

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR

TR10XX

DOUBLE ACTING SERIES

PNEUMATIC ACTUATORS

PROCEDURE NUMBER: Service - 015 (SE-015)

RELEASE DATE: February 2002

REPLACES: SE-015 (Dated October 1998)

1.0 **INTRODUCTION**

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis TR10XX "Scotch-Yoke" type pneumatic actuators (includes actuator models that have a -10 or -11 suffix at the end of the model number).

NOTE: When actuator model number has "-S" as a suffix then actuator is special and may have some differences that are not included in this procedure.

1.2 **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.

- 1.3 **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 well 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.

WARNING: This procedure should not supersede or replace any customer's plant safety or work procedures. If a conflict arises between this procedure and the customer's procedures the differences should be resolved in writing between an authorized customers representative and a authorized Bettis representative.

- 1.4 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.

1.5 Normal recommended service interval for this actuator series is five years to maximum total life cycle.

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 - Service Kit, commercial leak testing solution, and non-hardening thread sealant.

- 2.2 Tools - All tools are American Standard inch. Two large screwdrivers, medium standard screwdriver, small standard screwdriver with corners rounded, large adjustable wrench, breaker bar, 1/2" drive socket set, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 inch pounds). Refer to last page of this procedure for recommended tool style and size.

3.0 BETTIS REFERENCE MATERIALS

- 3.1 Assembly drawing 037082 for actuators manufactured from 1973 through September, 1981.
- 3.2 Assembly drawing 048013 for actuators manufactured October, 1981 through August, 1985.
- 3.3 Assembly drawing 065108 for actuators manufactured after September, 1985.
- 3.4 Exploded Detail drawing 065086 for actuators manufactured after September, 1985.
- 3.5 Rail Alignment Tool drawing part number 064899 (Refer to last page of this procedure).

4.0 LUBRICATION REQUIREMENTS

NOTE: The actuator should be re-lubricated at the beginning of each service interval using the following recommended lubricant.

- 4.1 For use in the actuator housing. Lubricants, other than listed in step 4.2 should not be used without prior written approval of Bettis Product Engineering.
- 4.2 All temperature services (-50°F to +350°F)/(-45.5°C to 176.6°C) use Bettis ESL-5 lubricant. ESL-5 lubricant is contained in the Bettis Service Kit in tubes or cans and they are marked ESL-4, 5 & 10 lubricant.

5.0 GENERAL DISASSEMBLY

- 5.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 5.2 Numbers in parentheses () indicate the bubble number (item reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawings, and actuator parts lists.
- 5.3 Front view of actuator: Yoke bore nearest workman, power cylinder to the right and housing side plate with accessory pads will be facing workman.
- 5.4 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.

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

- 5.5 Use a non-hardening thread sealant on all pipe threads.

- 5.6 Disassembly of actuator should be done in a clean area on a workbench when possible.
- 5.7 TR10XX series actuator models are heavy and will require a means of assistance. For actuator approximate weight refer to the following chart.

ACTUATOR MODEL	APPROXIMATE WEIGHT (LBS) (1)	ACTUATOR MODEL	APPROXIMATE WEIGHT (LBS) (1)
TR1007	1659	TR1016	1795
TR1010	1699	TR1020	1917
TR1012	1758		
(1) Weights listed for each model are for bare actuators without valve mounting brackets and accessories.			

6.0 **PNEUMATIC CYLINDER DISASSEMBLY**

- NOTE: 1. If not already removed disconnect all operating pressure from the actuator power cylinder (2-10).
2. Mark and record location of the pneumatic inlet ports on cylinder outer end cap (2-30) and inner end cap (2-40).
3. Rotate actuator to full counter-clockwise position.

6.1 Remove the pneumatic cylinder stop screw nut (1-100) from outer end cap (2-30).

6.2 The setting of the pneumatic cylinder stop screw (1-90) should be checked and setting recorded before this stop screw is loosened or removed.

NOTE: Pneumatic cylinder stop screw (1-90) may remain in outer end cap.

6.3 Remove tie bar nuts (2-100)) from outer end cap (2-30).

NOTE: The fit between cylinder (2-10) and outer end cap (2-30) is very tight. Break the end cap free by tapping with a breaker bar on lip provided on the end cap.

