

# Con-Tech<sup>®</sup>

MANUFACTURING, INC.

# SERVICE MANUAL



**EXTREME DUTY<sup>™</sup>**

**BridgeKing<sup>®</sup>**



**HIGH PERFORMANCE**  
The New Standard.

**ECOFin**

# Thank You

## FOR YOUR BUSINESS

Con-Tech Manufacturing would like to thank you for your confidence in our product. We strive daily to provide you, the customer, with products and equipment that will perform to **YOUR** expectations for many years to come.

To ensure the performance of your new equipment, we have enclosed a maintenance, operations & parts manual for your reference. If, over the course of your ownership, you have **ANY** questions about care and maintenance, please call us at 507-374-2239.

**So we can adequately handle your call, please have your mixer serial number ready.**

*Con-Tech Manufacturing, Inc.*

Date of Purchase \_\_\_\_\_

Model Number of Mixer \_\_\_\_\_

Serial Number of Mixer \_\_\_\_\_

Model Number of Direct Drive \_\_\_\_\_

Serial Number of Direct Drive \_\_\_\_\_

Model Number of Hydrostatic Pump \_\_\_\_\_

Serial Number of Hydrostatic Pump \_\_\_\_\_

Model Number of Hydrostatic Motor \_\_\_\_\_

Serial Number of Hydrostatic Motor \_\_\_\_\_



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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**NOTE:** Page numbers on the vendor supplied spec sheets may not be in sequence of the service manual.



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## LIMITED MIXER WARRANTY

Con-Tech Manufacturing Inc., a Minnesota corporation, hereinafter referred to as Con-Tech, warrants components manufactured by Con-Tech to be free from defects in material and workmanship under normal use and service for a period of 2 years. Con-Tech's obligation under this warranty is limited to repairing and replacing, at Con-Tech's opinion, any parts which are returned to Con-Tech's factory at Dodge Center, Minnesota 55927. Transportation charges must be prepaid by the customer. Parts must be returned within 30 days after date of delivery to customer. This warranty covers only parts which, upon examination by Con-Tech, are found to be defective in material or workmanship. Such repair or replacement of parts under this warranty will be made by Con-Tech without charge for such parts. Under no circumstances will Con-Tech be under any further liability with respect to such warranty.

***Equipment or accessories purchased by Con-Tech from other manufacturers shall be covered by that manufacturer's warranty.***

The Eaton hydrostatic pump and motor is warranted against defects in material and workmanship under normal use and service for a period of 5 years after date of delivery to customer. Leaks will be treated as a repair procedure and do not warrant full unit replacement. Lubricants and filters must be changed initially at 100 hours then every six-months or 1,000 hours thereafter, whichever comes first, with the recommended oil specification and correct filter. Service records must be available upon request.

The ZF drum drive is warranted against defects in material and workmanship under normal use and service for a period of 5 years after date of delivery to customer. Leaks will be treated as a repair procedure and do not warrant full unit replacement. Lubricants must be changed initially at 100 hours then every six-months or 1,000 hours thereafter, whichever comes first, with the recommended gear lube. Service records must be available upon request.

Components not listed above including (but not limited to) switches, gauges, lights, cables, harnesses, electrical controllers, hydraulic cylinders, air cylinders, and hoses are warranted for 1 year against defects in materials and workmanship.

Con-Tech warranty shall not apply to equipment that has been subject to misuse, negligence, accident, acid use, liquid nitrogen exposure or which has been repaired or altered without Con-Tech's prior knowledge and consent.

**CON-TECH WILL NOT BE RESPONSIBLE (FINANCIALLY OR OTHERWISE) FOR IN-WARRANTY REPAIRS MADE IN THE FIELD BY PERSONNEL OTHER THAN FROM CON-TECH WITHOUT PRIOR APPROVAL BY CON-TECH MANUFACTURING.**

**YOUR MIXER IS DESIGNED TO OPERATE ONLY WITH THE OEM PRODUCTS USED BY CON-TECH. THIS LIMITED WARRANTY WILL BE VOID IF THE CON-TECH PRODUCTS ARE MODIFIED OTHER THAN AS DONE AT CON-TENCH'S FACTORY, UNLESS AUTHORIZED BY CON-TECH IN WRITING. USE OF PARTS AND ASSEMBLIES FROM ANOTHER MANUFACTURER AS SUBSTITUTES FOR OEM PRODUCTS WILL ALSO VOID THE LIMITED WARRANTY. THERE WILL BE NO WARRANTY ON USED PARTS.**

**IN NO CASE SHALL CON-TECH MANUFACTURING BE LIABLE FOR CONSEQUENTIAL, INCIDENTAL, SPECIAL OR INDIRECT DAMAGES OF ANY KIND.**

**CON-TECH MAKES NO OTHER EXPRESSED OR IMPLIED WARRANTIES OF FITNESS OR MERCHANTABILITY OR ANY OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE WHICH EXCEEDS THE FORGOING WARRANTY IS HEREBY DISCLAIMED BY CON-TECH. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.**

The customer's exclusive remedy for breach of warranty as a result of defects in material and workmanship shall be as set forth herein. Any action for breach of warranty must be commenced within one year after the cause of action shall accrue, and no such action may be maintained which is not commenced within such period. Con-Tech neither assumes nor authorizes any other persons to assume for it any liability in connection with its equipment.



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# WARRANTY AS IT APPLIES TO ACID USE



Con-Tech Manufacturing shall not assume warranty liability should the failure of a component be traced to acid use. Any use of acid shall void the Con-Tech standard warranty regardless of purchase date, hours, etc. Acid is HIGHLY corrosive, caustic and can adversely affect the following:

- WIRING HARNESS
- LIGHTING
- HYDRAULIC HOSES
- HYDRAULIC CYLINDERS
- HYDRAULIC ADAPTERS
- STEEL MIXER COMPONENTS
- PAINT
- FASTENERS
- SEALS
- CABLES
- BUSHINGS
- GASKETS
- FRAME
- TRUCK CHASSIS & COMPONENTS

Con-Tech Manufacturing DOES NOT approve of acid use on any of our equipment or components.



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# GENERAL OPERATIONS

## CLEANING

Keep your mixer clean by washing down the drum, rear frame assembly and discharge chute after each load. **DO NOT** use acid of any kind. This can cause personal harm as well as damage to mixer components. Damage due to acid use is not covered by warranty. You will be rewarded with longer service life, better performance and eliminate the added weight of accumulated concrete.

## WATER SYSTEMS

1. Be sure to drain the tank, hoses and pipes during operations under freezing conditions.

### 2. Water Tank:

Water tanks include three safety controls preset at the factory. To fill water tank, the air line must be shut off and tank brought to zero pressure by releasing the air through the two way or ball valve. A decal is provided showing proper direction.

**The following safety controls should NEVER be altered:**

1. Hold-back valve on truck air tank-set at 75 P.S.I.
2. Pressure relief valve on water tank-set at 60 P.S.I.
3. Water tank operating pressure 55 lb. maximum.

## SAFETY PRECAUTIONS

The following safety rules should always be followed at all times.

### 1. Water Tanks

Always evacuate air completely before attempting to add water. Always depressurize the water tank during transit.

### 3. Warning

Always keep hands and feet clear of revolving parts while checking load or washing down mixer.

### 4. Hydraulics

Never operate hydraulic system if oil leak is present.

### 5. Air Brake Pressure

The water tank is connected to the truck air system by a pressure hold back valve on the truck air tank. This valve is set at 75 P.S.I. and should not be altered. It is recommended that the vehicle operator check the air brake pressure gauge in the truck cab to assure safe vehicle operation.

## IMPORTANT OPERATIONAL NOTE

The hydrostatic system has been built to allow a controlled amount of leakage between the moving and stationary internal parts of the pump and motor and conducted through a common hydraulic hose through the heat exchanger and back to the reservoir. The volume of oil that is produced by the charge pump in excess of that which is required to keep the hydraulic system fully charged is released to the case of the main pump and returned through the heat exchanger to the reservoir. This is the method employed to keep the hydraulic fluid within an acceptable operating temperature.

There are certain operating conditions that require special attention. For instance, when pouring low slump concrete higher system pressures are generated causing greater internal fluid leakage. Pouring low slump concrete coupled with high ambient temperatures may cause excessive internal leakage to the point where the charge pump may not be producing a great enough volume of hydraulic fluid to maintain a fully charged system. If this condition does exist the drum will stop turning.

The solution to this problem is simply to run the truck engine at 1200 RPM. This will increase the output of the charge pump and maintain a fully charged hydraulic system. Under normal operating conditions such as pouring 4" slump concrete where the ambient temperature is around 75 degrees (F), there should be no problem discharging the mixer around 600 R.P.M. engine idle speed. However, under severe discharge conditions, it is recommended that the truck engine speed be increased until a satisfactory performance is achieved.



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# LOCKOUT/TAG OUT SAFETY PROCEDURE

FOR ALL CONCRETE MIXERS



**GENUINE**  
**Con-Tech**  
MANUFACTURING, INC.  
**PARTS**

## SAFETY FIRST

ONLY USE ORIGINAL CON-TECH PARTS

Protect your investment in Con-Tech equipment. Do not jeopardize your warranty. Use only genuine Con-Tech replacement parts. Original Con-Tech parts insure the finest quality, longest life and proper reliable operation.

## ⚠ IMPORTANT INFORMATION

### LOCKOUT / TAG OUT

Always follow **Lockout / Tag Out** procedures any time maintenance is being performed on the mixer. See Lockout / Tag Out information in this manual.

*Also refer to OSHA regulation 29 FR 1910.147*

### CONFINED SPACE

The mixer drum is considered **Confined Spaced**. Any time you enter the drum, mandated OSHA Confined Space Regulations must be followed. See confined space information in this manual.

*Also refer to OSHA regulation 29 CFR 1910.146*

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[www.ctmmixers.com](http://www.ctmmixers.com)



# SAFETY LOCKOUT / TAG OUT INSTRUCTIONS

- SUBJECT** "SAFETY LOCKOUT / TAG OUT INSTRUCTIONS" for Con-Tech Manufacturing transit mixer drums powered by a hydraulic system.  
To "ALERT employees and PREVENT drum rotation before employees perform any service or maintenance activities where the start-up or drum rotation may cause serious personal injury or death.
- REASON** The reason for this instruction sheet is due to important mandatory regulations from OSHA concerning lockout procedures where individuals may be called upon to work in confined spaces and requests made by customers seeking methods to comply with the OSHA regulations. This INSTRUCTION SHEET is being provided as a service to our customers.
- NOTICE DATE** Con-Tech Manufacturing is notifying their employees and customers that a "DRUM LOCKOUT PROCEDURE" should be utilized on all concrete mixers.
- TOOLS REQUIRED** **Padlock with key; example:** The most effective method of preventing the accidental starting of the cable controlled mixer drum during servicing or maintenance activities is to remove the control valve arm which will cause control valve shaft to automatically return to neutral position. For an RE Controlled mixer drum, unplug the two coil leads and place them into LOTO box with a hasp and padlock. Place "DANGER LOCKOUT PROCEDURE IN EFFECT" tag onto safety lockout and place lockout through splined hole of control valve arm. Attach padlocks as show in **FIGURE 1**.

**FIGURE 1**



## ⚠ WARNING!

The padlock method is established so any person who may be required to work in the mixer drum receives a lock and tag with his name stamped on it and (1) key to fit that lock only. No one except the person who removed the control valve arm or coil leads and installed the padlock will be able to unlock it to replace the control valve arm or plug in the coil leads to engage the pump that allows the drum to rotate. If more than one person is working on the same machine, each person must put their own padlock onto the multi-lock, (6 maximum), like the one shown in **FIGURE 1**. *Failure to follow these warnings concerning Lockout / Tag Out procedures may result in serious personal injury or death*

### INFORMATION

These Lockout devices and procedures may be installed on Con-Tech Manufacturing mixers. For those desiring to apply this lock device and safety signs, please contact the Con-Tech Parts Department at **507-374-2239** for price and installation instructions.

#### Kit Includes: P/N #799256

- 2 - 12x18" Magnetic Caution Signs #799255
- 1 - Danger Lockout Tag #799106
- 3 - 8.5 x 6 Vinyl Warning Decals #799201
- 1 - Lockout for 6 Padlocks #799250
- 2 - Lockout Boxes #799259



# LOCKOUT PROCEDURE FOR CABLE CONTROLLED MIXER DRUM

**1** Before personnel perform any cable controlled mixer drum service or maintenance, the employer or supervisor must **"ALERT"** the unit driver that his truck and drum will be **"LOCKED OUT"** and that he must not attempt to restart it.



**2** Position drum hatch where convenient for service and maintenance if required.



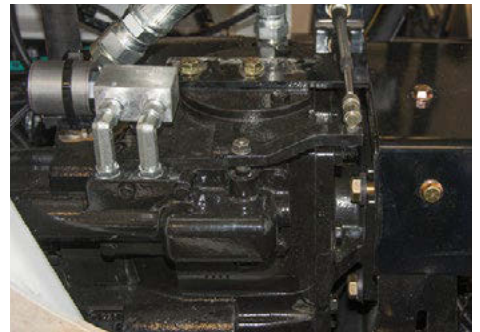
**3** Place drum control lever in neutral position so drum remains stationary.



**4** Before entering the drum, the service/maintenance person must shut off the truck engine and carry all ignition keys in their pocket. Roll up cab windows and lock all doors. **IMPORTANT:** Shutting off the truck engine will eliminate powered rotation of the mixer drum.



**5** Place magnetic "DANGER" signs on both doors. **"Man working on drum. Do not start or rotate drum."**



**6** **NOTE:** Position of control valve arm.



**7** Remove nut and lockwasher on control valve arm.



**8** Remove control valve arm and place safety lockout with white and red **"Danger Lockout procedure in effect"** tag in splined hole of control valve arm.



# LOCKOUT PROCEDURE FOR CABLE CONTROLLED MIXER DRUM



**9** Be sure that the mixer drum warning decals are clean, readable and properly positioned as shown. Decals should be replaced if damaged or unreadable.

**10** If more than one person is working on the mixer, each person must put their own padlock on the Lockout as shown.

## **⚠ CAUTION!**

**12** All tools and other foreign objects must be removed from the loaction. A check must be completed to ensure that no employees are in a place where movement or starting of the truck unit or drum will endanger them.



**13** When finished, remove the LOTO devices and reattach the control valve arm or plug in.



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# LOCKOUT PROCEDURE FOR RE CONTROLLED MIXER DRUM

**1** Before personnel perform any RE Controlled mixer drum service or maintenance, the employer or supervisor must **"ALERT"** the unit driver that his truck and drum will be **"LOCKED OUT"** and that he must not attempt to restart it.



**2** Position drum hatch where convenient for service and maintenance if required.



**3** Use toggle switch to place drum control lever in neutral position so drum remains stationary.



**4** Before entering the drum, the service/maintenance person must shut off the truck engine and carry all ignition keys in their pocket. Roll up cab windows and lock all doors. **IMPORTANT:** Shutting off the truck engine will eliminate powered rotation of the mixer drum.



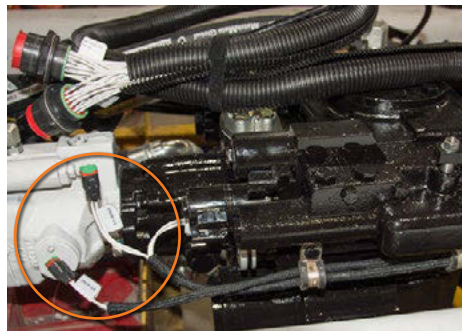
**5** Place magnetic "DANGER" signs on both doors. **"Man working on drum. Do not start or rotate drum."**



**6** **NOTE:** Position of control valve arm.



**7** Location of coil wires.



**8** To disable the Drum from rotating unplug Drum Charge/Discharge and Drum Start/Stop coil wires.



**9** Install Lockout box as shown. The drum is now locked out.



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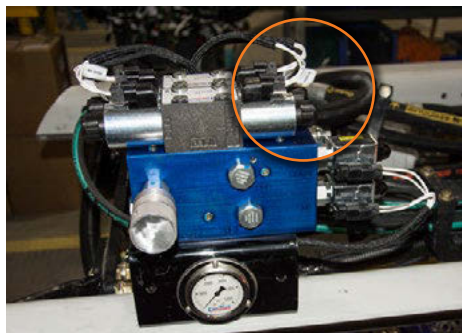
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# BRIDGEKING TRAILER LOCKOUT PROCEDURE

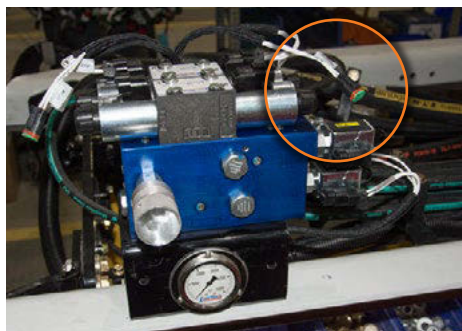
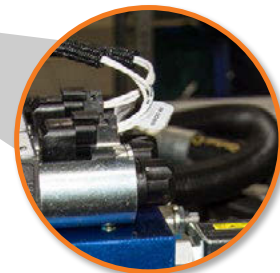
- 1 Before personnel perform any BridgeKing® Trailer service or maintenance, the employer or supervisor must **"ALERT"** the unit driver that his truck and drum will be **"LOCKED OUT"** and that he must not attempt to restart it.



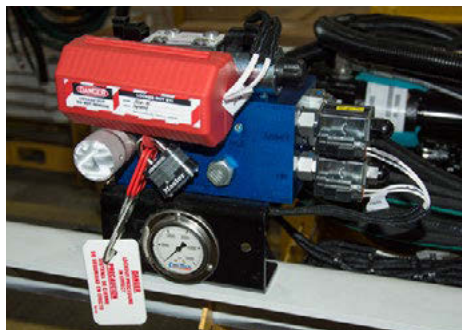
- 2 The service/maintenance person must shut off the truck engine and carry all ignition keys in their pocket. Roll up cab windows and lock all doors.  
**IMPORTANT:** Shutting off the truck engine will eliminate power to the BridgeKing® Trailer.



- 3 Lower trailer with the PRV2 turned fully counter-clockwise.



- 4 Unplug the BridgeKing® coil wires.



- 5 Install Lockout Boxes as shown. The BridgeKing® Trailer is now locked out.

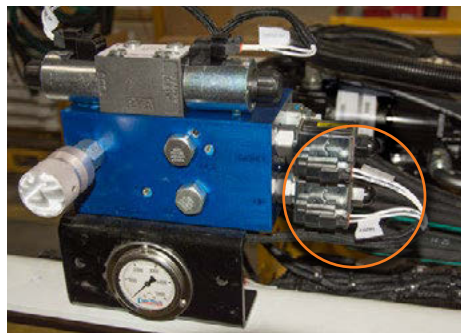


# CHUTE UP/DOWN LOCKOUT PROCEDURE

- 1 Before personnel perform any chute service or maintenance, the employer or supervisor must **"ALERT"** the unit driver that his truck and drum will be **"LOCKED OUT"** and that he must not attempt to restart it.



- 2 The service/maintenance person must shut off the truck engine and carry all ignition keys in their pocket. Roll up cab windows and lock all doors.  
**IMPORTANT:** Shutting off the truck engine will eliminate power to the chutes.



- 3 Lower chutes all the way down to disable the chute functions. .



- 4 Unplug the **chute up/down** coil wires.



- 5 Install Lockout Boxes as shown. The **chute up/down** is now locked out.



# CONFINED SPACE



**OSHA’s definition of confined space is as follows:**

- 1 Large enough for an employee to enter and perform work;
- 2 Has a limited or restricted opening for entry or exit
- 3 Not designed for continuous occupancy.  
This describes the types of areas employees can come in contact with on a daily basis.  
This is what would be a *non-permit required* confined space.

**A permit required confined space contains all of the three items above plus one or more of the following:**

- 1 A substance that has the ability to engulf or asphyxiate the entrant.
- 2 A potentially hazardous atmosphere.
- 3 Inwardly converging walls within the space or a floor the slopes downward, tapering to a small cross-section.
- 4 Contains any other serious safety or health hazard.

When a confined space has been identified as having any one of the above four potential hazards, an employer should identify it as such either with signs or another effective means of communication. When an employer has workers that will be entering confined spaces, there needs to be a written program developed that outlines and instructs on the proper procedures for working around these spaces.

See 29CFR 1910.146 for additional information.

**NOTE:** The drum must be blocked to prevent rotation should an employee enter the drum.



**799201**  
8.5 x 6 Vinyl  
Warning Decals

**799255**  
12 x 18” Magnetic  
Caution Signs



## IMPORTANT SAFETY INFORMATION

Call Con-Tech Manufacturing, Inc. at 507-374-2239 if assistance is needed.

**! DANGER**

### DANGER

indicates a hazardous situation which, if not avoided, will result in death or serious injury.

**! WARNING**

### WARNING

indicates a hazardous situation which, if not avoided, could result in death or serious injury.

**! CAUTION**

### CAUTION

indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

**NOTICE**

### NOTICE

is used to address practices not related to physical injury.

**SAFETY INSTRUCTIONS**

### SAFETY INSTRUCTIONS

(or equivalent) signs indicate specific safety-related instructions or procedures.

**NOTE:** For more information on ANSI Z535.4 requirements see the ANSI website or contact  
Con-Tech Manufacturing, 65740 State Hwy 56, Dodge Center, MN 55927

### THESE SAFETY PROCEDURES ARE FOR YOUR OWN PROTECTION:

Safety and safe working procedures must be followed at all times. OSHA procedures must be followed at all times when working on the mixer or the pneumatic, electrical, or hydraulic systems. Anytime you are working on the mixer or its related systems, you must do the following to prevent personal injury or death.

This is the published SAE J2967 LOTO information that is required; 7.3.2 The lockout procedure shall include, but not be limited to, the following to prevent serious personal injury or death:

1. Apply the parking brake.
2. Chock the wheels.
3. Shut down all power sources, such as the truck engine and auxiliary engines.
4. Remove the key from the vehicle ignition.
5. Install a tag or cover on the steering wheel or other appropriate location.
6. Place frame and body supports as needed.
7. Place operating equipment at the lowest potential energy level or position so as not to be subject to possible free fall.
8. Install blocking devices to prevent any raised or elevated device from falling or moving unexpectedly.
9. If the drum is to be entered, install devices to prevent the drum from rotating.
10. Relieve stored hydraulic or pneumatic pressure, after blocking devices are installed, if maintenance is to be done to the hydraulic or pneumatic system.

A copy of the Con-Tech policy on Lockout Procedures is available from  
Con-Tech Manufacturing, 65740 State Hwy 56, Dodge Center, MN 55927



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# IMPORTANT SAFETY INFORMATION

Call Con-Tech Manufacturing, Inc. at 507-374-2239 if assistance is needed.

THESE SAFETY PROCEDURES ARE FOR YOUR OWN PROTECTION:

## ⚠ WARNING!

Hydraulic hoses must be inspected on a daily basis for leaks, cuts, abrasions, damage, aging and proper clearance along the frame. Immediately replace any damaged or old hydraulic hoses before returning mixers to service. Replace hydraulic hoses every 3 years. Failure to follow the warnings concerning hydraulic hoses may result in serious personal injury. See pages in this manual for specs.

## ⚠ WARNING!

Correct hoses, fittings and adapters with the correct SAE rating must **ALWAYS** be used when replacing hoses to prevent possible serious injury. Never mix brands of hose, fittings and adapters. Example: brand "A" hose may not be compatible with a brand "B" fitting or adapter.

## ⚠ WARNING!

Hydraulic system is hot – **NEVER TOUCH** serious personal injury may result from hot oil.

## ⚠ WARNING!

If hydraulic pipe must be replaced be sure to follow the specifications in this manual. If incorrect hydraulic pipe is installed the hydraulic system may fail. Serious personal injury could also result from hydraulic pipe failure. Inspect hydraulic pipe on a weekly basis for abrasions, damage or rust.

## ⚠ WARNING!

**NEVER** remove hydraulic lines, fittings, or adapters until all pressure has been relieved from the hydraulic system. Failure to follow the warnings concerning hydraulic hoses may result in serious personal injury.

## ⚠ NOTICE!

**ALWAYS** use the proper tools and equipment when servicing the hydraulic system. Use only Con-Tech charging kit when recharging the accumulator.

## ⚠ WARNING!

**NEVER** operate the hydraulic system if a leak is present. Hydraulic oil under pressure can be injected under your skin.

## ⚠ WARNING!

**NEVER** heat hydraulic pipe. The carbon content of this steel tube is such that if heated for bending and either water or air quenched, the pipe may have lost its ductility and thereby be subject to failure under high pressure or hydraulic shock conditions.

## ⚠ WARNING!

Wearing rings, watches or jewelry while working with electrical and mechanical equipment can be hazardous and can cause serious and painful injuries if they come into contact with electrical wires, moving parts or hydraulic equipment.

## ⚠ WARNING!

When using the emergency jumper procedure to rotate the drum on a disabled mixer the following must be observed: Before removing the hydraulic motor from the mixer drive on both the operating and disabled mixer, be sure the drum has been allowed to turn freely so that it is balanced with no forces transmitted to the hydraulic motor. Failure to follow the warnings concerning emergency jumper procedures may result in serious personal injury.

## ⚠ WARNING!

When working on the hydraulic or electrical system of a BridgeKing® unit the trailer should be in the down position or chained if in the up position to prevent the trailer from lowering unexpectedly. **NEVER** stand behind or under the BridgeKing® trailer when in the up position. If the BridgeKing® cylinder will not lower or raise, call Con-Tech Manufacturing for assistance at **(507) 374-2239**. Failure to follow this warning may result in serious personal injury.

## ⚠ WARNING!

Slower speeds are required when going around curves or corners as the unit could upset or roll. Failure to follow this warning may result in serious personal injury.

## ⚠ NOTICE!

At the job site use the lowest transmission gear and proceed at low speed, 3 mph maximum, to the discharge area.

## ⚠ WARNING!

**ALWAYS** keep hands and feet clear of the mixer drum, revolving parts and moving parts while checking load or washing down the mixer. Never climb on ladder or platform while truck is in motion or drum is rotating. Use 3-point stance when climbing or coming down ladder. Serious personal injury may result due to a fall.

## ⚠ WARNING!

All personnel must stand clear of the chutes during raising and lowering and when chutes are loaded with concrete. Position chutes while they are not loaded. A loaded chute falling on a person may cause serious personal injury. All chutes must be handled with great care to avoid injury. Never stand on chutes.

## ⚠ WARNING!

Main, fold over and extension chutes must be inspected on a daily basis for damage, excessive wear, proper hardware fit, twist and overall condition to determine that they are safe to use. Never attempt to repair chutes. Unsafe chutes must be replaced with new chutes. Failure to follow this warning may result in serious personal injury.

## ⚠ WARNING!

The main and fold over chutes must be stowed and manually locked to the side of the mixer during transit. Failure to follow this warning may result in serious personal injury.



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# IMPORTANT SAFETY INFORMATION

Call Con-Tech Manufacturing, Inc. at 507-374-2239 if assistance is needed.

THESE SAFETY PROCEDURES ARE FOR YOUR OWN PROTECTION:

## ⚠️ WARNING!

Optional air chute lock is intended for use only on the job site. The manual chute lock must always be engaged during transport to prevent excessive wear. Serious personal injury may result due to improper usage.

## ⚠️ WARNING!

No passenger may be allowed in the cab unless a manufacturer's approved passenger seat and seat belt are provided. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

**NEVER** let other persons, other than the driver, handle the chutes, unfold the fold over and/or remove extensions, or stow and secure the extensions for transit. Keep hands away from chute hardware where the chutes connect. Never stand in the path of the chute as it is being unfolded or while in use. Failure to follow the warnings concerning chute safety may result in serious personal injury.

## ⚠️ DANGER!

The mixer and chassis should not be overloaded. Gross Vehicle Weights must meet Federal, State and Local laws.

## ⚠️ WARNING!

**NEVER** drive the truck with the water tank pressurized. A pressurized water tank may burst in the event of an accident. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

**NEVER** adjust or remove the OEM pressure regulator or pop-off pressure protection valve in the water tank system. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

**NEVER** attempt to repair or weld ANY water tank. Any tank that shows signs of leaks, corrosion, rust, dents, or gouges

must be immediately REPLACED. Water tank must be replaced every 3 years. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

**NEVER** pressurize an empty water tank. Pressurizing an empty water tank will increase the potential for damage and personal serious injury or death should a water tank burst.

## ⚠️ WARNING!

Safety decals must be replaced anytime they are damaged or missing or cannot be read clearly. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

The mixer must not be modified in any way without authorization from Con-Tech Mfg. Inc. Modifications may not comply with safety standards and may cause serious personal injury or death.

## ⚠️ WARNING!

Be sure everyone is clear of the area around the truck before operating the mixer. Remain attentive at all times when operating the controls. Watch the mirrors for activity. **NEVER** back up the mixer until you are completely sure it is safe. Use a spotter/observer and/or get out and check yourself to ensure it is safe to do so. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

Thoroughly understand the controls before operating the mixer. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

Wear the proper protective clothing when operating or maintaining the mixer. Hard hats, safety glasses, gloves and safety shoes **MUST** be worn. Reflective clothing is recommended for drivers and workers while pouring concrete during hours of darkness. Failure to follow this warning

may result in serious personal injury.

## ⚠️ WARNING!

**NEVER** enter under the chassis unless the mixer is in the Lockout / Tag Out mode. Remember to follow the Lockout / Tag Out procedures when working under the truck. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

When working on the mixer the wheels must be blocked, the parking brake on, Lockout / Tag Out procedures in effect and the keys out of the truck's ignition. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

**NEVER ROTATE DRUM** while backing up on uneven or soft terrain. Failure to follow this warning may result in serious personal injury.

## ⚠️ WARNING!

Driver/Operator of the BridgeKing® mixer **MUST** consult the axle psi placard (located near the axle pressure adjusting valve) to determine appropriate pressure setting based on the load that is being transported. Pressure is adjusted by turning the knob clockwise/ counterclockwise until the appropriate pressure is indicated on the gauge. If unit is equipped with auxiliary lift axles, it will also be indicated on the axle psi placard as to whether this axle should be raised or lowered based on the load being carried. Failure to properly set the axle pressure and/or the improper use of auxiliary axle may result in serious injury or death.

## ⚠️ WARNING!

To determine the correct weight distribution on a new mixer the unit must have weights verified on a scale before truck is put back in service. Scaling will verify correct air and/or hydraulic pressure for auxiliary axles and BridgeKing® trailer. Failure to follow this warning may result in serious personal injury.



# IMPORTANT SAFETY INFORMATION

**Call Con-Tech Manufacturing, Inc. at 507-374-2239 if assistance is needed.**

## THESE SAFETY PROCEDURES ARE FOR YOUR OWN PROTECTION:

### ⚠ WARNING!

Hydraulic components can be heavy. Use caution while lifting these components. Serious personal injury can be avoided with proper handling of the components. Failure to follow this warning may result in serious personal injury.

### ⚠ WARNING!

Increasing hydraulic pressure beyond the recommendations may result in serious personal injury. If you have questions or concerning hydraulic pressures or testing procedures, please contact Con-Tech manufacturing at 507-374-2239 before attempting the test procedures or making adjustments.

### ⚠ WARNING!

When performing hydraulic test procedures, use the proper hydraulic gauges. Installing an incorrect test gauge could result in serious injury if the gauge fails. Use properly rated hydraulic hoses to allow the test gauge to be read away from moving parts and functions.

### ⚠ WARNING!

**NEVER** climb on ladders or ride on platforms while the truck is in motion or when ladders or platforms are wet or slippery. Serious personal injury may result due to a fall.

### ⚠ WARNING!

Daily inspection should be performed on the mixer. This includes proper operation of the controls, hydraulics lock out systems, electrical systems, lighting system including turn signals, back up alarm, brake lights, clearance lights, head lamps, tail lamps, safety equipment, and work lights. The truck's air system must operate properly and have no leaks. Water and moisture should be drained from the truck's air system daily.

### ⚠ WARNING!

Optional air chute lock is intended for use only on the job site. The manual chute lock should always be engaged during transport. Excessive wear or injury may result due to improper usage.

### ⚠ WARNING!

Safety decals must be replaced anytime they are damaged or missing or cannot be read clearly. If you require safety decals, please contact Con-Tech Manufacturing at **507-374-2239** for replacement safety decals at no charge.

### ⚠ WARNING!

Thoroughly understand the controls before operating the mixer. Be sure everyone is clear of the area around the truck before operating the mixer. Remain attentive at all times when operating the controls. Failure to follow this warning may result in serious personal injury.

### ⚠ DANGER!

The trailer should be lowered when servicing the accumulator. **NEVER** stand behind the cylinder when charging the accumulator. Failure to follow this warning may result in serious personal injury.

### ⚠ WARNING!

If you are not familiar with the BridgeKing® trailer **NEVER** push or pull switches until you know what part of the system they will contact and understand the system's operation. Failure to follow this warning may result in serious personal injury.

### ⚠ WARNING!

Check the tire condition and tire pressure of the trailer wheels daily to be sure the tires are inflated to proper pressure to withstand the applied loads. Never exceed the recommended tire pressure marked on the tire sidewalls. Failure to follow this warning may result in serious personal injury.

### ⚠ WARNING!

Check trailer king pins, toe-in, tie rods, and components for proper adjustment. Replace any worn or loose components immediately. Contact Con-Tech Mfg at **507-374-2239** for any specifications or assistance you may require. Failure to follow this warning may result in serious personal injury.

### ⚠ WARNING!

The following safety guidelines must be followed by mechanics working on the BridgeKing® accumulator.

The cylinder rod must be extended (trailer on the ground) before the accumulator is charged.

**NEVER** stand behind the cylinder when charging the accumulator. The hose on the Con-Tech accumulator charge kit is long enough to allow the accumulator to be charged from the side of the mixer.

**NEVER** attempt to disassemble the cylinder.

Use only Con-Tech Manufacturing part **#750005 - Accumulator Charge Kit**

Purge air from the Accumulator Charge Kit hose by allowing a slight flow of nitrogen to escape while attaching the Accumulator Charge Kit to the Accumulator Charge Stem. The truck ignition key should be removed while charging the accumulator.

Read these instructions thoroughly before attempting to charge the accumulator.

Loosen only the top nut of the accumulator charge stem. If the bottom nut is loosened, damage to the o-ring seal could result. All gas pressure must be released from the accumulator before the accumulator charge stem can be removed for service.

If you have any questions or experience difficulty with the cylinder or charging the accumulator, please call Con-Tech Manufacturing at (507) 374-2239. Refer to the **Charging the BK Accumulator** section in this manual.



# IMPORTANT SAFETY INFORMATION

Call Con-Tech Manufacturing, Inc. at 507-374-2239 if assistance is needed.

## THESE SAFETY PROCEDURES ARE FOR YOUR OWN PROTECTION:

### **⚠ WARNING!**

Interference Between BridgeKing Trailer Axle and Chutes. If the BridgeKing axle is set in motion and then the chutes are raised, there is a possibility of interference between the axle and the chutes. DO NOT under any circumstances, start the trailer in motion and then raise the chutes. Damage to the chutes and chute attaching hardware can cause the chutes to collapse when loaded with concrete and cause bodily injury and/or death. Inspect chutes, chute hardware and all attaching components/structures daily.

### **⚠ DANGER!**

IF THE MIXER COMES INTO CONTACT OR CLOSE PROXIMITY WITH A POWER LINE OR THERE IS ANY ARCING, **STAY IN THE TRUCK CAB AND KEEP AWAY FROM THE METAL PARTS OF THE UNIT.** NEVER LET ANYONE COME CLOSE TO THE TRUCK. NEVER ATTEMPT TO JUMP CLEAR OF THE TRUCK. STAY IN THE CAB. THE POWER MUST BE DISCONNECTED BY THE POWER COMPANY BEFORE YOU CAN SAFELY LEAVE THE CAB.

#### **Electricity will arc:**

- 50,000 Volts or Less ..... 4 Feet
- 50,000+ Volts ..... 10 Feet
- 345,000 - 750,000 Volts ..... 16 Feet

Failure to follow this warning may result in serious personal injury.

KNOW THE CLEARANCE OF THE OVERHEAD OBSTRUCTIONS. NEVER DRIVE THE MIXER UNDER ANY OVERHEAD OBSTRUCTION WITHOUT KNOWING THE CLEARANCE HEIGHT. IF UNIT HAS A FLIP-UP HOPPER, BE SURE HOPPER IS IN THE LOWERED POSITION. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE MIXER BODY OR TRUCK, AND MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

### **⚠ DANGER!**

Stow chutes to the ditch side during transit. Use manual lock to secure chute into position.

### **⚠ WARNING!**

Be sure to read and understand this manual before you operate the mixer. If you are unable to read and comprehend this manual, please ask your supervisor to read and explain this manual to you.

## ENTERING THE MIXER DRUM FOR MAINTENANCE

### **CONFINED SPACE**

Mixer drums are considered “confined spaces” because while they are not designed for people, they are large enough for workers to enter and perform certain jobs. A confined space also has limited or restricted means for entry or exit and is not designed for continuous occupancy.

### **PERMIT REQUIRED CONFINED SPACE**

Depending on the state you are located in, mixer drums may also be considered “permit-required confined space”. Permit Required Confined Space describes a confined space that has one or more of the following characteristics: contains or has the potential to contain a hazardous atmosphere; contains material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as a heat stress. Permit Required Confined Space has more rigid requirements and requires ventilation, an exit plan, et.

**NOTE:** For information on Confined Space requirements, see 29 CFR 1910.146 or contact Con-Tech Manufacturing at 507-374-2239.



# TRUCK MAINTENANCE INFORMATION

## DAILY PRE-OPERATIONAL INSPECTION

- 1 Inspect hydraulic system for leaks. Please inspect all hoses for cuts, abrasion or rubbing that could cause a hose failure. If ANY leaks are present, please repair, tighten or replace as needed. Please make sure system has sufficiently cooled and is NOT under ANY pressure!
- 2 Check all hydraulic oil sight gauges for adequate oil level and fill as needed to the correct level. When filling hydraulic fluid, the oil MUST meet J20A specifications.
- 3 Start engine and allow adequate time for system warm up (5 minute minimum).
- 4 Rotate drum and inspect for proper roller operation. If any snapping or popping is heard from rollers or roller track area, stop drum immediately and check for proper roller alignment. Any damaged rollers MUST BE replaced to eliminate potential damage to the drum.
- 5 Visually check hydraulic vacuum gauge located on suction filter housing. If gauge reads above 10" of vacuum after system has reached operating temperature, replace filter.
- 6 Test run all mixer functions electrically to make sure the mixer is fully operational before putting into service. Any repairs should be made before the mixer is put on the road!

## INITIAL FLUID/FILTER CHANGE RECOMMENDATIONS

- 1 Initial change of fluid and filters at 100 hours (this is the normal break in period and will also allow for an initial visual inspection of the hydraulic fluid/filter for contaminants). Failure to perform this service may adversely effect performance of your Con-Tech mixer & void any warranty.
- 2 After this oil change, replace oil and all filters every 6 months or 1000 hours to insure the optimum performance from your mixer. (See recommended lubricants on next page)

## WEEKLY INSPECTION

- 1 Lubricate necessary components per Table 1 (at end of this section) Failure to follow recommended maintenance will result in premature failure of certain components & void any warranty.
- 2 Re-Torque bolts per Table 2 (at end of this section). Maintaining bolts (and torque) is considered a maintenance item. Failure to routinely check bolts may result in component failure & void your Con-Tech warranty.
- 3 Inspect oil (at operating temperature) for the presence of a milky substance and/or any foam. This would indicate a suction leak or the presence of water in the system. Call Con-Tech Service at 507-374-2239 for further information.
- 4 Inspect drum for proper max charge RPM (16-18 RPM at governed engine RPM).
- 5 Inspect drum and fins for concrete build up and excessive wear. Concrete build up can cause the drum to be out of balance and will affect the mixing capabilities of your Con-Tech Mixer.



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# TRUCK MAINTENANCE INFORMATION

## 6 MONTH INSPECTION

- 1 Change Hydraulic Fluid as per specifications on Table 1 (at end of this section)
- 2 Change Gear Lubricant in main gearbox as per specifications located in Table 1 (at end of this section)
- 3 All filters and hydraulic fluid must be replaced every **6 months or 1000 hours** to maintain your warranty and keep your Con-Tech Mixer operating at maximum performance. All filter O-rings must be pre-lubricated prior to installation. Inspect filters for presence of foreign materials such as copper or brass filings.

## LUBRICATION

Lubricate control cables using the Con-Tech Cable Lube Kit.

P/N 780100 (Lube Gun Assembly)

P/N 780101 (1/4" Lube Adapter)

P/N 780102 (5/16" Lube Adapter)

P/N 780103 (Cable Lube)

## CON-TECH RECOMMENDED LUBRICANTS

Gear Box - 07A / 07C / 07E

CML Gearbox - ZF Ecofluid X

Hydraulic Fluid - Chevron Rando

HD ISO 68

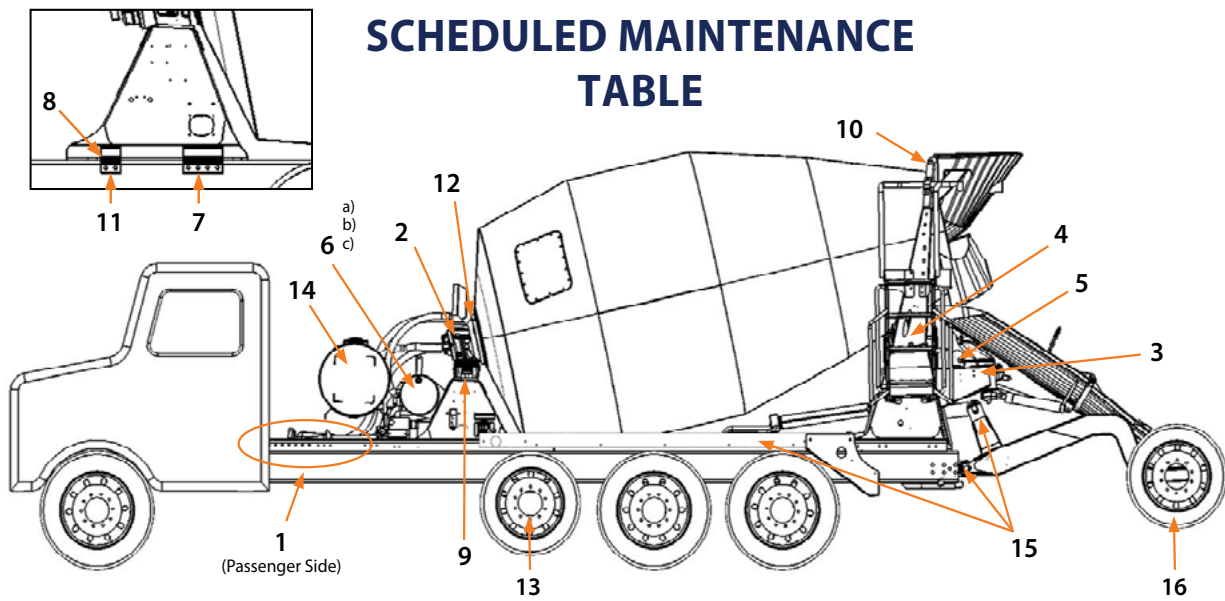
Roller Grease - Lubriplate 1500 Series

(SEE TABLE ON FOLLOWING PAGE)

**CALL CON-TECH SERVICE AT  
507-374-2239 FOR MORE INFORMATION.**



# SCHEDULED MAINTENANCE TABLE



REF	UNIT ASSEMBLY	LUBE TYPE	APPLICATION	FREQUENCY
1.	Drive Shaft U-Joint	General Purpose EP #2 Lithium	Zerk Fitting	Weekly
2.	Drum Drive-ZF	Recommended lubricant: GL5 Spec. 80W-90 to 80 F outside temperature.	Pour or Pump	Change oil after first 100 hours. Thereafter, change every 6 months or 1000 hours
	Drum Drive-Z-F-CML	ZF EcoMix-X Synthetic Gear Lube		Change every 10,000 hours
3.	Chute Pivot System	General Purpose EP #2 Lithium	Zerk Fitting	Weekly
4.	Drum Rollers	General Purpose EP #2 Lithium	Zerk Fitting	Weekly
5.	Rear Control Box	General Purpose EP #2 Lithium	Zerk Fitting	Weekly
6.	Hydraulic Filter & Fluid Service	ISO 68 under 80 F ISO 100 over 80 F	Fill to site gauge level	Change oil after first 100 hours. Thereafter, change every 6 months or 1000 hours.
a)	Spin On Suction Filter 735000		Replace	Change filter after first 100 hours. Thereafter, change every 1000 hours.
b)	BridgeKing High Pressure Filter 7350003		Replace	Change filter after first 100 hours. Thereafter, change every 1000 hours.
c)	BridgeKing Parker Pump Suction Filter 735102		Replace	Change filter after first 100 hours. Thereafter, change every 1000 hours.
7.	Main hold down bolts	Torque to 185 lbs.	Check	Weekly
8.	Sec. hold down bolts	Bolts snug	Check	Weekly
9.	Trans hold down	Torque to 300 lbs. - 7/8" bolt	Check	Weekly
10.	Debouncer	Adjustment range 3/8" to 1/2" maximum clearance		6 months
11.	Main frame bolts	Torque to 310 lbs.	Check	Weekly
12.	Drive flange bolts	Torque to 200 lbs. (5/8" bolt)	Check	First 100 hours. Monthly thereafter
13.	Wheel Lug Nuts	NA	Auxiliary Axles	Check wheel lug nut torque. The first 50-100 miles & every 10,000 miles thereafter. Torque to wheel manufacturer's recommendations.
14.	Water Tank	NA	Inspect	Refer to owner's manual

## BridgeKing

15.	BK Cylinder & Pivot Bushings	General Purpose EP #2 Lithium	Zerk Fitting	Weekly
16.	All applicable BK axle components	General Purpose EP #2 Lithium	King Pins, Slack Adjusters, S-Cams	Weekly

# MAINTENANCE PERIODIC INSPECTION

## CHECK DAILY

1. Visual roller track and roller alignment check. (See drawing). Check for “snapping” or “popping” noises while drum is turning.
2. Check oil level in hydraulic reservoir. Add oil if below sight gauge level.
3. Start engine and warm up with hydraulic system with truck engine at approximately 1200 RPM. and mixer drum turning at approximately 2 RPM. Warm up time is a minimum of 5 minutes.
4. Check vacuum gauge on oil filter. Replace element if reading exceeds 10 inches of vacuum after oil has reached operating temperature.
5. Hydraulic hoses must be inspected on a daily basis for cuts, abrasions, damage, aging and proper clearance along the frame. Immediately replace any damaged or old hydraulic hoses before returning mixer to service. Replace hydraulic hoses every 3 years.
6. Refer to page 24 for daily pre-trip inspection

## CHECK WEEKLY

7. Check pump drive shaft cap screws for proper tightness.
8. Lubricate complete mixer per lube chart supplied with mixer.
9. Draw sample of oil from reservoir and check for presence of water. If water is present, the oil will be milky in appearance. Milky oil should be drained from the system and replaced and the source of the water entry found and corrected.
10. Check filler cap and neck on oil reservoir for leaks. Make any necessary repairs immediately.
11. Check for and correct any external oil leaks. Check hydraulic hoses and tubes for cuts, abrasions and clearance.

**NOTE:** Do not tighten or loosen any connections while system is under pressure.

## CHECK WEEKLY (cont.)

12. Check and record drum RPM. while loading mixer with concrete and truck engine running at top governed R.P.M. If drum revolution is 2 RPM less than that recorded at previous check, see manual for component checkout.
13. Check inside of drum for concrete build up, clean as required.
14. Check mounting bolts for proper tightness.
15. Check transmission drive plate bolts. Torque to 200 ft. lbs.
6. Check transmission hold down bolts. Torque to 300 ft. lbs.

## 6 MONTHS

17. Change hydraulic suction oil filters. Remove filters and check for metal particles. The presence of minute particles of brass may indicate excessive wear or possible malfunction in one of the hydraulic components. Replace the hydrostatic pump spin-on filter with Con-Tech P/N 735000. Lubricate the new gasket, which comes with the oil filter and install in place of the old gasket before reinstalling filter.

*See Recommendations for Hydrostatic Lubricants* in this manual for hydraulic oil recommendations. For alternate hydraulic oil recommendations check with the factory. Multi-viscosity oils are not recommended for use in this system.

## ANNUALLY

18. BridgeKing® 100 Mesh Filter (144 Micron)  
Change first 100 hours, annually thereafter.





# BRIDGEKING® DAILY PRE-TRIP INSPECTION LIST

It is the responsibility of the driver to make a daily pre-trip inspection of his mixer (as well as the chassis).  
This will help insure that the mixer is safe to operate as well as minimize down time.

## EXTERIOR

		NOTES	OK	ATT'N REQ.
1.	Inspect all hydraulic hoses & fittings for rubbing, chafing, weather checking and/or leaking			
2.	Inspect water tank for leaks or abnormal surface defects (ie: rust, dents, flaking paint, etc)			
3.	Inspect drum attachment bolts at head socket of drum for signs of wear or looseness			
4.	Inspect ALL mixer mounting frame bolts for signs of damage or looseness a. When inspecting bolts for looseness, look for a "dust ring" of blackness around the head of the bolt/washer. This usually indicates a loose fastener b. When checking mixer mounting frame bolts, also check any mounting clips/angles for signs of wear or damage			
5.	Inspect fenders for damage, mounting bolts, excessive material build up a. ie: Dried concrete, stones and/rocks			
6.	Inspect mudflaps for damaged fasteners or signs of excessive wear			
7.	Inspect all exterior lights for proper operation (ie: side marker, tail, turn, back up, reverse)			
8.	Inspect climb ladder for signs of damage, excessive wear, fasteners or corrosion			
9.	Inspect hydraulic cylinders for signs of leaks or excessive wear in the mntg bushings or bolts			
10.	Inspect bridge axle for free play side to side & tire wear			
11.	Inspect rollers to insure the are properly greased, adjusted and rotating smoothly without noise or "play"			
12.	Check all chute connection points and fasteners for damage, fatigue, stretching or cracks			
13.	Inspect rear mixer control pendant (or wireless transmitter) for proper operation of mixer functions			
14.	Inspect rear pedestal area for material build up or loose rocks/stones			
15.	Inspect serial # & operational (axle psi) placards for damage and make sure they are legible			
	Inspect safety decals for proper installation and legibility (not shown)			
	Check chute rack for proper hold down straps/cables (not shown)			

## INTERIOR

		NOTES	OK	ATT'N REQ.
1.	Cycle all mixer switches in the cab to insure proper operation of all mixer functions. <b>NOTE:</b> The 'bridge' axle must NOT be allowed to touch the ground without the axle pressure turned all the way down and wheels properly 'chocked'.			
2.	Note proper operation of cab warning buzzers			
3.	Note proper operation of mixer status indicator (warning) lights in mixer console.			
4.	If equipped, check freeplay and proper operation of mixer drum control cable arm lever in mixer console			

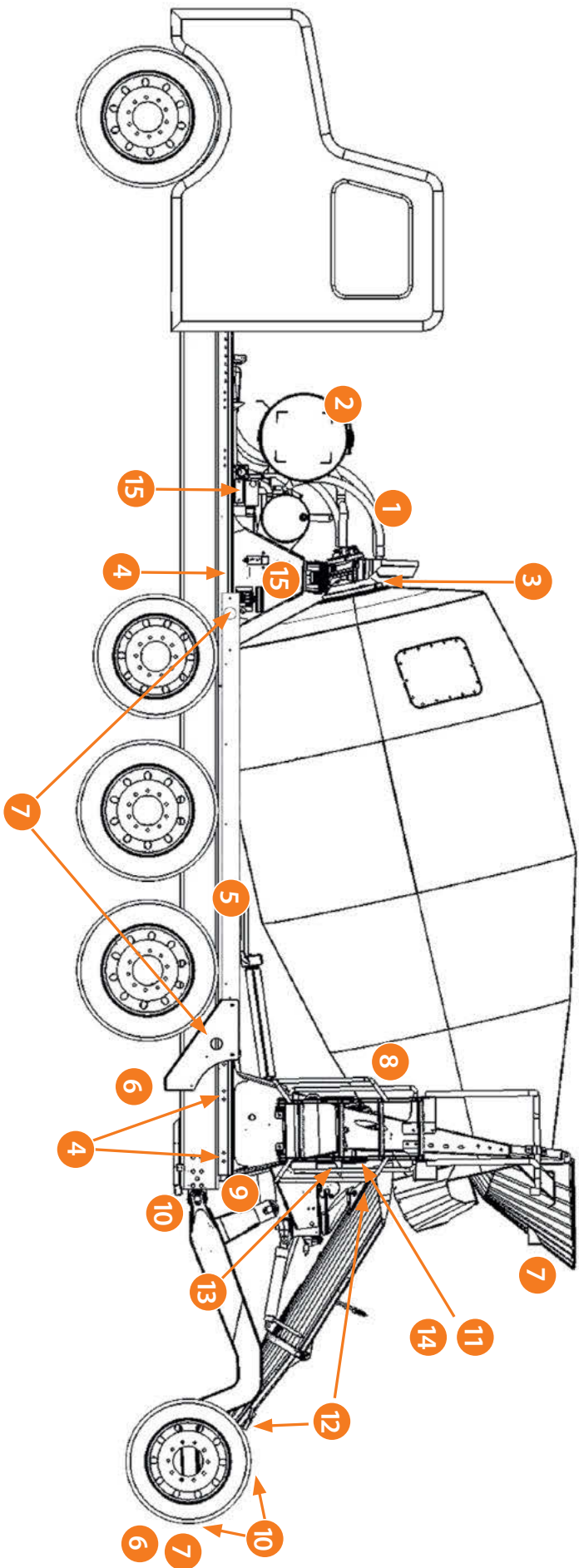


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# BRIDGEKING® DAILY PRE-TRIP INSPECTION LIST

It is the responsibility of the driver to make a daily pre-trip inspection of his mixer (as well as the chassis). This will help insure that the mixer is safe to operate as well as minimize down time.



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# BRIDGEKING® DAILY PRE-TRIP INSPECTION LIST

It is the responsibility of the driver to make a daily pre-trip inspection of his mixer (as well as the chassis).  
This will help insure that the mixer is safe to operate as well as minimize down time.

## EXTERIOR

		NOTES	OK	ATT'N REQ.
1.	Inspect all hydraulic hoses & fittings for rubbing, chafing, weather checking and/or leaking			
2.	Inspect water tank for leaks or abnormal surface defects (ie: rust, dents, flaking paint, etc)			
3.	Inspect drum attachment bolts at head socket of drum for signs of wear or looseness			
4.	Inspect ALL mixer mounting frame bolts for signs of damage or looseness a. When inspecting bolts for looseness, look for a "dust ring" of blackness around the head of the bolt/washer. This usually indicates a loose fastener b. When checking mixer mounting frame bolts, also check any mounting clips/angles for signs of wear or damage			
5.	Inspect fenders for damage, mounting bolts, excessive material build up a. ie: Dried concrete, stones and/rocks			
6.	Inspect mudflaps for damaged fasteners or signs of excessive wear			
7.	Inspect all exterior lights for proper operation (ie: side marker, tail, turn, back up, reverse)			
8.	Inspect climb ladder for signs of damage, excessive wear, fasteners or corrosion			
9.	Inspect hydraulic cylinders for signs of leaks or excessive wear in the mntg bushings or bolts			
10.	Inspect bridge axle for free play side to side & tire wear			
11.	Inspect rollers to insure the are properly greased, adjusted and rotating smoothly without noise or "play"			
12.	Check all chute connection points and fasteners for damage, fatigue, stretching or cracks			
13.	Inspect rear mixer control pendant (or wireless transmitter) for proper operation of mixer functions			
14.	Inspect rear pedestal area for material build up or loose rocks/stones			
15.	Inspect serial # & operational (axle psi) placards for damage and make sure they are legible			
	Inspect safety decals for proper installation and legibility (not shown)			
	Check chute rack for proper hold down straps/cables (not shown)			

## INTERIOR

		NOTES	OK	ATT'N REQ.
1.	Cycle all mixer switches in the cab to insure proper operation of all mixer functions. <b>NOTE:</b> The 'bridge' axle must NOT be allowed to touch the ground without the axle pressure turned all the way down and wheels properly 'chocked'.			
2.	Note proper operation of cab warning buzzers			
3.	Note proper operation of mixer status indicator (warning) lights in mixer console.			
4.	If equipped, check freeplay and proper operation of mixer drum control cable arm lever in mixer console			

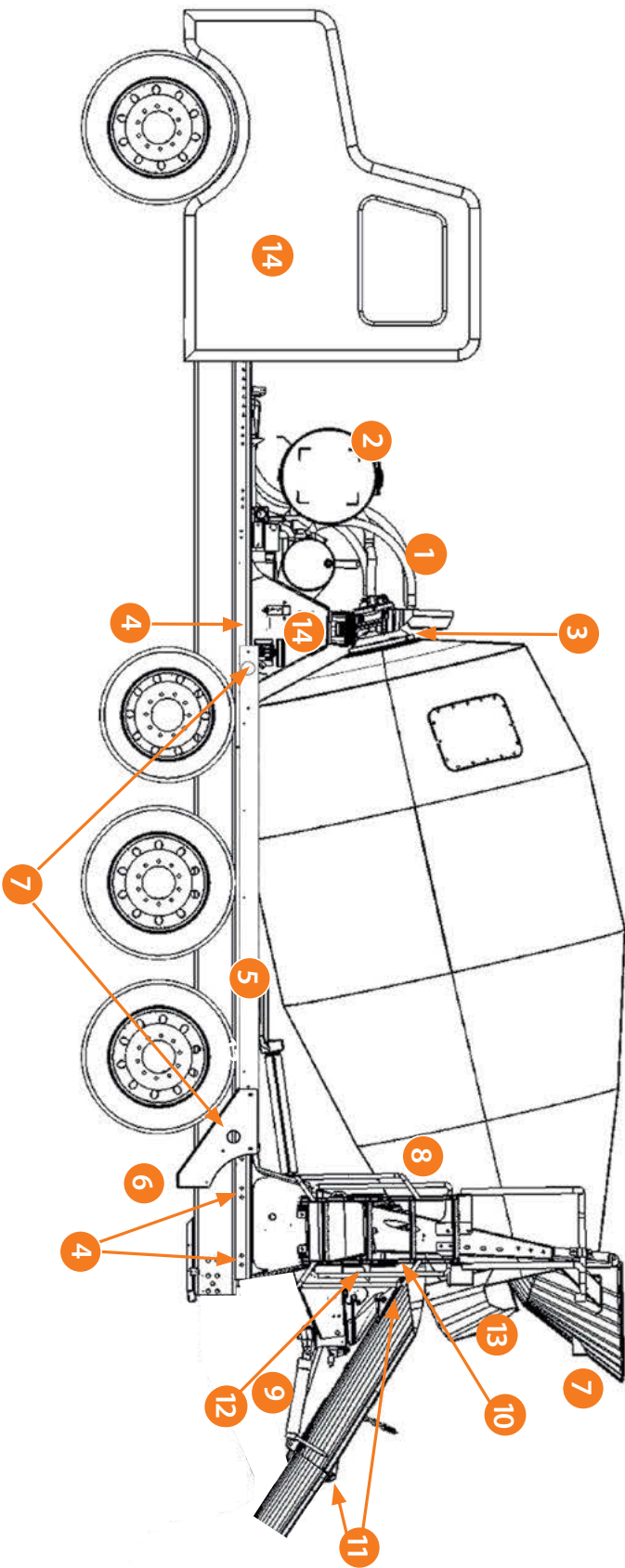


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# EXTREME DUTY DAILY PRE-TRIP INSPECTION LIST

It is the responsibility of the driver to make a daily pre-trip inspection of his mixer (as well as the chassis). This will help insure that the mixer is safe to operate as well as minimize down time.



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# CONTROLS ELECTRICAL

Cab Controls

Proximity Switches  
or Trailer Arm / Chutes

Omnex Wireless Controller

Extreme Duty Harness

BridgeKing<sup>®</sup> Harness

Rear Control Pendent



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# CAB CONTROL BOX

## CAB BOX – FUSE PANEL VIEW

The fuse panel is located on the RH (passenger side) of the cab mixer control console. The decal located next to the fuse panel indicates the proper amperage fuse required for each circuit. If a fuse is blown, it **MUST** be replaced with the exact amperage indicated on the decal. If not, you may damage the wiring harness or individual components within that circuit.

## CAB CONTROL BOX (TOP VIEW)

The cab control box is located to the RH side of the driver's seat. It houses all of the mixer control switches, drum counter, LED indicator lights, relays and fuse panel.

Cab box switch functions and indicators are as follows (starting at front of cab box)

### DRUM

Controls direction of drum rotation.

### DRUM S/S

Activates Pause-Resume (start-stop) of drum rotation. Activating this switch will cause the drum to stop rotating. When function is de-activated, drum speed and rotation will resume to where it was set previously.

### FAN ON INDICATOR

Indicates hydraulic oil fan cooler is running. The fan sensor is set to activate at when the oil temperature reaches 150°F. It is normal for this indicator light to be on when ambient temperature is above 50°F or during times of extreme use.

### CHUTE UP/DOWN

Raises and lowers the discharge chute.

### HOPPER

Raises and Lowers the material loading hopper. LED indicator will be ON if hopper is in raised position. All CTM mixers are equipped with auto down in reverse so the hopper will lower automatically if the truck is put in REVERSE. In order to reset hopper function (after truck is put in reverse), you must toggle this switch off-on.

### LOCK

Activates the Air Chute Lock. LED indicator light will be on when chute is UNLOCKED.

### WORK LIGHT

Will turn on/off work lights at rear of mixer.

### DRUM COUNTER

Indicates the number of drum revolutions (since last reset).

### PUSHER AXLE

If chassis is equipped with Con-Tech installed auxiliary air suspensions, this switch will raise and lower the axle. Please note, all trucks with factory mounted suspensions will have the controls mounted in the dash, on the driver's frame rail or both.

### ACTIVATE

This switch (on the Con-Tech BridgeKing® Mixer) must be held down prior to pressing the Up/Down switch for raising and lowering the BridgeKing® Auxiliary axle.

### UP/DOWN

This switch will activate (after pressing and holding the Activate switch) the motion of the BridgeKing® axle in the up or down direction. Motion of the trailer will only be started if the main discharge chute is in the CENTERED and DOWN position. The Chute Hazard indicator lamp will be ON if either of these two criteria are not met.

### START/STOP

When pressed in STOP direction, this switch will stop the travel of BridgeKing® axle in either the up or down direction. The LED indicator light will be ON when the axle is in STOP mode. Axle will continue in the direction of previous travel when pressed to START unless the Activate & Up/Dn switch has been pressed.



## CAB CONTROL BOX

### NOTE:

When axle STOP is activated, the CHUTE UP/DOWN functions will NOT operate. In order utilize chute up/down functions, the switch must be pressed to START ALL BridgeKing® mixers are designed so the BridgeKing® axle will raise automatically when the truck transmission is put in reverse. If the axle is in the DOWN mode, stopped AND the truck transmission is put in reverse, when axle travel is started (switch pressed to START), the axle will RAISE. If the chutes have been moved from the original position (when trailer was lowered), damage may occur. If any further clarification is required, please call the Con-Tech service department.

It is the responsibility of the operator to make sure all areas around the travel range of the BridgeKing® axle trailer are clear for safe operation!

In the event you need to replace any of the switches or drum counter, you must remove the 2 bolts (located on passenger side of console) at the top of the access door. The door will swing down after removal of the bolts.

Remove the white harness plug from the switch to be replaced. Be sure to remove the connector by pulling firmly on the white housing and do NOT pull on the

wires. To remove the switch, press inward on the locking tabs located on the ends of the switch. Push the switch up thru the panel. Snap new switch into panel, re-install connector in the same orientation (as it came off the old switch) and verify operation.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# CAB CONTROL BOX



Location	Function	Amp Rating	Location	Function	Amp Rating
F11	Chute Up/Down	5	F1	Chute Lock	5
F12	Hopper Up/Down	10	F2	Rear Pendant Power	10
F13	Drum Charge/Discharge	5	F3	Drum Start/Stop	5
F14	Work Light	15	F4	Fan	30
F15	Pusher/Tag	5	F5	Chute Hazard Prox	5
F16	BridgeKing Up/Down	5	F6	BridgeKing Start/Stop	5
F17	BridgeKing Alarm	5	F7	Wireless Remote	15
F18	Constant Speed	5	F8	Charger	3
F19	Spare	-	F9	Spare	-
F20	Spare	-	F10	Spare	-

796757

**Con-Tech**  
MANUFACTURING, INC.  
For Service Assistance Call  
**507-374-2239**

Part #799757

Fuse Box Located on  
Cab Control Box



Part # 715550



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## CAB CONTROL BOX



Allows the driver to infinitely control the position of the mixer control box via a durable RAM mount system. This allows for better ergonomics, line of site for switches and flexibility in location of the switch box. For ease of trouble shooting and diagnostics, the control system operates on standard 12V current.

All switches are highly visible with indicator warning lights and are logically placed for simple activation.



Durable RAM mount is easily adjusted to position the controls in your preferred location.



Clear and concise fuse panel legend is located directly above fuse access cover which is easily accessible from the passenger side.



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## PROXIMITY SWITCHES FOR TRAILER ARM / CHUTES

### PROXIMITY SWITCH FOR CHUTE:

On your Con-Tech BridgeKing® mixer (located below the main chute) is the CHUTE HAZARD proximity sensor. This sensor indicates to the electrical system and the driver if the chutes are off center or raised. If the chutes are off center or raised, the system will not allow the BridgeKing® trailer arm to be raised OR lowered.

During normal operation, when the chute is centered and down, the proximity switch light (located on the back of the proximity switch) will indicate yellow, when the chutes are raised or off-center, there will be no indicator light present).

### NOTE:

If the chutes are raised or off center and the emergency overrides (located on the Parker directional valve) are used, you may damage the discharge chutes and/or rear pedestal if the chutes are not centered and down.

### PROXIMITY SWITCH FOR BRIDGEKING® TRAILER MOTION ALARM:

Your Con-Tech BridgeKing® mixer is equipped with an alarm to indicate that the BridgeKing® axle is in motion (up/down). The proximity switch that initiates the alarm is located in the driver's side frame rail right above the trailer pivot bushing housing. To verify that the proximity switch is operating normally (other than the audible alarm), you can check the light on the back of the proximity switch itself. With the trailer in the full up or down position, there should be NO light on. When the trailer lug passes in front of the proximity switch, the light will turn yellow.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES  
WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON  
YOUR VEHICLES.**



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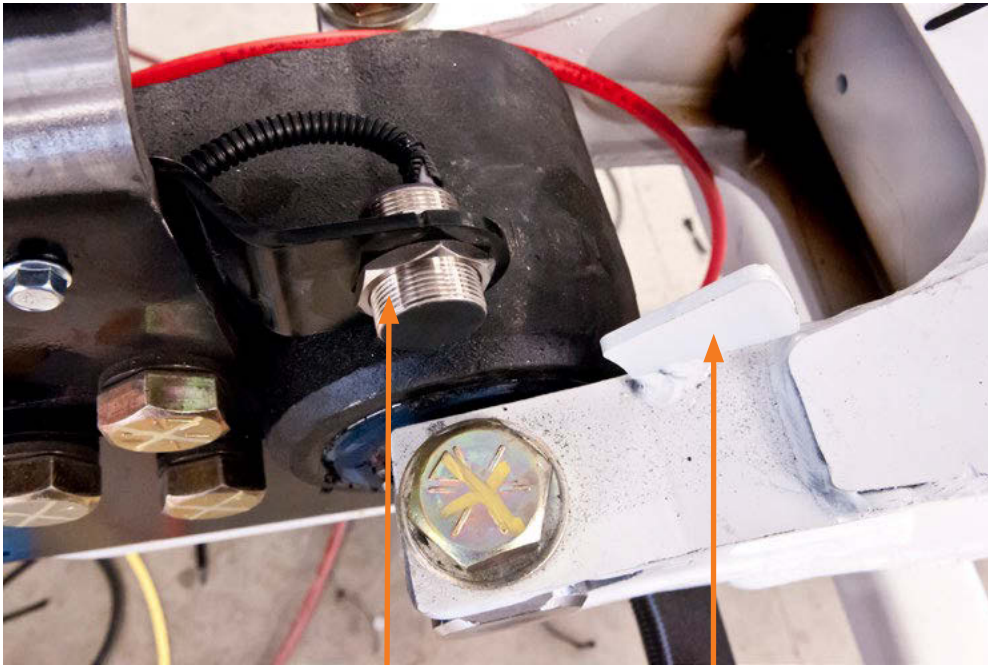
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## PROXIMITY SWITCHES FOR TRAILER ARM / CHUTES



MAIN CHUTE  
PROX SWITCH TARGET

MAIN CHUTE  
PROX SWITCH  
#715008



BRIDGEKING® TRAILER  
PROX SWITCH  
#715008

BRIDGEKING® TRAILER  
PROX SWITCH TARGET  
#245143



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## OMNEX WIRELESS CONTROLLER

As an option, Con-Tech offers Omnex Wireless Control Systems. This allows the operator to operate the mixer via wireless within 50' of the vehicle. It is imperative that the operator become familiar with the controls of the wireless unit prior to use on the job site. In the event of a lost or inoperative wireless transmitter, the mixer controls (on the console) will still operate normally.

The wireless transmitter operates on 4 AA rechargeable batteries. In the event the batteries will no longer recharge or they are dead, regular AA batteries can be used in place of the rechargeable style. **DO NOT** place the transmitter in the charging dock with non-rechargeable type batteries installed as damage can occur to the transmitter and/or docking station.

If access is required to the receiver unit, it is located inside the floor mounted cab console.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES  
WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON  
YOUR VEHICLES.**

**Please observe ALL OSHA lockout-tag out procedures when  
performing any type of work or maintenance on your vehicles.**

- #765030 **Omnex Kit**
- #765031 **Omnex Transmitter**
- #765032 **Omnex Receiver**
- #765033 **Omnex Charger Base**
- #765034 **Omnex Transmitter Pouch**

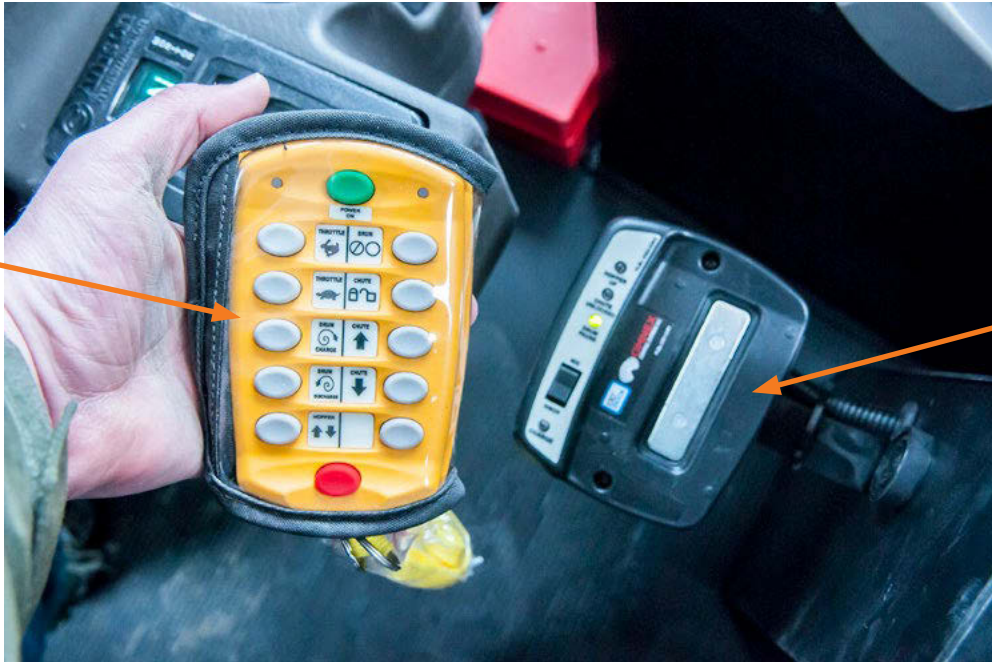


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## OMNEX WIRELESS CONTROLLER

OMNEX  
TRANSMITTER  
#765031



OMNEX  
TRANSMITTER  
CRADLE  
#765033



Always keep the transmitter in its charging cradle while NOT in use to insure charging and protection



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## OMNEX CONTROLLER RESET

### Resetting a R160 receiver for a new T110 transmitter code.

Before starting this procedure, remove the R160 "board " from the case. Release the clip on either side with a flat blade screwdriver and pull down. Keep the receiver connected to the truck power.

- 1** Power up the Receiver. The (E-Stop) light and the (Link) light will come on red (provided the Transmitter is off), and the (Status) light will come on green.
- 2** Turn on the Transmitter by pressing and holding the red [E-Stop] button and the green [Power] button, and then releasing first the red [E-Stop] button and then the green [Power] button. This will power up the Transmitter into Download Mode. The yellow (Active) light will begin flashing slowly (once per second).
- 3** Press and hold the [SETUP] button (yellow button on left side just above the left connector) on the Receiver. The (Status) light (far right LED-Green ) will flash slowly. Continue to hold the [SETUP] button (approximately 5 seconds) until the (Status) light starts flashing rapidly and then release; it will now remain on steady. NOTE: If left idle in Setup Mode for over 30 seconds, the Receiver will time out, indicated by the red (Status) light flashing rapidly. To return to Setup Mode, repeat step 3.
- 4** Press and release the green [Power] button on the Transmitter to start sending the ID Code to the Receiver. On the Transmitter, the red (Battery) light will come on and the yellow (Active) light will flash rapidly; on the Receiver, the (Link) light will become green. Once the ID Code has been downloaded, the red (Battery) light and the yellow (Active) light on the Transmitter will go out. The (Link) light on the Receiver will change from green to red.

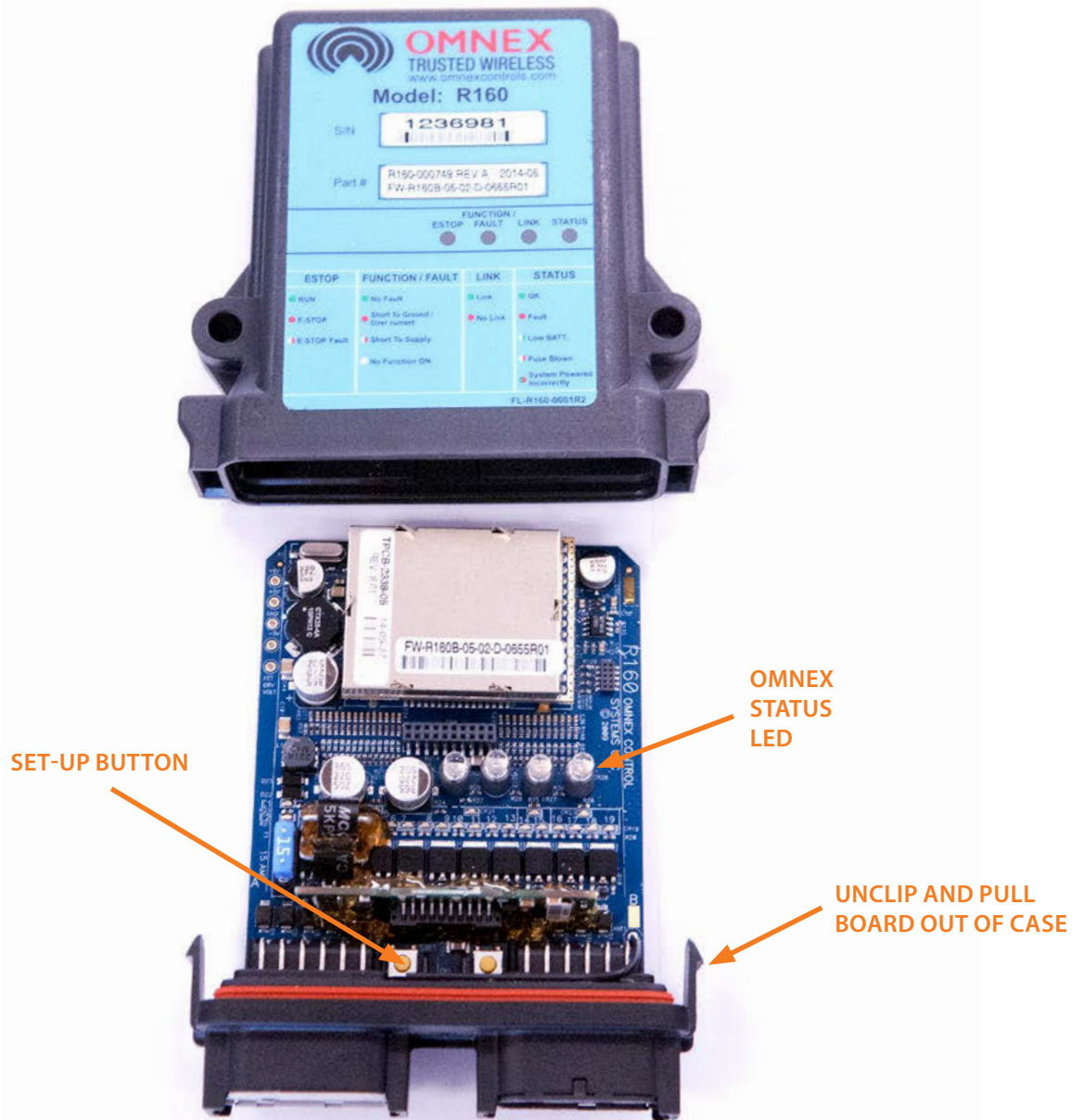
( SEE PHOTO ON OPPOSITE PAGE )



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# OMNEX CONTROLLER RESET



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**OMNEX**  
TRUSTED WIRELESS™

# GENERIC

## Installation / Configuration Manual

### T110 Transmitter R160 Receiver

Revised February 9, 2007

Version 6

DMAN - xxxx - xx

#74-1833 Coast Meridian Road, Port Coquitlam, BC, Canada • V3C 6G5

Ph# (604) 944-9247 • Fax# (604) 944-9267

Toll Free 1-800-663-8806

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**NOTE:** These instructions are intended only for installing and operating the remote control equipment described here. This is not a complete Operator's Manual. For complete operating instructions, please read the Operator's Manual appropriate for your particular machine.

## Safety Precautions

### READ ALL INSTRUCTIONS

**CAUTION:** Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Failure to follow the SAFETY PRECAUTIONS may result in radio equipment failure and serious personal injury

#### Installation

PROVIDE A SAFETY CUTOFF SWITCH. If maintenance is required, the radio must be disconnected from power

USE PROPER WIRING. Loose or frayed wires can cause system failure, intermittent operation, machine damage, etc.

DO NOT INSTALL IN HOT AREAS. This apparatus can be damaged by heat in excess of 158°F (70°C)

#### Personal Safety

MAKE SURE MACHINERY AND SURROUNDING AREA IS CLEAR BEFORE OPERATING. Do not activate the remote system unless it is safe to do so.

TURN OFF THE RECEIVER POWER BEFORE WORKING ON MACHINERY. Always disconnect the remote system before doing any maintenance to prevent accidental operation of the machine

#### Care

KEEP DRY. Do not clean the transmitter / receiver under high pressure. If water or other liquids get inside the transmitter battery or receiver compartment, immediately dry the unit. Remove the case and let the unit air dry

CLEAN THE UNIT AFTER OPERATION. Remove any mud, dirt, concrete, etc. from the unit to prevent clogging of buttons, switches, etc. by using a damp cloth.

#### Maintenance / Welding

DISCONNECT THE RADIO RECEIVER BEFORE WELDING on the machine the receiver is connected to. Failure to disconnect will result in the destruction of the radio receiver.

## System Overview

The **ORIGA T110 / R160** is a portable, long range, programmable radio remote control system. Designed as a compact and easy-to-use product, this member of the **ORIGA** family puts complete control of your machine where it's needed most, with the operator. It's robust, easy to install and has complete self-diagnostics. This system can be a simple cable replacement or add intelligence to make it a total control package. It's a radio, a PLC and a valve driver all in one.

The **ORIGA T110 / R160** system uses Frequency Hopping Spread Spectrum (FHSS) technology. FHSS devices concentrate their full power into a very narrow signal that randomly hops from frequency to frequency within a designated band. This transmission pattern, along with CRC-16 error-checking techniques, enables signals to overcome interference that commonly affects licensed radios.

The **R160 receiver** is designed to be powered from a 12VDC or 24VDC system. It features 19 solid state, high-side driver input / output controls and a reliable E-Stop control.

The **ORIGA T110** comes with 4 to 10 buttons to provide the user flexibility to control the functions they need. It uses standard, long lasting AA batteries. Each T110 transmitter uses a unique ID code to ensure that no two systems will conflict at a job site.

## Features

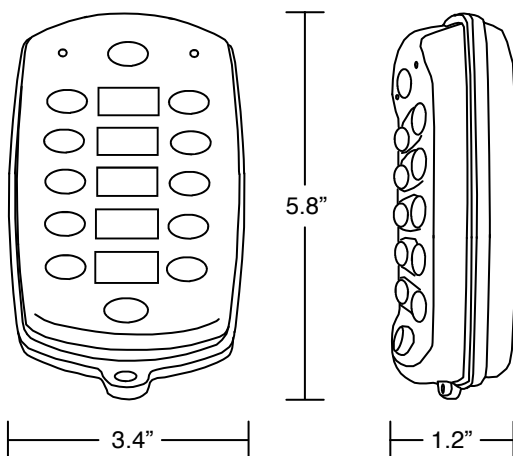
- FCC, ISC, CE approved
- License free
- 1200 foot range @ 900 MHz (900 ft. @ 2.4 GHz)
- Hand held / weatherproof / ergonomic
- Simple "wire-and-use" installation
- Resilient to impact and shock
- Available in both 900 MHz and 2.4 GHz
- Available with optional E-Stop for ensured operator safety
- Factory configurable for all custom applications.



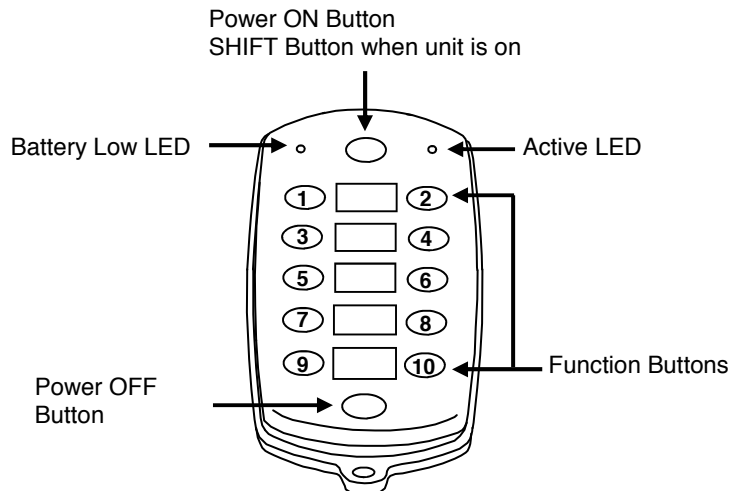
**R160 Receiver**

**T110 Transmitter**

## T110 Dimensions and Controls



DMAN-XXXX-XX (Rev x.x)

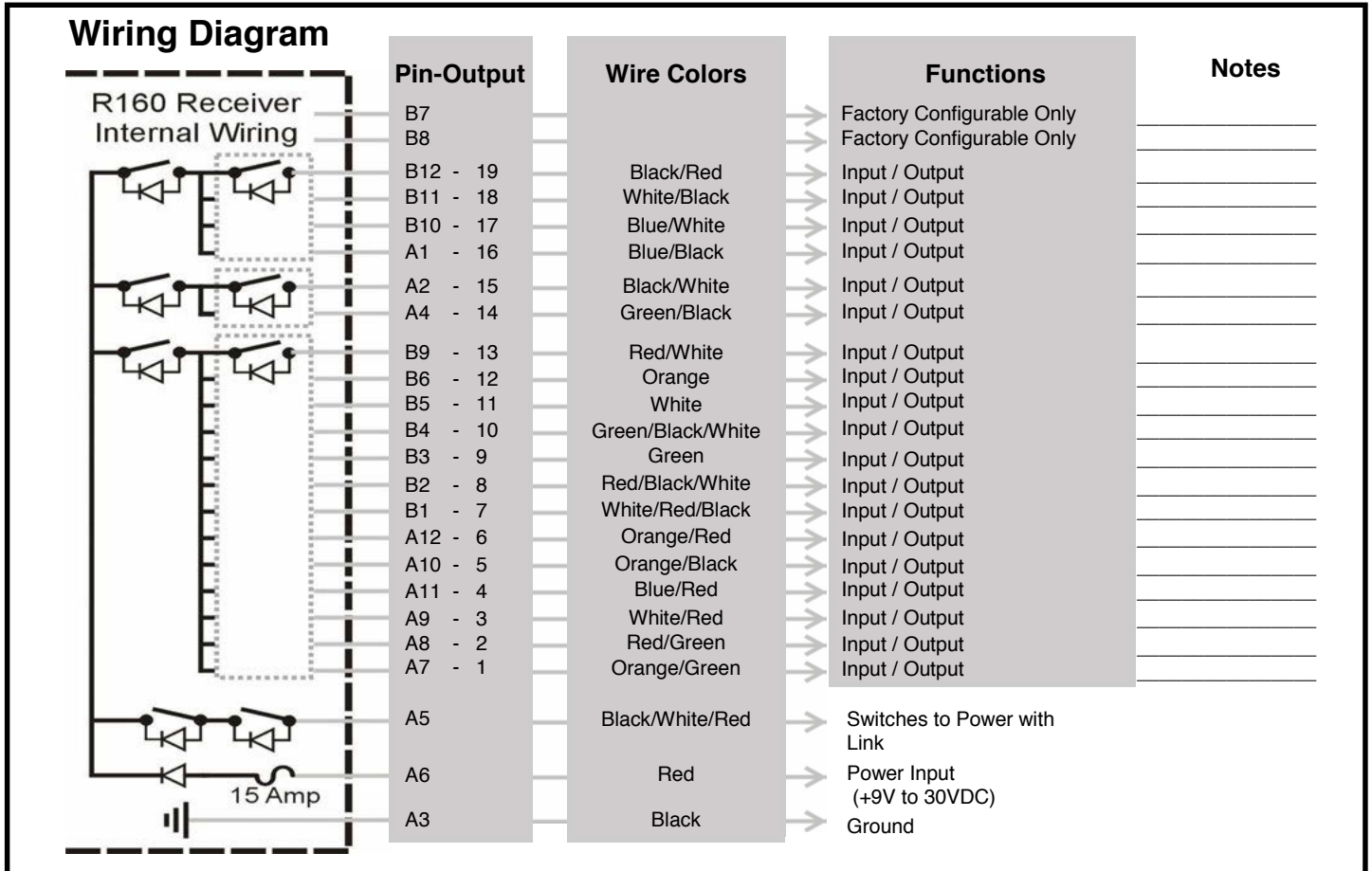


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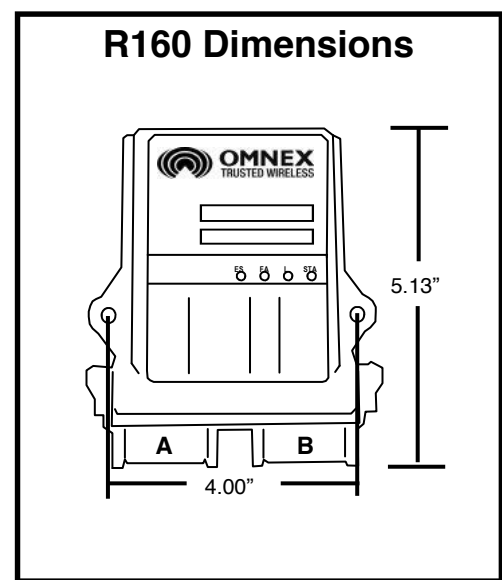
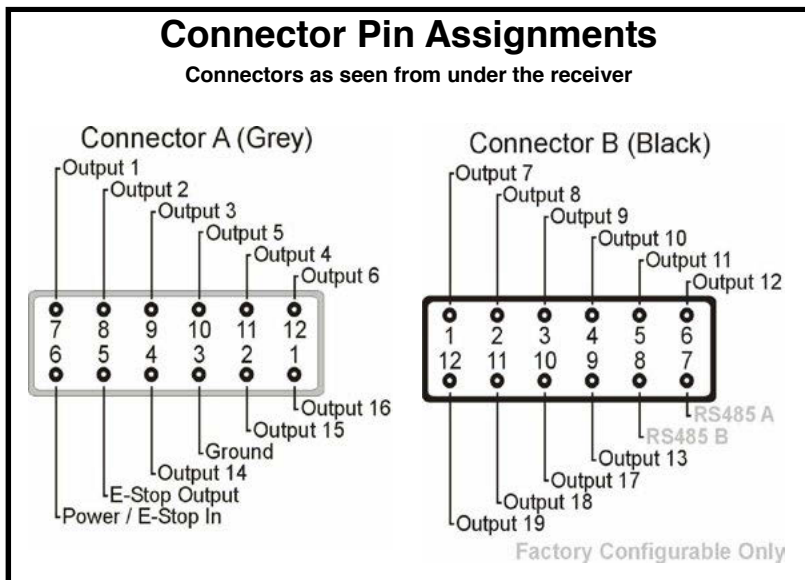
# Installing the Receiver

Use the **Wiring Diagram** and the **Connector Diagram** below to connect the receiver pins directly to the appropriate contacts of the machine electronics. R160 Output Cables can be provided with every system to simplify the wiring process. The Wire Color column below only applies to the OMNEX Output Cable configuration. Tips on mounting, power connections and filtering are also provided under **Installation Considerations**.



**Outputs:** 19 solid state, high-side driver outputs, 5A max. per pin and 7A max per bank, total combined current 15A

**Inputs:** All output pins can be factory configured as inputs. Input pins should be connected to a current limiting (fused) source



## Special Functions

### The [Shift] Function

Outputs 1-10 are controlled by the T110 [Function] buttons “1-10”. Outputs 11-19 are controlled by holding the T110 [Shift] button and pressing the [Function] buttons “1-9” (the GREEN Power [ON] button acts as the [Shift] button when the T110 is on).

## Installation Considerations

**NOTE:** The FCC and ISC require that the antenna be restricted to that supplied by the manufacturer and approved for use with this product. An optional 0dB coax wire antenna may be supplied. For other antenna options, please contact OMNEX Control Systems ULC

### Mounting and Installation

The receiver can be mounted by fastening two ¼” bolts through the two mounting holes in the unit’s enclosure. When mounting, ensure that the receiver is oriented so that the text is reading right and the connector is “down”.

When selecting a mounting point for the receiver, it is recommended that the location require only a minimal length of wiring to connect it to the control panel, that it will be in a visible area where it has good exposure to the operator and that it is mounted on a surface that is protected from the weather and sustains minimal vibration. It is also recommended that the receiver have the best possible line of sight with the transmitter for maximum operating range.

### Power Connections and Wiring

Whenever a power connection is made to an electronic device, it is a good practice to make both the Power (+) and Ground (-) connections directly to the Battery and avoid connecting the power from the charging side of existing wiring or making use of existing "ACC" or other peripheral connection points.

Make sure that wire of sufficient gauge and insulator type is used when connecting the outputs of the receiver to the control panel. Observe any component manufacturer's instructions and recommendations for proper integration of their product. This includes the power ratings and requirements of such components as relays, valves, solenoids, etc.

Be sure to test each of the outputs with a multi-meter prior to connecting the outputs to your end devices. This will ensure that each output has been programmed to operate in the manner required by each end device.

### Filtering and Noise Suppression

Whenever a solenoid or electromagnetic switch is controlled by the receiver, it is a good practice to install a Diode across its terminals to ensure that surges and spikes do not continue back into the circuit. Appropriate 36V Bi-directional Diodes kits can be ordered under the OMNEX part number “AKIT-2492-01”.

# Power the Transmitter

## 1. Install Batteries

Remove the battery cover on the back of the transmitter using a slotted screwdriver and insert 4 "AA" alkaline batteries. Orientation of the batteries is embossed inside the battery housing.

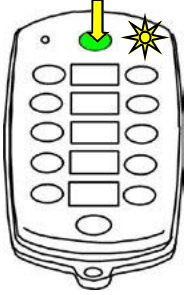


T110 Battery Housing

## 2. Turn on the Transmitter

Refer to the **Light Legend** below for diagram details.

### 1. Press Power [ON]



**WARNING:** do not install batteries backwards, charge, put in fire, or mix with other battery types. May explode or leak causing injury. **Replace all batteries at the same time as a complete set and do not mix and match battery types.**

**NOTE:** For operation at temperatures below  $-10^{\circ}\text{C}$  lithium batteries are recommended. Low temperatures reduce battery performance for both alkaline and lithium types. Refer to the battery manufacturer's specifications for detailed information on low temperature performance.

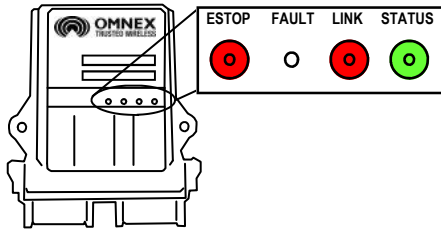
If the transmitter's (Active) light does not flash, check the battery orientation.

To turn off the transmitter, press the Power [OFF] button.

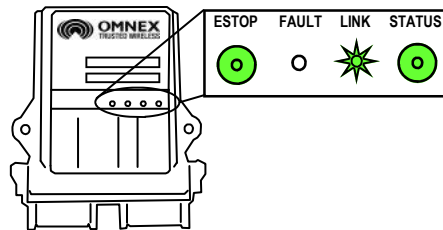
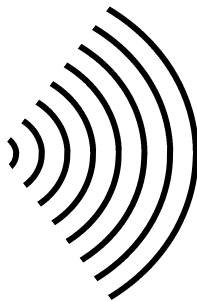
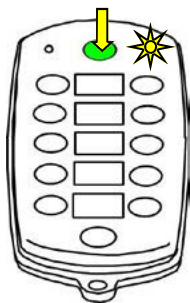
# Test the Transmitter / Receiver Link

Follow these steps to ensure that there is a radio link between the transmitter and receiver. Refer to the **Light Legend** below for diagram details

### 1. Power R160



### 2. Power T110



**NOTE:** The transmitter will shut itself off (and the receiver will then shut off all outputs) after 10 minutes of inactivity as a battery saving feature. Momentarily operating any button on the transmitter, including the [Power] button will restart the 10 minute timer.

**The ORIGA System is now ready for use.**

If the receiver's (Link) light does not become GREEN follow the steps under **Download ID Code**.

Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light
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# Download ID Code (Use in case of Link Test failure)

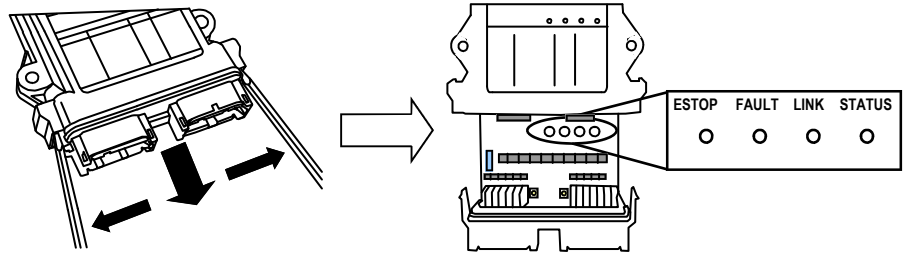
Follow these steps to download the transmitter's unique ID Code into the receiver. This will allow the receiver to establish a radio link with a specific transmitter. Refer to **Troubleshooting Chart #4** for Tips and Considerations

**NOTE:** It is necessary to download the ID Code when replacing either the transmitter or the receiver.

## 1. Opening the R160 Case

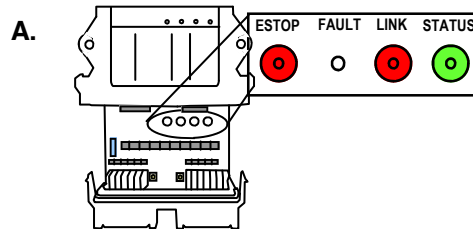
The cap is held on by two plastic tabs at opposing sides, which can be unlatched as shown using a screwdriver. Once the cap is free, the R160 can slide open.

Use a small slotted screwdriver to press the Side Tabs inward.



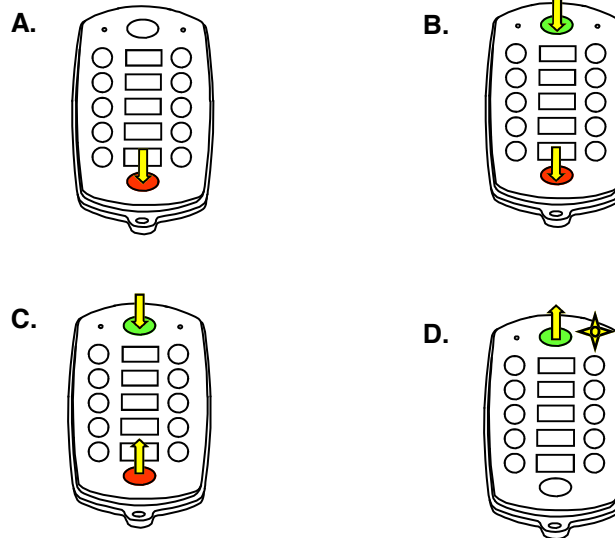
## 2. Power R160

A. Supply power to the receiver. The (E-Stop) light and the (Link) light will come on RED and the (Status) light will come on GREEN



## 3. Power T110 into Configuration Mode

- A. Press and Hold Power [OFF]
- B. Press and Hold Power [ON]
- C. Release Power [OFF] button
- D. Release Power [ON] button

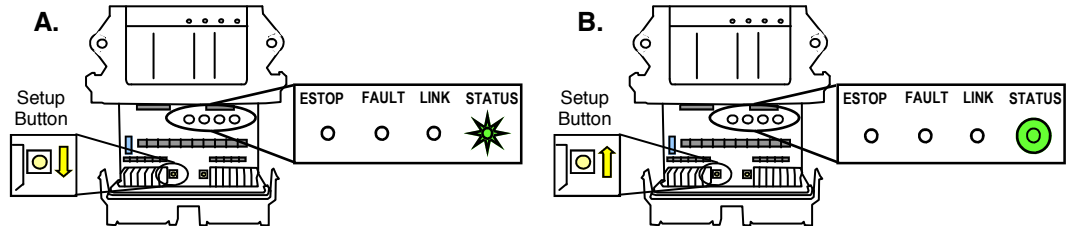


Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light
--------------	-------	------------	------------	-----------	-------------	--------------	-------------------------------

## Download ID Code (Use in case of Link Test failure)

### 4. Put R160 into Setup Mode

- A. Press & hold [Setup] button until (Status) light goes from slow flash to fast flash
- B. Release [Setup] button. (Status) light goes to solid GREEN, (Link) light turns off

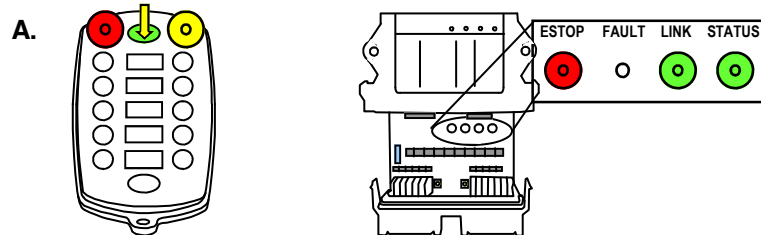


**NOTE:** If left idle in Setup Mode for over 30 seconds, the receiver will time out. The (Link) light and (Status) light will flash RED rapidly. To return to Setup Mode, repeat step 4.

### 5. Send Code

**NOTE:** When downloading a new ID to a receiver, a safety feature requires that the transmitter be in close proximity to the receiver. This will prevent a transmitter from accidentally reprogramming a different receiver in the area.

- A. Press Power [ON] button to send code



Once the ID Code has been downloaded, the RED (Battery) light and the YELLOW (Active) light on the transmitter will go out. The (Link) light on the receiver will change from GREEN to RED.

**NOTE:** When replacing the receiver cover, ensure the cover snaps completely into place to create a weather proof seal around the base of the receiver.

#### Light Legend

Solid

Slow Flash

Fast Flash

Red Light

Green Light

Yellow Light

Alternating Red & Green Light

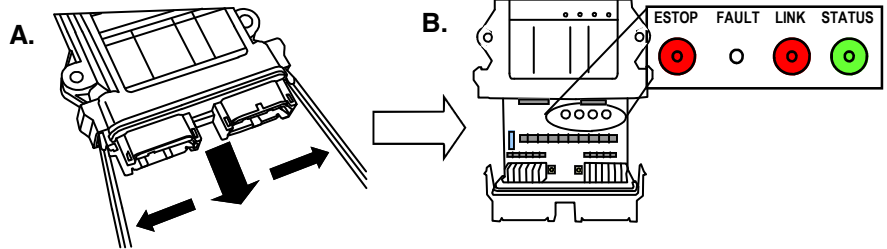


# Changing Start Up and Shutdown Configuration

The T110/R160 system has 3 available startup and shutdown modes that can be configured with the following steps.

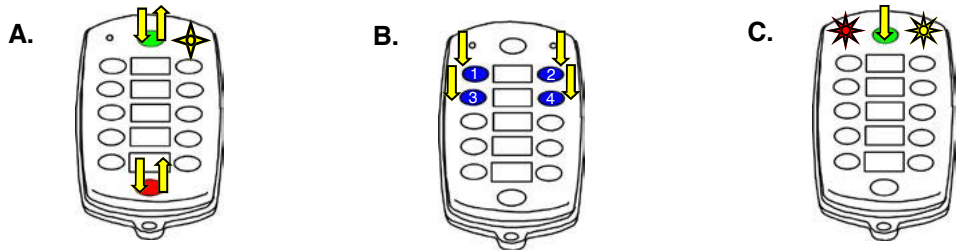
## 1. Opening the R160 Case and Power R160

- The cap is held on by two plastic tabs at opposing sides, which can be unlatched as shown using a screwdriver. Once the cap is free, the R160 can slide open.
- Supply power to the receiver. The (E-Stop) light and the (Link) light will come on RED and the (Status) light will come on GREEN



## 2. Power T110 into Configuration Mode & Enter Configuration Password

- Power T110 into configuration mode by following Step #3 from **Download ID Code**
- Press function buttons in order 3, 1, 4, 2
- Press Power [ON] button



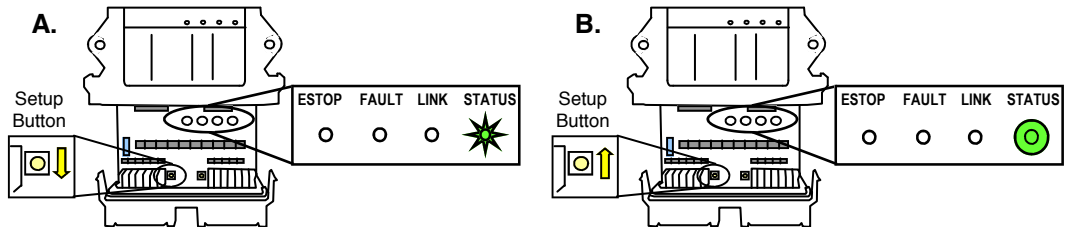
## 3. Enter Start Up and Shut Down Code

Enter the 10-digit Configuration Code associated with one of the following startup and shutdown modes:

<b>ON / OFF Mode</b>	1188888888	<b>ON</b> normal. <b>OFF</b> when T110 / R160 link is lost.
<b>Secure Mode</b>	4188888888	<b>ON</b> by entering the "3, 1, 4, 2" password on the T110 and pressing the GREEN [Power] button. <b>OFF</b> when T110 / R160 link is lost.
<b>Auto Power Down Mode</b>	5188888888	<b>ON</b> normal. <b>OFF</b> when T110 / R160 link is lost or after 10 minutes of being idle.

## 4. Put R160 into Setup Mode

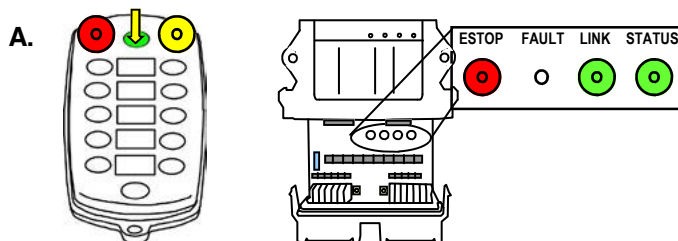
- Press & hold [Setup] button until (Status) light goes from slow flash to fast flash
- Release [Setup] button. (Status) light goes to solid GREEN, (Link) light turns off



**NOTE:** If left idle in Setup Mode for over 30 seconds, the receiver will time out. The (Link) light and (Status) light will flash RED rapidly. To return to Setup Mode, repeat step 4.

## 5. Send Code

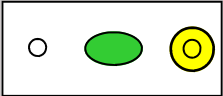
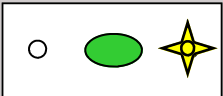
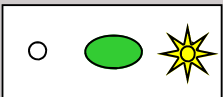
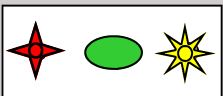

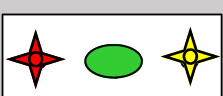
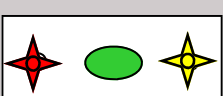
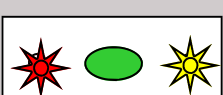
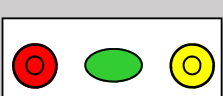
- Press Power [ON] button to send code



Once the ID Code has been downloaded, the RED (Battery) light and the YELLOW (Active) light on the transmitter will go out. The (Link) light on the receiver will change from GREEN to RED.

Light Legend	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light

## Diagnostics—T110 Transmitter

Indicator Lights	Description	Solution
	Occurs when ever a function is pressed. Will also remain on momentarily on Power Up.	N/A
	Transmitter is in Download mode.	To take it out of Download mode turn transmitter off and turn it back on again.
	Transmitter is in Operating mode.	N/A
	Low Battery.	Change Batteries <b>Note:</b> Low batteries will last approximately 8 hours once the Low Battery light begins to flash. Replace batteries during next break.
	Fast Flash for approx. 10 seconds indicates T110 failure.	Send the unit in for service.
	Stuck button detected.	Toggle the buttons a few times. Call for service. Send the unit in for service.
	<b>On Power Down</b> Unit is still powered, likely due to an on function or stuck button.	Toggle the buttons a few times. Call for service. Send the unit in for service.
	Transmitter is in Configuration mode.	To take it out of Configuration mode turn transmitter off and turn it back on again.
	Transmitter is downloading ID Code.	Wait for approximately 5 seconds. Once the download is complete the transmitter will automatically shut off.

<b>Light Legend</b>	Solid 	Slow Flash 	Fast Flash 	Red Light 	Green Light 	Yellow Light 	Alternating Red & Green Light 
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# Diagnostics - R160 Receiver

## Normal Operation

	<p>Transmitter is OFF If the transmitter is off, the receiver is operating properly.</p>
	<p>Transmitter is ON When the transmitter is turned on, the Link light (fast flashing) and E-Stop (GREEN) indicates the receiver is operating properly</p>
	<p>Transmitter is in Operation When a function is activated on the transmitter, the Fault light will turn on GREEN. This indicates the receiver is operating properly</p>
	<p>Transmitter is OFF When a latched function is activated then the transmitter is turned off, the Fault light will stay on GREEN. If the system was intentionally designed this way, the receiver is operating properly, if not call for service.</p>

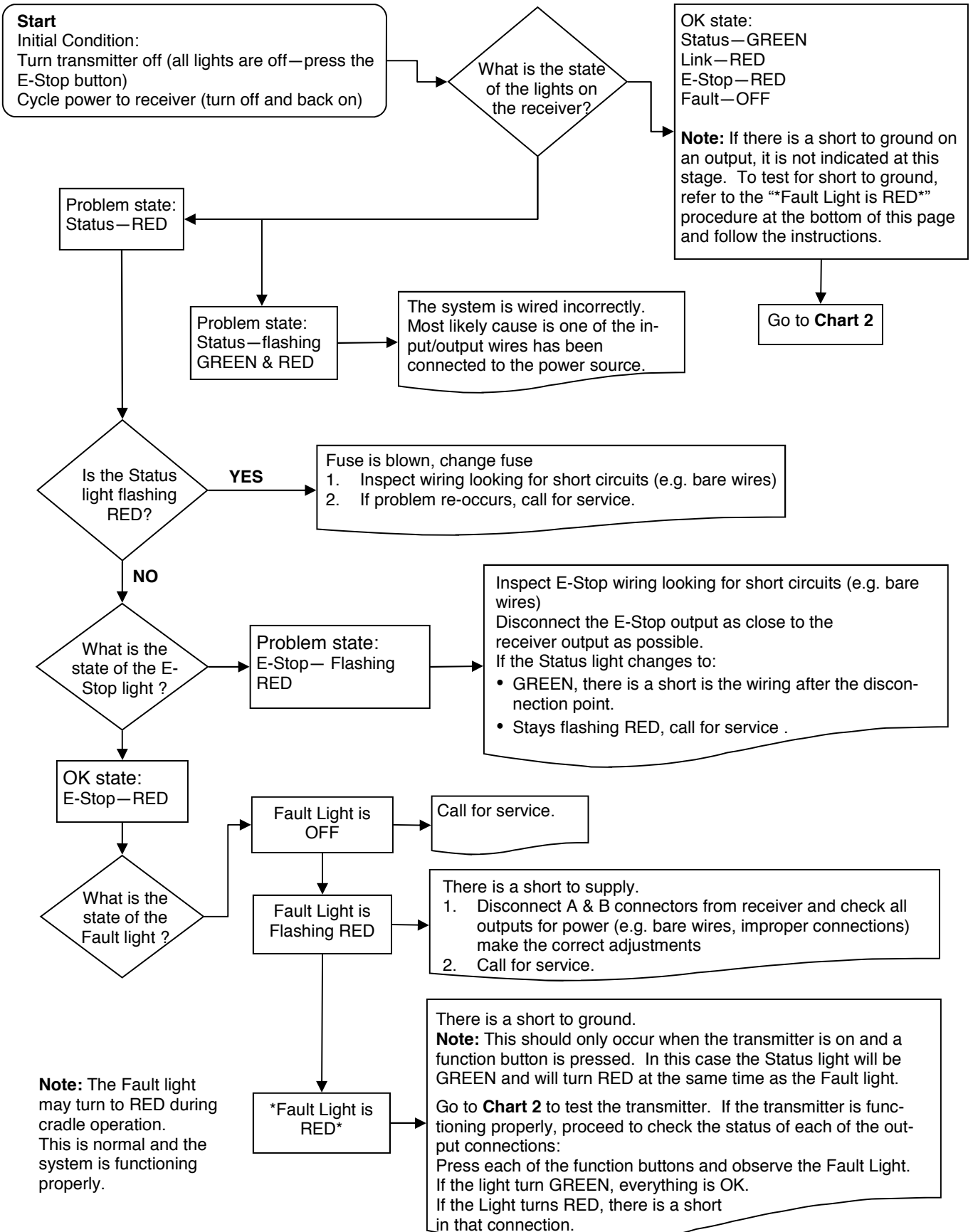
## Trouble Indicators

**Note:** In some cases, the indicator lights will be different depending on whether the transmitter is on or off. Please note the transmitter status in the "Description" column for each case.

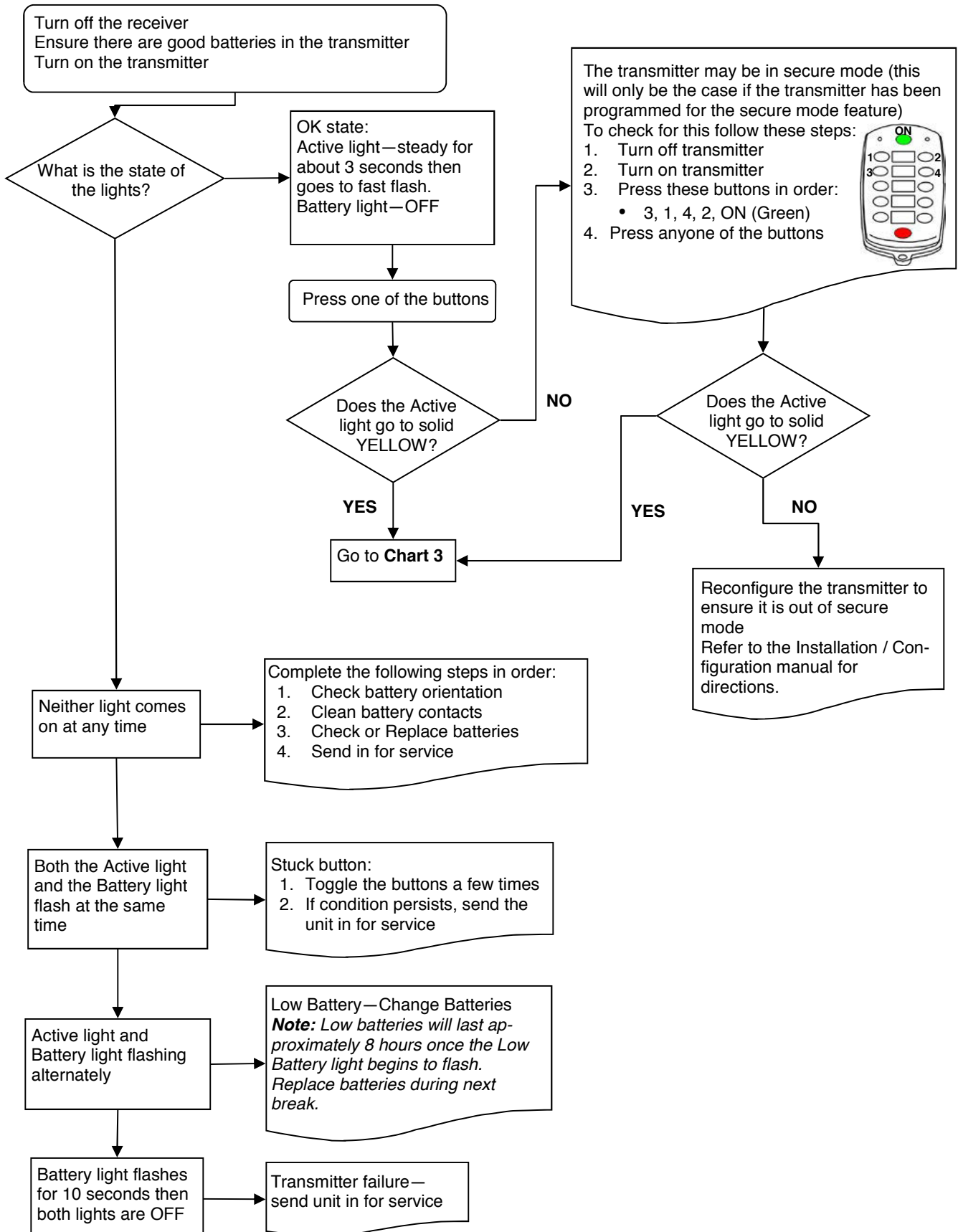
Indicator Lights	Description	Solution
	<p>Transmitter is ON The reason is the transmitter is not communicating with the receiver.</p>	Refer to <b>Troubleshooting Chart #3</b> for solutions
	<p>Transmitter is ON A low battery condition has been detected.</p>	To detect intermittent conditions caused by poor or corroded ground or power circuits, the GREEN light will continue to flash for 30 seconds after the condition has been removed.
	<p>Transmitter is ON An internal fault with the E-Stop has been detected.</p>	<p>Inspect E-Stop wiring for short circuit. Disconnect E-Stop wire as close to the receiver output as possible. If the Status light changes to:</p> <ul style="list-style-type: none"> <li>GREEN, a short occurs after disconnection point.</li> <li>Stays flashing RED, send it in for service .</li> </ul>
	<p>Transmitter is ON A short to ground or excessive current draw on an output. It is most likely caused by a wiring fault.</p>	<p>Ensure transmitter is functioning properly, check status of each output connection: Press each function button and observe Fault Light.</p> <ul style="list-style-type: none"> <li>If GREEN, everything is OK.</li> <li>If RED, there is a short in that connection.</li> </ul>
	<p>Transmitter is ON The E-Stop output has been connected with one of the other outputs</p>	Follow the wire and check for connections with other wires, disconnect to see if condition clears. If not, call for service.
	<p>Transmitter is OFF A wiring short to the battery has been detected.</p>	Refer to <b>Troubleshooting Chart #1</b> for solutions
	<p>Transmitter is OFF The receiver has detected an internal fault.</p>	Refer to <b>Troubleshooting Chart #1</b> for solutions
	<p>Transmitter is OFF Blown fuse detected.</p>	Refer to <b>Page 6</b> for instructions on how to open the receiver case to access fuse. Check wiring for shorts or bare spots. If fuses continue to blow, call for service.
	<p>Transmitter is ON A setup failure has occurred.</p>	Either hold the Setup button for 5 seconds to return to Setup mode or cycle power to return to the normal operating mode.
	<p>Transmitter is OFF The receiver is powered incorrectly.</p>	Most likely cause of this condition is that an output wire or the E-Stop wire has been connected to the power supply while the power wire is disconnected from the power supply.

<b>Light Legend</b>	Solid	Slow Flash	Fast Flash	Red Light	Green Light	Yellow Light	Alternating Red & Green Light
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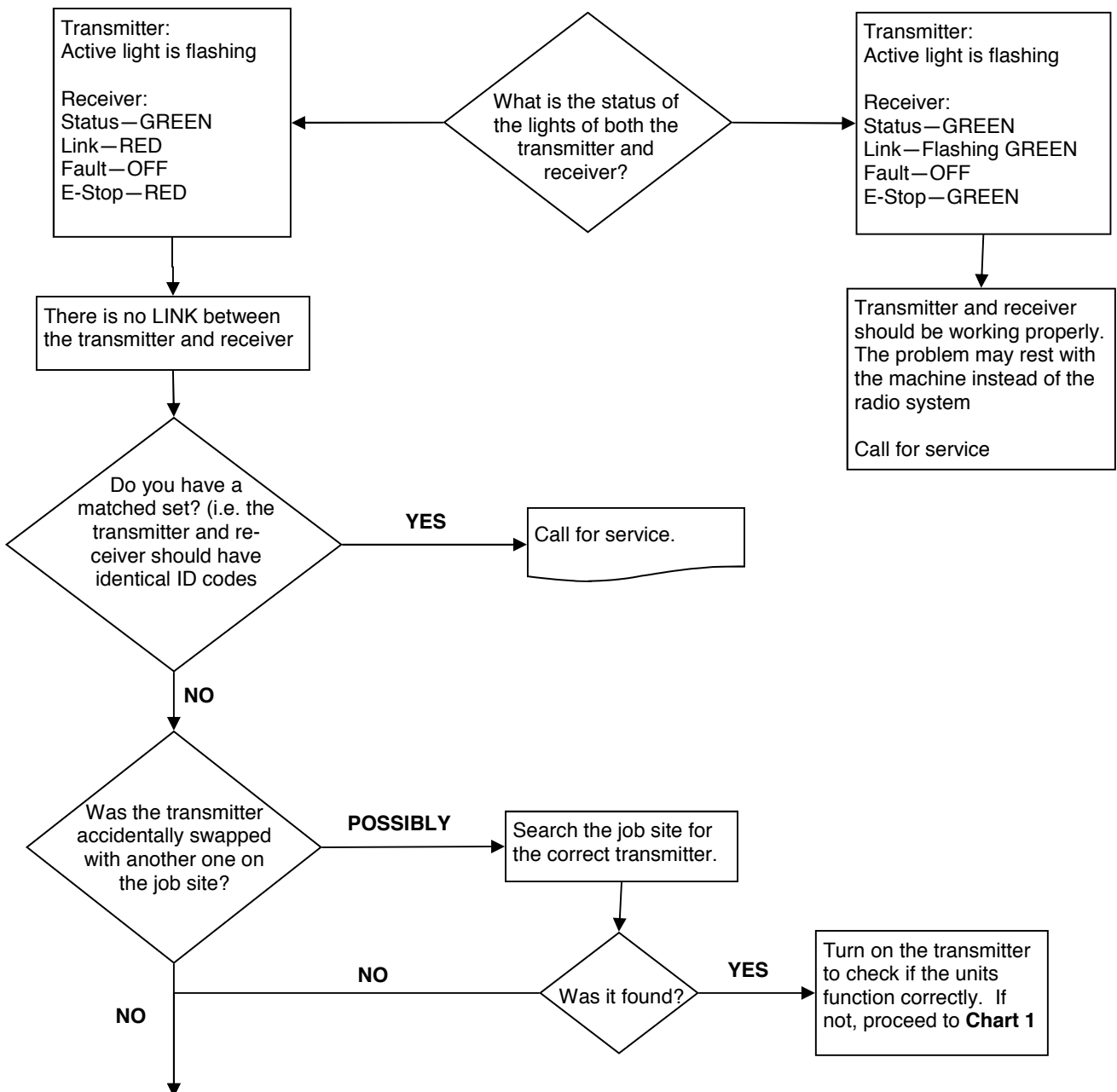
Test the Receiver – R160



Test the Transmitter—T110



Testing the Transmitter / Receiver Communication



The transmitter code may need to be re-downloaded to the receiver

**!!Caution!!**

**Note:** Before you proceed with the Download ID procedure located on **Page 7**, great care and caution must be adhered to. Also, refer to **Chart #4** for Tips and Considerations.

If by accident, the transmitters have been switched with another unit, by downloading the ID code to a new receiver, it is possible for the transmitter to operate 2 units at the same time (if the original receiver unit is still on the job site). Therefore it must be certain that the transmitter / receiver pair are the correct set.

Secondly, once the download procedure is completed, ensure all other units on the job site are stopped. Test the operation of the newly configured set to ensure no other machines on the site work with the same transmitter.

Once you are certain that the transmitter / receiver pair are a unique set, continue normal operations.

## Considerations when Downloading the ID

### Potential downloading issues

If testing of the receiver and transmitter both show the system as working (Chart 1 & 2), then the transmitter and receiver will both go into Download/Configuration mode.

Possible issues could arise during Step 4, the download phase of reprogramming. In this case there are 2 symptoms to look for:

1. The Link light on the receiver will not turn GREEN when the power switch is toggled on the transmitter to download
2. The receiver will “time out” indicating that it didn’t receive a signal from the transmitter within the 30 seconds from the time the receiver was put into Setup Mode.

If all indications appear normal during the download phase, test the link by turning on the transmitter (note: the transmitter shuts off after transmitting the ID code in Step 4)

1. If the Link light on the receiver doesn’t turn GREEN, the receiver didn’t receive all of the information that was sent from the transmitter.

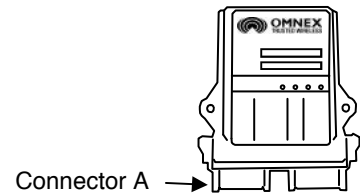
### Possible Solutions

1. Try the Downloading steps again
2. If this doesn’t correct the problem, send both the transmitter and receiver in for service.

**Note:** you could try to determine whether the fault lies with the transmitter or receiver by completing the Reprogramming procedure with a different transmitter. If this step works, then the fault lies with the original transmitter. If not, the fault may lie with the receiver.

### !!Caution!!

**Note:** Before attempting reprogramming with another transmitter, understand that reprogramming the receiver with another transmitter, could result in two receivers on the job site responding to the one transmitter. If the original transmitter was sent in for repair, disconnect the receiver (disconnect connector A) to continue using the machine without remote capability and without fear of inadvertently operating the machine with the other transmitter.



### Reprogramming Tips:

1. Be patient and deliberate when pressing the Power and E-Stop buttons in the correct order during power up in Configuration mode
2. Use a pointy instrument to depress the Setup button on the receiver (i.e. a pen) as the button is relatively small
3. Follow each step as laid out in the procedure
4. Never lay the receiver circuit board down on anything metallic (there are contact points on the back which could contact the metal and damage the receiver)

## Parts & Accessories

Part	OMNEX Part Number	Description
<b>Batteries</b>	B0010	4 x AA alkaline
<b>Fuse</b>	F0039	36V Bi-directional, Bussman ATC-15
<b>Belt Clip</b>	AKIT-2428-03	see illustration below
<b>Magnets</b>	AKIT-2428-01	see illustration below
<b>Bipolar Diode Kit</b>	AKIT-2492-01	Motorola P6KE36CA
<b>Dash Cradle</b>	Call OMNEX	see illustration below
<b>R160 Output Cable</b>	ACAB-2493-01	Generic Output Cable- see illustration below
<b>Connector Kit</b>	AKIT-2337-01	Includes Deutsch socket connectors, wedges, pins and sealing plugs
<b>Keypad Label T110</b>	FLBL-1726-25	Generic Line Pump Labels



Dash Cradle



Belt Clip



Magnets



R160 Output Cable

## Specifications

	R160 Receiver	T110 Transmitter
<b>Size</b>	5.1" x 4.7" x 1.4" (130mm x 119mm x 36mm)	5.8" x 3.4" x 1.2" (147mm x 86mm x 30mm)
<b>Weight</b>	0.65lbs (0.295kg)	.65 lbs (295g) incl. batteries
<b>Construction</b>	High impact plastic, weatherproof	High impact, low temperature plastic, weatherproof
<b>Input Power</b>	+9V to 30VDC	4AA alkaline batteries
<b>Battery Life</b>	N/A	160 hours (continuous use)
<b>Operating Temperature Range</b>	-40F to 158F (-40C to 70C)	-22 F to +140 F (-30 to +60 C)
<b>Outputs</b>	3A (max) each (sourcing), 10A (max) each (combined)	N/A
<b>Antenna</b>	Internal	Internal
<b>Approvals</b>	<b>USA-</b> FCC part 15.247 <b>Canada-</b> ISC RSS 210 Issue 6, Sept. 2005 <b>Europe-</b> CE, EN 440 <b>Australia-</b> C-Tick	

### FCC Rules and Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Part 15.247  
ISC RSS 210 Issue 6, Sept. 2005

### Warranty

OMNEX Control Systems ULC warrants to the original purchaser that the OMNEX products are free from defects in materials and workmanship under normal use and service for a period of ONE YEAR, parts (EXCLUDING: SWITCHES, CRYSTALS, OR PARTS SUBJECT TO UNAUTHORIZED REPAIR OR MODIFICATION) and labor from the date of delivery as evidenced by a copy of the receipt. OMNEX's entire liability and your exclusive remedy shall be, at OMNEX's option, either the (a) repair or (b) replacement of the OMNEX product which is returned within the warranty period to OMNEX freight collect by the OMNEX APPROVED carrier with a copy of the purchase receipt and with the return authorization of OMNEX. If failure has resulted from accident, abuse or misapplication, OMNEX shall have no responsibility to repair or replace the product under warranty. In no event shall OMNEX be responsible for incidental or consequential damage caused by defects in its products, whether such damage occurs or is discovered before or after replacement or repair and whether or not such damage is caused by the negligence of OMNEX Control Systems ULC.

### OMNEX Control Systems ULC

74-1833 Coast Meridian Road  
Port Coquitlam, BC, Canada  
V3C 6G5

Tel: 604-944-9247  
Fax: 604-944-9267

**Toll Free: 1-800-663-8806**

www.omnexcontrols.com



## EXTREME DUTY WIRE HARNESS

Your Con-tech mixer wiring harness is designed with durability in mind. It is wound in a nylon wrap to withstand to resist abrasion and incorporates Deutsch electrical connectors to combat moisture and corrosion. Please refrain from focused acid use in the areas in/around the wiring harness, electrical connectors and solenoids.

It is also recommended that you inspect the entire harness during preventative maintenance work on the mixer/chassis. Over time clips, clamps and zip ties can corrode and break. This will allow harnesses to rub/chafe on frame rails, brackets and hoses. This rubbing over time can wear thru the protective covering and possibly cause electrical shorts in the system.

Wiring schematics have been included in this maintenance manual.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

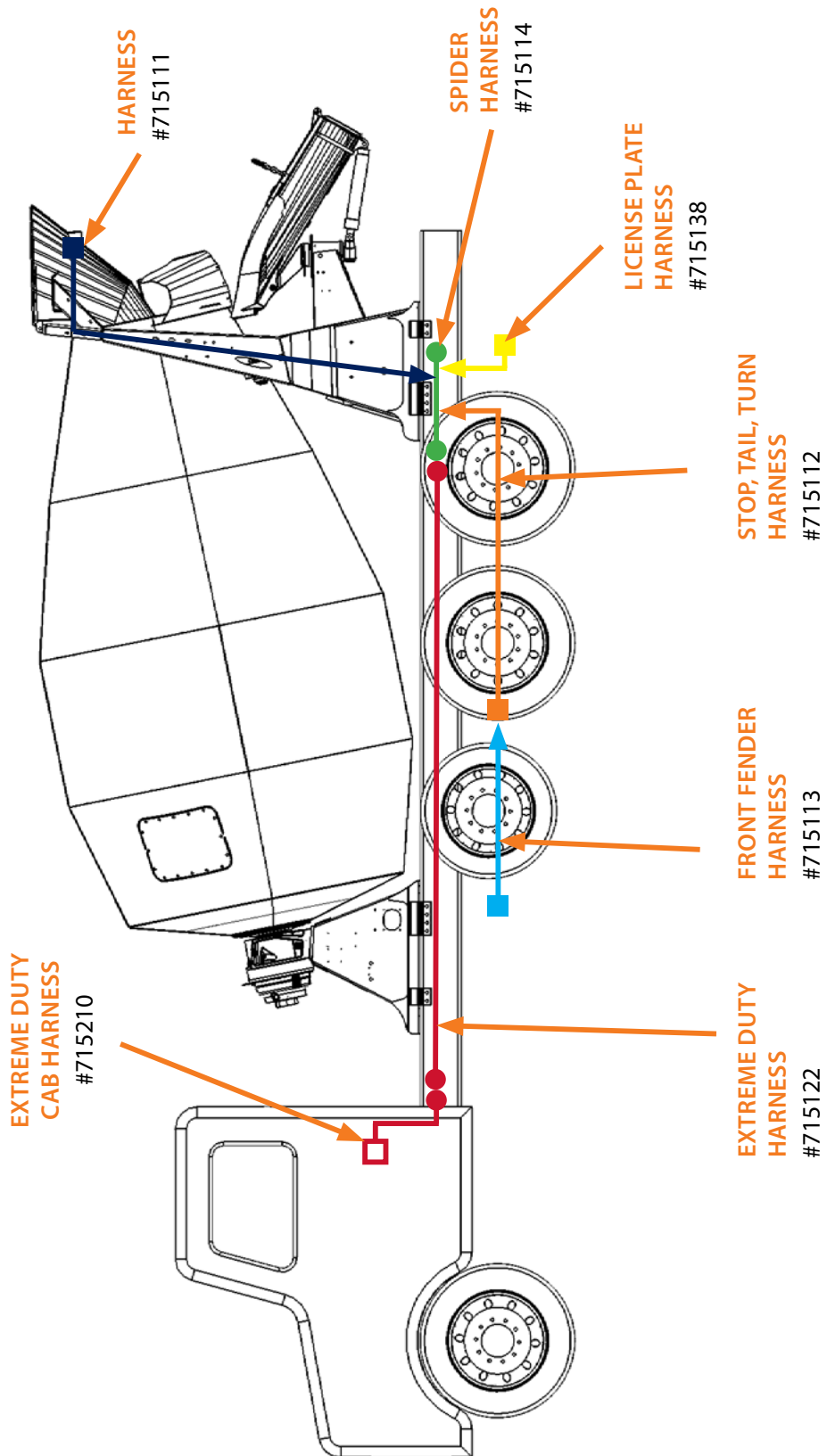
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR  
MAINTENANCE ON YOUR VEHICLES.**



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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# EXTREME DUTY WIRE HARNESS



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## BRIDGEKING® WIRE HARNESS

Your Con-tech mixer wiring harness is designed with durability in mind. It is wound in a nylon wrap to withstand to resist abrasion and incorporates Deutsch electrical connectors to combat moisture and corrosion. Please refrain from focused acid use in the areas in/around the wiring harness.

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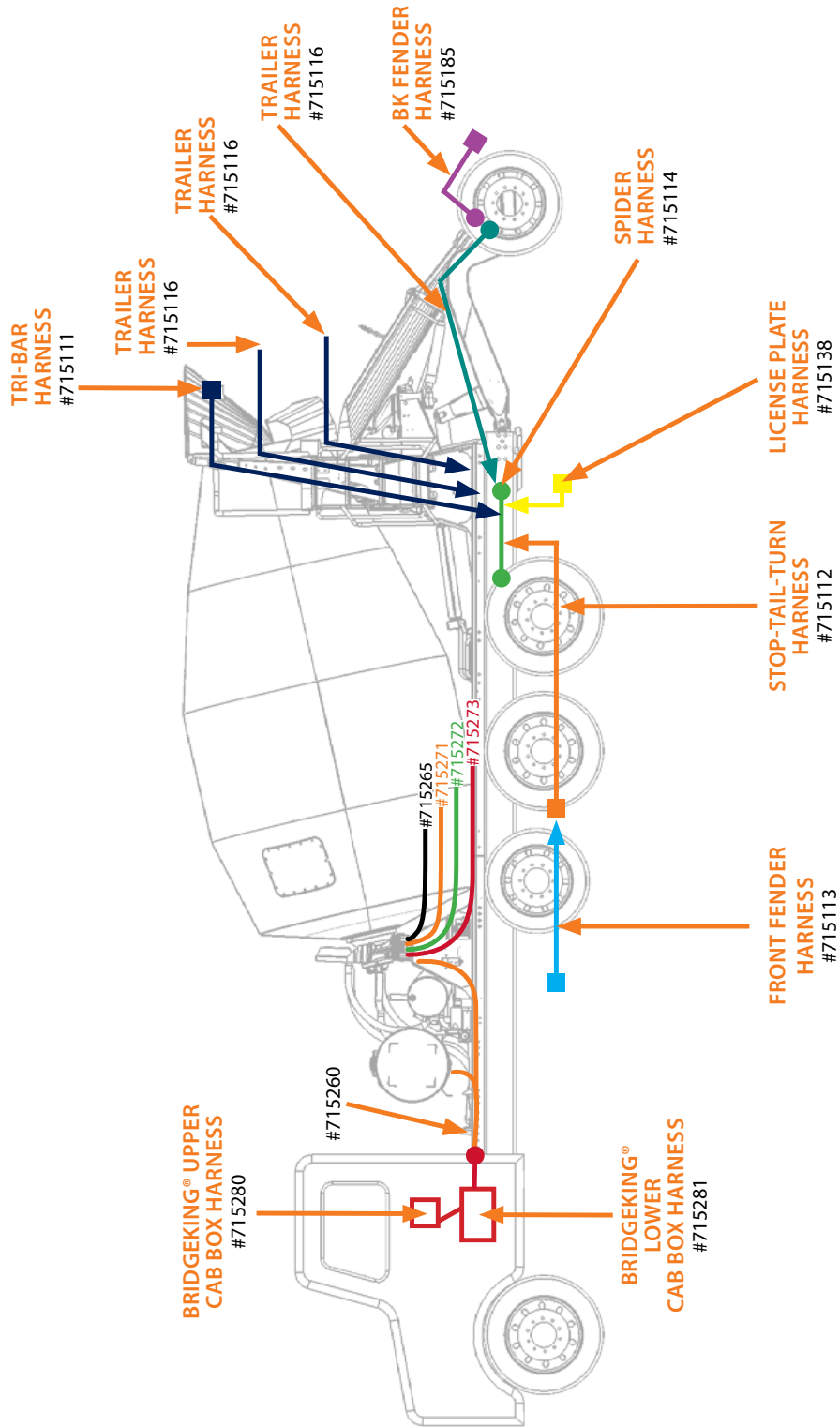
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# BRIDGEKING® WIRE HARNESS



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## REAR CONTROL PENDANT

Your Con-Tech rear pendant is designed with durability and function in mind. Con-Tech offers two lengths 5' and 25'. A wiring diagram is shown for a fully loaded pendant. If you are experiencing issues with your pendant and need to service it, use OEM replacement parts.

