

HTT

Harsco Track Technologies

Harsco

**HR18 SERIES A1
HR18 SERIES A1-1
UNIVERSAL HY-RAIL®
GUIDE WHEEL EQUIPMENT
HYDRAULICALLY OPERATED**

**OPERATOR'S SERVICE
AND PARTS MANUAL**

ISSUED 10 - 2006

BULLETIN 1220B

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■ **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 Track Technologies, Harsco Corporation.

When this manual is received, record the rail pilot 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 Track Technologies, Harsco Corporation.

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

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1.1 Safety Information



SAFETY IS A CRITICAL FACTOR IN THE DESIGN OF HARSCO TRACK TECHNOLOGIES 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.

1.1.1 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.

1.1 Safety Information

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- **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 35 MPH (56 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



1.1 Safety Information

- **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 REAR GUIDE WHEEL UNIT GUIDE WHEEL 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. HR18A1 GUIDE WHEEL UNIT RATED LOAD CAPACITY:
 - 6,000 lbs (2722 kg)
 - 3,000 lbs (1361 kg) maximum per guide wheel
- HR18A1-1 GUIDE WHEEL UNIT RATED LOAD CAPACITY:
7,000 lbs (3175 kg)
3,500 lbs (1588 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.

1.2 Description

The HR18 Series A1 and HR18 Series A1-1 HY-RAIL® guide wheel equipment can be applied to the front of various standard utility vehicles, cab chassis and pickup trucks. 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 Track Technologies. For information regarding special applications, contact Harsco Track Technologies, Harsco Corporation, Fairmont, Minnesota.

The guide wheels are 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 onto the vehicle frame. When the unit is in the "highway" position, the weight of the unit is carried on the vehicle frame. When the vehicle is placed in the "rail" position, load bearing guide wheel assemblies guide the vehicle on the track. Depending on the vehicle type, different mechanisms are used to hold the vehicle's front tires above the rail surface to ensure that the tires do not come into contact with the rails while the vehicle is propelling through crossings, switches, etc. A steering lock assembly is manually actuated, 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.

The vehicle's rear wheels provide propulsion for on track operation. On track braking is provided by the vehicle's rear brakes. To provide additional braking force, the front and rear guide wheel units may be equipped with optional air actuated tread-type composition brake shoes.

1.3 Vehicle Orientation

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

1.4 Serial Numbers

When this bulletin is received, complete the following record from the serial number tag on the front 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 1-2
FRONT GUIDE WHEEL UNIT SERIAL NUMBER TAG

HTT Harsco Track Technologies™ a harsco company		PATENT NUMBER <input type="text"/>
WHEN ORDERING PARTS FOR THIS ACCESSORY ALWAYS GIVE THE FOLLOWING INFORMATION		
Fairmont ™ HY-RAIL® GUIDE WHEEL EQUIPMENT	SERIAL NUMBER	SYMBOL
	<input type="text"/>	<input type="text"/>
		MODEL NUMBER <input type="text"/>
FAIRMONT, MN. 56031 U.S.A.		
52400K		

1

1.5 Specifications

1.5.1 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 Track Technologies. For information regarding special applications, contact Harsco Track Technologies, Harsco Corporation, Fairmont, Minnesota.

1.5.2 HR18A1 Guide Wheel Unit

Track Gauge	56-1/2 in	(1435 mm)
Guide Wheels - Flange Diameter	13-1/4 in	(337 mm)
- Tread Diameter	11 in	(280 mm)
Weight	390 lbs	(177 kg)
Maximum Load Capacity - Front Unit	6,000 lbs	(2722 kg)
(With vehicle at curb weight)		
Maximum Load Per Guide Wheel	3,000 lbs	(1361 kg)
(With vehicle at curb weight)		

1.5.3 HR18A1-1 Guide Wheel Unit

Track Gauge	56-1/2 in	(1435 mm)
Guide Wheels - Flange Diameter	13-1/4 in	(337 mm)
- Tread Diameter	11 in	(280 mm)
Weight	463 lbs	(210 kg)
Maximum Load Capacity - Front Unit	7,000 lbs	(3175 kg)
(With vehicle at curb weight)		
Maximum Load Per Guide Wheel	3,500 lbs	(1588 kg)
(With vehicle at curb weight)		

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NOTES

Horizontal lines for taking notes.

2.1 Speedometer



- **WHEN WHEEL/TIRE MODIFICATIONS ARE APPLIED, CHECK AND CHANGE SPEEDOMETER DRIVE RATIO IF NECESSARY. THE SPEEDOMETER DRIVE RATIO WILL INFLUENCE THE OPERATION OF THE VEHICLE'S ANTI-LOCK BRAKE SYSTEMS, ELECTRONICALLY CONTROLLED TRANSMISSION SHIFT TIMING AND SPEEDOMETER DISPLAY OF THE TRUE VEHICLE SPEED. FAILURE TO MAINTAIN CORRECT SPEEDOMETER DRIVE RATIO COULD RESULT IN SEVERE BODILY INJURY.**

2

Some vehicles require special larger diameter wheels and/or wheel spacers to properly space the vehicle tires for on track operation. Use of these wheel modifications may effect the speedometer drive ratio calibration. The speedometer drive ratio will influence the operation of the vehicle's anti-lock brake systems, electronically controlled transmission shift timing and speedometer display of the true vehicle speed. The vehicle speedometer must be re-calibrated when wheel modifications are applied to the vehicle. See the vehicle manufacturer or dealer for speedometer calibration information.

2.2 Preparing Vehicle For Operation

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

- a. Engine oil level.
- b. Radiator fluid level.
- c. Fuel tank level.
- d. Hydraulic reservoir level.
- e. Brakes work properly.
- f. Parking brake works properly.
- g. Head, brake and signal lights work properly.
- h. Tires properly inflated to 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.
- j. 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 USER'S GUIDE TO WHEELS AND RIMS produced by THE MAINTENANCE COUNCIL. To obtain this guide, contact:

THE MAINTENANCE COUNCIL
AMERICAN TRUCKING ASSOCIATION
2200 MILL ROAD
ALEXANDRIA, VA. 22314
Phone: (703) 838-1763

- k. Any other normal maintenance requirements.

2.3 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. Proper alignment and guide wheel loads.
- d. Proper lubrication at recommended operating hourly intervals.
- e. Hydraulic pressure properly adjusted.

2

2.4 Misalignment Indicators



■ **BEFORE OPERATING A VEHICLE WITH NEWLY INSTALLED GUIDE WHEEL EQUIPMENT ON TRACK, VERIFY THAT 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 Section - Guide Wheel Alignment Procedure.

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

2.5 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 PINS.
 - ALL RAIL GUIDE WHEEL FLANGES ARE ENGAGED ON THE INSIDE OF THE RAIL.
 - AXLE LOCKS ARE ENGAGED, HOLDING THE VEHICLE FRONT TIRES A MINIMUM OF 1-1/2" (38 mm) ABOVE THE RAIL.
 - THE FRONT WHEELS ARE POINTED STRAIGHT AHEAD AND THE STEERING WHEEL LOCK IS ENGAGED.
 - OPTIONAL BRAKES: 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 GUIDE WHEEL EQUIPMENT, DO NOT EXCEED HYDRAULIC SYSTEM FLOW OF 8 GPM. EXCESSIVE FLOW 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.

2.5 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. Start the auxiliary hydraulic power source or engage the mechanical PTO hydraulic pump. 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 wheels with the rails. See the Operator's Service And Parts Manual provided with the rear guide wheel unit for information on lowering the rear guide wheels.

2.5.1 Engaging Mechanical Axle Hooks - See Figures 2-1 and 2-2

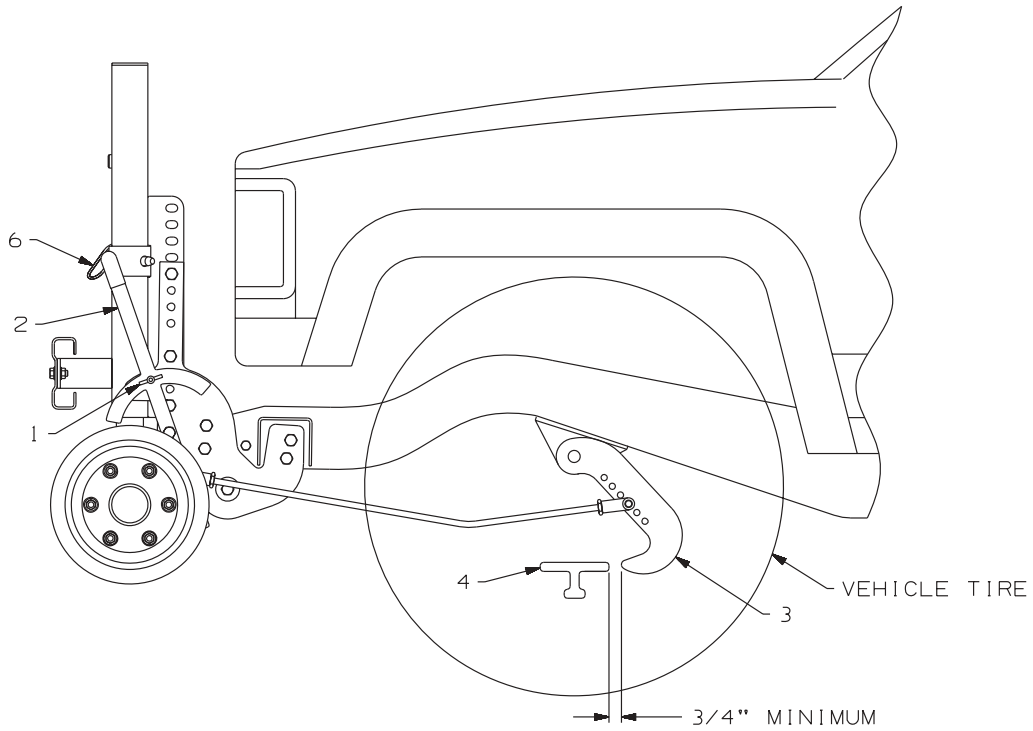
1. Remove lock pin (1). Button in "T" end of lock pin must be pushed in to remove pin. Push lever (2) towards the vehicle to engage axle hook (3) under the front axle (4).
2. Install lock pin (1) to secure lever (2) which will hold the axle hook under the axle. Button in "T" end of lock pin must be pushed in to install pin.
3. Repeat the procedure to engage the axle hook on the opposite side of the vehicle. Ensure that both axle hooks are fully engaged under the vehicle's axle to hold the front tires above the rail when the guide wheels are lowered.

Note: On some vehicle applications the axle hooks may be reversed and will engage under the axle from the front instead of from the rear as illustrated. This will cause the axle hook lock lever to engage and disengage the axle hooks in the opposite direction.

2.5 Placing Vehicle On Track

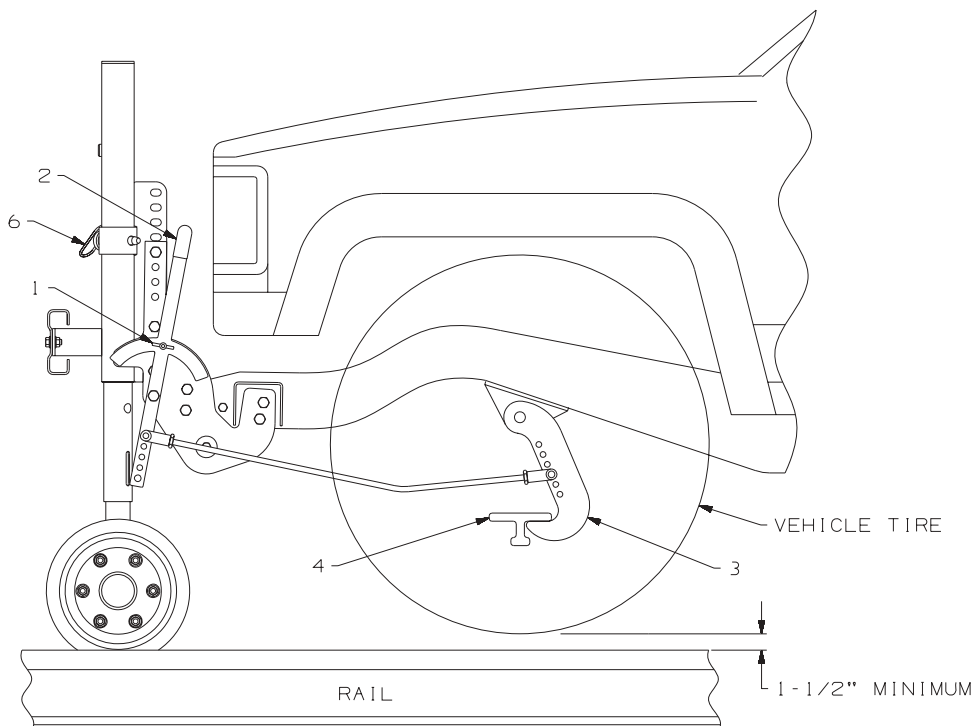
2.5.1 Engaging Mechanical Axle Hooks

FIGURE 2-1
FRONT GUIDE WHEEL UNIT - HIGHWAY POSITION



SE96A160A-1

FIGURE 2-2
FRONT GUIDE WHEEL UNIT - RAIL POSITION



SE96A161A-1

2.5 Placing Vehicle On Track

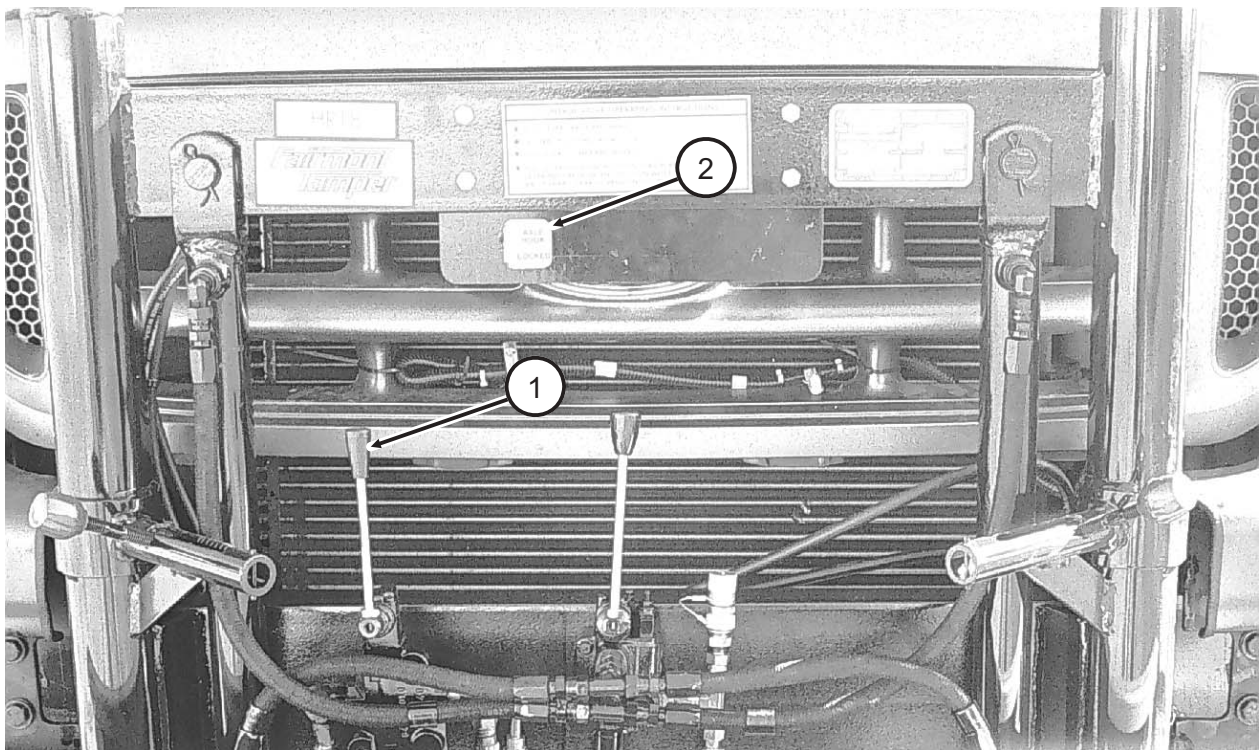
2.5.2 Engaging Hydraulic Axle Locks - See Figure 2-3

Some vehicles may be equipped with hydraulic cylinder / cable assemblies that retract and hold the vehicle front axle above the rail when the vehicle is in the "rail" position.

2

1. Pull control valve handle (1) away from the vehicle. The hydraulic cylinders, located above the front axle, will retract and snug up the cables to hold the front tires above the rail when the guide wheels are lowered. Release the control valve handle. It will return to the neutral position. Make sure the hydraulic cylinders are fully retracted.
2. The indicator plate (2) should indicate that the axle lock is engaged.

FIGURE 2-3
HYDRAULIC AXLE LOCK OPERATION



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2.5.3 Lowering The Front Guide Wheels - See Figure 2-4

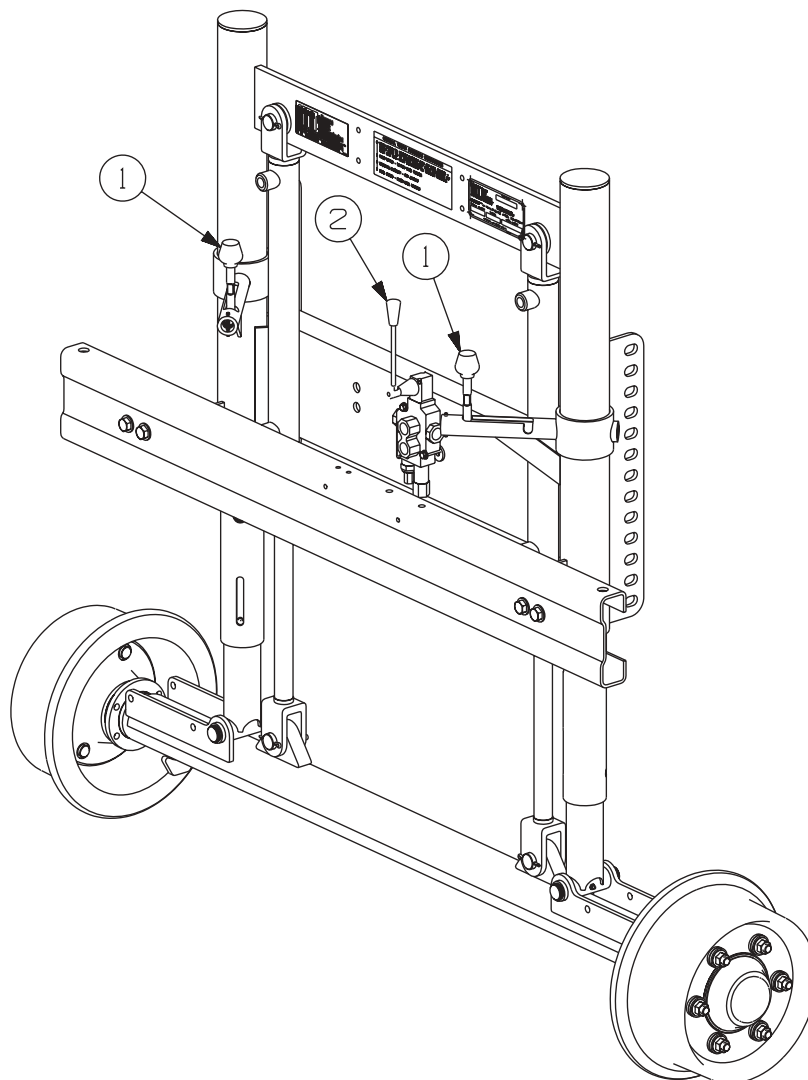
1. Rotate the lock handles (1) up and pull them out to disengage the lock. If necessary, slightly move the control valve handle (2) to raise or lower the guide wheels to release any tension on lock handles (1) so they can be pulled out. After pulling the lock handles out, rotate them further up to secure them in the disengaged position.

2.5 Placing Vehicle On Track

2.5.3 Lowering The Front Guide Wheels - Continued

2. Pull control valve handle (2) away from the vehicle to lower the guide wheels. After the the guide wheels have lowered a few inches, rotate lock handles (1) down to release them from the unlocked position. Continue to lower the guide wheels until the lock pins slide into the upper holes in the spring cell tubes. Release the control valve handle. Push the lock handles fully in and rotate them down to secure them in the engaged position. Be sure the rail guide wheel flanges are engaged on the inside of the rails.
3. Push control valve handle (2) fully rearward to the "detent" position for rail travel. The lever must be in the "detent" position to allow the guide wheel unit suspension to operate properly.

FIGURE 2-4
LOWERING / RAISING THE FRONT GUIDE WHEELS



2.5 Placing Vehicle On Track

1. Stop the auxiliary hydraulic power source or disengage the mechanical PTO hydraulic pump. 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. See Figures 2-5, 2-6, 2-7 and 2-8. 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.

3. 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.

FIGURE 2-5
STEERING LOCK IN UN-LOCK POSITION

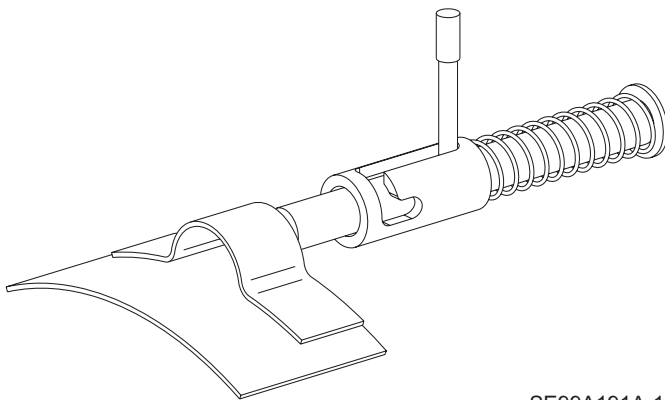


FIGURE 2-6
STEERING LOCK IN
LOCKED POSITION

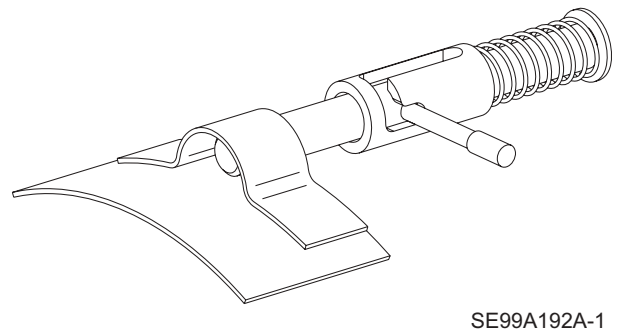


FIGURE 2-7
VELCRO STEERING LOCK OFF

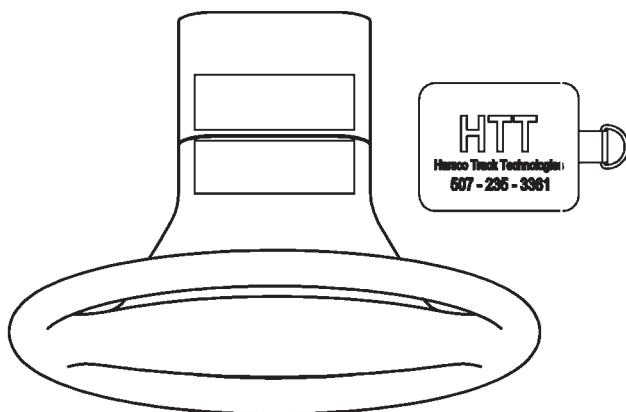
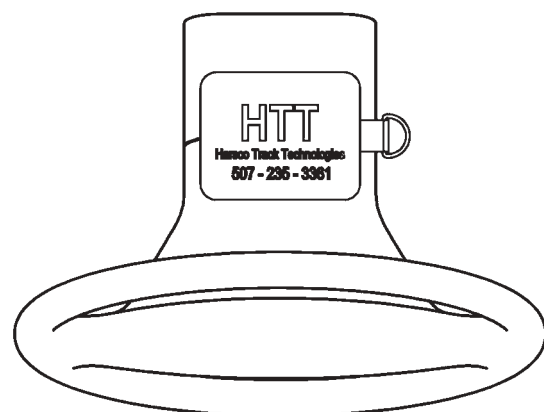


FIGURE 2-8
VELCRO STEERING LOCK ON



2.6 Guide Wheel Load On Track



- **IMPROPER LOADING OF GUIDE WHEEL EQUIPMENT CAN CAUSE DERAILMENT OF VEHICLE.**
- **APPLY VEHICLE PARKING BRAKE AND STOP VEHICLE ENGINE BEFORE CHECKING GUIDE WHEEL LOAD.**
- **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 FRONT GUIDE WHEEL UNIT IS:**
 - **HR18A1: 6,000 LBS (2722 kg) OR 3,000 LBS (1361 kg) MAXIMUM PER GUIDE WHEEL.**
 - **HR18A1-1: 7,000 LBS (3175 kg) OR 3,500 lbs (1588 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.

Whenever the vehicle is loaded or additional load is added to the existing vehicle load on track, check the load on the front guide wheels. The maximum load on the front guide wheel unit is:

- HR18A1: 6,000 lbs (2722 kg) or 3,000 lbs (1361 kg) maximum per guide wheel.
- HR18A1-1: 7,000 lbs (3175 kg) or 3,500 lbs (1588 kg) maximum per guide wheel.

Also, check the load on the rear guide wheel unit. See the Operator's Service And Parts Manual provided with the rear guide wheel unit for information on checking the load on the rear guide wheel unit.

2.6 Guide Wheel Load On Track

2.6.1 Checking Front Guide Wheel Load - See Figures 2-9 and 2-10

To check the load on the front guide wheels it is necessary to measure the deflection of the coil springs in the guide wheel unit's suspension system. Use the following procedure to check the load on the front guide wheels.

2

Note: See Placing Vehicle On Track.

1. Engage the axle hooks or locks on the front axle. Unlock and lower the guide wheels until they are slightly above the rails.
2. On the suspension tube on one side of the guide wheel unit, measure from the bottom of slot (1) to the bottom of roll pin (2). Record this dimension (A). Measure from the bottom of slot (1) to the bottom of roll pin (2) on the other suspension tube on the guide wheel unit. Record this dimension (B).
3. Fully lower and lock the guide wheels in the "rail" position. Make sure the control valve handle is fully forward, in the "detent" position, so the vehicle's front end weight is on the guide wheel unit's suspension system.
4. On the first suspension tube checked, again measure from the bottom of slot (1) to the bottom of roll pin (2). Record this dimension (AA). Measure from the bottom of slot (1) to the bottom of roll pin (2) on the other suspension tube on the guide wheel unit. Record this dimension (BB).
5. To determine the load on the guide wheel, subtract dimension (A) from dimension (AA) to obtain dimension (X), or subtract dimension (B) from dimension (BB) to obtain dimension (X).

Example: $(AA) - (A) = \text{dimension (X)}$. See Charts 2-11 and 2-12 to convert dimension (X) into the approximate load on the guide wheel.

6. If the measured front guide wheel load exceeds the maximum load capacity, the load must be redistributed or some of the load removed. Never operate the vehicle on track if the load on the front guide wheel exceeds the maximum load capacity of:

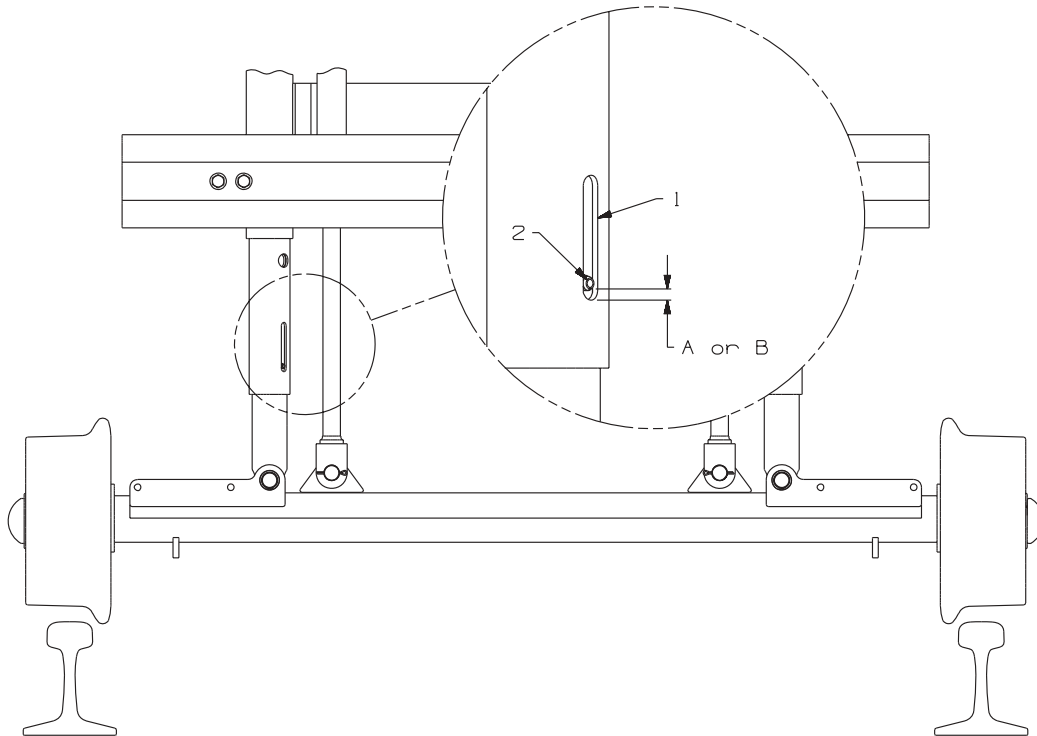
HR18A1: 6,000 lbs (2722 kg) or 3,000 lbs (1361 kg) maximum per guide wheel.

HR18A1-1: 7,000 lbs (3175 kg) or 3,500 lbs (1588 kg) maximum per guide wheel.

2.6 Guide Wheel Load On Track

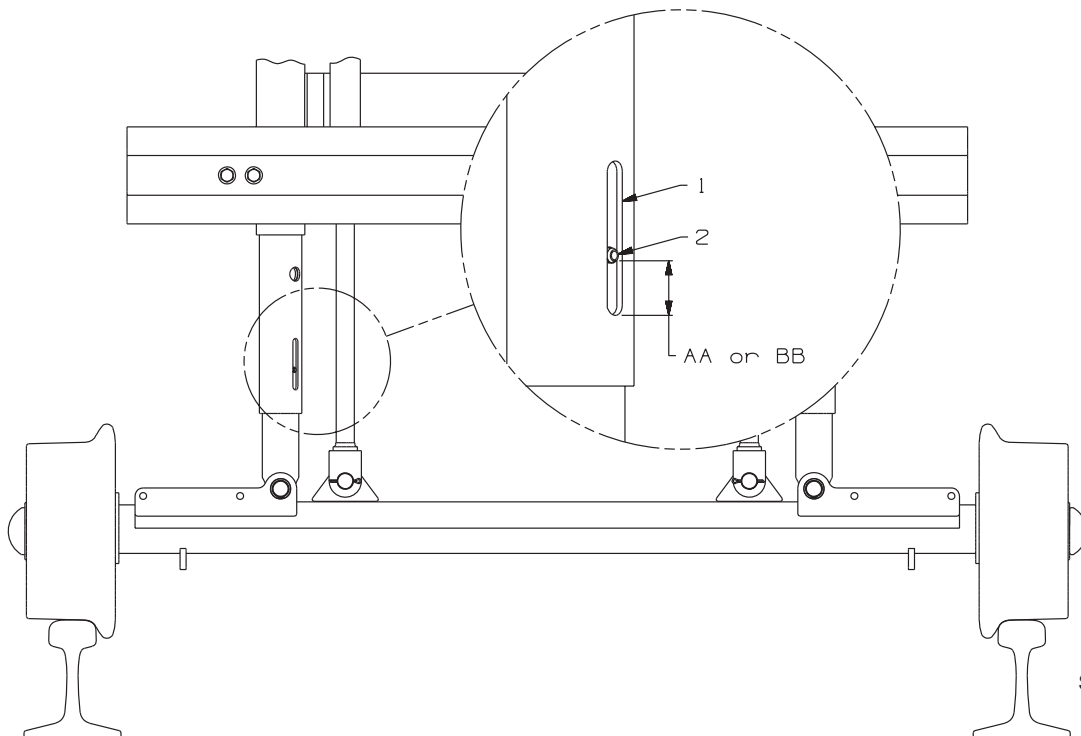
2.6.1 Checking Front Guide Wheel Load

FIGURE 2-9
MEASURING FOR CALCULATING GUIDE WHEEL LOAD



SE96A165A-1

FIGURE 2-10
MEASURING FOR CALCULATING GUIDE WHEEL LOAD



SE96A165A-2

2.6 Guide Wheel Load On Track

2.6.1 Checking Front Guide Wheel Load

CHART 2-11
 HR18A1 FRONT GUIDE WHEEL LOAD

DIMENSION X		APPROXIMATE LOAD PER SIDE	
1/8"	(3.2 mm)	350 lbs	(159 kg)
1/4"	(6.4 mm)	650 lbs	(295 kg)
3/8"	(9.5 mm)	950 lbs	(431 kg)
1/2"	(12.7 mm)	1,250 lbs	(567 kg)
5/8"	(15.9 mm)	1,550 lbs	(703 kg)
3/4"	(19.0 mm)	1,850 lbs	(839 kg)
7/8"	(22.2 mm)	2,150 lbs	(975 kg)
1"	(25.4 mm)	2,450 lbs	(1,111 kg)
1-1/8"	(28.6 mm)	2,750 lbs	(1,248 kg)
* 1-1/4"	(31.8 mm)	3,050 lbs	(1,383 kg)

CHART 2-12
 HR18A1-1 FRONT GUIDE WHEEL LOAD

DIMENSION X		APPROXIMATE LOAD PER SIDE	
1/8"	(3.2 mm)	350 lbs	(159 kg)
1/4"	(6.4 mm)	650 lbs	(295 kg)
3/8"	(9.5 mm)	950 lbs	(431 kg)
1/2"	(12.7 mm)	1,250 lbs	(567 kg)
5/8"	(15.9 mm)	1,550 lbs	(703 kg)
3/4"	(19.0 mm)	1,850 lbs	(839 kg)
7/8"	(22.2 mm)	2,150 lbs	(975 kg)
1"	(25.4 mm)	2,450 lbs	(1,111 kg)
1-1/8"	(28.6 mm)	2,750 lbs	(1,248 kg)
1-1/4"	(31.8 mm)	3,050 lbs	(1,383 kg)
1-3/8"	(34.9 mm)	3,350 lbs	(1,520 kg)
* 1-1/2"	(38.1 mm)	3,650 lbs	(1,656 kg)

* **FRONT GUIDE WHEEL IS OVERLOADED. REDISTRIBUTE OR REMOVE SOME OF THE LOAD.**

2.7 Check Vehicle Front Tire Clearance Above Rail

If the vehicle's front tire clearance above the rail is less than 1-1/2" (38 mm) see Adjustment Section - Vehicle Front Wheel Clearance. Never operate the vehicle on track when the front tire clearance above the rail is less than 1-1/2" (38 mm)

2.8 Propelling On Track



- **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 35 MPH (56 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 HR18 Series A HY-RAIL® Guide Wheel Equipment use the vehicle propulsion system to propel on track. Do not accelerate suddenly. Traction is reduced on rail. Spinning the vehicle tires could damage them.

2.9 Braking On Track



2

- 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.
- 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 HR18 Series A 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.

2.10 Vehicles Equipped With Crane Or Aerial Lift Device



- 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.

2.11 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 RAISE GUIDE WHEEL EQUIPMENT, DO NOT EXCEED HYDRAULIC SYSTEM FLOW OF 8 GPM. EXCESSIVE FLOW 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 removing the vehicle from the 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. 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. 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.

2.11 Removing Vehicle From Track

2.11.1 Raising The Front Guide Wheels - See Figure 2-4

1. Rotate the lock handles (1) up and pull out to disengage the lock. If necessary, slightly move the control valve handle (2) to raise or lower the guide wheels to release any tension on lock handles (1) so they can be pulled out. After pulling the lock handles out, rotate them further up to secure them in the disengaged position.
2. Push control valve handle (2) towards the vehicle to raise the guide wheels. After the the guide wheels have raised a few inches, rotate lock handles (1) down to release them from the unlocked position. Continue to raise the guide wheels until the lock pins slide into the lower holes in the spring cell tubes. Release the control valve handle. Push the lock handles fully in and rotate them down to secure them in the engaged position.

