheels, the vehicle and guide wheel equipment is properly aligned.
7. If the paint wore off the right front guide wheel flange and not off the left front guide wheel flange, the guide wheel unit is "flanging right".
 - a. Unlock and raise the guide wheels. Let the guide wheels rest on the rail. Slightly move the right front guide wheel forward or the left front guide wheel rearward. See the Operator's Service and Parts Manual for the front guide wheel unit.
 - b. Repaint the flanges and treads on all guide wheels. Lower and lock the guide wheel unit in the "rail" Position. Operate the vehicle a minimum of 1/4 mile at a normal operating speed. If the paint is worn evenly on all guide wheels, the vehicle and guide wheel equipment is properly aligned.
 - c. If the paint continues to wear off the right guide wheel flange and not off the left guide wheel flange, repeat Steps a. & b. If the vehicle unit continues to track improperly, go to Step 9.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.7 Vehicle Track Test

8. If the paint wore off the left guide wheel flange and not off the right guide wheel flange, the guide wheel unit is "flanging left".
 - a. Unlock and raise the guide wheels. Let the guide wheels rest on the rail. Slightly move the left front guide wheel forward or the right front guide wheel rearward. See the Operator's Service and Parts Manual for the front guide wheel unit.
 - b. Repaint the flanges and treads on all guide wheels. Lower and lock the guide wheel unit in the "rail" Position. Operate the vehicle a minimum of 1/4 mile at a normal operating speed. If the paint is worn evenly on all guide wheels, the vehicle and guide wheel equipment is properly aligned.
 - c. If the paint continues to wear off the left guide wheel flange and not off the right guide wheel flange, repeat Steps a. & b. If the vehicle continues to track improperly, go to Step 9.
9. Note which guide wheels, flange and/or tread the paint is worn on.
 - a. Repaint the flanges and treads on all guide wheels.
 - b. Operate the vehicle in reverse for a short distance at a normal operating speed.
 - c. Note which guide wheels, flange and/or tread the paint is worn on.

If the paint wore off the right front flange when traveling forward and then off the left rear flange when traveling in reverse or off the left front flange when traveling forward and then off the right rear flange when traveling in reverse, the vehicle is probably not aligned properly. Have the frame checked for proper alignment. See Vehicle Check.
10. If the vehicle continues to track improperly, repeat the String Lining and Guide Wheel Alignment Procedure.

3.2 Adjustments

3.2.1 Brake Shoe Clearance

3.2.1.1 Checking Brake Shoe Clearance - See Figure 3-10

The rear guide wheel unit may be equipped with guide wheel brakes.

1. Place the vehicle automatic transmission in "Park" or manual transmission in "Neutral". Apply the parking brake. If equipped, move the rail wheel brake control valve to the On position.
2. Measure the clearance between the brake shoe and the guide wheel tread. The clearance must not exceed 1/8 inch (3.2 mm), or adjustment is required. See Adjustment.
3. Repeat Step 2 to check the brake shoe clearance on the other guide wheel.

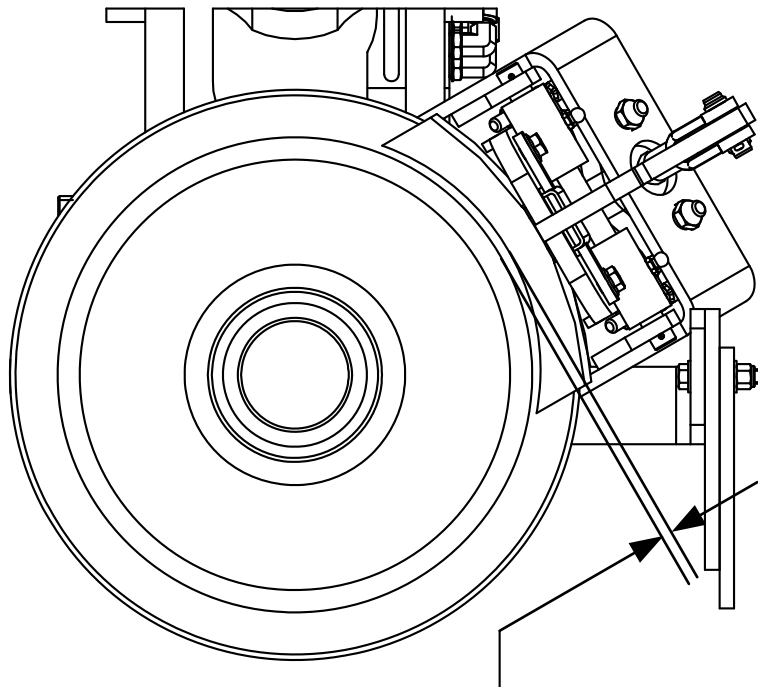
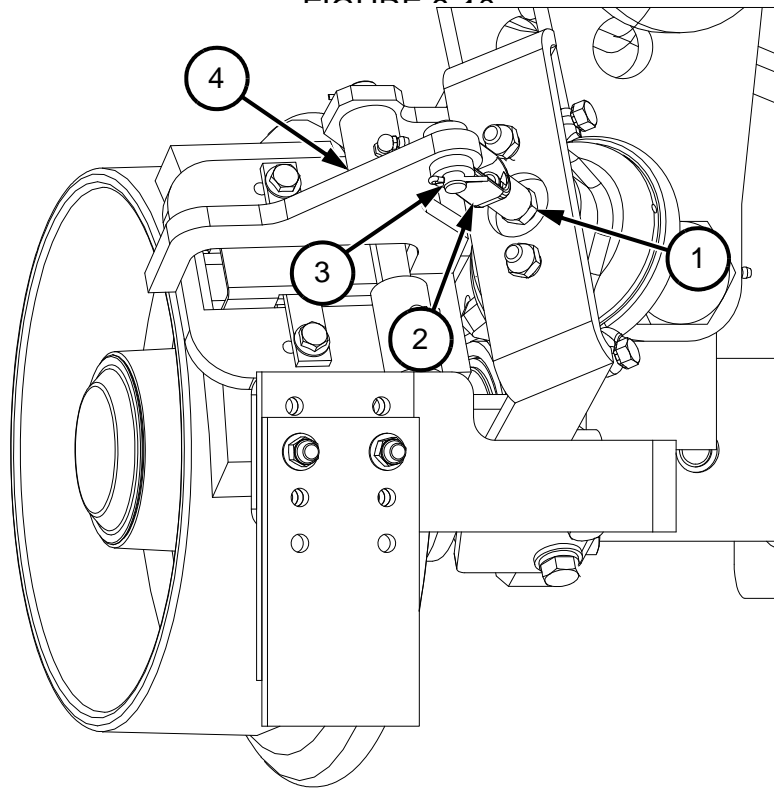
3.2.1.2 Adjusting Brake Shoe Clearance - See Figures 3-10

1. Loosen jam nut (1) on yoke (2). Remove the cotter pin from pin (3). Remove pin (3) from yoke (2). Turn yoke (2) counter-clockwise to adjust the brake shoe closer to the guide wheel tread or clockwise to adjust the brake shoe away from the guide wheel tread.
2. Adjust so the brake shoe is 1/32 - 1/16 inch (.8 - 1.6 mm) away from the guide wheel tread. Install pin (3) through yoke (2) and brake arm (4) and secure using the cotter pin. Tighten jam nut (1) securely. Recheck the brake shoe clearance and adjust if necessary.
3. Repeat Steps 1 and 2 to adjust the brake shoe clearance on the other rear guide wheel.
2. Measure the clearance between the brake shoe and the guide wheel tread. The clearance must not exceed 1/8 inch (3.2 mm), or adjustment is required.
3. Repeat Step 2 to check the brake shoe clearance on the other guide wheel brake.

3.2 Adjustments

3.2.1 Brake Shoe Clearance

FIGURE 3-13



1/8" MAXIMUM
ADJUST TO
1/32" - 1/16"

3.2 Adjustments

3.2.2 Rail Sweeps

The rear guide wheel units may be equipped with the rail sweeps. There may be different rail sweep groups for units equipped without brakes and units with brakes. The Checking and Adjusting Procedure is the same for both arrangements.

3.2.2.1 Checking Rail Sweeps - See Figure 3-11

1. Place the vehicle on straight, level track. Place the automatic transmission in "Park" or manual transmission in "Neutral". Apply the parking brake. Stop the engine.
2. Lower and lock the guide wheels in the "rail" position. The rear rail sweeps are mounted to the axle assembly and will lower to the rail when the guide wheels are lowered.
3. The rubber sweep (1) should clear the top of the rail by 1/4 inch (6.4 mm). If not, adjustment is necessary.

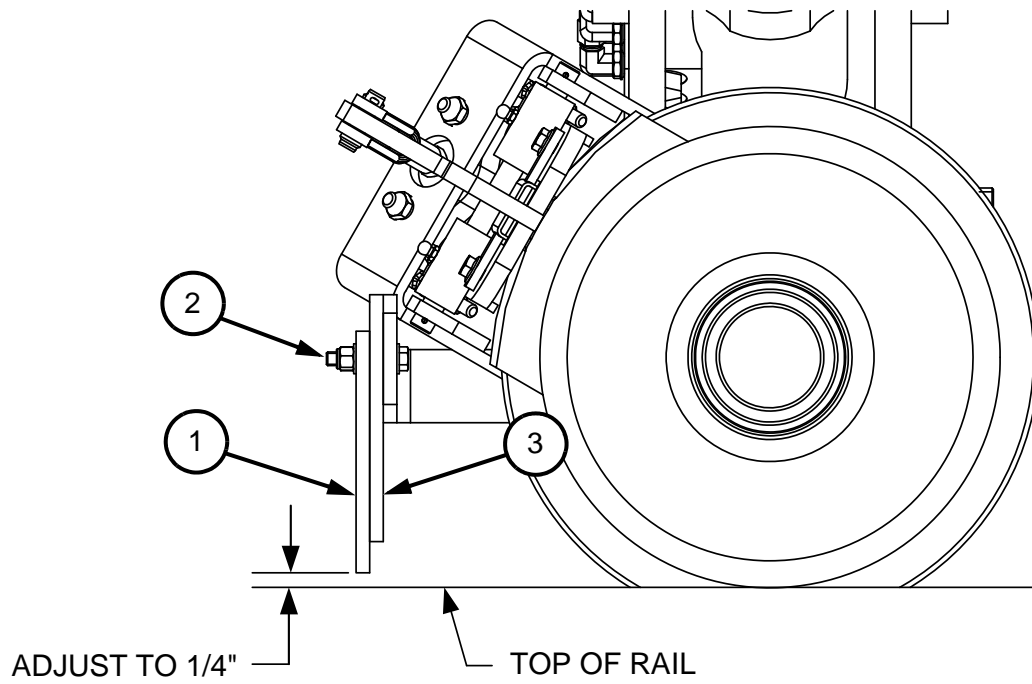
3.2.2.2 Adjusting Rail Sweeps - See Figure 3-11

1. Loosen two fasteners (2). Adjust the rubber sweep (1) until the sweep clears the top of the rail by 1/4 inch (6.4 mm). Re-tighten the fasteners.
2. If the rubber sweep cannot be lowered because the fasteners are at the bottom of the slots in the mounting plate, remove the two fasteners (2). Relocate the fasteners in the next upper set of holes in the rubber sweep. Adjust the rubber sweep.
3. If the rubber sweep (1) is in the last, upper set of holes, move the rear sweep (3) to the front and the front sweep (1) to the rear as a stiffener. Adjust the rubber sweep.
4. When both rubber sweeps are worn and can not be adjusted lowered, replace both rubber sweeps.

3.2 Adjustments

3.2.3 Rail Sweep Clearance

FIGURE 3-11
CHECKING / ADJUSTING RAIL SWEEPS



NOTES

3

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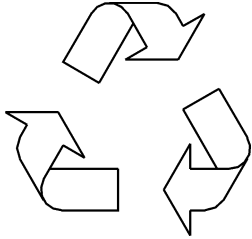
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4.1 Waste Disposal



Dispose of waste properly. Improper disposal of waste can threaten the environment. The operation and maintenance of Harsco Rail equipment may involve the use of such items as hydraulic oil, engine oil, fuel, coolant, brake fluid, filters, batteries, etc.

Use leak proof containers when draining fluids. Do not pour waste onto the ground, down a drain, or into any water source. Inquire on the proper way to recycle or dispose of waste according to applicable Federal, State and/or local regulations.

4.2 Maintenance Schedule



- **RE-TORQUE VEHICLE WHEEL LUG NUTS AND GUIDE WHEEL BOLTS AFTER THE FIRST 50 MILES OF OPERATION. THEREAFTER TORQUE WHEEL LUG NUTS ACCORDING TO VEHICLE MANUFACTURER'S WHEEL TORQUE SPECIFICATIONS. FAILURE TO COMPLY COULD RESULT IN SEVERE BODILY INJURY.**

4

4.2.1 Daily

1. Inspect the front and rear guide wheel units for damaged, worn or missing parts.
2. Check the mechanical and hydraulic locks and lock pins for ease of operation.
3. Check the hydraulic reservoir to ensure that the oil level is full. If low, fill to the proper level with the correct fluid.
4. When the vehicle is operated on the track, listen for unusual noises. Unusual noises may indicate incorrectly lowered guide wheels, damaged or missing parts, or insufficient lubrication. Pay attention to the quality of the ride. Check the guide wheel equipment alignment if the vehicle crowds one side of the track instead of floating from side to side. See Adjustments - Guide Wheel Equipment Alignment Procedure.