CAUTION: When separating cylinder (2-10) from outer end cap (2-30) and inner end cap (2-40) do not damage o-ring groove.

6.4 Remove outer end cap (2-30) from cylinder (2-10) and tie bars (2-60).

6.5 Pry inner end cap (2-40) away from the housing (1-10). Break the inner end cap free from cylinder (2-10) by tapping with a breaker bar on the lip provided on the end cap.

NOTE: When removing cylinder (2-10) off of piston (2-20), tilt cylinder (2-10) at an angle of approximately 15° to 30° degrees to the piston rod (2-70).

6.6 Remove cylinder (2-10) from the actuator.

WARNING: Keep split ring halves (2-80) in matched sets.

- 6.7 Remove split ring retainer (2-90) and split ring halves (2-80) from the outboard side of piston (2-20).
- 6.8 Remove piston (2-20) off piston rod (2-70) and tie bars (2-60).
- 6.9 FABRICATED PISTON DISASSEMBLY: Refer to assembly drawing Detail "A".
 - 6.9.1 Remove two retaining rings (2-120) from piston (2-20).
 - 6.9.2 Remove two piston tie bar bushing (2-110) from piston (2-20).

NOTE: Piston bushing (2-220) should be replaced each time the actuator is refurbished. The Bettis Service Kit should contain new piston bushings.

WARNING: Keep split ring halves (2-80) in matched sets.

- 6.10 Remove inboard split ring retainer (2-90) and split ring halves (2-80) from piston rod (2-70).
- 6.11 Remove o-ring seal (4-20).
- 6.12 Remove inner end cap (2-40) off piston rod (2-70) and tie bars (2-60).
- 6.13 Remove tie bars (2-60) from housing (1-10). NOTE: Flats on outboard end are provided for wrench placement.
- 6.14 Actuators manufactured 1975 through September, 1981 remove tie bar pins (2-110) from the hole where the tie bars were removed from the housing (1-10). Skip this step for actuators manufactured after October, 1981.
- 6.15 Unscrew and remove piston rod (2-70) from yoke pin nut (1-30). NOTE: Flats on outboard end of the piston rod are provided for wrench placement.
- 6.16 Remove rod bushing (2-50) either from the piston rod (2-70) or from the housing (1-10).

7.0 HOUSING DISASSEMBLY

- 7.1 Remove four socket cap screws (1-170) with gasket seal (6-80) from position indicator (1-410).
- 7.2 Remove position indicator (1-410) and yoke weather cover (6-110) from the top of yoke (1-330)/(7).
- 7.3 Remove the stop screw nut (1-100) from the blind end cap end of housing (1-10):
NOTE: Measure and record the exposed length of the blind end cap stop screw (1-90).
- 7.4 Remove hex cap screws (3-20) from blind end cap (3-10).
- 7.5 Remove blind end cap (3-10).

NOTE: Stop screw (1-90) may remain in blind end cap.

- 7.6 Remove the hex cap screws (1-170) with gasket seals (6-80) from the housing cover (1-20).
- 7.7 Remove the housing cover (1-20). NOTE: Cover (1-20) will have a very tight fit and it is not necessary to remove cover pins (1-160) from cover (1-20).
- 7.8 Remove upper yoke bushing (1-110) from around the upper yoke trunion of yoke (1-330)/(7).
- 7.9 OUTER RAIL REMOVAL: Actuators manufactured from 1975 through September, 1981 use step 7.9.1, actuators manufactured from October, 1981 through August, 1985 use step 7.9.2 and actuators manufactured after September, 1985 use step 7.9.3.

NOTE: To prevent outer rail (1-140) from falling or shifting in housing (1-10) hold or support rail (1-140) when removing rail pin (1-70).

- 7.9.1 Actuators manufactured from 1975 through September, 1981 - Remove outer rail (1-140) by removing rail pin (1-70). NOTE: Because tie bar pin (2-110) has been removed, the rail should lift out.

NOTE: To prevent outer rail (1-140) from falling or shifting in housing (1-10) hold or support rail (1-140) when removing screws (1-420).