2.11.2 Disengaging Mechanical Axle Hooks - See Figures 2-1 and 2-2

1. Remove lock pin (1). Button in "T" end of lock pin must be pushed in to remove pin. Pull lever (2) away from the vehicle to disengage axle hook (3) from under the front axle (4). Install lock pin (1) to secure lever (2) which will hold the axle hook out from under the axle. Button in "T" end of lock pin must be pushed in to install pin. Repeat the procedure to disengage the axle hook on the opposite side of the vehicle.
2. Ensure that both axle hooks are fully disengaged from under the vehicle's axle and that there is at least 3/4 inch (19 mm) of clearance between the axle hooks and the front axle.

Note: On some vehicle applications the axle hooks may be reversed and will engage under the axle from the front instead of from the rear as illustrated. This will cause the axle hook lock lever to engage and disengage the axle hooks in the opposite direction.

2.11.3 Disengaging Hydraulic Axle Locks - See Figure 2-3

Some vehicles may be equipped with hydraulic cylinder / cable assemblies that retract and hold the vehicle front axle above the rail when the vehicle is in the "rail" position.

1. Push control valve handle (1) towards the vehicle. The hydraulic cylinders, located above the front axle, will extend and remove the tension from the cables that hold the front axle above the rail. Release the control valve handle. It will return to the neutral position. Make sure the hydraulic cylinders are fully extended. If the axle locks are not fully disengaged, damage could occur to hydraulic cylinder / cable assembly when the vehicle is traveling on the highway.
2. The indicator plate (2) should indicate that the axle lock is disengaged.

2.11 Removing Vehicle From Track

1. Raise and lock the rear guide wheels in the "highway" position. See the Operator's Service And Parts Manual provided with the rear guide wheel unit for information on raising the rear guide wheels.
2. Stop the auxiliary hydraulic power source or disengage the mechanical PTO hydraulic pump. 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.
3. 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.

2.12 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 THE VEHICLE OWNER'S MANUAL FOR ADDITIONAL PRECAUTIONS.**

2.13 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 RAIL 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 WHEELS ARE LOWERED AND LOCKED IN RAIL POSITION.
 - ALL RAIL GUIDE WHEEL FLANGES ARE ENGAGED ON INSIDE OF RAILS.
 - FRONT GUIDE WHEEL UNIT AXLE LOCKS MUST BE FULLY ENGAGED HOLDING VEHICLE FRONT TIRES 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 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.

2.13 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 front and rear guide wheel flanges are engaged on the inside of the rails.
 - c. Front guide wheel unit axle locks must be fully engaged holding the vehicle front tires 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 wheel unit rail 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.

2.14 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.
 - FRONT GUIDE WHEEL UNIT AXLE LOCKS MUST BE FULLY DISENGAGED.
 - VEHICLE STEERING WHEEL LOCK DISENGAGED.

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

2.14 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.

2.14 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. Front guide wheel unit axle locks must be fully disengaged.
 - c. 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.

2.15 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 THE RAIL POSITION.
 - ALL RAIL GUIDE WHEEL FLANGES ARE ENGAGED ON INSIDE OF RAILS.
 - FRONT GUIDE WHEEL UNIT AXLE LOCKS MUST BE FULLY ENGAGED HOLDING VEHICLE FRONT TIRES 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.

2.15 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.

2.15 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 rail guide wheel flanges are engaged on the inside of the rails.
 - c. Front guide wheel unit axle locks must be fully engaged holding the vehicle front tires 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.

2.16 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 THE HIGHWAY POSITION.
 - FRONT GUIDE WHEEL UNIT AXLE LOCKS MUST BE FULLY DISENGAGE.
 - 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.

2.16 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 3. Make sure that the disabled vehicle's:
 - a. Front and rear guide wheels are raised and locked in the highway position.
 - b. Front guide wheel unit axle locks must be fully disengaged.
 - c. 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



■ **BEFORE PERFORMING ANY ADJUSTMENTS TO THE GUIDE WHEEL UNITS OR VEHICLE, ALWAYS PLACE THE AUTOMATIC TRANSMISSION IN "PARK" OR THE 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 Procedure must be completed when the guide wheel equipment is applied to the vehicle, or when any of the misalignment indicators occur. See Operation Section -Misalignment Indicators.

See The Operator's Service and Parts Manual provided with the rear guide wheel unit for the proper alignment procedure for the rear 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. Weights will be used when calculating the guide wheel load.
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 by adding leaf springs, coil springs, torsion bars, 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.
7. Verify that the vehicle the guide wheel equipment is being mounted on is equipped correctly (springs, tires, wheels, etc.). See the Harsco Track Technologies HY-RAIL® Vehicle Specifications Manual.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.1 Vehicle Check

8. Check the following measurements on the vehicle that the guide wheel equipment is to be mounted on before applying the guide wheel equipment to 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 Track Technologies, Harsco Corporation recommends that this be checked by a reputable alignment shop.
9. Follow the mounting instructions on the application drawing which is 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 Track Technologies, Fairmont Minnesota Facility to obtain these drawings.

10. After mounting the guide wheel equipment, have a four point alignment completed 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. Have the headlight aim checked and adjusted, if necessary.

3.1.2 Placing Vehicle On Track

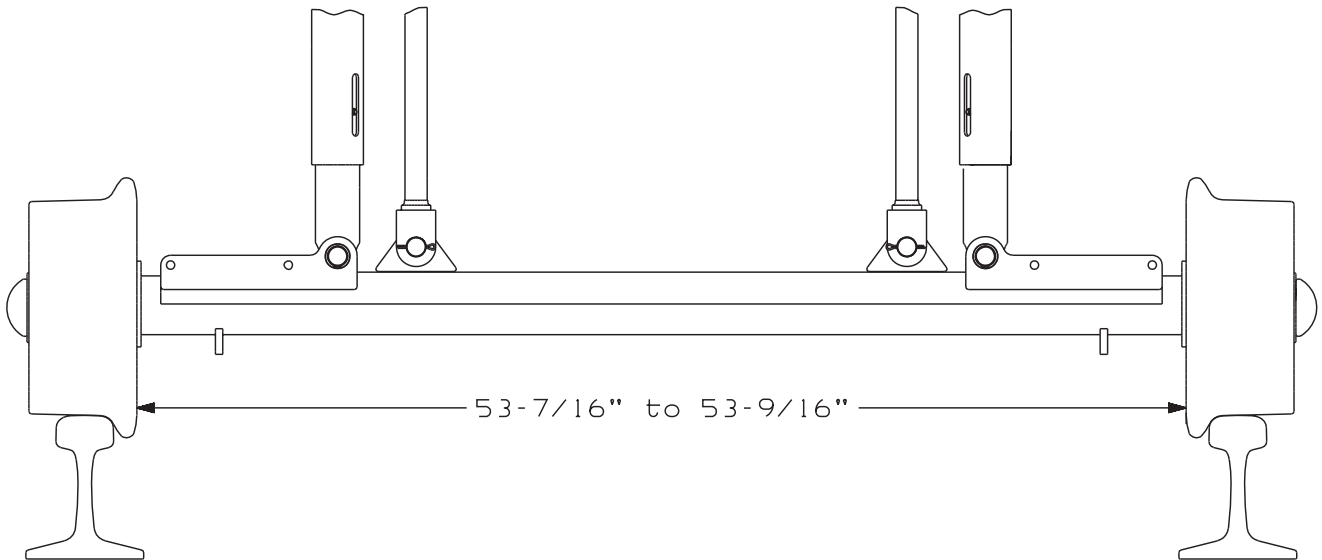
1. Place the vehicle on straight, level, tangent track or an alignment rack constructed for guide wheel equipment alignment. If track or an alignment rack is not available, use 4 x 4 inch lumber on a level floor to simulate track. Space the lumber so it measures 56-1/2 inches (1.435 m) between the inside edges.
2. Place the 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 Section - Placing Vehicle On Track.
3. Set the vehicle 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 Track Gauge - See Figure 3-1

1. Measure the track gauge of 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 53-7/16 to 53-9/16 inches (1357 - 1360 mm). The front guide wheel unit track gauge is preset at the factory and is non-adjustable.

FIGURE 3-1
GUIDE WHEEL TRACK GAUGE



SE97A102A-1

3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load



- **IMPROPER LOADING OF GUIDE WHEEL EQUIPMENT CAN CAUSE DERAILMENT OF VEHICLE.**
- **APPLY VEHICLE PARKING BRAKE AND STOP VEHICLE ENGINE BEFORE CHECKING GUIDE WHEEL LOAD.**
- **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 FRONT GUIDE WHEEL UNIT IS:**
 - **HR18A1: 6,000 LBS (2722 kg) OR 3,000 LBS (1361 kg) MAXIMUM PER GUIDE WHEEL.**
 - **HR18A1-1: 7,000 LBS (3175 kg) OR 3,500 lbs (1588 kg) MAXIMUM PER GUIDE WHEEL.**

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

Whenever the vehicle is loaded or additional load is added to the existing vehicle load on track, check the load on the front guide wheels. The maximum load on the front guide wheel unit is:

- HR18A1: 6,000 lbs (2722 kg) or 3,000 lbs (1361 kg) maximum per guide wheel.
- HR18A1-1: 7,000 lbs (3175 kg) or 3,500 lbs (1588 kg) maximum per guide wheel.

The front guide wheel unit load is not adjustable. If the front guide wheel unit is overloaded, redistribute or remove some of the load.

Also, check the load on the rear guide wheel unit. See the Operator's Service And Parts Manual provided with the rear guide wheel unit for information on checking the load on the rear guide wheel unit.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load

3.1.4.1 Checking Guide Wheel Load - See Figures 3-2 and 3-3

To check the load on the front guide wheels it is necessary to measure the deflection of the coil springs in the guide wheel unit's suspension system. Use the following procedure to check the load on the front guide wheels.

Note: See Section 2 - Placing Vehicle On Track.

3

1. Engage the axle hooks or locks on the front axle. Unlock and lower the guide wheels until they are slightly above the rails.
2. On the suspension tube on one side of the guide wheel unit, measure from the bottom of slot (1) to the bottom of roll pin (2). Record this dimension (A). Measure from the bottom of slot (1) to the bottom of roll pin (2) on the other suspension tube on the guide wheel unit. Record this dimension (B).
3. Fully lower and lock the guide wheels in the "rail" position. Make sure the control valve handle is fully forward, in the "detent" position, so the vehicle's front end weight is on the guide wheel unit's suspension system.
4. On the first suspension tube checked, again measure from the bottom of slot (1) to the bottom of roll pin (2). Record this dimension (AA). Measure from the bottom of slot (1) to the bottom of roll pin (2) on the other suspension tube on the guide wheel unit. Record this dimension (BB).
5. To determine the load on the guide wheel, subtract dimension (A) from dimension (AA) to obtain dimension (X), or subtract dimension (B) from dimension (BB) to obtain dimension (X).

Example: $(AA) - (A) = \text{dimension (X)}$. See Charts 3-4 and 3-5 to convert dimension (X) into the approximate load on the guide wheel.

6. If the measured front guide wheel load exceeds the maximum load capacity, the load must be redistributed or some of the load removed. Never operate the vehicle on track if the load on the front guide wheel exceeds the maximum load capacity of:

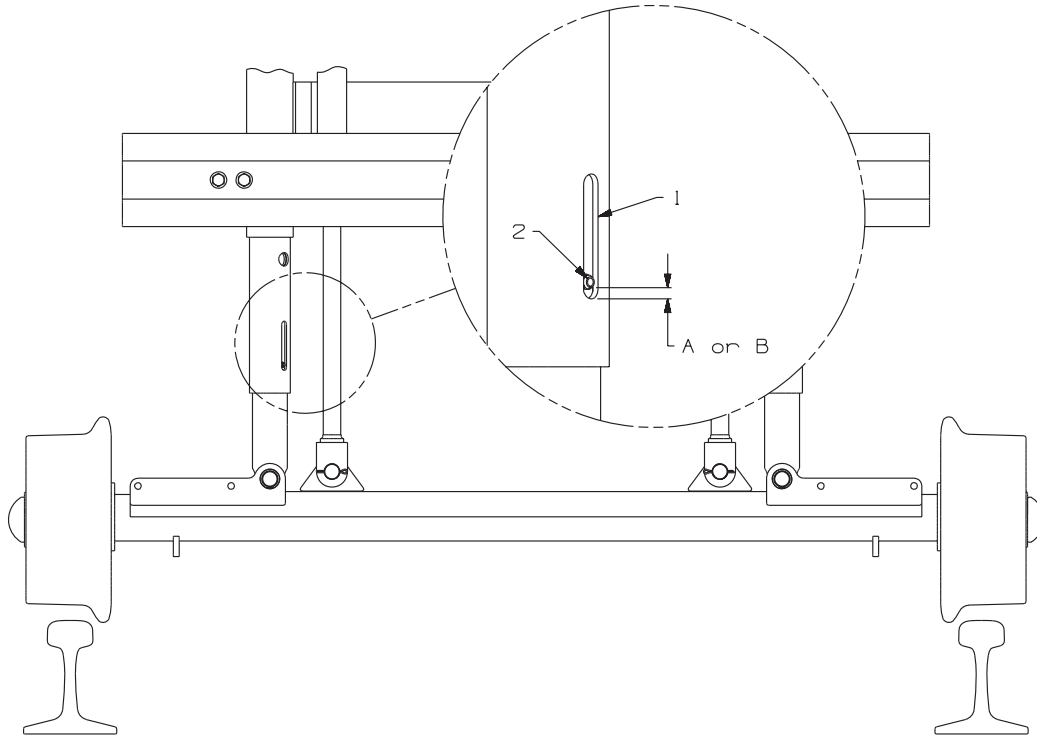
HR18A1: 6,000 lbs (2722 kg) or 3,000 lbs (1361 kg) maximum per guide wheel.

HR18A1-1: 7,000 lbs (3175 kg) or 3,500 lbs (1588 kg) maximum per guide wheel.

3.1 Guide Wheel Equipment Alignment Procedure

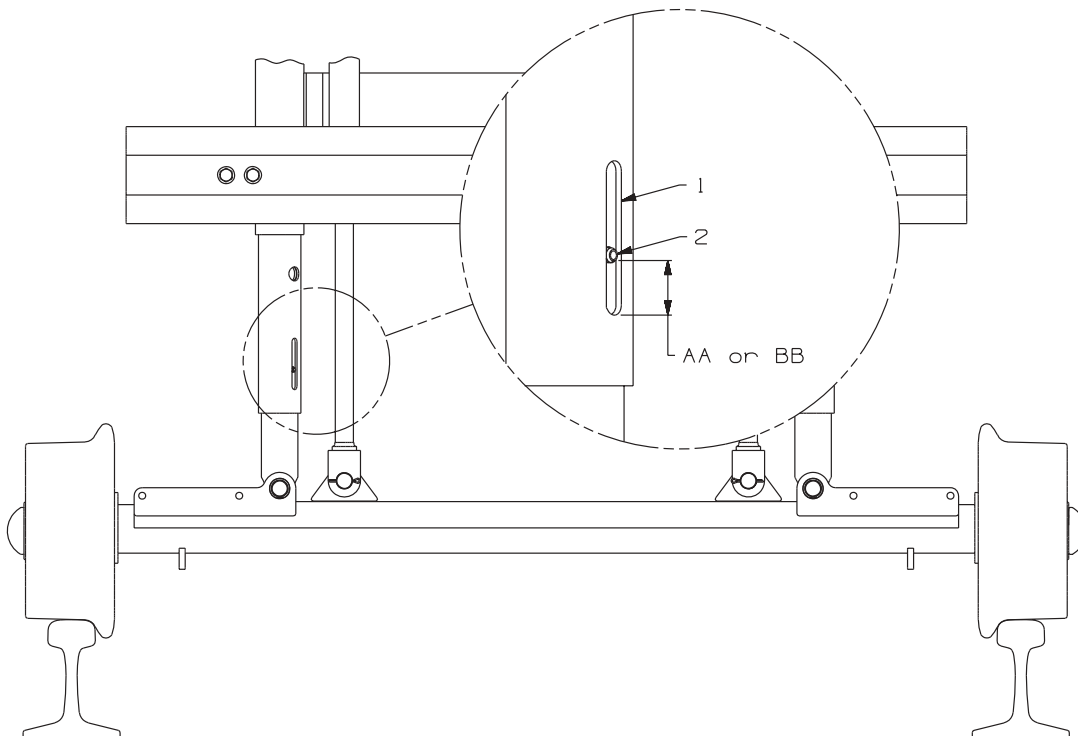
3.1.4 Guide Wheel Load

FIGURE 3-2
MEASURING FOR CALCULATING GUIDE WHEEL LOAD



SE96A165A-1

FIGURE 3-3
MEASURING FOR CALCULATING GUIDE WHEEL LOAD



SE96A165A-2

3.1 Guide Wheel Equipment Alignment Procedure

3.1.4 Guide Wheel Load

CHART 3-4
 HR18A1 FRONT GUIDE WHEEL LOAD

DIMENSION X		APPROXIMATE LOAD PER SIDE	
1/8"	(3.2 mm)	350 lbs	(159 kg)
1/4"	(6.4 mm)	650 lbs	(295 kg)
3/8"	(9.5 mm)	950 lbs	(431 kg)
1/2"	(12.7 mm)	1,250 lbs	(567 kg)
5/8"	(15.9 mm)	1,550 lbs	(703 kg)
3/4"	(19.0 mm)	1,850 lbs	(839 kg)
7/8"	(22.2 mm)	2,150 lbs	(975 kg)
1"	(25.4 mm)	2,450 lbs	(1,111 kg)
1-1/8"	(28.6 mm)	2,750 lbs	(1,248 kg)
* 1-1/4"	(31.8 mm)	3,050 lbs	(1,383 kg)

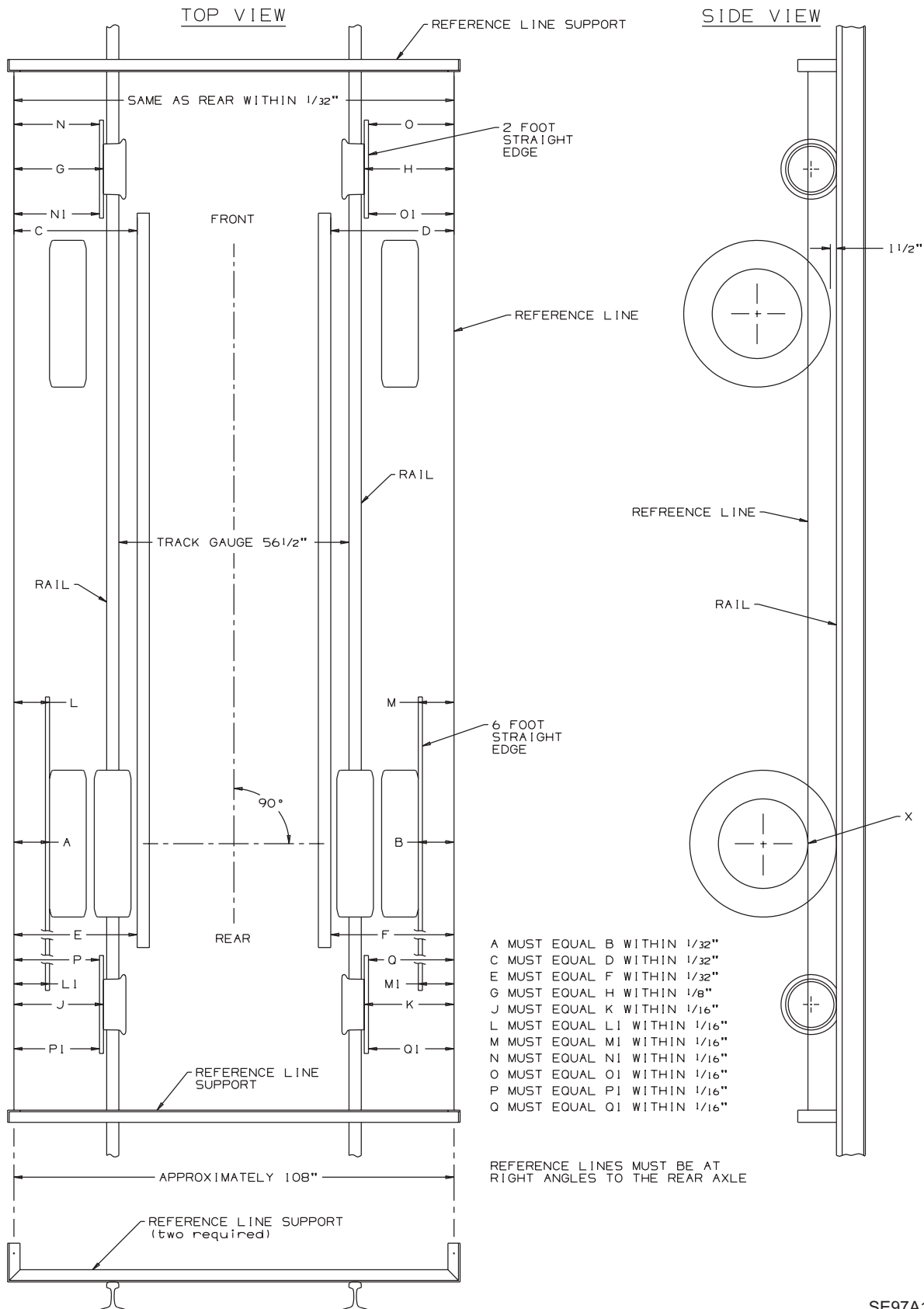
CHART 3-5
 HR18A1-1 FRONT GUIDE WHEEL LOAD

DIMENSION X		APPROXIMATE LOAD PER SIDE	
1/8"	(3.2 mm)	350 lbs	(159 kg)
1/4"	(6.4 mm)	650 lbs	(295 kg)
3/8"	(9.5 mm)	950 lbs	(431 kg)
1/2"	(12.7 mm)	1,250 lbs	(567 kg)
5/8"	(15.9 mm)	1,550 lbs	(703 kg)
3/4"	(19.0 mm)	1,850 lbs	(839 kg)
7/8"	(22.2 mm)	2,150 lbs	(975 kg)
1"	(25.4 mm)	2,450 lbs	(1,111 kg)
1-1/8"	(28.6 mm)	2,750 lbs	(1,248 kg)
1-1/4"	(31.8 mm)	3,050 lbs	(1,383 kg)
1-3/8"	(34.9 mm)	3,350 lbs	(1,520 kg)
* 1-1/2"	(38.1 mm)	3,650 lbs	(1,656 kg)

* FRONT GUIDE WHEEL IS OVERLOADED. REDISTRIBUTE OR REMOVE SOME OF THE LOAD.

3.1 Guide Wheel Equipment Alignment Procedure

FIGURE 3-6
GUIDE WHEEL EQUIPMENT ALIGNMENT



3

3.1 Guide Wheel Equipment Alignment Procedure

3.1.5 String Lining Set-Up - See Figure 3-6

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 Track Technologies 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 the rear guide wheel unit in the "rail" position. Unlock and lower the front guide wheel unit. Do not completely lower and lock the front guide wheels in the "rail" position. Place the control valve handle in the ON RAIL (detent) position so that the guide wheels rest on the rail.
3. The front guide wheel unit may have up to 1/2 inch (13 mm) of side to side movement. It will be necessary to use a pry bar to move the front guide wheel axle from side to side to locate the center of this side to side movement. Prior to taking any measurements from the string lines to the front guide wheels, use the pry bar to position the front guide wheel axle at the center of its side to side movement.
4. Establish parallel reference lines on each side of the vehicle as shown in Figure 3-6. 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 reference lines are in line with the bottom edge of the vehicle's rear rims (point X) and 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 (2.74 m) apart. The distance between the wires or cords must be equal or within 1/32 inch (.8 mm) at each support.
5. 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 reference line is level with the bottom edge of the rear vehicle wheel rim(s) (point X). The reference lines must be level.
6. Shift the supports on the rail until dimension A equals (=) B and dimension C equals (=) D or within 1/32 inch (.8 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.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.5 String Lining Set-Up - See Figure 3-6

7. 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: $[L \text{ (first dimension)} + L \text{ (second dimension)}] \div 2 = L \text{ (average dimension)}$

8. Shift the supports on the rail until dimension L (average) equals (=) M (average) and dimension L1 (average) equals (=) M1 (average) or within 1/16 inch (1.6 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.
9. After the reference lines have been established, measurements can be taken from these lines to the guide wheels to ensure correct alignment.

3.1.6 Front Guide Wheel Alignment - See Figure 3-6

1. Ensure that the front guide wheels are centered in their side to side movement. See String Lining Set-Up - Step 3.
2. Take measurements G and H. 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 G equals (=) H or is within 1/8 inch (3.2 mm). If not, see Adjustment.
3. The front guide wheels must track straight. Hold a two foot long straight edge against the outer edge of the front guide wheel. Take measurements N and N1 and measurement O and O1. Check that dimension N equals (=) N1 and that dimension O equals (=) O1 or is within 1/16 inch (1.6 mm). If not, see Adjustment.
4. Any adjustments made to the guide wheel unit may affect the measurements and alignments checked in the above steps because of the necessity to loosen or remove the guide wheel unit mounting bolts. Always re-check the above measurements and alignments when any adjustments are made.

3.1.7 Front Guide Wheel Adjustment - See Figures 3-6 and 3-7

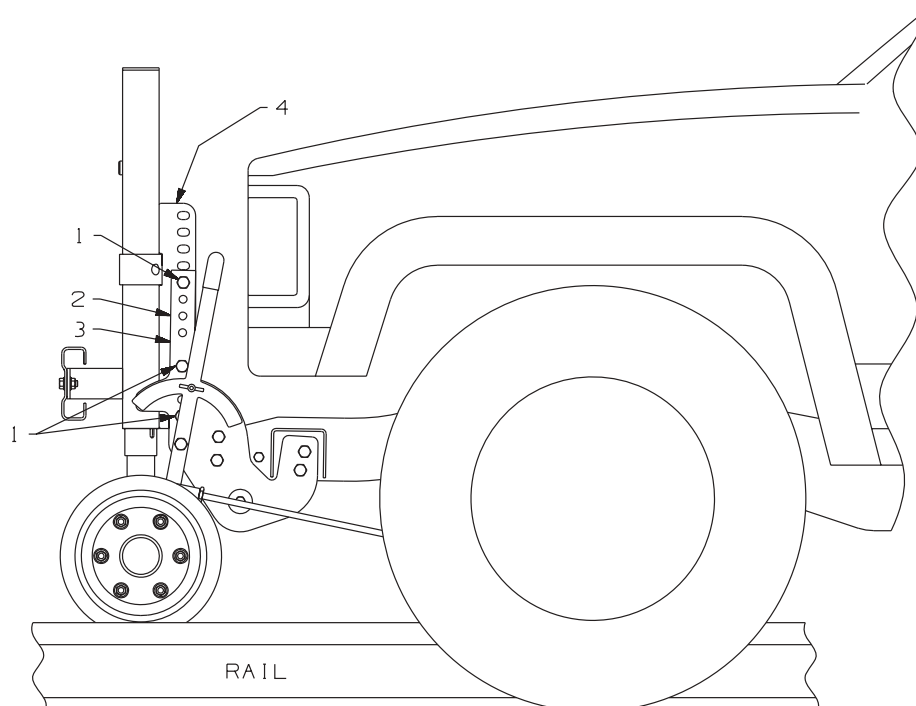
1. Move the control valve handle from the ON RAIL (detent) position to the neutral position. Let the guide wheels rest on the rails. Block or support the guide wheel unit.
2. To adjust the side to side alignment of the front guide wheel unit (dimensions G and H are equal or within 1/8 inch), remove the six 5/8 inch cap screws (1) that secure the guide wheel unit to the mounting brackets.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.7 Front Guide Wheel Adjustment - See Figures 3-6 and 3-7

- a. If dimension G is greater than dimension H, remove shim(s) (2) from between the mounting bracket (3) and the mounting plate (4) on the right side of the guide wheel unit and install the shim(s) between the mounting bracket (3) and the mounting plate (4) on the left side of the guide wheel unit.
 - b. If dimension H is greater than dimension G, remove shim(s) (2) from between the mounting bracket (3) and the mounting plate (4) on the left side of the guide wheel unit and install the shim(s) between the mounting bracket (3) and the mounting plate (4) on the right side of the guide wheel unit.
 - c. Install the six 5/8 inch cap screws (1). Torque the cap screws to 210 ft lbs (280 N-m).
3. To adjust the tracking alignment of the front guide wheel unit, loosen the six 5/8 inch cap screws (1). The holes in the guide wheel unit mounting plate (4) are slotted to allow forward or rearward adjustment of the guide wheel unit. If necessary, use a reamer to enlarge the mounting holes to allow adjustment.
- a. If dimension N is greater than N1 and dimension O is less than O1, move the left side of the guide wheel unit rearward or the right side of the guide wheel unit forward.
 - b. If dimension N is less than N1 and dimension O is greater than O1, move the left side of the guide wheel unit forward or the right side of the guide wheel unit rearward.
 - c. Torque the six 5/8 inch cap screws (1) to 210 ft lbs (280 N-m).

FIGURE 3-7
GUIDE WHEEL UNIT ALIGNMENT

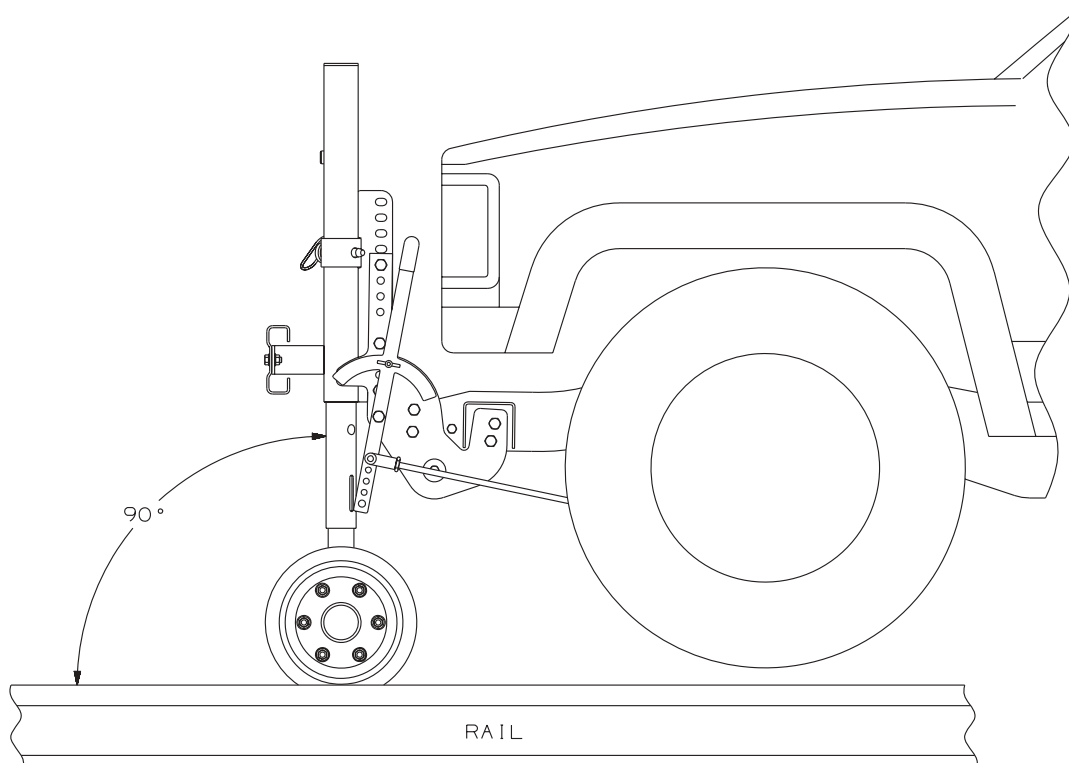


3.1 Guide Wheel Equipment Alignment Procedure

3.1.7 Front Guide Wheel Adjustment - See Figures 3-7 and 3-8

4. The guide wheel unit's spring cell suspension tubes must be perpendicular (90 degrees) to the rail when the vehicle is in the "rail" position to permit proper operation of the suspension system. *Note: The vehicle must be on level track.* A bubble level placed against the front or rear of the spring cell suspension tube can be used to check this. If the spring cell suspension tubes are not perpendicular (90 degrees) to the rail, the spring cell tubes must be adjusted.
5. To adjust the guide wheel unit's spring cell suspension tubes perpendicular (90 degrees) to the rail, loosen the six 5/8 inch cap screws (1). The holes in the guide wheel unit mounting plate (4) are slotted to allow forward or rearward adjustment of the guide wheel unit. If necessary, use a reamer to enlarge the mounting holes to allow adjustment. Place a bubble level against the front or rear of the spring cell suspension tube.
 - a. Move the top or bottom of the guide wheel unit forward or rearward until the spring cell suspension tubes are perpendicular (90 degrees) to the rail.
 - b. Torque the six 5/8 inch cap screws (1) to 210 ft lbs (280 N-m).
6. Repeat any procedures to ensure proper alignment of the guide wheel unit.

FIGURE 3-8
GUIDE WHEEL UNIT ALIGNMENT



3.1 Guide Wheel Equipment Alignment Procedure

3.1.8 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 Track Technologies 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.
5. Operate the vehicle for a short distance 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 lower the front of the vehicle from the "rail" position. Let the guide wheels rest on the rail. Place the control valve handle in the "neutral" position. Support the guide wheel unit. Loosen the mounting bolts and slightly move the right side of the guide wheel unit forward or the left side of the guide wheel unit slightly rearward. Torque the mounting bolts to 210 ft lbs.
 - b. Repaint the flanges and treads on all guide wheels. Lower and lock the guide wheel unit in the "rail" Position. Operate the vehicle for a short distance 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 front guide wheel flange and not off the left front guide wheel flange, repeat Steps a. & b. If the guide wheel unit is adjusted to the limit of the mounting hole slots, go to Step 39.

3.1 Guide Wheel Equipment Alignment Procedure

3.1.8 Vehicle Track Test - Continued

8. If the paint wore off the left front guide wheel flange and not off the right front guide wheel flange, the guide wheel unit is "flanging left".
 - a. Unlock and lower the front of the vehicle from the "rail" position. Let the guide wheels rest on the rail. Place the control valve handle in the "neutral" position. Support the guide wheel unit. Loosen the mounting bolts and slightly move the left side of the guide wheel unit forward or the right side of the guide wheel unit slightly rearward. Torque the mounting bolts to 210 ft lbs.
 - b. Repaint the flanges and treads on all guide wheels. Lower and lock the guide wheel unit in the "rail" Position. Operate the vehicle for a short distance 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 front guide wheel flange and not off the right front guide wheel flange, repeat Steps a. & b. If the guide wheel unit is adjusted to the limit of the mounting hole slots, go to Step 39.
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.
 - d. 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 Vehicle Front Tire Clearance - Rail Position - See Figure 3-9

The vehicle's front tire clearance should be checked whenever the vehicle is placed on rail or whenever the load on the vehicle is changed significantly.

1. Place the vehicle on straight, level, tangent track. Place the vehicle automatic transmission in "Park" or manual transmission in "Neutral". Apply the parking brake. Lower and lock both guide wheel units in the "rail" position. See Operation Section - Placing Vehicle On Track.

