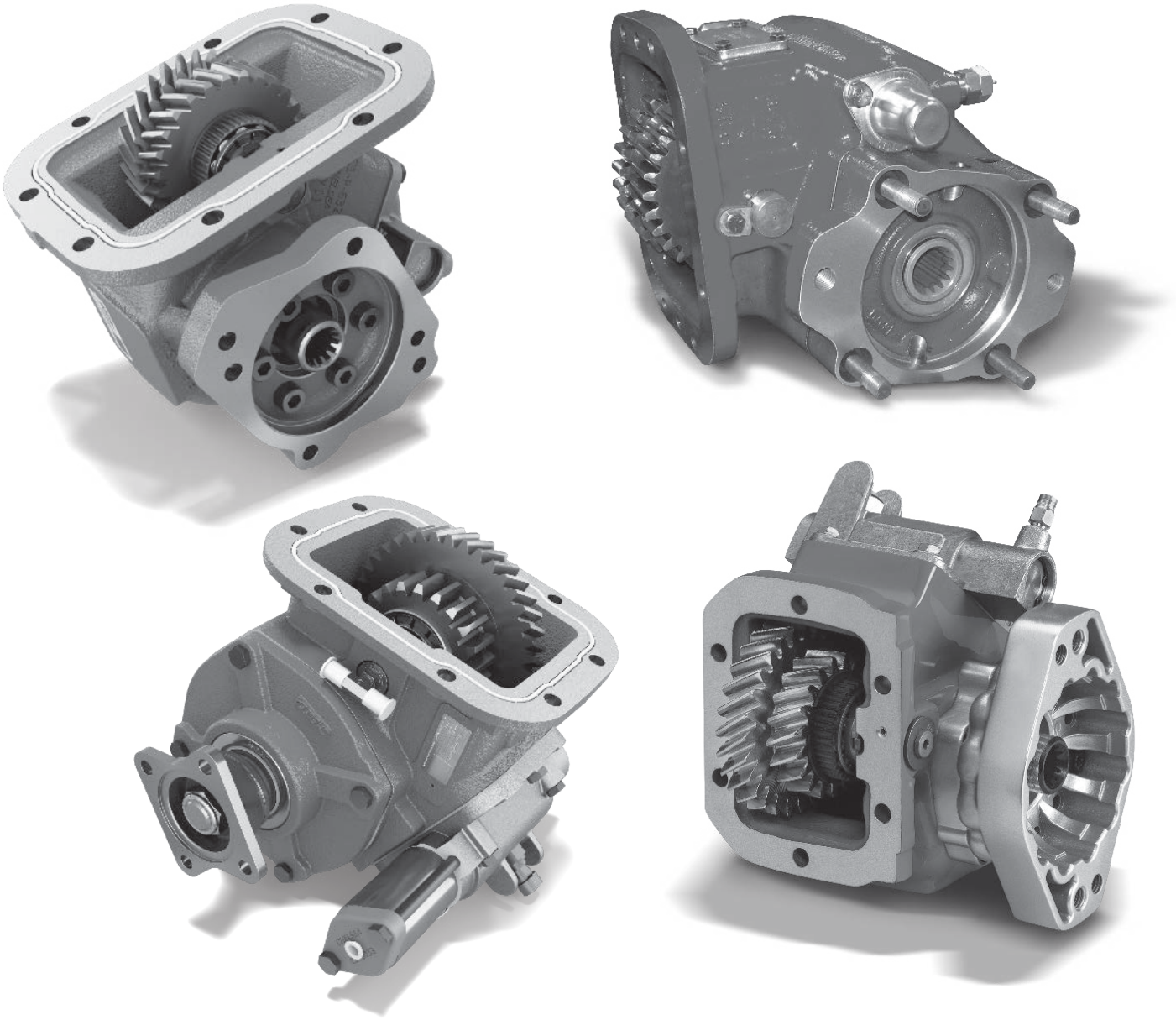
Effective: HY25-1135-M1/US July 2024
Supersedes: HY25-1135-M1/US May 2024



Power Take-Offs Owner's Manual

340, 348, 442, 447, 489, 660, 680, 823, 863, 880 Series

Parker Chelsea

ENGINEERING YOUR SUCCESS.

⚠ WARNING — User Responsibility

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Offer of Sale

The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the “Offer of Sale”.

⚠ **WARNING:** This product can expose you to chemicals including Lead and Lead Compounds, and Di(2-ethylhexyl)phthalate (DEHP) which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

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Continued on Next Page

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Foreword

This booklet will provide you with information on correct installation of Chelsea® Power Take-Offs (PTOs). Proper installation and setup procedures can help you get additional and more profitable hours from your truck equipment and components.

It is important that you be sure that you are getting the right transmission and PTO combination when you order a new truck. A mismatched transmission and PTO combination can result in unsatisfactory performance of your auxiliary power system from the start.

If you have questions regarding correct PTO and transmission combination, please contact your local Chelsea® representative. They can help you select the properly matched components to ensure correct and efficient applications.

Safety Information

These instructions are intended for the safety of the system designer, installer, operator, and supporting personnel. If you have any additional questions after reading the instructions below, please reach out to your local Chelsea representative.

General Safety Information

To prevent injury to yourself and/or damage to the equipment:

- Carefully read all owner's manuals, service manuals, and/or other instructions.
- Always follow procedures using proper tools and safety equipment.
- Ensure proper training is received prior to attempting to install equipment.
- Always block any raised or moving device that may injure a person working on or under a vehicle.
- Never work alone while under a vehicle, repairing equipment, or maintaining equipment.
- Always use proper components in applications for which they are approved.
- Never use worn-out or damaged components.
- Never operate the controls of the PTO or other driven equipment from any position that could result in getting caught in the moving machinery.

Proper Matching of PTO

WARNING: A Power Take-Off must be properly matched to the vehicle transmission and to the auxiliary equipment being powered. An improperly matched Power Take-Off could cause severe damage to the vehicle transmission, the auxiliary driveshaft, and/or to the auxiliary equipment being powered. **Damaged components or equipment could malfunction causing serious personal injury to the vehicle operator or to others nearby.**

To avoid personal injury and/or equipment damage:

- Always refer to Chelsea's catalogs, literature, and owner's manuals.
- Follow Chelsea's recommendations when selecting, installing, repairing, or operating a PTO.
- Never attempt to use a PTO that is not specifically recommended by Chelsea for the vehicle, transmission, and application.
- Always match the PTO's specified output capabilities with the requirements of the equipment to be powered.
- Never exceed the maximum speed listed in Chelsea's Applications Catalog.

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Safety Information (Continued)
Cold Weather Operation of PowerShift PTO

WARNING: During extreme cold weather operation [32°F (0°C) and lower], a disengaged PowerShift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up, and the viscous drag will quickly decrease.

The rotation of the PTO's output shaft could cause unexpected movement of the driven equipment resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- Driven equipment must have separate controls.
- The driven equipment must be left in the disengaged position when not in operation.
- Do not operate the driven equipment until the vehicle is allowed to warm up.

Rotating Auxiliary Driveshafts

WARNING: 

- Rotating auxiliary driveshafts can cause serious injury or death by snagging clothes, skin, hair, hands etc.
- Do not go under the vehicle when the engine is running.
- Do not work on or near an exposed shaft when the engine is running.
- Shut off the engine before working on the PTO or driven equipment.
- Exposed rotating driveshafts must be guarded.

Guarding Auxiliary Driveshafts

WARNING: 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 to specify guard(s) and PTO installer to install guard(s).

Using Set Screws

WARNING: 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.

Important Safety Information and Owner's Manual

WARNING: Chelsea Power Take-Offs are packaged with warning labels, safety information decals, instructions, and an owner's manual. These items are located in the envelope with the PTO mounting gaskets. Also, safety information and installation instructions are packaged with some individual parts and kits. Be sure to read the owner's manual and safety information before installing or operating the PTO. Always install the safety information decals according to the instructions provided. Place the owner's manual in the vehicle glove compartment.

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Safety Information (Continued)

WARNING: Operating the PTO with the Vehicle in Motion

Some Power Take-Offs may be operated when the vehicle is in motion. PTOs must be properly selected to operate at highway speeds, correctly matched to the vehicle's transmission, as well as the requirements of the driven equipment.

If in doubt about the PTO specifications and capabilities, avoid operating the PTO when the vehicle is in motion. Improper application and/or operation can cause serious personal injury as well as premature failure of the vehicle, driven equipment, and PTO.

Always remember to disengage the PTO when the driven equipment is not in operation.

PTO Safety Label Instructions

1. The two black and orange on white 5" x 7" pressure sensitive vinyl labels (PN 379274) must be placed one on each side of the vehicle in a position that would be **HIGHLY** visible to anyone that would go under the truck near the PTO rotating shaft. If the vehicle is to be painted after these labels are installed, cover them with two blank masking covers. Remove the masking covers after painting.
2. Place the one black and orange on white 3.5" x 5" pressure sensitive vinyl label (PN 379275) on the sun visor nearest the operator of the vehicle.
3. Place the one red and white with black lettering 3.5" x 7" pressure sensitive vinyl label (PN 379915) on the sun visor next to the above label (PN 379275).
4. Place the one white and black heavy-duty card (PN 379276) in the vehicle glove box in a position highly visible to the operator. For example, try to place this card on top of whatever may be in the glove box.

If you require labels, please order part number 328946X at no charge from your local Chelsea representative or send request direct to:

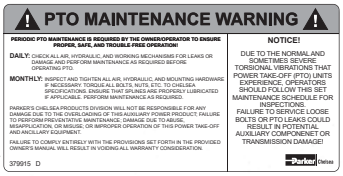
Parker-Hannifin Corporation
Chelsea Products Division
8225 Hacks Cross Road
Olive Branch, MS 38654

Phone: +1 (662) 895-1011
Email: chd_support@support.parker.com

Part #379276

Part #379275

Part #379915



Part #379274

This symbol warns of possible personal injury.

Pump Bracketing Best Practices

With changes in emissions standards, truck systems are experiencing more vibration and vibration related issues. Due to the changes, Parker Chelsea finds it necessary to discuss the importance of pump bracketing and the effects it can have on the mounted PTO. Parker Chelsea has made updates to the pump bracketing support guidelines listed in all PTO Owner's Manuals. This bulletin will discuss the importance of bracketing and the best practices to keep in mind when mounting a pump.

Please note, due to the high variance of applications and the increasing severity of vibration found in modern diesel engines Parker Chelsea's pump bracketing best practices cannot consider all factors affecting the PTO and Pump bracketing. Please use the following information as a GUIDELINE ONLY when installing pump bracketing.

Potential causes of bracket failures that can damage a PTO and/or Pump:

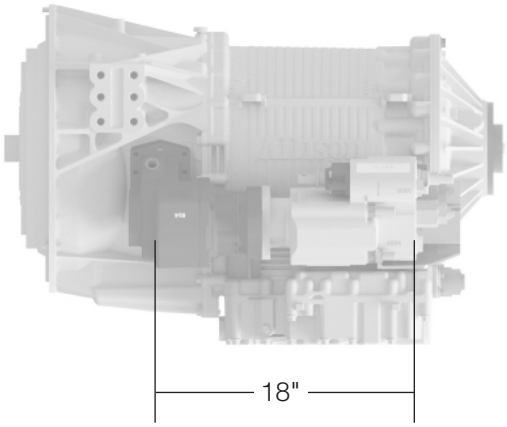
- Excessive preload from poor bracket design, fabrication, and installation.
- Excessive vibration from the vehicle's normal driving operation leading to high loads on the PTO bolts.
- Torque spikes from extreme vibration could be intense enough to break bolts in the bracketing. The worst cases occur while the truck is operating at highway speeds.

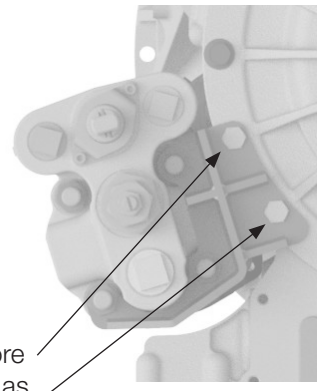
In addition to the conditions listed above, Chelsea requires the use of support brackets in all applications to ensure the Maximum Bending Moment (MBM) of the PTO and pump assembly is not exceeded. Exceeding the MBM can result in damage to PTO, transmission, driven equipment, and/or personnel. It is the responsibility of the installer to ensure that adequate support is implemented. All applications are unique and it is important to consider all parameters in designing a proper support bracket.

Use **CAUTION** to ensure the support bracket does not pre-load PTO and pump mounting. Prior to mounting, pumps must be fully supported by a jack until it is properly secured with support bracket(s). This will ensure the PTO is not being stressed by the bracket. Brackets must be designed to adequately eliminate deflections from weight, vibration, and truck movements.

PTO warranty will be voided if support brackets are not used when one of the following conditions apply:

- Combined weight of the pump, fittings, hoses, and oil exceeds 40 lbs [18.14 kg]
- Combined length of the PTO and pump is greater than 18 inches [45.72 cm]
- Pumps should have a support bracket when mounted onto a on a non-extended shaft PTO
- Extended Shaft PTOs: Please see applicable owner's manual for additional guidance





To ensure proper bracketing, brackets must attach at two or more transmission bolt locations as well as two or more pump (bolt) locations. Please reach out to your transmission manufacturer for proper bracket mounting locations.

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Pump Bracketing Best Practices (Continued)

An installed PTO/Pump bracket needs to be properly aligned. Misalignment in the X direction (**Fig. 1**) is substantially more impactful than misalignment in the Y or Z direction (**Fig. 2**). To prevent this, installing a fixture-built bracket is preferred. This allows the PTO/Pump to be installed prior to making the final welds on the bracket.

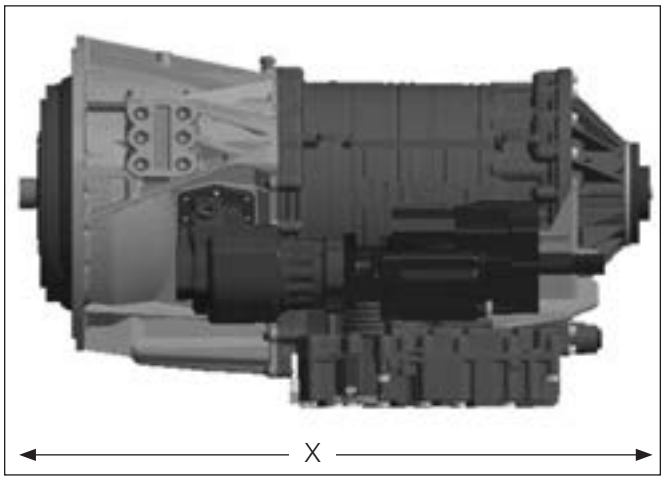


Figure 1

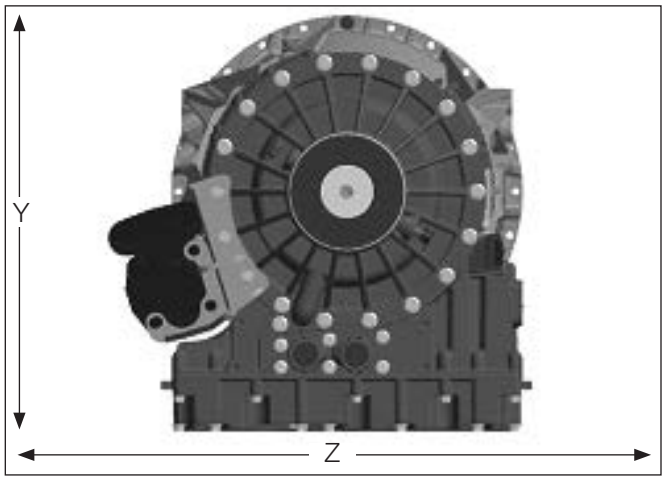
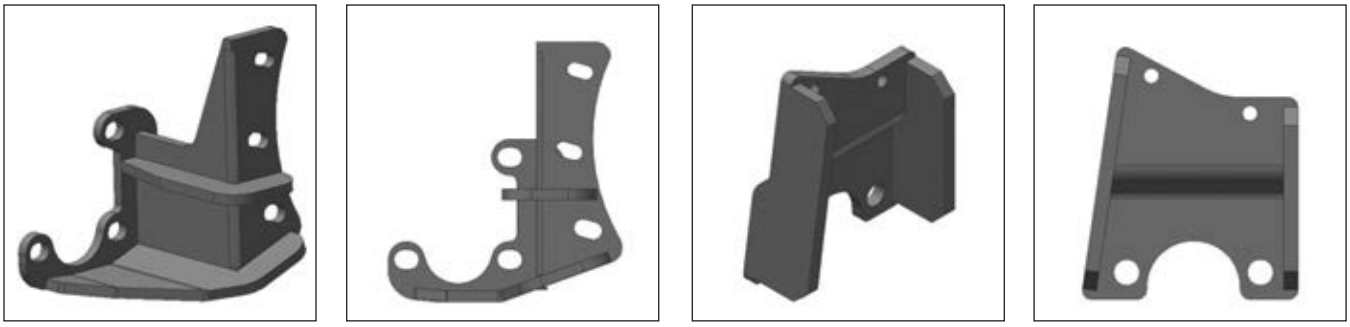


Figure 2

- The PTO/Pump should be treated as engine mounted components and installed per the engine manufacturer's published guidelines for engine mounted components when applicable.
- For proper bracketing, attach the bracket at two or more transmission bolt locations and two or more pump locations. Whenever possible, three attachment points in either (or both) locations is suggested. Please contact the transmission manufacturer for proper bracket mounting locations.
- Brackets should contain at least one gusset, preferably two. The gussets should be 3/8" thick and at least 1" deep. 3/8" steel is suggested particularly with gussets and in areas with reduced cross section.
- Please refer to the transmission and pump manufacturer's approved pump bracket support locations.



These best practices should be followed for optimal results. Please note, each bracketing situation is different so this bulletin must only be used as a guideline. For further bracketing assistance please refer to your PTO Owner's Manual or contact your Chelsea PTO representative for questions.

If you have any technical questions, contact us at:

Phone: +1 (662) 895-1011

Email: chd_support@support.parker.com

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Function of Auxiliary Power Shafts

An auxiliary power shaft transmits torque from the power source to the driven accessory. The shaft must be capable of transmitting the maximum torque and RPM required of the accessory, plus any shock loads that develop.

An auxiliary power shaft operates through constantly relative angles between the power source and the driven accessory. Therefore, the length of the auxiliary power shaft must be capable of changing while transmitting torque. This length change, commonly called slip movement, is caused by movement of the power train due to torque reactions and chassis deflections.

Joint operating angles are very important in an auxiliary power joint application. In many cases, the longevity of a joint is dependent on the operating angles in the chart below.

SPICER® UNIVERSAL JOINT OPERATING ANGLES			
Prop. Shaft RPM	**Max. Normal Operating Angle**	**Prop. Shaft RPM**	**Max. Normal Operating Angle**
3000	5° 50'	1500	11° 30'
2500	7° 00'	1000	11° 30'
2000	8° 40'	500	11° 30'
Above based on angular acceleration of 100 RAD/SEC^2			

This information is limited to 1000 through 1310 series applications. For applications requiring a series larger than 1310, please contact your driveline specialist.

Determining Shaft Type

1) Solid or tubular?
   a) In applications requiring more than 1000 RPM or where the application necessitates a highly balanced auxiliary power shaft, a tubular shaft should be used.
   b) Spicer's solid shaft auxiliary power joints are designed for intermittent service at 1000 or less RPM. Examples include driving of small hydraulic pumps, low speed product pumps, and winches.
2) Joint Series should be determined using the chart on the following page.