- 7.9.2 Actuators manufactured from October, 1981 through August, 1985 - Remove outer rail (1-140) by unscrewing first set of socket cap screws (1-420) with gasket seals (1-430). NOTE: Because tie bars and blind end cap screws with "tipped" ends have been removed, the rail should lift out.

- 7.9.3 Actuators manufactured after September, 1985 - Remove outer rail (1-140) by unscrewing two shoulder cap screws (1-420). NOTE: Because tie bars and blind end cap screws with "tipped" ends have been removed, the rail should lift out.

NOTE: Actuators manufactured from 1973 through September 1981 will have two yoke rollers (1-40) in place of one yoke roller listed in steps 7.10, 7.13 and 7.15.

- 7.10 Remove upper yoke roller (1-40).
- 7.11 Remove yoke pin (1-50).
- 7.12 Remove yoke pin nut (1-30) out from between the arms of yoke (1-330)/(7).
- 7.13 Remove the yoke roller (1-40) / (1-130) located inside yoke pin nut (1-30). NOTE: Actuators manufactured after September 1985 use item number (1-130) and is a longer roller than yoke roller item number (1-40).
- 7.14 Stop screw stud (3-30) may be removed if necessary.
- 7.15 Remove lower yoke roller (1-40) located inside the slot of the lower arm of yoke (1-330)/(7).

- 7.16 **INNER RAIL REMOVAL:** Actuators manufactured from 1975 through September, 1981 use step 7.16.1, actuators manufactured from October, 1981 through August, 1985 use step 7.16.2 and actuators manufactured after September, 1985 use step 7.16.3.

NOTE: To prevent inner rail (1-140) from falling or shifting in housing (1-10) hold or support rail (1-140) when removing rail pin (1-70).

- 7.16.1 Actuators manufactured from 1975 through September, 1981 - Remove inner rail (1-140) by removing rail pin (1-70). **NOTE:** Because tie bar pin (2-110) has been removed, the rail should lift out.

NOTE: To prevent inner rail (1-140) from falling or shifting in housing (1-10) hold or support rail (1-140) when removing screws (1-420).

- 7.16.2 Actuators manufactured from October, 1981 through August, 1985 - Remove inner rail (1-140) by unscrewing first set of socket cap screws (1-420) with gasket seals (1-430). **NOTE:** Because tie bars screws with "tipped" ends have been removed, the rail should lift out.

- 7.16.3 Actuators manufactured after September, 1985 - Remove inner rail (1-140) by unscrewing two shoulder cap screws (1-420). **NOTE:** Because tie bars and blind end cap screws with "tipped" ends have been removed, the rail should lift out.

CAUTION: **The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of torque output. This can only be accomplished by removing the yoke from the housing, which requires removing the actuator from the device it is mounted on.**

- 7.17 Rotate yoke (1-330)/(7) clockwise (or counter clockwise) approximately 45° degrees and remove by lifting from lower yoke bushing (1-120) and housing (1-10).

- 7.18 Remove lower yoke bushing (1-120).

- 7.19 Remove two socket cap screws (1-190) with lockwashers (1-220) from the switch hole cover (1-150).

- 7.20 Remove breather (1-270) and elbow fitting (1-260) from the pneumatic cylinder end of the housing (1-10).

8.0 GENERAL REASSEMBLY

CAUTION: **Only new seals that are still within the seal's expectant shelf life should be installed into actuator being refurbished.**

- 8.1 Remove and discard all used seals and gaskets.

- 8.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

CAUTION: **Actuator parts that reflect any of the following listed characteristics must be replaced with new parts.**

- 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.
- 8.4 INSTALLATION LUBRICATION INSTRUCTIONS: Using the correct lubrication as defined in Section 4.
- 8.4.1 Before installation coat all moving parts with lubricant.
- 8.4.2 Coat all seals with lubricant, before installing into seal grooves.

9.0 HOUSING REASSEMBLY

NOTE: Assemble using lubrication as defined in Section 4.