4.2 Maintenance Schedule

4.2.2 Weekly

1. Check the guide wheel equipment alignment. See Adjustment Section, Guide Wheel Equipment Alignment Procedure - Vehicle Track Test.
2. Inspect the guide wheel tread and flanges for wear or damage. See Maintenance - Guide Wheel Allowable Wear.
3. Spin each guide wheel by hand, checking for ease of rotation. If the guide wheel does not rotate easily, the guide wheel bearings may be lacking lubrication or may be damaged. Inspect, re-pack or replace the bearings if necessary.
4. Inspect the vehicle wheels, studs, lug nuts and tires for wear, damage, cuts etc.
5. Check the vehicle tires for correct inflation pressure. Operate at the tire manufacturer's recommended maximum pressure printed on the sidewalls of the tires, or the wheel manufacturer's recommended maximum pressure stamped on the wheel, whichever is lower.
6. Check all bolts for tightness. See Appendix A for bolt torque specification tables and grade identification markings used by manufacturers.

4.2.3 Every 2,000 Track Miles (3200 km)

Lubricate the guide wheel equipment every 2000 track miles (maximum) or each time the vehicle is serviced. See Guide Wheel Equipment Lubrication.

4.2.4 At 10,000 Track Miles (16000 km)

Re-pack and adjust the guide wheel bearings. See Re-packing Guide Wheel Bearings.

4.3 Guide Wheel Equipment Lubrication

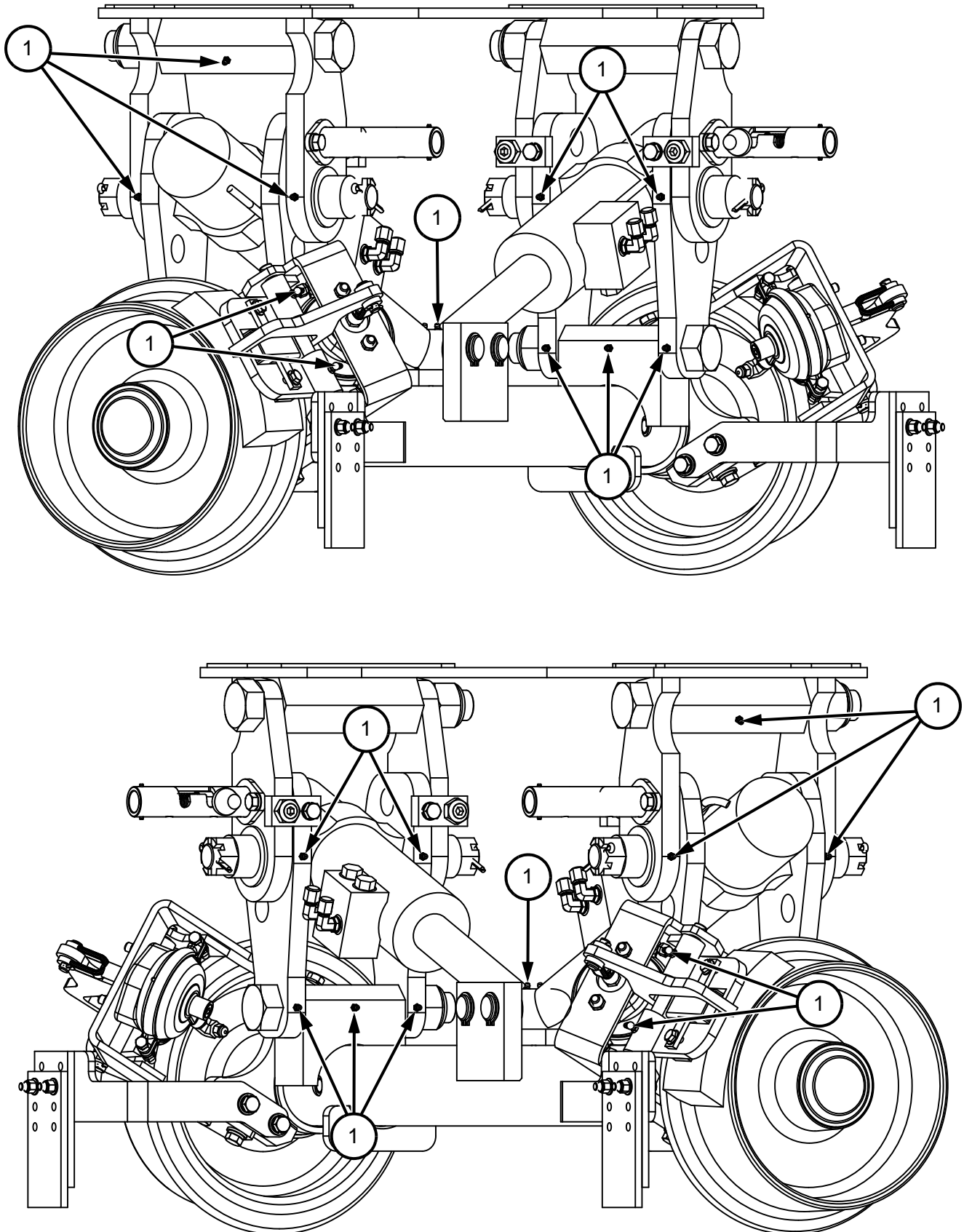
Lubricate the guide wheel equipment every 2000 track miles (maximum) or each time the vehicle is serviced.

4.3.1 Guide Wheel Unit Lubrication - See Figure 4-1

1. Apply the vehicle parking brake. Stop the vehicle engine. Turn the vehicle's ignition switch off.
2. Lubricate grease fittings (1) using Mobil Special Moly, or equivalent.
3. Re-pack the guide wheel bearings every 10,000 track miles (maximum) or at least once yearly (minimum), whichever occurs first. See Re-packing Guide Wheel Bearings.

4.3 Guide Wheel Equipment Lubrication

FIGURE 4-1
GUIDE WHEEL UNIT LUBRICATION



4.3 Guide Wheel Equipment Lubrication

4.3.2 Re-Packing Guide Wheel Bearings - See Figure 4-2

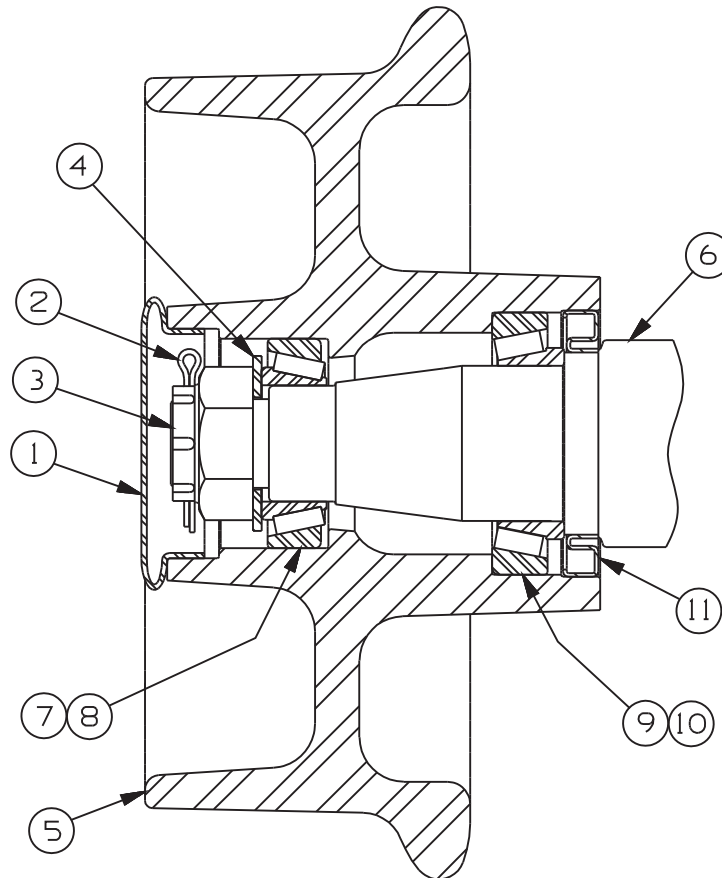
Re-pack the guide wheel bearings every 10,000 track miles (maximum) or at least once yearly (minimum), whichever occurs first.

1. Apply the parking brake. Raise and lock the front and rear guide wheel units in the "highway" position. Stop the vehicle engine. Shut off the vehicle ignition switch.
2. If the guide wheel equipment is equipped with brakes, it will be necessary to remove the brake shoe to allow removal of the guide wheel.
3. Remove the hub cap (1). Remove the 3/16 x 2-1/2 inch cotter pin (2), 1-1/2 inch castle nut (3) and spindle washer (4).
4. Pull the guide wheel (5) from the spindle (6). Remove the outer bearing cone (7) from the guide wheel (5). Remove the grease seal (11) and inner bearing cone (9) from the guide wheel (5).
5. Clean all components of old grease and dirt.
6. Inspect the spindle, bearing cones and cups (7 & 8, 9 & 10) for nicks, gouges and wear. If any of these are evident, replace the component.
7. Measure the guide wheel wear. See Maintenance - Guide Wheels, Allowable Wear.
8. Coat the spindle surface, grease seal surface, both bearing cup surfaces, pack both bearing cones and fill the guide wheel cavity 1/2 full (50 %) using Mobil grease XHP 222, or equivalent.
9. Install the inner bearing cone (9) into the guide wheel (5). Install a new grease seal (11) into the wheel.
10. Slide the guide wheel (5) with the inner bearing (9) and grease seal (11) onto the spindle (6). Install the outer bearing cone (7), spindle washer (4) and 1-1/2 inch castle nut (3) onto the spindle (6).
11. Torque the castle nut (3) to approximately 20 lb-ft while slowly turning the guide wheel in both directions to ensure bearings are fully seated. Then loosen the castle nut. This is especially important if new bearing cups have been installed.
12. Torque the castle nut (3) to 7 lb-ft (zero clearance). Then back the castle nut off 1/2 to 1 flat of the nut (.001 - .010 inch clearance). Secure the castle nut using a new cotter pin (2).
13. Place a bead of silicone sealant on the hub cap (1) where it mates with guide wheel (5). Install the hub cap (1) onto the guide wheel.
14. If removed, re-install the brake shoe.

4.3 Guide Wheel Equipment Lubrication

4.3.2 Re-Packing Guide Wheel Bearings

FIGURE 4-2
RE-PACKING GUIDE WHEEL BEARINGS



4.4 Guide Wheels

4.4.1 Allowable Wear - See Figure 4-3



- **REPLACE ANY GUIDE WHEEL IMMEDIATELY WHICH SHOWS DAMAGE AND/OR HAS WORN MORE THAN THE ALLOWABLE LIMITS. FAILURE TO COMPLY COULD RESULT IN DERAILMENT OF THE VEHICLE, AND SEVERE BODILY INJURY.**

The guide wheels must be checked for allowable wear a minimum of once yearly (every twelve months). Use the following procedure to check the guide wheel wear.

1. Tools needed: Harsco Rail wheel caliper (M019889), or equivalent.
2. Measure the guide wheel flange at Position "A" with the wheel caliper. The minimum allowable flange dimension at Position "A" is 7/8 inch (22.2 mm).

4

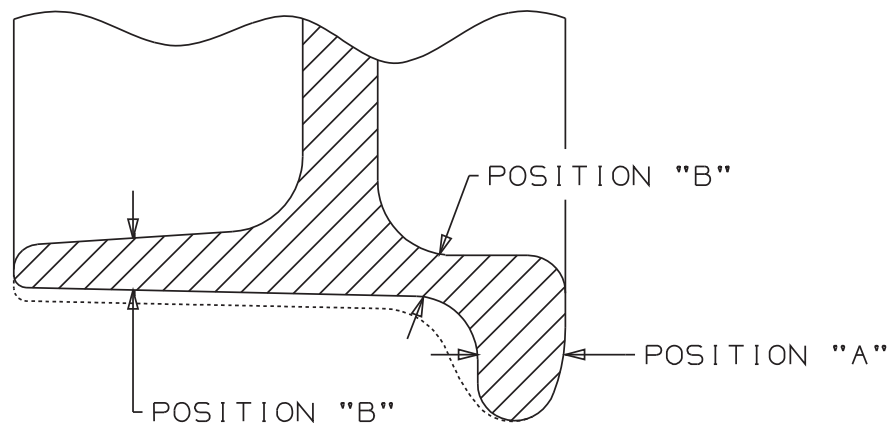
If the guide wheel flange dimension is less than the allowable limit, replace the guide wheel immediately.

3. Measure the guide wheel tread at Position "B" with the wheel caliper. The minimum allowable tread dimension at Position "B" is 1/2 inch (12.7 mm).

If the guide wheel tread dimension is less than the allowable limit, replace the guide wheel immediately.

4. The entire guide wheel must not have any gouges or cracks. If any of these are evident, replace the guide wheel immediately.

FIGURE 4-3
GUIDE WHEEL ALLOWABLE WEAR



4.5 Vehicle Wheels

4.5.1 Tire Replacement



- **USE REPLACEMENT TIRES WITH THE SAME ROLLING RADIUS, TREAD WIDTH, PLY RATING, AND LOAD RATING AS RECOMMENDED BY THE VEHICLE MANUFACTURER. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY AND/OR PROPERTY DAMAGE.**

Replacement tires must have the same rolling radius, tread width, ply rating, and load rating as recommended by the vehicle manufacturer. Using tires of equal diameter will help keep the speedometer reading and the guide wheel load accurate. Tires must have a minimum 6-1/2 inches of tread width. After installing new tire(s) on the vehicle, check guide wheel load. See the Adjustment Section - Guide Wheel Equipment Alignment Procedure.

Inflate tires to the tire manufacturer's recommended maximum pressure printed on the sidewalls of the tires or the wheel manufacturer's recommended maximum pressure stamped on the wheel, whichever is lower. The wheels and tires should be static balanced or balanced after installation on the vehicle for the best results. Torque vehicle wheel lug nuts to manufacturer's recommended specifications.

4

4.6 Bolt Torque Requirements



- **CHECK ALL BOLTS AND NUTS PERIODICALLY. KEEP BOLTS AND NUTS TIGHTENED TO THE TORQUE SPECIFIED IN APPENDIX A. IF BOLT REPLACEMENT BECOMES NECESSARY, REPLACE WORN BOLT WITH EQUAL S.A.E. GRADE NUMBER BOLT. FAILURE TO COMPLY COULD RESULT IN BODILY INJURY, AND/OR PROPERTY DAMAGE.**

See Appendix A for bolt torque specification tables and grade identification markings used by manufacturers.

