

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR MODELS

F102XX

DOUBLE ACTING SERIES

PNEUMATIC ACTUATORS

PART NUMBER: 112859

REVISION: "A"

DATE: September, 1993

1.0. INTRODUCTION

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis F102XX double acting series "Scotch-Yoke" pneumatic type actuators. When the model number has a "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.
- 1.2 **SAFETY STATEMENT:** Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by a trained, equipped, prepared and competent technician.

WARNING: For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the **WARNINGS, CAUTIONS** and **NOTES** contained in this procedure.

1.3 DEFINITIONS:

WARNING: If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.

CAUTION: If not observed, user may incur damage to actuator and/or injury to personnel.

NOTE: Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.

- 1.4 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.
- 1.5 The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.
- 1.6 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

2.0 SUPPORT ITEMS AND TOOLS

- 2.1 Support Items - Seal/Service Kit, razor sharp cutting instrument, Seal removal tool, commercial leak testing solution, and a non-hardening thread sealant.
- 2.2 Tools: All tools are American Standard inch. Large adjustable wrench, two (2) large screwdrivers, allen wrench set, set of open/box-end wrenches, rubber or leather mallet, torque wrench (up to 5,000 in.lbs.), breaker bar, 1/4" drift punch and a 1/2" drive socket set. For recommended tool and wrench sizes refer to Chart 1 on page 11.

3.0 BETTIS REFERENCE MATERIALS

- 3.1 Assembly Drawing part number 112256.
- 3.2 Base I Standard dimensional drawing part number 112257.

4.0 GENERAL DETAILS

- 4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 4.2 Numbers in parentheses, () indicate the bubble number (reference number used on the Bettis Assembly Drawing and actuator Part Lists.
- 4.3 As referenced in this procedure the front of the actuator is: Yoke bore nearest the technician. The top of the actuator will be the housing cover.
- 4.4 When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.
- 4.5 Use a non-hardening thread sealant on all pipe threads.

CAUTION: Apply the thread sealant per the manufacture's instructions.

- 4.6 Disassembly of actuator should be done in a clean area on a work bench.
- 4.7 **NOTE: Some components of this actuator are very heavy and will require a means of assistance.** The actuator weight can be determined from the Bettis Base I standard dimensional drawing.
- 4.8 LUBRICATION REQUIREMENTS: For use in all areas of the actuator.
 - 4.8.1 Standard and high temperature service (-20°F to 350°F) use Bettis ESL-5 (Kronaplate 100). ESL-5 is contained in the Bettis Service/Seal Kit.
 - 4.8.2 Low temperature service (-50°F to 150°F) use Kronaplate 50. This lubricant is not in the Service/Seal Kit.
- 4.9 It is a good practice to operate the actuator with the nominal operating pressure (NOP), as listed on the actuator name tag or the pressure used by the customer to operate the actuator during normal operation, before starting the general disassembly of the actuator. Notate and record any abnormal symptoms such as jerky or erratic operation. **NOTE: Pressure is not to exceed the maximum operating pressure rating listed on the name tag.**

5.0 GENERAL DISASSEMBLY

- 5.1 Unscrew and remove one snubber valve (1-170) from the housing cover and four from the housing mounting plate.
- 5.2 Remove stop screw nuts (2-110).
- 5.3 Tag the stop screws (2-100) left and right. The setting of the stop screws (2-100) should be checked and setting recorded before stop screws are loosened or removed.
- 5.4 Mark and record location of the pressure inlet ports on the two cylinders outer end caps (2-30) and inner end caps (2-20).

6.0 PRESSURE CYLINDERS DISASSEMBLY

- 6.1 Following steps will be performed on either power cylinder and then repeated on the other cylinder. However, steps 6.2 through 6.13 may be performed simultaneously on both cylinders.

- 6.2 Remove tie bar hex nuts (2-120).
- 6.3 Remove outer end cap (2-30) from the cylinder (2-10). The fit between the cylinder and the outer end cap is very tight. Break the end cap free by tapping with a breaker bar on lip provided on the end cap. **NOTE: Stop screw (2-100) may remain in outer end cap (2-30).**

CAUTION: Do not damage o-ring groove, for o-ring (5-40), when removing end cap.