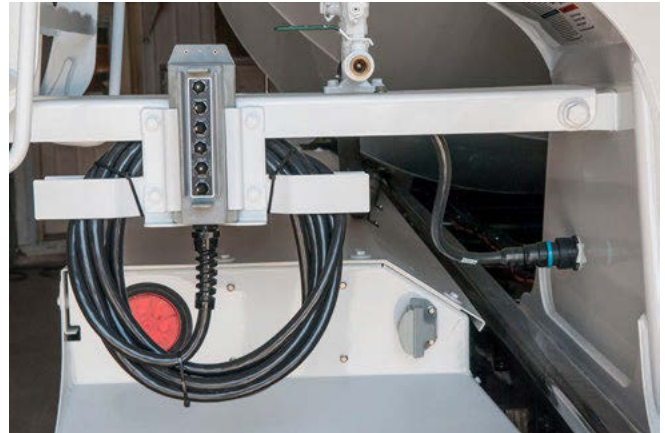
Wiring schematics have been included in this maintenance manual.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**

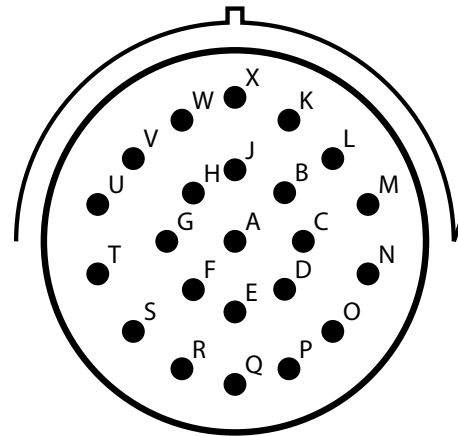
715505 - **CTM Rear Pendant (5' length)**

715525 - **CTM Rear Pendant (25' length)**



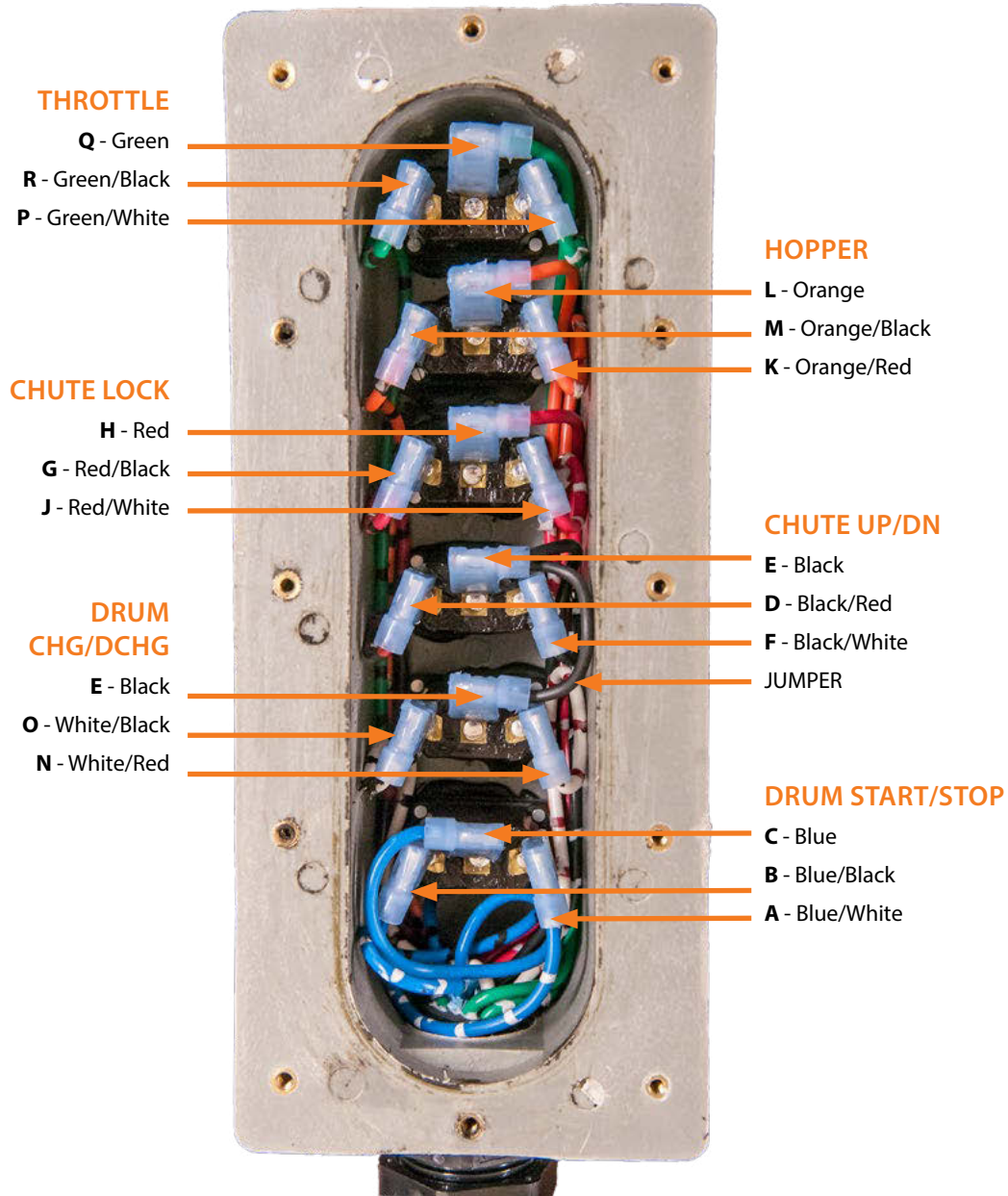
### Pendant Wiring

A	Drum Start/Stop	Blue/White	M	Hopper	Orange/Black
B	Drum Start/Stop	Blue/Black	N	Drum Charge	White/Red
C	Drum Start/Stop Signal	Blue	O	Drum Discharge	White/Black
D	Chute Down	Black/Red	P	Throttle High	Green/White
E	Pendant Power	Black	Q	Throttle Common	Green
F	Chute Up	Black/White	R	Throttle Low	Green/Black
G	Chute Lock	Red/Black	S	Plug	
H	Chute Lock Signal	Red	T	Plug	
J	Chute Lock	Red/White	U	Plug	
K	Hopper	Orange/Red	V	Plug	
L	Hopper Signal	Orange	W	Plug	
			X	Plug	



# REAR CONTROL PENDENT

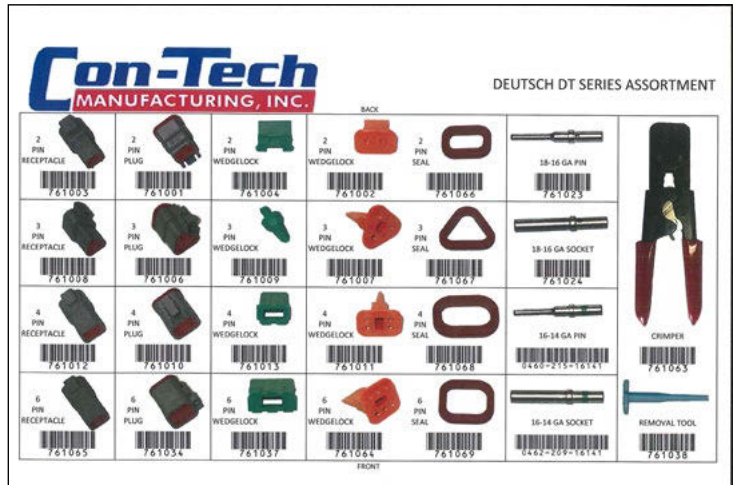
## Rear Pendent Wiring Diagram



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# DEUTSCH, WEATHER PACK & FUSE KITS



DEUTSCH CONNECTOR KIT #761054



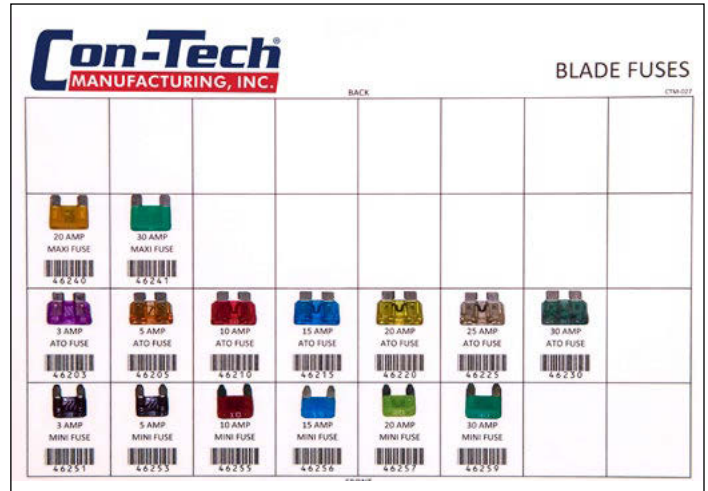
WEATHER PACK CONNECTOR KIT #761060



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# DEUTSCH, WEATHER PACK & FUSE KITS



## FUSE KIT #761062

Maintain your Con-Tech mixer using the same OEM Parts used to build your truck with these kits. They come in stackable bins that can be easily and conveniently stored. For more information, or to purchase any of our kits, please call the Con-Tech sales department.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# 1.1

## Counters, Panel Meters, Tachometers and Timers

### Totalizers

#### 1

#### 1/32 DIN LCD Totalizers

##### Product Description

Compact battery powered totalizers where AC power is unavailable.

##### Features

- Low price and high efficiency
- Large eight-digit LCD display, height of the figures 0.31 in (8 mm)
- Various counting modes like up/down differential available
- High voltage input for 10–260 Vac/Vdc voltage pulses
- IP65
- Screw terminals, RM 5 mm
- Lifetime of the battery approximately eight years
- Locking of the reset key
- Operating temperature 14° to 140°F (–10° to 60°C)
- All version of positive or negative counting edge
- Filter function for bounce-free counting with mechanical contacts

##### Standards and Certifications

- UL recognized
- CE marked



#### Product Selection

E5-024-C04\_



#### 1/32 DIN LCD Totalizers

##### Description

##### Catalog Number

##### Eight-Digit LCD Totalizer, Battery Power

4–30 Vdc powered, NPN/PNP 0.94 x 1.89 in (24 x 48 mm)

**E5-024-C0400**

10–120V input AC/DC powered, NPN only 0.94 x 1.89 in (24 x 48 mm)

**E5-024-C0408**

Count up/down 4–30 Vdc powered, NPN only, 0.94 x 1.89 in (24 x 48 mm)

**E5-024-C0410**

#### Technical Data and Specifications

##### 1/32 DIN LCD Totalizers

Description	Specification
Power supply	Non-replaceable lithium battery (lifetime approximately eight years at 68°F (20°C))
Display	LCD, eight-digits
Figure size	0.31 in (8 mm) high
Mode	Adding or subtracting (selectable), counting direction, differential counting or phase discriminator single or dual evaluation (selectable)
Display range	–9999999 to 99999999, with overflow display
Reset	Manual and electrical
Interference emissions	EN 55011 Class B, EN 61 000-6-2, EN 61010 Section 1 (only AC versions)
Housing	Dark gray RAL 7021
Operating temperature	14° to 131°F (–10° to 55°C)
Ambient temperature	14° to 140°F (–10° to 60°C)
Storage temperature	–4° to 158°F (–20° to 70°C)
Protection	IP65 (from front)
Weight	Approx. 1.76 oz (50g)

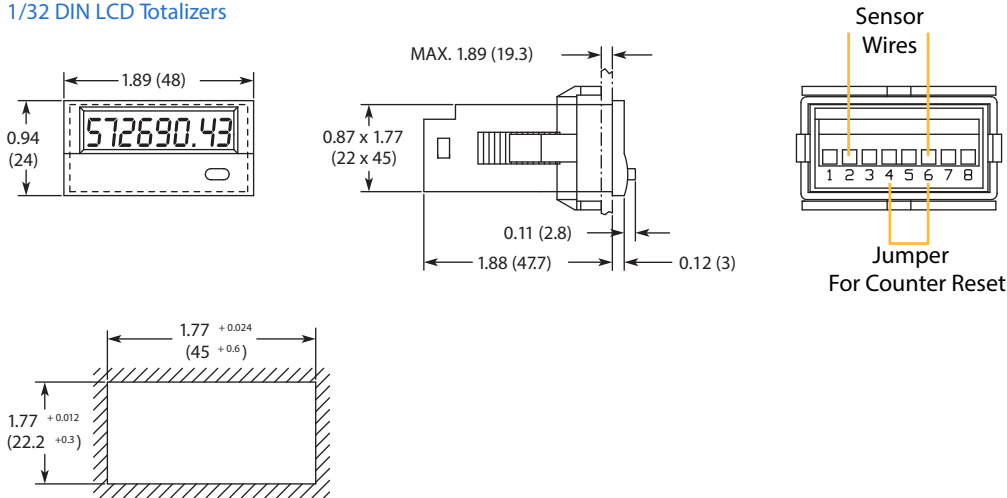
### 1/32 DIN LCD Totalizers, continued

Description	Specification
<b>Counting inputs:</b>	
Counting input of the DC version	Max. 30 Vdc
Slow counting input	Max. 30 Hz (NPN)
Fast counting input	Max. 12 kHz (PNP)
Switching level	NPN: Low 0–0.7V, High 3–30 Vdc PNP: Low 0–0.7V, High 3–30 Vdc
<b>Counting Input of the high voltage versions</b>	
Counting input	Optocoupler input, max. 30 Hz
Min. pulse time	16 ms
Switching level	Low: 0–2 Vac/Vdc High: 10–260 Vac/Vdc
Counting direction switching (only DC versions)	Contact input, open collector NPN (switching at 0 Vdc) Switching level, NPN—Low, 0–0.7V, High 3–5 Vdc
<b>Reset input (only DC and high voltage)—</b>	
Minimum pulse time	DC: 50 ms; high voltage: 16 ms
Contact input NPN	Low: 0–0.7V High: 3–30 Vdc
High voltage input	10–260 Vac/Vdc
Electrical reset key locking (for DC and AC)	Contact input, open collector NPN (switching at 0V) Switching level, NPN—Low, 0–0.7V, High 3–5 Vdc

### Dimensions

Approximate Dimensions in Inches (mm)

#### 1/32 DIN LCD Totalizers





**Model Number**

NBB15-30GM30-E2-Y262660

**Features**

- Basic series
- 15 mm flush
- Increased operating distance

**Accessories**

**BF 30**

Mounting flange, 30 mm

**EXG-30**

Quick mounting bracket with dead stop

**Technical Data**

**General specifications**

Switching element function	PNP	NC
Rated operating distance	$s_n$	15 mm
Installation		flush
Output polarity		DC
Assured operating distance	$s_a$	0 ... 12.15 mm
Reduction factor $r_{AI}$		0.3
Reduction factor $r_{Cu}$		0.3
Reduction factor $r_{304}$		0.75

**Nominal ratings**

Operating voltage	$U_B$	10 ... 30 V
Switching frequency	$f$	0 ... 150 Hz
Hysteresis	$H$	typ. 5%
Reverse polarity protection		reverse polarity protected
Short-circuit protection		pulsing
Voltage drop	$U_d$	$\leq 3$ V
Operating current	$I_L$	0 ... 100 mA
Off-state current	$I_r$	0 ... 0.5 mA typ. 0.1 $\mu$ A at 25 °C
No-load supply current	$I_0$	$\leq 15$ mA
Switching state indicator		all direction LED, yellow

**Functional safety related parameters**

MTTF <sub>d</sub>	2090 a
Mission Time (T <sub>M</sub> )	20 a
Diagnostic Coverage (DC)	0 %

**Ambient conditions**

Ambient temperature	-25 ... 70 °C (-13 ... 158 °F)
---------------------	--------------------------------

**Mechanical specifications**

Connection type	cable PVC , 1335 mm Deutsch contact 1060-16-0622
Core cross-section	0.5 mm <sup>2</sup>
Housing material	brass, nickel-plated
Sensing face	PBT
Degree of protection	IP67

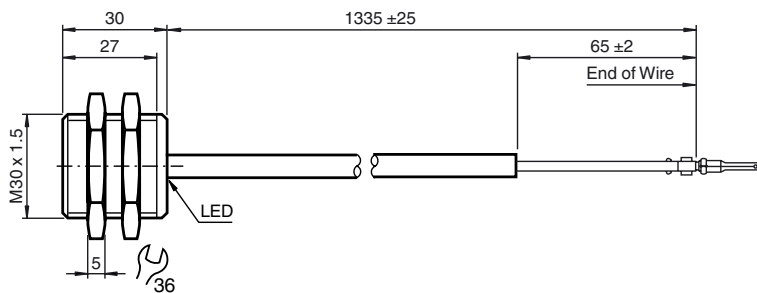
**Compliance with standards and directives**

Standard conformity	
Standards	EN 60947-5-2:2007 IEC 60947-5-2:2007

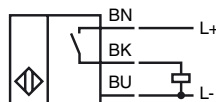
**Approvals and certificates**

UL approval	cULus Listed, General Purpose
CSA approval	cCSAus Listed, General Purpose
CCC approval	CCC approval / marking not required for products rated $\leq 36$ V

**Dimensions**

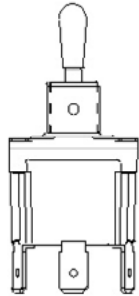


**Electrical Connection**



Release date: 2014-08-06 08:18 Date of issue: 2014-08-06 262660\_eng.xml

### 31NT91-1



*Actual product appearance may vary.*

**NT Series Toggle Switch, 1 pole, 3 position, Quick Connect terminal, Standard Lever**

#### Features

- Completely sealed switching chamber
- NEMA 3, 3R, 4, and 13
- UL recognized, File E12252, Vol. 1, Section 44
- CSA certified, File LR4442
- CE approved

#### Potential Applications

- Aerial lifts, scissor lifts, truck mounted tele-handlers, and cranes
- Construction equipment
- Agriculture equipment
- Material-handling equipment
- Factory-floor control units
- Machine tool equipment manufacturers

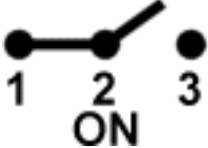

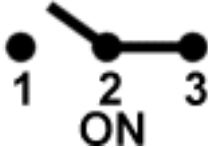
#### Description

MICRO SWITCH™ NT Series toggle switches meet the need for a rugged, cost-effective toggle switch. Quality construction features include a seal between the toggle lever and bushing, and between the cover and case. These switches can be used where panels are subject to splashes, hosedowns, or outdoor environments. The "Easy-Start" threaded bushing enables quick alignment of mounting nut to decrease the chance of cross threading. The panel stand-off with O-ring feature available on some listings, eliminates the need for behind-the-panel hardware, provides uniform panel height, and provides a panel to cover seal.



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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Product Specifications	
Circuitry/ Operating action	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p><b>Keyway Position</b></p>  <p>1    2    3 <b>ON</b></p> </div> <div style="text-align: center;"> <p><b>Center Position</b></p>  <p>1    2    3 <b>OFF</b></p> </div> <div style="text-align: center;"> <p><b>Opposite Keyway Position</b></p>  <p>1    2    3 <b>ON</b></p> </div> </div>
Product Type	MICRO SWITCH™ Toggle Switch
Ampere/ Voltage Range (Resistive Load)	0.5 A to 15 A at 0.5 Vac to 277 Vac, 0.5 A at 250 Vdc, 0.75 A at 115 Vdc, 0.5 A to 20 A at 0.5 Vdc to 28 Vdc
Circuitry	SPDT
Action	3 position
Mounting	Bushing 15/32 in
Termination	Quick Connect
Lever Type	Standard
UL/CSA Rating Code	L191: 15 A-125, 250, 277 Vac; 1/2 Hp-125 Vac; 1 Hp-250, 277 Vac; 5 A-120 Vac "L"
Comment	Switches are capable of withstanding a temperature of 160 degrees F continuously at full rated load
Availability	Global
UNSPSC Code	30211908
UNSPSC Commodity	30211908 Toggle switches
Series Name	NT

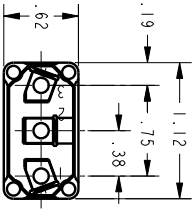
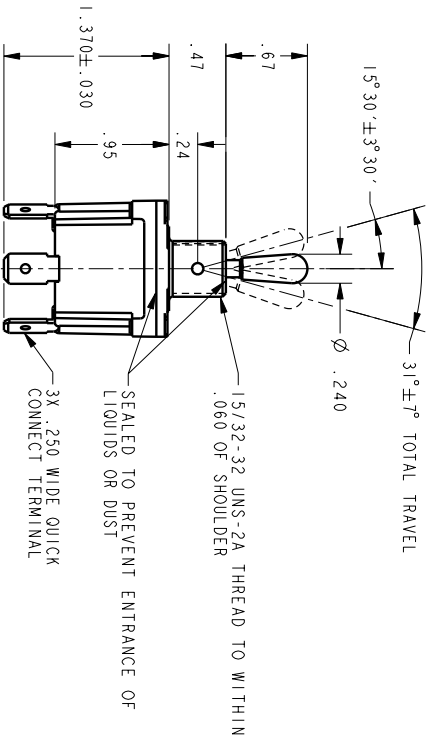
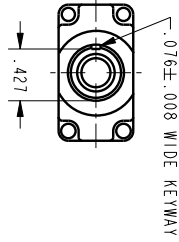
**MICRO SWITCH**  
a Honeywell Division  
FED. REG. CODE 91429

**SWITCH - TOGGLE**

**3INT91 SERIES CHART 1**

CATALOG LISTING

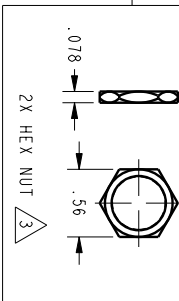
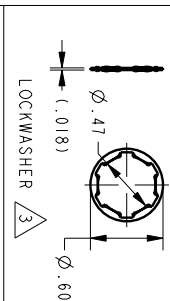
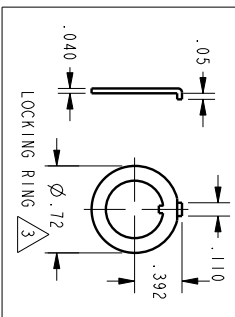
THIS DRAWING COVERS A PROPRIETARY ITEM AND IS THE PROPERTY OF MICRO SWITCH, A DIVISION OF HONEYWELL. THIS DRAWING IS NOT TO BE COPIED OR USED WITHOUT THE APPROVAL OF MICRO SWITCH.



ANSI Y14.5M-1982 APPLIES

CATALOG LISTING	CIRCUIT MADE WITH TOGGLE LEVER IN	KEYWAY SIDE	CENTER	OPPOSITE KEYWAY
3INT91-1	ON	OFF	ON	ON
3INT91-2	OFF	NONE	ON	ON
3INT91-3	ON	NONE	ON	ON
3INT91-21	NONE	OFF	ON	ON
3INT91-31	NONE	ON	ON	ON
3INT91-5	MOM OFF	NONE	ON	ON
3INT91-6	MOM ON	OFF	ON	OFF
3INT91-7	MOM ON	OFF	ON	MOM ON
3INT91-8	MOM ON	NONE	ON	MOM ON
3INT91-51	NONE	ON	MOM ON	MOM ON
3INT91-61	MOM ON	OFF	ON	NONE

CATALOG LISTING	ELECTRICAL DATA
3INT91-1	L191 15A 125, 250, 277 VAC
3INT91-2	L191 1/2HP 125 VAC
3INT91-3	1HP 250, 277 VAC
3INT91-21	5A 125 VAC "L"
3INT91-31	5A 125 VAC "L"
3INT91-5	L192 10A 125, 250, 277 VAC
3INT91-6	1/4HP 125 VAC
3INT91-7	1/2HP 250, 277 VAC
3INT91-8	3A 125 VAC "L"
3INT91-51	
3INT91-61	



- NOTES
- SWITCH WILL WITHSTAND TEMPERATURE OF 160°F CONTINUOUSLY AT FULL RATED LOAD
  - MICRO SWITCH CAT. LIST. MARKED ON SIDE OF SWITCH FURNISHED UNASSEMBLED
  - APPLIES ONLY TO "ON" AND "MOMENTARY ON" POSITIONS
  - TO ORDER WITHOUT HARDWARE ADD (-NH) SUFFIX TO CATALOG LISTING

REVISONS	DATE	BY	CHKD
A	09/23/89		
B	20/02/89		
C	20/03/91		
D	09/08/91		
E	20/07/92		
F	27/04/03		

ISSUE	6	CATALOG LISTING	3INT91 SERIES CHART 1
PAGE	1	OF	1

PTC/CAD	20	DRAWN	SAV	29NOV99	CHECK	SAV	29NOV99	CHECK	SAV	29NOV99	RELEASE NO.	PR-20625	REPLACES	
---------	----	-------	-----	---------	-------	-----	---------	-------	-----	---------	-------------	----------	----------	--

THIRD ANGLE PROJECTION	
SCALE	FULL
DO NOT SCALE PRINT	
UNLESS OTHERWISE SPECIFIED	
ONE PLACE	(.01) ± .030
TWO PLACE	(.00) ± .015
THREE PLACE	(.000) ± .005
ANGLES	±
WEIGHT	.07 LB APPROX



DT06-12SA-P012 CONN  
V12S-P012 WEDGELCK  
0462-201-16141 #16 TERM (16-18 GA)

POS	WIRE
1	19
2	4
3	19
4	1
5	1
6	13A
7	20
8	20
9	17
10	17
11	5
12	5

DT06-12SB-P012 CONN  
V12S-P012 WEDGELCK  
0462-201-16141 #16 TERM (16-18 GA)

POS	WIRE
1	16
2	20
3	20
4	20
5	20
6	20
7	20
8	20A
9	20
10	20
11	20
12	4BC

DT06-12SC-P012 CONN  
V12S-P012 WEDGELCK  
0462-201-16141 #16 TERM (16-18 GA)

POS	WIRE
1	11A
2	45
3	45
4	20B
5	20C
6	20
7	20
8	20
9	20
10	20
11	47
12	2E

DT06-12SD-P012 CONN  
V12S-P012 WEDGELCK  
114017 PLUG  
0462-201-16141 #16 TERM (16-18 GA)  
0462-209-16141 #16 TERM (14 GA)

POS	WIRE
1	25
2	25
3	25
4	25
5	25
6	25
7	25 (14 GA)
8	25 (14 GA)
9	25 (14 GA)
10	24
11	24
12	24

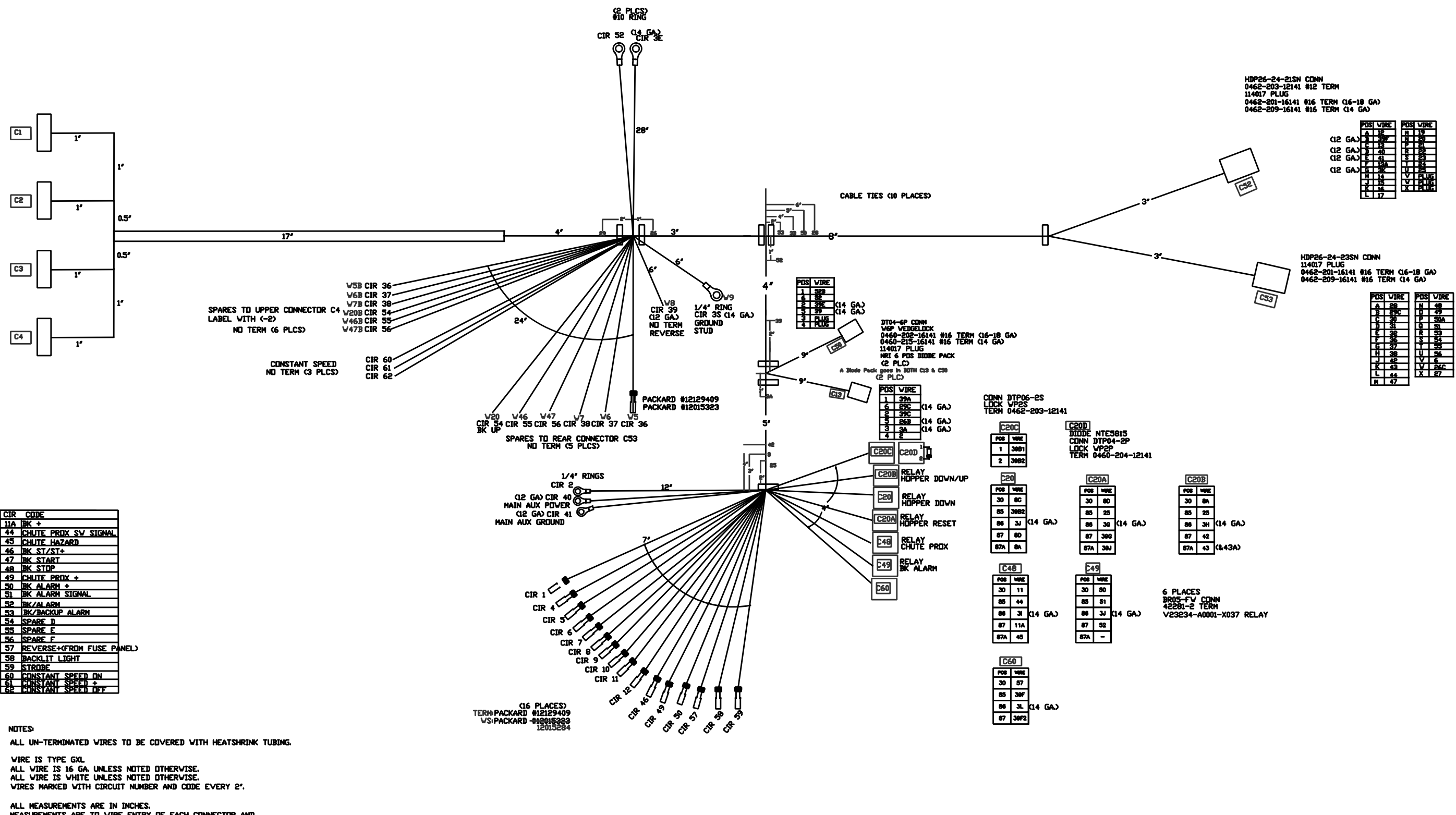
CIR	CODE
1	DRUM S/S +
2	IGNITION
3	GROUND
4	DRUM C/D +
5	CHUTE U/D +
6	FAN +
7	CHUTE LOCK +
8	HOPPER +
8A	HOPPER +
9	PUSHER/TAG +
10	WORK LIGHT +
11	BK +
12	REAR PNDNT +
13	DRUM STOP \S
13A	DRUM S\S
13B	DRUM S\S SIGNAL
14	CHARGE
15	DISCHARGE
16	CHUTE UP
17	CHUTE DOWN
19	FAN
20	CHUTE LOCK
21	CHUTE LOCK
22	LOCK SIGNAL
23	HOPPER
24	HOPPER
25	HOPPER SIGNAL
26	PUSHER UP
27	PUSHER DOWN
28	WORK LIGHT
29	BK UP
30	BK DOWN
31	COUNTER A
32	COUNTER B
33	THROTTLE HIGH
34	THROTTLE POWER
35	THROTTLE LOW
36	SPARE A
37	SPARE B
38	SPARE C
39	REVERSE
40	MAIN AUX POWER
41	MAIN AUX GRND
42	HOPPER UP LIGHT
43	HOPPER DOWN

CIR	CODE
11A	BK +
44	CHUTE PROX SV SIGNAL
45	CHUTE HAZARD
46	BK ST/ST+
47	BK START
48	BK STOP
49	CHUTE PROX +
50	BK ALARM +
51	BK ALARM SIGNAL
52	BK/ALARM
53	BK/BACKUP ALARM
54	SPARE D
55	SPARE E
56	SPARE F
57	REVERSE+(FROM FUSE PANEL)
58	BACKLIT LIGHT
59	STROBE
60	CONSTANT SPEED ON
61	CONSTANT SPEED +
62	CONSTANT SPEED OFF

NOTES:  
ALL UN-TERMINATED WIRES TO BE COVERED WITH HEATSHRINK TUBING.  
WIRE IS TYPE GXL.  
ALL WIRE IS 16 GA. UNLESS NOTED OTHERWISE.  
ALL WIRE IS WHITE UNLESS NOTED OTHERWISE.  
WIRES MARKED WITH CIRCUIT NUMBER AND CODE EVERY 2".

ALL MEASUREMENTS ARE IN INCHES.  
MEASUREMENTS ARE TO WIRE ENTRY OF EACH CONNECTOR AND WIRE LENGTH ON EACH WIRE END OR TERMINAL THAT DOES NOT ENTER A CONNECTOR.  
DOUBLE LINES INDICATE BRAID COVERING.  
SINGLE LINES INDICATE EXPOSED WIRE LENGTHS.

SPLICE 53 INCLUDES CIRCUITS 39,52 & 53. CIRCUIT 39 FROM C50-PDS 1 & CIRCUIT 52 FROM C51-PDS 1.



(16 PLACES)  
TERM:PACKARD #12129409  
V/S:PACKARD #12015323  
12015284



65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

www.ctmmixers.com

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DIMENSIONS ARE IN INCHES FRACTIONAL ± 1/32 MACH ± .02 BEND ± .5" TWO PLACE DECIMAL ± .01 THREE PLACE DECIMAL ± .001	BRAWN	2/11/16	1-507-374-2239
INTERPRET GEOMETRIC TOLERANCING PER MATERIAL	CHECKED		TITLE: <b>BK MIXER LOWER CAB HARNESS</b>
FINISH	ENG APPR.		SIZE PART NO. A 715281
APPLICATION	MFG APPR.		REV A
	QA		SCALE: 1:4 WEIGHT: SHEET 1 OF 2
	COMMENTS: CREATED FROM 1151-11 PROTOTYPE. B.J.H. 2/11/16		



**WIRE ENTRY VIEW - 11 PLACES**

(11 PLACES)  
PE 12052978 CONN  
LABEL CONNS

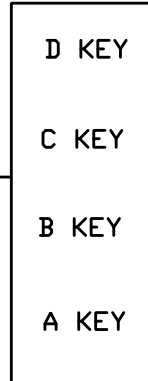
FOLD BACK AND BUNDLE WITH ZIP TIE

SPARES  
NO TERM (9 PLCS)

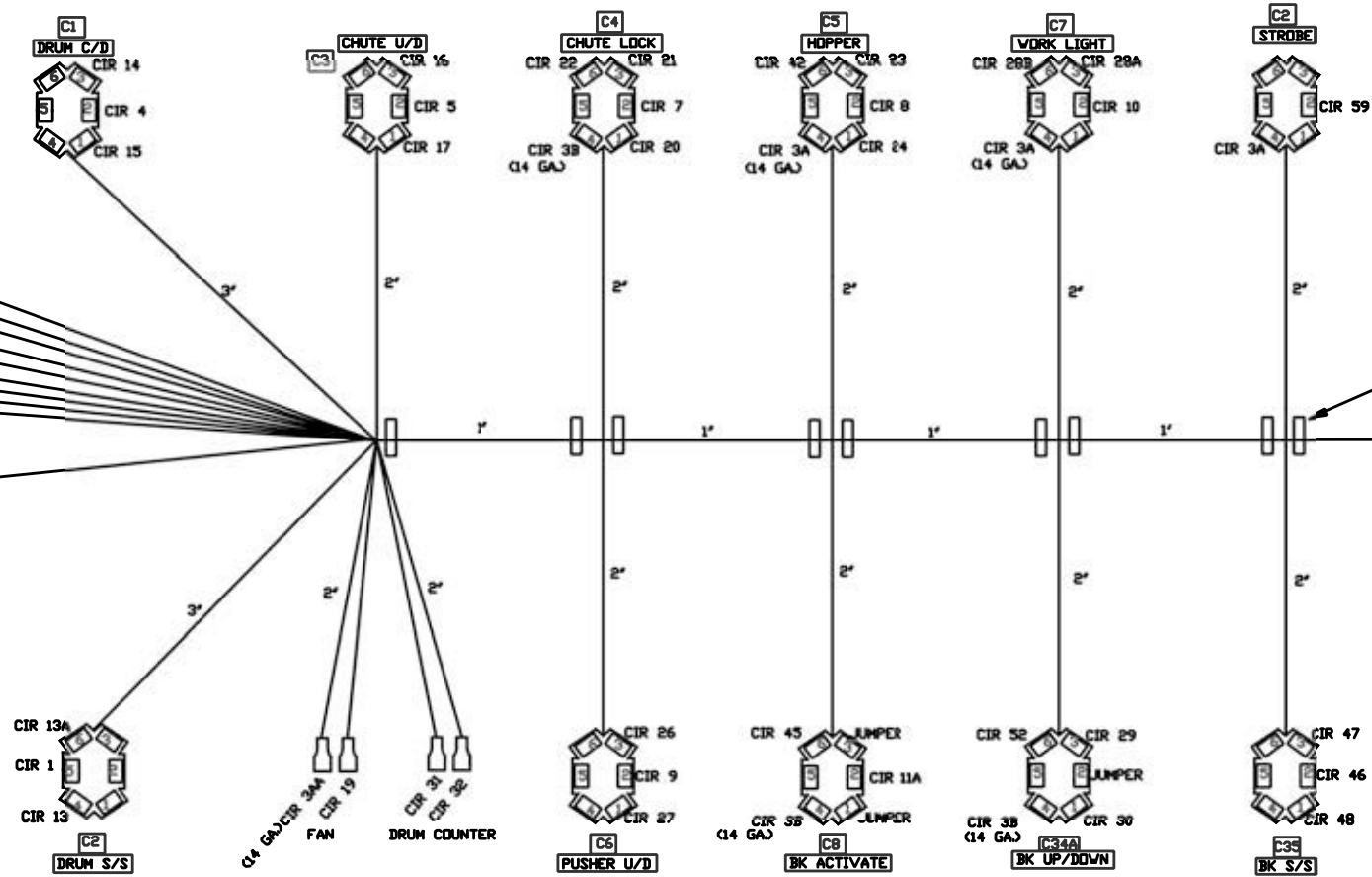
- CIR 36
- CIR 37
- CIR 38
- CIR 54
- CIR 55
- CIR 56
- CIR 60
- CIR 61
- CIR 62

NO TERM  
CIR 58

DT04-48P CONN  
V12P WEDGELCK  
114017 PLUG  
0462-201-16141 #16 TERM (16-18 GA)  
0462-209-16141 #16 TERM (14 GA)



POS	WIRE	POS	WIRE	POS	WIRE	POS	WIRE
A1	15	B1	16	C1	11A	D1	36
A2	4	B2	20	C2	45	D2	37
A3	14	B3	7	C3	10	D3	38
A4	19	B4	21	C4	20A	D4	34
A5	1	B5	22	C5	20B	D5	52
A6	13A	B6	17	C6	30	D6	56
A7	28	B7	9	C7	23	D7	3A (14 GA)
A8	31	B8	26	C8	59	D8	3B (14 GA)
A9	32	B9	24	C9	48	D9	3AA (14 GA)
A10	19	B10	8	C10	46	D10	60
A11	17	B11	23	C11	47	D11	61
A12	5	B12	48	C12	58	D12	62



ETC MOLEX# 19002-0025  
(250 FEMALE)  
SUPPLY MATING TERM FOR ALL FASTON RECEPTACLES (AMP/TYCON# 3-520106-2)

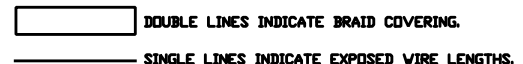
CIR	CODE
1	DRUM S/S +
2	IGNITION
3	GROUND
4	DRUM C/D +
5	CHUTE U/D +
6	FAN +
7	CHUTE LOCK +
8	HOPPER +
9A	HOPPER +
9	PUSHER/TAG +
10	WORK LIGHT +
11	BK+
12	REAR POINT +
13	DRUM STOP \S
13A	DRUM S/S
13B	DRUM S/S SIGNAL
14	CHARGE
15	DISCHARGE
16	CHUTE UP
17	CHUTE DOWN
19	FAN
20	CHUTE LOCK
21	CHUTE LOCK
22	LOCK SIGNAL
23	HOPPER
24	HOPPER
25	HOPPER SIGNAL
26	PUSHER UP
27	PUSHER DOWN
28	WORK LIGHT
29	BK UP
30	BK DOWN
31	COUNTER A
32	COUNTER B
33	THROTTLE HIGH
34	THROTTLE POWER
35	THROTTLE LDV
36	SPARE A
37	SPARE B
38	SPARE C
39	REVERSE
40	MAIN AUX POWER
41	MAIN AUX GND
42	HOPPER UP LIGHT
43	HOPPER DOWN

CIR	CODE
11A	BK +
44	CHUTE PROX SV SIGNAL
45	CHUTE HAZARD
46	BK ST/ST+
47	BK START
48	BK STOP
49	CHUTE PROX +
50	BK ALARM +
51	BK ALARM SIGNAL
52	BK/ALARM
53	BK/BACKUP ALARM
54	SPARE D
55	SPARE E
56	SPARE F
57	REVERSE+(FROM FUSE PANEL)
58	BACKLIT LIGHT
59	STROBE
60	CONSTANT SPEED ON
61	CONSTANT SPEED +
62	CONSTANT SPEED OFF

LABEL SPARES WITH (-2)

LABEL SPARES WITH (-2)

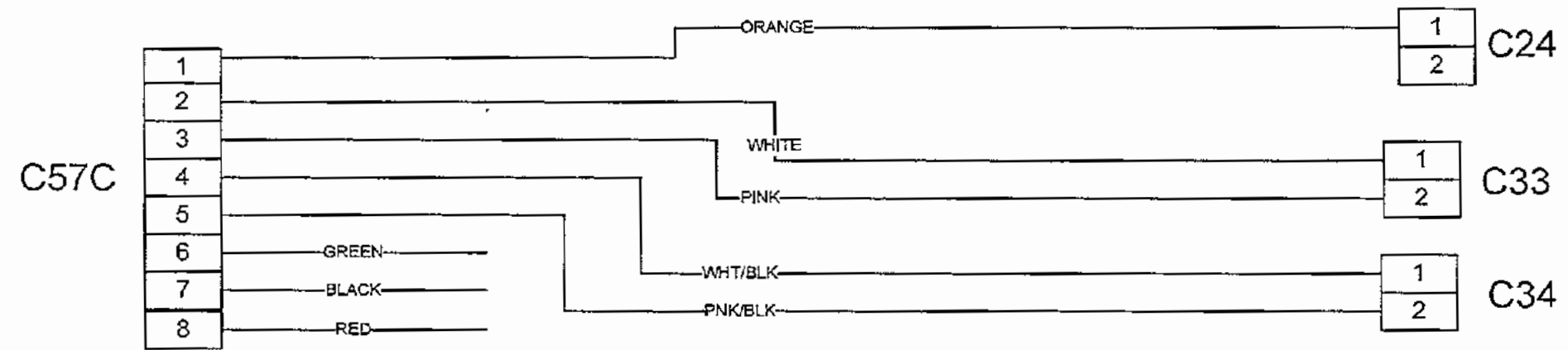
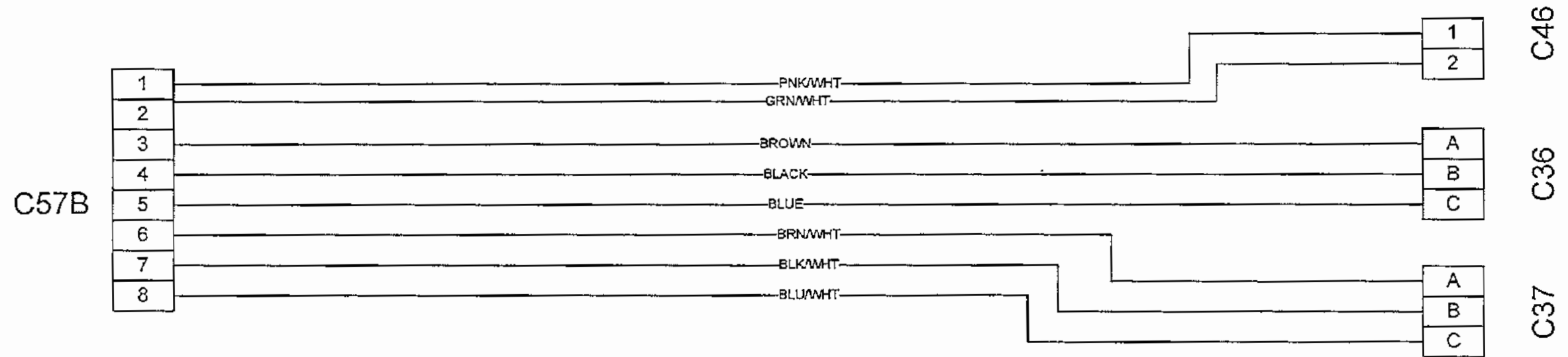
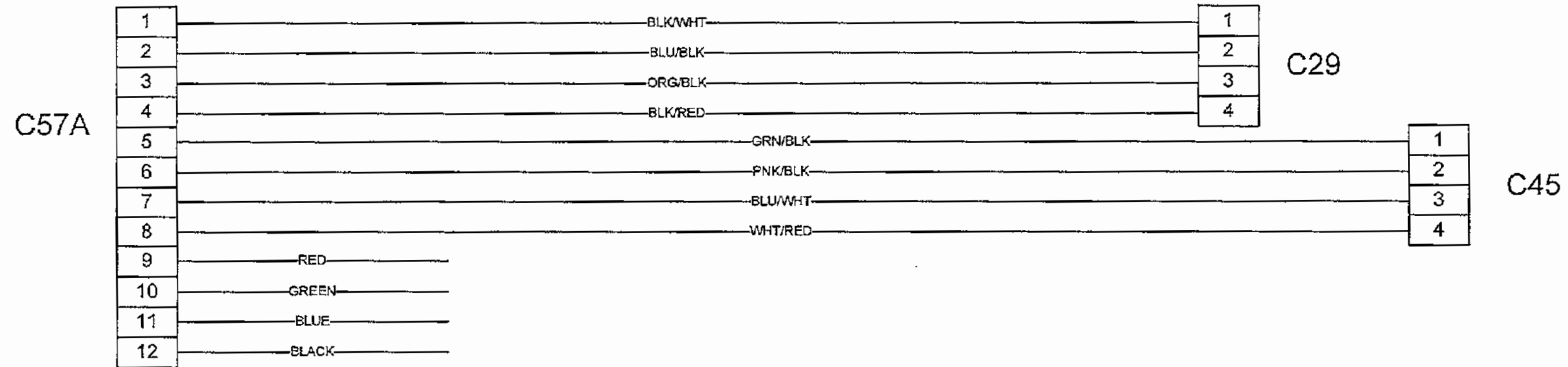
**NOTES:**  
ALL UN-TERMINATED WIRES TO BE COVERED WITH HEATSHRINK TUBING.  
WIRE IS TYPE GXL  
ALL WIRE IS 16 GA. UNLESS NOTED OTHERWISE.  
ALL WIRE IS WHITE UNLESS NOTED OTHERWISE.  
WIRES MARKED WITH CIRCUIT NUMBER AND CODE EVERY 2'.  
ALL MEASUREMENTS ARE IN INCHES.  
MEASUREMENTS ARE TO WIRE ENTRY OF EACH CONNECTOR AND WIRE LENGTH ON EACH WIRE END OR TERMINAL THAT DOES NOT ENTER A CONNECTOR.



SPLICE 53 INCLUDES CIRCUITS 39,52 & 53. CIRCUIT 39 FROM C50-PDS 1 & CIRCUIT 52 FROM C51-PDS 1.

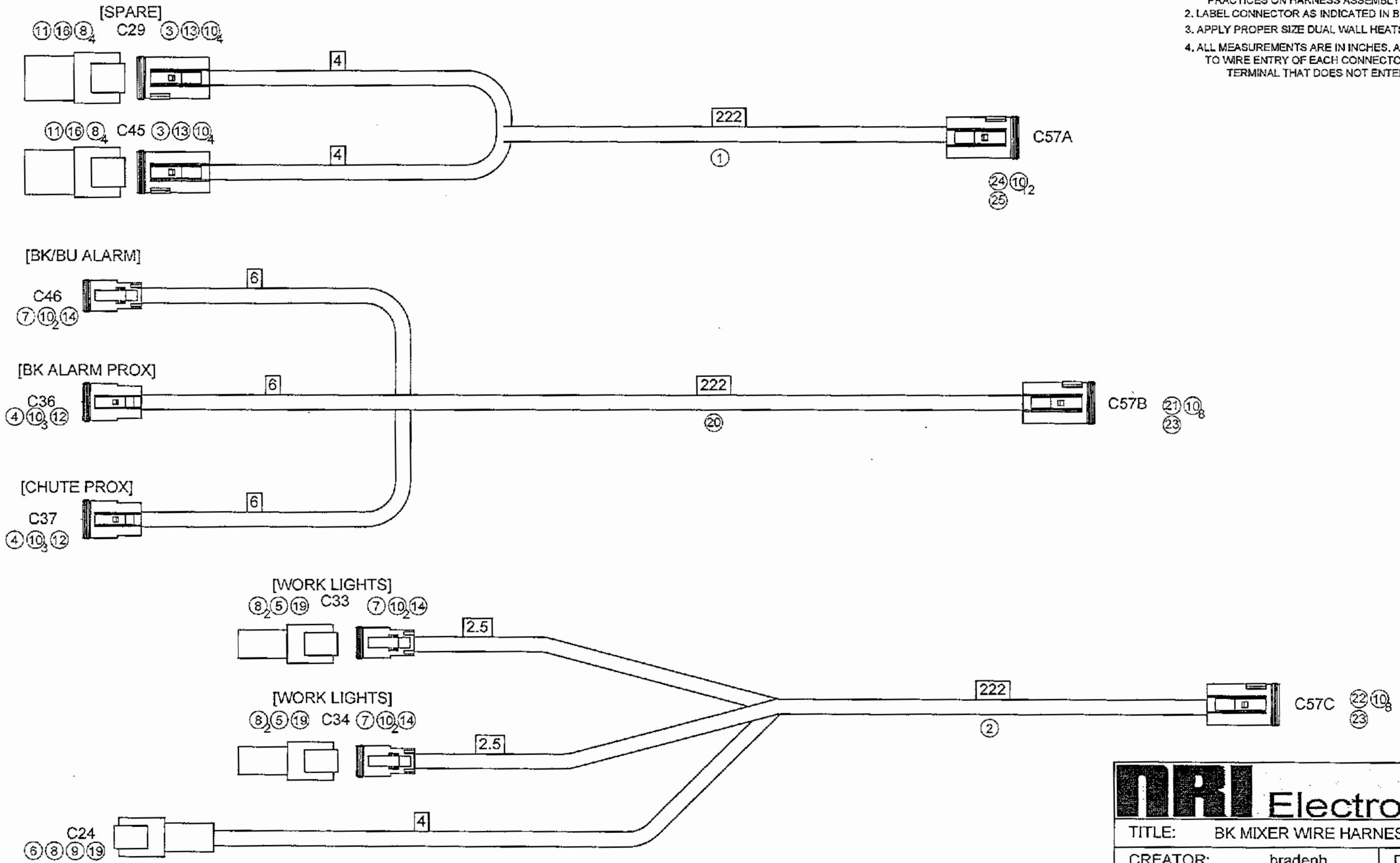
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DIMENSIONS ARE IN INCHES FRACTIONAL ± 1/32 MACH ± .02 BEND ± .5" TWO PLACE DECIMAL ± .01 THREE PLACE DECIMAL ± .001	DRAWN	B.J.H.	2/11/16
INTERPRET GEOMETRIC TOLERANCING PER:	CHECKED		
MATERIAL	ENG APPR.		
FINISH	MFG APPR.		
DO NOT SCALE DRAWING	DA		
	COMMENTS	CREATED PER PROTOTYPE 1151-10 REV B. B.J.H. 2/11/16	
	SIZE	PART NO.	REV
	A	715280	A
	SCALE: 1:1	WEIGHT:	SHEET 1 OF 2



TITLE:		
CREATOR:	bradenh	DATE: 2/22/2016
PART NUMBER:	715270	PROJECT:
CUSTOMER:	Con-Tech	ISSUE: D
FILENAME:	715270.vsd	Page 3 of 3

- NOTES: 1. REFER TO IPCA/HMA-620 STANDARD FOR RECOMMENDED PRACTICES ON HARNESS ASSEMBLY AND TESTING  
 2. LABEL CONNECTOR AS INDICATED IN BRACKETS  
 3. APPLY PROPER SIZE DUAL WALL HEATSHRINK TO CABLE ENDS  
 4. ALL MEASUREMENTS ARE IN INCHES. ALL MEASUREMENTS ARE TO WIRE ENTRY OF EACH CONNECTOR AND WIRE END OR TERMINAL THAT DOES NOT ENTER A CONNECTOR



<b>ORI Electronics Inc.</b>		
TITLE: BK MIXER WIRE HARNESS		
CREATOR: bradenh	DATE: 2/22/2016	
PART NUMBER: 715270	PROJECT:	
CUSTOMER: Con-Tech	ISSUE: E	
FILENAME: 715270.vsd	Page 1 of 3	

C2C

Pin	Signal	Color	Terminals	Target
1	WH/BK-C	WH/BLK	14001C/G	C57C 4
2	PK/BK-C	PK/BLK	14001C/G	C57C 5

DT06-2S-P012

C3C

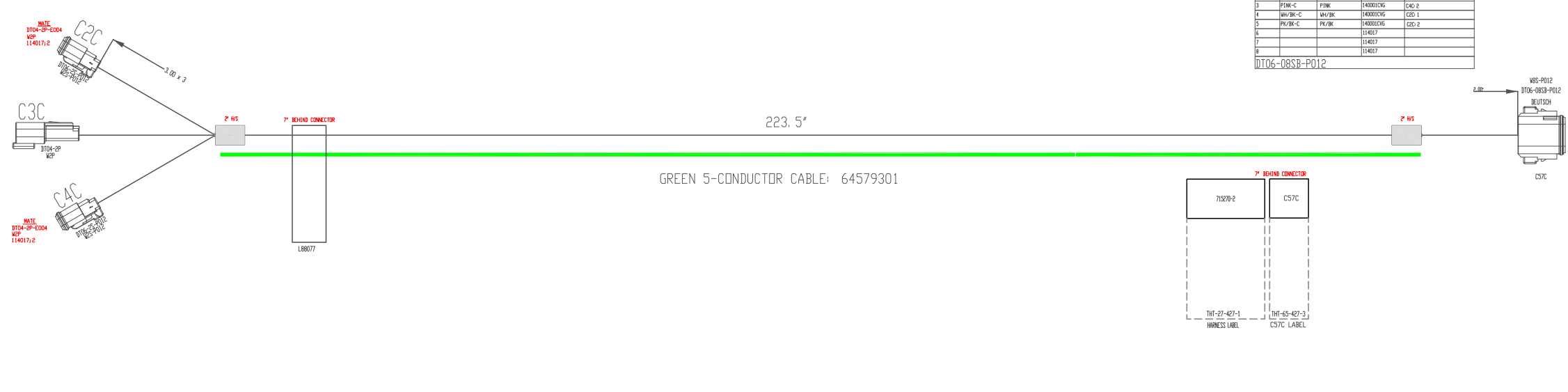
Pin	Signal	Color	Terminals	Target
1	DMG-C	DMG	14001C/G	C57C 1
2			114017	

DT04-2P

C4C

Pin	Signal	Color	Terminals	Target
1	WH-C	WH	14001C/G	C57C 2
2	PKM-C	PKM	14001C/G	C57C 3

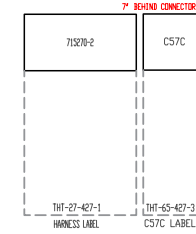
DT06-2S-P012



C57C

Pin	Signal	Color	Terminals	Target
1	DMG-C	DMG	14001C/G	C57C 1
2	WH-C	WH	14001C/G	C40 1
3	PKM-C	PKM	14001C/G	C40 2
4	WH/BK-C	WH/BK	14001C/G	C50 1
5	PK/BK-C	PK/BK	14001C/G	C50 2
6			114017	
7			114017	
8			114017	

DT06-08SB-P012



**UNLIMITED SERVICES**  
 170 Evergreen Rd. P.O. Box 170  
 Oconto WI. 54153

PART NO.	715270-3	REV.	A
DESC.	CABLE 64579301 (GREEN)		
COMPANY.	CON-TECH		
Drawn by:	CMM	Chk'd by:	-
App by:	-	Date:	5/1/18
Sheet	3	OF	3

REV.	DESCRIPTION	DATE	BY
A	UPDATED PIN ORIENTATION ON CONN. C1B. A-BROWN/WHITE B-BLACK/WHITE C-BLUE/WHITE	8/8/18	CMM



65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

www.ctmmixers.com

**C1B**

Pin	Signal	Color	Terminals	Target
A	BLK/WH	BLK/WHIT	140001CG	C57B 6
B	BLK/WH	BLK/WHIT	140001CG	C57B 7
C	BLK/WH	BLK/WHIT	140001CG	C57B 8

DT106-3S-P012

**C2B**

Pin	Signal	Color	Terminals	Target
1	PNK-B	PNK	140001CG	C57B 1
2	GRN-B	DK GRN	140001CG	C57B 2

DT106-2S-P012

**C3B**

Pin	Signal	Color	Terminals	Target
A	BRN-B	BRN	140001CG	C57B 3
B	BLU-B	BLU	140001CG	C57B 4
C	BLU-B	DK BLU	140001CG	C57B 5

DT106-3S-P012

CHUTE  
PANEL

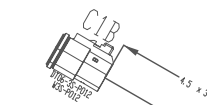
THF-45-427-3  
C1B LABEL

BL/BL  
ALARM

THF-45-427-3  
C2B LABEL

BL ALARM  
PANEL

THF-45-427-3  
C3B LABEL



P WTS

7" BEHIND CONNECTOR

L88077

225'

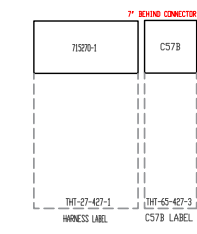
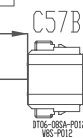
ORANGE 8-CONDUCTOR CABLE: 64579401

P WTS

**C57B**

Pin	Signal	Color	Terminals	Target
1	PNK-B	PNK	140001CG	C57B 1
2	GRN-B	DK GRN	140001CG	C57B 2
3	BRN-B	BRN	140001CG	C57B 3
4	BLU-B	BLU	140001CG	C57B 4
5	BLU-B	DK BLU	140001CG	C57B 5
6	BLK/WH-B	BLK/WHIT	140001CG	C57B 6
7	BLK/WH-B	BLK/WHIT	140001CG	C57B 7
8	BLK/WH-B	DK BLK/WHIT	140001CG	C57B 8

DT106-08SA-P012



		<b>UNLIMITED SERVICES</b> 170 Evergreen Rd. P.O. Box 170 Oconto WI. 54153	
PART NO.	715270-2	REV.	A
DESC.	CABLE 64579401 (ORANGE)		
COMPANY.	CON-TECH		
Drawn by:	CMM	Chk'd by:	-
App by:	-	Date:	5/1/18
Sheet	2 OF 3		

REV.	DESCRIPTION	DATE	BY
A	UPDATED PIN ORIENTATION ON CONN. C1B. A-BROWN/WHITE B-BLACK/WHITE C-BLUE/WHITE	8/8/18	CMM

**C2A**

Pin	Signal	Color	Terminals	Target
1	BLK/WH-A	BLK/WH	140001CG	C57A 1
2	BLU/BR-A	BLU/BLK	140001CG	C57A 2
3	GRY/BR-A	GRY/BLK	140001CG	C57A 3
4	BLK/BR-A	BLK/RED	140001CG	C57A 4

DT06-4S-P012

**C3A**

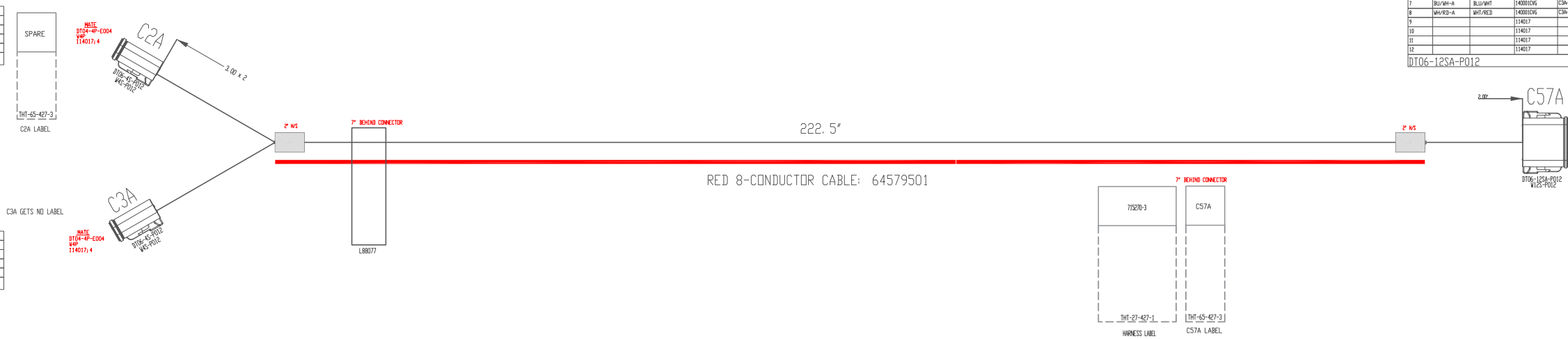
Pin	Signal	Color	Terminals	Target
1	GRN/BR-A	GRN/GR_BLU	140001CG	C57A 5
2	PNK/BR-A	PNK/BLK	140001CG	C57A 6
3	BLU/WH-A	BLU/WH	140001CG	C57A 7
4	WH/BR-A	WH/RED	140001CG	C57A 8

DT06-4S-P012

**C57A**

Pin	Signal	Color	Terminals	Target
1	BLK/WH-A	BLK/WH	140001CG	C57A 1
2	BLU/BR-A	BLU/BLK	140001CG	C57A 2
3	GRY/BR-A	GRY/BLK	140001CG	C57A 3
4	BLU/BR-A	BLU/RED	140001CG	C57A 4
5	GRN/BR-A	GRN/GR_BLU	140001CG	C57A 5
6	PNK/BR-A	PNK/BLK	140001CG	C57A 6
7	BLU/WH-A	BLU/WH	140001CG	C57A 7
8	WH/BR-A	WH/RED	140001CG	C57A 8
9			114017	
10			114017	
11			114017	
12			114017	

DT06-12SA-P012



**UNLIMITED SERVICES**  
 170 Evergreen Rd. P.O. Box 170  
 Oconto WI. 54153

PART NO.	715270-1	REV.	A
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REV.	DESCRIPTION	DATE	BY	DESC.
A	UPDATED PIN ORIENTATION ON CONN. C1B. A-BROWN/WHITE B-BLACK/WHITE C-BLUE/WHITE	8/8/18	CMM	CABLE 64579501 (RED)

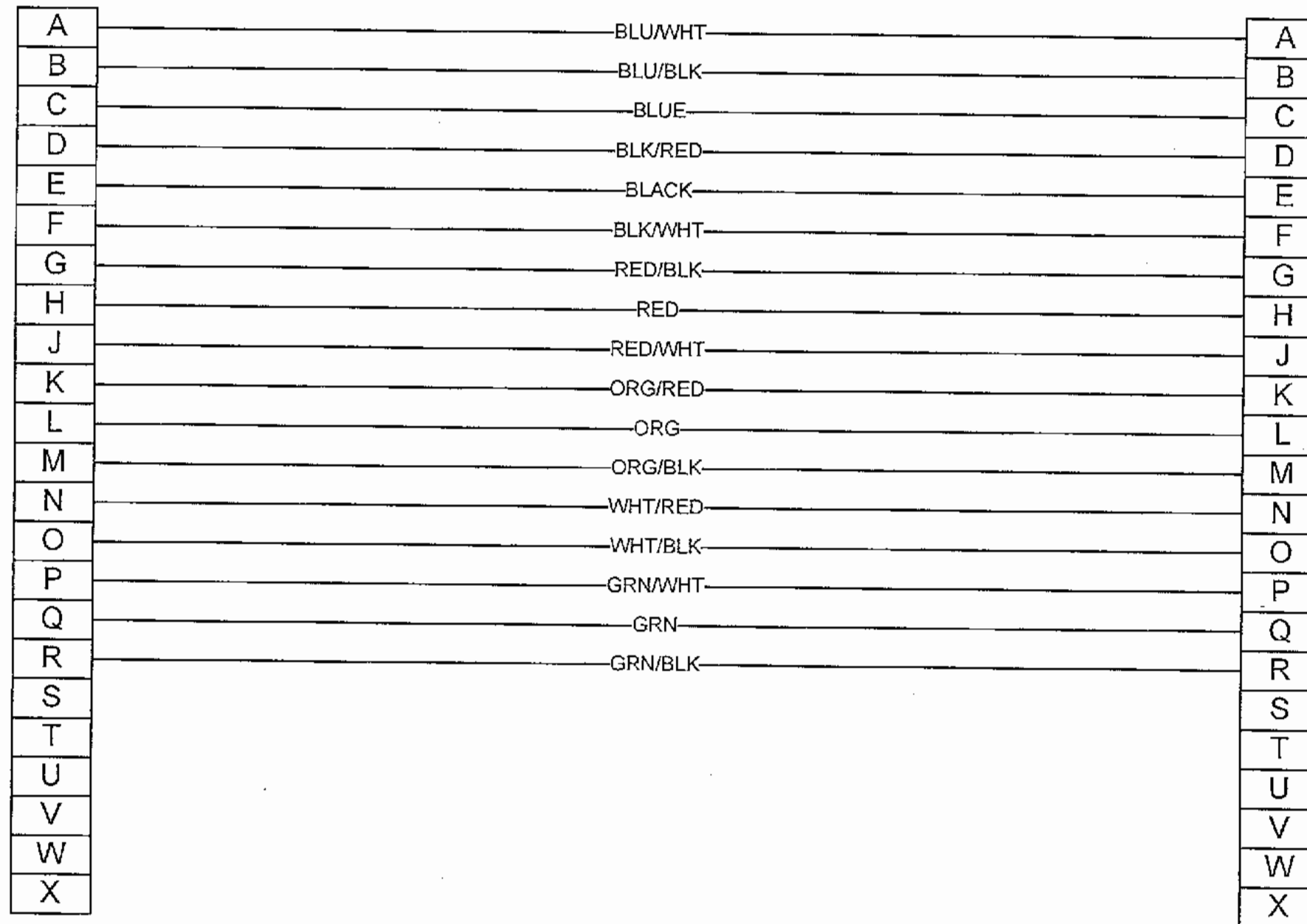
COMPANY.	CON-TECH		
Drawn by:	CMM	Chk'd by:	-
App by:	-	Date:	5/1/18
Size:	SHEET C	Sheet:	1 OF 3



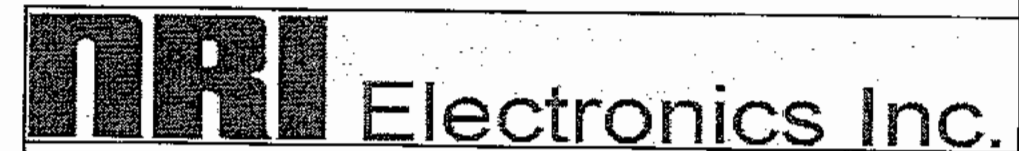
65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

[www.ctmmixers.com](http://www.ctmmixers.com)

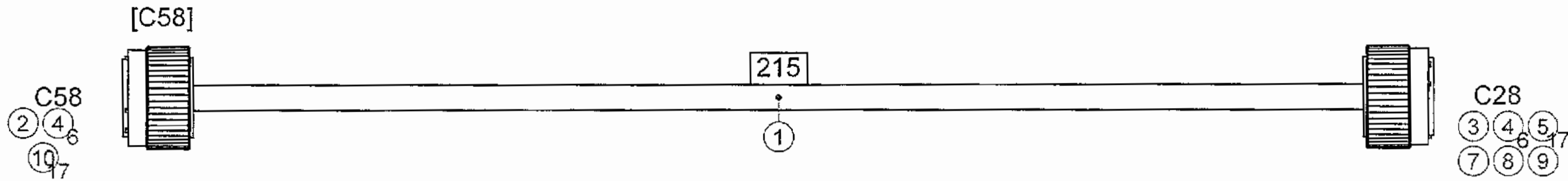
C58



C28



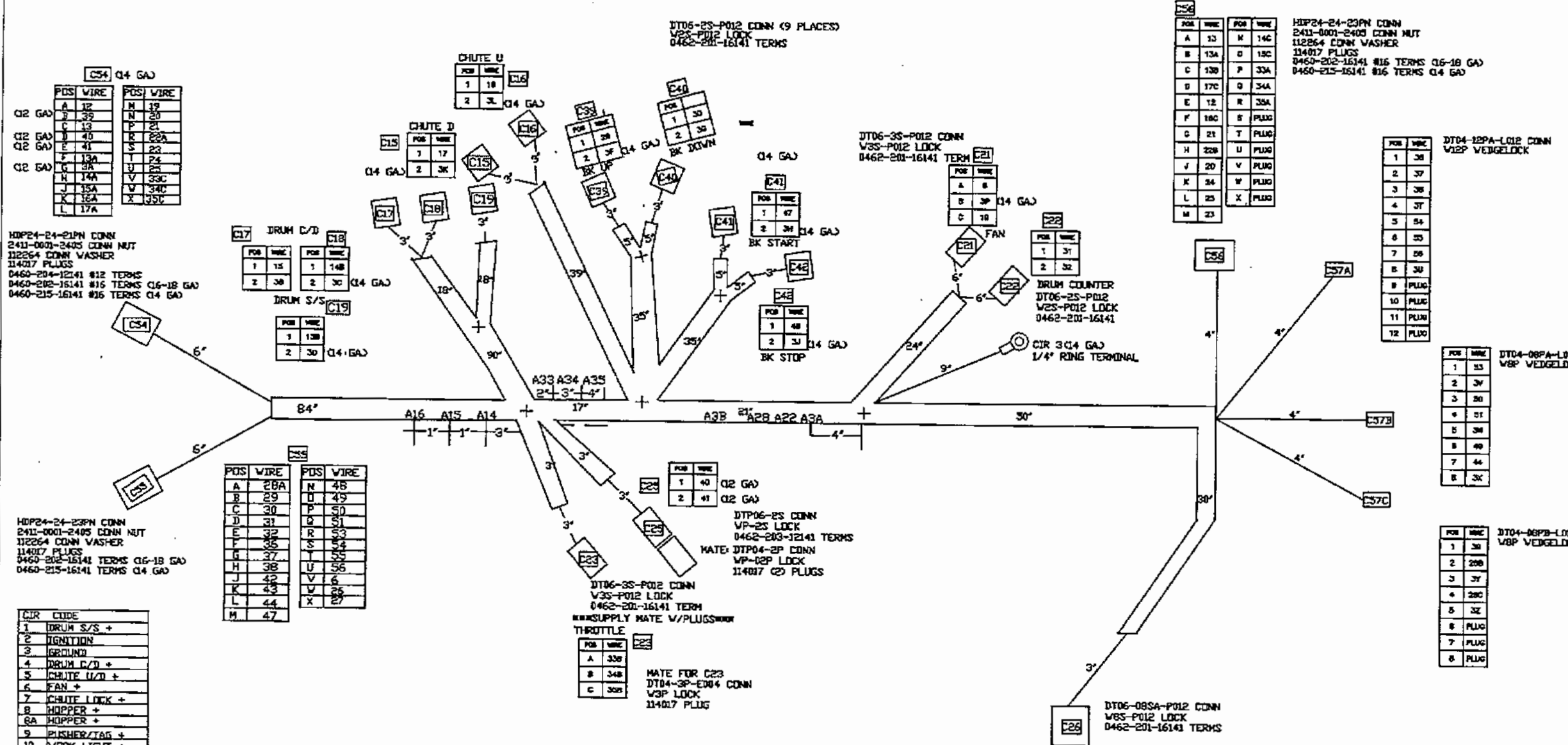
TITLE:	
CREATOR: bradenh	DATE: 1/20/2016
PART NUMBER: 715265	PROJECT:
CUSTOMER: Con-Tech	ISSUE: B
FILENAME: 715265.vsd	Page 3 of 3



- NOTES: 1. REFER TO IPC/WHMA-620 STANDARD FOR RECOMMENDED PRACTICES ON HARNESS ASSEMBLY AND TESTING  
 2. LABEL CONNECTOR AS INDICATED IN BRACKETS  
 3. APPLY PROPER SIZE HEATSHRINK TO CABLE ENDS  
 4. ALL MEASUREMENTS ARE IN INCHES, ALL MEASUREMENTS ARE TO WIRE ENTRY OF EACH CONNECTOR AND WIRE END OR TERMINAL THAT DOES NOT ENTER A CONNECTOR

<b>NRI Electronics Inc.</b>		
TITLE: BK MIXER WIRE HARNESS		
CREATOR: bradenh	DATE: 1/20/2016	
PART NUMBER: 715265	PROJECT:	
CUSTOMER: Con-Tech	ISSUE: B	
FILENAME: 715265.vsd	Page 1 of 3	





POS	WIRE	POS	WIRE
A	12	M	17
B	32	N	20
C	13	P	21
D	40	R	22A
E	41	S	22
F	13A	T	24
G	3A	U	25
H	14A	V	33C
J	15A	W	34C
K	16A	X	35C
L	17A		

HDP24-24-23PN CONN  
 2411-0001-2405 CONN NUT  
 112264 CONN WASHER  
 114017 PLUGS  
 0460-204-12141 #12 TERMS  
 0460-202-16141 #16 TERMS C16-18 GAJ  
 0460-215-16141 #16 TERMS C14 GAJ

POS	WIRE	POS	WIRE
1	15	1	14B
2	30	2	3C

HDP24-24-23PN CONN  
 2411-0001-2405 CONN NUT  
 112264 CONN WASHER  
 114017 PLUGS  
 0460-202-16141 TERMS C16-18 GAJ  
 0460-215-16141 TERMS C14 GAJ

POS	WIRE	POS	WIRE
A	28A	N	48
B	29	O	49
C	30	P	50
D	31	Q	51
E	32	R	53
F	35	S	54
G	37	T	55
H	38	U	56
J	42	V	6
K	43	W	26
L	44	X	27
M	47		

CIR CODE	
1	DRUM S/S +
2	IGNITION
3	GROUND
4	DRUM C/D +
5	CHUTE U/D +
6	FAN +
7	CHUTE LOCK +
8	HOPPER +
9A	HOPPER +
9	PUSHER/TAG +
10	WORK LIGHT +
11	DBK +
12	BEAR POINT +
13	DRUM STOP S/S
13A	DRUM S/S
13B	DRUM S/S SIGNAL
14	CHARGE
15	DISCHARGE
16	CHUTE UP
17	CHUTE DOWN
19	FAN
20	CHUTE LOCK
21	CHUTE LOCK
22	LOCK SIGNAL
23	HOPPER
24	HOPPER
25	HOPPER SIGNAL
26	PUSHER UP
27	PUSHER DOWN
28	WORK LIGHT
29	DBK UP
30	DBK DOWN
31	COUNTER A
32	COUNTER B
33	THROTTLE HIGH
34	THROTTLE POWER
35	THROTTLE LOW
36	SPARE A
37	SPARE B
38	SPARE C
39	REVERSE
40	MAIN AUX POWER
41	MAIN AUX GRND
42	HOPPER UP LIGHT
43	HOPPER DOWN

CIR CODE	
31A	DBK +
44	CHUTE PROX SV SIGNAL
45	CHUTE HAZARD
46	DBK ST/ST+
47	DBK START
48	DBK STOP
49	CHUTE PROX +
50	DBK ALARM +
51	DBK ALARM SIGNAL
52	DBK/ALARM
53	DBK/BACKUP ALARM
54	SPARE D
55	SPARE E
56	SPARE F

POS	WIRE	POS	WIRE
A	13	M	14C
B	13A	O	15C
C	13B	P	33A
D	17C	Q	34A
E	12	R	35A
F	18C	S	PLUG
G	21	T	PLUG
H	22B	U	PLUG
J	20	V	PLUG
K	54	W	PLUG
L	25	X	PLUG
M	23		

HDP24-24-23PN CONN  
 2411-0001-2405 CONN NUT  
 112264 CONN WASHER  
 114017 PLUGS  
 0460-202-16141 #16 TERMS C16-18 GAJ  
 0460-215-16141 #16 TERMS C14 GAJ

POS	WIRE
1	38
2	37
3	38
4	37
5	54
6	53
7	56
8	30
9	PLUG
10	PLUG
11	PLUG
12	PLUG

POS	WIRE
1	33
2	3V
3	30
4	51
5	3M
6	40
7	44
8	3K

POS	WIRE
1	30
2	20B
3	3Y
4	28C
5	3E
6	PLUG
7	PLUG
8	PLUG

NOTES:  
 WIRE IS TYPE GXL  
 ALL WIRE IS 16 GA UNLESS NOTED OTHERWISE  
 ALL WIRE IS WHITE UNLESS NOTED OTHERWISE  
 WIRES MARKED WITH CIRCUIT NUMBER AND CODE EVERY 2"  
 ALL MEASUREMENTS ARE IN INCHES  
 MEASUREMENTS ARE TO WIRE ENTRY OF EACH CONNECTOR AND  
 WIRE LENGTH ON EACH WIRE END OR TERMINAL THAT DOES  
 NOT ENTER A CONNECTOR.

DOUBLE LINES INDICATE BRAID COVERING  
 SINGLE LINES INDICATE EXPOSED WIRE LENGTHS

SPLICE S3 INCLUDES CIRCUITS 39, 52 & 53. CIRCUIT 39 FROM C50-POS 1  
 & CIRCUIT 52 FROM C51-POS 1

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 PERMISSION OF CON-TECH MANUFACTURING  
 INC. IN PROGRESS

UNLESS OTHERWISE SPECIFIED:	DATE	DATE
DRAWING: SEE IN INCHES	DATE	DATE
FUNCTIONAL: 1/2"	DATE	DATE
MEAS: 1/2"	DATE	DATE
FORM A-27	DATE	DATE
THIS PLACE BEING: ± IN	DATE	DATE
THREE PLACE BEING: ± IN	DATE	DATE
DA	DATE	DATE
CONVENTS REV 7 DATED FOR	DATE	DATE
WHICH REV 7/25	DATE	DATE
CONVENTS REV 7 DATED FOR	DATE	DATE
WHICH REV 7/25	DATE	DATE
TEMP CHANGED INVENT FOR 25%	DATE	DATE
ADJUSTED LENGTH FOR WARMUP 2	DATE	DATE
1/2/25	DATE	DATE
CONVENTS REV 8 CHANGED LENGTH	DATE	DATE
75" TO 50"	DATE	DATE

CON-TECH MANUFACTURING INC.	
1-507-374-2239	
TITLE: BK MIXER WIRE HARNESS	
SIZE: PART NO	REV
A 715260	D
SCALE: 1/4" = 1"	SHEET 2 OF 2

# AIR SYSTEM

MAC Valves

Coalescing Filter

Water Tank Controls

Auxiliary Air Tank

Chute Lock

Hopper Lift Cylinder

Pusher / Tag Axle

BridgeKing® Trailer Brakes



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## MAC AIR VALVE MANIFOLD SYSTEM

The MAC air valve manifold system that is responsible for auxiliary air functions such as chute lock, tip up hopper and air operated suspensions. Proper maintenance of the coalescing (water) filter is IMPERATIVE to the proper operation of the air solenoids. The filter MUST be drained daily and even more so in high humidity conditions. Any "milky" build up found in the filter must be removed to prevent damage to the valves. You should also report this to your maintenance department as this may be a symptom of a faulty air compressor.

In the event that the truck is to be stored for a long period of time (or being brought back into service after sitting for some time), it is recommended that the supply line to the manifold (after the filter) be removed and a table spoon of ATF or Polar-Lube® Blue air system treatment poured into the air line. Re-install air line and cycle all valves (manually).

**If you replace the fittings, make sure only DOT approved air fittings are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN  
PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR  
VEHICLES.**

**CHUTE LOCK MAC VALVE ASSEMBLY #760075**

**CHUTE LOCK / HOPPER MAC VALVE ASSEMBLY #760085**

**CHUTE LOCK / HOPPER / AXLE MAC VALVE ASSEMBLY #760080**

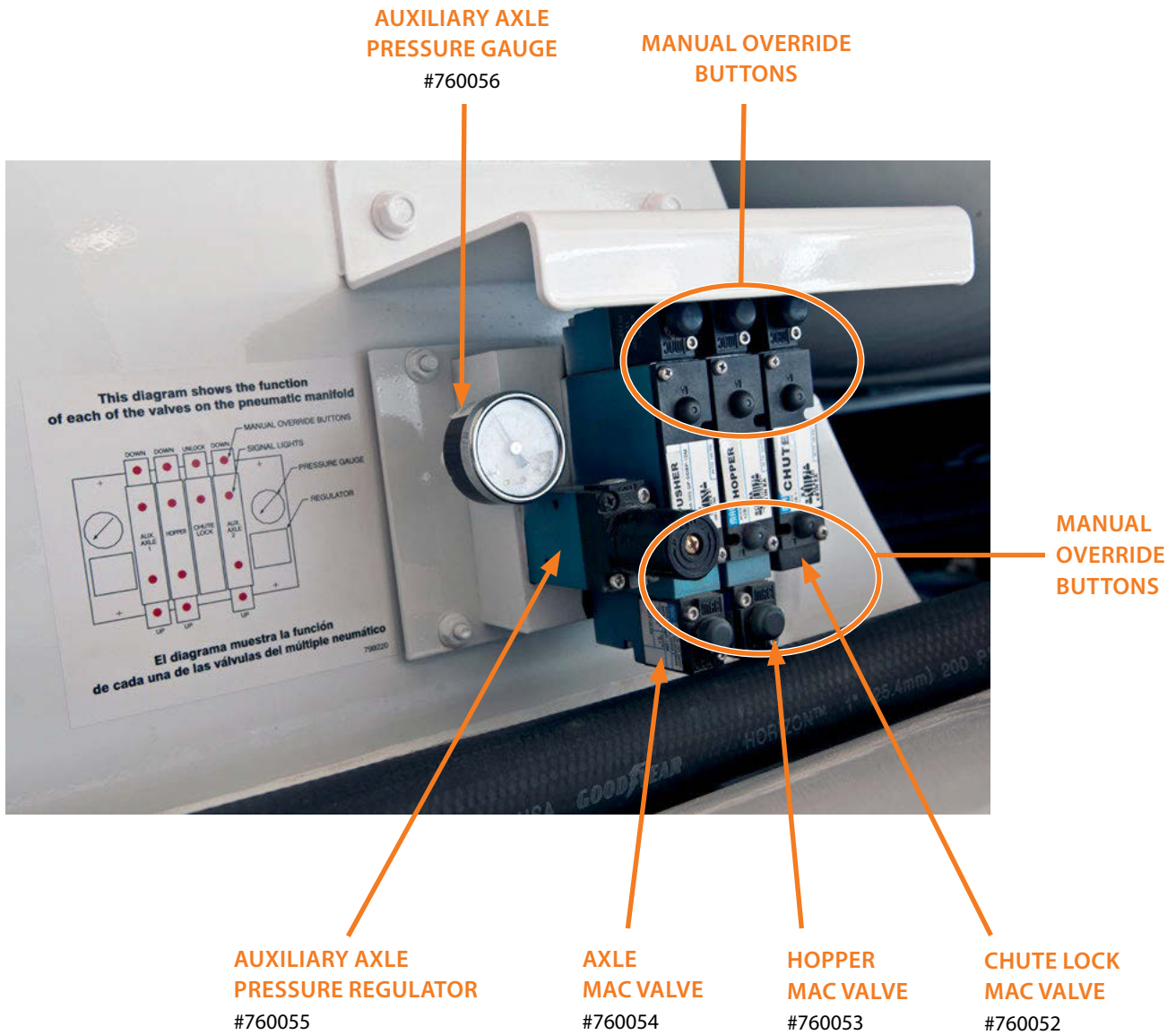
(Shown on next Page)



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# MAC AIR VALVE MANIFOLD SYSTEM



**AUXILIARY AXLE  
PRESSURE GAUGE**  
#760056

**MANUAL OVERRIDE  
BUTTONS**

**MANUAL  
OVERRIDE  
BUTTONS**

**AUXILIARY AXLE  
PRESSURE REGULATOR**  
#760055

**AXLE  
MAC VALVE**  
#760054

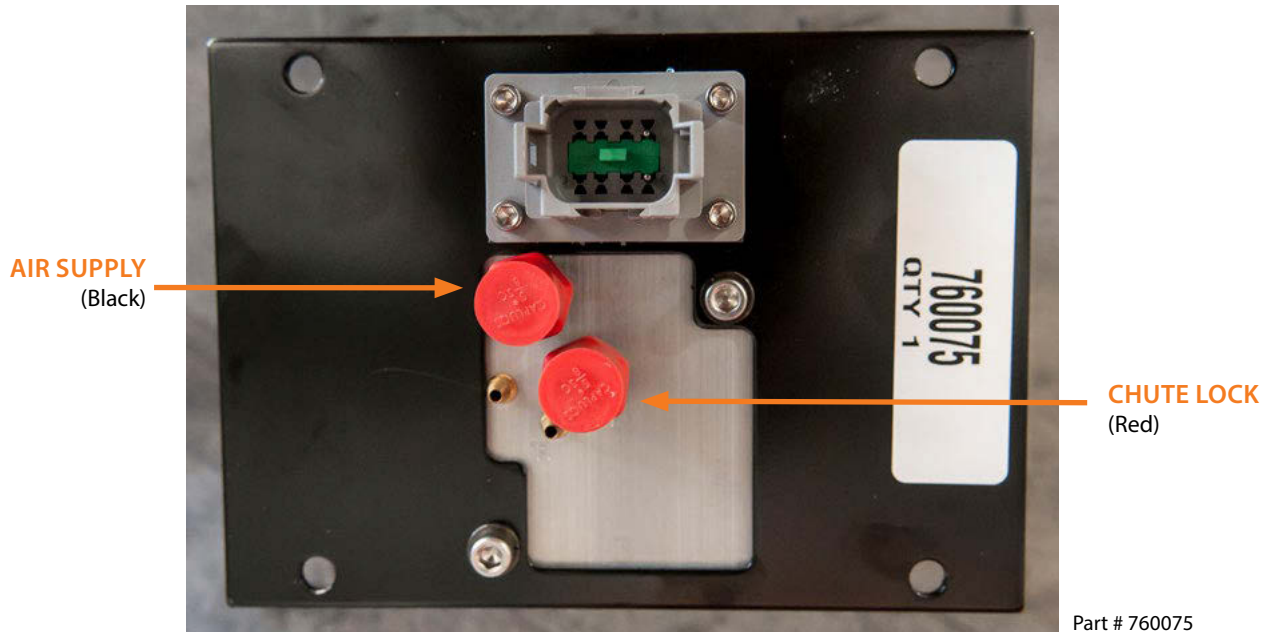
**HOPPER  
MAC VALVE**  
#760053

**CHUTE LOCK  
MAC VALVE**  
#760052

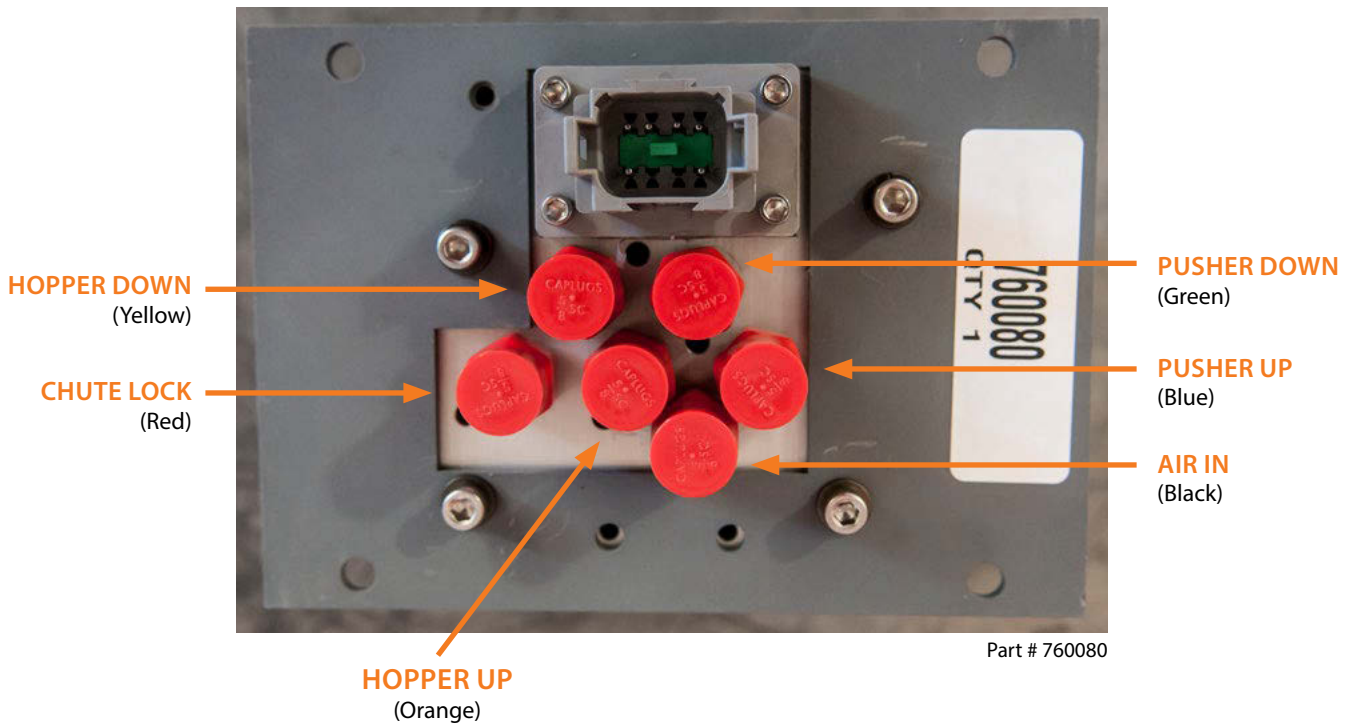


# MAC AIR VALVE MANIFOLD SYSTEM

## MANIFOLD - CHUTE LOCK



## MANIFOLD - CHUTE LOCK, HOPPER, PUSHER

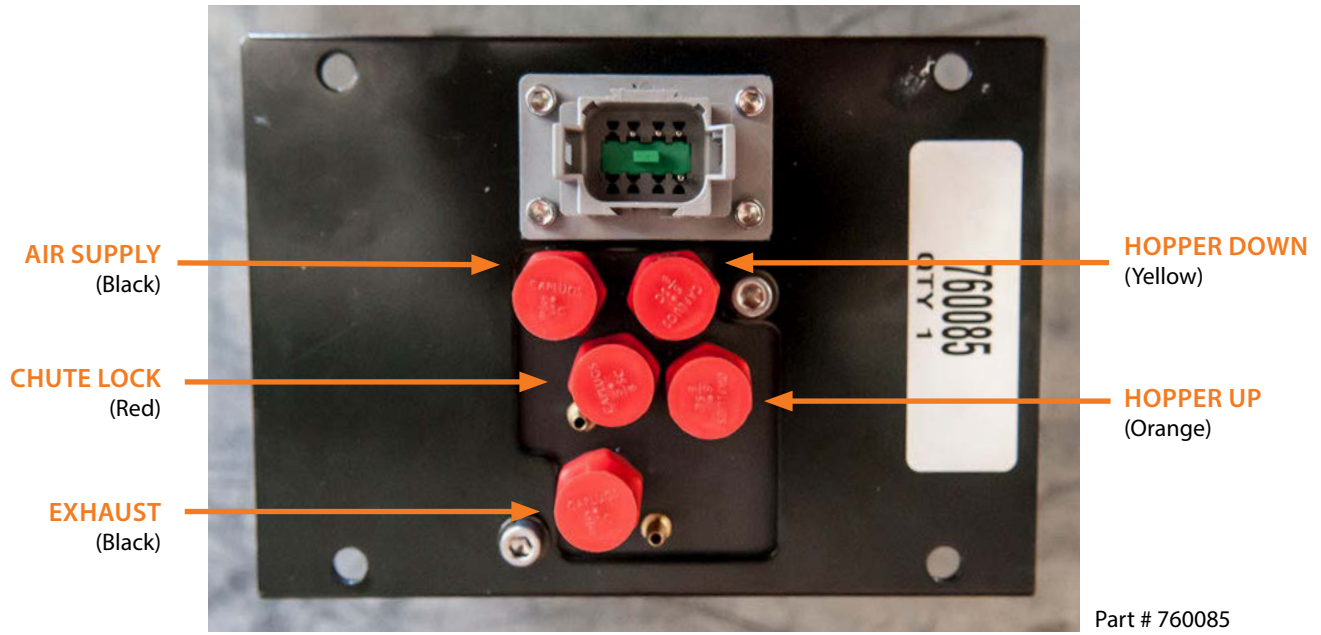


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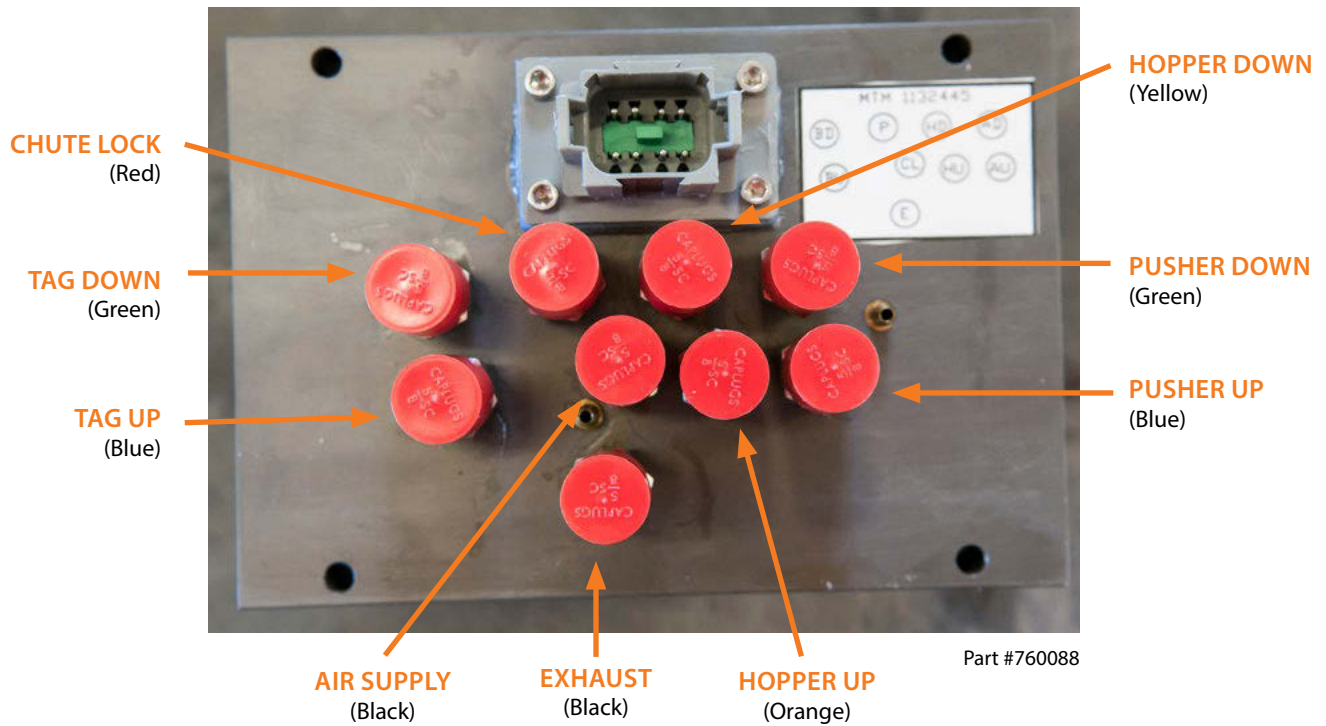
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# MAC AIR VALVE MANIFOLD SYSTEM

## MANIFOLD - CHUTE LOCK, HOPPER



## MANIFOLD - CHUTE LOCK, HOPPER, PUSHER, TAG AXLE

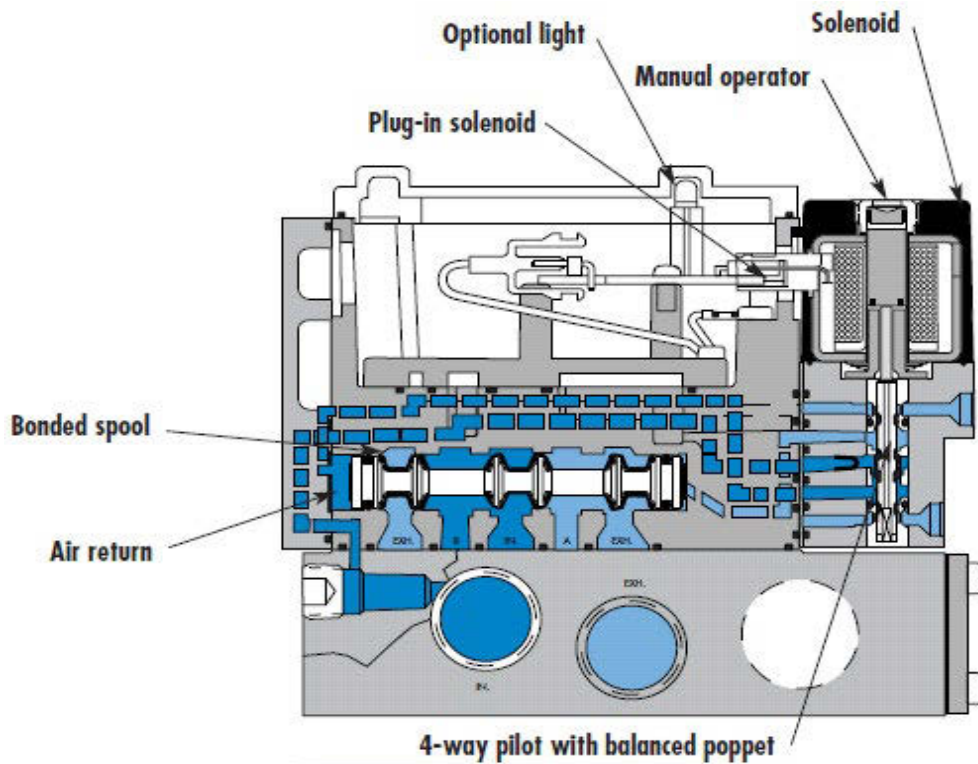


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# MAC VALVE MIXER VALVES

## MIXER VALVES



### SERIES FEATURES

- Patented MACSOLENOID® for fastest possible response times and virtually burn-out proof AC solenoid operation.
- Optional low watt DC solenoids.
- Optional memory spring.
- Plug-in design of valves and bases for ease of maintenance.
- 2 position or 3 position valve configurations.

Pressure range: 20 to 120 psi  
Filtration: 40 micron  
Temp Range: -20°F to 120°F  
Volts: 12vdc, 7.3 watts



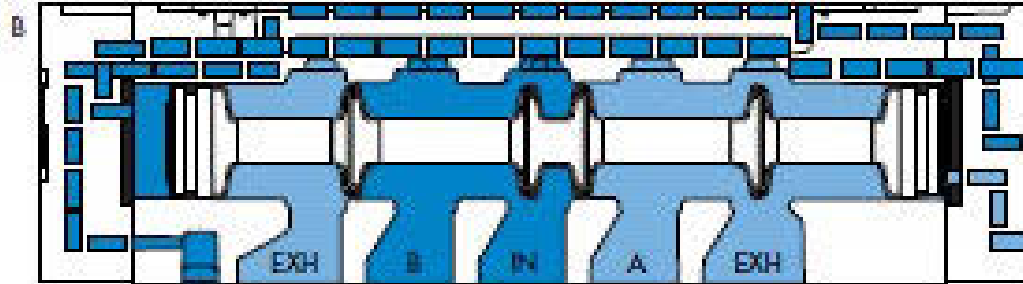
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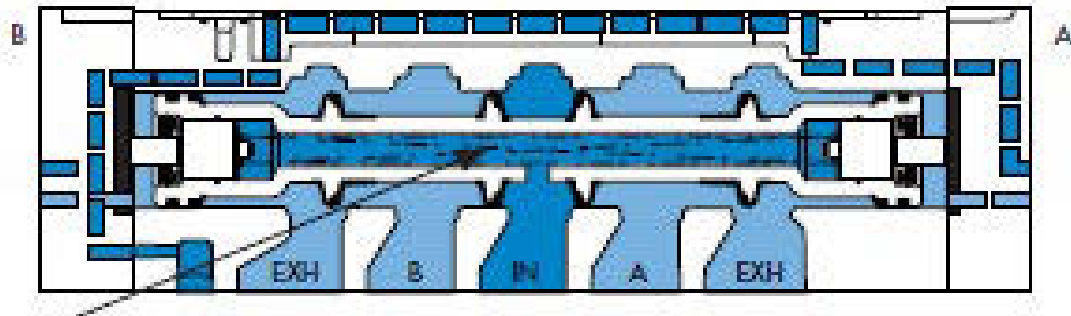
# MAC VALVE-CHUTE, HOPPER, AXLE VALVES

## SPOOL CONFIGURATIONS

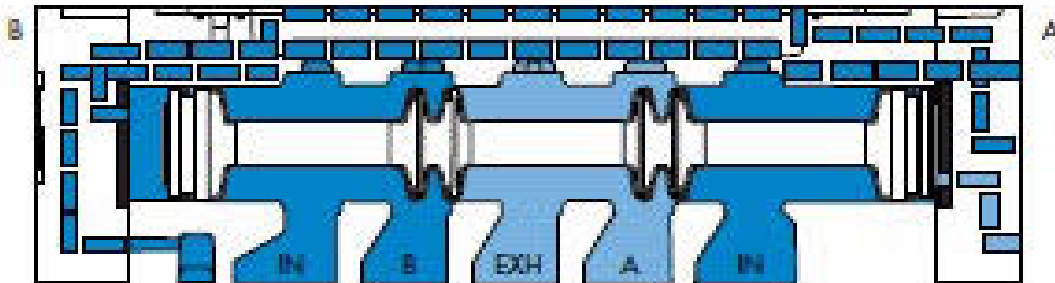
### CHUTE LOCK



### HOPPER



### LIFT AXLE



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## COALESCING FILTER SYSTEM

The coalescing filter should be inspected daily.

When replacing the coalescing filter unit, always make sure it is installed in the correct direction for proper air flow.

**If you replace the fittings, make sure only DOT approved air fittings are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

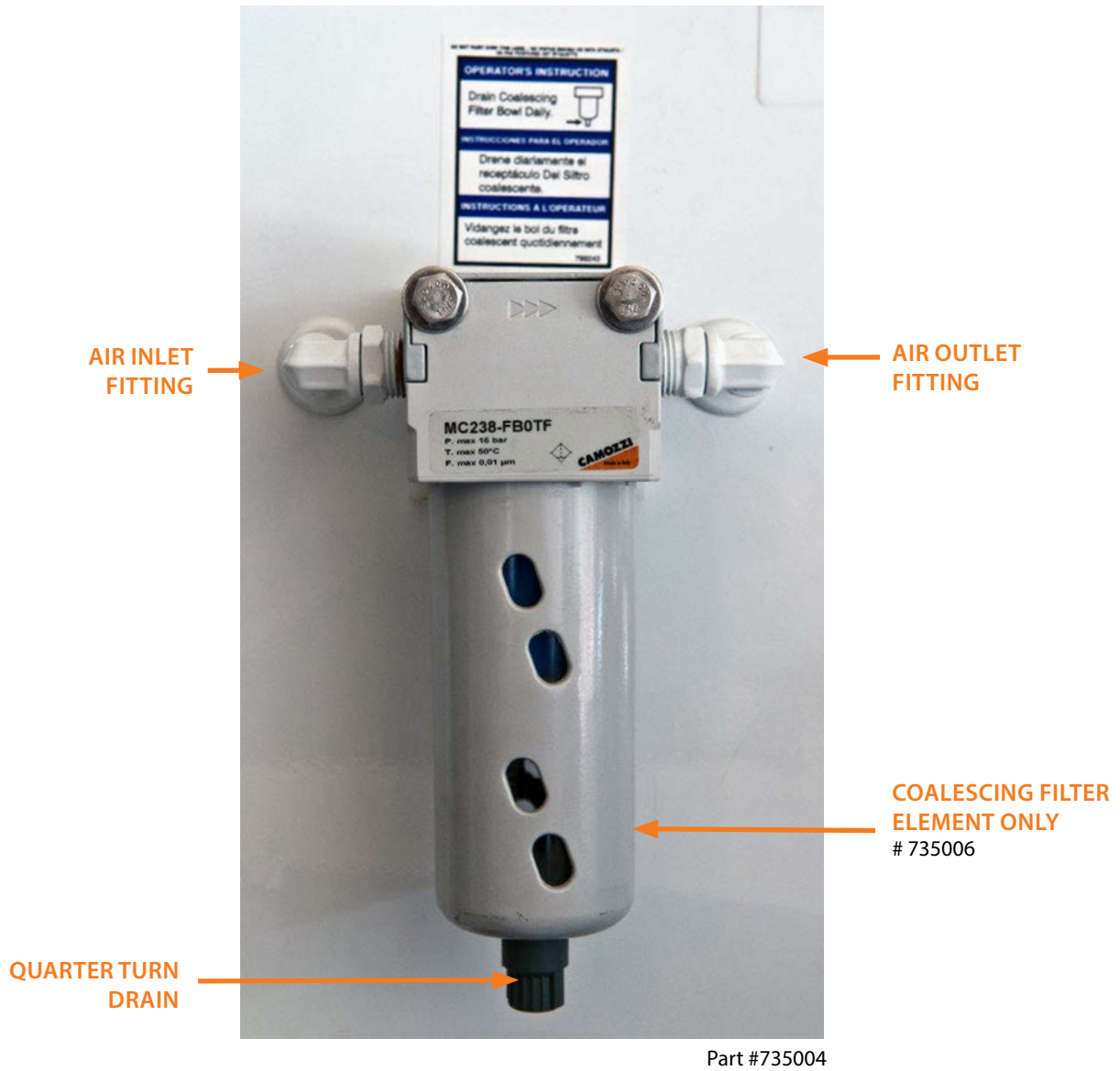
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR  
MAINTENANCE ON YOUR VEHICLES.**



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## COALESCING FILTER SYSTEM



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## WATER TANK SYSTEM CONTROLS

The water tank is connected to the truck air system by a pressure hold back valve on the truck air tank, or auxiliary air tank. This valve is set at 75 PSI and should not be altered. It is recommended that the vehicle operator check the air brake pressure gauge in the truck cab to assure safe vehicle operation.

Water tanks include three safety controls preset at the factory. To fill water tank, the air line must be shut off and tank brought to zero pressure by releasing the air through the two way or ball valve. A decal is provided showing proper direction.

The following safety controls should **NEVER** be altered. **PERSONAL INJURY OR DEATH MAY RESULT FROM MODIFYING THE PRESET AIR TANK PRESSURE VALVES.**

- 1** Hold-back valve on truck air tank-set at 75 PSI
- 2** Pressure relief valve on water tank-set at 60 PSI
- 3** Water tank air supply pressure set at 56 PSI with a fixed regulator.  
(Do not attempt to adjust)

**If you replace the fittings or airline, make sure only DOT approved air components are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**

**WARNING!** Never install a greater than 60 PSI regulator on the water tank system.

**WARNING!** Never over pressurize the water tank system.

**WARNING!** Never pressurize an empty water tank.

**WARNING!** Inspect water tank daily for damage or corrosion.

**WARNING!** DO NOT weld or repair a damaged tank.

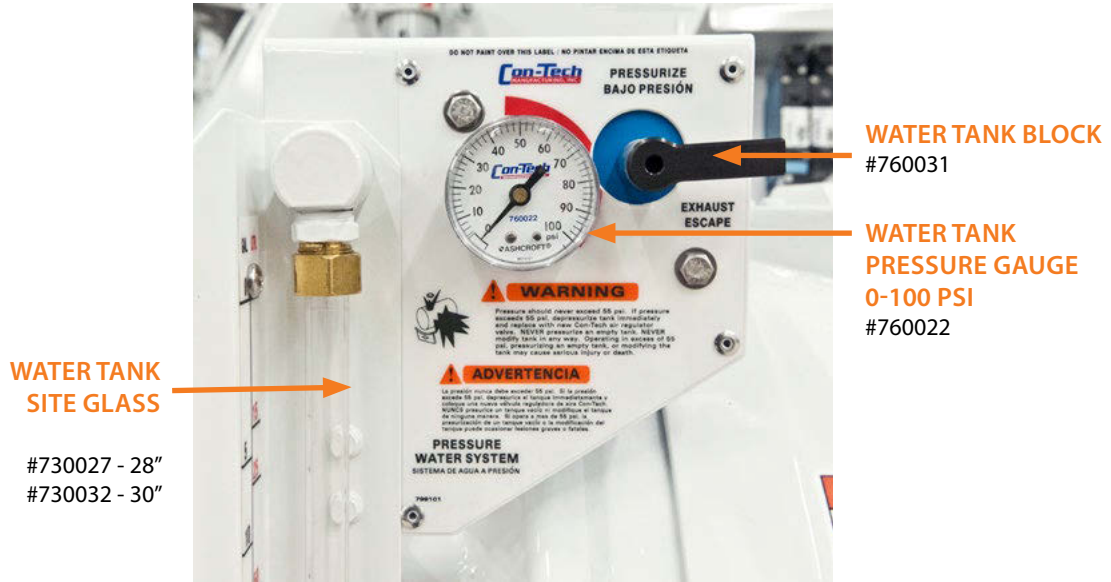


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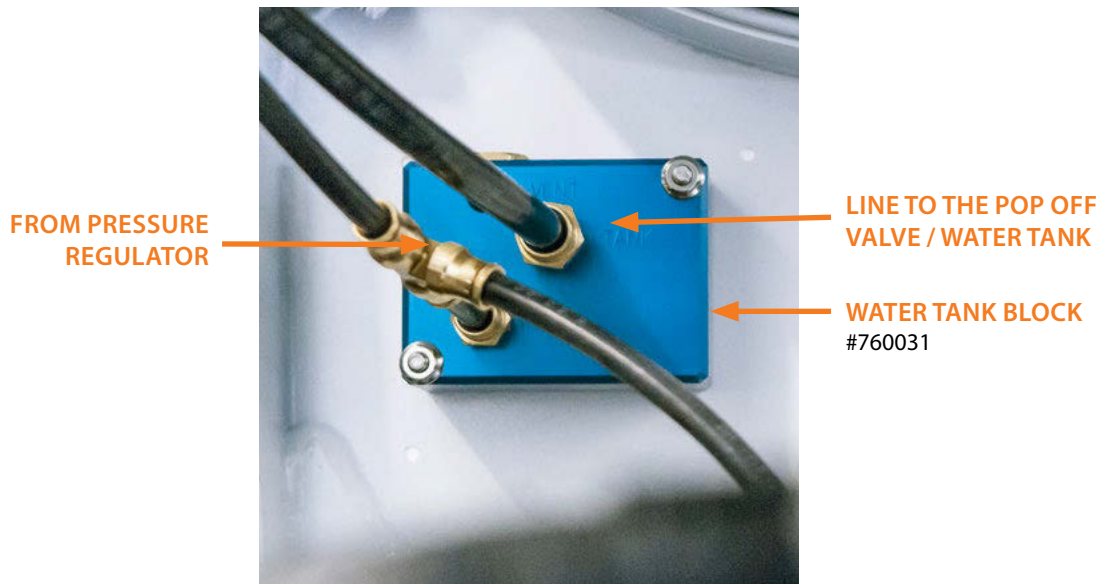
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# WATER TANK SYSTEM CONTROLS

## FRONT



## BACK



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## AUXILIARY AIR TANK CONTROLS

The auxiliary air tank is fitted with a 75 psi holdback valve, and a 0-60 psi pressure regulator for the water tank system. **NEVER OVER PRESSURIZE THE WATER TANK SYSTEM.** This air system can be drained using the drain valve with cable.

If you replace the fittings, make sure only DOT approved air fittings are installed.

**POP-OFF  
RELIEF VALVE**  
# 760030



### **WARNING!**

NEVER remove or tamper with pop-off valve.  
Only use Con-Tech replacement pop-off valve (60 psi).

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES  
WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE  
ON YOUR VEHICLES.**

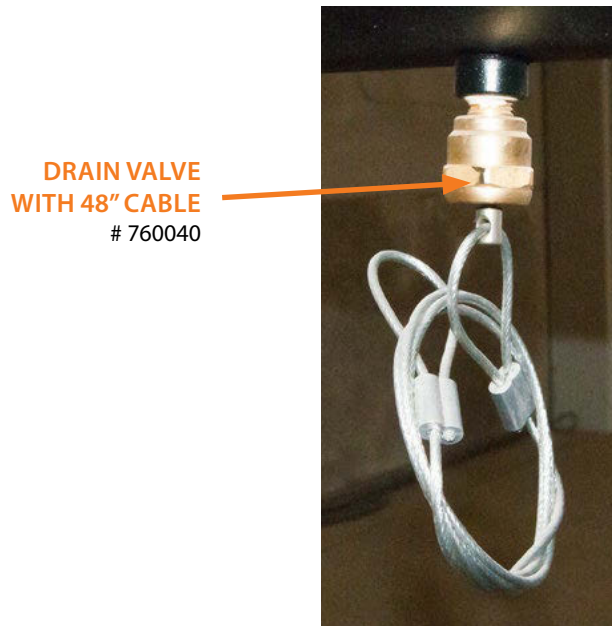
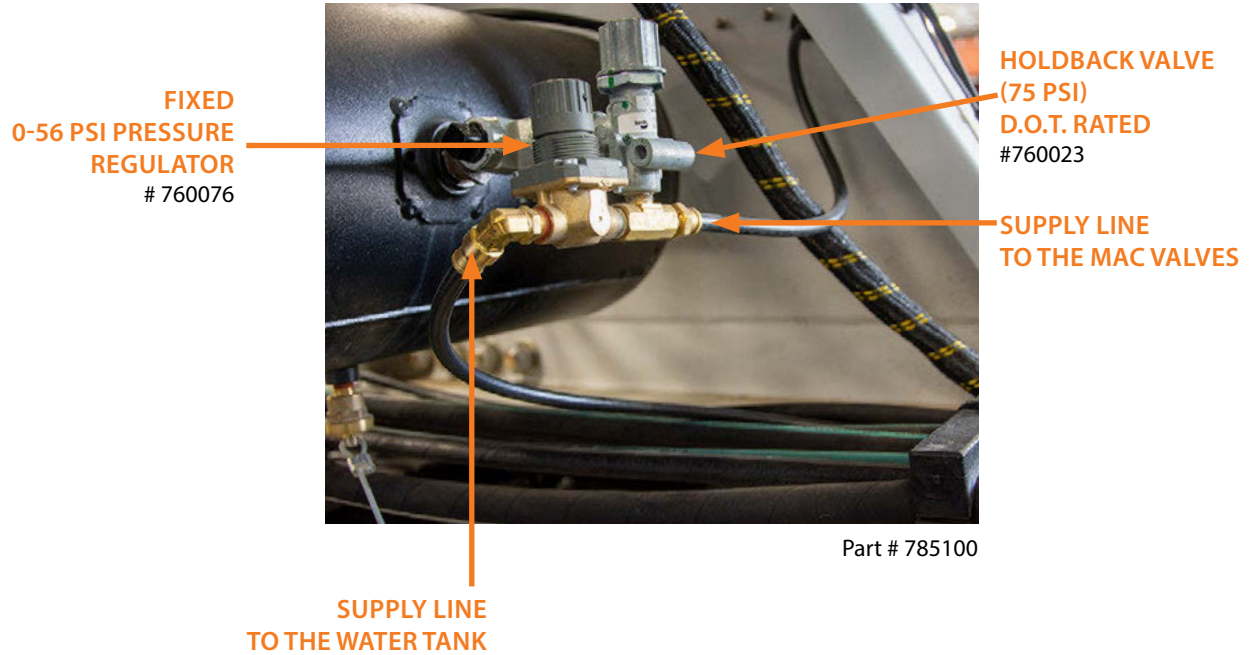


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## AUXILIARY AIR TANK CONTROLS

**NEVER INSTALL A GREATER THAN 60 PSI REGULATOR  
ON YOUR WATER TANK SYSTEM**



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## CHUTE LOCK

The air chute lock brake can be a spring return air actuator. When activated it will lock the main chute into position. When the released, the quick dump valve will speed up the release of the air, releasing the lock faster.

**If you replace the fittings, make sure only DOT approved air fittings are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

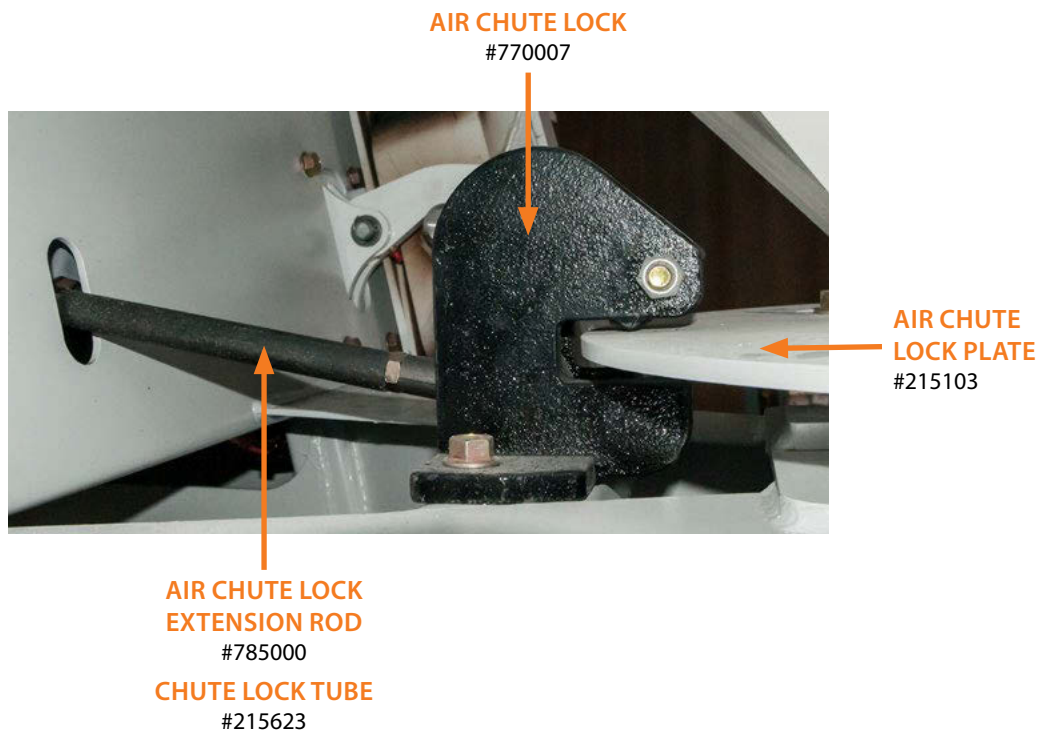
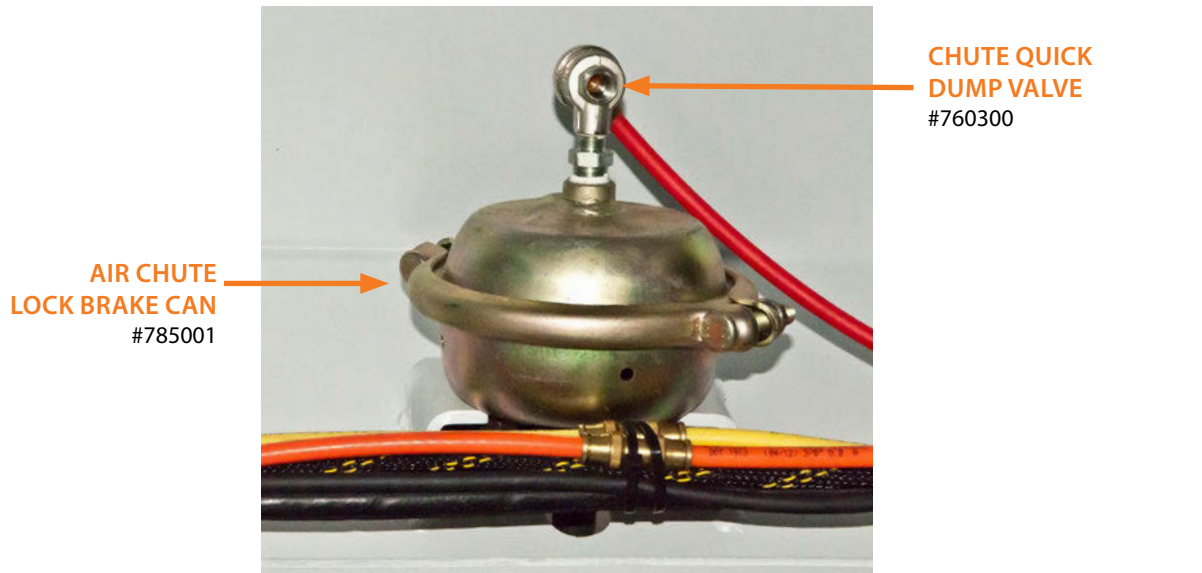
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK  
OR MAINTENANCE ON YOUR VEHICLES.**



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## CHUTE LOCK



65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

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## HOPPER LIFT CYLINDER

The hopper lift cylinder down airline is pressurized when the air tank is at 75 psi and over. Yellow airline is down, and the orange airline is up. NOTE: The fittings on the cylinder are not standard fittings. They have an orifice in them to ensure smooth operation. If a fitting needs replacement, contact the Con-Tech parts and a service department.

**If you replace the fittings, make sure only DOT approved air fittings are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES  
WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE  
ON YOUR VEHICLES.**



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## HOPPER LIFT CYLINDER

HOPPER DOWN  
(Yellow)



HOPPER AIR CYLINDER  
# 750002

HOPPER UP  
(Orange)



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## PUSHER / TAG AXLE QUICK RELEASE VALVES

(Con-Tech Installed Suspensions)

The operation of your pusher and or tag axle is done through the pusher up/down valve. When the pusher or tag axle switch is activated on the in cab control box, the MAC valve will allow air to the up bags, raising the axle "Up". When the switch is activated "down", the Mac valve will release air from the up bags, and supply air to the down bags lowering the suspension.

The quick dump valves on the front pedestal are for the pusher axle. If you have a tag axle, those valves will be located in the rear pedestal.

If you replace the fittings, make sure only DOT approved air fittings are installed.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK  
OR MAINTENANCE ON YOUR VEHICLES.**

**NOTE:** For factory mounted auxiliary suspensions,  
refer to the factory service manual.

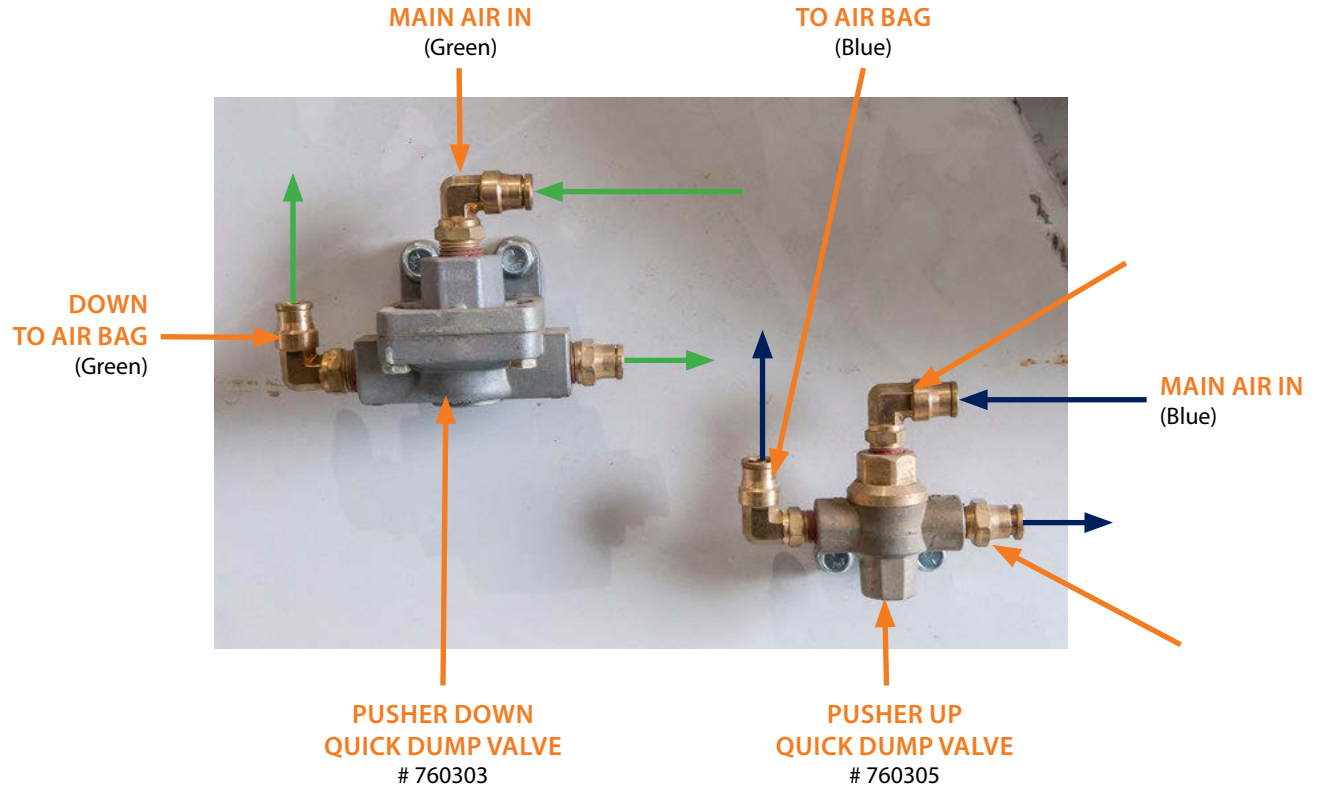


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# PUSHER / TAG AXLE QUICK RELEASE VALVES

(Con-Tech Installed Suspensions)



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## BRIDGEKING® TRAILER BRAKES

The brakes on the BridgeKing® trailer are controlled by the brake relay valve. It is located in the rear pedestal and applies the service brakes as well as the park brake. (On BridgeKing® axle)

**If you replace the fittings, make sure only DOT approved air fittings are installed.**

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

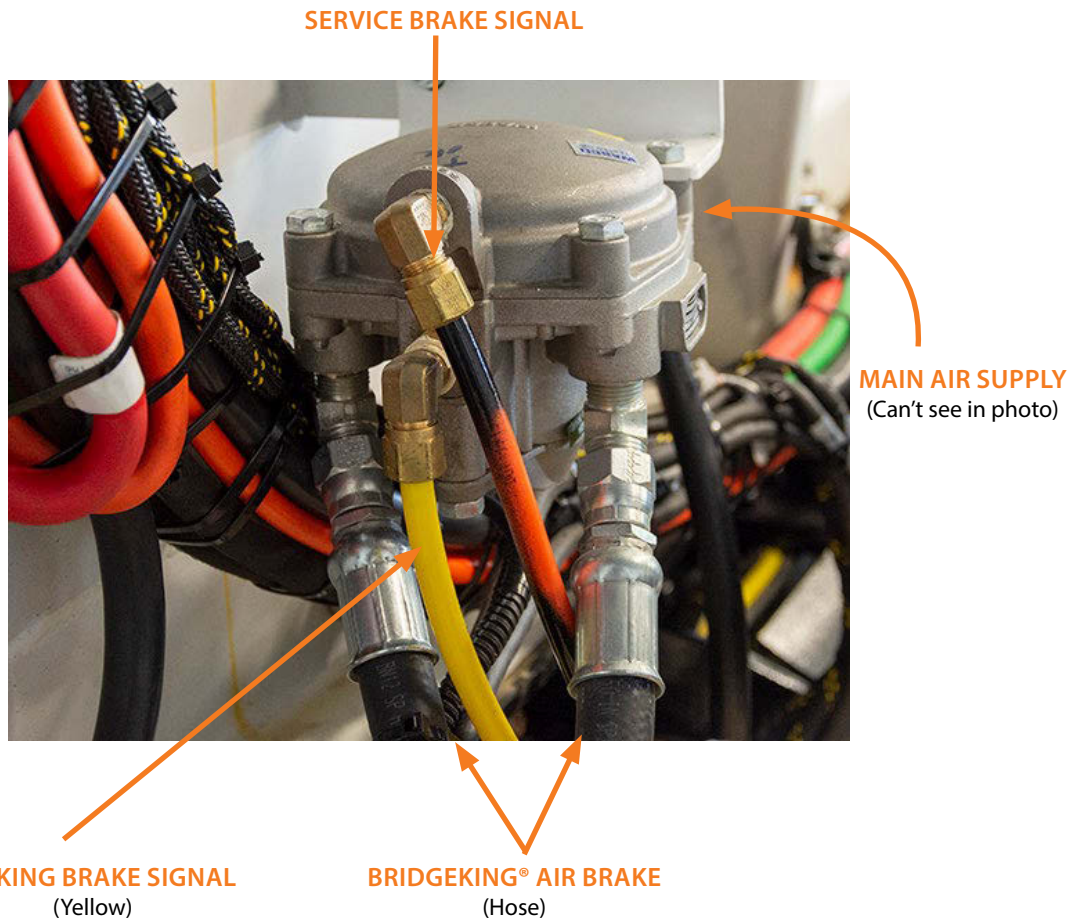
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF  
WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# BRIDGEKING® TRAILER BRAKES



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## Check & Quick Exhaust Valves Series VNR, VSC and VSO - NPTF/INCH

Check valves VNR  
Quick exhaust valves VSC, VSO  
Ports M5 [10-32 UNF], 1/8", 1/4",  
3/8", 1/2", NPTF  
cartridge  $\varnothing$ 4 mm [5/32" O.D.]



Construction	Poppet type
Mounting	In-line
Materials	Nickel-plated brass body, Brass body, Buna-N seals, Polyurethane seals, Stainless steel spring
Port sizes	M5 [10-32 UNF], 1/8", 1/4", 3/8", 1/2" NPTF; 5/32" O.D. cartridge
Installation	In-line
Operating temperature	32°F - 175°F, [dry air necessary down to -4° F]
Fluid	Filtered air
Lubricant	Oil compatible with Buna-N, [3° - 10° E]

### PNEUMATIC DATA

Operating pressure	0.3 - 10 bar, [5 - 145 psi]
Nominal pressure	6 bar [87 psi]
Nominal flow	*Qn Series VNR: 1/8" = 600 NL/min. [21.18 SCFM] 1/4" = 1400 NL/min. [49.44 SCFM] Series VSC: P → A, 1/8" = 600 NL/min. [21.19 SCFM] 1/4" = 1100 NL/min. [38.84 SCFM] 3/8" = 3300 NL/min. [116.53 SCFM] 1/2" = 3300 NL/min. [116.53 SCFM] A R, 1/8" = 950 NL/min. [33.55 SCFM] 1/4" = 1900 NL/min. [67.09 SCFM] 3/8" = 5100 NL/min. [180.08 SCFM] 1/2" = 5100 NL/min. [180.08 SCFM] Series VSO: P → A, 5/32" O.D. = 30 NL/min. [1.06 SCFM] A → R, 5/32" O.D. = 80 NL/min. [2.82 SCFM]
Lubricant	A → R, 5/32" O.D. = 80 NL/min. [2.82 SCFM]

\*Qn flowrate [SCFM] determined with a supply pressure of 6 bar, [87 psi], and with a pressure drop of 1 bar, [14.5 psi].

\*\* Soft-seal repair kits are available for Series VSC Quick-exhaust valves.

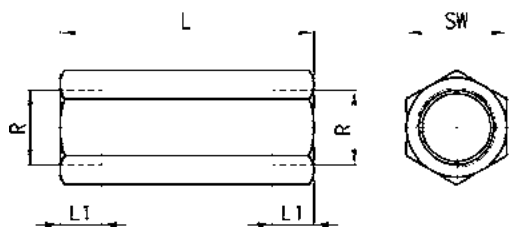
\*\*\*Dimensions are in millimeters.

Check Valves

The check valves in the VNR Series are available with M5 (10-32 UNF), 1/8" and 1/4" ports. They must be used when it is required to intercept a flow in one direction only. The design of these valves is of the poppet type and this feature allows operation at low pressures both when there is a free flow and during retention.

Materials used:

- OT58 (brass) body, Nickel Plated (1/4")
- Buna-N seals
- stainless steel spring



**VNR-205-M5**

Qn\*\* = 150 NL/min Minimum operating pressure = 1 bar (14.5 psi)

**VNR-210-02**

Qn\* = 600 NL/min Minimum operating pressure = 0.3 bar (4.3 psi)

**VNR-843-07TF**

Qn\* = 1400 NL/min Minimum operating pressure = 0.2 bar (2.9 psi)

\* Qn = determined with 6 bar and Dp = 1 bar

\*\* Qn = determined with 6 bar and Dp = 2 bar

DIMENSIONS

Mod.	R	L	L1	SW
<b>VNR-205-M5</b>	10-32 UNF	25	6	8
<b>VNR-210-02</b>	1/8"	34	7	13
<b>VNR-843-07TF</b>	1/4"	48	9	17

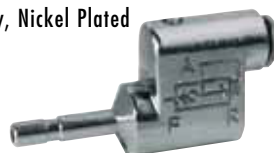


Quick exhaust valves Series VSO

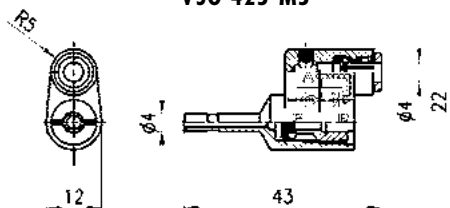
Quick exhaust valves are commonly used to increase the speed of cylinders or for rapid depressurisation of tanks containing compressed air. The models **VSO 425-M5** and **VSO 426-04** are specially designed for mounting on solenoid valves and valves incorporating a 5/32" O.D. port. We recommend that a silencer be mounted on the outlet (2931-M5).

Materials used:

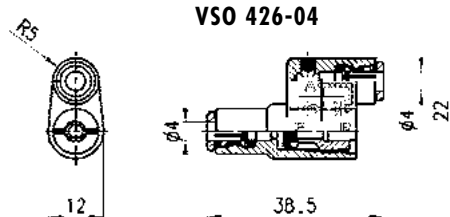
- OT58 (brass) body, Nickel Plated
- Buna-N seals



VSO 425-M5



VSO 426-04



Nominal flowrate

from P → A Qn\* 50 NL/min. [1.76 SCFM]

from A → R Qn\* 100 NL/min. [3.53 SCFM]

Qn\* = determined with 6 bar [87 psi] and DP = 1 bar (14.5 psi)

Minimum operating pressure = 1 bar (14.5 psi)

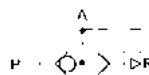
Cv Rating

from P → A: Cv = 0.04

from A → R: Cv = 0.09

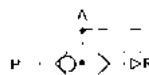
Mod.

**VSO 425-M5**



Mod.

**VSO 426-04**





## Quick exhaust valves Series VSC

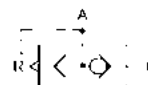
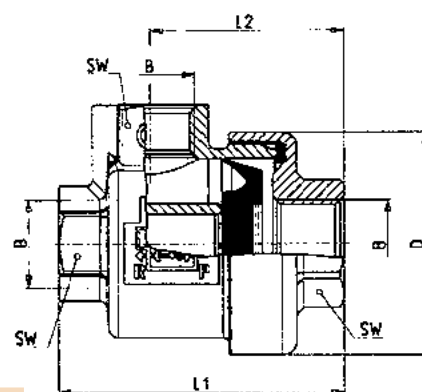
Quick exhaust valves are commonly used to increase the speed of cylinders or for rapid depressurisation of tanks containing compressed air. We recommend that a silencer be mounted on the outlet.