3.2 Adjustments

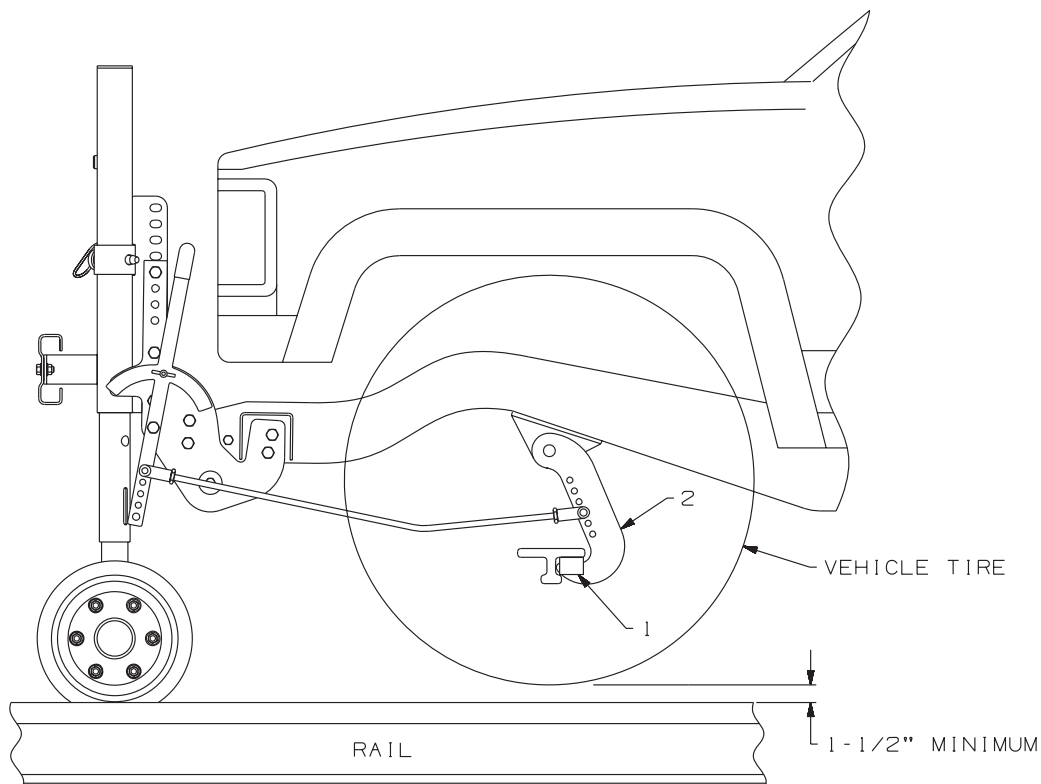
3.2.1 Vehicle Front Tire Clearance - Rail Position - See Figure 3-9

2. When the front guide wheel unit is lowered and locked in the "rail" position, the axle hooks will raise the vehicle's front tires above the rails. This is necessary to ensure clearance when the vehicle passes through switches, turnouts, crossings, frogs, etc. As the vehicle is loaded, the front tire clearance will decrease. The front tires must always clear the top of the rails by a minimum of 1-1/2 inches (38 mm) whenever the vehicle is on track. If not see Adjustment.

3.2.1.1 Adjustment - See Figure 3-9

1. A spacer (1) can be welded onto the axle hooks (2) to obtain the 1-1/2 inch (38 mm) minimum vehicle front tire to rail clearance. Both axle hooks must be adjusted to maintain the minimum vehicle front tire to rail clearance for both front tires.
2. If the front axle hooks cannot be modified to obtain the 1-1/2 inch (38 mm) minimum clearance, the guide wheel unit must be repositioned in a different set of mounting holes or different axle hooks must be applied to the vehicle. For axle hook replacement, contact Harsco Track Technologies, Harsco Corporation, Fairmont, Minnesota.

FIGURE 3-9
VEHICLE FRONT TIRE CLEARANCE



3.2 Adjustments

3.2.2 Axle Hooks

The axle hook clearance should be checked whenever adjustments are made to the guide wheel unit or whenever the load on the vehicle is changed significantly.

Park the vehicle on solid level ground. The vehicle must be loaded with its normal operating load. Place the vehicle automatic transmission in "Park" or manual transmission in "Neutral". Apply the parking brake. Stop the engine.

Note: On some vehicle applications the axle hooks may be reversed and will engage under the axle from the front instead of from the rear as illustrated. This will cause the axle hook lock lever to engage and disengage the axle hooks in the opposite direction.

3

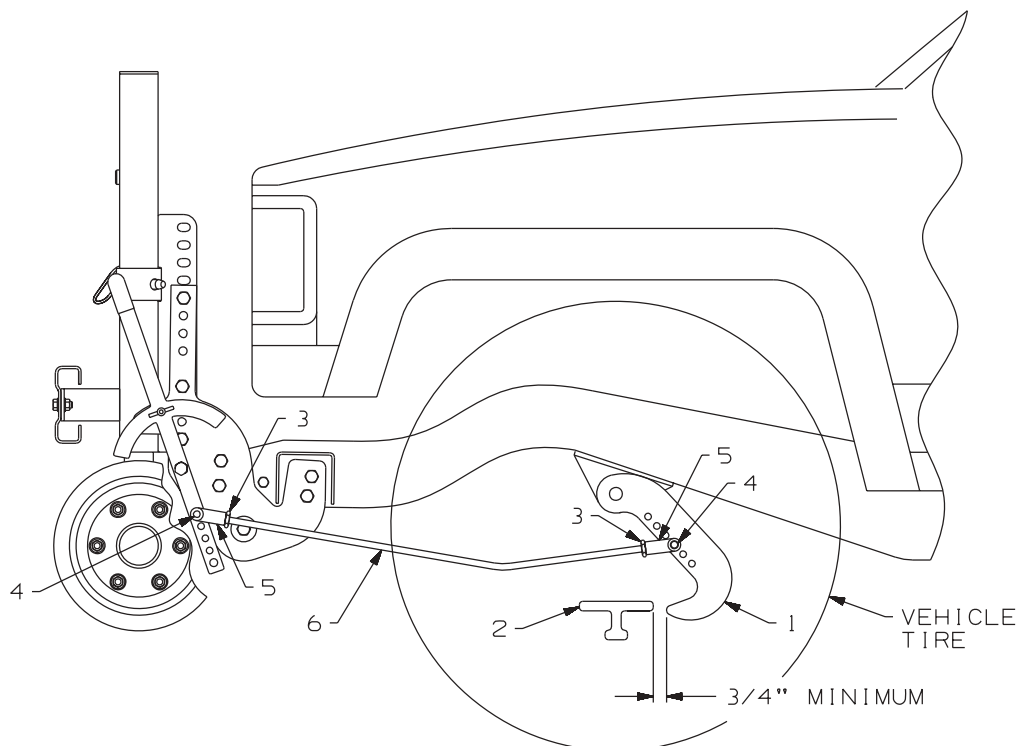
3.2.2.1 Checking Axle Hook Clearance - Disengaged - See Figure 3-10

1. Measure the distance from the "toe" of both axle hooks (1) to the axle (2). The minimum clearance between the axle hook "toe" and the axle is 3/4 inch (19 mm). If the axle hook clearance is incorrect, see Adjustment.

3.2.2.1.1 Adjustment - See Figure 3-10

1. Both axle hooks must be adjusted to obtain equal clearance from the axle. The axle hooks may be adjusted by loosening jam nut (3). Removing cotter pins and pins (4) and adjusting yokes (5) on rod (6) to obtain the minimum clearance of 3/4 inch (19 mm). Reinstall pins and cotter pins (4). Tighten Jam nut (3).

FIGURE 3-10
AXLE HOOK CLEARANCE - DISENGAGED



3.2 Adjustments

3.2.2 Axle Hooks

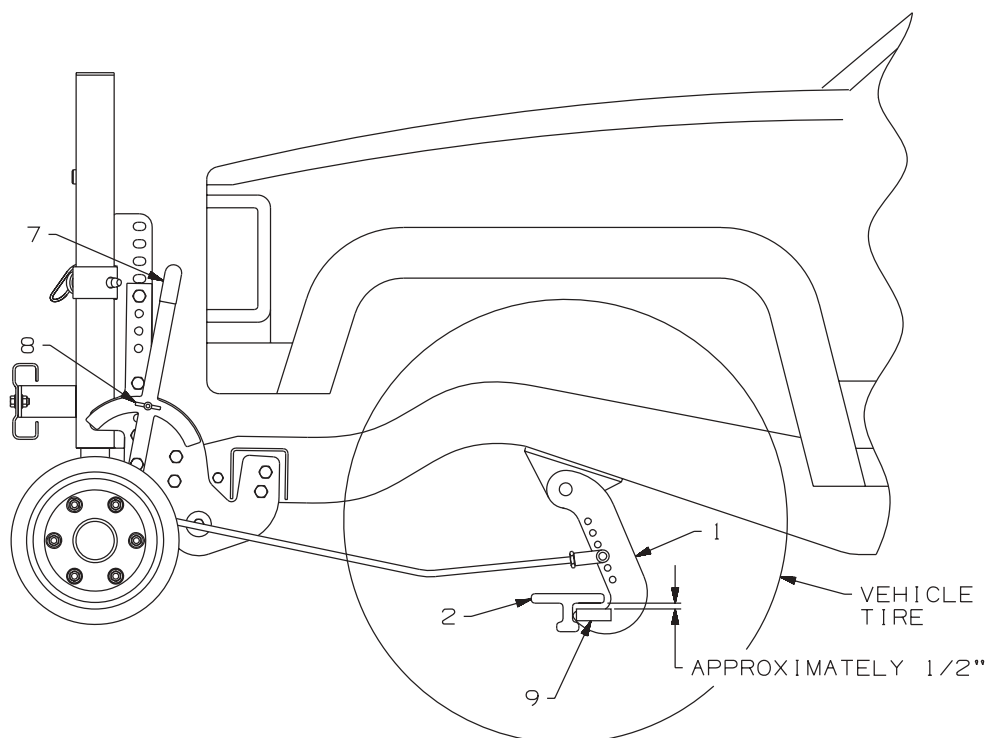
3.2.2.2 Checking Axle Hook Clearance - Engaged - See Figure 3-11

1. Remove lock pin (8). Button in "T" end of lock pin must be pushed in to remove the pin. Push lever (7) towards the vehicle to engage the axle hook under the axle.
2. There should be approximately 1/2 inch (12.7 mm) of clearance between the top of the axle hook (1) and the bottom of the axle (2). If not, see Adjustment.

3.2.2.2.1 Adjustment - See Figure 3-11

1. Both axle hooks must be adjusted to obtain equal clearance from the axle. If there is more than 1/2 inch (12.7 mm) of clearance between the top of the axle hook (1) and the bottom of the axle (2), the vehicle's tires may not be lifted high enough above the rails when the vehicle is in the "rail" position.
2. A spacer (9) may be welded to the axle hook to obtain the 1/2 inch (12.7 mm) clearance.
3. If there is less than 1/2 inch (12.7 mm) clearance between the top of the axle hook (1) and the bottom of the axle (2), the axle hook may not properly engage under the axle.
4. If the axle hooks cannot be modified to obtain the 1/2 inch (12.7 mm) clearance, a different set of axle hooks must be applied to the vehicle. For axle hook replacement, contact Harsco Track Technologies, Harsco Corporation, Fairmont, Minnesota.

FIGURE 3-11
AXLE HOOK CLEARANCE - ENGAGED



3.2 Adjustments

3.2.3 Brake Shoe Clearance - See Figure 3-12

The front guide wheel unit may be equipped with the optional brake group.

1. Apply the vehicle parking brakes. Be sure the vehicle air brake system or the optional Electrical / Air Brake Group is at operating pressure to fully release the guide wheel brakes. 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 brake.

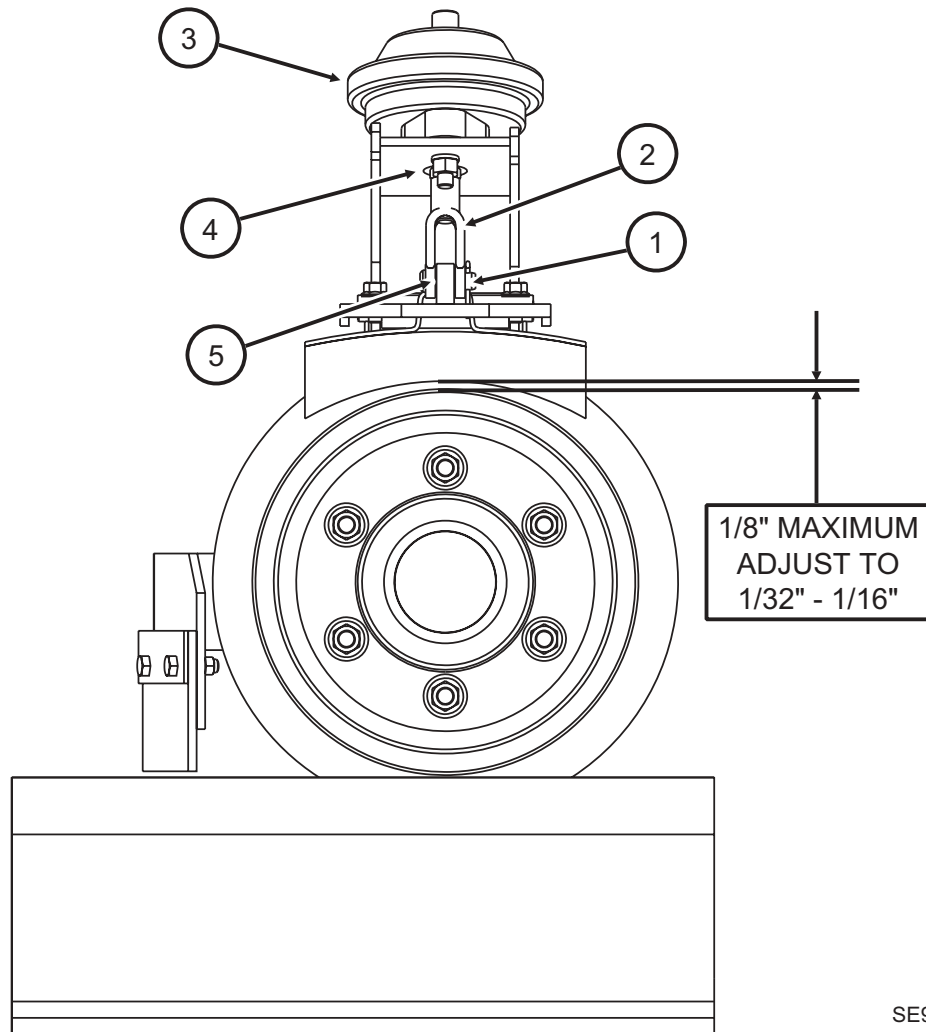
3.2.3.1 Adjustment - See Figures 3-12

1. Remove the cotter pin from the pin (1). Remove the pin (1) from the yoke (2) on the brake actuator (3). Loosen jam nut (4) and 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 the pin (1) through the yoke (2) and brake arm (5) and secure using the cotter pin. Tighten jam nut (4) securely. Recheck the brake shoe clearance.
3. Repeat Step a to adjust the brake shoe clearance on the other guide wheel brake.

3.2 Adjustments

3.2.3 Brake Shoe Clearance

FIGURE 3-12
BRAKE SHOE CLEARANCE



3.2 Adjustments

3.2.4 Brake Air Pressure Regulator Valve - See Figure 3-13

Vehicles that are not equipped with an air brake system from the vehicle manufacturer must be equipped with an auxiliary air system such as Harsco Track Technologies Electric Air Brake System. Any air supply system that is used must have an air regulator valve installed in the air system to regulate the air pressure to the rail guide wheel brakes.

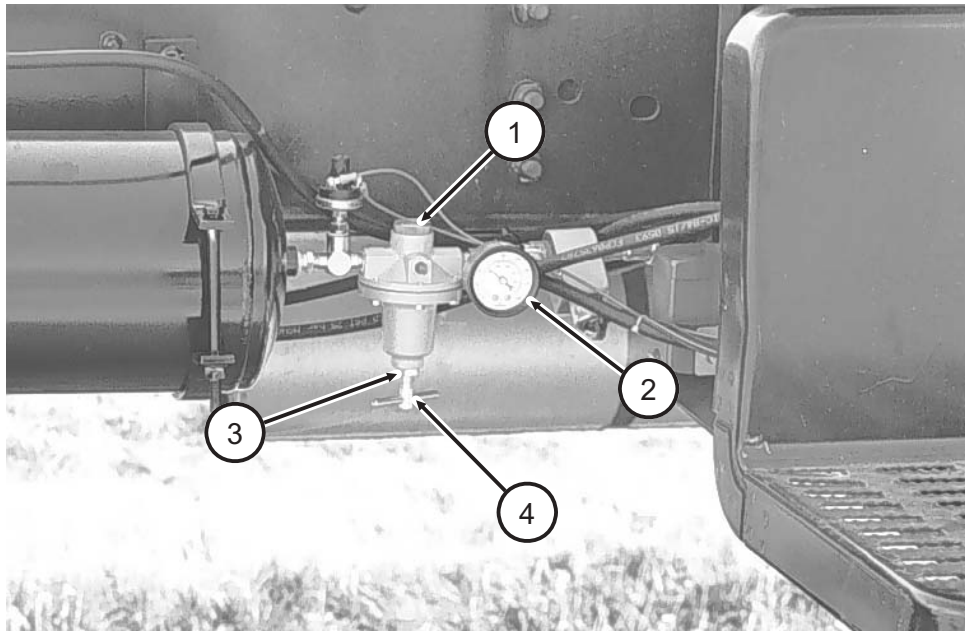
1. Place the vehicle on track. See Section 2 - Placing Vehicle On Track.
2. Apply the vehicle's parking brake. Place the vehicle's automatic transmission in PARK or manual transmission in NEUTRAL. Leave the vehicle's engine operating. Activate the rail guide wheel air brake system by moving the toggle switch to the ON position. Be sure the air brake system is at operating pressure.
3. The vehicle must be at normal operating weight when the brake system air pressure is set. A heavier loaded vehicle will require a higher air pressure setting while a lighter loaded vehicle will require a lower air pressure setting. If the system air pressure is set too high for the load on the vehicle, the guide wheels will lock up and slide on the rail causing flat spots to develop on the guide wheels. Likewise, If the system air pressure is set too low for the load on the vehicle, braking force will be reduced resulting in longer stopping distances.
4. Initially adjust the air regulator valve (1) until 25 PSI (172 kPa) is indicated on the air pressure gauge (2). To adjust the regulator valve, loosen jam nut (3). Turn the adjusting handle (4) clockwise to increase pressure or counter-clockwise to decrease pressure. After this initial adjustment, tighten the jam nut securely.
5. Be sure the test track is clear of all rail traffic before testing the brakes. Follow all railroad rules and regulations. Release the vehicle's parking brakes. Propel the vehicle forward and then apply the vehicle's brakes. The vehicle must stop in the shortest possible stopping distance without the rail guide wheels locking up and sliding on the rail.
 - a. If the rail guide wheels lock up and slide on the rail when the vehicle's brakes are applied, adjust the regulator valve to a lower air pressure setting. Repeat Step 4.
 - b. If the rail guide wheels do not stop the vehicle in the shortest possible stopping distance, adjust the regulator valve to a higher air pressure setting. Repeat Step 4.

Note: Many factors will determine the shortest possible stopping distance for a vehicle on track; such as vehicle weight, rear tire tread wear, vehicle speed, single or tandem rear axles, whether the front and/or rear guide wheel units are equipped with guide wheel brakes, rail conditions, etc.

3.2 Adjustments

3.2.4 Brake Air Pressure Regulator Valve

FIGURE 3-13
BRAKE SYSTEM AIR PRESSURE REGULATOR AND GAUGE



94-143

3.2 Adjustments

3.2.5 Rail Sweeps - See Figure 3-14

The front guide wheel unit may be equipped with rail sweeps.

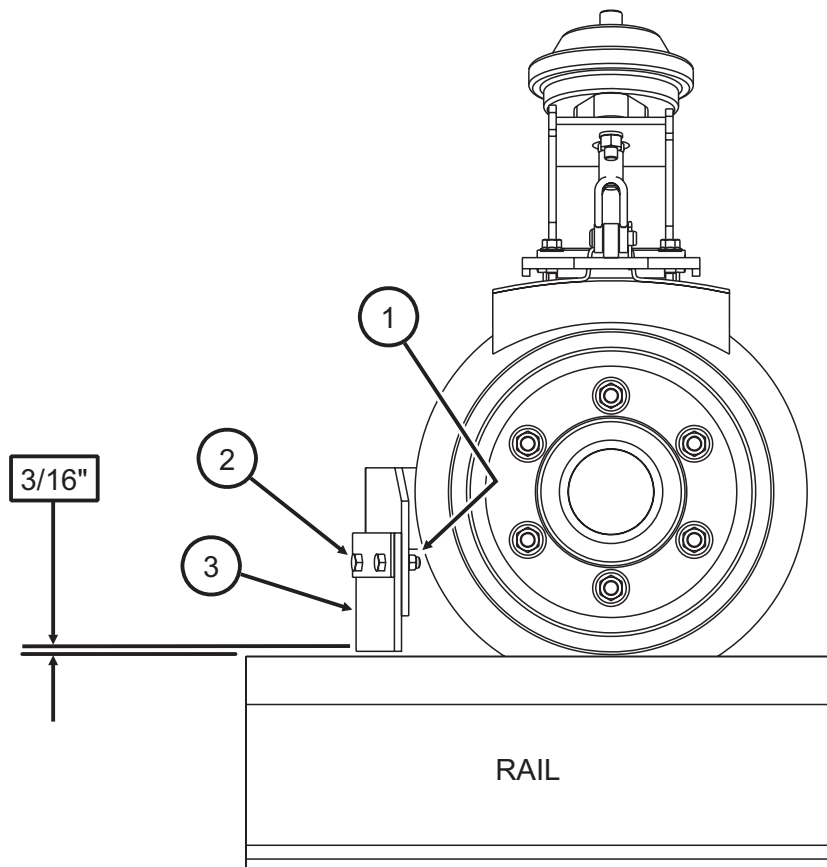
1. Place the vehicle on straight, level track. Place the vehicle automatic transmission in "Park" or manual transmission in "Neutral". Apply the vehicle parking brakes. Lower and lock the front and rear guide wheel units in the "rail" position.
2. The rubber rail sweeps should clear the top of the rail by 3/16 inch (4.8 mm). If not, see Adjustment.

3

3.2.5.1 Adjustment - See Figure 3-14

1. Loosen the two hex nuts (1) on cap screws (2). Adjust the rubber sweep (3) until it clears the top of the rail by 3/16 inch (4.8 mm). Re-tighten the two hex nuts (1) and cap screws (2).
2. Repeat Step a to adjust the rail sweep on the other guide wheel.
3. When the rubber sweep (3) is worn so it cannot be adjusted, replace the rubber sweep.

FIGURE 3-14
RAIL SWEEP CLEARANCE



**SECTION 4 - MAINTENANCE
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4.1 Maintenance Schedule



■ **RE-TORQUE VEHICLE WHEEL LUG NUTS AND GUIDE WHEEL LUG NUTS 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.**

4.1.1 Daily:

1. Inspect the front and rear guide wheel units for damaged, worn or missing parts.
2. Check the mechanical locks and lock pins for ease of operation.
3. The lock pins used in the axle hook lock handles should never be able to be pulled out unless the button on the "T" end of the pin is pushed in. The button in the lock pin must push in easily and also pop out when released. The locking balls in the end of the pin must work freely so the pin cannot be removed until the button in the lock pin is depressed. If the lock pin does not operate properly, replace the lock pin.
4. Check the hydraulic reservoir to ensure that the oil level is full. If low, fill to the proper level with the correct fluid.
5. 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

4.1.2 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 nut 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 Appendices - Appendix A, Bolt Torque Requirement Chart.

4.1 Maintenance Schedule

4.1.3 At 50 Vehicle Miles (80 Vehicle km):

Torque the vehicle wheel lug nuts and guide wheel lug nuts to the recommended specifications. Thereafter refer to the vehicle manufacturer's wheel torque specifications.

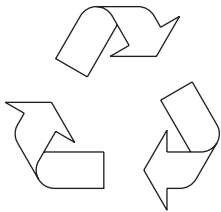
4.1.4 Every 2,000 Track Miles (3200 km):

Lubricate the guide wheel unit locations provided with grease fittings. See Guide Wheel Equipment Lubrication.

4.1.5 At 10,000 Track Miles (16000 km)

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

4.2 Waste Disposal



Dispose of waste properly. Improper disposal of waste can threaten the environment. The operation and maintenance of Harsco Track Technologies 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.

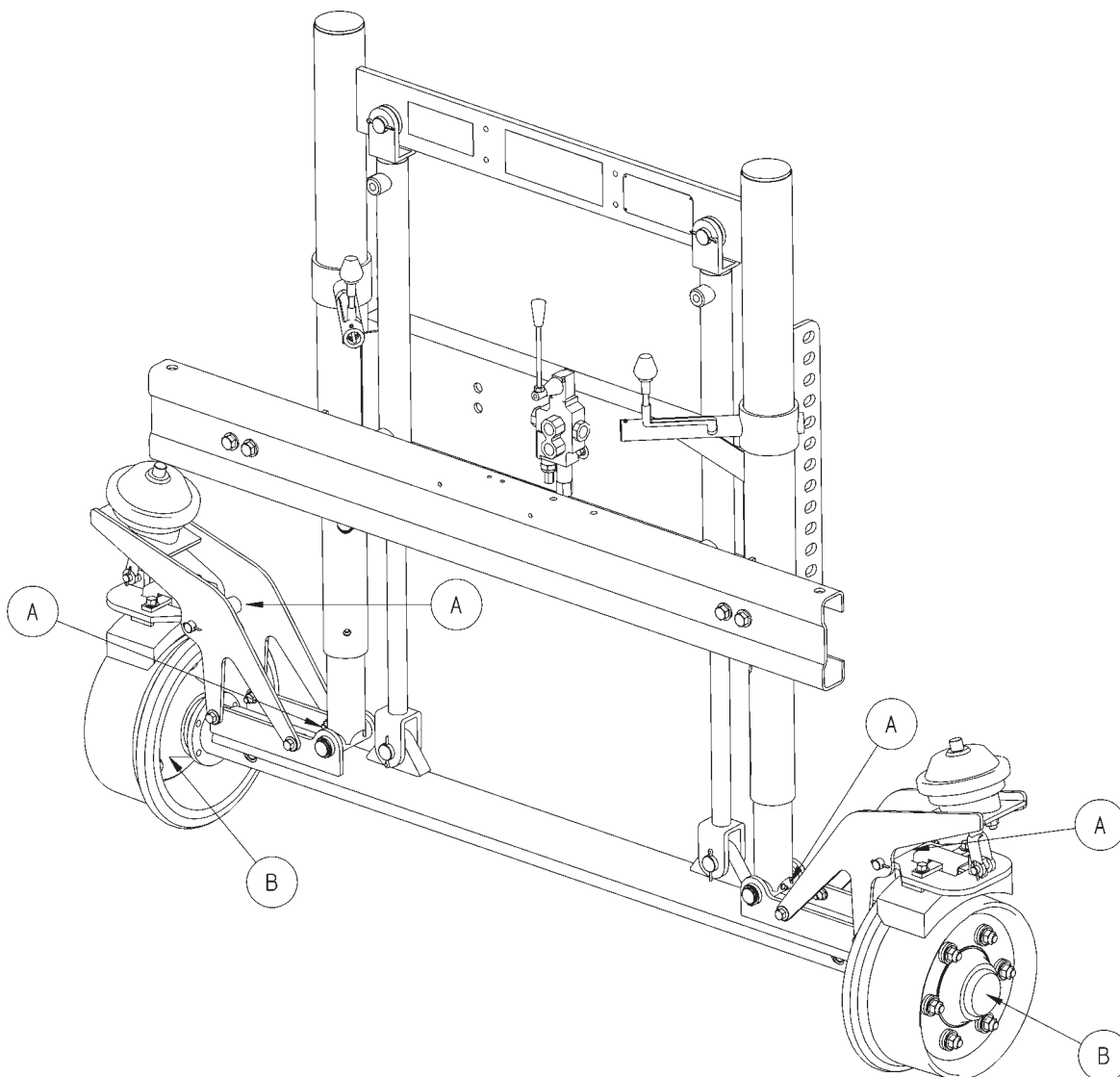
4.3 Guide Wheel Equipment Lubrication

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

4.3.1 Front Guide Wheel Unit Lubrication - See Figure 4-1

1. Apply the vehicle parking brake. Stop the vehicle engine.
2. Lubricate grease fittings (A) using Mobil Special Moly, or equivalent. The guide wheel unit may also be equipped with guide wheel brakes. Lubricate grease fittings (A) on the brake shoe pivot arms.
3. Re-pack the guide wheel bearings (B) every 10,000 track miles (maximum) or at least once yearly (minimum), whichever occurs first. See Re-packing Guide Wheel Bearings.

FIGURE 4-1
FRONT GUIDE WHEEL UNIT LUBRICATION



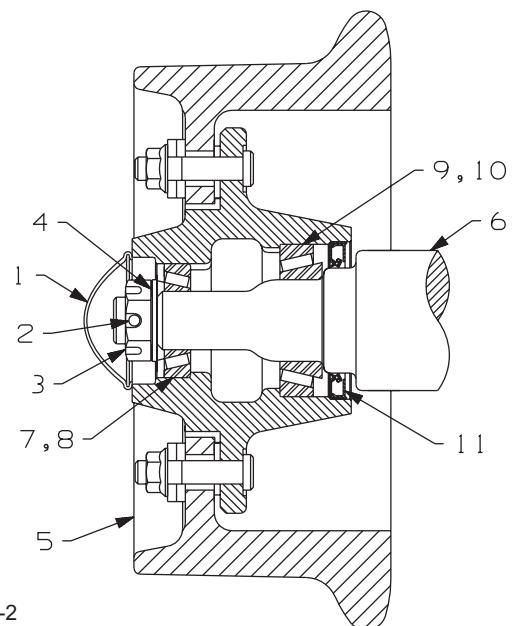
4.3 Guide Wheel Equipment Lubrication

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 vehicle parking brake. Raise and lock the front and rear guide wheel units in the "highway" position. Stop the vehicle engine. Turn the vehicle ignition switch off.
2. Remove the hub cap (1). Remove the 1/8 x 1-1/4 inch cotter pin (2), 1 inch castle nut (3) and spindle washer (4).
3. 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).
4. Clean all components of old grease and dirt.
5. 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.
6. Measure the guide wheel wear. See Maintenance - Guide Wheels, Allowable Wear.
7. 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 HP grease, or equivalent.
8. Install the inner bearing cone (9) into the guide wheel (5). Install a new grease seal (11) into the wheel.
9. 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 inch castle nut (3) onto the spindle (6).
10. Torque the castle nut (3) to approximately 20 ft lbs. Then loosen the castle nut. This is especially important if new bearing cups have been installed.
11. Torque the castle nut (3) to 7 ft lbs (zero clearance). Then back the castle nut off 1/2 to 1 flat of the nut (0.001 - 0.010 inch clearance). Secure the castle nut using a new cotter pin (2).
12. Install the hub cap (1) onto the guide wheel.

FIGURE 4-2
RE-PACKING GUIDE WHEEL
BEARINGS



4.4 Guide Wheels

Revised 10-2007

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 Track Technologies 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 1/2 inch (12.7 mm).

4

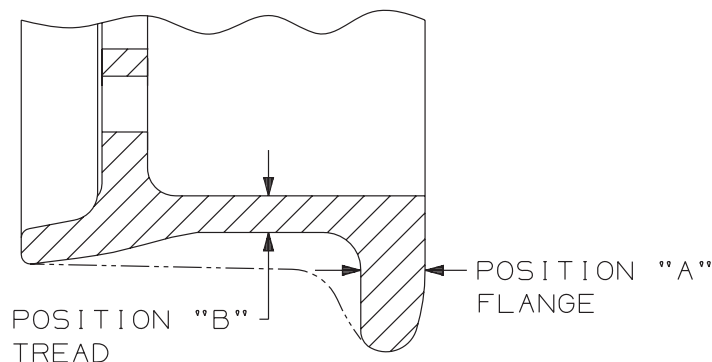
If the guide wheel flange dimension is less than the allowable limit, replace the guide wheel immediately.

3. Measure the guide wheel tread at Position "B" with the wheel caliper. The minimum allowable tread dimension at Position "B" is 5/16 inch (8 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
ALLOWABLE GUIDE WHEEL WEAR



SE92A128A-3

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 PRACTICE FOR SELECTION, INSTALLATION AND MAINTENANCE OF HOSE AND HOSE ASSEMBLIES. FAILURE TO COMPLY TO THIS STANDARD COULD RESULT IN SEVERE BODILY INJURY.

4.7.1 Inspection, Maintenance, Replacement And Installation

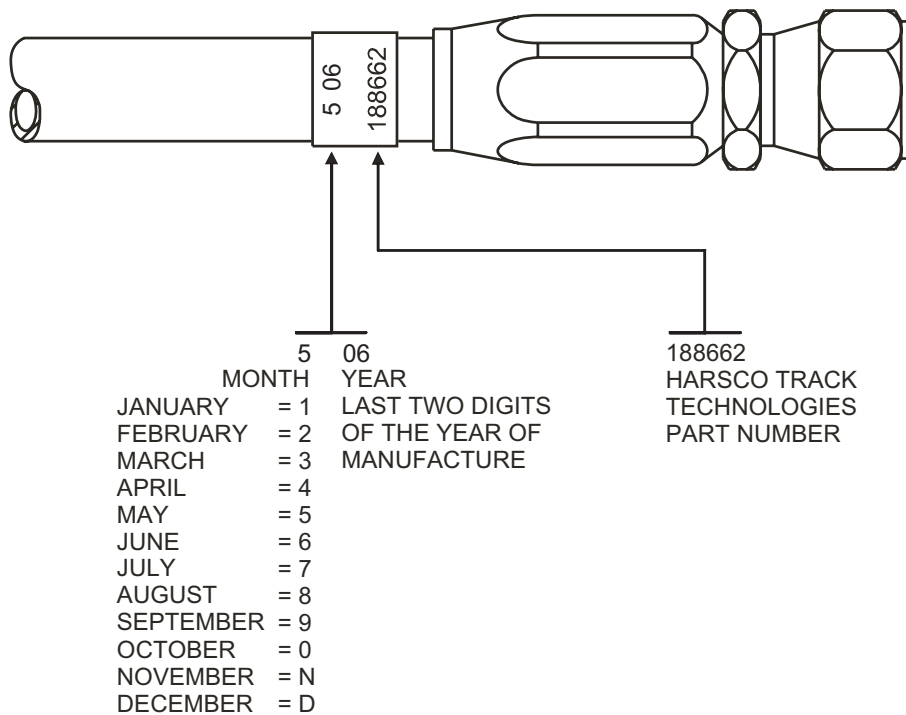
The inspection, maintenance, replacement and installation of hydraulic hose assemblies and fittings on this equipment must conform with SAE Standard J1273. See Appendix B.

4.7.2 Hose Band - See Figure 4-4

All Harsco Track Technologies original and replacement hose assemblies supplied for this equipment from Harsco Track Technologies, Fairmont Minnesota plant facility, have a hose band displaying the date of manufacture and the Harsco Track Technologies part number. The hose assembly illustrated in the example was manufactured in May 2006 and is Harsco Track Technologies 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>
5 Guide wheel unit does not lower or raise.	<p>Lock pins installed.</p> <p>Hydraulic pump not operating.</p> <p>Hydraulic reservoir oil level low.</p> <p>Components bent, broken, worn, etc.</p>	<p>Remove 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>
Guide wheel unit is difficult to lower or raise.	<p>Vehicle over-loaded.</p> <p>Components bent, broken, worn, etc.</p>	<p>Remove excess load from vehicle.</p> <p>Replace components.</p>
Lock pins cannot be inserted when rail pilot unit is in "rail" or "highway" position.	<p>Components bent, broken, worn, etc.</p>	<p>Replace components.</p>

5.1 Troubleshooting Guide Wheel Equipment

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
<p>Vehicle front tires clear rail less than 1-1/2" (38 mm) when vehicle is on track and loaded.</p>	<p>Vehicle overloaded.</p> <p>Axle Hooks not lifting front axle high enough.</p> <p>Hydraulic cylinder / cable axle locks not lifting front axle high enough.</p> <p>Front guide wheel unit not positioned in proper holes of mounting brackets.</p>	<p>Redistribute or remove some of the load.</p> <p>See Adjustment Section - Vehicle Front Tire Clearance - Rail Position.</p> <p>Repair or replace.</p> <p>Mount front guide wheel unit in correct mounting holes. See application drawings supplied with guide wheel equipment group.</p>
<p>Vehicle pulls noticeably to the left or right when on track.</p>	<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.</p> <p>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>

5.1 Troubleshooting Guide Wheel Equipment

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Vehicle derails.	Guide wheel units, vehicle rear axle, etc. not aligned with vehicle frame.	Check alignment. See Adjustment Section - Guide Wheel Equipment Alignment Procedure.
Vibration felt in the vehicle when traveling on track.	Guide wheel units mounting fasteners loose. Guide wheel bearings worn. Guide wheels worn. Vehicle rear rim bent. Vehicle rear tires out of balance.	Tighten all bolts to recommended torque. Replace bearings, wheel or axle. Check guide wheel wear. See Maintenance Section - Guide Wheels, Allowable Wear. Replace. Balance tires.
5 Vehicle load on front spring cells exceeds front guide wheel unit maximum rated load.	Vehicle overloaded.	Redistribute or remove some of the load.
Vibration felt in the vehicle when traveling on highway.	Guide wheel units mounting fasteners loose. Guide wheel units not locked in "highway" position. Vehicle rim bent. Vehicle tires out of balance.	Tighten all bolts to recommended torque. STOP IMMEDIATELY. Make sure both guide wheel units are locked in "highway" position. Replace. Balance tires.