- 6.4 Pry inner end cap (2-20) from adapter (2-160), using a breaker bar, Separate the cylinder (2-10) from inner end cap (2-20).

CAUTION: Do not damage o-ring groove, for o-ring (5-40) when removing end cap.

- 6.5 Remove cylinder (2-10) from the inner end cap (2-20). When removing the cylinder off of the piston, tilt the cylinder 15° to 30° degrees with respect to actuator centerline.
- 6.6 Remove tie bars (2-40) from the adapter plate (2-160). Flats on outboard end are provided for wrench placement. Using flats will prevent damage to surfaces of tie bars.

CAUTION: Do not use a pipe wrench for tie bar removal.

- 6.7 Remove split ring (2-70) and split ring retainer (2-90) from the outboard end of piston rod (2-50).
- 6.8 **NOTE: The piston (2-60) acts as the retainer for the inboard split rings (2-70). When removing the piston be careful to not loose the split rings (2-70).** Remove piston (2-60) from piston rod (2-50).
- 6.9 Remove the retaining rings (2-150) from the piston (2-60).
- 6.10 Remove the tie bar bushing (2-140) from the piston (2-60).
- 6.11 Remove o-ring seal (5-20) and slide inner end cap (2-20) off piston rod (2-50).
- 6.12 Remove rod seal (5-70) from inner end cap (2-20).

7.0 HOUSING DISASSEMBLY

- 7.1 Before removing the position indicator record or mark it's position. Loosen two each socket set screws (1-370) and remove position indicator (1-340).
- 7.2 Unscrew and remove hex cap screws (1-320) with seal gaskets (4-30) from position indicator cover (1-310).
- 7.3 Remove position indicator cover (1-310).
- 7.4 **NOTE: Mark and record the orientation of the position indicator drive (1-280) in relation to the top of the yoke (1-70).** Unscrew and remove eight in number hex cap screws (1-290) with lock-washers (1-300) from position indicator drive (1-280). Remove position indicator drive (1-280) from the top of the yoke (1-70).
- 7.5 From the upper yoke bushing (1-80) remove sixteen in number hex cap screws (1-150) with lock-washers (1-160) from four in number yoke bushing retainers (1-140). Remove four in number yoke bushing retainers (1-140).

- 7.6 **NOTE: The ten cover screws (1-240), that stick up and have hex nut (1-250) on them, are not to be removed.** Remove forty eight in number cover screws (1-40) and gasket seals (4-30).

- 7.7 To help in removing the housing cover (1-20) loosen the ten hex nuts (1-250). Alternately rotate the ten raised cover screws (1-240) clockwise until the cover is clear of the ten in number dowel pins (1-30).
- 7.8 Remove the housing cover (1-20). **NOTE: The cover will have a very tight fit. It is not necessary to remove dowel pins (1-30) from the actuator.**
- 7.9 Remove the upper yoke bushing (1-80) from the top of the yoke (1-70).
- 7.10 Remove two in number socket cap screws (1-120) and lock-washers (1-130) from the yoke pin retainer (1-110). Remove yoke pin retainer (1-110).
- 7.11 **NOTE: Remove yoke pin by inserting 1/2"-13 UNC screw into top of yoke pin and pull straight up and out.** Remove yoke pin (1-90).
- 7.12 Rotate the yoke arms, so as, to expose the guide block (1-50). **NOTE: The uppermost slide block (1-100) may fall out of yoke slot once the slot clears guide block (1-50).**
- 7.13 Remove the top and bottom slide blocks (1-100) from the yoke arms.
- 7.14 Insert a 3/8" diameter rod/punch through the small hole on top of the guide block (1-50) and into the hole in the rod extension (1-200). **NOTE: The rod extension (2-200) may need to be rotated to align its hole with hole in the guide block.** Holding this tool in place unscrew the piston rod (2-50) from the piston rod extension (1-200). Flats are provided on the piston rod for wrench placement. **NOTE: Do not use a pipe wrench on the piston rod as it may mark the rod and cause rod seal leakage.**
- 7.15 Remove four in number hex cap screws (1-270) and lock washers (1-360) from each side of housing (1-10). Remove two in number adapters (2-160).
- 7.16 Remove eight in number socket cap screws (1-220) from each rod extension flange (1-210).
- 7.17 Remove both rod extensions flange (1-210) from guide block (1-50).
- 7.18 Remove a rod extension (1-200) from each side of the Guide block (1-50).
- 7.19 Remove one in number spherical washers (1-230) from each rod extension (1-200).
- 7.20 Remove a second spherical washer (1-230) from each side of the guide block (1-50).
- 7.21 Remove guide bar (1-60) by sliding out of the guide block (1-50) and housing (1-10).
- 7.22 Remove the guide block (1-50).
- 7.23 Remove yoke (1-70) by lifting yoke up and out of the housing (1-10).
- 7.24 From the lower yoke bushing (1-80) remove sixteen in number hex cap screws (1-150) with lock-washers (1-160) from four in number yoke bushing retainers (1-140). Remove four in number yoke bushing retainers (1-140).
- 7.25 Remove lower yoke bushing (1-80) from the bottom of the housing or from the lower end of the yoke (1-70).