4.7 Hoses and Fittings



- ALL HOSES AND FITTINGS ON THIS EQUIPMENT MUST COMPLY WITH SAE STANDARD J1273 - RECOMMENDED PRACTICES FOR HYDRAULIC HOSE ASSEMBLIES. FAILURE TO COMPLY TO THIS STANDARD COULD RESULT IN SEVERE BODILY INJURY.

4.7.1 Inspection, Maintenance, Replacement And Installation

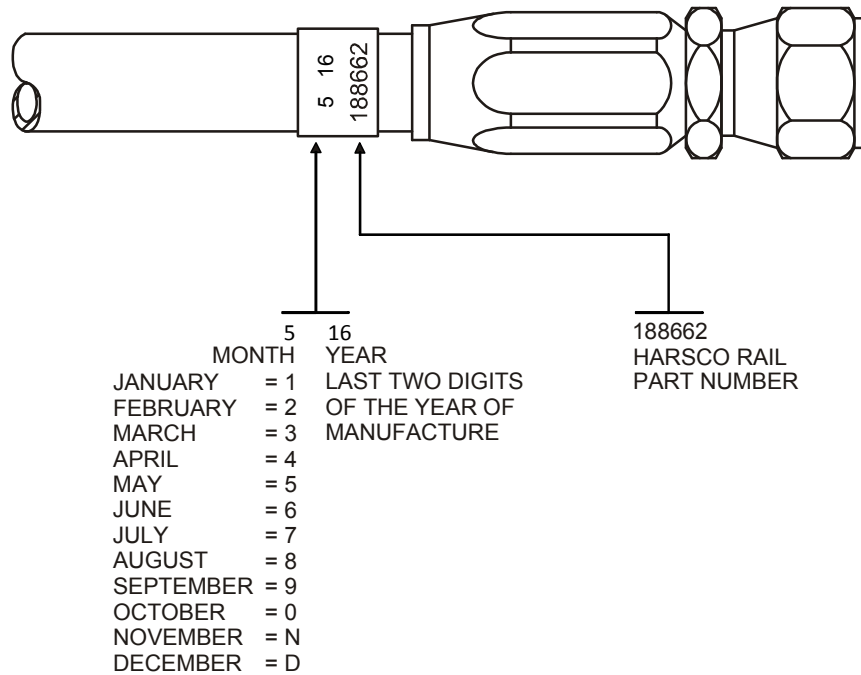
The inspection, maintenance, replacement and installation of hydraulic hose assemblies and fittings on this equipment must conform with SAE Standard J1273 -Recommended Practices For Hydraulic Hose Assemblies.

4.7.2 Hose Band - See Figure 4-4

All Harsco Rail original and replacement hose assemblies are supplied with a hose band displaying the date of manufacture and the Harsco Rail part number. The hose assembly illustrated in the example was manufactured in May 2016 and is Harsco Rail part number 188662.

4

FIGURE 4-4
HOSE BAND



**SECTION 5 - TROUBLESHOOTING
TABLE OF CONTENTS**

5.1 Troubleshooting Guide Wheel Equipment. 5 - 2

5.1 Troubleshooting Guide Wheel Equipment

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Hydraulic pump not delivering oil.	<p>Mechanical PTO not engaged or control valve not shifted to direct oil flow to guide wheel equipment.</p> <p>Switch for auxiliary electric powered hydraulic pump in OFF position.</p> <p>Hydraulic reservoir oil level low.</p> <p>Oil restricted to pump intake.</p> <p>Components bent, broken, worn, etc.</p>	<p>Engage mechanical PTO. Shift control valve to direct oil flow to guide wheel equipment.</p> <p>Move switch to ON position.</p> <p>Fill reservoir to full level with recommended hydraulic oil.</p> <p>Check all strainers and filters for dirt and sludge. Clean and replace if necessary.</p> <p>Replace components.</p>
<p>5 Guide wheel unit does not lower or raise.</p>	<p>Lock pins engaged.</p> <p>Hydraulic pump not operating.</p> <p>Hydraulic reservoir oil level low.</p> <p>Components bent, broken, worn, etc.</p> <p>Lack of lubrication.</p>	<p>Disengage lock pins. See Operation Section - Placing Vehicle On Track or Removing Vehicle From Track.</p> <p>Start hydraulic pump.</p> <p>Fill reservoir to full level with recommended hydraulic oil.</p> <p>Replace components.</p> <p>Lubricate guide wheel unit. See Maintenance - Guide Wheel Equipment Lubrication.</p>
Guide wheel unit is difficult to lower or raise.	<p>Vehicle over-loaded.</p> <p>Components bent, broken, worn, etc.</p> <p>Lack of lubrication.</p>	<p>Remove excess load from vehicle.</p> <p>Replace components.</p> <p>Lubricate guide wheel unit. See Maintenance - Guide Wheel Equipment Lubrication.</p>

5.1 Troubleshooting Guide Wheel Equipment

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Lock pins will not engage when guide wheel unit is in "rail" or "highway" position.	<p>Guide wheels not fully lowered or raised.</p> <p>Components bent, broken, worn, etc.</p> <p>Lack of lubrication.</p>	<p>Make sure unit is fully lowered or raised.</p> <p>Replace components.</p> <p>Lubricate lock mechanism.</p>
Vehicle load exceeds rear guide wheel unit maximum rated load.	Vehicle overloaded.	Redistribute or remove some of the load.
Vehicle pulls noticeably to the left or right when on track.	<p>Vehicle loaded heavy on one side.</p> <p>Guide wheel units, vehicle rear axle, etc. not aligned with vehicle frame.</p> <p>Incorrect or worn vehicle rear tire.</p> <p>Vehicle rear tires under inflated.</p> <p>Guide wheel brake shoes dragging.</p>	<p>Move load to center of vehicle.</p> <p>Check alignment. See Adjustment Section - Guide Wheel Equipment Alignment Procedure.</p> <p>Check for correct rear tire. Replace if necessary. Replace worn rear tire.</p> <p>Check pressure. Inflate if low. Do not exceed tire manufacturer's recommended maximum pressure printed on the sidewalls, or wheel manufacturer's recommended maximum pressure stamped on the wheel, whichever is lower.</p> <p>Re-adjust brake shoes. See Adjustment Section - Brake Shoe Clearance.</p>
Vehicle derails.	Guide wheel units, vehicle rear axle, etc. not aligned with vehicle frame.	Check alignment. See Adjustment Section - Guide Wheel Equipment Alignment Procedure.

5.1 Troubleshooting Guide Wheel Equipment

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Vibration felt in the vehicle when traveling on track.	<p>Guide wheel units mounting fasteners loose.</p> <p>Guide wheel bearings worn.</p> <p>Guide wheels worn.</p> <p>Vehicle rear rim bent.</p> <p>Vehicle rear tires out of balance.</p>	<p>Tighten all bolts to recommended torque.</p> <p>Replace bearings, wheel or axle.</p> <p>Check guide wheel wear. See Maintenance Section - Guide Wheels, Allowable Wear.</p> <p>Replace. See vehicle manufacturer.</p> <p>Balance tires.</p>
Vibration felt in the vehicle when traveling on highway.	<p>Guide wheel units mounting fasteners loose.</p> <p>Guide wheel units not locked in "highway" position.</p> <p>Vehicle rim bent.</p> <p>Vehicle tires out of balance.</p>	<p>Tighten all bolts to recommended torque.</p> <p>STOP IMMEDIATELY. Make sure both guide wheel units are locked in "highway" position.</p> <p>Replace. See vehicle manufacturer.</p> <p>Balance tires.</p>

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Serial Numbers

When this bulletin is received, complete the following record from the serial number tag on the front guide wheel unit. Always mention these factory serial numbers when calling or writing about the unit. The serial number tag is located on the frame assembly of the unit.

FIGURE 1
SERIAL NUMBER PLATE

HARSCO

PATENT NUMBER

WHEN ORDERING PARTS FOR THIS ACCESSORY ALWAYS GIVE THE FOLLOWING INFORMATION

HY-RAIL® GUIDE WHEEL EQUIPMENT

SERIAL NUMBER **SYMBOL** **MODEL NUMBER**

COLUMBIA, S.C. 29171 U.S.A.

82400K

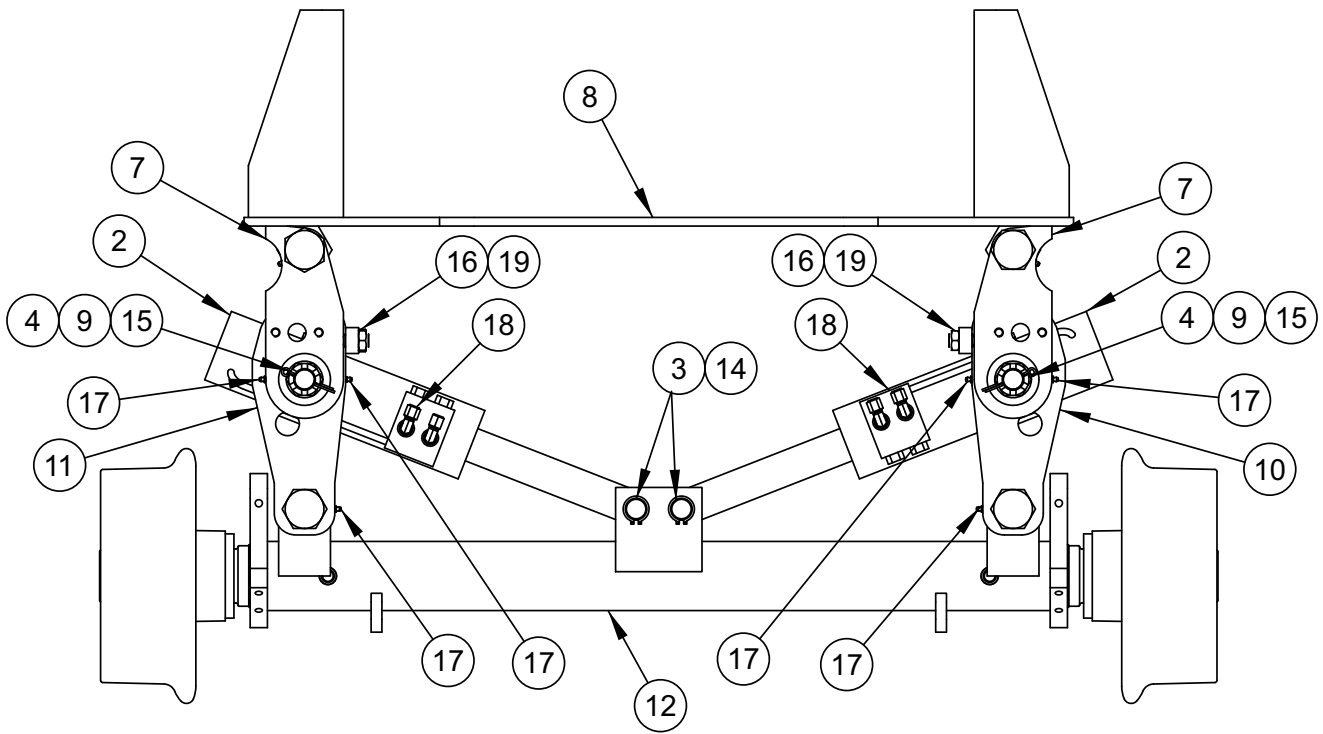
Instructions For Ordering Parts

1. Front - rear and left - right are determined from the operator's position.
2. Assemblies: Items listed in CAPITALS are assemblies which include all parts listed immediately following and indented to the right. When assemblies can be used, always order them to save work of fitting separate parts.
3. For convenience in ordering, parts are listed by item number, part number, description, and quantity in each assembly or group. If in doubt as to any part wanted, send full description, sketch, or send the old part with the order.
4. To insure prompt and correct shipment of parts on orders, always give:
 - a. Quantity of each part wanted.
 - b. Part number of each part as shown in this book. Include any prefix and suffix letters.
 - c. Description of each part as shown in this book.
 - d. Factory serial numbers recorded above.
 - e. Purchase order number (if required).
 - f. Preferred method of shipment.
5. All parts are shipped F.O.B. factory, transportation charges to be paid by customer. Terms to be determined by the Credit Department.