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Serial Numbers

When this bulletin is received, fill in the spaces provided below using the information from the serial number tag on the front rail pilot unit. Always provide these factory serial numbers when calling or writing about the unit. The serial number tag is located on the mounting frame on the unit.

HTT Harsco Track Technologies
a harsco company™

FAIRMONT™ HY-RAIL® GUIDE WHEEL EQUIPMENT

PATENT NUMBER

WHEN ORDERING PARTS FOR THIS ACCESSORY ALWAYS GIVE THE FOLLOWING INFORMATION

SERIAL NUMBER SYMBOL MODEL NUMBER

FAIRMONT, MN, 56031 U.S.A.

52400K

Instructions For Ordering Parts

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

Assemblies: When assemblies can be used, always order them to save work of fitting separate parts.

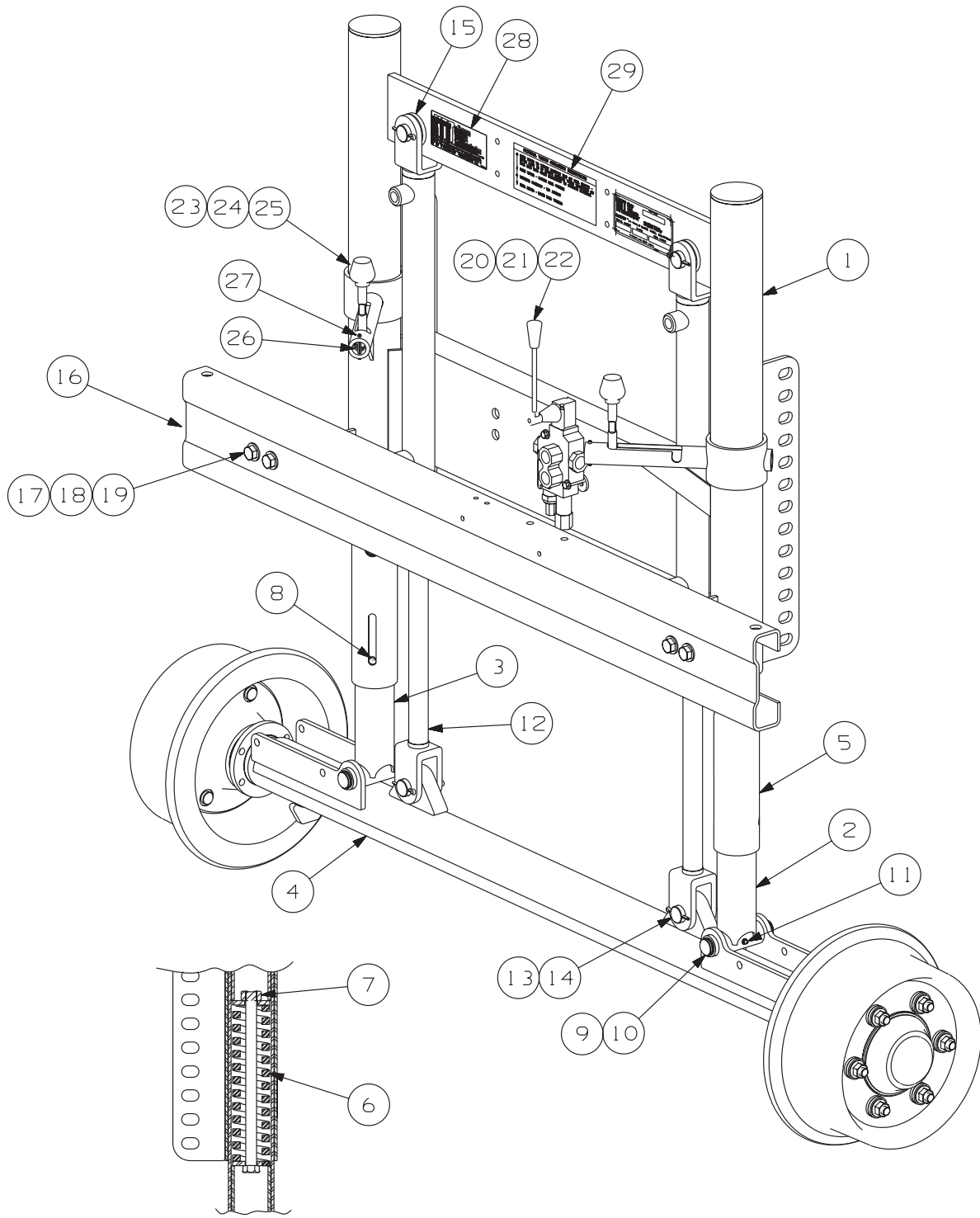
For convenience in ordering, parts are listed by item number, part number, description, and quantity (QTY) in each assembly or group. If in doubt as to any part wanted, send a full description, sketch, or send the old part with the order.

To insure prompt and correct shipment of parts on orders, always give:

1. Quantity of each part wanted.
2. Part number of each part as shown in this book. Include any prefix and suffix letters.
3. Description of each part as shown in this book.
4. Factory serial numbers from the serial number tag on the guide wheel unit.
5. Purchase order number (if required).
6. Preferred method of shipment.

All parts are shipped F.O.B. factory, transportation charges to be paid by customer. Terms to be determined by the Credit Department.

173142 GUIDE WHEEL UNIT - HR18A1



6

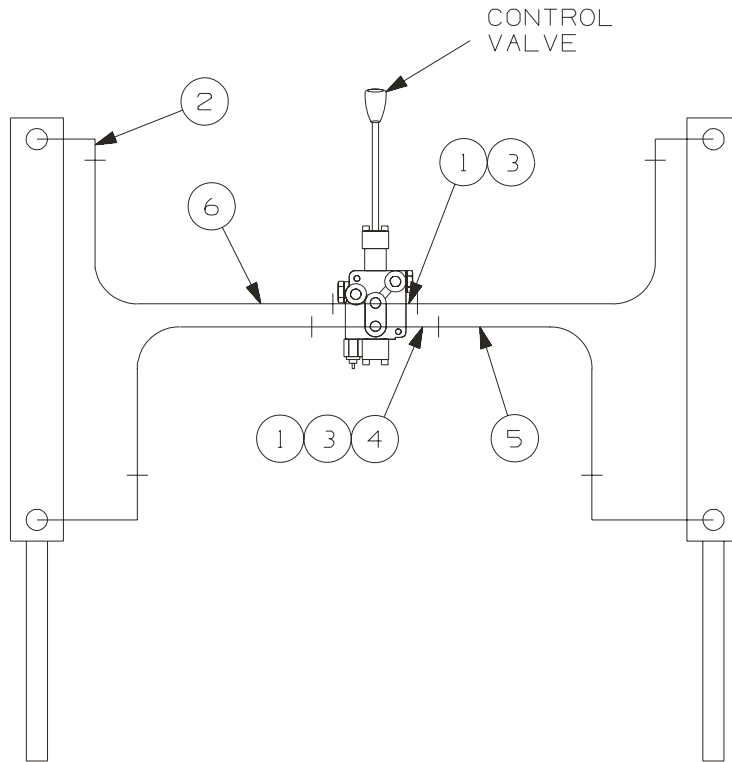
DETAIL A

SE173142A-1

173142 GUIDE WHEEL UNIT - HR18A1

ITEM	PART NO	DESCRIPTION	QTY
1	172463K	Frame	1
2	172466	Spring Cell, Left	1
3	172502	Spring Cell, Right	1
4	201634	Axle	1
5	172486	Tube	2
6	200318	Spring	2
7	190103	Hex Elastic Stop Nut, 5/8"-11 GR 5	2
8	174302	Roll Pin, 5/16 x 2-3/8"	2
9	172497	Pin	2
10	F016070	Retaining Ring	4
11	F008014	Grease Fitting	2
12	172495	Hydraulic Cylinder	2
13	170356	Pin	4
14	F002931	Cotter Pin, 5/32 x 1-1/2"	8
15	F001908	Wrought Washer	4
16	140790	Bumper	1
17	F001539	Cap Screw, 1/2-13 x 1-1/4" GR 5 Hex Hd	4
18	F002965	SAE Washer, 1/2"	4
19	F022037	Hex Flg Nut, 1/2"-13	4
20	184462	Control Valve	1
	FOR006555	Replacement Handle	1
21	F023403	Cap Screw, 1/4-20 x 1-1/4" GR 5 Hex Flg Hd	2
22	F022138	Hex Flg Nut, 1/4"-20	2
23	F014260K	Ball Handle	2
24	178105	Stud	2
25	184074	Pin	2
26	F017912	Compression Spring	2
27	700751150	Roll Pin, 3/16" x 1-1/2"	2
28	191761	Decal, Harsco Track Technologies	1
29	184073	Decal, Control Valve Operating Instructions	1

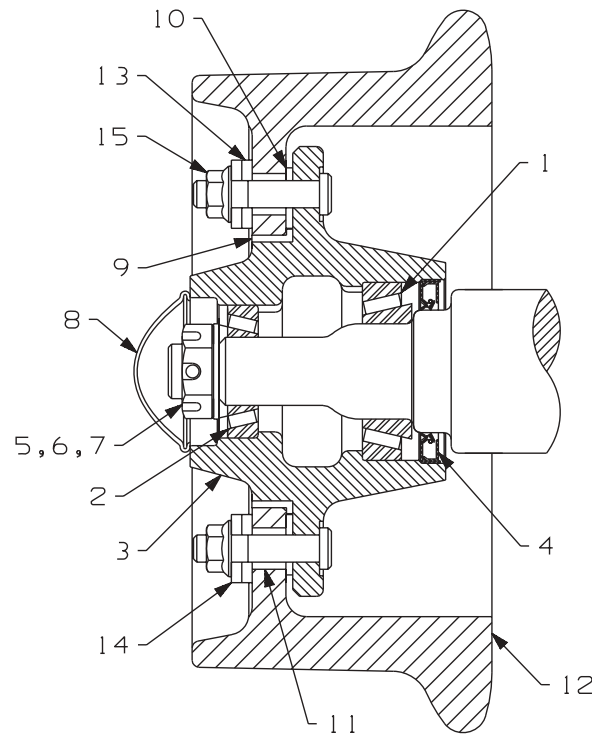
173142 GUIDE WHEEL UNIT - HYDRAULIC PIPING - HR18A1



6

ITEM	PART NO	DESCRIPTION	QTY
1	F013518	Adapter, 9/16 M JIC x 3/4 M STR	2
2	F013327	90° Elbow, 9/16 M JIC x 9/16 M STR.	4
3	F015626	Tee, 9/16 M JIC x 9/16 M JIC x 9/16 F STR.	2
4	F024715	Adapter Restrictor	1
5	188663	Hose, 5/16 x 14" Swivel 9/16 F JIC Both Ends.	2
6	188666	Hose, 5/16 x 25-1/2" Swivel 9/16 F JIC Both Ends	2

173142 GUIDE WHEEL UNIT - GUIDE WHEEL - HR18A1

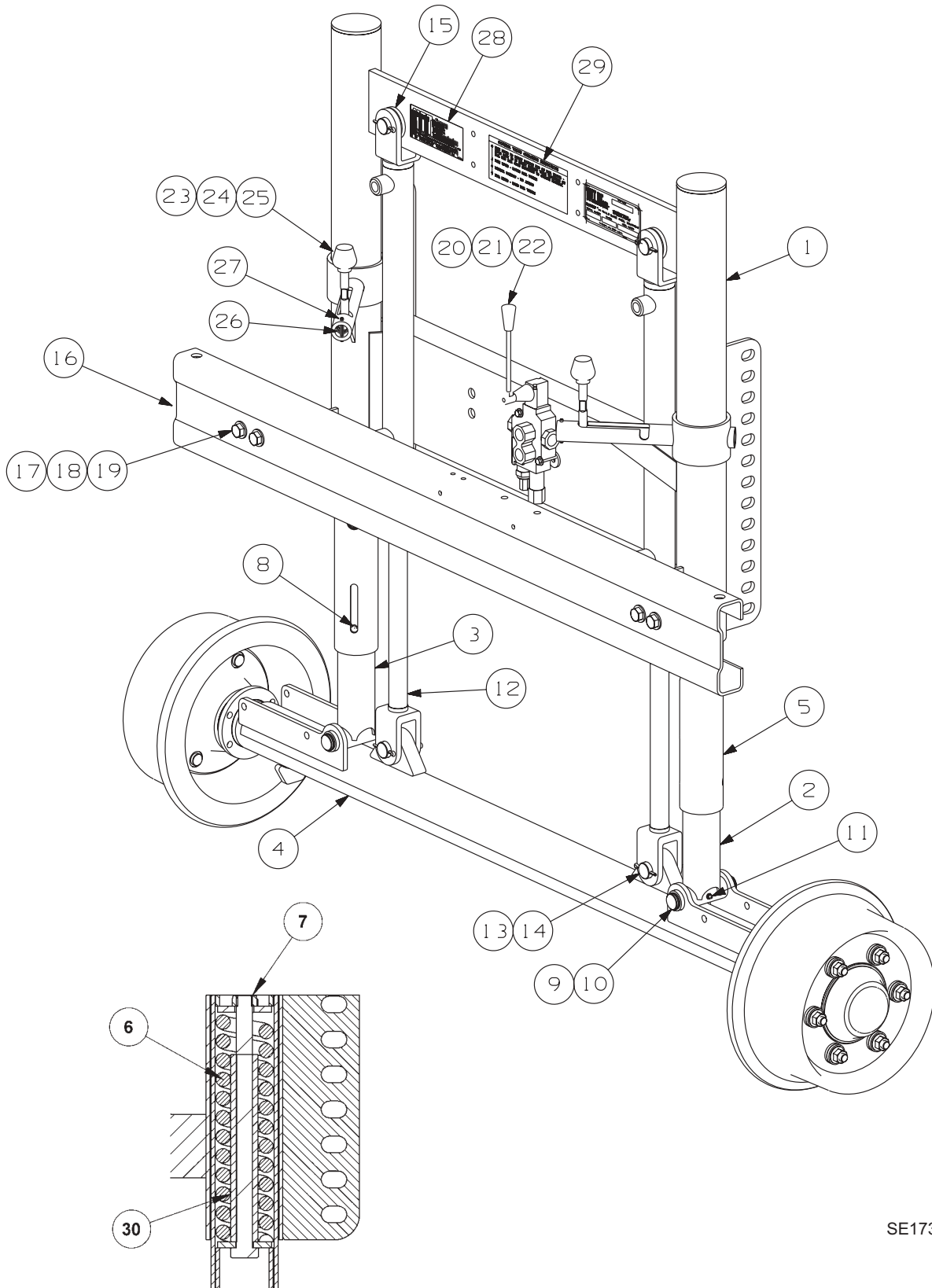


SE92A128A-1

Note: Quantities Listed Are For One Wheel Only.

ITEM	PART NO	DESCRIPTION	QTY
1	154745	Bearing Cup & Cone, Inside	1
2	157622	Bearing Cup & Cone, Outside	1
3	153739	HUB ASSEMBLY	1
3a	120884	Stud Bolt, 1/2-20 x 2-5/16"	6
4	F024339	Grease Seal	1
5	F008727	Axle Washer	1
6	F023270	Hex Slotted Nut, 1"	1
7	F001182	Cotter Pin, 1/8 x 1-1/4"	1
8	F023272	Dust Cap	1
9	108585	Insulating Flange	1
10	108586	Insulating Washer	1
11	100765	Insulating Bushing	6
12	140104	Guide Wheel	1
13	090177	Insulating Washer	6
14	072897	Washer, 33/64"	6
15	F021281	Hex Flg Nut, 1/2"-20	6

202619 GUIDE WHEEL UNIT - HR18A1-1



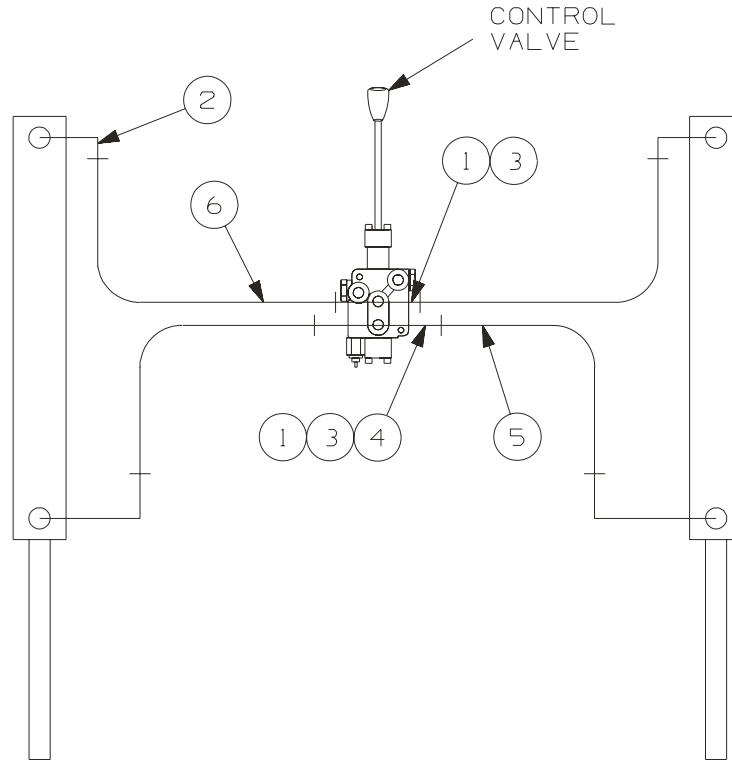
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SPRING DETAIL

202619 GUIDE WHEEL UNIT - HR18A1-1

ITEM	PART NO	DESCRIPTION	QTY
1	172463K	Frame	1
2	172466	Spring Cell, Left	1
3	172502	Spring Cell, Right	1
4	202604	Axle	1
5	172486	Tube	2
6	200318	Spring	2
7	190103	Hex Elastic Stop Nut, 5/8"-11 GR 5	2
8	174302	Roll Pin, 5/16 x 2-3/8"	2
9	172497	Pin	2
10	F016070	Retaining Ring	4
11	F008014	Grease Fitting	2
12	172495	Hydraulic Cylinder	2
13	170356	Pin	4
14	F002931	Cotter Pin, 5/32 x 1-1/2"	8
15	F001908	Wrought Washer	4
16	140790	Bumper	1
17	F001539	Cap Screw, 1/2-13 x 1-1/4" GR 5 Hex Hd	4
18	F002965	SAE Washer, 1/2"	4
19	F022037	Hex Flg Nut, 1/2"-13	4
20	184462	Control Valve	1
	FOR006555	Replacement Handle	1
21	F023403	Cap Screw, 1/4-20 x 1-1/4" GR 5 Hex Flg Hd	2
22	F022138	Hex Flg Nut, 1/4"-20	2
23	F014260K	Ball Handle	2
24	178105	Stud	2
25	184074	Pin	2
26	F017912	Compression Spring	2
27	700751150	Roll Pin, 3/16" x 1-1/2"	2
28	191761	Decal, Harsco Track Technologies	1
29	184073	Decal, Control Valve Operating Instructions	1
30	203118	Tube	2

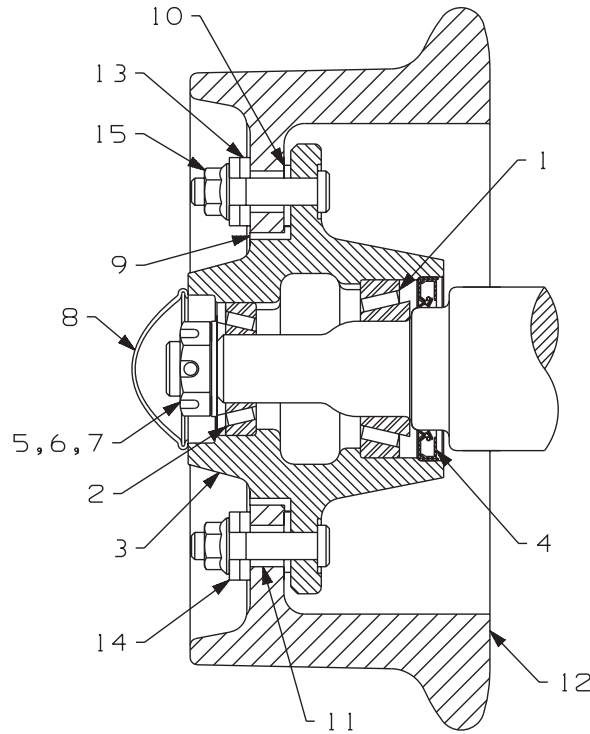
202619 GUIDE WHEEL UNIT - HYDRAULIC PIPING - HR18A1-1



6

ITEM	PART NO	DESCRIPTION	QTY
1	F013518	Adapter, 9/16 M JIC x 3/4 M STR	2
2	F013327	90° Elbow, 9/16 M JIC x 9/16 M STR.	4
3	F015626	Tee, 9/16 M JIC x 9/16 M JIC x 9/16 F STR.	2
4	F024715	Adapter Restrictor	1
5	188663	Hose, 5/16 x 14" Swivel 9/16 F JIC Both Ends.	2
6	188666	Hose, 5/16 x 25-1/2" Swivel 9/16 F JIC Both Ends	2

202619 GUIDE WHEEL UNIT - GUIDE WHEEL - HR18A1-1

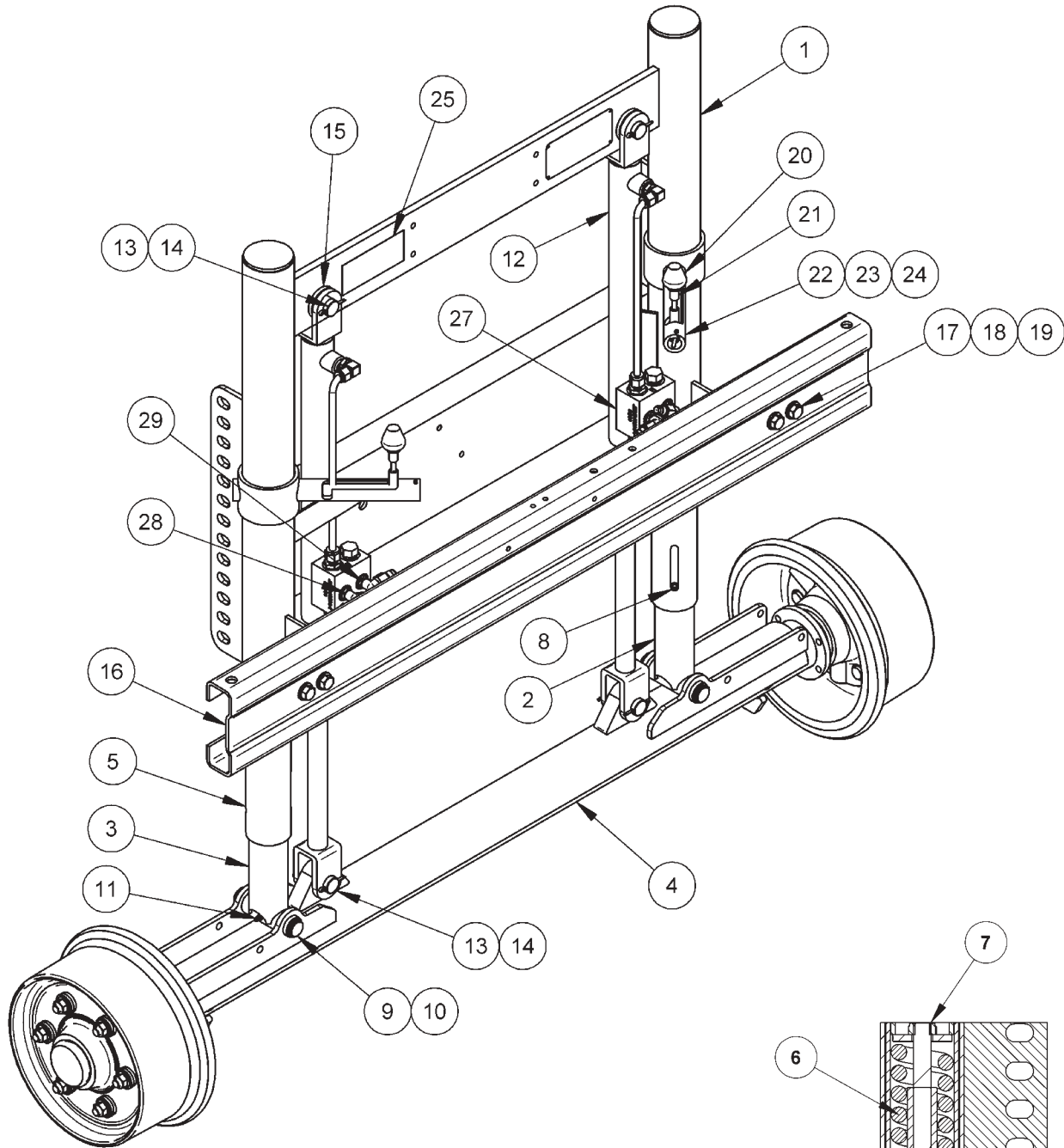


SE92A128A-1

Note: Quantities Listed Are For One Wheel Only.

ITEM	PART NO	DESCRIPTION	QTY
1	163176	Bearing Cup & Cone, Inside	1
2	163175	Bearing Cup & Cone, Outside	1
3	163177	HUB ASSEMBLY	1
3a	120884	Stud Bolt, 1/2-20 x 2-5/16"	6
4	F024339	Grease Seal	1
5	F008727	Axle Washer	1
6	F023270	Hex Slotted Nut, 1"	1
7	F001182	Cotter Pin, 1/8 x 1-1/4"	1
8	F023272	Dust Cap	1
9	108585	Insulating Flange	1
10	108586	Insulating Washer	1
11	100765	Insulating Bushing	6
12	140104	Guide Wheel	1
13	090177	Insulating Washer	6
14	072897	Washer, 33/64"	6
15	F021281	Hex Flg Nut, 1/2"-20	6

203935 GUIDE WHEEL UNIT - HR18A1-2



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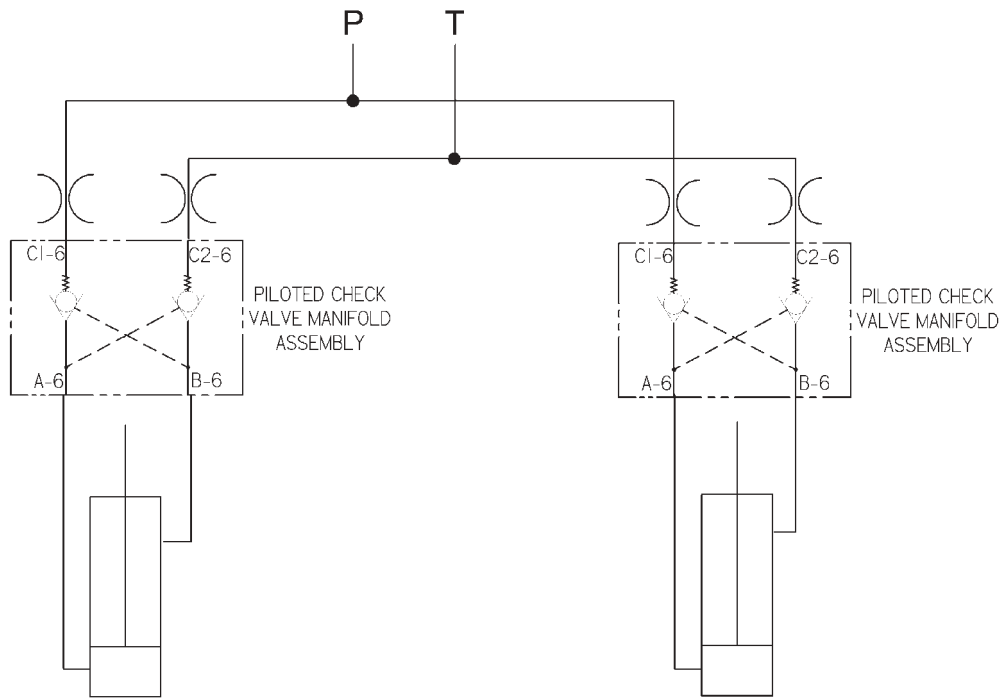
SE203935-B

SPRING DETAIL

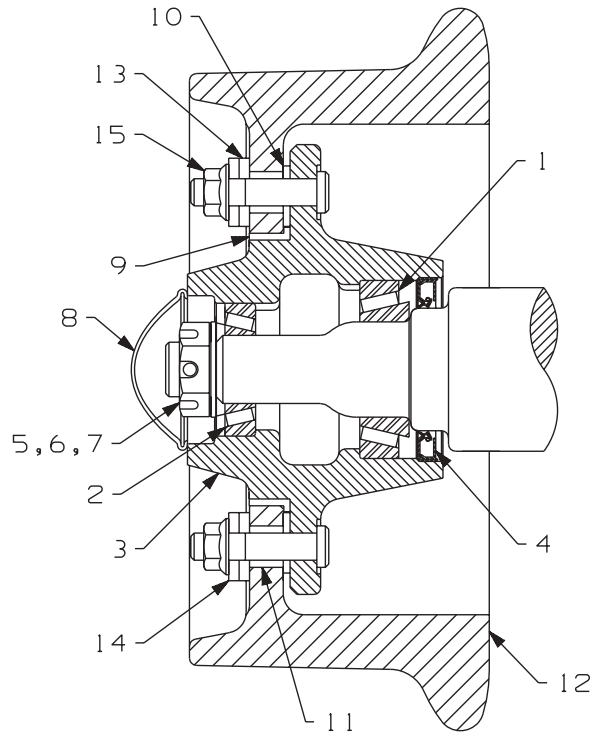
203935 GUIDE WHEEL UNIT - HR18A1-2

ITEM	PART NO	DESCRIPTION	QTY
1	172463K	Frame	1
2	172466	Spring Cell, Left	1
3	172502	Spring Cell, Right	1
4	202604	Axle	1
5	172486	Tube	2
6	200318	Spring	2
7	190103	Hex Elastic Stop Nut, 5/8"-11 GR 5	2
8	174302	Roll Pin, 5/16 x 2-3/8"	2
9	172497	Pin	2
10	F016070	Retaining Ring	4
11	F008014	Grease Fitting	2
12	172495	Hydraulic Cylinder	2
13	170356	Pin	4
14	F002931	Cotter Pin, 5/32 x 1-1/2"	8
15	F001908	Wrought Washer	4
16	140790	Bumper	1
17	F001539	Cap Screw, 1/2-13 x 1-1/4" GR 5 Hex Hd	4
18	F002965	SAE Washer, 1/2"	4
19	F022037	Hex Flg Nut, 1/2"-13	4
20	F014260K	Ball Handle	2
21	178105	Stud	2
22	184074	Pin	2
23	F017912	Compression Spring	2
24	700751150	Roll Pin, 3/16" x 1-1/2"	2
25	191761	Decal, Harsco Track Technologies	1
26	203118	Tube	2
27	203933	MANIFOLD ASSEMBLY (includes tube and fittings)	2
	203931	Replacement Tube	1
28	F013327	90° Elbow, 9/16 M JIC x 9/16 M STR	4
29	F024715	Adapter Restrictor	4

203935 GUIDE WHEEL UNIT - HYDRAULIC SCHEMATIC - HR18A1-2



203935 GUIDE WHEEL UNIT - GUIDE WHEEL - HR18A1-2



SE92A128A-1

Note: Quantities Listed Are For One Wheel Only.

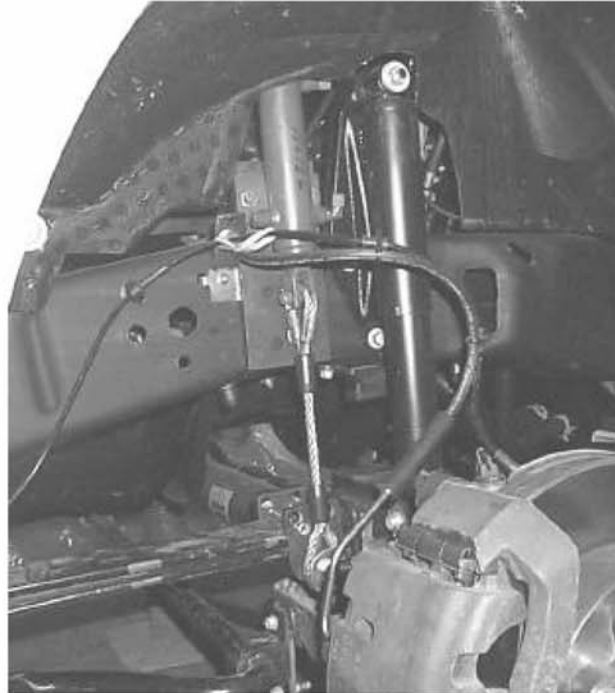
ITEM	PART NO	DESCRIPTION	QTY
1	163176	Bearing Cup & Cone, Inside	1
2	163175	Bearing Cup & Cone, Outside	1
3	163177	HUB ASSEMBLY	1
3a	120884	Stud Bolt, 1/2-20 x 2-5/16"	6
4	F024339	Grease Seal	1
5	F008727	Axle Washer	1
6	F023270	Hex Slotted Nut, 1"	1
7	F001182	Cotter Pin, 1/8 x 1-1/4"	1
8	F023272	Dust Cap	1
9	108585	Insulating Flange	1
10	108586	Insulating Washer	1
11	100765	Insulating Bushing	6
12	140104	Guide Wheel	1
13	090177	Insulating Washer	6
14	072897	Washer, 33/64"	6
15	F021281	Hex Flg Nut, 1/2"-20	6

187161 HYDRAULIC AXLE LOCK GROUP

PART NO	DESCRIPTION	QTY
187095	SIGN PLATE ASSEMBLY	1
187098	Plate	1
187152	PLATE ASSEMBLY	1
187096	Plate	1
187097	Angle	2
F018861	Cap Screw, 1/2-13 x 2-1/4" GR 8 Hex Hd	1
186283	Axle Lock Decal	1
187099	Hydraulic Cylinder	1
F014487	Elastic Stop Nut, 1/2"-13	1
187215	Cap Screw, 5/16-18 x 1-3/4" Hex Hd	1
F014476	Elastic Stop Nut, 5/16"	2
F018615	SAE Washer, 5/16"	1
F014734	90° Elbow, 7/16 M JIC x 7/16 M STR	2
188288	Control Valve	1
188287	Manifold	1
186287	Plate	4
F025499	Cap Screw, 5/8-11 x 6" GR 8 Hex Hd	2
F001121	Washer	4
F017188	Hex Elastic Stop Nut, 5/8"-11	2
187084	Cable (order Service Group #192398) (replaces both cables with chains)	2
187083	Plate	2
F002690	Cap Screw, 3/8-16 x 4-1/2" GR 5 Hex Hd	4
F011998	Elastic Stop Nut, 3/8"-16	4
F009681	SAE Washer, 3/8"	4
F023674	Cap Screw, 1/2-13 x 1-3/4" GR 8 Hex Hd	8
F002965	SAE Washer, 1/2"	8
F014487	Elastic Stop Nut, 1/2"-13	8
F005460	Yoke Pin Assembly	2
F001713	Cap Screw, 5/16-18 x 1-3/4" GR 5 Hex Hd	6
F014476	Elastic Stop Nut, 5/16"	6
F018615	SAE Washer, 5/16"	6
059412	Spacer	2
186282	Decal, Axle Lock	1
186186	Hydraulic Cylinder	2
F012504	Adapter, 9/16 M JIC x 9/16 M JIC	2
F024584	Adapter, 9/16 F JIC x 3/4 M STR	2
F019294	90° Elbow, 9/16 M JIC x 3/4 M STR	2
F014734	90° Elbow, 7/16 M JIC x 7/16 M STR	4
115493	Hose, 3/16 x 43" Swivel 7/16 F JIC Both Ends	2
156859	Hose, 3/16 x 72" Swivel 7/16 F JIC Both Ends	2
160424	Hose, 3/16 x 88" Swivel 7/16 F JIC Both Ends	2
023211	Hydraulic Axle Lock Application	

187161 HYDRAULIC AXLE LOCK GROUP

**FORD SUPER DUTY F-SERIES
 HYDRAULIC AXLE LOCK APPLICATION**



HR99-014

CHANGE	R/L	REVISION	DATE
61494	D	CHANGE TO DIGITAL APPLICATION DRAWING	5-99

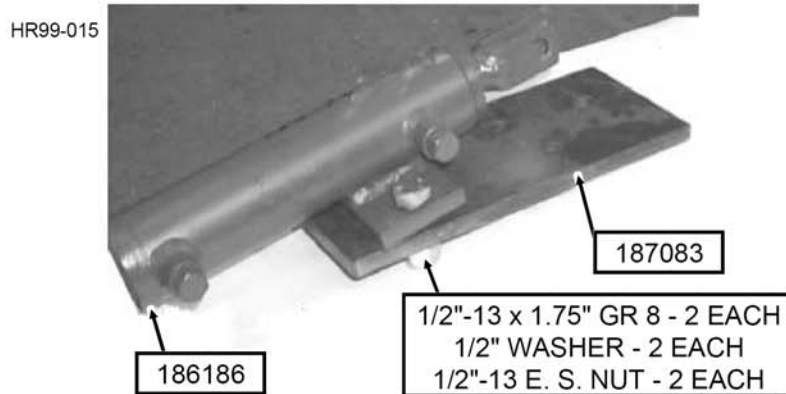
DR	ESK	APVD	DMW	APVD	TJB	CHKD
DATE	5-12-99	DRAWING	NUMBER	023211		

187161 HYDRAULIC AXLE LOCK GROUP

AXLE LOCK MOUNTING INSTRUCTIONS

CYLINDER MOUNTING

FIGURE 1
CYLINDER ASSEMBLY



1. Support vehicle so the axle is allowed to hang freely. Remove vehicle tires from front axle. THINK SAFETY.
2. See Figure 1. Plate 187083 has two sets of mounting holes for the cylinder. Bolt cylinder 186186 to plate 187083 in the lowest set of holes with 1/2"-13 x 1.75 GR 8 bolt, 1/2" washer, and 1/2"-13 elastic stop nut.
3. Install fittings and hydraulic hoses in cylinder ports. (See Hydraulic Piping Diagram - Page 5)
4. See Figures 2 and 3. Fasten the assembly to existing holes (A) in the frame using fasteners 1/2"-13 x 1.75 GR 8 bolt, 1/2" washer (on nut side only), and 1/2"-13 elastic stop nut. Holes in frame (A) may be required to be opened to .53 dia.