8.0 GENERAL RE-ASSEMBLY

CAUTION: Only new seals, that are still within the seals expectant shelf life, should be install back into actuator being refurbished.

- 8.1 Remove and discard all old seals and gaskets.
- 8.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 8.3 All parts should be thoroughly inspected for excessive wear, stress cracking, galling and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding or rotating motion. Sealing surfaces of the cylinder, tie bars and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

CAUTION: Actuator parts that reflect any of the above listed characteristics should be replaced with new parts.

- 8.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves. **NOTE: The parts and seals used in the actuator will be assembled using lubricant as identified in step 4.8..**
- 8.5 Piston T-seal and Rod T-seal installation instructions - The T-seal is a set composed of one rubber seal and two split skive-cut back-up rings.
 - 8.5.1 Install the T-seal into the seal grooves.
 - 8.5.2 Install a back-up ring on each side of the T-seal.
 - 8.5.3 When installing the back-up rings, do not align the skive-cuts.
 - 8.5.4 If the back-up rings are too long and the rings overlap beyond the skive-cuts, then the rings must be trimmed with a razor sharp instrument.
- 8.6 Prime and apply master gasket (510) to all surfaces as indicated on the assembly drawing (reference note 6 on the assembly drawing).

9.0 HOUSING GROUP REASSEMBLY

- 9.1 Apply lubricant to the yoke bushing bore in the housing (1-10) and arrange the housing with the yoke bore nearest you.
- 9.2 Install the o-ring seals (4-10) into both of the outer diameter o-ring grooves on the yoke bushings (1-80).
- 9.3 Install the o-ring seals (4-20) into both of the inner diameter o-ring grooves on the yoke bushings (1-80).
- 9.4 Install the one of the yoke bushings (1-80) into the bottom of the housing. Install four in number yoke bushing retainers (1-140). Fasten sixteen in number hex cap screws (1-150) and lock-washers (1-160).
- 9.5 Coat the bearing surfaces of the yoke (1-70) with lubricant and install into the lower yoke bushing (1-80).