WARNING: direct customer to driveline manuf/spec.

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Spicer® Universal Joint Engineering Data

Joint Series	**1000**	**1100**	**1280**	**1310**
Torque Rating				
Automotive (Gas or Diesel Engine) lb-ft Continuous	50	54	95	130
Tubing				
Diameter	1.750"	1.250"	2.500"	3.000"
Wall Thickness	.065"	.095"	.083"	.083"
W = Welded S = Seamless	W	S	W	W
Flange Diameter (Swing Diameter)				
Rectangular Type	3.500"	3.500"	3.875"	3.875"
Bolt Holes - Flange Yoke				
Circle	2.750"	2.750"	3.125"	3.125"
Diameter	.312"	.312"	.375"	.375"
Number	4	4	4	4
Male Pilot Dia.	2.250"	2.250"	2.375"	2.375"
Distance Across Lugs				
Snap Ring	2.188"	2.656"	3.469"	3.469"
Construction	2.188"	2.656"	3.469"	3.469"
Bearing Diameter	.938"	.938"	1.062"	1.062"

[1, 2] Maximum Operating Speed for Tube or Solid Shaft Diameter and Length

Tube	RPM - Revolutions per Minute				
OD x Wall Thickness (Joint Type)	**500**	**1000**	**1500**	**2000**	**2500**
1.750" x .065" (Welded)	117"	82"	67"	58"	52"
1.250" x .095" (Seamless)	91"	64"	52"	45"	40"
2.500" x .083" (Welded)	122"	87"	70"	62"	55"
3.000" x .083" (Seamless)	-	-	-	85"	76"
Solid Shaft	RPM - Revolutions per Minute				
Diameter	**500**	**1000**	**1500**	**2000**	**2500**
.750"	60"	42"	35"	30"	27"
.812"	62"	44"	36"	31"	28"
.875"	65"	46"	37"	32"	29"
1.000"	69"	49"	40"	35"	31"
1.250"	77"	55"	45"	39"	35"

[1] The numbers expressed above represent the maximum installed length for tubing or solid shaft in both two joint assemblies and joint shaft applications.
[2] Please contact your Chelsea representative for applications with speeds below 500 RPM and over 2500 RPM.

WARNING: direct customer to driveline manuf/spec.

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Power Take-Off Maintenance

Due to the normal and sometime severe torsional vibrations that PTOs experience, operators should follow a set maintenance schedule for inspections. Failure to service loose bolts or PTO leaks could result in potential auxiliary Power Take-Off or transmission damage.

Periodic PTO maintenance is required by the owner/operator to ensure proper, safe, and trouble-free operation.

Daily: Check all air, hydraulic, and working mechanisms before operating PTO and perform maintenance as required.

Monthly: Inspect for possible leaks and tighten all air, hydraulic, and mounting hardware if necessary. Torque all bolts, nuts, etc., to Chelsea's specifications. If applicable, ensure that splines are properly lubricated. Perform maintenance as required.

With regards to the direct mounted pump splines, the PTO requires the application of a specially formulated anti-fretting grease. This grease must be specified for both high pressure and high temperature applications. The addition of the grease has been proven to reduce the effects of torsional vibrations, which result in fretting corrosion on the PTO's internal splines as well as the pump's external splines. Fretting corrosion appears as a rusting and wearing of the pump shaft splines. Severe duty applications, which require long PTO running times and high torque, may require more frequent regreasing. Continuous duty applications with light loads require frequent regreasing due to the higher number of running hours, an example of this is utility trucks. It is important to note that service intervals will vary for every application and they are the responsibility of the end user of the product. Chelsea also recommends that you consult your pump's owner's manual and technical services for their maintenance guidelines. Fretting corrosion is caused by many factors and without proper maintenance; the anti-fretting grease can only reduce its effects on components.

Chelsea offers anti-fretting grease to our customers in two package sizes:

- 5/8 fluid ounce tube (PN 379688) - Provided with PTO where applicable
- 14-ounce grease cartridge (PN 379831)

Warranty: Failure to comply entirely with the provisions set forth in the appropriate owner's manual will result in voiding of warranty consideration.

⚠ This symbol warns of possible personal injury.

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PTO Shifting Procedure & Precautions

CAUTION: This vehicle is equipped with a Power Take-Off. Shut engine off before working on the Power Take-Off or getting below the vehicle. Consult the operating instructions before using the PTO (See sun visor).

POWER TAKE-OFF OPERATION — VEHICLE STATIONARY

Automatic Transmission with PowerShift PTO

Engage the PTO with the engine at idle speed.

NOTE: PowerShift PTO: The engine must be at idle or below 1000 RPM when the PTO is engaged. See the transmission manufacturer's instructions for special procedures.

IMPORTANT:

Failure to follow the proper shifting or operating sequences will result in premature PTO failure with possible damage to other equipment.

WARNING: Cold Weather Operation of PowerShift PTO

During extreme cold weather operation [32°F (0°C) and lower], a disengaged PowerShift Power Take-Off can momentarily transmit high torque that will cause unexpected output shaft rotation. This is caused by the high viscosity of the transmission oil when it is extremely cold. As slippage occurs between the Power Take-Off clutch plates, the oil will rapidly heat up and the viscous drag quickly decreases.

The rotation of the PTO's output shaft could cause unexpected movement of the driven equipment, resulting in serious personal injury, death, or equipment damage.

To avoid personal injury or equipment damage:

- Driven equipment must have separate controls.
- Driven equipment must be left in the disengaged position when not in operation.
- Driven equipment must not be operated until the vehicle is allowed to warm up.

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PTO Shifting Procedure

General Power Take-Off Operation – Vehicle Stationary

Manual Transmission

1. A Power Take-Off (PTO) is, and should be, operated as an integral part of the main transmission.
2. Before shifting the PTO into or out of gear, disengage the clutch and wait for the transmission or PTO gears to stop rotating.
3. Set parking brake.
4. Shift the transmission into NEUTRAL (N).
5. Shift PTO into gear.
6. Release the clutch pedal.

Automated Manual Transmission (AMT)

See transmission manufacture's recommended procedure for proper PTO operation and shifting sequence.

Mechanical Shift PTO

1. The transmission clutch must be disengaged prior to shifting the PTO into gear.

Clutch-type PTO

1. The PTO can be engaged without the transmission clutch being disengaged, but the engine RPMs must be at or under 1000.

Eaton Cummins Endurant Series Transmissions

Endurant HD™ Series: For engagement and disengagement operations, refer to Eaton Cummins PTO Installation Guide TRIG2610 EN-US.

Endurant XD™ Series: For engagement and disengagement operations, refer to Eaton Cummins PTO Installation Guide TRIG2620 EN-US.

Important: Failure to follow proper shifting or operating sequences will result in premature PTO failure with possible damage to other equipment.

WARNING: Do not attempt to work on an installed Power Take-Off with the engine running. Make sure to block any moving or raised device that may injure a person working on or under the truck. A lever or its linkage may be accidentally moved causing movement of the device which could cause injury to a person near the device.

This symbol warns of possible personal injury.

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PTO Shifting Procedure (Continued)

EATON Procision™ – Transmission Power Take-Off (PTO)

Stationary PTO Operation:

1. Confirm vehicle parking brake is applied and:
   - Shift Lever – Park is selected.
   - Push Button – Neutral is selected.
2. Confirm engine is running at idle RPM.
3. Depress and hold service brake.
4. Select transmission PTO switch.
5. Increase engine RPM to a minimum of 950 RPM to operate PTO.

NOTE: PTO is engaged when PTO indicator lamp illuminates if using the Chelsea supplied PTO switch and light.

NOTE: If PTO indicator lamp does not illuminate, momentarily raise engine speed by 200-300 RPM. If the PTO still does not engage, turn off the PTO switch and confirm vehicle parking brake is applied, service brake is depressed, and Park or Neutral is selected. Momentarily raise engine RPM by 200-300 RPM, return engine to idle RPM and repeat steps 3-5.

PTO Quick Disengage – Stationary PTO Operation automatically disengages if Reverse or a Drive mode is selected.

Mobile PTO Operation:

1. Confirm vehicle parking brake is applied and:
   - Shift Lever – Park is selected.
   - Push Button – Neutral is selected.
2. Confirm engine is running at idle RPM.
3. Depress and hold service brake.
4. Select desired mode.
5. Confirm transmission is in the desired mode.
6. Select transmission PTO switch.

NOTE: PTO is engaged when PTO indicator lamp illuminates if using the Chelsea supplied PTO switch and light.

7. Release vehicle parking brake.

NOTE: Mobile PTO Operation automatically disengages if vehicle speed and/or engine RPM exceeds 9 MPH (14 KPH) or 2700 RPM.

NOTE: If PTO indicator lamp does not illuminate, turn off the PTO switch, and confirm vehicle parking brake is applied, service brake is depressed, and Park or Neutral is selected. Momentarily raise engine RPM by 200-300 RPM, return engine to idle RPM and repeat steps 3-7.

NOTE: Stationary PTO is available when configured for Mobile PTO Operation. Follow Stationary PTO Operation instructions. Stationary PTO does not automatically disengage if Reverse or a Drive mode is selected.

Important: Follow PTO manufacturer instructions for proper use and operation.

Mounting the PTO

CAUTION: Oil may be hot.

WARNING: PTO for the EATON ENDURANT™ transmission (including PACCAR models) which include the 489, 680, 880 Series (**Fig. 3**) have UNIQUE main housings, gears, piloting studs, as well as, a special molded PTO-to-transmission mounting seal. See **Supplemental Installation Instructions (P/N 69-P-27)** included in the Installation Kit (328948-48X) for proper installation. **These special PTO DO NOT require the addition of extra gaskets/shims for backlash adjustment!** If there are any questions during the installation, stop, and call your local Chelsea Distributor for assistance.

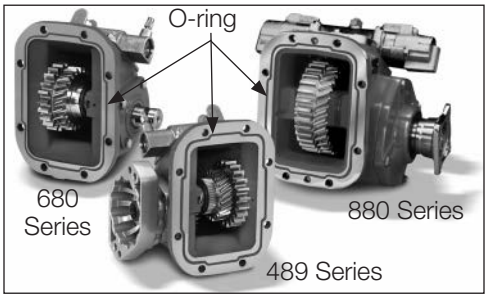

Figure 3

1. Drain the oil from the transmission and remove the PTO aperture cover plate (**Fig. 4**).


Figure 4

2. Discard the cover plate and cover plate gasket then clean the aperture pad using a putty knife or wire brush (**Fig. 5**).

NOTE: Stuff a rag in the aperture opening to prevent dirt from entering the transmission while you are cleaning it.


Figure 5

3. Using your hand, rock the PTO driver gear in the transmission (**Fig. 6**) and the driven gear in the PTO assembly (**Fig. 7**). Rocking the gears provides two important factors.

   a) It shows you the amount of backlash that has been designed into each unit.

   b) It is helpful in establishing the proper backlash when installing the PTO.


Figure 6

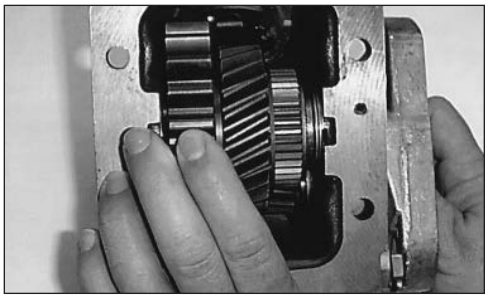
Figure 7

WARNING: Ensure all fasteners and fittings are torqued according to their manufacturer's specification.

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Mounting the PTO (Continued)

4. Install the proper studs (furnished with PTO) in the PTO aperture pad using a stud driver. Studs may have either interference fit threads (plain) or pre-applied locking/sealing compound for installation method (**Fig. 8**).

   Where holes are tapped through the transmission case, use studs with pre-applied locking and sealing compound Loctite 290 to prevent leaks.

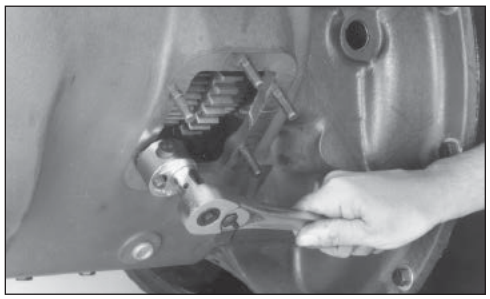
Figure 8

NOTE: Avoid contact of Permatex with automatic transmission fluid in automatics. Always check to be sure that the studs do not interfere with transmission gears.

5. Studs should be threaded into the transmission holes until the stud shank is even with transmission mounting surface. **DO NOT** install studs with shank below the aperture surface. Install studs with hand tools. **DO NOT** use power tools to install studs.

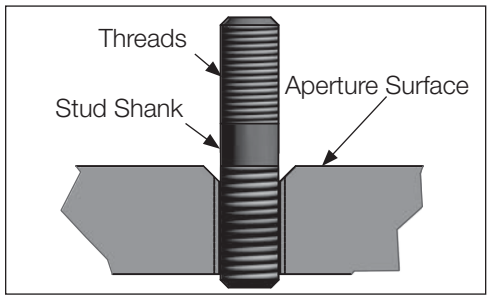

Figure 9

CAUTION: Over tightening of studs or running the shoulder past the transmission mounting surface may damage stud and/or transmission. Use of air impact tools is not recommended (**Fig. 9**).

6. Place the correct number of gaskets over studs (**Fig. 10**). **DO NOT** use Permatex between gaskets because you may want to add or subtract gaskets to obtain proper backlash.

   - When mounting a PTO use gaskets between all mounting surfaces.
   - **DO NOT** stack more than 3 gaskets together.
   - Usually one thick gasket .020" (.50 mm) will be required.
   - Remember the lubricant in the transmission also lubricates the PTO. Therefore, at least one gasket must always be used on either side of filler blocks, adapter assemblies or adapter plates. More gaskets may be required when establishing proper backlash.

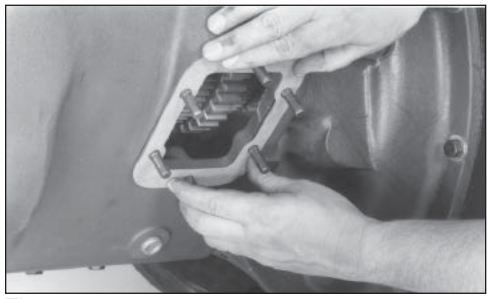
Figure 10

7. Secure PTO to the transmission.

   - Use Self-Locking nuts and/or cap screws provided with PTO (**Fig. 11**).

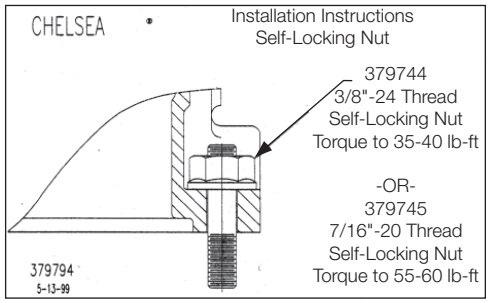

Figure 11

CAUTION: When installing the 489 Series PTO several direct mount pump flange options may interfere with the mounting fasteners directly under the flange. The nut must be threaded far enough onto the stud before the remaining (6) six cap screws and other nut are tightened to prevent interference with the flange and possible breakage of the PTO housing.

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Mounting the PTO (Continued)

8. Torque fasteners to their proper specifications (**Fig. 12**).
   Self-Locking Nuts:
   - (3/8"-24) for 6-Bolt applications 35-40 lb-ft [47-54 N-m].
   - (7/16"-20) for 8-Bolt applications 55-60 lb-ft [75-81 N-m].

   Cap screws:
   - (3/8") for 6-Bolt to 30-35 lb-ft [40-47 N-m].
   - (7/16") for 8-Bolt to 45-50 lb-ft [60-61 N-m].

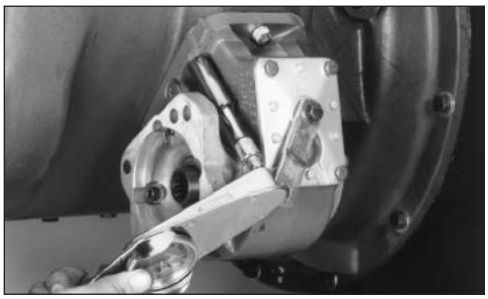
Figure 12

Checking Backlash

WARNING: PTO for the EATON ENDURANT™ transmission (including PACCAR models) which include the 489, 680, 880 Series (**Fig. 13**) have UNIQUE main housings, gears, piloting studs, as well as, a special molded PTO-to-transmission mounting seal. See **Supplemental Installation Instructions (P/N 69-P-27)** included in the Installation Kit (328948-48X) for proper installation. **These special PTO DO NOT require the addition of extra gaskets/shims for backlash adjustment!** If there are any questions during the installation, stop, and call your local Chelsea Distributor for assistance.

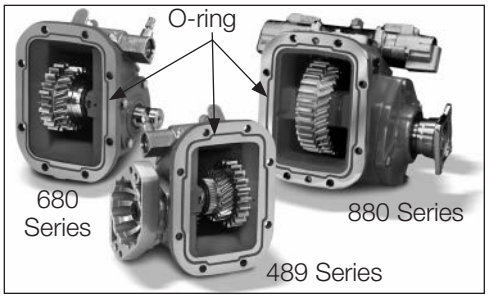

Figure 13

To check for proper backlash on PTO with shift cover.

1. Remove the PTO shift housing and/or inspection plate.

2. Mount the dial indicator so that it registers movement of the input gear (driven gear) of the PTO (**Fig. 14**).

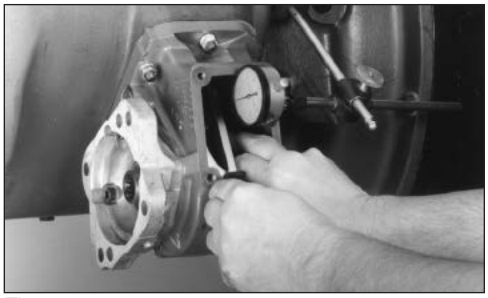
Figure 14

NOTE: For proper location of dial indicator contact point (See **Fig. 15**). (Two common type dial indicators shown).

3. Hold the PTO driver gear in transmission with a screwdriver or bar and rock the PTO input gear (driven gear) back and forth with your hand. Note the total movement on the dial indicator.

4. Establish backlash at .006"-.012" [.15 mm-.30 mm] by adding or subtracting gaskets.

   General rule: A Chelsea .010" gasket will change backlash approximately .006". A .020"gasket changes backlash approximately .012".

5. Replace the shift housing and/or inspection plate and retorque (4) four cap screws to 24-28 lb-ft [33-39 N-m].

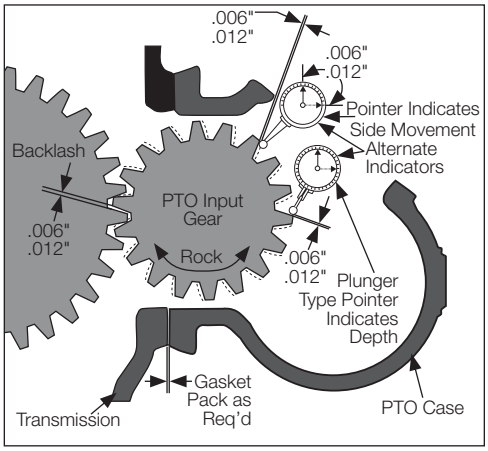

Figure 15

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Checking Backlash (Continued)

NOTE: Use a crossing pattern when torquing the bolts (**Fig. 16**).

NOTE: Apply a drop of Loctite 290 on each cap screw before reinstalling. Cap screws that are furnished with a conversion kit and are being installed for the first time do not require the drop of Loctite.