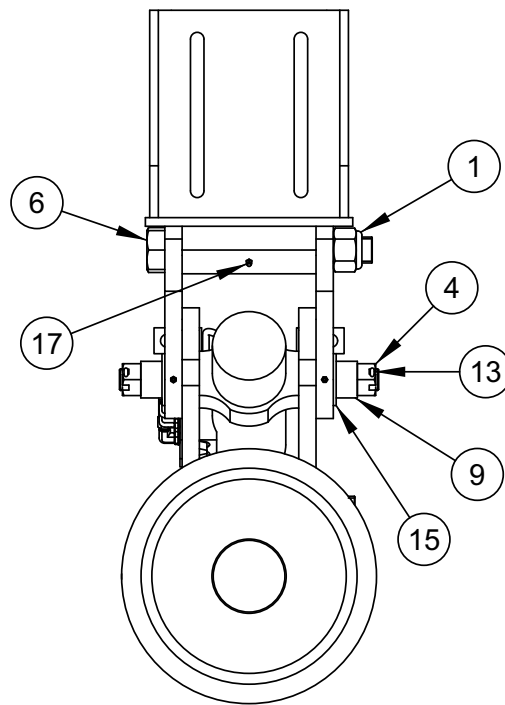
**HR3100B1-1 Rear Guide Wheel Unit Insulated
with Manual Locks, Brakes and Rail Sweeps - 5056066**

ITEM	PART NO	DESCRIPTION	QTY
	5065157	HR3100B1-1 Guide Wheel Unit, Insulated.	1
	5065266	Manual Lock Group	1
	5065161	Rail Sweep Group	1
	5065159	Brake Group.	1

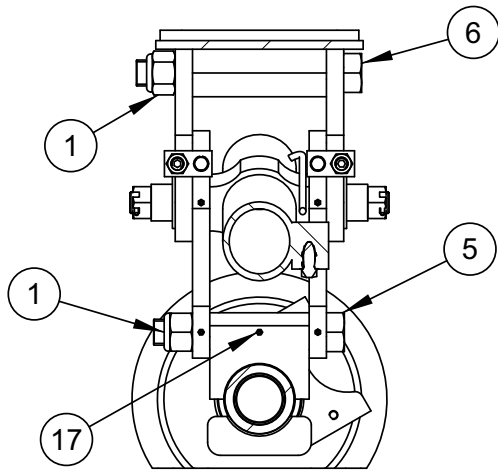
HR3100B1-1 Rear Guide Wheel Unit, Insulated - 5065157



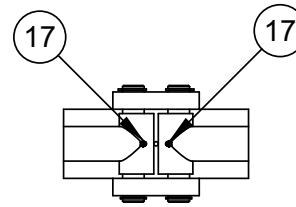
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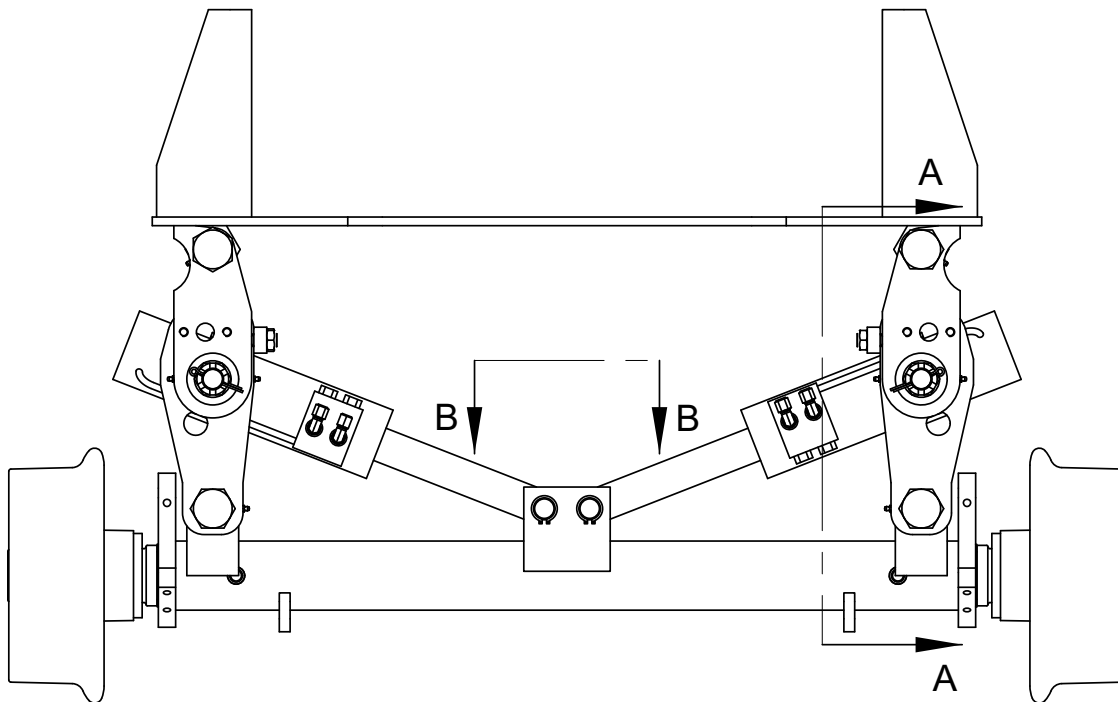
HR3100B1-1 Rear Guide Wheel Unit, Insulated - 5065157



SECTION A-A



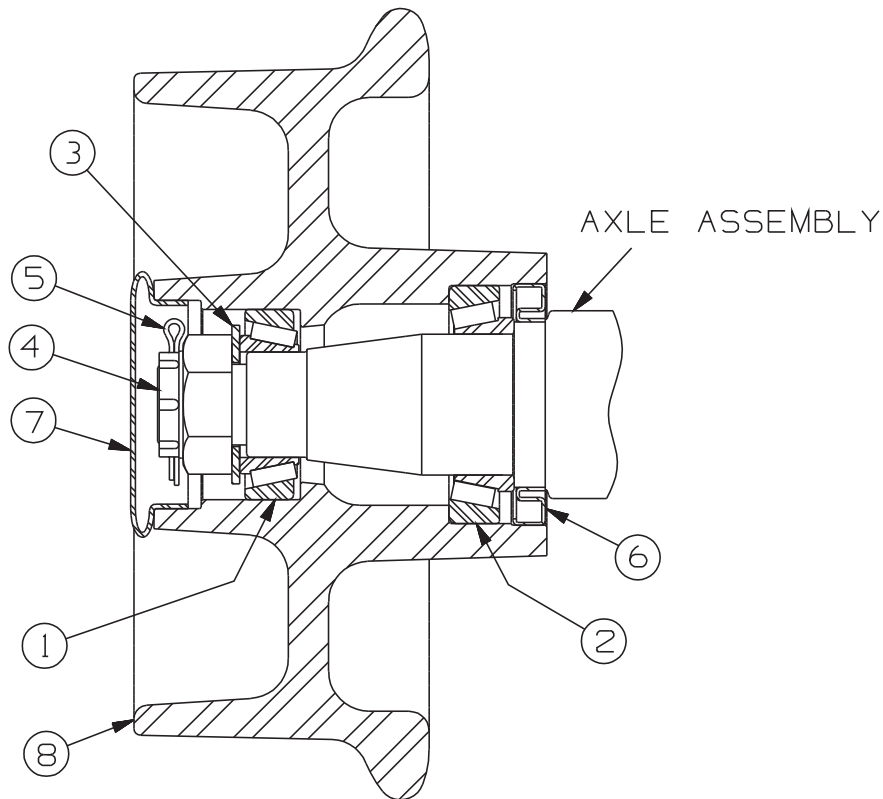
VIEW B-B



HR3100B1-1 Rear Guide Wheel Unit, Insulated - 5065157

ITEM	PART NO	DESCRIPTION	QTY
1	0-3011001-0-43	Nylon Lock Nut, 1-1/2" -6 UNC Grade 5	4
2	202488	Cylinder	2
3	203707	Pin	2
4	203786	Hex Slotted Nut, 1-1/4"-12	4
5	252272-588	Hex Head Cap Screw, 1-1/2-6 x 10" Grade 8	2
6	252272-590	Hex Head Cap Screw, 1-1/2"-6 x 12" Grade 8	2
7	5056069	Upper Link	4
8	5056159	Upper Structure	1
9	5057568	Spacer	4
10	5058443	Lower Link, Left	2
11	5058444	Lower Link, Right	2
12	5058829	Rear Axle Assembly	1
13	700743250	Cotter Pin, 1/4 x 2-1/2"	4
14	700843015	Retaining Ring	4
15	A0060023	Flat Washer, 1-1/2" SAE ZP	4
16	F003400	Hex Jam Nut, 3/4"-10 Grade 5 ZP	4
17	F008014	Grease Fitting	18
18	F013327	90° Elbow, 6 x 6 SAE	4
19	F023736	Socket Head Cap Screw, 3/4-10 x 1-1/2"	4

HR3100B1 Guide Wheel Assembly



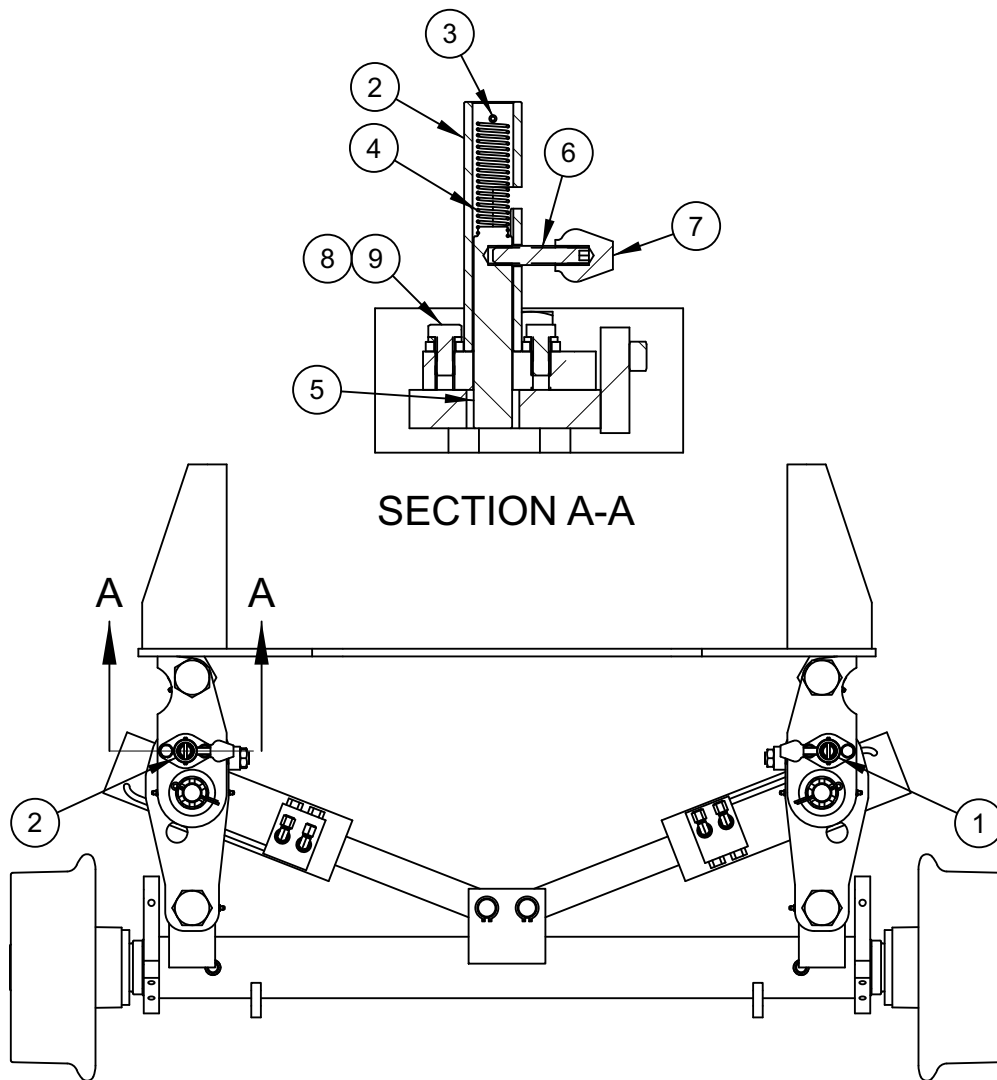
Note: Quantities listed are for one wheel only.

ITEM	PART NO	DESCRIPTION	QTY
1	159508	BEARING CUP & CONE, OUTSIDE	1
	F025051	Bearing Cup	1
	F025052	Bearing Cone	1
2	159507	BEARING CUP & CONE, INSIDE	1
	F025053	Bearing Cup	1
	F025054	Bearing Cone	1
3	F025049	Washer	1
4	F025249	Hex Slotted Nut, 1-1/2"-12 (part of axle assembly)	1
5	F003150	Cotter Pin, 3/16 x 2-1/2" (part of axle assembly)	1
6	F025057	Grease Seal	1
7	F025011	Grease Cap	1
8	175662	Wheel	1

5065266 Manual Lock Group

ITEM	PART NO	DESCRIPTION	QTY
1	5017296	Lock Pin Tube, Right	1
2	5017297	Lock Pin Tube, Left	1
3	F012413	Spring Pin, 3/16 x 1-3/4"	2
4	F023159	Spring	2
5	5060164	Lock Pin	2
6	201341	Stud	2
7	F014260K	Semi Ball Handle	2
8	F001075	Medium Lock Washer, 1/2" ZP	4
9	F003136	Hex Head Cap Screw, 1/2-13 x 1" Grade 5	4

5065266 Manual Lock Group

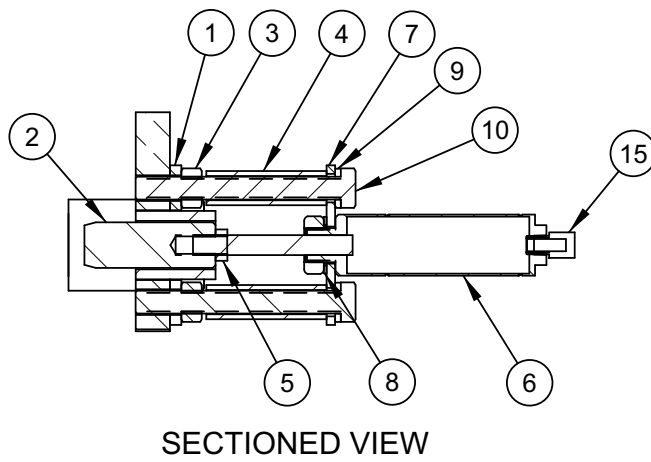
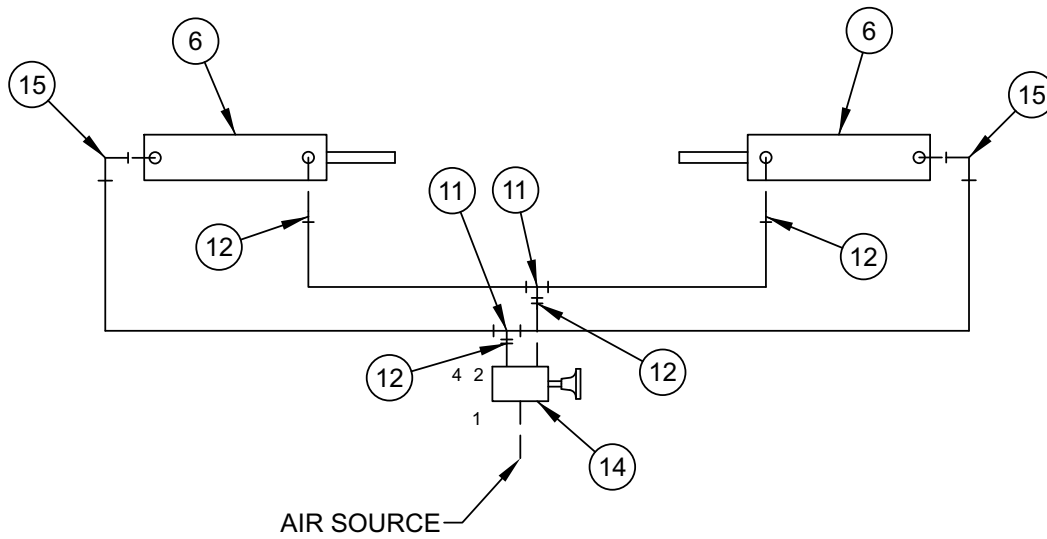