Materials used:

- OT58 (brass) body, Nickel Plated
- Desmopan seal (polyurethane)

<b>VSC 588-02</b>	$Q_n = P \rightarrow A$ 650 NL/min	$Q_n = A \rightarrow R$ 1000 NL/min
	Minimum operating pressure = 0,5 bar	
<b>VSC 544-04</b>	$Q_n = P \rightarrow A$ 1100 NL/min	$Q_n = A \rightarrow R$ 1900 NL/min
	Minimum operating pressure = 0,3 bar	
<b>VSC 538-06</b>	$Q_n = P \rightarrow A$ 4500 NL/min	$Q_n = A \rightarrow R$ 6300 NL/min
	Minimum operating pressure = 0,2 bar	
<b>VSC 522-08</b>	$Q_n = P \rightarrow A$ 4500 NL/min	$Q_n = A \rightarrow R$ 6300 NL/min
	Minimum operating pressure = 0,2 bar	

\*  $Q_n$  = determinated with 6 bar and  $D_p = 1$  bar



DIMENSIONS (in inches)						Flow ( $Q_n$ )			
Mod.	B NPTF	D	L1	L2	SW	P→A		A→R	
						SCFM	Cv	SCFM	Cv
<b>VSC 588-02</b>	1/8"	1.102	1.437	.984	.551	22.9	0.68	35.3	1.05
<b>VSC 544-04</b>	1/4"	1.299	1.653	1.122	.669	38.8	1.16	67.1	2.00
<b>VSC 538-06</b>	3/8"	1.692	2.263	1.555	.944	158.9	4.73	222.5	6.62
<b>VSC 522-08</b>	1/2"	1.692	2.302	1.555	.944	158.9	4.73	222.5	6.62

# Coalescing Filters Series MC

Port 1/4", 3/8" & 1/2" NPTF

Modular with metal bowl guard and bayonet-type mounting

The Series MC coalescing filters are available with 1/4", 3/8", 1/2" NPTF port.

The bowls of these filters are made of Nylon-Grilamid with an aluminum bowl guard and have a condensate drain valve in five (5) different options.



MODULAR FRL SERIES MC

## TECHNICAL SPECIFICATIONS

Construction	modular, coalescing elements		
materials	Body - Aluminum alloy, Bowl - Grilamid TR 55 (Nylon compound), Seals - Buna-N, internals in brass		
Port	NPTF:	1/4"	3/8" 1/2"
Max. condensate capacity	oz	.95	2.64 2.64
Weight	lbs	.75	1.52 1.52
Mounting	vertical in line or wall-mounting		
Operating temperature	-5° C - 50° C, (23° F - 122° F), with Dew Point of air at least 2° C (4° F) below the min working temperature		
porosity of filtering element	0,01µm, standard (other options available on request)		
Draining of condensate	manual - semi-automatic standard, (other options available in code Key)		
finish	enameled		

## PNEUMATIC DATA

Operating pressure	0.3 - 16 bar, (with depressurizing drain P Max. of 10 bar) : 4.35 - 232 psi, (P Max 145 psi w/ depressurizing drain) - "Spitter-Type" 1.5 - 15 bar for Full Automatic float drain, (22 - 220 psi), 3/8" & 1/2" models only
Nominal flow	see graph

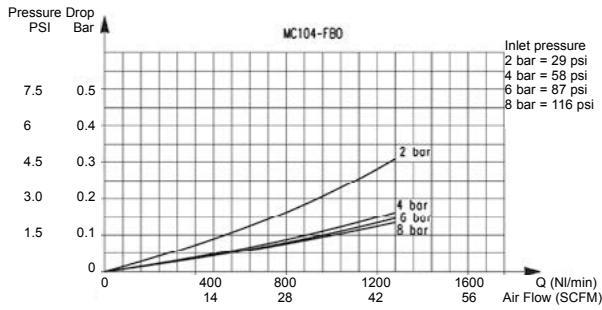
**CODING EXAMPLE**

MC	1	04	-	F	B	0	TF
----	---	----	---	---	---	---	----

<b>MC</b>	SERIES
<b>1</b>	SIZE 1 = 1/4" 2 = 3/8" or 1/2"
<b>04</b>	PORTS: 04 = 1/4" NPTF 38 = 3/8" NPTF 02 = 1/2" NPTF
<b>F</b>	FILTER
<b>B</b>	FILTERING ELEMENT B = 0,01 µm coalescing
<b>0</b>	DRAINING OF CONDENSATE 0 = normal - semiautomatic 3 = Fully automatic, Float-Drain, 3/8" & 1/2" 4 = depressurization, "Spitter-Type", 1/4" ONLY 5 = depressurization, protected, "Spitter-Type" w/ filter 8 = port 1/8" female, free-flow
<b>TF</b>	PORT TF = NPTF Blank = BSPP thread ports

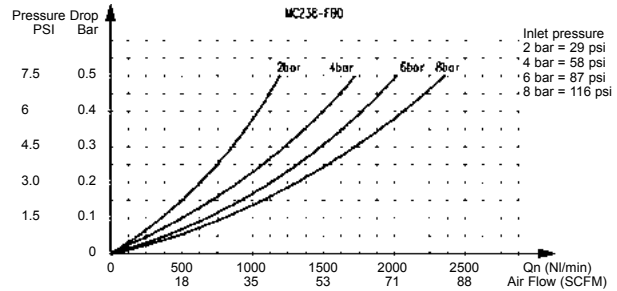
**FLOW DIAGRAMS**

**MC104-FB0TF - 1/4" Models**



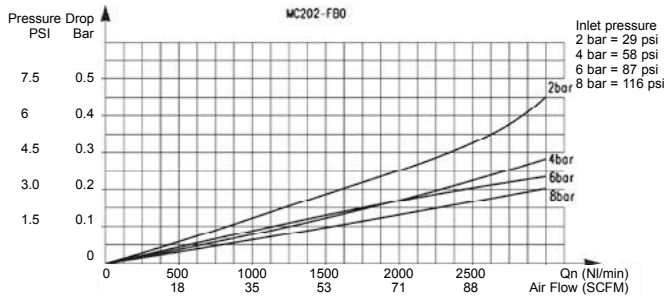
Pa = Inlet pressure  
ΔP = Pressure Drop  
Qn = Flow

**MC238-FB0TF - 3/8" Models**



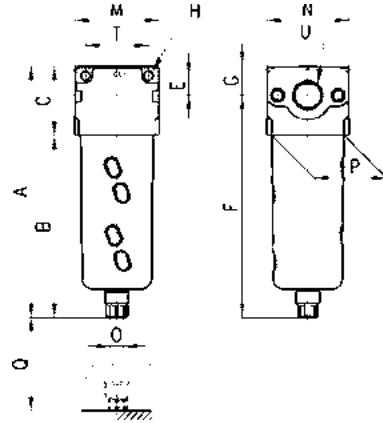
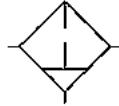
Pa = Inlet pressure  
ΔP = Pressure Drop  
Qn = Flow

**MC202-FB0TF - 1/2" Models**



Pa = Inlet pressure  
ΔP = Pressure Drop  
Qn = Flow

Coalescing filters Series MC



DIMENSIONS (in inches)

Mod.	A	B	C	E	F	G	H	M	N	DRAIN PORT NPTF		PORTS U (NPTF)		
										O	P	Q	T	U
MC104-FB0TF	5.630	4.016	1.614	.433	4.980	.650	.157	1.772	1.772	1/8	1.457	2.126	1.378	1/4"
MC238-FB0TF	7.244	5.236	2.008	.551	6.417	.827	2.441	2.441	2.362	1/8	2.087	2.874	1.811	3/8"
MC202-FB0TF	7.244	5.236	2.008	.551	6.417	.827	2.441	2.441	2.362	1/8	2.087	2.874	1.811	1/2"

MODULAR FRL SERIES MC



## PRECAUTIONS AND WARNINGS CONCERNING THE APPLICATION, INSTALLATION AND SERVICE OF MAC VALVES AND OTHER MAC VALVES PRODUCTS

The warnings and precautions below are important to be read and understood before designing into a system any MAC Valves products, and before installing or servicing any MAC Valves product. Improper use, installation or servicing of any MAC Valves product in some systems could create a hazard to personnel or equipment. No distinction in importance should be made between the terms warnings and precautions.

### WARNING :

Under no circumstances are MAC Valves products to be used in any application or in any manner where failure of the MAC Valves product to operate as intended could in any way jeopardize the safety of the operator or any other person or property.

- Do not operate outside of pressure range listed on a valve label or outside of the designated temperature range.
- Air supply must be clean and dry. Moisture or contamination can affect proper operation of the valve.
- Before attempting to repair, adjust or clean a MAC Valves product, consult catalog, parts & operation sheet, or factory for proper maintenance procedures, lubrication and cleaning agents. Never attempt to repair or perform other maintenance with air pressure to the valve.
- If air line lubrication is used do not use any lubrication other than those recommended in the catalog, parts & operation sheet or by the factory.

### APPLICATION PRECAUTIONS :

#### INDUSTRIAL USE -

- MAC Valve products are intended for general use in industrial pneumatic and/or vacuum systems. They are general purpose industrial products with literally thousands of different applications in industrial systems. These products are not inherently dangerous, but they are only a component of an overall system. The system in which they are used must provide adequate safeguards to prevent injury or damage in the event failure occurs, whether it be failure of switches, regulators, cylinders, valves or any other component.

#### POWER PRESSES -

MAC Valve products are not designed nor intended to be used to operate and/or control the operation of clutch and/or brake systems on power presses. There are special products on the market for such use.

#### 2-POSITION VALVES -

Some MAC valves are 2-position, 4-way valves. When air is supplied to the inlet port(s) of these valves, there will always be a flow path from the inlet to one of the outlets regardless of which of the two positions the valve is situated. Therefore, if pressurized air retained in the system would present a hazard in the application or servicing of the valve or system, a separate method in the system must be provided to remove the trapped air.

#### 3- POSITION VALVES-

Some MAC valves are 3-position, 4-way valves. These valves are either double solenoid or double remote air operated.

If either of the two operators is in control, air supplied to the inlet port(s) will pass through the valve to one of the outlets as on 2-position, 4-way valves. However, if neither operator is in control, the valve moves to a center position. Listed below are the various center position functions :

##### A. CLOSED CENTER-

With this type valve, when in the center position all ports are blocked (inlets and exhausts) meaning the air at both outlet ports is trapped. If trapping the air in both outlet ports would present a hazard in the application or servicing, a separate method in the system must be provided to remove the trapped air or this type valve should not be used.

##### B. OPEN CENTER-

With this type valve, when in the center position, the inlet port(s) is blocked and the two outlet ports are open to the exhaust port(s) of the valve. If having no air in either outlet port would present a hazard in the application or servicing, this type valve should not be used.

##### C. PRESSURE CENTER-

With this type valve, when in the center position, the inlet port(s) is connected to both outlet ports of the valve. If having pressurized air to either or both outlet ports would present a hazard in the application or servicing of the valve or system, a separate method in the system must be provided to remove the retained air or this type valve should not be used.

#### OPERATING SPECIFICATIONS -

MAC Valves products are to be installed only on applications that meet all operating specifications described in the MAC catalog for the MAC Valves product.

#### MANUAL OPERATORS-

Most MAC valves can be ordered with manual operators. Manual operators when depressed, are designed to shift the valve to the same position as would the corresponding solenoid or remote air pilot operator if it were activated. Care must be taken to order a type, if any, that will be safe for the physical location of the manual operator in the system. If intentional or accidental operation of a valve by a manual operator could cause personal injury or property damage, a manual operator should not be used.

#### REMOTE AIR OPERATED VALVES

Pilot valves supplying signal pressure to remote air operated valves should be 3-way valves with adequate supply and exhaust capacity to provide positive pressurizing and exhausting of the pilot supply line. Pilot lines should be open to exhaust when valves are deenergized.

#### INSTALLATION PRECAUTIONS :

- A. Do not install any MAC Valves product without first turning off air (bleed system completely) and electricity to the machine.
- B. MAC Valves products should only be installed by qualified, knowledgeable personnel who understand how the specific valve is to be pneumatically piped and electrically connected (where applicable). Flow paths through the valve are shown in the catalog and on the valve by use of ANSI or ISO type standard graphic symbols. Do not install unless these symbols and the valve functions and operations are thoroughly understood.
- C. If air line lubrication is used do not use any lubrication other than those recommended in the catalog, parts & operation sheet or by the factory.

#### SERVICE PRECAUTIONS :

- A. Do not service or remove from service any MAC Valves product without first shutting off both the air and electricity to the valve and making certain no pressurized air which could present a hazard is retained in the system.
- B. MAC Valves products should only be serviced or removed from service by qualified, knowledgeable personnel who understand how the specific product is used and/or how the specific valve is piped and used and whether there is air retained in the connecting lines to the valve or electric power still connected to the valve.
- C. Before attempting to repair, adjust or clean a MAC Valves product, consult catalog, parts & operation sheet, or factory for proper maintenance procedures, lubrication and cleaning agents. Never attempt to repair or perform other maintenance with air pressure to the valve.
- D. MAC Valves products are never to be stepped on while working on a machine. Damage to a MAC valve, or other product or lines to the product (either air or electrical lines) or accidental activation of a manual operator on the valve could result in personal injury or property damage.

#### LIMITATION OF GUARANTEE

This Guarantee is limited to the replacement or rebuilding of any valve or other product which should fail to operate properly. Valves or other products, under the MAC Guarantee, must be returned (with or without bases) transportation prepaid and received at our factory within the Guarantee period. They will be returned to the customer at the expense of MAC Valves, Inc., and will carry the same guarantee as provided under the Flat Rate Rebuild Program.

#### DISCLAIMER OF GUARANTEE

No claims for labor, material, time, damage, or transportation are allowable nor will any valve or other product be replaced or rebuilt under this guarantee which has been damaged by the purchaser not in the normal course of its use and maintenance during the warranty period. The guarantee does not apply to loss or damage caused by fire, theft, riot, explosion, labor dispute, act of God, or other causes beyond the control of MAC Valves, Inc. MAC Valves, Inc. shall in no event be liable for remote, special or consequential damages under the MAC Guarantee, nor under any implied warranties, including the implied warranty of merchantability.

The above Guarantee is our manner of extending the engineering and service resources of the MAC Valves, Inc. organization to assure our customer long, and continued satisfaction.



Manufacturers of Air Control Valves

MAC VALVES, INC.

• P.O. BOX 111 • 30569 BECK ROAD • WIXOM, MICHIGAN 48393-7011  
• Tel: (810) 624-7700 • Tlx: 164116 • Fax: (810) 624-0549

TO: ALL DISTRIBUTORS

DATE: DECEMBER 14, 1995

SALES BULLETIN: #34-95

SUBJECT: MARVEL MYSTERY OIL

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It has come to our attention that there are a few customers that are using Marvel Mystery Oil. This oil was formulated for automobile engines and may be a good product, however, it is devastating to rubber seals. When the oil comes in contact with the rubber it swells the seals which could cause the valve to stick. Unlike most oils that we have analyzed, Marvel Mystery Oil will evaporate out of the rubber, returning the seal to its original size. When valves are returned to us for evaluation, this problem can make it difficult to render an accurate diagnosis.

The second problem involves solvents used in Marvel Mystery Oil. These solvents will dissolve the lubricants molded into our rubber seals which can also lead to sticking particularly at low pressures when you have the least margins of force available.

Please make all your sales people aware of this situation and address it appropriately.

Sincerely,

MAC VALVES, INC.

A handwritten signature in black ink that reads "Jim Rude".

Jim Rude  
Sales Engineer

JR:rw



65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

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*Manufacturer of Air Control Valves*

**MAC VALVES, INC.**

• P.O. Box 111 • 30569 BECK ROAD • WIXOM, MICHIGAN 48393-7011  
 • Tel: (248) 624-7700 • Fax (248) 624-0549 • www.macvalves.com

February 25, 2000

**AIR VALVE LUBRICANTS**

MAC Valves has compiled for reference a partial list of suitable oils, given upon request, for customer applications. If given a choice, this list should help avoid potential problems down the road. The information is provided as the result of recent lab testings and a great deal of field experience. The suitable oil should have an aniline point in the 180-210 range and viscosity of 150-200 seconds at 100 (S.A.E. #10).

The following oils without additives are satisfactory:

<u>MANUFACTURER</u>	<u>OIL NUMBER</u>
NFO	NFO 10 H/NR
NFO	NFO 10 W/NR
CHEVRON	AW 10 MACHINE OIL
CHEVRON	HANDY OIL - 15
EXXON	TERESSTIC 32
MOBIL	MOBIL DTE LIGHT
MOBIL	DEXRON II ATF
MOBIL	AFT 210 TYPE F
MOBIL	DTE 13M
MOBIL	ALMO 525
MOBIL	MIST LUBE 24
MOBIL	DTE 24
MOBIL	HYDRAULIC OIL 13
MOBIL	HYDRAULIC OIL AW 32
WOLVERINE	A-INDUSTRIAL 150 R&O
TITAN	TYPE F ATF
TITAL	DEXRON II ATF
AMERICAN	INDUSTRIAL OIL - 32

The use of Kerosene, animal or vegetable fats should be avoided for additives or cleaning agents. Also, the use of any penetrants such as WD40 should NEVER be used on any rubber seals. MAC is willing to test and evaluate any oils a customer is using that is additional to this listing. Please contact our sales department with any questions.



65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

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# CHUTE PIVOT

## Chute Pivot Maintenance



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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## CHUTE PIVOT MAINTENANCE

Proper mixer lubrication is very important to getting the maximum performance from your Con-Tech Mixer. Due to the environment that it operates in on a daily basis, a liberal greasing maintenance schedule will minimize downtime and prevent unnecessary/premature repairs. All chute pivot attaching hardware must be inspected on a weekly basis. Failure to do so could result in premature wear & component failure.

Con-Tech Manufacturing recommends a General Purpose EP Lithium Based grease. Understanding that a DAILY greasing of these components can be somewhat difficult to do, Con-Tech recommends that you grease these components a minimum of every week. The main goal in maintaining a diligent lubrication schedule is to remove WATER from the drum roller and chute pivot assemblies.

During the greasing procedure, continue to fill component with grease until you see clean grease just starting to come out of the component seal.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR  
MAINTENANCE ON YOUR VEHICLES.**

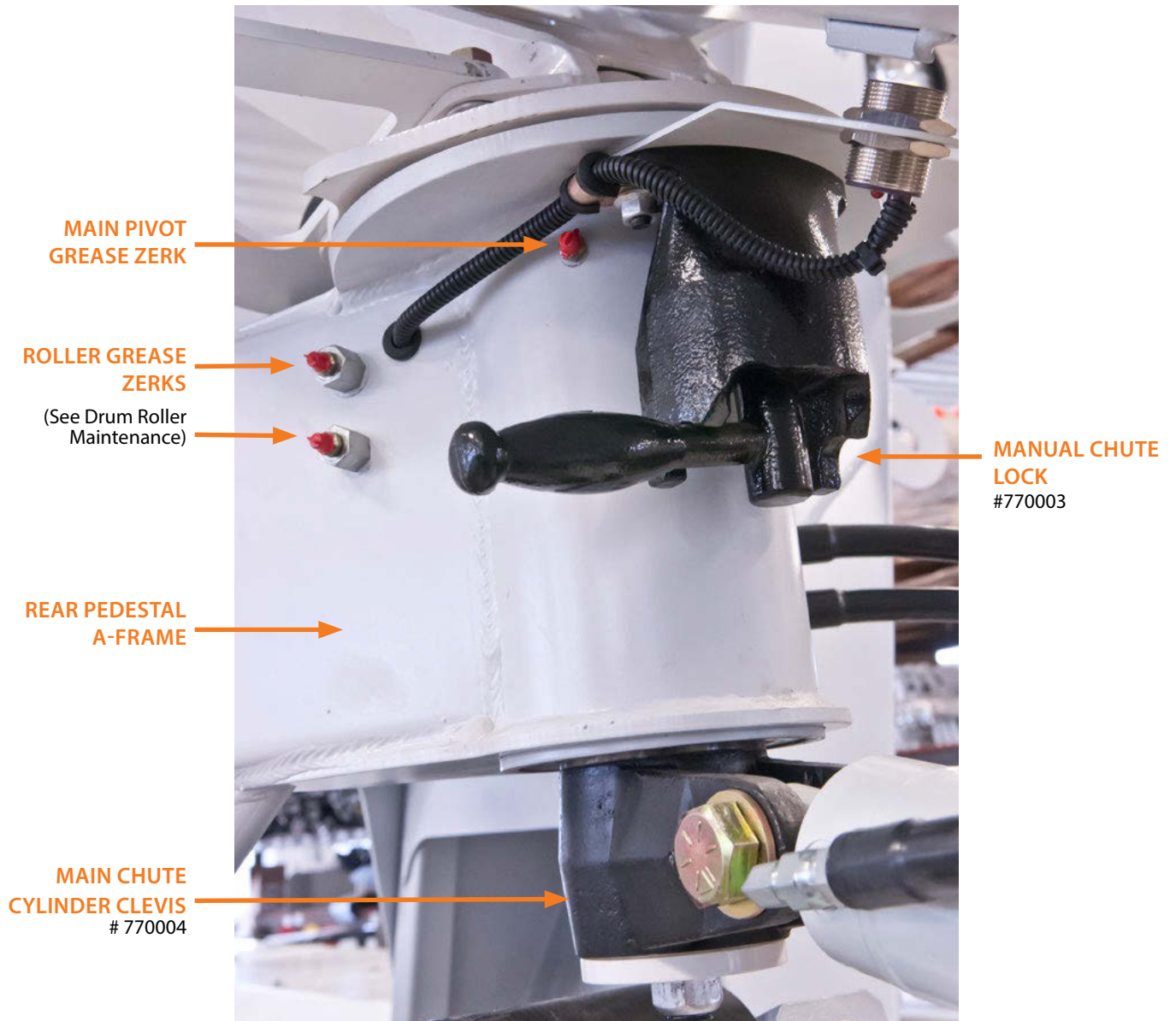
- 725014** - Seal, swivel Bearing, Qty 2
- 720005** - Cone, roller bearing, Qty 2
- 720006** - Roller bearing cup, Qty 2
- 215116** - Main pivot lower seal ring, Qty 1
- 770004** - Cast chute clevis, Qty 1
- 215261** - Chute cylinder clevis key, Qty 1
- 215110** - Main pivot washer, Qty 1



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## CHUTE PIVOT MAINTENANCE



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# HYDRAULICS



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## HYDROSTATIC FLUSH AND FILL PROCEDURES

When changing the hydrostatic pump and motor on your mixer, the hydrostatic system must be properly flushed and cleaned to prevent contamination from entering the new hydrostatic pump and motor being installed. Not properly flushing and cleaning components of contamination from the mixer system will result in shortened life and/or immediate pump and motor failure. The hoses, reservoir and oil cooler must be thoroughly flushed as described in the steps below. Both the hydrostatic pump and motor must be replaced as a set for warranty purposes.

### REMEMBER:

If either the pump or the motor fail, both units will be contaminated and must always be changed as a set.

OSHA Lockout and Tag Out Procedures must be followed before starting the project.

Here are the procedures as listed in the SAE J2967 mixer document:

1. Apply the parking brake
2. Chock the wheels
3. Shut down all power sources, such as the truck engine and auxiliary engines.
4. Remove the key from the vehicle ignition.
5. Install a tag or cover on the steering wheel or other appropriate location.
6. Place frame and body supports as needed.
7. Place operating equipment at the lowest potential energy level or positions as not to be subject to possible free fall.
8. Install blocking devices to prevent any raised or elevated device from falling.
9. If the drum is to be entered, install devices to prevent the drum from rotating.
10. Relieve stored hydraulic or pneumatic pressure, after blocking devices are installed, if maintenance is to be done to the hydraulic or pneumatic system.

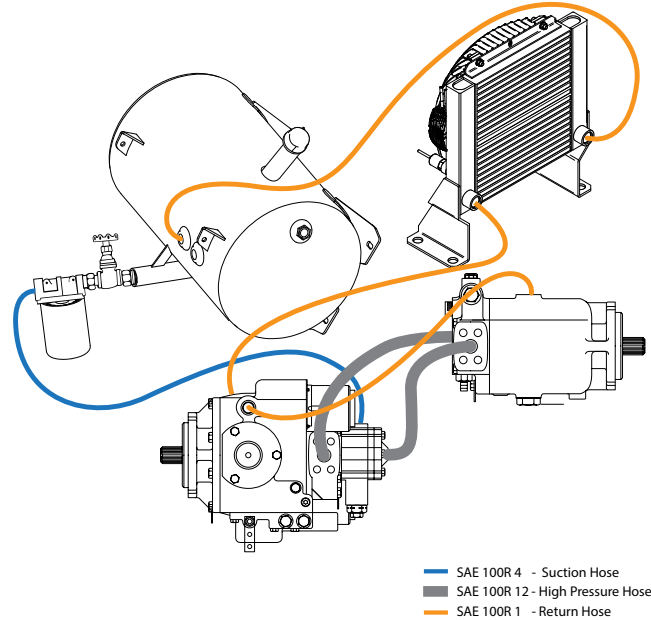
The purpose of LOTO is to restrain and secure all potential or kinetic energy. This process includes blocking when this energy exists, relieving pressure in hydraulic or pneumatic cylinders chaining the BridgeKing trailer if you are working on the trailer system while the trailer is up, etc.

### ⚠ WARNING!

Hot oil and hot components may cause serious personal injury. Do not allow hot oil or hot components to contact skin.

**NOTE:** Collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

**NOTE:** Use a lint free cloth for cleaning hydrostatic and system components.



### ⚠ WARNING!

Correct hoses, fittings, and adapters with the correct SAE rating must be used when replacing hoses to prevent possible serious injury. Always replace hoses, fittings and adapters with replacements that have a proper, suitable working pressure rating. Replacement hoses must be of the correct length and must comply with the hose manufacturer's installation guidelines and recommendations. Consult hose and fitting manufacturer's for correct specifications. Hydraulic hoses have the SAE ratings marked on the hose to assist you in selecting the correct hose. Any replacement hydraulic hoses and fitting assemblies must be supplied by the same manufacturer.

As an example: Brand 'A' hose and brand 'B' fitting will not normally be compatible. No 'twist' is allowed in the hydraulic hoses. 'Twist' may result in premature hose failure. Please contact Con-Tech Manufacturing at 507-374-2239 for assistance when necessary.

### ⚠ WARNING!

Hydraulic hoses, fittings, and pipe must be inspected on a DAILY BASIS for leaks, cuts, abrasions, damage, aging, improper clearance, and along the frame for hidden damage. If you find hoses with any such adverse conditions or damage, they must be replaced before the mixer is returned to service! In any event, all hydraulic hoses must be replaced every three years. Failure to properly inspect and maintain your mixer may result in serious personal injury.

# HYDROSTATIC FLUSH AND FILL PROCEDURES

- Step 1** With all hydraulic cylinders retracted and hydraulic fluid warm, drain the old fluids from the hydrostatic system including the pump and motor, oil cooler, hydraulic hoses, hydraulic tubing, and reservoir. If you have a mixer with a trailer, such as a BridgeKing®, the trailer must be chained in the up position to prevent the trailer from falling. Failure to chain the trailer in the up position may result in serious personal injury.
- Step 2** Remove the old oil filter(s) and properly discard. Remove the old hydrostatic pump and motor from the mixer, drain the fluids, cap the ports and set the pump and motor aside for returning as cores. Pumps and motors are heavy. To prevent personal injury use a lift to move the pump and motor. See the instructions on page 3 for returning the pump and motor cores to your Con-Tech branch.
- Step 3** Thoroughly flush the reservoir using clean diesel fluid. All contamination must be removed from the reservoir to prevent contaminating the new hydraulic fluid. The reservoir can be unplumbed and removed from the mixer if necessary for flushing purposes. After flushing the reservoir, cap the open ports to prevent contamination.
- Step 4** Remove the hydraulic hoses from the mixer and flush the hoses thoroughly using clean diesel fuel. After flushing, cap the ends of the hydraulic hoses to prevent contamination. Inspect the hydraulic hoses for wear, abrasion, cracks, improper bends, and other visible damage. Inspect the hose fittings for damage or wear. Refer to the warning on page 1. Any hydraulic hoses that have any of the above listed damage must be replaced before the mixer is returned to service. Failure to do so may result in serious personal injury. Replacement hydraulic hoses must meet the same SAE ratings and be the same length. Hydraulic hoses that are too short and too tight will fail prematurely. Hoses that are longer may catch or snag on other components. Replacement hoses must have the same hose outer covering to withstand wear and to resist acid wash chemicals. If you have questions on hydraulic hose call the Con-Tech phone number listed at the end of this document.
- Step 5** Flush the hydraulic tubing using clean diesel fuel. After flushing, cap the ends of the hydraulic hoses to prevent contamination. Inspect the hydraulic tubing for wear, abrasion, cracks, improper bends, and other visible damage. Inspect the tubing fittings for damage or wear. Refer to the warning on page 1. Any hydraulic tubing that has any of the above listed damage must be replaced before the mixer is returned to service. Failure to do so may result in serious personal injury. Cap the ends of the hydraulic tubing to prevent contamination. If the hydraulic high pressure tubing must be replaced it must conform to J1065 specifications to prevent personal injury. If you have questions on hydraulic tubing call the Con-Tech phone number listed at the end of this document.
- Step 6** Reverse flush the oil cooler using clean diesel fuel. Use care not to damage the cooler ports, cooling fins or fan motor. After flushing the oil cooler cap the ports to prevent contamination.
- Step 7** Carefully install the replacement pump and motor on the mixer. Pumps and motors are heavy. To prevent personal injury use a lift to move the pump and motor.
- Step 8** Install new hydraulic filters and a new 10 micron reservoir filter breather cap.
- Step 8.2** Reinstall the flushed hydraulic hoses on the hydrostatic system and reinstall the reservoir if removed. Don't install the case drain hose on the top of the pump and motor yet.
- Step 9** Reinstall the proper hydrostatic fluid. Recommended fluids are straight-weight hydraulic fluids. Viscosity recommendations: ISO 68 for average ambient temps less than 80°F and ISO 100 for average ambient temps greater than 80°F. Follow the manufacturer's recommendations. If you have questions on lubricants, call the Con-Tech phone number listed at the end of this document.
- Step 9.2** Refill the case of the pump with new hydraulic fluid using the top case drain port. Reinstall the top pump case drain hose.
- Step 10** Refill the case of the motor with new hydraulic fluid using the top case drain port. Reinstall the top motor case drain hose.
- Step 11** Refill the reservoir to the upper sight glass. Loosen fittings to bleed air from the tubing and components. Top off the reservoir to the upper sight glass.
- Step 12** Remove the Lockout Tag Out devices, start the mixer and allow it to idle for two or three minutes. Top off the reservoir again and allow the mixer to idle.
- Step 13** If you have a mixer with a trailer, such as a BridgeKing®, clear the area around the trailer. There may be air in the hydraulic cylinder and the cylinder movement may be erratic. Remain clear of the trailer area. Carefully remove the chain from the trailer. Operate the trailer two or three times and raise the trailer to the locked and stowed position.
- Step 14** The proper oil level is determined with all cylinders retracted and the oil level at the center of the upper sight glass when the hydraulic system is at operating temperature.
- NOTE:** Dispose of old hydraulic fluids and flush according to local and state regulations.

**See Page 19 for Flush & Fill Core Return Procedure.**



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# FLUSH AND FILL CORE RETURN PROCEDURE

Contact your Con-Tech area branch customer service representative to obtain a **Return Authorization (RA)** prior to sending your core back for credit. Please have the original invoice number when requesting the RA. The RA must accompany all returning cores to be processed.

***Return Collect Via Freight using NMFC Code 50 (Cores)***

## CON-TECH BRANCH LOCATIONS

### ***Con-Tech Headquarters***

65740 State Hwy 56, Dodge Center, MN 55927  
**phone:** 507-374-2239 **fax:** 507-374-1094

### ***Texas (Dallas)***

5843 Curtis Dr., Suite 500, Allen, TX 75002  
**phone:** 972-941-8592 **fax:** 972-941-8911

### ***Texas (Houston)***

11175 Windfern Road, Suite B, Houston, TX 77064  
**phone:** 832-688-8449

### ***Georgia (Atlanta)***

104 Hudson Industrial Dr., Griffin, GA 30224  
**phone:** 770-229-1773 **fax:** 770-227-3021

### ***Illinois (Chicago)***

1016 Airpark Drive, Suite D, Sugar Grove, IL 60554  
**phone:** 507-374-2239

### ***Ohio (Cleveland)***

38134 Western Pkwy, Unit #2, Willoughby, OH 44094  
**phone:** 440-946-3322

### ***Colorado (Denver)***

7279 E 96th Avenue, Suite E, Henderson, CO 80640  
**phone:** 507-418-0200

***Thank you!***

***We appreciate your business with Con-Tech Manufacturing.***



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# HYDROSTATIC PUMP AND MOTOR MAINTENANCE

## HYDRAULIC FLUID

### 1. ISO 68 - Ambient Less than 80° F

- A. Specifications
  1. SUS @ 210° F = 55-60
  2. Viscosity Index = 100-120
  3. Pour Point = -20° F Average

### 2. ISO 100 - Ambient More than 80° F

- A. Specifications
  1. SUS @ 210° F = 60-70
  2. Viscosity index = 100-120
  3. Pour point = +10° F Average

### 3. Recommended Additives

- A. Anti-Corrosion
- B. Anti-Rust
- C. Antioxidant
- D. Anti-Foam
- E. Anti-Wear
- F. Emulsifier
- G. Detergent

### 4. Hydraulic Fluid Breakdown

- A. Age of your fluid
  1. **Change your hydraulic fluid**
    - a. @ 100 hours (After initial break-in)
    - b. 6 Months / 1000 hours
- B. Heat
  1. Breakdown temperature varies with different brands.
- C. What effects fluid breakdown has.
  1. Oxidization
  2. Additive breakdown
  3. Varnishing
  4. Contaminates
  5. Loss of viscosity

### 5. Multiple Viscosity Fluids (MV)

(Use only approved MV Lubricants)

- A. Shear Factor
  1. Viscosity Index improver (VIP)
    - a. Synthetic polymer chain
    - b. Typically not shear stable in high pressure piston pumps.
- B. High viscosity index
  1. 130-150

### 6. Automatic Transmission Fluid (ATF)

- A. Should not be substituted in hydrostatic systems
- B. Not shear stable in high pressure piston pump.
  1. High viscosity index
    - a. 170-200
  2. Tends to shear to base stock viscosity
  3. Looses hydrodynamic film
  4. Not always compatible with hydraulic fluid
  5. Normally higher priced than hydraulic fluid

### 7. Water Base Oil

- A. **DO NOT USE** in hydrostatic systems
- B. Shortens lifetime of hydrostatics
- C. May void warranty.

### 8. Normal Operating Temperatures

- A. Outside temperature (Ambient) + 100°F
- B. Running warmer than normal
  1. Drum stall potential exists.
  2. Hydraulic fluid should be changed more often if system runs too warm.
    - a. Additive package breaks down
    - b. Hydraulic fluid's ability to tolerate heat lowers
- C. Operating cooler than normal:
  1. Moisture accumulation
    - a. Maximum moisture = .001%
  2. Hydraulic fluid should be changed more often
- D. Filter system Microns
  1. Coarse filter (Approx. 40 Microns)
  2. Fine filter (Approx. 5 Microns) (BK Only)
- E. Analyzing oil
  1. Use an analysis designed for hydrostatics
    - a. Cleanliness levels
    - b. SUS @ 210°F
    - c. Moisture content
    - d. Viscosity index





# HYDROSTATIC PUMP AND MOTOR MAINTENANCE

## 8. Normal Operating Temperatures (Cont.)

### F. Filtering oil from storage containers

1. Use a 10 micron filter
  - a. Low pressure applications
    1. Mixer hydro filter assembly
  - b. High pressure applications
    1. BridgeKing® high pressure filter assembly

## OIL RESERVOIR

### 1. Sealed or vented reservoirs

- A. Hydro has an even exchange of oil
- B. Chute lift cylinder volume minimal
  1. Cylinder capacity = .35 Gal
- C. A sealed reservoir remains cleaner
- D. Thermal expansion aids charge pump
- E. A vented reservoir is required if the system has a large cylinder such as on the BridgeKing®

### 2. Moisture Accumulation

- A. Source of Moisture
  1. Condensation
    - a. Cooling down of hydraulic fluid overnight
  2. Induced Moisture into the reservoir
    - a. Bad/leaking, fitting reservoir cap
    - b. Washing hot reservoir with cold water
    - c. Pressure washing
  3. Hydraulic fluid not reaching operating temperature
  4. Reservoir breather cap not properly installed

## HYDRAULIC HOSE

### 1. General Hose Information and Knowledge

- A. Ratings
  1. Operating Pressure
    - a. The pressure the hose is designed to operate at on a continuous basis
  2. Proof
    - a. The operating pressure x 2 for test purposes
  3. Burst
    - a. The pressure at which the hose bursts
    - b. Operating pressure x 4 minimum
  4. SAE = Society of automotive engineers
  5. DIN = Deutsch International Nominal
  6. Mil Spec = Military (lowest rating)

### B. Hose outer covering considerations when purchasing hydraulic hoses

1. Acid wash resistance
2. Synthetic rubber covering
3. UV exposure

### C. Twist Factor

1. 7° of twist per foot will shorten a hose life by 95%

### D. Hose Shrinkage

1. Anticipate a 4% shrinkage when pressurized
  - a. 2" on a 50" hose

### E. DO NOT PRESSURE WASH HOSES

### F. Hoses should be inspected daily for:

1. Cuts
2. Leaks
3. Abrasions
4. Damage
5. Improper clearance/tolerances
6. Aging
7. Check along frames for damage

### G. Hose Size = I.D. Measurement

1. Dash sizes in 16th of an inch
  - a. -4 = 1/4"
  - b. -6 = 3/8"
  - c. -8 = 1/2"
  - d. -12 = 3/4"
  - e. -16 = 1"

### 2. Suction Hose Applications

- A. SAE100R4 or equivalent
  1. 28" Vacuum
  2. 200 PSI maximum
  3. Aeroquip FC310, 2661 or equivalent

### 3. Chute Hose Applications

- A. SAE100R2 or DIN 20 022
  1. Minimum operating pressure of 3,000 PSI required
  2. Aeroquip GH781 or equivalent

### 4. Closed Loop System (Hydrostatic Pump & Motor)

- A. SAE100R12
  1. Minimum operating pressure of 4,000 PSI
  2. GH493 or equivalent



# HYDROSTATIC PUMP AND MOTOR MAINTENANCE

## SUCTION FILTER

- 1. 10 Micron ( $\mu$ ) Rating is Required**
  - A.  $1 \mu = 0.00003937$  Inch
  - B. Human hair = 70 microns
  - C. Lower limits of human visibility = 40 microns
  - D. White blood cell = 25 microns
    1. Not visible to the human eye
- 2. Beta Ratings Required by Eaton**
  - A. B10 = 2 minimum
  - B. B10 = 4 better rating
- 3. ISO Cleanliness Standard**
  - A. 18/13 required
    1. Particles per ML (1 cc)
      - a. 5 = 2,500 particles
      - b. 15 = 80 particles
- 4. 10 Inches of Mercury (Hg) Maximum Warm**
  - A. Red line on vacuum gauge
- 5. Bypass Opens at 20 Inches of Mercury**
  - A. Hydraulic fluid is unfiltered in bypass
  - B. Filter must withstand 20 inches of mercury
- 6. Many Filters Do Not Qualify**
  - A. Incorrect beta ratings
    1. B10 = 2 minimum rating

## HYDRAULIC FLUID FAN COOLER

- 1. Flow Capacity is Determined by Charge Pump Flow**
  - A. 1.28 charge pump @ 2,000 RPM = 10.5 GPM @ 95% efficiency
  - B. 12 Volt fan cooler
    1. 19,000 BTU w/ ram air
    2. 15,000 BTU w/ fan air
    3. Fan temperature switch to activate fan @157°F
    4. ZF mount is Standard
- 2. Reverse Flushing the Cooler**
  - A. In the event of a pump and/or motor failure the cooler must be flushed or system will be immediately contaminated on start up

## HYDROSTATIC PUMP

- 1. Rotation**
  - A. Front mount pumps = LH (CCW)
  - B. Rear mount REPTO pumps = RH (CW)
    1. Rear engine power take off
- 2. Input Shaft Sizes**
  - A. Production
    1. 1-1/2" tapered shaft
    2. 1350 Series drive line components
    3. Yoke torque = 320 lb. ft. minimum lubricated
- 3. Relief Valves in Pump**
  - A. 6,000 PSI clipping relief valves
  - B. Poppet style
    1. Tend to be self-cleaning
    2. Cooler Operation
- 4. Pump Configuration (CW or CCW)**
  - A. A-pad charge pump
  - B. Std mixer A-pad gear pump (Std mixer)
  - C. Pressure compensated piston pump (BK mixer)
  - D. 1-1/2" tapered shaft
- 5. Displacements**
  - A. 54 Series - production pump (5.4 cid)
- 6. Model and Serial Numbers**
  - A. The first two numbers of the model number indicate displacement
    1. Example: "54" = 5.4 cid
  - B. Third Digit of the Model Number
    1. "2" = Pump
    2. "3" = Motor
  - C. Fourth Digit of the Model Number
    1. "3" = Lip style input shaft seal
    2. "1" = Old style mechanical shaft seal



# HYDROSTATIC PUMP AND MOTOR MAINTENANCE

## HYDRAULIC LEAKS & DRUM STALL

### 1. Normal Internal Leakage of Hydraulic Fluid

- A. Leakage cleans, cools, and lubricates
- B. Normal leakage at operating temperature
  - 1. Pump = 1 GPM
  - 2. Motor = 1 GPM
- C. Charge pump capacity @ 600 RPM = 3 GPM
  - 1. Charge pump replaces leakage (make up fluid) in charge/discharge circuit
  - 2. Fluid not used for make up oil (leakage) aids cooling by dumping into pump case, flowing through the cooler & back to reservoir

### 2. Excessive Internal Leakage - Caused By:

- A. Wear
- B. Wrong hydraulic fluid (too thin)
- C. Overheated
  - 1. Possible cooler problems
    - a. Obstructed air flow
- D. When leakage exceeds the charge pump's Capacity for make up fluid the drum will stall

### 3. Solutions

- A. Increase charge pump capacity with Increased engine RPM's whenever possible
  - 1. Don't let engine idle with a load of Concrete while sitting at job sight
    - a. Use 1,000 or 1,200 rpm while sitting
- B. Hydraulic fluid with a SUS of 55-60@ 210°F
- C. Correct cooler capacity
- D. Larger hydrostatic motor
  - 1. Additional torque, but lower drum RPM

## REPLACING A HYDROSTATIC PUMP AND MOTOR

### 1. Important Items to Complete

- A. Keep everything extremely clean
- B. Check the hoses for cracks/damage, etc.
- C. Flush the system with diesel or a flushing fluid
  - 1. Flush reservoir and wipe clean
  - 2. Reverse flush the cooler
  - 3. Install new and correct suction filters
    - a. B10 = 2 Beta rating minimum
  - 4. Flush hoses and tubing and blow out with air
- D. Torque the pump yoke as per specifications
- E. Change both the pump and motor
- F. Install the correct hydraulic fluid
- G. Follow clean and flush procedures
- H. Pre-fill pump and motor cases with hydraulic fluid
- I. Pre-fill and/or bleed ALL hoses prior to start up



# RECOMMENDATIONS FOR HYDROSTATIC LUBRICANTS

*The following are approved ISO 68 specification lubricants for Eaton Transit Mixer  
Hydrostatics operation in ambient temperatures less than 80° F:*

Brand Name	SUS@210	VI	Pour Point (F)
Castrol Blue Hydraulic	54	105	-15
Castrol Paradene AW	54.1	95	-26
Chevron Rando HD AW68	54	99	-22
Citgo AW Hydraulic Oil	55	94	-20
Conoco Super Hydraulic Oil 68	56	100	-30
Exxon NUTO H68	54.8	97	-17
Fina AW Hydraulic Oil	55	96	-15
Kendall Four Seasons (7382)	56.0	100	-5
Mobil DTE10-16M	62	120	-11
Mobil *SHC500 Series	66	145	-55
Shell Tellus 65211	54	95	-10
Sunoco Sunvis 768	54.9	98	-15
Texaco Rando HD 68	55	103	-20
Unocal UNAX AW	55.4	102	-11

*The following are approved ISO 100 specification lubricants for Eaton Transit Mixer  
Hydrostatics operating in ambient temperatures more than 80° F:*

Brand Name	SUS@210	VI	Pour Point (F)
Castrol Blue Hydraulic	65	102	+5
Castrol Paradene AW	65.7	102	-15
Chevron Rando HD AW100	64	100	-15
Citgo AW Hydraulic Oil	63	96	+5
Conoco Super Hydraulic Oil 100	64	98	-25
Exxon NUTO H100	62.6	97	-9
Fina AW Hydraulic Oil	64	95	0
Kendall Four Seasons (7384)	63	95	+10
Mobil DTE10-18M	71	120	-29
Mobil *SHC500 Series	66	145	-55
Shell Tellus 65214	62	95	-5
Sunoco Sunvis 7100	64.7	95	-2
Texaco Rando HD 100	63	95	0
Unocal UNAX AW	65	100	+10

**NOTE:** No tractor fluids are recommended at this time.

\* Synthetic Hydraulic Oil

**NOTE:** Several other brand oils also meet the hydrostatic specifications.



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## HYDRAULIC TEST KIT

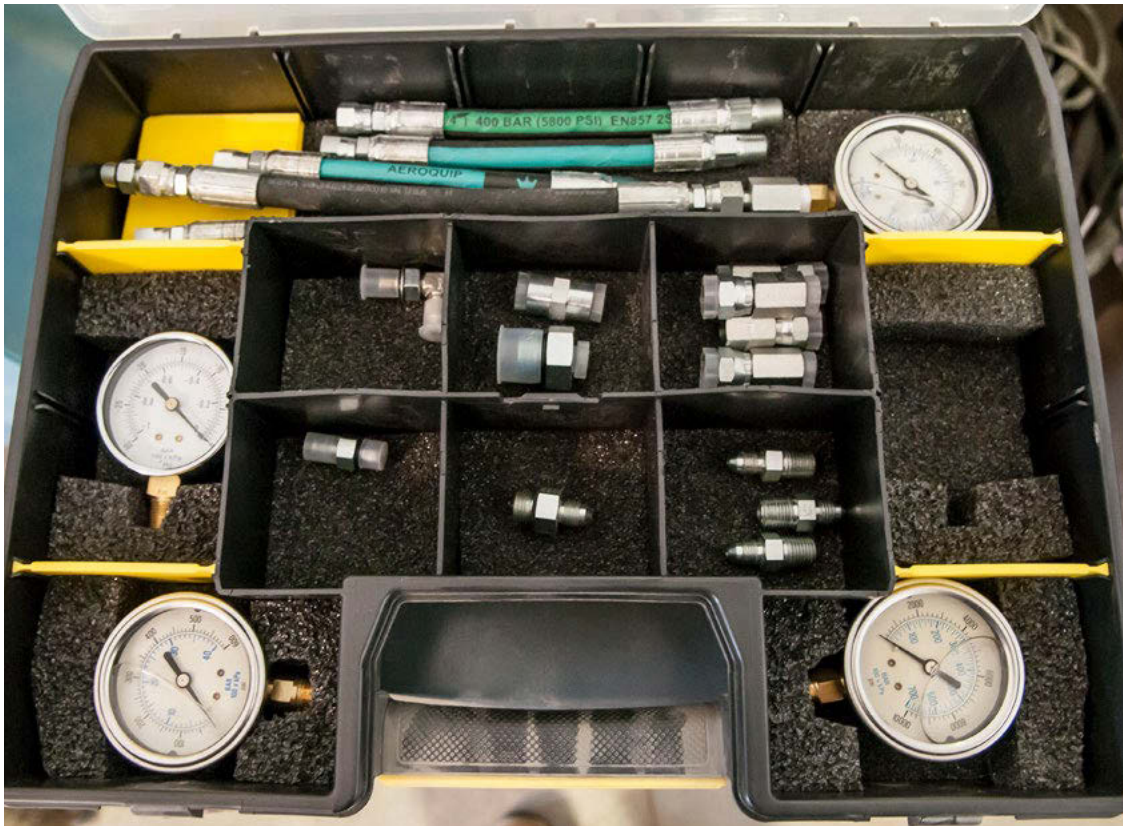
When servicing your Con-Tech mixer, it is best to have the proper tools and equipment to do the job. Con-Tech offers a hydraulic test kit to properly check and diagnose your mixer's hydraulic system. To purchase, call our Parts Sales Department.

For use, troubleshooting, and action steps, please review the "Troubleshooting" section.

For Instructions on hooking up your hydraulic test kit, please refer to pages 4 & 5 in the Eaton Troubleshooting Guide For Eaton Hydrostatic Transmissions used on Concrete Mixers No. 3-406.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



Part # 799600

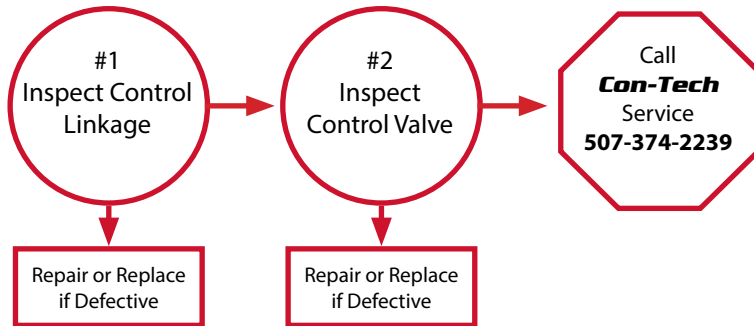


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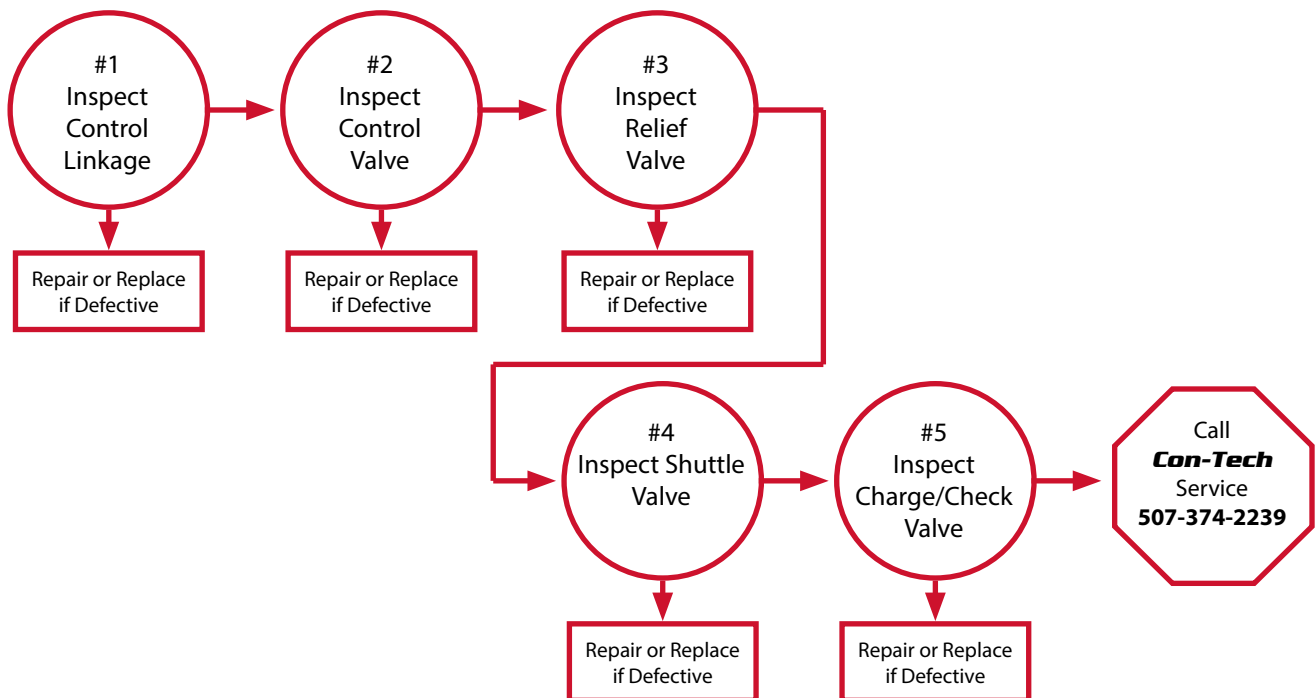
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# TROUBLESHOOTING PUMPS AND MOTORS

## NEUTRAL IS DIFFICULT TO FIND...



## MIXER DRUM ONLY TURNS IN ONE DIRECTION...



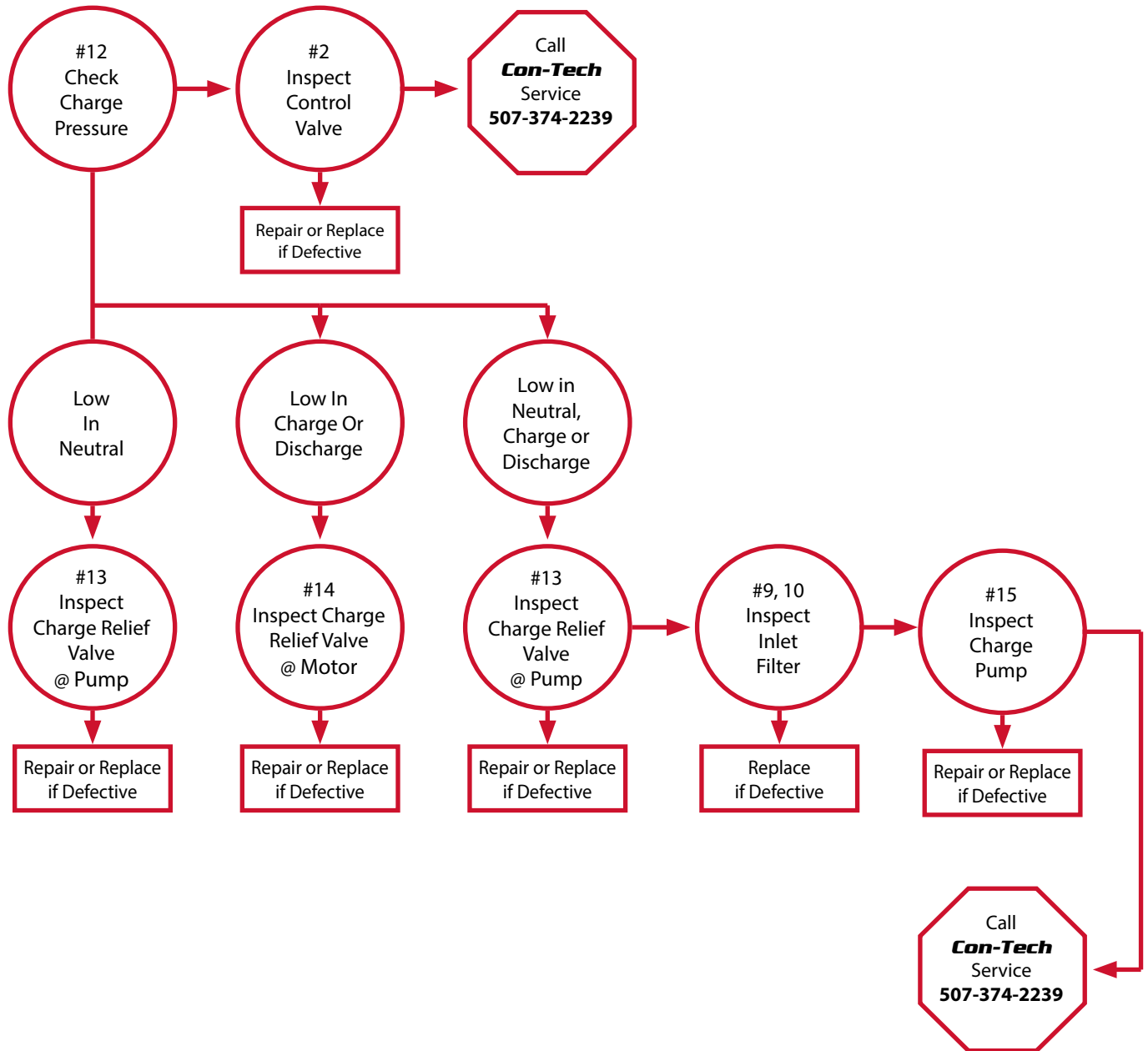
SEE PUMPS AND MOTORS STEPS AND ACTIONS FOR ADDITIONAL INFORMATION



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# TROUBLESHOOTING PUMPS AND MOTORS



SEE PUMPS AND MOTORS STEPS AND ACTIONS FOR ADDITIONAL INFORMATION



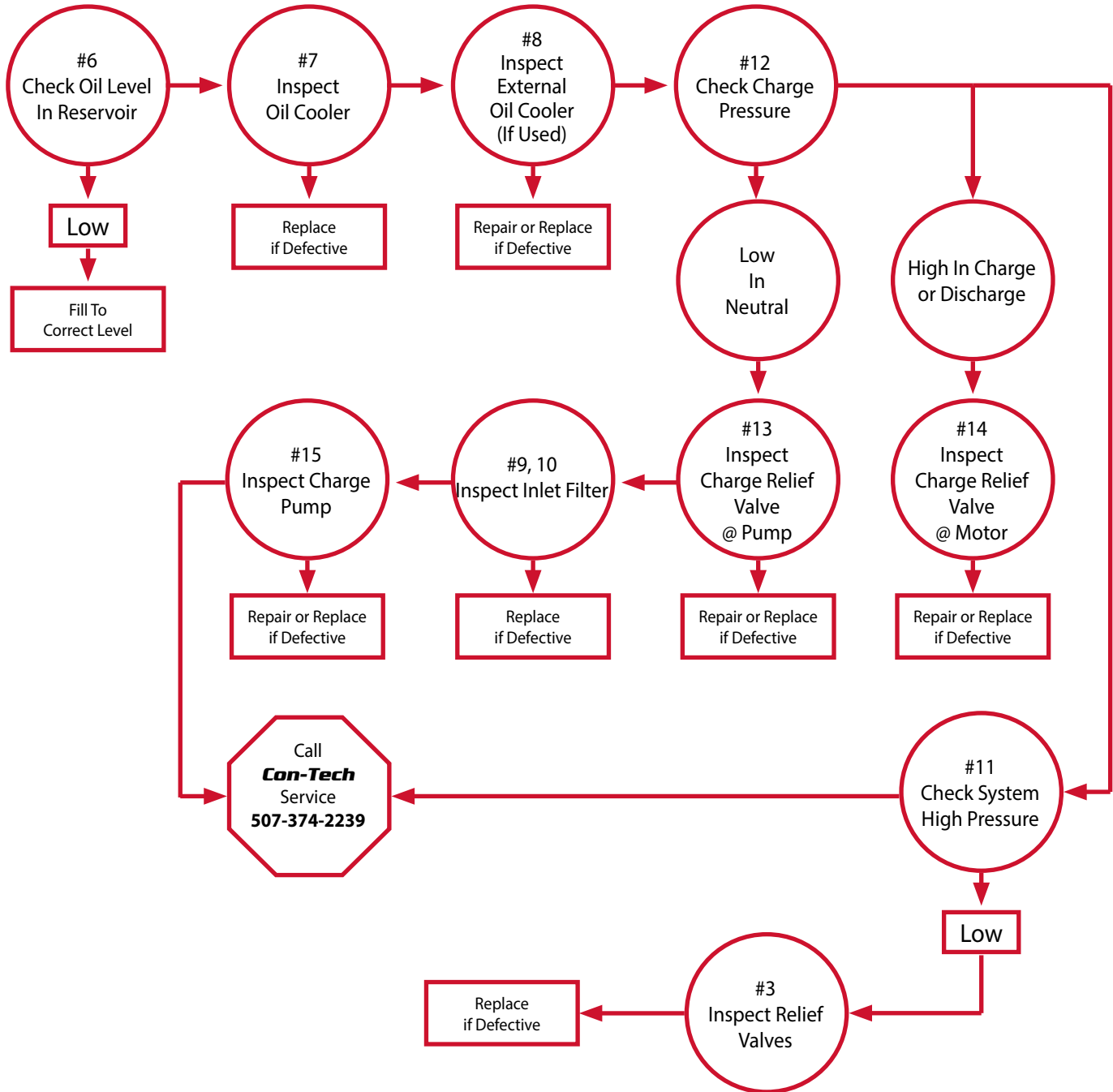
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# TROUBLESHOOTING PUMPS AND MOTORS

## MIXER HYDRAULIC SYSTEM IS RUNNING HOT...



SEE PUMPS AND MOTORS STEPS AND ACTIONS FOR ADDITIONAL INFORMATION

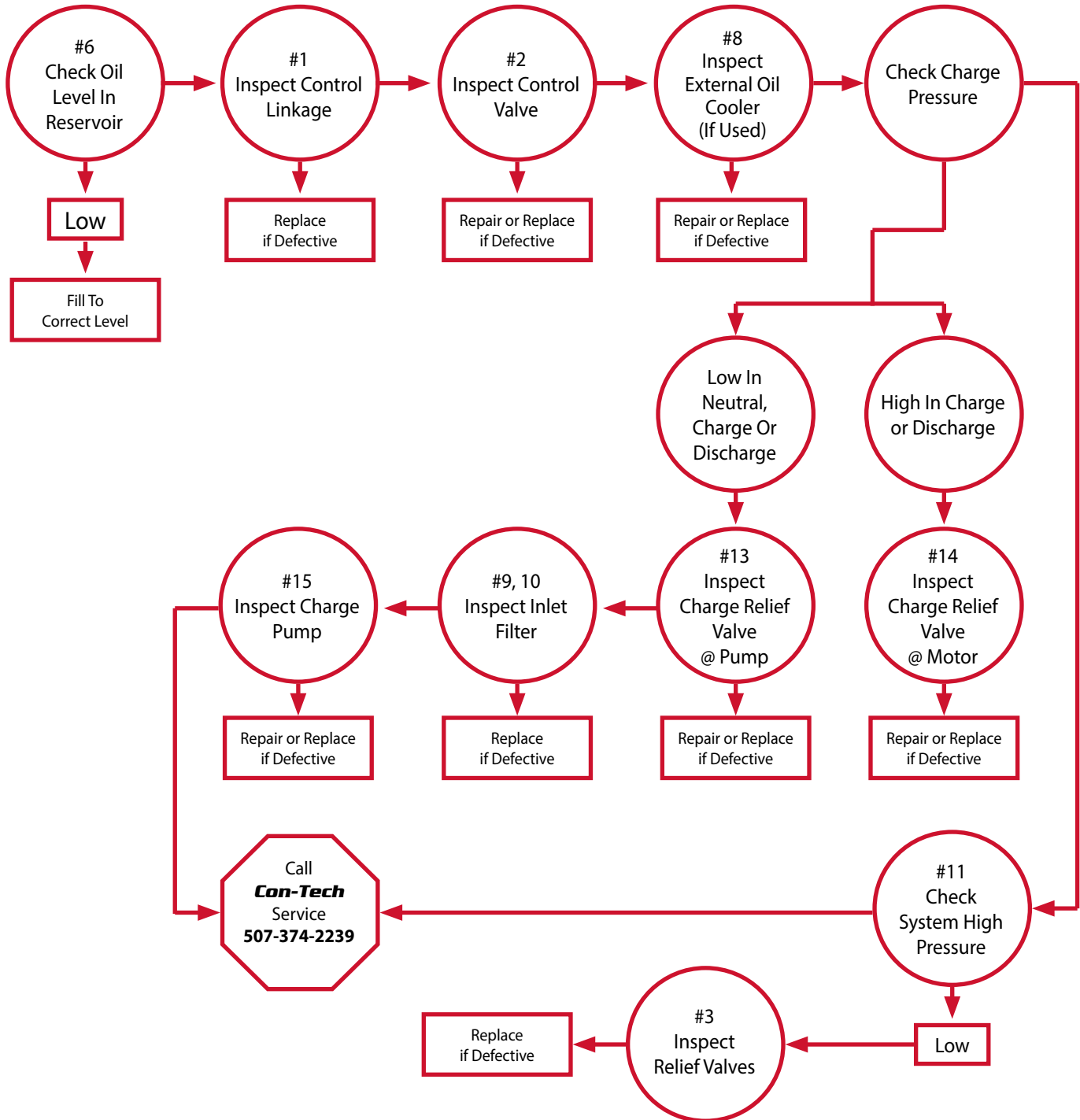


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# TROUBLESHOOTING PUMPS AND MOTORS

## MIXER DRUM DOES NOT OPERATE IN EITHER DIRECTION...



SEE PUMPS AND MOTORS STEPS AND ACTIONS FOR ADDITIONAL INFORMATION



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# PUMP AND MOTOR STEPS ACTION

## 1. INSPECT CONTROL LINKAGE FOR:

- a. Cables out of adjustment, binding, broken, etc.
- b. Cables not coordinated with control valve neutral
- c. Arm on control valve slipping on control valve shaft splines. Cable bracket loose or installed incorrectly

## 2. INSPECT CONTROL VALVE FOR:

- a. Plugged control orifice
- b. Damaged mounting gasket
- c. Mis-adjusted, damaged or broken neutral return spring
- d. Broken control connector pin
- e. Broken or missing control linkage pins
- f. Galled, stuck, or contaminated control spool
- g. Exchange control valves with a units which works properly to verify the control valve is at fault

## 3. \*INSPECT RELIEF VALVES FOR:

- a. Improper pressure relief setting
- b. Damaged or missing O-ring and backing ring
- c. Plugged orifices
- d. Center spool galled, stuck, or contaminated
- e. Poppet style relief valve may be stuck open or contaminated
- f. Older style motors have the high pressure relief valves installed in a manifold on the rear of the motor.
- g. Newer Eaton systems have poppet style high pressure relief valves (called power limiters) installed in the pump. These power limiters can be exchanged from port to port for test purposes.

## 4. INSPECT SHUTTLE VALVE (LOCATED ON THE END OF THE MOTOR) FOR:

- a. Bent or broken return centering spring
- b. Galled, stuck, or contaminated spool
- c. Bent or broken shuttle spools. Excess wear.

## 5. INSPECT CHARGE CHECK VALVES (LOCATED BEHIND CHARGE PUMP) FOR:

- a. Damaged or missing O-ring
- b. Damaged check ball seat
- c. Stuck check ball

## 6. CHECK OIL LEVEL IN RESERVOIR:

- a. Follow the manufacturer's recommendations
- b. Normally oil should be to the sight glass with all cylinders retracted
- c. Do not overfill reservoir

## 7. INSPECT OIL COOLER FOR:

- a. Obstructed air flow from dirt, grease, etc. on the outside of the cooler
- b. Improper plumbing
- c. Obstructed oil flow through the cooler; may require flushing the cooler or a new cooler

## 8. INSPECT EXTERNAL OIL COOLER BYPASS(IF USED):

- a. Broken, clogged, or defective bypass valve
- b. The Con-Tech cooler has an internal bypass rather than an external bypass

## 9. VACUUM HOSE SHOULD BE INSPECTED FOR:

- a. SAE 100R4 rating - This hose must be corrector the internal liner may collapse under vacuum applications. Pressure hose will not work.

## 10. INSPECT INLET FILTER FOR:

- a. Plugged or clogged filter element
- b. Obstructed inlet or outlet
- c. Incorrect rating filter (should be 10 micron filter designed for vacuum applications)
- d. High vacuum (10" max. vacuum when oil is warm)



# PUMP AND MOTOR STEPS ACTION

## 11. CHECK SYSTEM HIGH PRESSURE:

- a. See the test pages showing gauge installation and test procedures.
- b. An empty drum will normally register approximately 500 PSI on the test gauge
- c. A loaded drum will normally register from 2,500 -3,500 PSI on the gauge depending on the load and slump of the concrete in the drum
- d. **WARNING:** Do not attempt to “lock up” the system or prevent the drum from turning to test high pressure. The result may be serious damage to the system and serious personal injury.

## 12. \*CHECK CHARGE PRESSURE:

- a. Charge pressure is checked by installing a 0-600 PSI gauge in the O-ring port on the top of the pump. See the test pages showing gauge installation and test procedures.
- b. Charge pressure on the Eaton hydrostatic systems normally reads 240 - 260 PSI on the gauge when the pump is in neutral. The reading should drop 60 PSI when the pump is put in charge or discharge.
- c. A minimum reading of approximately 150 PSI on the gauge is required to turn the drum

## 13. \*INSPECT CHARGE RELIEF VALVE AT PUMP FOR:

- a. Improper charge relief pressure setting
- b. Plugged orifice
- c. Spool galled, contaminated, or stuck open or closed
- d. Damaged or missing O-ring
- e. Poppet valve held off seat
- f. Exchange a known good charge relief valve from another pump to verify the relief is the problem

## 14. \*INSPECT CHARGE RELIEF VALVE AT MOTOR FOR:

- a. Improper charge relief pressure setting
- b. Plugged orifice
- c. Spool galled, contaminated, or stuck open or closed
- d. Damaged or missing O-ring
- e. Poppet valve held off seat
- f. Exchange a known good charge relief valve from another pump to verify the relief is the problem

## 15. INSPECT CHARGE PUMP FOR:

- a. Broken tang
- b. Damaged or missing O-ring
- c. Broken drive key
- d. Excessive gerotor clearance
- e. Galled or broken gerotor set

\* Charge Relief Valve and High Pressure Relief Valve Identification: The relief valves are factory preset. The pressure code is stamped on the hex plug located on the end of the valve cartridge. To determine the pressure setting on the motor manifold high pressure relief valves, add a zero to the right of the stamped number (Eaton up to 1987). 1988 and newer high pressure relief valves (power limiter) located in the Eaton pump are marked internally. They must be removed to see the number.

Charge Pressure Relief Valves	High Pressure Relief Valves
016 = 160 PSI	500 = 5,000 PSI
022 = 220 PSI	550 = 5,500 PSI



## HYDRAULIC PUMP

Your Con-Tech Mixer comes equipped with an Eaton 54 Series Variable displacement hydraulic pump. This pump is responsible for turning the drum (both direction and speed). Power is supplied to the pump via the rear engine pto and drive shaft.

The pump (and drum speed/direction) can be controlled via two different methods:

1: Cable Control: The drum direction and speed is controlled by moving the cable control arms (located on cab console and on rear control box). In order to place the drum in neutral, you place the cable control arm in the “middle” of it’s travel range.

2: RE (Remote Electronic) Control: The drum direction and speed is controlled by an electronic control unit installed on the side of the pump. This controller is mounted between the cable controller and the pump case. This control also contains the drum start/stop function. Both the drum’s speed/direction and the start/stop functions are controlled by switches located in the cab and at the rear control station (or on the rear pendant).

For emergency drum operation on trucks equipped with RE controls, please see the following instructions: **See Page’s 78-79**

Regular hydraulic fluid and filter changes are a requirement for warranty coverage as well as maintaining the performance of your Con-Tech mixer. Eaton and Con-Tech require a fluid and filter change after the first 100 hours of operation. This will ensure the removal of break in contamination as well any other debris in the hydraulic system. The most contamination your hydraulic system will see will be in this first 100 hours. After this break in, Eaton and Con-Tech suggest fluid and filter replacement every 6 months or 1000-1200 hours (whichever comes first).

Con-Tech trucks come factory filled with Chevron Rando HD ISO 68 oil

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

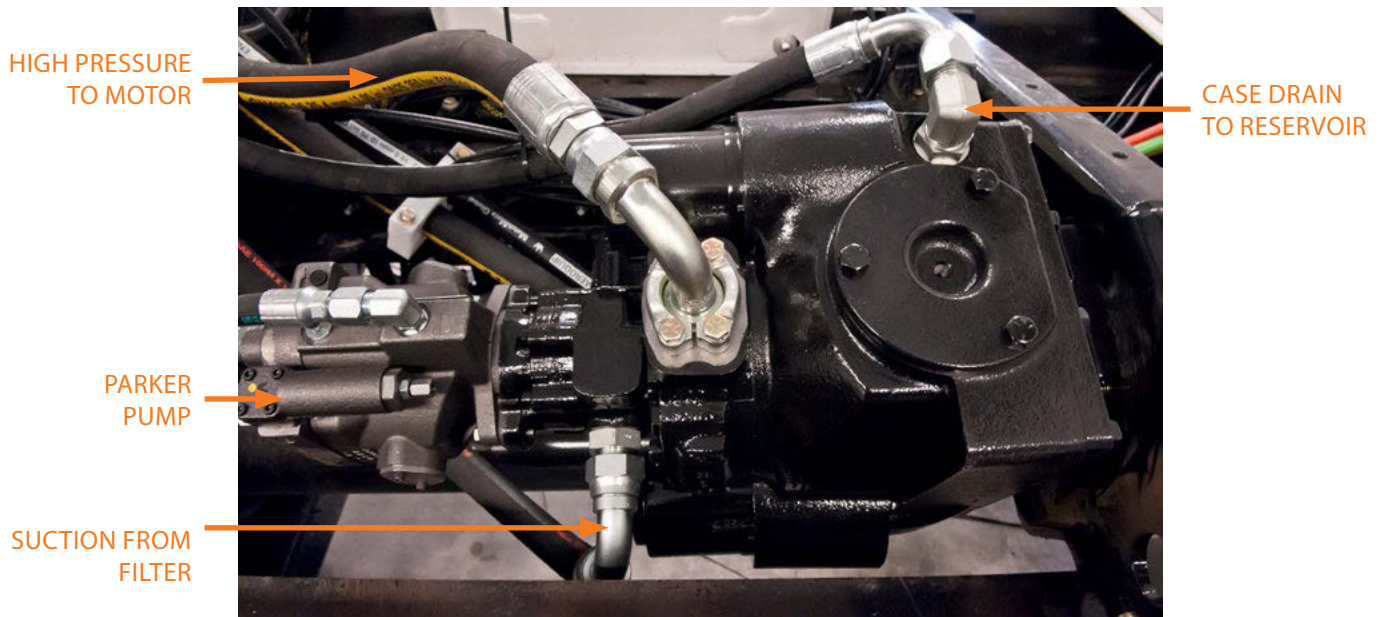
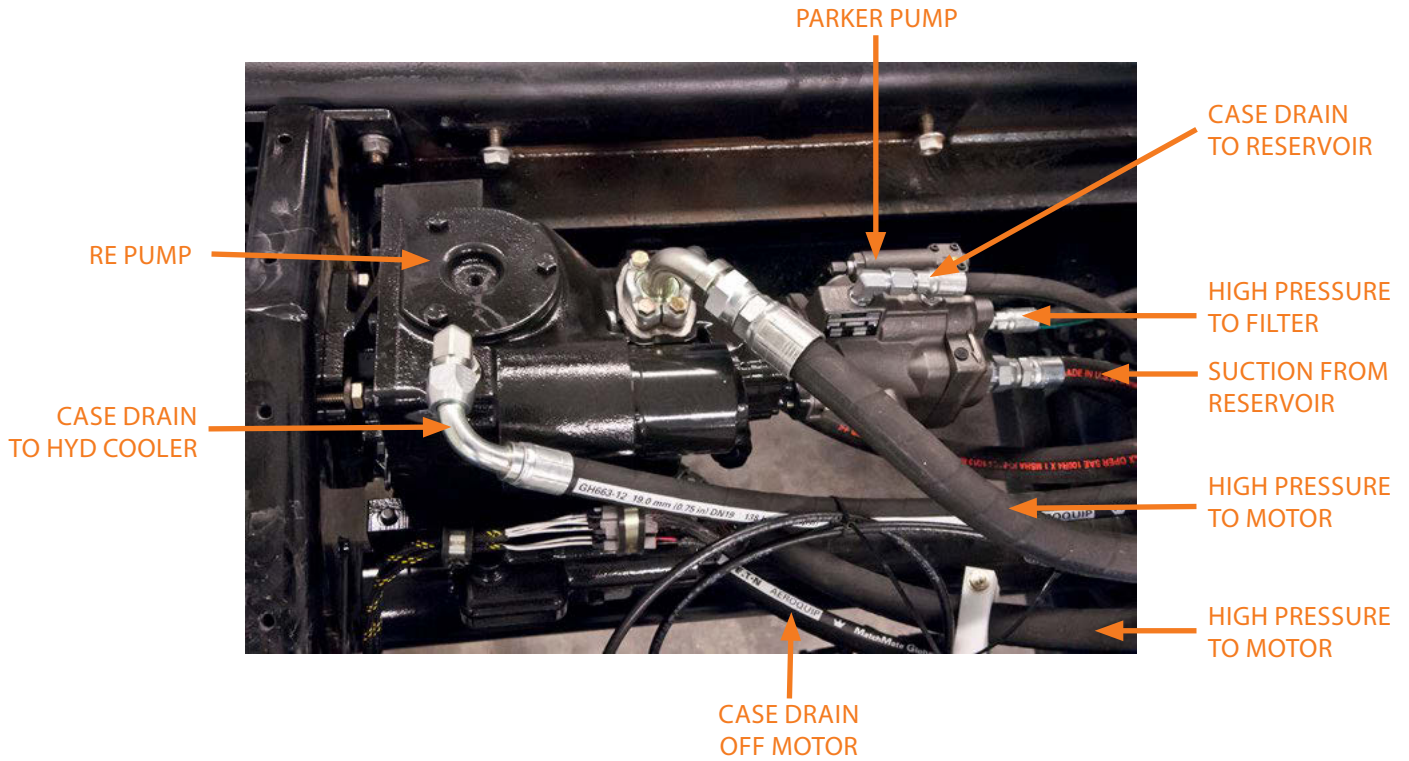
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# HYDRAULIC PUMP



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## HYDRAULIC MOTOR

Your Con-Tech mixer is equipped with an Eaton fixed displacement motor (located on the front of the ZF drive transmission). This motor is responsible for taking the hydraulic flow (and fluid direction) from the pump and driving the drum.

This motor requires VERY little maintenance. The biggest maintenance item that you could see from the motor is the output shaft seal leaking. If you find the ZF gearbox leaking gear lube from the output seal (and running down the head of the drum), immediately check the fluid level in the ZF drum drive. Take precaution in removing the dip stick from the ZF gearbox, as a leaking output seal from the hydraulic motor will create a small amount of pressure inside the ZF unit. Removing the dipstick quickly will result in a spray of gear lube from the gearbox.

If you find the gearbox to be overfilled, a failed output seal on the hydraulic motor is likely the cause. The motor output shaft is leaking hydraulic fluid and the case pressure of the hydraulic system is pushing hydraulic fluid into the gearbox. **Prior to performing ANY repairs, allow system to cool.**

### Seal Replacement:

1. Remove the four bolts holding the motor to the gearbox
2. Slide the motor back out of ZF input housing and rotate upward
3. Remove snap ring that is located on output shaft (of the motor) and remove
4. Remove lip seal located behind snap ring
5. Drive in new lip seal and install new snap ring (included in seal kit)
6. Re-Install motor on gearbox input housing and verify operation
7. Change gear lube in gearbox to remove hydraulic fluid
8. Run drum in charge for 20-30 minutes, inspect for leaks and re-check gearbox fluid level

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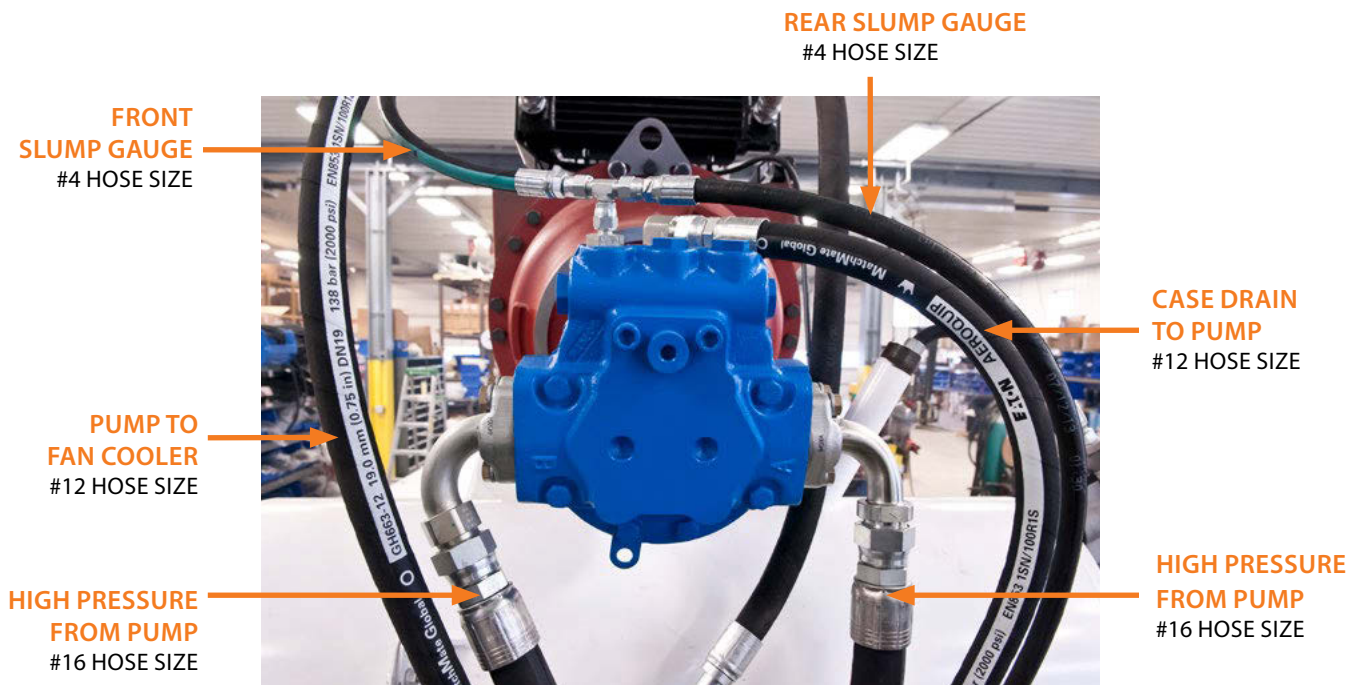
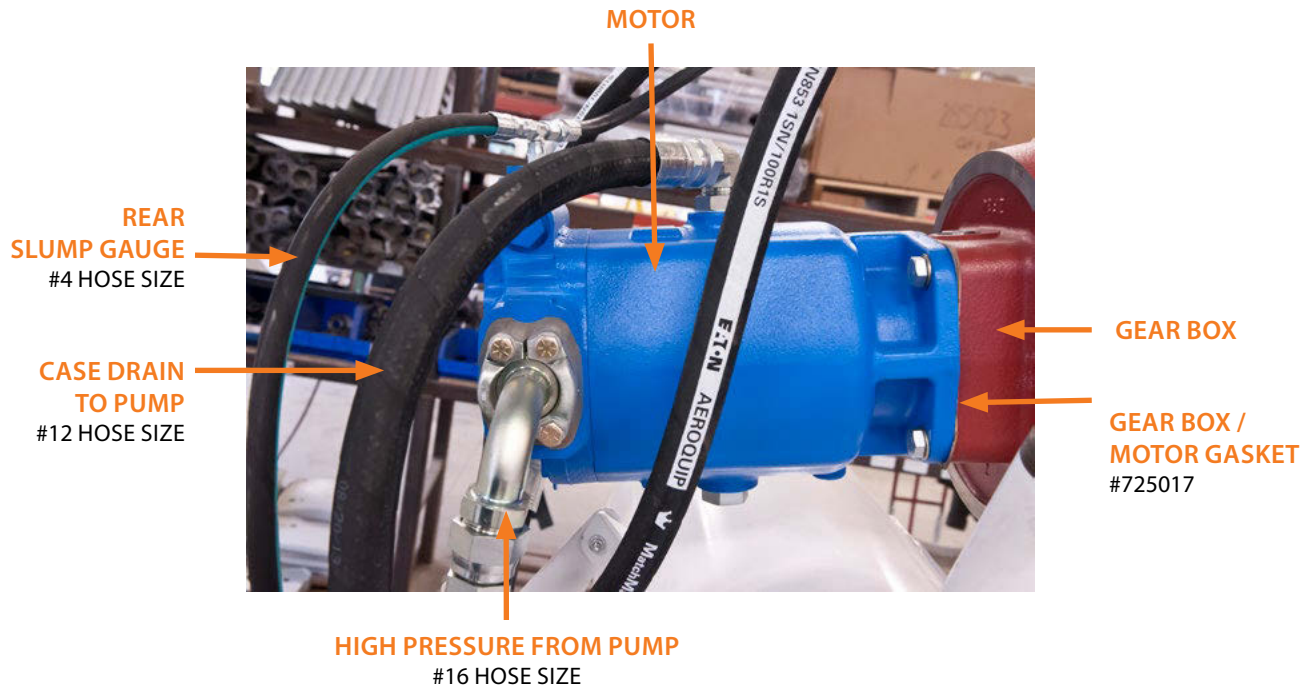
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# HYDRAULIC MOTOR



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## 'RE' PUMP CONTROLS

In the event of an ELECTRICAL failure in the pump control system, please see below for the override procedure to control the direction and speed of the drum.

1. Loosen the set nut counter-clockwise by hand or with pliers/channel locks. Continue to loosen the set nut all the way out till it stops against outer nut. **(Image A)**
2. Now loosen the outer nut counter-clockwise out as far as it will go. It will NOT fall out as there is an internal stop in the cartridge. **(Image B)**
3. Now the electric portion of the controls has been "locked out" and the pump direction/speed is being controlled by the manual lever arm. By rotating the lever arm in/out, you will now control the drum speed and direction. The neutral position of the lever arm will cause the drum to come to a stop. **(Image C)**
4. After the situation has been resolved, to return the pump control to the electric controller, **you must return the manual lever to the middle neutral position.**
5. Next screw the outer handle clockwise and snug it down with a pliers or channel locks.
6. You must then turn the set nut clockwise and snug that down also with pliers or channel locks.

Con-Tech trucks come factory filled with ISO 68 oil

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WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF  
WORK OR MAINTENANCE ON YOUR VEHICLES.**

**A.**



**B.**



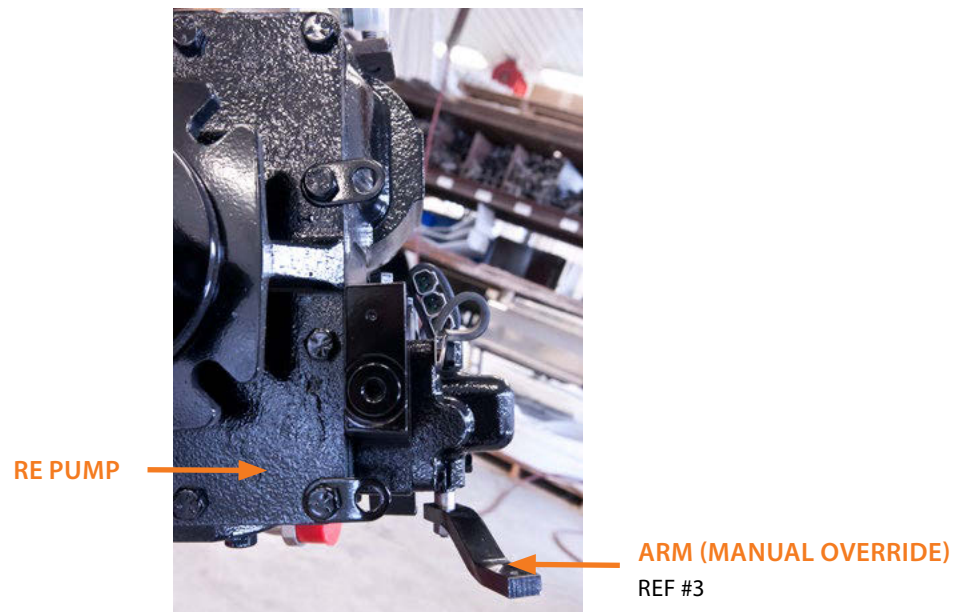
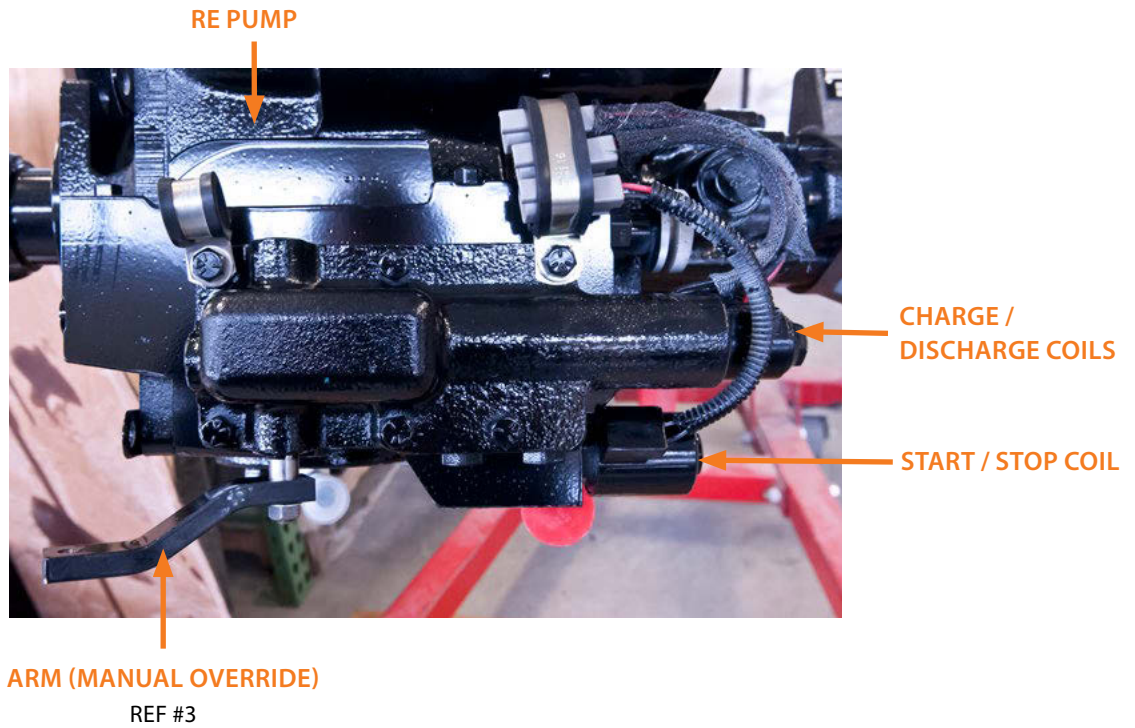
**C.**



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## 'RE' PUMP CONTROLS



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## HYDRAULIC RESERVOIR

Your Con-Tech mixer has either a 13 gallon oil reservoir (Extreme Duty), or a 18 gallon reservoir (BridgeKing®). Because BridgeKing® trucks have the additional BridgeKing® cylinder and high flow, a larger, vented oil reservoir is required.

**A 10 micron breather cap must be installed on all BridgeKing® oil reservoirs.**

Check the reservoirs oil level using the site glass on the end of the reservoir. If oil is not visible in the site glass, oil must be added.

**(Always Check that the BridgeKing® Cylinder/Arm is in the Up Position!)**

Always establish a routine, and use care when filling your oil reservoir. Clean off the fill tube and cap before removing the cap or breather to fill your reservoir. This reduces the risk of contamination.

Use only approved Hydraulic Fluid – **Do Not Use ATF OR ENGINE OIL**

Con-Tech trucks come factory filled with ISO 68 oil.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

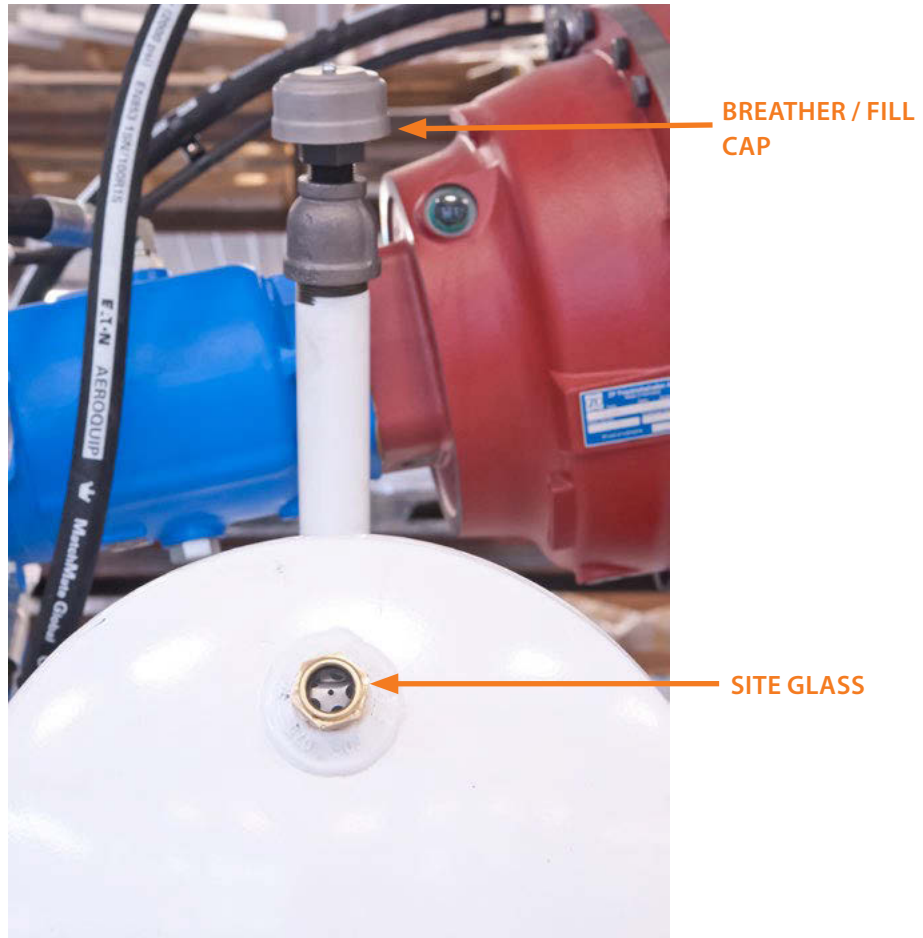
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## HYDRAULIC RESERVOIR



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# TYPICAL HYDRAULIC OIL PROPERTIES



## CHEVRON RANDO® HD ISO 10, 22, 32, 46, 68, 100, 150, 220, 320

### CUSTOMER BENEFITS

Chevron Rando HD oils deliver value through:

- **Longer equipment life** — Special antiwear additive package reduces wear by protecting surfaces when load causes breakdown of the lubricant film.
- **Reduced downtime** — Effective rust and oxidation inhibitor system prevents the production of abrasive particles from rust formation, and deposits, varnishes and sludges from oil breakdown, which can damage equipment surfaces and seals, and block filters prematurely.
- **Trouble-free operation** — Good hydrolytic stability and water separation characteristics provide excellent filterability in the presence of water contamination. Good anti-foam and air release properties ensure smooth operation and system efficiency.
- **Extended oil service life** — High oxidation stability resists oil thickening and deposit formation in service, eliminating the need for unscheduled change of hydraulic fluid.

### FEATURES

Chevron Rando HD **ISO 32, 46, and 68** are designed to give maximum hydraulic pump protection in mobile and stationary systems. They are formulated with ISO SYN® base stocks.

Chevron Rando HD **ISO 100, 150, and 200** are designed for all types of lubricant applications where a premium antiwear lubricant in their ISO viscosity grade is required, such as an AGMA Gear Lubricant or general machinery lubrication.

Chevron Rando HD oils provide excellent:

- antiwear protection
- oxidation and corrosion inhibition
- foam and aeration suppression

Under moderate loads and temperatures, the high viscosity index of Chevron Rando HD oils assures good film strength between metal surfaces and is further enhanced by antiwear additive protection.

### APPLICATIONS

Chevron Rando HD **ISO 10 and 22** can be used as spindle lubricants or as telemotor oils aboard ships.



Chevron Rando HD **ISO 32, 46, or 68** are recommended for:

- vane-, piston-, or gear-type pumps, especially where pressures exceed 1000 psi
- lightly loaded reciprocating compressors
- motors and bearings

Chevron Rando HD **ISO 100, 150, or 220** are recommended for:

- hydraulic equipment reduction gears
- reciprocating air compressors
- plain and antifriction bearings
- circulating oil systems

Chevron Rando HD oils are approved for:

- **Eaton-Vickers** 35VQ25A pump, M-2950-S (Mobile) and I-286-S (Stationary) (ISO 32, 46, 68)
- **Denison** HF-0/T6C, HF-2 (ISO 32, 46, 68)
- **Bosch Rexroth** (ISO 32,46, 68)

Chevron Rando HD oils meet the requirements of:

- **MAG Cincinnati, Cincinnati Machine** P-68 (ISO 32), P-70 (ISO 46), P-69 (ISO-68)
- **General Motors** LS2 Specification, LH for anti-wear hydraulic fluids (ISO 32, 46, 68)
- **ANSI/AGMA** 9005-D94, *Industrial Gear Lubrication*, for gear lubrication as rust and oxidation inhibited gear oils (ISO 46, 68, 100, 150, 220)
- **DIN** 51524-2

Chevron Rando HD **ISO 32, 46, 68, 100, 150, 220, and 320** are certified by **NSF** and are acceptable as lubricants where there is no possibility of food contact (H2) in and around food processing areas. The NSF Nonfood Compounds Registration Program is a continuation of the USDA product approval and listing program, which is based on meeting regulatory requirements of appropriate use, ingredient review and labeling verification.

Do not use in high pressure systems in the vicinity of flames, sparks and hot surfaces. Use only in well ventilated areas. Keep container closed.

## TYPICAL TEST DATA

	10	22	32	46	68	100	150	220	320
Product Number	273252	273276	273277	273278	273279	273228	273280	273281	277316
MSDS Number	23706	23548	23556	23556	23556	23550	23550	23550	23550
AGMA Grade	—	—	—	1	2	3	4	5	6
API Gravity	27.7	33.7	32.6	31.8	31.6	30.1	29.7	28.5	27.4
Viscosity, Kinematic cSt at 40°C cSt at 100°C	10.3 2.5	23.1 4.4	30.4 5.2	43.7 6.5	64.6 8.4	95.0 11.0	143 14.2	209 18.2	304 23.4
Viscosity, Saybolt SUS at 100°F SUS at 210°F	63 35	120 41	157 44	225 48	334 54	495 64	751 76	1105 93	1617 117
Viscosity Index	48	98	99	97	98	100	97	96	96
Flash Point, °C(°F)	154(309)	177(351)	220(428)	226(439)	235(455)	250(482)	260(500)	271(520)	277(531)
Pour Point, °C(°F)	-39(-38)	-36(-33)	-33(-27)	-30(-22)	-30(-22)	-15(+5)	-12(+10)	-12(+10)	-12(+10)
Oxidation Stability Hours to 2.0 mg KOH/g acid number, ASTM D 943	—	—	>5000	>5000	>5000	>2000	>1500	>1000	>1000

Typical test data are average values only. Minor variations which do not affect product performance are to be expected in normal manufacturing.

# HYDRAULIC SUCTION FILTER

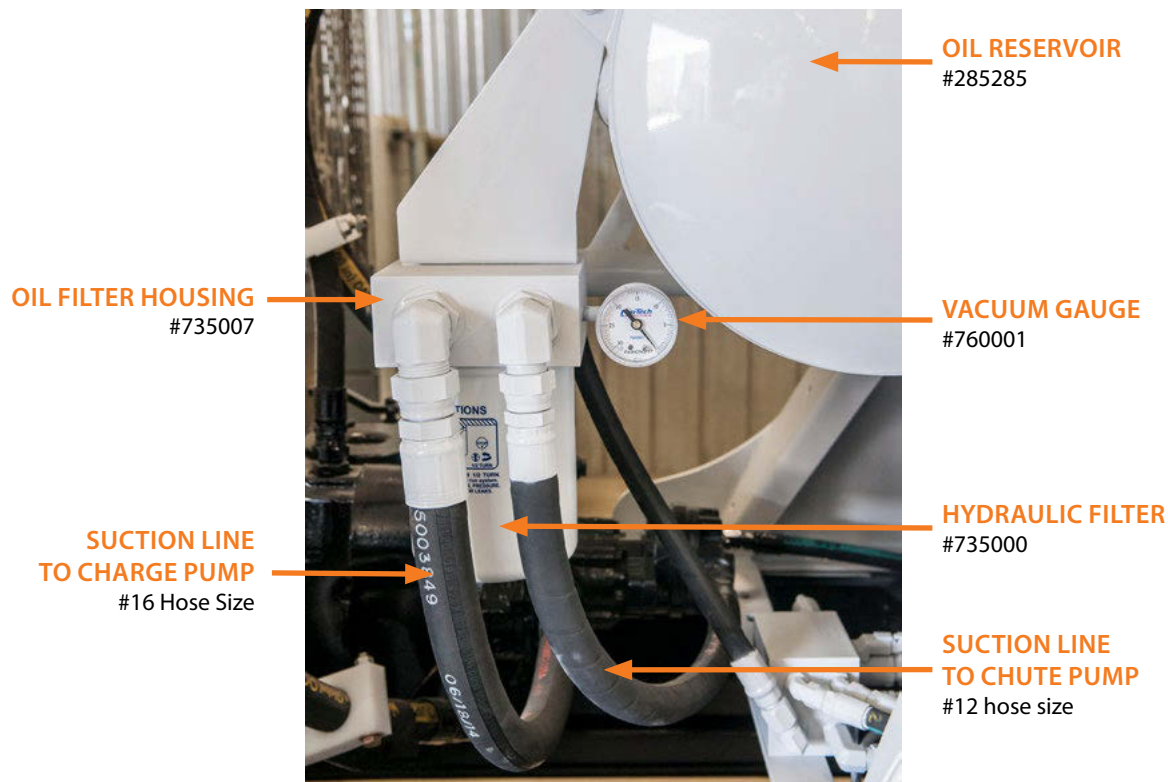
Every Con-Tech mixer uses a 10 micron hydraulic suction filter to protect the hydraulic system from contaminants. This filter is placed in the suction line to the pump. You should change your filter every time you replace your hydraulic fluid. **When a mixer is new, the filter and fluid must be changed at 100 hours.** After the initial service, change after 1000 hours, or every six months (**ONLY USE APPROVED OEM FLUIDS**). Always check your suction filter vacuum gauge when the oil is at operating temperature. At operating temperature you should read between 0 to 5 inches of vacuum. If you're reading over 10 inches of vacuum you should check your gate valve to make sure it is open, or replace your fluids and filter.

Use only approved Hydraulic Fluid – **Do Not Use ATF OR ENGINE OIL**  
 Con-Tech trucks come factory filled with ISO 68 oil.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**

## EXTREME DUTY



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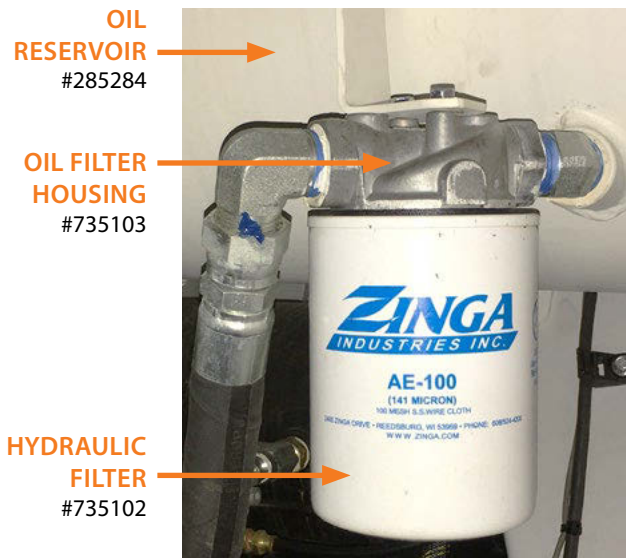
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# HYDRAULIC SUCTION FILTER

## Extreme Duty



## BridgeKing®



DO NOT PAINT THIS LABEL / NO PINTAR ENCIMA DE ESTA ETIQUETA

**NOTICE**

REPLACE 100 MESH FILTER ANNUALLY USING CON-TECH PART #735102

**Con-Tech**  
MANUFACTURING, INC.

507-374-2239 www.ctmmixers.com

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## HYDRAULIC FAN COOLER

Your Con-Tech Mixer is equipped with an ASA brand fan cooler. It is designed for maximum heat dissipation and durability.

The cooler is designed to come on at 158°F. As a general rule of thumb, your hydraulic system will run approximately 100°F above ambient (outside) temperature. This gives you an idea of when you should expect (or not to expect) to see the cooler running. During times of heavy use or extreme heat, it is not uncommon to see the cooler running continuously.

The LED indicator in the cab console will light yellow when the cooler is running. If the light/fan come on immediately when ignition key is turned on (when system is cold) OR you do not see the light on (in times of extreme use or heat), please contact your maintenance manager OR Con-Tech Service at 507-374-2239 immediately. Prolonged use with an inoperative fan cooler (or a continuously operating fan cooler) can cause damage to the electrical system and/or hydraulic system.

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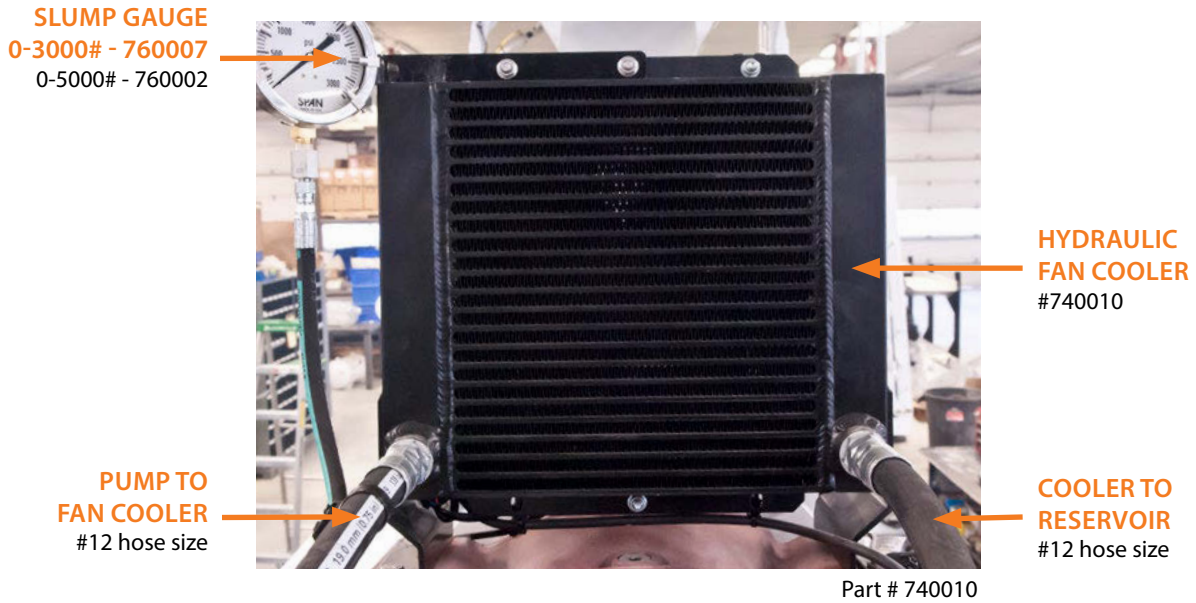
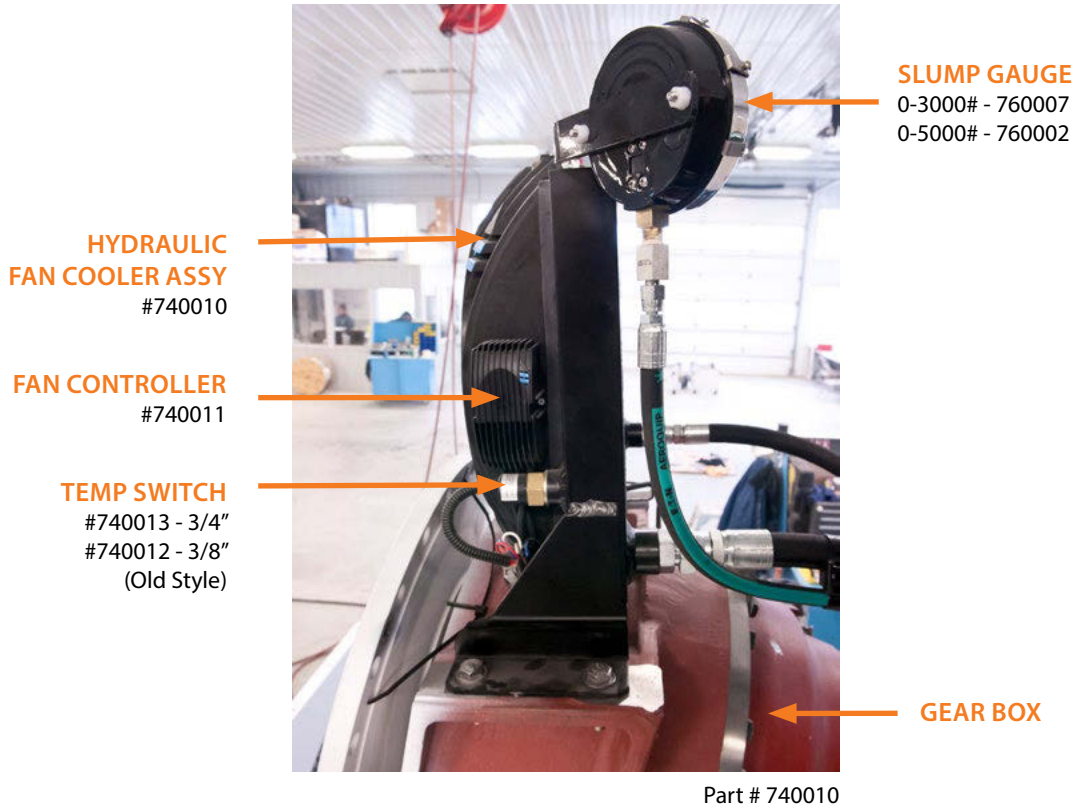
← **HYDRAULIC  
FAN COOLER ASSY**  
#740010



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# HYDRAULIC FAN COOLER



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# Hydraulics

## Series 1 Heavy Duty Hydrostatic Fixed Displacement Motors

Parts and Service

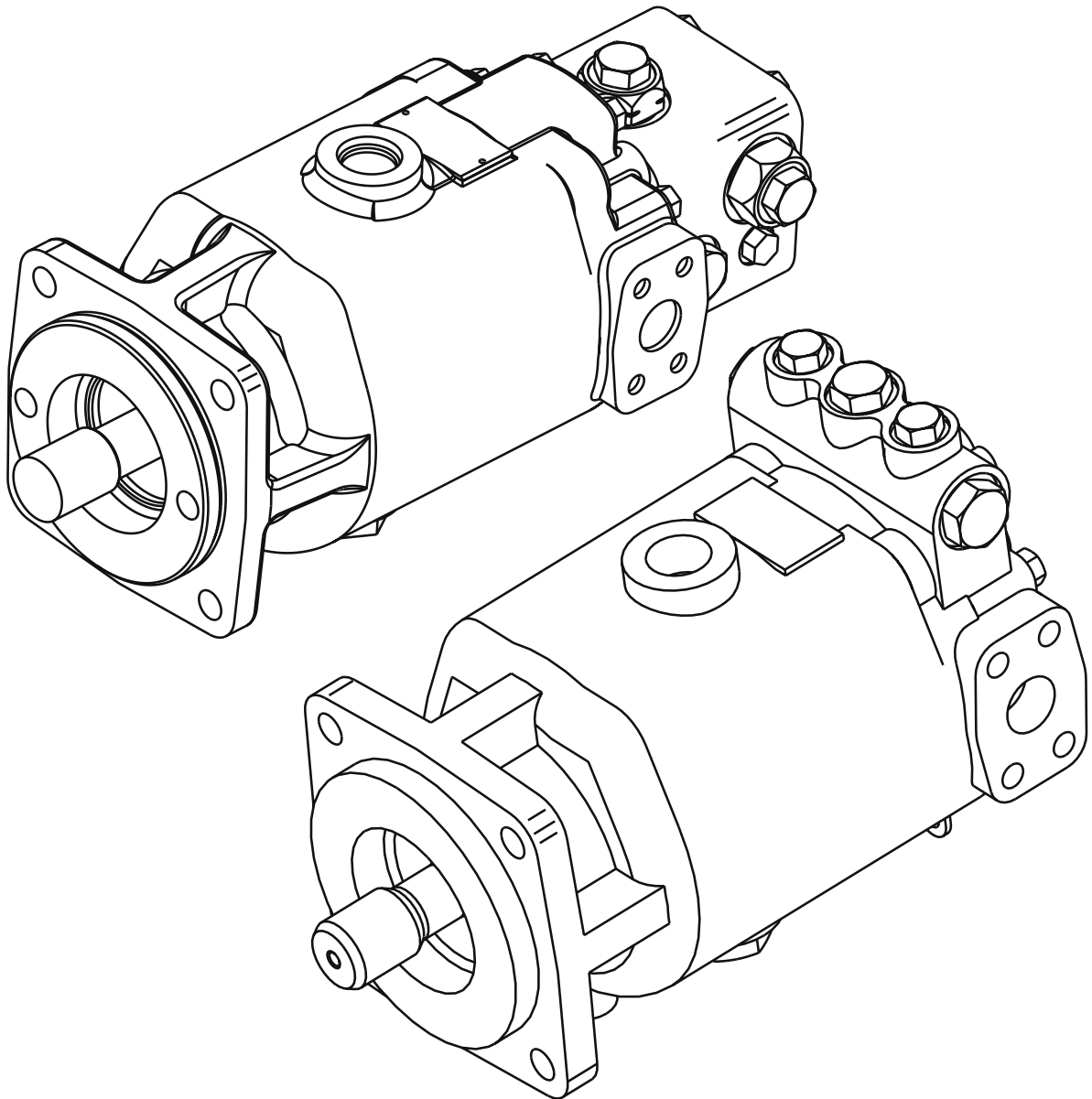
Model 3331/3333

Model 5431/5433

Model 3931/3933

Model 6431/6433

Model 4631/4631



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Series 1  
Hydrostatic  
Fixed Motor

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# Introduction

This manual will provide you with service information and procedures for disassembly and reassembly of Eaton® Series 1 Heavy Duty Hydrostatic Fixed Displacement Motors – Models 33, 39, 46, 54, and 64. Procedures outlined in this manual will allow you to better service your motors and obtain the best results possible. To ensure accuracy of repair and prevent part loss or damage, certain components or subassemblies are disassembled, inspected, and reassembled when removed from the motor.

Note: All requests or inquiries must be accompanied by the complete model and serial number.

**Important:** Cleanliness is extremely important when repairing a hydrostatic pump or motor. Before disconnecting the lines, clean foreign material from exterior of unit. Work in a clean area. Clean all metal parts in clean solvent. Blow parts dry with air. Don't wipe parts with cloth or paper towel, because lint or other matter could cause damage. Check all mating surfaces. Replace any parts that have scratches or burrs that could cause leakage. Don't use coarse grit paper, files or grinders on parts.

**Note:** All torque specifications are for lubricated threads. Bolts for gasketed surfaces should be checked for proper torque.

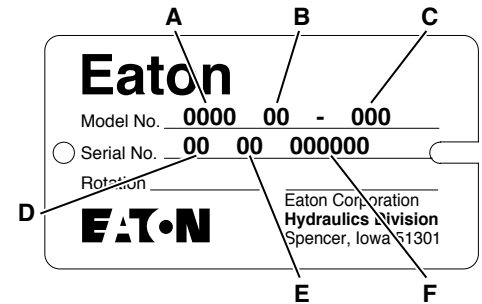
A good service policy is to replace all old seals with new seals whenever unit is disassembled. Lubricate seals (except metal sealing surfaces of shaft seal assembly) with petroleum jelly. Use only clean, recommended oil when assembling unit. See Hydrostatic Fluid Recommendations on page 28-29 or publication 03-401 and 03-405.

## ID Tag

Refer to specific motor assembly part listings for your Eaton motor when ordering replacement parts. Parts Lists are available from Eaton. Sample tag shows motor identification.

When ordering replacement parts, you must include the following information:

- A** - Displacement (cu.in./rev.)
  - 0033 = 3.3
  - 0039 = 3.9
  - 0046 = 4.6
  - 0054 = 5.4
  - 0064 = 6.4
- B** - Identifies Type of Product
  - 31 = Fixed Displacement Motor with Face Seal
  - 33 = Fixed Displacement Motor with Lip Seal
- C** - Identifies Specific Unit Configuration
- D** - Month of Manufacture
- E** - Year of Manufacture
- F** - Specific Serial Number of Unit

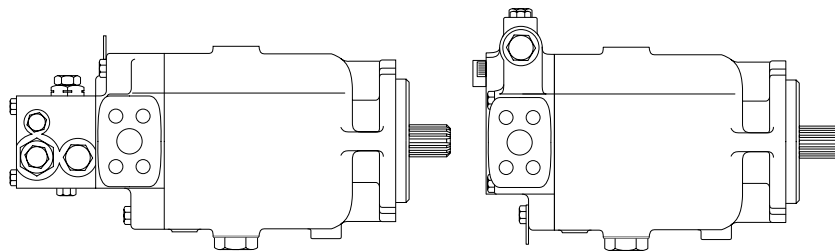


## Tools Required

- Stationary Seal Puller (1/4 in. x 20 UNC capscrew, 3 to 4 in. long)
- Retaining Ring Pliers, No. 5 or 7
- Breaker Bar or Ratchet Wrench
- 1-3/8 in. Hex Wrench
- 1 in. Hex Wrench
- 9/16 in. Socket
- 5/8 in. Socket
- Torque Wrench (200 lb-ft capacity)
- 1/4 in. Hex Bit Socket
- 1/4 in. Hex Key
- Loctite® No. 271
- Pliers
- Punch
- Magnetic Base Indicator
- Hammer
- Bearing Press or Driver
- Light Petroleum Jelly
- Cleaning Solvent
- Micrometer or Vernier Calipers
- Small Screwdriver (1/8 in. blade)
- Clean Lint Free Rags
- Special Tools needed (shown on pages 26 and 27).
- Bearing Cone Driver
- Rotating Seal Puller
- Limit Stop for Bearing Cone Installation
- Headless 5/16 in. Cap Screws, 5 to 6 in. Long (2)
- Low Clearance Bearing Puller

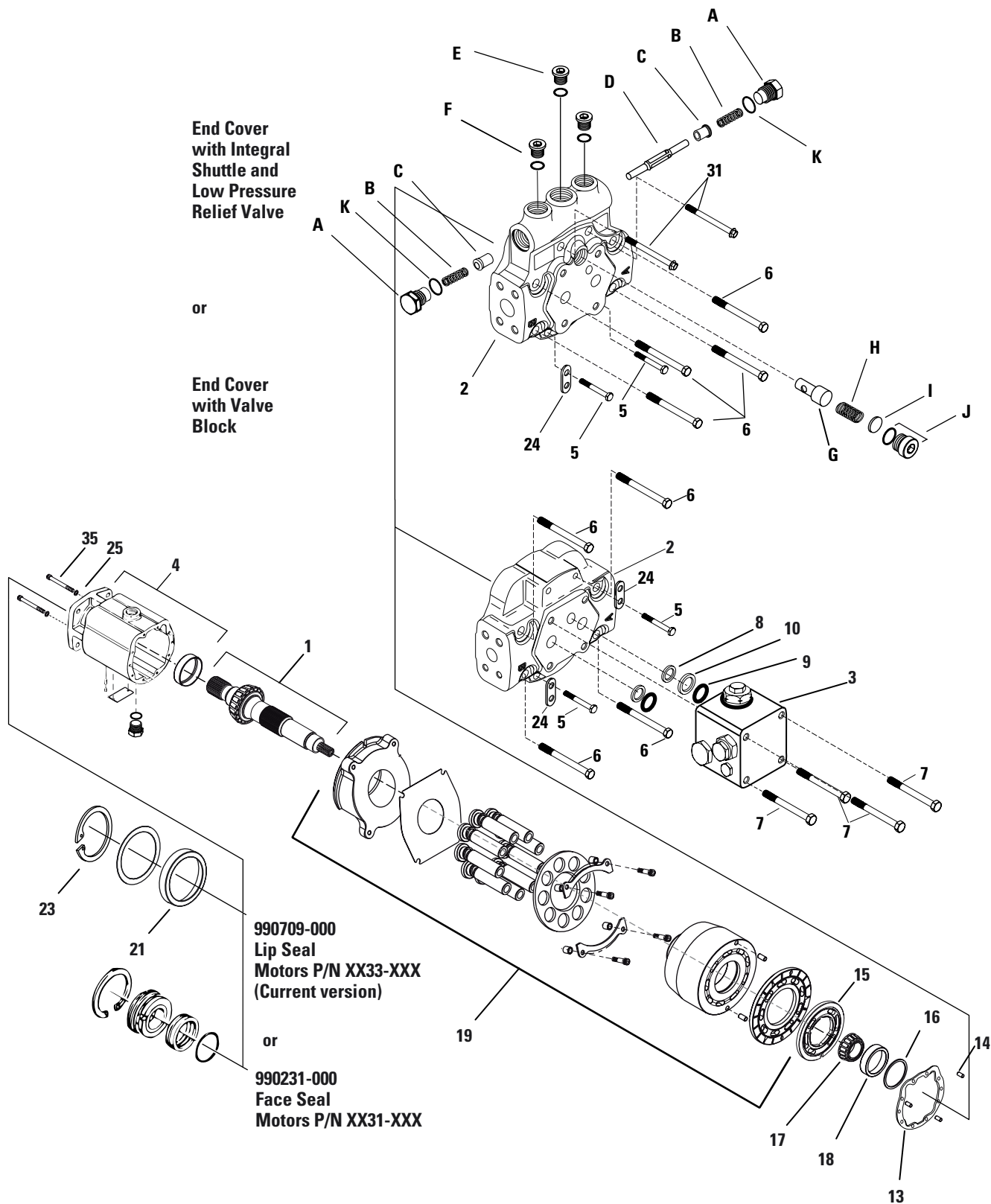
# Parts

## Assembly Drawing



Motors with Valve Blocks

Motors with Integral Shuttle and Low Pressure Relief Valves



# Parts

## Table 1.0 Parts List

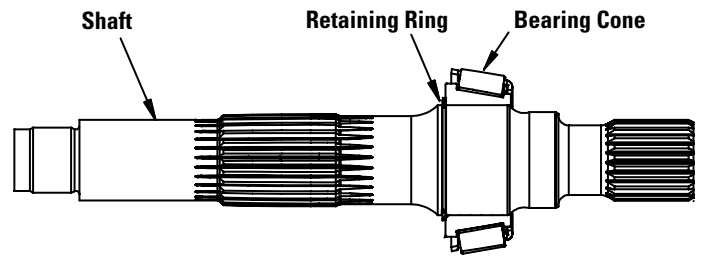
ITEM NO.	PART NO.	QTY.	DESCRIPTION	REFERENCE PAGES
1	See Table 2.0	1	Output Drive Shaft Subassembly for Motors with Lip Seal XX33-XXX (Current Production)	6
1	See Table 2.1	1	Output Drive Shaft Subassembly for Motors with Face Seal XX31-XXX	6-8
2	See Table 3.1	1	End Cover Subassembly for Motors with Integral Shuttle and Low Pressure Relief Valve	9
3	See Table 4.0, 4.1	1	End Cover for Motors with Valve Block Subassembly	10
3	See Table 4.2	1	Valve Block Subassembly	10
4	See Table 6.0	1	Fixed Motor Housing Subassembly	13
5	See Table 4.0	2	Hex Head Bolt 3/8-16 GR 8	9
6	See Table 4.0	4	Hex Head Bolt 3/8-16 GR 8	9
6	See Table 4.0	6	Hex Head Bolt 3/8-16 GR 8	9
7	See Table 4.0	4	Hex Head Bolt 3/8-16 GR 5	9
8	8775-021	1	Square Cut Seal Ring	
9	8765-118	2	O-ring	
10	101129-000	2	Back-up Ring	
13	103224-000	1	End Cover Gasket (model 33/39/46)	
13	103877-000	1	End Cover Gasket (model 54/64)	
14	98202-000	3	Dowel Pin (5/16 x 5/8 long)	
15	103230-000	1	33/39 Motor Valve Plate	
15	104189-000	1	46 Motor Valve Plate	
15	105104-000	1	54 Motor Valve Plate	
15	105099-000	1	64 Motor Valve Plate	
16	See Table 7.0		End Cover Bearing Shims	13
17	See Table 6.0	1	Bearing Cup*	13
18	See Table 6.0	1	Bearing Cone*	13
19	See Table 5.0-5.2	1	Rotating Group Subassembly	12
21	See Table 7.0	1	Seal Kit for Motors with Lip Seal only XX33-XXX (Current Production)	13
21	See Table 7.0	1	Seal Kit for Motors with Face Seal only XX31-XXX	13
23	See Table 7.0	1	Retaining Ring for Lip Seal	13
24	96558-000	2	Lifting Strap (models 33/39/46)	
24	96559-000	2	Lifting Strap (models 54/64)	
25	103223-000	2	Sealing Washer	
31	104511-300	2	Cap Screw, Socket Hd 3/8-16	
35	95912-300	2	Cap Screw, Socket Hd 5/16-18	

\*Cannot be purchased separately.