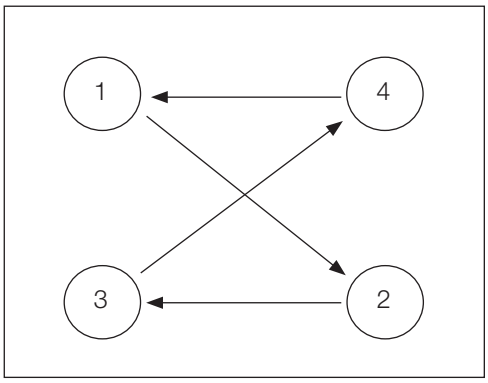

Figure 16

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Mounting the PTO (Continued)

Final Installation Steps

1. Remove the filler plug from the transmission and add recommended transmission lubricant to the level prescribed by the transmission or truck manufacturer (**Fig. 17**).

NOTE: If the PTO is mounted below oil level, additional lubricant will be required.

2. Run the PTO for 5-10 minutes and check for oil leaks and noise.

3. Should a quiet PTO become noisy after the universal joint connection is made, check the PTO driveline components for an out of phase condition, excessive or unequal joint angles or possibly worn parts in the driven accessory.

4. Re-torque all mounting bolts, nuts, cap screws and set up inspection routine of the PTO driveline components and the driven auxiliary equipment.

NOTE: Anticipate slight increase in PTO noise level as oil thins out at operating temperatures.

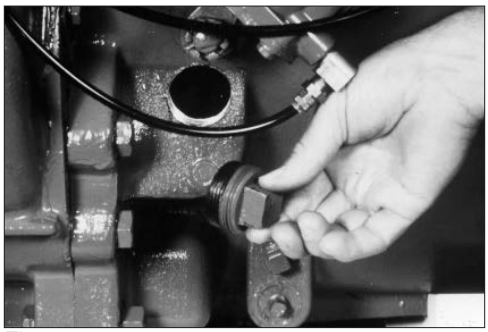
Figure 17

PTO Installation Tips for Automatic Transmissions

The procedure for installing a PTO on an automatic is basically the same as for a mechanical transmission. Power Take-Offs for automatic transmissions are assembled with a special drilled input shaft which allows the input gear to be pressure lubricated during operation (See page 39). After installing a PTO on an automatic transmission, connect pressure lubrication hose to the PTO, and the transmission per installation instructions shown on pages 40-42 of this booklet.

WARNING: Adapter assemblies are never used on an automatic transmission, unless specified on the application page, because they do not have pressure lubricated design features.

WARNING: Use only wire control with PTO made for wire cable control. If lever is desired, order PTO for lever control. The internal shifting mechanism for wire is not designed for heavy forces usually encountered with lever control linkage.

This symbol warns of possible personal injury.

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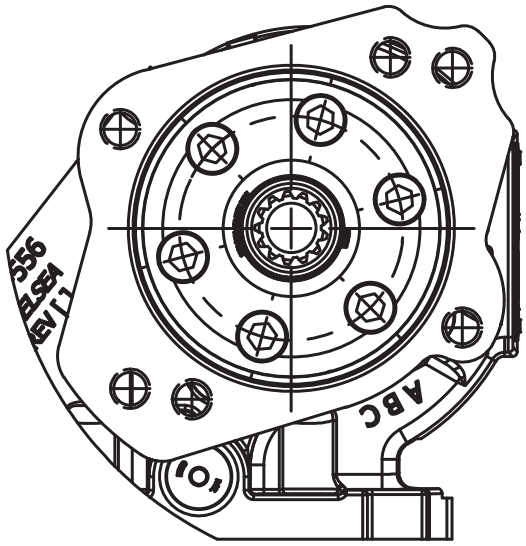
Installing Rotatable Flanges

The rotatable flange is shipped loose with the PTO units for ease of installation. After determining the flange position, attach the flange to the PTO bearing cap using the cap screws provided in the bag kit.

After installing the cap screws make sure to torque the screws to the proper specifications (See chart below).

Consideration should be taken on the size and weight of the pump being installed (See pages 4-5).



RK Flange Shown

NOTE: Reinstalling or tightening of a rotatable flange after it has become loose is not recommended. If a PTO has run for a length of time after the flange has become loose, the flange and/or bearing cap may not be to manufacturing tolerance and should be replaced.

Torque Chart

Outputs	Family	Pump Flange to Bearing Cap Cap Screw P/N	Qty.	Size Cap Screw	Cap Screw Bag Kit	Recommended Cap Screw Torque
GA, GB, PA, PF, RA, RB, RE, & RF	6-Bolt	378447-6	3	0.312"-18 x 1.000"	328170-207X	24-28 lb-ft [33-39 N-m]
RC, RD, & RH	6-Bolt	378446-4	6	0.250"-20 x 0.750"	328170-210X	8-12 lb-ft [11-16 N-m]
RJ & RK	6-Bolt	379740-6	6	M10-1.5 x 0.984"	328170-218X	35-40 lb-ft [48-54 N-m]

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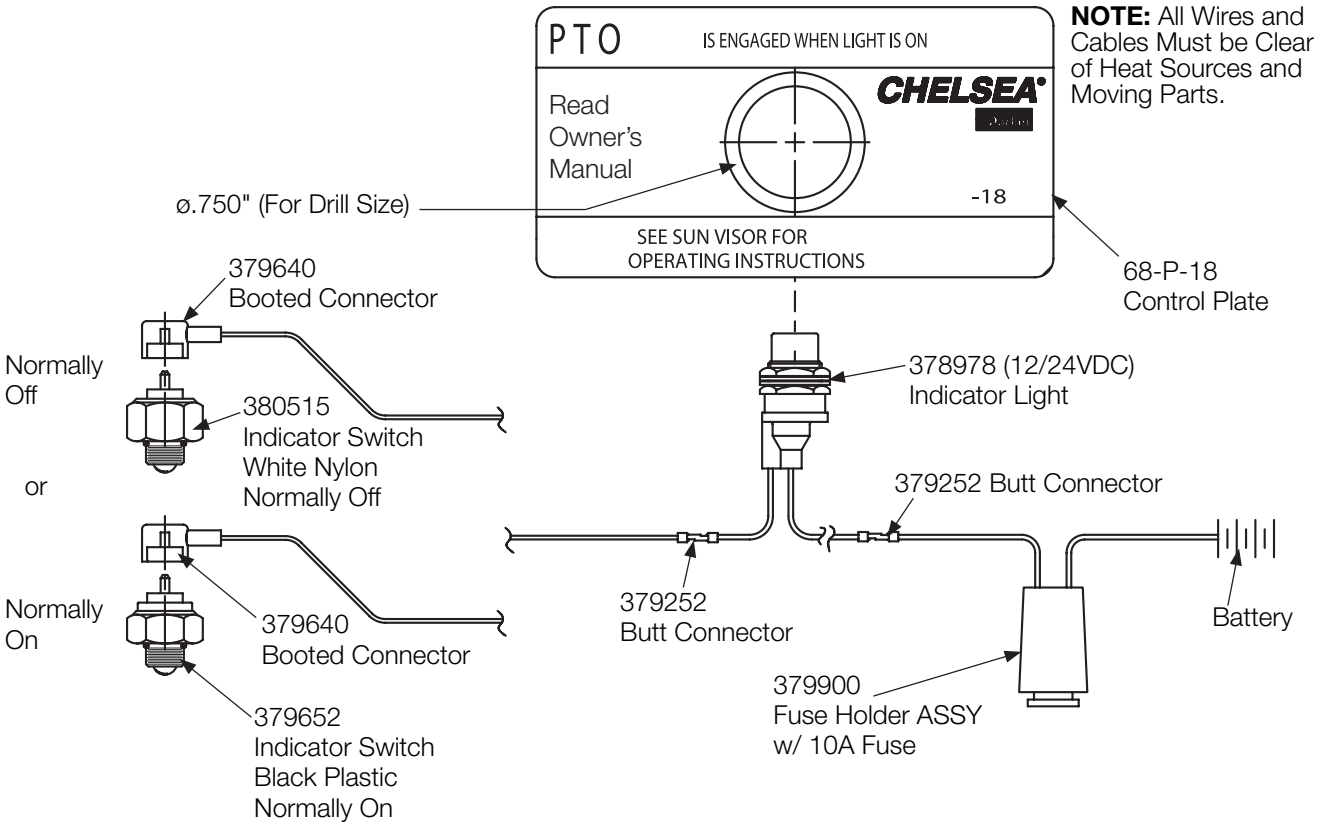
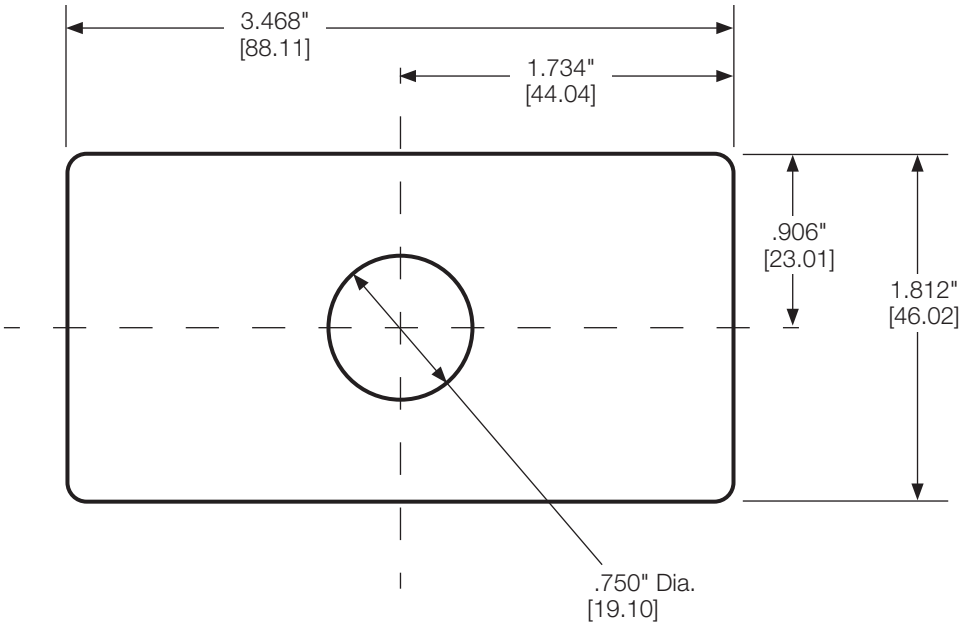
Indicator Light Installation Instructions (SK-286 Rev H)



Dash Drilling Template (SK-168 Rev A)



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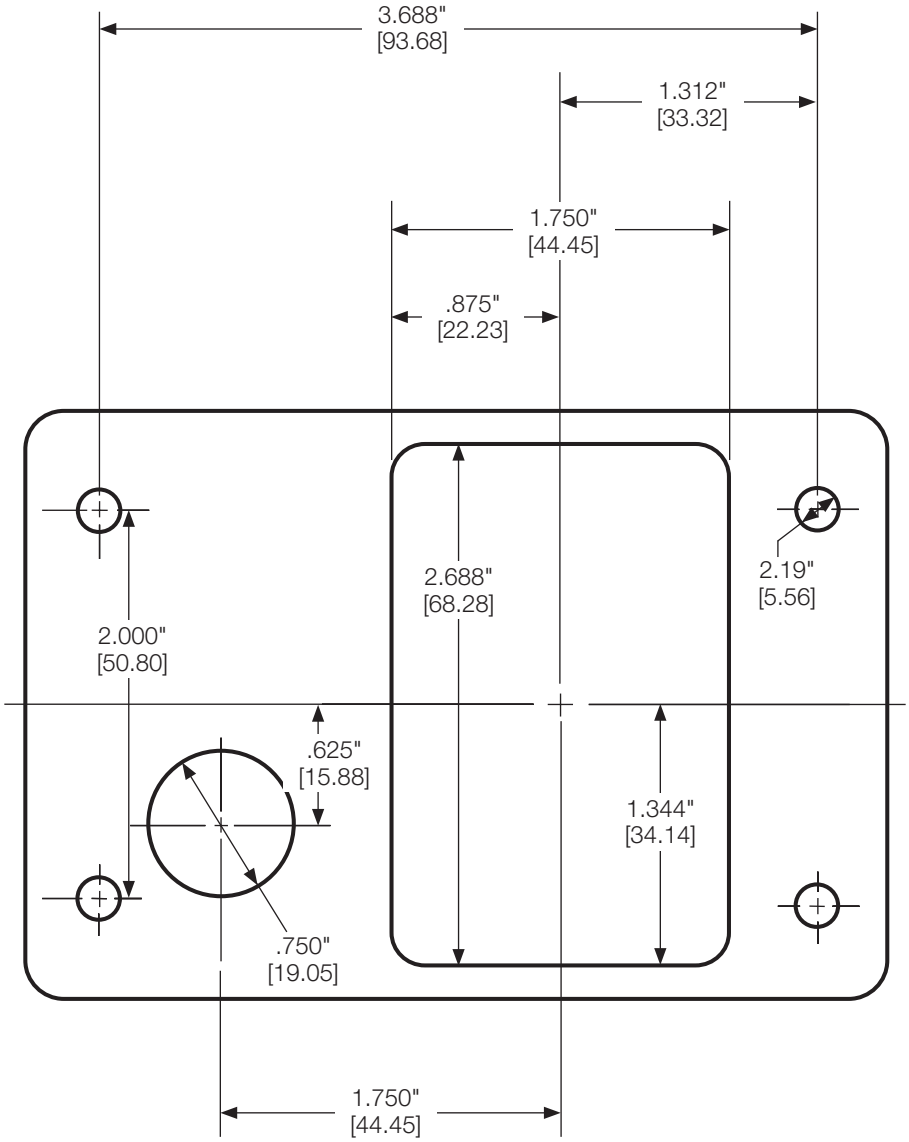
Dash Drilling Template for 6 & 8-Bolt Air Shift for Williams Valve (SK-204 Rev C)



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Adapter Plates

Adapter plates are used to permit mounting a 6-Bolt PTO on a transmission that has an 8-Bolt aperture (**Fig. 18**).

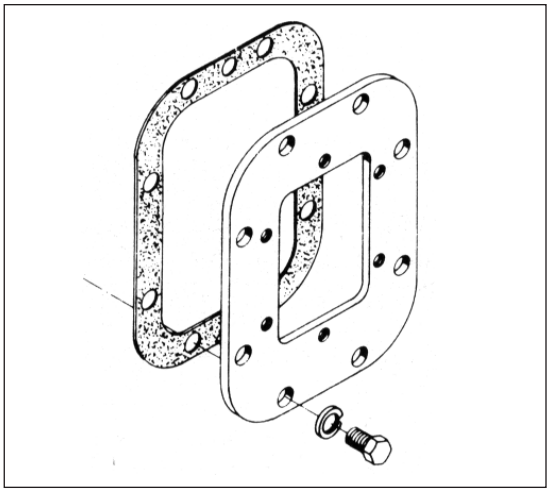

Figure 18

Filler Blocks/Spacers (7-A-XX & 8-A-XX)

Filler blocks may be required where it is necessary to use a spacer to mount the PTO to a particular transmission (**Fig. 19**).

NOTE: When using 7-A & 8-A spacer, .050" max gasket permissible between spacer and mounting surface.

*A gasket must be used on both sides of all spacers.

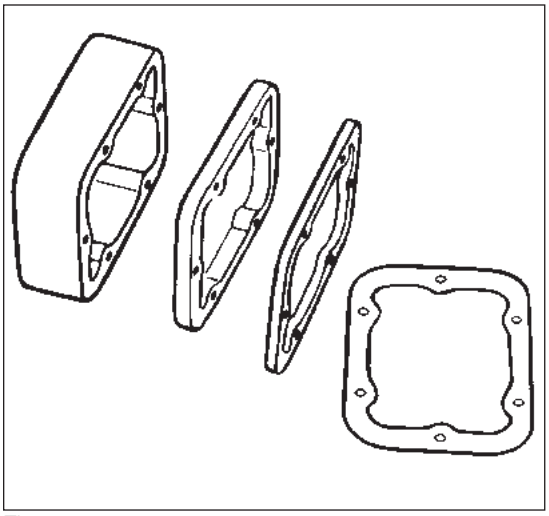

Figure 19

PTO Application and Adapter Assembly

Figure 20 illustrates typical adapter assembly configurations. Some PTO applications require adapter assemblies because it is impossible to reach the PTO driver gear in the transmission without this assembly. An adapter assembly will change the rotation of the PTO and this may be necessary for driving pumps or other accessory equipment. Obstructions, such as bulge in the transmission, exhaust pipes, or motor mounts can sometimes be compensated for through the use of an adapter.

Refer to Adapter Gears Owner's Manual HY25-1670-M1/US.

Figure 20

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Cable Control Installation Instructions*

1. Find a suitable area on the dash to install the cable control (328346-10X) and the control plate (68-P-18) indicator light.

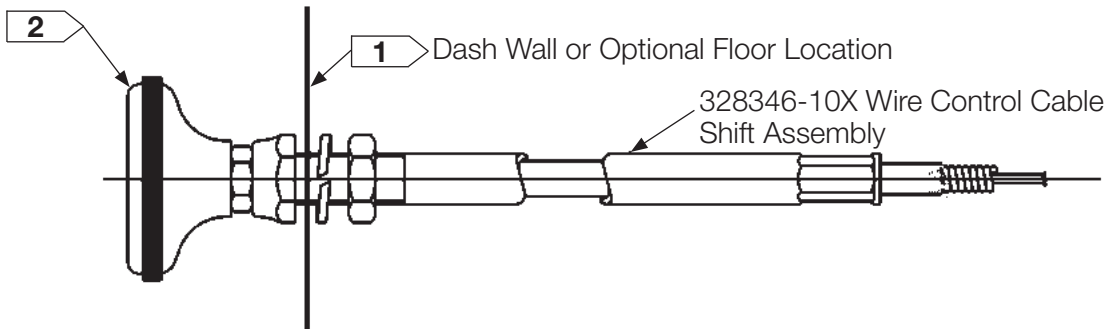
   Optional Location: As an option the control cable and knob can be located through floor. Using this option the control plate and indicator light should still be located on dash, in close proximity.

NOTE: The location of the cable control and the control plate should be as close to each other as possible and easily accessible by the driver or operator, but should not be an obstacle to driver movement nor interfere with other controls, instruments, or equipment.

2. **CAUTION:** Before drilling any holes, make sure there is adequate room on both sides through dash wall, drill a 1/2" (12.7 mm) diameter hole for the control cable [**1**].

3. Install the control cable on the dash using the hex nuts supplied with the cable. The knob can then be screwed into place [**2**]. The length of cable can then run through the firewall and back to the PTO — making sure it is kept away from the exhaust, moving parts, etc.

NOTE: Do not kink the cable. In order for the cable to operate properly, there can be no bends smaller than 6 inch radius. Total bends in the cable should not exceed 360° (example - four 90° bends in cable).



4. Using the template found on page 18 (SK-168 Rev A) drill the necessary holes for the control plate-indicator light.

5. Install the control plate (68-P-18) stick on decal and indicator light on the dash using the hardware supplied in the 328751-1X installation kit (**Fig. 21**).

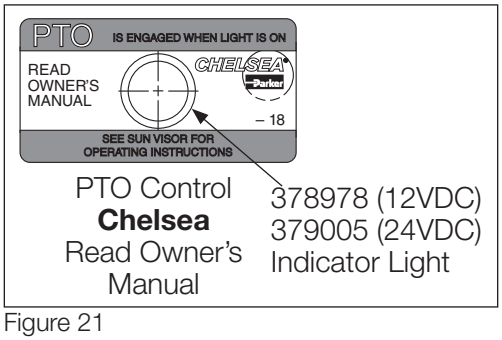


Figure 21

*All six-bolt wire shifts with the exception of the reversible, dual shift units, and some gear boxes.