5061571 Air Lock Group

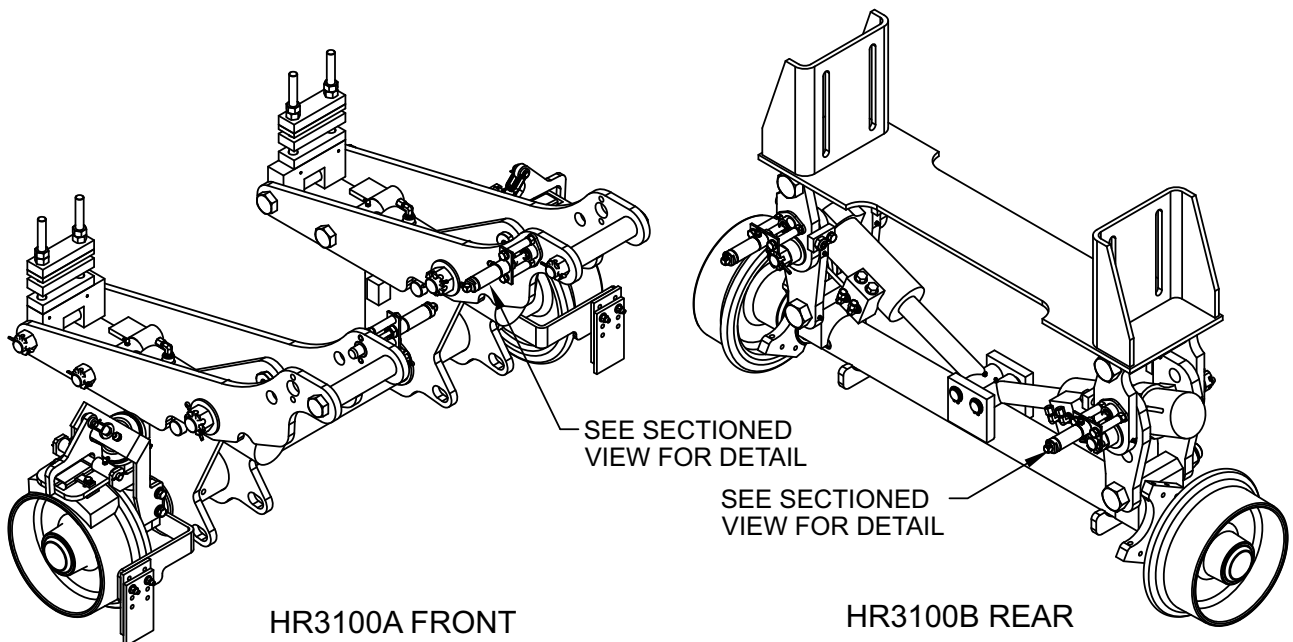
Note: Quantities listed are for one Guide Wheel Unit (Front or Rear) only.

ITEM	PART NO	DESCRIPTION	QTY
1	3416094	Lock Pin Sleeve	2
2	203943	Pin	2
3	F018812	Hex Nut, 1/2"-13 Grade 8 ZP	4
4	3428765	Spacer Tube	4
5	F016650	Hex Jam Nut, 7/16"-20	2
6	3410568	Air Cylinder	2
7	3426157	Cylinder Plate	2
8	F011479	Lock Washer, 3/4"	2
9	F001075	Lock Washer, 1/2" Medium ZP	4
10	F004229	Hex Head Cap Screw, 1/2-13 x 4-1/2	4
11	150243-3	Tee, Swivel Branch	2
12	F013193	Adapter, 1/8 MP x 1/4 JIC	4
13	5036888	Air Lock Decal	1
14	202401	Valve	1
15	F010677	90° Elbow, 4 x 2 NPT	2

5061571 Air Lock Group



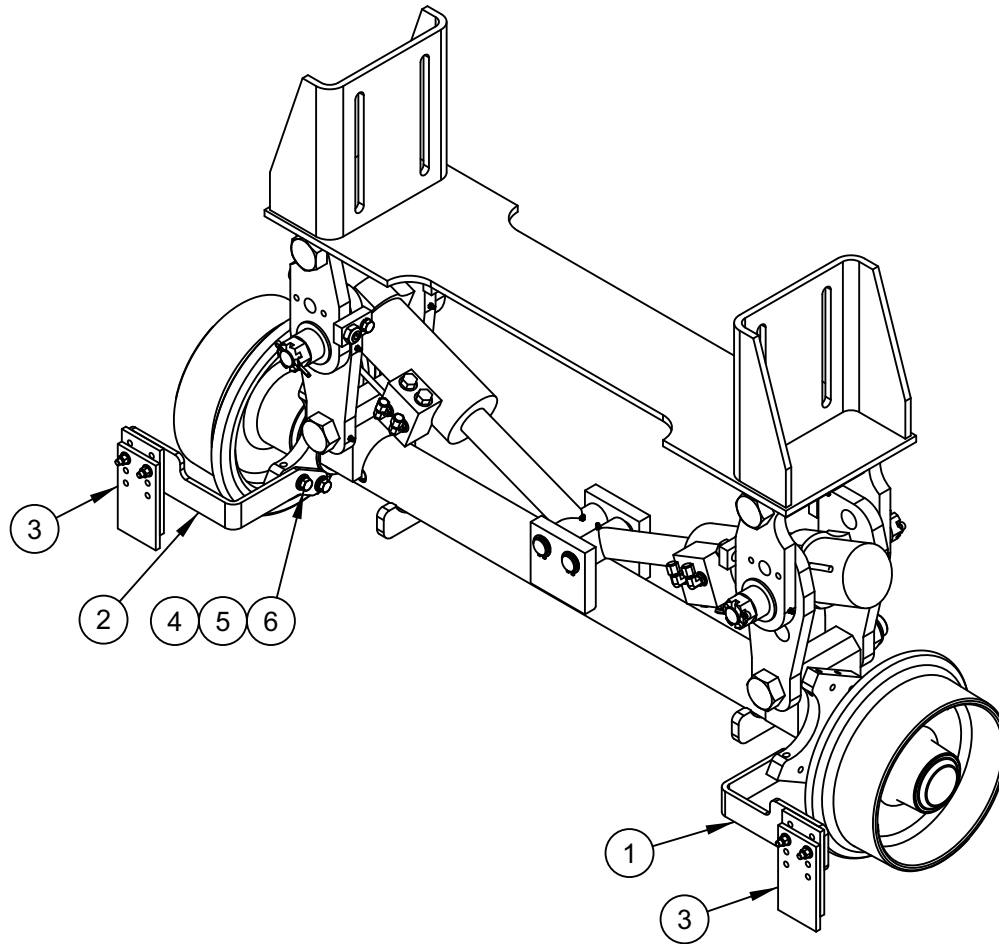
SECTIONED VIEW



HR3100A FRONT

HR3100B REAR

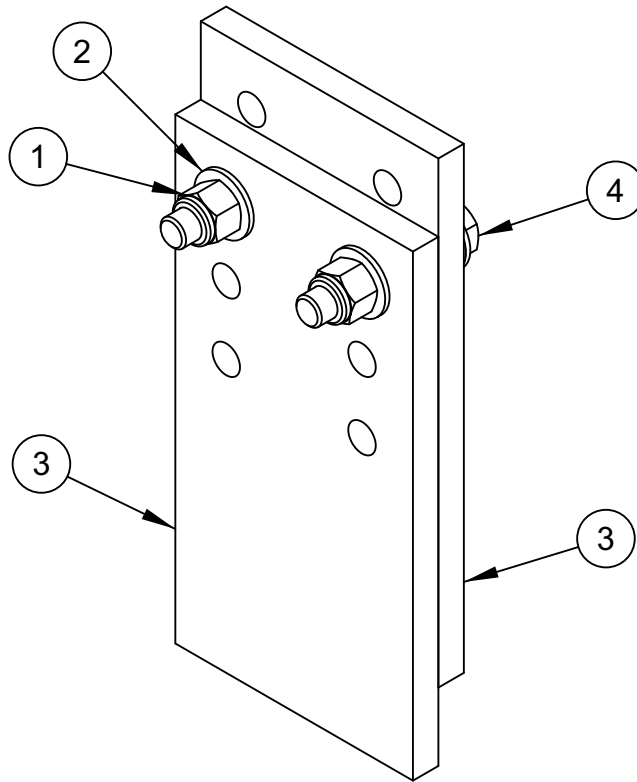
5065161 Rail Sweep Group



6

ITEM	PART NO	DESCRIPTION	QTY
1	5060359	Rail Sweep Mounting Bracket, Right	1
2	5060358	Rail Sweep Mounting Bracket, Left	1
3	5039909	Rail Sweep Assembly	2
4	F002965	SAE Flat Washer, 1/2"	4
5	F001075	Medium Lock Washer, 1/2" ZP.....	4
6	F001090	Hex Head Cap Screw, 1/2-13 x 1-1/2"	4

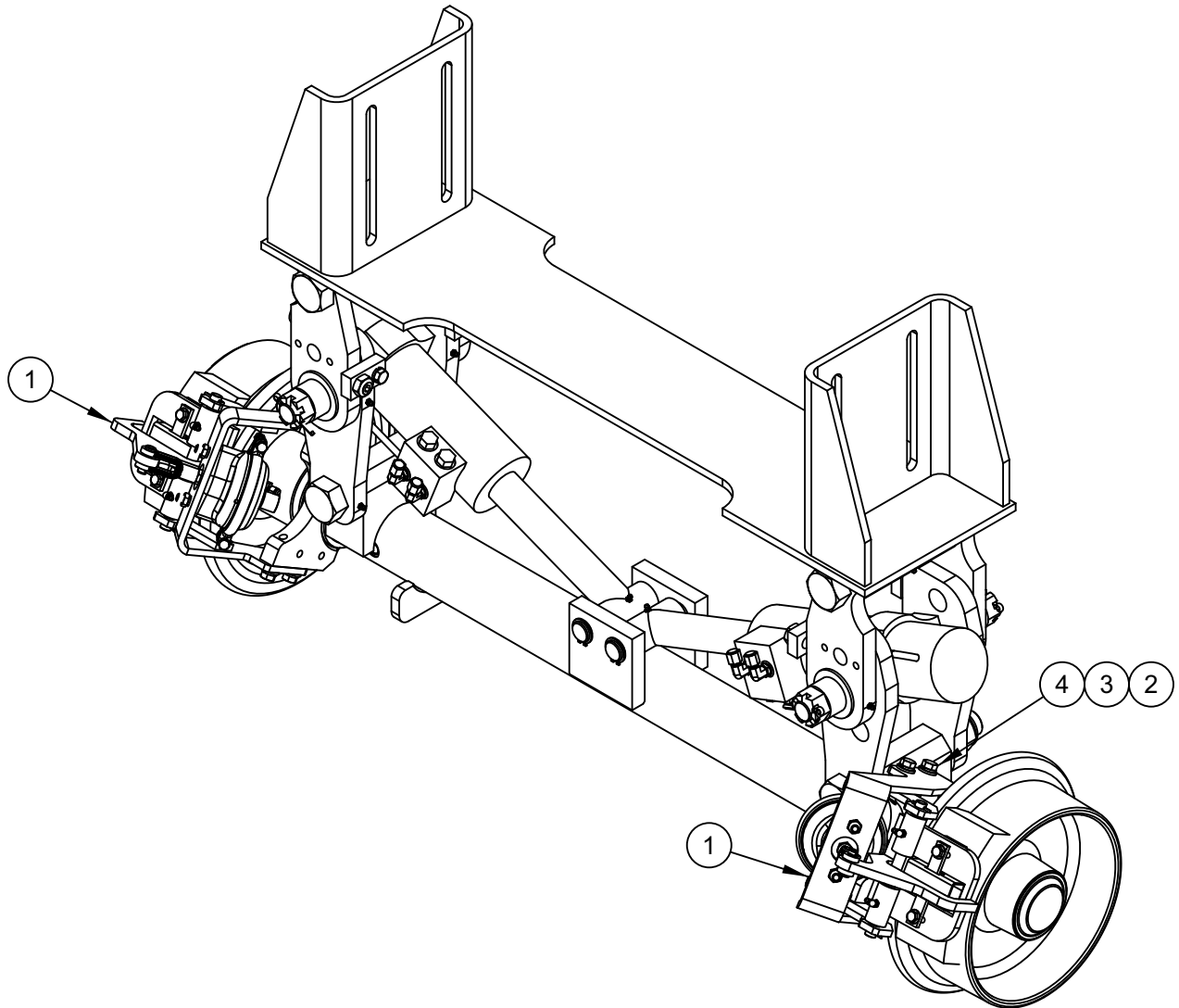
5039909 Rail Sweep Assembly



Note: Quantities listed are for one assembly only.