# Parts

## Drive Shaft

(Item 1)



**Table 2.0 Output Drive Shaft Assembly For Motors XX33-XXX (Lip Seal Design)**

### Models 3333-3933-4633

SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
112459-000	112458-000	103227-000	103222-188	23 Tooth, 16/32 Pitch Spline
112463-000	112462-000	103227-000	103222-188	20 Tooth, 16/32 Pitch Spline (3/8-24) UNF x [.75] DP
112465-000	112464-000	103227-000	103222-188	21 Tooth, 16/32 Pitch Spline
112467-000	112466-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline
112480-000	112479-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline, Speed Sensor
112482-000	112481-000	103227-000	103222-188	21 Tooth, 16/32 Pitch Spline, Speed Sensor
112498-000	112497-000	103227-000	103222-188	1.5 Diameter Straight with [.3750] X [2.5] Square key
112500-000	112499-000	103227-000	103222-188	19 Tooth, 16/32 Pitch Spline
112504-000	112503-000	103227-000	103222-188	1.375 Diameter Tapered W/ [.375] X [1.00] Square key
112506-000	112505-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline (3/8-24) UNF x [.75] DP
112508-000	112507-000	103227-000	103222-188	23 Tooth, 16/32 Pitch SplinePitch Spline (3/8-24) UNF x [.75] DP
112510-000	112509-000	103227-000	103222-188	19 Tooth, 16/32, Pitch Spline, Speed Sensor
112519-000	112518-000	103227-000	103222-188	20 Tooth, 16/32, Pitch Spline, Speed Sensor
112521-000	112520-000	103227-000	103222-188	1.5 Diameter Straight W/ [.3750] X [2.5] Square key, (3/8-24) UNF x [.75] DP
112525-000	112524-000	103227-000	103222-188	1.5 Tapered with [.375] X [1.00] Square key
114289-000	114288-000	103227-000	103222-188	21 Tooth, 16/32 Pitch Spline (M10 x 1.5 threaded hole)

### MODELS 5433-6433

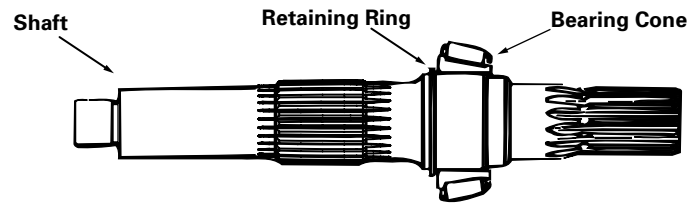
SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
112484-000	112483-000	103808-000	103222-200	14 Tooth, 12/24 Pitch Spline
113201-000	113201-000	103808-000	103222-200	23 Tooth, 16/32 Pitch Spline
113338-000	113337-000	103808-000	103222-200	21 Tooth, 16/32 Pitch Spline
113344-000	113343-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline, Speed Sensor
113346-000	113345-000	103808-000	103222-200	23 Tooth, 16/32 Pitch Spline (3/8-24) UNF x [.75] DP
113348-000	113347-000	103808-000	103222-200	1.375 Diameter Tapered W/ [.375] X [1.00] Square Key
113350-000	113349-000	103808-000	103222-200	1.5 Diameter Straight W/ [.3750] X [2.5] Square Key
113352-000	113251-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline, Speed Sensor
113356-000	113355-000	103808-000	103222-200	14 Tooth 12/24 Pitch Spline, Speed Sensor
113358-000	113357-000	103808-000	103222-200	1.5 Diameter Straight W/ [.3750] X [2.5] Square Key, (3/8-24) UNF x [.75] DP
113360-000	113359-000	103808-000	103222-200	21 Tooth, 16/32 Pitch Spline (3/8-24) UNF x [.75] DP
113362-000	113361-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.3750] X [2.5] Square Key, Speed Sensor
113364-000	113363-000	103808-000	103222-200	21 Tooth, 16/32 Pitch Spline W/ (M10 x 1.5 threaded hole)
113811-000	113810-000	103808-000	103222-200	14 Tooth, 12/24 Pitch Spline (3/8-24) UNF x [.75] DP
114816-000	114815-000	103808-000	103222-200	19 Tooth, 16/32 Pitch Spline



# Parts

## Drive Shaft

(item 1)



**Table 2.1 Output Drive Shaft Assembly For Motors XX31-XXX (Face Seal Design)**

**MODEL 3331-3931**

SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
103226-000	103229-000	103227-000	103222-188	21 Tooth, 16/32, Pitch Spline
104378-000	104396-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline
105197-000	105196-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline, Speed Sensor
105353-000	105352-000	103227-000	103222-188	21 Tooth, 16/32, Pitch Spline, Speed Sensor
105380-000	105379-000	103227-000	103222-188	[1.500] Diameter Straight W/ [.3750] X [2.5] Square Key
105391-000	105392-000	103227-000	103222-188	19 Tooth, 16/32, Pitch Spline
105426-000	105427-000	103227-000	103222-188	[1.500] Diameter Straight W/ [.3750] X [2.5] Square Key
105451-000	105450-000	103227-000	103222-188	[1.375] Diameter Taper W/ [.375] X [1.00] Woodruff Key
107519-000	107518-000	103227-000	103222-188	14 Tooth, 12/24 Pitch Spline, 3/8-24
110106-000	110098-000	103227-000	103222-188	23 Tooth, 16/32, Pitch Spline, 3/8-24 UNF x [.75] DP
111122-000	111121-000	103227-000	103222-188	19 Tooth, 16/32, Pitch Spline, Speed Sensor

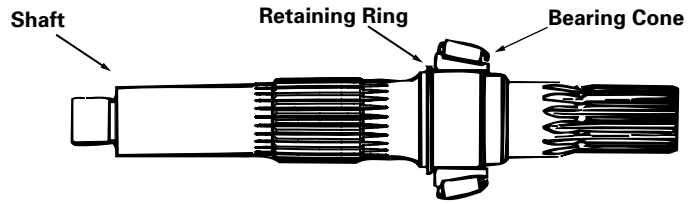
**Model 4631**

SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
103579-000	103577-000	103227-000	103222-188	23 Tooth, 16/32, Pitch Spline
104190-000	104192-000	103227-000	103222-188	14 Tooth 12/24, Pitch Spline
105123-000	105121-000	103227-000	103222-188	21 Tooth, 16/32, Pitch Spline, Speed Sensor
105364-000	105365-000	103227-000	103222-188	20 Tooth, 16/32, Pitch Spline, 3/8-24 UNF x [.75] DP
105449-000	105448-000	103227-000	103222-188	19 Tooth, 16/32, Pitch Spline
106910-000	106909-000	103227-000	103222-188	20 Tooth, 16/32, Pitch Spline, Speed Sensor
107315-000	107314-000	103227-000	103222-188	[1.500] Diameter Straight W/ [.3750] X [2.5] Square key, 3/8-24 UNF x [.75] DP
109261-000	109260-000	103227-000	103222-188	14 Tooth 12/24, Pitch Spline, Speed Sensor
110107-000	110099-000	103227-000	103222-188	23 Tooth, 16/32, Pitch Spline, 3/8-24
111052-000	111051-000	103227-000	103222-188	[1.500] Diameter Taper W/ [.375] X [1.00] Square Key
111780-000	111779-000	103227-000	103222-188	19 Tooth, 16/32, Pitch Spline, Speed Sensor

# Parts

## Drive Shaft

(item 1)



### Output Drive Shaft Assembly For Motors XX31-XXX (Face Seal Design)

#### Model 5431

SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
105052-000	105057-000	103808-000	103222-200	14 Tooth 12/24, Pitch Spline
105060-000	105061-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline
105070-000	105071-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline, Speed Sensor
105170-000	105167-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline
105331-000	105332-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline W/ 3/8-24 UNF x [.75] DP
105335-000	105336-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.375] X [2.5] Square key
106143-000	106142-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline, Speed Sensor
108211-000	108203-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.375] X [2.5] Square Key, 3/8-24 UNF x [.75] DP
110692-000	110691-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline W/ 3/8-24 UNF x [.75] DP
111602-000	111601-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline W/ M10 X 1.5 threaded hole

#### MODEL 6431

SHAFT ASSEMBLY	SHAFT	BEARING CONE	RETAINING RING	DESCRIPTION
104640-000	105053-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline
105062-000	105063-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline
105066-000	105067-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline
105270-000	105269-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline, Speed Sensor
105356-000	105357-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.3750] X [2.5] Square key
107355-000	107354-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.3750] X [2.5] Square key, 3/8-24 UNF x [.75] DP
107632-000	107631-000	103808-000	103222-200	23 Tooth, 16/32, Pitch Spline, 3/8-24 UNF x [.75] DP
111141-000	111142-000	103808-000	103222-200	[1.500] Diameter Straight W/ [.3750] X [2.5] Square key
111591-000	111590-000	103808-000	103222-200	21 Tooth, 16/32, Pitch Spline, Speed Sensor
113438-000	113437-000	103808-000	103222-200	14 Tooth 12/24, Pitch Spline

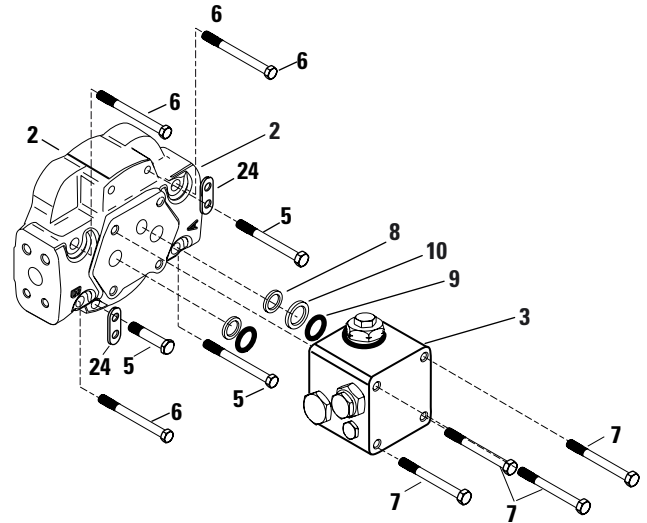
# Parts

## End Cover

(Item 2)

**Table 3.0 End Cover Bolt Matrix**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
5	103090-150	2	Hex Head Bolt 3/8-16 GR 8 (models 33/39/46)
5	103091-200	2	Hex Head Bolt 3/8-16 GR 8 (models 54/64)
6	103090-275	4	Hex Head Bolt 3/8-16 GR 8 (models 33/39/46)
6	103091-300	4	Hex Head Bolt 3/8-16 GR 8 (models 54/64)
7	95863-400	4	Hex Head Bolt 3/8-16 GR 5 (Valve Block)
31	104511-300	2	Hex Head Bolt 3/8-16 (Integral Shuttle)



**Table 3.1 End Cover with Integral Shuttle and Low Pressure Relief Valve**

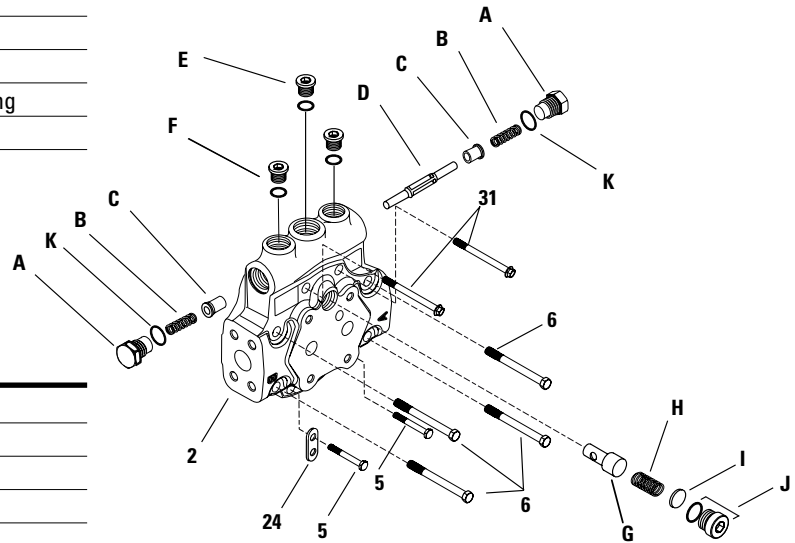
ITEM NO.	PART NO.	QTY.	DESCRIPTION
A	104635-000	2	Shuttle Valve Plug/O-ring
B	101730-00	2	Shuttle Spring (Low-Rate)
B	102530-000	2	Shuttle Spring (High-Rate)
C	101727-000	2	Shuttle Valve
D	102418-000	1	Shuttle Spool
E	25090-008	1	Gauge Port Plug/O-ring
F	25090-006	2	Gauge Port Plug/O-ring
G	104634-000	1	Plunger
H	See table 3.3	1	Low Pressure Relief Valve Spring
I	104659-XXX	A/R	Low Pressure Relief Valve Shims
J	104657-000	1	Low Pressure Relief Valve Plug/O-ring
K	8785-010	2	O-ring

A/R – As Required

**Table 3.2 Low Rate Shuttle Valve Service Kit Motors with Integral Shuttle**

**Kit No. 990851-000**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
A	104635-000	2	Shuttle Valve Plug/O-ring
B	101730-000	2	Shuttle Spring (Low-Rate)
C	101727-000	2	Shuttle Valve
D	102418-000	1	Shuttle Spool
K	8785-010	2	O-ring



**Table 3.3 Low Pressure Relief Valve Spring (Integral Shuttle Motor Design)**

SPRING P/N	PRESSURE SETTING RANGE bar[lbf/in <sup>2</sup> ]
104658-000	11,0 [160]- 16,5[240]
110272-000	19,3[280] - 20,7[300]

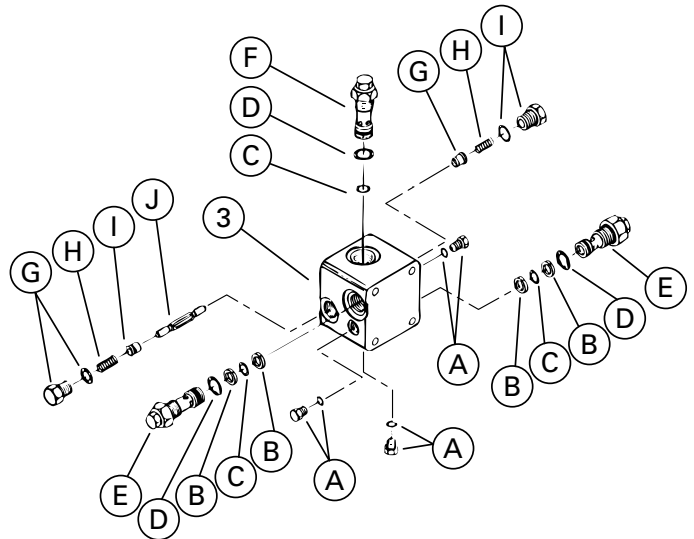
# Parts

## Valve Block

(Item 3)

**Table 4.0 Valve Block Subassembly**

ITEM			
NO.	P/N	QTY.	DESCRIPTION
A	25090-004	3	Gauge Port Plug/O-ring
B	96083-062	4	Back-up Ring
C	8765-017	3	O-ring
D	8785-010	3	O-ring
E	(See Table 4.2)	2	High Pressure Relief Cartridge 101047-XXX
F	(See Table 4.2)	1	Low Pressure Relief Cartridge 101048-XXX
G	101727-000	2	Shuttle Valve
H	(See Table 4.2)	2	Shuttle Spring
L	101729-000	2	Shuttle Valve Plug/O-ring
J	102418-000	1	Shuttle Spool



**Table 4.1**

### Low Pressure Relief Valve Setting Designation

PART NUMBER-XXX	bar [lbf/in <sup>2</sup> ]
XXXXX-016	= 11 [160]
XXXXX-020	= 13,7 [200]
XXXXX-022	= 15,2 [220]
XXXXX-024	= 16,5 [240]
XXXXX-026	= 17,9 [260]
XXXXX-028	= 19,3 [280]

**Table 4.2**

### High Pressure Relief Valve Setting Designation

PART NUMBER-XXX	bar [lbf/in <sup>2</sup> ]
XXXXX-150	= 103,4 [1500]
XXXXX-200	= 137,9 [2000]
XXXXX-250	= 172,4 [2500]
XXXXX-300	= 206,8 [3000]
XXXXX-350	= 241,3 [3500]
XXXXX-400	= 275,8 [4000]
XXXXX-450	= 310,3 [4500]
XXXXX-500	= 344,7 [5000]
XXXXX-525	= 379,2 [5200]
XXXXX-550	= 396,4 [5500]
XXXXX-600	= 413,7 [6000]
XXXXX-650	= 448,1 [6500]*
XXXXX-675	= 465,4 [6750]*

\*Do not set this pressure level without Eaton Engineering approval

# Parts

## Valve Block Kits

**Table 4.3 Valve Block Subassembly**

VALVE BLOCK S/A	BLOCK	*HPRV A-PORT	*HPRV B-PORT	LPRV	SHUTTLE SPRING	DESCRIPTION
101732-XXX	107131-000	101047-XXX	101047-XXX	101048-016	101730-000	160 psi, LPRV, High Rate
102687-XXX	107131-000	101047-XXX	101047-XXX	101048-022	101730-000	220 psi, LPRV, High Rate
102769-XXX	107131-000	101047-XXX	101047-XXX	101048-020	101730-000	200 psi, LPRV, High Rate
103062-XXX	107131-000	101047-XXX	101047-XXX	103355-016	101730-000	160 psi, Orifice LPRV, Low Rate
103071-XXX	107131-000	101047-XXX	101047-XXX	101048-028	101730-000	280 psi, LPRV, High Rate
103533-XXX	107131-000	103114-XXX	103114-XXX	101048-028	101730-000	280 psi, LPRV, High Rate, HPRV w/THD. Retainer
104923-XXX	107131-000	103114-XXX	103114-XXX	103355-016	101730-000	160 psi, Orifice LPRV, Low Rate, HPRV w/THD. Retainer
104955-XXX	107131-000	103114-XXX	103114-XXX	101048-016	101730-000	160 psi, LPRV, High Rate, HPRV w/THD. Retainer
105941-XXX	107131-000	101047-XXX	101047-XXX	101048-028	102530-000	280 psi, LPRV, High Rate
105963-XXX	107131-000	103114-XXX	103114-XXX	103355-022	102530-000	220 psi, Orifice, LPRV, Low Rate HPRV w/THD. Retainer
105964-XXX	107131-000	103114-XXX	103114-XXX	101048-028	102530-000	280 psi, LPRV, High Rate, HPRV w/THD. Retainer
106707-XXX	107131-000	101047-XXX	101047-XXX	101048-018	101730-000	180 psi, LPRV, High Rate
107134-000	-	-	-	-	-	End Cover Sealing Plate
107149-XXX	107131-000	103114-XXX	103114-XXX	103355-016	102530-000	160 psi, Orifice LPRV, Low Rate, HPRV w/THD. Retainer
107196-XXX	107131-000	101047-XXX	101047-XXX	103072-030	101730-000	300 psi, LPRV, High Rate
110618-XXX	107131-000	101047-XXX	101047-XXX	101048-024	101730-000	240 psi, LPRV, High Rate

\*Note: High pressure relief setting XXX=lbf/in<sup>2</sup>

**Table 4.4 Low Rate Shuttle Valve Service Kit**

**Kit No. 990202-000**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	8785-010	2	Tube Fitting, O-ring
2	101729-000	2	Valve plug
3	102530-000	2	Shuttle Valve Spring
4	102418-000	1	Shuttle Spool
5	101727-000	2	Shuttle Valve

**Table 4.5 Shuttle Valve Service Kit For Valve Block S/A (High Rate Shuttle Spring)**

**Kit No. 990071-000**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	8785-010	2	Tube Fitting, O-ring
2	101729-000	2	Valve Plug
3	102418-000	1	Shuttle Spool
4	101730-000	2	Shuttle Valve Spring
5	101727-000	2	Shuttle Valve

**Table 4.6 Valve Block Sealing Kit**

**Kit No. 990029-001**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	101129-000	2	Back-up Ring
2	8765-118	2	O-ring
3	8775-018	1	Seal Ring
4	8775-021	1	Seal Ring

**Table 4.7 High Pressure Relief Valve Seal Kit**

**Kit No. 990104-000**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	8785-014	1	Tube Fitting, O-ring
2	8770-0117	2	Back-up ring
3	8765-117	1	O-ring

**Table 4.8 High Pressure Relief w/Thd. Retainer Seal Kit**

**Kit No. 990554-000**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	8785-008	1	Tube Fitting, O-ring
2	8785-014	1	Tube Fitting, O-ring
3	8770-020	2	Back-up ring
4	8765-020	1	O-ring

**Table 4.9 End Cover Sealing Plate Kit**

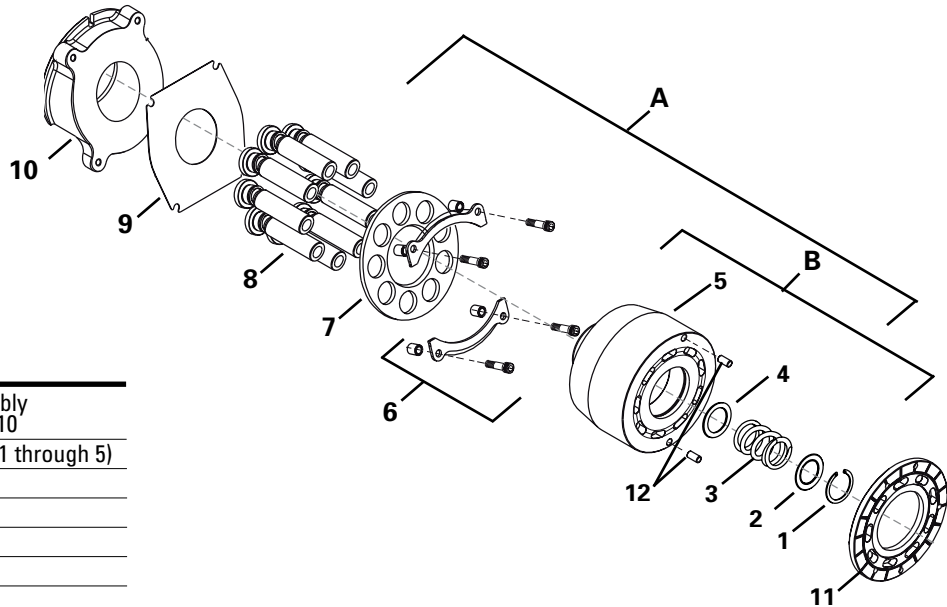
**Kit No. 990003-001**

ITEM NO.	PART NO.	QTY.	DESCRIPTION
1	107134-000	1	End cover Sealing Plate
2	095863-150	4	Hex head Bolts
3	008765-118	2	O-Ring
4	101129-000	2	Backup Ring
5	008775-021	1	Sealing Ring

# Parts

## Rotating Group

(Item 19)



**Table 5.0 Rotating Group Subassembly**

**Models 3331/3333**

**Subassembly 103247-000**

ITEM	PART NO.	QTY.	DESCRIPTION
A	103239-000		Rotating Group Subassembly Include all except item 9, 10
B	990412-000	1	Barrel Kit (includes items 1 through 5)
1	103278-200	1	Retaining Ring
2	103242-000	1	Spacer Cyl Barrel Spring
3	103240-000	1	Cylinder Barrel Spring
4	103243-000	1	Spacer Shaft Spring
5	103245-000	1	Barrel and Sleeve S/A
6	990416-000	1	Hold-down Kit (See Table 6.2)
7	103244-000	1	Shoe Retainer Plate
8	101073-000	9	Shoe Piston Subassembly
9	103236-000	1	Fixed Clr Thrust Plate
10	103248-000	1	Swashplate Subassembly
11	103241-000	1	Bearing Plate
12	98202-000	2	Dowel Pin(5/16 x 5/8 long)

**Models 3931/3933**

**Subassembly 103234-000**

ITEM	PART NO.	QTY.	DESCRIPTION
A	103239-000		Rotating Group Subassembly Include all except item 9, 10
B	990412-000	1	Barrel Kit (includes items 1 through 5)
1	103278-200	1	Retaining Ring
2	103242-000	1	Spacer Cyl Barrel Spring
3	103240-000	1	Cylinder Barrel Spring
4	103243-000	1	Spacer Shaft Spring
5	103245-000	1	Barrel and Sleeve S/A
6	990416-000	1	Hold-down Kit (See Table 6.2)
7	103244-000	1	Shoe Retainer Plate
8	101073-000	9	Shoe Piston Subassembly
9	103236-000	1	Fixed Clr Thrust Plate
10	103238-000	1	Swashplate Subassembly
11	103241-000	1	Bearing Plate
12	98202-000	2	Dowel Pin (5/16 x 5/8 long)

**Model 5431/5433**

**Subassembly 103874-000**

ITEM	PART NO.	QTY.	DESCRIPTION
A	103851-000	1	Rotating Group Subassembly Include all except item 9, 10
B	990414-000	1	Barrel Kit (includes items 1 through 5)
1	103278-225	1	Retaining Ring
2	103815-000	1	Spacer Cyl Barrel Spring
3	103813-000	1	Cylinder Barrel Spring
4	103816-000	1	Spacer Shaft Spring
5	103854-000	1	Barrel and Sleeve S/A
6	990417-000	1	Hold-down Kit (See Table 6.2)
7	103853-000	1	Shoe Retainer Plate
8	101077-000	9	Shoe Piston Subassembly
9	103809-000	1	Fixed Clr Thrust Plate
10	103872-000	1	Swashplate Subassembly
11	103852-000	1	Bearing Plate
12	98202-000	2	Dowel Pin (5/16 x 5/8 long)

**Model 4631/4633**

**Subassembly 106607-000**

ITEM	PART NO.	QTY.	DESCRIPTION
A	106608-000	1	Rotating Group Subassembly Include all except item 9, 10
B	990413-000	1	Barrel Kit (includes items 1 through 5)
1	103278-200	1	Retaining Ring
2	103242-000	1	Spacer Cyl Barrel Spring
3	103240-000	1	Cylinder Barrel Spring
4	103243-000	1	Spacer Shaft Spring
5	104195-000	1	Barrel and Sleeve S/A
6	990416-000	1	Hold-down Kit (See Table 6.2)
7	104211-000	1	Shoe Retainer Plate
8	106609-000	9	Shoe Piston Subassembly
9	103236-000	1	Fixed Clr Thrust Plate
10	103238-000	1	Swashplate Subassembly
11	104198-000	1	Bearing Plate
12	98202-000	2	Dowel Pin (5/16 x 5/8 long)

**Model 6431/6433**

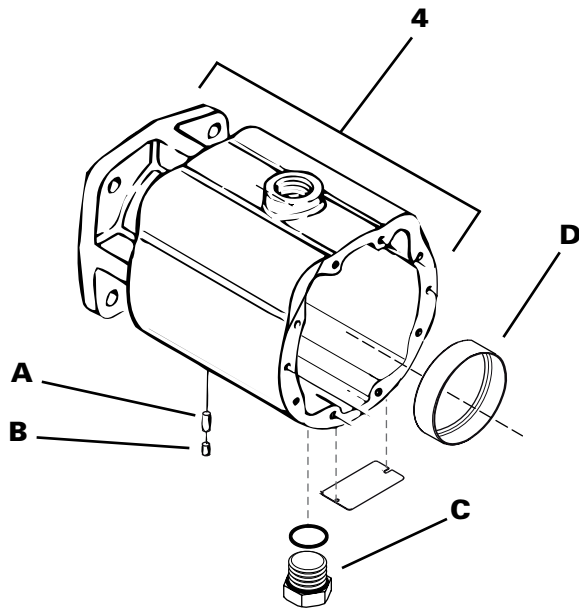
**Subassembly 103871-000**

ITEM	PART NO.	QTY.	DESCRIPTION
A	103812-000	1	Rotating Group Subassembly Include all except item 9, 10
B	990415-000	1	Barrel Kit (includes items 1 through 5)
1	103278-225	1	Retaining Ring
2	103815-000	1	Spacer Cyl Barrel Spring
3	103813-000	1	Cylinder Barrel Spring
4	103816-000	1	Spacer Shaft Spring
5	103821-000	1	Barrel and Sleeve Subassembly
6	990417-000	1	Hold-down Kit (See Table 6.2)
7	103817-000	1	Shoe Retainer Plate
8	103818-000	9	Shoe Piston Subassembly
9	103809-000	1	Fixed Clr Thrust Plate
10	103872-000	1	Swashplate Subassembly
11	103814-000	1	Bearing Plate
12	98202-000	2	Dowel Pin (5/16 x 5/8 long)

# Parts

## Motor Housing

(Item 4)



**Table 6.0 Fixed Housing Subassembly**

(Item 4)

PART NO.	MODEL	DESCRIPTION
112612-000	33-39-46	Main Housing
112611-000	33-39-46	Main Housing
112613-000	33-39-46	Main Housing
112614-000	33-39-46	Main Housing
112615-000	33-39-46	Main Housing
112616-000	33-39-46	Main Housing
4998770-001	33-39-46	Main Housing
113336-000	54-64	Main Housing
113339-000	54-64	Main Housing
113340-000	54-64	Main Housing
114237-000	54-64	Main Housing

**Table 6.1 Motor Housing Subassembly**

ITEM	QTY.	DESCRIPTION	MODEL	PART NO.
A	1	Dowel Pin		95904-100
B	1	Socket Pipe Plug (1/8-27)		95653-012
C	1	Case Drain Plug/O-ring		25090-012
D	1	Bearing Cup	33-39-46	103232-000
			54-64	103807-000

# Parts

## Kits

(Item 4)

**Table 7.0 Service Kits**

### Shaft Bearing

MODEL	PART NO.	DESCRIPTION
33-46	990014-000	End Cover Bearing Kit
54-64	990016-000	End Cover Bearing Kit
33-46	990089-000	Mounting Flange Bearing Kit
54-64	990387-000	Mounting Flange Bearing Kit

### End Cover Shim Kits

MODEL	PART NO.	DESCRIPTION
33-46	990017-000	End Cover Shim Kit
54-64	990019-000	End Cover Shim Kit

### Overhaul Gasket Kits

MODEL	PART NO.	DESCRIPTION
33-46	990092-001	Overhaul Gasket Kit
54-64	990094-001	Overhaul Gasket Kit

### Speed Sensor Kits

#### Magnetic Speed Sensor Kit Kit No. 9900002-000

QTY	PART NO.	DESCRIPTION
1	106524-000	Speed Pickup
1	105129-000	Washer
1	105132-062	Threaad Seal
1	04-07-707	Installation Instructions

#### Hall Effect Speed Sensor Assembly P/N 109823-000

(Ref. Installation Instructions 4-416)

### Shaft Seal Kits

#### 990709-000 Shaft Seal Kit (Lip Design)

For Models 3333/3933/4633/5433/6433

PART NO.	QTY.	DESCRIPTION
108395-000	1	Drive Shaft Seal
101680-250	1	Retaining Ring
107836-000	1	Spacer

#### 990231-000 Shaft Seal Kit (Mechanical Face Seal)

For Models 3331/3931/4631/5431/6431

PART NO.	QTY.	DESCRIPTION
102591-000	1	Stationary Seal S/A
96108-281	1	Retaining Ring
102419-000	1	Rotating Seal
104166-131	1	O-Ring

#### Quadrature Speed Sensor Kit No.9900121-001

QTY	PART NO.	DESCRIPTION
1	114264-001	Quadrature speed Sensor(two speed signals in quadrature with 1 pulse per target tooth)
1	E-MOPI-TI-002-E	Installation Instructions

#### Quadrature Speed Sensor Kit No.9900121-002

QTY	PART NO.	DESCRIPTION
1	114264-002	Quadrature speed Sensor (2-pulse per target tooth signal and 1 directional signal)
1	E-MOPI-TI-002-E	Installation Instructions



# Disassembly

## Shaft Seal

**Note:** Thoroughly clean the exterior of the unit before disassembly. Make sure all open ports are sealed.

1. Remove the shaft seal following the procedure for your type of seal.  
There are two types of shaft seals. Depending on the part number of your motor, either type of seal may have been used. A unit **MUST** be serviced with the same type of seal as was originally installed. The seals are not interchangeable.

**Important:** Clean surface area around stationary seal assembly.

### Motors Having Lip Seal (xx33-xxx Part Number Configuration)

- a. Using a pair of retaining ring pliers, remove retaining ring.
- b. Use a punch and hammer to punch a hole in the shaft seal.
- c. Install a 3-inch sheet metal screw with the point blunted into the punched hole just far enough to pull the shaft seal out of its pocket.
- d. Carefully insert the blade of a flat screw driver behind the seal and pry out the seal taking care not to damage the output drive shaft.



STEP A



STEP B



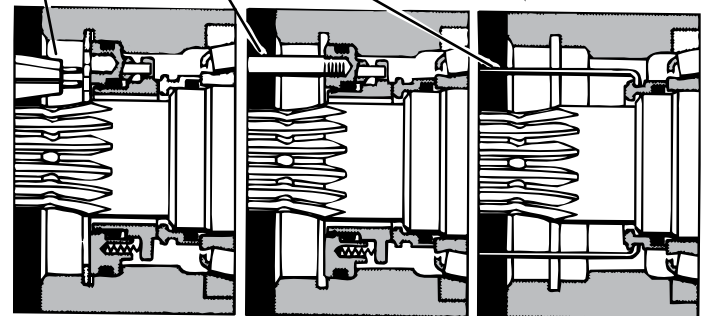
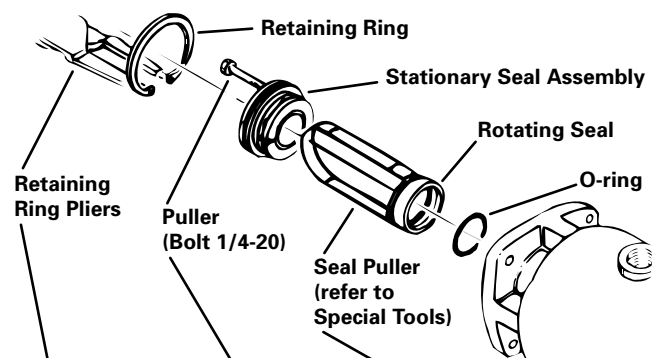
STEP C



STEP D

### Motors Having Face Seal (xx31-xxx Part Number Configuration)

- a. Using a pair of retaining ring pliers, remove retaining ring.
- b. Insert 1/4x20 bolt into the threaded hold of the stationary seal assembly to pull assembly from mounting flange.
- c. Using rotating seal puller (see special tools), grip outside diameter of bronze rotating seal. Remove seal from output drive shaft.
- d. O-ring may remain in rotating seal recess. If not found in recess, remove O-ring from output drive shaft.



# Disassembly

Seal all open ports. Thoroughly clean exterior of motor before disassembly.

Cleanliness is extremely important when repairing a hydrostatic pump or motor. Work in a clean area, as the level of cleanliness maintained when repairing the unit may affect performance. After washing the parts with clean solvent, blow dry the parts with filtered, moisture free air. Inspect all mating surfaces. Replace all damaged parts. Do not use grit paper, files or grinders on finished parts.

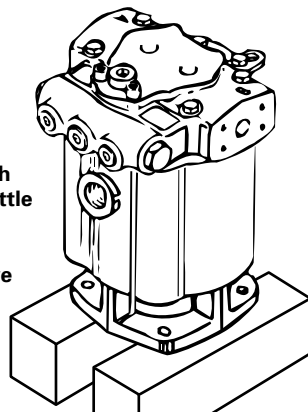
Whenever a unit is disassembled, it is a good service policy to replace all seals. Lubricate the seals with petroleum jelly. Use only clean, recommended oil when assembling the unit. See Hydrostatic Fluid Recommendations on page 28-29 or publication No. 03-401 & 03-405 for recommended fluids.

**⚠ CAUTION:** Disconnect or disable all electrical or mechanical power to the pump before beginning work.

## Valve Block/ Integral Shuttle End Cover

1. There are two types of Series 1 hydrostatic motors. If your motor has an integral shuttle and low pressure relief valve, go to step 14 on page 16. If you have a motor with a valve block, continue with step 2.

Motor with  
Integral Shuttle  
and Low  
Pressure  
Relief Valve



4. Using a 1-3/8 in. hex wrench, remove the low pressure relief valve cartridge.

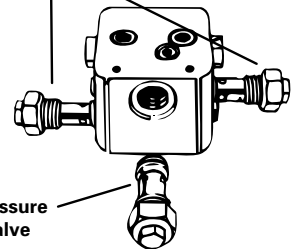
**Note:** The low pressure relief valve doesn't have back-up rings. There is only one O-ring in the lower groove.

5. Using a 1-3/8 in. hex wrench, remove the two high pressure relief valves from valve block.

**Note:** The high pressure relief valves have two white back-up rings and one O-ring in the lower groove.

High and low pressure relief settings are preset at the factory. Stamping on cartridge identifies setting. See examples.

High Pressure  
Relief Valves



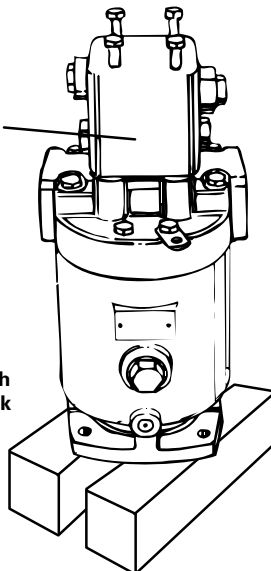
Low Pressure  
Relief Valve

## Motors with Valve Block Disassembly

2. Position the motor on its mounting flange as shown. Loosen all the relief valves and plugs in the valve block. Remove the four bolts that hold the valve block to the motor. Then remove the valve block.
3. Remove O-rings and back-up rings from mounting face of valve block.

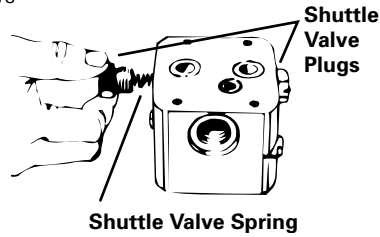
Valve Block

Motor with  
Valve Block

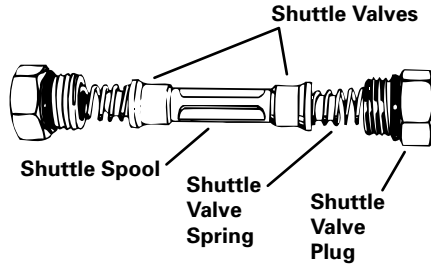


# Disassembly

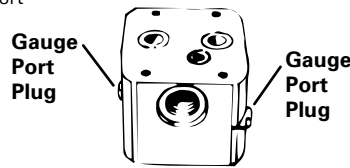
- Using a 1 in. hex wrench, remove the two shuttle valve plugs. Then remove shuttle valve springs.



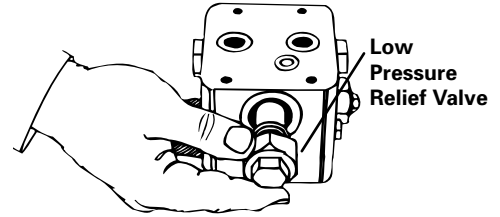
- Remove shuttle valves and shuttle spool.



- Remove the three gauge port plug assemblies.



- Install low pressure relief valve. Torque valve to 75 lb-ft [100 Nm].  
Continue with step 19, page 15.



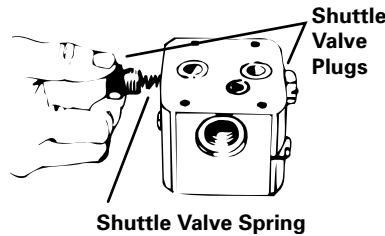
**Table 8.0 Torque Specifications – lb-ft [Nm]**

WHERE USED	MODEL 33-39-46	MODEL 54-64
Gauge Port Plug Assembly	16 [22]	16 [22]
Shuttle Cap	68 [92]	68 [92]
High Pressure Relief Valve	25 [34]	25 [34]
Low Pressure Relief Valve	75 [100]	75 [100]
End Cover Bolts – Grade 8	39 [53]	63 [85]
Relief Valve (Feathering)	25 [34]	25 [34]
Socket Pipe Plug	16 [22]	16 [22]
Valve Block Mounting Bolts	28 [38]	28 [38]

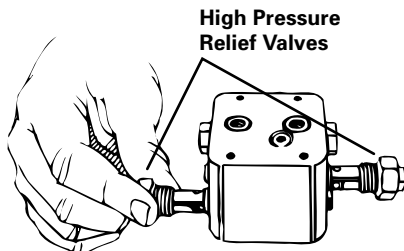
# Assembly

## Assembly of Valve Block

- Install the three gauge port plug assemblies. Torque to 16 lb-ft [22Nm].
- Install shuttle spool and shuttle valves in valve block.
- Install shuttle valve springs and shuttle valve plugs. Torque plugs to 68 lb-ft [92Nm].



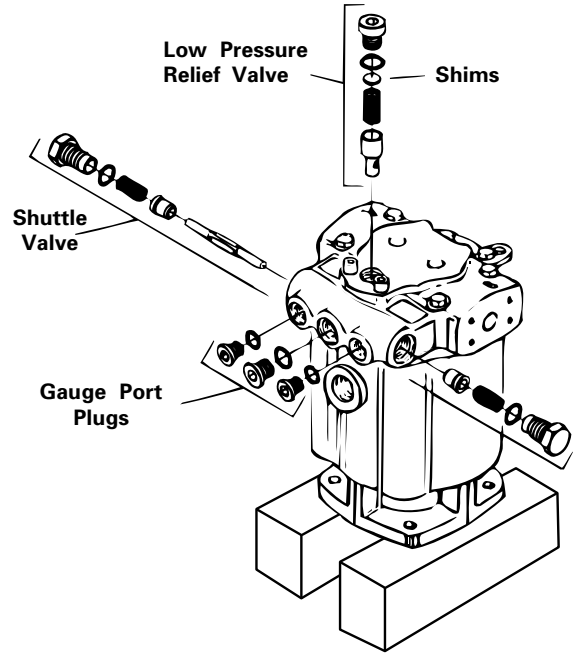
- Install the two high pressure relief valves. Torque to 25 lb-ft [34 Nm].



# Disassembly

## Motor with Integral Shuttle and Low Pressure Relief Valve

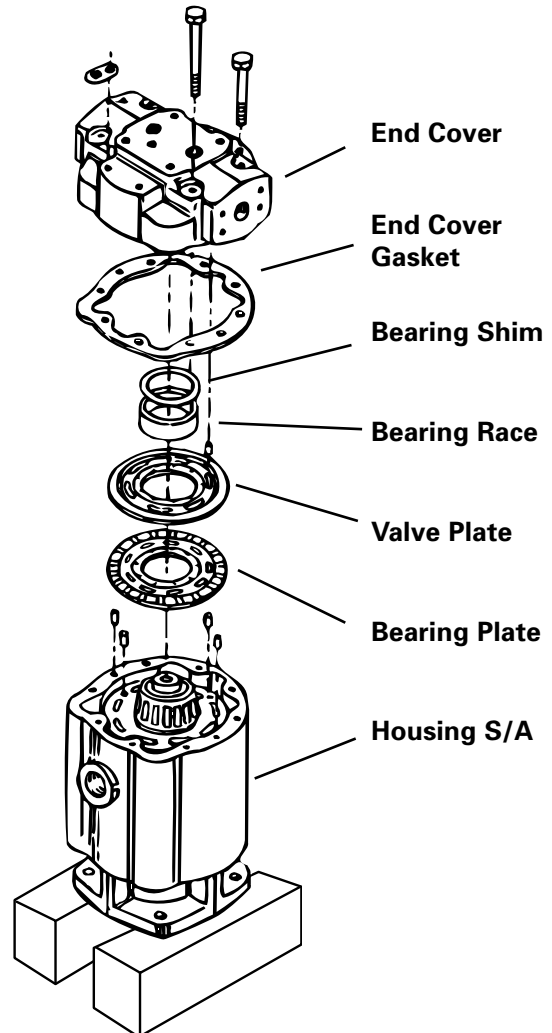
14. Position the motor on its mounting flange as shown.
15. Using a 1-3/8 in hex wrench, remove the low pressure relief valve.  
**Note:** Retain the shims, they are used to adjust the relief setting.
16. Using a 1 in. hex wrench, remove the shuttle valve plugs.
17. Remove shuttle valves and shuttle spool.
18. Remove the gauge port plugs.



## End Cover

**The procedure is the same for either end cover.**

19. Remove eight hex bolts from end cover.  
**Caution:** Internal parts are spring loaded. To avoid internal part damage, remove six bolts leaving two bolts opposite each other tight. Gradually and evenly remove the two remaining bolts.
20. Carefully remove end cover, gasket and the two end cover dowel pins.  
**Caution:** Remove any parts (valve plate, bearing cup, or shims) that may have stuck to the end cover. Be careful not to drop any.
21. Remove rear bearing cup from end cover, using a slight twisting motion. Bearing cup is slip-fit into end cover.
22. Remove and retain rear bearing shims from end cover. Shims are used to adjust shaft bearing end play of motor output shaft.



# Disassembly

## Rotating Group

Use extreme care when handling all close tolerance internal parts of motor. Keep parts clean.

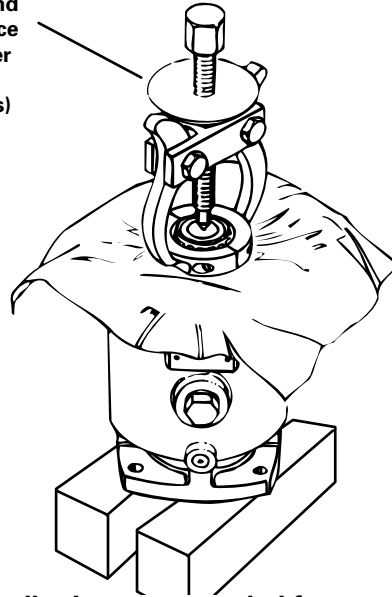
23. Remove end cover gasket and dowel pins from motor housing. Gasket may have remained on end cover during removal.

24. Remove bearing plate and pins from cylinder barrel. If using a small screwdriver to pry bearing plate from cylinder barrel, make sure bearing plate and barrel surfaces are not scratched or damaged.

**Important:** Handle the bearing plate and valve plates with extreme care. They are lapped to extremely close tolerances for flatness.

25. Install bearing puller and remove bearing from output shaft (refer to Special Tools).

Hub Puller and Low Clearance Bearing Puller (refer to Special Tools)



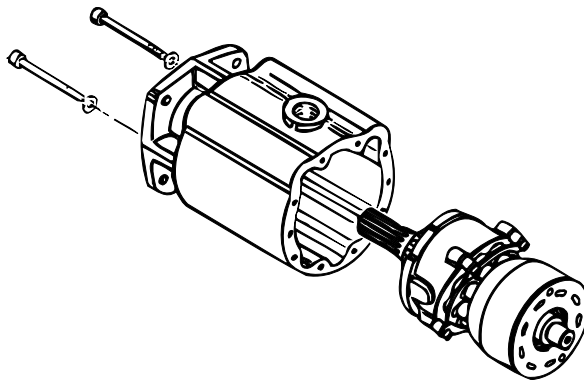
Low clearance bearing puller is recommended for removal of end cover bearing cone. The bearing puller pulls against bearing rollers, not against inner cup. It is designed to prevent bearing cone and cylinder barrel face from being damaged when bearing is removed. Low clearance between end cover bearing and cylinder barrel makes it difficult to use any other type of bearing puller.

26. Carefully reposition motor on its side. Using 1/4 in hex bit socket, remove the two cap screws that hold swashplate in the housing.

27. Remove and discard sealing washers from cap screws. Replace with new sealing washers.

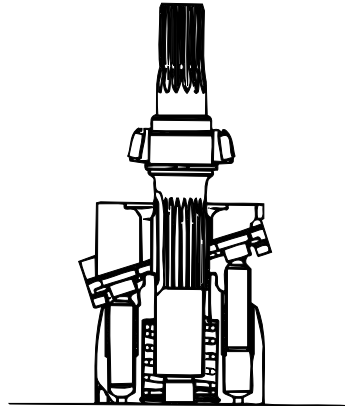
28. Push inward on shaft assembly to dislodge the swashplate from its pocket in housing.

29. Carefully remove output shaft/cylinder barrel assembly from housing.



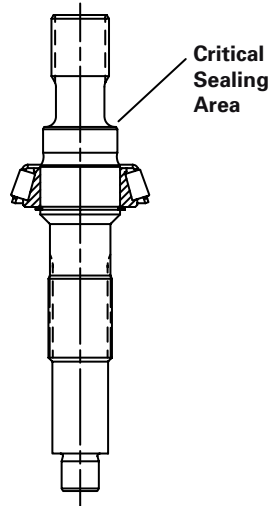
# Disassembly

30. Position the shaft/cylinder barrel subassembly with the shaft facing up. Carefully lift out the output drive shaft subassembly.



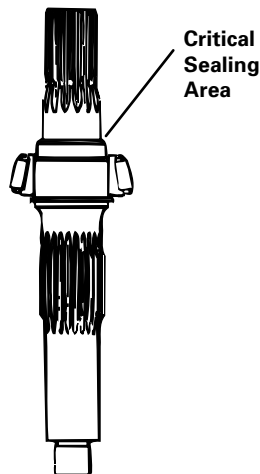
31. When bearing cone must be replaced, use a press to remove cone from shaft subassembly.

**Important:** When removing or installing bearing cone, do not damage shaft sealing area (stepped area between bearing journal and output drive shaft splines). This area is critical for sealing the shaft seal.



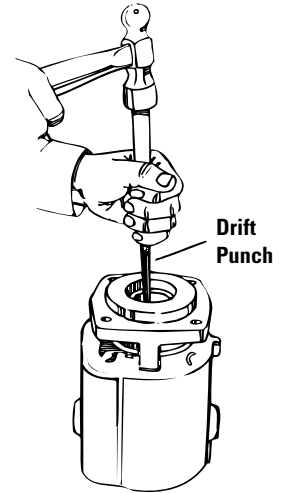
- 31.a. You must use special stop limit tool (refer to Special Tools) when installing new cone.

**Units Having Lip Seal  
(xx33-xxx Part Number Configuration)**

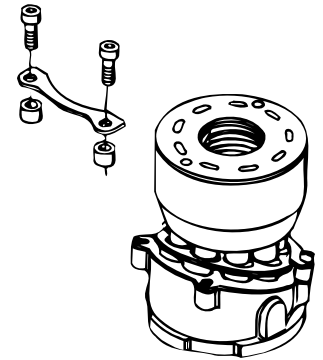


**Units Having Face Seal  
(xx31-xxx Part Number Configuration)**

32. If bearing cup needs replacing, carefully remove the cup using a hammer and drift punch.

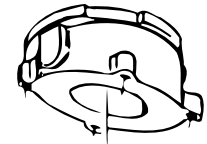


33. Reposition cylinder barrel/swashplate with the swashplate on the bottom. Using a 1/4-inch hex key, remove the cap screws from the retaining strap on one side of the swashplate.

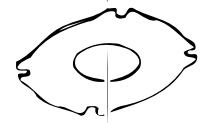


Loosen the cap screws on the other retaining strap to make it easier to remove cylinder barrel from the swashplate.

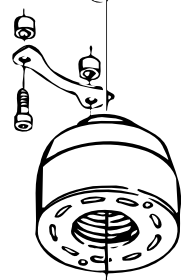
34. Carefully reposition cylinder barrel/swashplate with swashplate facing up. Remove the swashplate by lifting slightly and sliding it over to disengage from the retaining strap.



35. Remove cap screws, retaining strap, spacers and thrust plate from swashplate.



36. Disassemble cylinder barrel subassembly. Place it on a clean protective surface for inspection and cleaning.



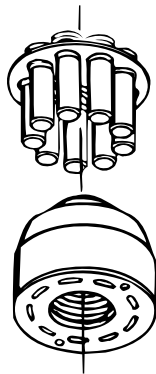
# Assembly

## Rotating Group

Before reassembly, clean all parts and assemblies in clean solvent and blow them dry with compressed air. Inspect and replace all scratched or damaged parts. When reworking parts. Do not use coarse grit paper, files or grinders on any finished surfaces. Replace all gaskets and O-rings.

Lubricate O-rings with petroleum jelly for retention during reassembly. Freely lubricate all bearings and finished part surfaces with clean hydraulic fluid. This will provide required start-up lubrication for moving parts.

1. Lubricate and install shoe retainer plate and piston shoes in cylinder barrel subassembly. After installation, freely lubricate brass shoe faces with clean hydraulic fluid.



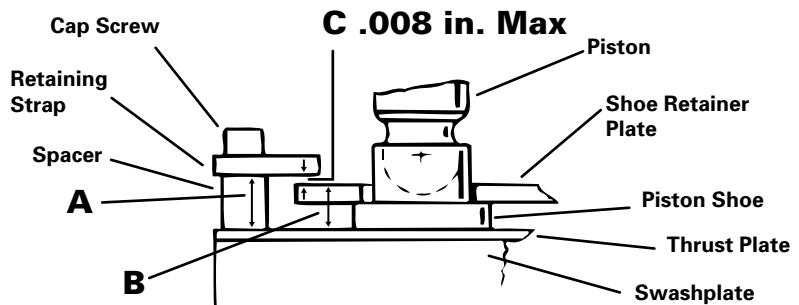
## Check Fixed Clearance

2. Before assembling motor any further, you must check the fixed clearance of motor.  
  
Measure the height of retaining strap spacer with a micrometer or vernier calipers.

There are two fixed spacer heights – one for the 33, 39, 46 units and one for the 54, 64 units. Spacers are critical to the unit design and may not be interchanged.

3. Measure combined thickness of both piston shoe flange and shoe retainer plate. Subtracting this measurement from spacer height gives fixed clearance of unit.
4. Fixed clearance must not exceed .008 inches [.20 mm]. If fixed clearance exceeds .009 inches [.02 mm], replace worn parts, (i.e., piston shoe sub-assemblies, thrust plate, retaining strap and/or shoe retainer plate).

**Note:** An alternate method of checking fixed clearance is with the use of a feeler gauge. If using this method, make sure gauge is inserted between retaining strap and shoe retainer plate only. Piston shoe faces could be damaged if gauge is inserted between piston shoe and thrust plate.



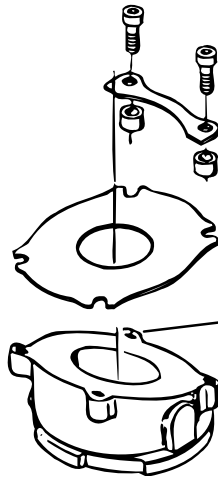
$$A \text{ (Spacer Height)} - B \text{ (Shoe Flange + Retainer Plate)} = C \text{ (Fixed Clearance .008 Max)}$$

# Assembly

3. Apply one or two drops of Loctite® No. 271 in first or second thread down in each of the four holes in swashplate.

4. Lightly lubricate and install thrust plate, aligning cap screw holes. Install spacers, retaining strap and cap screws on one side of the swashplate. DO NOT tighten cap screws at this time.

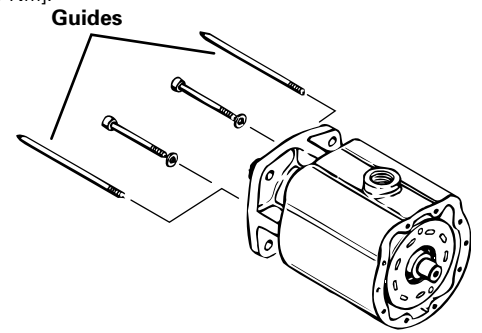
5. Place cylinder barrel Subassembly on clean, flat surface with piston shoes facing up. Carefully install swashplate on cylinder barrel by slightly lifting the side without retaining strap. Slide swashplate over to engage installed retaining strap around piston retainer.



Apply Loctite (four threaded holes)

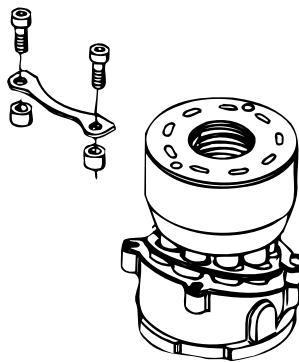
10. Holding cylinder barrel sub-assembly carefully in position in housing, reposition motor on its side. Remove headless cap screws used as guides.

11. Install new sealing washers on the two swashplate cap screws. Install the cap screws in swashplate. Tighten to 20 to 24 lb-ft [27 to 33 Nm].



**Loctite parts must contact only those surfaces intended for assembly. Wipe excess Loctite from swashplate with non-petroleum base solvent applied to cloth. Do not apply Loctite to threads more than 15 minutes before installing cap screws. If Loctite stands for more than 15 minutes, repeat application. If repeating application, it is not necessary to remove previously applied Loctite.**

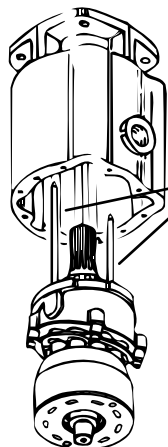
6. Carefully reposition cylinder barrel/swashplate with the swashplate down. Install the remaining spacers, retaining strap and cap screws. Tighten all four cap screws 16-19 lb-ft [22 to 26 Nm].



7. Carefully reposition cylinder barrel/swashplate with cylinder barrel face on a clean, flat surface. Lubricate and install output drive shaft subassembly into cylinder barrel subassembly.

8. Install two headless 5/16 inch cap screws, five to six inches long, in swashplate to use as guides (refer to Special Tools).

9. Aligning pin in housing with notch in swashplate, carefully slide housing over output drive shaft/swashplate/cylinder barrel subassembly.



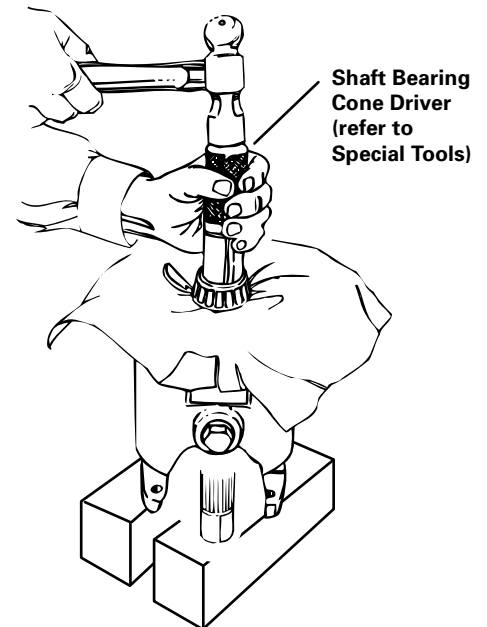
Guides - Headless Cap Screws (refer to Special Tools)

## CAUTION

12. Carefully reposition and support motor on mounting flange. Support output shaft in a slightly raised position.

Using a press or bearing cone driver (refer to Special Tools), install end cover bearing cone on output shaft.

Bearing cone must seat against shoulder of output shaft.

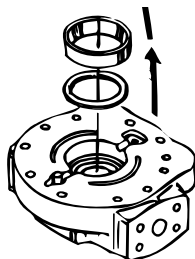




# Assembly

## End Cover

13. Install two dowel pins and gasket on end cover.
14. Lubricate and install bearing shims and bearing cup into end cover.



### Check Output Shaft End Play

15. You must check the end play of the output drive shaft subassembly.

Install the end cover without installing either valve or bearing plates. This eliminates spring tension against the output shaft.

Install cap screws in end cover and slowly and evenly tighten them. On models 33/39/46 torque cap screws to 39 lb-ft [53 Nm]. On models 54/64, torque to 63 lb-ft [85 Nm].

Place and support motor assembly on end cover. Gently tap output shaft inward with hammer.

Install magnetic base indicator on mounting flange with gauge on output shaft end. Use pliers to grip output shaft as low as possible. Pry upward to determine shaft end play. Indicator must read .002 to .007 inches [.05 to .17 mm] shaft end play.

If end play is incorrect, adjust by adding or removing shims under bearing cup located in end cover.

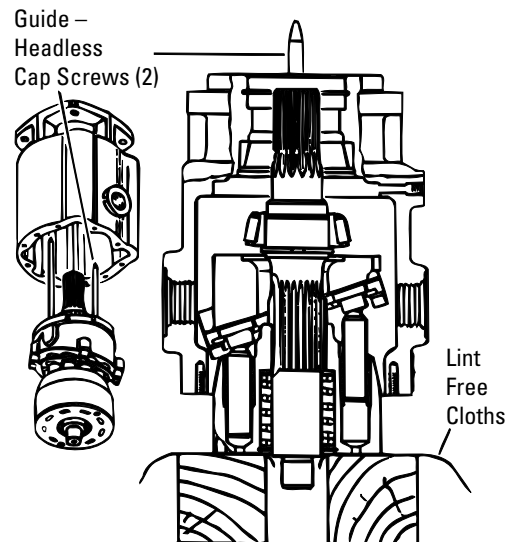
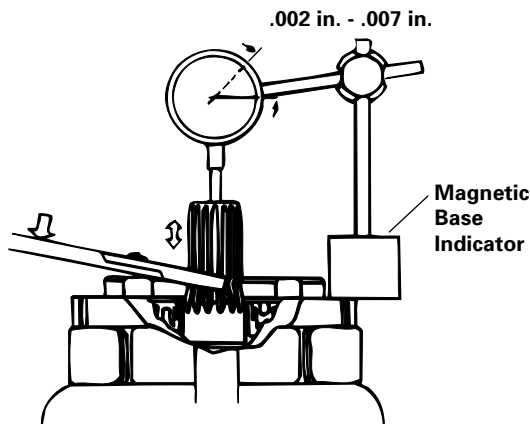
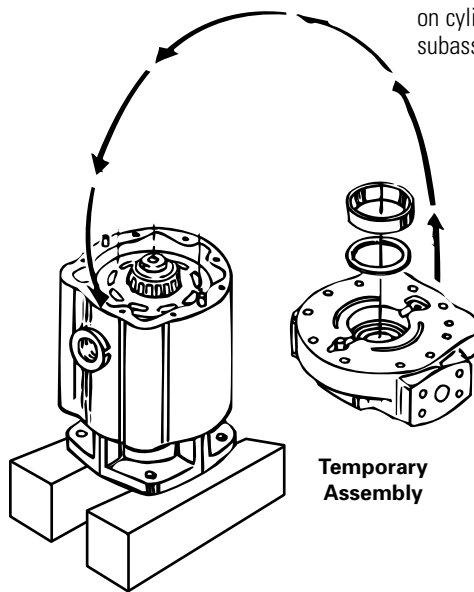
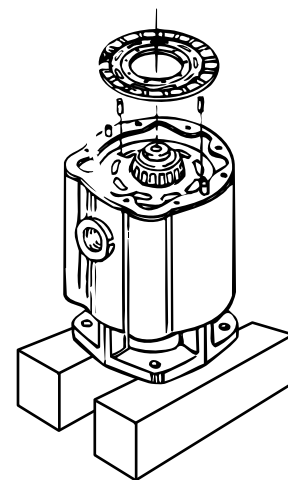


Figure 23

16. After adjusting end play, reposition motor on mounting flange and remove end cover.
17. Install two dowel pins in face of cylinder barrel subassembly. Freely lubricate bearing plate with dowel pins and install it on cylinder barrel subassembly.



# Assembly

## Shaft Seal Installation

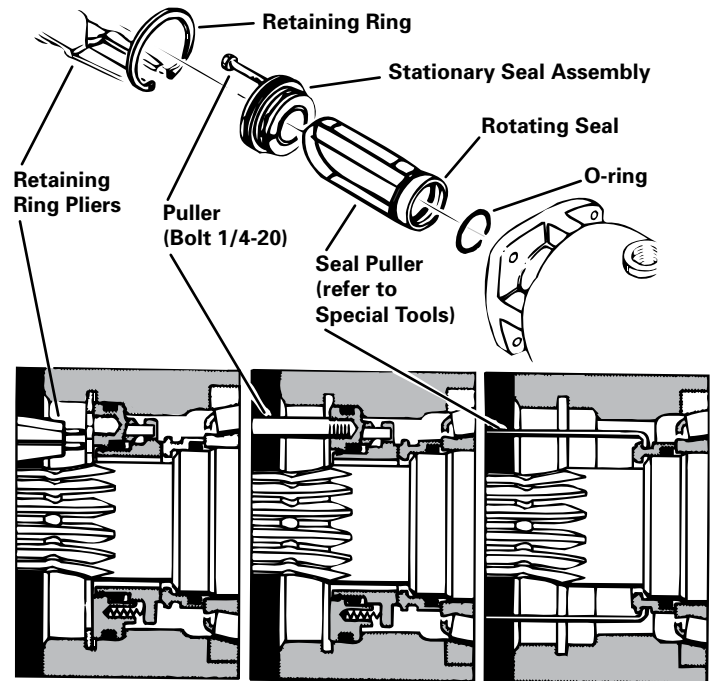
For best sealing results, clean the metal-to-metal seal surfaces. The cleaner must evaporate and not leave any residue, and must be compatible with Viton.

Do not touch these surfaces. Coat with clean, filtered oil before reassembly.

**Note:** There are two types of shaft seals. Depending on the date of manufacture, either type of seal may have been used. A unit **MUST** be serviced with the same type of seal as was originally installed. The seals are not interchangeable.

### Units Having Face Seal (xx31-xxx Part Number Configuration)

22. Reinstall the shaft seal following the procedure for your type of seal.
  - a. Lubricate O-ring seal of rotating seal. Then install rotating seal with seal puller. Ensure rotating seal O-ring is placed inside the rotating seal before assembly onto the output drive shaft.
  - b. Lubricate O-ring seal of stationary seal subassembly. Then install stationary seal subassembly.
  - c. Using a No. 5 or No. 7 retaining ring pliers, install retaining ring (beveled side of ring out).

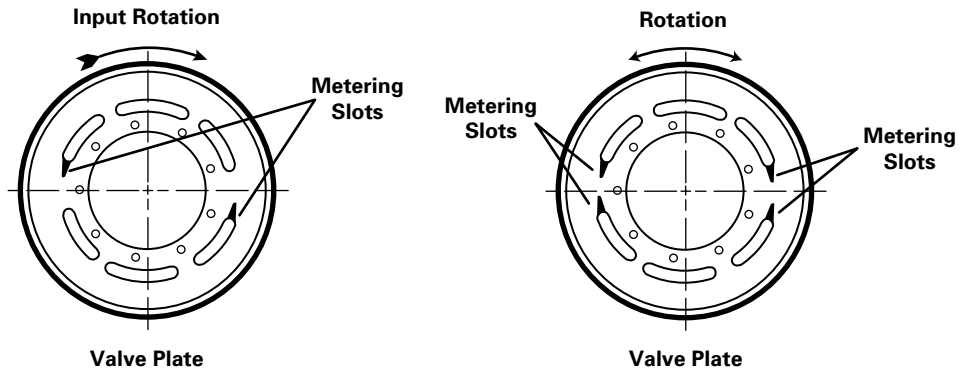


# Assembly

If you have a motor with a face seal, use the following procedure. If you have a motor with a lip seal, use the procedure on page 24.

Pump valve plates are all uni-directional and motor valve plates are bi-directional. The pump valve plate is identified by two metering slots and rotates clockwise. The motor valve plate has four metering slots and is bi-directional. Pump and motor valve plates are not interchangeable.

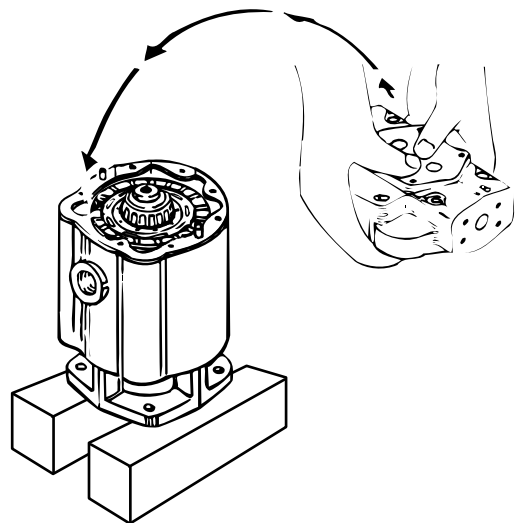
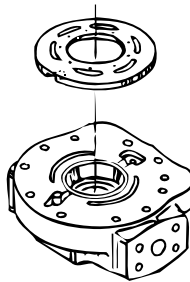
Note: Use extreme care when handling all close tolerance internal parts of motor. Keep parts clean.



18. Install valve plate dowel pin in the face of end cover.
19. Using petroleum jelly, lightly coat side of valve plate facing the end cover to hold valve plate during assembly. Install valve plate over bearing cup, aligning it with dowel pin. Valve parts must rest flat and be flush with end cover.
20. Holding the valve plate firmly in position, install end cover on housing.
21. Install cap screws in end cover. Tighten them slowly and evenly.

Torque the cap screws in a star pattern. Models 33/39/46 should be torqued to 39 lb-ft [53 Nm]. Models 54/64 should be torqued to 63 lb-ft [85 Nm].

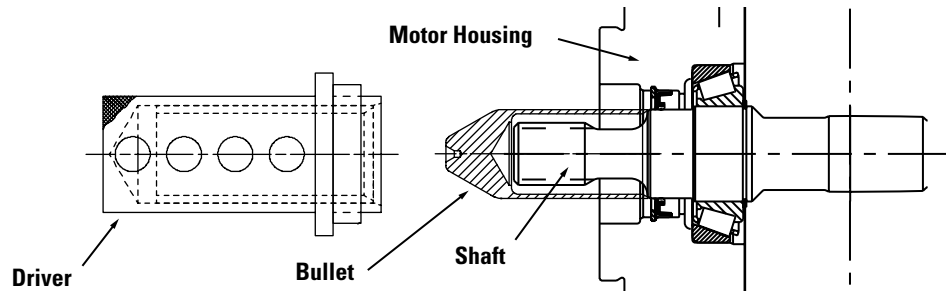
Torque each screw a second time to compensate for gasket compression set.



# Assembly

## Units Having Lip Seal (xx33-xxx Part Number Configuration)

**Note:** Lip seal kits come with a shaft seal, retaining ring, and spacer. The spacer is only required for units that have extensive use in the field. The spacer puts the seal in a new location on the shaft sealing area. If using the spacer, install the spacer between the shaft seal and the retaining ring in step f.



**Ensure the shaft sealing surface and housing seal bore are clean and free of all dirt and debris to avoid introducing any contaminants into unit.**

1. Grease the inside surface of seal that contacts shaft.
2. Select correct bullet and driver. Bullet and drive shaft chamfer must align with each other leaving no gap between the bullet and shaft. Bullet should pilot on shaft diameter so bullet cannot shift side to side, allowing step between bullet and shaft seal diameter.
3. Press the new, greased shaft seal over a shaft bullet. Closed face of the shaft seal faces the closed end of the bullet.
4. With the shaft seal on the bullet, insert bullet over drive shaft and into the seal pocket. Take care to ensure seal is properly aligned with housing bore as seal is pressed in to minimize chance of damaging seal.
5. Using the driver and a mallet, push the seal until the tool bottoms on the pilot of flange.
6. Remove the tool and insert the retaining ring into the seal pocket. A spacer is required, whenever there is a significant groove in the shaft from the seal. (A maximum of two spacers may be used before the shaft must be replaced), place it between the shaft seal and the retaining ring.
7. Using the tool and mallet, drive the seal, spacer(as required if using, and retaining ring in until the retaining ring snaps into place in the groove.

# Assembly

## Valve Block/ Integral Valves

**If your motor has an integral shuttle and low pressure relief valve, go to step 25.**

**If you have a motor with a valve block, continue with step 23.**

### Motor with Valve Block

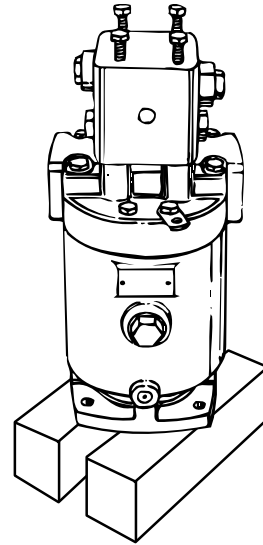
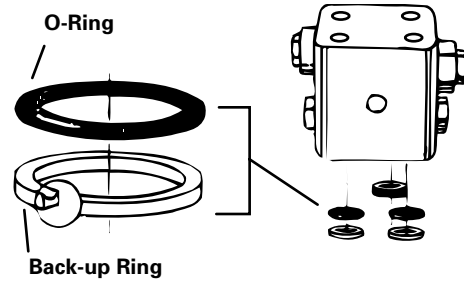
23. Install O-rings and back-up rings on valve block.

The high pressure ports require an O-ring and back-up ring. The O-ring goes on first, then the back-up ring. The curved side of ring goes toward the O-ring.

Install square-cut ring in low pressure drain port of valve block.

**Note:** Be careful not to damage O-rings and back-up rings. Use clean petroleum jelly to hold O-rings and back-up rings in place during block installation.

24. Position valve block on end cover. Install four hex bolts. Torque bolts 28 lb-ft [38 Nm].



### Motor with Integral Shuttle and Low Pressure Relief Valve

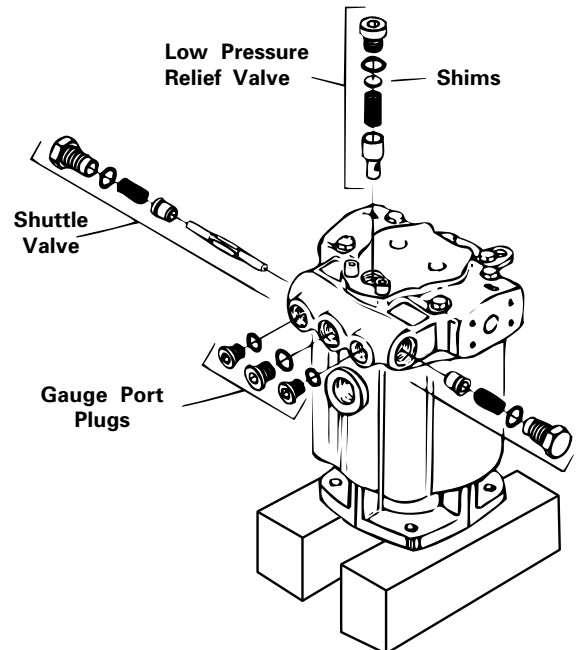
25. Install two outer gauge port plug assemblies. Torque to 25 - 31 lb-ft [18 - 23 Nm].

Install center gauge port plug assembly. Torque to 40 - 48 lb-ft [30 - 35 Nm].

26. Lubricate and install shuttle spool and shuttle valves. The smaller ends face the center of the spool.

27. Install the shuttle valve springs and plugs. Torque to 68 - 82 lb-ft [50 - 60 Nm].

28. Install the low pressure relief valve plunger and spring. Lubricate and insert the shims in the relief valve plug. Install the plug over the spring, making sure the shims are not dislodged. Screw the plug in and torque to 68 - 82 lb-ft [50 - 60 Nm].



# Special Tools

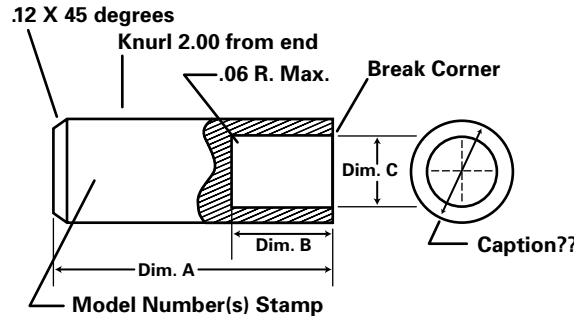
## Bearing Cone Driver (End Cover end)

### Dimensions

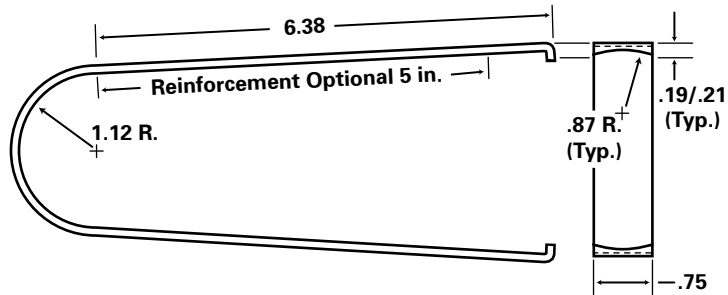
MODEL	A	B	C	D
33/39/46	4.0	1.5*	1.01	1.25
54/64	4.0	1.5*	1.30	1.48

\*1.5 in. from shaft with splined drive for B pad Charge Pump

Material: C.R.S., Hardern to Rc 50-55



## Rotating Seal Puller



Available from  
Owatonna Tool Co.  
No. CAS - 1844

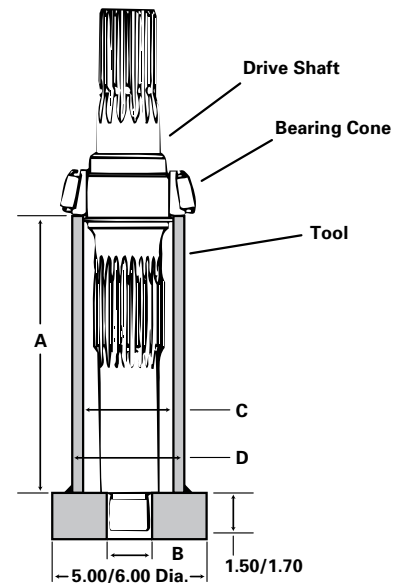
Material: SAE 1074  
Spring Steel  
16 Ga. x .75 Wide

## Limit Stop for Bearing Cone Installation

### Dimensions

MODEL	A	B	C	D
33/39/46	5.803	1.00/1.20	2.20/2.30	3.00 Min.
54/64	6.682	1.30/1.32	2.20/2.30	3.00 Min.

Material: Steel



## Headless Cap Screw



5/16 - 18 UNC Cap Screw - 2 Required  
Remove head and grind end into cone

## Torque Specifications - lb-ft [Nm]

WHERE USED	MODEL 33-39-46	MODEL 54-64
End Cover Bolts - Grade 8	39 [53]	63 [85]
Relief Valve (Low Press.)	75 [100]	75 [100]
Relief Valve (High Press.)	25 [34]	25 [34]
Shuttle Cap	68 [92]	68 [92]
Socket Pipe Plug	16 [22]	16 [22]
Valve Block Mounting Bolts	28 [38]	28 [38]

# Special Tools

## Shaft Seal Installation Tools

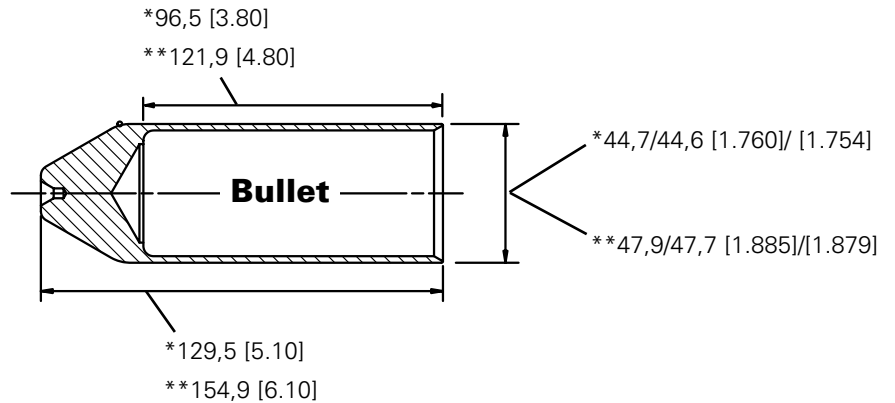
### Bullet/Driver Selection

Each seal requires use of a specific bullet and driver. Check measurements and/or part numbers of bullet and driver to determine the correct bullet and driver to use for your unit.

Measurements are expressed in standard mm[Inch].

\*(units using seal 108395-000)

\*\* (units using seal 110192-000)

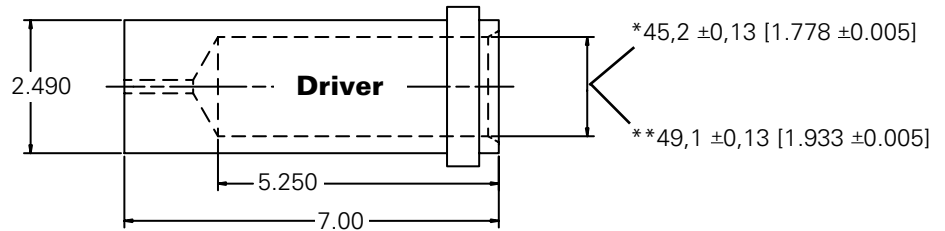


### Units using seal 108395-000

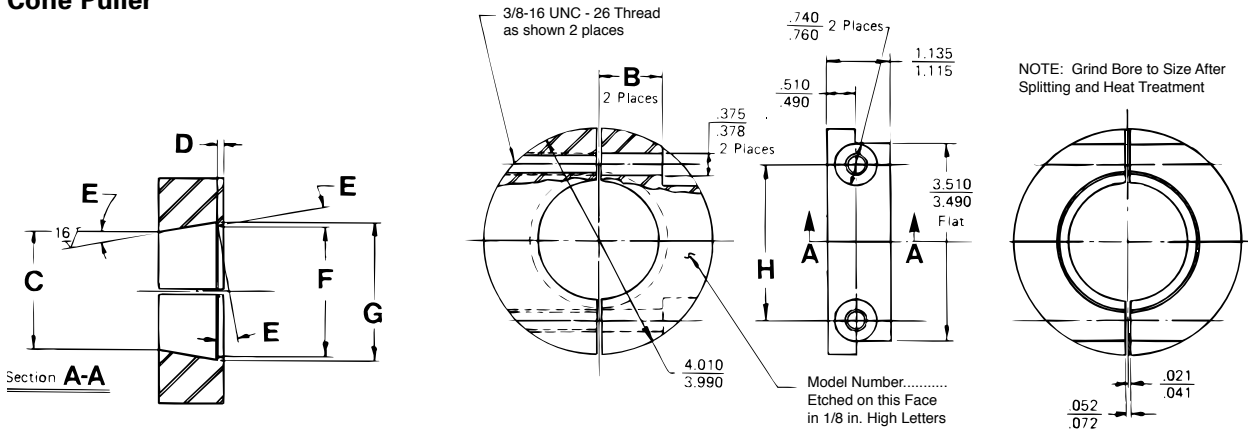
SEAL ID	BULLET	DRIVER
1.750	4994026-001	4994028-001

### Units using seal 110192-000

SEAL ID	BULLET	DRIVER
1.875	4994027-001	4994028-002



### Low Clearance Bearing Cone Puller



#### Dimensions

MODEL	PART NO.	B	C Ø Ref	D	E	F Ø	G Ø
33/39/46	990469-001	1.060 ±.010	1.565	.132 ±.003	13 <sup>º</sup> ±0'±0°-15'	1.910 ±.003	2.023 ±.003
54/64	990469-002	1.25 ±.010	2.071	.128 ±.003	10 <sup>º</sup> ±0'±0°-15'	2.313 ±.003	2.435 ±.003
54/64	990469-003	1.25 ±.010	1.603	.138 ±.003	20 <sup>º</sup> ±0'±0°-15'	2.226 ±.003	2.321 ±.003

Material: Stentor 45 - 55 R<sub>c</sub> Heat Treat

# Hydraulic Fluid Recommendations

## Introduction

The ability of Eaton hydrostatic components to provide the desired performance and life expectancy depends largely on the fluid used. One of the most important characteristics to consider when choosing a fluid to be used in a hydraulic system is viscosity. Viscosity choice is always a compromise; the fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. Viscosity requirements are specified later in this document.

## Viscosity and Temperature

Fluid temperature affects viscosity. In general, as the fluid warms it gets thinner and viscosity decreases. The opposite is true when fluid cools.

When choosing a fluid, consider the start-up and operating temperatures of the hydrostatic system. Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where the cooling system begins to operate. From then on, the fluid is maintained at the temperature for which the hydrostatic system was designed.

In actual applications this sequence varies; hydrostatic systems are used in many environments from very cold to very hot. Cooling systems also vary from very elaborate to very simple, so ambient temperature may affect operating temperature.

## Cleanliness

Cleanliness of the fluid is extremely important. Eaton recommends that the fluid used in its hydrostatic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. The code allows a maximum of 2500 particles per milliliter greater than 5 $\mu$ m and a maximum of 80 particles per milliliter greater than 15 $\mu$ m. When components with different cleanliness requirements are used in the same system, the cleanest standard should be applied. A reputable filter supplier can supply filter information.

## Fluid Maintenance

Maintaining correct fluid viscosity and cleanliness level is essential for all hydrostatic systems. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. Test and establish fluid maintenance schedules designed to meet the viscosity and cleanliness requirements.

## Fluid Selection

Premium grade petroleum based hydraulic fluids will provide the best performance. These fluids typically contain additives that are beneficial. Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors. Premium grade petroleum-based hydraulic fluids carry an ISO VG rating.

SAE grade crankcase oils may be used, but it should be noted that these oils may not contain all of the recommended additives. Using crankcase oils may increase fluid maintenance requirements.

Hydraulic fluids that contain V.I. (viscosity index) improvers, sometimes called multi-viscosity oils, may be used. These V.I.-improved fluids are known to "shear-down" with use. Their actual viscosity drops below the rated value. Fluid maintenance must be increased if V.I.-improved fluids are used. Automotive automatic transmission fluids contain V.I. improvers.

Synthetic fluids may be used. A reputable fluid supplier can provide information on synthetic fluids. Review applications that require the use of synthetic fluids with your Eaton representative.



# Hydraulic Fluid Recommendations

## Viscosity/Cleanliness Guidelines

MINIMUM	OPTIMUM RANGE	ISO CLEANLINESS MAXIMUM	REQUIREMENTS
10cSt [60 SUS]	16 - 39 cSt [80 - 180 SUS]	2158 cSt [10,000 SUS]	18/13

### Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups. Thick oil can cause high case pressures which in turn cause shaft seal problems.
- If the color of the fluid has become black, it is possible an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements.

### RATING WITH BIODEGRADABLE OIL

### COMMENTS

80% of normal pressure rating listed for mineral oils.

82° C (180° F) max fluid temp (unit)  
71° C (160° F) max fluid temp (reservoir)

## Biodegradable Oil (Vegetable) Guidelines

### Additional Notes:

- Viscosity and ISO cleanliness requirements must be maintained as outlined.
- Based on limited product testing to date, no reduction in unit life is expected when operating at the pressure ratings indicated above.
- Vegetable oil is miscible with mineral oil. However, only the vegetable oil content is biodegradable. Systems being converted from mineral oil to vegetable oil should be repeatedly flushed with vegetable oil to ensure 100% biodegradability.
- Specific vegetable oil products may provide normal unit life when operating at pressure ratings higher than those indicated above.

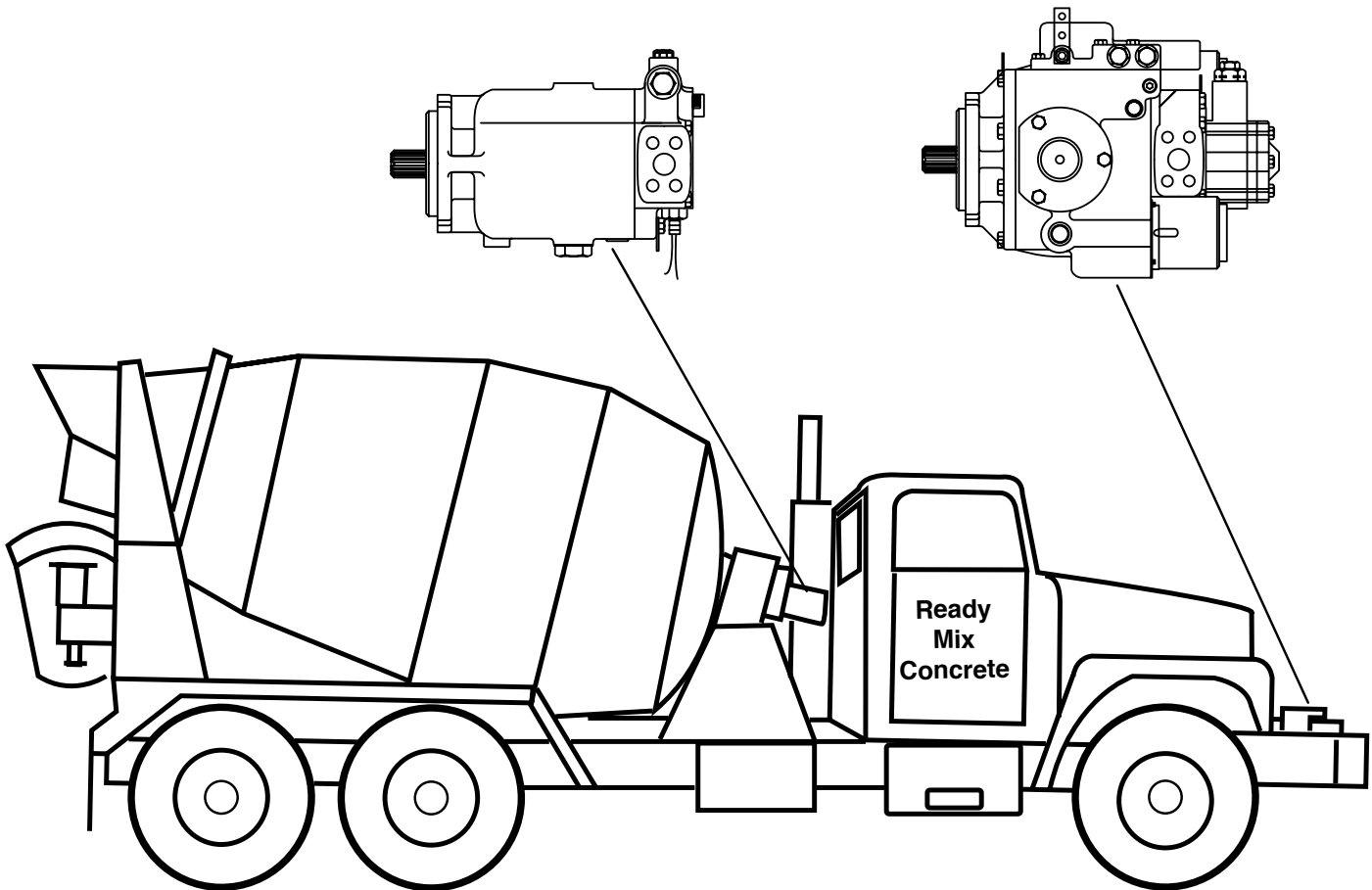
## Note:

A reputable supplier can help you make the best selection of hydraulic fluid for use in Eaton hydrostatic products. For satisfactory operation, the following recommendations apply:

- The filter system used in the hydraulic circuit must be capable of maintaining the fluid at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5µm and a maximum of 80 particles per milliliter greater than 15µm.
  - At normal operating temperatures, optimum viscosity ranges are from 80–180 SUS [16–39 cSt]. Viscosity should never fall below 60 SUS [10cSt] and, at the lowest expected startup temperature, should not exceed 10,000 SUS [2158 cSt].
  - The fluid should contain anti-wear agents, rust inhibitors, and anti-foaming agents.
- Note:** If the fluid becomes black or milky, an overheating or water contamination problem exists. Take fluid level readings when the fluid is cold.

**Eaton**<sup>®</sup>  
Heavy Duty Hydrostatic Transmissions

No. 3-406  
July, 1995



Troubleshooting Guide for  
Eaton Hydrostatic Transmissions  
used on Concrete Mixers

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Introduction .....	2
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Fault-Logic Troubleshooting .....	7-11
Action Step Comments .....	12-13
Hydraulic Fluid Recommendations .....	14-15

# Introduction

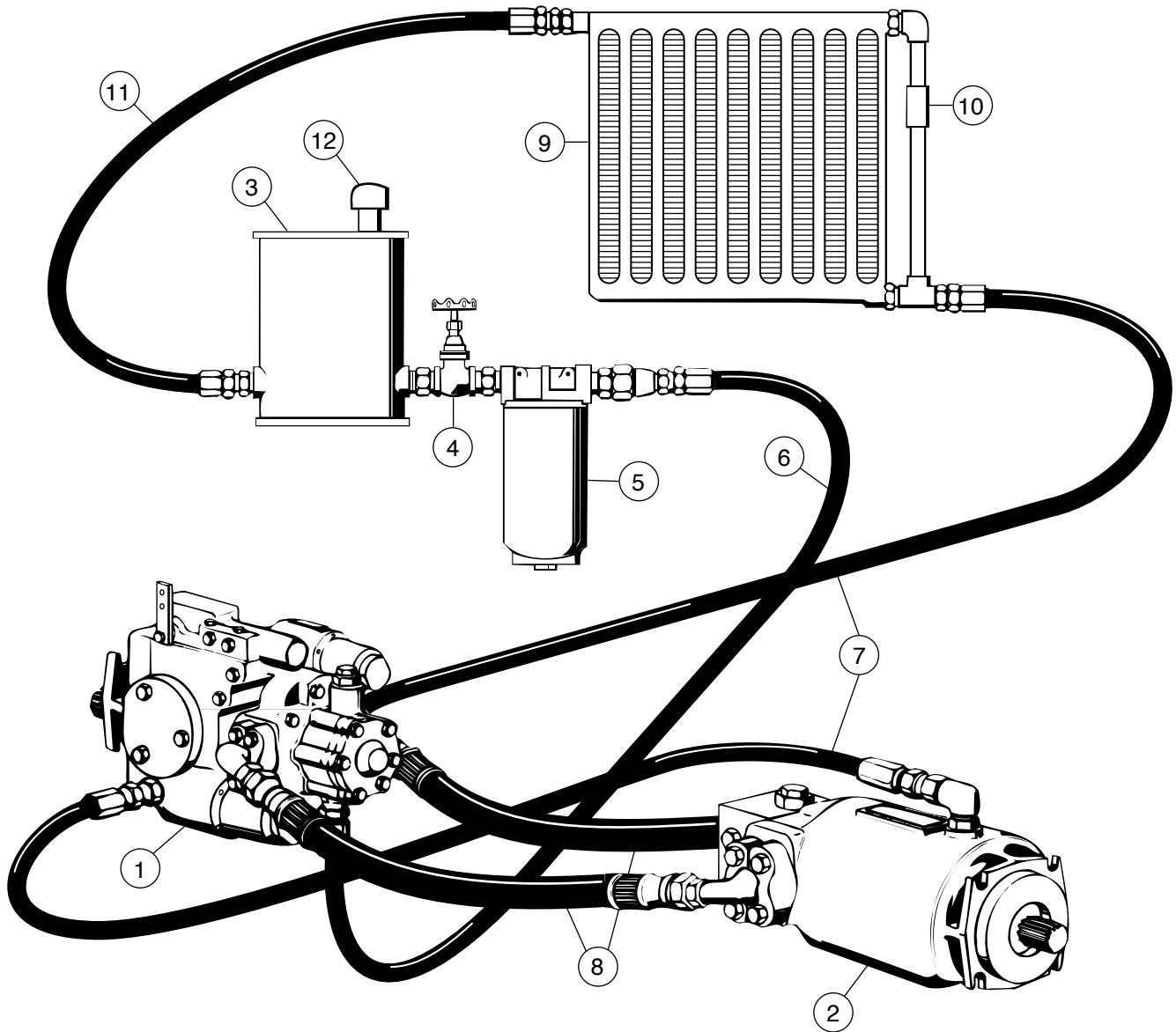
This manual provides troubleshooting information for a typical hydrostatic system. It will help you to diagnose minor problems that may occur with Eaton Heavy Duty Hydrostatic Transmissions.

The following publications are also available for Eaton Heavy Duty Hydrostatic Transmissions:

Technical Data for Hydrostatic Closed-Circuit Schematics .....	No. 3-403
Eaton Heavy Duty Hydrostatic Start-Up Procedure .....	No. 2-402
Eaton Hydrostatic Variable Pump Repair Manual (Series 0) .....	No. 7-603
Eaton Hydrostatic Variable Pump Repair Manual (Series 1) .....	No. 7-606
Eaton Hydrostatic Fixed Pump Repair Manual (Series 0) .....	No. 7-122
Eaton Hydrostatic Fixed Pump Repair Manual (Series 1) .....	No. 7-127

# Typical Hydrostatic System

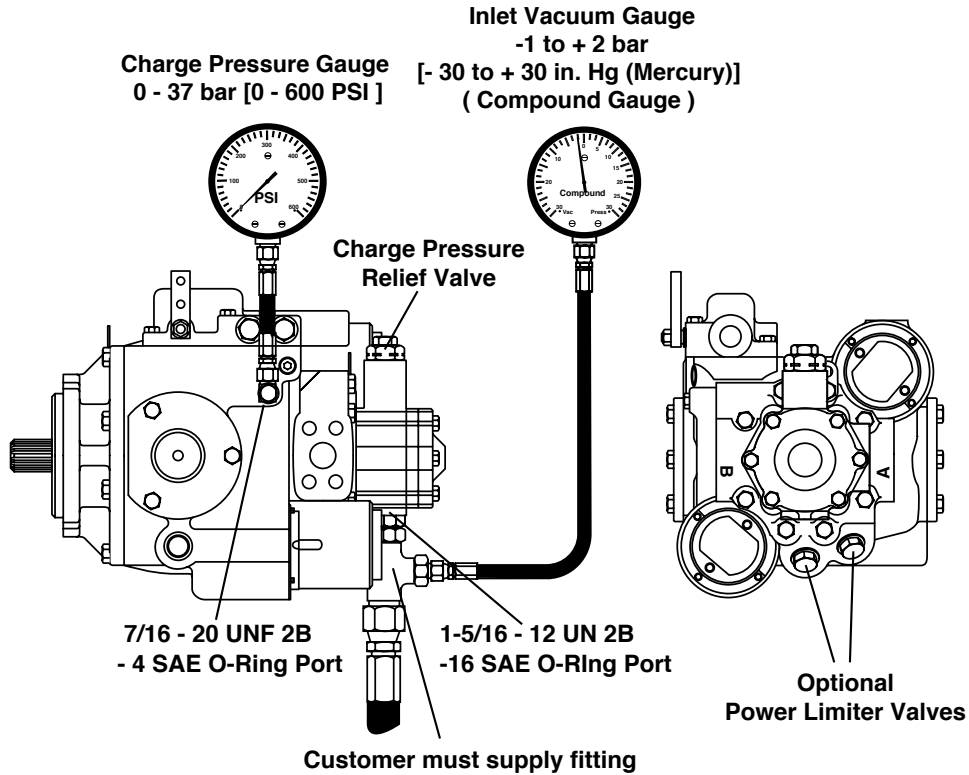
## Variable Pump-Fixed Motor



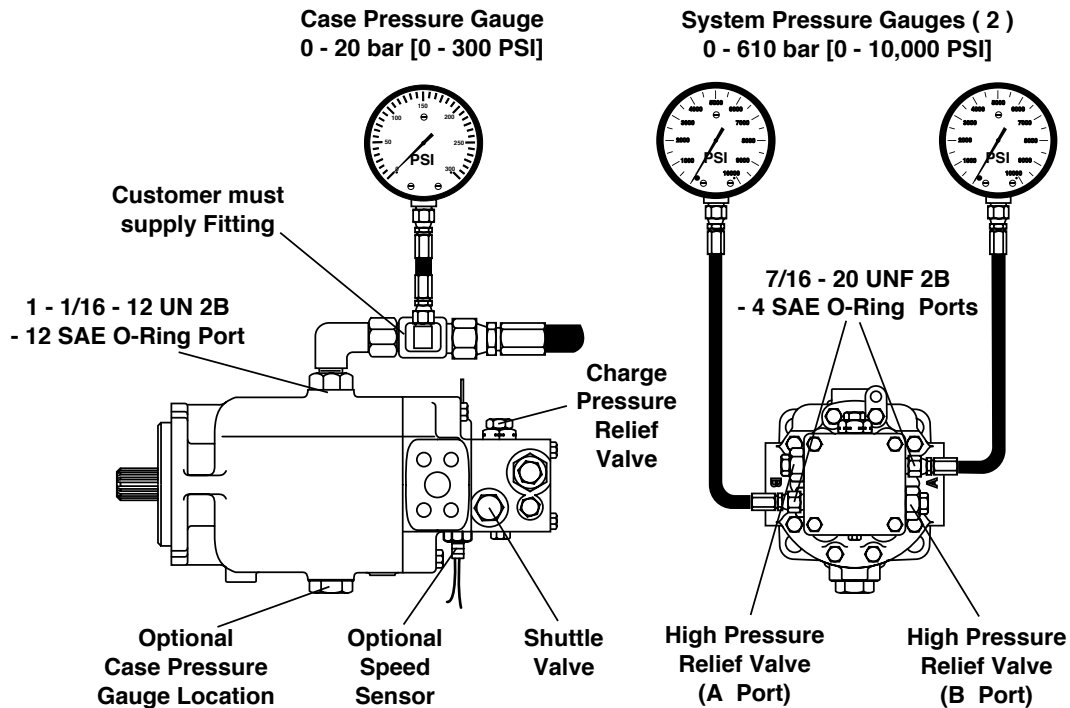
- |   |                                      |    |                                 |
|---|--------------------------------------|----|---------------------------------|
| 1 | Variable Displacement Pump           | 7  | Pump and Motor Case Drain Lines |
| 2 | Fixed or Variable Displacement Motor | 8  | High Pressure Lines             |
| 3 | Reservoir                            | 9  | Heat Exchanger                  |
| 4 | Shut-off Valve (Optional)            | 10 | Heat Exchanger By-pass Valve    |
| 5 | Filter                               | 11 | Reservoir Return Line           |
| 6 | Charge Pump Inlet Line               | 12 | Reservoir fill Cap and Breather |

# Gauge Requirements, Gauge Port Size and Locations

## Variable Displacement Pumps

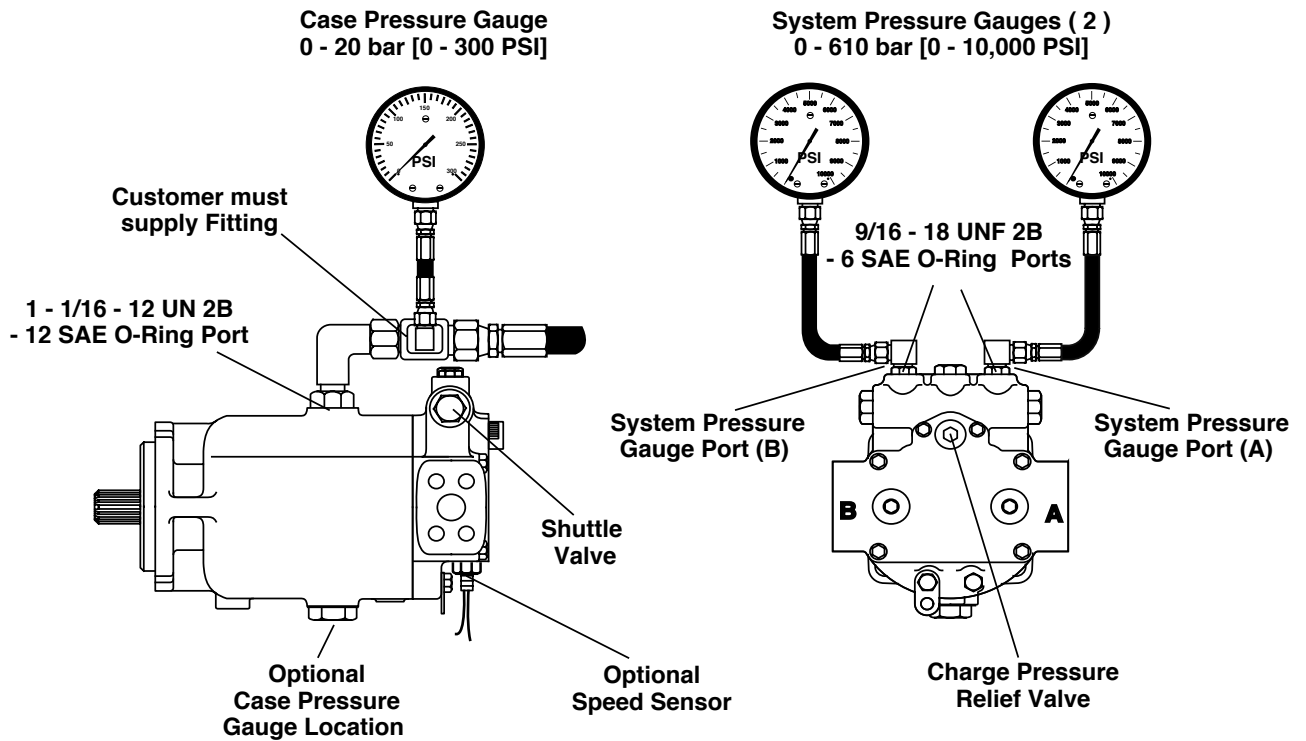


## Fixed Displacement Motor



# Gauge Requirements, Gauge Port Size and Locations

## Fixed Displacement Motors (with Integral Shuttle)



**Note:** To protect your instrumentation, all gauges should be dampened (or snubbed) and mounted with flexible lines.

# Pressure Readings

The pressures given in this manual are gauge pressures or delta pressures. A pressure gauge reads zero when connected to atmospheric pressure. Any reading above or below this zero point is referred to as gauge pressure (bar [PSI]). Delta pressure is the difference of two gauge pressures in a hydraulic circuit.

*Example:*

- Charge pressure reading of 16,5 bar [240 PSI]
- Case pressure reading of 1,5 bar [20 PSI]
- Differential pressure of 15,0 Δ bar [220 Δ PSI]

Typical hydrostatic circuits usually include a inlet pressure, case pressure, low or charge pressure and system or high pressure. These pressures will vary per each individual application and operating conditions.

## Nominal Operating Pressures

(At Normal Operating Temperature)

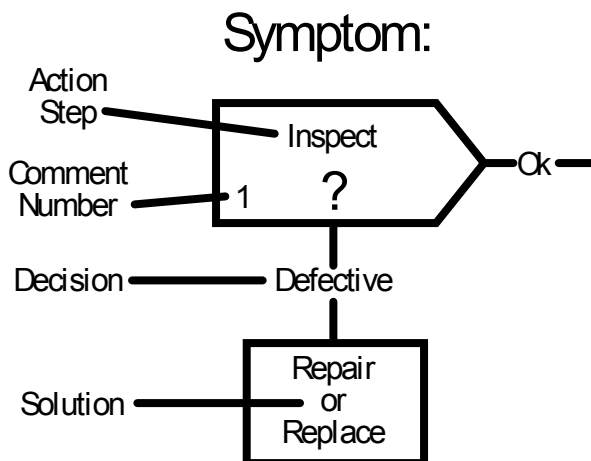
Inlet Vacuum:	Should not exceed 254 mm [10 in.] mercury (Hg.) for an extended period of time
Case pressure:	Should not exceed 2,8 bar [40 PSI] for an extended period of time
Charge Pressure:*	Neutral 15,2 Δ bar [220 Δ PSI] Forward or Reverse 11,0 Δ bar [160 Δ PSI]

\* Charge Pressure Relief valves are factory preset to their nominal setting with a 7,6 l/min [2 GPM] flow rate. The original valve pressure will increase approximately ,45 bar per 3,8 l/min [6.5 PSI per 1 GPM] additional flow over the valve. The charge pressures given above are typical. Higher charge pressures may be set at the factory for your particular application.

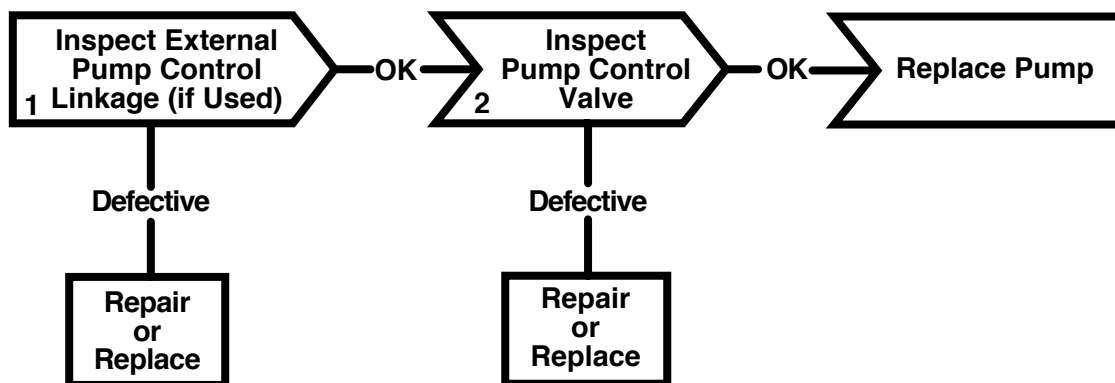
# Fault-Logic Troubleshooting

This guide is designed as a diagnostic aid for the user to locate possible transmission problems. Match the transmission symptoms with the problem statements and follow the action steps shown in the box diagrams. This will help in correcting minor problems, eliminating unnecessary mixer down time.

Following the fault-logic diagrams are diagram action comments to further help explain the action steps shown in the diagrams. Where applicable, the action comment number of the statement appears in the action block of the diagram.

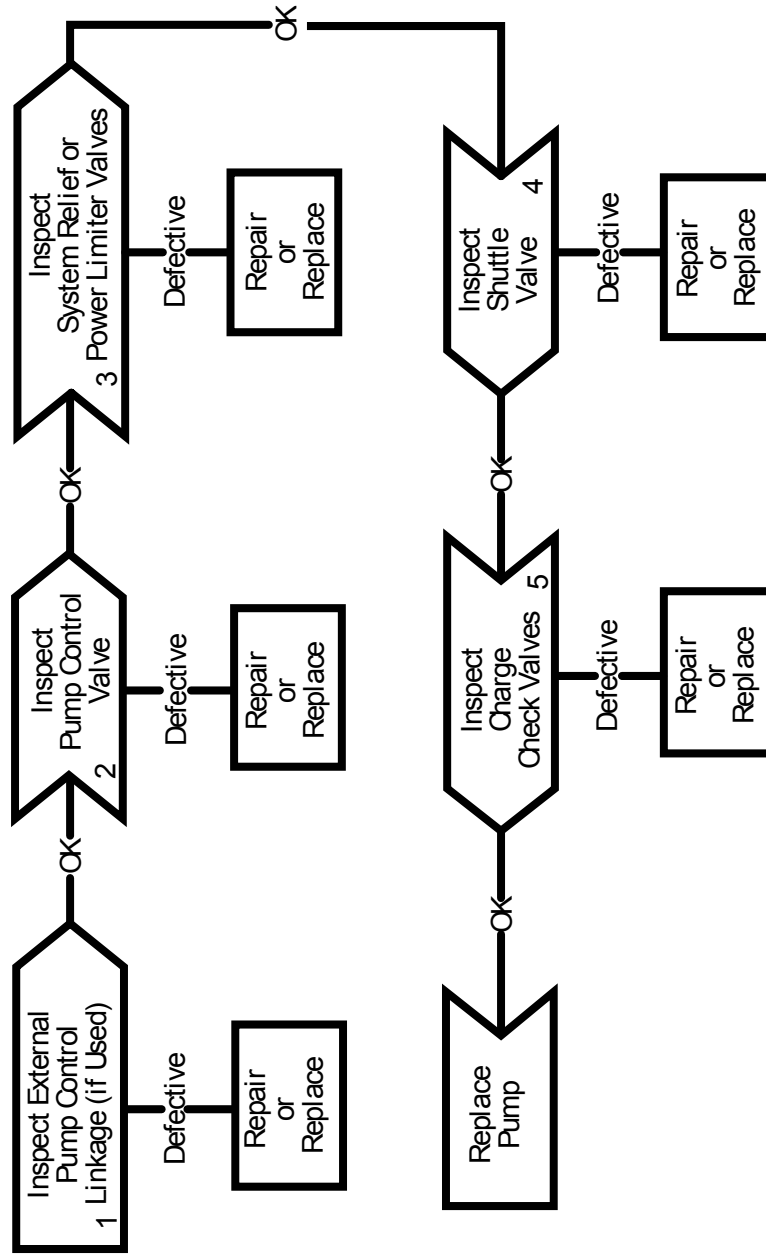


## Neutral Difficult or Impossible to Find

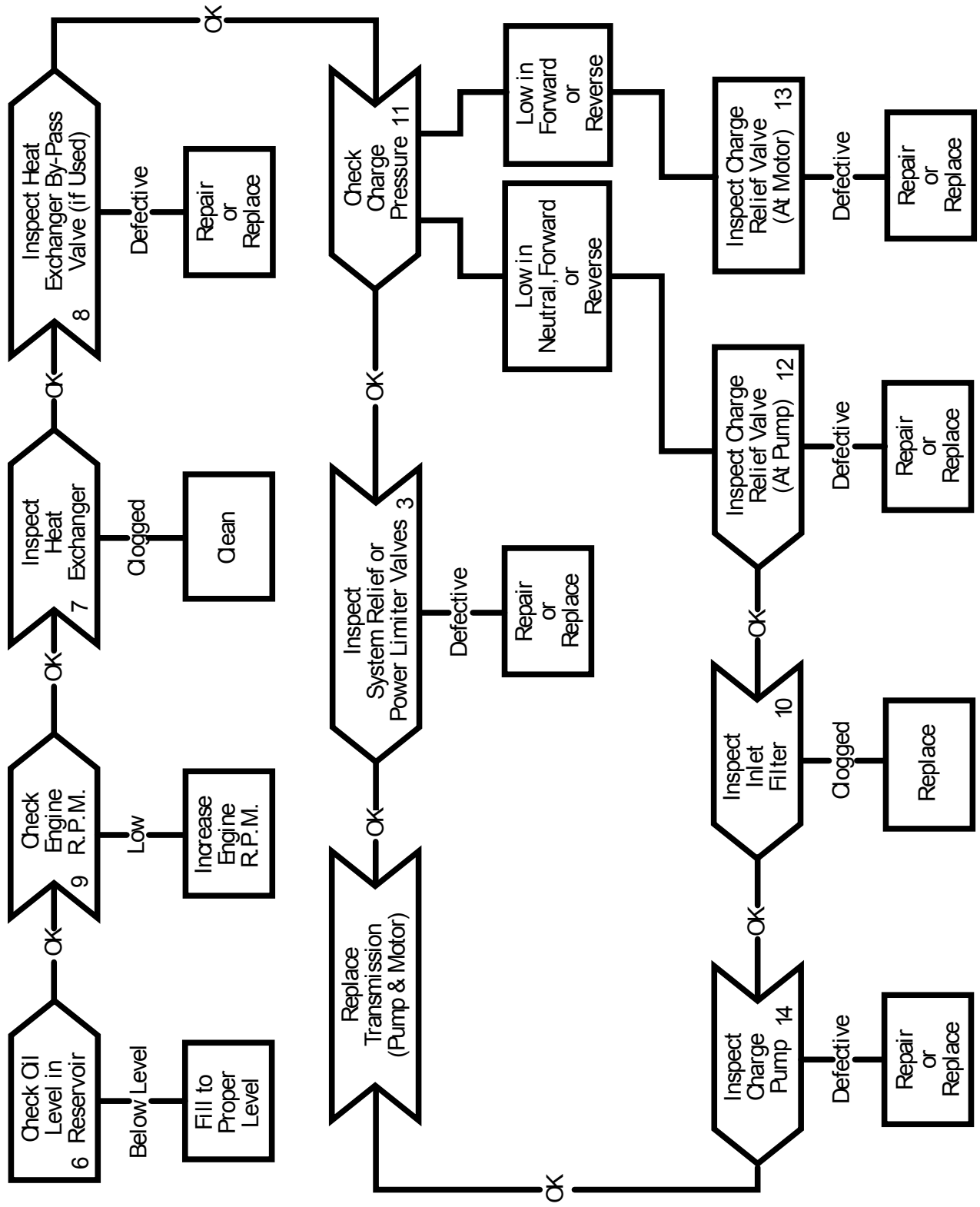




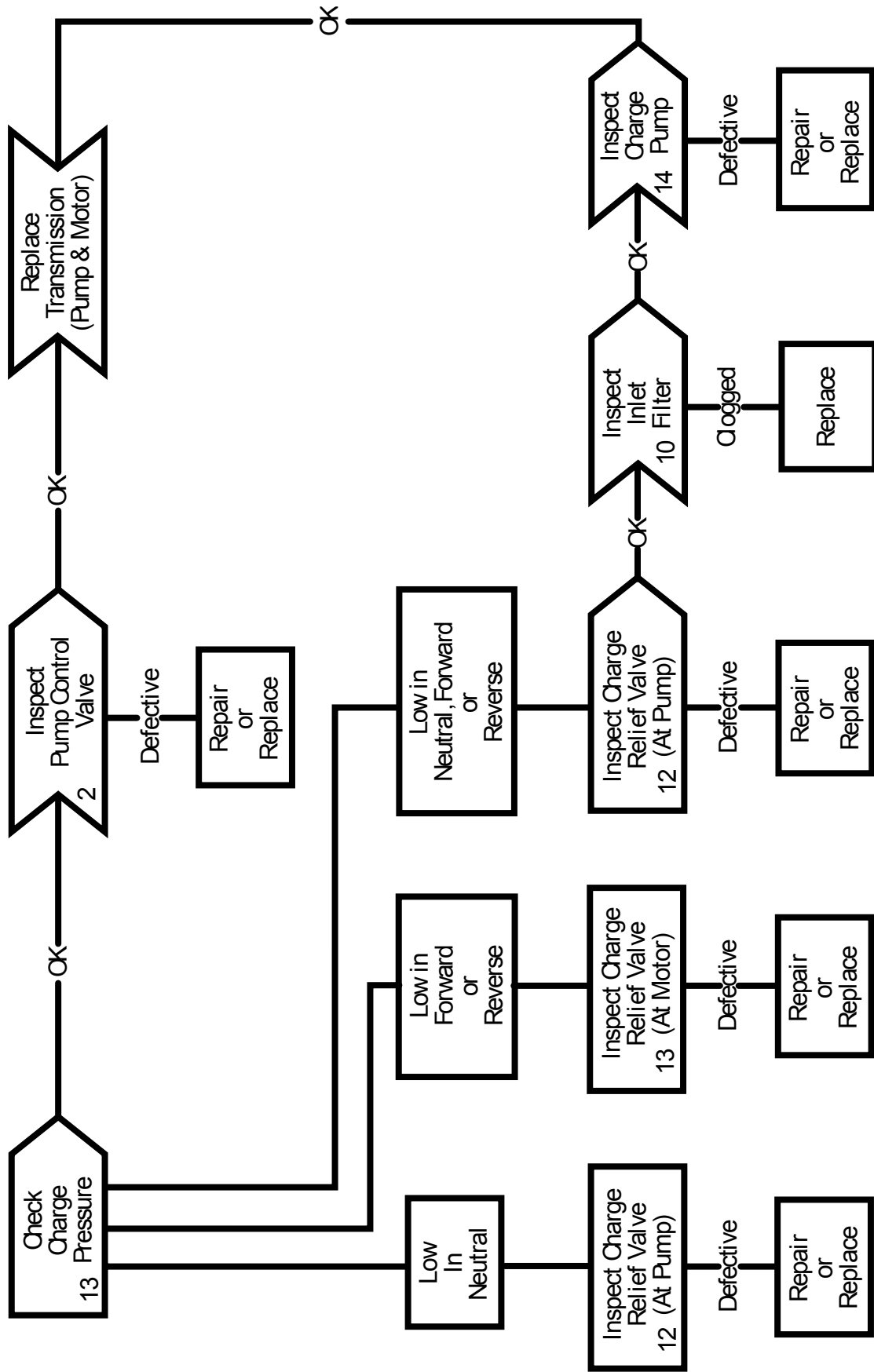
# Drum Turns in One Direction Only



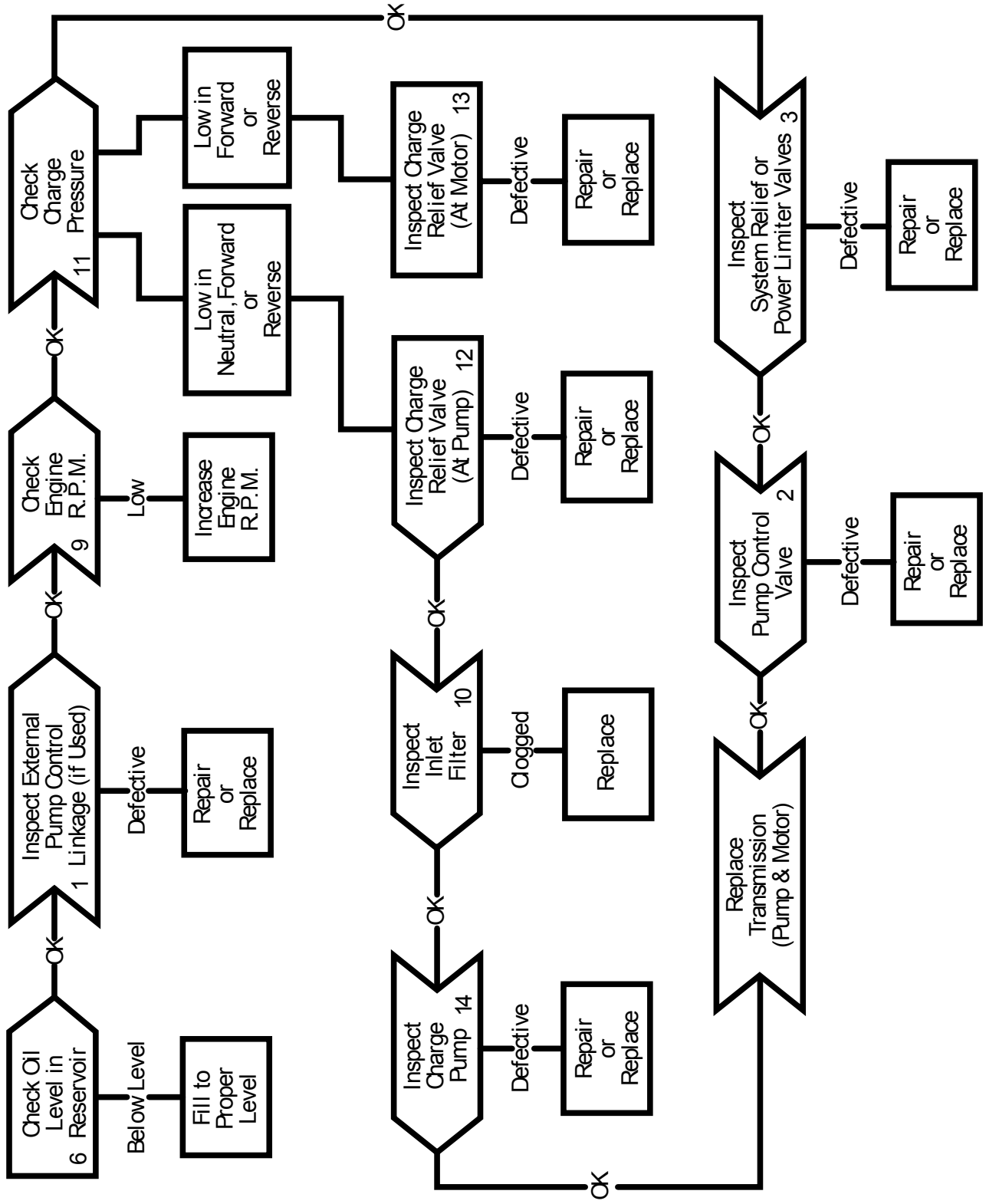
# Hydraulic System Operating Hot



# Drum Response Sluggish



# Drum Stalls or Will Not Turn In Either Direction



# Diagram Action Step Comments

1. Inspect External Pump Control Linkage for:
  - (Manual Operated Controls)
  - A. Misadjusted or disconnected
  - B. Binding, bent or broken
  
  - (Electrical Operated Controls)
  - A. Disconnected electrical signal connection
  
2. Inspect Pump Control Valve for:
  - (Manual Operated Controls)
  - A. Plugged control orifice
  - B. Damaged mounting gasket
  - C. Misadjusted, damaged or broken neutral return spring
  - D. Broken control connector pin
  - E. Broken or missing control linkage pin(s)
  - F. Galled, stuck or bent control spool
  
  - (Electrical Operated Controls)
  - A. Plugged control orifice
  - B. Damaged mounting gasket
  - C. Galled, stuck or bent control spool
  - D. Stuck solenoid valve(s)
  - E. Defective solenoid coil(s)
  - F. Misadjusted speed sensor (when used)
  - G. Defective speed sensor (when used)
  - H. Defective electronics module
  - NOTE: When the electronic transit mixer control is used, follow the control box fault detector instructions.
  
3. Inspect System Relief or Power Limiter Valves for:
  - (System Relief Valves)
  - A. Improper pressure relief setting (Consult owners/operator manual for system relief valve settings.)
  - B. Damaged or missing O-ring and/or back-up ring(s)
  - C. Plugged orifice
  - D. Piston galled or stuck
  - E. Valve poppet held off seat
  
  - (Power Limiter Valves)
  - A. Improper pressure relief setting (Consult owners/operator manual for power limiter valve settings.)
  - B. Broken spring
  - C. Valve held off seat
  
4. Inspect Shuttle Valve for:
  - A. Bent or broken return centering spring
  - B. Galled or stuck shuttle spool
  - C. Bent or broken shuttle spool
  
5. Inspect Charge Check Valves for:
  - A. Damaged or missing O-ring and/or back-up ring(s)
  - B. Damaged check ball seat
  - C. Stuck check ball
  
6. Check Oil Level in Reservoir:
  - A. Consult owner/operators manual for the proper type fluid and level.
  
7. Inspect Heat Exchanger for:
  - A. Obstructed air flow (air cooled)
  - B. Obstructed water flow (water cooled)
  - C. Improper Plumbing (inlet to outlet)
  - D. Obstructed or insufficient fluid flow
  - E. Cooling fan Failure (if used)
  
8. Inspect Heat Exchanger By-Pass Valve for:
  - A. Improper pressure setting
  - B. Stuck or broken valve
  
9. Check Engine R.P.M.
  - A. Consult owner/operators manual for minimum engine rpm.
  
10. Inspect Inlet Filter for:
  - A. Plugged or clogged filter
  - B. Obstructed inlet or outlet
  - C. Collapsed inlet line to charge pump
  - D. Open inlet to charge pump
  
- 11.\* Check Charge Pressure:
  - A. Consult page 4 in this manual for charge pressure gauge installation location.
  - B. Consult owner/operators manual for charge relief valve settings.
  
- 12.\* Inspect Charge Relief Valve for:
  - (at Pump)
  - A. Improper charge relief pressure setting
  - B. Plugged Orifice
  - C. Piston galled or stuck open and/or closed
  - D. Damaged or missing O-ring
  - E. Valve poppet held off seat

## Diagram Action Step Comments

- 13.\* Inspect Charge Relief Valve for:  
(at Motor)
- A. Improper charge relief pressure setting
  - B. Plugged Orifice
  - C. Piston galled or stuck open and/or closed
  - D. Damaged or missing O-ring
  - E. Valve poppet held off seat

14. Inspect Charge Pump for:  
(Standard and A-Pad Pumps)
- A. Broken drive tang
  - B. Damaged or missing o-ring(s)
  - C. Broken drive key
  - E. Galled or broken gerotor set

(B-Pad Pumps)

- A. Stripped or broken drive coupling
- B. Stripped or broken drive spline
- C. Damaged or missing o-ring(s)
- D. Broken drive key
- F. Galled or broken gerotor set

### \*System / Charge Relief Valve Pressure Setting Identification

The system and charge pressure relief valves are all factory preset. For identification, a pressure code is stamped on the hex plug located on the end of the system and charge pressure valve cartridges.

This same code is also used on the power limiter valves. The code number is stamped on the end of the valve cartridge. (Power limiter valves must be removed to view pressure code.) To determine the pressure setting of each valve, add a zero to the right of the stamped coded number.

#### Charge Pressure Valve Examples

016 = 160  $\Delta$  PSI Setting [ 11,0  $\Delta$  bar ]

022 = 220  $\Delta$  PSI Setting [ 15,2  $\Delta$  bar ]

#### System and Power Limiter Valve Pressure Examples

400 = 4000  $\Delta$  PSI Setting [ 275  $\Delta$  bar ]

500 = 5000  $\Delta$  PSI Setting [ 345  $\Delta$  bar ]

# Hydraulic Fluid Recommendations

## Introduction

The ability of Eaton hydraulic components to provide desired performance and life expectancy depends largely on the fluid used. The purpose of this document is to provide readers with the knowledge required to select the appropriate fluids for use in systems that employ Eaton hydraulic components.

One of the most important characteristic to consider when choosing a fluid to be used in a hydraulic system is viscosity. Viscosity choice is always a compromise; the fluid must be thin enough to flow easily but thick enough to seal and maintain a lubricating film between bearing and sealing surfaces. Viscosity requirements for each of Eaton's product lines are given on the back of this document.

## Viscosity and Temperature

Fluid temperature affects viscosity. In general, as the fluid warms it gets thinner and its viscosity decreases. The opposite is true when fluid cools. When choosing a fluid, it is important to consider the start-up and operating temperatures of the hydraulic system. Generally, the fluid is thick when the hydraulic system is started. With movement, the fluid warms to a point where a cooling system begins to operate. From then on, the fluid is maintained at the temperature for which the hydraulic system was designed. In actual applications this sequence varies; hydraulic systems are used in many environments from very cold to very hot. Cooling systems also vary from very elaborate to very simple, so ambient temperature may affect operating temperature. Equipment manufacturers who use Eaton hydraulic components in their products should anticipate temperature in their designs and make the appropriate fluid recommendations to their customers.

## Cleanliness

Cleanliness of the fluid in a hydraulic system is extremely important. Eaton recommends that the fluid used in its hydraulic components be maintained at ISO Cleanliness Code 18/13 per SAE J1165. This code allows a maximum of 2500 particles per milliliter greater than 5  $\mu\text{m}$  and a maximum of 80 particles per milliliter greater than 15  $\mu\text{m}$ . When components with different cleanliness requirements are used in the same system, the cleanest standard should be applied. OEM's and distributors who use Eaton hydraulic components in their products should provide for these requirements in their designs. A reputable filter supplier can supply filter information.

## Fluid Maintenance

Maintaining correct fluid viscosity and cleanliness level is essential for all hydraulic systems. Since Eaton hydraulic components are used in a wide variety of applications it is impossible for Eaton to publish a fluid maintenance schedule that would cover every situation. Field testing and monitoring are the only ways to get accurate measurements of system cleanliness. OEM's and distributors who use Eaton hydraulic components should test and establish fluid maintenance schedules for their products. These maintenance schedules should be designed to meet the viscosity and cleanliness requirements laid out in this document.

## Fluid Selection

Premium grade petroleum based hydraulic fluids will provide the best performance in Eaton hydraulic components. These fluids typically contain additives that are beneficial to hydraulic systems. Eaton recommends fluids that contain anti-wear agents, rust inhibitors, anti-foaming agents, and oxidation inhibitors. Premium grade petroleum based hydraulic fluids carry an ISO VG rating.

SAE grade crankcase oils may be used in systems that employ Eaton hydraulic components, but it should be noted that these oils may not contain all of the recommended additives. This means using crankcase oils may increase fluid maintenance requirements.

Hydraulic fluids that contain V.I. (viscosity index) improvers, sometimes called multi-viscosity oils, may be used in systems that employ Eaton hydraulic components. These V.I. improved fluids are known to "shear-down" with use. This means that their actual viscosity drops below the rated value. Fluid maintenance must be increased if V.I. improved fluids are used. Automotive automatic transmission fluids contain V.I. improvers.

Synthetic fluids may be used in Eaton hydraulic components. A reputable fluid supplier can provide information on synthetic fluids. Review applications that require the use of synthetic fluids with your Eaton representative.

## Viscosity Requirements

Product Line	Minimum	Optimum Range	Maximum	ISO Cleanliness Requirements	Comments
Heavy Duty Piston Pumps and Motors	60 SUS [10 cSt]	80 - 180 SUS [16 - 39 cSt]	10,000 SUS [2158 cSt]	18/13	

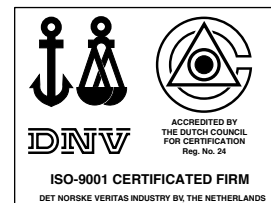
### Additional Notes:

- Fluids too thick to flow in cold weather start-ups will cause pump cavitation and possible damage. Motor cavitation is not a problem during cold start-ups, except for two speed motors. Thick oil can cause high case pressures which in turn can blow motor shaft seals.
- When choosing a hydraulic fluid, all the components in the system must be considered and the optimum viscosity range adjusted accordingly. For example, when a medium duty piston pump is combined with a Geroler motor the optimum viscosity range becomes 100 - 150 SUS [20 - 32 cSt] and viscosity should never fall below 70 SUS [13 cSt].
- If the natural color of the fluid has become black it is possible that an overheating problem exists.
- If the fluid becomes milky, water contamination may be a problem.
- Take fluid level reading when the system is cold.
- Contact your Eaton representative if you have specific questions about the fluid requirements of Eaton hydraulic components.

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**Hydraulics Division**  
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Eaton Ltd.  
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 Genrothes, Fife  
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 Telephone 01-592-771-771  
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Eaton GmbH  
**Hydraulics Products**  
 Am Schimmersfeld 7  
 40880 Ratingen, Germany  
 Telephone 02102-406-830  
 Fax 02102-406-800



Quality System Certified  
 Products in this catalog are manufactured  
 in an ISO-9001-certified site.



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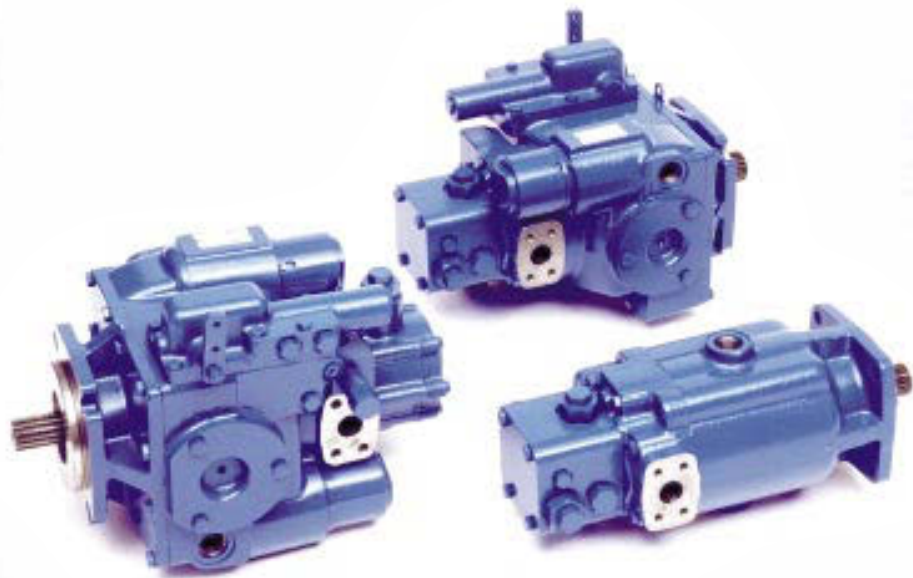
Eaton®  
Heavy Duty Hydrostatic Transmissions

No. 11-866  
Revised June, 1997



Hydraulics

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Models 33 through 76  
Hydrostatic Transmissions

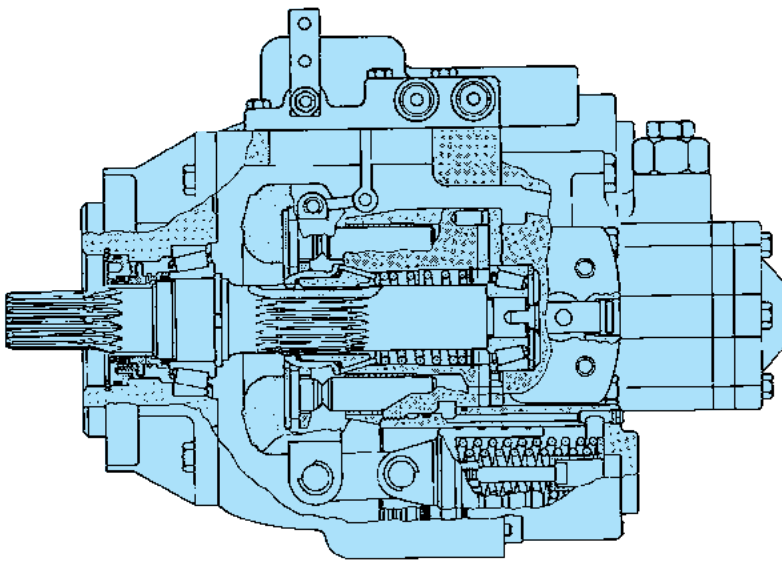
We Manufacture

Solutions

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# Heavy Duty Features/Benefits

- **6000 PSI Pressure Rating**
- **Speeds to 4510 RPM**
- **10,000 Hour B10 Bearing Design Life**
- **3 Year Warranty**



**Variable Pump**

**Advanced cylinder barrel design** – permits high speed and pressure.

**Fixed clearance slipper hold down** – on Models 33 through 64 allows operation at high speed and reduces friction. Model 76 is a ball guide unit.

**Pistons** – have long engagement with cylinder bore resulting in low leakage.

**Hydraulic servo control** – provides low effort operation with low control pressure. Large servo pistons hold swashplate position and provide damping.

**Large case drain ports** – minimize case back pressure.

**Drive shafts** – a wide variety of options are available to suit every need.

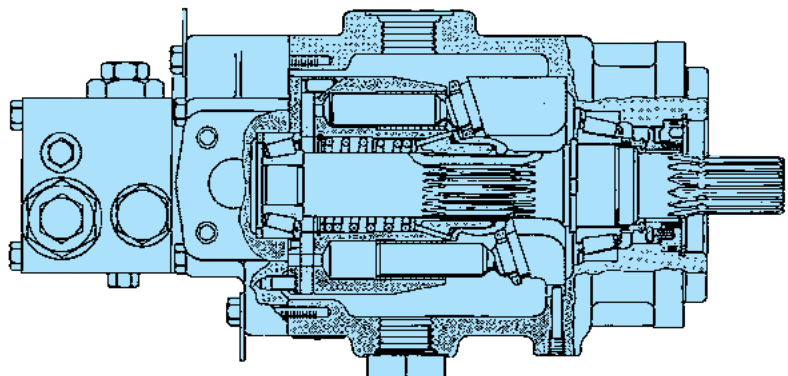
**High strength swashplates on variable pumps and motors** – resist deflection under high load.

**High strength cast iron housings** – provide greater noise damping and wall strength.

**High flow check valves in pumps** – keep the system primed with minimal pressure drop.

**Charge pumps on pumps** – gerotor type, several displacement options are available to suit the needs of every application. All cast iron construction.

**Cartridge shaft seal** – lends itself to easy serviceability. Mechanical face seal design tolerates high speed and high case pressures.



**Fixed Motor**

# Heavy Duty Features/Benefits

**Bi-metal bearing plate** – has steel for high speed and pressure. Bronze provides greater bearing properties.

**Valve plate** – hardened steel for long life.

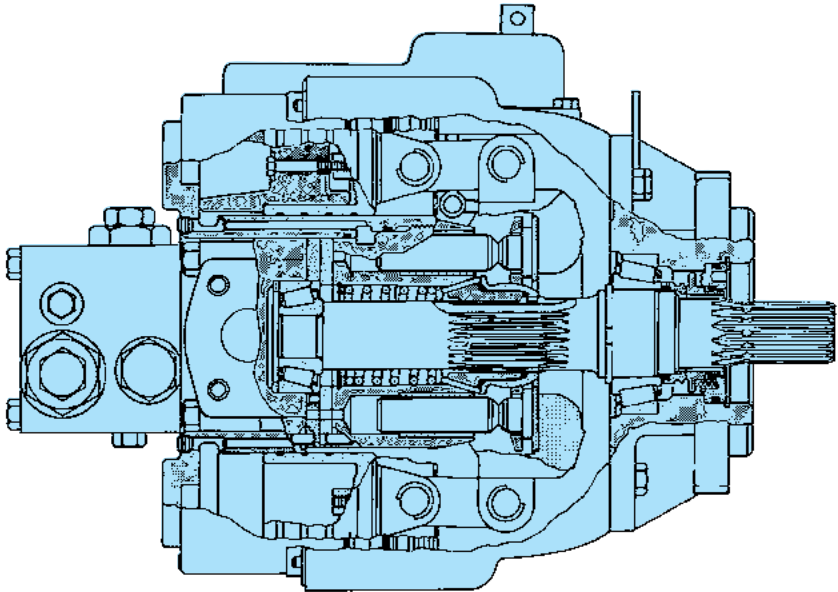
**End cover** – large passages minimizes losses. Both side and rear ports are available on Models 33 through 64 fixed motors.

**C-Pad rear mount** – available on Models 33 through 64 variable pumps for tandem units or for a through shaft.

**Relief valves** – pilot operated cartridge and fast acting direct types available.

**Controls** – a wide variety of control options are available for pumps and motors to meet application needs.

**Ports** – SAE code 61 and code 62 as well as o-ring boss ports are available.



**Variable Motor**

## Table of Contents

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# Pump Performance

## Pump Performance

Model		33	39	46	54	64	76
Displacement	in <sup>3</sup> /rev	3.32	3.89	4.60	5.44	6.44	7.62
	cm <sup>3</sup> /rev	54,4	63,7	75,3	89,1	105,5	124,8
Maximum Shaft Speed*	RPM @ 18°	4510**	4160	4160	3720	3720	2775
Peak Pressure***	PSI [bar]	6000 [415]	6000 [415]	6000 [415]	6000 [415]	6000 [415]	6000 [415]
Output Flow	GPM @ 3500 PSI	61.5	67.3	79.2	84.1	99.1	87.9
	LPM @ 241 bar	233	255	300	318	375	333
Input Torque	lb-in @ 3500 PSI	2049	2346	2786	3285	3900	4552
	Nm @ 241 bar	232	265	315	371	441	514

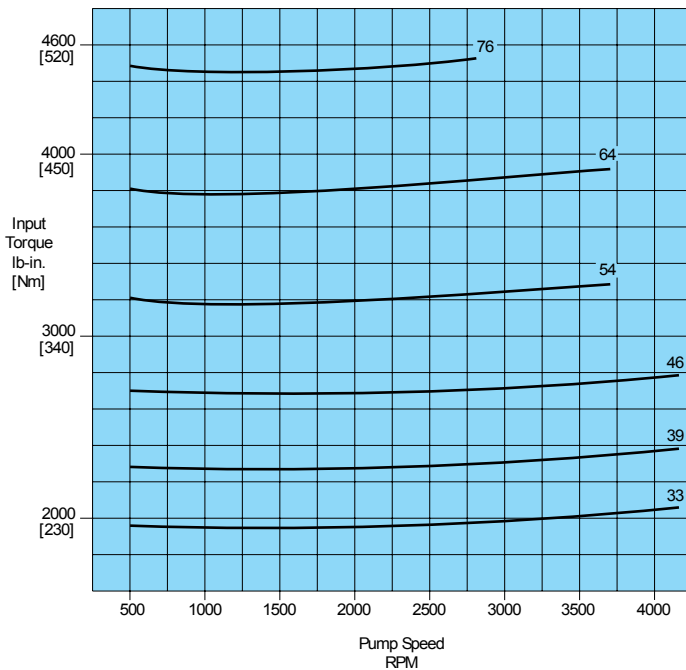
Pump performance calculated at 96% efficiency.

\* The maximum pump shaft speed may be limited by the charge pump speed rating.

\*\* The maximum swashplate angle on model 33 pumps is 15.5°.

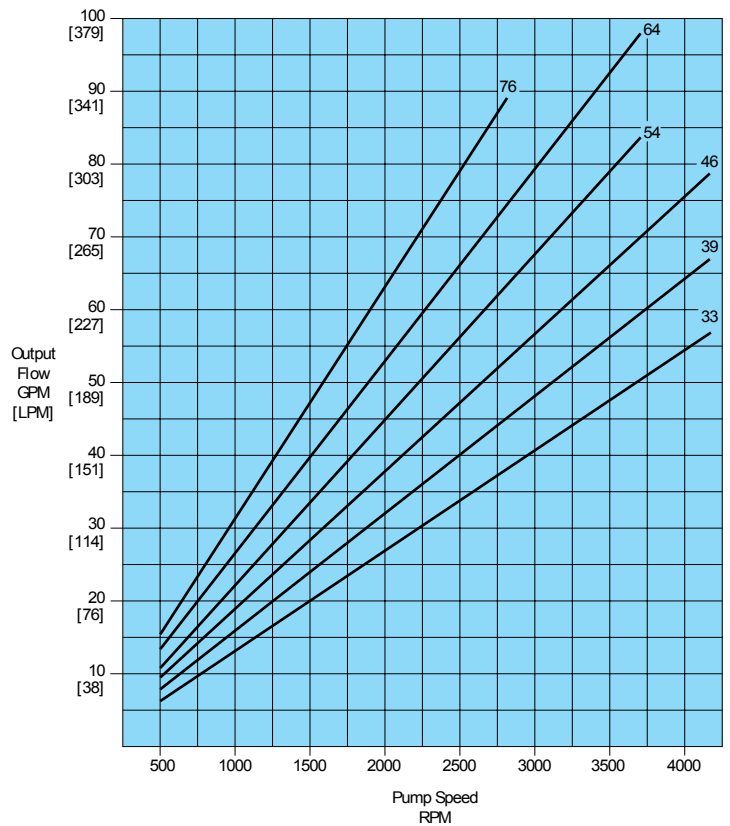
\*\*\* Peak pressure should not exceed 1% of operating time.