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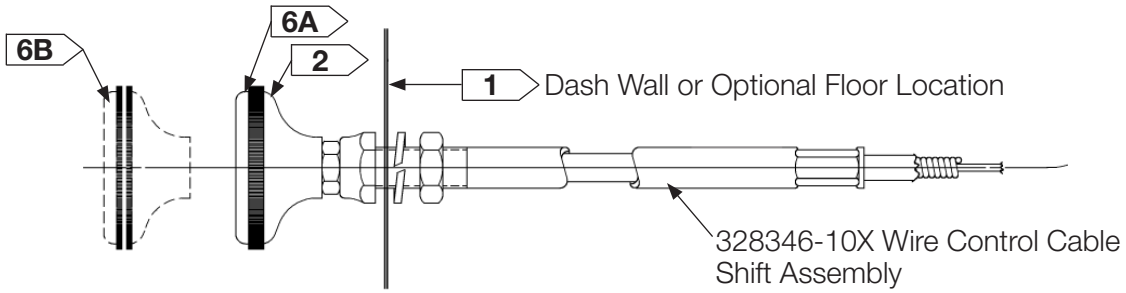
Cable Control Installation Instructions* (Continued)

6. Determine from which direction the cable must come in order for the unit to be disengaged when the knob is all the way in.

NOTE: The shifter must always be installed in the following manner:

CABLE IN: PTO DISENGAGED [**6A**]: OUT OF GEAR POSITION
CABLE OUT: PTO ENGAGED [**6B**]: IN GEAR POSITION



7. Install the wire control bracket found in either the 328380X or 328380-1X wire control parts bag [**7**].

8. Line the cable up with the wire control bracket and shifter lever (disengaged position) on the PTO cover assembly [**8**].

NOTE: It may be necessary to change the position of the shifter lever on the PTO To do this, remove the shifter cover from the unit. This will prevent the possible loss of the poppet and/or spring into the transmission if the shifter post assembly should be pushed through the cover when reinstalling the lever.

9. Shift the PTO to the engaged position to see how much of the cable casing must be cut to allow the lever enough travel to shift in and out completely. The casing need only go just beyond the bracket, whereas, the wire must be long enough to go through the swivel pin in the shifter lever [**9**].

NOTE: In some instances the cable control may not be long enough. Chelsea has available four longer lengths than the standard ten-foot cable. These come in five foot increments (i.e., 328346-15X = 15-foot cable).

10. When the length of the casing has been determined, pull the wire back through until the case can be cut without cutting the wire. Use a hacksaw or heavy pair of side cutters to cut the casing.

NOTE: The cable can be held by a bench vise as long as the jaws are not tightened to the point where the case mushrooms. If a vise is not accessible, a pair of vise grips will do the job.

*All six-bolt wire shifts with the exception of the reversible, dual shift units, and some gear boxes.

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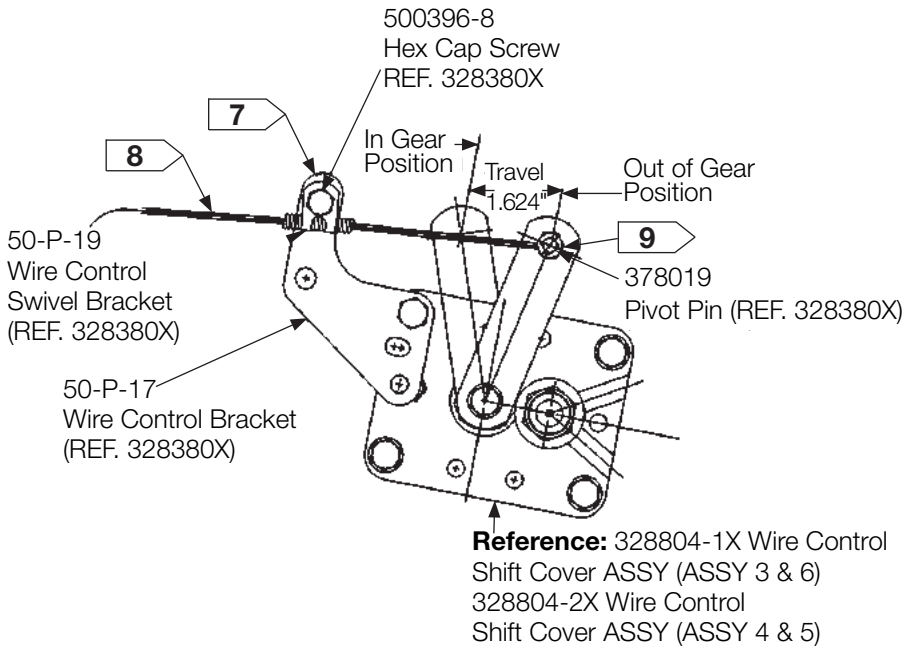
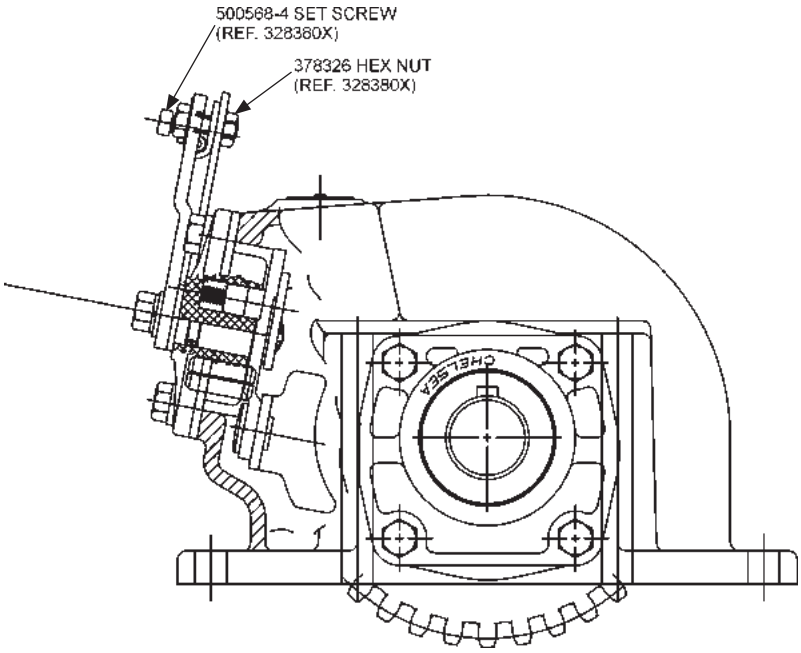
Cable Control Installation Instructions* (Continued)



11. Push the wire back through and install the cable using the hardware from the previously mentioned wire control parts bag (328380X).

12. Cut the excess wire after the cable casing and wire have been installed and tightened.



*All six-bolt wire shifts with the exception of the reversible, dual shift units, and some gear boxes.

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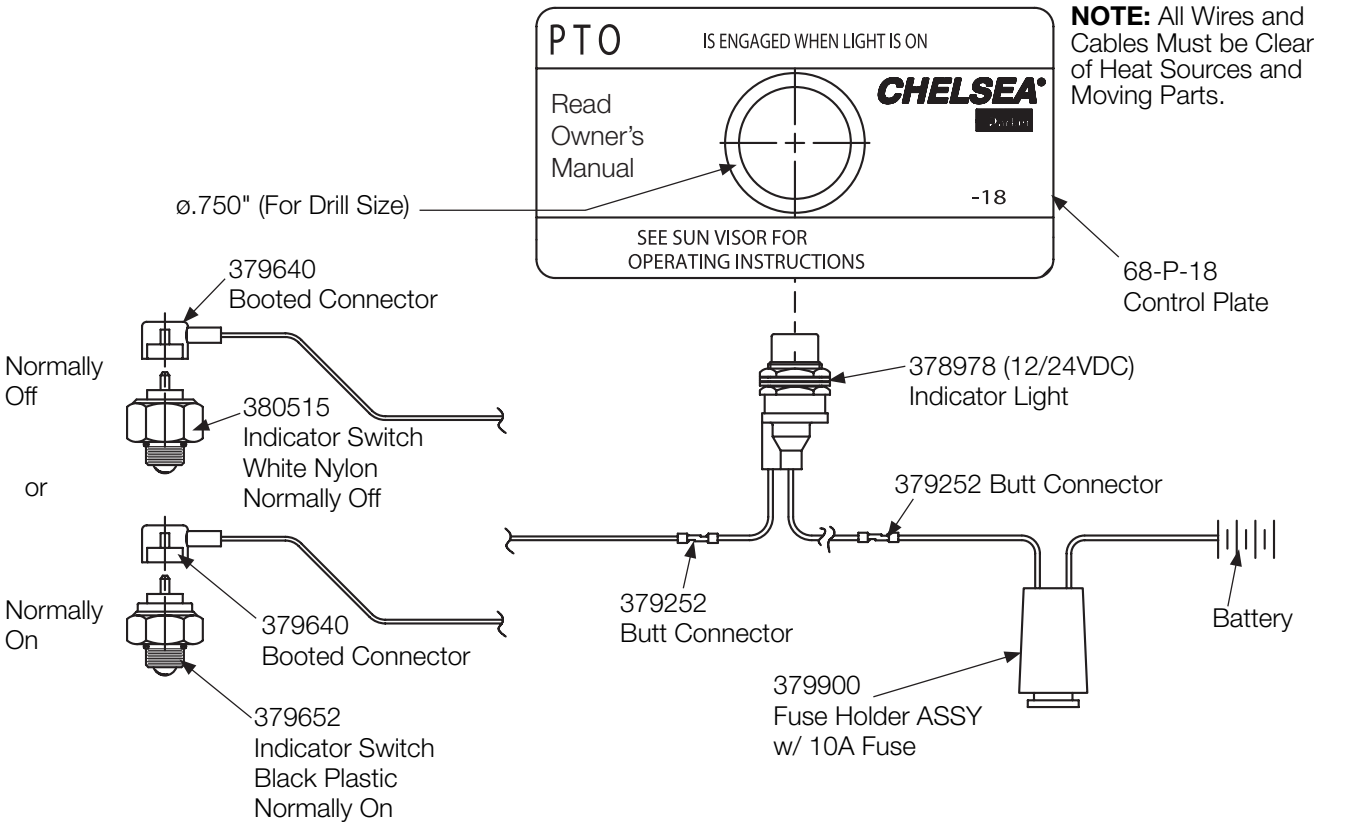
Cable Control Installation Instructions* (Continued)

Indicator Light Installation Sketch (SK-286 Rev H)



CAUTION: Indicator switches are capable of 0.5A maximum.

NOTE: All wires and cables must be clear of heat source and moving parts.

13. Shift the PTO to ensure enough casing has been removed to allow full gear engagement.

14. Install the wiring for the indicator light using the schematic above (SK-286 Rev H).

NOTE: Check both the cable and indicator light wires to be certain that they are not near the exhaust system or any moving parts. Carefully fasten to stationary parts of the vehicle if necessary.

15. Shift the PTO The following should be adhered to:

[**15A**] **CABLE IN:** PTO DISENGAGED: LIGHT OUT

[**15B**] **CABLE OUT:** PTO ENGAGED: LIGHT ON

NOTE: The PTO should be checked for continuity as per the instructions in this manual.

NOTE: Cable must be rigidly mounted-possibly to the transmission within 12-24" of the PTO.

*All six-bolt wire shifts with the exception of the reversible, dual shift units, and some gear boxes.

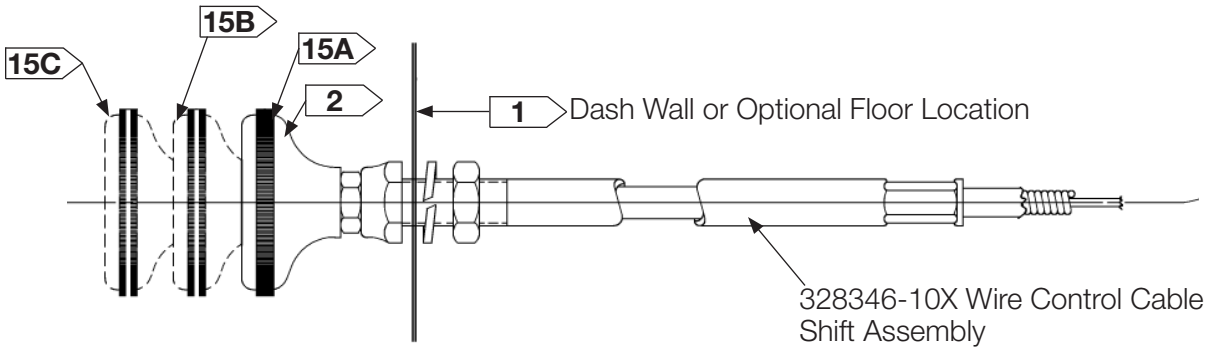
Cable Control Installation Instructions (Continued)
(Reversibles, dual shift units, and some gear boxes)

1. Use steps #1-#5 from previous instructions.
2. In step #6 the cable can come from either direction since the PTO will always be engaged when all the way in or out.
3. Follow step #7 and #8.
4. In step #9 shift the PTO from forward to reverse or vice versa to determine the amount of travel needed and the length of casing to be cut.
5. Follow step #10-#14.
6. Step #15 will show the folding:

   CABLE IN: PTO ENGAGED: LIGHT ON [**15A**]

   CABLE OUT (1st position): PTO DISENGAGED: LIGHT OUT [**15B**]

   CABLE OUT (2nd position): PTO ENGAGED: LIGHT ON [**15C**]



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Indicator Switch Continuity Check

In order to ensure that the switch is functioning properly, the following procedure can be used with the unit on a bench, or installed.

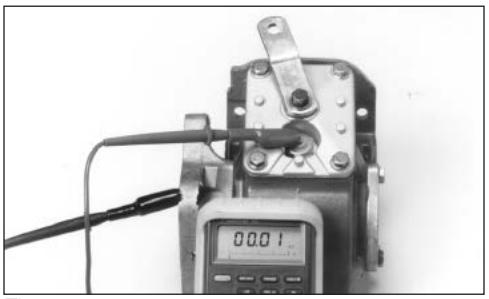

Figure 22

1. Use a continuity checker, battery type, either meter or light. Attach one (1) probe to the screw on the Indicator Switch.
2. With the other probe, make contact with the shifter cover or housing (**Fig. 22**).
3. Actuate shifting device and the meter or light* should be actuated when PTO gear is engaged.
4. Shift unit out of gear and the meter or light* should return to normal as shown.

This test procedure can be used to check Chelsea wire, lever, and air shifter covers, although an air source would be necessary for the latter.

* If a meter is not available the light in the 328751-1X can be used. A 6VDC battery is all that is necessary for a power source.

CAUTION: Indicator switches are capable of 0.5A maximum.

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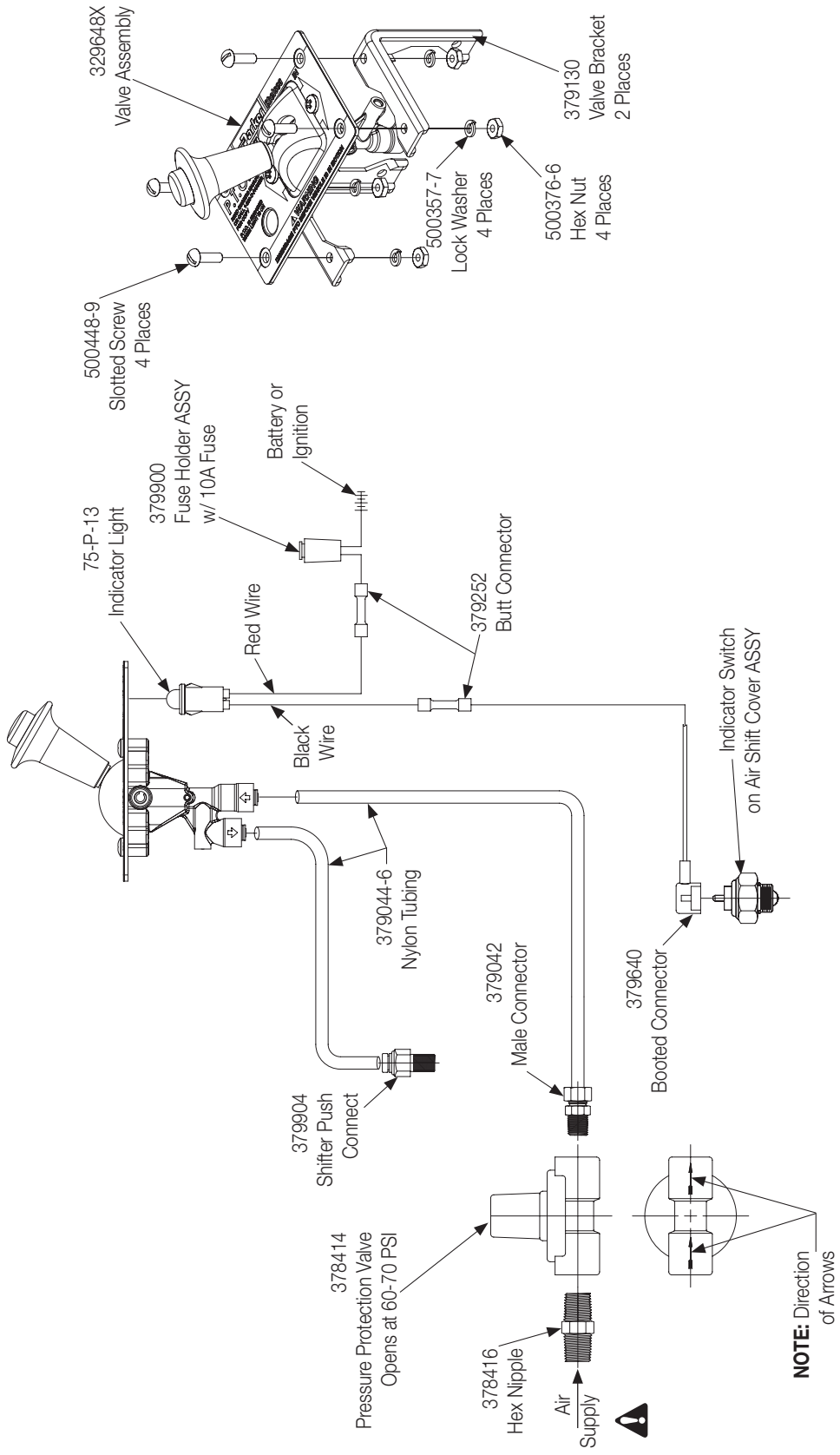
Shift Option A
Air Shift
442/447/489/660/680 Series

(SK-462)



Installation Kit: 328388-98X
See SK-204 Drilling Template for Control Plate

NOTE: When this installation is used on vehicles with automatic transmissions the PTO drive must be stopped before shifting.

WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

CAUTION: When installing nylon tubing avoid sharp angles, exhaust, and manifold systems.