ITEM	PART NO	DESCRIPTION	QTY
1	F011998	Elastic Stop Nut, 3/8"-16	2
2	F009681	SAE Flat Washer, 3/8" ZP	4
3	3423618	Rail Sweep	2
4	252272-109	Hex Head Cap Screw, 3/8-16 x 2" Grade 8	2

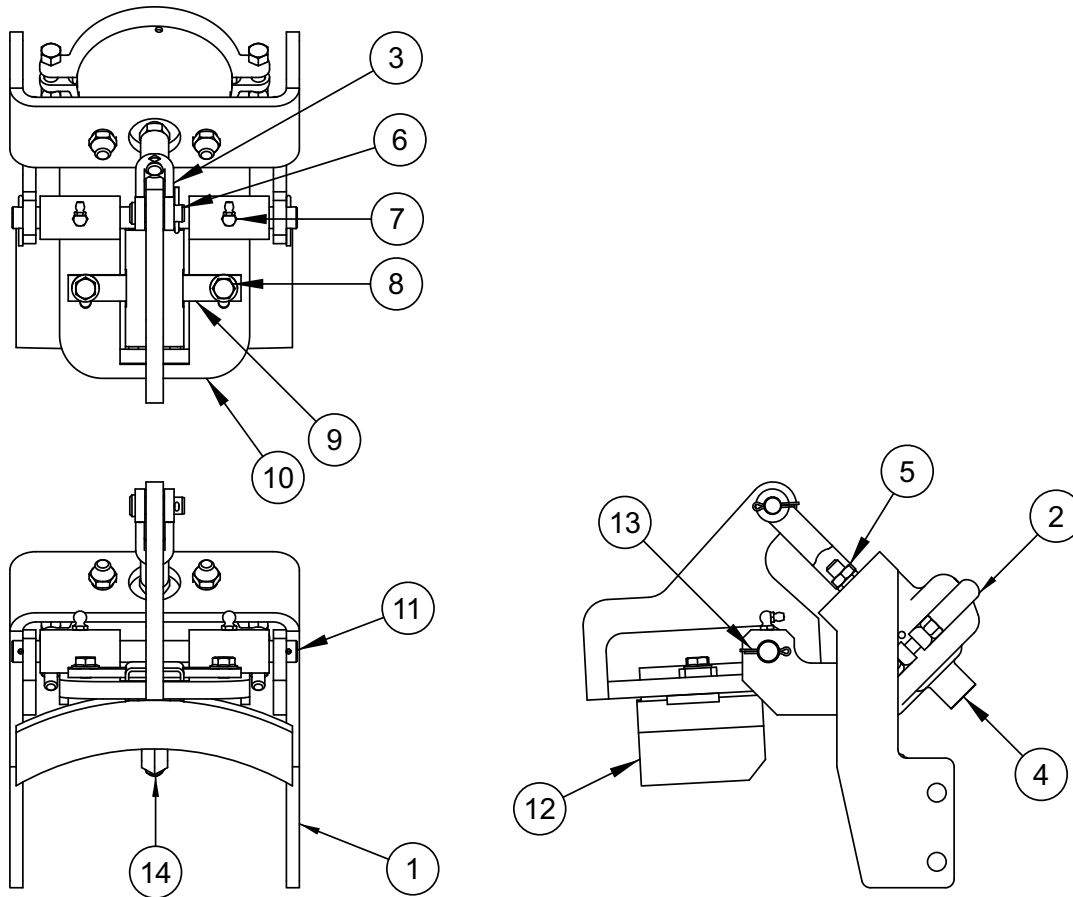
5065159 Brake Group



6

ITEM	PART NO	DESCRIPTION	QTY
1	5056046	Brake Assembly	2
2	F002965	SAE Flat Washer, 1/2"	8
3	F001075	Medium Lock Washer, 1/2" ZP.	8
4	F001090	Hex Head Cap Screw, 1/2-13 x 1-1/2"	8

5056046 Brake Assembly

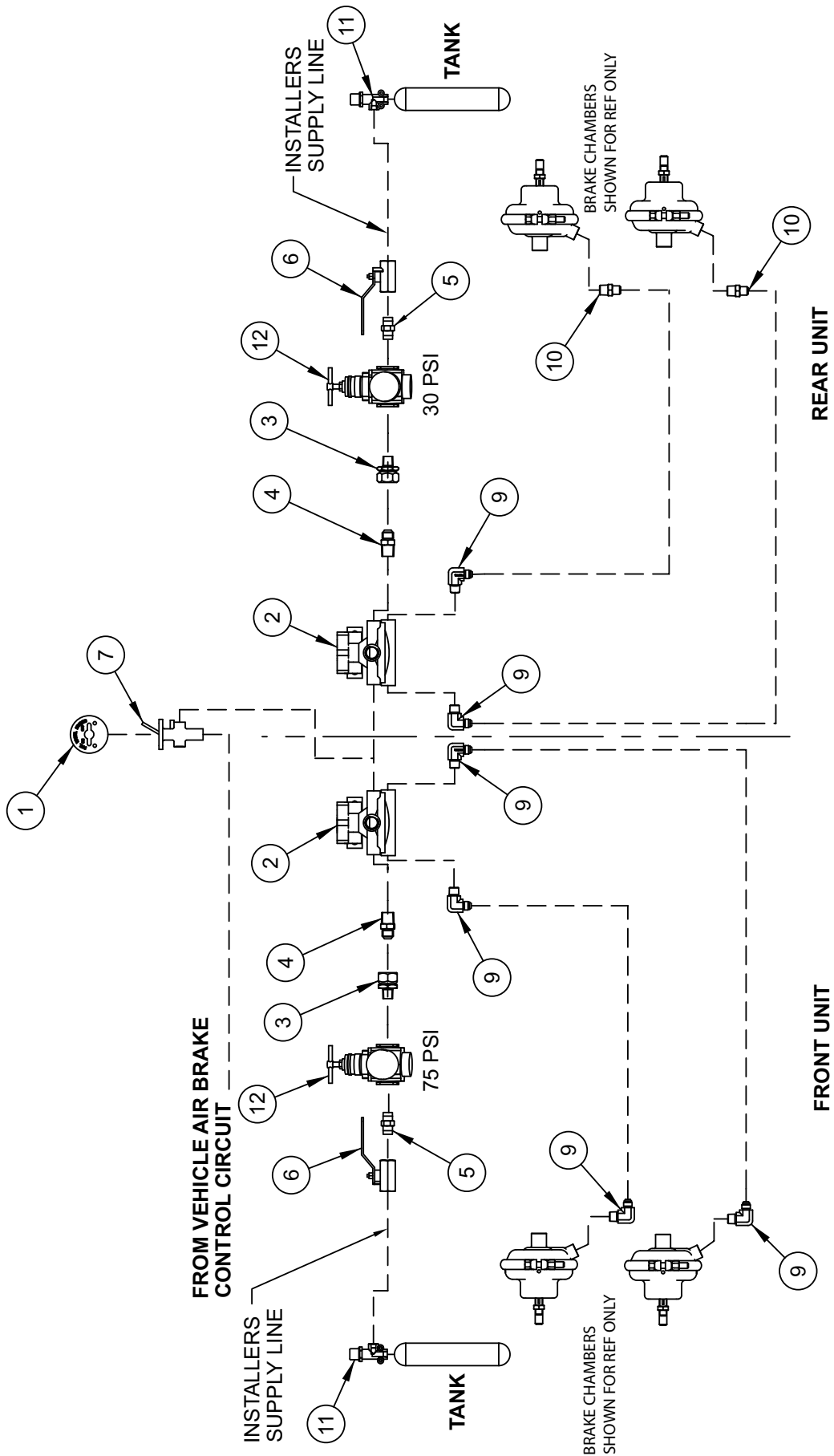


Note: Quantities listed are for one assembly only.

ITEM	PART NO	DESCRIPTION	QTY
1	5056053	Brake Bracket	1
2	F025058	Brake Actuator	1
3	F005459	Yoke	1
4	F011169	Plug, 6 NPT Socket Head	1
5	F011013	Jam Nut, 1/2"-20 Grade 5 ZP.	1
6	F005460	Yoke Pin Assembly	1
7	F010722	Grease Fitting, 90° Elbow	2
8	F023416	Hex Head Cap Screw, 3/8-16 x 3/4" Grade 5.	2
9	157694	Link	1
10	5040558	Plate Assembly	1
11	203856	Pin	1
12	0-3683003-0-04	Brake Shoe	1
13	F001104	Cotter Pin, 1/8 x 1"	2
14	F015104	90° Elbow, 4 x 6 NPT	1

5022421 Air Brake Control System - Front And Rear Units

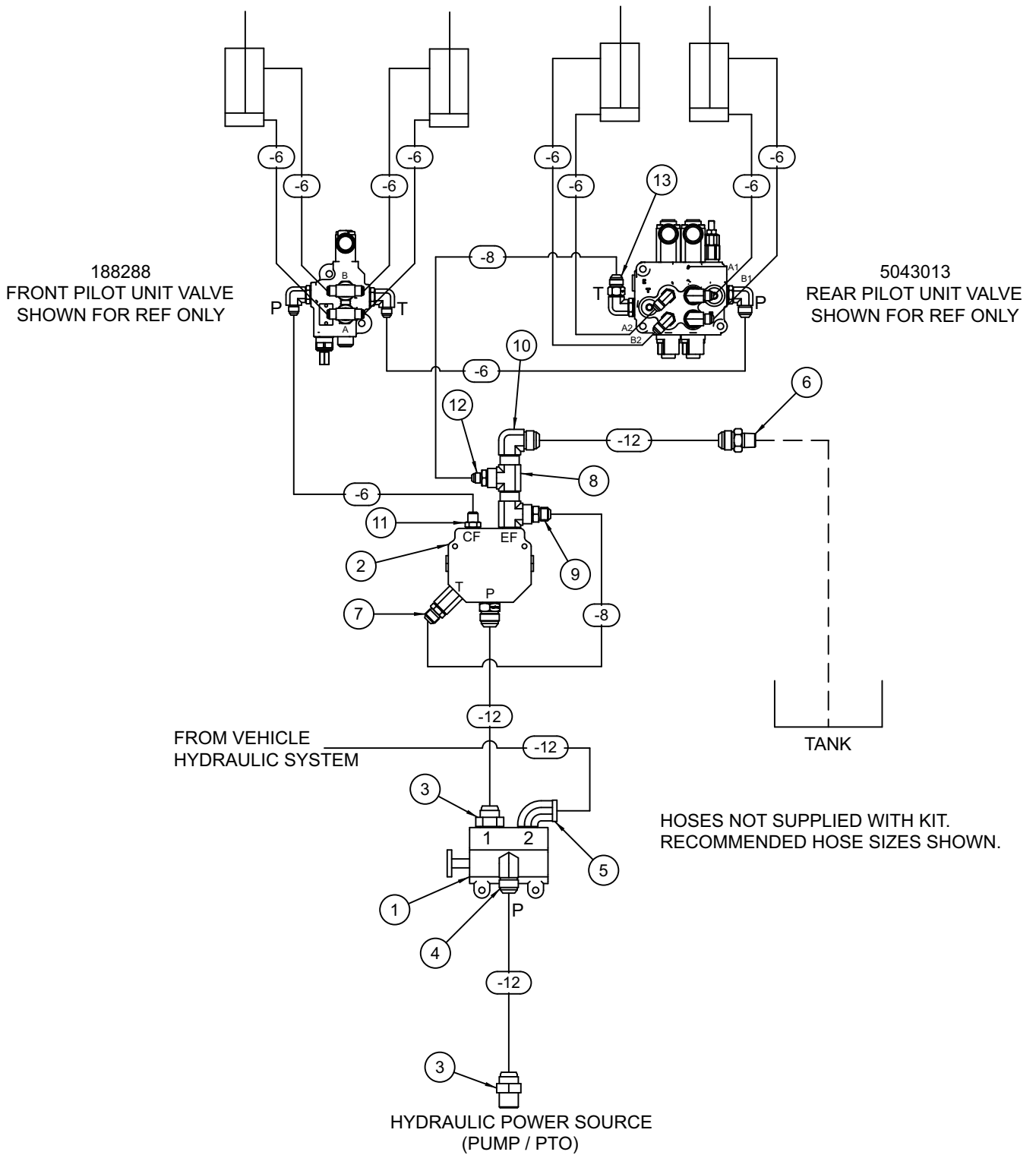
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5022421 Air Brake Control System - Front And Rear Units

ITEM	PART NO	DESCRIPTION	QTY
1	122583	Instruction Plate	1
2	F022420	Relay Valve	2
3	F040304	Adapter, 8 FS x 6 NPT	2
4	F012027	Adapter, 8 x 8 NPT	2
5	F011604	Adapter, 6 NPT x 6 NPT	2
6	F020683	Ball Valve	2
7	F019332	Air Control Valve	1
9	F012055	90° Adapter, 6 NPT x 6 JIC	6
10	F012056	Adapter, 6 JIC x 6 NPT Straight	2
11	5022702	Pressure Protection Valve	2
12	500705000	Air Regulator	2