- 9.6 Install the remaining yoke bushing (1-80) onto the upper bearing surface of yoke (1-70). Install four in number yoke bushing retainer (1-140). Fasten sixteen in number hex cap screws (1-150) and lock-washers (1-160).
- 9.7 Apply lubricant to the guide block (1-50) and guide bar (1-60).
- 9.8 Install one of the spherical washers (1-230) into the right side of the guide block (1-50). **NOTE: The spherical side of the washer will be facing to the right or to the outside of the guide block.**
- 9.9 Install the second spherical washer (1-230) over the threaded end of the rod extension (1-200). **NOTE: The spherical side of the washer will go on the rod extension facing the head of the rod extension.**
- 9.10 Install the rod extension (1-200) into the right side of the guide block (1-50) and up against the first spherical washer (1-230).
- 9.11 Install the rod extension flange (1-210) over the rod extension (1-200) and retain with eight in number socket cap screws (1-220).
- 9.12 Repeat steps 9.8 through 9.11 for the left side of Guide block (1-50).
- 9.13 Install guide bar (1-60) into left side of housing (1-10). Take the guide block (1-50) and insert the guide bar (1-60) through the guide block and then insert the guide bar into the right side of the housing (1-10).
- 9.14 Prepare the mounting surfaces of the adapters (2-160) and adapter mounting sides of the housing (1-10) per master gasket instructions (reference note 6 on assembly drawing).
- 9.15 Place eight in number lock washers (1-360) on to hex cap screws (1-270).
- 9.16 Install end cap o-ring seal (4-40) into the adapter (2-160).
- 9.17 Insert hex cap screws (1-270), four on each side of the housing, through the inside of housing (1-10) and into matching holes in adapter (2-160). Do not tighten the hex cap screws (1-270).
- 9.18 Install the rod bushings (2-80) through the adapter (2-160) and into the side of housing (1-10). Tighten hex cap screws (1-270).
- 9.19 Install the piston rods (2-50) by inserting through the adapters (2-160). Screw piston rods (2-50) into the rod extensions (1-200). Secure the piston rods in the rod extension by inserting a 3/8" inch diameter punch into the hole in the head of the rod extensions (1-200) and using a wrench on the piston rod outer end to tighten the piston rod onto the piston rod extension (1-200).
- 9.20 Install the sliding blocks (1-100) by mounting one sliding block down into the lower yoke arm with the two tapped holes facing up.
- 9.21 While holding the second sliding block (1-100) in the upper yoke arm, place guide block (1-50) in between the yoke arms and sliding blocks.
- 9.22 Align holes in upper sliding block with the matching holes in the guide block. Install the yoke pin (1-90) by inserting into the hole in the sliding block (1-100). The yoke pin can be held in place by fastening a screw into the tapped hole in the upper end of the yoke pin.

- 9.23 While holding the yoke pin in place slide the yoke pin retainer (1-110) into the yoke pin groove and attach to the sliding block (1-100) using socket cap screws (1-120) with lock-washers (1-130).

10.0 PRESSURE CYLINDER RE-ASSEMBLY

- 10.1 Prepare the mounting surface of the inner end cap (2-20) per master gasket instructions (reference note 6 on assembly drawing).
- 10.2 Coat the rod seal (5-70) with lubricant and install, lip first, into the recess provided in the inner end cap (2-20).

CAUTION: Install the rod seal with energizer ring facing outboard side (away from housing).

- 10.3 Install adapter o-ring seal (5-10) into the seal groove in the adapter (2-160).
- 10.4 Coat two tie bar o-ring seals (5-20) with lubricant and install into the inner end cap (2-20).
- 10.5 Install the inner end cap (2-20) over the piston rod (2-50) and the rod bushing (2-80), protruding from the adapter (2-160). **NOTE: The pressure inlet port should be positioned in the position recorded in section 5.**
- 10.6 Apply lubricant to the end cap o-ring seal (5-40) and install into the O.D. o-ring groove of inner end cap (2-20).
- 10.7 Install the o-ring seals (5-30) into the O.D. groove on the tie bar bushings (2-140).
- 10.8 **NOTE: Refer to section 8 for proper T-seal installation instructions.** Apply lubricant to two sets of piston tie bar T-seal components (5-80) and install the rod T-seals (5-60) into the I.D. groove in the tie bar bushings (2-140).
- 10.9 Install the tie bar bushings (2-140) into the piston (2-60) and retain with retaining rings (2-150).
- 10.10 Coat the end of piston rod (2-50) with lubricant.
- 10.11 Apply lubricant to the piston o-ring (5-20) and place onto the piston rod (2-50).
- 10.12 Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain by installing the recessed area of piston (2-60) onto the piston rod and over the split ring set (2-70).
- 10.13 Install a matched set of split rings (2-70) into the piston rod and retain with the split ring retainer (2-90).
- 10.14 Coat the piston T-seal components (5-50) with lubricant and install into the piston external seal groove. Refer to section 8 for proper "T" seal installation instructions.