### Input Torque vs Speed



System Pressure ..... 3500 psi [240 bar]  
 Charge Pressure ..... 220 psi [15 bar]  
 Oil Viscosity ..... 60 SUS  
 Temperature ..... 180° F [82° C]

### Output Flow vs Speed



# Motor Performance

## Motor Performance

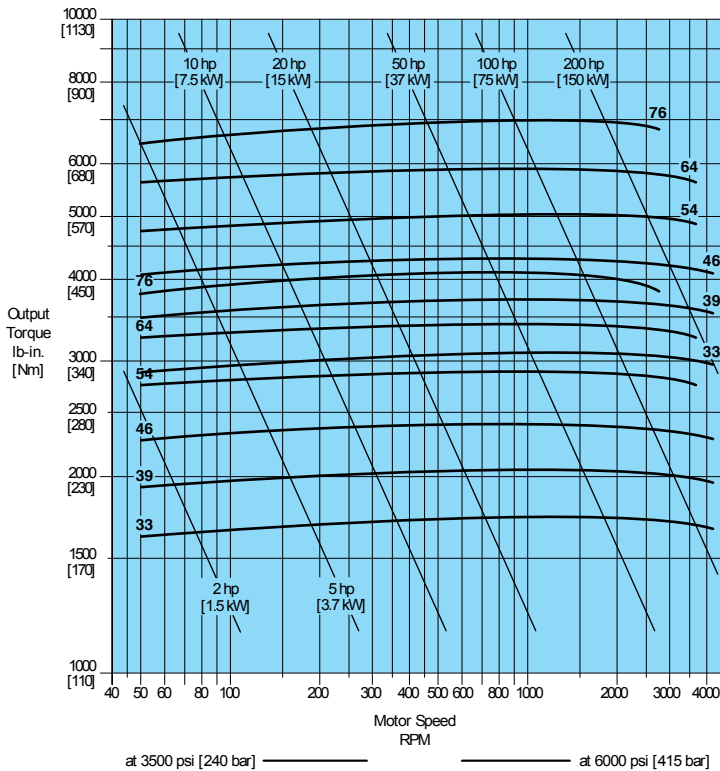
Model		33	39	46	54	64	76
Displacement	in <sup>3</sup> /rev	3.32	3.89	4.60	5.44	6.44	7.62
	cm <sup>3</sup> /rev	54,4	63,7	75,3	89,1	105,5	124,8
Maximum Shaft Speed	RPM @ 18°	4510*	4160	4160	3720	3720	2775
	RPM @ 10°	5380~	5380~	5380~	4810~	4810~	3425~
Maximum Output Torque †	lb-in	2959	3511	4149	4916	5807	6911
	Nm	334	397	469	556	656	781

\* The maximum swashplate angle on model 33 motors is 15.5°.

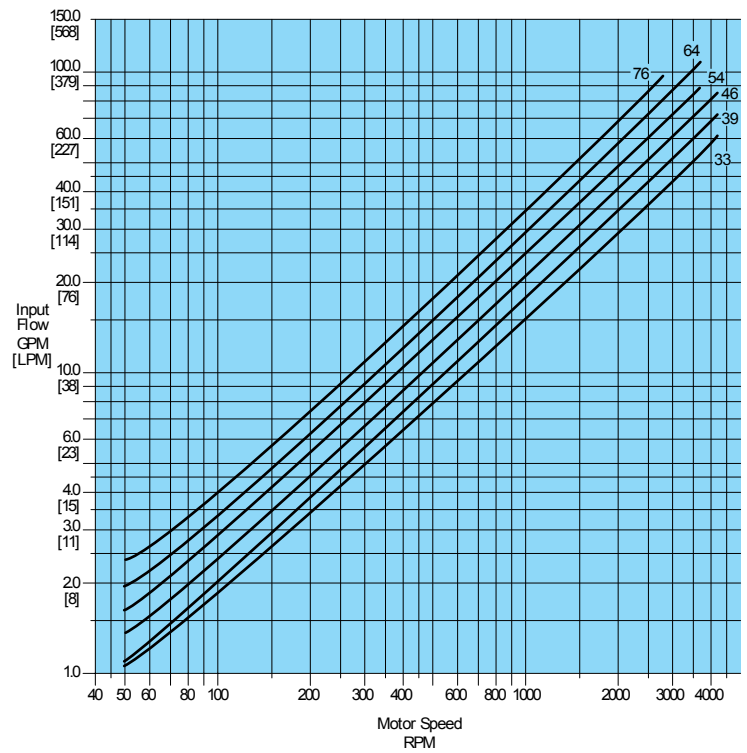
~ These shaft speeds require maximum charge pressure relief: 340 psi [23 bar] pump and 280 psi [19 bar] motor.

† Maximum output torque is measured at 6000 psi [415 bar].

### Output Torque vs Speed



### Input Flow vs Speed



System Pressure ..... 3500 psi [240 bar]  
 Charge Pressure ..... 220 psi [15 bar]  
 Oil Viscosity ..... 60 SUS  
 Temperature ..... 180° F [82° C]

**Note:** Operating the motor below 50 RPM is not recommended.

# Charge Pump Performance

Eaton offers a choice of four charge pump displacements to go with their heavy duty transmission line: .85, 1.28, 1.70, and 2.12 in<sup>3</sup>/rev [13,9; 21,0; 27,8; 34,7 cm<sup>3</sup>/rev]. These charge pumps are available with one or more of the following options:

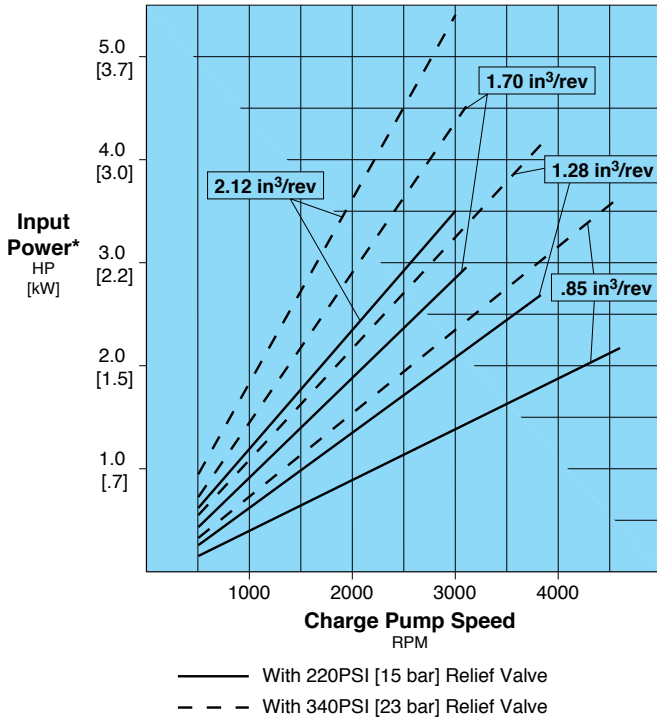
- a pressure sensing port
- remote pressure side filter ports
- a spin-on pressure side filter
- mounting flanges for auxiliary pumps

## Charge Pump Performance

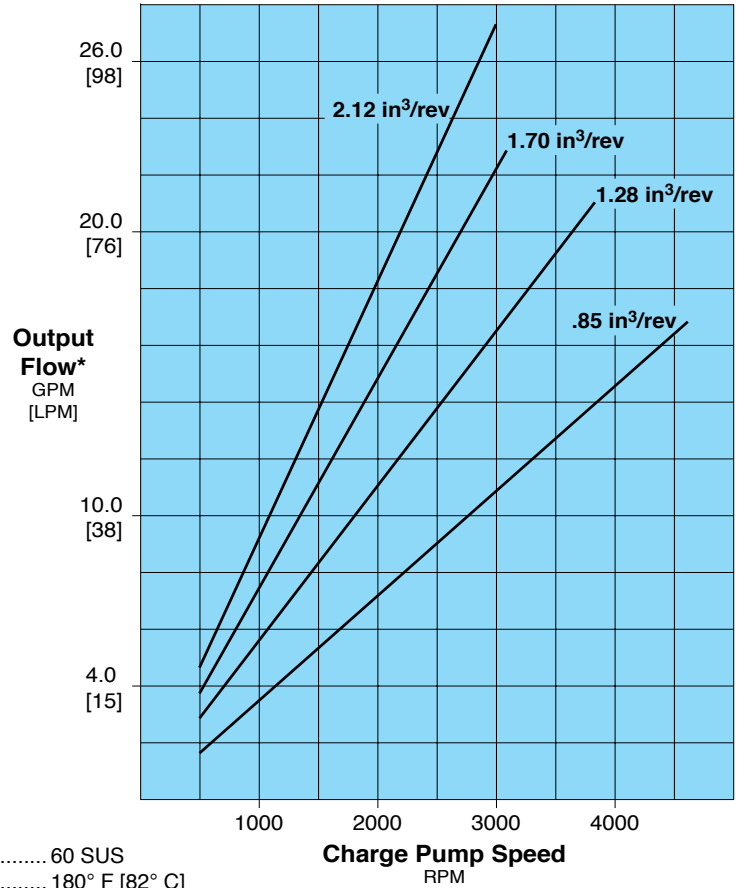
Displacement	in <sup>3</sup> /rev	.85	1.28	1.70	2.12
	cm <sup>3</sup> /rev	13,9	21,0	27,9	34,7
Maximum Shaft Speed	RPM	4600	3800	3100	3000
Output Flow @ Maximum Speed*	GPM	16.9	21.0	22.8	27.5
	LPM	64,0	79,5	86,3	104,2
Input Power @ 220 PSI [15 bar] and Maximum Speed*	HP	2.17	2.70	2.93	3.54
	kW	1,62	2,01	2,18	2,64

\*Theoretical Values

### Charge Pump Power vs Speed

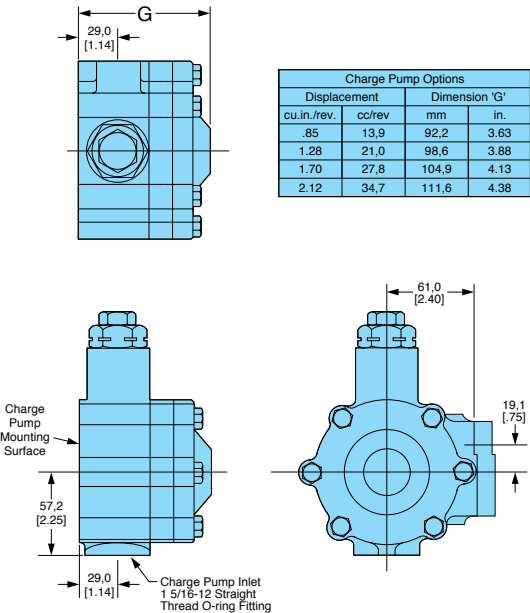


### Charge Pump Flow vs Speed

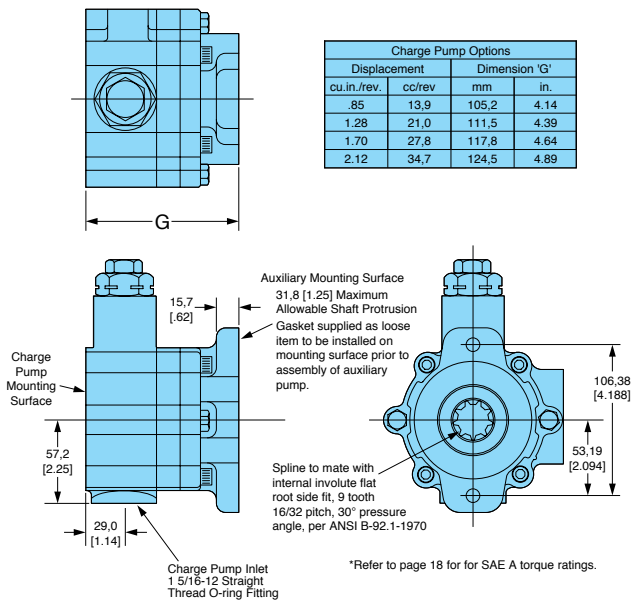


# Charge Pump Dimensions

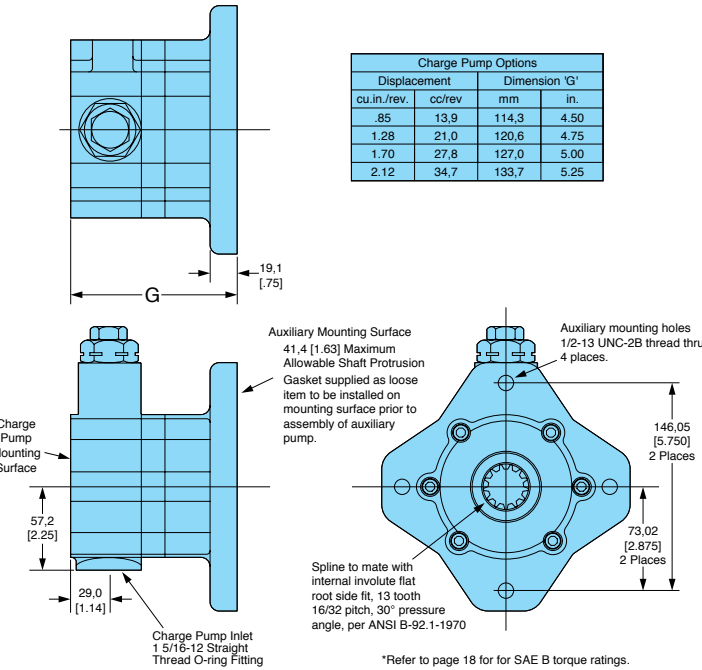
## Charge Pump with Auxiliary Pressure Port



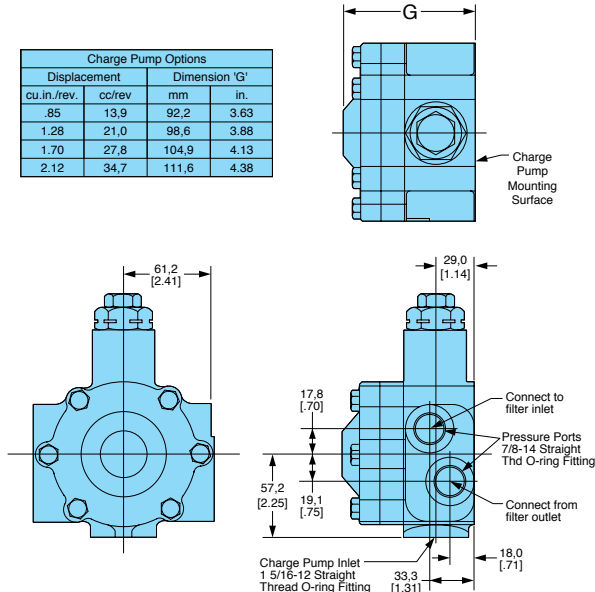
## Charge Pump with SAE A Auxiliary Mount



## Charge Pump with SAE B Auxiliary Mount

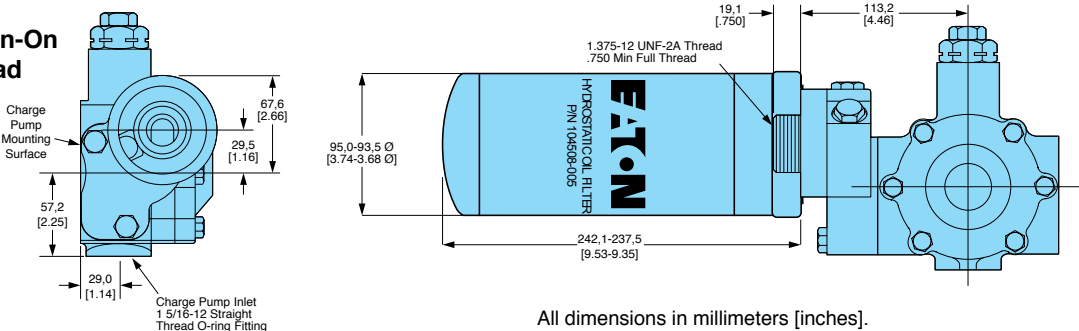


## Charge Pump with Remote Filter Ports



## Charge Pump with Spin-On Pressure Side Filter Pad

\*Note: This option supplied with filter.



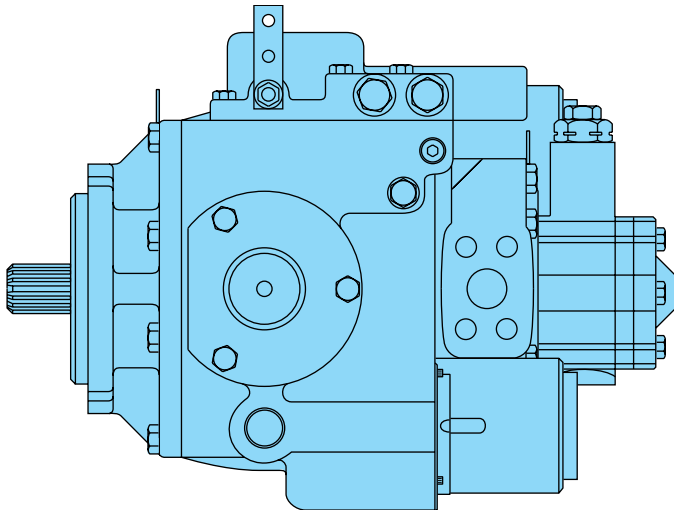
All dimensions in millimeters [inches].

# Heavy Duty Hydrostatic Transmissions

Eaton heavy duty hydrostatic transmissions are self-lubricating, sealed systems that transfer power to remote locations without a mechanical power train. This feature allows greater design flexibility in locating power train components.

Eaton hydrostatic transmissions offer infinitely variable output speeds from zero to maximum, in both forward and reverse. This allows the operator to exactly match engine power to load conditions and thus optimize performance, productivity and fuel economy.

Eaton hydrostatic transmissions are currently used on agricultural combines, transit mixer drum drives, timber harvesters, construction equipment, farm tractors, saw mills, mining equipment and many other applications.

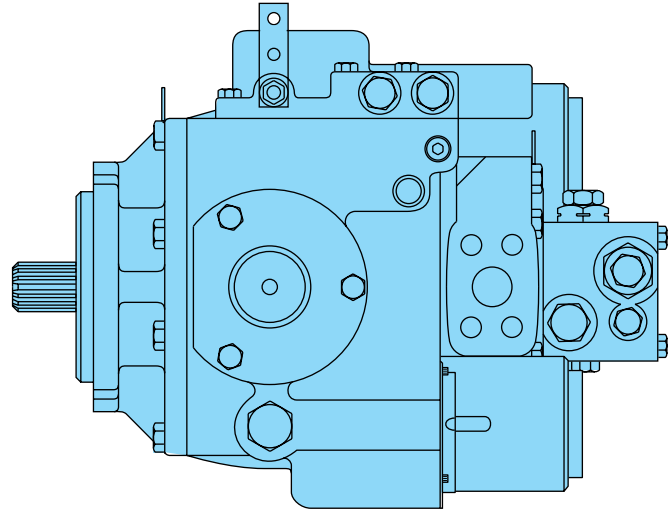


**Variable Pump**

## Eaton heavy duty variable pumps

The Eaton heavy duty variable displacement pump contains a rotating cylinder barrel and pistons. The displacement control directs control pressure to the two servo pistons that position the swashplate. The variable pump is powered into stroke and springs, on the servo pistons, bring it out of stroke. The swashplate pivots on tapered roller bearings. A bolt-on charge pump, with a cartridge type charge pressure relief valve, is available in four displacements.

One lever controls direction, varies speed and provides dynamic braking. This ease of operation, in conjunction with a wide variety of control options, allows Eaton hydrostatic transmissions to be readily adapted to many applications.

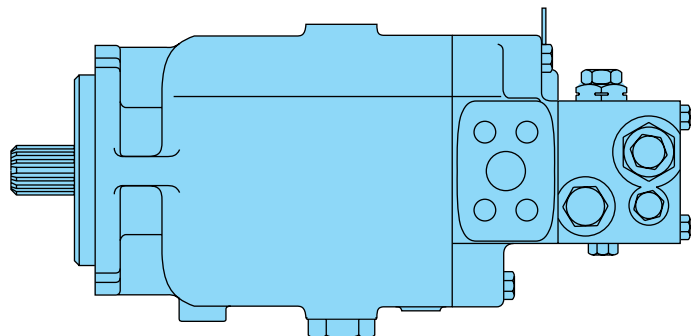


**Variable Motor**

## Eaton heavy duty motors

The Eaton heavy duty motors contains a rotating cylinder barrel and pistons. The variable motor has two internal servo pistons that control the movement of the swashplate which pivots on tapered roller bearings. The variable motor provides a broader speed range and allows the use of a smaller displacement pump.

The end covers, on both the fixed and variable motors, are standard with a bolt-on valve block. The valve block contains two high pressure relief valves, a shuttle valve, and a charge pressure relief valve. The high pressure relief valves limit the closed loop pressure by cross porting when the pressure limit is reached. The shuttle valve and charge pressure relief valve direct charge flow into the motor housing for flushing and cooling.

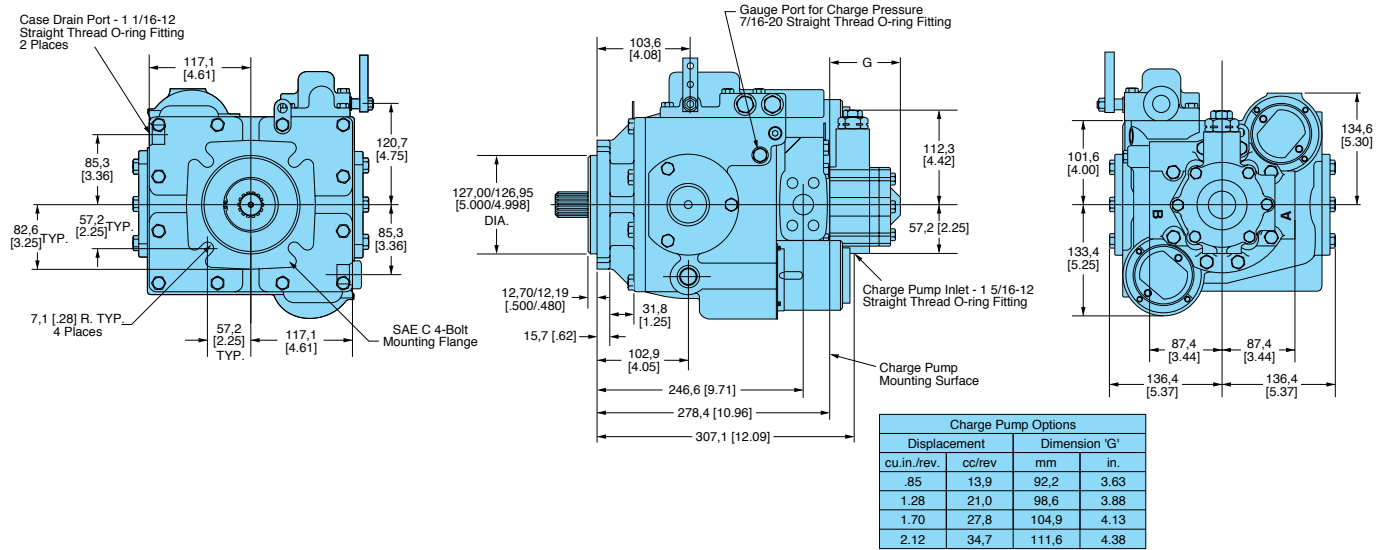


**Fixed Motor**

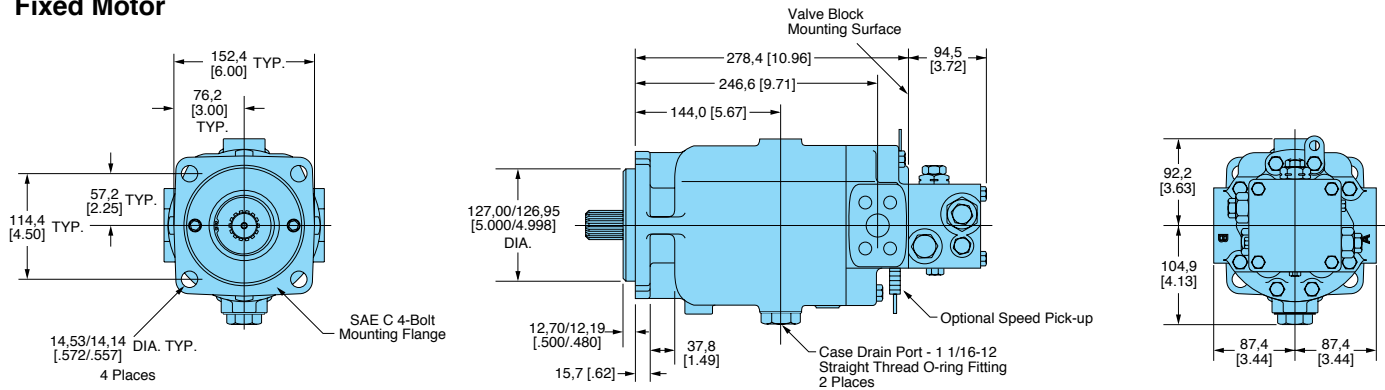


# Models 33, 39, and 46 Dimensions

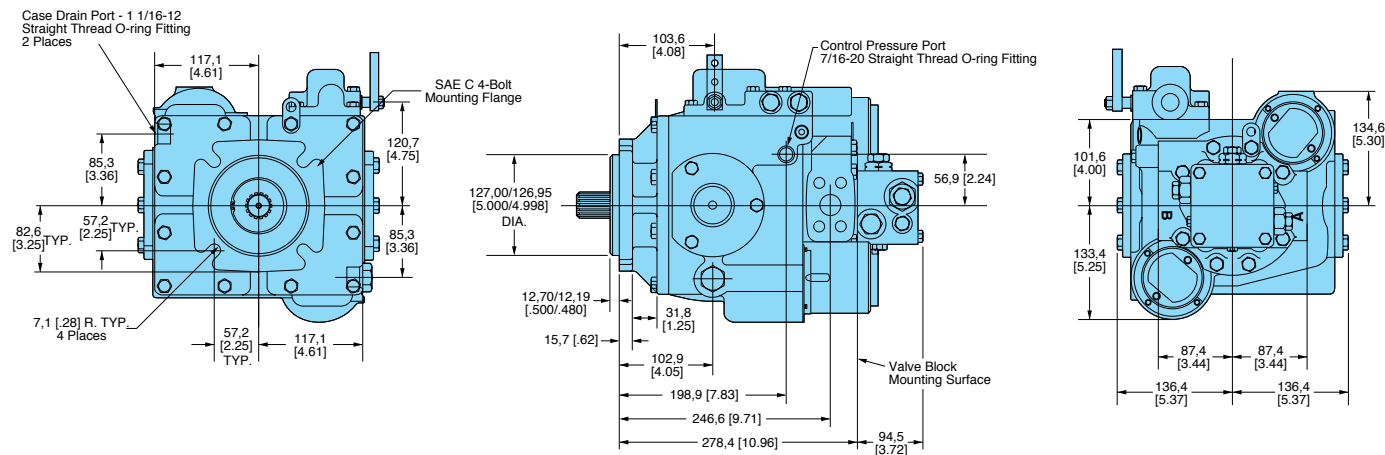
## Variable Pump



## Fixed Motor



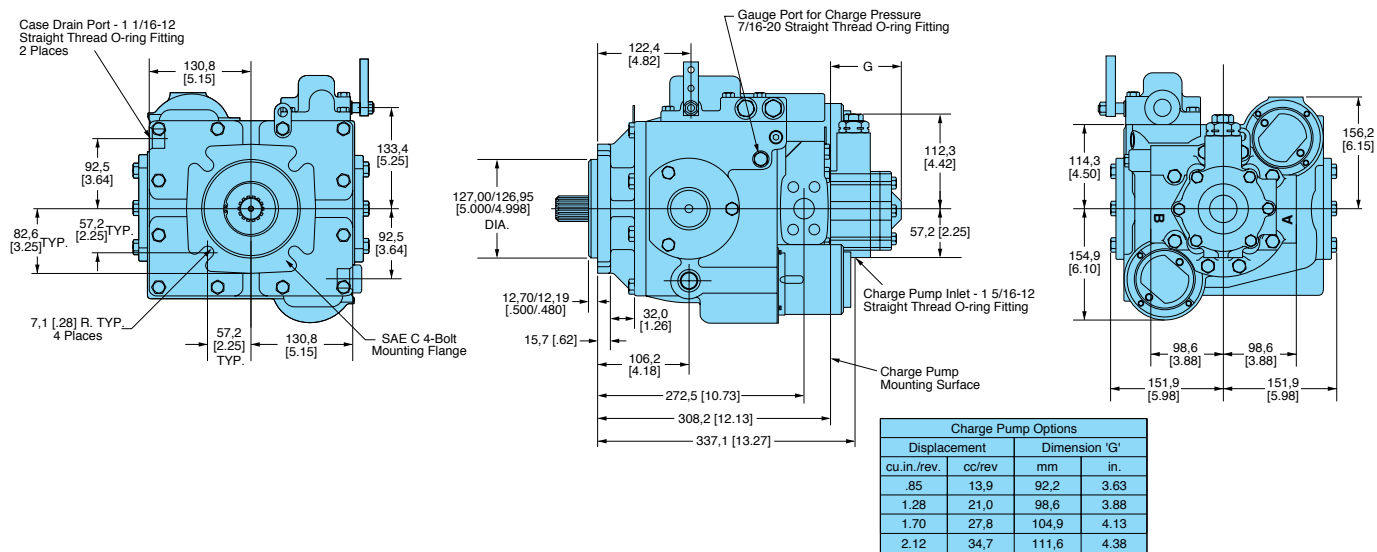
## Variable Motor



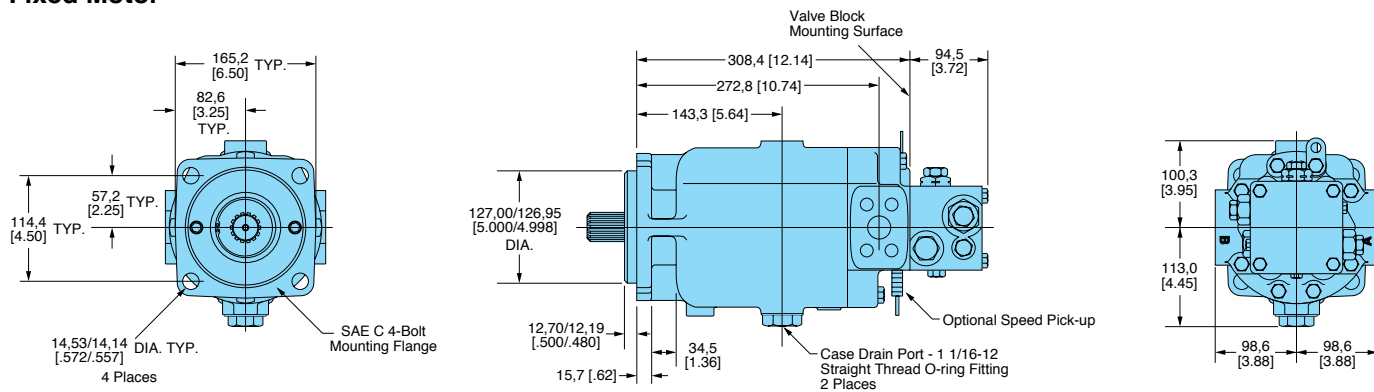
**Notes:** All dimensions are given in millimeters [inches].  
 The variable pumps and motors are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.  
 The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.  
 The lever on the standard control has linkage connection holes at 1 and 2 inch radii from the control shaft center.  
 Detailed drawings of available shafts and ports are shown on page 21.

# Models 54 and 64 Dimensions

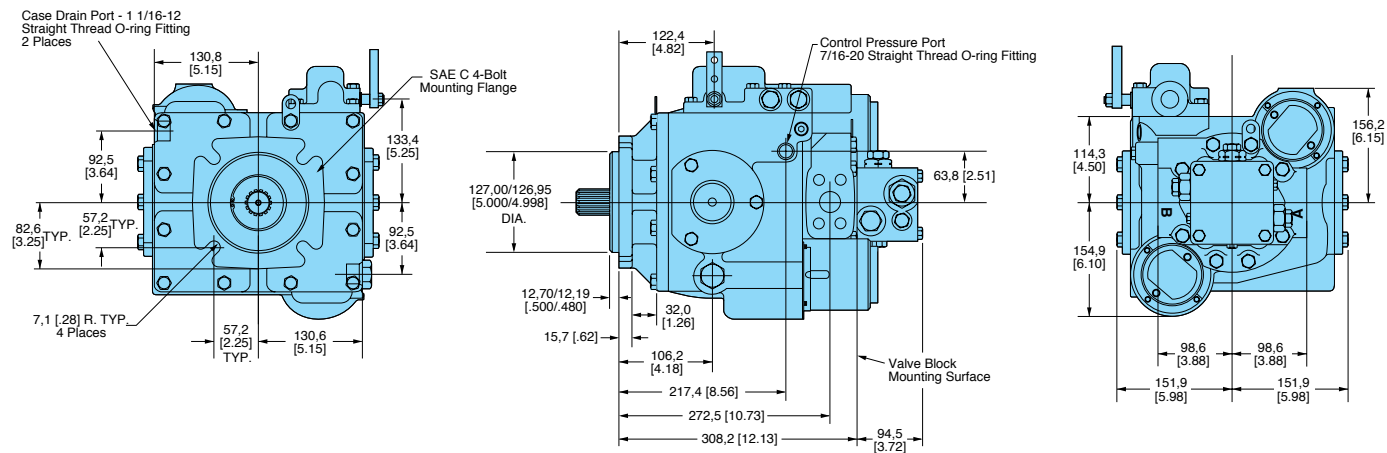
## Variable Pump



## Fixed Motor

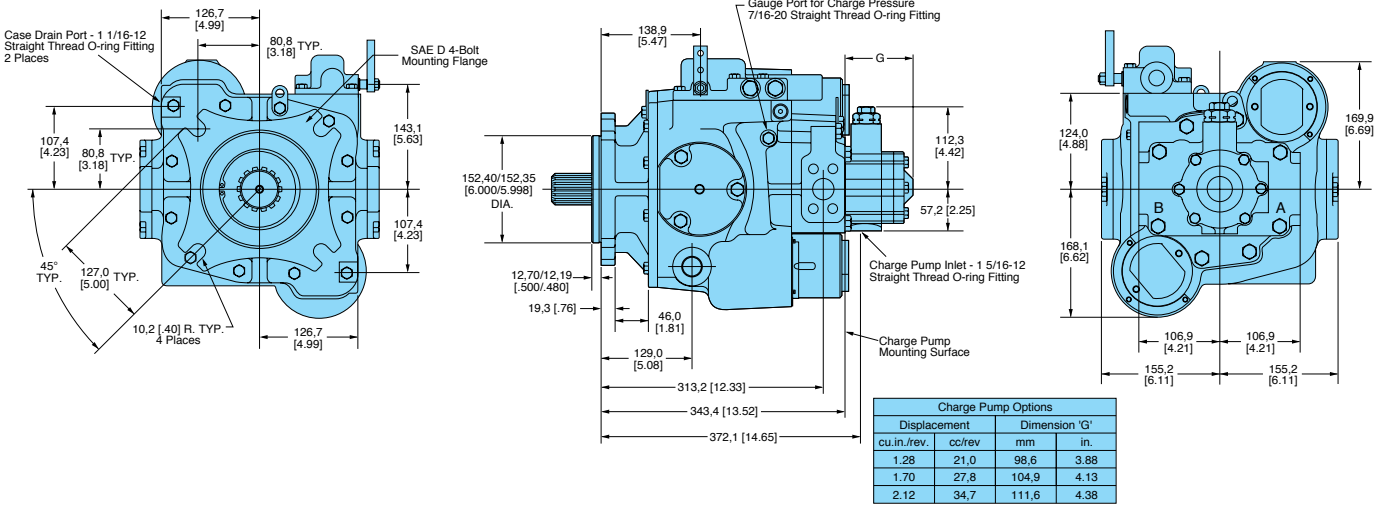


## Variable Motor

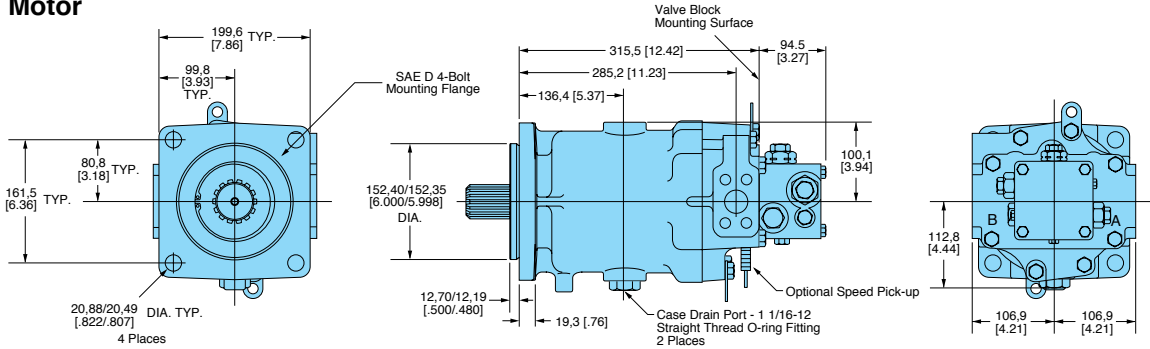


# Model 76 Dimensions

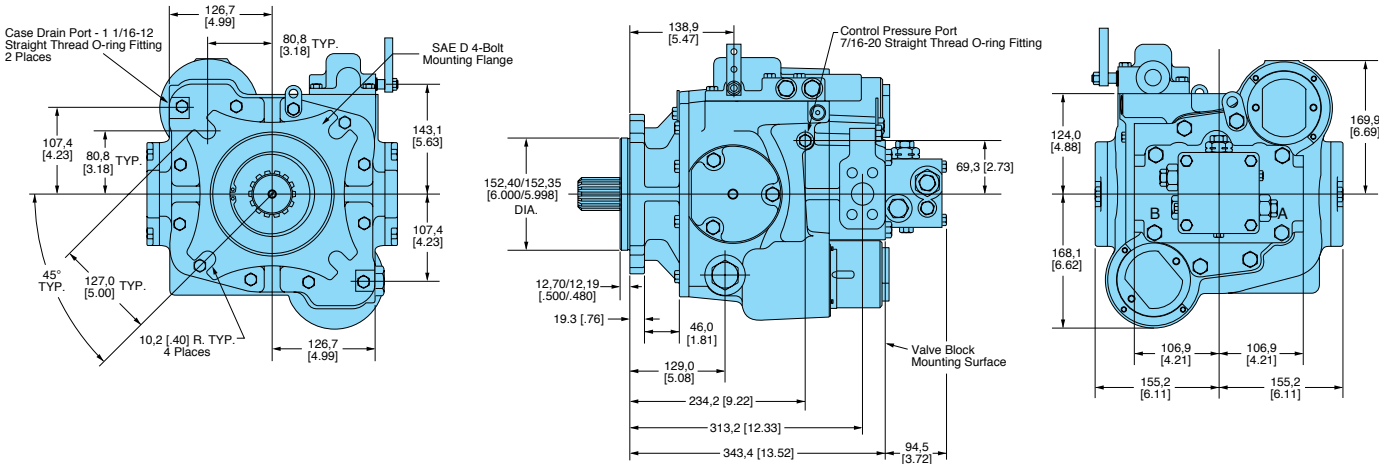
## Variable Pump



## Fixed Motor



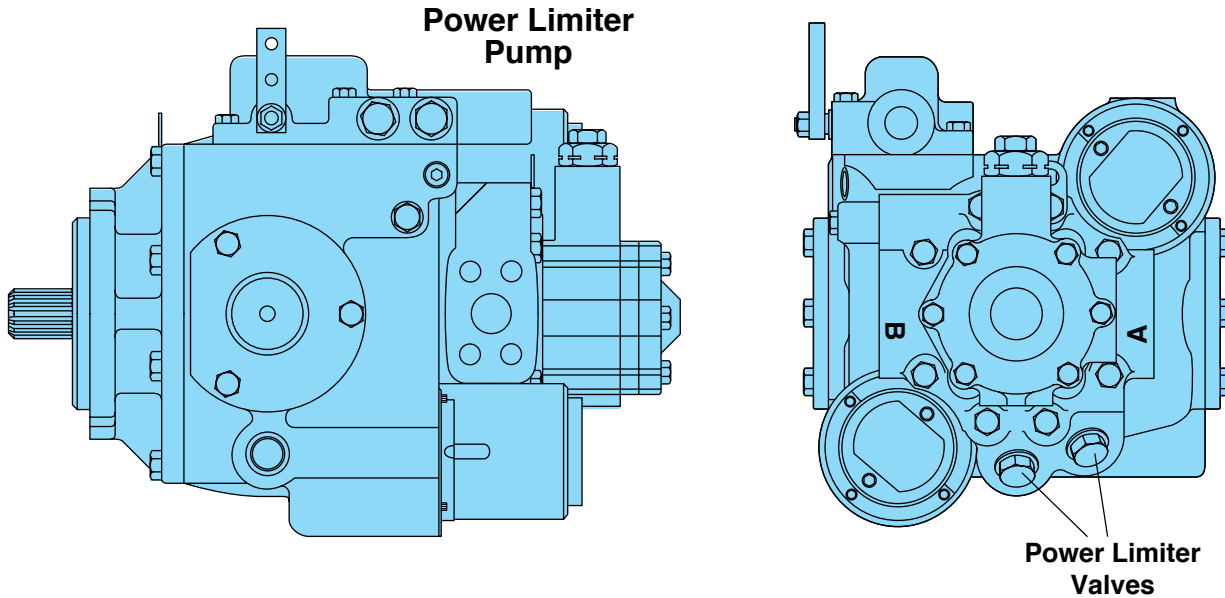
## Variable Motor



### Heavy Duty Component Approximate Weights lb [Kg]

Model	Variable Pump	Fixed Motor	Variable Motor
33	138 [62,6]	83 [37,6]	140 [63,5]
39	138 [62,6]	83 [37,6]	140 [63,5]
46	138 [62,6]	83 [37,6]	140 [63,5]
54	188 [85,3]	106 [48,1]	190 [86,2]
64	188 [85,3]	106 [48,1]	190 [86,2]
76	226 [101,7]	121 [54,5]	228 [102,6]

# Power Limiter Pumps and Integral Shuttle Valve Motors Models 33 through 64



## Power Limiter Valve Operation\*

Power limiter valves (PLV) are high pressure relief valves built into the pump's end cover. When pressure in the high pressure loop gets too high, the PLV opens to the pump case. Besides an immediate drop in the loop high pressure, the open PLV also causes control pressure to drop. This in turn allows the centering springs on the servo pistons to bring the pump out of stroke until the pressure drops to the relief valve setting and the PLV closes.

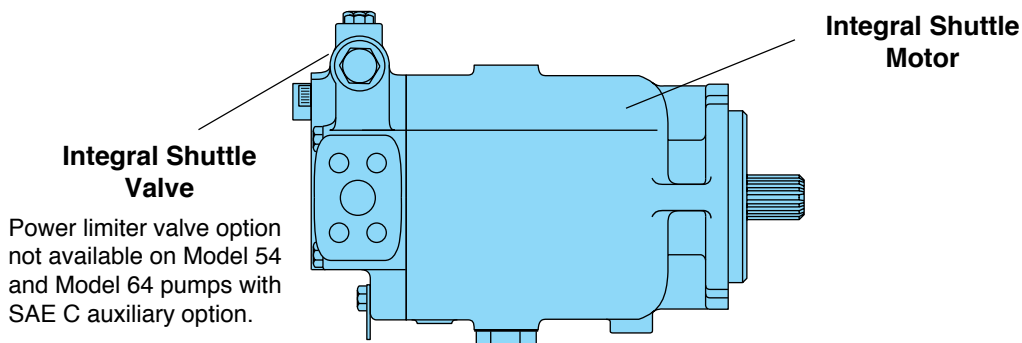
The PLV will also act as a check valve to prevent cavitation in the event of a rapid pressure rise and hose expansion.

A motor with integral shuttle valve is used in conjunction with the power limiter valve pump.

\* Note: Power limiter valves are not recommended for applications with large overrunning loads.

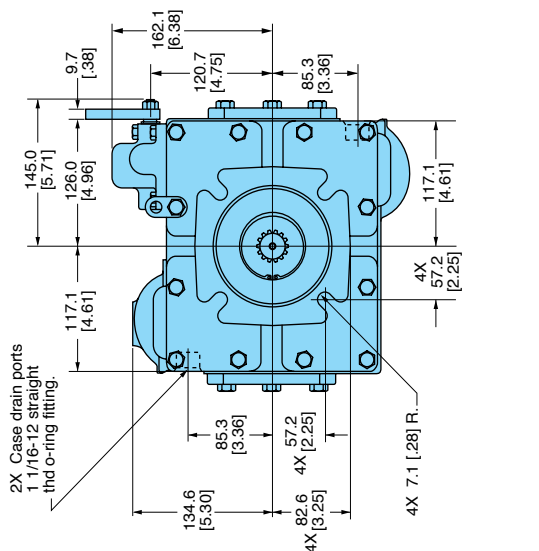
## Feature/Benefits

- The motor is shorter and lighter allowing it to fit in tighter spaces.
- The motor's integral shuttle valve and low pressure relief assure good loop flushing.
- The motor is available with side ports, end ports, or both allowing maximum mounting flexibility.
- The power limiter valves (PLV) are quick, direct acting relief valves that prevent high pressure spikes.
- The power limiter pump is ideally suited for use with motors that do not have valve blocks because it eliminates the need for a remote valve block.

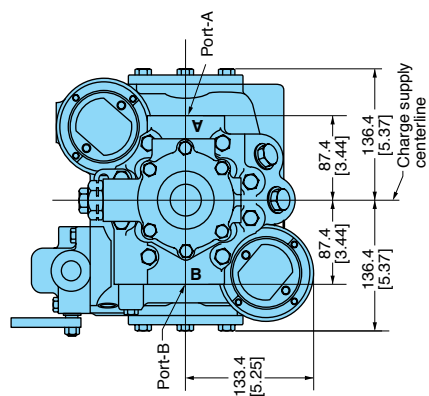
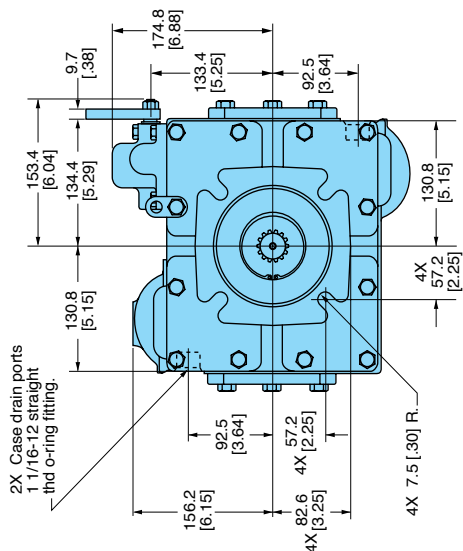


# Power Limiter Pump Dimensions

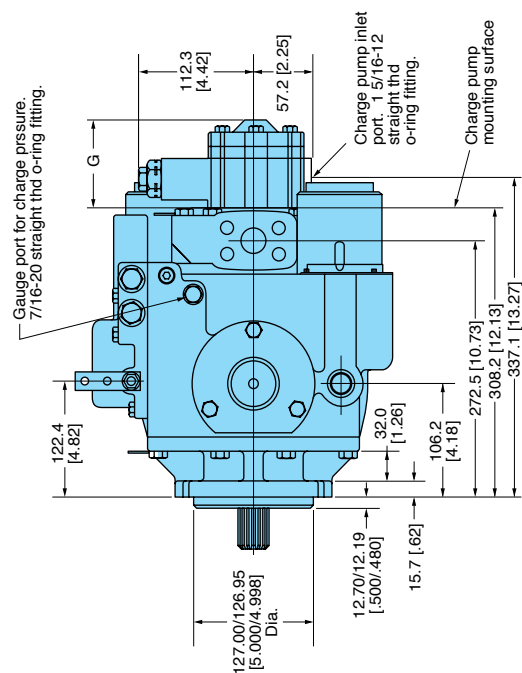
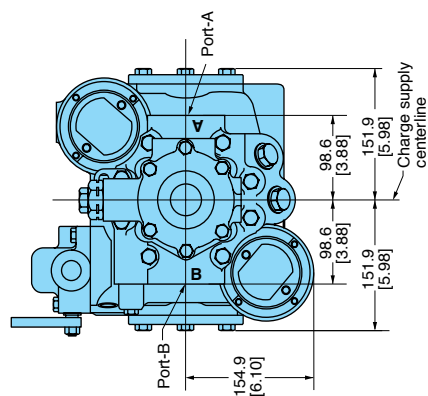
## Models 33, 39, and 46 Power Limiter Pumps



## Models 54 and 64 Power Limiter Pumps

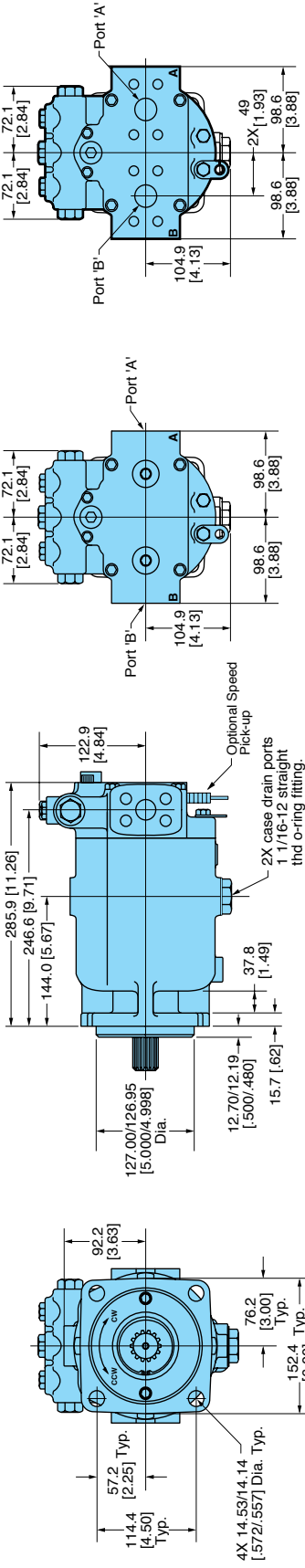


Charge Pump Options		
Displacement	Dimension 'G'	
	cu.in./rev.	cc/rev
.85	13.9	92.2
1.28	21.0	96.6
1.70	27.8	104.9
2.12	34.7	111.6

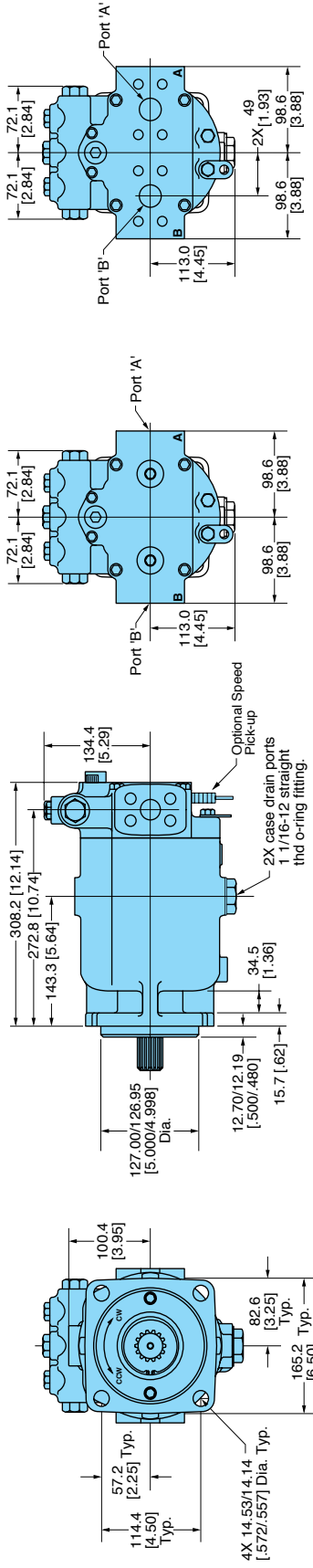


# Integral Shuttle Motor Dimensions

## Models 33, 39, and 46 Integral Shuttle Motors



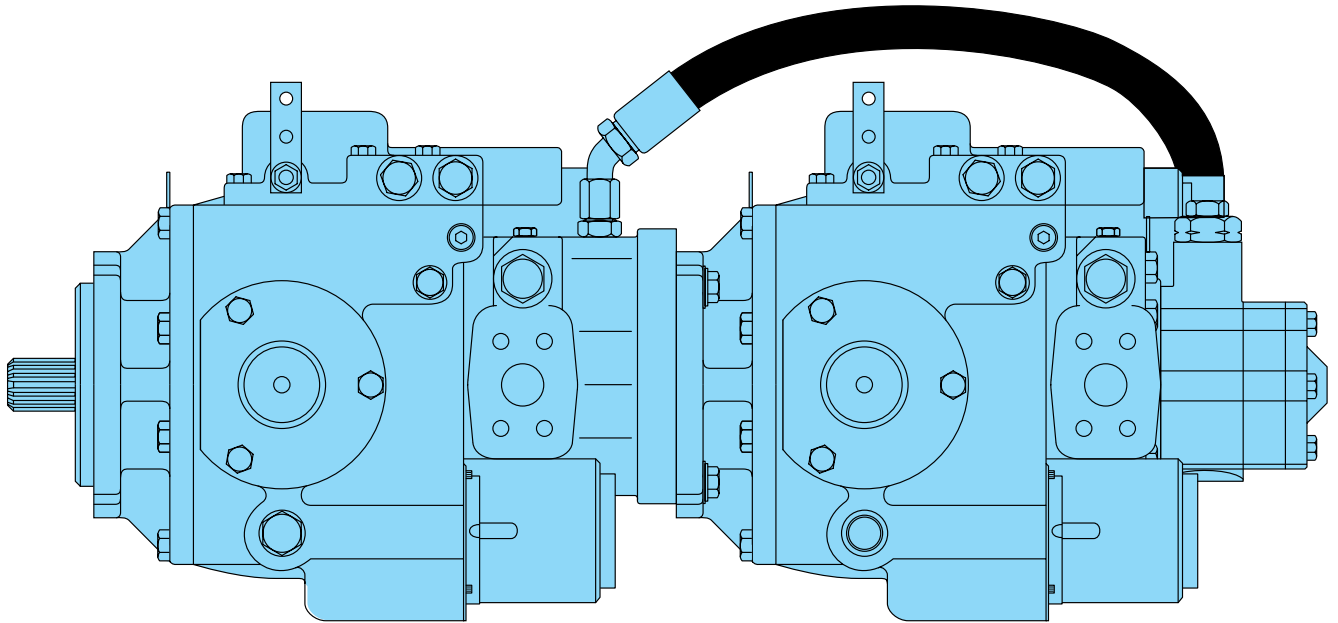
## Models 54 and 64 Integral Shuttle Motors



PL Pump and IS Motor Approximate Weights		lb [Kg]	
Model	PL Pump	IS Motor	
33	138 [62.6]	70 [31.8]	
39	138 [62.6]	70 [31.8]	
46	138 [62.6]	70 [31.8]	
54	188 [85.3]	93 [42.2]	
64	188 [85.3]	93 [42.2]	

**Notes:** All dimensions are given in millimeters [inches]. The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23. The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative. The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center. Detailed drawings of available shafts and ports are shown on page 21.

# Heavy Duty Tandem Pumps Models 33 through 64



## Tandem Pump Applications

Tandem pumps are most typically used in applications where two independent sources of hydraulic power are required while taking advantage of using only one power source to drive the two pumps. This saves on the expense of driving two pumps by eliminating the split drive gear box or eliminating another power source such as a second engine or motor. Tandem pumps can be used on machines such as track drive equipment where independent power is required at each track. Speed and power can be controlled to each side of the vehicle for steering and vehicle speed control both in forward and reverse directions.

Tandem pumps can also be used to create the equivalent flow of one larger displacement pump by combining the flows of the two pumps. This is an economic advantage over using a single large displacement pump.

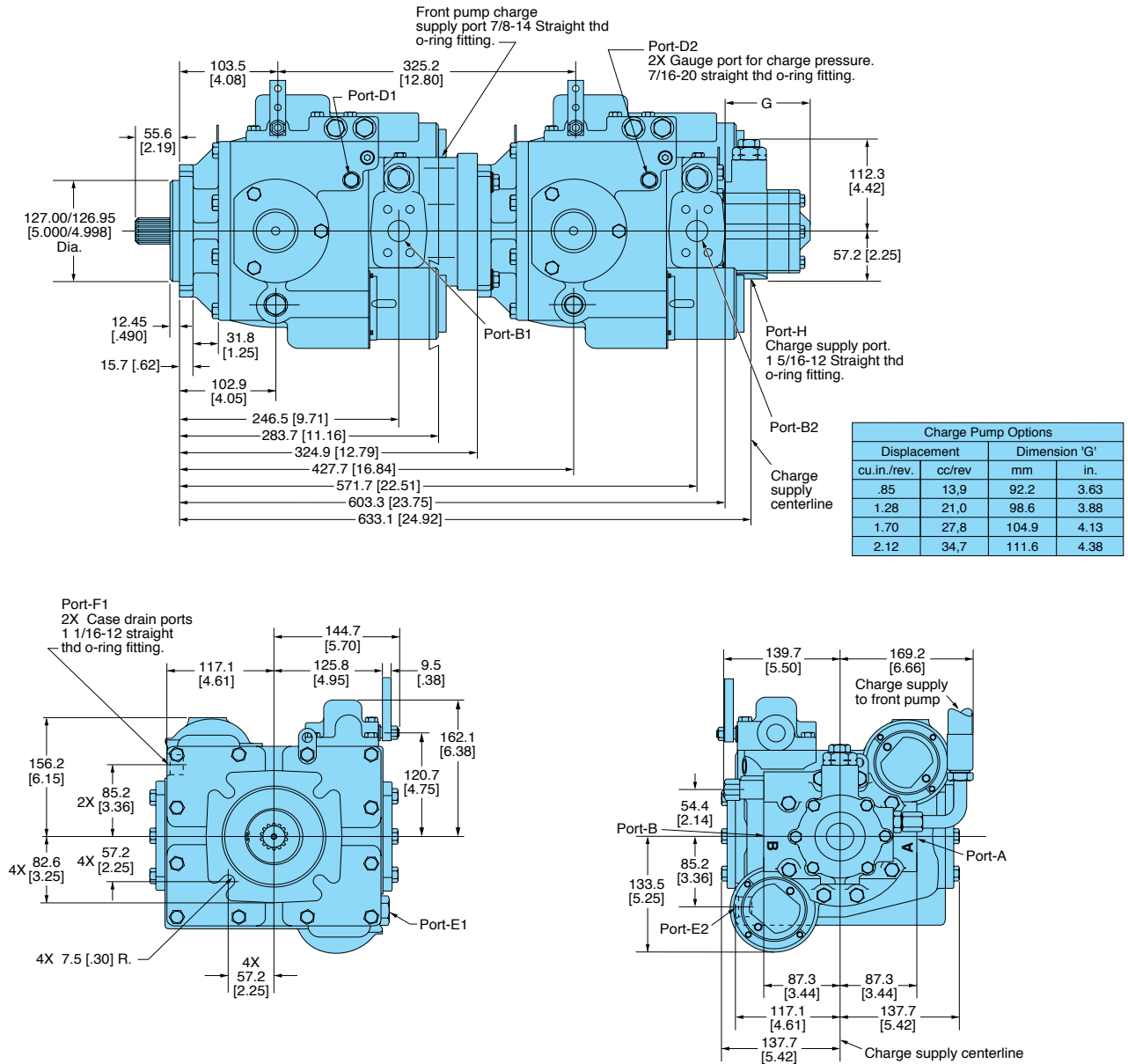
Tandem pumps may also be used in industrial, construction or mining applications where several sources of hydraulic power are required while taking advantage of using only one power source to drive the two pumps.

## Features/Benefits

- Pumps mounted in tandem save the expense of a pump drive.
- Tandem pumps, in some applications, are required because of space limitations.
- The rear pump may be the same displacement or smaller than the front pump.
- A tandem pump may be used as an economical alternative for a larger displacement pump by combining the flow of both pumps. For example, combining the flows of two 6.4 in<sup>3</sup>/rev pumps connected in tandem provides the flow equivalent to a 12.8 in<sup>3</sup>/rev pump.
- Charge pumps with SAE A or SAE B auxiliary mounts are available.
- Pump has standard SAE C flange mount.
- Rear pump can be the same displacement or smaller than front pump.

# Tandem Dimensions

## Models 33, 39, and 46 Tandem Pumps



**Notes:** All dimensions are given in millimeters [inches].

The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

The variable pumps are shown with standard charge pumps. Installation drawings of other charge pumps are available from your Eaton representative.

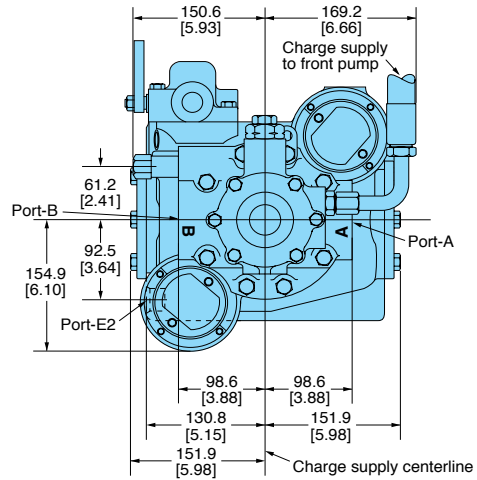
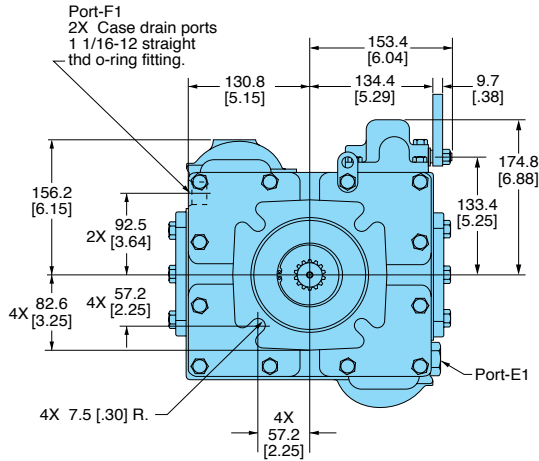
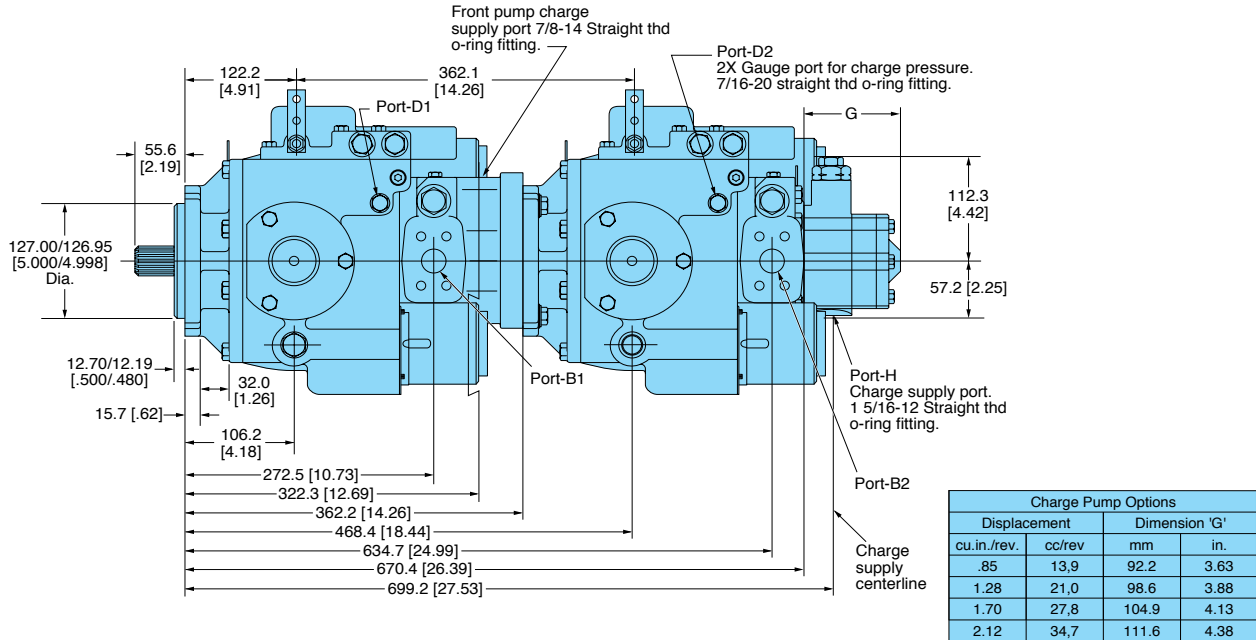
The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center.

Detailed drawings of available shafts and ports are shown on page 21.



# Tandem Dimensions

## Models 54 and 64 Tandem Pumps



## Tandem Pump Approximate Weights

Front Pump	Rear Pump	Weight lb [kg]
Model 33 - 46	Model 33 - 46	276 [125.2]
Model 54 - 64	Model 54 - 64	376 [170.6]
Model 54 - 64	Model 33 - 46	326 [147.9]

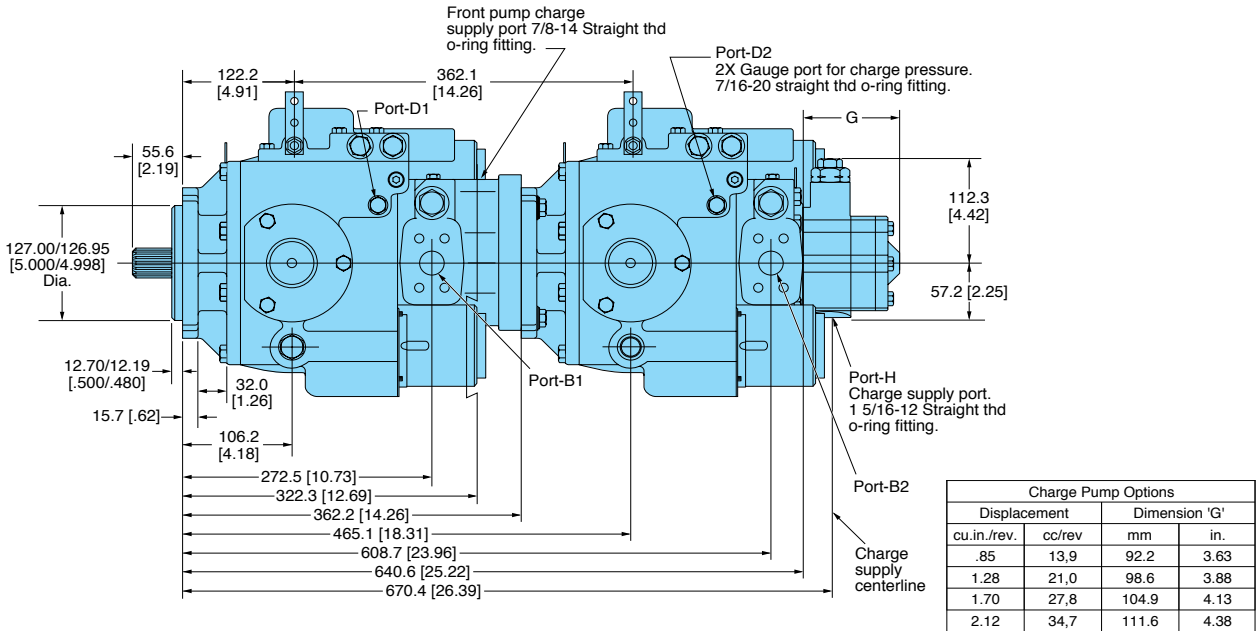
## Tandem Pump Application Information

Some tandem applications require larger displacement charge pumps.

Refer to the Heavy Duty Application manual (no. 5-401) for more information on heavy duty pump and motor applications.

# Tandem Application Information

## Tandems, Model 54 or 64 Front Pump with Model 33, 39, or 46 Rear Pump



### Maximum Shaft Torque Limitations

The total input torque, as well as, the torque at each of the drive shaft coupling points must be considered in a tandem pump system.

Torque calculation formulas and the maximum allowable shaft torque limits, for each shaft coupling point in the tandem pump, are given below.

For longest shaft life, use the largest shaft possible.

### Shaft Coupling Point

	lb-in.	Nm
<b>Input Shaft Models 54 – 64</b> .....	11150 ...	1260
<b>Input Shaft Models 33 – 46</b> .....	8550 .....	966
<b>Front/Rear Pump Coupler</b> .....	6600 .....	746
<b>Charge Pump</b> .....	2050 .....	232
<b>B-Pad Auxiliary Pump</b> .....	1852 .....	209
<b>A-Pad Auxiliary Pump</b> .....	517 .....	58

### Shaft Torque Formulas

$$\text{Max. Aux Pump Torque} = \frac{(\text{Max Displ}_{\text{aux pmp}})(\text{Max Pressure}_{\text{aux pmp}})}{(6.28)(.9)}$$

$$\text{Max. Chg Pump Torque} = \frac{(\text{Max Displ}_{\text{chg pmp}})(\text{Max Pressure}_{\text{chg pmp}})}{(6.28)(.9)} + \text{Max. Aux Pump Torque}$$

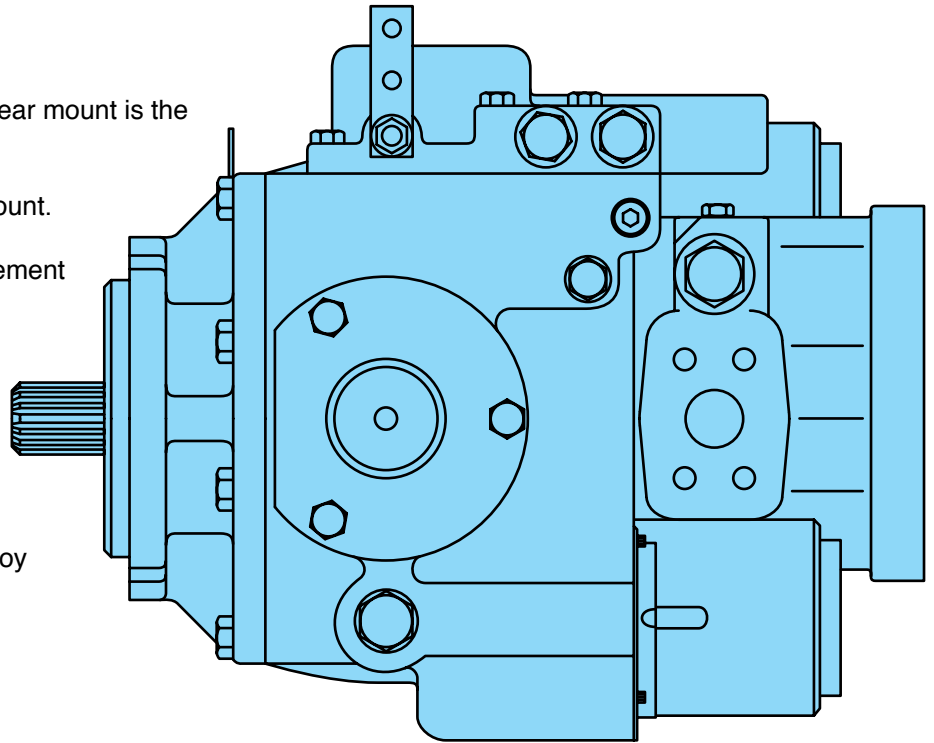
$$\text{Max. Front/Rear Pump Coupler Torque} = \frac{(\text{Max Displ}_{\text{pmp 2}})(\text{Max Pressure}_{\text{pmp 2}})}{(6.28)(.9)} + \text{Max. Chg Pump Torque}$$

$$\text{Max. Input Shaft Torque} = \frac{(\text{Max Displ}_{\text{pmp 1}})(\text{Max Pressure}_{\text{pmp 1}})}{(6.28)(.9)} + \text{Max. Front/Rear Pump Coupler Torque}$$

# Heavy Duty Pumps with C-Pad Rear Mount Models 33 through 64

## Features/Benefits

- The heavy duty pump with a C-Pad rear mount is the front half of the tandem unit.
- Pump has standard SAE C flange mount.
- Rear pump can be the same displacement or smaller than front pump
- The rear mount accepts a standard SAE C flange.
- This pump is ideal for applications that require two different pumps. Road rollers and some construction equipment are applications that employ two different pumps.



## Application Information

### Maximum Shaft Torque Limitations

The total input torque, as well as, the torque at the drive shaft coupling point must be considered when the pump with the SAE C rear mount is used. Maximum torque values and formulas are given on page 18.

### Pumps with SAE C Rear Mount

A 14 tooth, 12/24 pitch, internal spline coupling (Part No. 105853) is required between front and rear pump. A coupling is provided with each SAE C Pump. Optional couplings with 21 tooth, 16/32 pitch; and 23 tooth, 16/32 pitch, are also available.

Pump requires remote charge pump and charge pressure relief. (Charge pressure relief may be built into pump.)

Refer to the Heavy Duty Application manual (no. 5-401) for more information on heavy duty pump and motor applications.

### Rear Pump Mounting Information

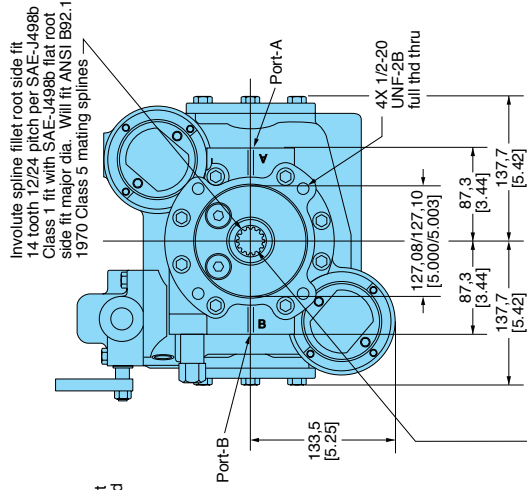
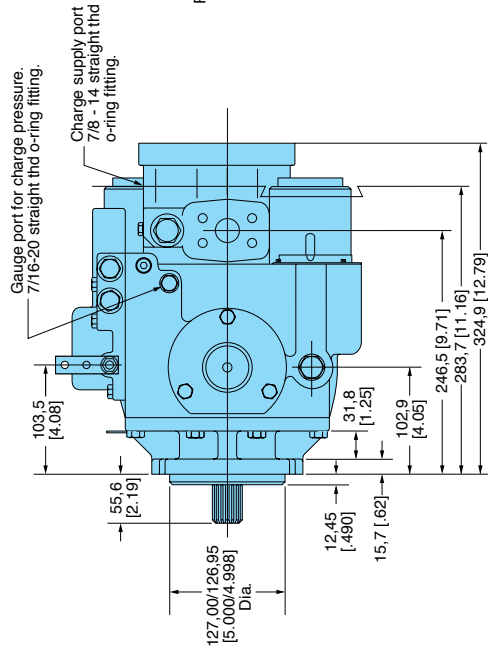
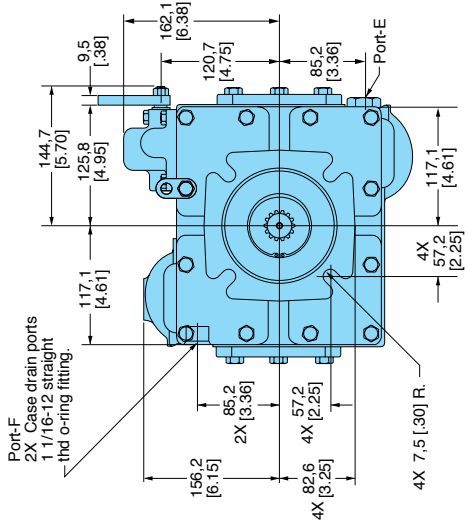
When an Eaton heavy duty pump is used as the rear pump, remove its shaft seal so part of the case flow will flow past the bearing into the front pump. It is also necessary to connect the rear pump's upper case drain port to the front pump's lower case drain port, otherwise high case pressures may result.

In all cases, check case pressures and ensure that they do not exceed 40 PSI [3 bar].

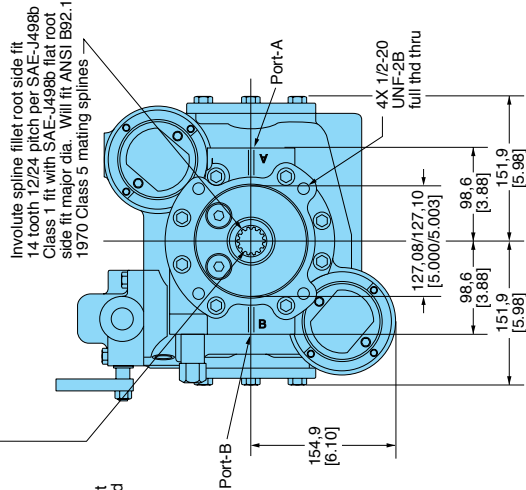
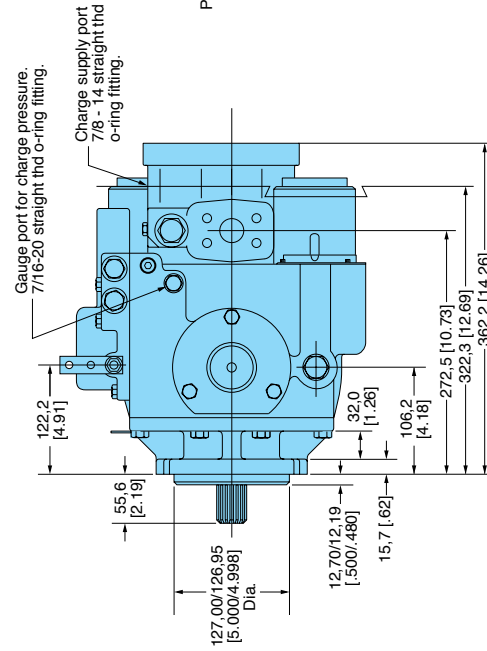
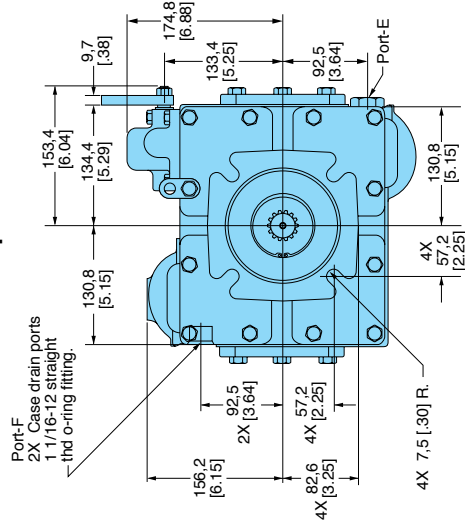
Heavy Duty Application manual (no. 5-401) gives more information on proper case flow routing.

See previous page for shaft torque ratings.

### Models 33, 39, and 46 Pumps with C-Pad Rear Mount



### Models 54 and 64 Pumps with C-Pad Rear Mount



Optional couplings with  
21 tooth 16/32 pitch  
and 23 tooth 16/32  
pitch also available.

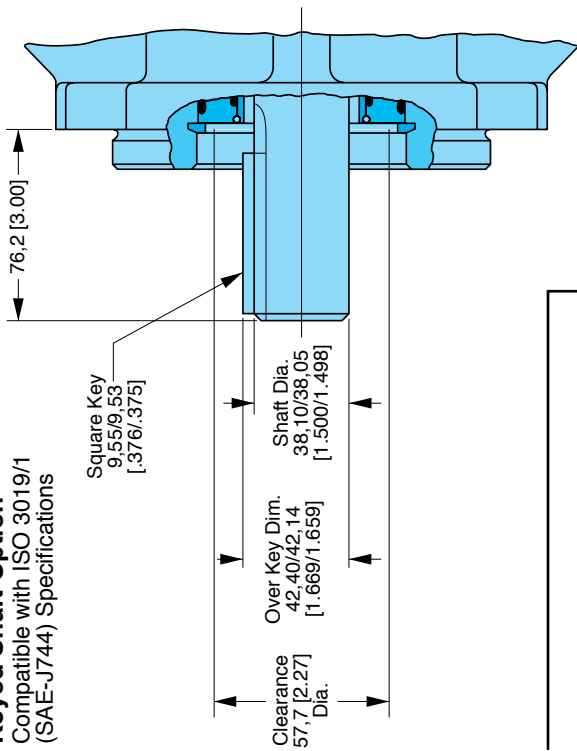
**Notes:** All dimensions are given in millimeters [inches].  
The variable pumps are shown with standard controls. Installation drawings of other controls are available from your Eaton representative. Optional controls are shown on page 23.

The lever on the standard pump control has linkage connection holes at 1 and 2 inch radii from the control shaft center. Detailed drawings of available shafts and ports are shown on page 21.

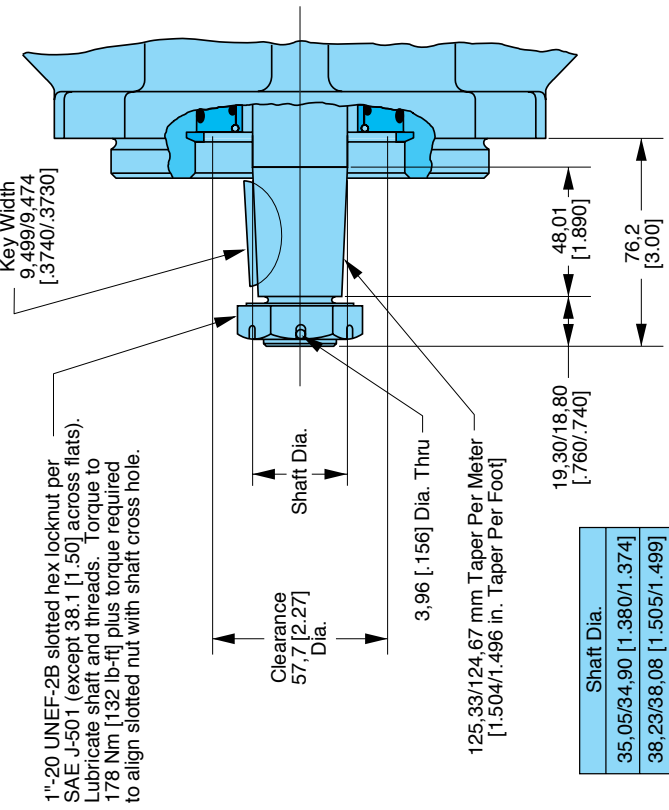
# Dimensions

# Models 33 through 64 Shaft and Port Dimensions

## Keyed Shaft Option Compatible with ISO 3019/1 (SAE-J744) Specifications



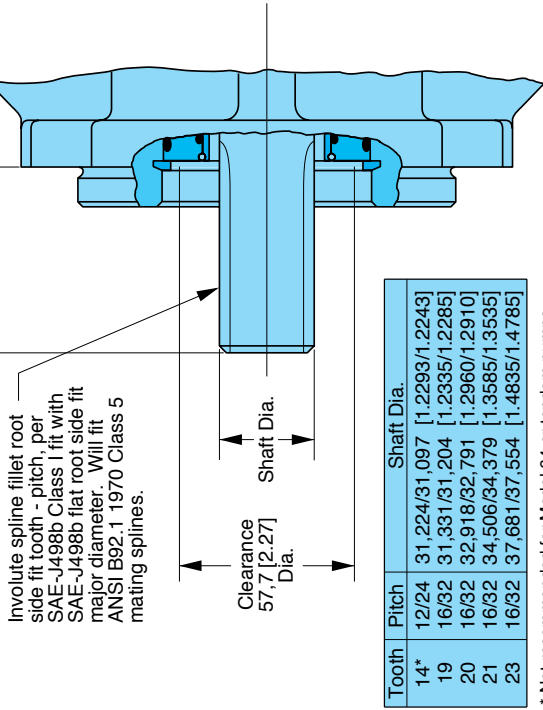
## Tapered Shaft Options Compatible with ISO 3019/1 (SAE-J744) Specifications



1"-20 UNEF-2B slotted hex locknut per SAE J-501 (except 38.1 [1.50] across flats). Lubricate shaft and threads. Torque to 178 Nm [132 lb-ft] plus torque required to align slotted nut with shaft cross hole.

Shaft Dia.	
35.05/34.90	[1.380/1.374]
38.23/38.08	[1.505/1.499]

## Splined Shaft Options Compatible with ISO 3019/1 (SAE-J744) Specifications

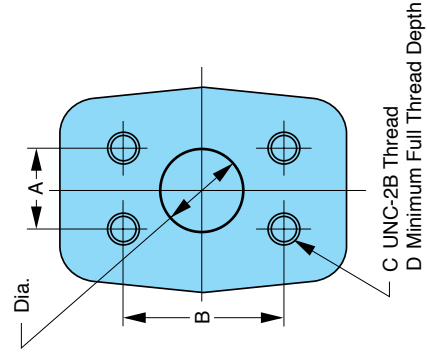


Involute spline fillet root side fit tooth - pitch, per SAE-J498b Class I fit with SAE-J498b flat root side fit major diameter. Will fit ANSI B92.1 1970 Class 5 mating splines.

Tooth	Pitch	Shaft Dia.
14*	12/24	31,224/31,097 [1.2293/1.2243]
19	16/32	31,331/31,204 [1.2335/1.2285]
20	16/32	32,918/32,791 [1.2960/1.2910]
21	16/32	34,506/34,379 [1.3585/1.3535]
23	16/32	37,681/37,554 [1.4835/1.4785]

\* Not recommended for Model 64 or tandem pumps.

## Split Flange Port Options Per SAE-J518 Specifications



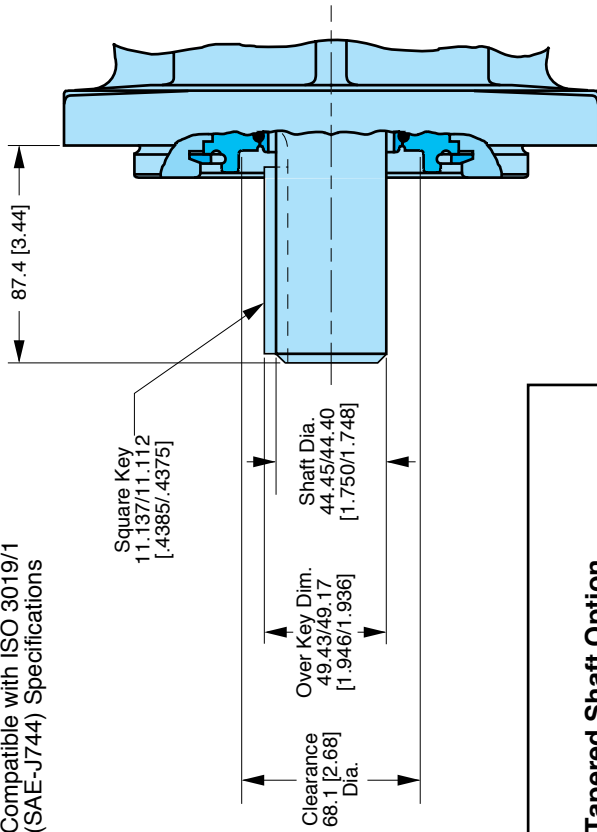
Code	Dia.	A	B	C	D
61	25.4 [1.00]	26.19 [1.031]	52.37 [2.062]	3/8-16	22.4 [0.88]
62	25.4 [1.00]	27.76 [1.093]	57.15 [2.250]	7/16-14	27.0 [1.06]

All dimensions given in millimeters [inches].

# Model 76 Shaft and Port Dimensions

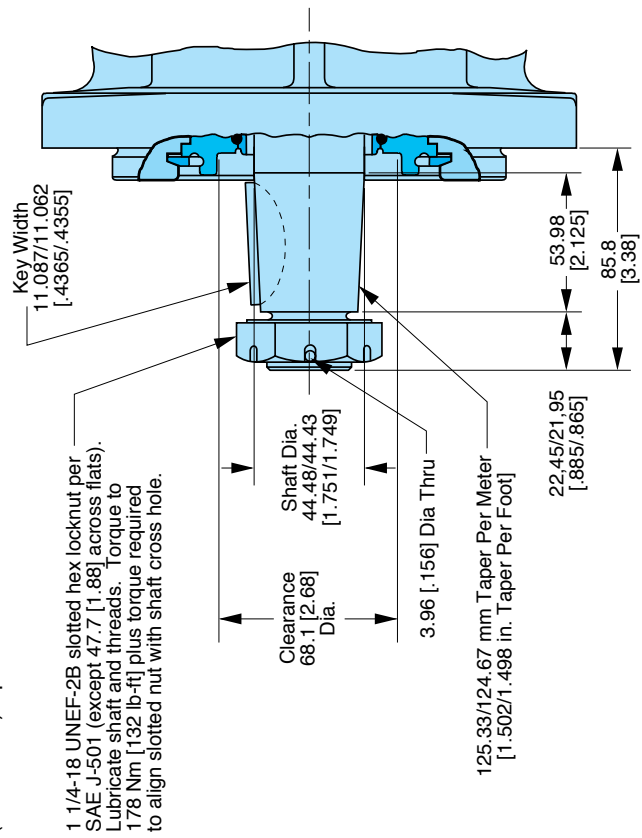
## Keyed Shaft Option

Compatible with ISO 3019/1 (SAE-J744) Specifications



## Tapered Shaft Option

Compatible with ISO 3019/1 (SAE-J744) Specifications

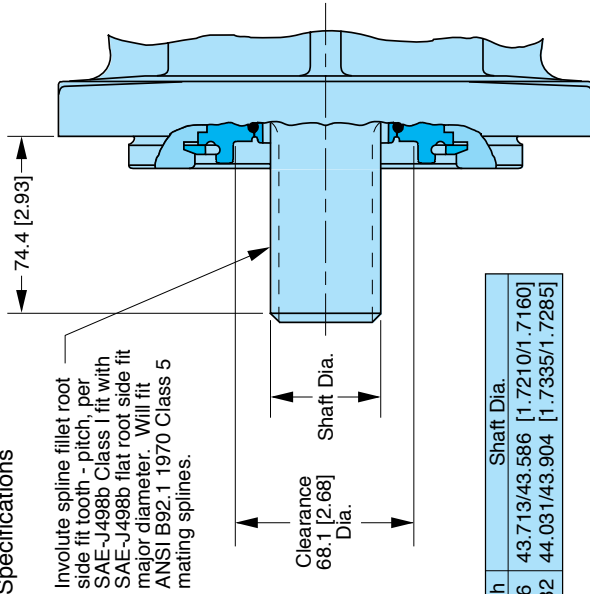


1 1/4-18 UNEF-2B slotted hex locknut per SAE J-501 (except 47.7 [1.88] across flats). Lubricate shaft and threads. Torque to 178 Nm [132 lb-ft] plus torque required to align slotted nut with shaft cross hole.

All dimensions given in millimeters [inches].

## Splined Shaft Options

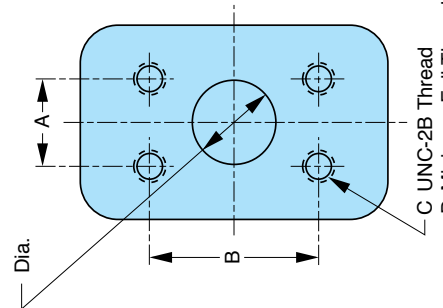
Compatible with ISO 3019/1 (SAE-J744) Specifications



Tooth	Pitch	Shaft Dia.
13	8/16	43.713/43.586 [1.7210/1.7160]
27	16/32	44.031/43.904 [1.7335/1.7285]

## Split Flange Port Options

Per SAE-J518 Specifications

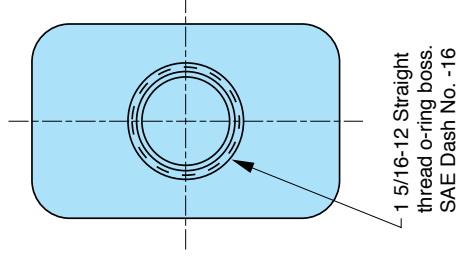


Code	Dia.	A	B	C	D
61	25.4 [1.00]	26.19 [1.031]	52.37 [2.062]	3/8-16	22.4 [.88]
62	25.4 [1.00]	27.76 [1.093]	57.15 [2.250]	7/16-14	27.0 [1.06]

D Minimum Full Thread Depth

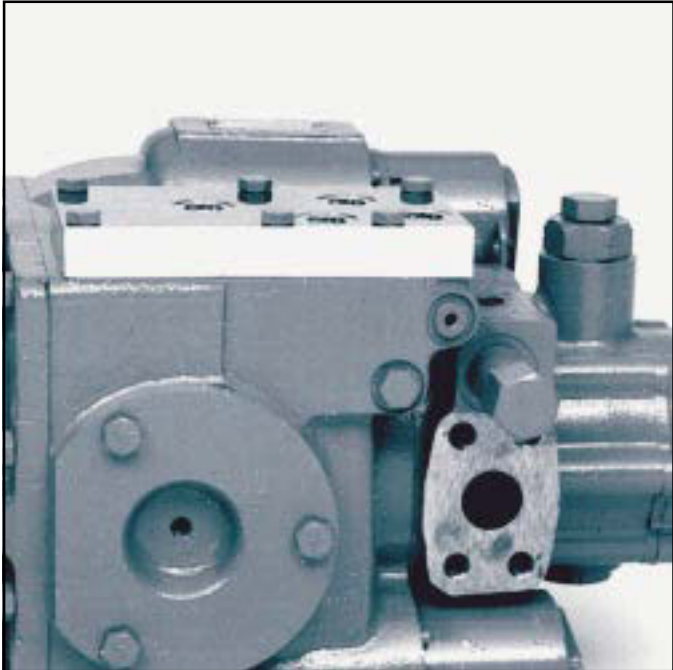
## O-ring Port Option

Per SAE-J514 Specifications



# Pump Controls

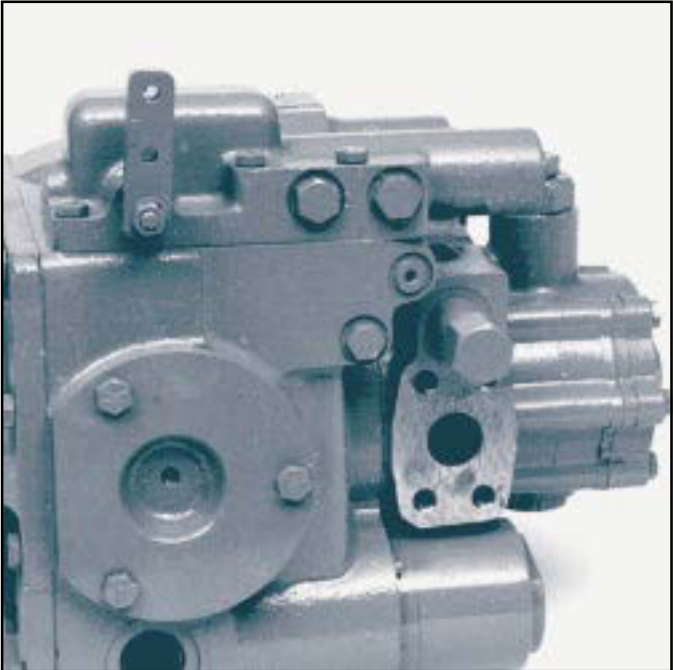
## Port Plate



The port plate is the simplest control option available. It fits all Eaton heavy duty pumps and motors.

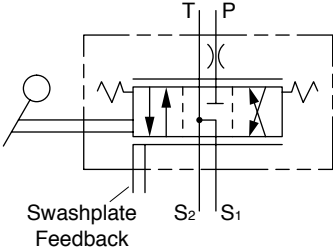
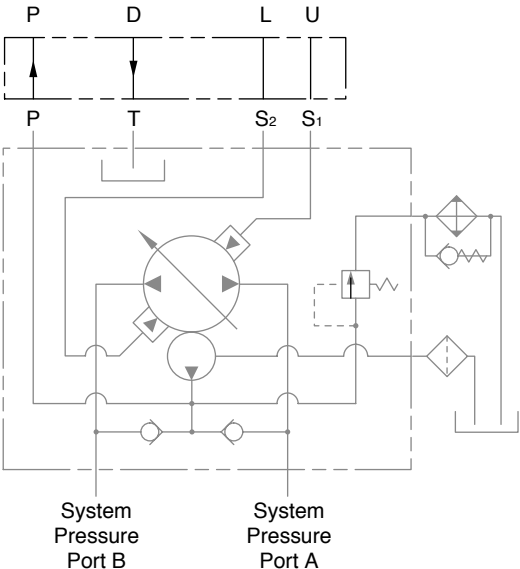
The port plate is commonly used as a slave control that receives commands from other controls in the same system.

## Standard Variable Pump Control



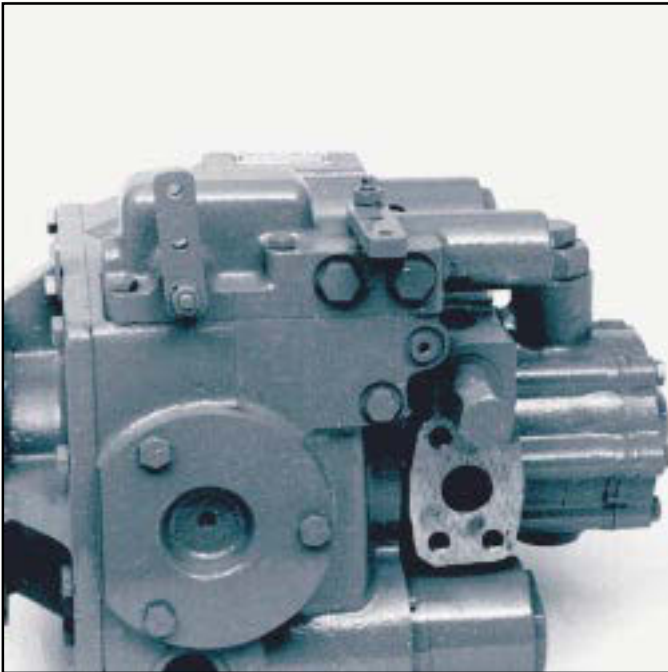
The standard variable pump control is the most common type of control used on heavy duty hydrostatic variable displacement pumps. It is normally actuated by direct mechanical linkages or cables.

A wide band neutral zone controller is available. It expands the center lever position where the pump output is zero flow.

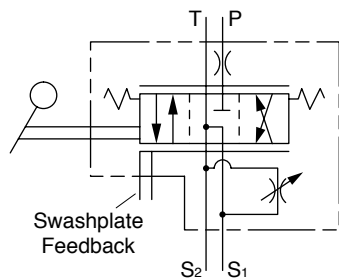


# Pump Controls

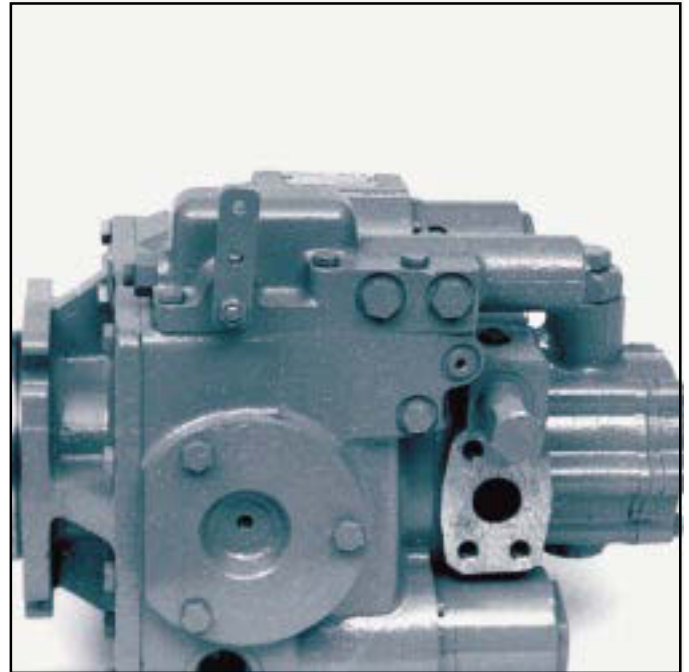
## Standard Control with Inching Valve



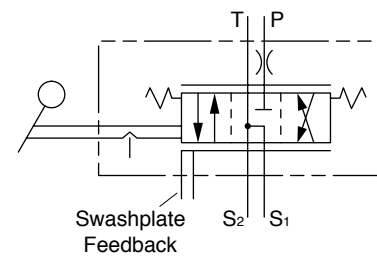
The inching valve is an option that is used in conjunction with the standard variable pump control. This control option would typically be used on a vehicle propel transmission. When the inching valve is operated with a foot pedal it functions like a clutch. A metering orifice in the inching valve's rotary spool cross ports the servo pressure lines providing the operator with smooth acceleration and deceleration.



## Standard Control with Neutral Detent



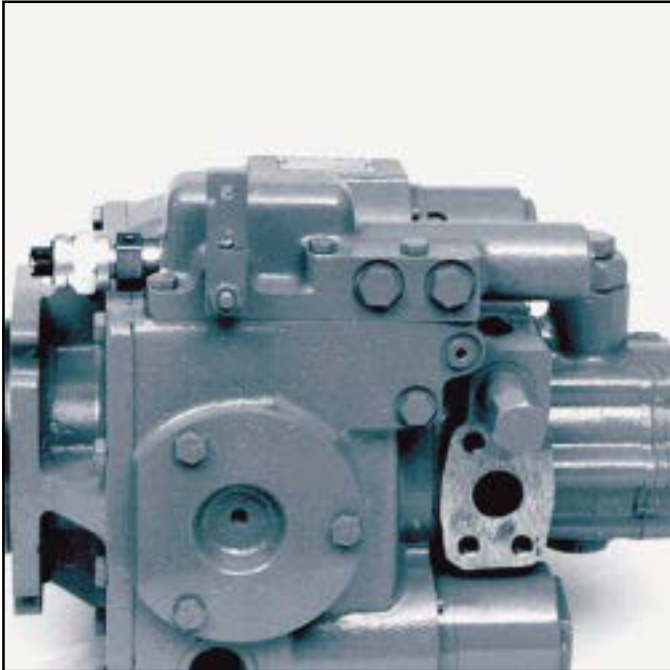
The neutral detent feature on the standard control valve provides a more positive feel when finding neutral. This control is a good choice for transmissions that have long control linkages or cables with varying amounts of free play.



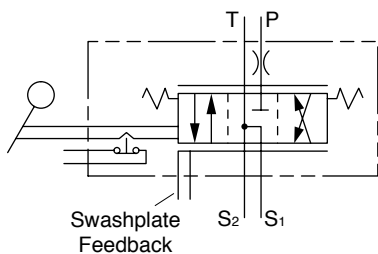


# Pump Controls

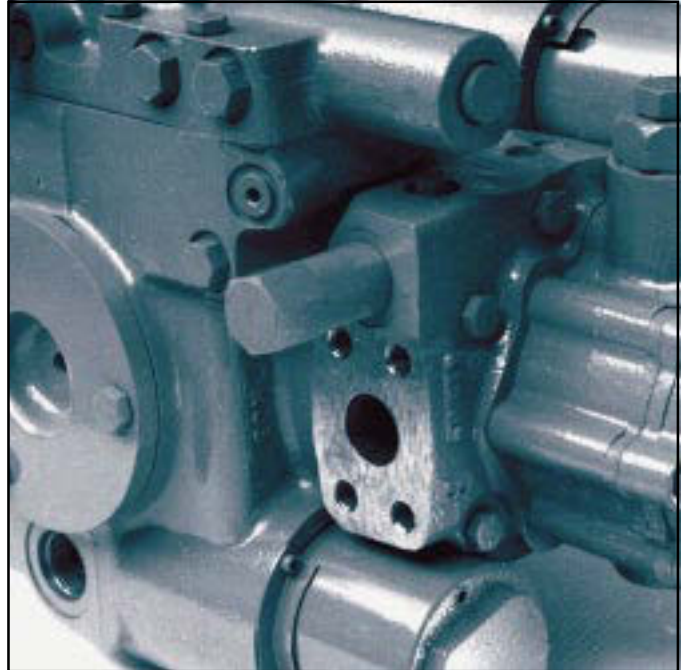
## Standard Control with Neutral Lock-out



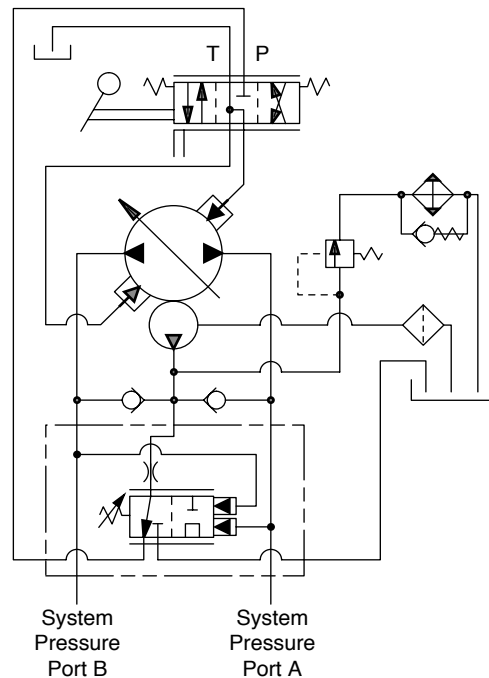
The neutral lock-out feature is an electrical switch that is closed when the transmission is in neutral. This switch can be used to prevent the activation of certain functions that require the pump to be in neutral. The lock-out feature is commonly used to prevent starting the prime mover or activating auxiliary functions. The electrical switch is available as normally open or normally closed.



## Internal Pressure Override Control (IPOR)

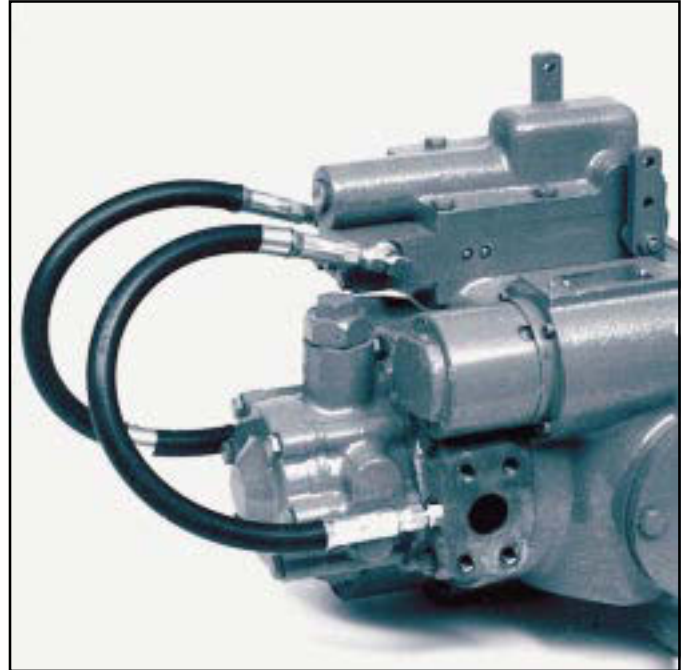


The internal pressure override (IPOR) protects the transmission from running at overload conditions for extended periods. It senses system pressure and allows the pump to destroke if pressures exceed a preset limit. The override pressure setting is shim adjustable. Since the IPOR is built into the pump end cover it is not a field conversion option.

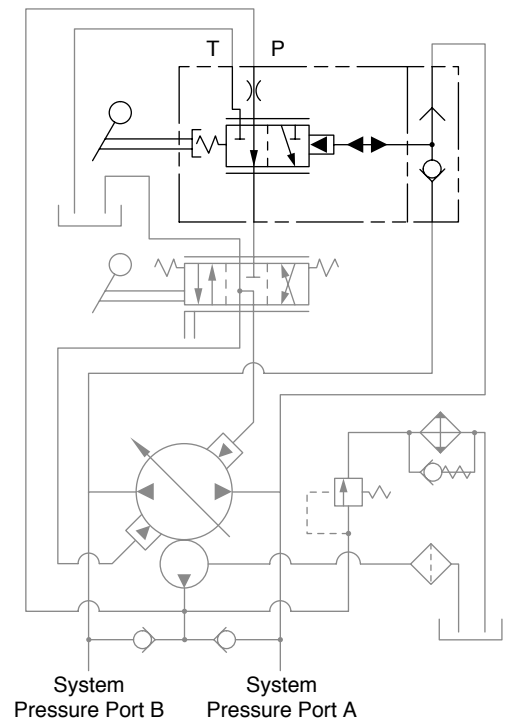


# Pump Controls

## Remote Pressure Override

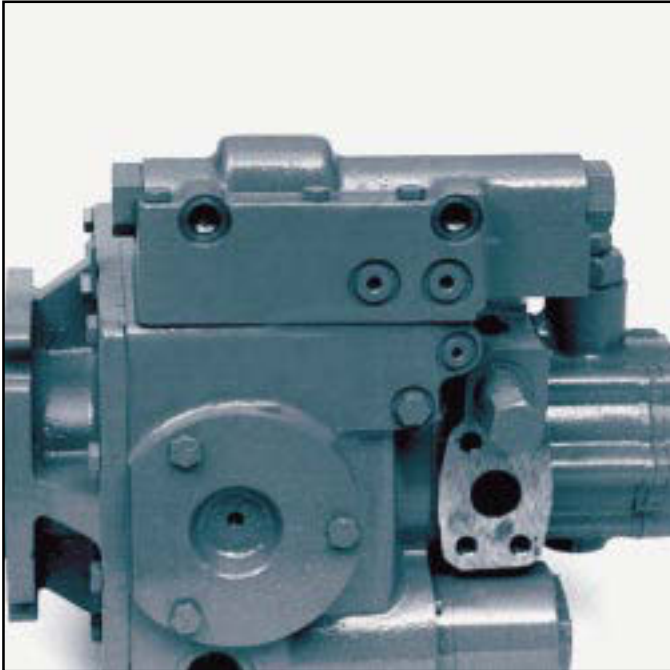


The remote pressure override control provides a means to remotely adjust the pressure setting of the pressure override valve. This control may be used in applications requiring variable system pressure protection to prevent overloads and excessive heat generation. This valve operates similarly to the IPOR control.



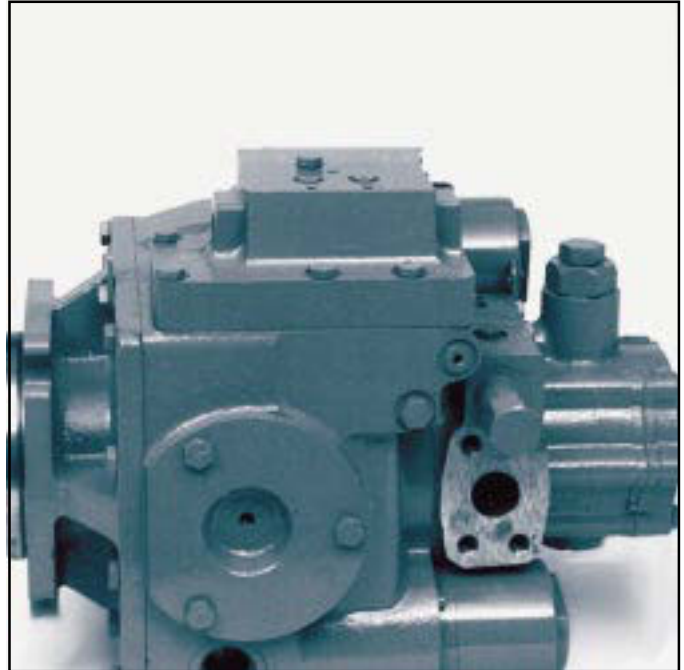
# Pump Controls

## Hydraulic Remote Control Pump Control

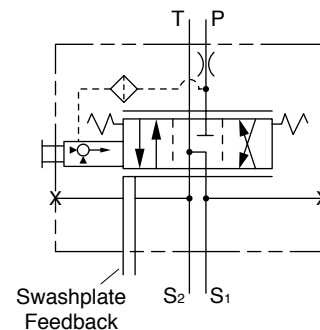
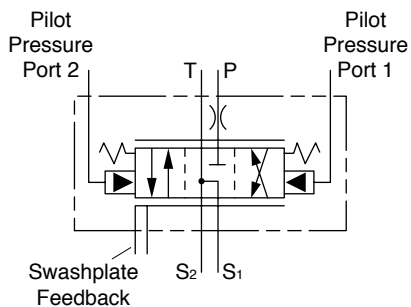


The hydraulic remote control uses a remote pilot pressure signal to move the control spool. This control can be used where cables or mechanical linkages are not feasible.

## Electronic Control (ESC)

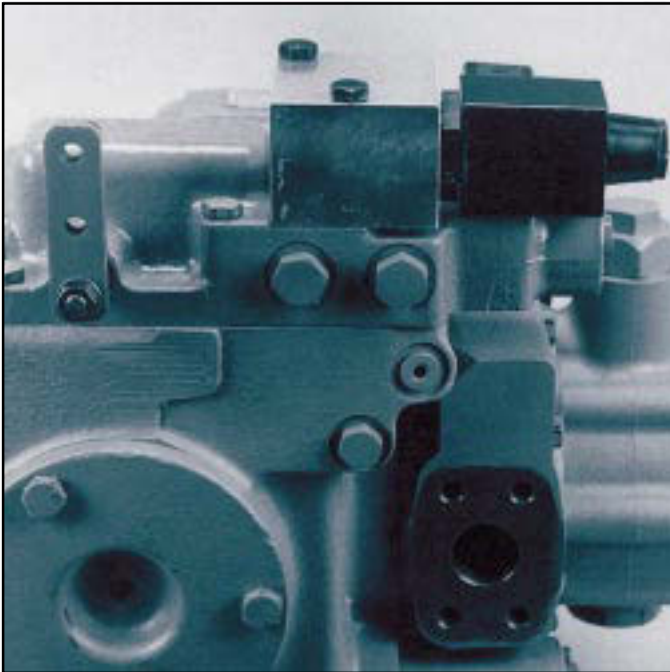


The electronic control (ESC) uses an electrical signal to change the displacement of the variable pump. The input signal may be manually or automatically controlled. The ESC requires a 0 to 100 milliamperes signal.



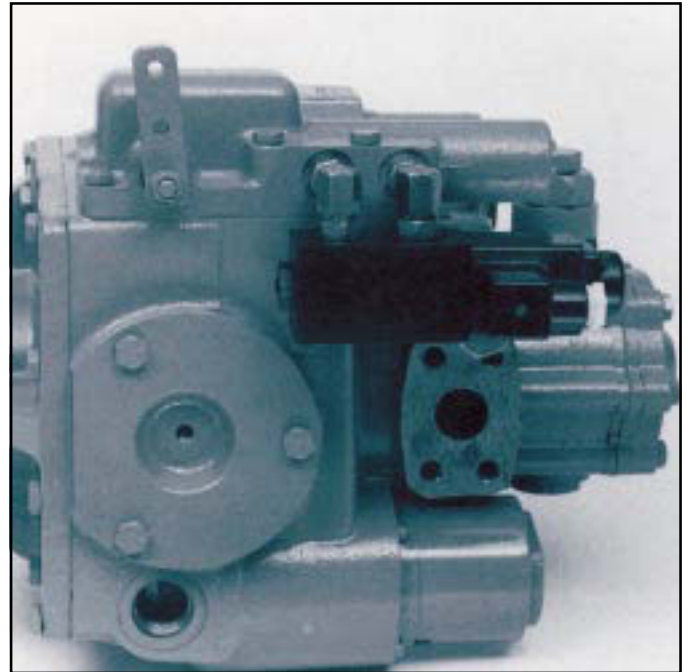
# Pump Controls

## Destroke Control



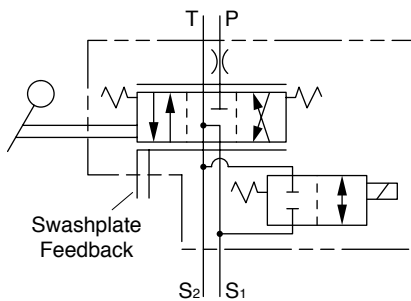
The heavy duty Destroke Control is a solenoid valve mounted on the standard variable pump control. When energized, the valve cross-ports control pressure allowing centering springs to bring the pump out of stroke. It can be energized with a single switch, push-button, or dead man's switch. The solenoid coil is available in 12 volt or 24 volt DC and normally open and normally closed configurations.

## Destroke Solenoid



The heavy duty Destroke Solenoid is available to field convert the standard variable pump control into a destroke control.

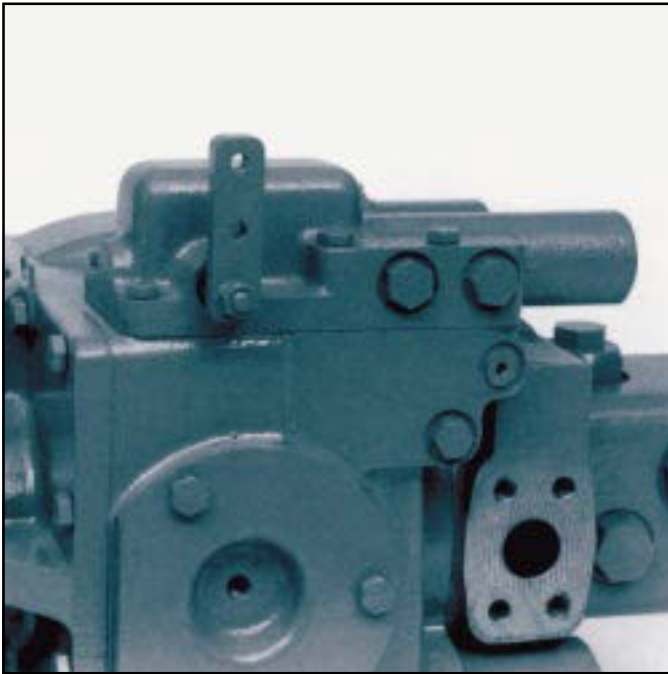
An Anti-Stall Electronics Module is available to drive a normally closed destroke valve. The electronic circuit monitors engine speed. When engine speed drops the anti-stall electronic reduce the pump's displacement.



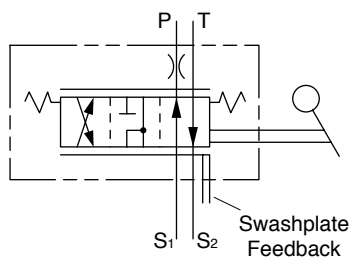
**Anti-Stall Electronics Module**

# Variable Motor Controls

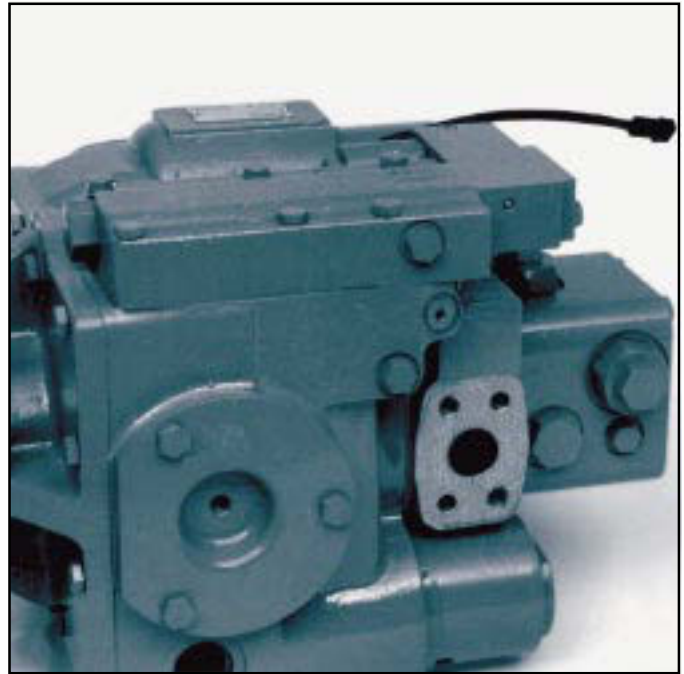
## Manual Control



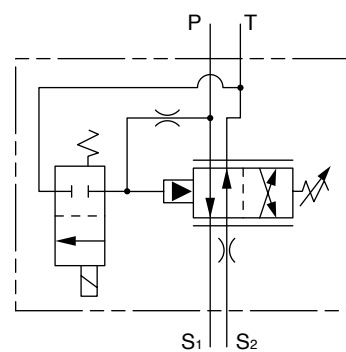
The manual displacement control for variable motors permits remote control of motor displacement using mechanical links or cables. The control operates similarly to the pump manual control, except the motor is biased to maximum displacement when the control handle is in a "neutral" position. Motor displacement may be controlled between maximum and minimum by moving the control lever.



## Stroking Valve Control

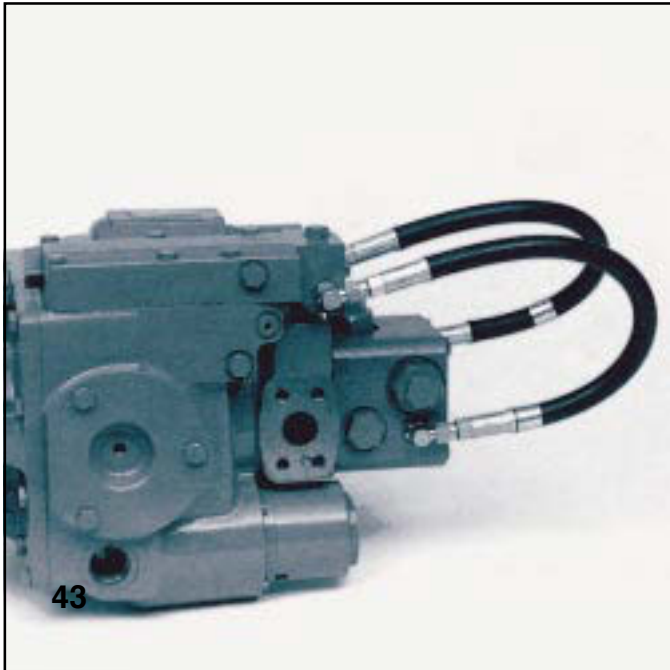


The variable motor stroking control provides a means of controlling motor displacement remotely via an electrical signal. When no electrical signal is supplied to the solenoid valve, the motor will be commanded to maximum displacement to provide maximum torque. Conversely, providing an electrical signal to the solenoid valve will command minimum displacement for maximum output speed. The control is available in 12 volt and 24 volt DC configurations.

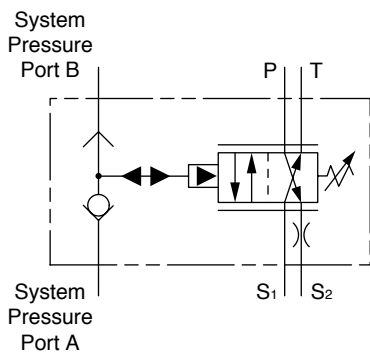


# Variable Motor Controls

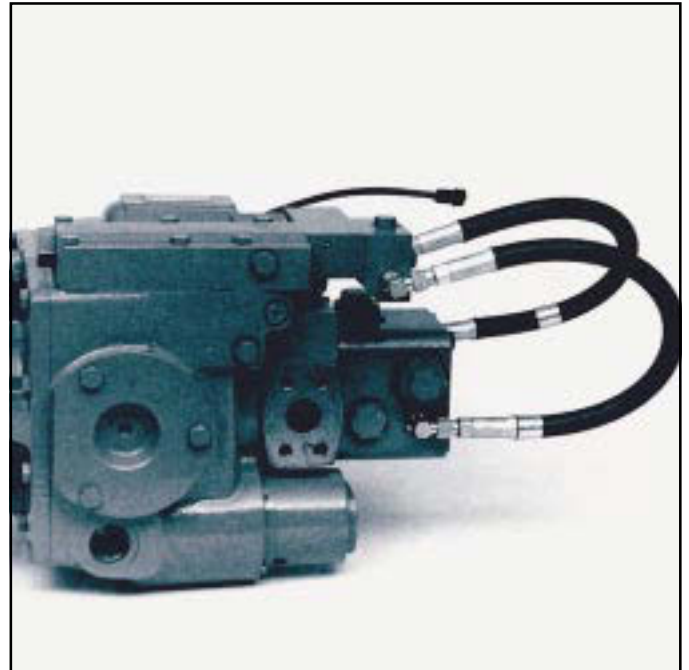
## Pressure Response Control



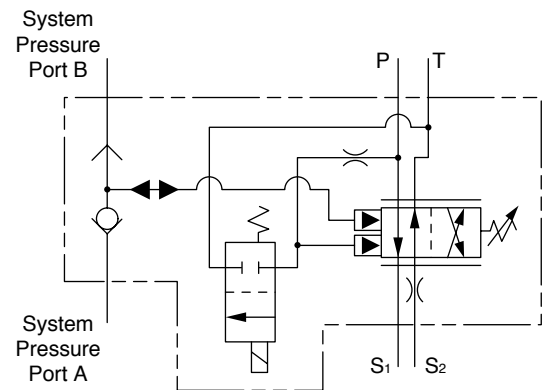
The variable motor pressure response control automatically adjusts motor displacement to meet torque requirements by sensing system pressure. The motor is biased to minimum displacement until system pressure reaches the pressure response setting. The control will then increase motor displacement to maintain the control pressure setting until maximum motor displacement is reached or the load on the system is reduced.



## Pressure Response Control with Stroking Valve

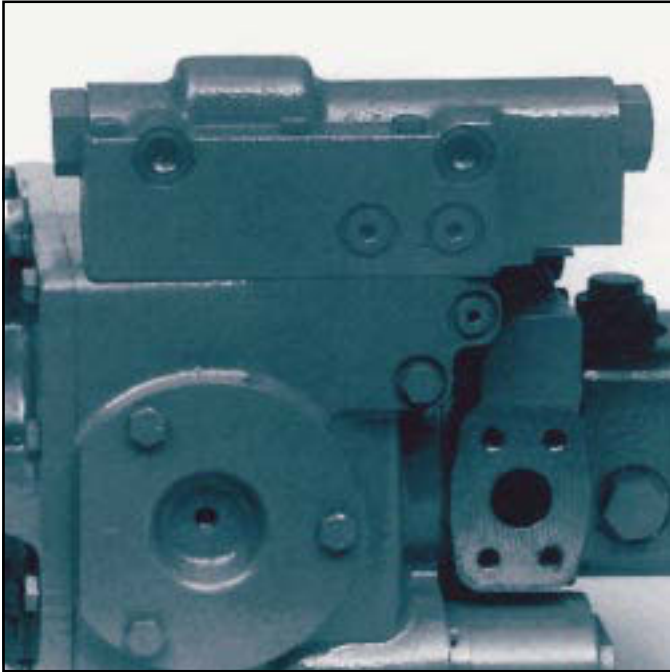


This control valve is a combination of the pressure response control and the stroking valve. With the stroking valve solenoid energized it works like the variable motor pressure response control. De-energize the stroking valve solenoid and the motor goes to full stroke. The control is available in 12 volt and 24 volt configurations.

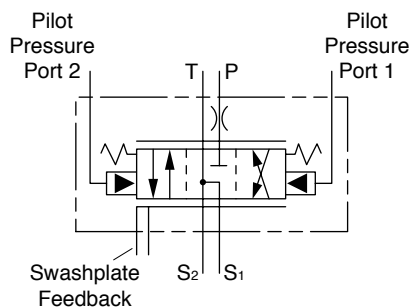


# Variable Motor Controls

## Hydraulic Remote Control Variable Motor Control



The hydraulic remote control uses a remote pilot pressure to move the control spool. There are two versions of the control available for variable motors. The first version contains a feedback linkage that biases the motor to minimum angle when the pilot pressure is below the control range. The second version contains a feedback linkage that biases the motor to full displacement when the pilot pressure is below the control range. This version permits the use of a single pilot signal to control the displacement of both the pump and motor. The operating pressure ranges of the hydraulic remote controls on pump and motor are selected such that the pump reaches full displacement before the pilot signal begins to reduce the displacement of the variable motor. This system provides infinitely variable speed control range and maximum motor output torque at lower speeds.





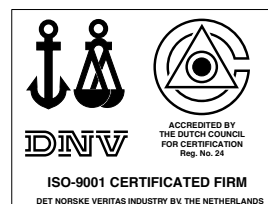
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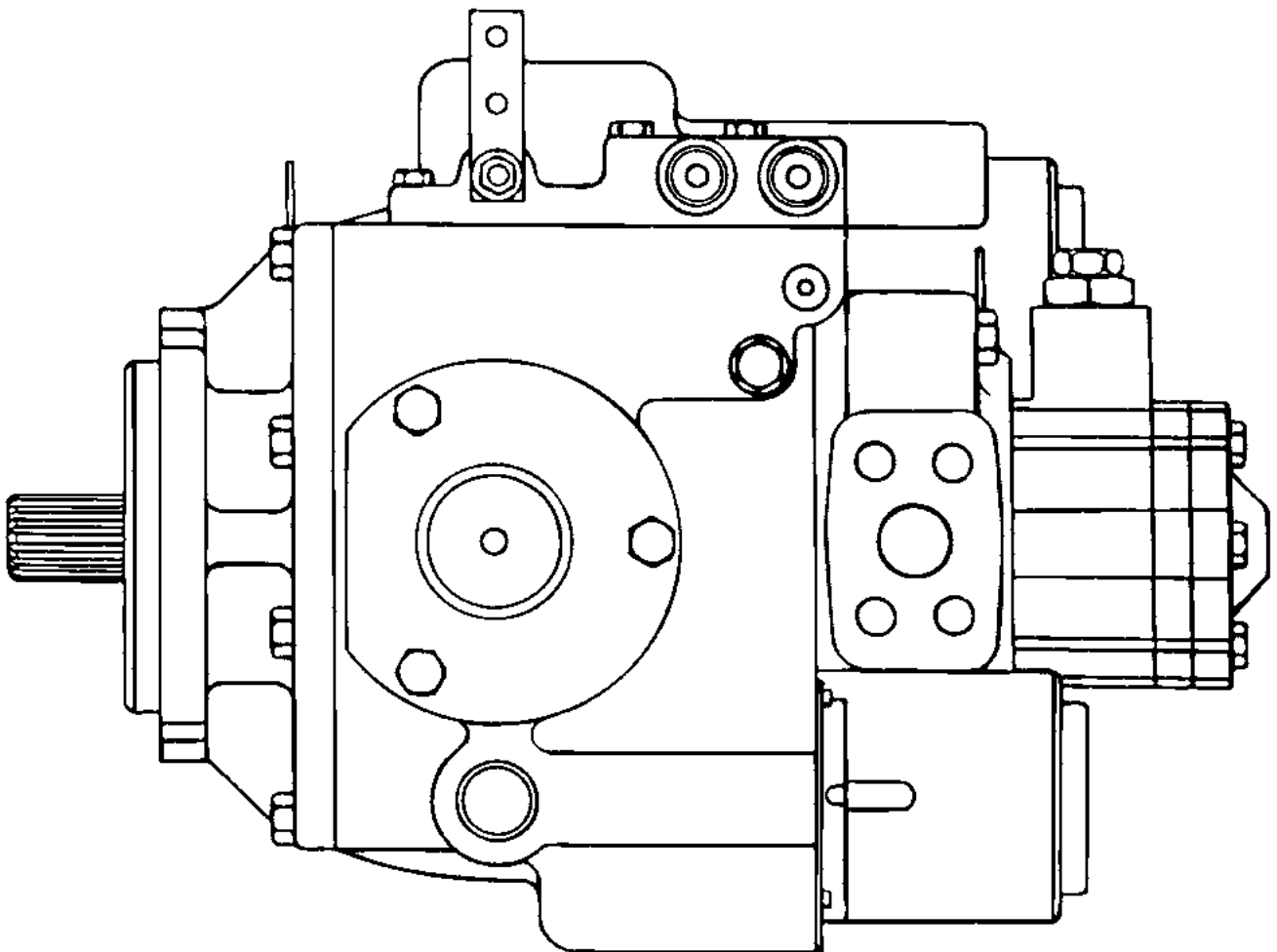




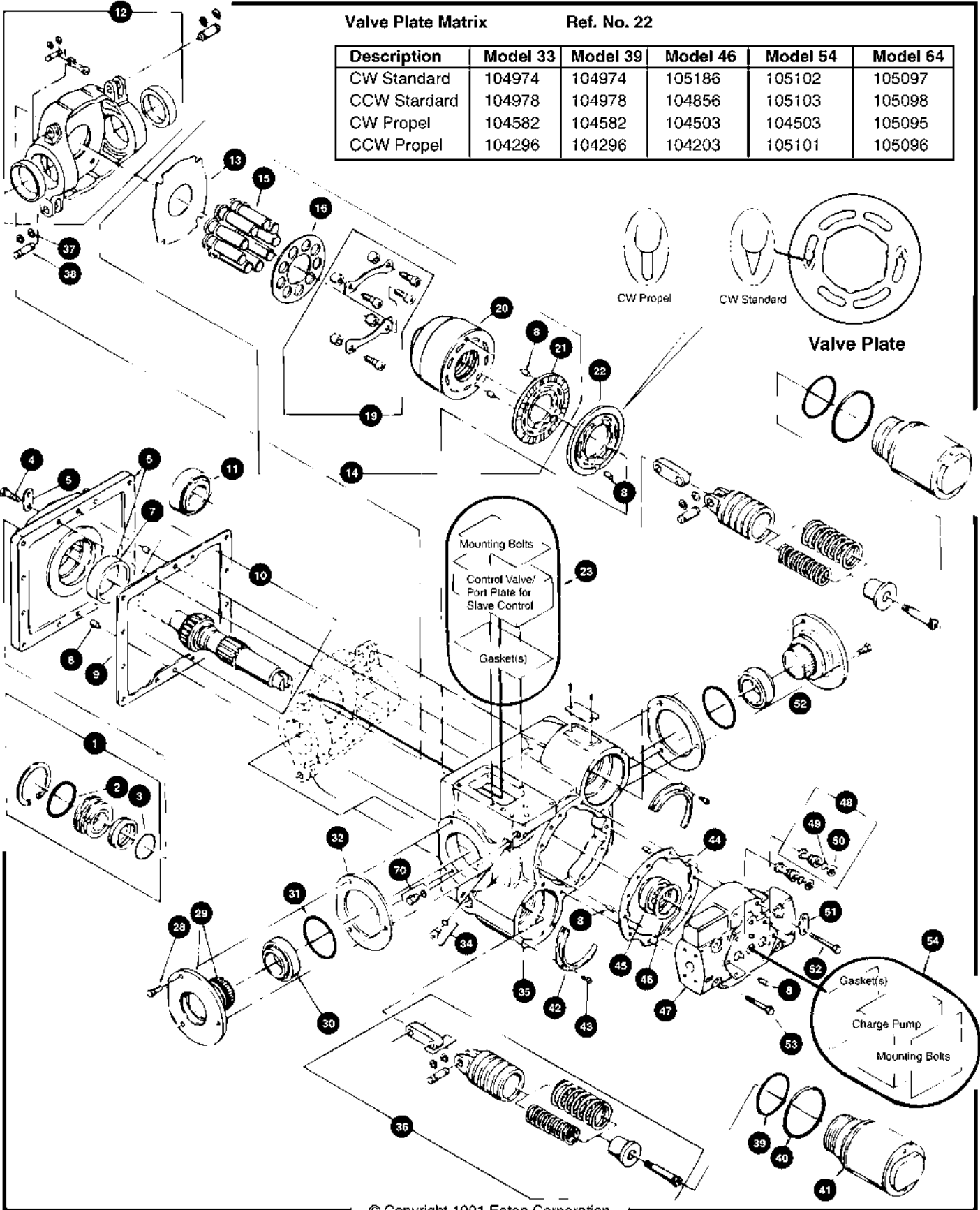
# Hydraulics

Hydrostatic Variable Pumps - Series 1, Models 33-64

**Hydrostatic Variable Pumps - Series 1, Models 33-64**



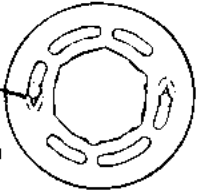
# Parts Drawing



**Valve Plate Matrix**

**Ref. No. 22**

Description	Model 33	Model 39	Model 46	Model 54	Model 64
CW Standard	104974	104974	105186	105102	105097
CCW Standard	104978	104978	104856	105103	105098
CW Propel	104582	104582	104503	104503	105095
CCW Propel	104296	104296	104203	105101	105096



Mounting Bolts  
Control Valve/  
Port Plate for  
Slave Control  
Gasket(s)

Gasket(s)  
Charge Pump  
Mounting Bolts

## Parts List

Ref. No.	Description	Qty	Model 33	Model 39	Model 46	Model 54	Model 64
1	Kit, Shaft Seal	1	990231	990231	990231	990231	990231
2	O-ring	1	8761-145	8761-145	8761-145	8761-145	8761-145
3	O-ring	1	104166-131	104166-131	104166-131	104166-131	104166-131
4	Bolt, Mounting Flange	12	95863-100	95863-100	95863-100	95864-125	95864-125
5	Strap, Shipping	2	96558	96558	96558	96559	96559
6	S/A, Mounting Flange	1	104207	104207	104207	103803	103803
7	Cup, Bearing	1	103232	103232	103232	103808	103808
8	Dowel	7	98202	98202	98202	98202	98202
9	Gasket, Mounting Flange	1	8828	8828	8828	8826	8826
10	S/A, Drive Shaft	1	*	*	*	*	*
11	Bearing Kit, Mtg. Flange	1	990389	990389	990389	990387	990387
12	S/A, Swashplate	1	104301	104226	104226	104463	104463
13	Plate, Thrust	1	103236	103236	103236	103809	103809
14	Kit, Rotating Group	1	990425	990425	990427	990429	990431
15	S/A, Piston Slipper	9	101073	101073	104199	101077	103818
16	Plate, Slipper Retaining	1	103244	103244	104211	103853	103817
19	Kit, Series 1 Hold Down	1	990416	990416	990416	990417	990417
20	Kit, Cylinder Barrel	1	909412	990412	990413	990414	990415
21	Plate, Bearing	1	103241	103241	104198	103852	103814
22	Plate, Valve	1	*	*	*	*	*
23	Option, Control	1	**	**	**	**	**
28	Bolt, Trunnion	6	95863-088	95863-088	95863-088	95864-088	95864-088
29	S/A, Trunnion	2	103982	103982	103982	23591	23591
30	Kit, Trunnion Bearing	2	990024	990024	990024	990024	990024
31	O-ring	3	8761-231	8761-231	8761-231	8761-234	8761-234
32	Shim Pack, Trunnion	2	9900012	990012	990012	990013	990013
34	S/A, O-ring Plug	1	25083-004	25083-004	25083-004	25083-004	25083-004
35	Housing	1	101838	101838	101838	103805	103805
36	S/A, Servo Pison	2	104401	104401	104401	102638	102638
37	Retaining Ring, External	4	95820-056	95820-056	95820-056	95820-056	95820-056
38	Pink, Linkage	2	95654	95654	95654	95654	95654
39	O-ring	2	8761-143	8761-143	8761-143	8761-234	8761-234
40	O-ring	2	8761-147	8761-147	8761-147	8761-237	8761-237
41	Kit, Servo Sleeve	2	990037	990037	990037	990038	990038
42	Retainer, Servo	2	95675	95675	95675	95844	95844
43	Screw, Cap	6	95890-038	95890-038	95890-038	95890-038	95890-038
44	Gasket, End Cover	1	8734	8734	8734	103042	103042
45	Kit, End Cover Bearing	1	990014	990014	990014	990016	990016
46	Shim Pack, Shaft	1	990017	990017	990017	990019	990019
47	End Cover	1	*	*	*	*	*
48	S/A, Check Valve	2	101187	101187	101187	101187	101187
49	O-ring	2	8765-113	8765-113	8765-113	8765-113	8765-113
50	Ring, Back-up	2	8770-113	8770-113	8770-113	8770-113	8770-113
52	Bolt, End Cover	6	103090-275	103090-275	103090-275	103091-300	103091-300
53	Bolt, End Cover	2	103090-150	103090-150	103090-150	103091-200	103091-200
54	Charge Pump	1	**	**	**	**	**
70	S/A, O-ring Plug	1	25090-004	25090-004	25090-004	25090-004	25090-004

\* See charts on opposite page and back page for specific part number.