5065969 Hydraulic System Group - Abbreviated

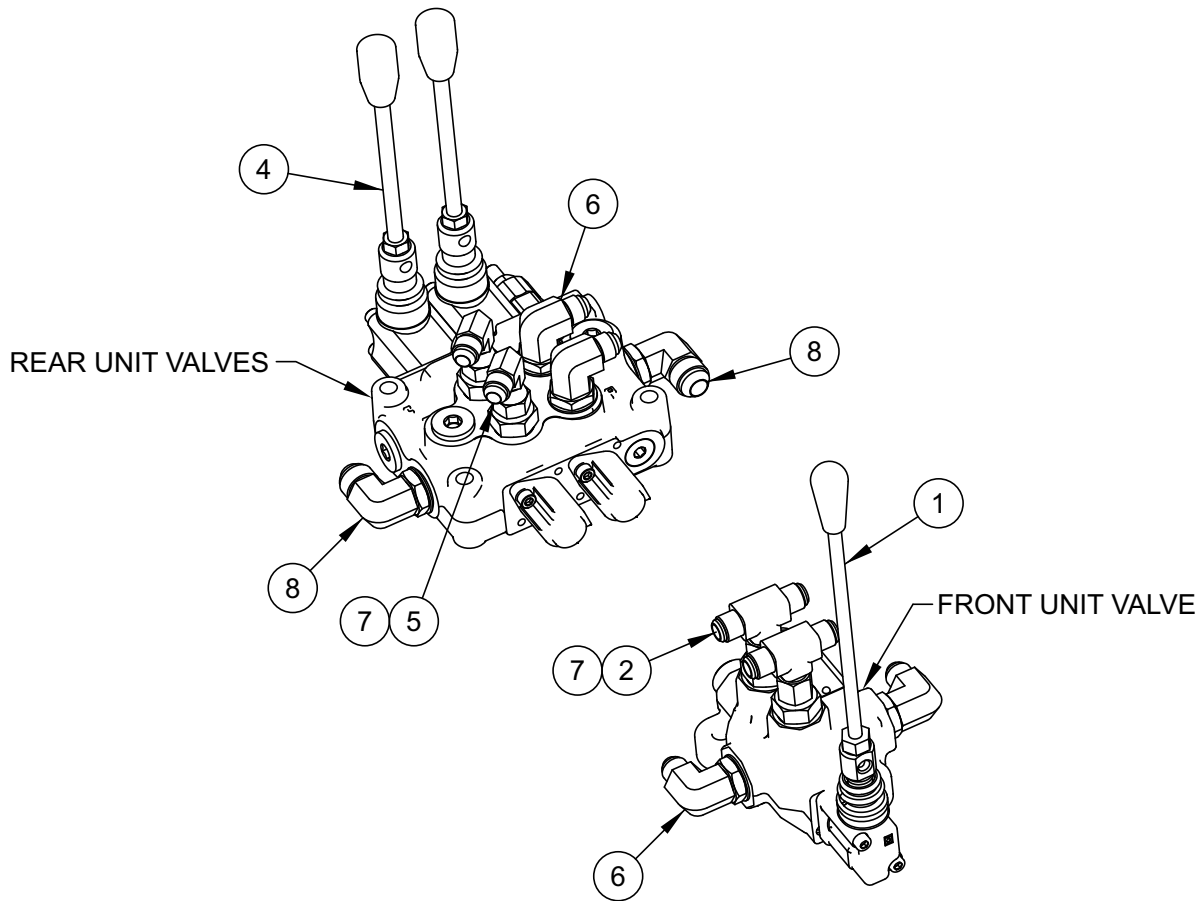


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5065969 Hydraulic System Group - Abbreviated

ITEM	PART NO	DESCRIPTION	QTY
1	F016490	Control Valve	1
2	F018086	Flow Divider	1
3	F010581	Adapter, 12 x 12 NPT STR	2
4	F010586	90° Elbow, 3/4 MP x 3/4 JIC	1
5	F012010	90° Elbow, 12 NPT x 12 FPT	1
6	F013210	Adapter, 12 x 8 NPT STR.	2
7	F011170	Adapter, 8 x 6 NPT STR.	1
8	F010692	Tee, 8 FPT x 8 NPT x 8 FPT	2
9	F012027	Adapter, 8 x 8 NPT STR.	1
10	F010584	90° Elbow, 12 x 8 NPT	1
11	F012056	Adapter, 6 JIC x 6 NPTF STR	1
12	F015959	Adapter, 6 x 8 NPT STR.	1
13	0-3304034-0-16	Adapter, 8 JIC x 6 JIC Swivel.	1

3428304 Hydraulic Valve Group



6

ITEM	PART NO	DESCRIPTION	QTY
1	188288	Control Valve	1
2	F015626	Tee, 6 x 6 x 6 FS	2
4	5043013	Valve	1
5	F012808	90° Elbow, 6 x 6 FS	2
6	F019294	90° Elbow, 6 x 8 SAE	4
7	F013518	Adapter, 6 x 8 SAE	4
8	150167-6	90° Elbow, O-Ring x 8	2

Steering Lock Groups

Individual steering lock components are not available as repair parts. Steering lock groups are sold as complete replacement groups only.

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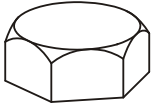
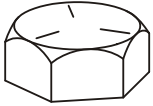
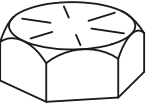


Appendix A

**STANDARD BOLT TORQUE REQUIREMENTS TABLE
STANDARD TYPE FASTENERS**

The torque values listed below are for standard-type fasteners only. The torque values listed are based on wet and (lubricated) dry conditions. The torque values for 1/4 and 5/16 inch size fasteners are listed in lb-in and N-m torque equivalents. The torque values for all other size fasteners are listed lb-ft and N-m torque equivalents. Use lower grade torque values if bolt and nut have different SAE grades. Manufacturer's SAE grade markings may vary.

STANDARD MARKINGS AND TORQUE SPECIFICATIONS

SAE Grade	1 or 2				5				8			
Fastener Standard SAE Grade Markings												
Fastener Body Size Inch-Thread	Torque				Torque				Torque			
	Wet		Dry		Wet		Dry		Wet		Dry	
	lb-in	N-m	lb-in	N-m	lb-in	N-m	lb-in	N-m	lb-in	N-m	lb-in	N-m
1/4 - 20	49	5.5	65	7.3	75	8.5	100	11.3	107	12.0	142	16.0
1/4 - 28	56	6.5	74	8.3	86	9.7	114	12.8	122	13.8	162	18.3
5/16 - 18	103	11.6	137	15.5	157	17.7	208	23.5	220	24.8	293	33.1
5/16 - 24	113	12.7	150	16.9	173	19.5	230	25.9	244	27.5	325	36.7
Fastener Body Size Inch-Thread	Torque				Torque				Torque			
	Wet		Dry		Wet		Dry		Wet		Dry	
	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m
3/8 - 16	15	20	20	27	23	31	31	42	32	43	43	58
3/8 - 24	17	23	23	31	26	35	35	47	37	50	49	66
7/16 - 14	24	32	32	43	37	50	49	66	52	70	69	93
7/16 - 20	27	36	36	49	42	57	56	76	58	78	77	104
1/2 - 13	39	53	52	70	57	77	76	103	80	108	106	144
1/2 - 20	41	55	55	74	64	87	85	115	90	122	120	163
9/16 - 12	53	72	71	96	82	111	109	148	115	156	153	207
9/16 - 18	59	80	78	106	91	123	121	164	129	175	172	233
5/8 - 11	73	99	97	131	113	155	150	203	160	217	213	289
5/8 - 18	83	112	110	149	128	173	170	230	180	244	239	324
3/4 - 10	129	175	172	233	200	271	266	361	282	382	375	508
3/4 - 16	144	195	192	260	223	302	297	403	315	427	419	568
7/8 - 9	124	168	165	224	323	438	430	583	454	615	604	819
7/8 - 14	138	187	184	249	355	481	472	640	501	679	666	903
1 - 8	188	255	250	339	483	655	642	870	681	923	906	1228
1 - 14	210	285	279	378	541	733	720	976	764	1036	1016	1377
1-1/8 - 7	266	361	354	480	596	808	793	1075	966	1310	1285	1742
1-1/8 - 12	297	403	395	535	668	906	888	1204	1083	1468	1440	1952
1-1/4 - 7	375	508	499	676	841	1140	1119	1517	1363	1848	1813	2458
1-1/4 - 12	415	563	552	748	930	1261	1237	1677	1509	2046	2007	2721
1-3/8 - 6	492	667	654	887	1102	1494	1466	1988	1787	2423	2377	3223
1-3/8 - 12	560	759	745	1010	1255	1701	1670	2264	2034	2758	2705	3667
1-1/2 - 6	653	885	868	1177	1463	1983	1946	2638	2371	3215	3153	4275
1-1/2 - 12	734	995	976	1323	1645	2230	2188	2966	2668	3617	3548	4810

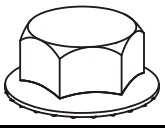

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Appendix A

**STANDARD BOLT TORQUE REQUIREMENTS TABLE
SERRATED TYPE FLANGE FASTENERS**

The torque values listed below are for serrated-type flange fasteners only. The torque values listed are based on wet (lubricated) and dry conditions. The torque values for all other size fasteners are listed in lb-ft and N-m torque equivalents. Use lower grade torque values if bolt and nut have different SAE grades. Manufacturer's SAE grade markings may vary.

STANDARD MARKINGS AND TORQUE SPECIFICATIONS

SAE Grade	1 or 2				5			
Fastener Standard SAE Grade Markings								
Fastener Body Size Inch-Thread	Torque				Torque			
	Wet		Dry		Wet		Dry	
	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m
1/4 - 20	8	10.8	11	14.9	11	14.9	15	20.3
1/4 - 28	9	12.2	12	16.3	12	16.3	16	21.7
5/16 - 18	13	17.6	17	23.0	20	27.1	27	36.6
5/16 - 24	13	17.6	17	23.0	32	43.3	43	58.3
3/8 - 16	23	31	31	42	40	54	53	72
3/8 - 24	25	34	33	45	43	58	57	77
7/16 - 14	38	51	51	69	55	74	73	99
7/16 - 20	40	54	53	72	60	81	80	108
1/2 - 13	60	81	80	108	95	129	127	172
1/2 - 20	65	88	87	118	100	135	133	180
9/16 - 12	78	106	104	141	140	190	187	253
9/16 - 18	85	115	113	153	150	203	200	271
5/8 - 11	125	169	167	226	190	258	253	343
5/8 - 18	135	183	180	244	220	298	293	397
3/4 - 10	225	305	300	407	350	474	467	633
3/4 - 16	250	339	333	451	400	542	533	723
7/8 - 9	350	474	467	633	550	746	733	994
7/8 - 14	375	508	500	678	600	813	800	1085
1 - 8	480	651	640	868	750	1017	1000	1356
1 - 14	500	678	666	903	800	1085	1066	1445







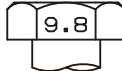


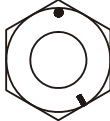
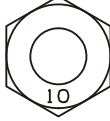


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Appendix A

**BOLT TORQUE REQUIREMENTS TABLE
METRIC TYPE FASTENERS**

Do not use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically. Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original. Make sure fastener's threads are clean and that thread engagement is properly started. This will help prevent them from failing when tightening.

* Lubricated means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. Dry means plain or zinc plated without any lubrication.

Property Class and Head Markings	4.8				8.8		9.8	
								
Property Class and Head Markings	5			10				
								
Size	Class 4.8				Class 8.8 or 9.8			
	* Lubricated		* Dry		* Lubricated		* Dry	
	N - m	lb - ft	N - m	lb - ft	N - m	lb - ft	N - m	lb - ft
M 6	4.8	3.5	6	4.5	9	6.5	11	8.5
M 8	12	8.5	15	11	22	16	28	20
M10	23	17	29	21	43	32	55	40
M12	40	29	50	37	75	55	95	70
M14	63	47	80	60	120	88	150	110
M16	100	73	125	92	190	140	240	175
M18	135	100	175	125	260	195	330	250
M20	190	140	240	180	375	275	475	350
M22	260	190	330	250	510	375	650	475
M24	330	250	425	310	650	475	825	600
M27	490	360	625	450	950	700	1200	875
M30	675	490	850	625	1300	950	1650	1200
M33	900	675	1150	850	1750	1300	2200	1650
M36	1150	850	1450	1075	2250	1650	2850	2100

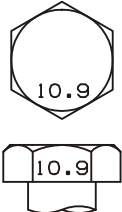
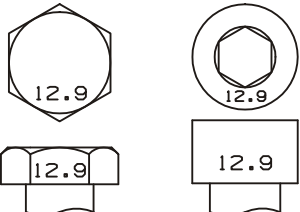
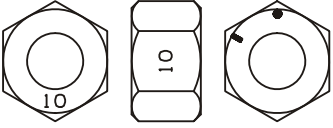
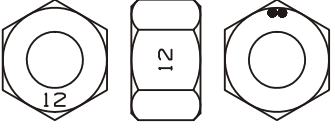
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Appendix A

**BOLT TORQUE REQUIREMENTS TABLE
METRIC TYPE FASTENERS**

Do not use these values if a different torque value or tightening procedure is given for a specific application. Torque values listed are for general use only. Check tightness of fasteners periodically. Fasteners should be replaced with the same or higher property class. If higher property class fasteners are used, these should only be tightened to the strength of the original. Make sure fastener's threads are clean and that thread engagement is properly started. This will help prevent them from failing when tightening.

* Lubricated means coated with a lubricant such as engine oil, or fasteners with phosphate and oil coatings. Dry means plain or zinc plated without any lubrication.