FIGURE 2
PASSENGER TRUCK RAIL

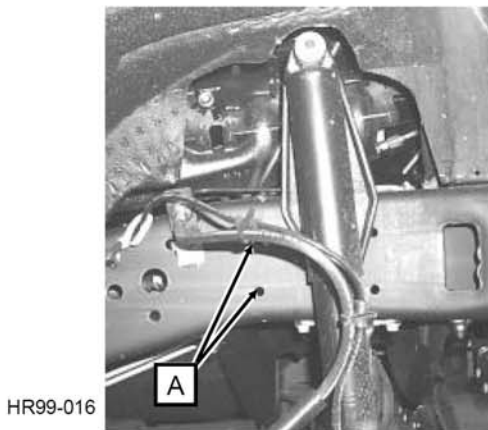
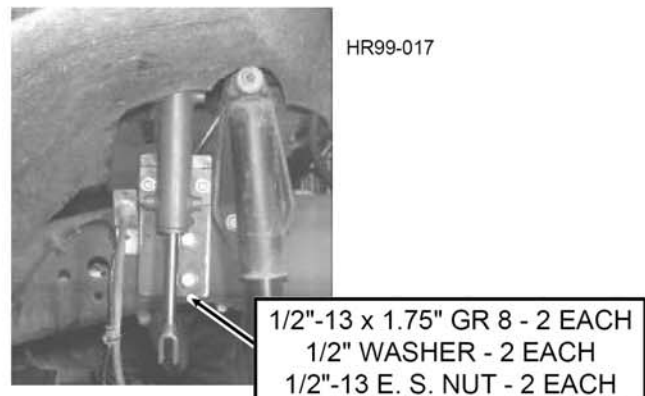


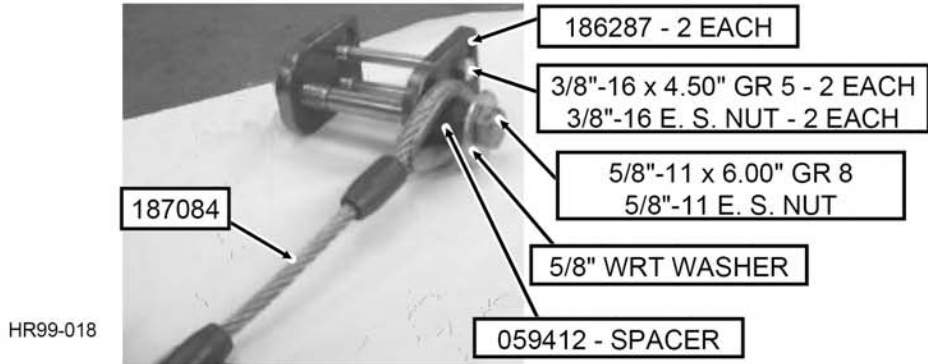
FIGURE 3
ASSEMBLY ON
PASSENGER RAIL



187161 HYDRAULIC AXLE LOCK GROUP

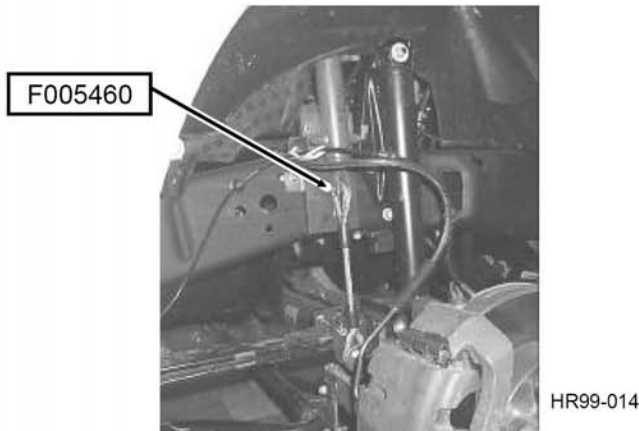
CYLINDER MOUNTING - continued

FIGURE 4
CABLE ASSEMBLY



5. See Figure 4. Fasten the two plates (186287) to the spring with two 3/8"-16 x 4.50" grade 5 bolts and 3/8"-16 elastic stop nuts for the top. At the bottom, use 5/8"-11 x 6.00" grade 8 bolt, tube (059412), 5/8" wrought washer, cable (187084), and 5/8"-11 elastic stop nut. Spring may need to be compressed together to obtain correct spacing on plates 186287.
6. See Figure 5. Use pin F005460 to connect cable to the cylinder.
7. With no load on the axle and the cylinder extended, the cable should be snug.
8. Re-install vehicle tires. Torque the lug nuts to the vehicle manufacture's specifications.

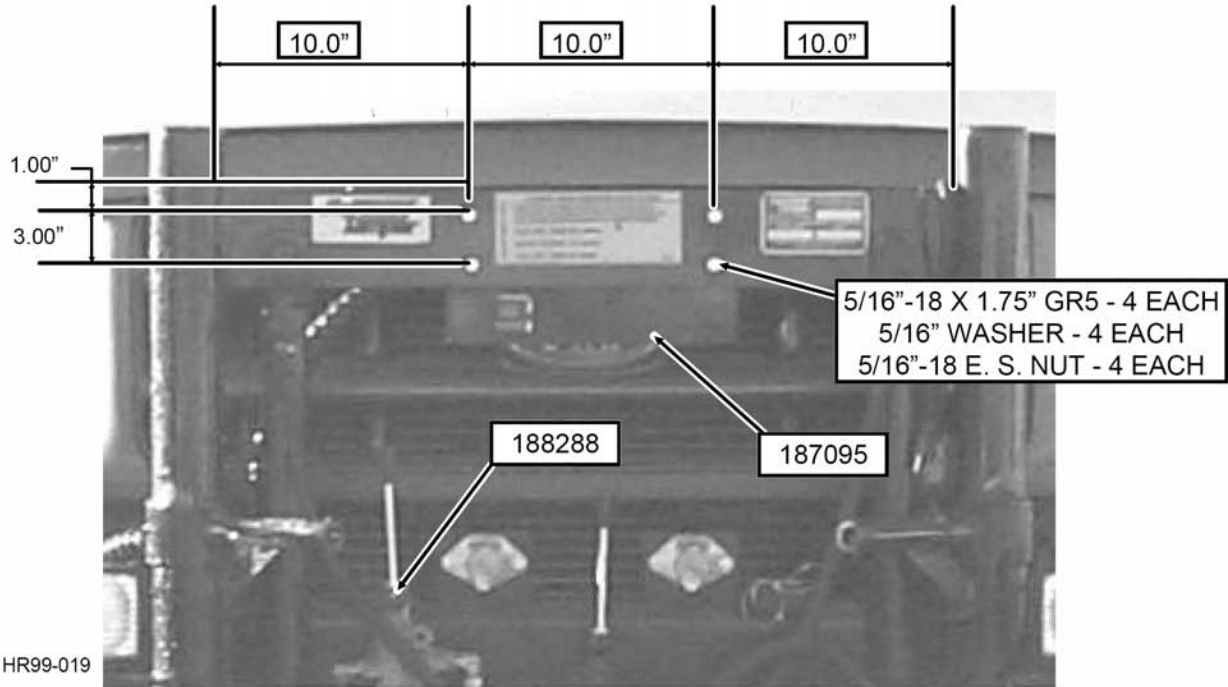
FIGURE 5
CYLINDER ASSEMBLY



187161 HYDRAULIC AXLE LOCK GROUP

SIGN PLATE ASSEMBLY MOUNTING

FIGURE 6
SIGN PLATE ASSEMBLY



6

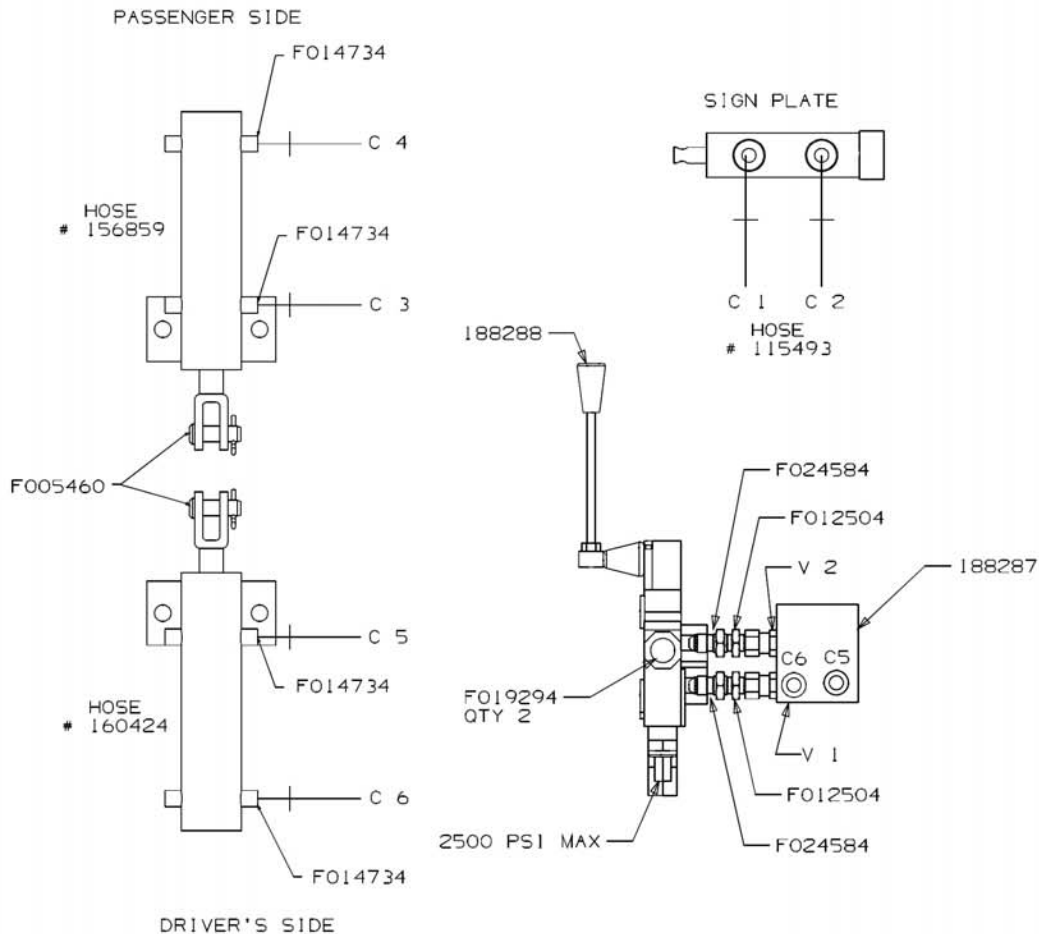
INSTALLATION OF SIGN PLATE ASSEMBLY

1. Drill (4) .34 diameter holes using dimensions shown. Mount plate assembly 187095 with 5/16" - 18 x 1.75 grade 5 bolt, 5/16" washer, and 5/16"-18 elastic stop nut.

187161 HYDRAULIC AXLE LOCK GROUP

HYDRAULIC PIPING DIAGRAM

FIGURE 7
HYDRAULIC PIPING FOR AXLE LOCKS



HYDRAULIC PIPING (INSTALLING HOSES ON CYLINDERS)

HR99-020

1. The sign plate cylinders, use hoses numbered 115493.
2. The passenger side cylinders, use hoses numbered 156859.
3. The driver side cylinders, use hoses numbered 160424.
4. Place fitting F014736 on manifold 188287 in ports C1-C6.
5. Cylinder ports are through ports, use the port that best suits the application.
6. Using the "T" port on the pilot unit control valve hose to the "P" port on the valve number 188288 using fittings F019294. The "T" port on valve 188288 goes to the "in" port on the rear pilot unit.

187161 HYDRAULIC AXLE LOCK GROUP

BILL OF MATERIAL

QTY	PART NO	DESCRIPTION
2	059412	SPACER
2	115493	HOSE ASSEMBLY
2	156859	HOSE ASSEMBLY
2	160424	HOSE ASSEMBLY
2	186186	CYLINDER
1	186282	DECAL
4	186287	PLATE
2	187083	PLATE
2	187084	CABLE
1	187095	SIGN PLATE ASSEMBLY
1	188287	MANIFOLD
1	188288	CONTROL VALVE
8	F023674	HEX HEAD CAP SCREW - 1/2" - 13 x 1.75" GR8
2	F001121	WROUGHT WASHER - 5/8"
8	F002965	SAE WASHER - 1/2"
4	F001713	HEX HEAD CAP SCREW - 5/16" - 18 x 1.75" GR5
4	F002690	HEX HEAD CAP SCREW - 3/8" - 16 x 4.50" GR5
2	F025499	HEX HEAD CAP SCREW - 5/8" - 11 x 6.00" GR8
2	F005460	YOKE PIN ASSEMBLY
2	F012504	BULKHEAD UNION
8	F004487	ELASTIC STOP NUT - 1/2" - 13
4	F014476	ELASTIC STOP NUT - 5/16" - 18
4	F011998	ELASTIC STOP NUT - 3/8" - 16
2	F017188	ELASTIC STOP NUT - 5/8" - 11
4	F018615	SAE WASHER - 5/16"
4	F009681	SAE WASHER - 3/8"
2	F024584	HYDRAULIC ADAPTER
8	F014736	STR 4 x 4 SAE
2	F019294	ELBOW - 90° 6 x 8 SAE
4	F014734	ELBOW - 90° 4 x 4 SAE

6

188531 HYDRAULIC AXLE LOCK GROUP

PART NO	DESCRIPTION	QTY
187095	SIGN PLATE ASSEMBLY	1
187098	Plate	1
187152	PLATE ASSEMBLY	1
187096	Plate	1
187097	Angle	2
F018861	Cap Screw, 1/2-13 x 2-1/4" GR 8 Hex Hd	1
186283	Axle Lock Decal	1
187099	Hydraulic Cylinder	1
F014487	Elastic Stop Nut, 1/2"-13	1
187215	Cap Screw, 5/16-18 x 1-3/4" Hex Hd	1
F014476	Elastic Stop Nut, 5/16"	2
F018615	SAE Washer, 5/16"	1
F014734	90° Elbow, 7/16 M JIC x 7/16 M STR	2
188288	Control Valve	1
188287	Manifold	1
188429	Plate	4
188420	Cable (order Service Group #192398) (replaces both cables with chains)	2
187083	Plate	2
F002965	SAE Washer, 1/2"	8
F014487	Elastic Stop Nut, 1/2"-13	4
F005460	Yoke Pin Assembly	2
F001713	Cap Screw, 5/16-18 x 1-3/4" GR 5 Hex Hd	6
F014476	Elastic Stop Nut, 5/16"	6
F026081	Hex Flg Nut, 1/2"-13 GR 8	4
F023386	Cap Screw, 1/2-13 x 1-1/2" GR 5 Hex Flg Hd	4
F016095	Elastic Stop Nut, 7/16"-14	4
F023111	Washer	4
F016108	Cap Screw, 7/16-14 x 1-3/4" GR 8 Hex Hd	4
F024396	Cap Screw, 1/2-13 x 6-1/2" GR 8 Hex Hd	4
F023012	Hardened Washer	2
188443	Hex Half Nut, Self Locking	1
F018615	SAE Washer, 5/16"	6
186186	Hydraulic Cylinder	2
188444	Hydraulic Hose Group	1
186282	Decal, Axle Lock	1
F017188	Hex Elastic Stop Nut, 5/8"-11	2
095576	Spacer	4
188442	Carriage Bolt, 5"	2
F020964	Collar	4
023422	Hydraulic Axle Lock Application	

188531 HYDRAULIC AXLE LOCK GROUP

**FORD SUPER DUTY F-SERIES
 HYDRAULIC AXLE LOCK APPLICATION**



HR99-027

6

CHANGE	R/L	REVISION	DATE
62450	A	CHG F023424 FLANGE BOLT	1/00

DR	DMW	APVD	DMW	APVD	TJB	CHKD
DATE	9-16-99	DRAWING		NUMBER	023422	

188531 HYDRAULIC AXLE LOCK GROUP

CYLINDER MOUNTING

1. Support vehicle so the axle is allowed to hang freely. Remove vehicle tires from front axle. THINK SAFETY.
2. See Photo 1. Mounting plate, 187083, has two sets of mounting holes for the cylinders. Bolt cylinder, 186186, to mounting plate 187083 in the lowest set of holes with 1/2"-13 x 1- 1/2" flange bolt, 1/2"-13 flange nut.
3. Install hydraulic fittings and hoses in cylinder ports, #4 o'ring 90 degree fitting in the top port and a #4 o'ring straight, in the bottom port. Attach hoses per print. Drivers side is mirrored (Ref. photo 2 and Hydraulic Piping Diagram on Page 6).

PHOTO 1
CYLINDER ASSEMBLY PASSENGER SIDE

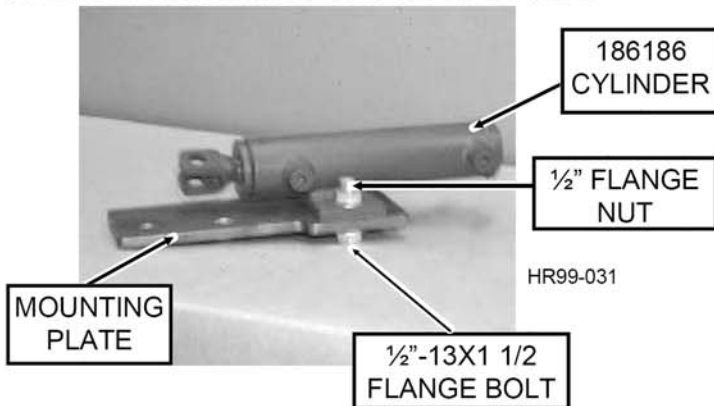


PHOTO 2
PASSENGER'S SIDE



4. See Photo 3 and 4. Bolt the assembly to existing holes (A) in the frame using 7/16"-14 x 1- 3/4" GR 8 bolt, 7/16" washer (nut side only), 7/16"-14 elastic stop nut, on the inside of the truck frame.

PHOTO 3
PASSENGER TRUCK
FRAME

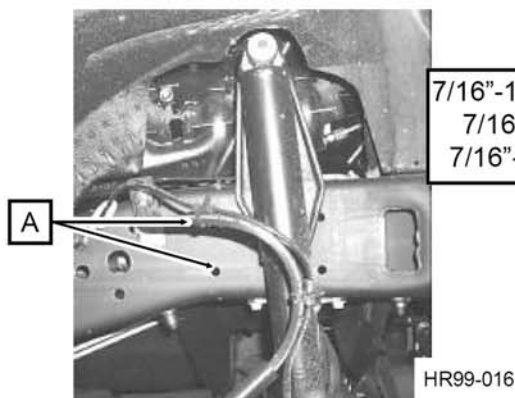
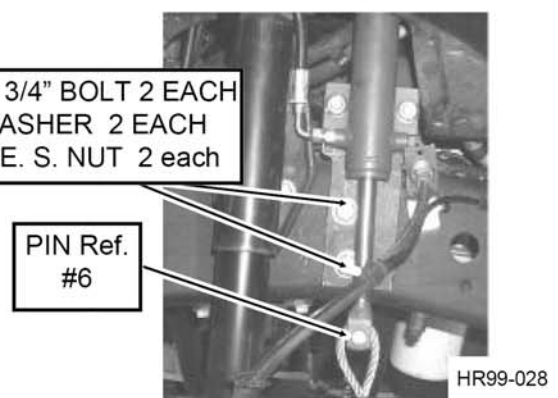
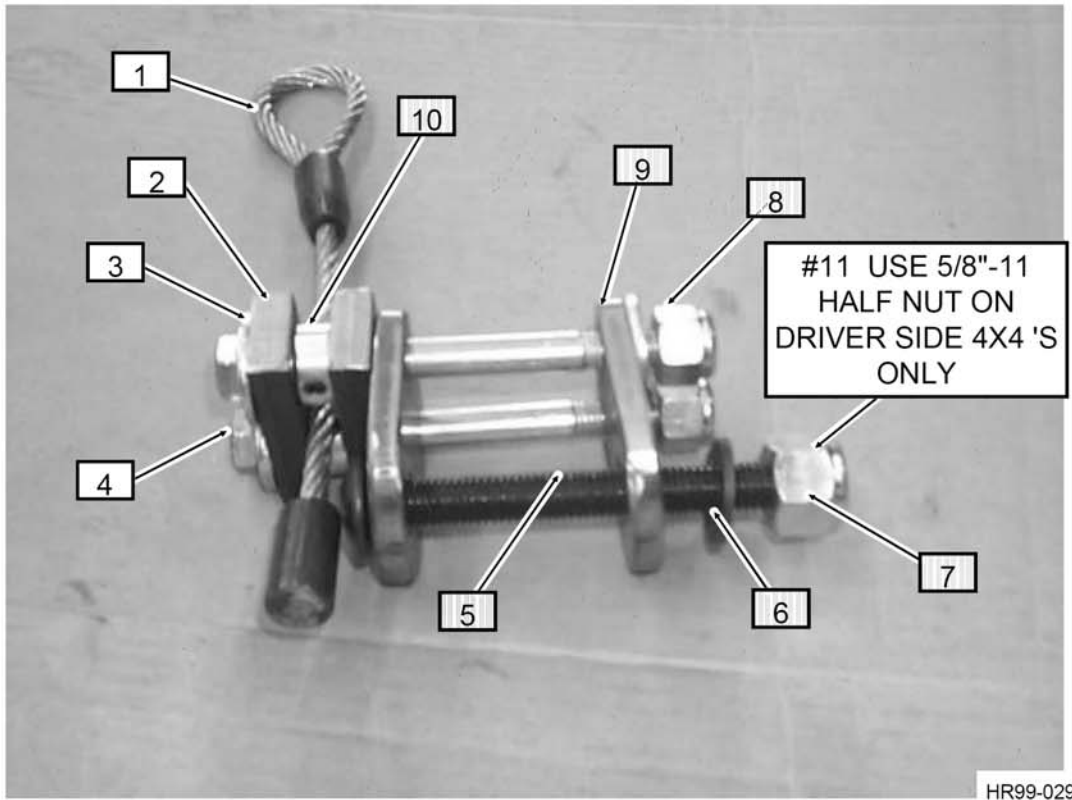


PHOTO 4
ASSEMBLY ON DRIVERS
SIDE FRAME



188531 HYDRAULIC AXLE LOCK GROUP

PHOTO 5
DRIVERS SIDE



6

ITEM	PART NUMBER	QTY. PER SIDE	DESCRIPTION
1	188420	1	CABLE
2	095576	2	SPACER BAR
3	F002965	4	1/2" WASHER
4	F024396	2	HEX HEAD CAP SCREW 1/2"-13X6-1/2"
5	188442	2	5/8"-11 X5" CARRIAGE BOLT
6	F023012	1	5/8" WASHER
7	F017188	1	5/8"-11 ELASTIC STOP NUT
8	F014487	1	1/2"-13 ELASTIC STOP NUT
9	188429	2	SPRING PLATE
10	F020964	2	ROUND SPACER
11	188443	1	5/8"-11 ELASTIC STOP HALF NUT

188531 HYDRAULIC AXLE LOCK GROUP

PASSENGER SIDE
4 X 2 / 4 X 4



HR99-027

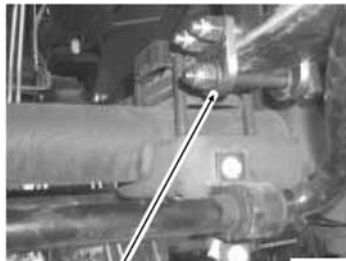
CABLE TO
BE +/- 2 DEGREE'S

DRIVER SIDE
4 X 2 / 4 X 4



HR99-033

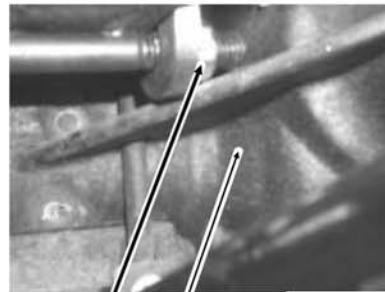
PASSENGER SIDE
4 X 2 / 4 X 4



HR99-032

AS CLOSE TO THE
AXLE AS POSSIBLE

DRIVER SIDE
4 X 4



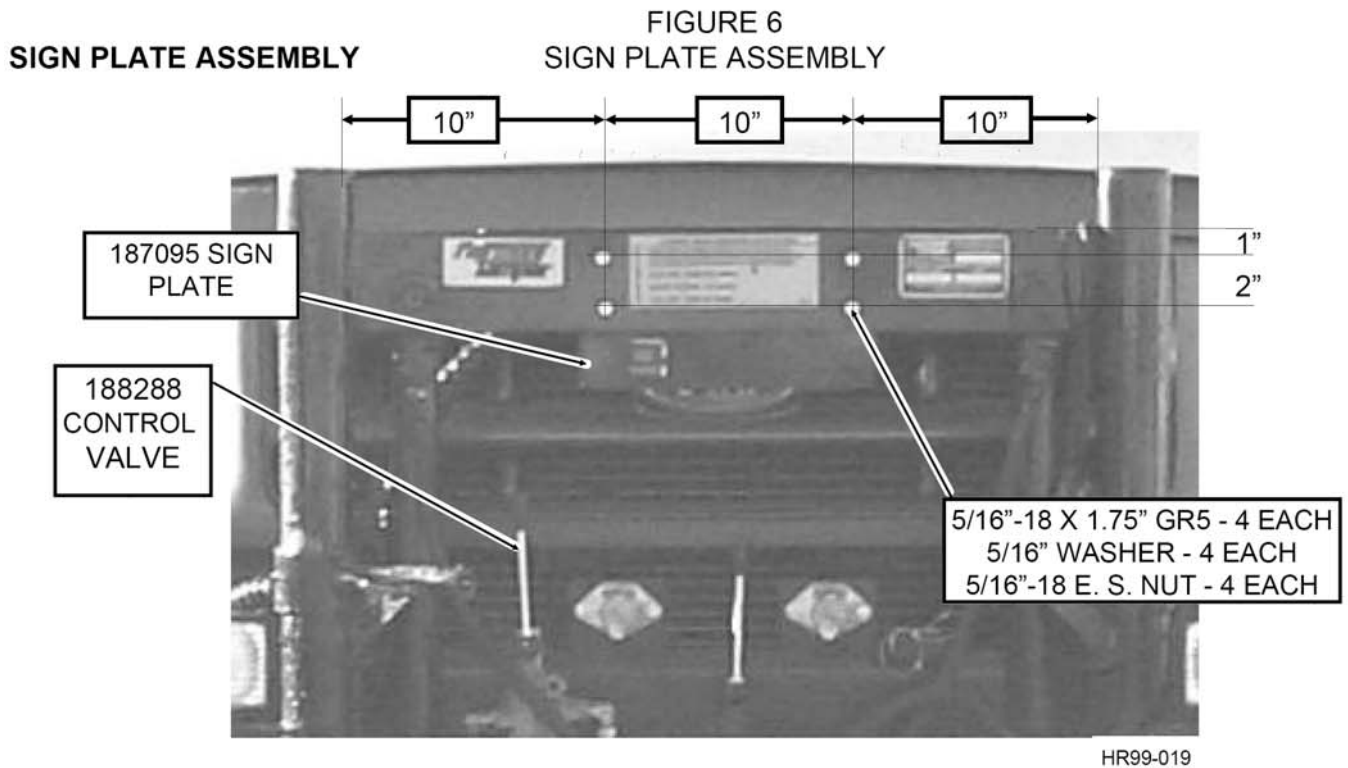
HR99-034

HALF NUT

4 X 4 HOUSING

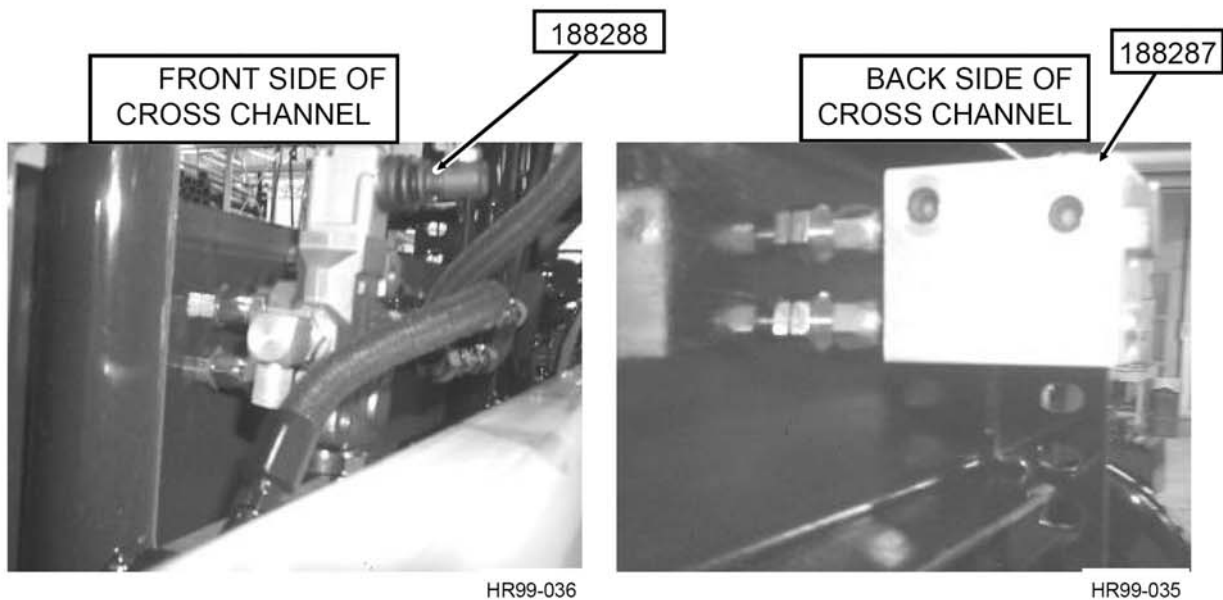
6. Install spring clamp assembly to the back side of the axle on vehicle spring, as close to the axle as possible with the cable on the out side of the spring. See photo's above.
7. See photo 4. Use pin F005460 to connect cable to cylinder.
8. With no load on the axle and the cylinder extended, the cable should be snug.
9. Re-install vehicle tires. Torque the lug nuts to the vehicle's manufacture's specifications.

188531 HYDRAULIC AXLE LOCK GROUP



6

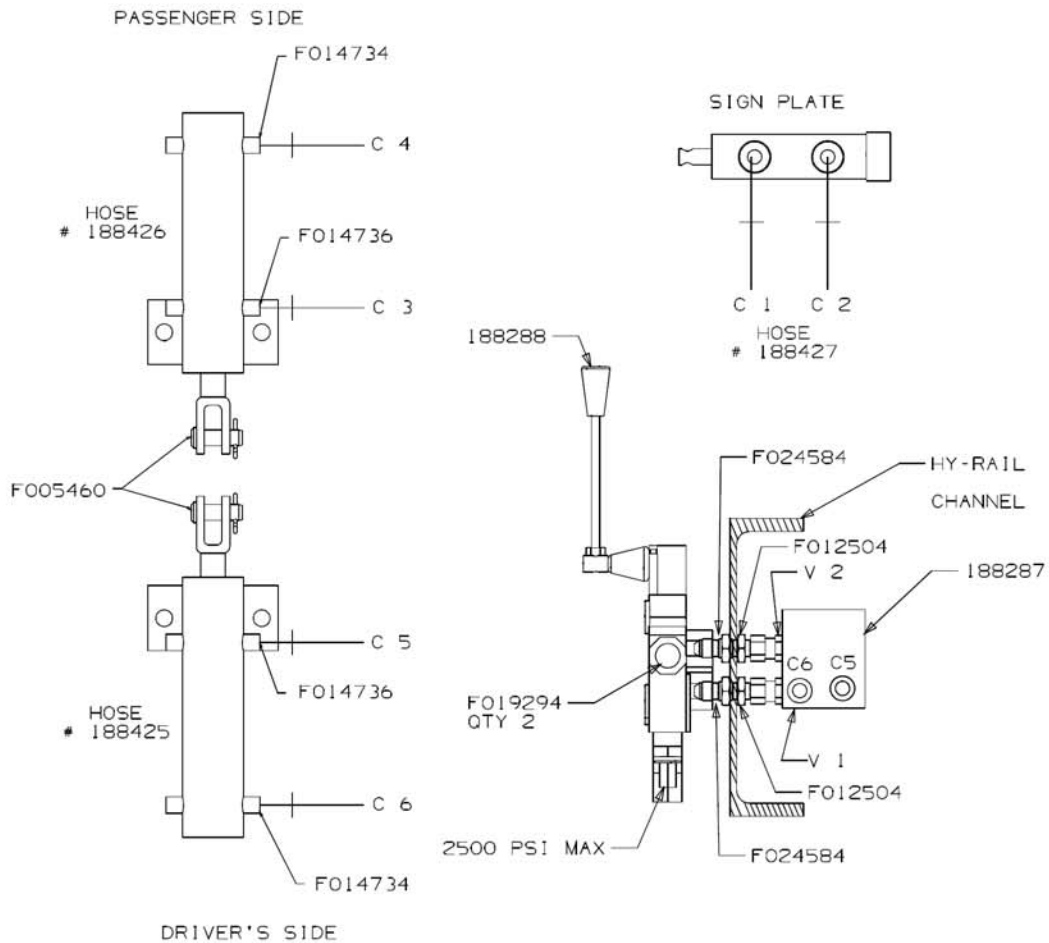
1. Drill (4) 5/16" diameter holes using dimensions shown. Mount plate assembly 187095 with 5/16" - 18 x 1- 3/4" grade 5 bolt, 5/16" washer, and 5/16"-18 elastic stop nut.



188531 HYDRAULIC AXLE LOCK GROUP

HYDRAULIC PIPING DIAGRAM

FIGURE 7
HYDRAULIC PIPING FOR AXLE LOCKS



HYDRAULIC PIPING (INSTALLING HOSES ON CYLINDERS)

1. The sign plate cylinders, use hoses numbered 188427.
2. The passenger side cylinders, use hoses numbered 188426
3. The driver side cylinders, use hoses numbered 188425
4. Place fitting F014736 on manifold 188287 in ports C1-C6.
5. Cylinder ports are through ports, use the port that best suits the application.
6. Using fittings F019294, and hose 188496, plumb the tank port of the front pilot unit, to the pressure port of the axle lock valve 188288. The tank port of the axle lock valve, plumb to the pressure port of the rear pilot unit.