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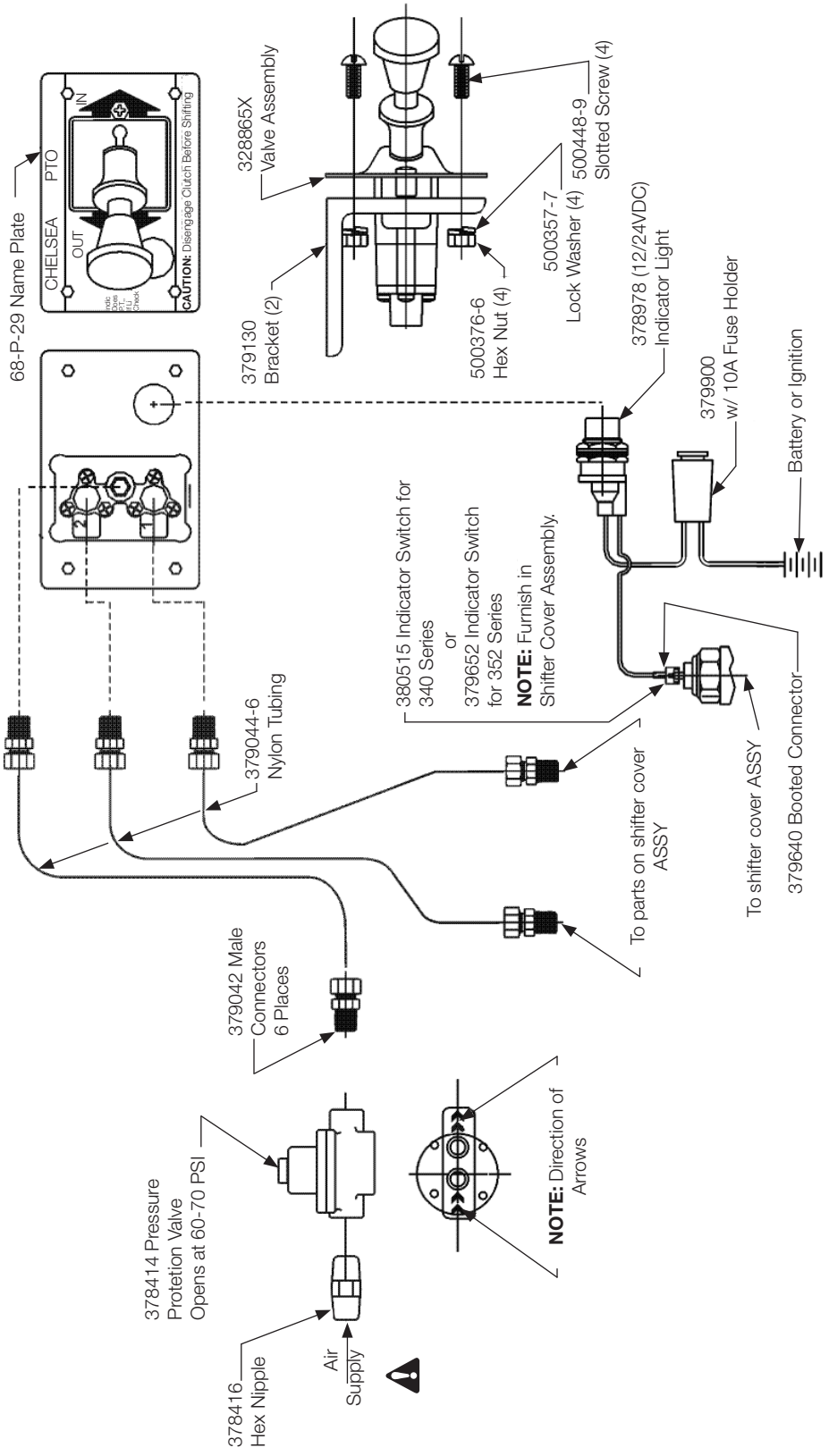
Shift Option A
Air Shift
340/348 Series

(SK-228 Rev H)



WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.
CAUTION: When installing nylon tubing avoid sharp angles, exhaust, and manifold systems.
NOTE: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.
NOTE: Template for control plate on page 21.

Installation Kit: 328388-40X

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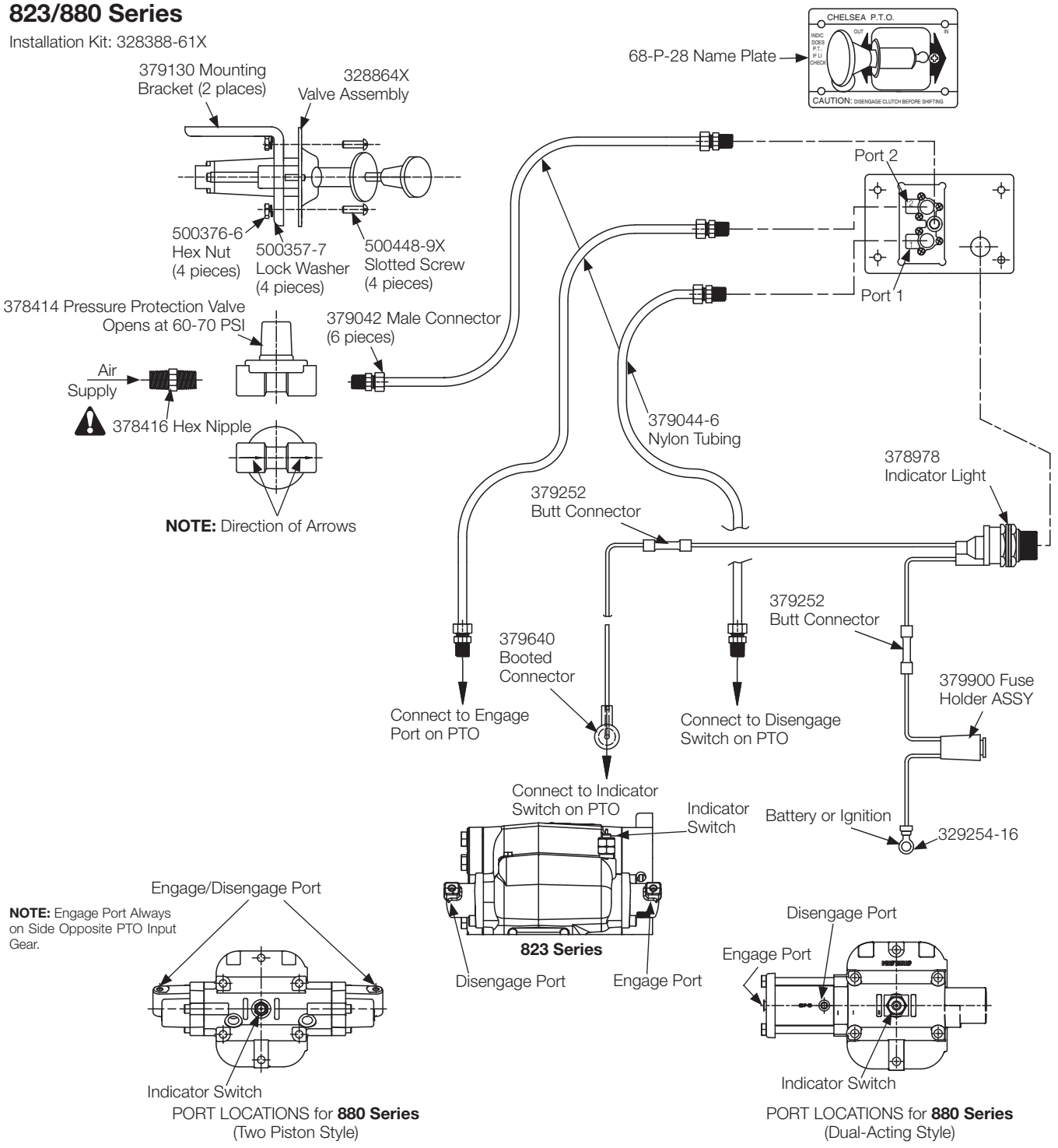
Shift Option A
Air Shift
823/880 Series

(SK-276 Rev M)

Installation Kit: 328388-61X



NOTE: Direction of Arrows

NOTE: Engage Port Always on Side Opposite PTO Input Gear.

PORT LOCATIONS for **880 Series** (Two Piston Style)

PORT LOCATIONS for **880 Series** (Dual-Acting Style)

WARNING: Connect directly to the air supply. Do not use tubing between the air supply and the pressure protection valve.

CAUTION: When installing nylon tubing avoid sharp angles, exhaust, and manifold systems.

IMPORTANT: When this installation is used on vehicles with automatic transmissions, the PTO drive gear must be stopped before shifting.

NOTE: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

NOTE: The template for the control plate is on page 21.

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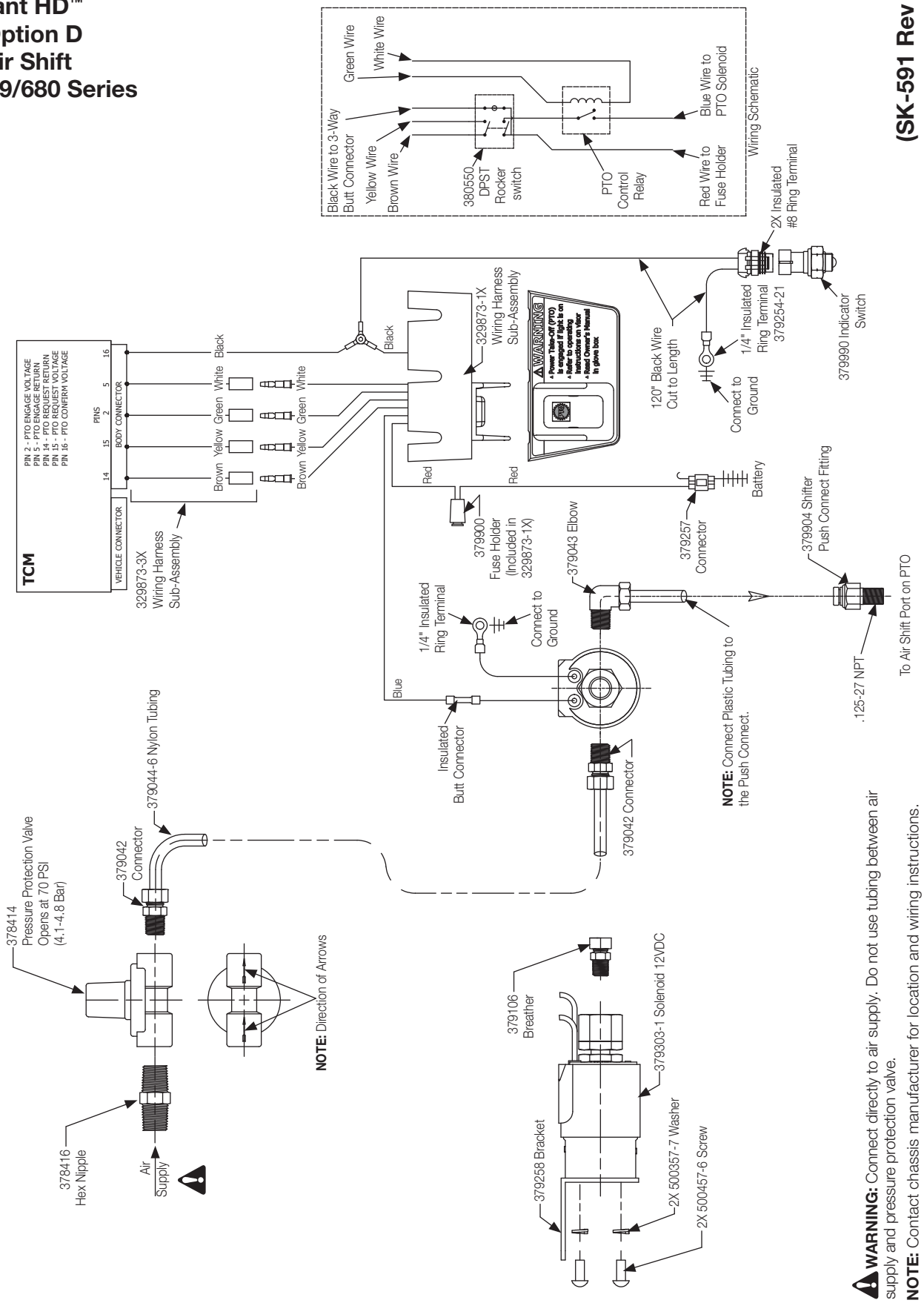
Eaton Procision™ Endurant HD™ Shift Option D Elec/Air Shift 442/489/680 Series

(SK-591 Rev G)



Wiring Harness Kit: 329896X (12VDC)
Electric/Air Kit: 329874X (12VDC)

WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.
NOTE: Contact chassis manufacturer for location and wiring instructions.

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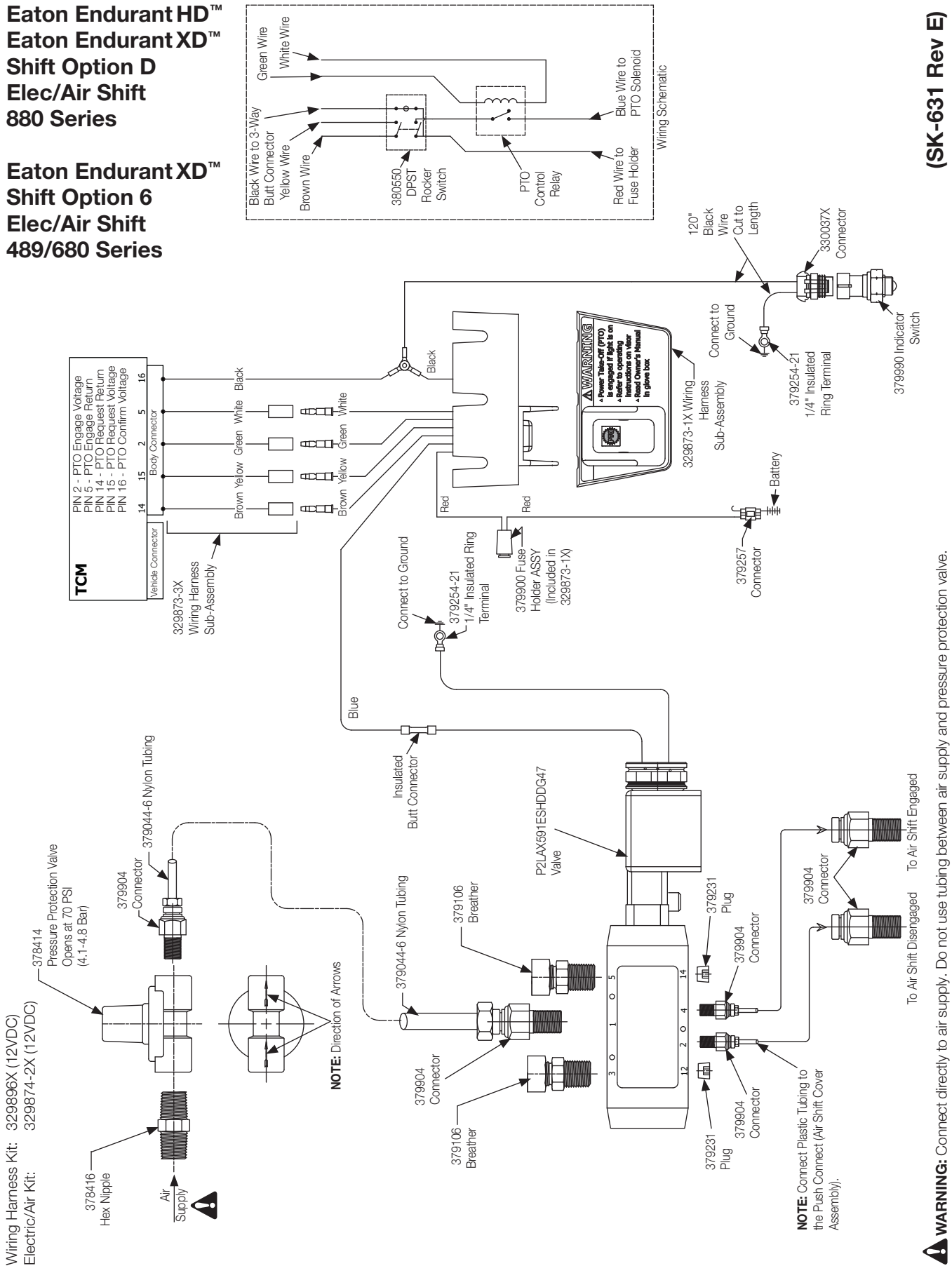
Eaton Endurant HD™
Eaton Endurant XD™
Shift Option D
Elec/Air Shift
880 Series

Eaton Endurant XD™
Shift Option 6
Elec/Air Shift
489/680 Series

(SK-631 Rev E)



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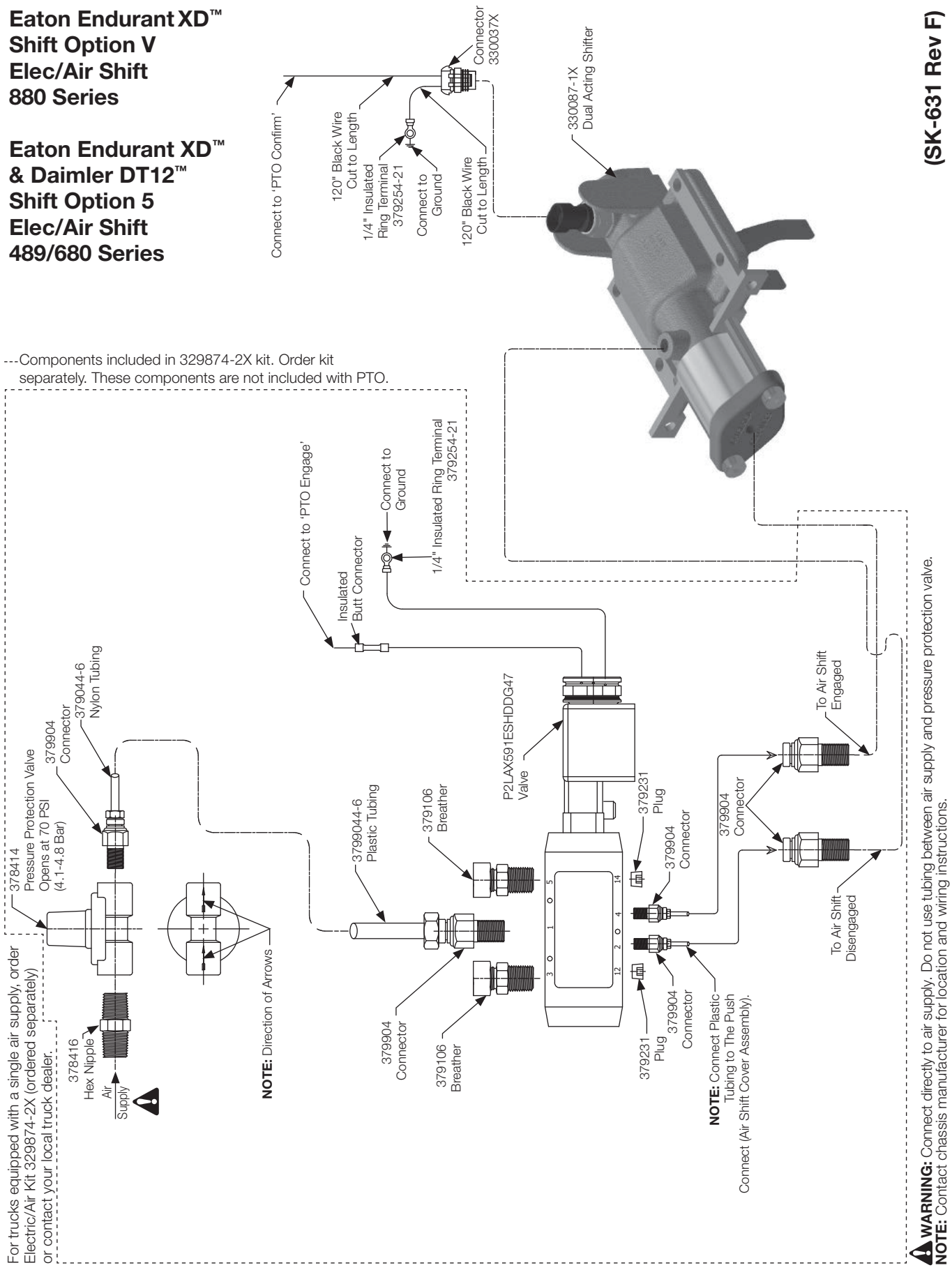
Eaton Endurant XD™
Shift Option V
Elec/Air Shift
880 Series