- 9.1 If removed, install pipe plugs (1-200) into housing (1-10).
- 9.2 Apply lubricant to lower yoke bushing (1-120) and yoke bore in housing.
- 9.3 Actuators manufactured from 1973 through September 1981 install o-ring seal (6-70) into lower yoke bushing (1-120). NOTE: Actuators manufactured after September 1981 will not use an o-ring seal on the lower yoke bushing.
- 9.4 Install lower yoke bushing (1-120) into housing (1-10).
- 9.5 Apply lubricant to yoke (1-330)/(7) in the lower trunion area and the lower yoke arm slot.
- 9.6 Install yoke (1-330)/(7) into lower yoke bushing. NOTE: Yoke hub with tapped holes faces up. Rotate yoke to mid-stroke position.

NOTE: Actuators manufactured from 1973 through September 1981 will have two yoke rollers (1-40) in place of one yoke roller listed in steps 9.8, 9.16 and 9.18.

- 9.7 Apply lubricant to all surfaces of yoke rollers (1-40) and slots in the two arms of yoke (1-330)/(7).
- 9.8 Install yoke roller (1-40) into the slot of the lower arm of yoke (1-330)/(7).
- 9.9 Actuators manufactured from 1973 through September 1981 lubricate and install o-ring seals (6-50) into outer diameter seal groove of four rail pins (1-70).
- 9.10 Apply lubricant to two rails (1-140).
- 9.11 Install inner rail (1-140) by sliding rail into housing between the arms of yoke (1-330)/(7) and fasten per step 9.12.
- 9.12 INNER RAIL INSTALLATION - Actuators manufactured from 1975 through September, 1981 use step 9.12.1, actuators manufactured from October, 1981 through August, 1985 use step 9.12.2 and actuators manufactured after September, 1985 use step 9.12.3.

9.12.1 Actuators manufactured from 1975 through September, 1981 - Install rail pins (1-70) with o-ring seal (6-50) through each end of housing (1-10) and into the inner rail (1-140).

9.12.2 Actuators manufactured from October, 1981 through August, 1985 - Install socket cap screws (1-420) with gasket seals (1-430) through each end of housing (1-10) and into the inner rail (1-140).

NOTE: Do not tighten the socket cap screws (1-420) at this point. Tie bars with "tipped" ends will be added later to support rail. Until that time, for cylinder (2-10) side of housing (1-10) use two adapter pieces (see drawing of part number 064899) as temporary replacements. For blind end cap side of housing (1-10) use cap screw (3-20) to support blind end cap end of inner rail (1-140).

9.12.3 Actuators manufactured after September, 1985 - Install shoulder screws (1-420) through each end of housing (1-10) and into the inner rail (1-140).

NOTE: Do not tighten the shoulder bolts at this point. Tie bars with "tipped" ends will be added later to support rail. Until that time, for cylinder (2-10) side of housing (1-10) use two adapter pieces (see Drawing B-064899) as temporary replacements. For blind end cap side of housing (1-10) use cap screw (3-20) to support blind end cap end of inner rail (1-140).

9.13 Apply lubricant to the upper and lower surfaces of yoke pin nut (1-30).

9.14 Install yoke pin nut (1-30) between upper and lower arms of yoke (1-330)/(7). NOTE: Arrange yoke pin nut to be parallel to rail (1-140).

9.15 If removed install hex head screw (3-30) into the left end of yoke pin nut (1-30).

9.16 Install second yoke roller as follows: Actuators manufactured from 1975 through September 1981 and October 1981 through August 1985 use step 9.16.1 and actuators manufactured after September 1985 use step 9.16.2.

9.16.1 Actuators manufactured from 1975 through August 1985 - Install the yoke roller (1-40) into slot of yoke pin nut (1-30) and align hole in this yoke roller to the hole in the previous installed yoke roller.

9.16.2 Actuators manufactured after September 1985 - Install long yoke roller (1-130) into slot of yoke pin nut (1-30). Align hole of long yoke roller with hole in the previous installed yoke roller (1-40).

9.17 Apply lubricant to yoke pin (1-50) and install through middle and lower yoke rollers.

9.18 Install final yoke roller (1-40) into slot of upper arm of yoke (1-330)/(7).

9.19 Apply lubricant to surfaces of upper yoke trunion (1-330)/(7) and upper yoke bushing (1-110).

9.20 Install upper yoke bushing (1-110) over trunion of yoke (1-330)/(7).

9.21 Install outer rail (1-140) by sliding rail into housing between the arms of yoke (1-330)/(7) and fasten per step 9.22.