188531 HYDRAULIC AXLE LOCK GROUP

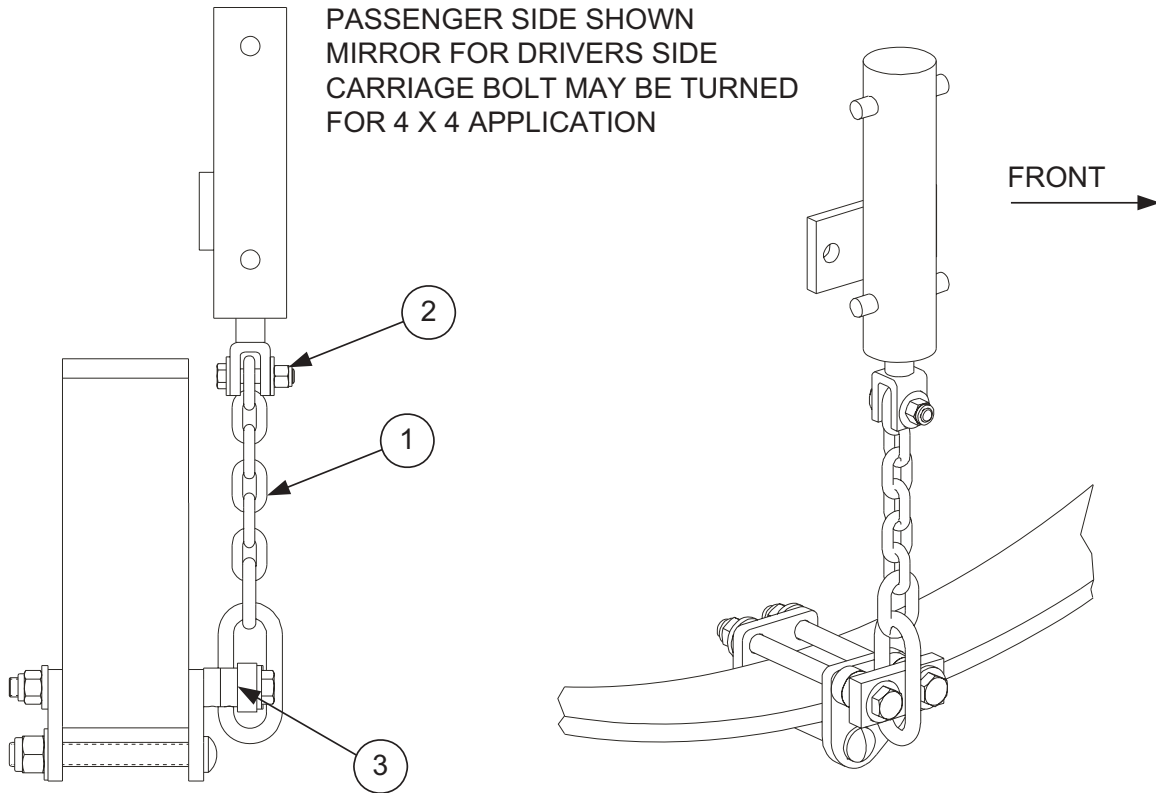
BILL OF MATERIAL

QTY	PART NO	DESCRIPTION
1	187095	SIGN PLATE ASSEMBLY
1	188288	CONTROL VALVE
1	188287	MANIFOLD
4	188429	PLATE
2	188420	CABLE
1	187083	PLATE
8	F002965	½" WASHER
4	F014487	½" - 13 ELASTIC STOP NUT
2	F005460	YOKE PIN ASSEMBLY
6	F001713	HEX HEAD CAP SCREW 5/16 "- 18 X 1-3/4"
6	F014476	5/16" ELASTIC STOP NUT
4	F026081	FLANGE NUT ½"
4	F023386	FLANGE BOLT ½"
4	F016095	7/16" ELASTIC STOP NUT
4	F002744	HARDENED WASHER 7/16"
4	F016108	HEX HEAD CAP SCREW 8 7/16 "- 14 X 1-3/4"
4	F024396	HEX HEAD CAP SCREW 8 ½" - 13 X 6 -½"
2	F023012	5/8" HARDENED WASHER
1	188443	SELF LOCKING HALF NUT 5/8" -11
6	F018615	5/16" WASHER
2	186186	CYLINDER
1	188444	HYD. HOSE GROUP
1	186282	AXLE LOCK DECAL
2	F017188	5/8" ELASTIC STOP NUT
4	095576	SPACER BAR
2	188442	5/8"-11 X 5" CARRIAGE BOLT
4	F020964	ROUND SPACER

6

192398 HYDRAULIC AXLE LOCK SERVICE GROUP

ITEM	PART NO	DESCRIPTION	QTY
	192398	HYDRAULIC AXLE LOCK SERVICE GROUP.....	1
1	192384	Lift Chain.....	2
2	193856	Fastener Kit Group.....	1
3	F020964	Collar.....	4



192399 HYDRAULIC AXLE LOCK GROUP

PART NO	DESCRIPTION	QTY
1 193856	Fastener Kit Group	1
2 095576	Spacer	2
3	Guide Wheel Unit (reference).	1
4 186186	Hydraulic Cylinder	2
5 186282	Axle Lock Decal	1
6 187083	Plate	2
7 187095	SIGN PLATE ASSEMBLY	1
187098	Plate	1
187152	PLATE ASSEMBLY	1
187096	Plate	1
187097	Angle	2
F018861	Cap Screw, 1/2-13 x 2-1/4" GR 8 Hex Hd	1
186283	Axle Lock Decal	1
187099	Hydraulic Cylinder.	1
F014487	Elastic Stop Nut, 1/2"-13	1
187215	Cap Screw, 5/16-18 x 1-3/4" Hex Hd	1
F014476	Elastic Stop Nut, 5/16"	2
F018615	SAE Washer, 5/16"	1
F014734	90° Elbow, 7/16 M JIC x 7/16 M STR	2
8 188287	Manifold	1
9 188288	Control Valve	1
10 188429	Plate	4
11 188442	Carriage Bolt, 5/8-11 x 5"	2
12 192384	Chain	2
13 F001713	Cap Screw, 5/16-18 x 1-3/4" GR 5 Hex Hd	4
14 F002965	Wrought Washer, 1/2"	4
15 F012504	Bulkhead Union	2
16 F013500	Elastic Stop Nut, 1/2"	4
17 F014476	Elastic Stop Nut, 5/16"	4
18 F014487	Elastic Stop Nut, 1/2"-13	4
19 F016108	Cap Screw, 7/16-14 x 1-3/4" GR 8 Hex Hd	4
20 F017188	Hex Elastic Stop Nut, 5/8"-11	2
21 F018615	Washer, 5/16"	4
22 F020964	Collar	8
23 F023012	Hardened Washer	2
24 F023111	Wrought Washer, 3/8"	4
25 F023674	Cap Screw, 1/2-13 x 1-3/4" Hex Hd	4
26 F024047	Washer.	8
27 F024396	Cap Screw, 1/2-13 x 6-1/2" GR 8 Hex Hd	4
28 F016095	Elastic Stop Nut, 7/16"-14	4
188444	Hydraulic Hose Group	1

6

192399 HYDRAULIC AXLE LOCK GROUP

MOUNTING INSTRUCTIONS:

1. INSTALLING COMPONENTS ON PILOT UNIT

- △ DRILL (4) .34 DIA. HOLES, USING DIM SHOWN MOUNT PLATE ASSY 187095 WITH F001713, F014476, F018615 FASTENERS.

CYLINDER MOUNTING

2. INSTALLING COMPONENTS ON TRUCK

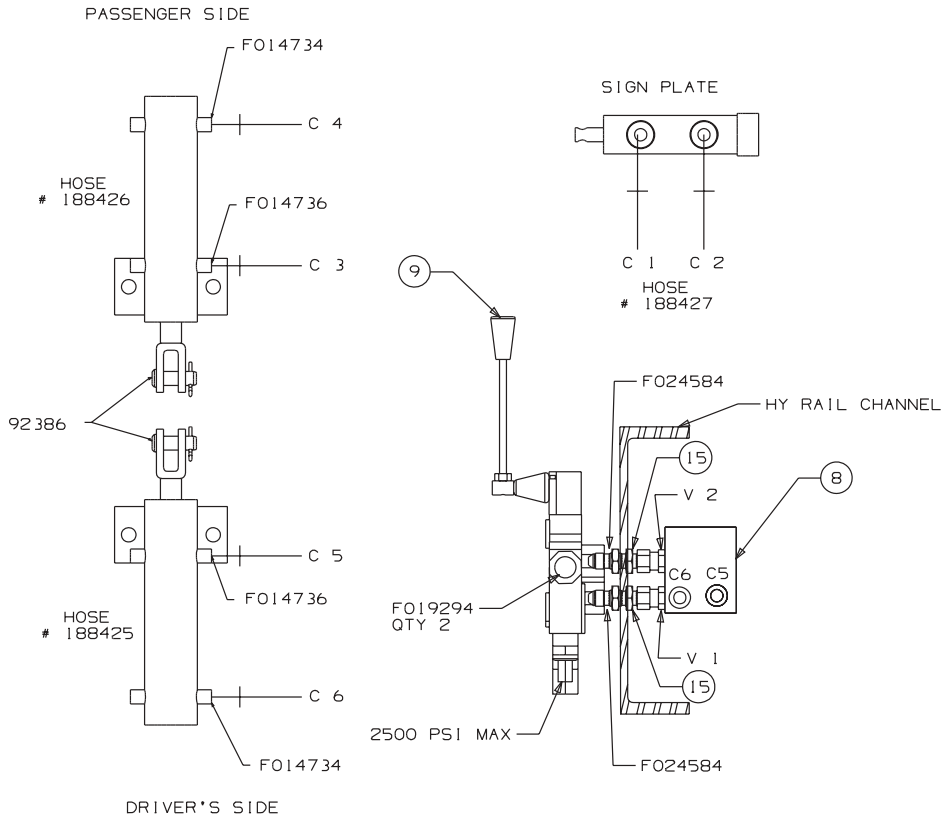
- △ SUPPORT VEHICLE SO THE AXLE IS ALLOWED TO HANG FREELY. REMOVE VEHICLE TIRES FROM FRONT AXLE. THINK SAFETY.
- △ PLATE 187083 HAS TWO SETS OF MOUNTING HOLES FOR THE CYLINDER. BOLT CYLINDER 186186 TO PLATE 187083 IN THE LOWEST SET OF HOLES WITH FASTENERS SHOWN.
- △ INSTALL FITTINGS AND HYD. HOSES IN CYLINDERS PORTS. SEE HYD. PIPING.
- △ FASTEN THE ASSEMBLY TO EXISTING HOLES IN THE FRAME. WITH F016108, F023111, AND F016095 AS FASTENERS.
- △ INSTALL PLATE 188429 TO SPRING WITH TWO F024396 BOLTS FOR THE TOP. AT THE BOTTOM USE BOLT 188442, WASHER F024047, AND LOCK NUT F017188. SPRING MAY NEED TO BE COMPRESSED TOGETHER TO OBTAIN CORRECT SPACING ON PLATES 188429.
- △ USE FASTENER GROUP 193856 TO CONNECT CHAIN TO THE CYLINDER.
- △ WITH NO LOAD ON THE AXLE AND THE CYLINDER EXTENDED, THE CHAIN SHOULD BE SNUG.
- △ RE-INSTALL VEHICLE TIRES, RE-TORQUE TO VEHICLE SPECS.

HYDRAULIC PIPING

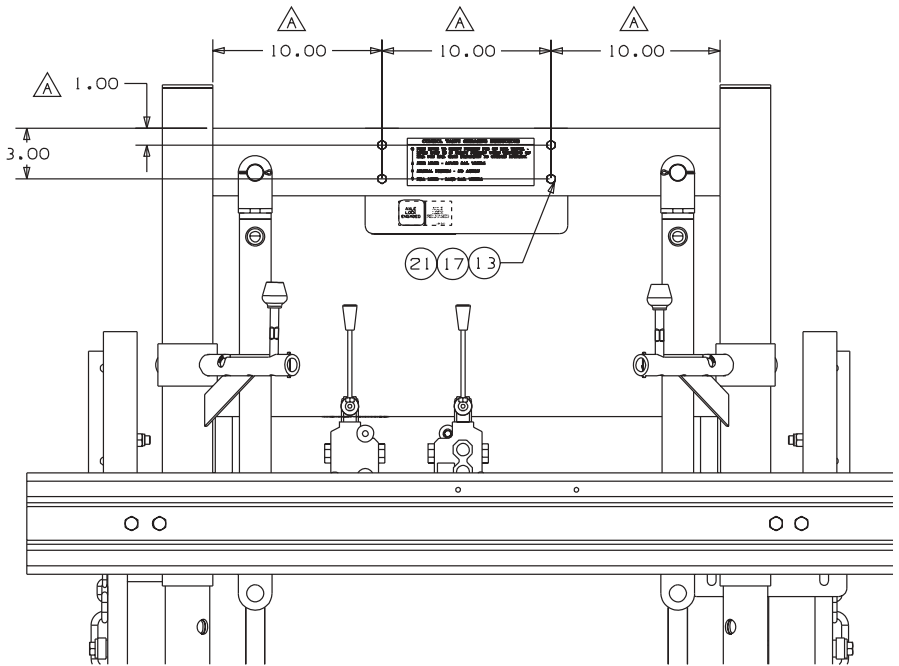
3. INSTALLING HOSES ON CYLINDERS

- A) THE SIGN PLATE CYLINDERS,
USE HOSES NUMBERED 188427.
- B) THE PASSENGER SIDE CYLINDERS,
USE HOSES NUMBERED 188426.
- C) THE DRIVER SIDE CYLINDERS,
USE HOSES NUMBERED 188425.
- D) PLACE FITTING F014736 ON
MANIFOLD 188287 IN PORTS C1-C6.
- E) CYLINDER PORTS ARE THUR PORTS,
USE THE PORT THAT BEST SUITS THE
APPLICATION.
- F) USING THE "T" PORT ON THE PILOT
UNIT CONTROL VALVE HOSE TO THE "P"
PORT ON THE VALVE NO 188288 USING
FITTINGS F019294. THE "T" PORT ON
ON VALVE 188288 GOES TO THE "IN"
PORT ON THE REAR PILOT UNIT.

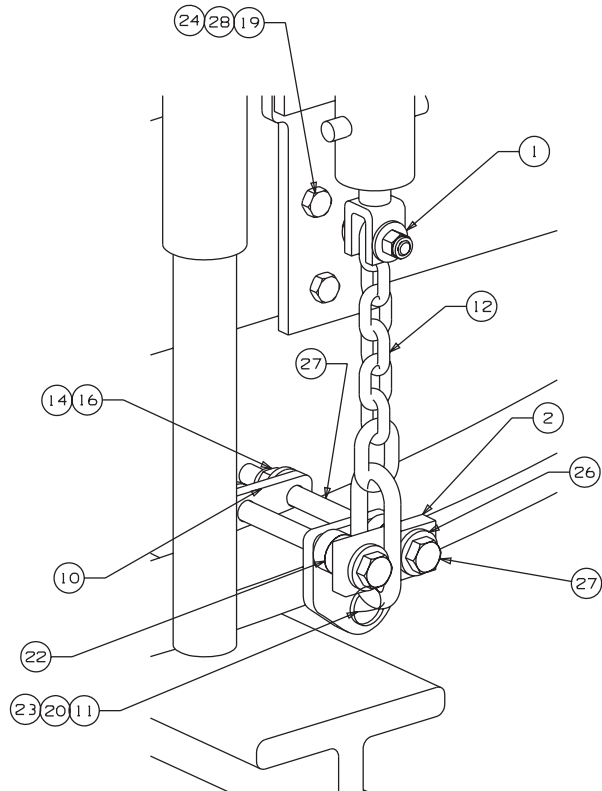
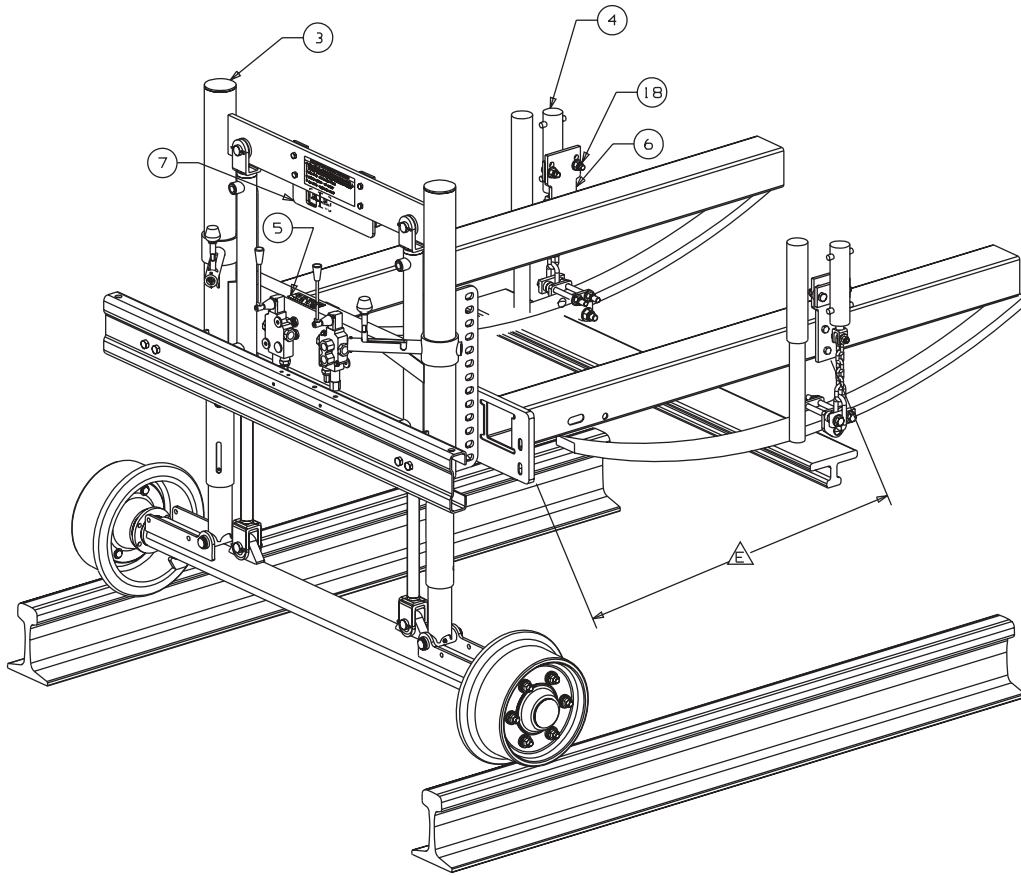
192399 HYDRAULIC AXLE LOCK GROUP



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192399 HYDRAULIC AXLE LOCK GROUP



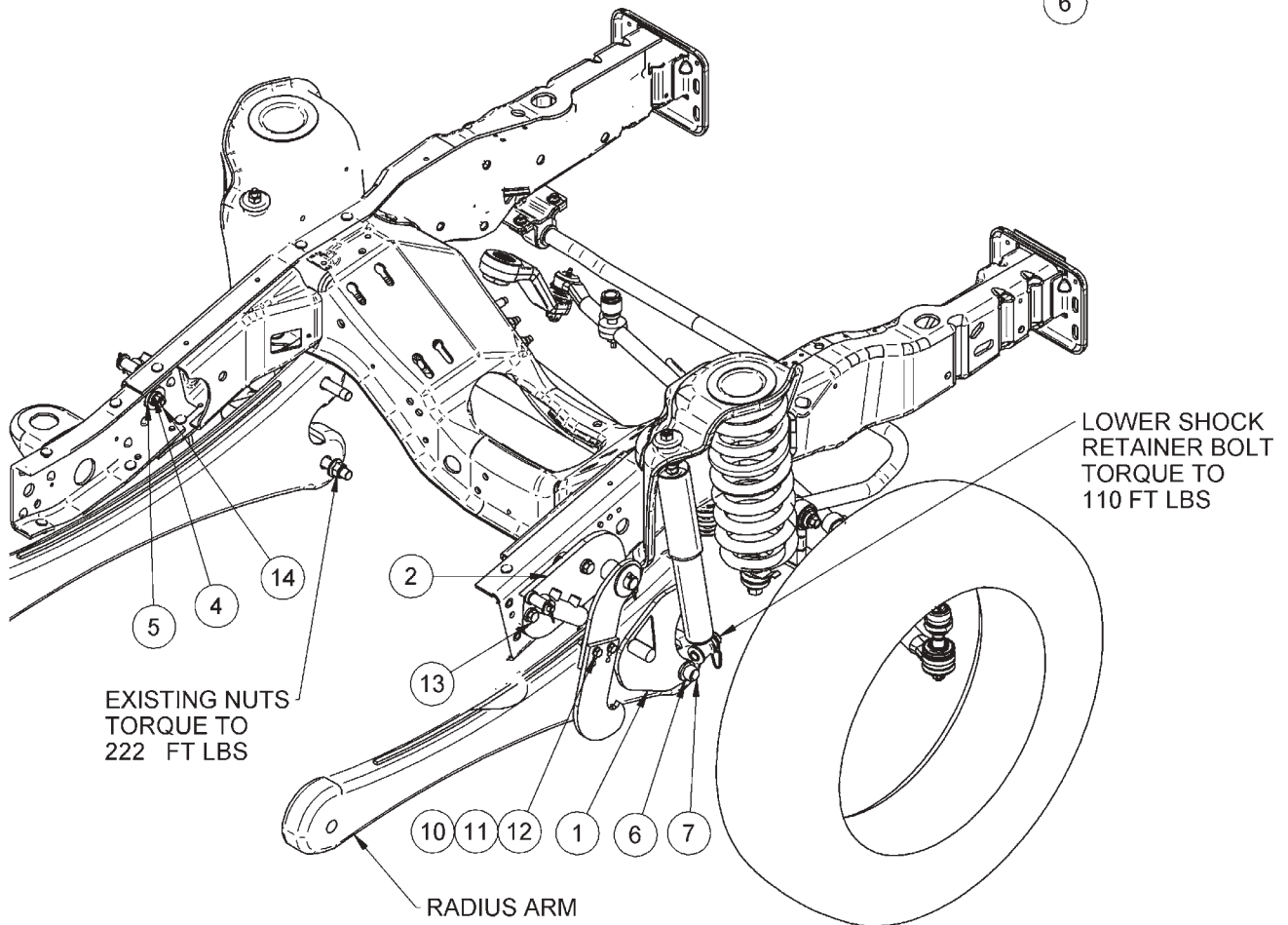
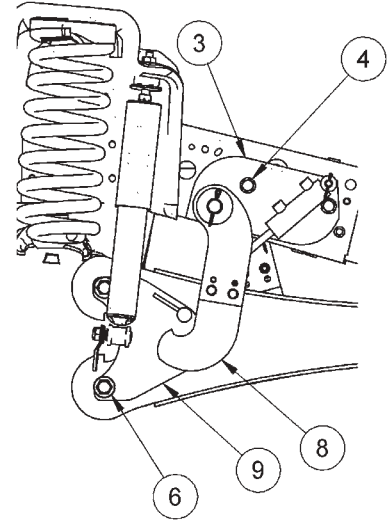
203249 HYDRAULIC AXLE LOCK GROUP

PART NO	DESCRIPTION	QTY
1 203242	Passenger Side Radius Arm Plate	1
2 203232	Passenger Side Axle Bracket	1
3 203231	Drivers Side Hook Bracket	1
4 202063	Hardened Washer, 1/2'	8
5 202066	Hardened Washer, 7/8	2
6 F021137	Hardened Washer	4
7 203248	Cap Screw, M18 x 2.5 x 130 mm Hex Soc Hd	4
8 203247	Hook, Bottom Plate	2
9 203243	Driver Side Radius Arm Plate.	1
10 F018615	Washer, 5/16".	12
11 F011998	Elastic Stop Nut, 3/8-16"	4
12 F019742	Cap Screw, 3/8-16 x 1-3/4" GR 8 Hex Hd	4
13 F018861	Cap Screw, 1/2-13 x 2-1/4" GR 8 Hex Hd	4
14 F013500	Elastic Stop Nut, 1/2"-13	4
15 203254	Hydraulic Hose Group	1
16 F001713	Cap Screw, 5/16-18 x 1-3/4" GR 5 Hex Hd	4
17 187095	SIGN PLATE ASSEMBLY	1
187098	Plate	1
187152	PLATE ASSEMBLY	1
187096	Plate	1
187097	Angle	2
F018861	Cap Screw, 1/2-13 x 2-1/4" GR 8 Hex Hd	1
186283	Axle Lock Decal	1
187099	Hydraulic Cylinder.	1
F014487	Elastic Stop Nut, 1/2"-13	1
187215	Cap Screw, 5/16-18 x 1-3/4" Hex Hd	1
F014476	Elastic Stop Nut, 5/16"	2
F018615	SAE Washer, 5/16"	1
F014734	90° Elbow, 7/16 M JIC x 7/16 M STR	2
18 186282	Axle Lock Decal	1
19 188288	Control Valve	1
20 188287	Manifold	1
21 F014476	Elastic Stop Nut, 5/16"-18	4

203249 HYDRAULIC AXLE LOCK GROUP

MOUNTING INSTRUCTIONS

1. MOUNT PASSENGER SIDE AXLE HOOK BRACKET (ITEM 2) TO FRAME USING HOLES AND SLOT IN FRAME. HOLE MAY NEED TO BE OPENED UP TO 17/32".
2. FASTEN WITH FASTENERS SHOWN.
3. REMOVE THE FRONT BOLTS THAT HOLD THE RADIUS ARM TO THE AXLE. REMOVAL OF THE LOWER SHOCK BOLT MAY BE REQUIRED. IF SO RE-TORQUE TO 110 FT. LBS. BOLT THE PASSENGER SIDE RADIUS ARM PLATE (ITEM 1) USING THE HOLES IN RADIUS ARM AND FASTENER WITH NEW BOLTS 203248 (ITEM 7). TORQUE TO 222 FT LBS.
4. BOLT HOOK BOTTOM TO HOOK TOP, WITH FASTENERS SHOWN. ALLOW 3/4" OF CLEARANCE BELOW THE HOOK, AT CURB WEIGHT WHEN ENGAGED. HOOK MUST HAVE A MIN. OF 3/4" CLEARANCE WHEN RETRACTED IN ROAD POSITION.
5. REPEAT FOR DRIVERS SIDE.



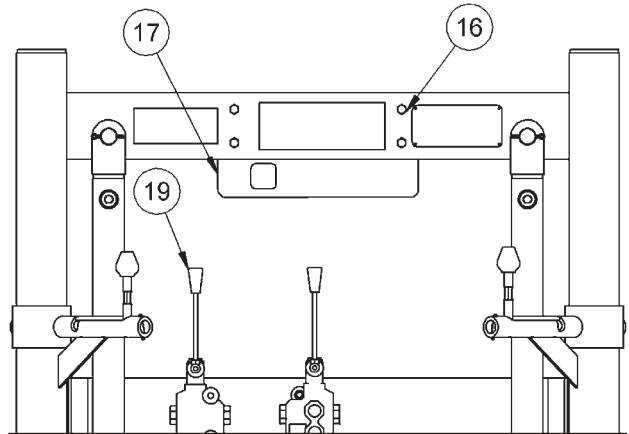
203249 HYDRAULIC AXLE LOCK GROUP

HYDRAULIC PIPING WITH HOSE KIT # 203254

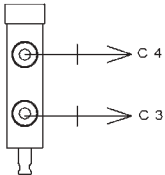
ALL HOSES AND FITTINGS ARE INCLUDED IN KIT NUMBER 203254.
INSTALLING HOSES ON CYLINDERS AS FOLLOWS:

- A. SIGN PLATE CYLINDERS, USE HOSES NUMBERED 188427.
- B. PASSENGER SIDE CYLINDER, USE HOSES NUMBERED 203255.
- C. DRIVER SIDE CYLINDER USE, HOSES NUMBERED 203255.
- D. PLACE FITTING F014736 ON MANIFOLD 188287 IN PORTS C1-C6.
- E. USING THE RETURN " T " PORT ON THE PILOT UNIT CONTROL VALVE USE HOSE 1888496 TO THE PRESSURE PORT " P " PORT ON THE AXLE LOCK VALVE NO. 188288 USING FITTINGS F019294. THE RETURN " T " PORT ON VALVE 188288 GOES TO THE " IN " PORT ON THE REAR PILOT UNIT.

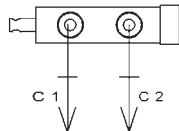
MOUNT SIGN PLATE ASSEMBLY 187095 TO UPPER CROSS PLATE ON PILOT UNIT, IN THE FOUR EXISTING HOLES USING FASTENERS F001713, F014476, AND F018615.



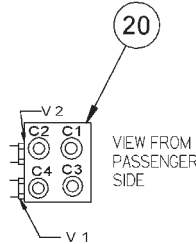
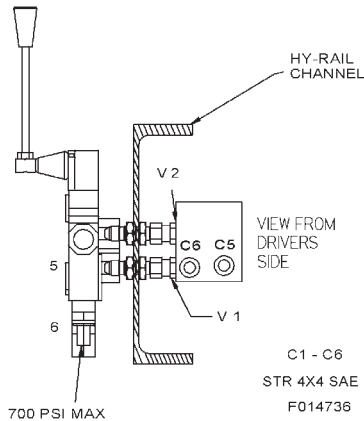
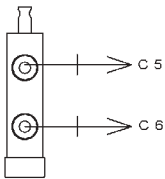
PASSENGER SIDE



SIGN PLATE

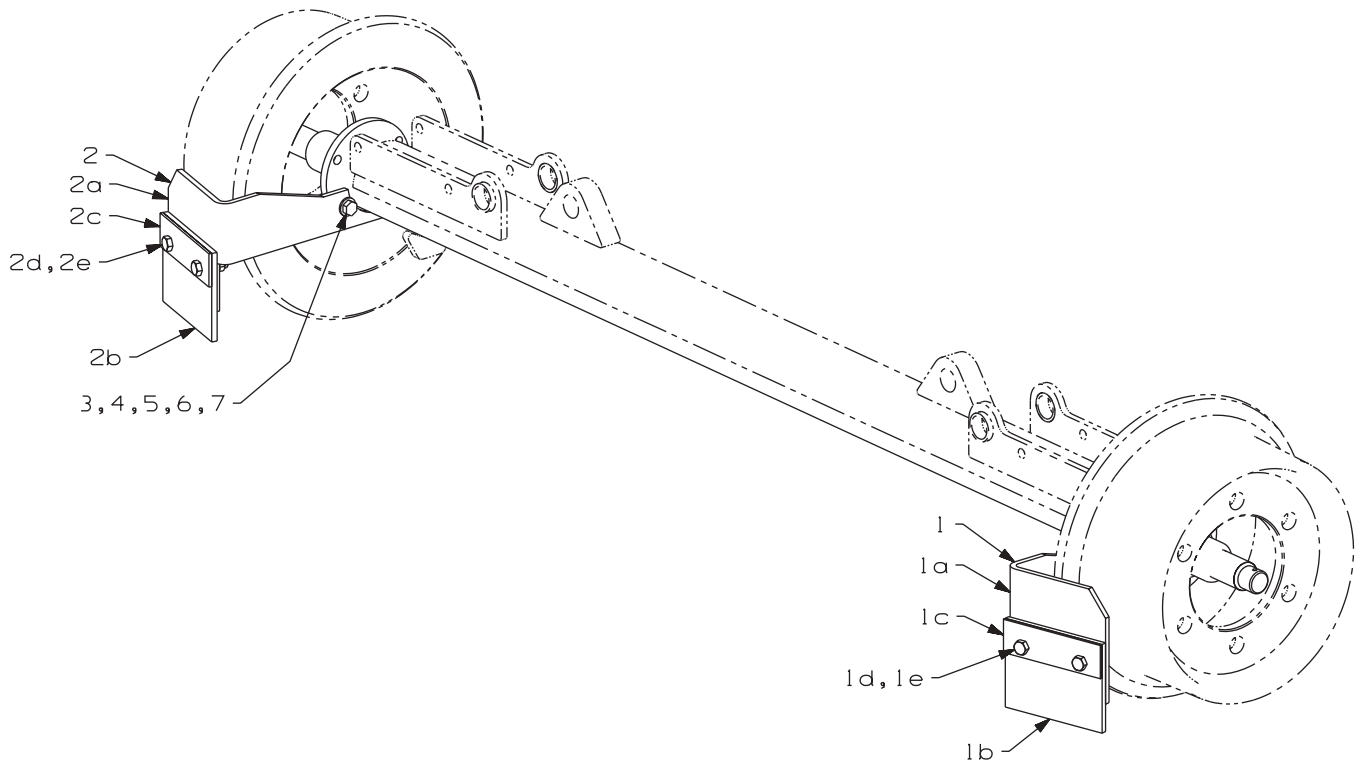


DRIVER'S SIDE



C1 - C6
STR 4X4 SAE
F014736

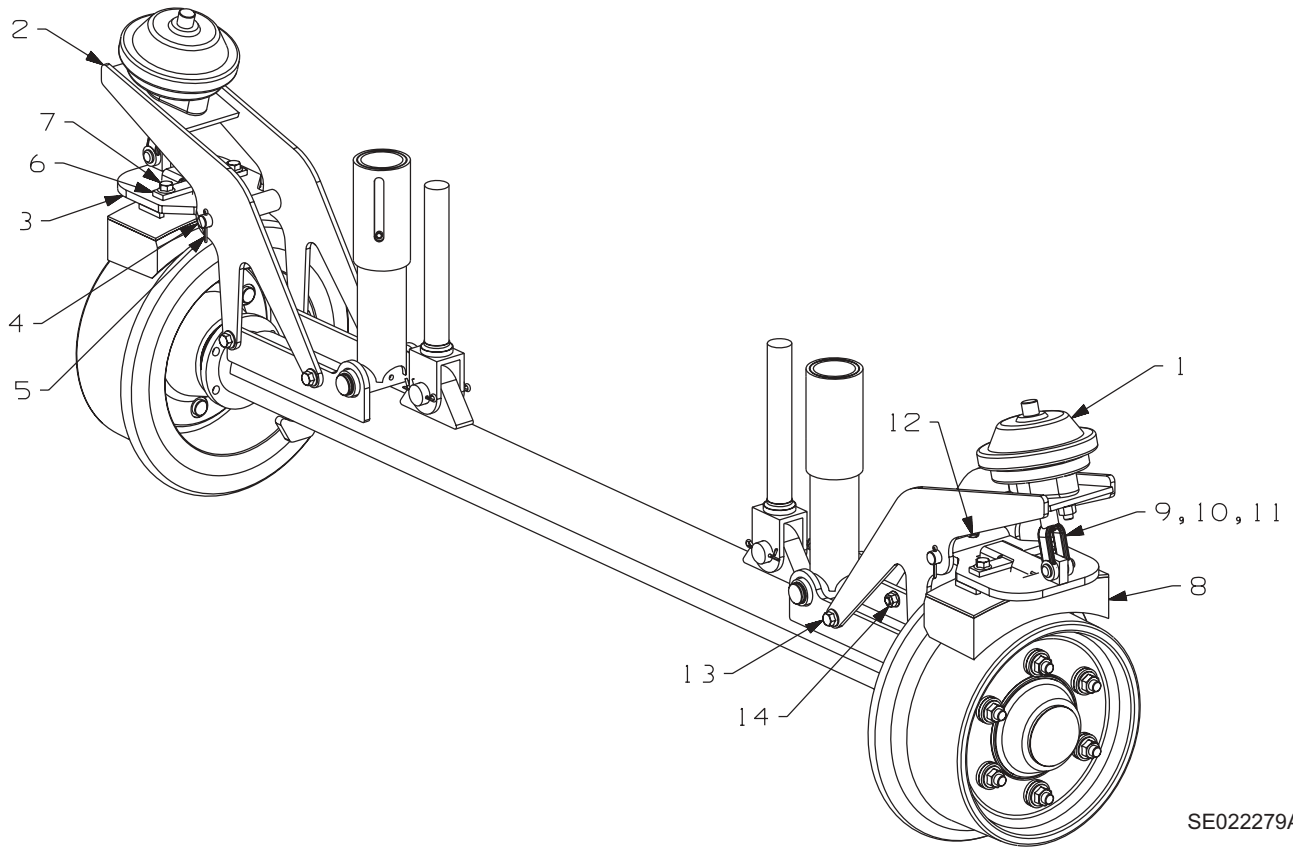
175665 RAIL SWEEP GROUP



SE022415A-1

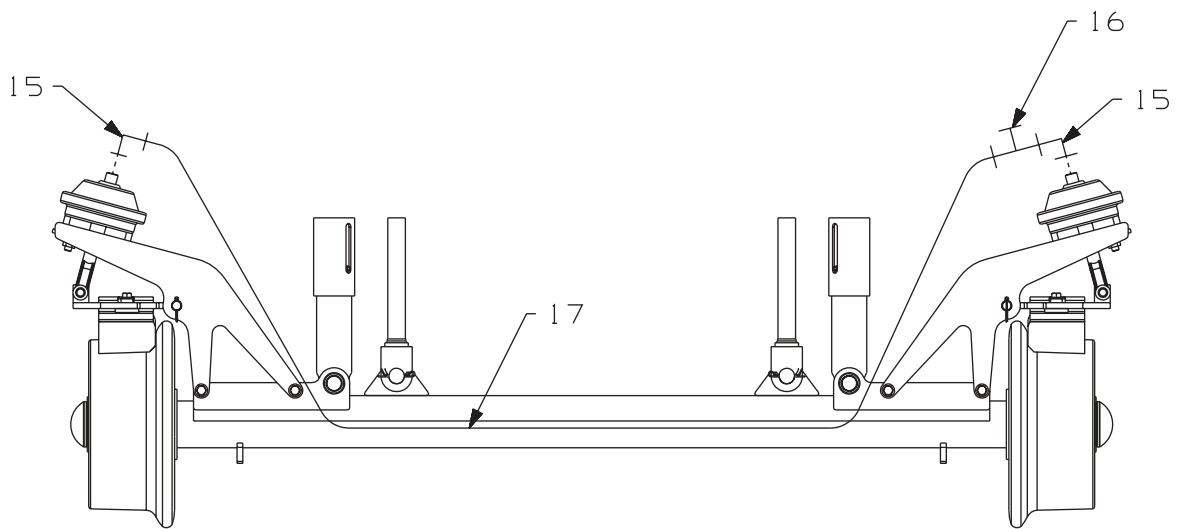
ITEM	PART NO	DESCRIPTION	QTY
1	176650	RAIL SWEEP ASSEMBLY, LEFT	1
1a	176649	Bracket	1
1b	108509K1	Rail Sweep	1
1c	108510	Plate	1
1d	F023225	Hex Flg Nut, 3/8"-16 GR 5	2
1e	F001125	Cap Screw, 3/8-16 x 1-1/4" GR 5 Hex Hd.	2
2	176651	RAIL SWEEP ASSEMBLY, RIGHT	1
2a	176654	Bracket	1
2b	108509K1	Rail Sweep	1
2c	108510	Plate	1
2d	F023225	Hex Flg Nut, 3/8"-16 GR 5	2
2e	F001125	Cap Screw, 3/8-16 x 1-1/4" GR 5 Hex Hd.	2
3	F001024	Cap Screw, 3/8-16 x 1-1/2" Hex Hd	4
4	175604	Spacer	4
5	F007020	Hex Nut, 3/8"-16	4
6	F009681	SAE Washer, 3/8"	4
7	F001025	SAE Lock Washer, 3/8"	4