\*\* See separate parts list for specific part number.

EATON  
 PARTS INFORMATION  
 HYDROSTATIC VARIABLE PUMPS  
 SERIES 1, MODELS 33 THRU 64  
 NO. 6-608

EACH ORDER MUST INCLUDE  
 THE FOLLOWING INFORMATION

- |                   |                      |
|-------------------|----------------------|
| 1. Product Number | 4. Part Number       |
| 2. Date Code      | 5. Quantity of Parts |
| 3. Part Name      |                      |

HOW TO ORDER  
 REPLACEMENT PARTS

**Drive Shaft Matrix Ref. No. 10**

Description	Model 33	Model 39	Model 46	Model 54	Model 64
1-1/2 Str. Keyed	104897	104897	104897	105074	105074
1-3/8 Tapered	104954	104954	N/A	105054	105054
1-3/8 Tapered*	105210	105210	N/A	N/A	N/A
14T-12/24P	104204	104204	104204	105050	105050
14T-12/24P*	104961	104961	104961	105072	105072
21T-16/32P	104586	104586	104586	105068	105068
21T-16/32P*	104933	104933	104933	N/A	N/A
23T-16/32P	104504	104504	104504	105064	105064
23T-16/32P*	N/A	N/A	N/A	104375	104375

101540 - 3/8 Square Key (for 1-1/2 Straight Keyed Shaft)

101017 - Woodruff Key (for 1-3/8 Tapered Shafts)

96898 - Slotted Nut (for 1-3/8 Tapered Shafts)

\*With Splined Drive End for B Pad Charge Pump

**End Cover Matrix Ref. No. 47**

Description Main Ports	Model 33	Model 39	Model 46	Model 54	Model 64
1 inch Code 61	50515	50515	104209	50517	105080
1 inch Code 61 w/Pressure Tap	101433	101433	104210	101415	105107
1 inch Code 61 IPOR S/A	103152	103152	105017	103100	105177
1 inch Code 62	101331	101331	104577	102182	105081
1 inch Code 62 IPOR S/A	104913	104913		103466	105142
1 inch Code 62 w/Pressure Tap	101441	101441		101958	
1 inch O-ring	101490	101490	104265	101492	

Code 61 - SAE Code 61, Split Flange, 3000 PSI, Drilled and Tapped for 3/8-16 UNC 2B Thread Bolt

Code 62 - SAE Code 62, Split Flange, 6000 PSI, Drilled and Tapped for 7/16-14 UNC 2B Thread Bolt

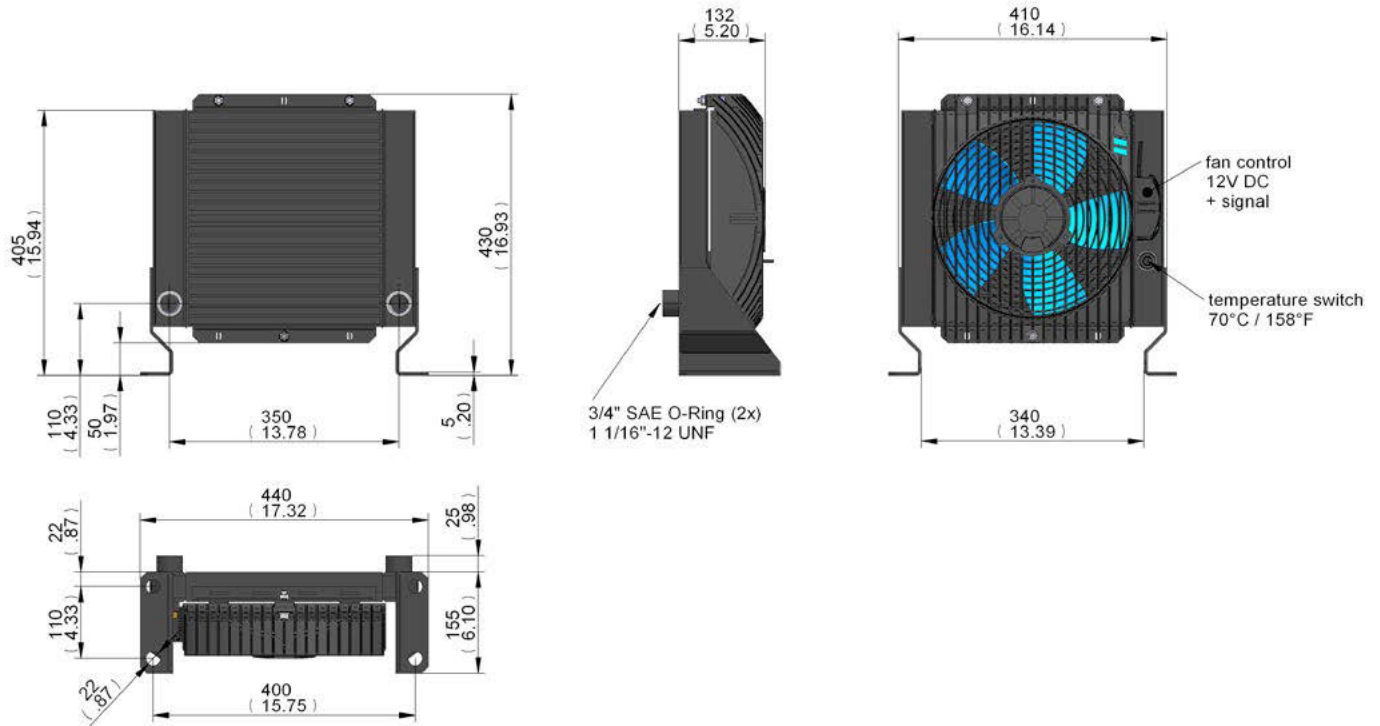
Eaton  
 14515 Lone Oak Road  
 Eden Prairie, MN 55344  
 USA  
 Tel: 952 937-9800  
 Fax: 952 974-7722  
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 Victoria 3011  
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 Tel: (61) 3 9319 8222  
 Fax: (61) 3 9318 5714

Eaton  
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 Hampshire PO9 2NB  
 England  
 Tel: (44) 23 92 486 451  
 Fax: (44) 23 92 487 110

# Oil/Air Cooler TT 10X

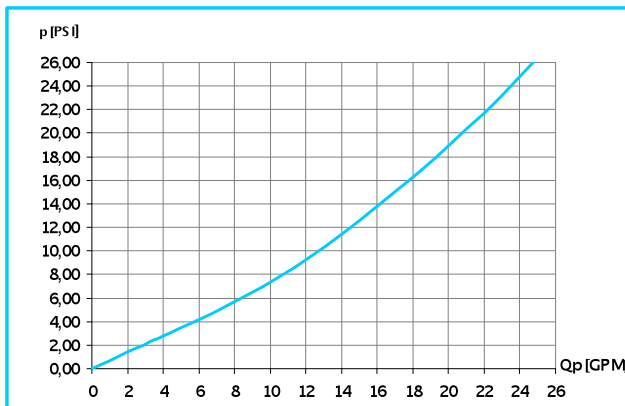
12V DC with temperature control



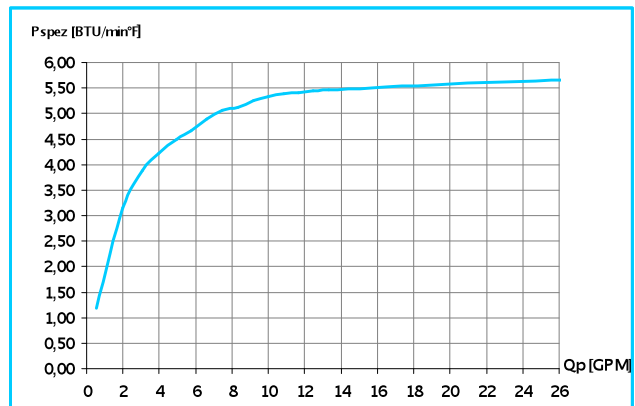
## Technical Data

order number	description	power [HP]	current [A]	protection	revolution [rpm]	air flow [SCFM]	noise level [dB(A)]	weight [lbs]
ASATT10UD01X	TT 10X 12V DC	0.15	8.4	IP 68	2650	800	78	17.6

pressure drop radiator at 150 SSU



specific cooling performance

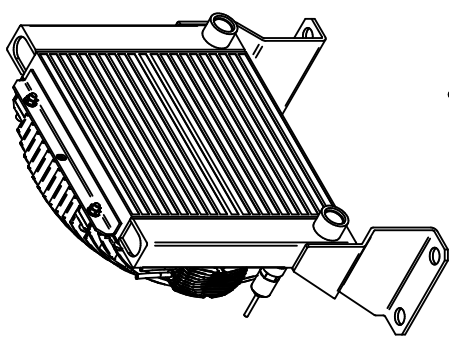


### radiator

material:	aluminium
working temperature range:	-5°F to +210°F (oil temperature)
air fin shape:	wavy
working pressure:	26 bar / 375PSI

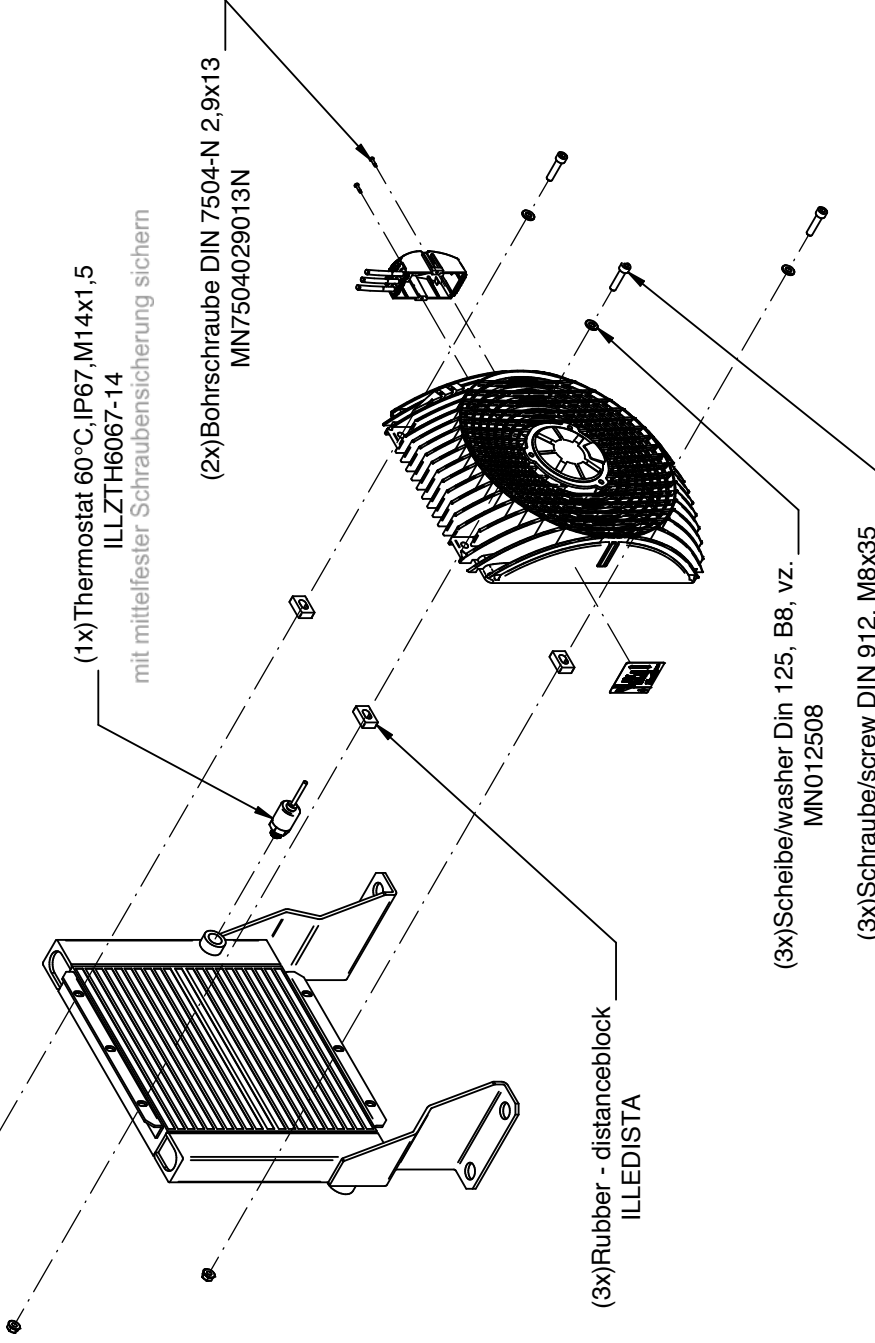
This data sheet shows a technical overview of our products. Please contact us if more exact information is needed. As we are constantly improving our products, their characteristics, dimensions and weights may also change, although we do our best to incorporate these changes continually. The information in this data sheet is intended to be used as a first general guideline only. asa assumes no liability for any information therein, any errors, omissions, misprints, nor any direct or indirect damages, losses or costs resulting therefrom. The cooling performance and the general technical values indicated in this catalogue are measured at a test bench according to asa testing procedures. Because there is no standardized testing procedure, tests used by other manufacturers could have different results. Due to different conditions in testing and application environments the cooling performance may also vary by +/- 15%. Therefore we recommend all coolers to be checked under the system operating conditions. This is also true of vibrations and mechanical stress as well as for pressure peaks and thermal stress and any other relevant factors.

(3x)Sperrzahnmutter DIN 6923, M8  
MN692308



(1x)Thermostat 60°C, IP67, M14x1,5  
ILLZTH6067-14  
mit mittelfester Schraubensicherung sichern

(2x)Bohrschraube DIN 7504-N 2,9x13  
MN7504029013N



(3x)Rubber - distanceblock  
ILLEDISTA

(3x)Scheibe/washer Din 125, B8, vz.  
MN012508

(3x)Schraube/screw DIN 912, M8x35  
MN091208035

**Zwischenprüfungen:**

- Verschlusschraube(n) mit Schlagschrauber nachziehen.
- Spaltmasse und Rechtwinkeligkeit der montierten Komponenten kontrollieren und ggf. korrigieren.
- Lüfterfunktionstest und freien Lauf des Ventilators kontrollieren (lt. QMA / QM5) und ggf. Position des motors korrigieren.

**Kühlerbeipack:**

- Aufstellungs- und Betriebsanleitung

free size tolerance	surface	date	name
Din 2768-m		21.02.08	AT
		23.01.14	DV
		23.01.14	ML
		23.01.14	PP

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index	modification	date	name
01	Platte um 63 mm verlängert	23.01.14	DV

scale	2:1	weight	0,841 kg
item number(s):	ASATT10UD01X		
description	Explosionszeichnung TT 10X 12V DC		
drawing number	F-02591-01		
page	1		
drawing file:	□ BC □ MC □ MTC □ update: ERP:..		





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# EXTREME DUTY CHUTE LIFT SYSTEM

Standard Chute Block

Auxiliary Hydraulic Gear Pump



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## EXTREME DUTY CHUTE LIFT SYSTEM

On Extreme Duty trucks, your main chute hydraulics are operated through the open center chute lift block. Located in the front pedestal, it receives its fluids from the auxiliary gear pump. This block continually allows fluid circulation to the reservoir. It simply diverts fluid to the raise/lower side of the chute cylinder. In the event that you need to check the hydraulic pressure on the chute lift system, you must insert a gauge on the hose going from the block to the cylinder.

**Use only approved Hydraulic Fluid – Do Not Use ATF OR ENGINE OIL**

Con-Tech trucks come factory filled with ISO 68 oil.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

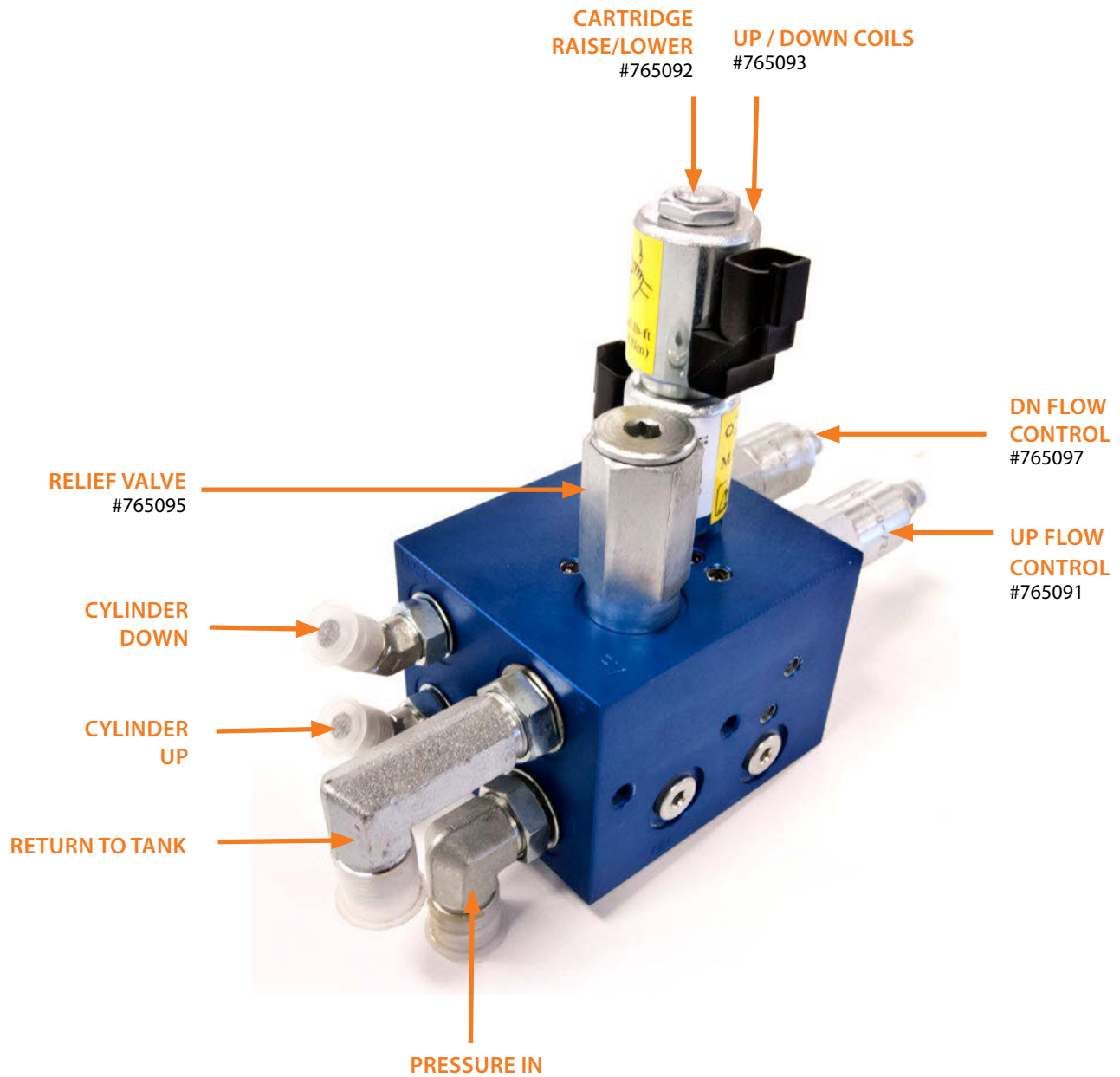
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# EXTREME DUTY STANDARD CHUTE BLOCK



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# AUXILIARY HYDRAULIC GEAR PUMP

The auxiliary hydraulic gear pumps function is to provide fluid to the chute lift block to operate the chute lift hydraulics. It is fed directly from the suction filter and runs directly into the chute lift block, back to the reservoir.

**Use only approved Hydraulic Fluid – Do Not Use ATF OR ENGINE OIL**

Con-Tech trucks come factory filled with ISO 68 oil.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

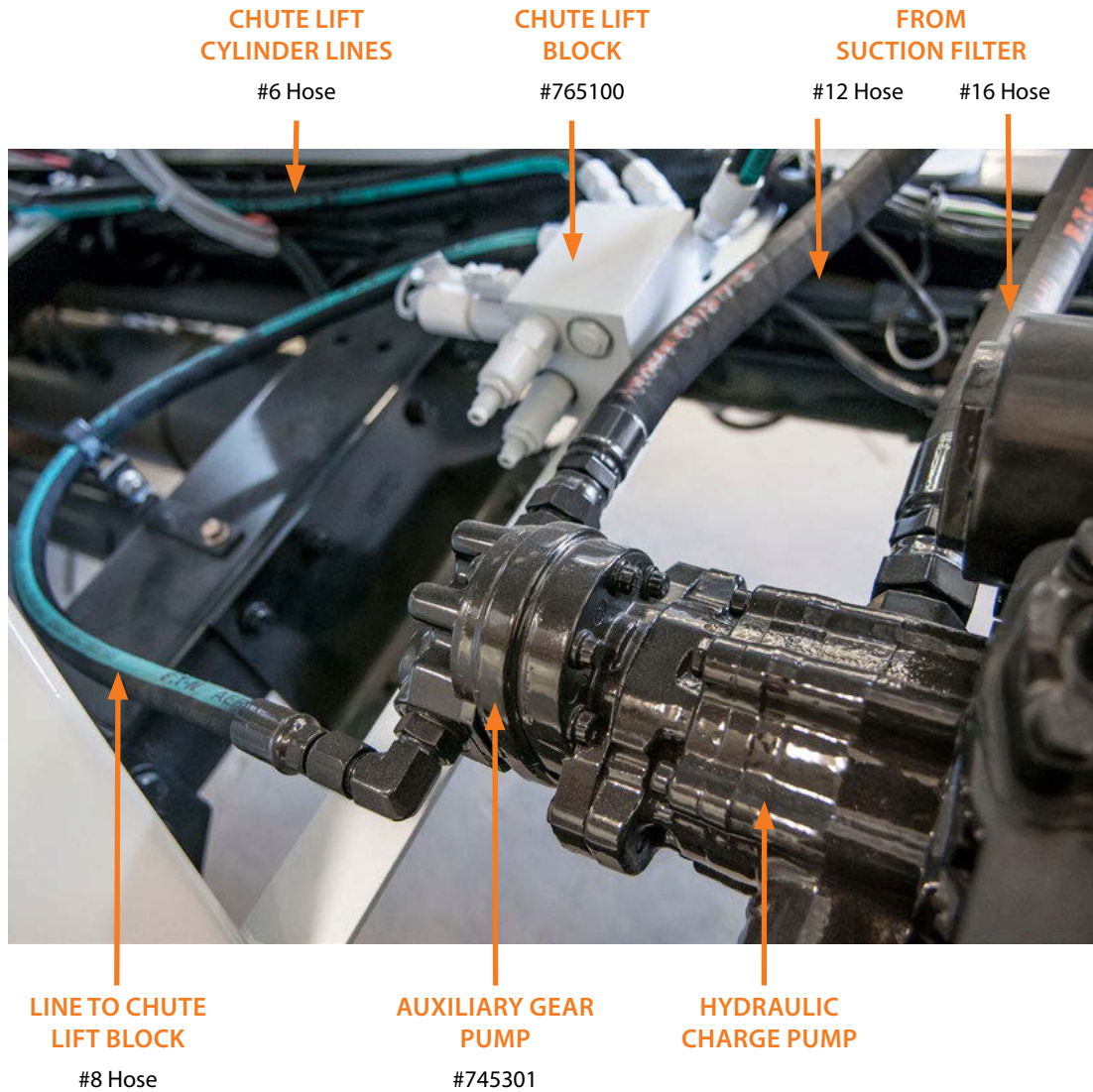
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# AUXILIARY HYDRAULIC GEAR PUMP



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# BridgeKing® Axle Chute System

High Pressure Filter Assembly

Parker Auxiliary Pump

BridgeKing® Combo Block

High Flow Block

CB4 Block

Proximity Switches for Trailer / Chutes

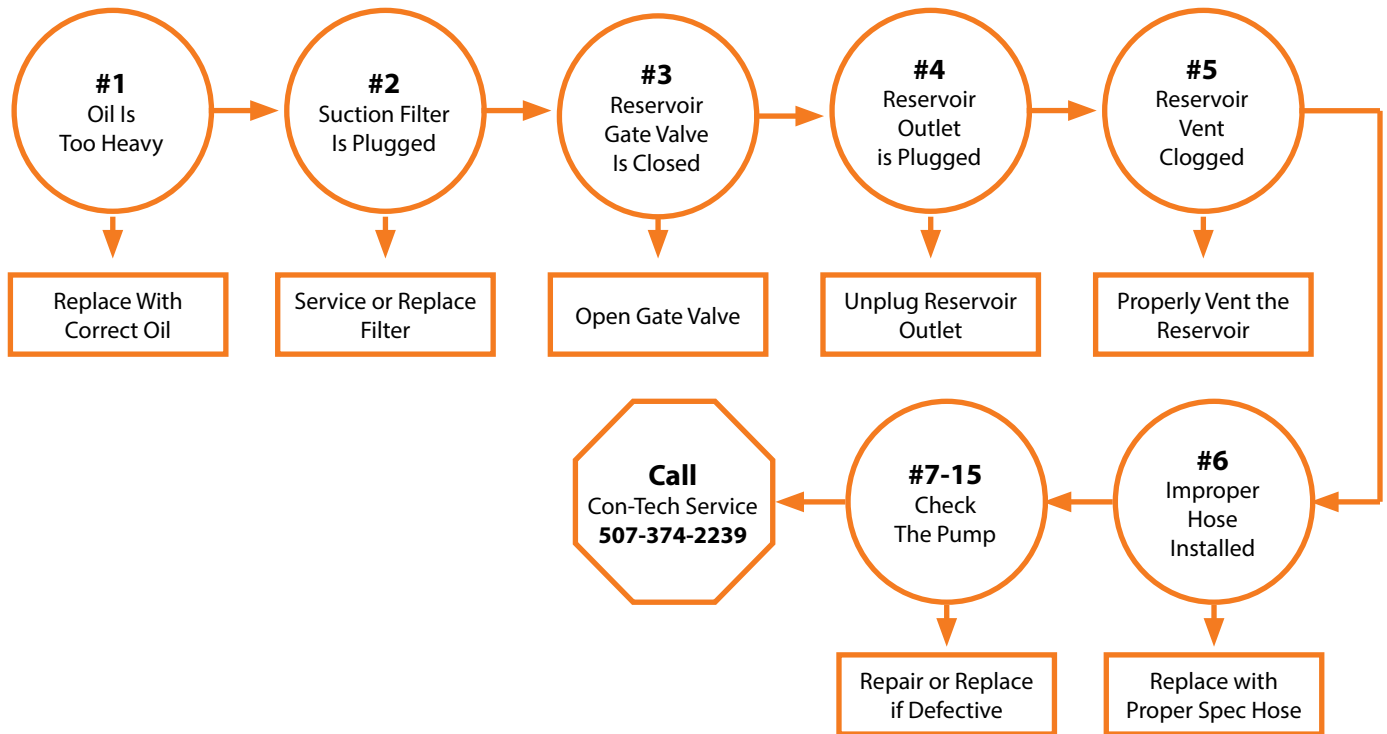


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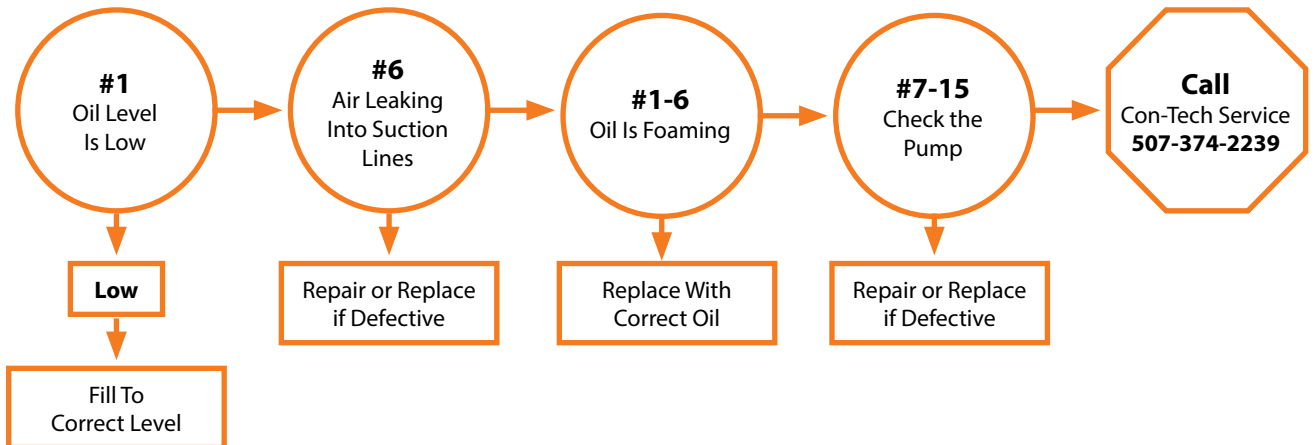
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# TROUBLESHOOTING BRIDGEKING HYDRAULICS

## PUMP NOISE DUE TO CAVITATION...



## PUMP NOISE DUE TO AERATION...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.



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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## PUMP WILL NOT BUILD ADEQUATE PRESSURE...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.



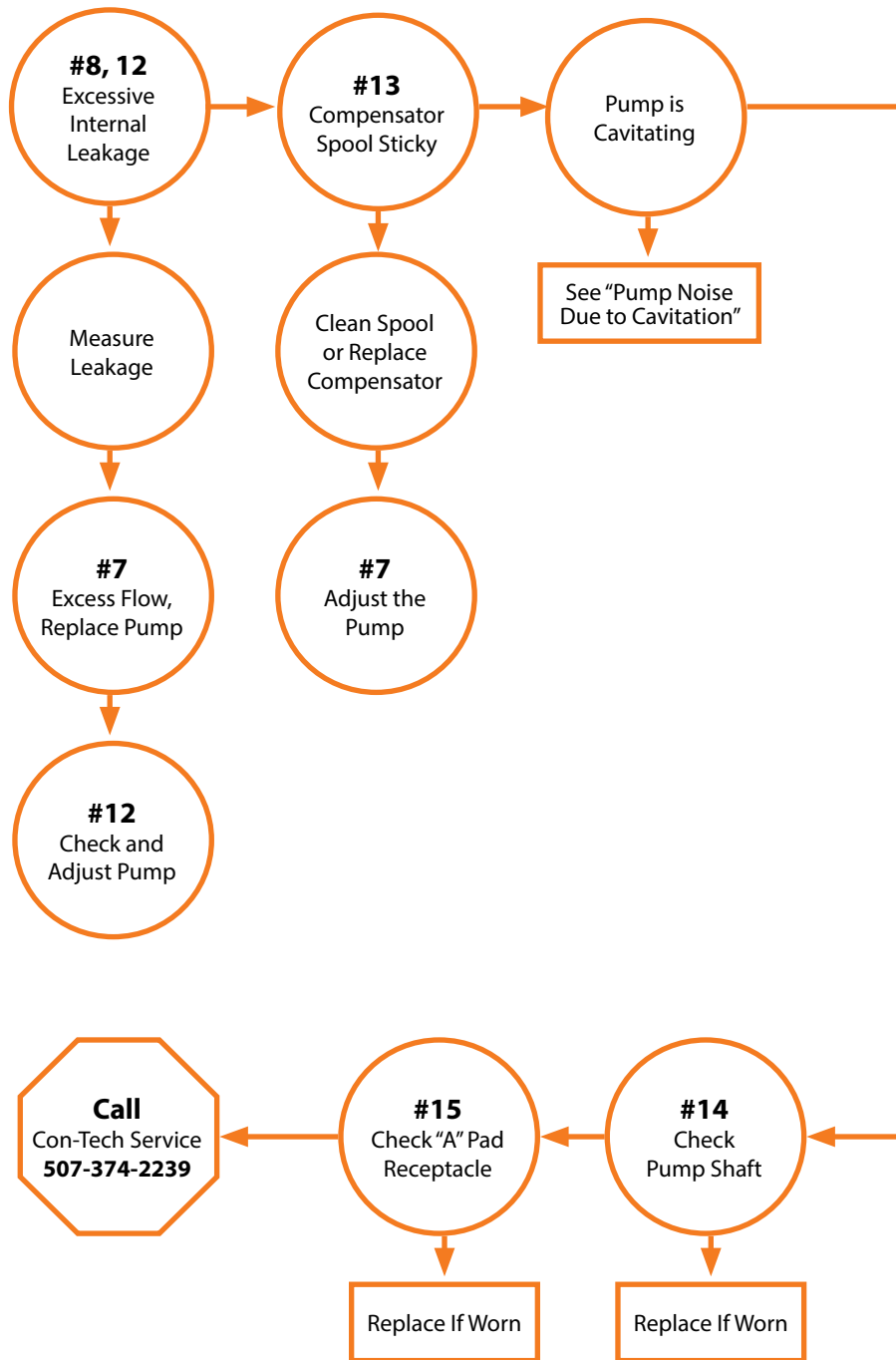
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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## PUMP WILL NOT DEVELOP ADEQUATE FLOW...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

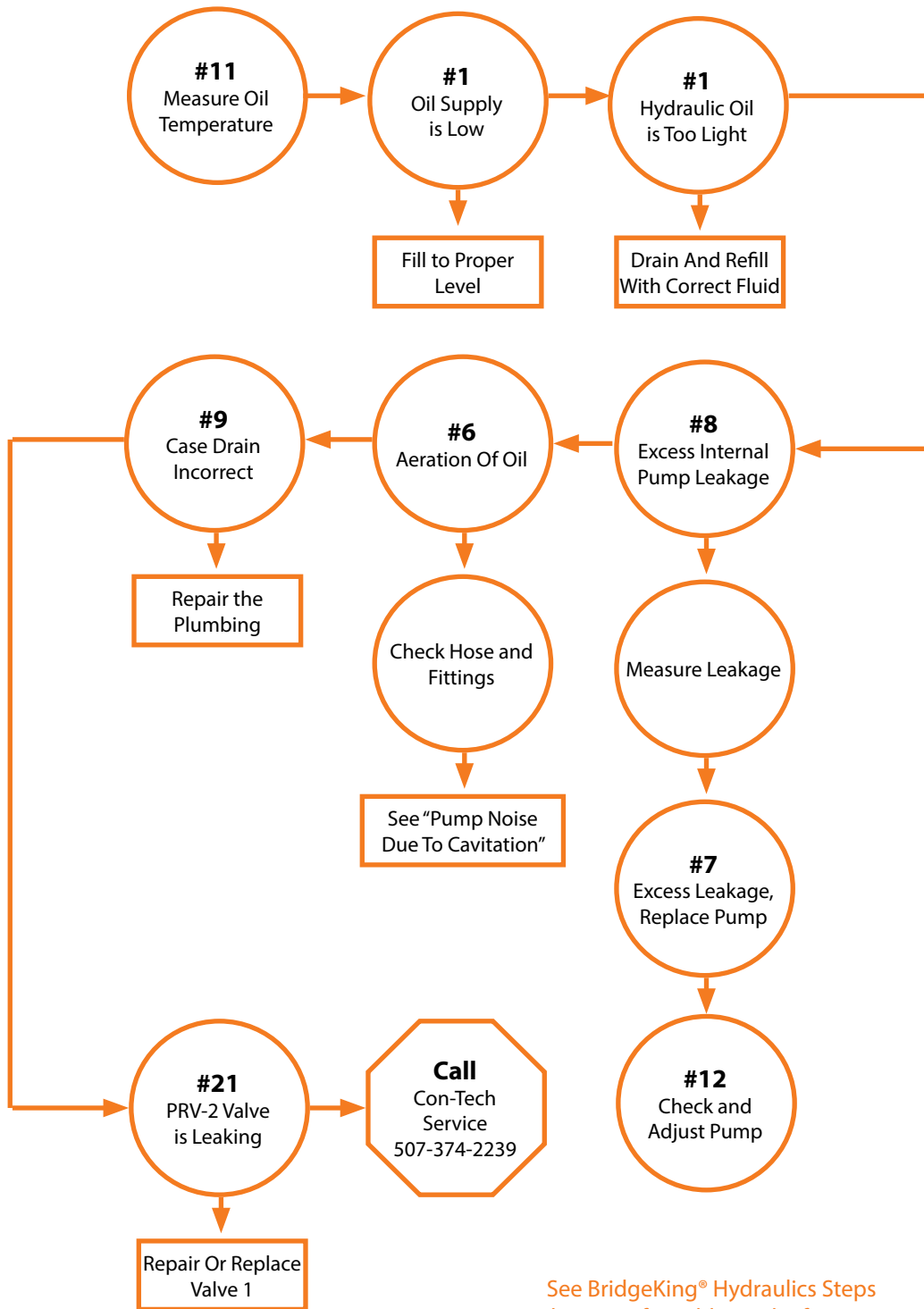


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## BRIDGEKING® SYSTEM IS OVERHEATING...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

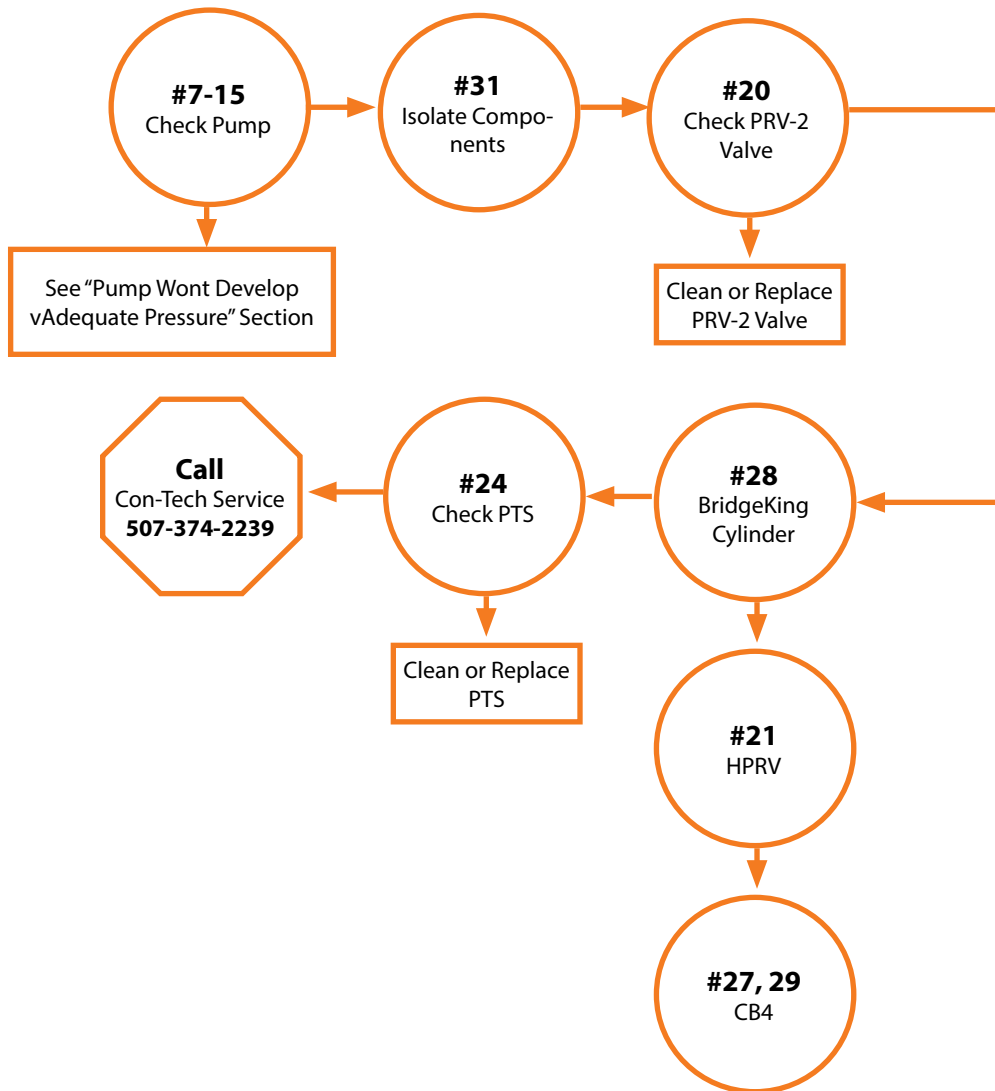


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

BRIDGEKING® DOES NOT BUILD ADEQUATE PRESSURE IN TRAILER DOWN POSITION...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

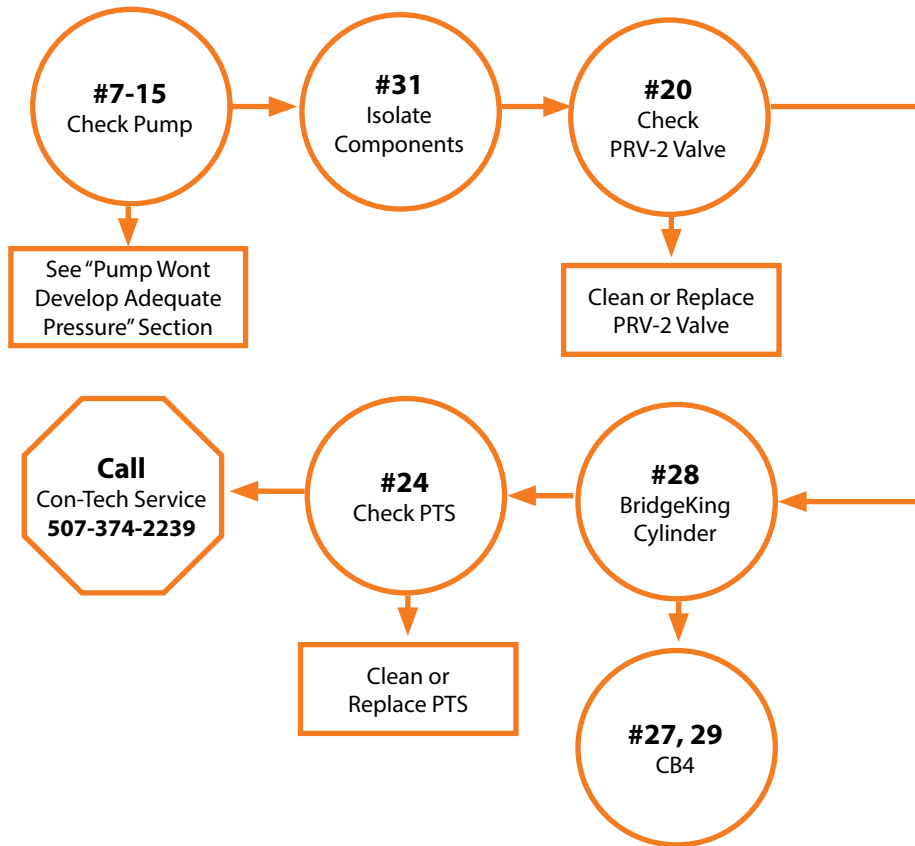


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

BRIDGEKING® DOES NOT BUILD ADEQUATE PRESSURE IN TRAILER UP POSITION...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

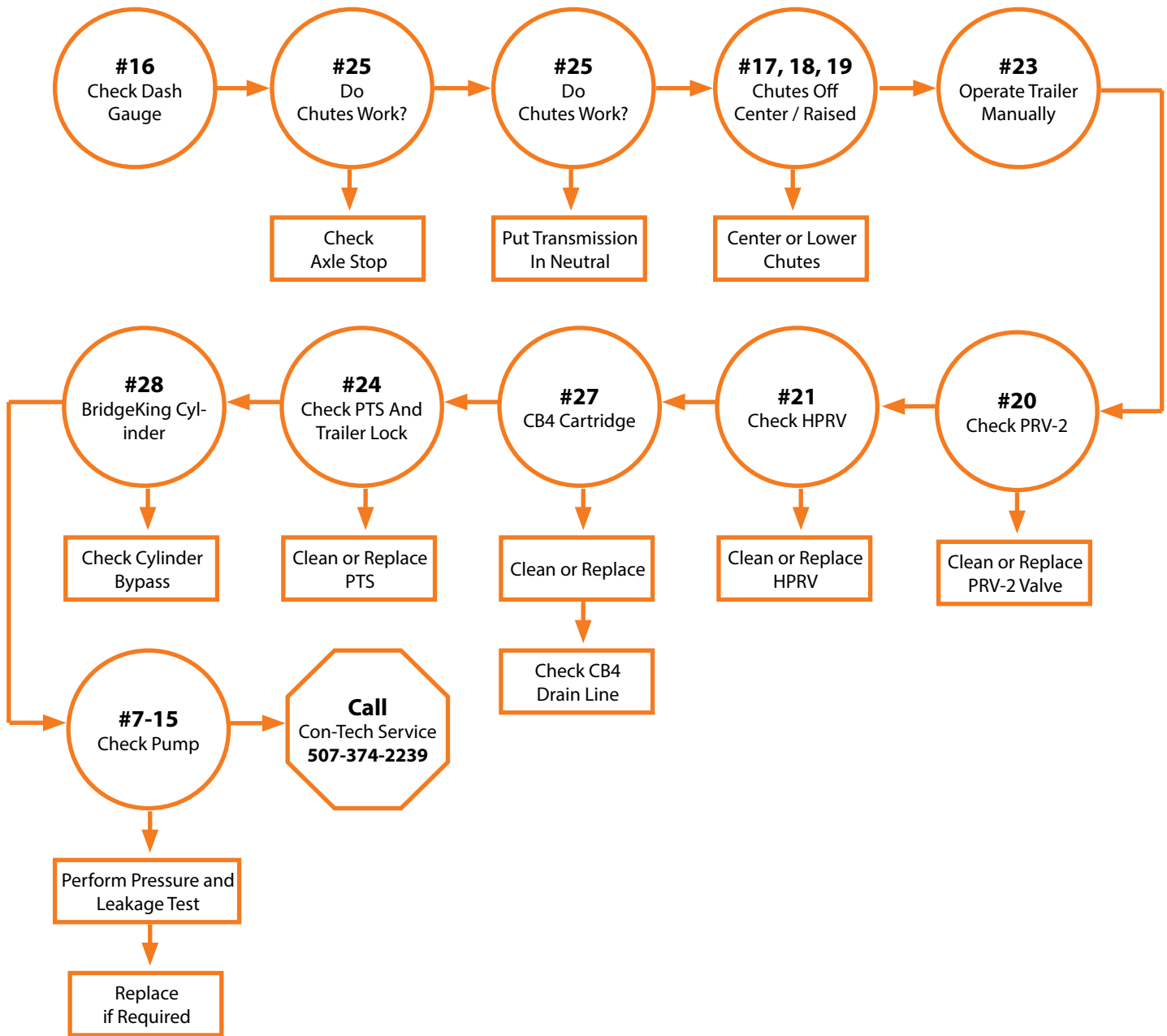


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## BRIDGEKING® TRAILER WON'T LOWER OR LOWERS SLOWLY...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

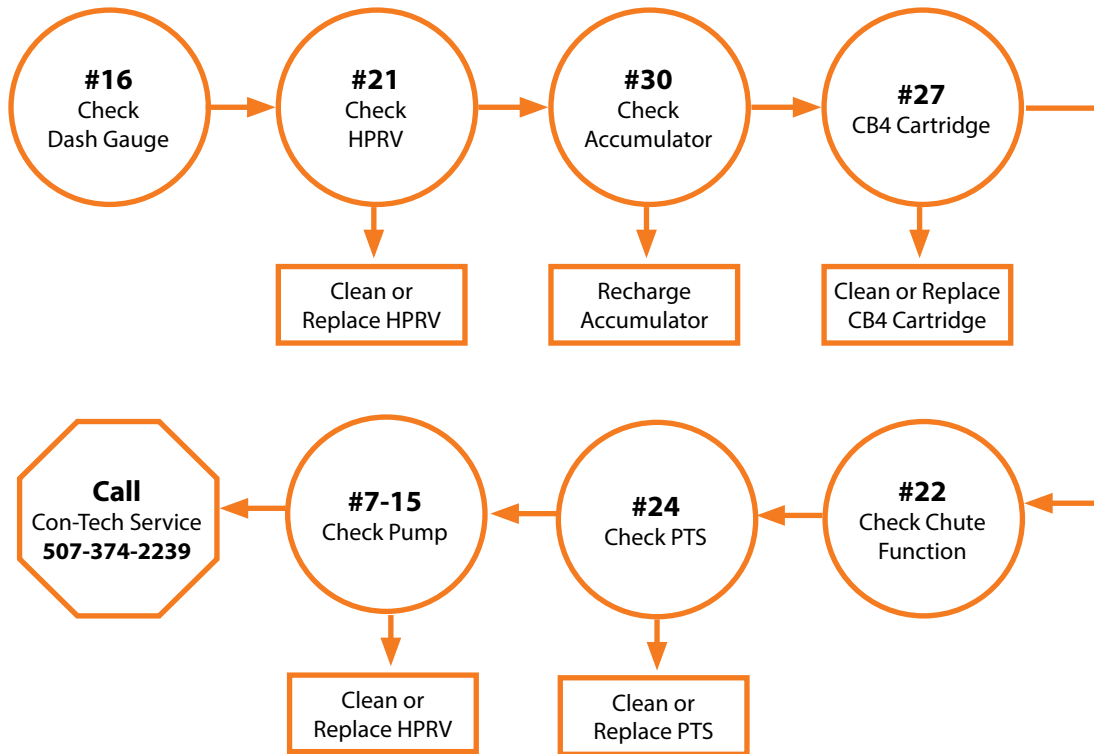


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

BRIDGEKING® TRAILER LOWERS SLOWLY OR HESITATES BEFORE LOWERING...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

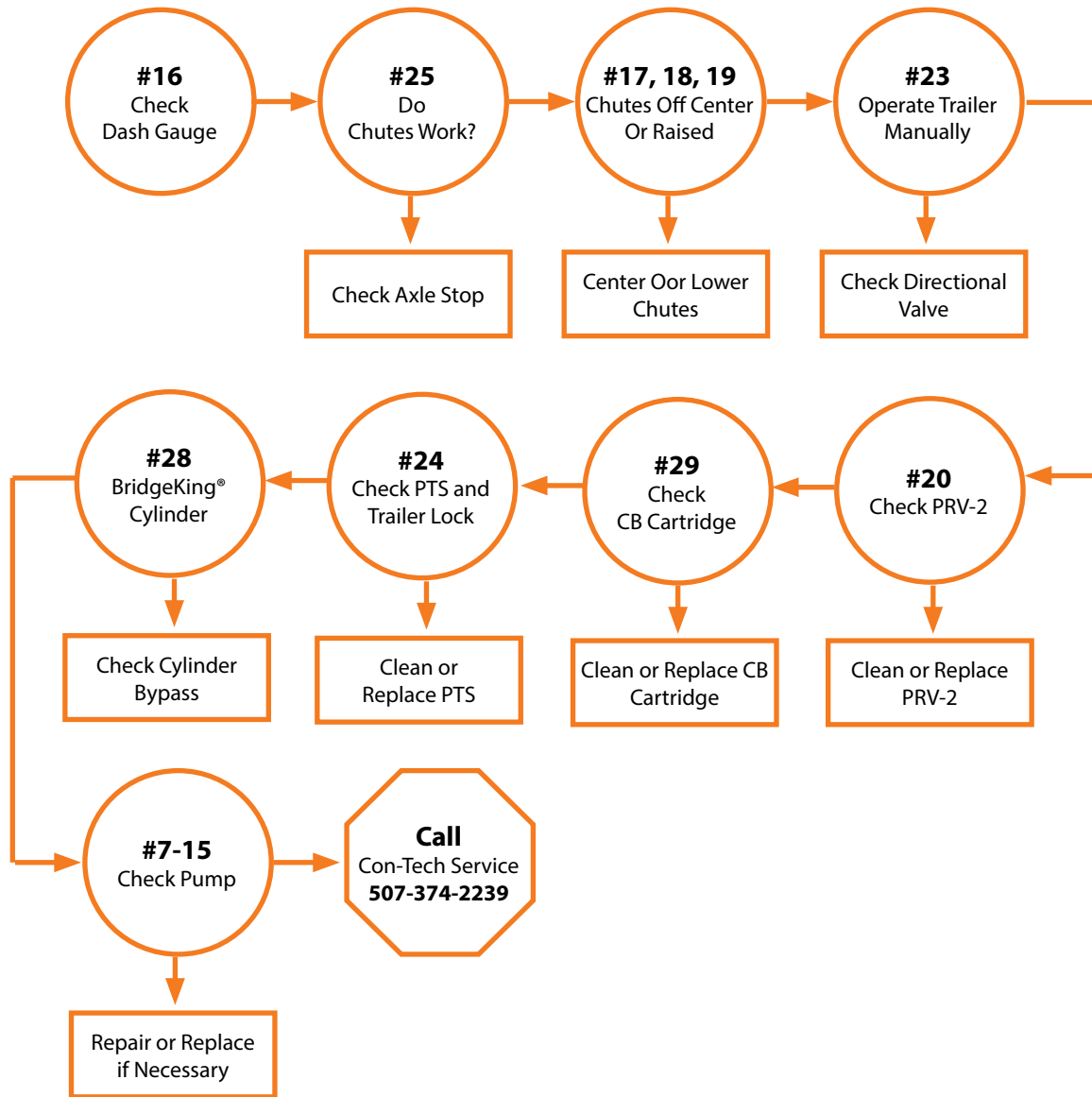


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## BRIDGEKING® TRAILER WON'T RAISE OR TRAILER RAISES SLOWLY...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.

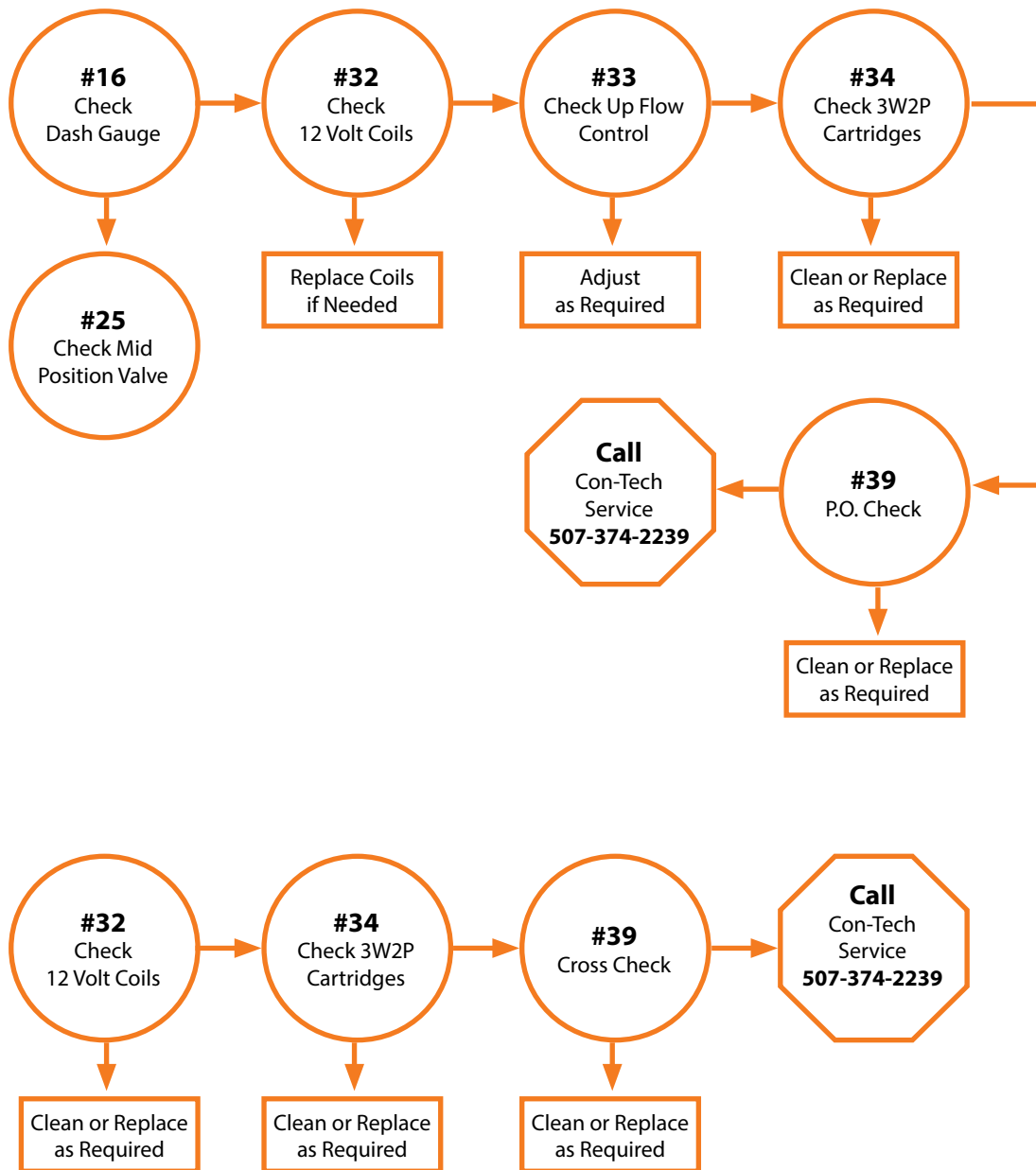


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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## BRIDGEKING® CHUTES WON'T RAISE - DOUBLE ACTING CYLINDER...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.



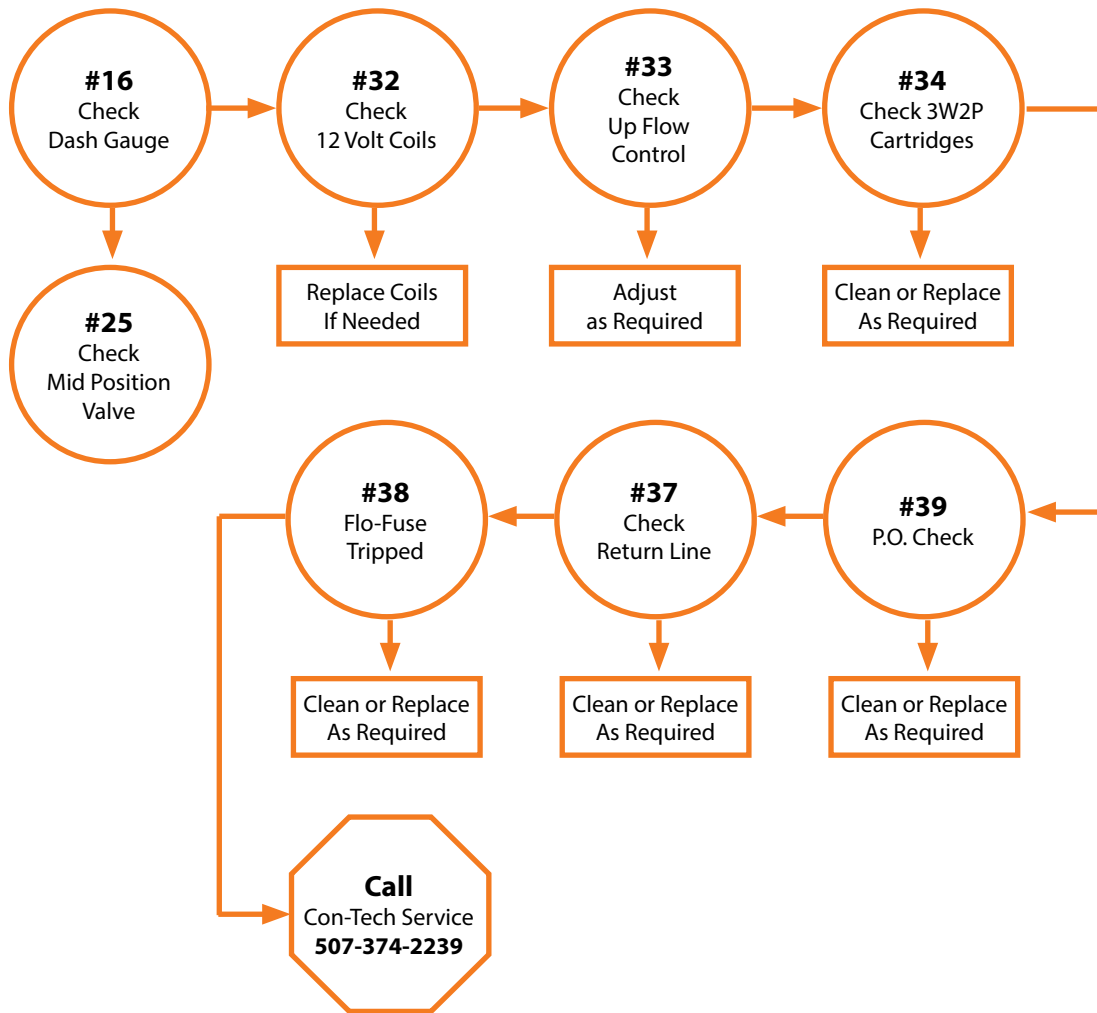
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# TROUBLESHOOTING BRIDGEKING® HYDRAULICS

## BRIDGEKING® CHUTES WON'T RAISE - DOUBLE ACTING CYLINDER...



See BridgeKing® Hydraulics Steps and Actions for Additional Information.



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# BRIDGEKING® HYDRAULICS STEPS AND ACTIONS

1. **Oil viscosity incorrect , low or wrong specification**
  - a. Change to proper ISO spec oil for outside temperature
  - b. ISO 68 (SUS 55-60 below 80°F)
  - c. ISO 100 (SUS 60-65 above 80°F)
  - d. Change oil and filters after first 100 hours in service and every six months thereafter
  - e. Refill reservoir to proper level
  - f. Use only approved Hydraulic Fluid –  
**Do Not Use ATF OR ENGINE OIL**
  - g. Contact the Con-Tech service department for oil specs
2. **Gate valve on reservoir closed**
  - a. Turn counter clockwise until fully open
  - b. When fully open install tie wrap to prevent vibration from closing gate valve
3. **Reservoir outlet plugged**
  - a. Oil must flow freely from reservoir outlet
4. **Reservoir vent clogged**
  - a. Clean or replace 10 micron breather cap on reservoir
  - b. 10 micron cap
  - c. If breather cap is not installed on your Con-Tech reservoir, install breather cap to properly vent the reservoir.
5. **Check for proper hose**
  - a. SAE100R4 suction hose should be installed between the reservoir and pump
  - b. Hose should be the same diameter and length as original hose
  - c. Improper hose size or rating may collapse under suction
  - d. Inspect for air leaks on suction side
  - e. Inspect fittings for air leaks
  - f. Inspect spin on filter gasket for air leaks
6. **Install new pump**
  - a. Lightly lubricate spline on pump with moly grease or equivalent before installing
  - b. Compensator will require adjustment (Step #12)
  - c. Pre fill pump case and hoses
7. **Excessive internal leakage**
  - a. Remove case drain line pump and measure volume flowing from case drain when pump is at operating temperature
  - b. Measure volume for 15 seconds and multiply by 4 to get your flow per minute
  - c. Normal case drain is 1.0 gpm on a new pump
  - d. Maximum allowable case drain is 2.5 gpm
  - e. Contact the Con-Tech service department
8. **Case drain incorrectly plumbed**
  - a. Current plumbing routes the pressure compensated pump case drain directly to the reservoir
  - b. All BridgeKing® pump case drains must go direct to the reservoir
9. **Call the Con-Tech service department for assistant at 507-374-2239**
10. **Measure oil temperature**
  - a. Measure oil temperature in the reservoir with an infra red heat gun or candy thermometer
  - b. Determine if the heat is caused by hydrostatic system or BridgeKing® hydraulic system
  - c. Maximum temperature should be outside temperature plus 100 degrees F
  - d. Ideal oil temperature should be 170° F- 180° F
11. **Check pump pressure**
  - a. Deadhead pump pressure line at Parker Filter inlet with a 0 – 5,000 psi gauge
  - b. Pressure should be adjusted at the compensator
  - c. Pressure should be the maximum required amount on the BridgeKing® Axle Placard +100 psi



# BRIDGEKING® HYDRAULICS STEPS AND ACTIONS

## 12. Compensator spool sticky

- a. Remove spool and clean
- b. Check compensator spring
- c. Compensator spool should move freely in bore
- d. LH and RH PC compensator are the same but mounted opposite
- e. Use new O-ring for the installation

## 13. Check pump shaft

- a. Check spline for worn spline
- b. Replace shaft if worn
- c. A-Pad receptacle on the Eaton A-Pad may also be worn

## 14. Check A-Pad receptacle

- a. Check for worn receptacle
- b. Replace receptacle if worn
- c. PC pump shaft will also be worn

## 15. Check cab gauge pressure

- a. 1,000+ psi minimum pressure typically required to move trailer up and down
- b. This is approximately the minimum setting of the PRV-2
- c. If there is no pressure in the cab gauge, the optional mid position axle stop valve may be activated and neither the trailer or chutes will function

## 16. Check red chute light

- a. If chute hazard LED light is on, chute is not centered or fully lowered
- b. If the chute is down, centered, & light remain on
  1. Unplug chute center prox, if light goes out, replace the prox
  2. If light remains on, replace the prox relay located in the in-cab control box (C48)

## 17. Check adjustment PRV-2 valve

- a. The pressure should reach compensated pressure when the PRV-2 is turned fully clockwise with trailer in the up position
- b. Minimum pressure when PRV-2 is turned fully counter clockwise should be approx. 1,000 psi
- c. Maximum pressure should be the maximum pressure on the BridgeKing® placard plus 100 psi
- d. The PRV-2 can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- e. Replace the PRV-2 if necessary

## 18. Check High Pressure Relief Valve (HPRV)

- a. The HPRV is located on the High Flow Block on the barrel end of the BridgeKing® trailer cylinder
- b. If the HPRV is leaking, partial flow may be going to the reservoir and preventing full pressure from building up in the down mode - this condition will typically cause heat and slow trailer down speed
- c. The HPRV can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- d. Replace the HPRV cartridge if it is leaking

## 19. Check chute function

- a. If the chute lift section malfunctions, oil flow can flow to the reservoir which can also cause trailer up/down movement problems
- b. Turn the chute up speed flow control fully clockwise to shut off the flow of the oil to the chute system – this will isolate the chute lift system from the BridgeKing® trailer system
- c. See the section on the closed center chute lift block

## 20. Operate trailer manually (PRV-2 should be adjusted no higher than 1,000 psi)

- a. Shift the directional valve manually
- b. If trailer operates, problem is probably electrical
- c. If trailer doesn't operate, problem is probably hydraulic
- d. If trailer safety latch operates, directional valve is sending a hydraulic signal to the high flow block



# BRIDGEKING® HYDRAULICS STEPS AND ACTIONS

## 21. Check PTS and trailer lock

- a. Earlier models have the PTS located in the control block
- b. The PTS should receive a signal when the directional valve is shifted
- c. The PTS signal also unlatches the trailer lock – the lock should open when PTS shifts to the down position or the lock should relax in the up position
- d. If the PTS doesn't shift fully, the trailer speeds may be slow or the pressure low
- e. Inspect the PTS O-rings and orifice behind PTS
- f. You should be able to push in against the spring on the center spool of the PTS and it should return freely
- g. The PTS can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- h. Replace the PTS if necessary

## 22. Do chutes work?

- i. Optional axle mid-position stop valve activated
- j. Activated mid-position stops all flow to system including chutes
  1. Trailer won't operate
  2. Chutes won't operate

## 23. Truck in Reverse

- a. Putting truck in reverse automatically raises axle **(chutes must be centered and down)**
- b. Putting truck in reverse bypasses chute down or chute centered interlocks
- c. Truck in reverse prevents axle from going down

## 24. CB (Counter Balance) cartridge

- a. If CB cartridge is stuck closed, oil cannot leave the rod end of the cylinder and cylinder will move down slowly or stop
- b. If CB cartridge is stuck closed, dash gauge will not drop when trailer is lowered
- c. The CB cartridge controls the trailer down speed of 30 – 45 seconds

- d. Check drain line from CB cartridge - only occasional drops should enter drain line from CB cartridge
- e. If there is pressure in the drain line (which is a tank line), the CB cartridge will not open and trailer will not lower
- f. The CB cartridge can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- g. Replace the CB if necessary

## 25. BridgeKing® Cylinder

- a. If oil bypasses at the piston the trailer may be slow, not develop adequate pressure, or not move up or down
- b. When the cylinder barrel end is pressurized, only drops should bypass to the rod end
- c. Check with Con-Tech Service for the proper procedure to check oil bypass in the BridgeKing® cylinder

## 26. CB one way check valve

- a. The CB Manifold assembly has a one way check valve to allow oil to flow to the rod end of the cylinder when the trailer is being raised
- b. The one way check can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- c. Replace the one way check if necessary

## 27. Check Accumulator

- a. Accumulator pressure should be 1150 psi
- b. Low accumulator pressure may cause trailer down hesitation of up to 20 seconds before trailer starts down
- c. Other symptoms of a low or flat accumulator include dash gauge fluctuates and a rough ride for the driver
- d. A low or flat accumulator will cause damage to the BridgeKing® pivot bushings, BridgeKing® mount, and BridgeKing® cylinder bushings
- e. See the section on charging the accumulator for the proper safety procedures



# BRIDGEKING® HYDRAULICS STEPS AND ACTIONS

## 28. Isolate Components

- The trailer and chute lift systems can be isolated from the main control block on the BridgeKing® hydraulic system
- The hydraulic hoses going from the control block to the cylinder can be removed and capped off and the manifold ports plugged at the cylinder or control block – whichever is easiest
- The chute system can be isolated by turning the up flow control fully off on later systems
- Isolating the cylinder and chute lift systems one at a time provides a “process of elimination” to help locate problems

## 29. Check 12 volt coils

- When the chute up button is depressed, the up coil will be energized
- When the chute down button is depressed, the down coil will be energized
- An energized coil will be an electromagnet and will attract a piece of metal such as a knife blade
- You can also hear a “clicking” noise when the coil is energized if the cartridge is shifting
- If neither coil is energized when the chute up/down button is depressed, check the electrical circuit and or fuses
- If both coils energize correctly when the chute up/down button is depressed, check the hydraulic system
- Most coils have an O-ring seal which must be in place when a coil is reinstalled
- If an electrical circuit malfunctions, partial voltage may cause a cartridge to shift slightly resulting in chutes drifting up or down

## 30. Check up flow control (chute up speed)

- If the chute up speed control is turned entirely off, no oil will be available for the chutes
- If the up speed control is out of adjustment, turn both the up and down speed control to the center of their adjustment range as a place to start again
- If the up speed control is adjusted to approximately maximum up chute speed, the chute may go up when the down button is depressed

## 31. Check 3W2P cartridges

- Both 3W2P (three way/two position cartridges) are the same and are interchangeable
- The coil can be removed from the cartridge and the 3W2P cartridges removed for inspection and cleaning
- Inspect the O-ring on the cartridge to be sure they are not chipped or damaged
- Clean the cartridge with WD40
- Because both cartridges are interchangeable, they can be swapped into the other cavity which may reverse the problem - the chute that wouldn't go up probably won't lower

## 32. P.O. Check Valves

- A pilot operated check valve holds the chute in the up position
- If the P.O. check leaks, oil can pass to the reservoir rather than raise the chute
- If the P.O. check leaks; the chute will drift down
- The P.O. check can be cleaned and flushed with WD40 **(Do not use a parts washer!)**
- Replace the P.O. check if necessary



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## BRIDGEKING® HYDRAULICS STEPS AND ACTIONS

### 33. Check down flow control

- a. If the chute up speed control is turned entirely off the chutes will not lower
- b. If the down speed control is out of adjustment, turn both the up and down speed control to the center of their adjustment range as a place to start again
- c. The down flow control cartridge be cleaned and flushed with WD40 (**Do not use a parts washer!**)
- d. Replace the cross checks if necessary

### 34. Check return line

- a. An obstructed return line to the reservoir will prevent oil from leaving the chute lift system
- b. An obstructed return line will result in a chute which won't lower

### 35. Flo-Fuse Down

- a. Excess chute speed will trip flo-fuse and chute will not lower
- b. If flo-fuse is tripped. The chute must be lifted to reset the flo-fuse
- c. If new chute lift cylinder is installed the air must be thoroughly bled from the chute lift cylinder and hydraulic hose or the air (which is compressible may trip the flo-fuse



## HIGH PRESSURE FILTER ASSEMBLY

Your BridgeKing® high pressure filter assembly has a flow style by-pass indicator (it only reads while oil is flowing ). During operation of the BridgeKing® trailer, if the indicator is showing, you have a restricted filter.

The high pressure by-pass will function any time the outlet pressure becomes 50 psi lower than the inlet pressure. If you have 2500 psi going into the housing and your filter is starting to restrict flow and your outgoing pressure drops below 2450 psi, the by-pass will open to keep the flow moving.

Your high pressure filter element should be replaced with a Beta Rating of B10=200. Con-Tech part # 735003

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

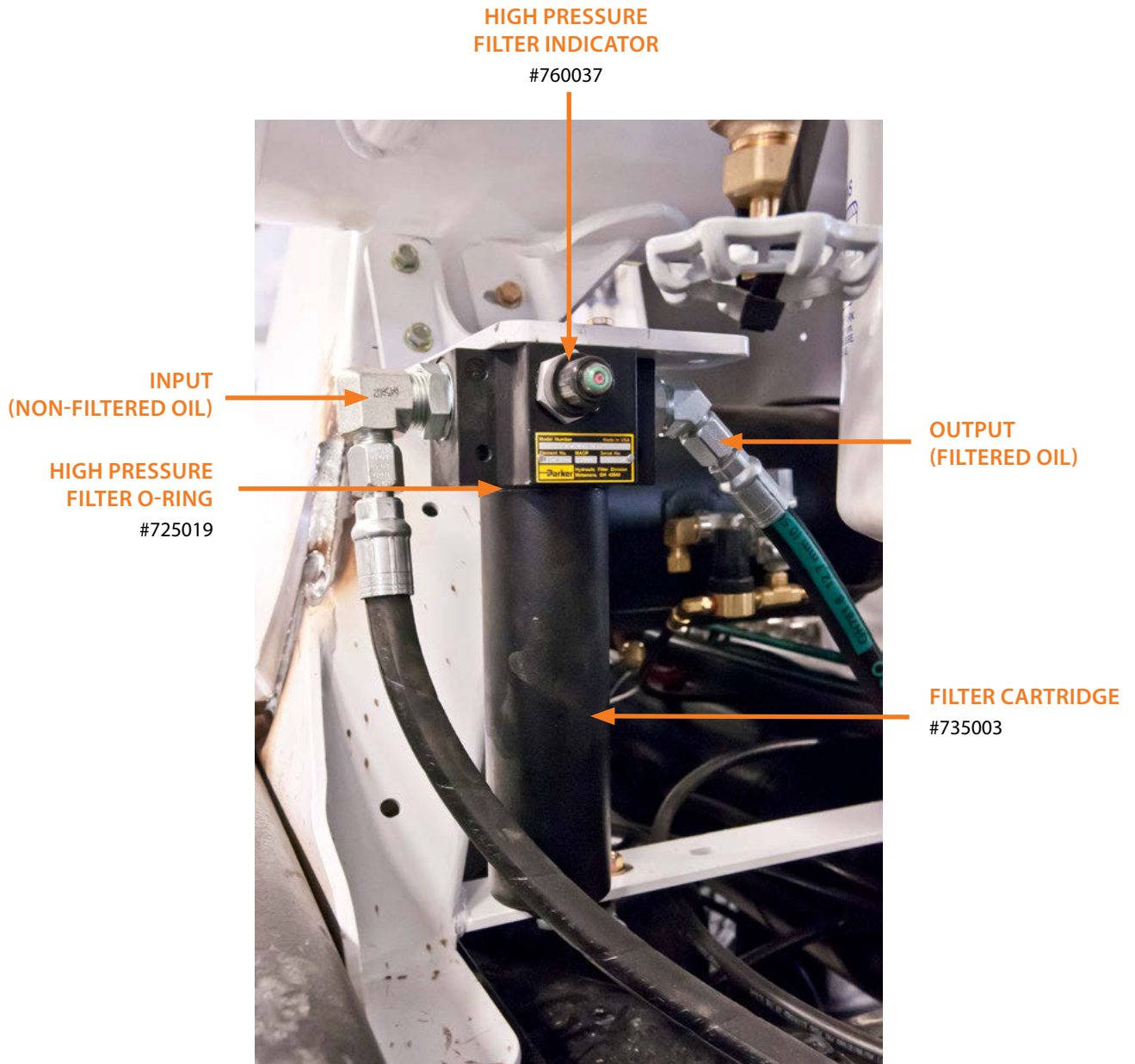
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# HIGH PRESSURE FILTER ASSEMBLY



Part #735010



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## PARKER AUXILIARY PUMP

The pressure compensated piston pump is responsible for the hydraulic pressure for the BridgeKing® Axle System as well as the pressure required to run the chutes. This means that the pump will detect pressure demands of the system and supply additional flow/pressure as needed.

This pump is factory preset for 3100 psi. The hydraulic pressure may be required to be adjusted throughout the life of the pump. Establishing pump pressure is fairly simple. With the engine turned off and all pressure relieved from the system, simply remove the high pressure (smaller of the two coming out the end of the pump) hose from the filter assembly and install a gauge directly into the hose. **THE GAUGE MUST BE RATED FOR 5000 PSI OR GREATER!** Start the truck and run at idle. The gauge should read approximately 100 psi above what the highest pressure setting is on the axle psi placard.

To adjust the pump maximum pressure setting, simply loosen the adjuster “jam nut” and screw the adjusting stem clockwise until the desired gauge pressure reading is obtained. Lock down the jam nut, shut off engine and allow hydraulic pressure to relive from the system, remove gauge and re-install hydraulic hose.

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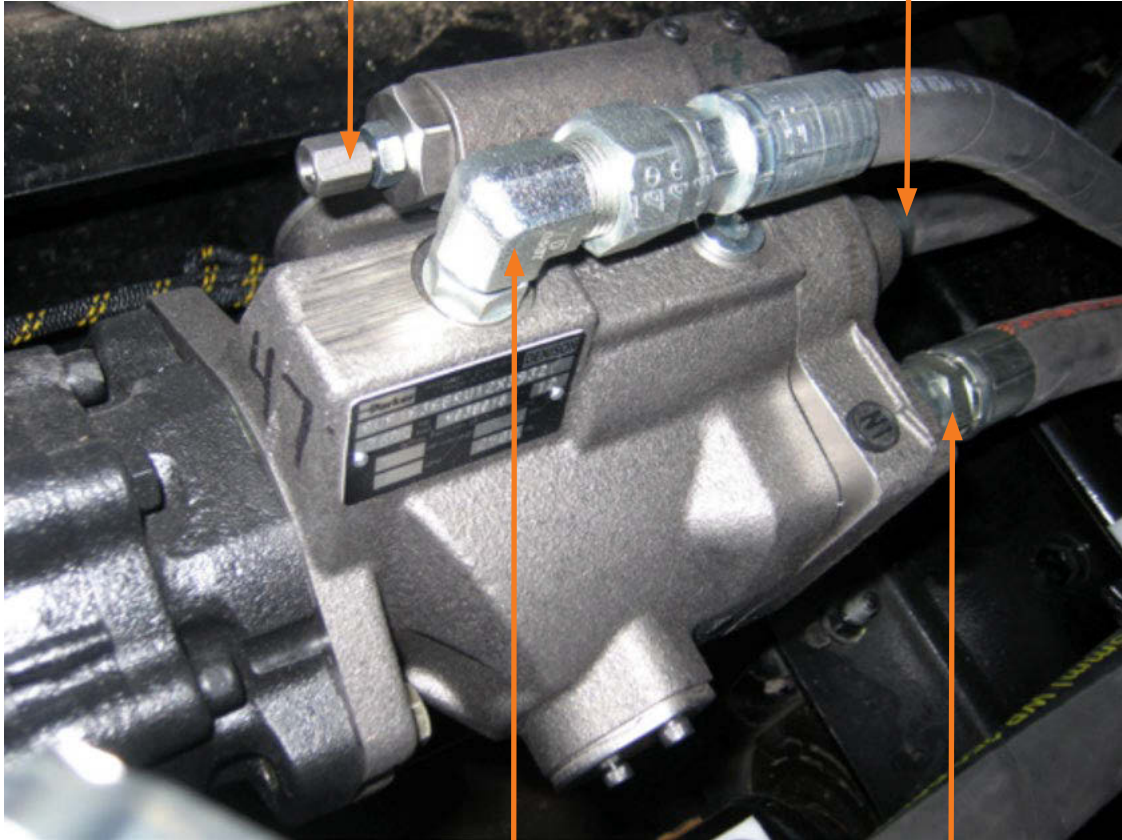
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## PARKER AUXILIARY PUMP

PRESSURE COMPENSATOR  
ADJUSTMENT SCREW

PRESSURE PORT  
#8 Hose Size



Part #745300

CASE DRAIN PORT

SUCTION PORT  
#12 Hose Size



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## BRIDGEKING® MAIN CONTROL BLOCK

The Main Control Block controls all hydraulic functions for the BridgeKing® trailer as well as the chute raise and lower functions. The following illustrations point out all the components of the Main Control Block as well as their function and built in overrides.

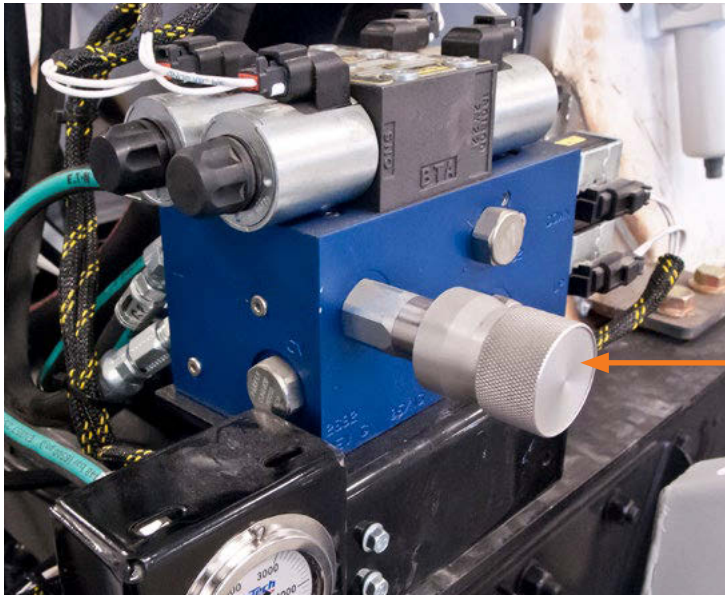
The overrides are only to be used in EMERGENCY situations. **THE OPERATOR MUST BE AWARE THAT WHEN THE OVERRIDES ARE USED, THAT ALL SAFETY INTERLOCKS WILL BE DISABLED.** The chutes WILL BE DAMAGED if they are not centered and in the fully down position when utilizing the trailer up/down overrides.

Also, remember that when the axle mid-position stop is activated, the chute raise/lower functions will be disabled as well.

Please note, that before ANY repairs or maintenance is performed on any Con-Tech mixers, all OSHA lock out/tag out procedures must be followed. All hydraulic pressure must be relieved and/or allowed to dissipate FULLY from the system. Failure to do so can result in bodily harm or fatal injuries!

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



**TRAILER PRESSURE  
CONTROL VALVE**  
(PRV-2)  
#760027



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# BRIDGEKING® MAIN CONTROL BLOCK

**PARKER VALVE TRAILER UP / DOWN**  
(Manual Override Located Under the Cap)  
#760158

**PARKER VALVE TRAILER START / STOP**  
(Manual Override Located Under the Cap)  
#760158

**CHUTE UP SPEED CONTROL**  
(In = Fast)  
#760160

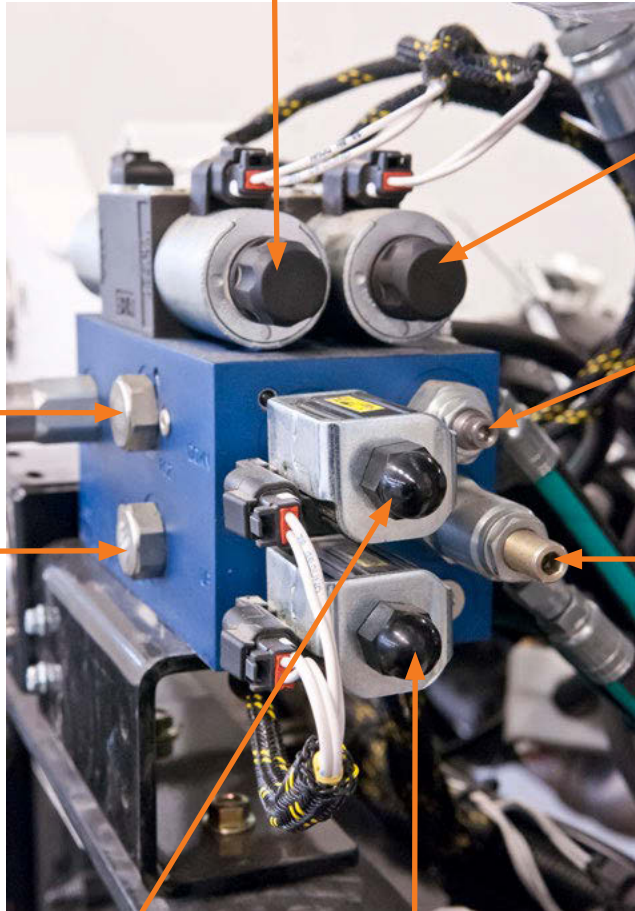
**CHUTE DOWN SPEED CONTROL**  
(Out = Fast)  
#760159

**PILOT OPERATED CHECK VALVE**  
#760095

**PILOT OPERATED CHECK VALVE**  
#760095

**CHUTE LOWER CONTROL CARTRIDGE**  
(Manual Override Located Under the Cap)  
#760166

**CHUTE RAISE CONTROL CARTRIDGE**  
(Manual Override Located Under the Cap)  
#760166



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## BK CYLINDER HIGH FLOW BLOCK

The High Flow Block is located at the “barrel” (front) end of the BridgeKing® cylinder. It consists of a High Pressure Relief Valve (HPRV): The HPRV cartridge is a large 70 gpm cartridge has been designed to relieve pressures over 3,200 psi in the barrel end of the BridgeKing® cylinder to the reservoir. When the accumulator is functioning properly, the HPRV is seldom used. However, if the accumulator is “flat”, the HPRV will prevent pressure spikes from back feeding into the hydraulic system. The typical failure mode of the HPRV cartridge is that it can allow oil to flow to the reservoir rather than pressurize the barrel end of the BridgeKing® cylinder. Typically shown by the BridgeKing® gauge, it will register full pressure when the trailer is up, but will not generate pressure in the down position. If this happens, the system may not be able to achieve the amount of regulated pressure required. If oil is passing through the HPRV, you will notice that the High Flow Block will begin to warm up rapidly. Frequently, the oil flow can be heard bypassing to the reservoir.

The high flow block also contains the pilot to shift cartridge (PTS). The PTS cartridge is hydraulically pilot operated. This hydraulic pilot pressure (flow at compensated pressure) comes from the Directional Control Valve on the Control Block when the trailer “down” switch is activated in the truck cab. When the PTS spool has a pilot pressure, oil flows through the PTS spool to the barrel end of the BridgeKing® cylinder, lowering the BridgeKing® trailer. When the PTS spool does not have pilot pressure, oil flows through the PTS spool to the rod end of the BridgeKing® cylinder, raising the BridgeKing® trailer. A hydraulic line is routed from the High Flow Block to the spring loaded single acting displacement cylinder which opens the BridgeKing® trailer hook. It takes 160 psi to shift the PTS spool against it’s spring forces. It takes 50 psi to open the trailer hook. That means the hook will open before the PTS spool shifts. When the PTS receives pilot pressure, the PTS spool shifts against the internal spring, forcing and allowing the regulated pressure to enter the barrel end of the cylinder. We now have regulated pressure on both the barrel end and rod end of the BridgeKing® cylinder. Because the barrel end of the cylinder has more area than the rod end of the cylinder, the barrel end of the cylinder has more force and the cylinder extends (trailer lowers). Oil leaving the rod end of the cylinder joins the oil flowing to the barrel end of the cylinder. When the up switch is activated in the truck cab, the directional control valve on the control block shifts to the opposite position and stops the pilot pressure to the PTS. When this pilot pressure is stopped, the internal spring force on the PTS spool returns the PTS spool to it’s spring loaded position.

This PTS spool position prevents regulated pressure from entering the barrel end of the cylinder and at the same time allows the oil in the barrel end of the BridgeKing® cylinder to flow to the reservoir. Because we always have regulated pressure on the rod end of the cylinder, the cylinder retracts making the trailer go up.

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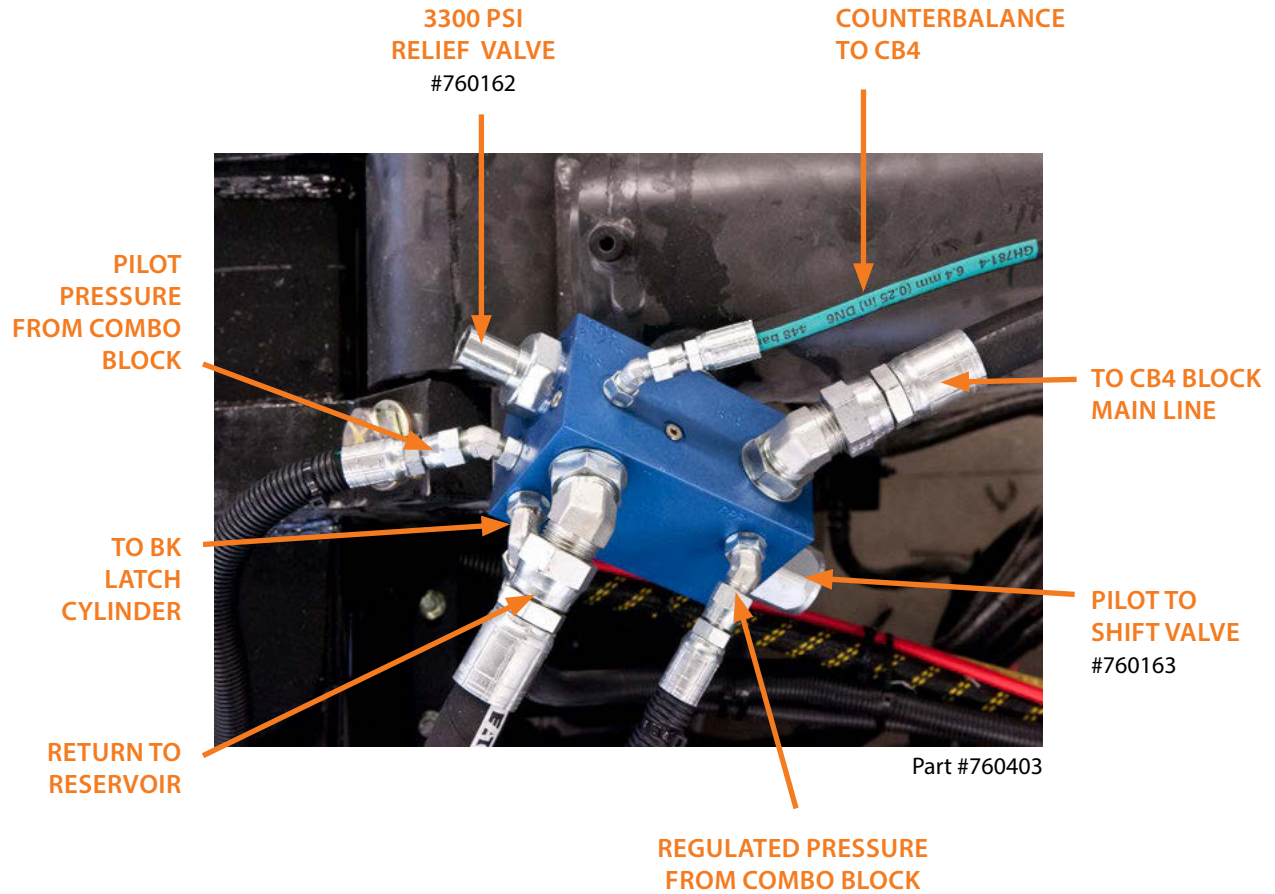
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## BK CYLINDER HIGH FLOW BLOCK



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## BK CYLINDER CB4 BLOCK

The function of the CB4 block is to prevent the BridgeKing® from being lowered when the truck is turned off. It also limits the speed that the BridgeKing® trailer can be lowered. The CB4 cartridge is sensitive to pressure differences between the cylinder rod end and regulated pressure port on the CB4 block assembly. If the regulated pressure on the CB4 block is lower than the regulated pressure in the BridgeKing® cylinder barrel end, the CB4 cartridge will close. Thus trapping oil in the Bridge King cylinder rod end and terminating cylinder movement.

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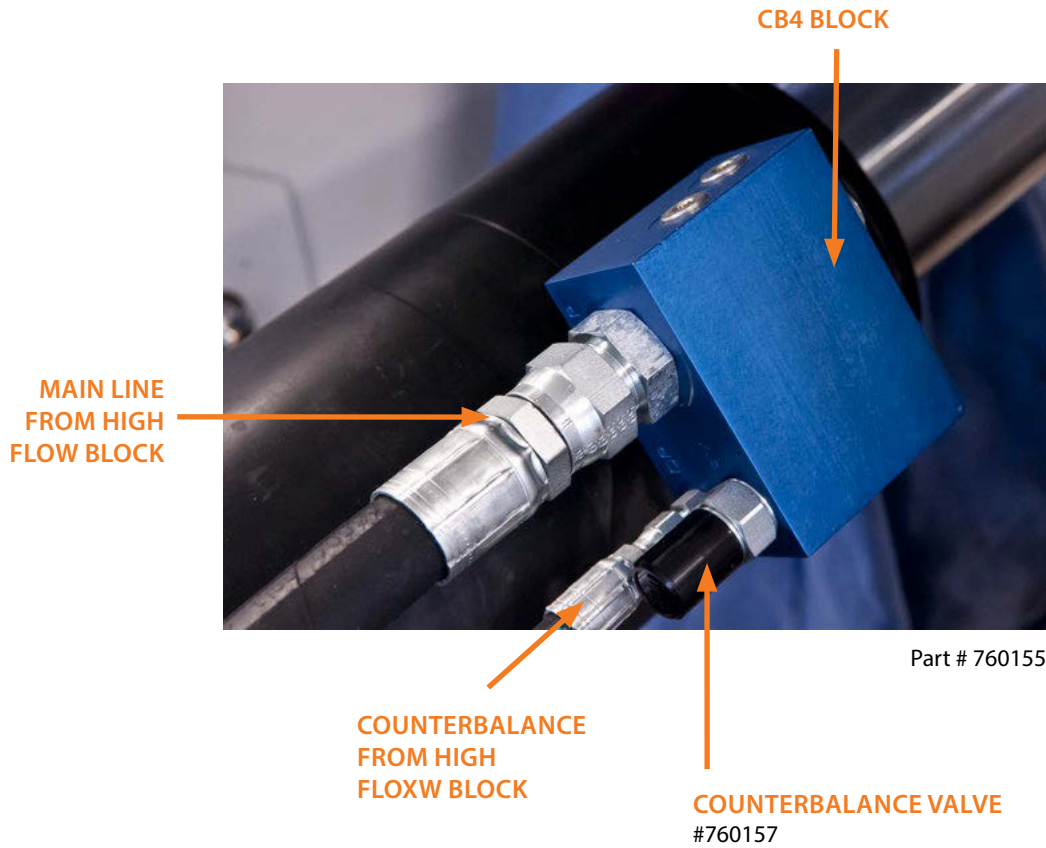
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## BK CYLINDER CB4 BLOCK



**WARNING!**  
Do not remove CB4 cartridge with any pressure in the BridgeKing® cylinder, or if the trailer is in mid-position.  
**SERIOUS INJURY OR DEATH CAN RESULT!**



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# BRIDGEKING<sup>®</sup> TRAILER SYSTEM

Bushing Maintenance

Trailer Axle

Charging the BridgeKing<sup>®</sup> Accumulator



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## PIVOT BUSHING MAINTENANCE

The BridgeKing® is fitted with 4 polyurethane bushings that are specially designed for performance and longevity. Maintain your bushings with a routine lubrication. Grease your bushings once a week to ensure proper performance and optimal life. Make sure to align the grease zerk & "O" in the polyurethane to ensure grease flow to the entire bushing.

Bushings are located at the chassis and BridgeKing® trailer, as well as both ends of your BridgeKing® cylinder.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

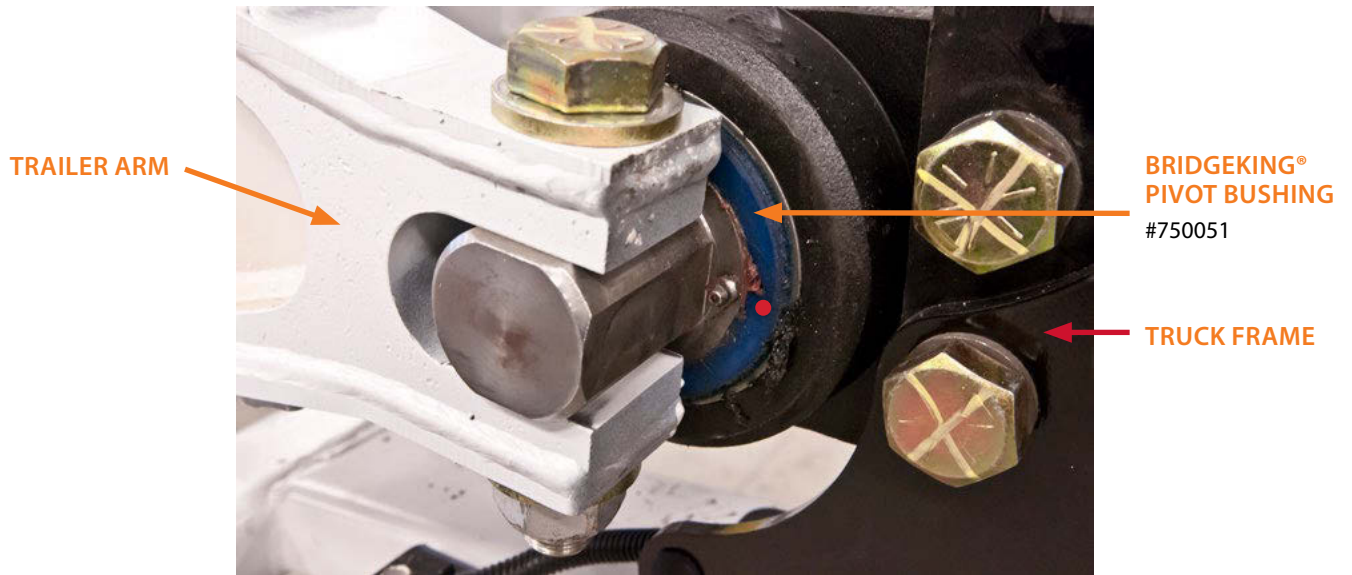
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# PIVOT BUSHING MAINTENANCE



Part # 750051



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## BRIDGEKING® TRAILER AXLE

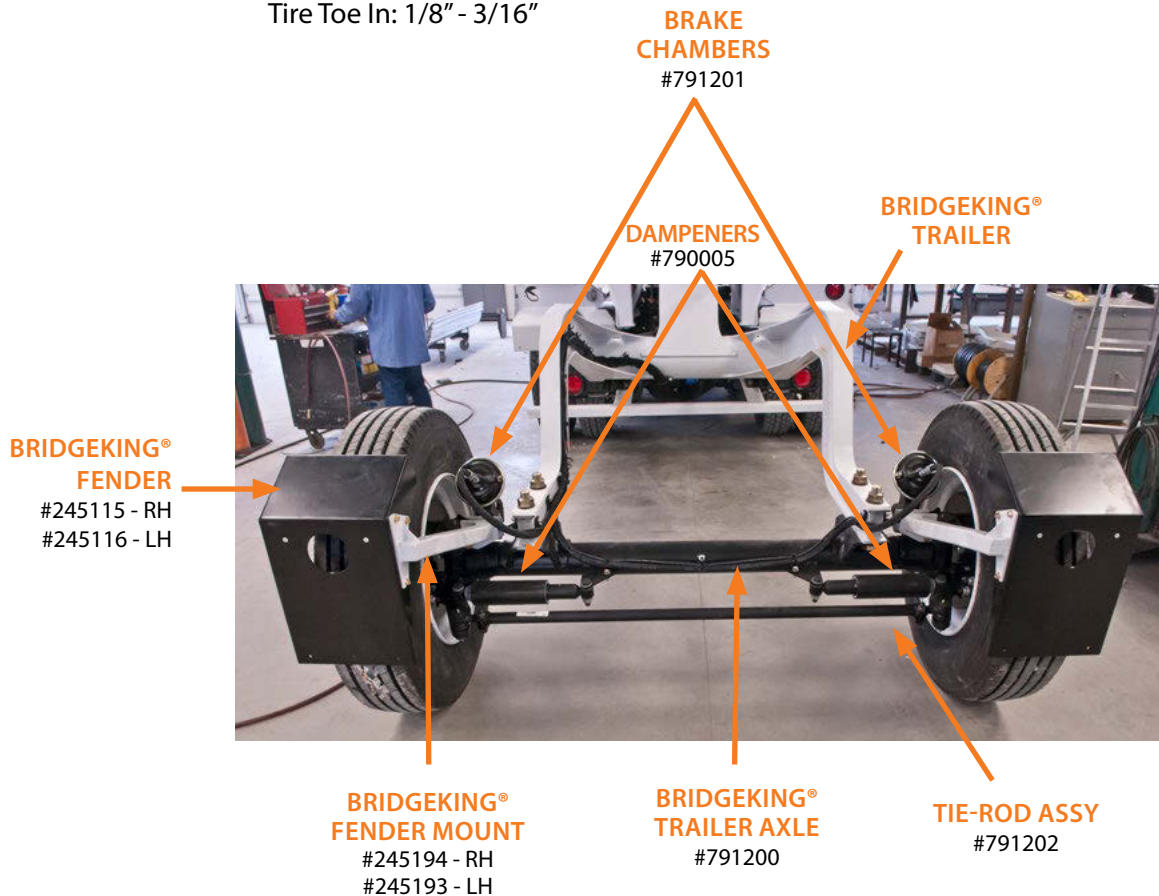
Con-Tech BridgeKing® trucks are fitted with a Hendrickson bridge axle. The function of the BridgeKing® axle is to increase the overall length of the truck from the front steer axle, to the bridge axle. This increases the GVW, in accordance with federal bridge laws.

For proper maintenance of your Hendrickson axle see the Hendrickson Installation and Preventative Maintenance Procedures at the end of this section.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**

Tire Toe In: 1/8" - 3/16"



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## BRIDGEKING® TRAILER AXLE

**BRIDGEKING®  
FENDER MOUNT**  
# 245194 - RH  
# 245193 - LH



**BRIDGEKING®  
TRAILER**

**BRIDGEKING®  
TRAILER AXLE**  
# 791200



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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# CHARGING THE BK ACCUMULATOR

## CLEANING

It is important to always maintain the BridgeKing® cylinder accumulator pressure. This should be checked every 60 days. It is normal for the accumulator to lose some of the nitrogen during normal use. Con-Tech offers a charge kit, Part #750005.

1. To charge the accumulator in the BridgeKing® cylinder you must adjust your PRV2 valve to the minimum and then lower the BridgeKing trailer. If the PRV2 is not at minimum, the trucks rear wheels can come off the ground, causing it to roll away. Always have your truck wheels blocked for safety.
2. When the trailer is lowered, turn off the engine. Turn the key back on and operate the Up/Down switch for the trailer to relieve the pressure in the BridgeKing system. Turn the key back off.
3. When the ignition is off, follow all OSHA Lockout / Tag Out procedures to prevent anyone from starting the truck and raising the trailer arm during the charge process.
4. When the truck is properly locked out, bring the nitrogen cylinder next to the chassis and charge the truck. Double check to make sure your charging bottles have more pressure than the cylinder. (If it does not, the nitrogen will flow back towards the bottle.) **Image A**
5. Clean and remove any concrete or dirt off of the area of the charging stem and remove the guard. **Image B**
6. Remove the accumulator charge stem cap. Do not lose this cap. It is needed to keep debris and contamination out of the charging stem. **Image C**
7. Before installation, make sure the accumulator charge system has the O-ring installed. Install the accumulator charge kit on to the BridgeKing® charge stem (finger tight)
8. The air in the charging hose must be purged before you charge the system. Slightly loosen the charge stem adaptor and turn on the nitrogen allowing the air to be pushed out. Re-tighten the stem adaptor finger tight. **Image D**



A



B



C



D



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## CHARGING THE BK ACCUMULATOR

9. Using a 3/4" wrench on the stem mounting nut, and another 3/4" wrench on the charge stem, carefully loosen the nut. Turn the nut one full rotation counterclockwise before the tapered seat begins to open. Turn the nut an additional 1/4 turn and read the gauge on the accumulator charge kit. The reading is the current pressure in the BridgeKing Accumulator. **Image E**
10. If the accumulator pressure is less than 1150 P.S.I., open the nitrogen bottle until the accumulator charge kit gauge reads 1150 psi. When this achieved, gently close the stem. Do not overtighten the stem. This may to the charge stem. **Image F**
11. After the charge stem is closed, check the seal with some soapy water for leaks. If the stem is not sealed properly, the soapy water will bubble. Replace the charge stem cap and guard.

**If you have any service issues,  
call Con-Tech Service at 507-374-2239.**

Please observe ALL OSHA Lockout / Tag Out procedures when performing any type of work or maintenance on your vehicles.



### **⚠ WARNING!**

**Driver/Operator of the BridgeKing® accumulator, the following safety guidelines must be followed:**

The cylinder rod must be extended (trailer on the ground) before the accumulator is charged.

NEVER stand behind the cylinder when charging the accumulator.

The hose on the Con-Tech accumulator charge kit is long enough to allow the accumulator to be charged from the side of the mixer.

**NEVER** attempt to disassemble the cylinder.

Use only Con-Tech Manufacturing **Part #750005 - Accumulator Charge Kit**

Purge air from the Accumulator Charge Kit hose by allowing a slight flow of nitrogen to escape while attaching the Accumulator Charge Kit to the Accumulator Charge Stem.

The truck ignition key should be removed while charging the accumulator.

Read these instructions thoroughly before attempting to charge the accumulator.

Loosen only the top nut of the accumulator charge stem. If the bottom nut is loosened, damage to the o-ring seal could result. All gas pressure must be released from the accumulator before the accumulator charge stem can be removed for service.



### **Con-Tech Accumulator Charge Kit**

**Part #750005**

If you have any questions or experience difficulty with the cylinder or charging the accumulator, please call Con-Tech Manufacturing at (507) 374-2239.



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# **H** TECHNICAL PROCEDURE

## CON-TECH BRIDGE AXLE

**SUBJECT:** Installation and Preventative  
Maintenance Procedures

**LIT NO:** H751

**DATE:** October 2013



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## INTRODUCTION

Why use a Bridge Axle? Hendrickson suspensions and axles carry countless loads of freight and raw materials off-road and over the highways. Bridge Axles lengthen the distance from front steer axle to increase the GVW, in accordance with federal bridge laws. Hendrickson Bridge Axles also reduce weight over standard booster axles and allow for increased payload.

The Hendrickson Bridge Axle also helps to meet U.S. Department of Transportation FHWA-HOP-06-105.

For further information, contact:  
U.S. Department of Transportation  
Federal Highway Administration  
Office of Freight Management and Operations  
Phone: 202-366-9210  
Fax: 202-366-3302  
Web site: [http://www.ops.fhwa.dot.gov/freight/publications/brdg\\_frm\\_wghts/](http://www.ops.fhwa.dot.gov/freight/publications/brdg_frm_wghts/)

The following instructions are intended for use with Hendrickson Bridge Axles.

**NOTE:** Read the entire installation instruction document thoroughly before proceeding with a suspension installation.

It is very important that the proper Bridge Axle is selected for the vehicle application. The following criteria must be considered when selecting a bridge axle:

- trailer and fender interface compatibility
- required capacity
- loaded caster
- tire size

For additional information concerning bridge axle selection, or other suspension models contact the Hendrickson Auxiliary Axle System's Customer Service Department.

**⚠ CAUTION:** The vehicle manufacturer should be consulted before making any changes to the vehicle's frame. Typically, vehicle manufacturers do not permit cutting or altering the vehicle and doing so could void any applicable manufacturer warranty coverage.

## SPECIAL NOTES

Non-functioning components are to be returned to Hendrickson Specialty Products - Auxiliary Axle

Systems, in exchange for replacement components, provided product warranty conditions are met.

Hendrickson auxiliary axles with factory installed axles may require toe setting adjustments. Also, check for sufficient wheel bearing lubrication (oil).

It is the responsibility of the installer to ensure that the vehicle will function properly under the increased weight conditions and loading that will exist when an additional axle is installed, particularly braking.

It is the responsibility of the installer to determine the correct location of the suspension in order to provide the proper vehicle load distribution. The load carried by each axle must not exceed the rated capacity of the components involved or the applicable State and Federal laws where the truck is to be operated.

It is the installer's responsibility to ensure that proper clearances exist:

- Between the trailing arms and bridge axle (if applicable)
- Around the tires—laterally, fore, aft, and vertically
- Around any moving components

No welding to any of the Bridge Axle components is permitted, except where specified by Hendrickson Specialty Products - Auxiliary Axle Systems.

No alteration of any of the Bridge Axle components is permitted.

Any installation deviations must be approved, in writing, by Hendrickson Specialty Products - Auxiliary Axle Systems Product Engineering Department. Failure to comply with these installation instructions without written permission will void the suspension warranty.

**⚠ CAUTION:** Subjecting aluminum components to certain acid washes may result in premature corrosion and warranty could be affected. It is recommended that you monitor which cleaning solvents are being used on your vehicle.

**⚠ CAUTION:** Acid washes also degrade the rubber, urethane and plastic parts or the axle assembly.



## REQUIRED EQUIPMENT AND MATERIALS FOR INSTALLATION

The following equipment and materials are needed when installing a Hendrickson Bridge Axle:

1. Trammel bar.
2. Crane or other lifting device.
3. Compressed air supply.
4. Air impact gun.
5. Air fittings, tubing and associated tools.
6. Socket set and wrenches, including the following sizes:
  - 1-5/16" - Tie Rod
  - 1-1/8" - Steering Knuckle & Stop Bolt
7. Angle measuring instrument (magnetic protractor) for self-steer axle.
8. Wheel chocks.
9. Frame jacks or supports.

## INSTALLATION INSTRUCTIONS

### SAFETY FIRST

Be sure to read and follow all installation and maintenance procedures.

### LIFTING

Practice safe lifting procedures. Consider size, shape and weight of assemblies. Obtain help or the assistance of a crane or lift truck when lifting heavy assemblies. Make sure the path of travel is clear.

### PARTS HANDLING

When handling parts, be sure to wear appropriate gloves, safety glasses and other safety equipment to prevent serious injury.

### UNPACK AXLE

Separate any kitted parts for use during installation.

## PRE-INSTALLATION CHECKLIST AND PROCEDURES

Before beginning the installation:

1. Check that the new axle matches the specifications provided by your Production or Engineering Department.
2. On all Bridge Axle applications:
  - a. Verify that the axle spacing conforms to Federal and local bridge laws.
  - b. Verify that the Bridge Axle location is based on: front axle steer angle, vehicle wheel-base and maximum recommended auxiliary axle spacing.
  - c. Verify that the vehicle will have the proper load distribution after installation.

**⚠ WARNING: ADEQUATE BRIDGE AXLE SUPPORT MUST BE PROVIDED. FAILURE TO PROVIDE ADEQUATE SUSPENSION SUPPORT COULD RESULT IN SUSPENSION DAMAGE AND/OR DAMAGE TO THE VEHICLE.**

4. Confirm that the components listed on the axle assembly drawing have been provided in sufficient quantities. Contact the Hendrickson Auxiliary Axle Customer Service Department if any components are missing or damaged.

## PRIOR TO INSTALLATION

### AXLE IDENTIFICATION

The serial number tag is an identification label attached to the suspension system. It contains a unique serial number and the model identification number for that specific axle. (Label is located on the rear center of the axle or side rail.)

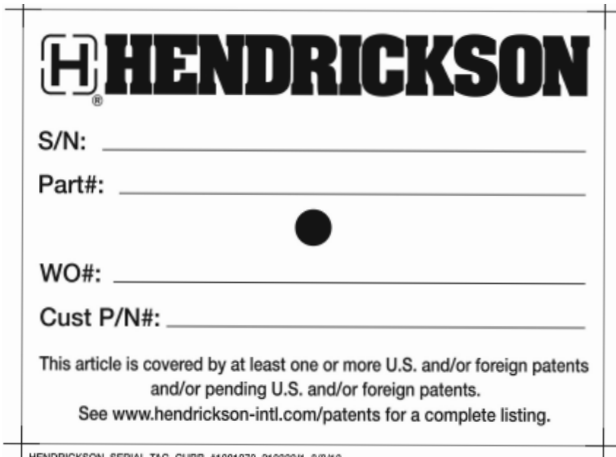


Figure 1. Serial Tag

## AXLE ADJUSTMENTS

### TOE SETTING

Toe is the relationship of the distance between the front of the tires and the distance between the rear of the tires on the same self-steer axle measured at spindle height. When the front distance is less than the rear distance, the wheels are in a “toe-in” condition. (See Figure 2)

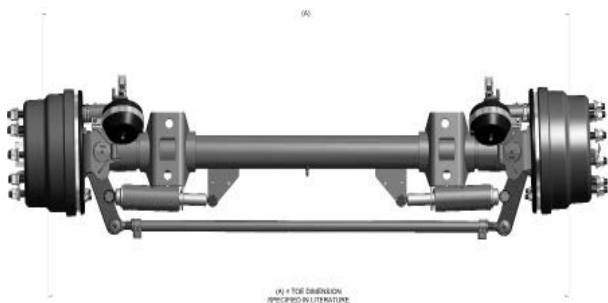


Figure 2. Determining TOE

1. Lift axle until tires are free to spin. Scribe a line on center tread of each tire while rotating tires.
2. Use a trammel bar or tape measure to measure the distance between the scribed lines on the front and rear of the tires at spindle height.

3. Loosen the tie rod clamp bolts. Rotate tie rod tube to provide a toe-in setting of 1/16” to 1/8” toe-in in the loaded condition.

**NOTE:** Setting toe on an Bridge Axle is often best performed in the unloaded state, off the ground. Confirm that the toe-in for the operating, loaded, condition has been achieved as it may differ between the unloaded and loaded state.

### TURN ANGLE - MECHANICAL STOP

A mechanical turn angle stop (bolt) is an adjustable fastener that limits the steer axle’s turn radius angle and allows users to avoid tire contact with vehicle accessories. Customer supplied axle(s) must have a turn angle stop. It is important that the stop is set so wheel interference does not occur.

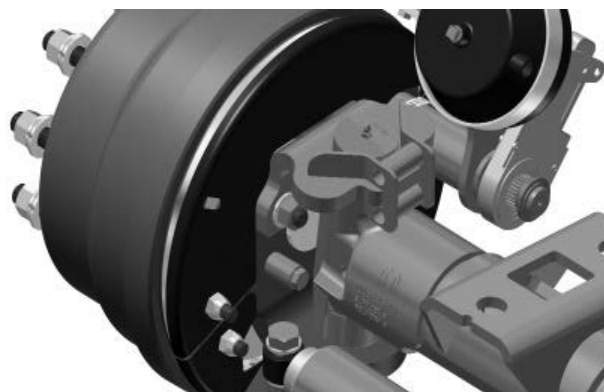


Figure 3. Axle Turn Limiting Stop Screw

1. Adjust the axle turn limiting stop screw for maximum turn angle (See Assembly Drawing) while providing adequate chassis clearance.
2. Torque the clamp bolts to Hendrickson Auxiliary Axle System’s recommended values.

**NOTE:** Factory setting of turn limiting screw varies.

## OPTIONS

### AXLE CONTROLS

When operating a truck in reverse (backing), a conventional Bridge Axle **must** be raised into a non-steering configuration. See [H] HAC Series Air Kit Literature for all options.

### MANUAL AND AUTOMATIC LIFT

An alternative method to locking the steering mechanism is to lift the suspension when reversing. Various manual and electric air control kits are available as options. Contact Customer Service for more details.



## FINAL ASSEMBLY

1. Install all miscellaneous hardware and torque the mounting bolts as per the chassis manufacturers specifications.
2. Install wheels and torque lug nuts.
3. Check that the steer axle wheel bearings are filled with oil by inspecting hub cap fill level.
4. Install air brake lines for the steer axle brakes, per the chassis manufacturer's specifications.
5. Inspect brakes and adjust if necessary.

**NOTE:** Suspensions purchased from Hendrickson Auxiliary Axle Systems require brake adjustment, even if supplied with automatic slack adjusters.

## FINAL INSPECTION

1. Check that all bolts are tightened to Hendrickson Auxiliary Axle System's recommended torque values. (See Appendix)
2. Check the air control system for leaks and propevalve function.
3. Move the Bridge Axle through its entire travel range including full wheel cut with wheels and tires installed to ensure adequate component clearances (i.e., fenders, brake chambers, etc.) have been provided.
4. Inspect the bridge axle for the following:
  - Wheels lug nuts are torqued.
  - Wheels rotate freely.
  - Brakes are properly adjusted.
  - Wheel hubs are sufficiently filled with the manufacturer's recommended lubricant.

## PREVENTATIVE MAINTENANCE

Regular lubrication intervals should be followed to help prevent premature wear to the kingpin bushings.

### GREASING AND LUBRICATION SPECIFICATIONS

COMPONENT	GREASING INTERVAL	GREASE
<b>KINGPIN BREAK IN</b>	5,000 miles or as needed	NLGI-1 or NLGI-2
<b>KINGPIN BUSHINGS</b>	10,000 miles or every 6 months	NLGI-1 or NLGI-2

## KINGPIN LUBRICATION

On the Hendrickson Bridge Axle, the kingpin grease fittings are located on the top and bottom of the kingpin.

1. Prior to greasing the kingpins on the vehicle the suspension must be in a loaded condition.
2. Clean off all the grease fittings with a clean shop towel prior to lubrication.
3. Lubricate the kingpins through the grease fittings on the top and bottom of the steering knuckle.
4. Force the required lubricant into the upper and lower kingpin grease fittings until new lubricant flows from locations A and B. (See Figure 4)

**NOTE:** Greasing at the lower zerk should purge grease from the thrust bearing shell.

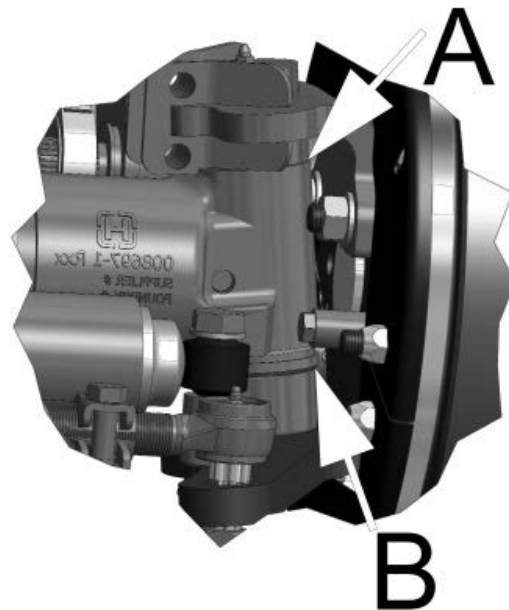


Figure 4. Kingpin Lubrication

## KINGPIN BUSHING INSPECTION INSPECTION PROCEDURE

1. Chock the wheels to help prevent the vehicle from moving. Set the parking brake.
2. Raise the axle off the ground.

### CHECKING THE UPPER KINGPIN BUSHING

3. Affix a magnetic base dial indicator on the axle and place the tip of the dial indicator on the inside of the upper kingpin connection as shown in Figure 5.

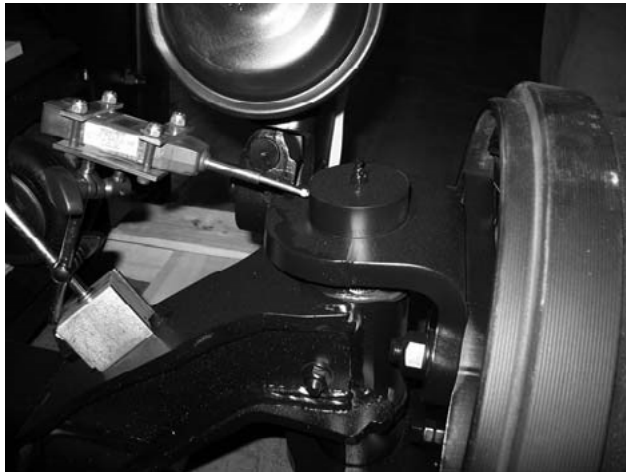


Figure 5. Upper Kingpin Bushing Check

4. Set the dial indicator to "0" zero.
5. Move the top of the tire in and out by applying reasonable, constant pressure and then releasing.
6. Check the reading on the dial indicator. If the dial indicator moves more than 0.025", the upper bushing is worn or damaged. Replace both bushings. Refer to the Kingpin Bushing Removal and Installation sections in this publication.

### CHECKING THE LOWER KINGPIN BUSHING

7. Install a dial indicator so that the base is on the axle and the indicator tip is against the inside of the bottom of the knuckle.
8. Set the dial indicator to "0" zero.

**IMPORTANT:** If one bushing is worn or damaged, it is mandatory to replace both the top and bottom bushings on that knuckle assembly.

## STEERING KNUCKLE INSPECTION AND ADJUSTMENT

### CHECKING VERTICAL END PLAY (UP AND DOWN MOVEMENT)

1. Chock the tires to help prevent the vehicle from moving.
2. Set the parking brake.
3. Raise the axle off the ground.
4. If necessary, remove the wheels, hubs and drums.
5. Place a dial indicator on each side of the axle as follows:
  - a. Ensure wheels are positioned straight ahead.
  - b. Place the magnetic dial indicator base on the axle.
  - c. Place the tip of the dial indicator on top of the upper kingpin connection.
6. Place a jack and a wood block (with a hole that allows clearance for the lower kingpin grease fitting) under the lower kingpin grease cap area. (See Figure 6)
7. Set the dial indicator to "0" zero.



Figure 6 Vertical End Play Checking

8. Raise the jack until the dial indicator shows the end of vertical travel. Measure and record the dial indicator reading. Vertical (up and down) inspection clearance must be between 0.008" and 0.030".

## ADJUSTING VERTICAL END PLAY

1. If vertical clearance is greater than 0.030", replace the thrust bearing.
2. After replacing the thrust bearing, if vertical clearance is greater than 0.018", install shims (Hendrickson part no. R-001764-1Q12) between the top of the axle and the bottom of the upper kingpin connection to obtain the proper clearance specification. See the Steering Knuckle Disassembly section.
3. If vertical clearance is less than 0.008", remove the shims from between the top of the axle and the bottom of the upper kingpin connection to obtain the proper clearance specification.
4. Repeat steps 2 or 3 until proper clearance is achieved.
5. Lower the jack.

## STEERING KNUCKLE DISASSEMBLY

1. Remove the wheel and hub assembly.
2. Remove the brake components from the steering knuckle.
3. Remove the tie rod assembly. (See Figure 7)

**⚠ WARNING: REMOVAL OF TIE ROD BOLTS ALLOWS SHOCKS TO FULLY EXTEND**

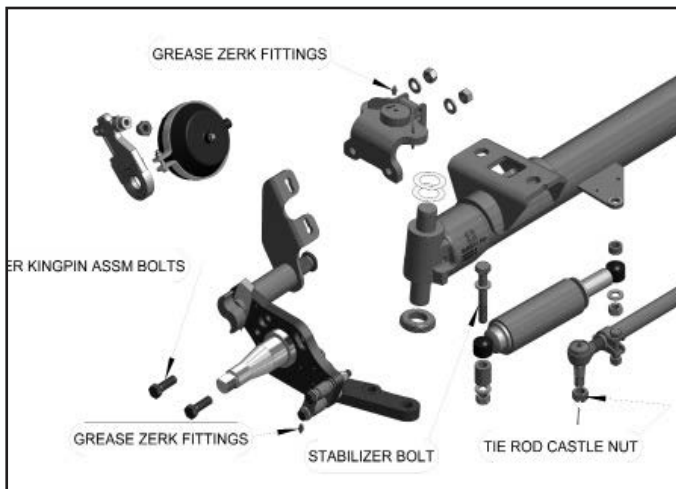


Figure 7 Knuckle Disassembly

4. Remove the stabilizer bolts.
5. Remove the bolts that connect upper kingpin assembly to the backbone.

**⚠ WARNING: REMOVAL OF THE BOLTS WILL ALLOW THE BACKBONE TO SEPARATE FROM THE AXLE WHICH CAN RESULT IN COMPONENT DAMAGE AND/OR PERSONAL INJURY. BACKBONE MUST BE SUPPORTED BEFORE REMOVAL OF THE TWO BOLTS.**

**HINT:** Remove the grease zerks from the knuckle assemblies. This will allow the knuckle assemblies to freely slide up and down the kingpins without creating back pressure.

5. Remove the backbone from the kingpin by sliding it down the kingpin.
6. Remove the upper kingpin assembly from the axle by sliding it up and off the kingpin.

## KINGPIN PREPARATION AND MEASUREMENT

### CLEANING THE GROUND OR POLISHED PARTS

- Use a cleaning solvent to clean ground or polished parts and surfaces. DO NOT USE GASOLINE.

**⚠ CAUTION: Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to the parts will result.**

### CLEANING THE ROUGH PARTS

- Rough parts can be cleaned with the ground or polished parts. Rough parts can also be cleaned in hot solution tanks with a weak alkaline solution. The parts must remain in the hot solution tanks until they are completely cleaned and heated.

### DRYING THE CLEANED PARTS

- Parts must be dried immediately after cleaning. Dry the parts with clean paper towels, clean rags or compressed air. Do not dry bearings by spinning with compressed air. Damage to the bearings will result.





## PREVENTING CORROSION ON CLEANED PARTS

- Apply a light coating of oil to all cleaned and dried parts that are going to be reused. Do not apply oil to the brake lining or the brake drums. If parts are to be stored, apply an effective rust inhibitor to all surfaces.

**⚠ WARNING: TO HELP PREVENT SERIOUS EYE INJURY, ALWAYS WEAR PROPER EYE PROTECTION WHEN YOU PERFORM VEHICLE MAINTENANCE OR SERVICE.**

**⚠ WARNING: SOLVENT CLEANERS CAN BE FLAMMABLE, POISONOUS AND CAUSE BURNS. TO HELP AVOID SERIOUS PERSONAL INJURY, CAREFULLY FOLLOW THE MANUFACTURER'S PRODUCT INSTRUCTIONS/GUIDELINES AND THE FOLLOWING PROCEDURES:**

1. WEAR PROPER EYE PROTECTION.
2. WEAR PROTECTIVE CLOTHING.
3. WORK IN A WELL-VENTILATED AREA.
4. DO NOT USE GASOLINE, SOLVENTS OR OTHER MATERIALS THAT CONTAIN GASOLINE THAT CAN EXPLODE.
5. HOT SOLUTION TANKS OR ALKALINE SOLUTIONS MUST BE USED CORRECTLY. FOLLOW THE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND GUIDELINES CAREFULLY TO HELP PREVENT PERSONAL ACCIDENT OR INJURY.

1. Prepare and polish the kingpin by removing all grease and excess debris using a fine grit (220 grit or higher) emery cloth and parts solvent. (See Figures 8 through 11)



Figure 8.



Figure 9.



Figure 10. Dirty Kingpin



Figure 11. Kingpin After Cleaning



2. Inspect the kingpin for wear or damage. Use a micrometer and measure the upper and lower kingpin in two locations. Positions must be 90 degrees (perpendicular) from each other. (See Figures 12 through 15) If the kingpin diameter is less than 1.802", kingpin replacement may be necessary. Contact the Hendrickson Customer Service Department at 800-660-2843.



Figure 12.

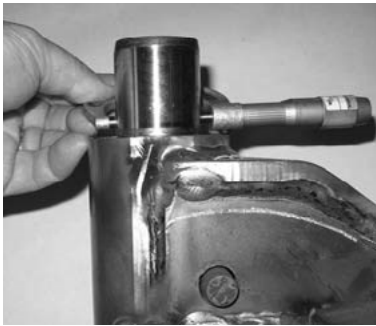


Figure 13.



Figure 14.



Figure 15.

## FABRICATED KNUCKLE KINGPIN BUSHING INSTALLATION

1. A hydraulic press with a minimum forcing capacity of 5 tons will be required.

**⚠ WARNING: BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SET-UP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY AND/OR COMPONENT DAMAGE.**

2. Install the backbone assembly or upper kingpin connection in the press.
3. Remove worn kingpin bushing housing
4. Install the new kingpin housing from the machined side (axle side) of the backbone ensuring squareness between the housing and the backbone.



Figure 16.



Figure 17.



## BRIDGE AXLE (BA) AND TIE ROD STRUCTURAL INSPECTION

Periodic inspection of the Bridge Axle and tie rod are strongly recommended. Cleaning the BA and tie rod prior to the inspection will improve the ability to see all structural component condition.

Contact Hendrickson Auxiliary Axle Customer Service for replacement parts or parts kits (800) 660-2843.

## ROUND TUBE TIE ROD ADJUSTMENT

In order for a steerable suspension system to steer or track correctly, it is necessary for the wheels to be in a "toe-in" condition. Toe is the difference between the foremost and rearmost point on the tires at spindle height. When the foremost distance is less than the rearmost distance, the wheel pair is said to have toe-in. Toe not only affects tire wear, but also straight-line stability and corner handling. Having a proper toe setting is important for directional stability. On steerable axles, the toe is pre-set during assembly, however sometimes it becomes necessary to adjust the toe. It is also necessary to verify the toe upon axle installation. For additional information regarding toe settings or lift axle systems, please contact the Hendrickson Customer Service Department at 800-660-2829.

To adjust the toe setting, follow these instructions.

### DETERMINING THE TOE SETTING

**⚠ WARNING: NEVER PERFORM MAINTENANCE ON A SUSPENSION WITHOUT FIRST RELEASING AIR PRESSURE FROM AIR SPRINGS. COMPONENT DAMAGE, INJURY OR DEATH CAN OTHERWISE RESULT.**

1. Lift axle until tires are free to spin.
2. Support the suspension with jack stands.
3. Scribe a line on center tread of each tire while rotating tires.
4. Use a trammel bar or tape measure to measure the distance between the scribed lines on the front side of the tires at spindle height.
5. Use a trammel bar or tape measure to measure

the distance between the scribed lines on the back side of the tires at spindle height.

6. Subtract the distance between the front side and back side of the tires. This is the toe setting. Toe Setting = Rear Distance - Front Distance
7. If the toe setting is set in between 1/16" and 1/8", for a standard tie rod, no adjustment is required. If the toe setting is set in more or less than the 1/16" to 1/8" range, refer to the Adjusting the Toe Setting section of this publication as adjustment is necessary.

### ADJUSTING THE TOE SETTING

1. Loosen the tie rod clamp bolts, stabilizer mounting u-bolts (if applicable) and nuts.
2. Rotate tie rod tube to provide a toe-in setting of 1/16" to 1/8".
3. Torque the clamp bolts to 50 ft-lbs.

### STEERING KNUCKLE ASSEMBLY

After replacing the kingpin housings, it is necessary to reassemble the steering knuckle assemblies.

1. Install the thrust bearing on the lower kingpin, so the top side is up (the thrust bearing may be stamped "TOP" or the black seal will designate the top side), when the axle is in the operating position.
2. Pack the bearing dimples with multipurpose grease (NLGI Grade 2).
3. Install the backbone assembly on the kingpin. It will be necessary to support the backbone assembly with a bottle jack and a block of wood under the backbone assembly. (See Figure 18)

**Hint:** The easiest way to install the knuckle is with the zerk grease fitting not installed in the backbone assemblies. In this manner, it does not create back pressure. The assembly can then freely slide up and down on the kingpin.

4. Raise the bottle jack so that there is no free play between the backbone, thrust bearing and the bottom of the axle.
5. Install the upper kingpin connection on the upper kingpin. (See Figure 18)

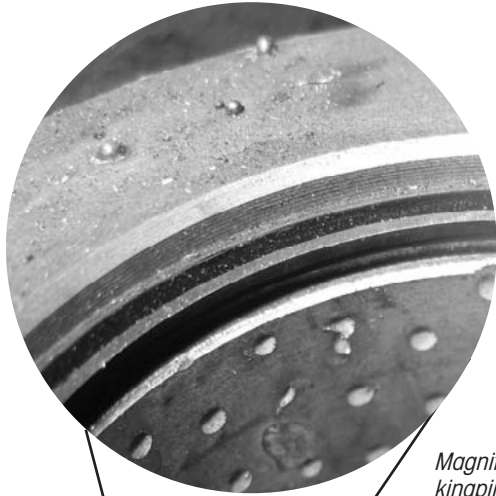


Figure 18.