9.22 OUTER RAIL INSTALLATION - Actuators manufactured from 1975 through September, 1981 use step 9.22.1, actuators manufactured from October, 1981 through August, 1985 use step 9.22.2 and actuators manufactured after September, 1985 use step 9.22.3.

9.22.1 Actuators manufactured from 1975 through September, 1981 - Install rail pins (1-70) with o-ring seal (6-50) through each end of housing (1-10) and into the outer rail (1-140).

9.22.2 Actuators manufactured from October, 1981 through August, 1985 - Install socket cap screws (1-420) with gasket seals (1-430) through each end of housing (1-10) and into the outer rail (1-140).

NOTE: Do not tighten the socket cap screws (1-420) at this point. Tie bars with "tipped" ends will be added later to support rail. Until that time, for cylinder (2-10) side of housing (1-10) use two adapter pieces (see drawing of part number 064899) as temporary replacements. For blind end cap side of housing (1-10) use cap screw (3-20) to support blind end cap end of outer rail (1-140).

9.22.3 Actuators manufactured after September, 1985 - Install shoulder screws (1-420) through each end of housing (1-10) and into the outer rail (1-140).

NOTE: Do not tighten the shoulder bolts at this point. Tie bars with "tipped" ends will be added later to support rail. Until that time, for cylinder (2-10) side of housing (1-10) use two adapter pieces (see drawing of part number 064899) as temporary replacements. For blind end cap side of housing (1-10) use cap screw (3-20) to support blind end cap end of outer rail (1-140).

NOTE: A new rod bushing is provided in some Bettis Service Kits.

9.23 Apply lubricant to piston rod (2-70) and rod bushing (2-50). Install rod bushing over the piston rod.

9.24 Install piston rod (2-70) through the right-hand side of housing (1-10) and screw into yoke pin nut (1-30). NOTE: Do not tighten piston rod (2-70). For wrenching purposes piston rod will be equipped with flats on its outboard end or a 1/2 inch female square on its outboard end.

9.25 TIE BAR INSTALLATION - Actuators manufactured from 1975 through September 1981 use steps 9.25.1 and 9.25.2. Actuators manufactured after September 1981 use steps 9.25.3 through step 9.25.5 or 9.25.6.

9.25.1 Actuators manufactured from 1975 through September 1981 - Apply lubricant to the two tie bar pins (2-110) and to two tie bars (2-60). Install one tie bar pin into inboard end of each tie bar (2-60).

9.25.2 Remove temporary adapter pieces one at a time and then install tie bars (2-60) into the right side of housing (1-10) with tie bar pins being inserted into the rails (1-140).

CAUTION: Tighten the tie bars until threads bottom out, then back out one-half turn.

9.25.3 Actuators manufactured after September 1981 - Apply lubricant to the two tipped tie bars (2-60).

9.25.4 Actuators manufactured after September 1981 - Remove temporary adapter pieces one at a time and then install the two tipped tie bars (2-60) into the right side of housing (1-10) with the tipped end of the tie bars being inserted into the rails (1-140).

CAUTION: Tighten the tie bars until threads bottom out, then back out one-half turn.

9.25.5 Actuators manufactured from October 1981 through August 1985 - After both tie bars (2-60), and before the blind end cap screws (3-20) are removed for the installation of the blind end (3-10), install and then tighten all four shoulder cap screws (1-420) with gasket seals (1-430).

9.25.6 Actuators manufactured after September 1985 - After both tie bars (2-60), and before the blind end cap screws (3-20) are removed for the installation of the blind end (3-10), install and then tighten all four shoulder cap screws (1-420).

9.26 Install end cap gasket (6-20) onto end of housing (1-10).

9.27 Install blind end cap (3-10) and, retain with blind end cap screws (3-20).

9.28 If removed, install the stop screw (1-90) into blind end cap (3-10).

9.29 Adjust blind end cap stop screw (1-90) back to setting recorded in section 5.

9.30 Apply lubricant to o-ring seal (6-60) and install into stop screw nut (1-100).

NOTE: Side (faces) of blind end cap screws (3-20) must be parallel before stop screw nut can be installed.