Eaton Endurant XD™
& Daimler DT12™
Shift Option 5
Elec/Air Shift
489/680 Series

(SK-631 Rev F)



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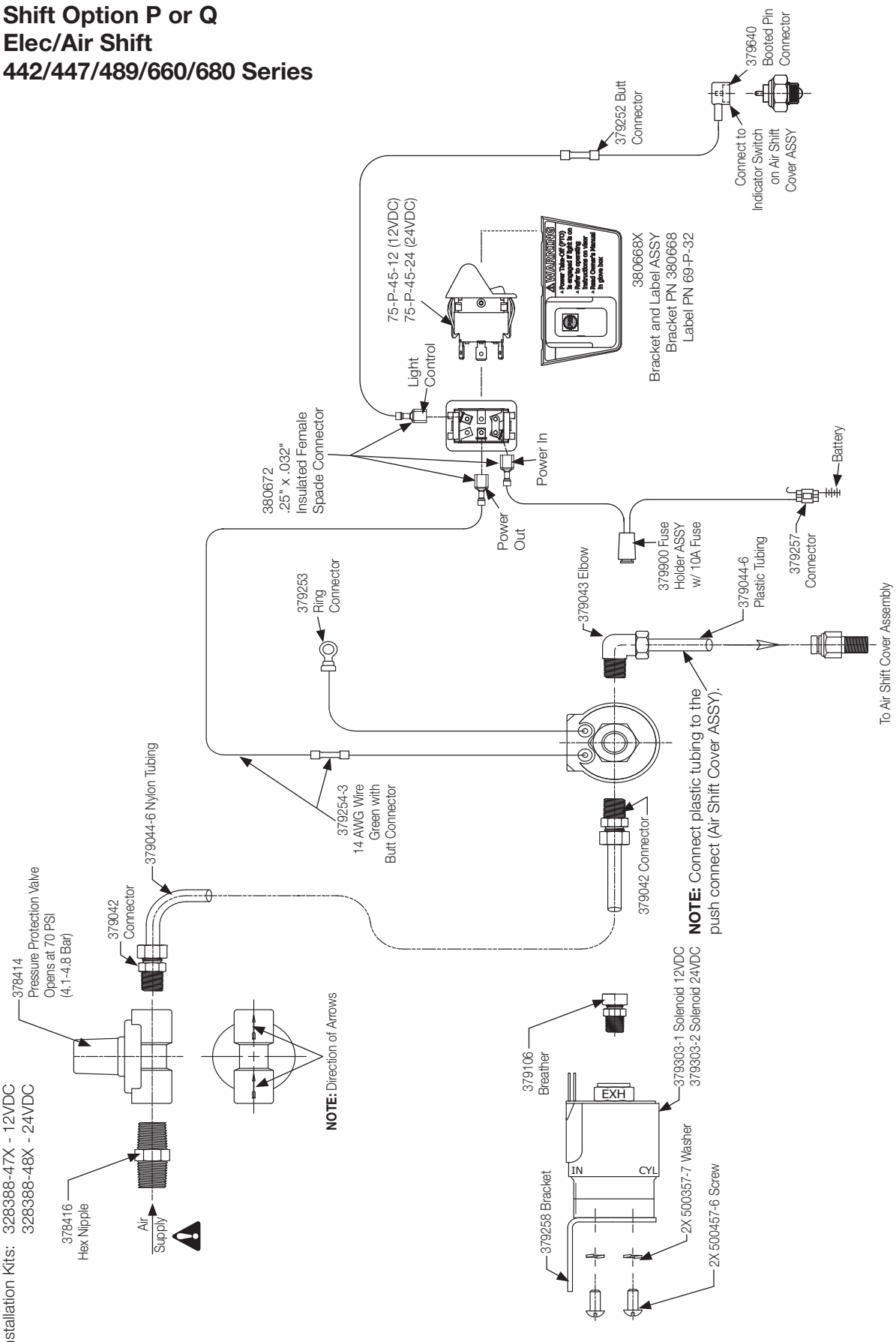
Shift Option P or Q
Elec/Air Shift
442/447/489/660/680 Series

(SK-238 Rev M)



WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.
CAUTION: When installing nylon tubing avoid sharp angles, exhaust, and manifold systems.
IMPORTANT: When this installation is used on vehicles with automatic transmissions the PTO drive gear must be stopped before shifting.
NOTE: Tube nut is reusable as long as nylon tubing is not removed from the tube nut.

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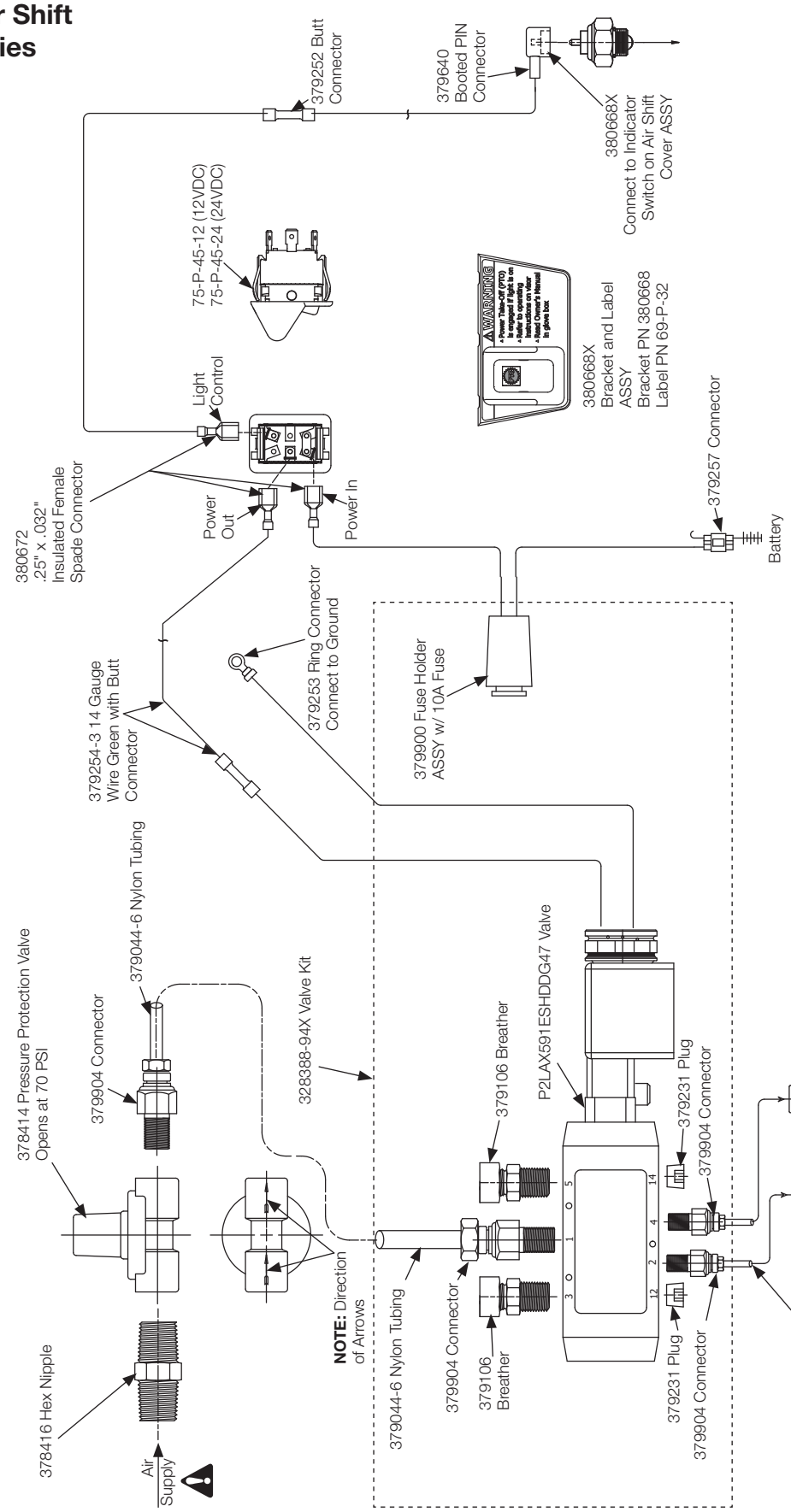
Shift Option P or Q
Elec/Air Shift
880 Series



(SK-447 Rev D)

Installation Kit: 328388-93X (12VDC)

WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.

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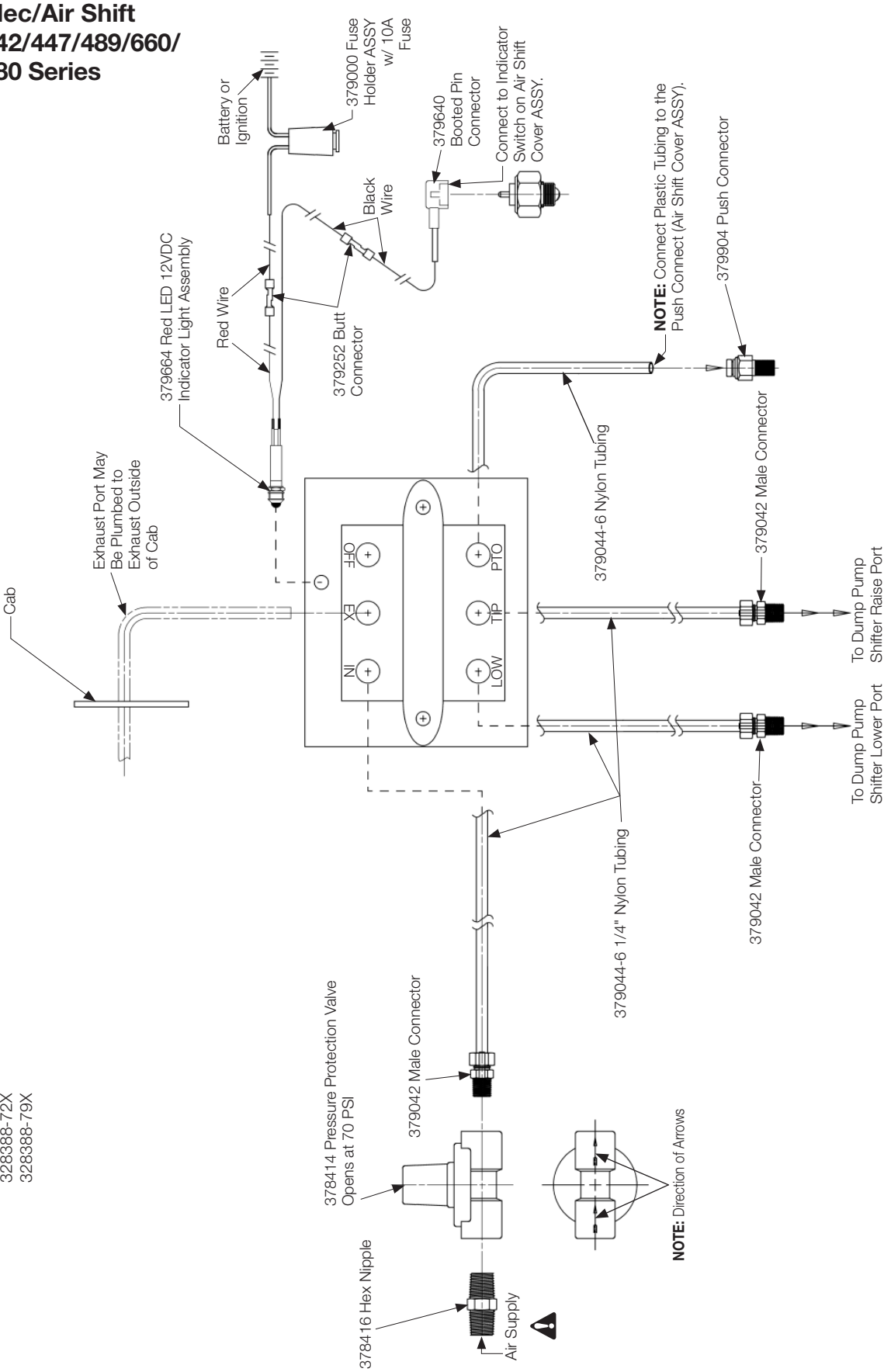
Shift Option S, T or U Elec/Air Shift 442/447/489/660/ 680 Series

(SK-297 Rev J)



Air Shift Installation Kits: 328388-65X
328388-72X
328388-79X

WARNING: Connect directly to air supply. Do not use tubing between air supply and pressure protection valve.
CAUTION: When installing nylon tubing avoid sharp angles, exhaust, and manifold systems.
IMPORTANT: When this installation is used on vehicles with automatic transmissions, the PTO drive gear must be stopped before shifting.
NOTE: Air control value must be fitted inside a waterproof housing when installed outside the driver's cab.

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Notes

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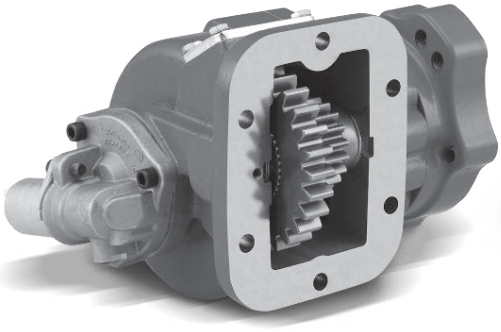
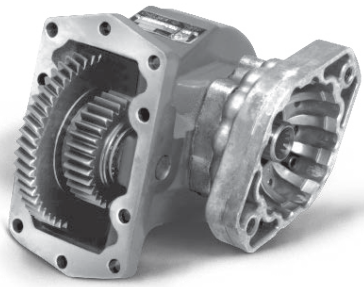
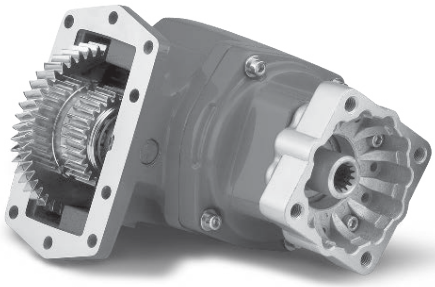
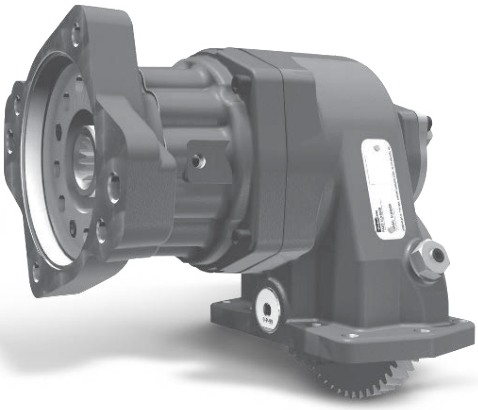
ALLISON









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PTO Shifting Procedure – Automatic Transmission

With Manual Shift PTO (Includes Air Shift)

NOTE: On automatic transmissions, the gears in the transmission turn when the transmission is in neutral, therefore, gear clashing will occur if the Power Take-Off (PTO) is shifted into gear at this time.

With Converter Driven Gear

1. Shift transmission lever into any of the drive positions (this will stop transmission gear from turning).
2. Shift PTO into gear.
3. Shift transmission into neutral (this will start gears turning).

With Engine Driven Gear

1. Shift PTO into gear before starting engine. This procedure should eliminate gear clash.

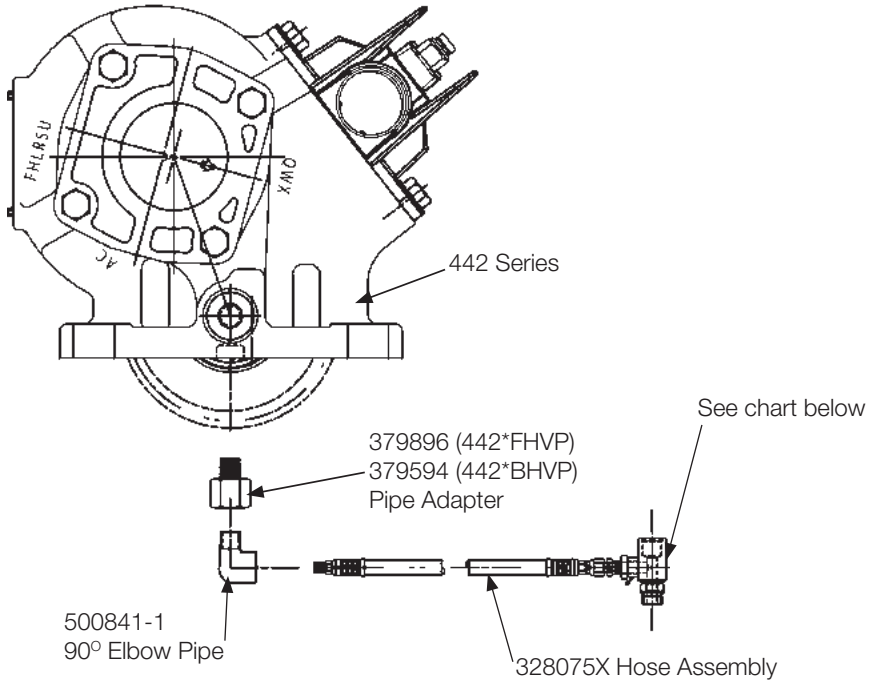
With PowerShift PTO

1. Engage PTO with engine at idle speed.
2. See transmission manufacturer's instructions for special procedures.

WARNING: Use only wire control with PTO made for wire cable control.

Do not attempt to work on an installed PTO with the engine running. Make sure to block any moving or raised device that may injure a person working on or under the truck. A lever or its linkage may be accidentally moved causing movement of the device which could cause injury to a person near the device.

Pressure Lube for Allison 1000, 2000/2400 Series 442 Series (SK-382 Rev B)



Pressure Lube Hose Connection

Chart I

Dimensional Information				
TEE FITTING	**378840**	**378880**	**378970**	**378897**
D	.750-16 UNF 2A	.875-14 UNF 2A	1.062-12 UNF 2A	1.312-12 UN 2A
E	.250-18 NPTF	.250-18 NPTF	.250-18 NPTF	.250-18 NPTF
F	.750-16 NPTF	.875-14 UNF 2NB	1.062-12 UNF 2B	1.312-12 UN 2B

Allison 1000, 2000/2400 Series Converter Housing Options

Converter Housing Group Number	SAE Number	Description	1000	2000	2400	Chelsea Fitting
34-561	#3	Integral Cooler Ports	STD.	—	—	378840
34-562	#2	Manifold Pad	OPT.	STD.	STD.	378970
34-563	#3	Manifold Pad	OPT.	STD.	STD.	378970
34-565	#3	Integral Cooler Ports	STD.	—	—	378840
34-566	#2	Manifold Pad	OPT.	STD.	STD.	378970
34-567	#2	Manifold Pad	OPT.	STD.	STD.	378970
34-572	#3	Integral Cooler Ports	STD.	—	—	378840
34-573	#3	Integral Cooler Ports	STD.	—	—	378840

The specific T fitting for each Automatic Transmission is called out at the bottom of each transmission's application sheet. If a T fitting is not called out, then a standard pipe tee will adapt.