Magnification of kingpin bushing and lip seal installed in steering knuckle.

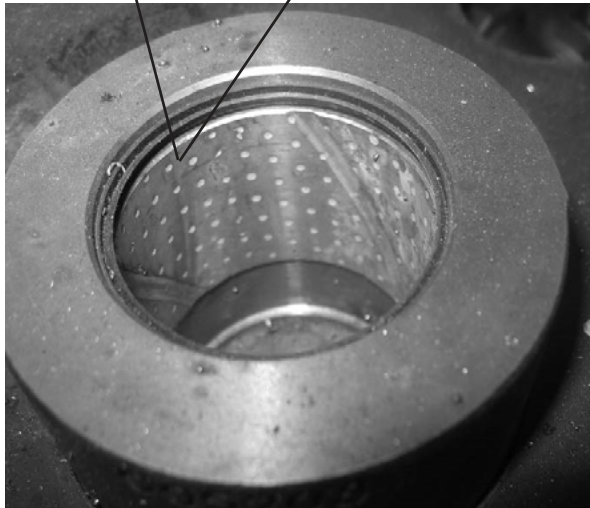


Figure 19.

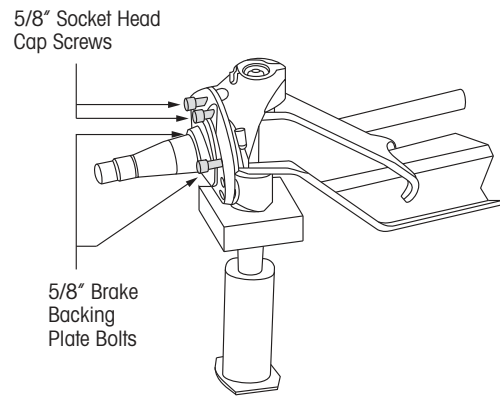


Figure 20.

**NOTE:** Two guide studs may be substituted in place of the brake backing plate bolts.

6. Install the two new 3/4" - 10 x 2.25" Grade 8 HEX bolts and secure with washer and nuts to finger tight.
7. Apply slight upward pressure on the upper kingpin connection.
8. Insert feeler gauges between the upper kingpin connection and the top of the axle. Check the clearance between the upper kingpin connection and the top of the axle. (See Figure 21)
9. Remove the brake backing plate bolts and socket head cap screws. (See Figure 20)
10. Remove the upper kingpin connection.
11. Install the appropriate amount of shims to achieve 0.008" to 0.018" clearance between the upper kingpin connection and the top of the axle.

**EXAMPLE:** If 0.050" clearance were measured, 0.040" shims would be required to obtain the required 0.008" to 0.018" clearance.



Figure 21.



12. Install the upper kingpin connection onto the kingpin.
13. Slide two 0.010" feeler gauges on each side of the kingpin between the axle and the upper kingpin connection.

**⚠ WARNING: PRIOR TO INSTALLATION ENSURE THAT ALL RESIDUAL LOCTITE MATERIAL IS REMOVED FROM THE MOUNTING BOLTS AND THE THREADED HOLES IN THE UPPER KINGPIN CONNECTION, AND NEW LOCTITE 277 OR EQUIVALENT IS APPLIED TO HELP ENSURE THAT THE BOLTS SUSTAIN THE PROPER TORQUE REQUIREMENT. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.**

14. Install the hex head bolts and tighten to 175-200 ft-lbs torque.

**NOTE:** The Hendrickson Genuine Part 3/4-10 x 2-1/2 GRADE 8 HEX bolt (PN: R-6110C125H4H8). Apply LocTite.

15. Once the final torque of the hex nuts has been obtained, remove the two 0.010" feeler gauges and lower the bottle jack.

### Vertical End Play

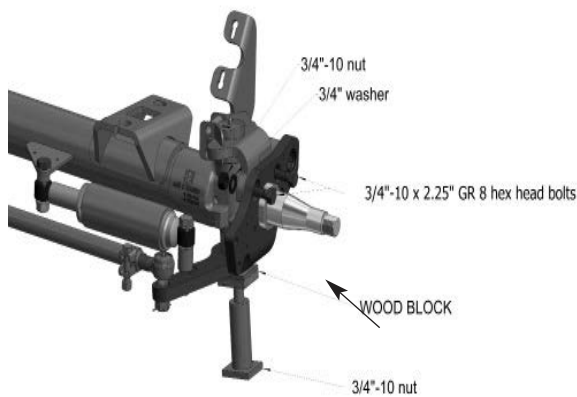


Figure 22.

16. Affix a magnetic base dial indicator on the axle and place the tip of the dial indicator on top of the upper kingpin connection. (See Figure 22)
17. Zero the dial indicator.

18. Raise the bottle jack until there is no clearance between the backbone and the bottom of the axle.
  19. Check the reading on the dial indicator. The specification for vertical travel on the steering knuckle assemblies is 0.008" to 0.018".
  20. If the clearance is not within the required specification, repeat steps 3 through 9 until the proper clearance is obtained by adding or removing shims.
  21. If the vertical travel is not within the specification, repeat steps 3 through 16 until the proper vertical travel is obtained.
  22. Remove the bottle jack to remove the load off the knuckle assembly and continue assembling the wheel ends.
  23. Install the tie rod cross tube into the tie rod arm.
  24. Tighten the castle nuts to 185 ft-lbs torque, then rotate the castle nut to the next castle slot and install the cotter pin.
  25. Tighten bolts to 140-160 ft-lbs torque.
- NOTE:** LocTite applied to knuckle assembly bolts is a critical procedure to ensure that these bolts sustain the torque requirement of the kingpin connection.
26. Install new o-rings on the grease caps and lubricate the o-rings with grease.
  27. Install zerk grease fittings and new retaining rings.




## APPENDIX A RECOMMENDED BOLT TORQUES

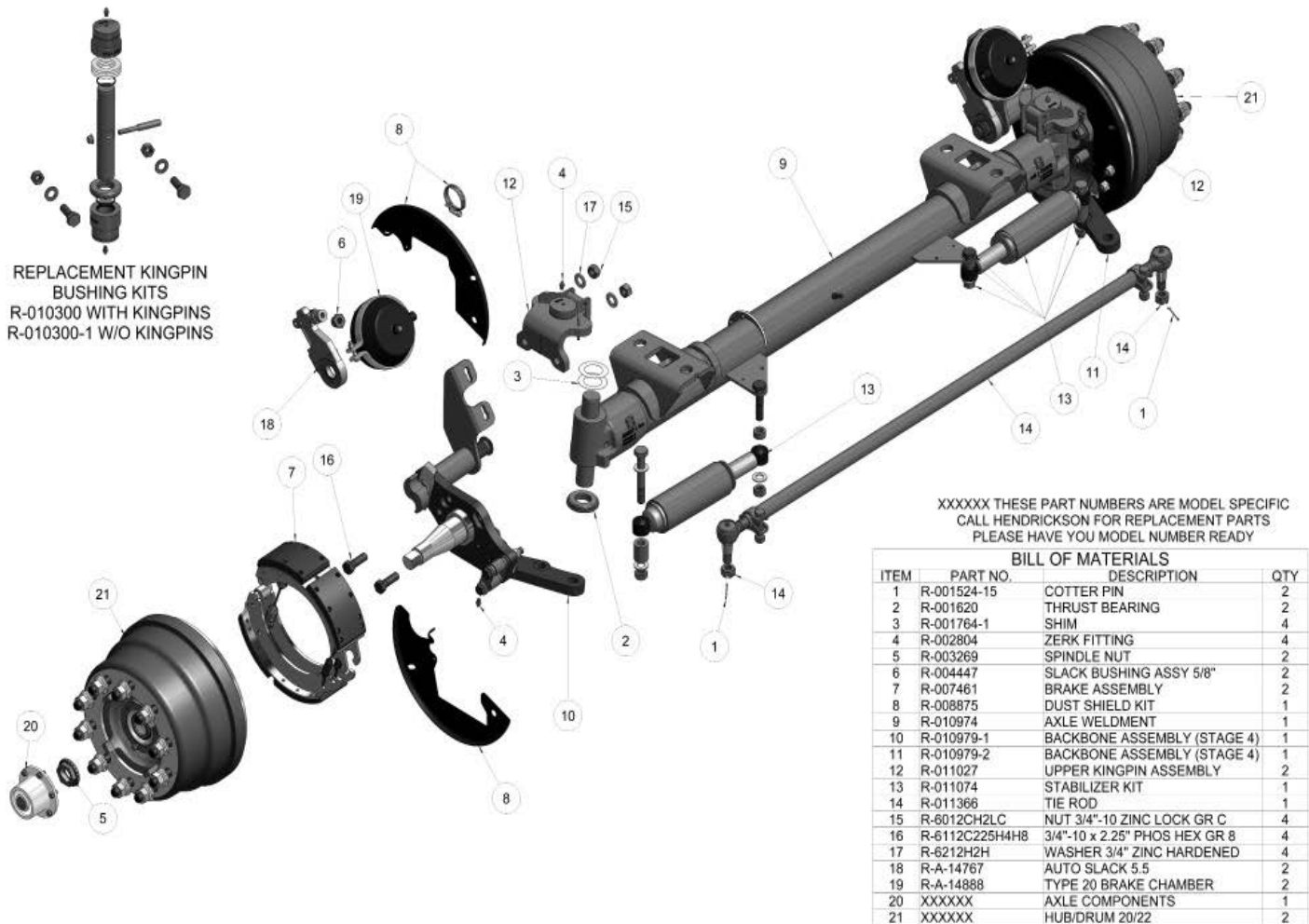
Refer to table below for bolt torque values.

For more information on torque values, refer to MacLean Vehicle Systems literature, *Axilok Uniized Wheel Bearing Nut System: Installation and Removal Procedures*.

TORQUE TABLE			
Item	Part Number	Quantity	Torque
Stabilizer nut	6112C350H4H8	2	80-120 ft. lbs.
Stabilizer bolt	6112C550H4H8	2	
Tie rod castle nut	Included in tie rod end	2	180 ft. lbs.
Knuckle main nut	6012CH2LC	4	250-300 ft. lbs.
Knuckle main bolt	6112C225H4H8	4	
Brake anchor pin nut	6010CH2LC	2	160-200 ft. lbs.
Brake anchor pin bolt	6110C500H4H8	2	
Brake chamber mounting nut	Included in brake chamber	4	130-150 ft. lbs.
Jam nut	Included in brake chamber	2	33-90 ft. lbs



REPLACEMENT KINGPIN  
BUSHING KITS  
R-010300 WITH KINGPINS  
R-010300-1 W/O KINGPINS



XXXXXX THESE PART NUMBERS ARE MODEL SPECIFIC  
CALL HENDRICKSON FOR REPLACEMENT PARTS  
PLEASE HAVE YOU MODEL NUMBER READY

ITEM	PART NO.	DESCRIPTION	QTY
1	R-001524-15	COTTER PIN	2
2	R-001620	THRUST BEARING	2
3	R-001764-1	SHIM	4
4	R-002804	ZERK FITTING	4
5	R-003269	SPINDLE NUT	2
6	R-004447	SLACK BUSHING ASSY 5/8"	2
7	R-007461	BRAKE ASSEMBLY	2
8	R-008875	DUST SHIELD KIT	1
9	R-010974	AXLE WELDMENT	1
10	R-010979-1	BACKBONE ASSEMBLY (STAGE 4)	1
11	R-010979-2	BACKBONE ASSEMBLY (STAGE 4)	1
12	R-011027	UPPER KINGPIN ASSEMBLY	2
13	R-011074	STABILIZER KIT	1
14	R-011366	TIE ROD	1
15	R-6012CH2LC	NUT 3/4"-10 ZINC LOCK GR C	4
16	R-6112C225H4H8	3/4"-10 x 2.25" PHOS HEX GR 8	4
17	R-6212H2H	WASHER 3/4" ZINC HARDENED	4
18	R-A-14767	AUTO SLACK 5.5	2
19	R-A-14888	TYPE 20 BRAKE CHAMBER	2
20	XXXXXX	AXLE COMPONENTS	1
21	XXXXXX	HUB/DRUM 20/22	2



## APPENDIX B BRAKE REPLACEMENT

**⚠ WARNING: ADEQUATE SUSPENSION SUPPORT MUST BE PROVIDED! FAILURE TO PROVIDE ADEQUATE SUSPENSION SUPPORT COULD RESULT IN SERIOUS BODILY HARM OR FATAL INJURY. EYE PROTECTION STRONGLY RECOMMENDED**

For replacement brake kits, contact the Hendrickson Customer Service Department at (800) 660-2843

1. Raise and support the suspension to which the brakes are to be replaced. Remove wheel, brake drum and axle end components to expose the brake shoes.
2. Remove the outer retaining spring and inner retaining spring.

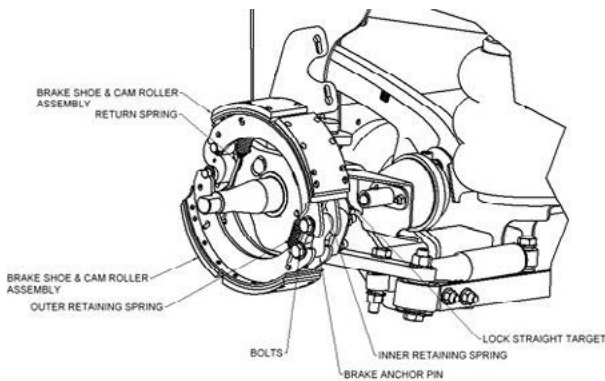


Figure 27. Removal of Outer and Inner Retaining Spring

3. Support the lower brake shoe assembly and remove the return spring. Set parts aside and remove the upper brake shoe.



Figure 28. Removal of Return Spring

4. Remove the brake bolts and brake anchor pin. If lock straight target is present, note position for proper reassembly location.



Figure 29. Removal of Brake Bolts and Anchor Pin

5. Replacement brake kit for each specific axle will have the necessary parts to be replaced. Discard worn or damaged parts. If a part is not included in the kit, contact customer service (800) 660-2843.
6. Install new parts in reverse order from step 4. Brake bolts through the anchor pin are to be installed with a torque of 160 ft-lbs.

When reinstalling the spring, be sure the spring is completely clipped into the mounting hole. Failure to do so could result in brake failure.





# SERVICE REPLACEMENT BRAKE CHAMBERS

TYPE 16

CATALOG  
02-E-01

## TYPE 16 2 1/4" STROKE



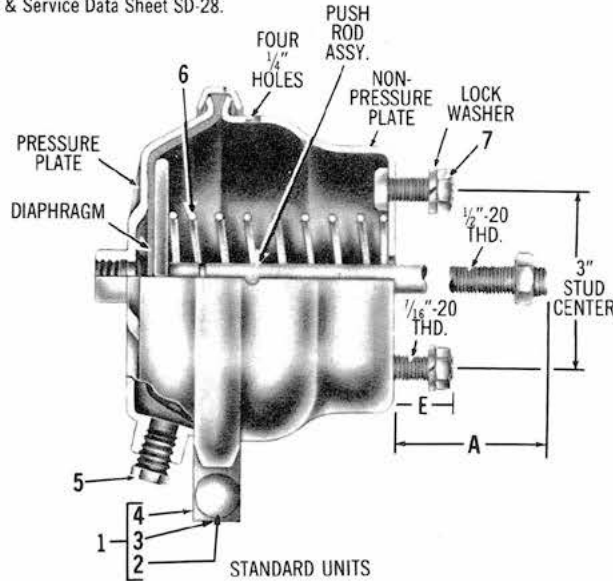
### SERVICE CHAMBERS:

- (1) Have long threaded Push Rod that may be cut to length.
- (2) Do not include Yoke.

SEE CONVERSION LIST ON BACK OF PAGE

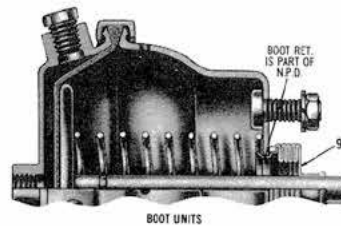
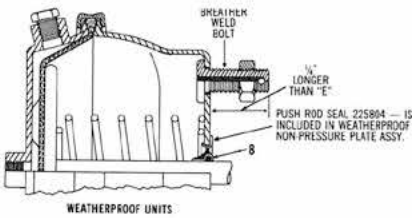
A Brake Chamber is an actuator which converts the energy of air pressure into a mechanical force. Brake Chambers are available in nine sizes, providing a wide range of output forces and strokes. The type of chamber indicates the diaphragm's effective area (Type 30 = 30 sq. in. effective area).

For further information regarding installation and maintenance, consult Instruction & Service Data Sheet SD-28.



### REFERENCE DETAILS

No.	Pc. No.	Quan.	Description
<b>STANDARD UNITS</b>			
1	282825	1	Clamp Ring Assy.
2	246926	2	Clamp Ring
3	249573	2	Nut
4	242386	2	Bolt
5	230111	1	Pipe Plug, 1/4"
6	234192	1	Spring
7	214526	2	Nut
<b>WEATHERPROOF UNITS</b>			
Add:			
8	212264	1	Grommet
<b>BOOT UNITS</b>			
Add:			
9	239506	1	Boot



### SPRING LOAD

SPRING	LOAD AT 0" STROKE (LBS.)	LOAD INCREASE PER INCH OF STROKE (LBS.)
PC. NO. 234192	20	9.5
240298	55	18.5

YOKES, SPRINGS, DIAPHRAGMS & BOOTS SHOWN ON CATALOG 02-J-1

TYPE 16 SERVICE BRAKE CHAMBER PC. NO.	PUSH ROD ASSY. PC. NO.	YOKE ASSY. PC. NO.	YOKE LOCK NUT PC. NO.	LOCK WASHER (2 REQ'D.) PC. NO.	NON-PRESSURE PLATE PC. NO.	DIAPHRAGM PC. NO.	A ROD END TO PLATE	E STUD END TO PLATE	M INLET PORT SIZE	PRESSURE PLATE PC. NO.	INLET LOCATION	FEATURES	
<b>STANDARD TYPE UNITS</b>													
A 275531	275427	NONE	204781	NONE	275428	234189-R	3.00	1.00	1/4"	225735	SIDE	5/8" PUSH ROD	
B 287350	225272	NONE	201438	202984	275165	234189-R	2.50	1.00	3/8"	287283	CENTER	HEAVY SPRING	
	287595	226067	205948	201438	202984	281344	234189-R	2.75	2.12	3/8"	287223	SIDE	LONG MTG. BOLTS
	286808	224724	NONE	201438	NONE	225945	236665-N	9.00	1.00	1/4"	225735	CENTER	NEOPRENE DIAPHRAGM
	288799	224724	NONE	201438	202984	226083	234189-R	9.00	1.50	3/8"	287284	C & S	STD. UNIT
<b>WEATHERPROOF TYPE UNITS</b>													
	228911	229965	NONE	NONE	202984	225952	236665-N	3.00	1.00	1/4"	225735	SIDE	NEOPRENE DIAPHRAGM
	287685	225042	205948	201438	NONE	226906	234189-R	8.50	—	3/8"	287283	CENTER	STUD MOUNTING
	287686	275088	NONE	NONE	NONE	275090	234189-R	2.12	—	3/8"	287283	SIDE	STUD MOUNTING
	288800	224724	NONE	201438	202984	225952	234189-R	9.00	1.00	3/8"	287284	C & S	STD. W. P. UNIT
<b>BOOT TYPE UNITS</b>													
	275164	225272	NONE	201438	202984	275165	234189-R	2.50	1.00	1/4"	225735	CENTER	HVY. SPRING
	288801	224724	NONE	201438	202984	229213	234189-R	9.00	2.50	3/8"	287284	C & S	STD. BOOT UNIT
	288802	224724	NONE	201438	202984	229213	236665-N	9.00	2.50	3/8"	287284	C & S	NEOPRENE DIAPHRAGM

A-PUSH ROD FOR THIS CHAMBER IS 5/8" DIA.  
B-SUBSTITUTE SPRING, 240298 FOR ITEM 6.

N-NEOPRENE  
R-RUBBER

BRAKE CHAMBERS NOT AVAILABLE  
IN REMANUFACTURED EXCHANGE.

**TYPE 16 BRAKE CHAMBER CONVERSION LIST**

ORIG. EQUIP. PC. NO.	SERVICE REPLACEMENT	
	SERVICE CHAMBER PC. NO.	YOKE ASSY. PC. NO.
<b>STANDARD UNITS</b>		
225924	288799	NONE
226055	288799	205948
226212	288799	NONE
226213	288799	NONE
226214	288799	NONE
226215	288799	NONE
226477	288799	205948
226677	288799	NONE
226702	288799	205948
226714	288799	205948
226892	288799	205948
227154	288799	NONE
227859	286808	205948
227949	288799	205948
228052	288799	205948
228237	288799	205433
228423	288799	NONE
229469	288799	205948
229511	288799	NONE
229683	288799	NONE
229745	288799	202797
229760	288799	202797
275072	288799	NONE
275074	288799	NONE
275075	288799	NONE
275426	275531	275429
275531	275531	NONE
275367	288799	NONE
276690	287595	NONE
280411	288799	NONE
281261	288799	205948
281342	287595	205948
281343	288799	205948
282804	288799	205948

ORIG. EQUIP. PC. NO.	SERVICE REPLACEMENT	
	SERVICE CHAMBER PC. NO.	YOKE ASSY. PC. NO.
<b>STANDARD UNITS</b>		
284845	288799	202797
286808	286808	NONE
286852	288799	NONE
287222	288799	202797
287350	287350	NONE
287352	288799	205948
287574	288799	NONE
287575	288799	NONE
287576	288799	NONE
287577	288799	NONE
287578	288799	205948
287579	288799	NONE
287580	288799	202797
287581	288799	NONE
287582	288799	NONE
287583	288799	205433
287584	288799	NONE
287585	288799	205948
287586	288799	NONE
287587	288799	NONE
287588	288799	202797
287589	288799	202797
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287591	288799	NONE
287592	288799	NONE
287593	288799	NONE
287594	288799	NONE
287595	287595	205948
287596	288799	205948
287597	288799	205948
287598	288799	205948
287775	288799	NONE
288096	288799	205948

ORIG. EQUIP. PC. NO.	SERVICE REPLACEMENT	
	SERVICE CHAMBER PC. NO.	YOKE ASSY. PC. NO.
<b>WEATHERPROOF UNITS</b>		
225938	288800	205948
226118	288800	205948
226665	288800	NONE
226673	288800	NONE
226805	287685	205948
226806	288800	205433
227923	288800	205948
228911	228911	NONE
228958	288800	NONE
229840	288800	NONE
275086	287686	NONE
276407	288800	NONE
279514	288800	205948
282473	288800	NONE
287614	288800	205948
287615	288800	NONE
287616	288800	205433
287617	288800	205948
287618	288800	NONE
287619	288800	NONE
287685	287685	205948
287686	287686	NONE
287692	288800	NONE
287736	288800	NONE
287737	288800	202797

ORIG. EQUIP. PC. NO.	SERVICE REPLACEMENT	
	SERVICE CHAMBER PC. NO.	YOKE ASSY. PC. NO.
<b>BOOT UNITS</b>		
229278	288801	205948
229284	288801	NONE
229288	288801	NONE
229293	288801	205948
229299	288802	228802
229980	288801	205948
275164	275164	NONE
279826	288801	205948
279851	288801	205948
280478	288801	205948
287682	288801	NONE
287683	288802	228802
287684	288801	205948
287741	288801	205948
288232	288801	205948

## Bendix® LQ-5™ Bobtail Ratio Valve

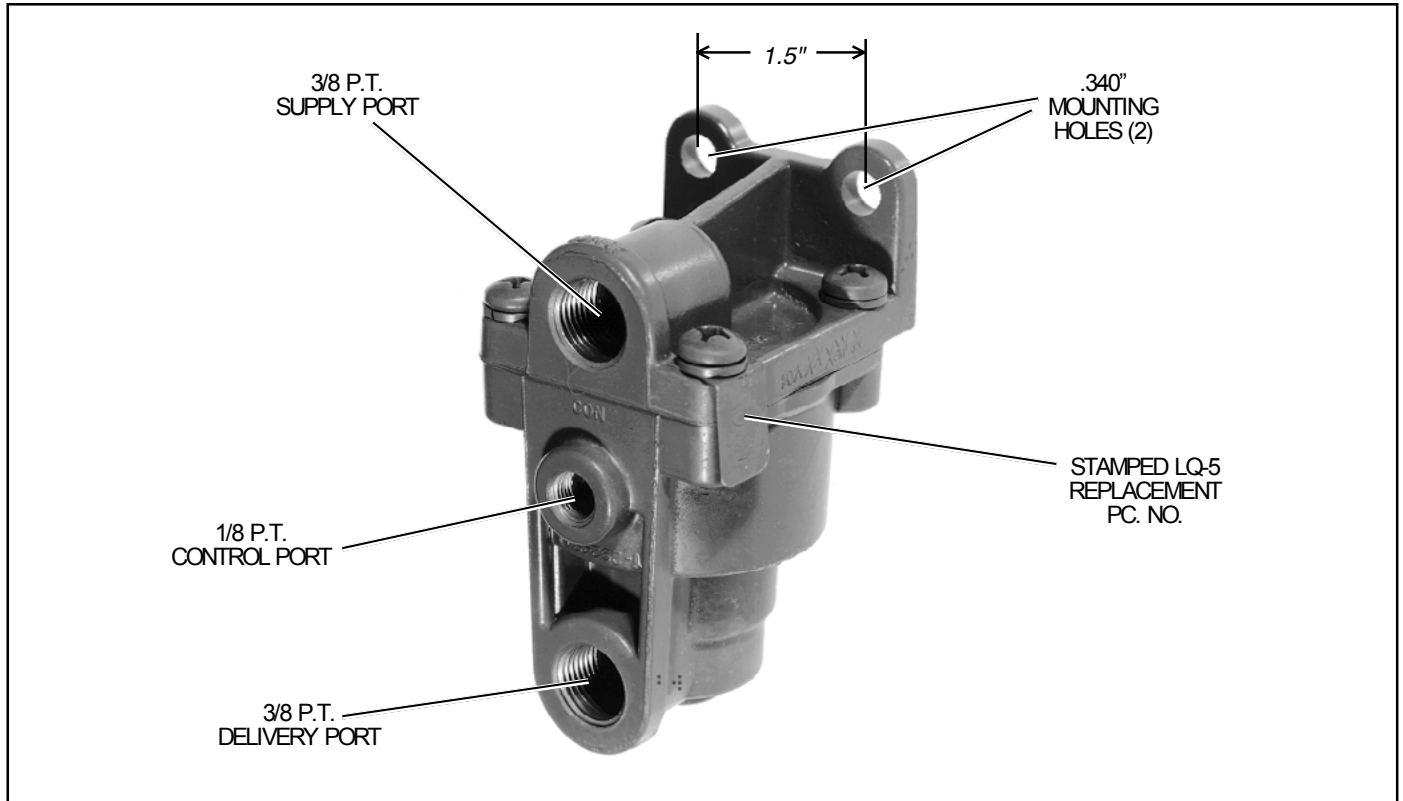


FIGURE 1 - LQ-5™ BOBTAIL RATIO VALVE

### DESCRIPTION

The LQ-5™ bobtail ratio valve is used on the front (steering) axle of tractor air brake systems to reduce brake application pressure during normal tractor-trailer operation. It is designed for tractor systems only and replaces the existing front axle limiting valve. It is not to be used on straight trucks or towing trucks. Also, a quick release valve must be installed between the LQ-5™ valve delivery and the brake chambers.

**IMPORTANT:** Do not replace the BP-1™ front brake proportioning valve with the LQ-5™ valve. The LQ-5™ valve will not function properly in the BP-1™ valve system.

**Caution:** The LQ-5™ valve can replace the LQ-4™ ratio valve on tractors. The LQ-5™ valve control port must be connected to the trailer supply line. When the tractor is disconnected from the trailer, bobtail tractor braking performance is improved because full brake valve pressure will be applied to the steering axle brakes.

Although it is not mandatory, the LQ-5™ valve is used in conjunction with the BP-R1™ bobtail brake proportioning relay valve, only when a customer specifies a front axle ratio valve. The BP-R1™ valve and LQ-5™ valve combine to reduce stopping distance and improve tractor control in bobtail mode. (For more information on the BP-R1™ valve, see SD-03-1067.)

### OPERATION

#### GENERAL

After an initial delivery, the LQ-5™ valve limits front axle brake pressure during normal tractor-trailer operation. The LQ-5™ valve has two spring-loaded pistons: a blend back piston and a proportioning piston. The “stepped” proportioning piston determines actual air pressure reduction and the blend back piston allows the valve’s delivery pressure to “blend back” and reach a 1:1 ratio during high pressure brake applications.

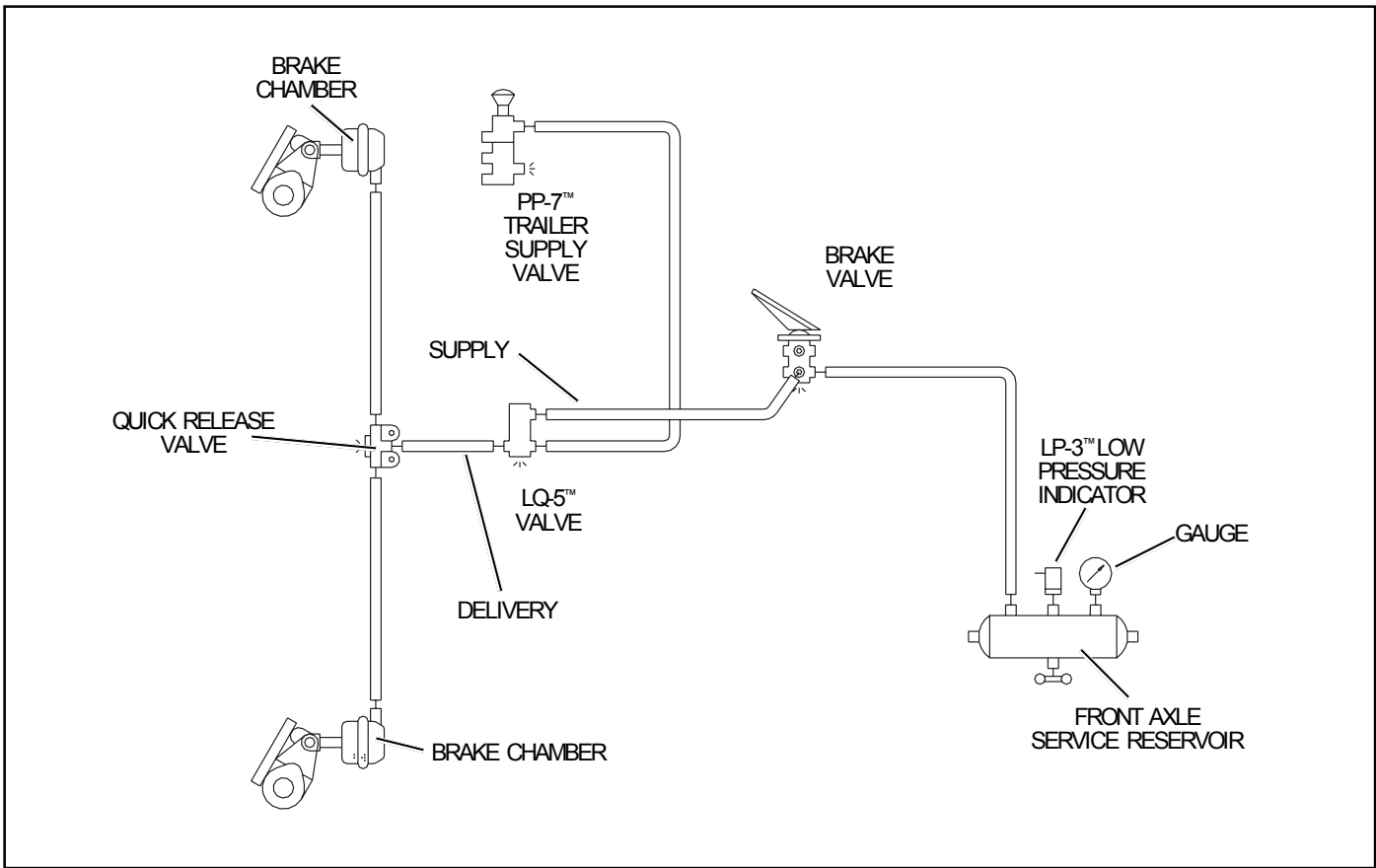


FIGURE 2 - LQ-5™ BOBTAIL RATIO VALVE INSTALLATION

The LQ-5™ valve also allows full service pressure to pass through it when the trailer supply valve (red octagonal button) is pulled out—when the tractor is running in bobtail mode.

**Note:** LQ-5™ valve control pressure, which comes from the trailer supply line, will vary. As a result, the LQ-5™ valve delivery and blend back ranges will also vary, because the blend back piston works against control pressure. Figure 3 shows the LQ-5™ valve delivery range at two control pressures: 90 psi and 120 psi.

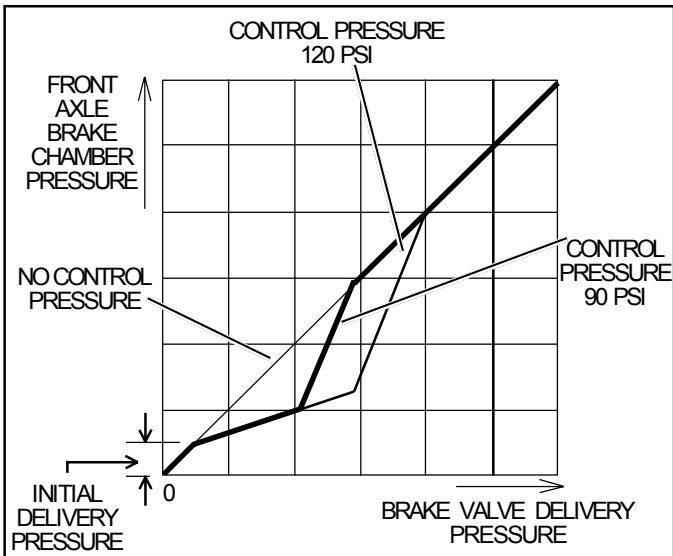


FIGURE 3 - LQ-5™ BOBTAIL RATIO VALVE PERFORMANCE CURVE

## TRACTOR-TRAILER MODE

### Brake Application—LQ-5™ Valve Limiting

During tractor-trailer operation, the trailer supply valve (red octagonal button) is depressed and delivers air pressure simultaneously to the trailer and to the LQ-5™ valve control port. Air pressure enters the LQ-5™ valve control port and displaces the blend back piston, against the resistance of its spring, until the piston contacts the cover.

Control pressure holds the blend back piston against the cover and the “initial delivery” spring forces the proportioning piston to its seat in the body, which opens the inlet. The “initial delivery” pressure is designed to ensure that the brake linings contact the brake drums before proportioning occurs. The exhaust valve is sealed due to its spring. Brake valve air pressure enters the supply port, moves through the center of the pistons, around the inlet/exhaust valve, and out to the front axle actuators.

Air pressure being delivered to the brake actuators is also present beneath the proportioning piston. Because the area on the delivery side of the proportioning piston is larger than that on the supply side, the delivery side needs less air pressure to apply the same force.

Therefore after the initial delivery pressure, the LQ-5™ valve delivers less air pressure to the front axle than it receives from the brake valve.

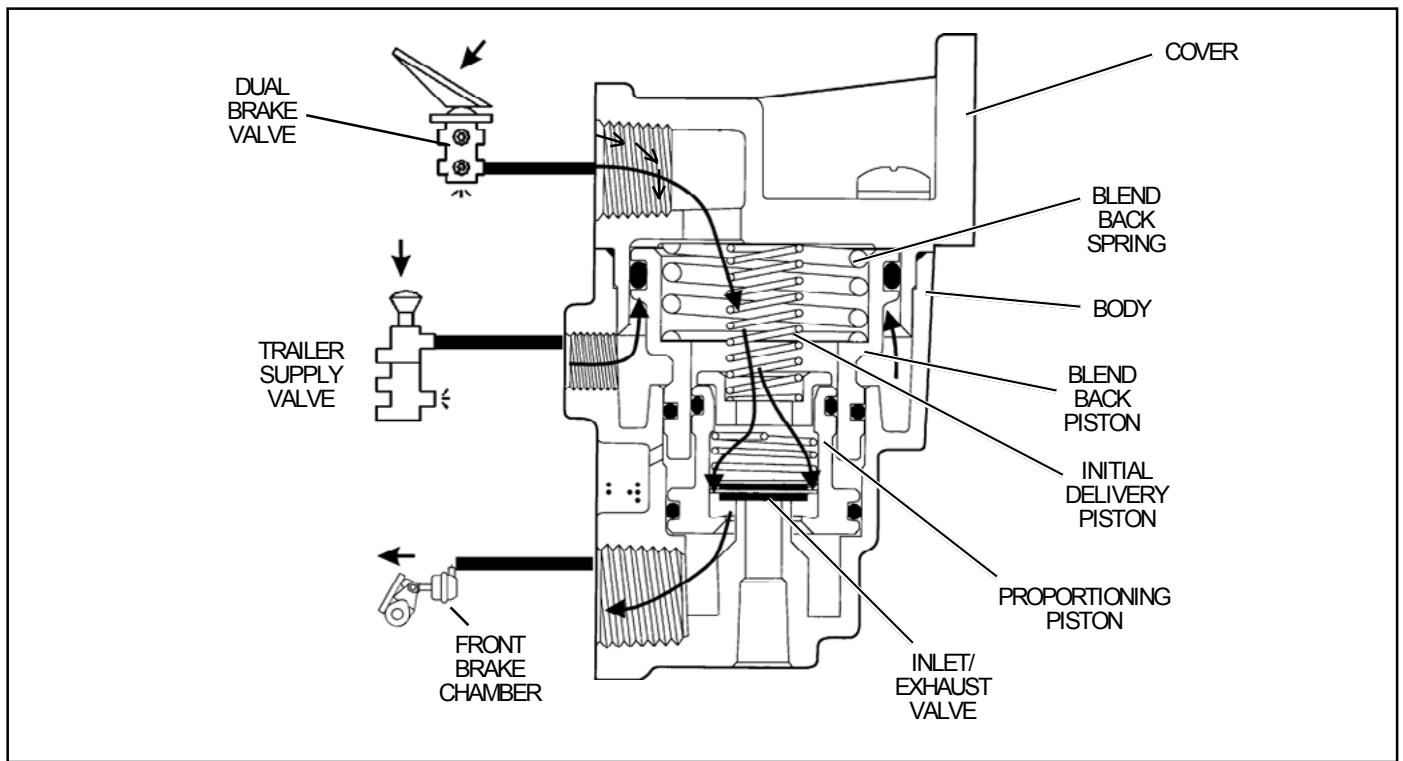


FIGURE 4 - LQ-5™ BOBTAIL RATIO VALVE LIMITING: TRACTOR-TRAILER MODE (SHOWN DURING INITIAL DELIVERY)

### BALANCED BRAKE VALVE APPLICATION - LQ-5™ VALVE HOLDING

The forces acting on the proportioning piston are equal when air pressure beneath the piston is approximately one-half of that above. (For example, if a 40 psi brake application is made, approximately 20 psi would be present beneath the proportioning piston.) At this point, the proportioning piston lifts and closes the inlet. The exhaust passage remains sealed. With both the inlet and exhaust valves closed, the LQ-5™ valve is balanced—front axle air pressure is neither increasing nor decreasing.

### BRAKE VALVE RELEASE

Upon brake valve release, air pressure above the blend back piston returns to the brake valve and exhausts. Air pressure from the delivery line lifts the proportioning piston and inlet/exhaust valve away from the exhaust seat in the body. Air then flows out the open exhaust passage. Air from the actuators exhausts through the quick release valve. (See Figure 2.)

If the service brakes are rapidly released, air pressure may lift the inlet/exhaust valve further against the relatively light resistance of the valve spring. Air would then also flow back through the open inlet and out to the brake valve.

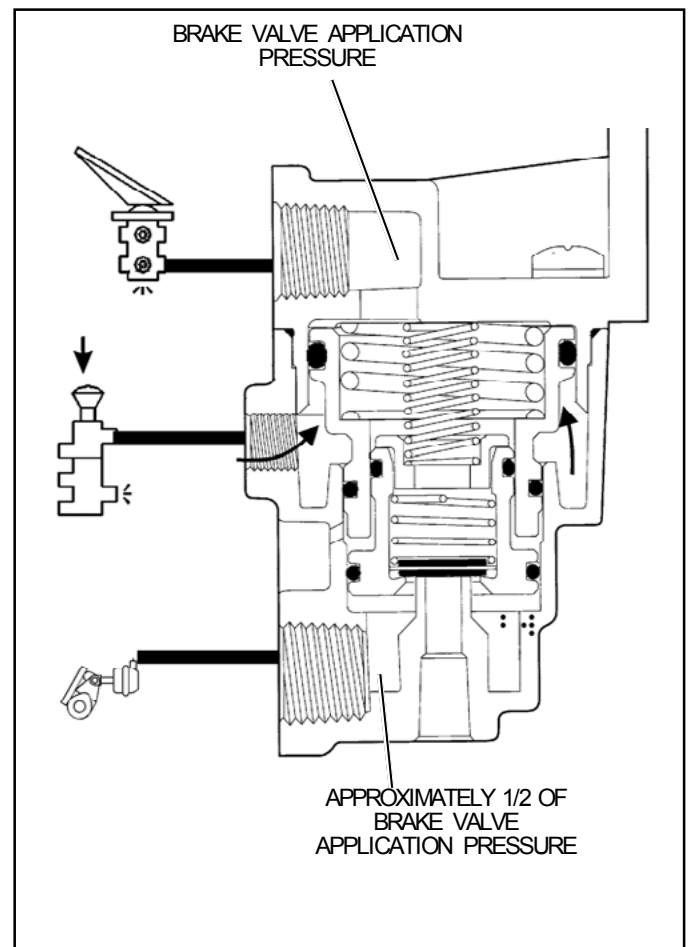
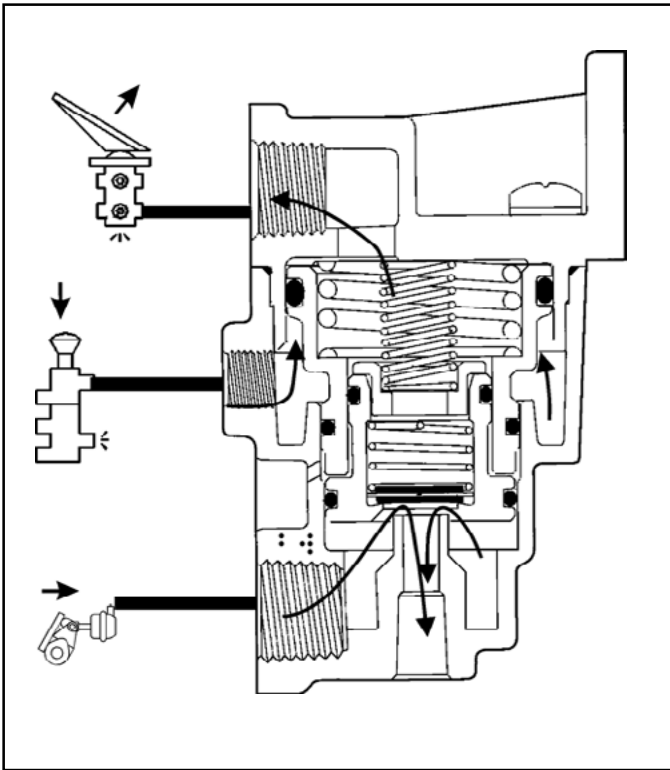
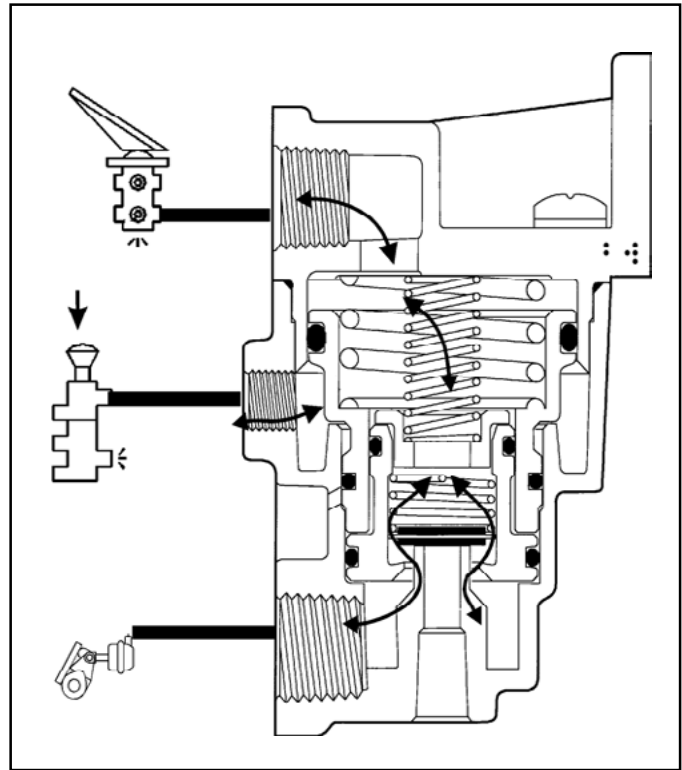


FIGURE 5 - LQ-5™ BOBTAIL RATIO VALVE HOLDING: TRACTOR-TRAILER MODE



**FIGURE 6 - LQ-5™ BOBTAIL RATIO VALVE RELEASING: TRACTOR-TRAILER MODE**

When air pressure beneath the proportioning piston depletes to less than approximately 8 psi, the valve spring is able to seat the exhaust valve. The “initial delivery” spring keeps the inlet open and allows air from the LQ-5™ valve delivery to flow through the valve, out the supply and back to the brake valve.



**FIGURE 8 - LQ-5™ BOBTAIL RATIO VALVE MODE**

**BRAKE APPLICATION—LQ-5™ VALVE BLENDING BACK**

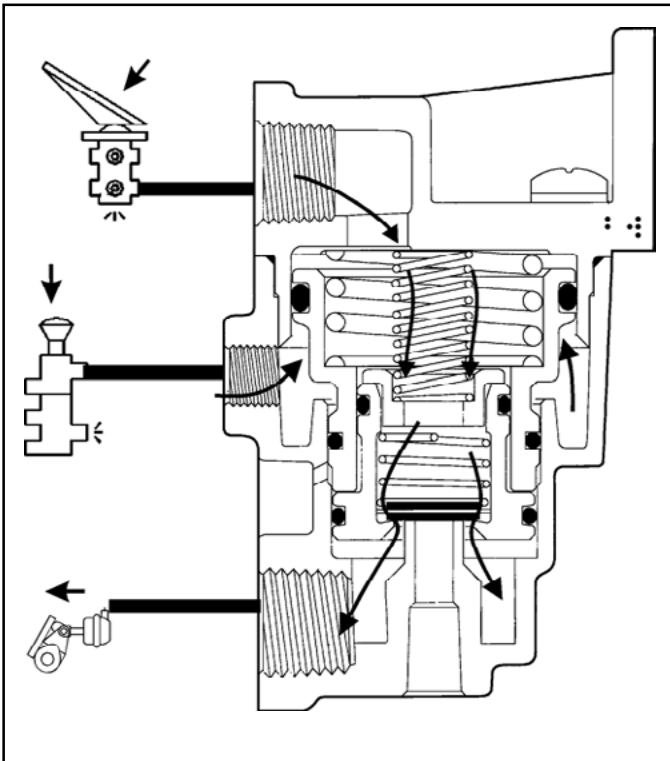
Service brake pressure enters the LQ-5™ valve supply port and combines with the force of the blend back spring to work against control pressure. When service pressure is sufficiently high (see Figure 3), the total downward force begins to overcome the upward force of control pressure on the blend back piston. The blend back piston is forced into contact with the proportioning piston. Both pistons now move as one. Because of the added surface area of the blend back piston, LQ-5™ valve delivery pressure “catches up” as supply pressure increases. When the piston assembly contacts its seat in the body, the LQ-5™ valve delivers full application pressure. There is then a 1:1 ratio between supply and delivery.

**BOBTAIL MODE**

**BRAKE VALVE APPLICATION, BALANCE, RELEASE**

When the trailer supply valve is pulled out, air in the LQ-5™ valve control port flows back to the trailer supply valve and exhausts to atmosphere. With no control pressure, the blend back piston is forced by its spring to contact the proportioning piston. The inlet/exhaust valve is held by its spring and seals the exhaust passage. Both pistons, now moving as one, reach their stop in the body.

This is the position for bobtail mode apply, hold and release. The LQ-5™ valve delivers full service application pressure in



**FIGURE 7 - LQ-5™ BOBTAIL RATIO VALVE BLENDING BACK: TRACTOR-TRAILER MODE**

bobtail mode. Upon brake valve release, delivery air pressure flows back through the LQ-5™ valve, to the brake valve and out to atmosphere. Air from the actuators exhausts through the quick release valve.

**WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:**

When working on or around a vehicle, the following general precautions should be observed at all times.

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.
2. Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.
3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning **ANY** work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.
9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.

## PREVENTIVE MAINTENANCE

### GENERAL

Perform the following tests and inspections at the prescribed intervals. If the LQ-5™ valve fails to function as described or if leakage is excessive, repair the valve or replace it with a new or genuine Bendix remanufactured unit, available at any authorized parts outlet.

**Important:** Review the Bendix Warranty Policy before performing any intrusive maintenance procedures. A warranty may be voided if intrusive maintenance is performed during the warranty period.

No two vehicles operate under identical conditions, as a result, maintenance intervals may vary. Experience is a valuable guide in determining the best maintenance interval for air brake system components. At a minimum, the valve should be inspected every 6 months or 1500 operating hours, whichever comes first, for proper operation. Should the valve not meet the elements of the operational tests noted in this document, further investigation and service of the valve may be required.

### OPERATION & LEAKAGE TESTS

#### OPERATION TEST

To properly test the LQ-5™ valve, use a pair of test gauges or gauges of known accuracy.

1. With the trailer supply valve pushed in (tractor-trailer mode), install two air gauges in the front axle service system: one between the brake valve and the LQ-5™ valve and one at a front axle actuator.
2. Build system pressure to governor cut-out setting.
3. Make a service brake application with the foot valve and have someone observe the gauges. When the gauge between the foot valve and the LQ-5™ valve reaches 40 psi, the actuator gauge should read approximately 20 psi ( $\pm 5$  psi).
4. Make a full service brake application. Both gauges should read the same pressure.
5. With the trailer supply valve pulled out (bobtail mode), make a 30-40 psi service brake application. Both gauges should read the same pressure.
6. Remove the test gauges.

#### LEAKAGE TEST

1. Build system pressure to governor cut-out. With the trailer supply valve pushed in (tractor-trailer mode), apply a soap solution to the LQ-5™ valve exhaust port. The leakage should not exceed a 1" bubble in less than 3 seconds.

2. Make and hold a full brake application and apply a soap solution to the exhaust port and around the cover where it joins the body. The leakage should not exceed a 1" bubble in less than 3 seconds.

### VALVE REMOVAL

1. Secure the vehicle on a level surface by means other than the brakes.
2. Drain air system completely, making sure all reservoirs are at atmospheric pressure.
3. Identify and mark all air lines and their respective connections on the valve.
4. Disconnect all air lines.
5. Remove the valve from the vehicle.

### VALVE INSTALLATION

If the vehicle has a front axle ratio or limiting valve (such as the Bendix® LQ-4™ valve), it can be replaced with an LQ-5™ valve. The LQ-5™ valve control port must be connected to the trailer supply line. Also, a quick release valve must be installed between the LQ-5™ valve delivery and the brake chambers.

1. Install all air line fittings making certain thread sealing material does not enter the valve.
2. Mount the assembled valve on the vehicle with the exhaust pointing down.
3. Reconnect all air lines to the valve using the identification made during *Valve Removal*, Step 3.
4. After installing the LQ-5™ valve, test all air fittings for excessive leakage and tighten as needed.

### DISASSEMBLY

The following disassembly and assembly procedures are for reference only. Always have the appropriate maintenance kit on hand and use its instructions in lieu of those presented here. Refer to Figure 9 throughout the procedures.

**Caution:** The LQ-5™ valve may be lightly clamped in a bench vise, but overclamping will damage the valve and cause leakage and/or malfunction. If a vise is used, clamp around the supply port and the mounting surface.

1. Remove all air fittings from the valve.
2. Before removing the four Phillips head screws that secure the cover to the body, mark the relationship between cover and body.
3. Remove and retain the screws and the metal tag with the LQ-5™ valve piece number on it. Separate cover from body. Remove and discard o-ring (1).

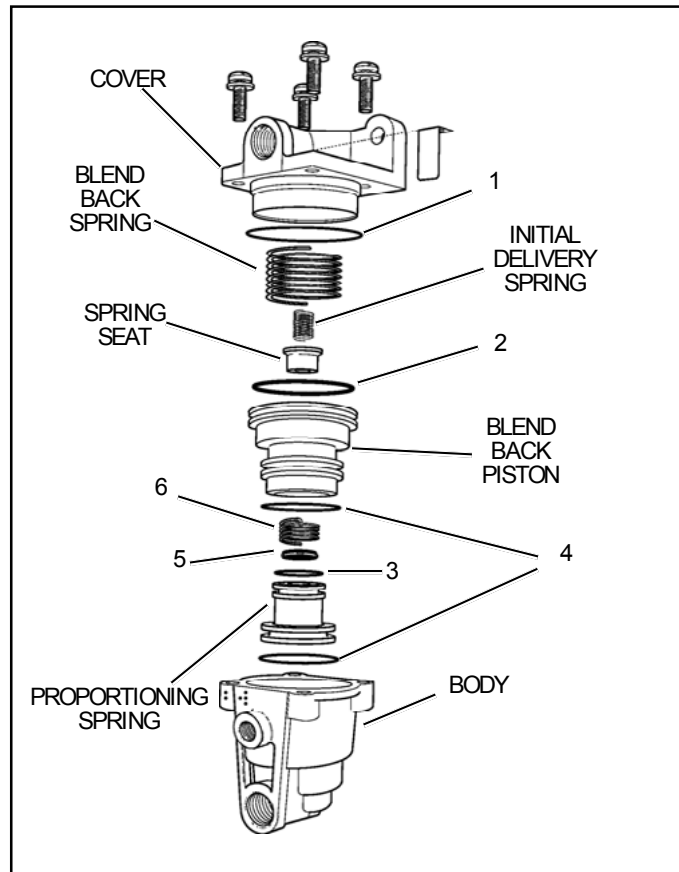


FIGURE 9 - LQ-5™ BOBTAIL RATIO VALVE

4. Remove the blend back and proportioning pistons from the body.
5. Separate and retain the pistons. Remove and retain the spring seat from the proportioning piston.
6. With a pair of needle nose pliers, grasp the end of the valve spring (6) inside the proportioning piston. Remove the spring by pulling and turning clockwise. Discard the spring.
7. Remove and discard inlet/exhaust valve (5) from proportioning piston.
8. Remove and discard o-rings (2), (3), (4) from the pistons.

### CLEANING & INSPECTION

1. Clean all metal parts with mineral spirits or an equivalent solvent.
2. Thoroughly dry all metal parts.
3. Inspect interior and exterior of all metal parts that will be reused for severe corrosion, pitting or cracks. Superficial corrosion and/or pitting on the exterior of the body or cover is acceptable. Replace entire valve if interior of body or cover shows signs of corrosion or pitting.
4. Inspect body and cover bores for deep scuffing or gouges. Replace entire valve if either is found.



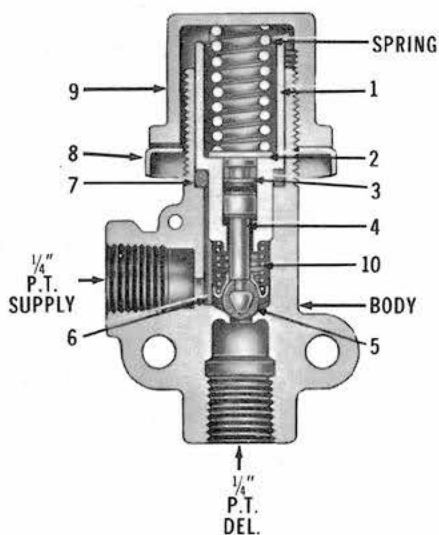
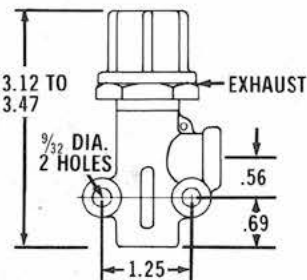
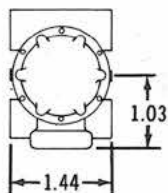
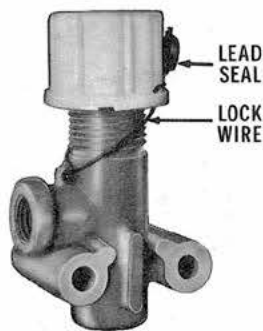
5. Make certain all air channels are clear and free of obstruction.
6. Inspect all pipe threads and make sure they are clean and free of thread sealant.
7. Inspect all air line fittings for corrosion and replace as necessary.
4. Insert the proportioning piston into the small bore of the blend back piston and install the piston assembly in the body.
5. Install spring seat into the piston assembly bore, small end first.
6. Install the “initial delivery” spring on the inner wall of the spring seat.

## ASSEMBLY

1. Before assembly, lubricate o-rings, pistons, and body and cover bores with the lubricant in the Bendix maintenance kit.
2. Install o-rings (3 & 4) on proportioning piston. Install o-rings (2 & 4) on blend back piston. Install o-ring (1) on cover.
3. Place inlet/exhaust valve (5) into the inner diameter of the proportioning piston and retain with valve spring (6). Use needle nose pliers to install the spring by grasping it on the bar that intersects its end and turning clockwise while pressing down. The bar must be away from (not touching) the valve.  
**Note:** Make sure spring coils do not overlap each other as the spring compresses into the proportioning piston. Also, make sure the valve is square, contacts the seat, and doesn't bind.
7. Install the blend back spring in the inner diameter of the blend back piston so that it surrounds the “initial delivery” spring.
8. Place the cover on the body in the proper position, as marked in *Disassembly*, Step 2. Make sure the springs are square when the cover is attached to the body.
9. Using the Phillips head screws and their lock-washers, secure the cover to the body. Torque the screws to 50-80 inch pounds.
10. Install all air line fittings, making sure thread sealing material does not enter the valve.
11. Mount LQ-5™ valve on the vehicle and perform *Operation and Leakage Tests* before returning the vehicle to service.



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The pressure protection valve is a normally closed, pressure control valve which can be referred to as a non-exhausting sequence valve. These valves are used in many different applications. An example would be in an air brake system to protect one reservoir, or reservoir system from another, by closing automatically at a preset pressure should a reservoir system failure occur. The valves can also be used to delay filling of auxiliary reservoirs to insure a quick build-up of brake system pressure.

The closing pressure of the PR-2 is externally adjustable while the PR-4 has a fixed setting.

For installation and maintenance information, see Instruction & Service Data Sheet, SD-03-55

WEIGHT - .4 LBS

VMRS. NO. 13-010-044

DEVICE CODE IS 2010

PR-2 NOT AVAILABLE IN REMFR. EXCHANGE.

COMMON SERVICE PARTS			
NO.	PC. NO.	QUAN.	DESCRIPTION
1	241910	1	PISTON
2	241914	1	PISTON PLUG
3	236640	1	GROMMET, 1/4" O.D.
4	241911	1	VALVE STEM
5	239773	1	VALVE
6	241913	1	VALVE GUIDE
7	242391	1	GROMMET, .590" O.D.
8	241952	1	STAMPED NUT
9	248103	1	ADJUSTING CAP
10	241912	1	VALVE SPRING

SUB ASSY. AND DETAIL REFERENCE

PR-2 PRESSURE PROTECTION VALVE PC. NO.	CUSTOMER IDENTIFICATION	SPRING PC. NO.	BODY PC. NO.	NOMINAL CLOSING PRESSURE P.S.I.	FOR SERVICE USE PC. NO.
277147	NONE	241916	242446	65	277147
277148	NONE	241916	242446	85	277148
277222	NONE	241916	242446	95	277222
277226	NONE	241915	242446	60	277226
277227	NONE	241916	242446	75	277227
277971	NONE	241916	242446	80	277971
A 279505	NONE	241916	242446	65	279505
281467	NONE	241915	242446	50	281467
A 282517	NONE	241915	242446	60	282517
283038	FORD DOHA-2A435-A	241916	247278	85	277148
283933	NONE	241916	247278	85	283933
285537	TEREX 9228724	241916	242446	65	277146
285539	TEREX 9214478	241916	242446	95	277222
285540	TEREX 9246147	241916	242446	90	282133
285541	TEREX 9249220	241916	242446	75	277227

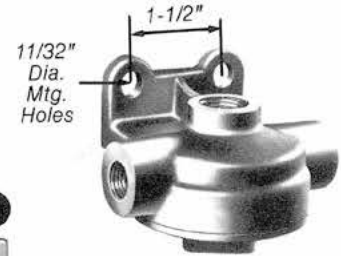
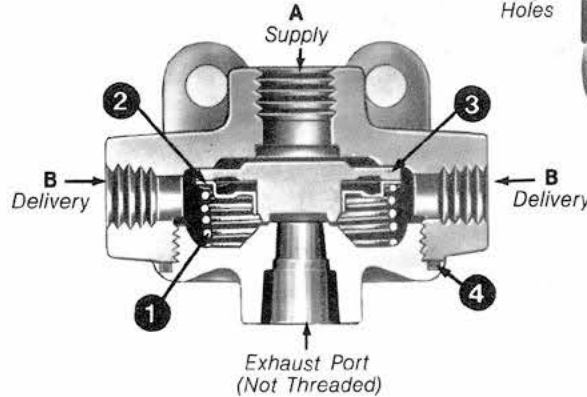
A-ADD LOCKWIRE, 243947 & LEAD SEAL 237324

The QRV, QR-1 & QRN Quick Release Valves are responsible for the rapid exhaust of air pressure, generally from brake chambers or spring brakes. They decrease the brake release time due to their mounting location which is generally close to the brake chamber or spring brake they serve. The QRV, QR-1 and QRN are all interchangeable with regard to fit and function. The QRN is the newest design of the three and in most cases can be used as a replacement for either the QRV or QRN.

For service/maintenance information consult service data sheets:

- SD-03-69 — QRV & QR-1
- SD-03-74 — QRN

**Weight:** QR-1 is 11.2 oz.    **Device Code:** QR-1 is 901  
 QRV is 1 lb.                      QRV is 900  
 QRN is 14 oz.                     QRN is 905



**Maintenance Kit 275875** Consists of:

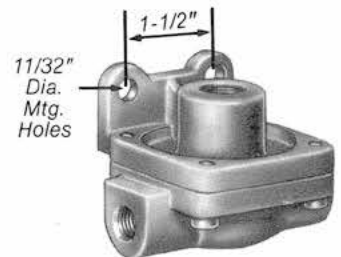
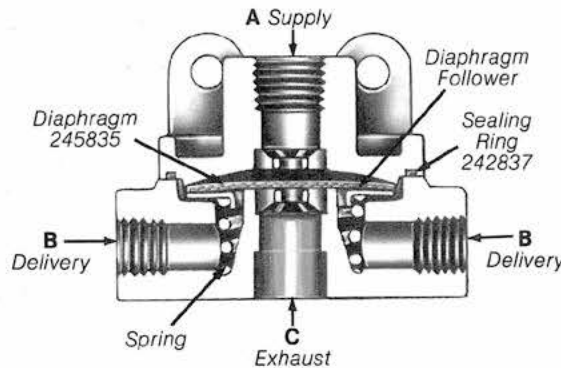
KEY NO.	DESCRIPTION	QUANTITY
1	Spring	1
2	Spring Seat	1
3	Diaphragm	1
4	Sealing Ring	1

QRV QUICK RELEASE VALVE FOR SERVICE OR REMAN. USE PC. NO.	PORT SIZES (P.T.)		SUPPLY & DELIVERY DIFFERENTIAL (PSI)	QRN REPLACEMENT
	A SUPPLY	B DELIVERY		
205000	3/8	1/4	1 Max.	065067*
224417	3/8	3/8	1 Max.	065067

\*Requires reducer bushing 212862 in each delivery port

# QR-1

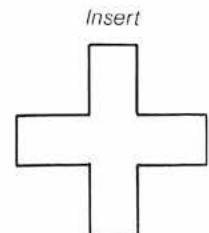
# SERVICE PARTS CHANGEOVER



QR-1 QUICK RELEASE VALVE FOR SERVICE OR REMFR. EXCH. USE PC. NO.	DIAPHRAGM FOLLOWER PC. NO.	SPRING PC. NO.	INSERT PC. NO.	PORT SIZES (P.T.)			SUPPLY & DELIVERY DIFFERENTIAL (PSI)	QRN REPLACEMENT
				A SUPPLY	B DELIVERY	C EXHAUST		
229813	-	-	-	3/8	1/4	-	1 Max.	065067*
229844	-	-	-	1/2	1/4	-	1 Max.	065066*
229859	-	-	-	3/8	3/8	-	1 Max.	065067
229860	-	-	-	1/2	3/8	-	1 Max.	065066
278481	243344	243345	-	3/8	1/4	-	5-8	065068*
278482	243344	243345	-	1/2	1/4	-	5-8	-
278483	243344	243345	-	1/2	3/8	-	5-8	-
281024	-	-	-	1/4	1/4	-	1 Max.	065067**
288251	-	-	-	3/8	3/8	3/8	1 Max.	065070
289042	-	-	292362	3/8	1/4	-	1 Max.	065067*
289525	-	-	292362	3/8	3/8	-	1 Max.	065067
101487	-	-	292362	1/2	3/8	-	1 Max.	065066
101647	243344	243345	-	1/2	3/8	3/8	5-8	-

\*Requires reducer bushing 212862 in each delivery port

\*\*Requires reducer bushing 212862 in supply and delivery ports



Insert  
 Pc. No. 292362

# RELAY VALVE

R-12  
VERTICAL

CATALOG  
03-B-04C

The relay valve is primarily used on long wheel base vehicles to apply and release rear axle(s) service or parking brakes.

It is an air operated, graduating directional control valve of high capacity and fast response. Upon receipt of signal pressure from the service brake valve, the relay valve will graduate, hold and release air pressure from the brake chambers to which it is connected.

The relay valve is used to balance the time of brake applications on heavy duty vehicles. They are especially needed where large volumes of air are required or long service lines cause the capacity of the brake valve to be exceeded.

Relay valves can be remote or reservoir mounted and differ primarily in the design.

The R-12 is piston operated and is offered with either vertical delivery ports which are primarily used on trailers or horizontal delivery ports which are primarily used on truck/tractors.

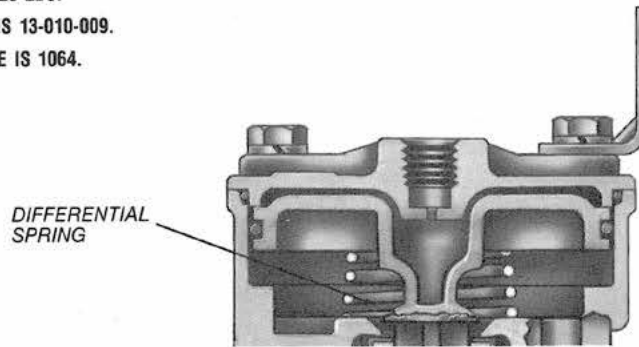
For service/maintenance information, see Service Data Sheet SD-03-31.

**MAINTENANCE KIT IS PC. NO. 102802**

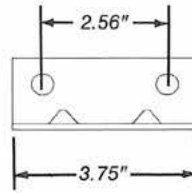
**WEIGHT - 2.25 LBS.**

**VMRS. NO. IS 13-010-009.**

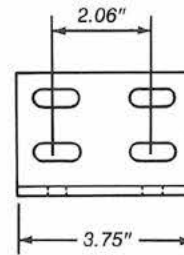
**DEVICE CODE IS 1064.**



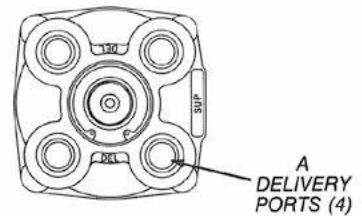
## Mounting Brackets



PC. NO.  
294314



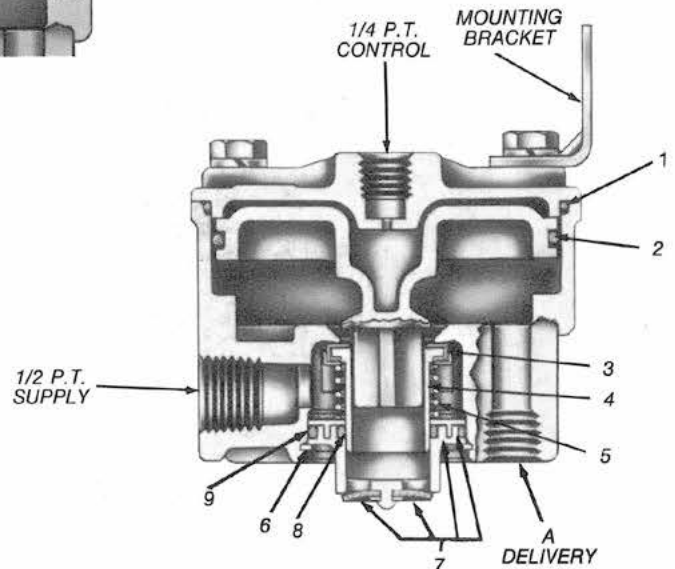
PC. NO.  
296010  
(UNIVERSAL)



Bottom View

## Maintenance Kit 102802 consists of:

Key No.	Qty.	Description
1	1	O-Ring
2	1	O-Ring
3	1	Valve Retainer
4	1	Inlet & Exhaust Vlv.
5	1	Valve Spring
6	1	Retaining Ring
7	1	Exh. Cover Complete
8	1	O-Ring
9	1	O-Ring



R-12 Vertical Service Replacement Pc. No.	Crack Pressure (P.S.I.)	A Delivery Port Size (P.T.)	Mounting Bracket Pc. No.	Differential Spring Pc. No.
102626	4	1/2	296010	—
103912	7.5	1/2	296010	297991
104561	5.5	3/8	296010	296340
065104	4	3/8	296010	—

Reducer bushings may be required to facilitate changeover. See page 07-A-4 for piece numbers.

**CRACK PRESSURE IS THE AMOUNT OF CONTROL PRESSURE REQUIRED BY THE VALVE TO INITIATE AIR DELIVERY.**

# DRUM DRIVE GEARBOX

ZF Maintenance

P / PK



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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# ZF P7300/PK7500 MAINTENANCE INFORMATION



## 1 OIL QUALITY

GL5 Spec 80w-90 or 85w-140

## 2 OIL LEVEL CHECK

### • CHECK OIL LEVEL DAILY!

- Vehicle should be parked in a horizontal position with stopped engine.
- Check on the warm unit after a short period of dripping (about 1 minute), dipstick screwed in.

## 3 OIL FILLING-UP

Fill up with fresh oil if level is down near the lower mark of dipstick, but do not let the oil level fall down below lower mark. Do not exceed upper mark during filling up. **DO NOT OVERFILL.**

## 4 OIL CHANGE AND OIL QUANTITIES

First oil change after 100 operating hours. Every 1000 operating hours, or at least once a year. The transmission should be run 5 minutes before making an oil change. Oil changes should be done with a warm unit and horizontal parked vehicle as follows:

- Stop engine.
- Open drain plug with o-ring and drain old oil.
- Clean drain plug and sealing surface on housing and install plug with a new o-ring.
- Unfasten oil dipstick and clean sealing surface on main housing.
- Fill with oil and do not exceed upper mark of screwed in dipstick. **DO NOT OVERFILL.**
- Re-fit dipstick with a new copper ring.
- Check of tightness.

## OIL QUANTITY

**P 7300** (Approx. 12.1 quarts)

**PK 7500** (Approx. 17.4 quarts)

## IMPORTANT INSTRUCTION

Check all gearbox mounting bolts to and from pedestal. Torque to 300 lbs. ft.

Check all gearbox flange bolts to drum MONTHLY. Torque to 200 lbs. ft.



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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# Spare Parts Catalog

P 7300

Material number: 4108.017.100





Pos.	Information	Amendment number
A10	KUNDE:MC NEILUS	
A11	CUSTOMER:	
A16	IDENT-NR:0115324	K00372/04
A17	CUSTOMER-NUMBER:	
A20	FREIGABE: .....	
A50	PROJEKT-NR.:39121	
A51	PROJECT-NO.:	
A52	LASTENHEFT:4108 700 247(4)	
A53	SPECIFICATION:	
B04	FAHRZEUGDATEN:	
B05	VEHICLE DATA:	
B06	FAHRMISCHER 12 KUBIK	
B07	READY-MIX TRUCK	
B16	MOTOR: HYDROMOTOR BIS 90 CCM	
B17	ENGINE/MAKE/TYPE:	
B20	DREHMOMENT: T-MAX= 485 NM	
B21	INPUT TORQUE:	
B26	DREHZAHL: N-MAX= 2500 UPM	
B27	SPEED:	
B30	DREHMOMENT-ABTR.:T-MAX= 72000 NM	
B31	OUTPUT TORQUE:	
F02	AGGREGATBESCHREIBUNG:	
F03	PRODUCT DESCRIPTION	
F04	PLANETENGETRIEBE: P 7300	
F05	PLANETARY GEAR DRIVE:	
F10	UEBERSETZUNG GES:I=144,3	
F11	RATIO:	
F12	ABTRIEB: I= 6,35	
F13	OUTPUT	
F14	ANTRIEB: I= 22,71	



Pos.	Information	Amendment number
F15	INPUT	
G32	NEBENANTRIEB: OHNE	
G33	POWER TAKE-OFF: WITHOUT	
G34	INDUKTIVGEBER: OHNE	
G35	INDUCTIVE TRANSMITTER: WITHOUT	
K02	ZEICHNUNGEN:	
K03	DRAWINGS:	
K06	SCHNITT: 4108 017 049(0)	
K07	SECT.DRAWING:	
K16	EINBAU: 4108 617 002(0)	K00560/02
K17	INST.DRAWING:	
K40	SCHEMA: 4108 700 217(4)	
K41	DIAGRAM:	
K80	PRUEFANWEISUNG: 4108 760 005(4)	
K81	TEST SPECIFICATION:	
L02	MONTAGEHINWEIS:	
L03	MOUNTING HINTS:	
L06	PRUEFL.U.KORROSIONSSCHUTZ S.TB-MITTLG.500/76	
L07	TEST RUN AND PROTECTION AGAINST CORROSION	
L08	KONSERVIERUNGSMITTEL CA. O.50L	
L09	PRESERVATIVE SLUSHING:	
L40	BAUMUSTERSCHILDBESCHRIFTUNG:	
L41	DATA ON TYPE PLATE:	
L42	BAUMUSTER: P 7300	
L44	AGGREGAT-NR:	
L46	STUECKLISTEN-NR:	
L48	UEBERSETZUNG GES:IF=144.3	
L50	ZF-LIST OF LUBRICANTS SAE 90	
L52	BAUMUSTERSCHILD AUF ANTRIEBSGEHAEUSE MONTIERT	
L53	MODEL PLATE MOUNTED ON INPUT HOUSING	



Pos.	Information	Amendment number
L60	BARCODE - LABEL AN KRANOESE BEFESTIGEN	
T02	OELINFUELLMENGE:	
T03	OIL CAPACITY:	
T20	GESAMT: CA.....L	
T21	TOTAL:	
T26	OELFUELLUNG: NEIN	
T27	OIL FILLING: NO	
T30	OELSORTE:MILDWIRK. EP-HOCHDR.GETR.OELE SAE 90	
T31	OIL TYPE:EASED EP-HIGH PRESSURE GEARBOX OILS	
T32	OELSORTE:SCHMIERSTOFFL.TE ML 07	
T33	OIL GRADE:SPECIFICATION TE ML 07	
T40	GESAMT-TROCKENMASSE: 355KG	
T41	WEIGHT/MASS (DRY):	
T46	FARBE: UNGRUNDIERT	
T47	COLOR: NOT PRIMERPAINTET	
T50	VERPACKUNG: .....	
T51	PACKING:	
Z02	*	

# Assembly group overview

Page 1 from 1

Material number: 4108.017.100

P 7300 /



Graphics	Pos.	Material number	Name	VKF	Amend. no.	Amend. start	Prod. no.	Material feature / tech. info.	ID
410810101400	001	4108.101.097	HOUSING	1		00.00.0000			0
410810200100	002	4108.102.053	INPUT	1		00.00.0000			0
410810301100	003	4108.103.132	OUTPUT	1	K01247/06	00.00.0000			0
410819600100	004	4108.196.021	LOOSE PARTS	1		00.00.0000			0

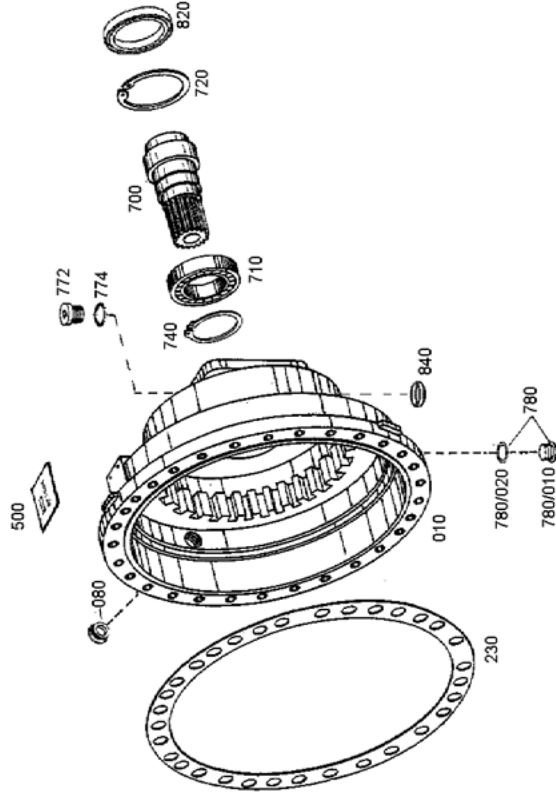
**VKF** Incidence factor

**ID** Identification (output code)

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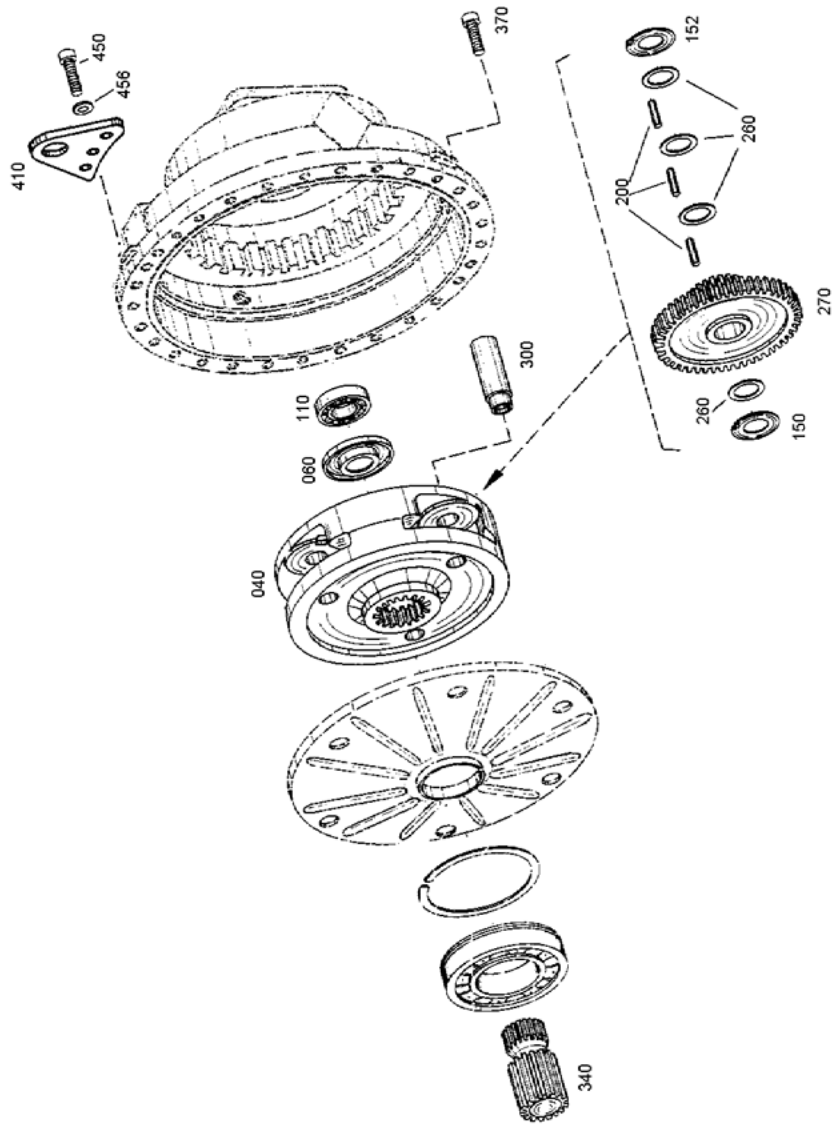
05.02.2007

Material number: 4108.017.100 P 7300 /  
Plant: 410810101400 HOUSING  
Material-assembly-group-no: 4108.101.097





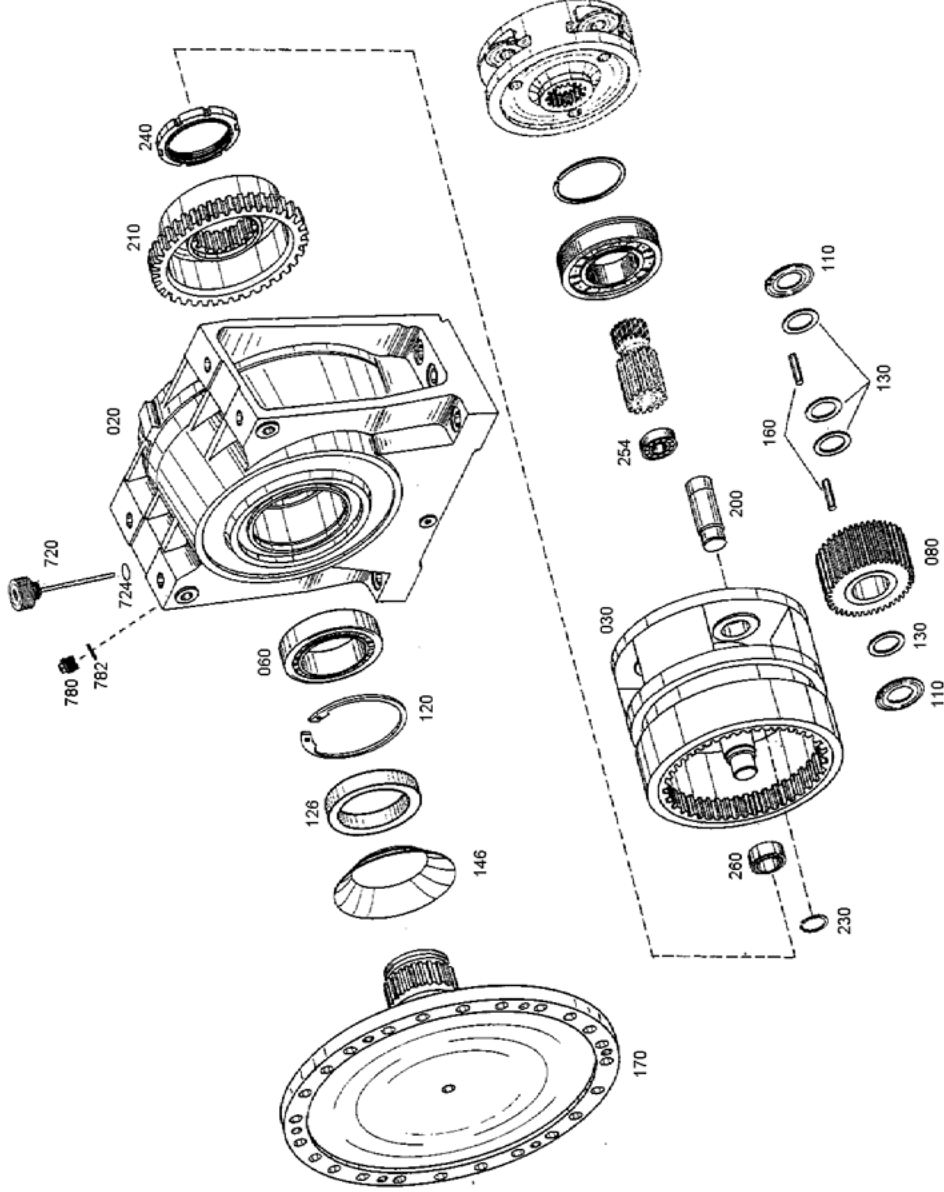
Pos.	Material number	Name	VKF	Amend. no.	Amend. start	Prod. no.	Material feature / tech. info.	OTK no.	External material	ID	Weight	SP
010	4108.201.288	HOUSING	1	K00453/02	..	..	IN 4108 201 239			0	0,010	
080	0501.215.601	OIL SIGHT GLASS	1	K01079/06	00.00.0000	00.00.0000				0	0,000	
230	4108.306.172	GASKET	1		00.00.0000					0	0,020	
500	0730.365.127	TYPE PLATE	1		00.00.0000					0	0,005	
700	4108.301.450	INPUT SHAFT	1		00.00.0000		Z=14 IN 4108 301 429			0	1,400	
710	0750.116.277	BALL BEARING	1	K01434/97	..	..				0	0,250	
720	0630.502.039	RETAINING RING	1		00.00.0000		80X2,5			0	0,030	
740	0630.531.064	RETAINING RING	1		00.00.0000					0	0,100	
772	0636.302.014	VERSCHL.SCHRAUB	1	K01073/98	..	..	M18 X 1,5 DIN 908 ST			0	0,030	
774	0634.801.057	SEALING RING	1	K01073/98	..	..	A18 X 22 DIN 7603 CU			0	0,002	
780	---	SCREW PLUG	1	K00835/97	00.00.0000	00.00.0000	M 22X1,5 KPL. MIT O- RING			0	0,050	
7010	0636.302.015	SCREW PLUG	1		00.00.0000					0	0,050	
7020	0634.304.287	O-RING	1		00.00.0000					0	0,001	
820	0634.300.610	SHAFT SEAL	1		00.00.0000		60 X 80X10 B			0	0,030	
840	0630.361.009	SEALING CAP	1	K00453/02	..	..	..18			0	0,005	





Pos.	Material number	Name	VKF	Amend. no.	Amend. start	Prod. no.	Material feature / tech. info.	OTK no.	External material	ID	Weight	SP
040	4108.302.192	PLANET CARRIER	1	K01182/ 93	..	..	EN-GJS-600-3			0	11	
060	4108.302.007	LAGERBLECH	1		00.00.0000		ST13.03			0	0,063	
110	0750.116.343	BALL BEARING	1	K01435/ 97	..	..				0	0,044	
150	0730.106.813	THRUST WASHER	3	K01673/ 98	00.00.0000	00.00.0000				0	0,010	
152	0730.106.813	THRUST WASHER	3		00.00.0000					0	0,010	
200	0735.470.120	NEEDLE ROLLER	198		00.00.0000					0	0,004	
260	0730.102.644	INTERM. WASHER	12		00.00.0000		67SICR5			0	0,003	
270	4108.302.190	PLANET GEAR	3	K00003/ 93	..	..	Z=68/17 IN 4108 302 081			0	2,600	
300	4108.302.062	BEARING PIN	3		00.00.0000		100CR6			0	0,330	
340	4108.303.337	SUN GEAR	1	K00282/ 05	..	..	Z=17			0	0	
370	0636.101.071	CAP SCREW	27	K00480/ 93	00.00.0000	00.00.0000	M 12 X 40			0	0,040	
410	4108.302.199	SHEET	1	K01098/ 93	00.00.0000	00.00.0000	F270			0	0,210	
450	0636.101.073	CAP SCREW	3	K01969/ 95	00.00.0000	00.00.0000	M 12 X 45			0	0,050	
456	0630.001.049	WASHER	2	K00653/ 94	00.00.0000	00.00.0000	13			0	0,006	







Pos.	Material number	Name	VKF	Amend. no.	Amend. start	Prod. no.	Material feature / tech. info.	OTK no.	External material	ID	Weight	SP
020	4108.203.168	BEARING HOUSING	1	K00597/06	00.00.0000	00.00.0000	KPL.			0	119,500	
030	4108.303.345	PLANET CARRIER	1	K01200/05	..	..	Z=39 P7300			0	48,400	
060	0750.117.735	ROLLER BEARING	1		00.00.0000					0	7,600	
080	4108.303.298	PLANET GEAR	4		00.00.0000		Z=36 IN 4108 306 148			0	6,100	
110	0730.102.684	THRUST WASHER	8		00.00.0000					0	0,022	
120	0630.502.067	RETAINING RING	1		00.00.0000		180X4			0	0,146	
130	0730.102.816	INTERM.WASHER	16		00.00.0000		S=2,0			0	0,017	
146	0750.112.251	SEALING COLLAR	1	K01369/04	..	..				0	0	
160	0750.119.092	NEEDLE ROLLER	184		00.00.0000					0	0,009	
170	4108.303.346	BEARING FLANGE	1	K01200/05	..	..	Z=35			0	60	
200	4108.303.289	PIN	4		00.00.0000		IN 4108 303 288			0	1,440	
210	4108.303.320	CLUTCH BODY	1		00.00.0000		Z=39			0	18	
230	0630.501.031	RETAINING RING	4		00.00.0000		38 X 1,75 DIN 471			0	0,006	
240	0737.502.084	SLOTTED NUT	1		00.00.0000					0	0,490	
370	4108.303.359	RETAINING CLIP	1	K01215/06	00.00.0000	00.00.0000	EN10270-1-SM-3.4			0	0,000	
480	0636.016.033	HEXAGON SCREW	1	K01215/06	00.00.0000	00.00.0000	M 16 X 20			0	0,060	
720	4108.203.149	OIL DIPSTICK	1	K01247/06	00.00.0000	00.00.0000				0	0,080	
724	0634.801.074	SEALING RING	1	K01247/06	00.00.0000	00.00.0000	A 22 X 27			0	0,003	
780	0636.302.015	SCREW PLUG	1	K01990/99	00.00.0000	00.00.0000				0	0,050	
782	0634.801.074	SEALING RING	1	K01856/98	..	..	A 22 X 27			0	0,003	

Material number: 4108.017.100 P 7300 /  
Plant: 410819600100 LOOSE PARTS  
Material-assembly-group-no: 4108.196.021



Material number: 4108.017.100 P 7300 /  
Plant: 410819600100  
Material-assembly-group-no: 4108.196.021



Pos.	Material number	Name	VKF	Amend. no.	Amend. start	Prod. no.	Material feature / tech. info.	OTK no.	External material no.	ID	Weight	SP
010	4108.302.139	GASKET	1		00.00.0000		11940			0	0,003	

**VKF** Incidence factor

**OTK** Optional technical kit

**ID** Identification (output code)

**SP** Supplier plant

# DRUM ROLLER MAINTENANCE

Drum roller adjustment and maintenance is CRITICAL to maintaining optimum performance of your Con-Tech mixer. Failing to follow a regular WEEKLY maintenance schedule can result in premature wear, costly repairs, and downtime.

The drum rollers should be inspected every week (for alignment and bearing wear) and greased using a General Purpose EP #2 Lithium grease. The greasing procedure should consist of pumping enough grease into the rollers until it comes OUT of the seal area clean and free of contaminants. If you have any service issues, call Con-Tech service at **507-374-2239**. Please observe ALL OSHA lockout-tag out procedures when performing any type of work or maintenance on your vehicles.

## ROLLER ALIGNMENT STEPS

### 1 DRUM ROLLER ALIGNMENT PREP

If your Con-Tech mixer is equipped with a BridgeKing trailer axle, lower it to the ground. Once the axle is on the ground turn off the ignition, perform Lockout / Tag Out procedure, release the pressure on the BridgeKing trailer and relieve any stress on the truck frame. All pusher axles should be up. Truck must be unloaded. See Image A

### 2 DRUM ROLLER GAP

Make sure your rollers are shimmed to meet the proper air gap of .012" - .030" between the roller and the track. Double check your gap after all steps are complete. See Image B

### 3 ROLLER SPACING

Using a 3/4" thick spacer, place it on the forward face of the roller track and adjust the roller to be flush with the 3/4" spacer or dimension. Do this to both rollers. See Image C

### 4 ROLLER ALIGNMENT

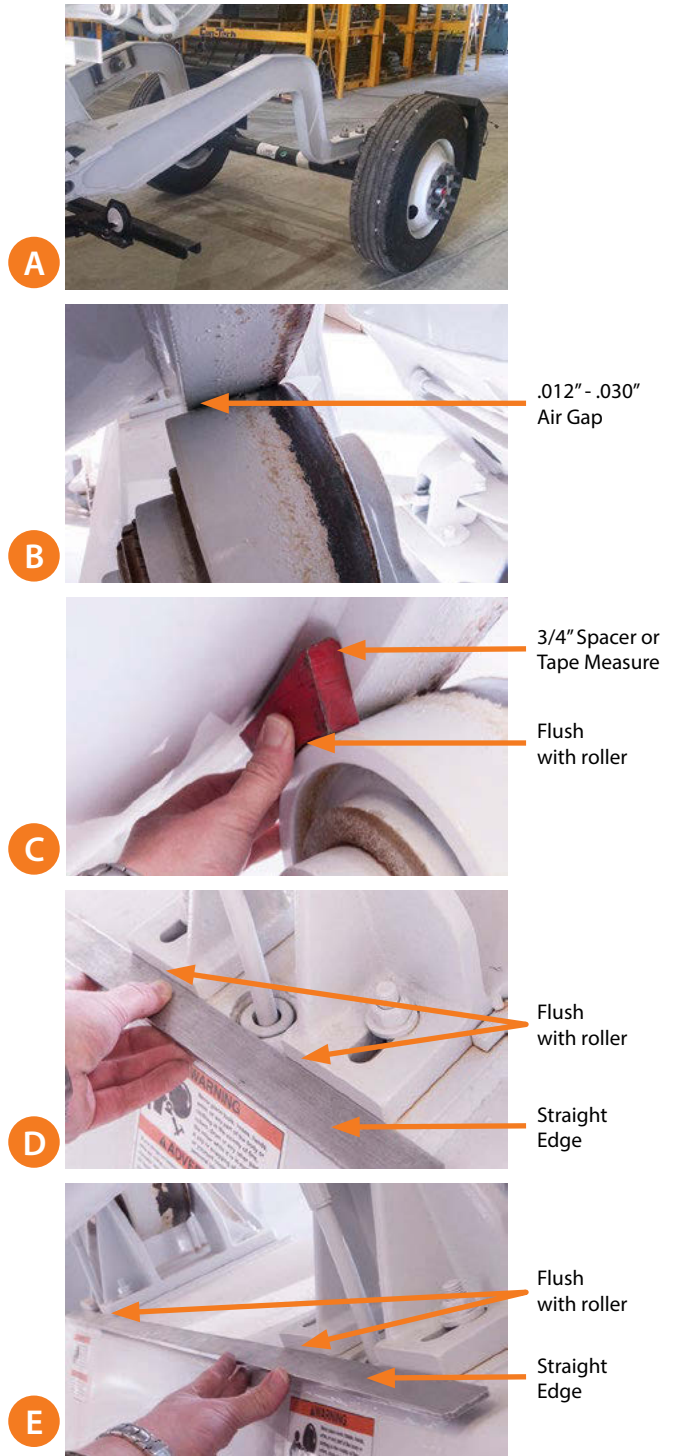
Using a straight edge or a 4' level, align both front edges of the roller foot to be flush with the straight edge. This must be done while maintaining the 3/4" offset spacing on the roller track face. See Images D & E

\* Visually inspect roller to roller track contact area when loaded to verify proper shimming. Variances in chassis frames and size of load will affect how much shimming is required.

\* Each drum roller is equipped with two tapered roller bearings. Seals are provided to exclude water and dirt. If it becomes necessary to replace the bearings the assembly must be thoroughly cleaned before installing the new bearings. Pack the bearings with a General Purpose EP #2 Lithium grease. (See lube chart and maintenance schedule).

### \* Troubleshooting Roller Noise

If a snapping, popping or grinding noise is heard coming from the roller area, you can spray water or grease on the track/roller. If noise persists, remove, repair, or replace roller. If the noise goes away when sprayed or greased, you must align the rollers.



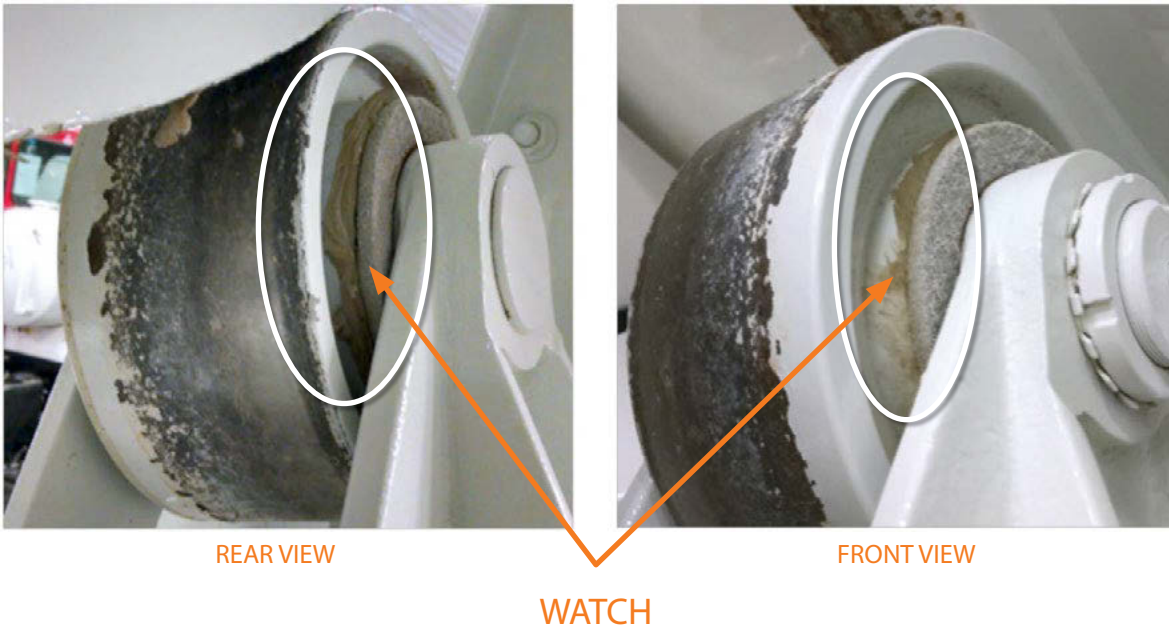
65740 State Hwy 56, Dodge Center, MN 55927 phone 507-374-2239 fax 507-374-1094

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## DRUM ROLLER MAINTENANCE

### GREASING THE ROLLER

- Greasing intervals are very important. **GREASE ROLLERS WEEKLY** using an EP#2 lithium based grease. It is **NOT POSSIBLE** to over grease rollers.
- Since roller seals are designed to **PURGE** grease, it is imperative that the roller is greased regularly and with sufficient grease to **FLUSH OUT** contaminants. During the greasing process a roller will be completely greased when you start to see **CLEAN** grease coming out of the roller lip seal/felt dust ring area on both the front and rear sides of the roller.



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# THROTTLE AND DRUM CONTROLS OPERATION

Many mixer operators are incorrectly controlling the drum speed by manipulating the throttle. In other words, with the engine at low idle the drum is set into motion at low R.P.M. and then the drum speed is increased by advancing the throttle.

This is the incorrect way to operate the mixer and may cause damage to the hydrostats.

It is a case of excessive and improper use of the throttle control. Proper operation is as follows:

1. Set engine speed at approximately 1200 R.P.M. This will ensure adequate torque delivery to the pump and will ensure adequate charge pump fluid delivery to the hydraulic system. This is especially important when handling low slump concrete. Failure to do this may result in erratic drum operation or even cause the drum to stop turning.
2. Always control drum speed by manipulating the drum control lever, not the throttle lever. Moving the drum control lever causes the drum to move in either the charge or discharge direction. The farther the control lever is moved, the faster the drum will revolve.
3. **Charging**  
Actuate forward-reverse lever to the mix direction, set engine speed to maximum governed R.P.M. and charge control lever for maximum R.P.M.
4. **Mixing and Agitating**  
Proper mixing speed for the Con-Tech drum is 16 to 18 R.P.M. In general, a proper mix can be obtained with 70 revolutions (at full throttle) of the mixer drum. This count begins when the mixer is fully loaded and ends when the mixer begins transport to the job site from the plant. Agitating speed should be set between 1 and 6 R.P.M., depending upon length of haul.
5. **Discharging**  
To discharge, actuate the control lever to discharge position increasing drum speed to the desired setting. A drum speed of 4 R.P.M. will be sufficient for most work. However, greater or lesser speeds can be used depending on job conditions and type of mix. A good rule of thumb to follow is, the higher the slump of the concrete the greater the allowable drum R.P.M., and the lower the slump the slower the drum should turn for maximum discharge rate. Discharge chute position is easily controlled by adjusting the chute height with the chute lifter and rotating the chute manually about its pivot point. A lock system is provided to lock the chutes and prevent chute rotation when leaving the pouring position.



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ISO-9001 Registered Quality System.  
ISO-21469 Compliant.

Sales, Service & Distribution Center

Newark, NJ 07105

Phone: 973-589-9150 Fax: 973-589-4432

Manufacturing, Sales, Service & Distribution Center

Toledo, OH 43605

Phone: 419-691-2491 Fax: 419-693-3806

Sales and Tech Service Support

Phone: 1-800-733-4755

## LUBRIPLATE "1500" Series

LUBRIPLATE No. 1500, 1550, 1551, and 1552 are lithium complex greases that can be used for a variety of industrial, automotive and heavy-duty construction applications. These rugged, extreme pressure lubricants can withstand higher operating temperatures than traditional lithium multi-purpose greases as well as most lithium complex greases.

LUBRIPLATE No. 1552 and No. 1551 are tacky, adhesive and very water resistant. The film strength and shear stability of these products are exceptional resulting in wear reduction and long lubricant life.

LUBRIPLATE No. 1552 and No. 1551 provide outstanding lubrication in a variety of applications including:

Automotive (including the fleet and truck operator)

Marine

Construction

Logging

Mining

Industrial

LUBRIPLATE No. 1550 is ideal for heavy load, tight tolerance situations and can be pumped easily through automatic dispensing systems on construction and mining equipment as well as industrial applications.

LUBRIPLATE No. 1500 can be used for a variety of industrial and automotive applications. It is ideally suited for use in leaky gear cases that require a semi-fluid grease. It is also recommended for use in new on-highway trailer wheel bearings where a semi-fluid grease is required. LUBRIPLATE No. 1500 can also be used in centralized lubrication systems, especially those operating at higher temperatures.



**Typical Characteristics**

	<b><u>No. 1552</u></b>	<b><u>No. 1551</u></b>	<b><u>No. 1550</u></b>	<b><u>No. 1500</u></b>
<b>Base Oil Properties</b>				
Saybolt Viscosity @ 100°F	1100 SUS	1100 SUS	1100 SUS	1100 SUS
Saybolt Viscosity @ 210°F	92 SUS	92 SUS	92 SUS	92 SUS
Kinematic Viscosity @ 40°C	215 cSt	215 cSt	215 cSt	215 cSt
Kinematic Viscosity @ 100°C	18 cSt	18 cSt	18 cSt	18 cSt
Flash Point °F/°C	500/260	500/260	500/260	500/260
Fire Point °F/°C	545/285	545/285	545/285	545/285
Specific Gravity	0.96	0.9485	0.9018	0.90
NLGI Grade (ASTM D-217)	2	1	0	00
Texture	Tacky	Tacky	Tacky	Tacky
Dropping Point, °F (ASTM D-2265)	500°F+	470°F	451°F	N/A
<b>Four Ball Wear (ASTM D-2266)</b>				
40 kg. 1200 rpm, 1 hr. @ 167°F	0.45 mm	0.45 mm	0.45 mm	0.54 mm
Timken EP Test (ASTM D-2509)	60 lb. OK Load	50 lb. OK Load	50 lb. OK Load	50 lb. OK Load
Four Ball EP Test (ASTM D-2596)	680 kg. OK Load	480 kg. OK Load	460 kg. OK Load	420 kg. OK Load
Oil Separation (ASTM D-1742)	1.1%	5.0%	Not Applicable	Not Applicable
<b>Evaporation Loss (ASTM D-972)</b>				
@ 100°C	0.24%	0.24%	0.24%	0.24%
<b>Oxidation Stability (ASTM D-942)</b>				
Psi drop after 100 hours	2 lbs.	2 lbs.	2 lbs.	2.5 lbs.
Psi drop after 500 hours	8 lbs.	8 lbs.	8 lbs.	10 lbs.
<b>Corrosion (ASTM D-130)</b>				
3 hours	1a	1a	1a	1a
<b>Water Washout (ASTM D-1264)</b>				
@ 175°F	2.75%	9.9%	N/A	N/A
<b>Wheel Bearing Leakage (ASTM D-4290)</b>				
	5.5 gms.	5.5 gms.	N/A	N/A

**Packaging Availability**

	<b><u>No. 1552</u></b>	<b><u>No. 1551</u></b>	<b><u>No. 1550</u></b>	<b><u>No. 1500</u></b>
Carton 4/7 lb. Jugs	-----	-----	-----	L0163-007
Carton 12/2 lb. Bottles	-----	-----	-----	L0163-013
35 lb. Pail	L0166-035	L0165-035	L0164-035	L0163-035
120 lb. Drum	L0166-039	L0165-039	L0164-039	L0163-039
420 lb. Drum	L0166-040	L0165-040	L0164-040	L0163-040
Carton 40/14.5 oz. Cartridges	L0166-098	L0165-098	-----	-----

# PUSHER AXLE

IF YOUR CHASSIS CAME WITH A FACTORY MOUNTED PUSHER,  
PLEASE REFERENCE THE CHASSIS SERVICE MANUAL.

**CALL CON-TECH SERVICE AT 507-374-2239  
WITH ANY SERVICE ISSUES.**

**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT  
PROCEDURES WHEN PERFORMING ANY TYPE OF WORK  
OR MAINTENANCE ON YOUR VEHICLES.**



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# TECHNICAL PROCEDURE

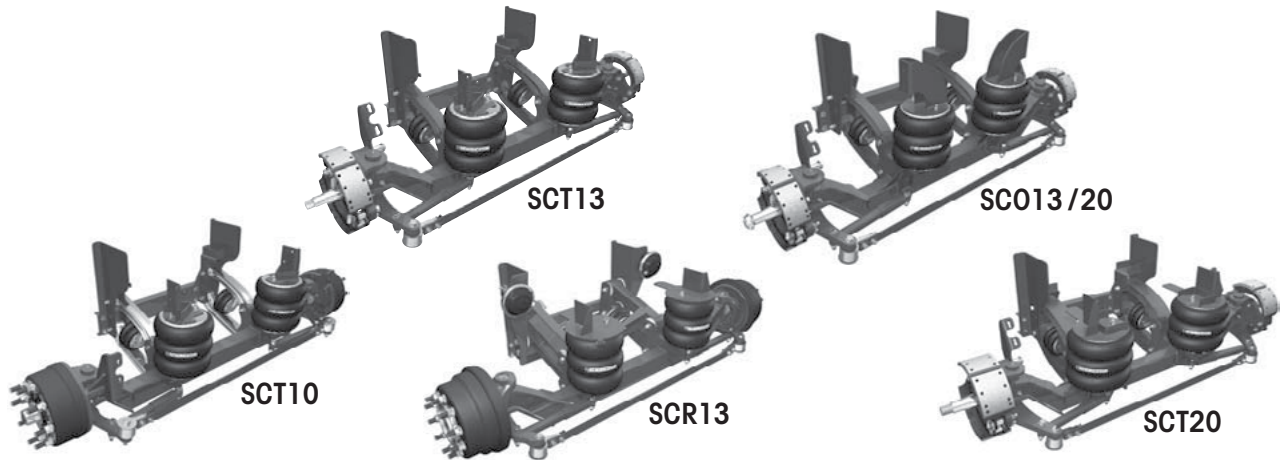
## STEERABLE SUSPENSION SYSTEM

**SUBJECT:** Installation and Preventative  
Maintenance Procedures

**LIT NO:** H633

**DATE:** May 2011

**REVISION:** E



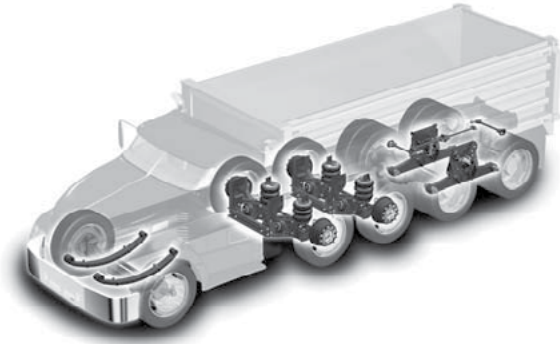
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## INTRODUCTION

Why use a Lift Axle? Hendrickson suspensions carry countless loads of freight and raw materials off-road and over the highways. The Hendrickson Auxiliary Axle Suspension System with optimized weight, short package space and a CTR with PerfectTrak™ technology improves product performance and durability while offering owner-operators increased payload and reduced maintenance.



The lift axle suspension also helps to meet U.S. Department of Transportation FHWA-HOP-06-105.

For further information, contact:  
 U.S. Department of Transportation  
 Federal Highway Administration  
 Office of Freight Management and Operations  
 Phone: 202-366-9210  
 Fax: 202-366-3302  
 Web site: [http://www.ops.fhwa.dot.gov/freight/publications/brdg\\_frm\\_wghts/](http://www.ops.fhwa.dot.gov/freight/publications/brdg_frm_wghts/)

The following instructions are intended for use with Hendrickson COMPOSILITE™ Auxiliary Lifiable Air Ride Suspensions.

**NOTE:** Read the entire installation instruction document thoroughly before proceeding with a suspension installation.

It is very important that the proper suspension is selected for the vehicle application. The following criteria must be considered when selecting a suspension:

- required capacity
- loaded frame-to-ground measurement
- driveline clearance
- axle travel
- axle spacing
- tire size for auxiliary axle
- Requirement for a steerable or non-steerable suspension

For additional information concerning suspension selection, or other suspension models contact the Hendrickson Auxiliary Axle System's Customer Service Department.

**⚠ CAUTION:** Steerable suspension systems, as with all air suspension systems, must be installed with the proper amount of tire-to-ground clearance to help ensure proper operation. If there is too much ground clearance, the suspension will not carry its share of the load. Too little ground clearance may result in damage to the suspension or other vehicle components installing a suspension with a ride height that is "out of range" may result in:

- insufficient axle lift
- improper axle load
- insufficient ground clearance
- component overload

The vehicle manufacturer should be consulted before making any changes to the vehicle's frame. Typically, vehicle manufacturers do not permit cutting or altering the vehicle's frame or side rail and doing so could void any applicable manufacturer warranty coverage.

## SPECIAL NOTES

Non-functioning components are to be returned to Hendrickson Auxiliary Axle Systems, in exchange for replacement components, provided product warranty conditions are met.

Hendrickson Auxiliary Lifiable Air Ride Suspensions with factory installed axles may require toe setting adjustments. Also, check for sufficient wheel bearing lubrication (oil).

It is the responsibility of the installer to ensure that the vehicle will function properly under the increased weight conditions and loading that will exist when an additional axle is installed, particularly braking.

It is the responsibility of the installer to determine the correct location of the suspension in order to provide the proper vehicle load distribution. The load carried by each axle must not exceed the rated capacity of



the components involved or the applicable State and Federal laws where the truck is to be operated.

It is the installer's responsibility to ensure that proper clearances exist:

- Between the drive shaft and/or roll-off cylinder and the auxiliary axle (if applicable)
- Around the tires—laterally, fore, aft, and vertically
- Around the air springs when they are at their maximum diameter (refer to suspension assembly drawing for specifications)
- Around any moving suspension components

No welding to any of the suspension components is permitted, except where specified by Hendrickson Auxiliary Axle Systems.

No alteration of any of the suspension components is permitted.

Any installation deviations must be approved, in writing, by Hendrickson Auxiliary Axle Systems Product Engineering Department. Failure to comply with these installation instructions without written permission will void the suspension warranty.

**⚠ CAUTION:** Subjecting aluminum components to certain acid washes may result in premature corrosion and warranty could be affected. It is recommended that you monitor which cleaning solvents are being used on your vehicle.

**⚠ CAUTION:** Acid washes also degrade the rubber, urethane and plastic parts or the axle assembly.

## REQUIRED EQUIPMENT AND MATERIALS FOR INSTALLATION

The following equipment and materials are needed when installing a Hendrickson Steerable Auxiliary Liffable Air Ride Suspension:

1. Frame Fasteners: 5/8-11 x 2 1/4" long grade 8 flange bolts and 5/8 IFI Grade C prevailing torque flange nuts and the corresponding frame drill bit.

2. Torque wrench (capability of 450 ft. lbs. for frame bolt installation).
3. Tape measure or scale(s) and machinist square.
4. Trammel bar.
5. Crane or other lifting device.
6. Hammer and center punch.
7. Compressed air supply.
8. Air impact gun.
9. Air fittings, tubing and associated tools.
10. Socket set and wrenches, including the following sizes:
  - 3/8"
  - 9/16"
  - 3/4"
  - 15/16"
  - 1-1/8"
  - 1-1/4" deep well socket
11. C-clamps or bar clamps with the minimum opening equal to the vehicle frame height.
12. Suspension assembly drawing supplied by Hendrickson. Plumbing schematics supplied for pre-plumb suspensions only.
13. Angle measuring instrument (magnetic protractor) for self-steer axle.
14. Wheel chocks.
15. Frame jacks or supports.

## INSTALLATION INSTRUCTIONS

### SAFETY FIRST

Be sure to read and follow all installation and maintenance procedures.

### LIFTING

Practice safe lifting procedures. Consider size, shape and weight of assemblies. Obtain help or the assistance of a crane or lift truck when lifting heavy assemblies. Make sure the path of travel is clear.

### PARTS HANDLING

When handling parts, be sure to wear appropriate gloves, eyeglasses and other safety equipment to prevent serious injury.

### UNPACK AXLE

Separate kitted parts for use during installation.

## PRE-INSTALLATION CHECKLIST AND PROCEDURES

Before beginning the installation:

1. Check that the new suspension matches the specifications provided by your Production or Engineering Department.
2. Verify that the suspension model configuration (axle drop, suspension and axle seat type) is compatible with the vehicle's loaded frame-to-ground measurement, intended tire size and driveline clearance.

- Driveline clearances should be considered when deciding the correct axle drop. In lifted position there should be more than 2" clearance between drive line and axle.

Drive line drop clearance measurement, Figure 1, Dimensions "A" + "B" with axle in full up position Dimension "C" is the Spindle CL to Axle

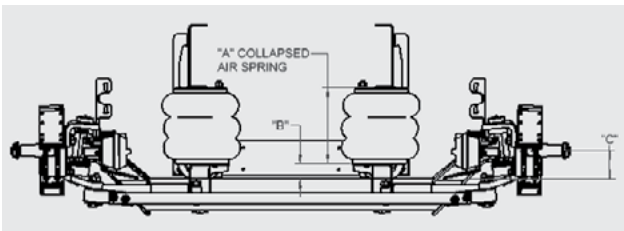


Figure 1. Driveline Drop Clearance

3. On a truck or trailer auxiliary suspension application:

- a. Verify that the axle spacing conforms to Federal and local bridge laws.
- b. Verify that the auxiliary suspension location is based on: front axle steer angle, vehicle wheel-base and maximum recommended auxiliary axle spacing.
- c. Verify that the vehicle will have the proper load distribution after installation.
- d. Verify that there is sufficient fore/aft frame rail clearance to mount the auxiliary suspension(s).

4. On truck frames:

- a. Verify that the frame width is within the allowable mounting range of the suspension (refer to the suspension assembly drawing).
- b. Mark the location of the suspension side rails on the frame rails. (Refer to the suspension assembly drawing) Check for interferences with any existing bracketry or mounting bolts.
- c. Check for any interferences between the axle and the drive shaft, if applicable (refer to the suspension assembly drawing).
- d. Verify that the vehicle crossmembers and backing plates are correctly positioned for proper support of the suspension.

**⚠ WARNING: ADEQUATE SUSPENSION SUPPORT MUST BE PROVIDED WITHIN THE VEHICLE FRAME! A CROSSMEMBER MUST BE LOCATED 12" FORE OR AFT OF THE SIDE RAIL PIVOT BOLT CENTERLINE. FAILURE TO PROVIDE ADEQUATE SUSPENSION SUPPORT COULD RESULT IN SUSPENSION DAMAGE AND/OR DAMAGE TO THE VEHICLE FRAME. (SEE FIGURE 1)**

5. Confirm that the components listed on the suspension assembly drawing have been provided in sufficient quantities. Contact the Hendrickson Auxiliary Axle Customer Service Department if any components are missing or damaged.



## PRIOR TO INSTALLATION

### AXLE IDENTIFICATION

The serial number tag is a identification label attached to the suspension system. It contains a unique serial number and the model identification number for that specific suspension system. (Label is located on the rear center of the axle or side rail.)

### SUSPENSION ADJUSTABILITY

Suspension flexibility can be achieved with adjustable spacers which allows for a ride height range of four (4) inches.

Hendrickson Auxiliary Axle offers frame width and ride height adjustability with certain models reducing multiple part number stocking.

### ADJUSTABLE RIDE HEIGHT (IF REQUIRED)

The adjustable ride height feature accommodates five different ride height requirements.

Ride height adjustment spacers are provided for the bushing saddle and the upper air spring plate to adjust to a higher ride height. The parts box will include the following ride height adjustment spacers:

- Two one-inch bushing saddle spacers
- Two one-inch air spring plate spacers
- Two two-inch bushing saddle spacers
- Two two-inch air spring plate spacers

The following example uses a suspension specified with a 12.5-inch base ride height and shows which spacers are need based on the required ride height.

RIDE HEIGHT REQUIRED	SPACER REQUIRED
11.5	No spacers required
12.5	No spacers required
13.5	1" spacer optional
14.5	1" required, 2" optional
15.5	2" required

**NOTE:** Ride height is always +/-1".

### RIDE HEIGHT SPACER INSTALLATION (IF EQUIPPED)

1. Determine if a spacer is needed based on the ride height required and the base ride height of suspension model to be installed.
2. If no spacers are required, move to the adjustable frame width feature section. If spacers are required move to step 3.

3. Position spacers, per figures 2 and 3, to accommodate required ride height. The same spacer size must be used for bushing saddles and air spring plates.

**NOTE:** Do not drill holes in the frame rail until the ride height is determine to be optimal. Do not weld spacer in position and do not remove after installation.

### ADJUSTABLE FRAME WIDTH

The adjustable frame width feature allows the same suspension to accommodate frame width ranges of 33.5 inches to 34.5 inches. The suspension will ship at 34.0 inches with one frame width spacer in position on each side. The parts box will include two additional frame width spacers.

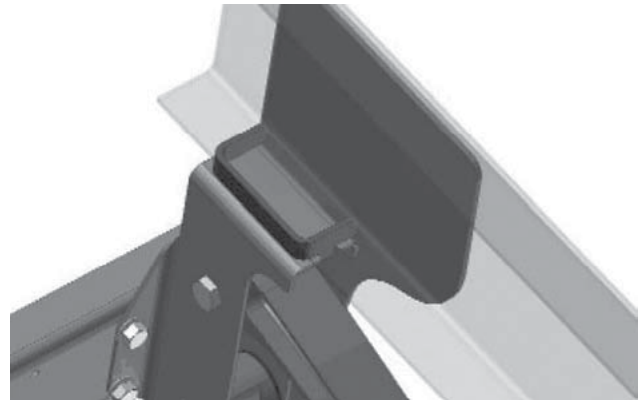


Figure 2 - Bushing saddle spacer



Figure 3 - Air spring plate spacer



**FRAME WIDTH ADJUSTMENT PROCEDURES**

1. Determine the required frame width based on the vehicle's dimension.
2. If a 34.0-inch frame width is needed, do not adjust the frame width. Proceed with standard suspension installation.
3. If a 33.5 inch frame width is needed, loosen but do not remove the four pivot bolts connecting the hanger to the bushing saddle. Next, loosen the four bolts connecting the cross member to the hangers. Remove the frame width spacer on both sides of the suspension. Retorque the pivot bolts and cross member bolts. See torque values below. (See figure 4 for frame width spacer reference)
4. If a 34.5 inch frame width is needed, loosen but do not remove the four pivot bolts connecting the hanger to the bushing saddle. Next, loosen the four bolts connecting the cross member to the hangers. Add one frame width spacer to both sides of the suspension. Retorque the pivot bolts and cross member bolts. See torque values below. (See figure 3 for frame width spacer reference)

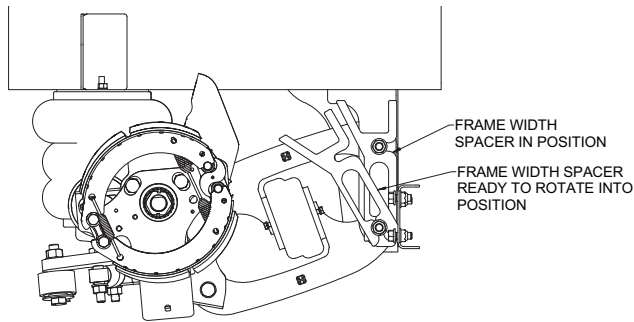


Figure 4 - Frame width spacer

**SC10/13**

BOLT	TORQUE VALUE
Pivot Bolts	225 ft-lbs
Cross member	180 ft-lbs

**SC20**

BOLT	TORQUE VALUE
Pivot Bolts	425 ft-lbs
Cross member	180 ft-lbs

**SUSPENSION MOUNTING INSTALLATION PROCEDURES**

Before installing a suspension:

1. Check that the correct auxiliary suspension and axle was chosen based on the individual design criteria. Review the pre-installation check.
2. If the vehicle frame is forward-sloping or tapered, see Caster Angle Section before drilling.
3. Position the vehicle on a flat level surface.
4. Determine the location of the auxiliary axle mounting position on the outside of the vehicle frame rails. Refer to the suspension assembly drawing and mark the front edge of the auxiliary suspension side rails on the vehicle frame. (See Figure 5)
5. Correct any interferences that occur between the auxiliary suspension mounting surface and any existing frame bolts or brackets (located in the marked areas). The auxiliary suspension side rail(s) can be drilled to accommodate existing bolts.

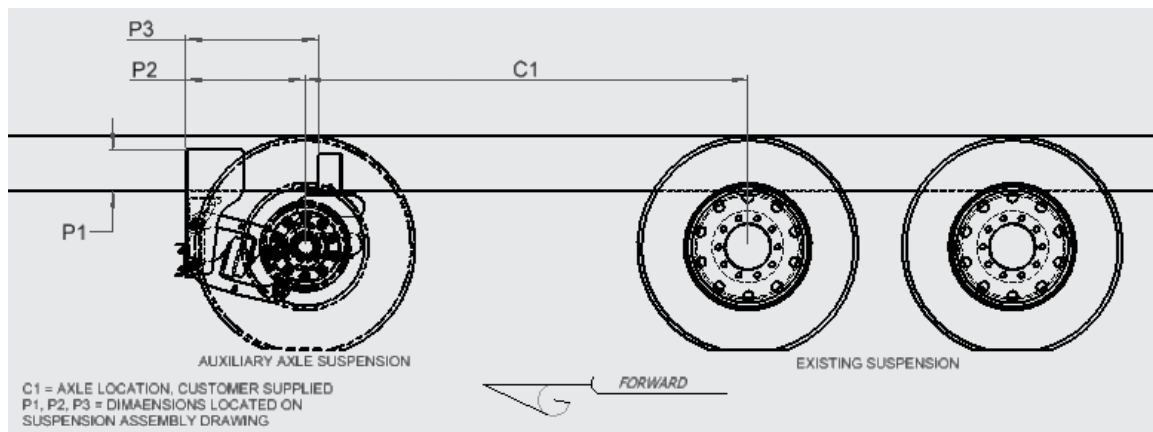


Figure 5. Suspension Mounting Position



- Before any modifications to the hanger are made, contact Engineering at (800) 660-2843. Refer to the suspension assembly drawing to verify that vehicle cross members and backing plates are positioned correctly for the intended axle location. (See Figure 5)

**⚠ WARNING: FAILURE TO PROPERLY AND SUFFICIENTLY ATTACH FRAME BOLT CONNECTIONS TO SUPPORT THE SUSPENSION OR REINFORCE THE VEHICLE FRAME CAN RESULT IN PREMATURE FRAME FAILURE, LOSS OF VEHICLE CONTROL, AND LOSS OF SUSPENSION WARRANTY COVERAGE. A CROSS MEMBER MUST BE WITHIN 12 INCHES (MINIMUM), FORE OR AFT OF THE FRAME BRACKET PIVOT BOLT CENTERLINE.**

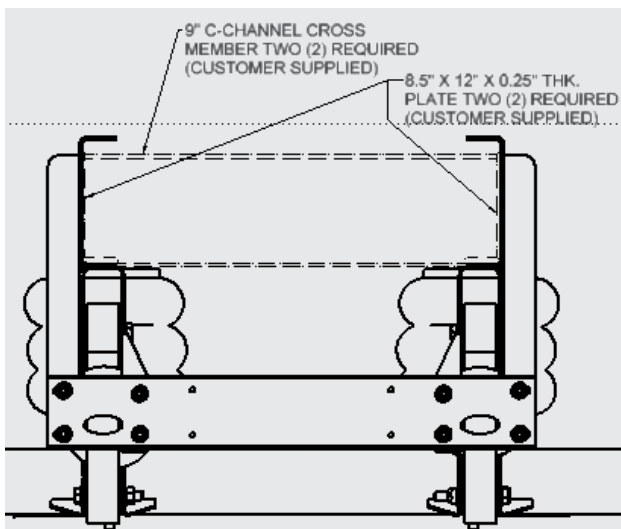


Figure 6. Cross Member Positioning (Customer Supplied)

## SUSPENSION FRAME RAIL INSTALLATION

- With the cross members and backing plates installed in the intended suspension location, raise the auxiliary suspension into position. Use both the cross members and the previously marked suspension side rail marks as locators.
- Once the suspension is positioned, use C-clamps to hold the suspension side rail and saddle on the truck frame rail.

**NOTE:** The entire auxiliary suspension mounting surfaces must be flush with both the side and bottom of the vehicle frame rails or spacers. Failure to do so will void the suspension warranty. (See Figure 8)

- The auxiliary suspension must remain aligned (parallel) to the other properly aligned axles on the vehicle during the entire installation process. Verify the alignment of the suspension using a trammel bar or measuring tape.

**NOTE:** Due to the steering of the axle, measuring to the wheel centers is not recommended. For a proper alignment measure to the front edge of the suspension side rail.

- Verify that the measurements between the suspension hanger brackets (see Figure 9) at the frame and at the bottom of the brackets are within the allowable tolerance. Hangers must be parallel to one another vertically.
- Minimum recommended bolt hole pattern for hanger to frame attachment. Figure 7 shows a reference mounting bolt hole pattern. Use 5/8 - 11 Hex Bolt Grade 8 for frame mounting and torque to 180 ft-lbs. Contact Hendrickson Auxiliary Axle Customer Service with your specific bolt pattern for evaluation of applicability.

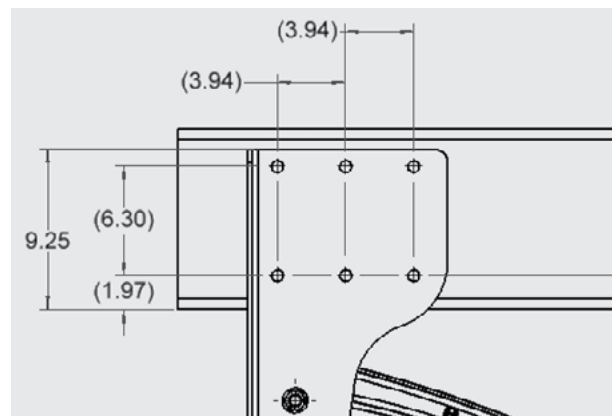


Figure 7. Reference Mounting Bolt Pattern

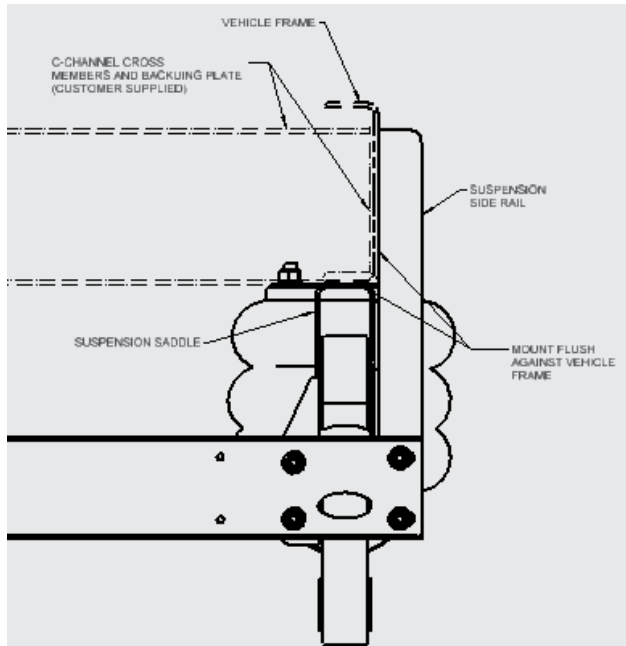


Figure 8. Suspension Mounting to Frame

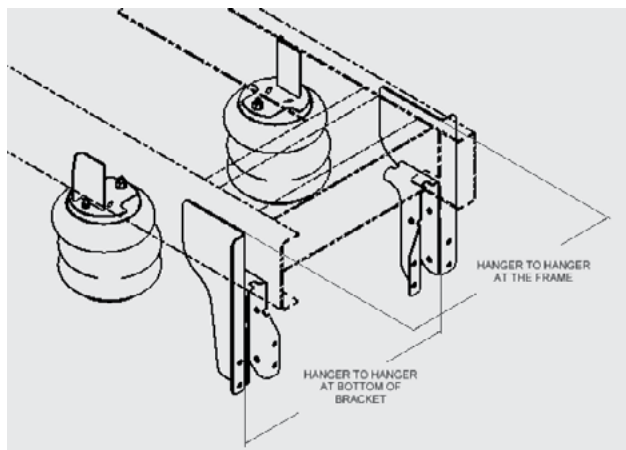


Figure 9. Hanger Positioning

## UPPER AIR SPRING PLATE ASSEMBLY AND AIR SPRING INSTALLATION

1. Raise and position the upper air spring plate assembly under the vehicle frame rail. Once the assembly is at the correct position (refer to the suspension assembly drawing), clamp it to the vehicle frame rail with C-clamps.
2. With the upper air spring plate assembly tight against the vehicle frame rail, mark the location of the mounting holes on the outward side of the assembly. Punch mark all hole centers. (See the supplied suspension assembly drawing for recommended hole locations.)

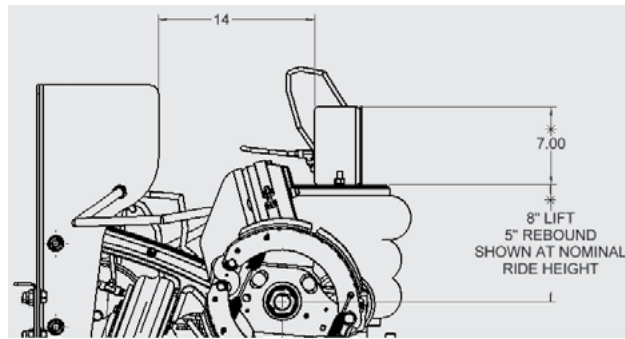


Figure 10. Upper Air Spring Plate Location

3. Drill one 13/16" diameter hole through the upper air spring assembly, vehicle frame rail and the customer supplied backing plate. Check the upper air spring plate assembly location. Fasten with one 5/8"-11 x 2-1/4" large flange grade 8 bolt, 5/8" SAE grade 8 and a 5/8" IFI grade C prevailing-torque type steel hex flange nut. (See Figure 11) Torque to 180 ft-lbs.

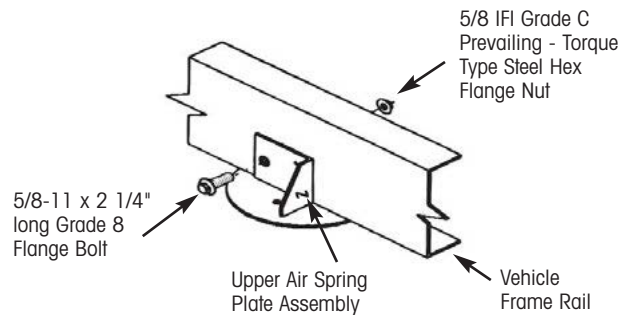


Figure 11. Upper Air Spring Plate Assembly Installation

4. Drill, install and snug the remaining fasteners on that side.
5. Inspect the position of the opposite side of the suspension. Make sure the upper air spring plate assembly is snug against the vehicle frame rail. Also check that the auxiliary axle is parallel to existing axles. Repeat steps #3 and #4 for the opposite side of the suspension.
6. Remove the clamps from both sides of the vehicle frame rail.
7. Align the upper air spring stud with the hole on the upper air spring plate assembly. Insert and reinstall fasteners.

## AXLE ADJUSTMENTS

### TOE SETTING

Toe is the relationship of the distance between the front of the tires and the distance between the rear of the tires on the same self-steer axle measured at spindle height. When the front distance is less than the rear distance, the wheels are in a "toe-in" condition. (See Figure 12)

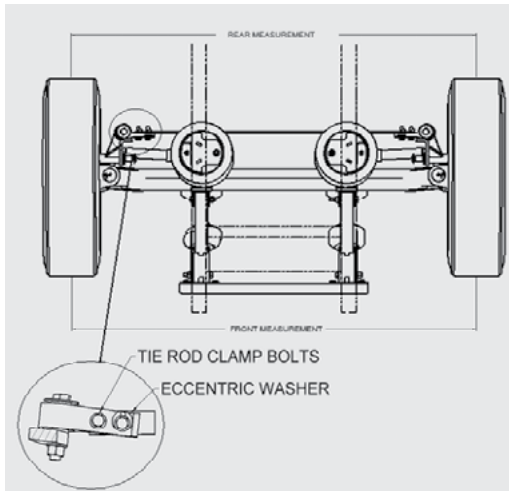


Figure 12. Determining TOE

1. Lift axle until tires are free to spin. Scribe a line on center tread of each tire while rotating tires.
2. Use a trammel bar or tape measure to measure the distance between the scribed lines on the front and rear of the tires at spindle height.
3.
  - a. Compliant Tie Rod: Loosen the tie rod clamp bolts. Rotate eccentric washer to a toe setting of  $\frac{1}{16}$ " to  $\frac{1}{8}$ " toe-in. Rotate CW to increase toe and CCW to Decrease. (See Figure 12)
  - b. Rigid Tie Rod: Loosen the tie rod clamp bolts. Rotate tie rod tube to provide a toe-in setting of  $\frac{1}{16}$ " to  $\frac{1}{8}$ " toe-in.
4. Torque the clamp bolts to Hendrickson Auxiliary Axle System's recommended values. (See Appendix)

### TURN ANGLE - MECHANICAL STOP

A mechanical turn angle stop (bolt) is an adjustable fastener that limits the steer axle's turn radius angle and allows users to avoid tire contact with vehicle accessories. Customer supplied axle(s) must have a turn angle stop. It is important that the stop is set so wheel interference does not occur.