CAUTION: Make certain the back-up rings, components of the rod T-seal (5-60), are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and tie bar, the components could be damaged, becoming a potential source of leakage.

- 10.15 Take "housing-end" of tie bars (2-40), end without wrench flat, and install by carefully inserting tie bars into the piston (2-60) and through the rod T-seal (5-60), inner end cap (2-20) and screw the tie bars into the adapter (2-160).

CAUTION: Tighten the tie bars (2-40) until the threads bottom out, then back out each tie bar one-half turn.

10.16 Apply lubricant to the bore of the cylinder (2-10).

10.17 Slide the lubricated end of the cylinder (2-10) over the piston (2-60) and onto the inner end cap (2-20). When sliding the cylinder over the piston seal tilt cylinder 15° to 30° degrees to the piston rod.

CAUTION: If needed, when installing the cylinder, hammer on the end of the cylinder only with a non metallic object.

CAUTION: Make certain the back-up rings, components of the piston T-seal (5-50), are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and cylinder, the components could be damaged, becoming a potential source of leakage.

10.18 If removed, install stop screw (2-100) into outer end cap (2-30). Back stop screw as far out as possible.

10.19 Apply lubricant to two end cap tie bar o-ring seals (5-20) and install into the outer end cap (2-30).

10.20 Apply lubricant to the outer end cap cylinder o-ring seal (5-40) and install onto the end cap (2-30).

10.21 Install outer end cap (2-30) onto the tie bars and into the end of the cylinder (2-10).

10.22 Install the two tie bar nuts (2-120) onto the tie bars (2-40). **NOTE: While the nuts are being tightened, do not allow the tie bars to turn.** Torque the tie bar nuts to 470 ±45 foot pounds.

11.0 HOUSING COVER INSTALLATION

11.1 Prepare the mounting surfaces of the housing (1-10) and the housing cover (1-20) per master gasket instructions (reference note 6 on assembly drawing).

11.2 Place the housing cover gasket (4-90) on the housing (1-10).

11.3 Remove forty eight in number housing cover hex cap screws (1-40) and replace the gasket seals (4-30) with new seals.

11.4 Install the housing cover (1-20), being careful not to damage the cover gasket (4-90).

11.5 Using the ten in number hex cap screws (1-240) lower the housing cover onto the housing (1-10).

11.6 Install forty eight in number housing cover socket cap screws (1-40) with gasket seals (4-30). **NOTE: Leave finger tight - do not tighten.**

11.7 **NOTE: Do this step only if the cover pins (1-30) have been pulled or if the pins are being replaced.** Drive the ten in number dowel pins (1-30) through the cover (1-20) and into the housing (1-10). The pins should be flush with the cover.

11.8 Tighten the housing cover hex cap screws (1-40).

11.9 Tighten the ten in number hex nuts (1-250).

11.10 Install the position indicator drive (1-280) onto the top of the yoke (1-70) and retain with hex cap screws (1-290) with lock-washers (1-300). **NOTE: Refer to step 7.4 for correct installation position.**

11.11 Install the wear ring (4-60) into bottom groove inside the position indicator cover (1-310).

- 11.12 Install the oring seal (4-50) into the seal groove on the middle area of the position indicator cover (1-310).

- 11.13 Install the rod wiper (4-100) into the top groove inside position indicator cover (1-310).
- 11.14 Prepare the position indicator cover mounting surface of the housing cover (1-20) and the mounting surface of the position indicator cover per master gasket instructions (reference note 6 on assembly drawing).
- 11.15 Install the o-ring seal (4-80) into the seal groove on the position indicator cover (1-310).
- 11.16 Install the position indicator cover (1-310), being careful not to damage the o-ring seal (4-50), wear ring (4-60) and rod wiper (4-100).
- 11.17 Install and tighten position indicator cover hex cap screws (1-320) with seal gaskets (4-30).
- 11.18 **NOTE: Refer to step 7.1 for correct position indicator placement.** Install the position indicator (1-340) over the exposed shaft of the position indicator drive (1-280) and retain in this position by tightening two in number socket set screw (1-370).