175226 FRONT UNIT BRAKE GROUP - HR18A1
203605 FRONT UNIT BRAKE GROUP - HR18A1-1



SE022279A-1

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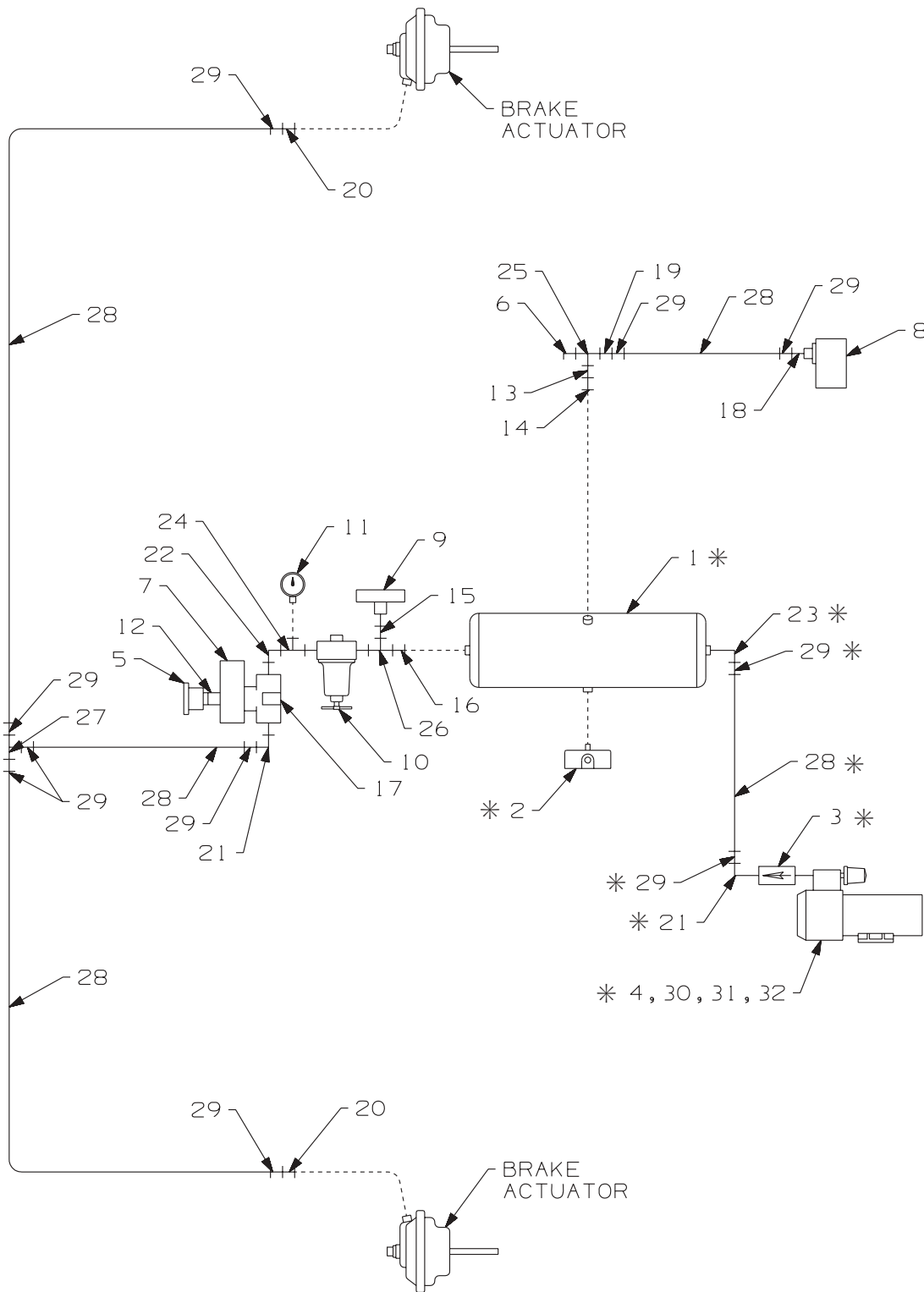


SE022279A-2

175226 FRONT UNIT BRAKE GROUP - HR18A1
203605 FRONT UNIT BRAKE GROUP - HR18A1-1

ITEM	PART NO	DESCRIPTION	QTY
1	F025058	Brake Actuator	2
2	172476	Brake Bracket.	2
3	172475	Plate (HR18A1)	2
3	203551	Plate (HR18A1-1).	2
4	172472	Pin	2
5	F001104	Cotter Pin, 1/8 x 1"	4
6	157694	Link	2
7	F023416	Cap Screw, 3/8-16 x 3/4" Hex Flg Hd.	4
8	F022274	Brake Shoe	2
9	F005459	Yoke End	2
10	F005460	Yoke Pin With Cotter Pin	2
11	F011013	Hex Jam Nut, 1/2"-20.	2
12	F008014	Grease Fitting.	2
13	F021315	Cap Screw, 3/8-16 x 1-1/4" Hex Flg Hd	8
14	F023225	Hex Flg Nut, 3/8"-16.	8
15	F015104	90° Elbow, 7/16 M JIC x 3/8 M NPT.	2
16	F021905	Tee, 7/16 F JIC x 7/16 M JIC x 7/16 M JIC	1
17	138206	Hose, 3/16 x 75" Swivel 7/16 F JIC Both Ends.	1

163987 ELECTRIC/AIR BRAKE SYSTEM GROUP - FULL
163988 ELECTRIC/AIR BRAKE SYSTEM GROUP - ABBREVIATED
BRAKE SYSTEM AIR PIPING



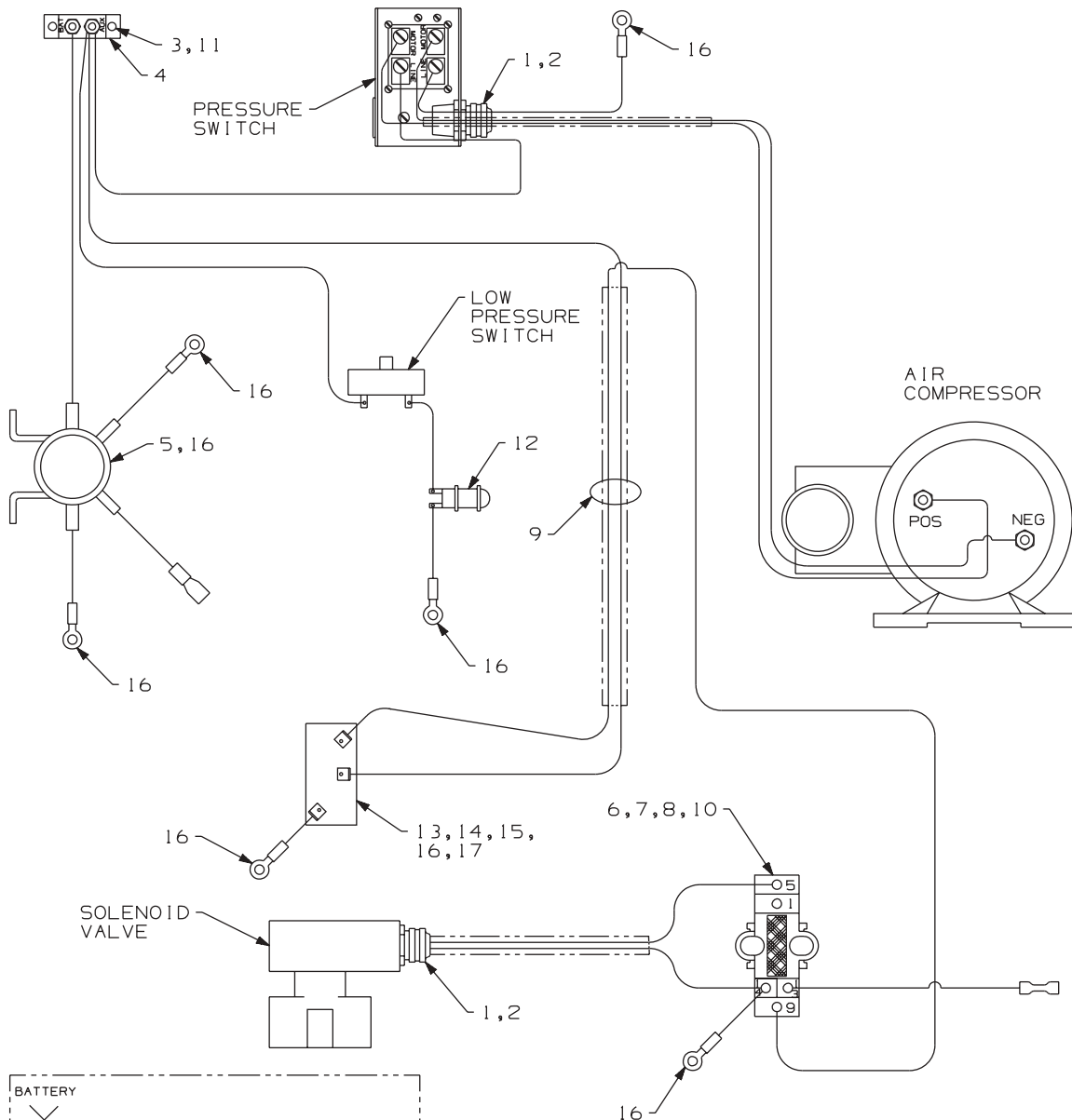
SE021269A-1

* ITEMS NOT INCLUDED IN THE 163988 ELECTRIC/AIR BRAKE SYSTEM GROUP - ABBREVIATED

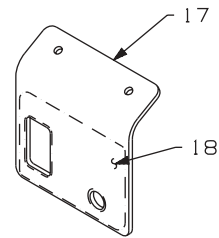
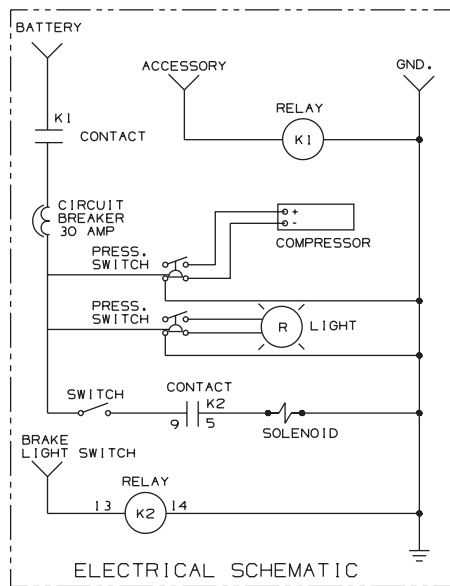
**163987 ELECTRIC/AIR BRAKE SYSTEM GROUP - FULL
 163988 ELECTRIC/AIR BRAKE SYSTEM GROUP - ABBREVIATED
 BRAKE SYSTEM AIR PIPING**

ITEM	PART NO	DESCRIPTION	QTY
1	F009910	Air Reservoir	1
1a	F022776	Reservoir Mounting Bracket.	2
1b	F040088	Hex Flg Nut, 5/16"-18.	4
1c	F023415	Cap Screw, 5/16-18 x 1-1/2" Hex Flg Hd	4
2	F021131	Moisture Ejection Valve	1
3	F015447	Check Valve.	1
4	F025423	Air Compressor	1
5	F025816	Vent	1
6	F010144	Safety Valve.	1
7	F025025	Solenoid Valve	1
8	F019402	Pressure Switch	1
8a	157631	Pressure Switch Mounting Angle	1
9	F025055	Low Pressure Switch	1
10	F018668	Regulator	1
11	F019924	Pressure Gauge	1
12	F001737	Coupling, 1/8 F NPT x 1/8 F NPT.	1
13	F023936	Coupling, 1/4 F NPT x 1/4 F NPT.	1
14	F013373	Hex Nipple, 1/4 M NPT x 3/8 M NPT	1
15	F004386	Bushing, 1/4 M NPT x 1/8 F NPT.	1
16	F008844	Bushing, 3/8 M NPT x 1/4 F NPT.	1
17	F011132	Plug, 1/8 M NPT.	1
18	F023041	Adapter, 7/16 M JIC x 1/4 M NPT	1
19	F023087	Adapter, 9/16 F JIC x 7/16 M JIC.	1
20	F024046	Adapter, 7/16 M JIC x 3/8 M NPT	2
21	F011937	90° Elbow, 7/16 M JIC x 1/4 M NPT.	2
22	F013685	90° Elbow, 1/4 M NPT x 1/4 M NPT.	1
23	F015104	90° Elbow, 7/16 M JIC x 3/8 M NPT.	1
24	F010680	Tee, 1/4 M NPT x 1/4 F NPT x 1/4 F NPT	1
25	F011241	Tee, 9/16 M JIC x 1/4 F NPT x 1/4 M NPT.	1
26	F015809	Tee, 1/4 M NPT x 1/4 M NPT x 1/4 F NPT.	1
27	F014241	Tee, 7/16 M JIC x 7/16 M JIC x 7/16 M JIC	1
28	F012222	Hose, 1/4" I.D.	600"
29	F012507	Swivel Hose Fitting, 7/16 F JIC	10
30	161888	Cover, Air Compressor.	1
31	F023255	Cap Screw, 3/8-16 x 1" Hex Flg Hd	4
32	F023225	Hex Flg Nut, 3/8"-16.	4

163987 ELECTRIC/AIR BRAKE SYSTEM GROUP - FULL
163988 ELECTRIC/AIR BRAKE SYSTEM GROUP - ABBREVIATED
BRAKE SYSTEM ELECTRICAL WIRING



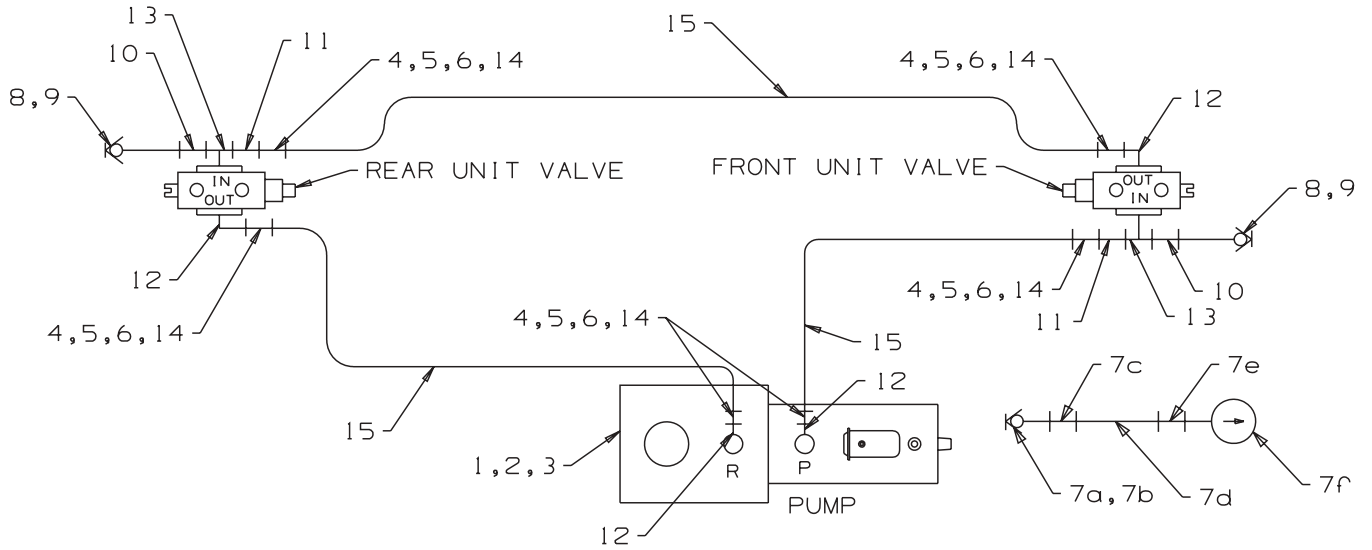
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**163987 ELECTRIC/AIR BRAKE SYSTEM GROUP - FULL
 163988 ELECTRIC/AIR BRAKE SYSTEM GROUP - ABBREVIATED
 BRAKE SYSTEM ELECTRICAL WIRING**

ITEM	PART NO	DESCRIPTION	QTY
1	F014874	Cable Grip	2
2	F013279	Lock Nut.	2
3	F009594	Machine Screw, #10-24 x 5/8" Rd Hd	2
4	F014406	Circuit Breaker	1
5	F018469	Solenoid	1
6	F023445	Relay Socket	1
7	F023444	Relay	1
8	F023443	Bail	1
9	F017311	Grommet	1
10	F007801	Screw, #8 x 5/8" Rd Hd Self-Tap	2
11	F022039	Hex Flg Nut, #10-24	2
12	F017159	Indicator Light.	1
13	F023886	Switch	1
14	F009594	Machine Screw, #10-24 x 5/8" Rd Hd	4
15	F022039	Hex Flg Nut, #10-24	4
16	F009265	Screw, #12 x 1/2" Rd Hd Self-Tap	9
17	168107	Switch Mount	1
18	168464	Decal, Panel.	1
19	157633	Decal, Do Not Propel...(not Illustrated).	1

**168104 HYDRAULIC POWER PACK GROUP
HYDRAULIC SYSTEM**

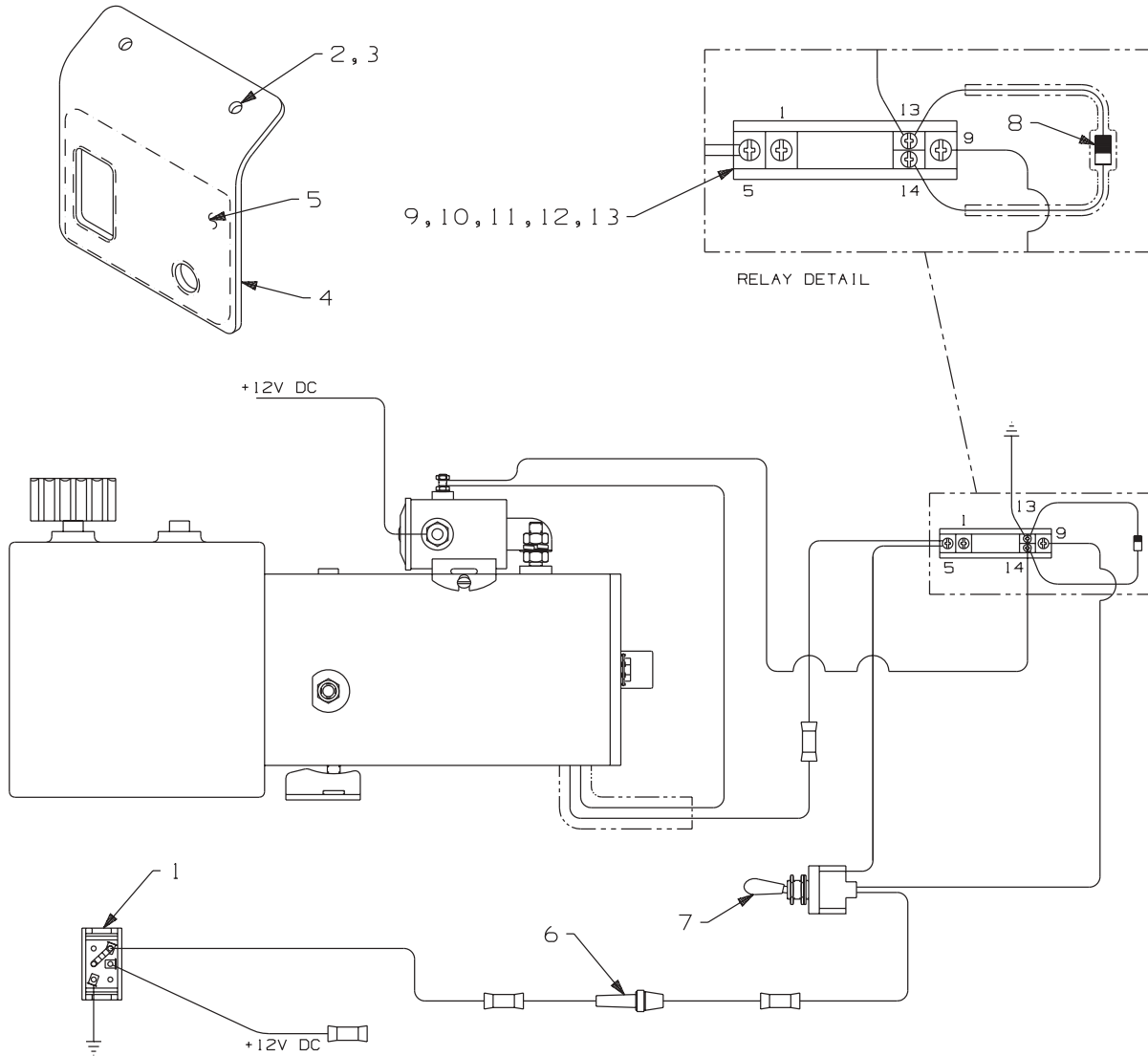


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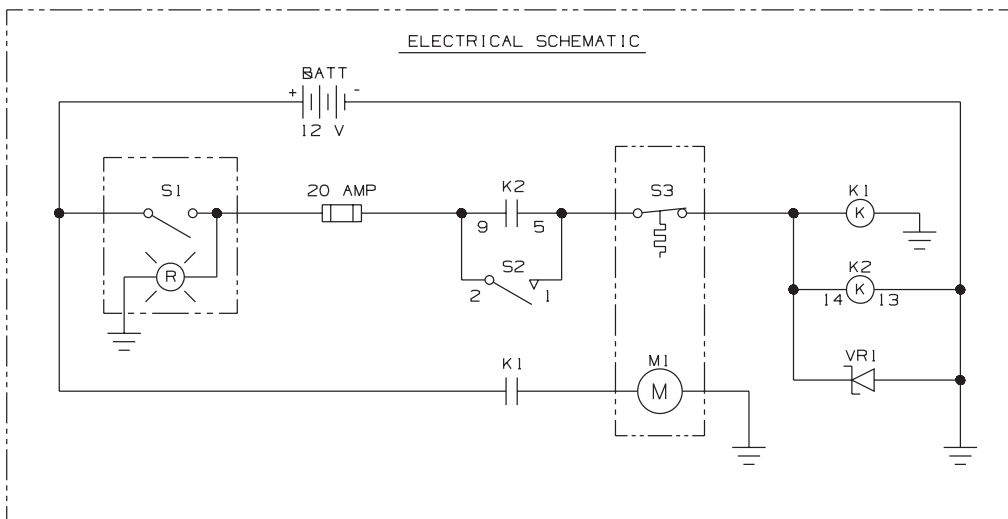
**168104 HYDRAULIC POWER PACK GROUP
 HYDRAULIC SYSTEM**

ITEM	PART NO	DESCRIPTION	QTY
1	186119	Hydraulic Unit.	1
2	F004683	Cap Screw, 3/8-16 x 5/8" Hex Hd.	2
3	F001025	SAE Lock Washer, 3/8"	2
4	F009825	Cap Screw, 1/4-20 x 1" Hex Hd	8
5	F009535	SAE Lock Washer, 1/4"	8
6	F007022	Hex Nut, 1/4"-20.	8
7	099137K	PRESSURE GAUGE ASSEMBLY	1
7a	F015110K	Female Coupler	1
7b	F015111	Dust Cap.	1
7c	F012056	Adapter, 3/8 M NPT x 9/16 M JIC	1
7d	171878	Hose, 3/8 x 14" Swivel 9/16 F JIC Both Ends	1
7e	F011109	Adapter, 9/16 M JIC x 1/4 F NPT	1
7f	F011432K	Pressure Gauge - 0 to 3000 PSI, 1/4 M NPT	1
8	F015303K	Male Coupler	2
9	F015077	Dust Cap	2
10	F011604	Nipple, 3/8 M NPT x 3/8 M NPT	2
11	F012056	Adapter, 3/8 M NPT x 9/16 M JIC	2
12	F012055	90° Elbow, 3/8 M NPT x 9/16 M JIC	4
13	F011594	Tee, 3/8 F NPT x 3/8 F NPT x 3/8 M NPT	2
14	F019242	Hose Clamp	8
15	140348	HOSE GROUP.	1
15a	F010693	Hose, 5/16" I.D.	720"
15b	F011392	Swivel Hose Fitting, 9/16 F JIC.	6

**168104 HYDRAULIC POWER PACK GROUP
ELECTRICAL SYSTEM**



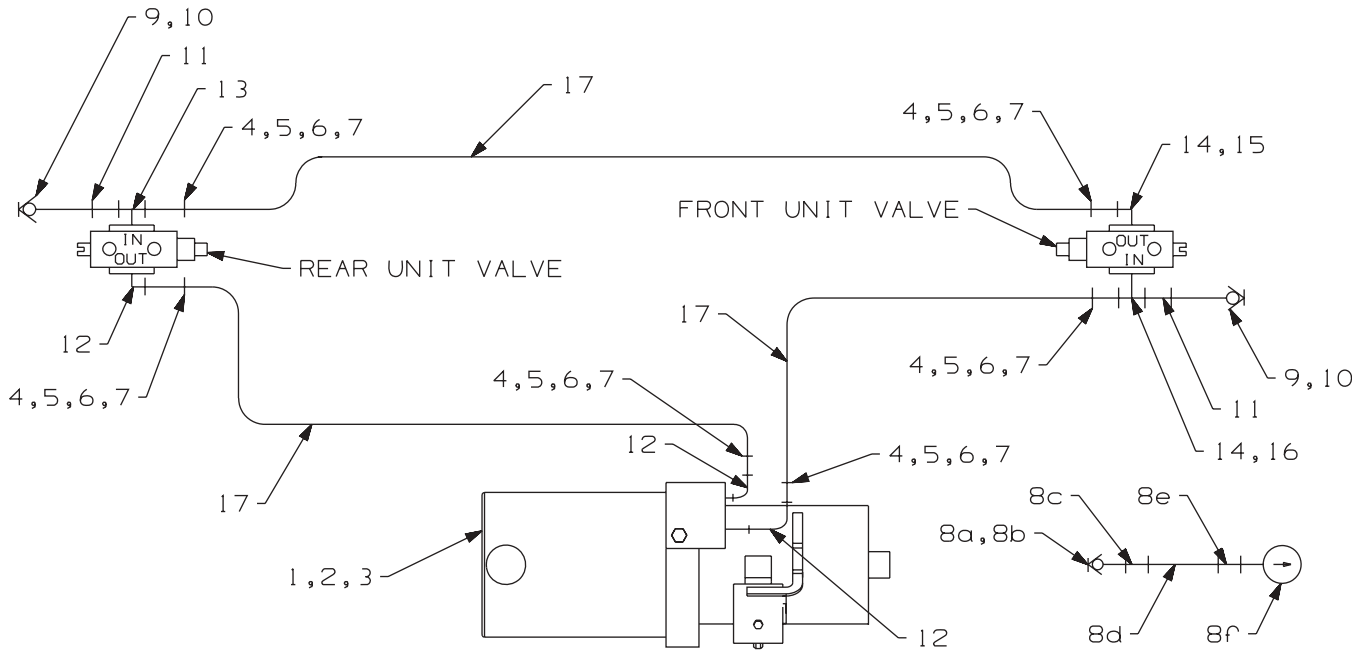
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**168104 HYDRAULIC POWER PACK GROUP
 ELECTRICAL SYSTEM**

ITEM	PART NO	DESCRIPTION	QTY
1	F023886	Switch, ON/OFF	1
2	F009594	Machine Screw, #10-24 x 5/8" Rd Hd	2
3	F022039	Hex Flg Nut, #10-24	2
4	168107	Switch Mount	1
5	168108	Decal, Panel	1
6	F017476	Fuse Holder - with 20 Amp Fuse	1
7	F017149	Switch	1
8	F022246	Noise Suppressor	1
9	F007801	Screw, #8 x 5/8" Rd Hd Self-Tap	2
10	F023563	Connector	2
11	F023443	Bail	1
12	F023444	Relay	1
13	F023445	Relay Socket	1

**186157 HYDRAULIC POWER PACK GROUP
HYDRAULIC SYSTEM**

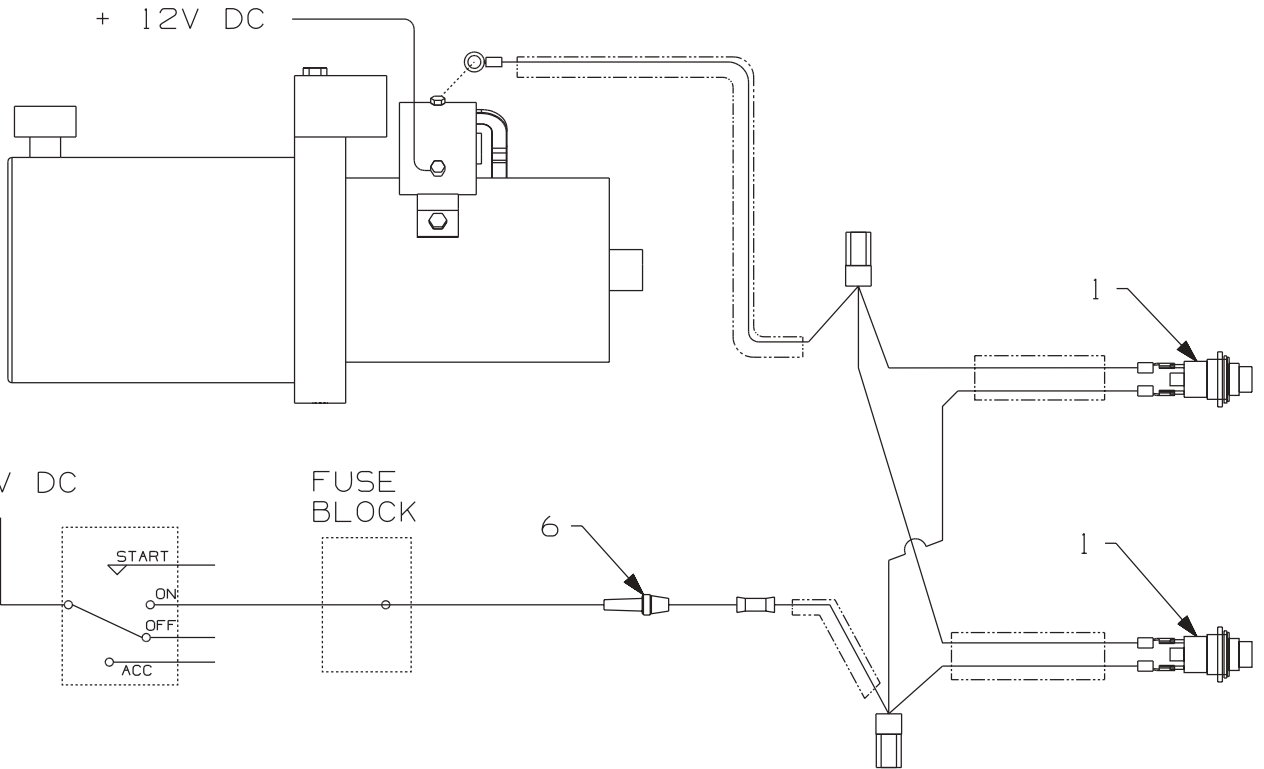
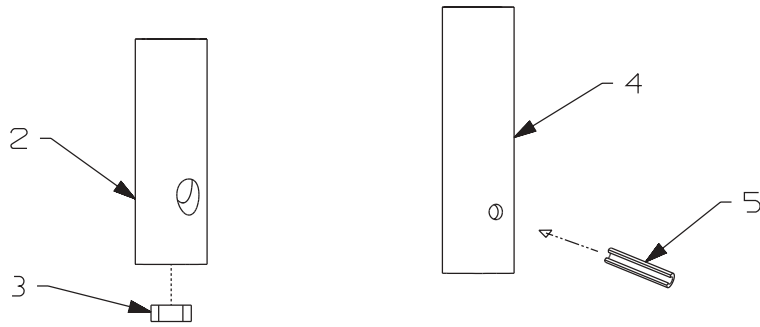


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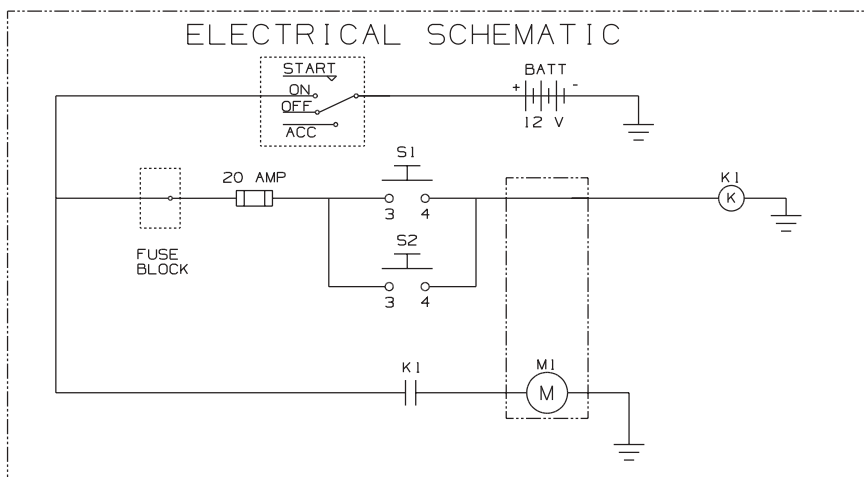
**186157 HYDRAULIC POWER PACK GROUP
 HYDRAULIC SYSTEM**

ITEM	PART NO	DESCRIPTION	QTY
1	186119	Hydraulic Unit.	1
2	F004683	Cap Screw, 3/8-16 x 5/8" Hex Hd.	2
3	F001025	SAE Lock Washer, 3/8"	2
4	F019242	Hose Clamp	8
5	F009825	Cap Screw, 1/4-20 x 1" Hex Hd	8
6	F009535	SAE Lock Washer, 1/4"	8
7	F007022	Hex Nut, 1/4"-20.	8
8	099137K	PRESSURE GAUGE ASSEMBLY	1
8a	F015110K	Female Coupler	1
8b	F015111	Dust Cap.	1
8c	F012056	Adapter, 3/8 M NPT x 9/16 M JIC	1
8d	171878	Hose, 3/8 x 14" Swivel 9/16 F JIC Both Ends	1
8e	F011109	Adapter, 9/16 M JIC x 1/4 F NPT	1
8f	F011432K	Pressure Gauge - 0 to 3000 PSI, 1/4 M NPT	1
9	F015303K	Male Coupler	2
10	F015077	Dust Cap	2
11	F011604	Nipple, 3/8 M NPT x 3/8 M NPT	2
12	F012055	90° Elbow, 3/8 M NPT x 9/16 M JIC.	4
13	F011594	Tee, 3/8 F NPT x 3/8 F NPT x 3/8 M NPT	1
14	F013518	Adapter, 9/16 M JIC x 3/4 M STR	2
15	F012808	90° Elbow, 9/16 F STR x 9/16 M JIC	1
16	F015626	Tee, 9/16 M JIC x 9/16 M JIC x 9/16 F STR.	1
17	140348	HOSE GROUP.	1
17a	F010693	Hose, 5/16" I.D.	720"
17b	F011392	Swivel Hose Fitting, 9/16 F JIC.	6

**186157 HYDRAULIC POWER PACK GROUP
ELECTRICAL SYSTEM**



6



**186157 HYDRAULIC POWER PACK GROUP
ELECTRICAL SYSTEM**

ITEM	PART NO	DESCRIPTION	QTY
1	200201	Switch	2
2	186118	Handle / Switch Mount Tube, HR18A Rail Pilot Unit	1
3	F025777	Hex Nut, M8 x 1.25	1
4	184549	Handle / Switch Mount Tube, HR2000 Rail Pilot Unit.....	1
5	700751087	Spring Pin, 3/16 x 7/8"	1
6	F017476	Fused Line Connector With 20 amp Fuse	1

180001 DECAL SERVICE GROUP

PART NO	DESCRIPTION	QTY
180001	DECAL SERVICE GROUP	1
175229	Decal, Operating Instructions	1
140220	Decal, Warning: Do Not Operate.....	2
F018082	Decal, Safety Instructions: Lock Front Wheels...	1
155007	Decal, HY-RAIL® Vehicle Completed By...	1
184073	Decal, Control Valve Operating Instructions	1
191761	Decal, Harsco Track Technologies	1
022609	Decal Application Drawing	1
BUL #1220	Operator's Service and Parts Manual	1

STEERING LOCK GROUPS

Individual steering lock components are not available as repair parts. Steering lock groups are sold as complete replacement groups only. See vehicle application charts to find the correct steering lock group applicable to your make, model and year of vehicle.