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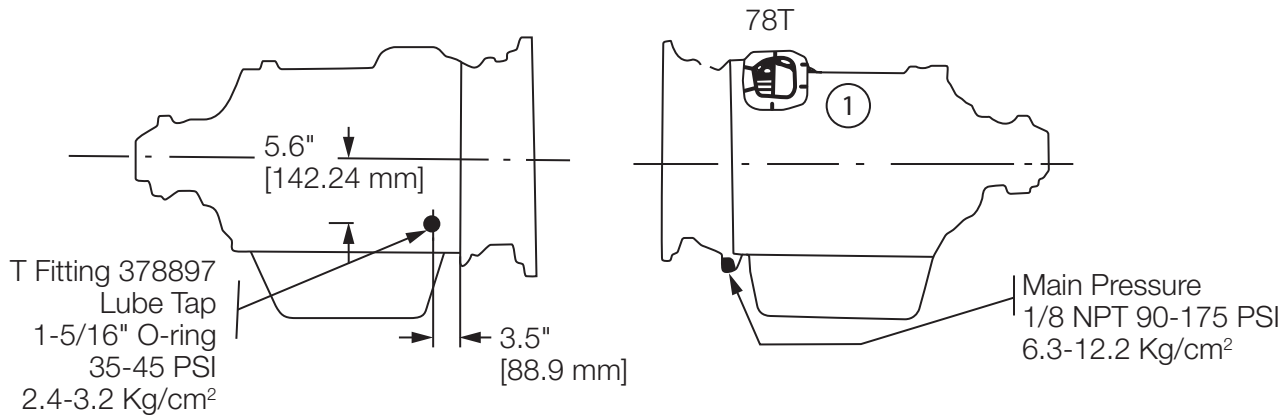
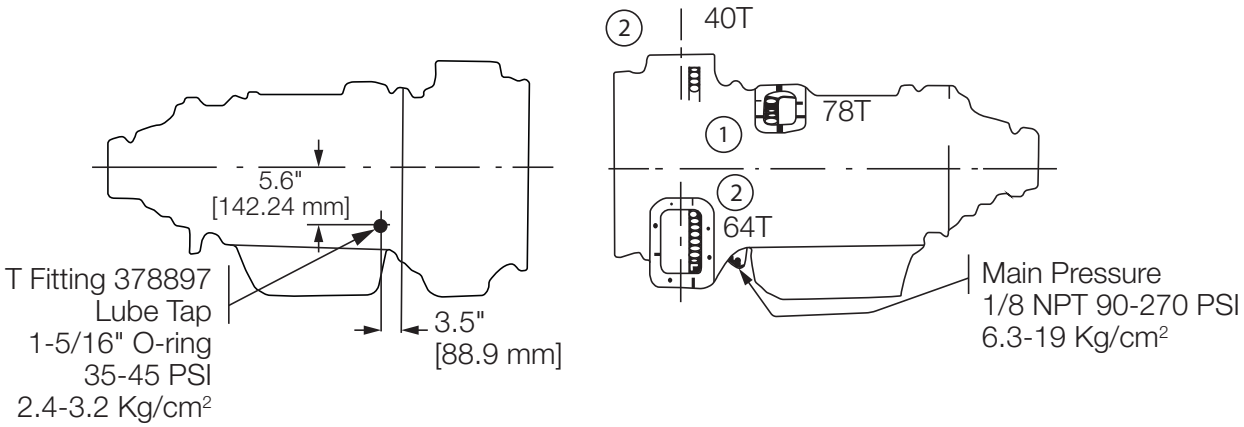
PTO Openings

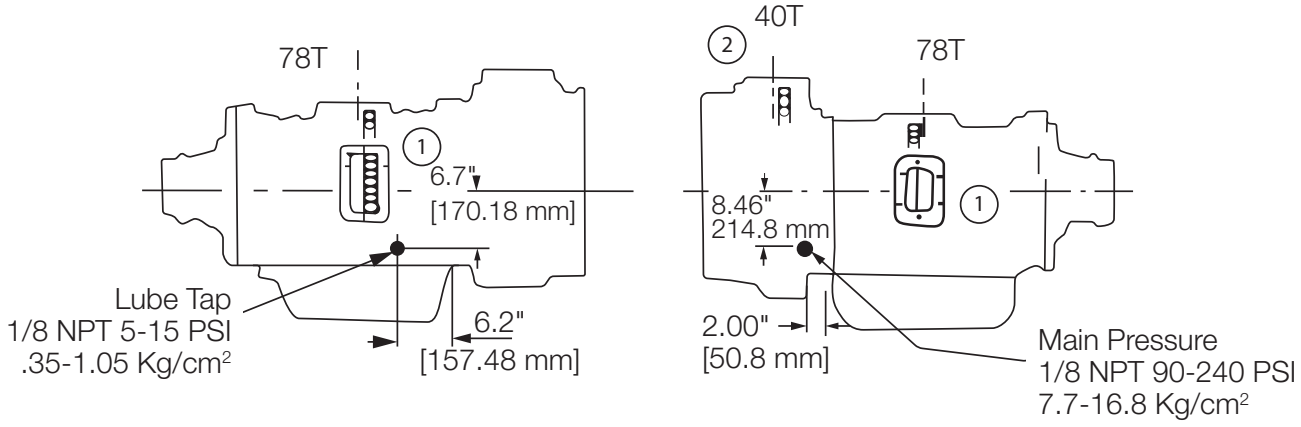
HT-740
HT-750D



CLT-750



HT-70



1. Converter driven PTO Drive Gear.
2. Engine driven PTO Drive Gear.

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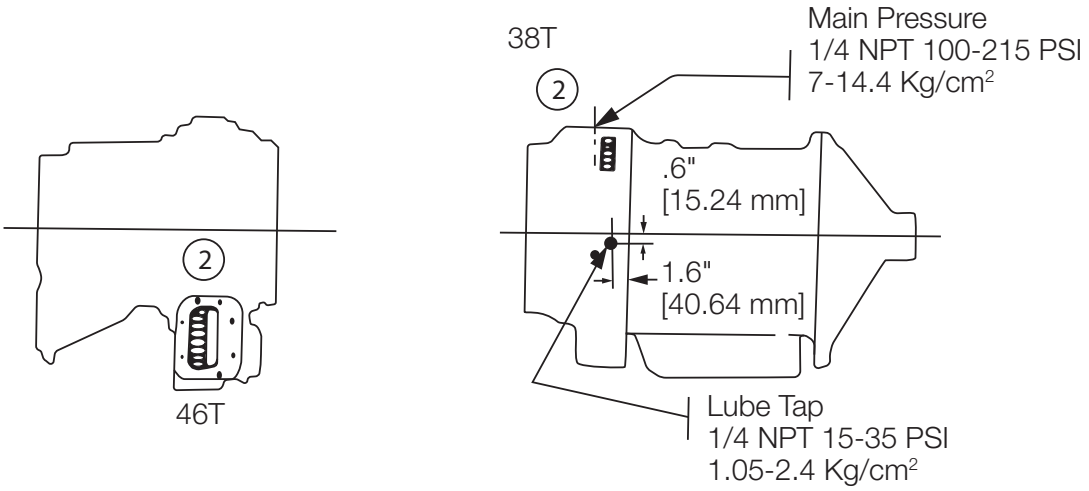
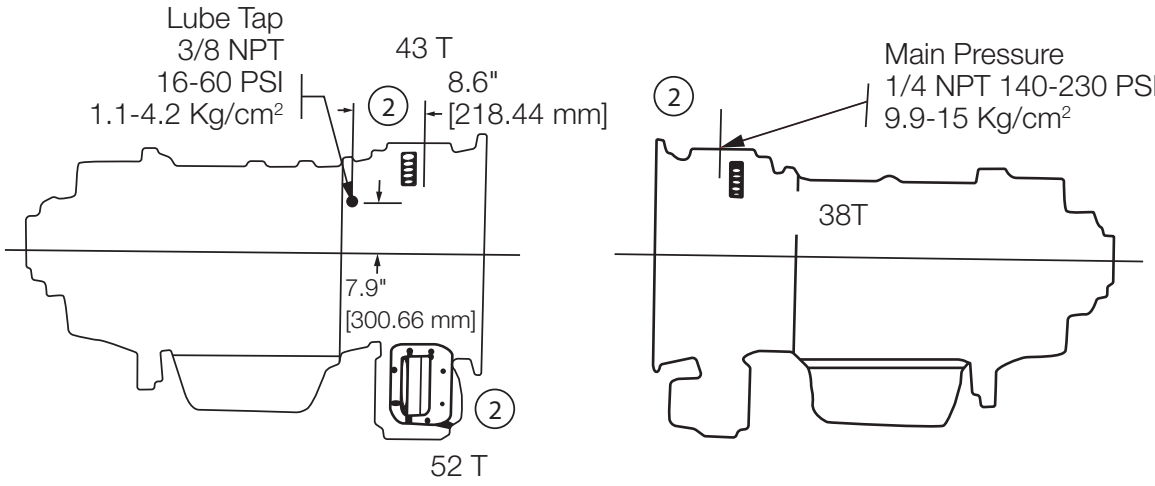
PTO Openings (Continued)

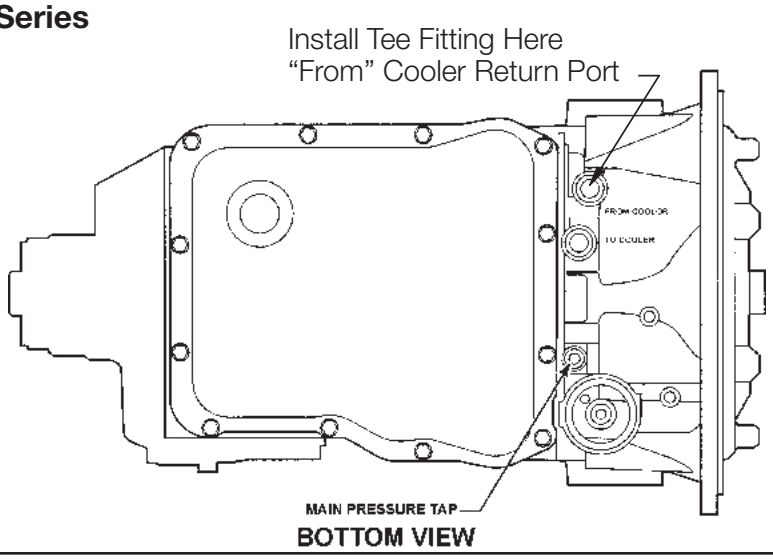
5000 Series



8000 Series



1000, 2000/2400 Series



1. Converter driven PTO Drive Gear.
2. Engine driven PTO Drive Gear.

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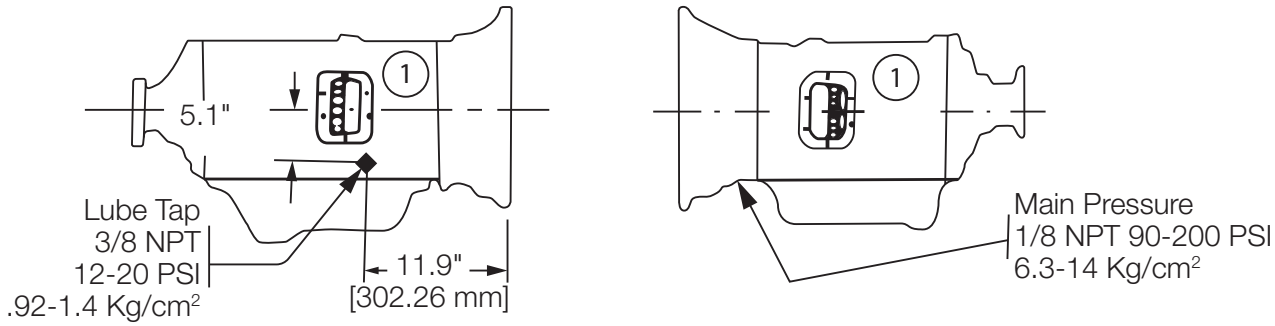
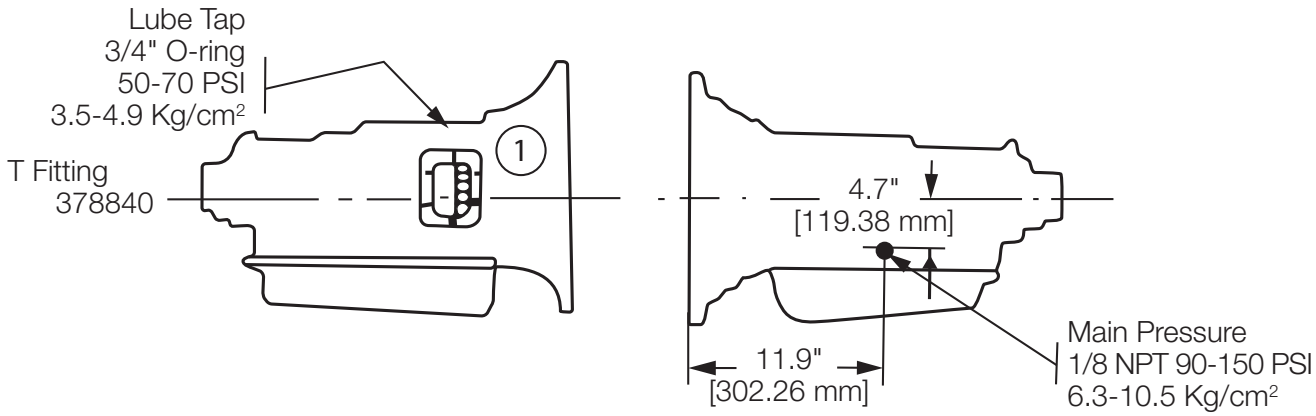
PTO Openings (Continued)

MT-30-42 (57 Teeth)
6-Speed



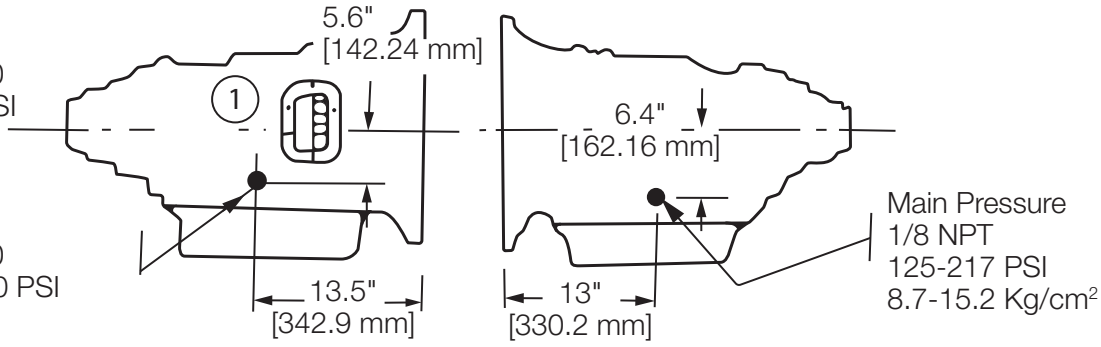
3341-3441 (55 Teeth)
AT-540



4-Speed (64 Teeth)
MT-640

T Fitting 378880
Lube Tap
Before Nov. 1974
Use T Fitting 378880
7/8" O-ring 25-30 PSI
1.75-2.1 Kg/cm²

After Nov. 1974
Use T Fitting 378970
1-1/16" O-ring 25-30 PSI
1.75-2.1 Kg/cm²



NOTE: Use cooler return port for PTO lubrication. The T fitting is to be installed in the port that is coming from the cooler back to the transmission.

1. Converter driven PTO Drive Gear.

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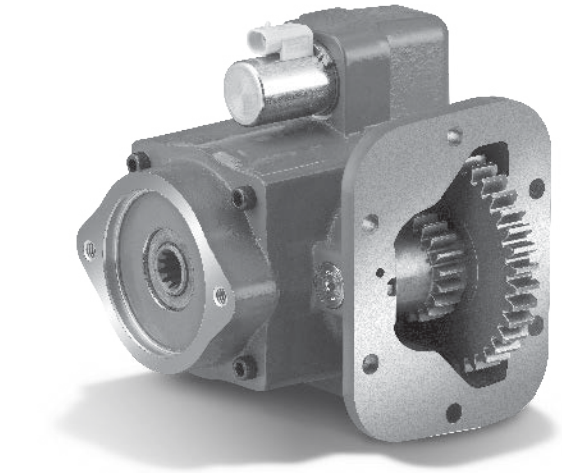
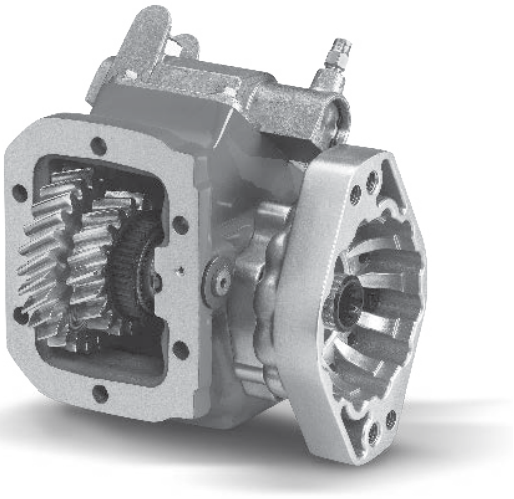
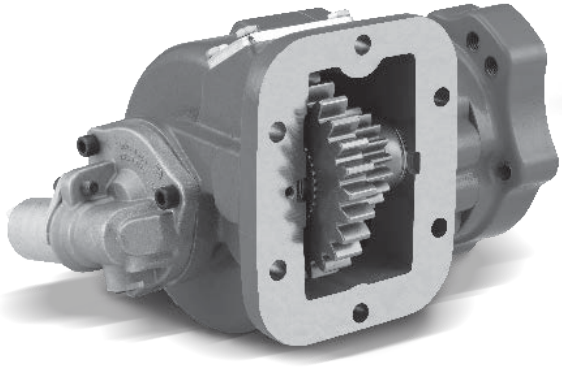
DODGE/RAM







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Overview

PTO Operation

The 3500/4500/5500 Dodge Chassis Cab vehicle, when equipped with either the automatic Aisin 6-speed or manual G56 6-speed transmissions, will allow for an aftermarket upfit with a transmission driven PTO (Power Take-Off). The customer will have the ability to operate the PTO in either a "stationary" or "mobile" mode. The vehicles will be factory set to the "stationary" mode. In order to select the "mobile" mode a Daimler Chrysler Dealership is required to modify the vehicles settings using their proprietary Dealer service tool.

Stationary Mode

To operate the PTO in this mode the vehicle must meet the following conditions:

- Be in park positions (vehicles equipped with automatic transmission).
- Up fitter provided (on/off) switch has been activated.
- Parking brake applied (vehicles equipped with manual transmission).
- Vehicle must be running.
- No vehicle, brake, or clutch switch faults present.
- PTO must be correctly installed using the vehicle provided circuits.

The customer has the choice to operate the PTO by utilizing the cruise control switches or by utilizing a remote control (provided by the PTO supplier). To operate the feature using the cruise control switches the customer must first activate the up fitter provided on/off switch. Next, the cruise control "on" switch is selected. Following this step the "set" switch must be depressed. The vehicle is now in the PTO mode and is ready for use. In order to increase or decrease the engine idle speed, to optimize the PTO function, the "accel" and "decel" cruise switches can be used respectively. To disengage PTO operation and return to standard vehicle operation simply turn the up fitter provided on/off switch to the off position.