12.0 ACTUATOR TESTING

- 12.1 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. A small amount of leakage may be tolerated. Generally, a small bubble which breaks about three seconds after starting to form is considered acceptable. If excessive leakage across the piston is noted the actuator must be disassembled and the cause of leakage must be determined and corrected.
- 12.2 **CAUTION: Pressure is not to exceed the maximum operating pressure rating listed on the actuator name tag.** Unless otherwise listed, all leak testing will use 65 psig or the normal customer operating pressure.
- 12.3 Before testing for leaks, alternately apply and release 65 psi pressure to the each side of the piston to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 12.4 Apply 65 psig pressure to the pressure port in the outer end cap (2-30).
- 12.5 Apply a leak testing solution to the following areas:
 - 12.5.1 Joint between the outer end cap (2-30) and the cylinder (2-10). Checks cylinder to end cap o-ring seal.
 - 12.5.2 Around the tie bar hex nuts (2-120) on the cylinder outer end cap (2-30). Checks tie bars to outer end cap o-ring seals.
 - 12.5.3 The pressure inlet port in the inner end cap (2-20). Checks piston to cylinder, piston to tie bar, and piston to piston rod seals.
 - 12.5.4 Remove pressure from pressure inlet port in the outer end cap.
- 12.6 Apply 65 psig pressure to the pressure port in the inner end cap (2-20).
- 12.7 Apply a leak testing solution to the following areas:
 - 12.7.1 Joint between the inner end cap (2-20) and the cylinder (2-10). Checks cylinder to inner end cap o-ring seal.

12.7.2 Around the joint of inner end cap (2-20), adapter (2-160) and the housing (1-10).

12.7.3 The snubber valve port hole in the housing cover (1-20). Checks the rod seal and the tie bars to end cap o-ring seals.

12.7.4 Remove pressure from pressure inlet port in the inner end cap.

12.8 If an actuator was disassembled and repaired, the above leakage test must be performed again.

13.0 RETURN TO SERVICE

13.1 Replace the software components of five in number snubber valves (1-170). Install one snubber valve in the housing cover (1-20) and four in number snubber valves into the housing mounting ring.

13.2 Adjust both stop screws (2-100) back to settings recorded in section five under General Disassembly.

13.3 Install two in number o-ring seals (5-30) into stop screw nuts (2-110).

13.4 Tighten both stop nuts (1-110) securely.

13.5 Actuator is ready to be returned to service.

13.6 After the actuator is installed on the valve all accessories should be hooked up and tested for proper operation and replaced if found defective.

CHART NO. 1 - TOOL STYLE AND WRENCH SIZES

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED WRENCH STYLE
1-40	3/4"	48	Cover Screws	Socket
1-120	3/8"	2	Yoke pin retainer	Allen
1-150	9/16"	32	Yoke bushing retainer	Socket
1-170	7/8"	5	Snubber	Deep socket
1-220	1/2"	16	Rod extension	Allen
1-240	3/4"	10	Cover lifting screws	Socket
1-250	3/4"	10	Cover lifting nuts	Open end
1-270	2-1/16"	8	Housing to adapter	Socket
1-290	7/16"	8	Position indicator drive	Socket
1-320	3/4"	8	Position indicator cover	Socket
1-350	1-1/2"	16	Lifting lug screws	Socket
1-370	1/8"	2	Position indicator	Allen
2-40	1-1/4"	2	Tie bars flats	Open end or adjustable
2-50	2-1/8"	1	Piston rod flat	Crows foot (1)
2-100	1-1/4"	2	Stop screws	Open end or adjustable
2-110	3-3/4"	2	Stop Screw nut	Open end or adjustable
2-120	3-1/2"	4	Tie bar nuts	Crows foot or deep socket

(1) No alternate style recommended or wrench placement not provided.

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