APPENDIX A - CONVERSION TABLES
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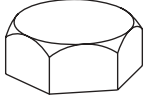
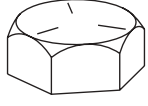

BOLT TORQUE REQUIREMENTS - STANDARD TYPE FASTENERS..... A - 2
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Appendix A

**FIGURE A-1
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

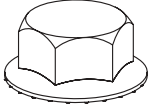
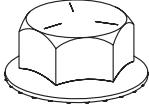
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Appendix A

**FIGURE A-2
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	Torque							
	Wet		Dry		Wet		Dry	
	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m	lb-ft	N-m
Fastener Body Size Inch-Thread	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

**FIGURE A-3
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

**FIGURE A-4
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								
Property Class and Head Markings								
	<p>Class 10.9</p>				<p>Class 12.9</p>			
Size	* 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

FIGURE A-5
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

FIGURE A-6
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

A

Appendix A

**FIGURE A-7
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

**FIGURE A-8
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

**FIGURE A-9
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

FIGURE A-10
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

A

Appendix A

FIGURE A-11
 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

FIGURE A-12
 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

APPENDIX B - SAE J1273


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Recommended Practices for Hydraulic Hose Assemblies

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 SURFACE VEHICLE RECOMMENDED PRACTICE	SAE J1273	REV. AUG2004
	Issued 1979-09 Revised 2004-08	
	Superseding J1273 DEC2002	

Recommended Practices for Hydraulic Hose Assemblies

Foreword—This SAE Recommended Practice is intended as a guide to consider when selecting, routing, fabricating, installing, replacing, maintaining, and storing hose for fluid-power systems. It is subject to change to keep pace with experience and technical advances. For those new to hose use in fluid-power systems, this guide outlines practices to note during each phase of system design and use. Experienced designers and users skilled in achieving proper results, as well as the less experienced, can use this outline as a list of considerations to keep in mind.

Fluid power systems are complex and require extensive knowledge of both the system requirements and the various types of hose. Therefore, all-inclusive, detailed, step-by-step instructions are not practical and are beyond the scope of this document. Less experienced designers and users who need more information can consult specialists such as hose suppliers and manufacturers. This guide can improve the communication process.

Safety Considerations—These recommended practices involve safety considerations; note these carefully during all phases of design and use of hose systems. Improper selection, fabrication, installation, or maintenance of hose and hose assemblies for fluid-power systems may result in serious personal injury or property damage. These recommended practices can reduce the likelihood of component or system failure, thereby reducing the risk of injury or damage.

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1. **Scope**—SAE J1273 provides guidelines for selection, routing, fabrication, installation, replacement, maintenance, and storage of hose and hose assemblies for fluid-power systems. Many of these SAE Recommended Practices also may be suitable for other hoses and systems.

2. **References**

2.1 **Applicable Publications**—The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

- SAE J343—Test and Procedures for SAE 100 R Series Hydraulic Hose and Hose Assemblies
- SAE J514—Hydraulic Tube Fittings
- SAE J517—Hydraulic Hose
- SAE J1927—Cumulative Damage Analysis for Hydraulic Hose Assemblies

2.1.2 ISO PUBLICATION—Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

- ISO 3457—Earth moving machinery—Guards and shields—Definitions and specifications

3. **Definitions**—These explanations serve only to clarify this document and are not intended to stand alone. They are presented sequentially, with the former helping to explain the latter.

3.1 **Fluid Power**—Energy transmitted and controlled using pressurized hydraulic fluids or compressed air.

3.2 **Hose**—Flexible conductor. In this document, the term hose also may refer to a hose assembly with related accessories used in fluid power applications.

3.3 **Hose Fitting or Fitting**—Connector which can be attached to the end of a hose.

3.4 **Hose Assembly**—Hose with hose fittings attached.

3.5 **Hose Failure**—Occurrence in which a hose stops meeting system requirements.

3.6 **Hose Service Life**—Length of time a hose meets system requirements without needing replacement.

4. **Safety Considerations**—Listed in 4.1 to 4.7 are some potential conditions and situations that may lead to personal injury and/or property damage. This list is not necessarily all inclusive. Consider reasonable and feasible means, including those described in this section, to reduce the risk of injuries or property damage.

Training, including the information in this document, for operators, maintenance personnel, and other individuals working with hoses under pressure is encouraged.

4.1 **Fluid Injections**—Fine streams of escaping pressurized fluid can penetrate skin and enter a human body. These fluid injections may cause severe tissue damage and loss of limb.

Consider various means to reduce the risk of fluid injections, particularly in areas normally occupied by operators. Consider careful routing, adjacent components, warnings, guards, shields, and training programs.



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Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Avoid contact with escaping fluids. Treat all leaks as though pressurized and hot enough to burn skin. Never use any part of your body to check a hose for leaks.

If a fluid-injection accident occurs, see a doctor immediately. **DO NOT DELAY OR TREAT AS A SIMPLE CUT!** Any fluid injected into the skin must be surgically removed *within a few hours* or gangrene may result. Doctors unfamiliar with this type of injury should consult a knowledgeable medical source.

- 4.2 Whipping Hose**—If a pressurized hose assembly blows apart, the fittings can be thrown off at high speed, and the loose hose can flail or whip with great force. This is particularly true in compressible-fluid systems.

When this risk exists, consider guards and restraints to protect against injury.

- 4.3 Burns from Conveyed Fluids**—Fluid-power media may reach temperatures that can burn human skin. If there is risk of burns from escaping fluid, consider guards and shields to prevent injury, particularly in areas normally occupied by operators.

- 4.4 Fire and Explosions from Conveyed Fluids**—Most fluid-power media, including fire-resistant hydraulic fluids, will burn under certain conditions. Fluids which escape from pressurized systems may form a mist or fine spray which can flash or explode upon contact with an ignition source.

Consider selecting, guarding, and routing hose to minimize the risk of combustion (see Section 5 and ISO 3457).

- 4.5 Fire and Explosions from Static-Electric Discharge**—Fluid passing through hose can generate static electricity, resulting in static-electric discharge. This may create sparks that can ignite system fluids or gases in the surrounding atmosphere.

When this potential exists, select hose specifically designed to carry the static-electric charge to ground.

- 4.6 Electrical Shock**—Electrocution could occur if hose conducts electricity through a person. Most hoses are conductive. Many contain metal or have metal fittings. Even nonconductive hoses can be conduits for electricity if they carry conductive fluids.

Be aware of routing or using hose near electrical sources. When this cannot be avoided, select appropriate hose. Nonconductive hoses should be considered. SAE J517—100R7 and 100R8 hoses, with orange covers marked “Nonconductive” are available for applications requiring nonconductive hose.

- 4.7 Mechanisms Controlled by Fluid Power**—Mechanisms controlled by fluids in hoses can become hazardous when a hose fails. For example, when a hose bursts, objects supported by fluid pressure may fall, or vehicles or machines may lose their brakes or steering.

If mechanisms are controlled by fluid power, consider safe modes of failure that minimize risks of injury or damage.

- 5. Hose Selection and Routing**—A wide variety of interacting factors influence hose service life and the ability of each fluid-power system to operate satisfactorily, and the combined effects of these factors on service life are often unpredictable. Therefore, these documents should not be construed as design standards. For applications outside the specifications in SAE J517, SAE J514, or other relevant design standards, performance of hose assemblies should be determined by appropriate testing.

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Carefully analyze each system. Then design routings and select hose and related components to meet the system-performance and hose-service-life requirements, and to minimize the risks of personal injury and/or property damage. Consider the following factors:

- 5.1 System Pressures**—Excessive pressure can accelerate hose assembly failure. Analyze the steady-state pressures, and the frequency and amplitude of pressure surges, such as pulses and spikes. These are rapid and transient rises in pressure which may not be indicated on many common pressure gages and can be identified best on high-frequency-response electronic measuring instruments.

For maximum hose service life, hose selection should be based on a system pressure, including surges, that is less than the hose maximum working pressure. Hose may be used above its maximum working pressure where reduced life expectancy is acceptable. SAE J1927 provides one method to help predict wire-reinforced hose service life for a given hydraulic application, where the surge pressure peaks vary, and/or the highest pressure peaks occur infrequently.

- 5.2 Suction**—For suction applications, such as inlet flow to pumps, select hose to withstand both the negative and positive pressures the system imposes on the hose.
- 5.3 External Pressure**—In certain applications, such as in autoclaves or under water, the external environmental pressures may exceed the fluid pressure inside the hose. In these applications, consider the external pressures, and if necessary, consult the manufacturers.
- 5.4 Temperature**—Exceeding hose temperature ratings may significantly reduce hose life. Select hose so the fluid and ambient temperatures, both static and transient, fall within the hose ratings. The effects of external heat sources should not raise the temperature of the hose above its maximum operating temperature. Select hose, heat shields, sleeving, and other methods for these requirements, and route or shield hose to avoid hose damage from external heat sources.
- 5.5 Permeation**—Permeation, or effusion, is seepage of fluid through the hose. Certain materials in hose construction are more permeable than others. Consider the effects of permeation when selecting hose, especially with gaseous fluids. Consult the hose and fluid manufacturers for permeability information.
- 5.6 Hose-Material Compatibility**—Variables that can affect compatibility of system fluids with hose materials include, but are not limited to:
- a. Fluid pressure
 - b. Temperature
 - c. Concentration
 - d. Duration of exposure

Because of permeation (see 5.5), consider compatibility of system fluids with the hose, tube, cover, reinforcement, and fittings. Consult the fluid and hose manufacturers for compatibility information.

NOTE—Many fluid/elastomer compatibility tables in manufacturers' catalogs show ratings based on fluids at 21 °C, room temperature. These ratings may change at other temperatures. Carefully read the notes on the compatibility tables, and if in doubt, consult the manufacturer.

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5.7 Environment—Environmental conditions can cause hose and fitting degradation. Conditions to evaluate include, but are not limited to:

- a. Ultraviolet light
- b. Salt water
- c. Air pollutants
- d. Temperature (see 5.4)
- e. Ozone
- f. Chemicals
- g. Electricity
- h. Abrasion

If necessary, consult the manufacturers for more information.

5.8 Static-Electric Discharge—Fluid passing through hose can generate static electricity resulting in static-electric discharge. This may create sparks that can puncture hose. If this potential exists, select hose with sufficient conductivity to carry the static-electric charge to ground.

5.9 Sizing—The power transmitted by pressurized fluid varies with pressure and rate of flow. Select hose with adequate size to minimize pressure loss, and to avoid hose damage from heat generation or excessive velocity. Conduct calculations, or consult the manufacturers for sizing at flow velocities.

5.10 Unintended Uses—Hose assemblies are designed for the internal forces of conducted fluids. Do not pull hose or use it for purposes that may apply external forces for which the hose or fittings were not designed.

5.11 Specifications and Standards—When selecting hose and fittings for specific applications, refer to applicable government, industry, and manufacturer's specifications and standards.

5.12 Unusual Applications—Applications not addressed by the manufacturer or by industry standards may require special testing prior to selecting hose.

5.13 Hose Cleanliness—The cleanliness requirements of system components, other than hose, will determine the cleanliness requirements of the application. Consult the component manufacturers' cleanliness information for all components in the system. Hose assemblies vary in cleanliness levels; therefore, specify hose assemblies with adequate cleanliness for the system.

5.14 Hose Fittings—Selection of the proper hose fittings for the hose and application is essential for proper operation and safe use of hose and related assembly equipment. Hose fittings are qualified with the hose. Therefore, select only hose fittings compatible with the hose for the applications.

Improper selection of hose fittings or related assembly equipment for the application can result in injury or damage from leaks, or from hose assemblies blowing apart (see 4.2, 6.2, 6.3, and 6.4).

5.15 Vibration—Vibration can reduce hose service life. If required, conduct tests to evaluate the frequency and amplitude of system vibration. Clamps or other means may be used to reduce the effects of vibration. Consider the vibration requirements when selecting hose and predicting service life.

5.16 Hose Cover Protection—Protect the hose cover from abrasion, erosion, snagging, and cutting. Special abrasion-resistant hoses and hose guards are available for additional protection. Route hose to reduce abrasion from hose rubbing other hose or objects that may abrade it. (See Figure 1)

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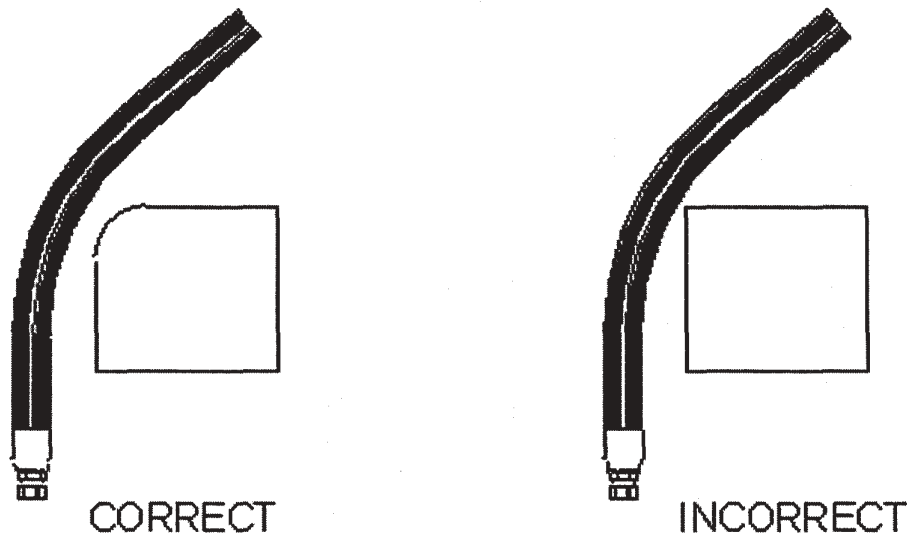


FIGURE 1—PREVENTION OF EXTERNAL DAMAGE

5.17 External Physical Abuse—Route hose to avoid:

- a. Tensile loads
- b. Side loads
- c. Flattening
- d. Thread damage
- e. Kinking
- f. Damage to sealing surfaces
- g. Abrasion
- h. Twisting

5.18 Swivel-Type Adapters—Swivel-type fittings or adapters do not transfer torque to hose while being tightened. Use these as needed to prevent twisting during installation.

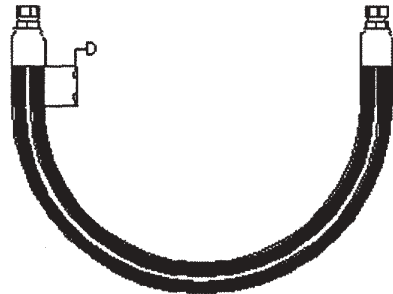
5.19 Live Swivels—If two components in the system are rotating in relation to each other, live swivels may be necessary. These connectors reduce the torque transmitted to the hose.

5.20 Slings and Clamps—Use slings and clamps to support heavy or long hose and to keep it away from moving parts. Use clamps that prevent hose movement that will cause abrasion.

5.21 Minimum Bend Radius—The minimum bend radius is defined in SAE J343 and is specified in other SAE standards and hose manufacturer's product literature. Routing at less than minimum bend radius may reduce hose life. Sharp bending at the hose/fitting juncture may result in leaking, hose rupturing, or the hose assembly blowing apart (see 4.2 and Figures 2A and 2B).

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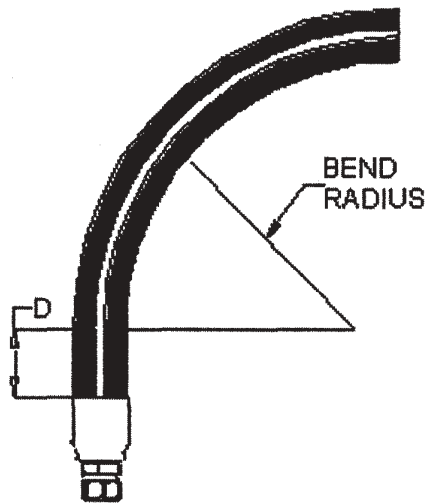


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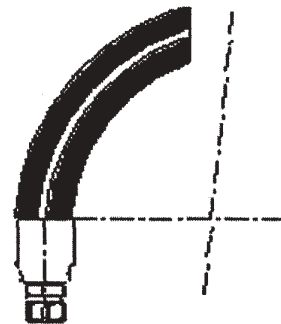


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FIGURE 2A—MINIMUM BEND RADIUS



CORRECT



INCORRECT

FIGURE 2B—MINIMUM BEND RADIUS

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5.22 Elbows and Adapters—In special cases, use elbows or adapters to relieve hose strain (see Figure 3).

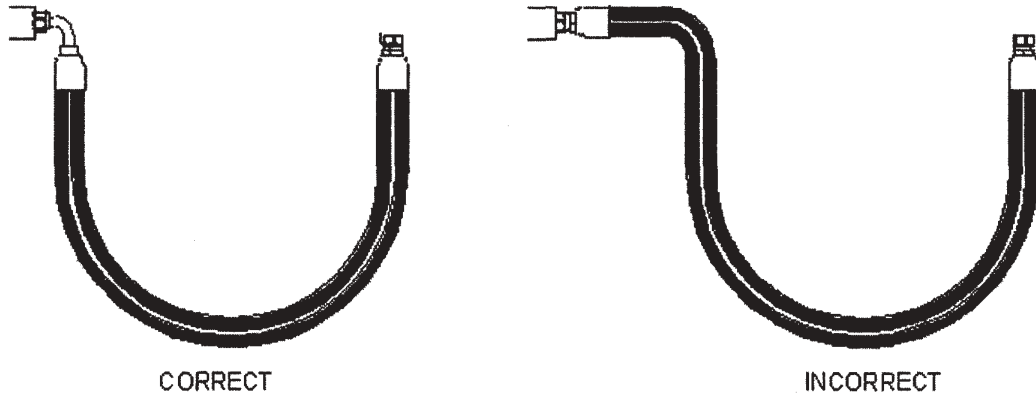


FIGURE 3—ELBOWS AND ADAPTERS

5.23 Lengths—Unnecessarily long hose can increase pressure drop and affect system performance. When pressurized, hose that is too short may pull loose from its fittings, or stress the fitting connections, causing premature metallic or seal failures. When establishing hose length, refer to Figures 4, 5, and 6; and use the following practices:

5.23.1 MOTION ABSORPTION—Provide adequate hose length to distribute movement and prevent bends smaller than the minimum bend radius.

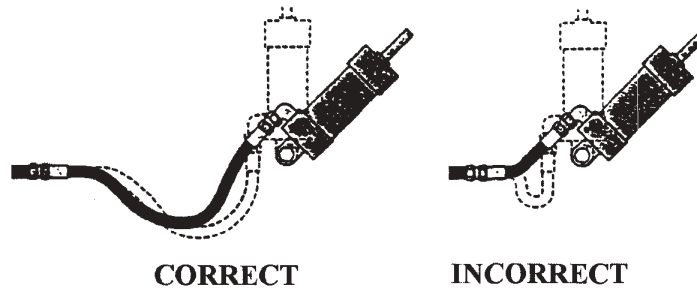


FIGURE 4—MOTION ABSORPTION

5.23.2 HOSE AND MACHINE TOLERANCES—Design hose to allow for changes in length due to machine motion and tolerances.

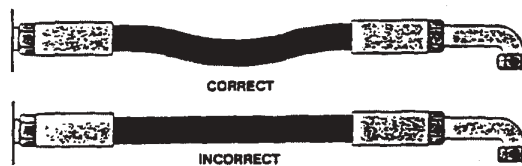


FIGURE 5—HOSE AND MACHINE TOLERANCES

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5.23.3 HOSE LENGTH CHANGE DUE TO PRESSURE—Design hose to accommodate length changes from changing pressures. Do not cross or clamp together high- and low-pressure hoses. The difference in length changes could wear the hose covers.

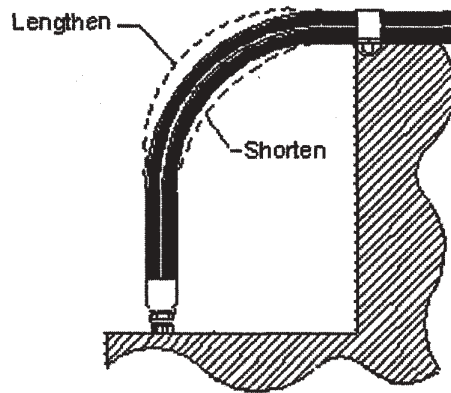


FIGURE 6—HOSE LENGTH CHANGE DUE TO PRESSURE

5.24 Hose Movement and Bending—Hose allows relative motion between system components. Analyze this motion when designing hose systems. The number of cycles per day may significantly affect hose life. Also avoid multiple planes of motion and twisting motion. Consider the motion of the hose when selecting hose and predicting service life. In applications that require hose to move or bend, refer to Figures 7A, 7B, and 8; and use these practices:

5.24.1 BEND IN ONLY ONE PLANE TO AVOID TWISTING

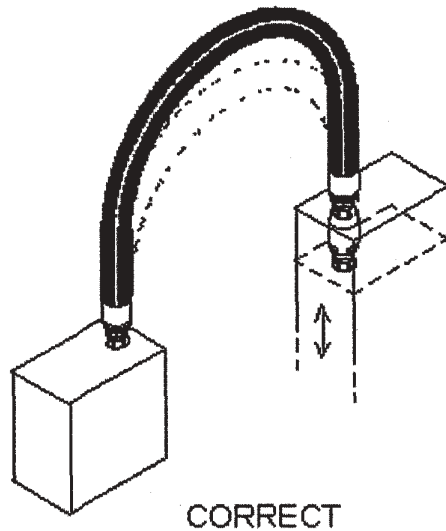


FIGURE 7A—BEND IN ONLY ONE PLANE TO AVOID TWISTING

B

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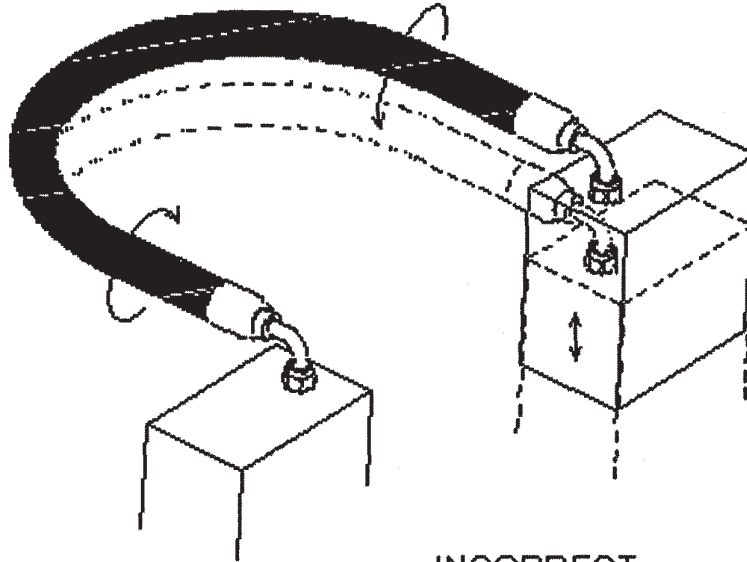


FIGURE 7B—BEND IN ONLY ONE PLANE TO AVOID TWISTING

5.24.2 PREVENT HOSE BENDING IN MORE THAN ONE PLANE—If hose follows a compound bend, couple it into separate segments, or clamp it into segments that flex in only one plane.

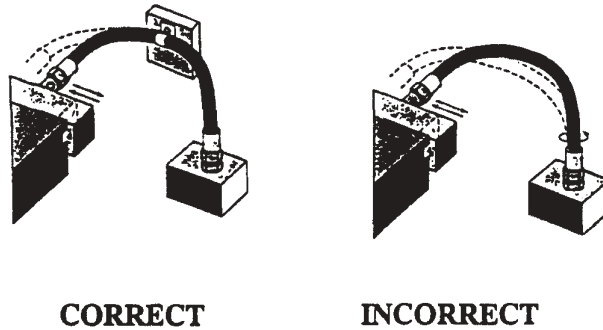


FIGURE 8—PREVENT HOSE BENDING IN MORE THAN ONE PLANE

6. **Hose-Assembly Fabrication**—Persons fabricating hose assemblies should be trained in the proper use of equipment and materials. The manufacturers' instructions and the practices listed as follows must be followed. Properly assembled fittings are vital to the integrity of a hose assembly. Improperly assembled fittings can separate from the hose and may cause serious injury or property damage from whipping hose, or from fire or explosion of vapor expelled from the hose.

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6.1 Component Inspection—Prior to assembly, examine components for:

- a. Style or type
- b. Cleanliness
- c. Loose covers
- d. Nicks
- e. Size
- f. Inside obstructions
- g. Visible defects
- h. Damage
- i. Length
- j. Blisters
- k. Burrs

6.2 Hose Fittings—Hose fitting components from one manufacturer are not usually compatible with fitting components supplied by another manufacturer. For example, do not use a hose fitting nipple from one manufacturer with a hose socket from another manufacturer.

It is the responsibility of the fabricator to consult the manufacturer's written instructions or the manufacturer directly for information on proper fitting components.

6.3 Hose and Fitting Compatibility—Care must be taken to determine proper compatibility between the hose and fitting. Base selection on the manufacturers' recommendations substantiated by testing to industry standards such as SAE J517. Hose from one manufacturer is not usually compatible with fittings from another. Do not intermix hose and fittings from two manufacturers without approval from both manufacturers.

6.4 Hose Assembly Equipment—Assembly equipment from one manufacturer is usually not interchangeable with that from another manufacturer. Hoses and fittings from one manufacturer should not generally be assembled with the equipment of another manufacturer.

6.5 Safety Equipment—During fabrication, use proper safety equipment, including eye protection, breathing apparatus, and adequate ventilation.

6.6 Reuse of Hose and Fittings—When fabricating hose assemblies, do **not** reuse:

- a. Field-attachable fittings that have blown or pulled off hose
- b. Any part of hose fittings that were permanently crimped or swaged to hose
- c. Hose that has been in service after system checkout (see 7.7)

6.7 Cleanliness of Hose Assemblies—Hose assemblies may be contaminated during fabrication. Clean hoses to specified cleanliness levels (see 5.13).

7. Hose Installation and Replacement—Use the following practices when installing hose assemblies in new systems or replacing hose assemblies in existing systems:

7.1 Pre-Installation Inspection—Before installing hose assemblies, examine:

- a. Hose length and routing for compliance with original design
- b. Assemblies for correct style, size, length, and visible nonconformities
- c. Fitting sealing surfaces for burrs, nicks, or other damage

NOTE—When replacing hose assemblies in existing systems, verify that the replacement is of equal quality to the original assembly.

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- 7.2 **Handling During Installation**—Handle hose with care during installation. Kinking hose, or bending at less than minimum bend radius may reduce hose life. Avoid sharp bending at the hose/fitting juncture (see 5.21).
- 7.3 **Twist Angle and Orientation**—Pressure applied to a twisted hose may shorten the life of the hose or loosen the connections. To avoid twisting, use the hose lay line or marking as a reference (see Figure 9).

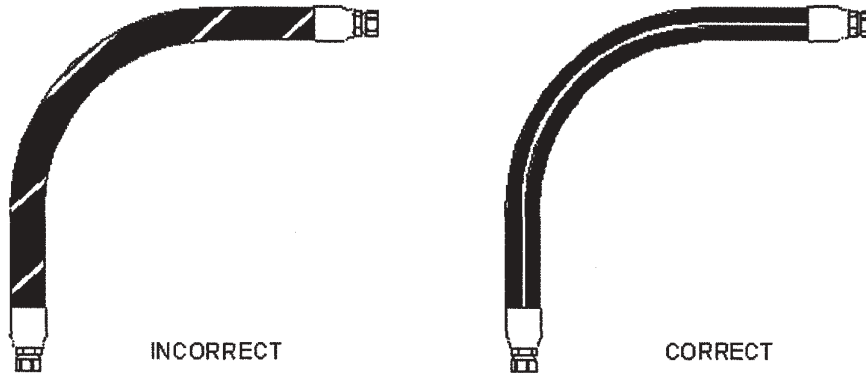


FIGURE 9—TWIST ANGLE AND ORIENTATION

- 7.4 **Securement and Protection**—Install necessary restraints and protective devices. Determine that such devices do not create additional stress or wear points.
- 7.5 **Routing**—Review proper routing practices provided in Section 5 and make appropriate corrections to obtain optimum performance.
- 7.6 **Assembly Torque**—The connection end of a hose fitting is normally threaded to obtain a tight pressure seal when attached to a port, an adapter, or another fitting. Sometimes bolts or screws provide the threaded connection. Each size and type of connection requires different torque values, and these may vary due to type of material or exterior coating.

Follow appropriate torquing instructions to obtain a proper pressure seal without over-torquing. A properly calibrated torque wrench should be used to tighten each connection, except when the manufacturer specifies tightening a specified number of hex flat turns beyond finger tight to obtain a seal.

- 7.7 **System Checkouts**—In hydraulic or other liquid systems, eliminate all air entrapment after completing the installation. Follow manufacturers' instructions to test the system for possible malfunctions and leaks.
 - 7.7.1 To avoid injury during system checkouts:
 - a. Do not touch any part of the system when checking for leaks (see 4.1).
 - b. Stay out of potentially hazardous areas while testing hose systems (see Section 4).
 - c. Relieve system pressure before tightening connections.

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8. Maintenance Inspection—A hose and fitting maintenance program may reduce equipment downtime, maintain peak operating performance, and reduce the risk of personal injury and/or property damage. The user should design and implement a maintenance program that suits the specific application and each specific hose in that application.

8.1 Inspection Frequency—Evaluate factors such as the nature and severity of the application, past history, and manufacturers' information to establish the frequency of visual inspections and functional tests.

8.2 Visual Inspection (Hose and Fittings)—Visually inspect hose and fittings for:

- a. Leaks at hose fitting or in hose
- b. Damaged, cut, or abraded cover
- c. Exposed reinforcement
- d. Kinked, crushed, flattened, or twisted hose
- e. Hard, stiff, heat cracked, or charred hose
- f. Blistered, soft, degraded, or loose cover
- g. Cracked, damaged, or badly corroded fittings
- h. Fitting slippage on hose
- i. Other signs of significant deterioration

If any of these conditions exist, evaluate the hose assemblies for correction or replacement.

8.3 Visual Inspection (All Other Components)—When visually inspecting hose and fittings, inspect for related items including:

- a. Leaking ports
- b. Damaged or missing hose clamps, guards, or shields
- c. Excessive dirt and debris around hose
- d. System fluid: level, type, contamination, condition, and air entrainment

If any of these are found, address them appropriately.

8.4 Functional Test—Functional tests determine if systems with hose are leak free and operating properly. Carry out functional tests per information from equipment manufacturers.

9. Hose Storage—Age control and the manner of storage can affect hose life. Use the following practices when storing hose.

9.1 Age Control—Maintain a system of age control to determine that hose is used before its shelf life has expired. Shelf life is the period of time when it is reasonable to expect the hose to retain full capabilities for rendering the intended service.

Store hose in a manner that facilitates age control and first-in, first-out usage based on manufacturing date on hose or hose assembly. Per SAE J517:

- a. Shelf life of rubber hose in bulk form, or in hose assemblies passing visual inspection and proof test, is forty quarters (ten years) from the date of manufacture.
- b. Shelf life of thermoplastic and polytetrafluoroethylene hose is considered to be unlimited.

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9.2 Storage—Store hose and hose assemblies in a cool, dark, dry area with the ends capped. When storing hose, take care to avoid damage that could reduce hose life, and follow the manufacturers' information for storage and shelf life. Examples of factors that can adversely affect hose products in storage are:

- a. Temperature
- b. Ozone
- c. Oils
- d. Corrosive liquids and fumes
- e. Rodents
- f. Humidity
- g. Ultraviolet light
- h. Solvents
- i. Insects
- j. Radioactive materials

If there are questions regarding the quality or usability of hose or hose assemblies, evaluate appropriately:

- a. Flex the hose to the minimum bend radius and compare it with new hose. After flexing, examine the cover and tube for cracks. If any appear, no matter how small, reject the hose.
- b. If the hose is wire reinforced, and the hose is unusually stiff, or a cracking sound is heard during flexing, check for rust by cutting away a section of the cover from a sample. Rust would be another reason for rejection.
- c. If doubt still persists, contact hose assembler to conduct proof-pressure tests or any other tests needed to verify hose quality.

10. Notes

10.1 Marginal Indicia—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

PREPARED BY THE SAE FLUID CONDUCTORS AND CONNECTORS TECHNICAL COMMITTEE SC3—
TRAINING AND EDUCATION SUBCOMMITTEE

SAE J1273 Revised AUG2004

Rationale—To correct verbiage in Section 9.1.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—SAE J1273 provides guidelines for selection, routing, fabrication, installation, replacement, maintenance, and storage of hose and hose assemblies for fluid-power systems. Many of these SAE Recommended Practices also may be suitable for other hoses and systems.

Reference Section

SAE J343—Test and Procedures for SAE 100 R Series Hydraulic Hose and Hose Assemblies

SAE J514—Hydraulic Tube Fittings

SAE J517—Hydraulic Hose

SAE J1927—Cumulative Damage Analysis for Hydraulic Hose Assemblies

ISO 3457—Earth moving machinery—Guards and shields—Definitions and specifications

Developed by the SAE Fluid Conductors and Connectors Technical Committee SC3—Training and Education Subcommittee

Sponsored by the SAE Fluid Conductor and Connectors Technical Committee

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