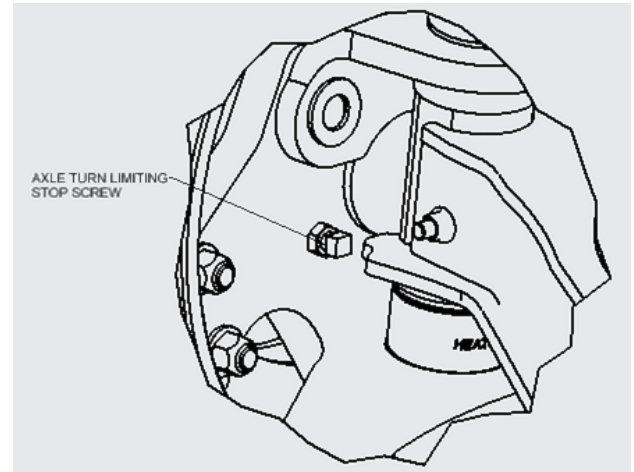


Figure 13. Axle Turn Limiting Stop Screw

1. Adjust the axle turn limiting stop screw for maximum turn angle (See Assembly Drawing) while providing adequate chassis clearance.
2. Torque the clamp bolts to Hendrickson Auxiliary Axle System's recommended values. (See Suspension Assembly Drawing.)

**NOTE:** Factory setting of turn limiting screw varies.

## OPTIONS

### AXLE CONTROLS

When operating a truck in reverse (backing), a conventional self-steering axle must be either raised or locked into a non-steering configuration. See [H] HAC Series Air Kit Literature for all options.

### LOCK STRAIGHT

The lock straight kit is available as an option on the Hendrickson COMPOSILITE™ suspension system. This kit straightens the self-steer axle wheels and locks them in place in the down or up position. This kit is only available on select models and must be specified at time of purchase.

### MANUAL AND AUTOMATIC LIFT

An alternative method to locking the steering mechanism is to lift the suspension when reversing. Various manual and electric air control kits are available as options. Contact Customer Service for more details.

## FINAL ASSEMBLY

1. Install all miscellaneous hardware and torque the mounting bolts as per the suspension assembly drawing.
2. Install air controls and plumbing.

3. Install wheels and torque lug nuts.
4. Check that the steer axle wheel bearings are filled with oil by inspecting hub cap fill level.
5. Install air brake lines for the steer axle brakes, per the chassis manufacturer's specifications.
6. Inspect brakes and adjust if necessary.

**NOTE:** Suspensions purchased from Hendrickson Auxiliary Axle Systems require brake adjustment, however they are supplied with automatic slack adjusters.

## FINAL INSPECTION

1. Check that all suspension bolts are tightened to Hendrickson Auxiliary Axle System's recommended torque values. (See Suspension Assembly Drawing)
2. Check the air control system for leaks and proper valve function.
3. Move the suspension through its entire travel with wheels and tires installed to ensure that adequate component clearances (i.e., air springs, brake chambers, etc.) have been provided.

**⚠ CAUTION:** With the vehicle unloaded, the ride (or down) air spring air pressure must be limited to a maximum of 30 psi to avoid improper vehicle loading or component damage.

4. Inspect the auxiliary axle for the following:
  - Wheels lug nuts are torqued.
  - Wheels rotate freely.
  - Brakes are properly adjusted.
  - Wheel hubs are sufficiently filled with the manufacturer's recommended lubricant.

## PREVENTATIVE MAINTENANCE

Regular lubrication intervals should be followed to help prevent premature wear to the kingpin bushings.

### GREASING AND LUBRICATION SPECIFICATIONS

COMPONENT	GREASING INTERVAL	GREASE
<b>KINGPIN BREAK IN</b>	5,000 miles or as needed	NLGI-1 or NLGI-2
<b>KINGPIN BUSHINGS</b>	10,000 miles or every 6 months	NLGI-1 or NLGI-2

## KINGPIN LUBRICATION

On the Hendrickson COMPOSILITE™, the kingpin grease fittings are located on the top and bottom of the kingpin grease caps.

1. Prior to greasing the kingpins on the vehicle the suspension must be in a loaded condition.
2. Clean off all the grease fittings with a clean shop towel prior to lubrication.
3. Lubricate the kingpins through the grease fittings on the top and bottom of the steering knuckle.
4. Force the required lubricant into the upper and lower kingpin grease fittings until new lubricant flows from locations A and B. (See Figure 14)

**NOTE:** Greasing at the lower zerk should purge grease from the thrust bearing shell.

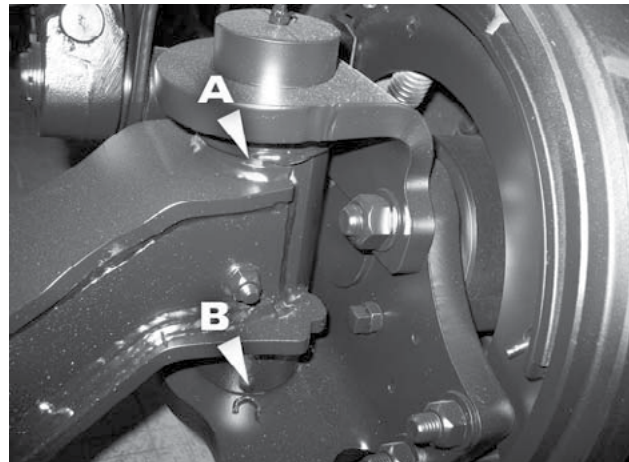


Figure 14. Kingpin Lubrication

## KINGPIN BUSHING INSPECTION INSPECTION PROCEDURE

1. Chock the wheels to help prevent the vehicle from moving. Set the parking brake.
2. Raise the lift axle off the ground.

### CHECKING THE UPPER KINGPIN BUSHING

3. Affix a magnetic base dial indicator on the axle and place the tip of the dial indicator on the inside of the upper kingpin connection as shown in Figure 15.

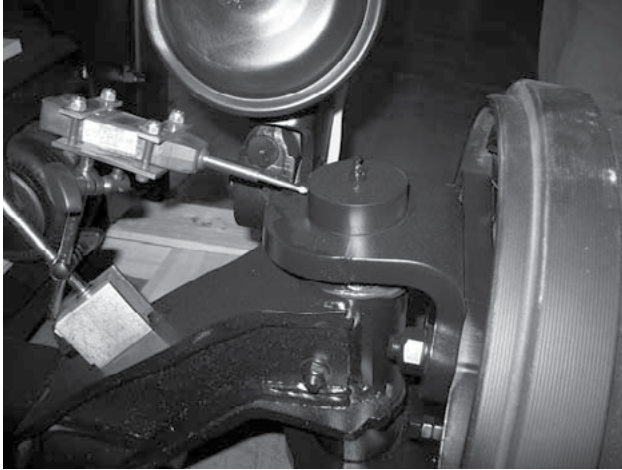


Figure 15. Upper Kingpin Bushing Check

4. Set the dial indicator to "0" zero.
5. Move the top of the tire in and out by applying reasonable, constant pressure and then releasing.
6. Check the reading on the dial indicator. If the dial indicator moves more than 0.025", the upper bushing is worn or damaged. Replace both bushings. Refer to the Kingpin Bushing Removal and Installation sections in this publication.

## CHECKING THE LOWER KINGPIN BUSHING

7. Install a dial indicator so that the base is on the axle and the indicator tip is against the inside of the bottom of the knuckle.
8. Set the dial indicator to "0" zero.

**IMPORTANT:** If one bushing is worn or damaged, it is mandatory to replace both the top and bottom bushings on that knuckle assembly.

## STEERING KNUCKLE INSPECTION AND ADJUSTMENT

### CHECKING VERTICAL END PLAY (UP AND DOWN MOVEMENT)

1. Chock the tires to help prevent the vehicle from moving.
2. Set the parking brake.
3. Raise the lift axle off the ground.

4. If necessary, remove the wheels, hubs and drums.
5. Place a dial indicator on each side of the axle as follows:
  - a. Ensure wheels are positioned straight ahead.
  - b. Place the magnetic dial indicator base on the axle.
  - c. Place the tip of the dial indicator on top of the upper kingpin connection.
6. Place a jack and a wood block (with a hole that allows clearance for the lower kingpin grease fitting) under the lower kingpin grease cap area. (See Figure 16)
7. Set the dial indicator to "0" zero.

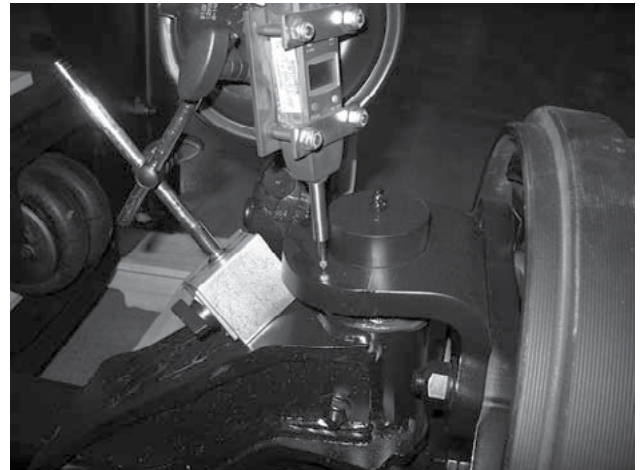


Figure 16. Vertical End Play Checking

8. Raise the jack until the dial indicator shows the end of vertical travel. Measure and record the dial indicator reading. Vertical (up and down) inspection clearance must be between 0.008" and 0.030".

### ADJUSTING VERTICAL END PLAY

1. If vertical clearance is greater than 0.030", replace the thrust bearing.
2. After replacing the thrust bearing, if vertical clearance is greater than 0.018", install shims (Hendrickson part no. R-001764-1Q12) between the top of the axle and the bottom of the upper kingpin connection to obtain the proper clearance specification. See the Steering Knuckle Disassembly section.



3. If vertical clearance is less than 0.008", remove the shims from between the top of the axle and the bottom of the upper kingpin connection to obtain the proper clearance specification.
4. Repeat steps 2 or 3 until proper clearance is achieved.
5. Lower the jack.

## STEERING KNUCKLE DISASSEMBLY

1. Remove the wheel and hub assembly.
2. Remove the brake components from the steering knuckle.
3. Remove the tie rod assembly. (See Figure 17)

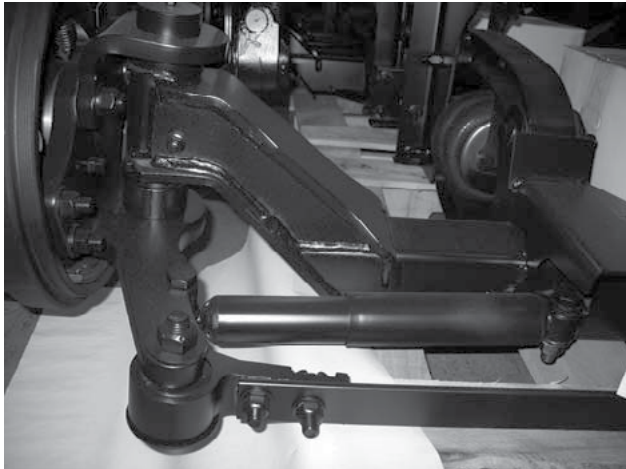


Figure 17. Knuckle Disassembly

4. Remove the bolts that connect upper kingpin assembly to the backbone.

**⚠ WARNING: REMOVAL OF THE BOLTS WILL ALLOW THE BACKBONE TO SEPARATE FROM THE AXLE WHICH CAN RESULT IN COMPONENT DAMAGE AND/OR PERSONAL INJURY. BACKBONE MUST BE SUPPORTED BEFORE REMOVAL OF THE TWO BOLTS.**

**HINT:** Remove the grease zerks from the knuckle assemblies. This will allow the knuckle assemblies to freely slide up and down the kingpins without creating back pressure.

5. Remove the backbone from the kingpin by sliding it down the kingpin.
6. Remove the upper kingpin assembly from the axle by sliding it up and off the kingpin.

## KINGPIN PREPARATION AND MEASUREMENT

### CLEANING THE GROUND OR POLISHED PARTS

- Use a cleaning solvent to clean ground or polished parts and surfaces. **DO NOT USE GASOLINE.**

**⚠ Caution:** Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to the parts will result.

### CLEANING THE ROUGH PARTS

- Rough parts can be cleaned with the ground or polished parts. Rough parts can also be cleaned in hot solution tanks with a weak alkaline solution. The parts must remain in the hot solution tanks until they are completely cleaned and heated.

### DRYING THE CLEANED PARTS

- Parts must be dried immediately after cleaning. Dry the parts with clean paper towels, clean rags or compressed air. Do not dry bearings by spinning with compressed air. Damage to the bearings will result.

## PREVENTING CORROSION ON CLEANED PARTS

- Apply a light coating of oil to all cleaned and dried parts that are going to be reused. Do not apply oil to the brake lining or the brake drums. If parts are to be stored, apply an effective rust inhibitor to all surfaces.

**⚠ WARNING: TO HELP PREVENT SERIOUS EYE INJURY, ALWAYS WEAR PROPER EYE PROTECTION WHEN YOU PERFORM VEHICLE MAINTENANCE OR SERVICE.**

**⚠ WARNING: SOLVENT CLEANERS CAN BE FLAMMABLE, POISONOUS AND CAUSE BURNS. TO HELP AVOID SERIOUS PERSONAL INJURY, CAREFULLY FOLLOW THE MANUFACTURER'S PRODUCT INSTRUCTIONS/GUIDELINES AND THE FOLLOWING PROCEDURES:**

- 1. WEAR PROPER EYE PROTECTION.**
- 2. WEAR PROTECTIVE CLOTHING.**
- 3. WORK IN A WELL-VENTILATED AREA.**
- 4. DO NOT USE GASOLINE, SOLVENTS OR OTHER MATERIALS THAT CONTAIN GASOLINE THAT CAN EXPLODE.**
- 5. HOT SOLUTION TANKS OR ALKALINE SOLUTIONS MUST BE USED CORRECTLY. FOLLOW THE MANUFACTURER'S RECOMMENDED INSTRUCTIONS AND GUIDELINES CAREFULLY TO HELP PREVENT PERSONAL ACCIDENT OR INJURY.**

1. Prepare and polish the kingpin by removing all grease and excess debris using a fine grit (220 grit or higher) emery cloth and parts solvent. (See Figures 19 through 22)



Figure 19.



Figure 20.



Figure 21. Dirty Kingpin



Figure 22. Kingpin After Cleaning



2. Inspect the kingpin for wear or damage. Use a micrometer and measure the upper and lower kingpin in two locations. Positions must be 90 degrees (perpendicular) from each other. (See Figures 23 through 26) If the kingpin diameter is less than 1.802", kingpin replacement may be necessary. Contact the Hendrickson Customer Service Department at 800-660-2843.

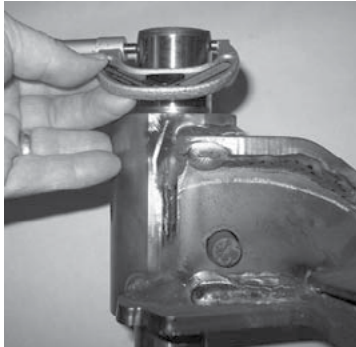


Figure 23.

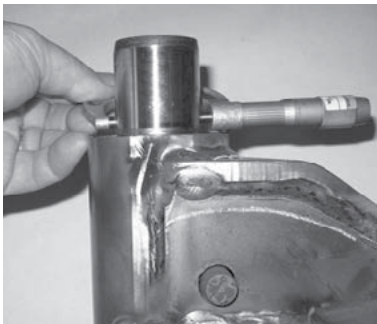


Figure 24.



Figure 25.



Figure 26.

## FABRICATED KNUCKLE KINGPIN BUSHING INSTALLATION

1. A hydraulic press with a minimum forcing capacity of 5 tons will be required.

**⚠ WARNING: BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SET-UP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY AND/OR COMPONENT DAMAGE.**

2. Install the backbone assembly or upper kingpin connection in the press.
3. Remove worn kingpin bushing housing
4. Install the new kingpin housing from the machined side (axle side) of the backbone ensuring squareness between the housing and the backbone.

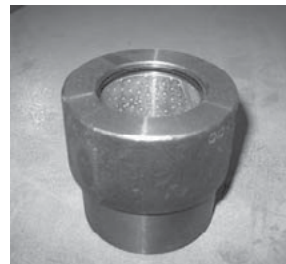


Figure 27.

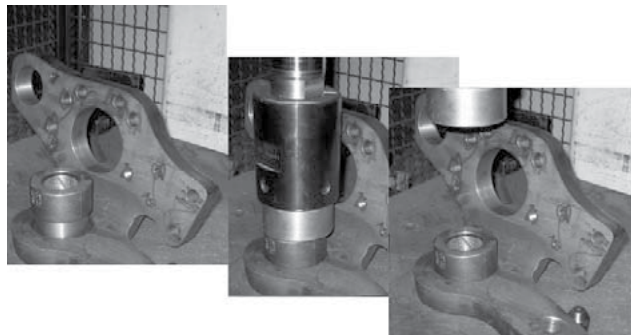


Figure 28.



## LIFT BEAM URETHANE BUSHINGS

REPLACEMENT OF THE LIFT BEAM URETHANE BUSHINGS AND INNER SLEEVE.

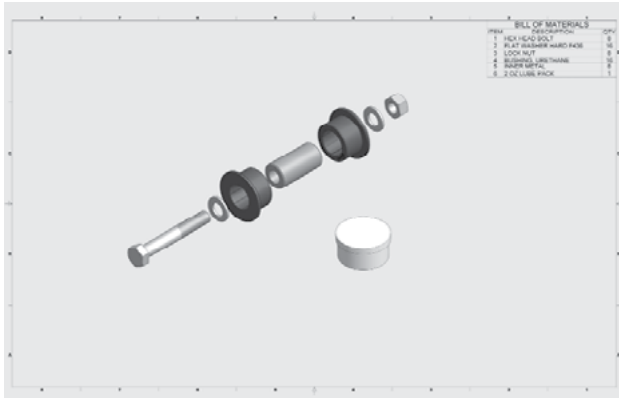


Figure 29. Urethane Bushing Service Kit

### Pivot Bushing/Bolt Kits:

SC10/13: R-008839

SC10/13 Adjustable: R-008839-1

SC20: R-008839-2

SC20 Adjustable: R-008839-3

Remove all urethane bushings and internal metal sleeves. Clean the ID of the lift beam bushing holes. Press in the urethane bushings. Lube the ID of the bushings and the OD of the sleeves with lubricant provided in service kit. Press in the internal metal sleeves. Once completed, ensure that the inner metal sleeves are flush with the urethane bushing.

## LIFT AXLE (LA) AND COMPLIANT TIE ROD (CTR) STRUCTURAL INSPECTION

Periodic inspection of the LA and CTR are strongly recommended. Cleaning the LA and CTR prior to the inspection will improve the ability to see all structural component condition.

Contact Hendrickson Auxiliary Axle Customer Service for replacement parts or parts kits (800) 660-2843.

## PRE SC ROUND TUBE TIE ROD ADJUSTMENT

In order for a steerable suspension system to steer or track correctly, it is necessary for the wheels to be in a "toe-in" condition. Toe is the difference between the foremost and rearmost point on the tires at spindle height. When the foremost distance is less than the rearmost distance, the wheel pair is said to have toe-in. Toe not only affects tire wear, but also straight-line

stability and corner handling. Having a proper toe setting is important for directional stability. On steerable axles, the toe is pre-set during assembly, however sometimes it becomes necessary to adjust the toe. It is also necessary to verify the toe upon axle installation.

For additional information regarding toe settings or lift axle systems, please contact the Hendrickson Customer Service Department at 800-660-2829.

To adjust the toe setting, follow these instructions.

### DETERMINING THE TOE SETTING

**⚠ WARNING: NEVER PERFORM MAINTENANCE ON A SUSPENSION WITHOUT FIRST RELEASING AIR PRESSURE FROM AIR SPRINGS. COMPONENT DAMAGE, INJURY OR DEATH CAN OTHERWISE RESULT.**

1. Lift axle until tires are free to spin.
2. Support the suspension with jack stands.
3. Scribe a line on center tread of each tire while rotating tires.
4. Use a trammel bar or tape measure to measure the distance between the scribed lines on the front side of the tires at spindle height.
5. Use a trammel bar or tape measure to measure the distance between the scribed lines on the back side of the tires at spindle height.
6. Subtract the distance between the front side and back side of the tires. This is the toe setting.  
Toe Setting = Rear Distance - Front Distance
7. If the toe setting is set in between 1/16" and 1/8", no adjustment is required. If the toe setting is set in more or less than the 1/16" to 1/8" range, refer to the Adjusting the Toe Setting section of this publication as adjustment is necessary.

### ADJUSTING THE TOE SETTING

1. Loosen the tie rod clamp bolts, stabilizer mounting u-bolts (if applicable) and nuts.
2. Rotate tie rod tube to provide a toe-in setting of 1/16" to 1/8".
3. Torque the clamp bolts to 50 ft-lbs.

### CAST KNUCKLE KINGPIN BUSHING REMOVAL

**NOTE:** A hydraulic press with a minimum forcing capacity of 2.5 tons (minimum press capacity of 5,000 psi or use an arbor press) is required.

**⚠ WARNING: BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SETUP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY OR COMPONENT DAMAGE.**

1. Remove the grease cap retaining ring.
2. Install the backbone upside down in press. Be sure to support the backbone assembly so that it sits in-line with the press. (See Figure 30)
3. Use the grease cap to press out the kingpin bushing and seal. Remove the grease zerk in the grease cap or use a hollow driver, to press out the kingpin bushing.

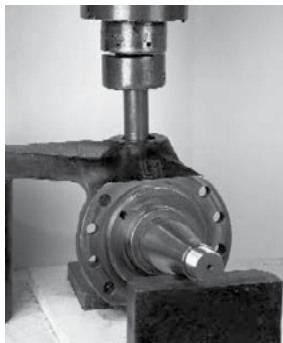


Figure 30.

4. Use the same procedure to remove the kingpin bushing in the upper kingpin connection.
5. Clean the parts and then inspect before reassembling.

### CAST STEERING KNUCKLE BORE MEASUREMENT

Complete the following steering knuckle bore inspection and the measurement instructions prior to installing the kingpin bushing.

1. Measure the upper knuckle bore inside diameter at two locations. Always use an inside micrometer or a telescoping gauge when taking a knuckle bore measurement. Some out-of-roundness at the top and bottom of the bore edges is acceptable. The steering knuckle bore diameter is 1.938" +/- 0.003".
2. Measure the upper and lower bore in two positions and at two locations. The two positions must be 90 degrees opposed from each other. (See Figures 31 through 32) If the average measurement is more than the knuckle bore maximum diameter specification, replace the knuckle.



Figure 31.

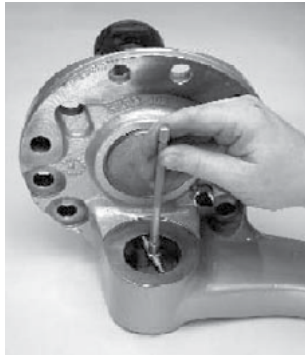


Figure 32.

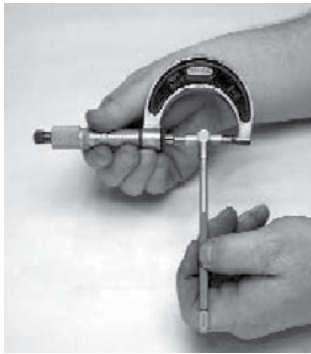


Figure 33.

## KINGPIN BUSHING INSTALLATION

1. A hydraulic shop press with a minimum forcing capacity of 5 tons will be required.

**⚠ WARNING: BEFORE APPLYING HYDRAULIC PRESSURE TO ANY TOOLING SET-UP, ALWAYS CHECK TO BE SURE THE PRESS PLATE, ADAPTERS AND COMPONENTS BEING WORKED ON ARE POSITIONED PROPERLY, I.E. "IN LINE" WITH THE RAM. IMPROPER POSITIONING CAN CAUSE PERSONAL INJURY OR COMPONENT DAMAGE.**

2. Install the backbone assembly, steering arm or upper kingpin connection in the press.
3. Install the kingpin bushing from the machined side (axle side) of the backbone using a bushing driver. Press in bushing to a depth of no less than 15/64" (.236") or 6 millimeters and no more than 5/16" (.32") or 8 millimeters. (See Figures 34 and 35)

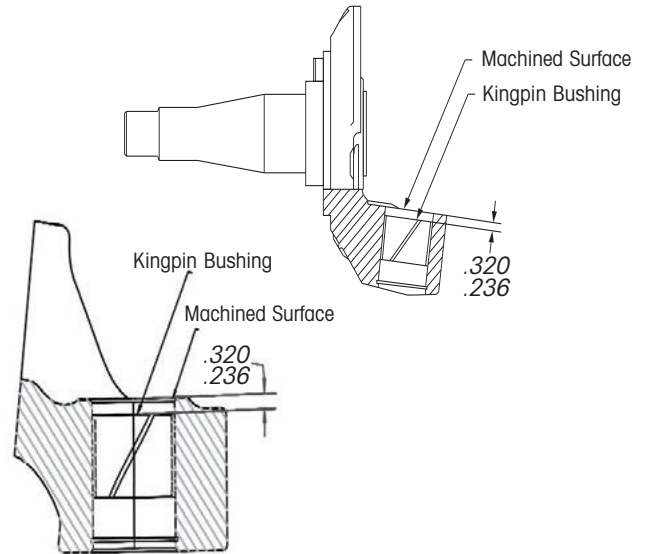


Figure 34.



Figure 35.

4. Following this procedure, it is necessary to ream the kingpin bushings to fit the kingpins. (See Kingpin Bushing Reaming Instructions.)

## KINGPIN BUSHING REAMING

**⚠ Caution:** Ream the kingpin bushings with an adjustable straight flute reamer. Do not hone or burnish the kingpin bushings. Honing or burnishing will damage the bushings and void the warranty.

**⚠ WARNING:** WHEN INSTALLING STEERING KNUCKLE COMPONENTS IN A VICE, IT IS NECESSARY TO PROTECT THE MACHINED SURFACES FROM

**GOUGES AND/OR MARRING BY USING BRASS JAWS. FAILURE TO DO SO CAN CAUSE PREMATURE PART DAMAGE, DAMAGE TO THE STEERING KNUCKLE COMPONENTS, LOSS OF WARRANTY, LOSS OF VEHICLE CONTROL, PERSONAL INJURY OR PROPERTY DAMAGE.**

1. Install the backbone assembly in a vise with brass jaws. It is acceptable to mount the knuckle components in a vise either vertically or horizontally when performing the reaming procedure.
2. Install the reamer into the backbone until the blades touch the kingpin bushing.

**NOTE:** The bushing bore diameter is to be 0.001 larger than the kingpin diameter.

3. Rotate the reamer smoothly with light downward pressure. Do not apply too much pressure. (See Figure 36)

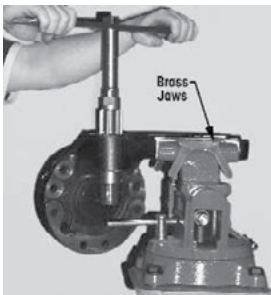


Figure 36.

4. Slide the reamer out of the bottom of the backbone assembly. If it is necessary to remove the reamer from the top, rotate the reamer opposite of the cutting rotation.
5. Clean and remove all bearing material from the knuckle assembly. Be sure to remove material from the grease channels and dimples.
6. Clean the 5/8" brake backing plate bolts with a wire wheel and run a tap through the threads of the backbone / upper kingpin connection. Flush

out with brake cleaner and dry with compressed air.

7. Repeat steps 1 through 6 to the upper kingpin connection.

**⚠ WARNING: PRIOR TO INSTALLATION ENSURE THAT ALL RESIDUAL LOCTITE MATERIAL IS REMOVED FROM THE MOUNTING BOLTS AND THE THREADED HOLES IN THE UPPER KINGPIN CONNECTION, AND NEW LOCTITE 277 OR EQUIVALENT IS APPLIED TO HELP ENSURE THAT THE BOLTS SUSTAIN THE PROPER TORQUE REQUIREMENT. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.**

**NOTE:** The Hendrickson Genuine Part socket head cap screw (PN: 6110C125H4A8) comes with a pre-applied loctite compound.

8. Install the backbone and upper kingpin connection on the kingpin.
9. Check for the proper fit by rotating the knuckle assembly back and forth to verify there is no binding on the kingpin. (See Figures 37 and 38)
10. If the bushing is too tight, repeat steps 1 through 9 until the proper clearance is achieved.

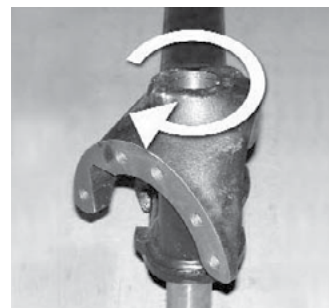


Figure 37.

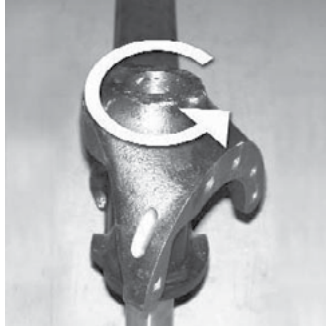


Figure 38.

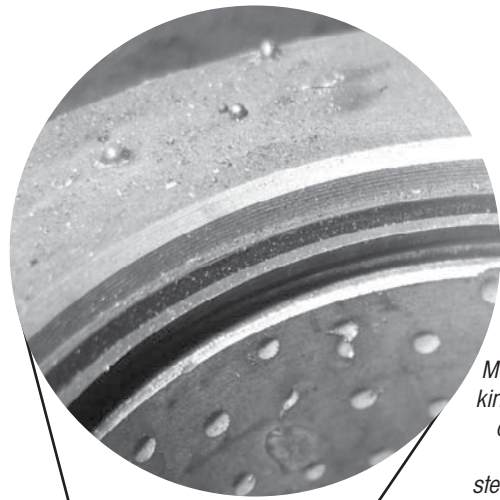
### KINGPIN SEAL INSTALLATION

1. Place the backbone in a vise with brass jaws or place on a suitable workbench. The backbone will have the machined surface facing up (axle side up).
2. Lay the kingpin seal into the bore of the backbone. The seal lip should face outward (toward the axle).
3. Use a bushing driver tool to press the seal firmly into the backbone.
4. Install the kingpin seal until it makes contact with the kingpin bushing. (See Figures 39 and 40)
5. Repeat steps 1 through 4 on the upper kingpin connection.

### STEERING KNUCKLE ASSEMBLY

After replacing the kingpin bushings, it is necessary to reassemble the steering knuckle assemblies.

1. Install the thrust bearing on the lower kingpin, so the top side is up (the thrust bearing may be stamped "TOP" or the black seal will designate the top side), when the axle is in the operating position.
2. Pack the bearing dimples with multipurpose grease (NLGI Grade 2).
3. Install the backbone assembly on the kingpin. It will be necessary to support the backbone assembly with a bottle jack and a block of wood under the backbone assembly.



*Magnification of kingpin bushing and lip seal installed in steering knuckle.*

Figure 39.

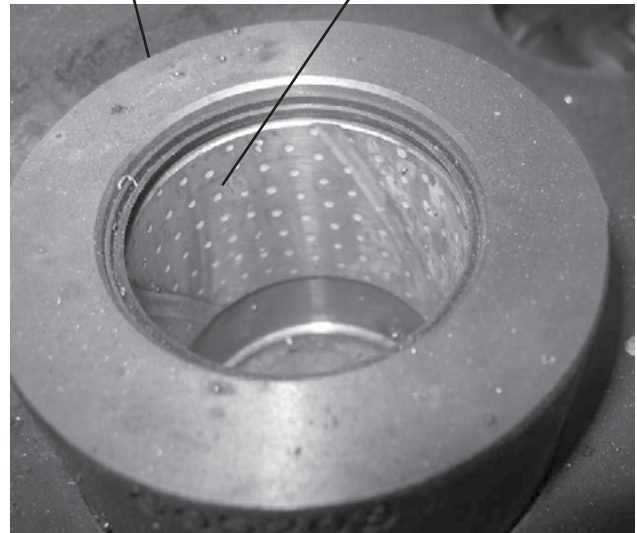


Figure 40.

**Hint:** The easiest way to install the knuckle is with the grease cap not installed in the backbone assemblies. In this manner, it does not create back pressure. The assembly can then freely slide up and down on the kingpin.

4. Raise the bottle jack so that there is no free play between the backbone, thrust bearing and the bottom of the axle.
5. Install the upper kingpin connection on the upper kingpin. (See Figure 41)
6. Install the left and right brake backing plate bolts finger tight. These are for guide purposes only.

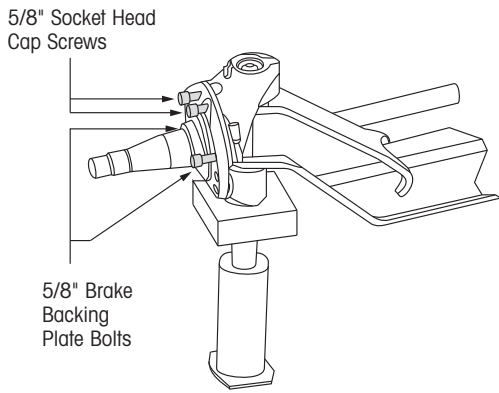


Figure 41.

**NOTE:** Two guide studs may be substituted in place of the brake backing plate bolts.

7. Install the two new socket head cap screws until they are finger tight.
8. Apply slight upward pressure on the upper kingpin connection.
9. Insert feeler gauges between the upper kingpin connection and the top of the axle. Check the clearance between the upper kingpin connection and the top of the axle. (See Figure 42)
10. Remove the brake backing plate bolts and socket head cap screws. (See Figure 41)
11. Remove the upper kingpin connection.
12. Install the appropriate amount of shims to achieve 0.008" to 0.011" clearance between the upper kingpin connection and the top of the axle.



Figure 42.

**EXAMPLE:** If 0.050" clearance were measured, 0.040" shims would be required to obtain the required 0.008" to 0.011" clearance.

13. Install the upper kingpin connection onto the kingpin.
14. Slide two 0.010" feeler gauges on each side of the kingpin between the axle and the upper kingpin connection.

**⚠ WARNING:** PRIOR TO INSTALLATION ENSURE THAT ALL RESIDUAL LOCTITE MATERIAL IS REMOVED FROM THE MOUNTING BOLTS AND THE THREADED HOLES IN THE UPPER KINGPIN CONNECTION, AND NEW LOCTITE 277 OR EQUIVALENT IS APPLIED TO HELP ENSURE THAT THE BOLTS SUSTAIN THE PROPER TORQUE REQUIREMENT. FAILURE TO DO SO CAN CAUSE LOSS OF VEHICLE CONTROL RESULTING IN PERSONAL INJURY OR PROPERTY DAMAGE.

15. Install the socket head cap screws and tighten to 175-200 ft-lbs torque.

**NOTE:** The Hendrickson Genuine Part socket head cap screws (PN: R-6110C125H4H8). Apply LocTite.

16. Once the final torque of the socket cap screws has been obtained, remove the two 0.010" feeler gauges and lower the bottle jack. Check the remaining bolt holes to ensure that the bolts will thread in.

### Vertical End Play

Checking vertical end play can be performed with the wheel end assembly on.

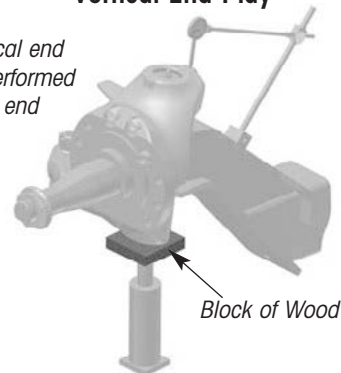


Figure 43.



**APPENDIX A  
RECOMMENDED BOLT TORQUES**

Refer to suspension assembly drawings for bolt torque values.

**AUXILIARY SUSPENSION LOCATION**

1. Locate your vehicle wheel base on the table below.
2. Follow the row to the right column that most closely represents your vehicle's front inside turn angle.

COMPOSILITE™ SUSPENSION LOCATION CHART

VEHICLE WHEEL BASE	FRONT AXLE INSIDE TURN ANGLE		
	35°	40°	45°
140"	120"	100"	84"
160"	137"	115"	96"
180"	154"	129"	108"
200"	171"	143"	120"
220"	189"	157"	132"
240"	206"	172"	144"
260"	223"	186"	156"
280"	240"	201"	168"

Table 1. Suspension Location Chart

3. The number in the front axle inside turn angle column (shaded area) is the maximum distance that the self-steer axle can be placed in front of the vehicle's rear tandem. (See Figure 44)

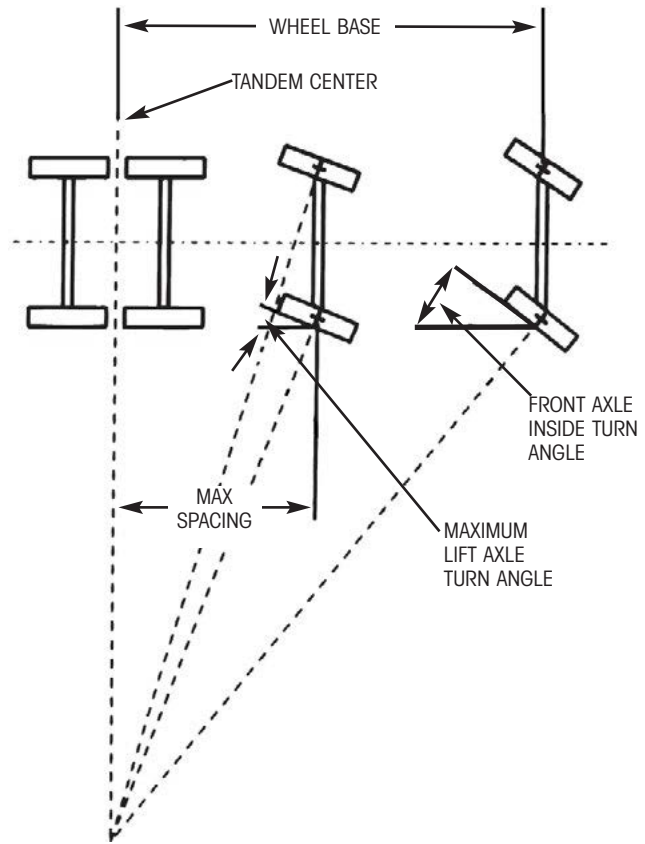


Figure 44. Maximum Auxiliary Suspension Spacing

COMPOSILITE™ STEERABLE LIFT AXLE SPECIFICATIONS

MODEL	MAXIMUM CAPACITY (lbs.)	APPLICATION WEIGHT (lbs.)		RIDE HEIGHTS (inches +/- 1")
		Truck	Trailer (SCW)	
SC10	10,000	675	664	12.5 - 20.5
SC13	13,500	796	785	8.5 - 18.5
SC20	20,000	1,340	1,315	9.5 - 13.5
SCO13	13,500	856	N/A	8.5 - 18.5
SCO20	20,000	1,326	N/A	9.5 - 13.5
SCH10	10,000	1,133	N/A	10.5 - 20.5
SCR13	13,500	1,029	N/A	9.0 - 15.0

Table 2. Steerable Lift Axle Specifications



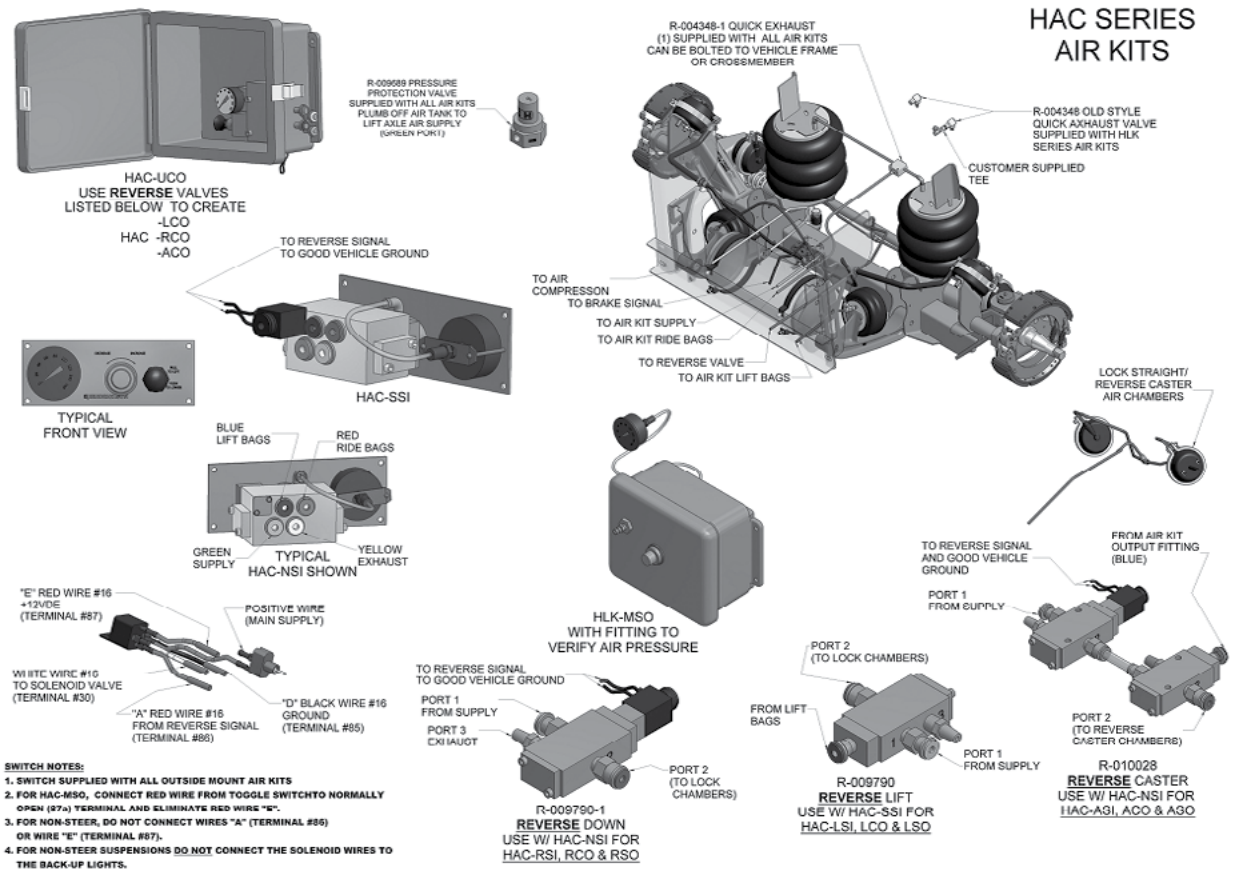


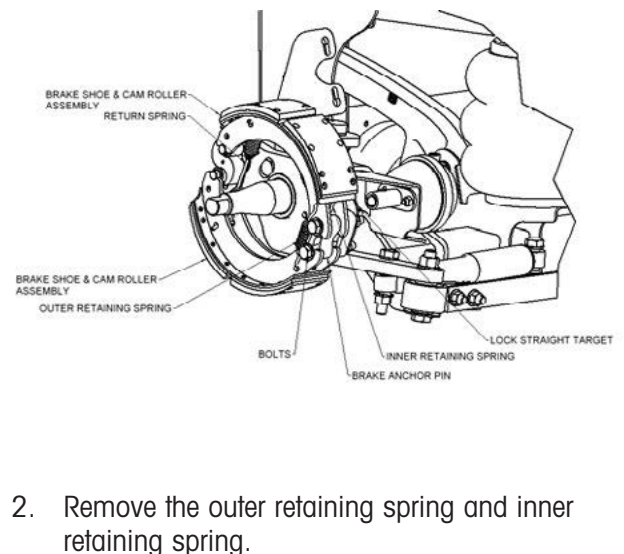
Figure 45. HAC Series Air Kit

## APPENDIX B BRAKE REPLACEMENT

**⚠ WARNING: ADEQUATE SUSPENSION SUPPORT MUST BE PROVIDED! FAILURE TO PROVIDE ADEQUATE SUSPENSION SUPPORT COULD RESULT IN SERIOUS BODILY HARM OR FATAL INJURY. EYE PROTECTION STRONGLY RECOMMENDED**

For replacement brake kits, contact the Hendrickson Customer Service Department at (800) 660-2843

1. Raise and support the suspension to which the brakes are to be replaced. Remove wheel, brake drum and axle end components to expose the brake shoes.



2. Remove the outer retaining spring and inner retaining spring.

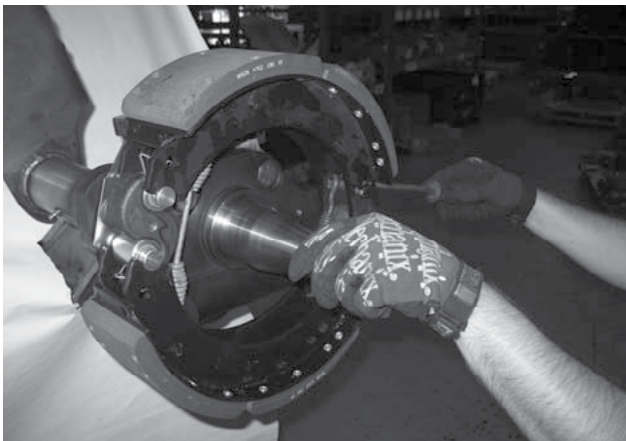


Figure 46. Removal of Outer and Inner Retaining Spring

3. Support the lower brake shoe assembly and remove the return spring. Set parts aside and remove the upper brake shoe.



Figure 47. Removal of Return Spring

4. Remove the brake bolts and brake anchor pin. If lock straight target is present, note position for proper reassembly location.

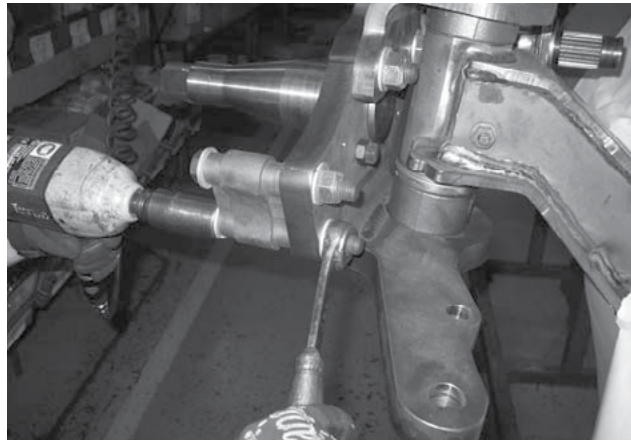


Figure 48. Removal of Brake Bolts and Anchor Pin

5. Replacement brake kit for each specific axle will have the necessary parts to be replaced. Discard worn or damaged parts. If a part is not included in the kit, contact customer service (800) 660-2843.
6. Install new parts in reverse order from step 4. Brake bolts through the anchor pin are to be installed with a torque of 160 ft-lbs.

When reinstalling the spring, be sure the spring is completely clipped into the mounting hole. Failure to do so could result in brake failure.

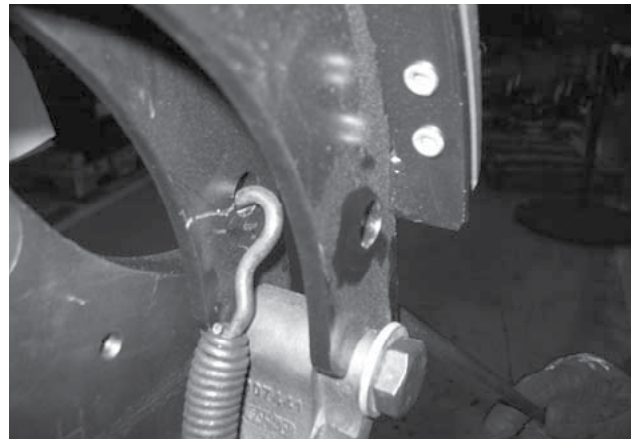


Figure 49. Spring Clipped Completely Into Mounting Hole

www.hendrickson-intl.com



Auxiliary Axle Systems  
277 North High Street  
Hebron, OH 43025 USA  
740.929.5600  
Fax 740.929.5601

Auxiliary Axle Systems  
250 Chrysler Drive, Unit #3  
Brampton, ON L6S 6B6 Canada  
905.789.1030  
Fax 905.789.1033

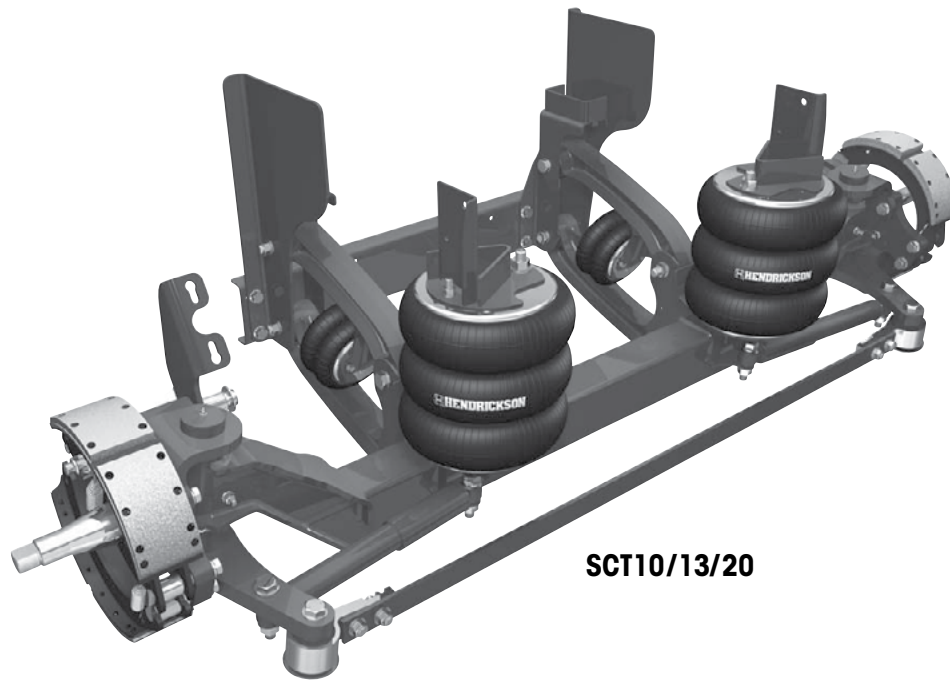
# **H** PARTS LIST

## REPLACEMENT PARTS COMPOSITITE™ SC STEERABLE SUSPENSION SYSTEMS

LIT NO: H732

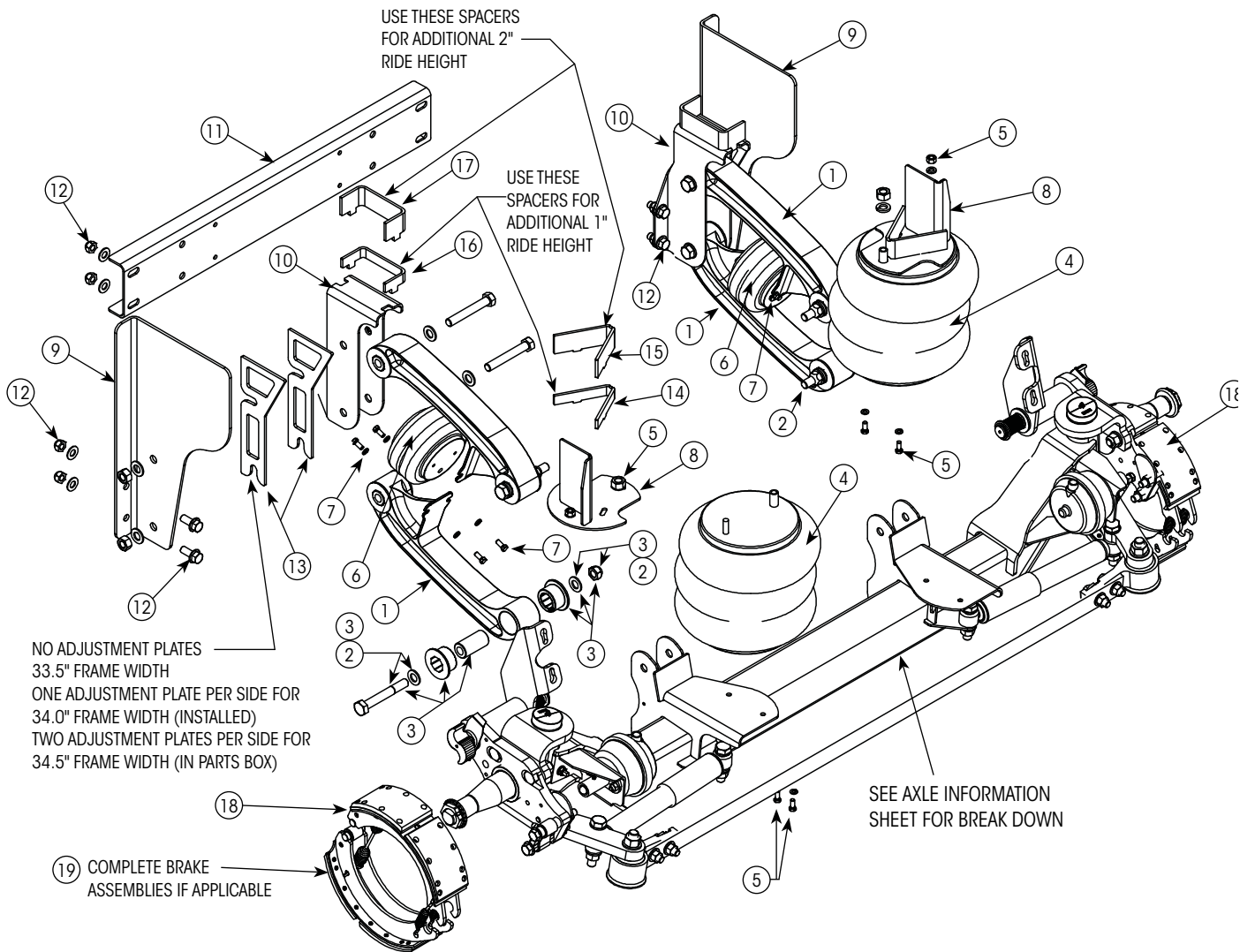
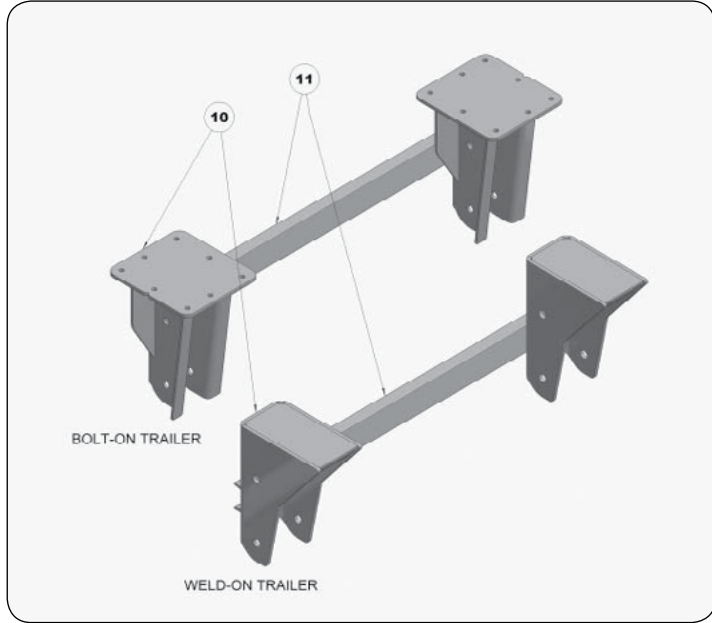
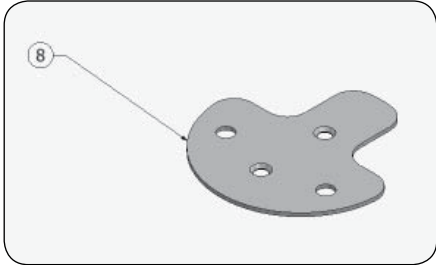
DATE: October 2011

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SCT10/13/20

REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS





# REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS

ITEM	DESCRIPTION	YEARS OF SERVICE	SUSPENSION SERIES	TRUCK PREFIX	QTY.	PART NO.
1	BEAM ASSEMBLY	2010 - Present	SC 10K	SCT10	4	R-009690
		2010 - Present	SC10K ADJ	SCT10	4	R-009690
		2010 - Present	SC13K	SCT13	4	R-008940
		2010 - Present	SC13K ADJ	SCT13	4	R-008940
		2010 - Present	SC20K	SCT20	4	R-010125
		2010 - Present	SC 20K ADJ	SCT20	4	R-010125
2	PIVOT BOLT KIT	2010 - Present	SC 10K	SCT10	1	R-005009
		2010 - Present	SC10K ADJ	SCT10	1	R-007659
		2010 - Present	SC13K	SCT13	1	R-005009
		2010 - Present	SC13K ADJ	SCT13	1	R-007659
		2010 - Present	SC20K	SCT20	1	R-007040
		2010 - Present	SC 20K ADJ	SCT20	1	R-007961
3	BUSHING & PIVOT BOLT KIT	2010 - Present	SC 10K	SCT10	1	R-008839
		2010 - Present	SC10K ADJ	SCT10	1	R-008839-1
		2010 - Present	SC13K	SCT13	1	R-008839
		2010 - Present	SC13K ADJ	SCT13	1	R-008839-1
		2010 - Present	SC20K	SCT20	1	R-008839-2
		2010 - Present	SC 20K ADJ	SCT20	1	R-008839-3
4	RIDE SPRING	2010 - Present	SC 10K	SCT10	2	R-B-14487
		2010 - Present	SC10K ADJ	SCT10	2	R-B-14487
		2010 - Present	SC13K	SCT13	2	R-B-14487
		2010 - Present	SC13K ADJ	SCT13	2	R-B-14487
		2010 - Present	SC20K	SCT20	2	R-01346
		2010 - Present	SC 20K ADJ	SCT20	2	R-01346
5	RIDE SPRING BOLT KIT	2010 - Present	SC 10K	SCT10	2	R-007596
		2010 - Present	SC10K ADJ	SCT10	2	R-007596
		2010 - Present	SC13K	SCT13	2	R-007595
		2010 - Present	SC13K ADJ	SCT13	2	R-007596
		2010 - Present	SC20K	SCT20	2	R-01357
		2010 - Present	SC 20K ADJ	SCT20	2	R-01357
6	LIFT SPRING	2010 - Present	SC 10K	SCT10	2	R-005079
		2010 - Present	SC10K ADJ	SCT10	2	R-005079
		2010 - Present	SC13K	SCT13	2	R-005079
		2010 - Present	SC13K ADJ	SCT13	2	R-005079
		2010 - Present	SC20K	SCT20	2	R-010214
		2010 - Present	SC 20K ADJ	SCT20	2	R-010214
		1999 - Present	PST13 KIT ONLY	PST13	2	R-B-14486
7	LIFT SPRING BOLT KIT	2010 - Present	SC 10K	SCT10	1	R-A-1134
		2010 - Present	SC10K ADJ	SCT10	1	R-A-1134
		2010 - Present	SC13K	SCT13	1	R-A-1134
		2010 - Present	SC13K ADJ	SCT13	1	R-A-1134
		2010 - Present	SC20K	SCT20	1	R-A-1134
		2010 - Present	SC 20K ADJ	SCT20	1	R-A-1134
8	UPPER AIR SPRING PLATE	2010 - Present	SC 10K	SCT10	1	R-005065-1/2
		2010 - Present	SC10K ADJ	SCT10	1	R-005065-1/2
		2010 - Present	SC13K	SCT13	1	R-005065-1/1
		2010 - Present	SC13K ADJ	SCT13	1	R-005065-1/2
		2010 - Present	SC20K	SCT20	1	R-010040-1/2
		2010 - Present	SC 20K ADJ	SCT20	1	R-010108-1/2

**NOTE:** -1 Driver's Side, -2 Passanger's Side (Typical). Check page 3 for Inboard/Outboard clarification.

## REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS



ITEM	DESCRIPTION	YEARS OF SERVICE	SUSPENSION SERIES	TRUCK PREFIX	QTY.	PART NO.
9	HANGER SIDE RAIL	2010 - Present	SC 10K	SCT10	1	R-008937-1/-2
		2010 - Present	SC10K ADJ	SCT10	1	R-008937-1/-2
		2010 - Present	SC13K	SCT13	1	R-008937-1/-2
		2010 - Present	SC13K ADJ	SCT13	1	R-008937-1/-2
		2010 - Present	SC20K	SCT20	1	R-010143-1/-2
		2010 - Present	SC 20K ADJ	SCT20	1	R-010143-1/-2
10	BUSHING SADDLE	2010 - Present	SC 10K	SCT10	1	R-008936-1/-2
		2010 - Present	SC10K ADJ	SCT10	1	R-008936-1/-2
		2010 - Present	SC13K	SCT13	1	R-008936-1/-1
		2010 - Present	SC13K ADJ	SCT13	1	R-008936-1/-2
		2010 - Present	SC20K	SCT20	1	R-010114-1/-2
		2010 - Present	SC 20K ADJ	SCT20	1	R-010114-1/-2
11	CROSS MEMBER	2010 - Present	SC 10K	SCT10	1	R-008938-1/-2/-3
		2010 - Present	SC10K ADJ	SCT10	1	R-008939
		2010 - Present	SC13K	SCT13		R-008938-1/-2/-3
		2010 - Present	SC13K ADJ	SCT13		R-008939
		2010 - Present	SC20K	SCT20	1	R-007041-1/-2/-3
		2010 - Present	SC 20K ADJ	SCT20	1	R-007944
12	CROSS MEMBER BOLT KIT	2010 - Present	SC 10K	SCT10	1	R-007677
		2010 - Present	SC10K ADJ	SCT10	1	R-007677
		2010 - Present	SC13K	SCT13	1	R-007677
		2010 - Present	SC13K ADJ	SCT13	1	R-007677
		2010 - Present	SC20K	SCT20	1	R-009046
		2010 - Present	SC 20K ADJ	SCT20	1	R-009046
13	FRAME WIDTH SPACERS	2010 - Present	SC10K ADJ	SCT10	2	R-007420
		2010 - Present	SC13K ADJ	SCT13	2	R-007420
		2010 - Present	SC 20K ADJ	SCT20	2	R-008299
14	1" RIDE HEIGHT SPRING SPACER	2010 - Present	SC10K ADJ	SCT10	2	R-007425-1
		2010 - Present	SC13K ADJ	SCT13	2	R-007425-1
		2010 - Present	SC 20K ADJ	SCT20	2	R-008340-1
15	2" RIDE HEIGHT SPRING SPACER	2010 - Present	SC10K ADJ	SCT10	2	R-007425-2
		2010 - Present	SC13K ADJ	SCT13	2	R-007425-2
		2010 - Present	SC 20K ADJ	SCT20	2	R-008340-2
16	1" RIDE HEIGHT SADDLE SPACER	2010 - Present	SC10K ADJ	SCT10	2	R-007417-1
		2010 - Present	SC13K ADJ	SCT13	2	R-007417-1
		2010 - Present	SC 20K ADJ	SCT20	2	R-008154-1
17	2" RIDE HEIGHT SADDLE SPACER	2010 - Present	SC10K ADJ	SCT10	2	R-007417-2
		2010 - Present	SC13K ADJ	SCT13	2	R-007417-2
		2010 - Present	SC 20K ADJ	SCT20	2	R-008154-2
18	QC BRAKE SHOE KIT	2010 - Present	SC 10K	SCT10	2	R-006097
		2010 - Present	SC10K ADJ	SCT10	2	R-006097
		2010 - Present	SC13K	SCT13	2	R-007442
		2010 - Present	SC13K ADJ	SCT13	2	R-007442
		2010 - Present	SC20K	SCT20	2	R-010112
		2010 - Present	SC 20K ADJ	SCT20	2	R-010112
19	COMPLETE BRAKE ASSEMBLY	2010 - Present	SC 10K	SCT10	1	R-005896-1/-2
		2010 - Present	SC10K ADJ	SCT10	1	R-005896-1/-2

**NOTE:** -1 Driver's Side, -2 Passenger's Side (Typical). Check page 3 for Inboard/Outboard clarification.



## REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS

ITEM	DESCRIPTION	YEARS OF SERVICE	SUSPENSION SERIES	TRAILER PREFIX	QTY.	PART NO.
1	BEAM ASSEMBLY	2010 - Present	SCW	SCW13	4	R-008940
		2010 - Present	SCB	SCB13	4	R-008940
2	PIVOT BOLT KIT	2010 - Present	SCW	SCW13	1	R-005009
		2010 - Present	SCB	SCB13	1	R-005009
3	BUSHING AND PIVOT BOLT KIT	2010 - Present	SCW	SCW13	1	R-008839
		2010 - Present	SCB	SCB13	1	R-008839
4	RIDE SPRING	2010 - Present	SCW	SCW13	2	R-001015
		2010 - Present	SCB	SCB13	2	R-001015
5	RIDE SPRING BOLT KIT	2010 - Present	SCW	SCW13	2	R-A-13075
		2010 - Present	SCB	SCB13	2	R-A-13075
6	LIFT SPRING	2010 - Present	SCW	SCW13	2	R-005079
		2010 - Present	SCB	SCB13	2	R-005079
7	LIFT SPRING BOLT KIT	2010 - Present	SCW	SCW13	1	R-A-1134
		2010 - Present	SCB	SCB13	1	R-A-1134
8	UPPER AIR SPRING PLATE	2010 - Present	SCW	SCW13	2	R-005168
		2010 - Present	SCB	SCB13	2	R-005168
9	2 SADDLES AND CROSSMEMBER WELDMENT	2010 - Present	SCW	SCW13	1	R-005021
		2010 - Present	SCB	SCB13	1	R-005503
10	BUSHING SADDLE	2010 - Present	SCW	SCW13	X	R-005020
		2010 - Present	SCB	SCB13	X	R-005502-1/-2
11	CROSS MEMBER	2010 - Present	SCW	SCW13	1	R-002948-30
		2010 - Present	SCB	SCB13	1	R-002948-30
<b>Note:</b> 12...17 N/A						
18	QC BRAKE SHOE KIT	2010 - Present	SCW	SCW13	2	R-007442
		2010 - Present	SCB	SCB13	2	R-007442
19	COMPLETE BRAKE ASSEMBLY	2010 - Present	SCW	SCW13	X	N/A
		2010 - Present	SCB	SCB13	X	N/A

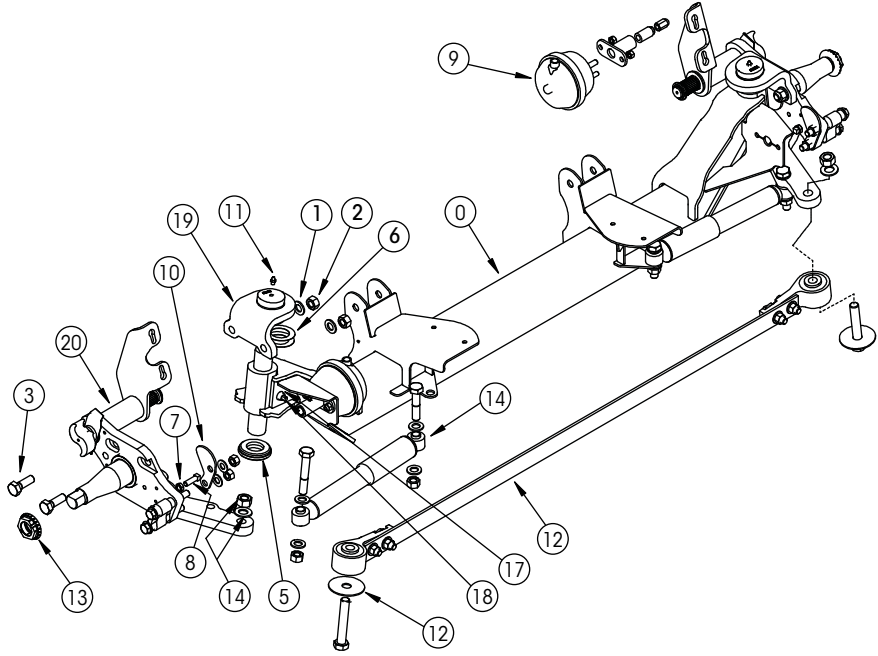
**NOTE:** -1 Driver's Side, -2 Passenger's Side (Typical). Check page 3 for Inboard/Outboard clarification.

TRAILER MOUNT

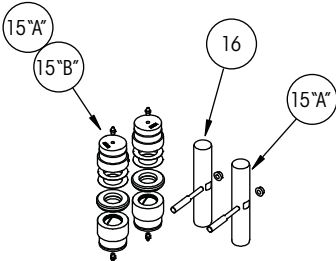
1 - 19



AXLE ASSEMBLIES



MODEL PREFIX SC...



R-010300 w/ KINGPIN  
DRAW KEY and NUT

R-010300-1 w/out  
KINGPIN DRAW KEY  
and NUT





# REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS

ITEM	DESCRIPTION	SUSPENSION SERIES	MODEL PREFIX	QTY.	PART NO.
1	UPPER KING PIN WASHERS	SC	SCT13	4	R-6212H2H
		SC	SCT20	4	R-6214H2H
2	UPPER KING PIN NUTS	SC	SCT10	12	R-6009CH2LC
		SC	SCT13	4	R-6012CH2LC
		SC	SCT20	4	R-6014CH2LC
3	BACKBONE BOLTS, SHORT	SC	SCT10	6	R-6109C200H4H8
		SC	SCT13	4	R-6112C225H4H8
		SC	SCT20	4	R-6114C300H4H8
4	BACKBONE BOLTS LONG	SC	SCT10	6	R-6109C300H4H8
5	THRUST BEARING INCLUDED WITH KINGPIN KIT	SC	SCT10	2	R-001620
		SC	SCT13	2	R-001620
		SC	SCT20	2	R-001620
6	SHIMS INCLUDED WITH KINGPIN KIT	SC	SCT10	4	R-001764-1
		SC	SCT13	4	R-001764-1
		SC	SCT20	4	R-001764-1
7	TURN STOP JAM NUT	SC	SCT13	2	R-6008CH2JC
		SC	SCT20	2	R-6008CH2JC
8	TURN STOP SCREW	SC	SCT13	2	R-6108C125H4S8
		SC	SCT20	2	R-6108C150H4S8
9	LOCK STRAIGHT KIT (OPTIONAL)	SC	SCT13	1	R-002600-2
		SC	SCT20	1	R-010116
10	LOCK STRAIGHT TARGET (OPTIONAL)	SC	SCT13	2	R-008495
11	KINGPIN CAP OR ZERK FITTING	SC	SCT10	4	R-002804
		SC	SCT13	4	R-002804
		SC	SCT20	4	R-002804
12	TIE ROD ASSEMBLY	SC	SCT10	1	R-009889
		SC	SCT13	1	R-009426
		SC	SCT20	1	R-009989
13	SPINDLE NUT	SC	SCT10	2	R-003269
		SC	SCT13	2	R-003269
		SC	SCT20	2	R-005142
14	STABILIZER KIT	SC	SCT10	1	R-009596
		SC	SCT13	1	R-009596 *
		SC	SCT20	1	R-009580

ITEM 14\* R-009580 Ride Height A/B

# REPLACEMENT PARTS FOR AFTERMARKET SUSPENSIONS



ITEM	DESCRIPTION	SUSPENSION SERIES	MODEL PREFIX	QTY.	PART NO.	
					A	B
15	KINGPIN BUSHING KIT	SC	SCT10	1	R-010300	R-010300-1
	WITH KINGPIN "A"	SC	SCT13	1	R-010300	R-010300-1
	KINGPIN BUSHING KIT	SC	SCT20	1	R-010300	R-010300-1
	WITHOUT KINGPIN "B"					
16	REPLACEMENT KINGPIN	SC	SCT10	2	R-006303	
		SC	SCT13	2	R-006303	
		SC	SCT20	2	R-006303	
17	DRAW KEY	SC	SCT10	2	R-008670	
		SC	SCT13	2	R-008670	
		SC	SCT20	2	R-008670	
18	DRAW KEY NUT	SC	SCT10	2	R-6007FH4FC	
		SC	SCT13	2	R-6007FH4FC	
		SC	SCT20	2	R-6007FH4FC	
19	UPPER KINGPIN CONNECTION	SC	SCT10	1 EA	R-006011-1/-2	
		SC	SCT13	1 EA	R-009692	
		SC	SCT20	1 EA	R-009957	
20	CURRENT KNUCKLE BACKBONE	SC	SCT10	1 EA	R-009897-1/-2	
		SC	SCT13	1 EA	R-009598-1/-2	
		SC	SCT20	1 EA	R-009951-1/-2	

**NOTE:** -1 Driver's Side, -2 Passenger's Side (Typical). Check page 3 for Inboard/Outboard clarification.

AXLE ASSEMBLIES

15 - 20

www.hendrickson-intl.com



Specialty Products – Auxiliary Axle Systems  
 277 North High Street  
 Hebron, OH 43025 USA  
 740.929.5600  
 Fax 740.929.5601

Specialty Products – Auxiliary Axle Systems  
 250 Chrysler Drive, Unit #3  
 Brampton, ON L6S 6B6 Canada  
 905.789.1030  
 Fax 905.789.1033



# PTO / DRIVE SHAFT

## Drive Shaft Maintenance



65740 State Hwy 56, Dodge Center, MN 55927 **phone** 507-374-2239 **fax** 507-374-1094

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## PTO SHAFT

Inspecting and maintaining your driveline components will ensure proper function and prevent serious mechanical failures. This should be done on a daily level.

When your driveline is not properly maintained it can cause:

- Premature wear in the u-joint and slip joint.
- Slip spline wear, seizure, and galling.
- Excessive driveline vibration.
- Transmission, bell housing, and clutch housing failures.
- Transmission tail shaft housing and seal failures.
- Shaft Support housing and rubber insulator failures.

When your driveline is properly maintained and routinely lubricated, it will provide reliable and safe vehicle operation.

**CALL CON-TECH SERVICE AT 507-374-2239 WITH ANY SERVICE ISSUES.**

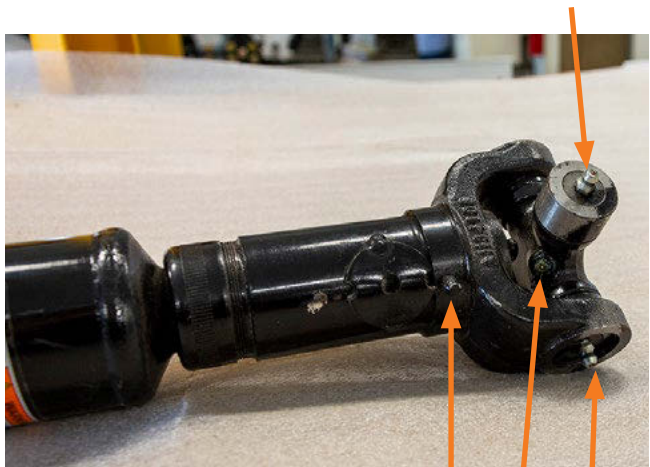
**PLEASE OBSERVE ALL OSHA LOCKOUT-TAG OUT PROCEDURES WHEN PERFORMING ANY TYPE OF WORK OR MAINTENANCE ON YOUR VEHICLES.**



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# PTO SHAFT

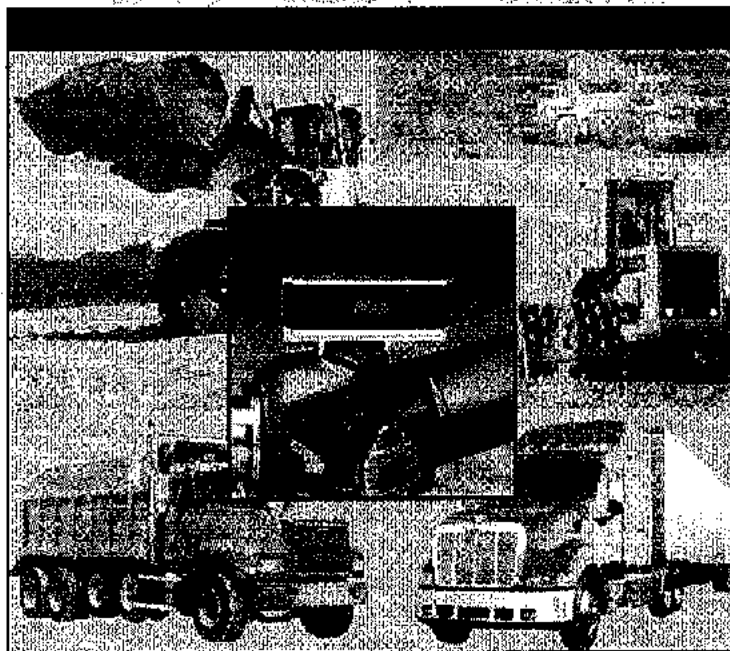


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## DRIVELINE INSTALLATION



**J3311-1-DSSP  
AUGUST 2008**

**Supersedes  
J3311-1-HVTSS, Dated  
February 2005**



**SPICER**

*Drivetrain Products*

### General Safety Information

To prevent injury to yourself and /or damage to the equipment:

- Read carefully all owners manuals, service manuals, and/or other instructions.
- Always follow proper procedures and use proper tools and safety equipment.
- Be sure to receive proper training.
- Never work alone while under a vehicle or while repairing or maintaining equipment.
- Always use proper components in applications for which they are approved.
- Be sure to assemble components properly.
- Never use worn-out or damaged components.
- Always block any raised or moving device that may injure a person working on or under a vehicle.
- Never operate the controls of the power take-off or other driven equipment from any position that could result in getting caught in the moving machinery.



#### **WARNING: GUARDING AUXILIARY DRIVESHAFTS**

We strongly recommend that a power take-off and a directly mounted pump be used to eliminate the auxiliary driveshaft whenever possible. If an auxiliary driveshaft is used and remains exposed after installation, it is the responsibility of the vehicle designer and PTO installer to install a guard.

#### **WARNING: USING SET SCREWS**

Auxiliary driveshafts may be installed with either recessed or protruding set screws. If you choose a square head set screw, you should be aware that it will protrude above the hub of the yoke and may be a point where clothes, skin, hair, hands, etc. could be snagged. A socket head set screw, which may not protrude above the hub of the yoke, does not permit the same amount of torquing as does a square head set screw. Also a square head set screw, if used with a lock wire, will prevent loosening of the screw caused by vibration. Regardless of the choice made with respect to a set screw, an exposed rotating auxiliary driveshaft must be guarded.

#### **WARNING: THIS SYMBOL WARNS OF POSSIBLE PERSONAL INJURY.**

#### **WARNING: ROTATING DRIVESHAFTS**

- Rotating auxiliary driveshafts are dangerous. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.
- Do not go under the vehicle when the engine is running.
- Do not work on or near an exposed shaft when engine is running.
- Shut off engine before working on power take-off or driven equipment.
- Exposed rotating driveshafts must be guarded.



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## Introduction

### **This brochure is intended for:**

- Installers who install Spicer driveshafts into an application where the transmission and axle are not in direct line with each other, causing the driveshaft universal joints to operate at an angle.
- Anyone experiencing vibration problems with their application or their vehicle that driveshaft assembly balancing will not correct.
- Truck Equipment Distributors who:
  - Re-work a chassis to change the wheel base.
  - Install a midship mounted power take-off or fire pump.
  - Mount any other PTO-driven device such as a blower, hydraulic pump, or hydraulic motor.

Universal joint failures, as a rule, are of a progressive nature, which, when they occur, generally accelerate rapidly resulting in a mass of melted trunnions and bearings.

Some recognizable signs of universal joint deterioration are:

1. Vibrations - Driver should report to maintenance.
2. Universal joint looseness - End play across bearings.
3. Universal joint discoloration due to excessive heat build-up.
4. Inability to purge all four trunion seals when re-lubing universal joint.

Items 2) thru 4) should be checked at re-lube cycle and, if detected, reported to the maintenance supervisor for investigation.

Experience with universal joint failures has shown that a significant majority are related to lubricating film breakdown. This may be caused by a lack of lubricant, inadequate lube quality for the application, inadequate initial lubrication, or failure to lubricate properly and often enough.

Failures which are not the result of lubrication film breakdown are associated with the installation, angles and speeds, and manufacturing discrepancies.

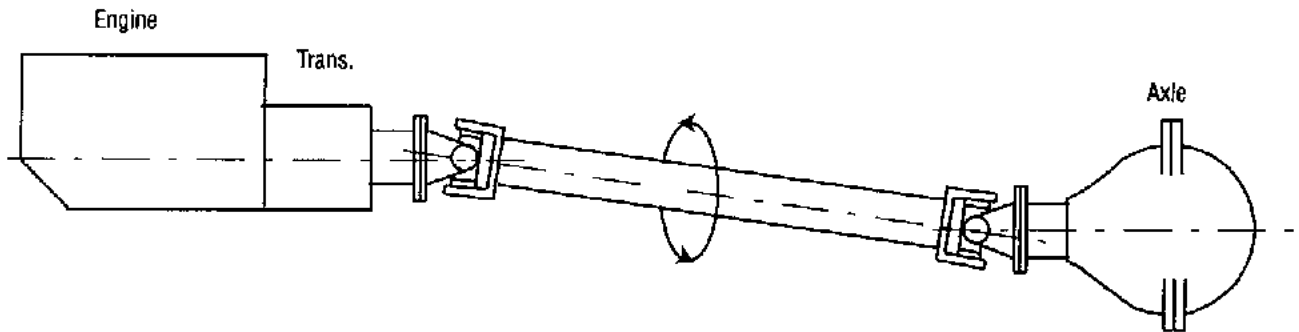
Driveshaft failures through torque, fatigue, and bending are associated with overload, excessively high universal joint angles, and drive shaft lengths excessive for operating speeds.

## Driveshaft Torque

The following problems are usually a result of torque overloads:

- Twisted driveshaft tube
- Broken yoke shaft, slip yoke, tube yoke, flange yoke, end yoke
- Broken journal cross

### How much torque can be generated in your application?



**Driveshaft Torque**

### How to Calculate Torque:

$$LGT = T \times TLGR \times TE \times SR \times TCR \times C$$

- LGT = Maximum Driveshaft Low Gear Torque
- T = Net Engine Torque or 95% of the Gross Engine Torque
- TLGR = Transmission Low Gear Ratio (forward)\*
- TE = Transmission Efficiency (automatic = 0.8; manual = 0.85)
- SR = Torque Converter Stall Ratio (if applicable)
- TCR = Transfer Case Ratio (if applicable)
- C = Transfer Case Efficiency (if applicable, 0.95)

### How to Calculate Wheel Slip:

$$WST = (.71 \times W \times RR) / (11.4 \times AR)$$

- WST = Wheel Slip Torque Applied to the Driveshaft
- W = Axle Capacity (lbs)
- RR = Tire Rolling Radius (in)
- AR = Axle Ratio

### For On Road Applications

Relate the lesser of above to Spicer universal joint ratings. If your torque exceeds the Spicer rating for the universal joint used in your application, switch to a size with a rating compatible to your calculation. However, the series selected cannot be more than one series below the series called for by the LGT calculation.

### For Off Road or On-Off Road Applications

Use Low Gear Torque value only to verify or switch to a size with a rating compatible to your calculation.

## Common Causes of Vibrations

The three most common causes of driveshaft vibration are: Driveshaft Imbalance, Critical Speed, and Universal Joint Operating Angles.

### Driveshaft Imbalance

Eliminate the potential for balance problems before you undertake any other measures.

A driveshaft on a vehicle usually rotates at a higher rate of speed than the tire. For that reason, like tires, driveshafts should be balanced.

Any time you build or rework a driveshaft, make sure it is dynamically balanced at 3000 RPM for Light Duty or 2500 RPM for Heavy Duty, to the following specifications:

Series	Specification
1310, 1330	.375 oz-in total at each end of shaft *
1350, 1410	.500 oz-in total at each end of shaft *
1480 - 1880	1.00 oz-in for each ten pounds of driveshaft weight divided proportionally at each end of shaft
* Passenger Car, Light Truck, Van, and SUV only. Industrial, Mobile Off-Highway, PTO, etc. same as 1480 - 1880.	

### Critical Speed

Every driveshaft has a critical speed. Critical speed is the point at which a rotating driveshaft begins to bow off its normal rotating centerline.

Driveshafts begin to vibrate as they approach critical speed. If they are operated at near critical speed for an extended period, they often fail. This can damage the vehicle and possibly injure persons nearby.

As a driveshaft fabricator or installer, you are responsible for checking the safe operating speed of any driveshaft you fabricate or specify into an application. Make sure it will not operate at a speed higher than Spicer's recommended safe operating speed. Use Spicer Calculator (P/N J 3253) to determine safe operating speed.

### Checking for a Possible Critical Speed Problem

Here is what you must do to make sure you won't have a critical speed problem:

- Determine the safe operating speed of the driveshaft you want to use in your application. Insert the tube diameter and center-to-center installed length of the shaft you want to use into a Spicer Safe Operating Speed Calculator (P/N. J3253). The calculator will tell you the safe operating speed of the shaft you have chosen.
- Determine the NORMAL and MAXIMUM POSSIBLE operating speed of the driveshaft.  
REMEMBER:
  - On vehicles with a standard transmission that have a 1:1 direct drive high gear and no overdrive, MAXIMUM POSSIBLE driveshaft RPM is the same as the maximum possible ENGINE RPM.
  - On vehicles that have an overdrive transmission, MAXIMUM POSSIBLE driveshaft RPM is higher than maximum possible ENGINE RPM.

## Maximum Possible Driveshaft RPM

To calculate the maximum possible driveshaft RPM in vehicles having an overdrive transmission, divide the maximum possible engine RPM by the overdrive ratio. (See examples below.)

Example 1:
Max. engine RPM: 2100
Overdrive ratio: .79
$2100 / .79 = 2658$ maximum possible driveshaft RPM

Example 2:
Max. engine RPM 6000
Overdrive ratio: .66
$6000 / .66 = 9091$ maximum possible driveshaft RPM

Compare the maximum possible driveshaft RPM with the safe operating speed determined from the Safe Operating Speed Calculator. If the maximum possible driveshaft RPM meets or exceeds the safe operating speed determined from the calculator, you must do whatever is required to raise the critical speed of the driveshaft you have chosen for the application.

### Sample Specification:

To specify a driveshaft for the application described in Example 1 above, compare the safe operating speed for the driveshaft selected with the maximum possible driveshaft RPM calculated (2658 RPM). Make sure the safe operating speed of the driveshaft is greater than 2658 RPM.

### Changing the Safe Operating Speed of a Driveshaft

A driveshaft's safe operating speed can be raised by increasing its tube diameter or by shortening the installed center-to-center length of the driveshaft. Changing the installed length of a driveshaft will require the use of multiple driveshafts with center bearings.

**Important:** The critical speed of an assembly can be affected by driveshaft imbalance, improper universal joint operating angles, or improperly phased driveshafts. (A properly phased driveshaft has the in-board yokes of the shaft in line with each other.) Each of the above items will tend to lower the true critical speed from the values shown on the calculator.

Since critical speed can ultimately cause driveshaft failure, it is extremely important to be very precise in all applications.

## Universal Joint Operating Angles

### Every Universal Joint that Operates at an Angle Creates a Vibration

Universal joint operating angles are probably the most common causes of driveline vibration in vehicles that have been reworked, or in vehicles that have had auxiliary equipment installed.

Universal joint operating angles are a primary source of problems contributing to:

- Vibrations
- Reduced universal joint life
- Problems with other drivetrain components that may include:
  - Transmission gear failures
  - Synchronizer failures
  - Differential problems
  - Premature seal failures in axles, transmissions, pumps, or blowers
  - Premature failure of gears, seals, and shafts in Power Take-Offs

When you rework a chassis or install a new driveshaft in a vehicle, make sure that you follow the basic rules that apply to universal joint operating angles:

**RULE 1:** UNIVERSAL JOINT OPERATING ANGLES AT EACH END OF A DRIVESHAFT SHOULD ALWAYS BE AT LEAST 1 DEGREE.

**RULE 2:** UNIVERSAL JOINT OPERATING ANGLES ON EACH END OF A DRIVESHAFT SHOULD ALWAYS BE EQUAL WITHIN 1 DEGREE OF EACH OTHER (ONE HALF DEGREE FOR MOTOR HOMES AND SHAFTS IN FRONT OF TRANSFER CASE OR AUXILIARY DEVICE).

**RULE 3:** FOR VIRTUAL VIBRATION FREE PERFORMANCE, UNIVERSAL JOINT OPERATING ANGLES SHOULD NOT BE LARGER THAN 3 DEGREES. IF THEY ARE, MAKE SURE THEY DO NOT EXCEED THE MAXIMUM RECOMMENDED ANGLES.

A universal joint operating angle is the angle that occurs at each end of a driveshaft when the output shaft of the transmission and driveshaft and the input shaft of the axle and driveshaft are not in line. (See Fig 1)

The connecting driveshaft operates with an angle at each universal joint. It is that angle that creates a vibration.

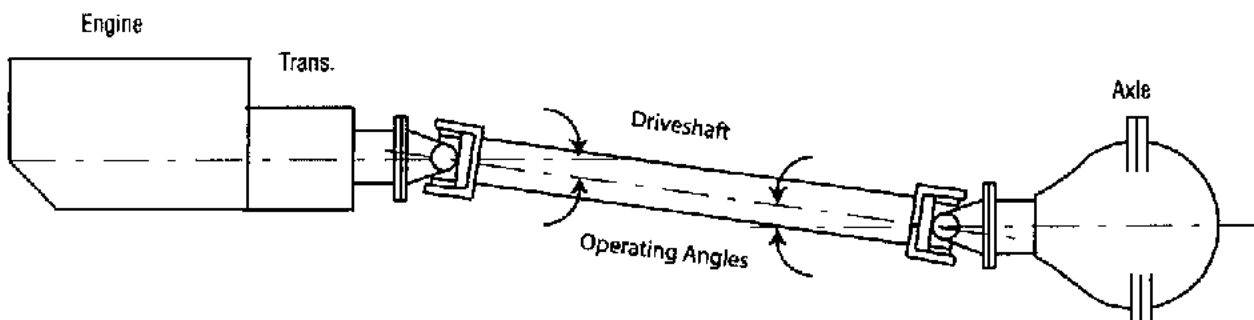


Figure 1

### Reducing and Canceling Vibration

A key point to remember about universal joint operating angles: To reduce the amount of vibration, the angles on each end of a driveshaft should always be **SMALL**.

To cancel an angle vibration, the universal joint operating angles need to be **EQUAL** within 1 degree at each end of a driveshaft. On motor home applications and auxiliary transmission installations, the tolerance is 1/2 degree. (See Fig 2)

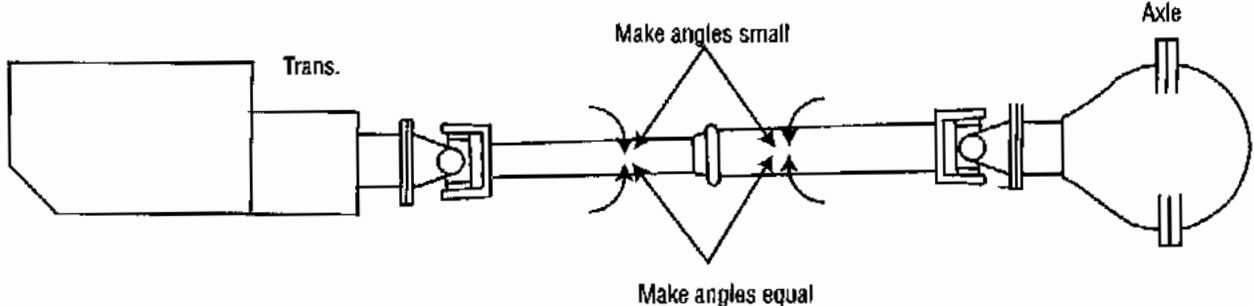


Figure 2

## Single Plane and Compound Universal Joint Operating Angles

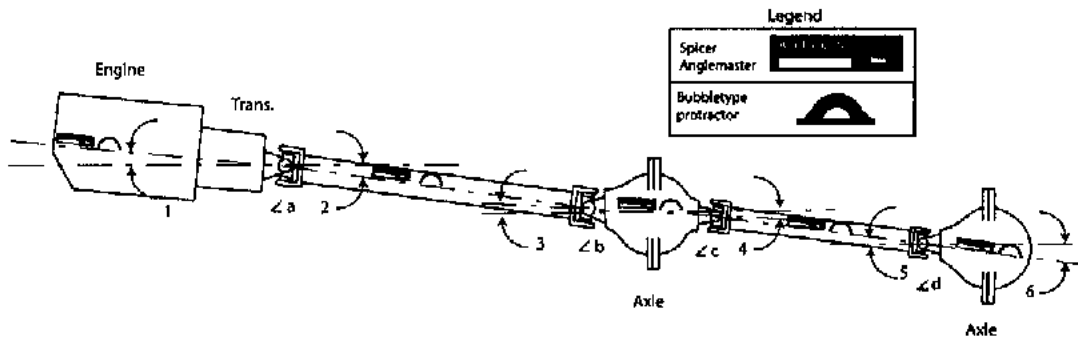
There are two types of universal joint operating angles: Single Plane and Compound.

### Single Plane

Single Plane angles occur when the transmission and axle components are in line when viewed from either the top or side, but not both.

Determining the universal joint operating angle in an application where the components are in line when viewed from the top, but not in line when viewed from the side, is as simple as measuring the slope of the components in the side view, and adding or subtracting those slopes to determine the angle. (See Fig. 3)

These angles should be **small and equal** within 1 degree.



**Figure 3**

The most convenient way to determine universal joint angles in the side view is through the use of a Spicer Anglemaster™ or a bubble type protractor.

Using an Anglemaster or a bubble protractor, record inclination angles of drivetrain components. Set Anglemaster or protractor on machined surfaces of engine, transmission, axle, or on machined lugs of transmission and axle yoke(s).

**Note:** Universal joint angles can change significantly in a loaded situation. Therefore, check vehicle loaded and unloaded to achieve the accepted angle cancellation.

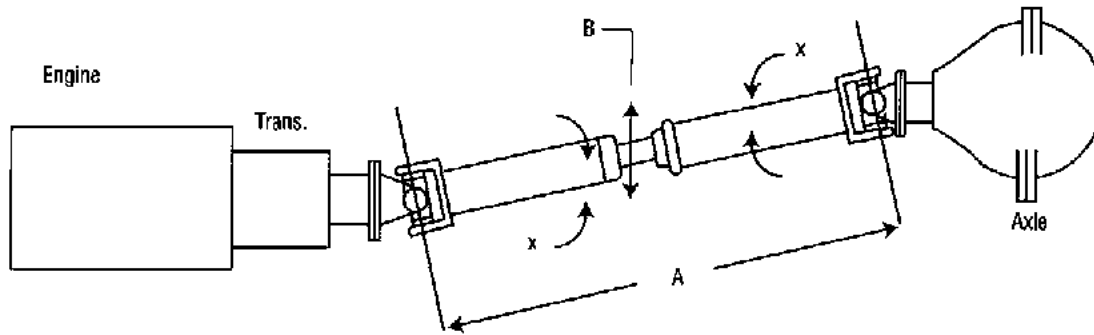
**Example:**

Engine-Transmission Output	4°30' Down (1)
Main Driveshaft	7°00' Down (2)
Input 1st Rear Axle	4°00' Up (Input Shaft Nose Up) (3)
Output 1st Rear Axle	4°00' Down (4)
Inter-axle Shaft	7°00' Down (5)
Input 2nd Rear Axle	4°15' Up (Pinion Shaft Nose Up) (6)
Note: If inclination of driveshaft is opposite connecting component, add angles to obtain the universal joint operating angle.	
Angle a = (2) - (1) = 7°00' - 4°30' = 2°30' (2.50°)	
Angle b = (2) - (3) = 7°00' - 4°00' = 3°00' (3.00°)	
Angle c = (5) - (4) = 7°00' - 4°00' = 3°00' (3.00°)	
Angle d = (5) - (6) = 7°00' - 4°15' = 2°45' (2.75°)	



# Installation Techniques

Determining the universal joint operating angles on a driveshaft that is straight when viewed from the side and offset when viewed from the top requires the use of a special chart (See Angle Chart). In this type of application, the centerlines of the connected components **must be parallel** when viewed from the top as shown. These angles also should be **small and equal** within 1 degree. (See Fig. 4)



Angles in Top View

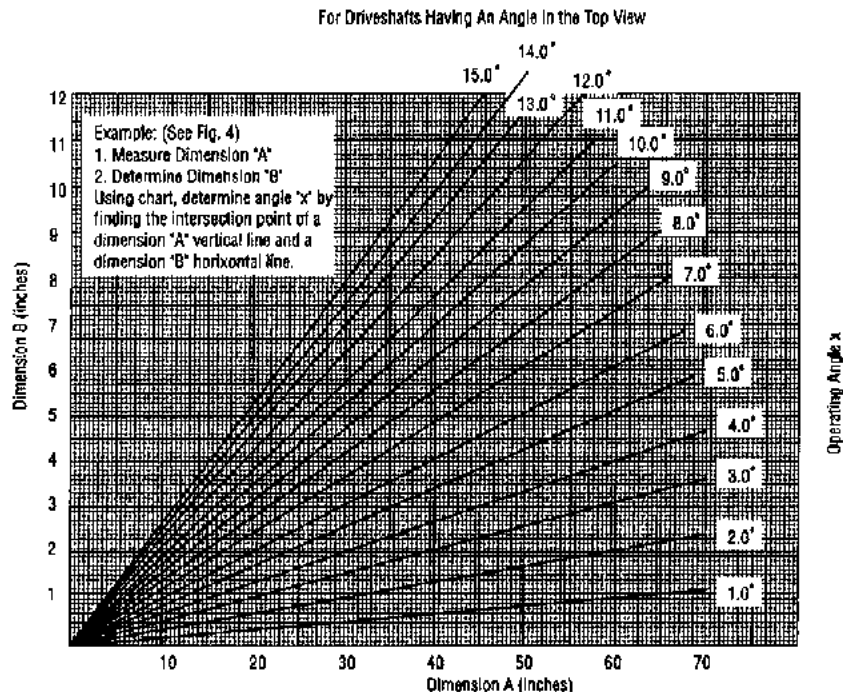
**Figure 4**

Measure dimensions "A" and "B" shown in figure 4. Use the instructions in the angle chart below to determine the size of the angle. Look at the Angle Chart and note that the smaller the offset, the smaller the resultant angle.

To reduce the possibility of vibration, keep any offset between connected points to a minimum.

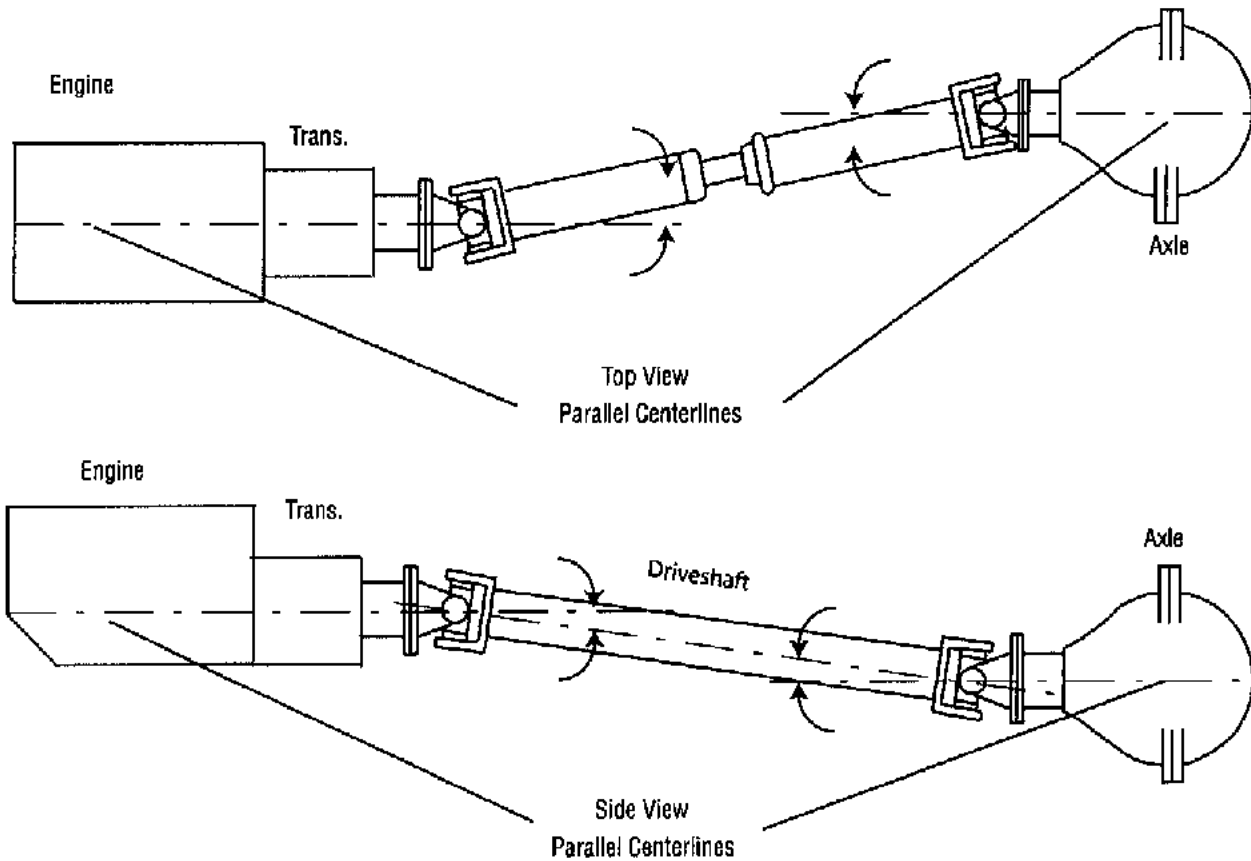
There are two things you can do to always make sure Single Plane angles are **SMALL** and **EQUAL**: Make sure the transmission and axle are mounted so their centerlines are parallel when viewed from both the side and the top. Make sure the offset between them is small in both views.

## ANGLE CHART



## Compound Angles

Compound universal joint operating angles occur when the transmission and axle are not in line when viewed from BOTH the top and side. Their centerlines, however, are parallel in both views. (See Fig. 5)



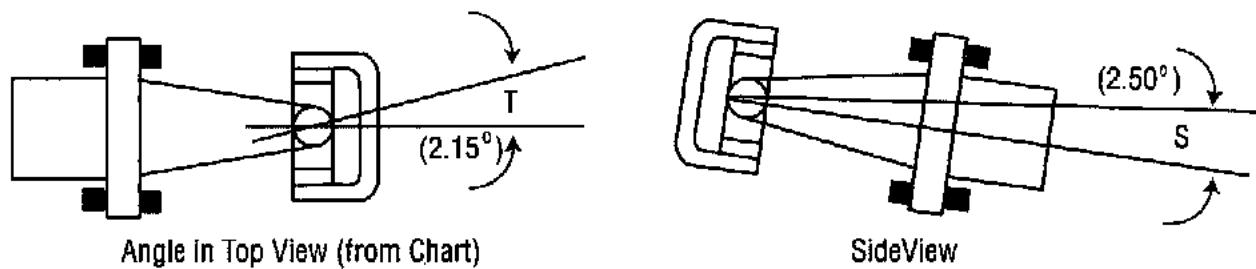
**Figure 5**

When you have a compound angle, you have to calculate the "True Universal Joint Operating Angle" of each universal joint. It is the True Universal Joint Operating Angle that must meet the three rules shown on page 5.

## True Universal Joint Operating Angle

The True Universal Joint Operating Angle, which must be calculated for each end of the shaft with compound angles, is a combination of the universal joint operating angle in the top view, as determined from the chart, and the measured universal joint operating angle in the side view.

To determine the true universal joint operating angle for one end of a shaft, (compound angle  $C^\circ$  in the formula shown in Fig. 6) insert the universal joint operating angle measurement obtained in the side view and the universal joint operating angle obtained from the chart into the formula.



$$\text{Compound Angle } (C^\circ) = \sqrt{T^2 + S^2}$$

$$T = 2.15^\circ \text{ (A calculated angle)}$$

$$S = 2.5^\circ \text{ (The measured angle)}$$

$$C = \sqrt{2.15^2 + 2.5^2}$$

$$C = \sqrt{10.873}$$

$$C = 3.3^\circ \text{ (True operating angle)}$$

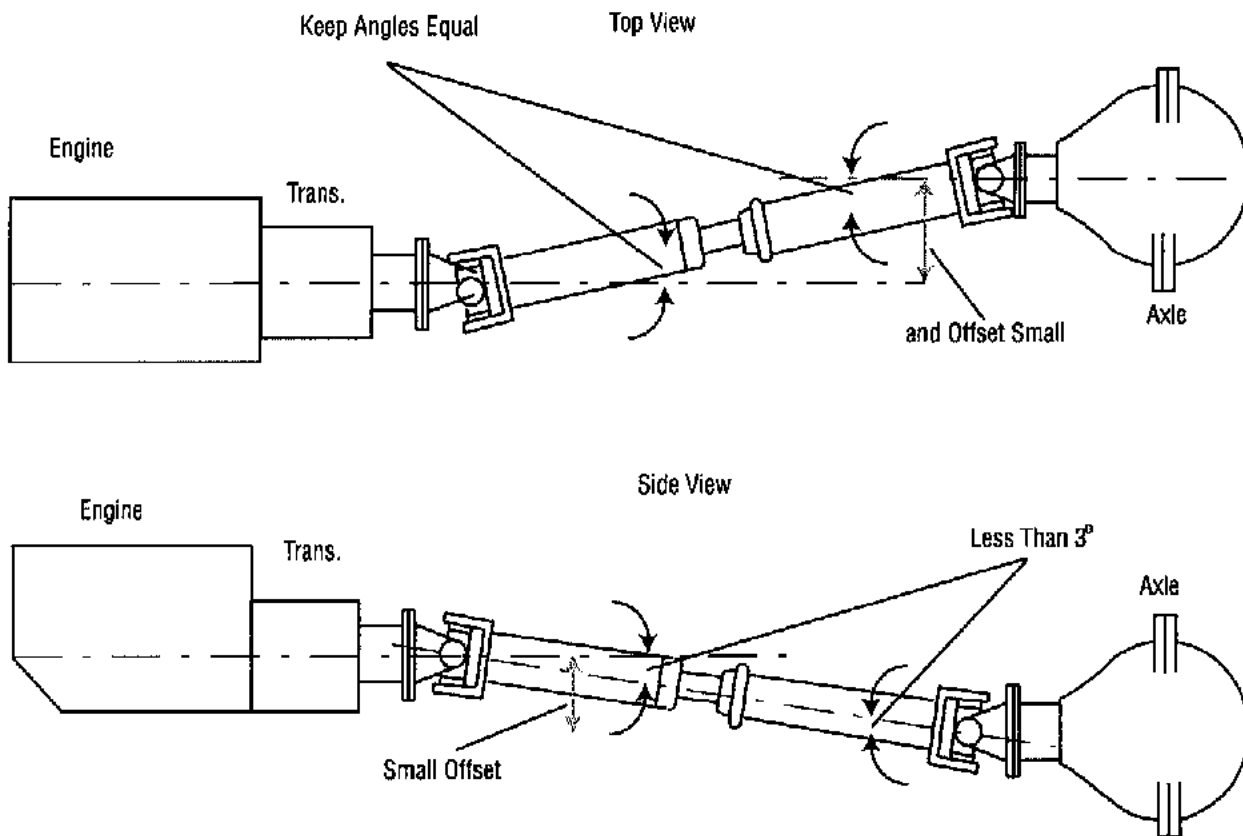
**Figure 6**

Do the same for the other end of the shaft. Compare the resultant calculated universal joint operating angle for each end. They should be EQUAL within 1 degree. If they're not, the driveshaft will vibrate.

## Eliminating Compound Angle Induced Vibrations

Compound universal joint operating angles are one of the most common causes of driveline vibration. To avoid these problems, remember these important points:

- When setting up an application that requires compound universal joint operating angles, always keep the centerlines of the transmission and axle parallel in both views.
- Always keep the offset between their horizontal and vertical centerlines small.



**Figure 7**

**Note:** Centerlines of transmission and axle must be parallel in both top and side views to use this method of determining true universal joint operating angle. Please contact Spicer Driveshaft Engineering if you have an application where the components cannot be installed with their centerlines parallel.

If adjustments must be made to the system:

- Install shims between the axle housing and springs to rotate the axle input yoke to change operating angles.
- Change operating angle on torque arm type suspensions by lengthening or shortening torque arms.
- Raise, lower, or shift side-to-side a pump, blower, or other piece of auxiliary equipment to change operating angles.

**Note:** It is important to remember to keep the centerlines of two components that are connected by a driveshaft parallel in both the top and side views, so the operating angles will ALWAYS be equal.

# Installation Techniques

## Angle Size

The magnitude of a vibration created by a universal joint operating angle is proportional to the size of the universal joint operating angle. Spicer Engineers recommend true universal joint operating angles of 3 degrees or less.

Obtain the true universal joint operating angle, as explained above, and if it is greater than 3 degrees, compare it to this chart.

Driveshaft RPM	Maximum Operating Angle	Interaxle	
		Parallel	Intersecting
5000	3.2°	-	-
4500	3.7°	-	-
4000	4.2°	3.8°	3.8°
3500	5.0°	4.4°	4.4°
3000	5.8°	5.1°	4.8°
2500	7.0°	6.0°	4.8°
2000	8.7°	6.0°	4.8°
1500	11.5°	6.0°	4.8°

The angles shown on this chart are the maximum universal joint operating angles recommended by Spicer Engineers and are directly related to the speed of the driveshaft. Any universal joint operating angle greater than 3 degrees will lower universal joint life and may cause a vibration. Remember to check maximum safe driveshaft RPM by using the Spicer Safe Operating Speed Calculator.

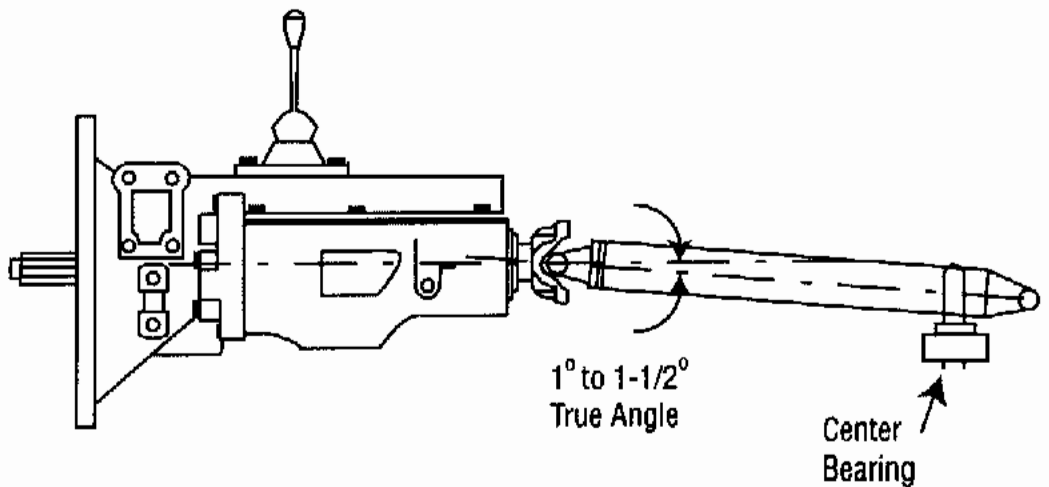
Compound Angle  
Vibrations

## Multiple Shaft Installations

### Multiple Shaft Set Up Recommendations

In general, multiple shaft installations follow the same guidelines, except there are different recommendations for setting up the driveline:

- For a 2-shaft application, set up the first coupling shaft (sometimes called a jackshaft) so that the universal joint operating angle that occurs at the transmission end is 1 to 1-1/2 degrees. (See Fig. 8)



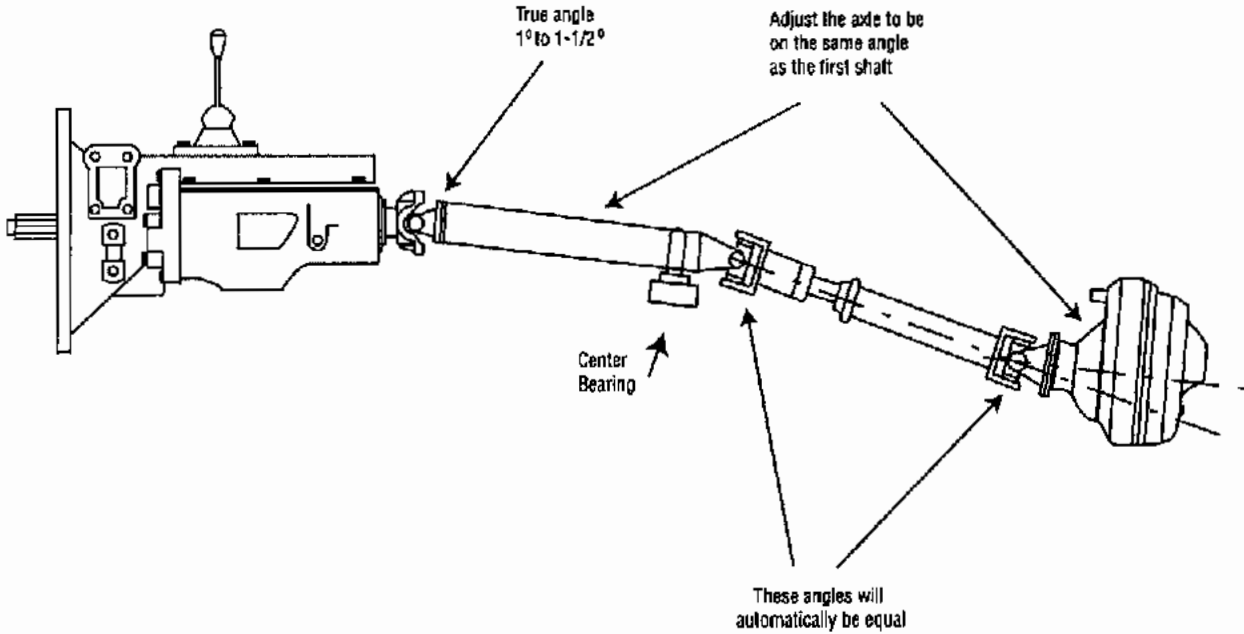
**Figure 8**

- Try to avoid building a compound universal joint operating angle into the first coupling shaft by installing it in line with the transmission.
- If it ends up being compound, make sure the true universal joint operating angle, determined by using the information mentioned earlier, is 1 to 1-1/2 degrees.

Install or tilt the axle so it is mounted on the same angle as the first coupling shaft (the centerlines of the axle and the first coupling shaft will be parallel).

**Note:** BY FOLLOWING THIS PROCEDURE, THE UNIVERSAL JOINT OPERATING ANGLE AT EACH END OF THE LAST SHAFT WILL AUTOMATICALLY BE EQUAL. (See Fig. 9)

# Installation Techniques

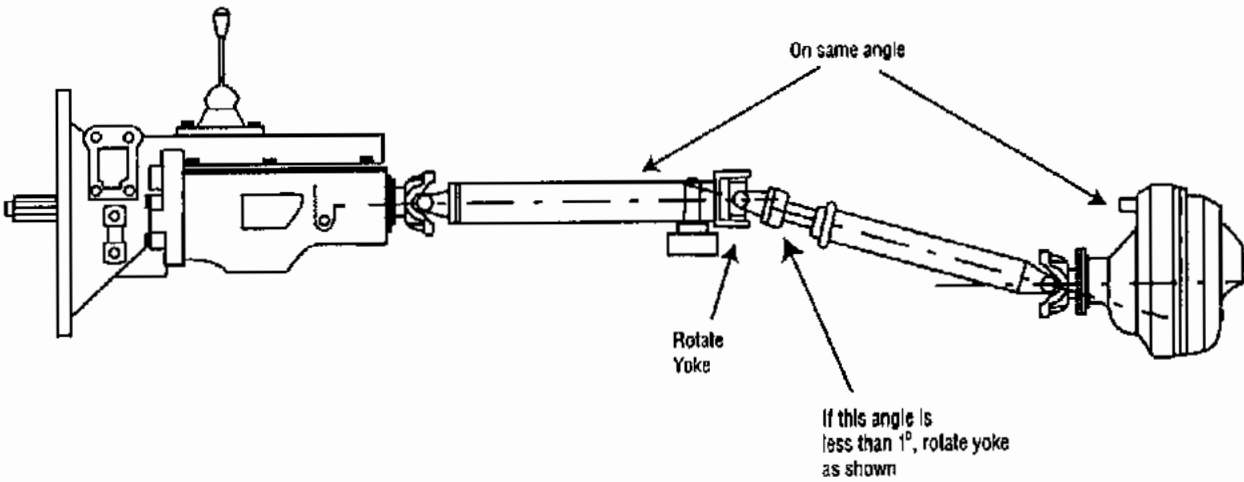


Multiple Shaft Installations

**Figure 9**

If there is an offset in the installation of the axle, make sure it does not create too large of a compound universal joint operating angle. Whenever possible, mount the axle directly in line with the first coupling shaft (when viewed from the top).

Check the actual universal joint operating angle at the rear of the first coupling shaft. If it is less than 1° and the transmission universal joint operating angle is greater than 1.5°, rotate the end yoke at the center bearing position so that the ears of the yoke are 90° to the ears of the tube yoke on the transmission end of the coupling shaft. (See Fig. 10) As an alternative, rotate the slip yoke on the driveshaft 90° if the slip spline has 16 teeth.



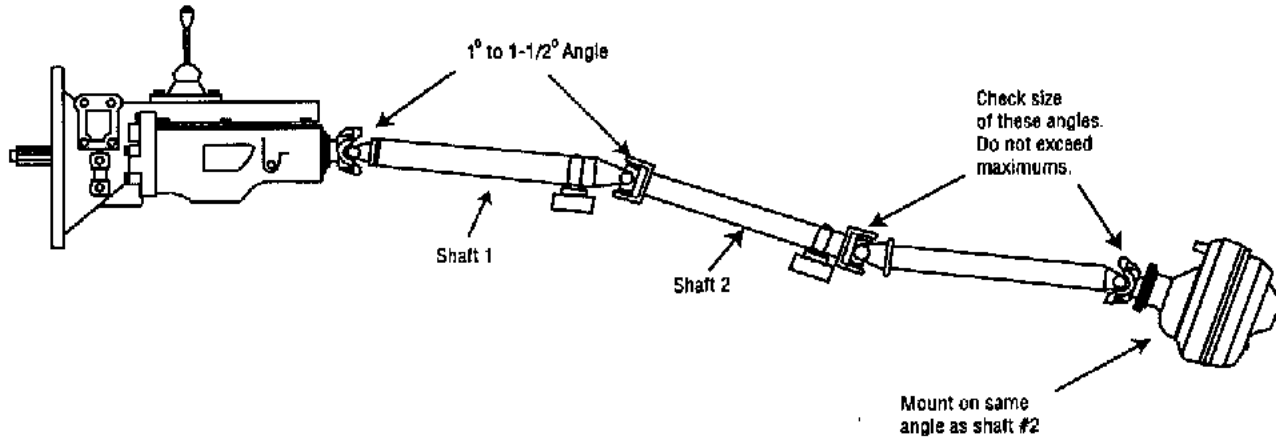
**Figure 10**

## Installation Techniques

On applications having more than two shafts, mount the first coupling shaft as outlined in the preceding example, and each additional coupling shaft at a 1 to 1-1/2 degree universal joint operating angle to the previous coupling shaft.

Install or tilt the axle to the same angle as the last fixed coupling shaft so the centerline of the axle and the last fixed coupling shaft are parallel.

**Note:** THIS ASSURES THE UNIVERSAL JOINT OPERATING ANGLE AT EACH END OF THE LAST SHAFT WILL AUTOMATICALLY BE EQUAL (See Fig. 11).



**Figure 11**



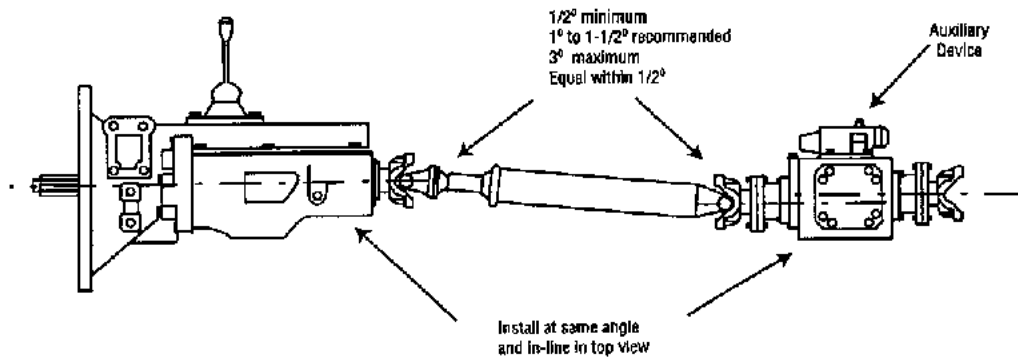
## Mounting a Midship-Mounted PTO, Pump, or Auxiliary Transmission

When installing a midship-mounted PTO, auxiliary transmission, or midship-mounted pump into the main driveline of a vehicle, install it at the same angle as the transmission. Keep the offset to a minimum to reduce universal joint operating angles.

**Note:** Do not make the universal joint operating angle less than 1/2 degree.

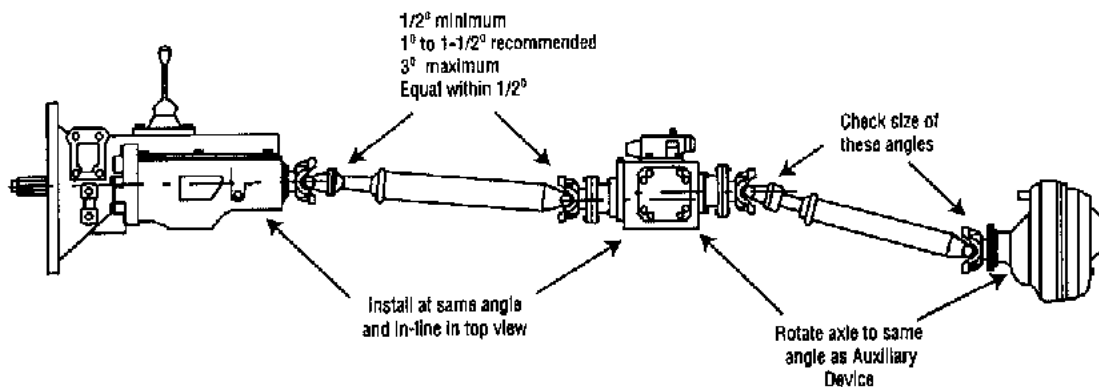
Before bolting the device in place, check the universal joint operating angles that occur at each end of the driveshaft. They must be 1 to 1-1/2 degrees and they must be equal to within 1/2 degree for this type of application.

If the device ends up being installed in direct line with the transmission, with little or no universal joint operating angle on the joints, raise or lower it so there is enough offset to create the required 1 to 1-1/2 degree universal joint operating angle on each end of the driveshaft. (See Fig. 12)



**Figure 12**

If there is only one driveshaft between the device and the rear axle, rotate the rear axle (using shims in the appropriate place) so it is the same angle as the device. This makes the universal joint operating angle at each end of the driveshaft equal (See Fig. 13). Check the size of the universal joint operating angles to determine if they meet recommendations.



**Figure 13**

If there is more than one driveshaft between the device and the rear axle, install the driveshaft as outlined earlier with a 1 to 1-1/2 degree universal joint operating angle on the input end of each shaft. Then rotate the axle so it is on the same angle as the last fixed shaft. The universal joint operating angle on each end of the last shaft will automatically be equal. (See Fig. 14)

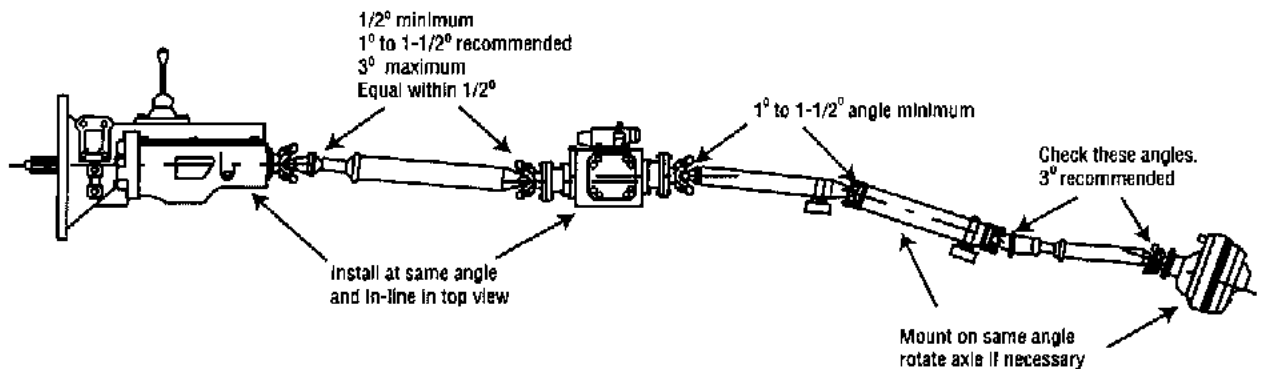


Figure 14

### Mounting a Remote-Driven Pump, Blower, or Similar Device

Remote mounted-pumps, blowers, or similar devices are usually driven by a side, top, or bottom-mounted PTO and use an auxiliary driveshaft.

Many times these devices are mounted to the vehicle frame or cross member. The usual method of mounting, where the driven device is mounted parallel with the ground without regard to the mounted angle of the PTO, will produce a vibration that may cause failure of the PTO, pump, blower, or other driven device.

Any remote driven device must be mounted parallel and in line, if possible, with the PTO.

To select the appropriate auxiliary driveshaft for these types of applications, you should consider proper torque, safe operating speed (which is different than the critical speed for tubular driveshafts), and angularity. (See Maximum Safe Operating Speed Chart on page 18).

An auxiliary driveshaft must be capable of transmitting the maximum torque and RPM required by the driven equipment. For most low-torque applications operating at less than 1200 RPM, solid bar-stock constructed driveshafts are adequate. For applications requiring additional torque or RPMs, tubular shafts should be fabricated.

## Maximum Safe Operating Speed

MAXIMUM OPERATING SPEED* BY TUBE SIZE, SOLID SHAFT SIZE, AND LENGTH *(For speeds over 6000 RPM, contact Spicer Universal Joint Division Engineering)											
TUBING	MAXIMUM INSTALLED LENGTH (IN INCHES) FOR GIVEN RPM										
Diameter & Wall Thickness W - Welded S - Seamless	Centerline to Centerline of Joints for a Two Joint Assembly or Centerline of Joint to Centerline of Center Bearing for a Joint and Shaft										
	RPM - Revolutions Per Minute										
	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000
1.750" x .065" W	82"	67"	58"	52"	-	-	-	-	-	-	-
1.250" x .095" S	64"	52"	45"	40"	37"	34"	32"	-	-	-	-
2.500" x .083" W	87"	70"	62"	55"	50"	45"	43"	41"	39"	37"	35"
3.000" x .083" W	-	-	85"	76"	70"	64"	60"	57"	54"	51"	49"
<b>SOLID SHAFT DIAMETER</b>											
.750"	42"	35"	30"	27"	25"	-	-	-	-	-	-
.812"	44"	36"	31"	28"	26"	-	-	-	-	-	-
.875"	46"	37"	32"	29"	27"	-	-	-	-	-	-
1.000"	49"	40"	35"	31"	28"	-	-	-	-	-	-
1.250"	55"	45"	39"	35"	32"	-	-	-	-	-	-

Maximum Operating Speed

To prevent premature wear, auxiliary driveshaft breakage, and possible injury to people or equipment, be aware of the critical speed of these types of driveshafts. Critical speed, explained earlier in this guide, is different for these solid shaft and small tube driveshafts.


Refer to the chart above for maximum safe operating speed information on these types of shafts.

If the chart indicates that the critical speed may be a problem, use multiple shafts. Be sure to use support bearings where necessary and set up the true universal joint operating angles as indicated earlier in this guide.

As with all driveshafts, auxiliary driveshafts should be:

- Carefully installed to minimize vibrations caused by incorrect universal joint operating angles
- Capable of absorbing shock loads
- Capable of changing length as needed
- Guarded so as to prevent inadvertent entanglement

### Special Notes Regarding Auxiliary Driveshafts

 **WARNING:** Working on or near an auxiliary driveshaft when the engine is running is extremely dangerous and should be avoided. You can snag clothes, skin, hair, hands, etc. This can cause serious injury or death.

- Shut off engine before working on power take-off or driven equipment.
- Do not go under the vehicle when the engine is running.
- Do not engage or disengage driven equipment by hand from under the vehicle when the engine is running.
- Fasteners should be properly selected and torqued to the manufacturer's specifications.
- If a setscrew protrudes above the hub of an end yoke, you may want to replace it with a recessed (Allen-type) setscrew.
- If you decide that a recessed setscrew does not have enough holding power for your application and you must use a protruding setscrew, be sure no one can come in contact with the rotating driveshaft or the protruding setscrew.
- **Exposed rotating driveshafts must be guarded!**
- Lubricate auxiliary driveshafts according to manufacturer's specifications.



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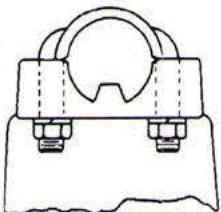
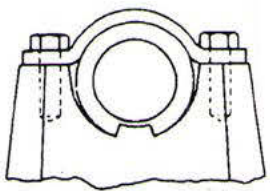

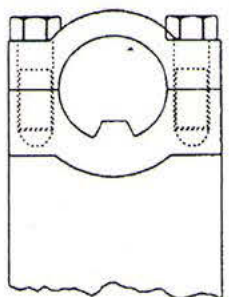
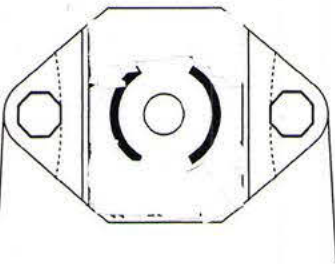

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# UNIVERSAL JOINT KIT ATTACHING HARDWARE & TORQUE SPECIFICATIONS CHART

<b>U-BOLT</b>		Series	Spicer Kit No.	U-Bolt Ass'ys.	Recommended Nut Torque	
		1280	5-200X	2-94-28X	14-17 Lb. Ft.	
		1310	5-153X	2-94-28X	14-17 Lb. Ft.	
		1330	5-213X	2-94-28X	14-17 Lb. Ft.	
		1350	5-178X	3-94-18X	20-24 Lb. Ft.	
		1410	5-160X	3-94-18X	20-24 Lb. Ft.	
		1480	5-188X	3-94-28X	32-37 Lb. Ft.	
		1550	5-155X	3-94-28X	32-37 Lb. Ft.	
		<b>BEARING STRAP</b>		Series	Spicer Kit No.	Strap Kit Ass'ys.
		SPL90	SPL90X	90-70-28X	45-60 Lb. Ft.	
		1210	5-443X	2-70-18X	13-18 Lb. Ft.	
		1280	5-200X	2-70-18X	13-18 Lb. Ft.	
		1310	5-153X	2-70-18X	13-18 Lb. Ft.	
		1330	5-213X	2-70-18X	13-18 Lb. Ft.	
		1350	5-178X	3-70-28X	30-35 Lb. Ft.	
		1410	5-160X	3-70-28X	30-35 Lb. Ft.	
		1480	5-188X	3-70-38X	55-60 Lb. Ft.	
		1550	5-155X	3-70-38X	55-60 Lb. Ft.	
		1610	5-438X	5-70-28X	55-60 Lb. Ft.	
		1710	5-515X	6.5-70-18X	130-135 Lb. Ft.	
		1760	5-469X	6.5-70-18X	130-135 Lb. Ft.	
1810	5-510X	6.5-70-18X	130-135 Lb. Ft.			
 <b>WARNING:</b> Bearing Strap Retaining Bolts Should <b>NOT</b> Be Reused.						
<b>CAP &amp; BOLT</b>		Series	Spicer Kit No.	Cap & Bolt Ass'ys.	Recommended Bolt Torque	
		1650	5-165X	5-70-18X	77-103 Lb. Ft.	
		1850	5-185X	8-70-18X	110-147 Lb. Ft.	
		1850	5-227X	8-70-18X	110-147 Lb. Ft.	
		1910	5-316X	N.S.S.	110-147 Lb. Ft.	
		1950	5-339X	9-70-18X	271-362 Lb. Ft.	
		2010	5-371X	N.S.S.	102-118 Lb. Ft.	
		2050	5-340X	9-70-28X	744-844 Lb. Ft.	
		2110	5-372X	N.S.S.	171-197 Lb. Ft.	
		2150	5-298X	9-70-38X	744-844 Lb. Ft.	
		2210	5-373X	N.S.S.	260-298 Lb. Ft.	
		<b>BEARING PLATE</b>		Series	Spicer Kit No.	Bolt Part No.
		1610	*5-279X	5-73-709	N.A.	26-35 Lb. Ft.
		1710	*5-280X	6-73-209	N.A.	38-48 Lb. Ft.
		1760	*5-407X	6-73-209	N.A.	38-48 Lb. Ft.
		1810	*5-281X	6-73-209	N.A.	38-48 Lb. Ft.
		1880	*5-308X	7-73-315	N.A.	60-70 Lb. Ft.
		<b>New part nos. for kits with lockstraps available after Spring, 1994</b>				
 <b>WARNING:</b> Self Locking Bolts Should <b>NOT</b> Be Reused		1610	5-654X	5-73-109	98-1741	17-24 Lb. Ft.
		1710	5-656X	6-73-109	230323	32-42 Lb. Ft.
		1760	5-658X	6-73-109	230323	32-42 Lb. Ft.
		1810	5-660X	6-73-109	230323	32-42 Lb. Ft.
		1880	5-668X	7-73-115	231009	50-66 Lb. Ft.

\* THESE U-JOINT KITS WILL USE SELF-LOCKING BOLTS WITH LOCK PATCH™ AFTER SPRING, 1994. A LOCKSTRAP WILL NO LONGER BE NEEDED.

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	ELECTRIC MOTOR	GAS OR DIESEL	SHORT DURATION				
→ 1000	75	50	310	420	2500	55	2.50
1100	80	55	330	670	4000	47	2.50
1210	95	65	420	850	6000	43	3.00
1280	140	95	570	1,250	6000	43	3.75
→ 1310	195	130	800	1,600	6000	47	3.75
1330	220	150	890	1,850	5000	50.5	4.13
→ 1350	310	210	1,240	2,260	5000	51	4.25
1410	375	250	1,500	2,700	5000	51	4.69
1480	500	340	2,000	3,330	5000	55	4.81
1550	640	430	2,400	4,400	5000	55	5.63
1650	952	635	3,640	6,400	4000	61	6.38
1610	975	640	3,650	6,500	4500	58	7.00
1710	1,330	900	4,800	8,000	4500	62	7.75
1760	1,630	1,100	5,800	10,200	4500	62	8.56
1810	1,850	1,250	6,500	12,000	4500	66	9.13
1820	2,550	1,700	8,900	16,000	3000	80	9.75
1850	2,550	1,700	8,900	16,000	3000	80	9.75
1880	2,550	1,700	8,900	16,000	3000	80	9.75
1910	3,600	2,400	12,000	20,800	2500	80	8.88
1950	5,400	3,600	18,000	34,000	2500	80	11.25
2050	11,500	7,500	36,000	68,000	2000	80	14.13
2150	22,500	15,000	72,000	135,000	1500	80	17.50

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