Property Class and Head Markings	10.9				12.9			
								
Property Class and Head Markings	10				12			
								
Size	Class 10.9				Class 12.9			
	* Lubricated		* Dry		* Lubricated		* Dry	
	N - m	lb - ft	N - m	lb - ft	N - m	lb - ft	N - m	lb - ft
M 6	13	9.5	17	12	15	11.5	19	14.5
M 8	32	24	40	30	37	28	47	35
M10	63	47	80	60	75	55	95	70
M12	110	80	140	105	130	95	165	120
M14	175	130	225	165	205	150	260	190
M16	275	200	350	255	320	240	400	300
M18	375	275	475	350	440	325	560	410
M20	530	400	675	500	625	460	800	580
M22	725	540	925	675	850	625	1075	800
M24	925	675	1150	850	1075	800	1350	1000
M27	1350	1000	1700	1250	1600	1150	2000	1500
M30	1850	1350	2300	1700	2150	1600	2700	2000
M33	2500	1850	3150	2350	2900	2150	3700	2750
M36	3200	2350	4050	3000	3750	2750	4750	3500

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Appendix A

RECOMMENDED HYDRAULIC FITTING ASSEMBLY TORQUE

Straight Thread O-Ring Boss Low Pressure with 37° (SAEJ514)				Straight Thread O-Ring Boss High Pressure with O-Ring Seal (ORS) (J1453)			
Dash Size	Thread Size (inches)	Jam Nut or Straight Fitting Torque		Dash Size	Thread Size (inches)	Jam Nut or Straight Fitting Torque	
		lb-ft	N-m			lb-ft	N-m
-03	3/8-24	8-9	12-13	-03	3/8-24	8-10	11-13
-04	7/16-20	13-15	18-20	-04	7/16-20	14-16	20-22
-05	1/2-20	14-15	19-21	-05	1/2-20	18-20	24-27
-06	9/16-18	23-24	32-33	-06	9/16-18	24-26	33-35
-08	3/4-16	40-43	55-57	-08	3/4-16	50-60	68-78
-10	7/8-14	43-48	59-64	-10	7/8-14	72-80	98-110
-12	1-1/16-12	68-75	93-101	-12	1-1/16-12	125-135	170-183
-14	1-3/16-12	83-90	113-122	-14	1-3/16-12	160-180	215-245
-16	1-5/16-12	112-123	152-166	-16	1-5/16-12	200-220	270-300
-20	1-5/8-12	146-161	198-218	-20	1-5/8-12	210-280	285-380
-24	1-7/8-12	154-170	209-230	-24	1-7/8-12	270-360	370-490
-32	2-1/2-12	218-240	296-325				

O-Ring Seal (ORS)				SAE 37° (JIC)			
Dash Size	Thread Size (inches)	Swivel Nut		Dash Size	Thread Size (inches)	Swivel Nut	
		lb-ft	N-m			lb-ft	N-m
-04	9/16-18	10-12	14-16	-04	7/16-20	11-12	15-16
-06	11/16-16	18-20	24-27	-05	1/2-20	15-16	20-22
-08	13/16-16	32-35	43-47	-06	9/16-18	18-20	24-28
-10	1-14	46-50	62-68	-08	3/4-16	38-42	52-58
-12	1-3/16-12	65-70	88-95	-10	7/8-14	57-62	77-85
-16	1-7/16-12	92-100	125-136	-12	1-1/16-12	79-87	108-119
-20	1-11/16-12	125-140	170-190	-16	1-5/16-12	108-113	148-154
-24	2-12	150-165	204-224	-20	1-5/8-12	127-133	173-182
				-24	1-7/8-12	158-167	216-227
				-32	2-1/2-12	245-258	334-352

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Metric			British Standard Pipe Parallel (BSPP)		
Thread Size	Straight Adapter or Locknut Torque		Thread Size	Straight Adapter or Locknut Torque	
mm	lb-ft	N-m	Inches **	lb-ft	N-m
M10 x 1	13-15	18-20	G 1/8-28	13-15	18-20
M12 x 1.5	15-19	20-25	G 1/4-19	19-23	25-30
M14 x 1.5	19-23	25-30	G 3/8-19	33-40	45-55
M16 x 1.5	33-40	45-55	G 1/2-14	55-70	75-95
M18 x 1.5	37-44	50-60	G 3/4-14	103-118	140-160
M20 x 1.5	52-66	70-90	G 1-11	162-184	220-250
M22 x 1.5	55-70	75-95	G 1-1/4-11	170-192	230-260
M26 x 1.5	81-96	110-130	G 1-1/2-11	258-347	350-470
M27 x 2	96-111	130-150			
M33 x 2	162-184	220-250			
M42 x 2	170-192	230-260			
M48 x 2	258-347	350-470			

** "G" denotes parallel threads, other than ISO 6149 (Port connection only)

Appendix A

INCH TO MILLIMETER CONVERSION TABLE
1 INCH = 25.4 MILLIMETERS

FRACTIONS	DECIMALS	MILLIMETERS	FRACTIONS	DECIMALS	MILLIMETERS
1/64	.016	0.397	33/64	.516	13.097
1/32	.031	0.794	17/32	.531	13.494
3/64	.047	1.191	35/64	.547	13.891
1/16	.063	1.588	9/16	.563	14.288
5/64	.078	1.984	37/64	.578	14.684
3/32	.094	2.381	19/32	.594	15.081
7/64	.109	2.778	39/64	.609	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.141	3.572	41/64	.641	16.272
5/32	.156	3.969	21/32	.656	16.669
11/64	.172	4.366	43/64	.672	17.066
3/16	.188	4.763	11/16	.688	17.463
13/64	.203	5.159	45/64	.703	17.859
7/32	.219	5.556	23/32	.719	18.256
15/64	.234	5.953	47/64	.734	18.653
1/4	.250	6.350	3/4	.750	19.050
17/64	.266	6.747	49/64	.766	19.447
9/32	.281	7.144	25/32	.781	19.844
19/64	.297	7.541	51/64	.797	20.241
5/16	.313	7.938	13/16	.813	20.638
21/64	.328	8.334	53/64	.828	21.034
11/32	.344	8.731	27/32	.844	21.431
23/64	.359	9.128	55/64	.859	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.391	9.922	57/64	.891	22.622
13/32	.406	10.319	29/32	.906	23.019
27/64	.422	10.716	59/64	.922	23.416
7/16	.438	11.113	15/16	.938	23.813
29/64	.453	11.509	61/64	.953	24.209
15/32	.469	11.906	31/32	.969	24.606
31/64	.484	12.303	63/64	.984	25.003
1/2	.500	12.700	1	1.000	25.400

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FEET TO METERS CONVERSION TABLE
1 FOOT = 0.3048 METER

FEET	METERS	FEET	METERS	FEET	METERS	FEET	METERS	FEET	METERS
100	30.480	10	3.048	1	0.305	0.1	0.030	0.01	0.003
200	60.960	20	6.096	2	0.610	0.2	0.061	0.02	0.006
300	91.440	30	9.144	3	0.914	0.3	0.091	0.03	0.009
400	121.920	40	12.192	4	1.219	0.4	0.122	0.04	0.012
500	152.400	50	15.240	5	1.524	0.5	0.152	0.05	0.015
600	182.880	60	18.288	6	1.829	0.6	0.183	0.06	0.018
700	213.360	70	21.336	7	2.134	0.7	0.213	0.07	0.021
800	243.840	80	24.384	8	2.438	0.8	0.244	0.08	0.024
900	274.320	90	27.432	9	2.743	0.9	0.274	0.09	0.027
1,000	304.800	100	30.480	10	3.048	1.0	0.305	0.10	0.030

Appendix A

POUNDS TO KILOGRAMS CONVERSION TABLE
1 POUND = 0.4536 KILOGRAM

LB	KG	LB	KG	LB	KG	LB	KG	LB	KG
1,000	453.59	100	45.36	10	4.54	1	0.45	0.1	0.05
2,000	907.18	200	90.72	20	9.07	2	0.91	0.2	0.09
3,000	1,360.78	300	136.08	30	13.61	3	1.36	0.3	0.14
4,000	1,814.37	400	181.44	40	18.14	4	1.81	0.4	0.18
5,000	2,267.96	500	226.80	50	22.68	5	2.27	0.5	0.23
6,000	2,721.55	600	272.16	60	27.22	6	2.72	0.6	0.27
7,000	3,175.15	700	317.51	70	31.75	7	3.18	0.7	0.32
8,000	3,628.74	800	362.87	80	36.29	8	3.63	0.8	0.36
9,000	4,082.33	900	408.23	90	40.82	9	4.08	0.9	0.41
10,000	4,535.92	1,000	453.59	100	45.36	10	4.54	1.0	0.45

POUNDS PER SQUARE INCH TO BAR CONVERSION TABLE
1 PSI = 0.06895 BAR

PSI	BAR	PSI	BAR	PSI	BAR	PSI	BAR
1,000	68.95	100	6.90	10	0.69	1	0.07
2,000	137.90	200	13.79	20	1.38	2	0.14
3,000	206.84	300	20.68	30	2.07	3	0.21
4,000	275.80	400	27.58	40	2.76	4	0.28
5,000	344.70	500	34.47	50	3.45	5	0.35
6,000	413.64	600	41.36	60	4.14	6	0.41
7,000	482.58	700	48.26	70	4.83	7	0.48
8,000	551.52	800	55.15	80	5.52	8	0.55
9,000	620.46	900	62.05	90	6.21	9	0.62
10,000	689.48	1,000	68.95	100	6.90	10	0.69



POUNDS PER SQUARE INCH TO KILOPASCALS CONVERSION TABLE
1 PSI = 6.895 kPa

PSI	kPa	PSI	kPa
10	68.95	1	6.90
20	137.90	2	13.79
30	206.84	3	20.68
40	275.80	4	27.58
50	344.70	5	34.47
60	413.64	6	41.36
70	482.58	7	48.26
80	551.52	8	55.15
90	620.46	9	62.05
100	689.48	10	68.95

Appendix A

FAHRENHEIT TO CELSIUS (Centigrade) CONVERSION TABLE
(DEGREES F - 32°) ÷ 1.8 = DEGREES C

deg F	deg C	deg F	deg C	deg F	deg C	deg F	deg C
1	-17.2	51	10.6	101	38.3	151	66.1
2	-16.7	52	11.1	102	38.9	152	66.7
3	-16.1	53	11.7	103	39.4	153	67.2
4	-15.6	54	12.2	104	40.0	154	67.8
5	-15.0	55	12.8	105	40.6	155	68.3
6	-14.4	56	13.3	106	41.1	156	68.9
7	-13.9	57	13.9	107	41.7	157	69.4
8	-13.3	58	14.4	108	42.2	158	70.0
9	-12.8	59	15.0	109	42.8	159	70.6
10	-12.2	60	15.6	110	43.3	160	71.1
11	-11.7	61	16.1	111	43.9	161	71.7
12	-11.1	62	16.7	112	44.4	162	72.2
13	-10.6	63	17.2	113	45.0	163	72.8
14	-10.0	64	17.8	114	45.6	164	73.3
15	-9.4	65	18.3	115	46.1	165	73.9
16	-8.9	66	18.9	116	46.7	166	74.4
17	-8.3	67	19.4	117	47.2	167	75.0
18	-7.8	68	20.0	118	47.8	168	75.6
19	-7.2	69	20.6	119	48.3	169	76.1
20	-6.7	70	21.1	120	48.9	170	76.7
21	-6.1	71	21.7	121	49.4	171	77.2
22	-5.6	72	22.2	122	50.0	172	77.8
23	-5.0	73	22.8	123	50.6	173	78.3
24	-4.4	74	23.3	124	51.1	174	78.9
25	-3.9	75	23.9	125	51.7	175	79.4
26	-3.3	76	24.4	126	52.2	176	80.0
27	-2.8	77	25.0	127	52.8	177	80.6
28	-2.2	78	25.6	128	53.3	178	81.1
29	-1.7	79	26.1	129	53.9	179	81.7
30	-1.1	80	26.7	130	54.4	180	82.2
31	-0.6	81	27.2	131	55.0	181	82.8
32	0.0	82	27.8	132	55.6	182	83.3
33	0.6	83	28.3	133	56.1	183	83.9
34	1.1	84	28.9	134	56.7	184	84.4
35	1.7	85	29.4	135	57.2	185	85.0
36	2.2	86	30.0	136	57.8	186	85.6
37	2.7	87	30.6	137	58.3	187	86.1
38	3.3	88	31.1	138	58.9	188	86.7
39	3.9	89	31.7	139	59.4	189	87.2
40	4.4	90	32.2	140	60.0	190	87.8
41	5.0	91	32.8	141	60.6	191	88.3
42	5.6	92	33.3	142	61.1	192	88.9
43	6.1	93	33.9	143	61.7	193	89.4
44	6.7	94	34.4	144	62.2	194	90.0
45	7.2	95	35.0	145	62.8	195	90.6
46	7.8	96	35.6	146	63.3	196	91.1
47	8.3	97	36.1	147	63.9	197	91.7
48	8.9	98	36.7	148	64.4	198	92.2
49	9.4	99	37.2	149	65.0	199	92.8
50	10.0	100	37.8	150	65.5	200	93.3

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Appendix A

MILES PER HOUR TO KILOMETERS
PER HOUR CONVERSION TABLE
1 MPH = 1.609 KM/H

MPH	KM/H	MPH	KM/H	MPH	KM/H
10	16.09	1	1.61	0.1	0.16
20	32.19	2	3.22	0.2	0.32
30	48.28	3	4.83	.03	0.48
40	64.37	4	6.44	0.4	0.64
50	80.47	5	8.05	0.5	0.80
60	96.56	6	9.66	0.6	0.97
70	112.65	7	11.27	0.7	1.13
80	128.75	8	12.87	0.8	1.29
90	144.84	9	14.48	0.9	1.45
100	160.93	10	16.09	1.0	1.61

U.S. GALLONS TO LITERS CONVERSION TABLE
1 U.S. GALLON = 3.785 LITERS

GAL	LITER	GAL	LITER	GAL	LITER	GAL	LITER
100	378.54	10	37.85	1	3.79	0.1	0.38
200	757.08	20	75.71	2	7.57	0.2	0.76
300	1,135.62	30	113.56	3	11.36	0.3	1.14
400	1,514.16	40	151.42	4	15.14	0.4	1.51
500	1,892.71	50	189.27	5	18.93	0.5	1.89
600	2,271.25	60	227.12	6	22.71	0.6	2.27
700	2,649.79	70	264.98	7	26.50	0.7	2.65
800	3,028.33	80	302.83	8	30.28	0.8	3.03
900	3,406.87	90	340.69	9	34.07	0.9	3.41
1,000	3,785.41	100	378.54	10	37.85	1.0	3.79

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APPENDIX RR - REVISION RECORD

CHANGE	REV	REVISION DESCRIPTION	BY	DATE
EC600779	A	NEW RELEASE	BJG	5-2016



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