To operate the PTO via a remote switch the customer must make sure the above conditions are met. It is vital for proper operation that the PTO and remote have been installed correctly paying special attention to ensure the vehicle provided wiring has been connected properly. This is the responsibility of the installer of the PTO and switches/remote system. It is the responsibility of the PTO manufacturer to ensure that their electrical (switches and remote) system is compatible with the vehicle's electrical architecture and software functionality.

Overview (Continued)

Mobile Mode

To operate the PTO in this mode the vehicle must meet the following conditions:

- Dealer selected mobile mode activated via Dealer proprietary service tool.
- Up fitter provided (on/off) switch has been activated.
- Vehicle must be in "park" or "drive" position (vehicles equipped with automatic transmission).
- Parking brake must not be applied.
- No vehicle, brake or clutch switch faults present.
- Vehicle must be running.
- PTO must be correctly installed using the vehicle provided circuits.

The customer may choose to use the PTO while the vehicle is moving. To do so the PTO function must be activated before putting the vehicle in gear and moving. This is accomplished by activating the up fitter provided PTO on/off switch. At this point the customer may place the vehicle in a forward or reverse gear and have PTO operation. To disengage PTO operation and return to "standard vehicle operation" simply turn the up fitter provided on/off switch to the off position. Since this is a torque converter driven gear in the transmission, PTO function will not occur until the wheels start moving at a rate of approximately 5-7 MPH.

NOTE: For application specific information with respect to PTO and pump requirements and additional vehicle information (wiring schematics, preset idle values, engine speed limits, vehicle hardware, and software requirements) please refer to the Dodge Body Builders Guide by accessing "Wiring Diagrams" and choosing the appropriate links.

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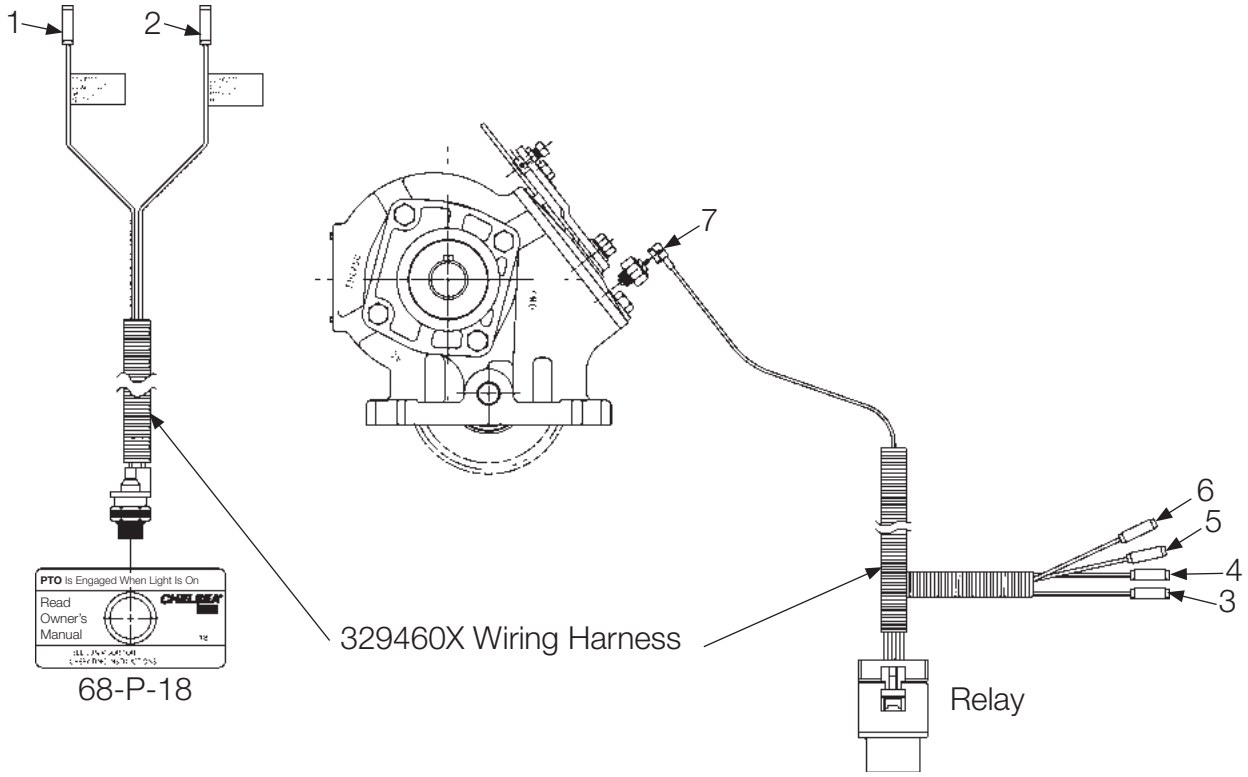
Wiring Chart - Model Year 2007-2011 Dodge Chassis Cab, 6.7L w/ G56 Transmission

	Chelsea Wire	Connected to Dodge Wire	Location
1	Violet	G425 Violet w/ Yellow Stripe	Upfitter Connector Near Brake Pedal inside Cab
2	Pink	F922 Pink w/ Red Stripe	Upfitter Connector Near Brake Pedal inside Cab
3	Violet	G425 Violet w/ Yellow Stripe	Upfitter Connector Near Brake Pedal inside Cab
4	Pink	K425 Pink w/ Yellow Stripe	Upfitter Connector Near Brake Pedal inside Cab
5	Violet	V937 Violet w/ Brown Stripe	Upfitter Connector Near Brake Pedal inside Cab
6	Pink	F922 Pink w/ Red Stripe	Upfitter Connector Near Brake Pedal inside Cab
	Chelsea Wire	**Connected To Dodge Wire**	**Location**
7	Black w/ Booted Connector	Indicator Switch	PTO

Wiring Installation 442 Series w/o EOC (SK-433 Rev A)



NOTES:

a. Using Butt Connectors, Join Chelsea Light Wire #1 G425 to Chelsea Relay Harness Wire #3 G425.
b. Using a Splice Connector, Join Chelsea Light Wire #2 F922 to Chelsea Relay Harness Wire #6 F922 to Ram Gray Connector Harness F922 Pink w/ Yellow Stripe (Do Not Cut Ram F922 Pink w/ Yellow Stripe Wire).
c. Using Butt Connectors, Join Chelsea Relay Wire #4 K425 to Ram Black Connector Harness Wire K425 Orange w/ Brown Stripe.
d. Using Butt Connectors, Join Chelsea Relay Wire #5 V937 to Ram Black Connector Harness Wire V937 Violet w/ Brown Stripe.
e. Pass Black Booted Connector Through Fire Wall and Attach to Indicator Switch on PTO.

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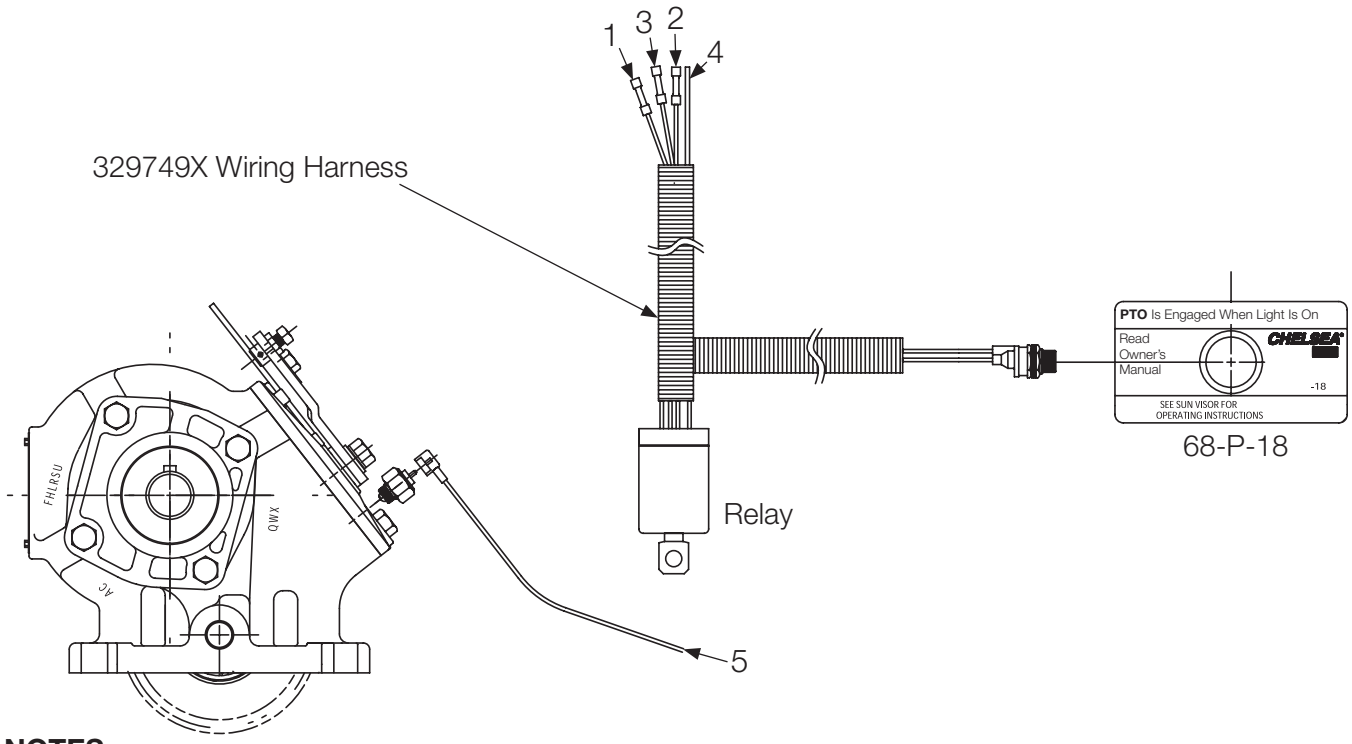
Wiring Chart - Model Year 2011+ Ram (Dodge) Chassis Cab, 6.7L w/ G56 Transmission

	Chelsea Harness Wire	Connected To Ram Wire	Upfitter Harness	Location
1	Black	Chelsea Booted Connector		Through Firewall inside Cab
2	Orange	K425 Orange w/ Brown Stripe	Black Connector Harness	Upfitter Connector Near Brake Pedal inside Cab
3	Violet	V937 Violet w/ Brown Stripe	Black Connector Harness	Upfitter Connector Near Brake Pedal inside Cab
4	Pink	F922 Pink w/ Yellow Stripe	Gray Connector Harness	Upfitter Connector Near Brake Pedal inside Cab
	Chelsea Wire	**Connected To Wire**	**Upfitter Harness**	**Location**
5	Black w/ Booted Connector	Chelsea Black Harness Wire	Pass Through Firewall	PTO

Wiring Installation 442 Series w/o EOC (329749X)



NOTES:

a. Using a Splice Connector, Join Chelsea Pink Wire F922 Ram Gray Connector Harness F922 Pink w/ Yellow Stripe.
b. (Do Not Cut Ram F922 Pink w/ Yellow Stripe Wire).
c. Using Butt Connectors, Join Chelsea Orange Wire K425 to Ram Black Connector Harness Wire K425 Orange w/ Brown Stripe.
d. Using Butt Connectors, Join Chelsea Violet Wire V937 to Ram Black Connector Harness Wire V937 Violet w/ Brown Stripe.
e. Pass Blunt End of Black Booted Connector from PTO Through Fire Wall.
f. Using Butt Connectors, Join Chelsea Black Wire to Chelsea Booted Connector Blunt End Coming through Firewall.

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Delay Relay Switch

The 329749X includes an Adjustable Delay Relay. The factory setting for the relay is 2.5 seconds. The 1 and 2 switches from the factory will be in the ON position with the PTO knob to the farthest clockwise position. This will represent a 2.5 second delay from the engagement of the Power Take-Off to the sending of the signal to the Ram Control Module to disable the ODB II Monitoring System (**Fig. 23**).

If the clutch pedal is not released in 2.5 seconds, the Ram Control Module will deactivate Power Take-Off Mode and return Engine Throttle to Idle Condition. If a larger delay period is required, Turn the Number 1 Position Switch to the Off Position and turn the PTO knob to the farthest counter-clockwise position. This will again set the delay to 2.5 seconds. From this point, turn the PTO knob clockwise until an appropriate delay is met. The farthest clockwise position will now represent a 14 second delay. See chart on side of relay for switch settings (**Fig. 24**).

Figure 23

Figure 24

Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Offer of Sale

WARNING: This product can expose you to chemicals including Lead and Lead Compounds, and Di(2-ethylhexyl)phthalate (DEHP) which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

1. Definitions. As used herein, the following terms have the meanings indicated.

Buyer: means any customer receiving a Quote for Products.

Buyer's Property: means any tools, patterns, plans, drawings, designs, specifications materials, equipment, or information furnished by Buyer, or which are or become Buyer's property.

Confidential Information: means any technical, commercial, or other proprietary information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered, or made available, whether directly or indirectly, to Buyer.

Goods: means any tangible part, system or component to be supplied by Seller.

Intellectual Property Rights: means any patents, trademarks, copyrights, trade dress, trade secrets or similar rights.

Products: means the Goods, Services and/or Software as described in a Quote.

Quote: means the offer or proposal made by Seller to Buyer for the supply of Products.

Seller: means Parker-Hannifin Corporation, all divisions, subsidiaries and businesses selling products under these terms.

Seller's IP: means patents, trademarks, copyrights, or other intellectual property rights relating to the Products, including without limitation, names, designs, images, drawings, models, software, templates, information, any improvements or creations or other intellectual property developed prior to or during the relationship contemplated herein.

Services: means any services to be provided by Seller.

Software: means any software related to the Goods, whether embedded or separately downloaded.

Special Tooling: means equipment acquired by Seller or otherwise owned by Seller necessary to manufacture Goods, including but not limited to tools, jigs, and fixtures.

Terms: means the terms and conditions of this Offer of Sale.

2. Terms. All sales of Products by Seller will be governed by, and are expressly conditioned upon Buyer's assent to, these Terms. These Terms are incorporated into any Quote provided by Seller to Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic data interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms or conditions of purchase. Any Quote made by Seller to Buyer shall be considered a firm and definite offer and shall not be deemed to be otherwise despite any language on the face of the Quote. Seller reserves all rights to accept or reject any purported acceptance by Buyer to Seller's Quote if such purported acceptance attempts to vary the terms of the Quote. If Seller ships Products after Buyer issues an acceptance to the Quote, any additional or different terms proposed by Buyer will not become part of the parties' business relationship unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence. If the transaction proceeds without such agreement on the part of Seller, the business relationship will be governed solely by these Terms and the specific terms in Seller's Quote.

3. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices for any reason and at any time by giving ten (10) days prior written notice. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Under any circumstances, Buyer may not withhold or suspend payment of any amounts due and payable as a deduction, set-off or recoupment of any amount, claim or dispute with Seller. Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law. Seller reserves the right to require advance payment or provision of securities for first and subsequent deliveries if there is any doubt, in Seller's sole determination, regarding the Buyer's creditworthiness or for other business reasons. If the requested advance payment or securities are not provided to Seller's satisfaction, Seller reserves the right to suspend performance or reject the purchase order, in whole or in part, without prejudice to Seller's other rights or remedies, including the right to full compensation. Seller may revoke or shorten any payment periods previously granted in Seller's sole determination. The rights and remedies herein reserved to Seller are cumulative and in addition to any other or further rights and remedies available at law or in equity. No waiver by Seller of any breach by Buyer of any provision of these terms will constitute a waiver by Seller of any other breach of such provision.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages or additional costs resulting from any delay. All deliveries are subject to our ability to procure materials from our suppliers. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

5. Warranty. The warranty for the Products is as follows: (i) Seller warrants that all products sold conform to the applicable Parker Chelsea standard specification for the lesser period of 2 years (24 Months) from date of service or 2-1/2 years (30 Months) from date of build (as marked on the product name plate; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS,**

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Parker Hannifin Corporation
Chelsea Products Division
Olive Branch, MS 38654 USA

Offer of Sale (Continued)

AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED, UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH-RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".

6. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

7. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCTS, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.

8. Confidential Information. Buyer acknowledges and agrees that Confidential Information has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller and shall return all such Confidential Information to Seller within thirty (30) days upon request.

9. Loss to Buyer's Property. Buyer's Property will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Also, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

10. Special Tooling. Seller may impose a tooling charge for any Special Tooling. Special Tooling shall be and remain Seller's property. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole determination at any time.

11. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect Seller's security interest.

12. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

13. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of Buyer's Property; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms, including any legal or administrative proceedings, collection efforts, or other actions arising from or relating to such failure to comply. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

14. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

15. Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

16. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of any events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, cyber related disruptions, cyber-attacks, ransomware sabotage, delays or failures in delivery from carriers or suppliers, shortages of materials, sudden increases in the price of raw material or components, shutdowns or slowdowns affecting the supply of raw materials or components, or the transportation thereof, oil shortages or oil price increases, energy crisis, energy or fuel interruption, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, embargoes, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by an event of force majeure shall be tolled for the duration of such event of force majeure and rescheduled for mutually agreed dates as soon as practicable after the event of force majeure ceases to exist. The right to allocate capacity is in the Seller's sole discretion. An event of force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or subcontractors. An event of force majeure in the meaning of these Terms means any circumstances beyond Seller's control that permanently or temporarily hinders performance, even where that circumstance was already foreseen. Buyer shall not be entitled to cancel any orders following its claim of an event of force majeure.

17. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not

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invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

18. Duration. Unless otherwise stated in the Quote, any agreement governed by or arising from these Terms shall: (a) be for an initial duration of one (1) year; and (b) shall automatically renew for successive one-year terms unless terminated by Buyer with at least 180-days written notice to Seller or if Seller terminates the agreement pursuant to Section 19 of these Terms.

19. Termination. Seller may, without liability to Buyer, terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property, (d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

20. Ownership of Rights. Buyer agrees that (a) Seller (and/or its affiliates) owns or is the valid licensee of Seller's IP and (b) the furnishing of information, related documents or other materials by Seller to Buyer does not grant or transfer any ownership interest or license in or to Seller's IP to Buyer, unless expressly agreed in writing. Without limiting the foregoing, Seller retains ownership of all Software supplied to Buyer. In no event shall Buyer obtain any greater right in and to the Software than a right in a license limited to the use thereof and subject to compliance with any other terms provided with the Software. Buyer further agrees that it will not, directly or through intermediaries, reverse engineer, decompile, or disassemble any Software (including firmware) comprising or contained within a Product, except and only to the extent that such activity may be expressly permitted, either by applicable law or, in the case of open-source software, the applicable open-source license.

21. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any Intellectual Property Rights except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third-party claim that one or more of the Products infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer (including Seller's use of Buyer's Property); or (ii) directed to any Products for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

22. Governing Law. These Terms, the terms of any Quote, and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.

23. Entire Agreement. These Terms, along with the terms set forth in the Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the Quote and these Terms, the terms set forth in the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. No modification to these Terms will be binding on Seller unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence, 'clickwrap' or other purported electronic assent to different or additional terms. Sections 2-25 of these Terms shall survive termination or cancellation of any agreement governed by or arising from these Terms.

24. No 'Wrap' Agreements/No Authority to Bind. Seller's clicking any buttons or any similar action, such as clicking "I Agree" or "Confirm," to utilize Buyer's software or webpage for the placement of orders, is NOT an agreement to Buyer's Terms and Conditions. **NO EMPLOYEE, AGENT OR REPRESENTATIVE OF SELLER HAS THE AUTHORITY TO BIND SELLER BY THE ACT OF CLICKING ANY BUTTON OR SIMILAR ACTION ON BUYER'S WEBSITE OR PORTAL.**

25. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer represents that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Law.

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