9.31 Install the stop screw nut (1-100) with o-ring seal (6-60) onto blind end cap stop screw (3-90).

9.32 Install hole cover gasket (6-40) onto housing cover (1-20).

9.33 Install lockwasher (1-220) onto two socket cap screws (1-190).

9.34 Install Bettiswitch cover (1-150) over hole cover gasket (6-40).

9.35 Install and tighten socket cap screws (1-190) with lockwasher (1-220) through Bettiswitch cover and into housing cover (1-20).

9.36 Install the cover gasket (6-10) onto housing.

9.37 Install gasket seals (6-80) onto socket cap screws (1-170).

- 9.38 Install cover (1-20) onto top of housing (1-10).
- 9.39 Install hex cap screws (1-170) with gasket seals (6-80) through housing cover (1-20) and into housing (1-10). NOTE: Do not tighten hex cap screws (1-170).
- 9.40 If removed, install the cover pins (1-160) into housing until the cover pins are flush with top of cover.
- 9.41 Tighten the cover screws (1-170).
- 9.42 Tighten piston rod (2-70) to a torque of approximately 2000 inch pounds (166 ft. lbs.). Flats are provided on the outer end cap for wrenching purposes.
- 9.43 Install position indicator (1-410) and yoke weather cover (6-110) with hex cap screw (1-170) and gasket seal (6-80). NOTE: With yoke at mid-stroke, position indicator will point away at approximately 45^o to the right (about 2 o'clock position).

10.0 **PNEUMATIC CYLINDER REASSEMBLY**

NOTE: Assemble using lubrication as defined in Section 4.

- 10.1 Install end cap gasket (6-20) onto the right-hand side of housing (1-10) by installing over the piston rod (2-70).

CAUTION: Install rod seal (4-60) with energizer ring facing outboard (away from housing).

- 10.2 Apply lubricant to rod seal (4-60) and install into recess (counter bore) provided in inner end cap (2-40).
- 10.3 Apply lubricant to six o-ring seals (4-10).
- 10.4 Install o-seals (4-10) into the internal seal grooves of the tie bar bores in both inner end cap (2-40) and the outer end cap (2-30).

NOTE: If the o-ring seals are retained in the end caps with "staked" washers check position and placement of washers before installing o-ring seals. If washer is loose then re-stake the washer to the end cap.

- 10.5 Install inner end cap (2-40) by sliding over tie bars (2-60), piston rod (2-70) and rod bushing (2-50).

NOTE: New retainer rings (2-90) are provided in Bettis standard Service Kits.

- 10.6 Install matched set of split ring halves (2-80) into the inner most groove on piston rod and retain with retaining ring (2-90).
- 10.7 Apply lubricant to o-ring seal (4-30) and install into outer diameter seal groove of the inner end cap (2-40).

- 10.8 Apply lubricant to o-ring seal (4-20) and install into the seal groove located on the outboard end of piston rod (2-70).
- 10.9 Install o-seal (4-10) into the internal seal grooves of the tie bar bores in piston (2-20). Refer to step 10.10 for assembling fabricated piston equipped with piston bushings (2-130).
- 10.10 FABRICATED PISTON REASSEMBLY: Refer to assembly drawing Detail "A".
- 10.10.1 Install o-ring seals (4-70) into the outer diameter seal groove on piston bushings (2-110).
- 10.10.2 Install o-ring seals (4-10) into the inner diameter seal groove in piston bushing (2-110).
- 10.10.3 Install piston bushing (2-110) into piston (2-20).

CAUTION: The piston bushings (2-110) should be replaced each time the actuator is refurbished. **NOTE:** The Bettis Service Kit should contain new piston bushings.

- 10.10.4 Install retaining rings (2-120) into piston (2-20).
- 10.11 Install piston (2-20) onto piston rod (2-70). **NOTE:** The piston will install over the o-ring seal (4-20) and up against matched set of split ring halves install in step 10.6.

NOTE: New retainer rings (2-90) are provided in Bettis standard Service Kits.

- 10.12 Install a second matched set of split ring halves (2-80) into the outboard groove of piston rod (2-70) and retain with retaining ring (2-90).

NOTE: The original seal used in the outer diameter seal groove of piston (2-20) was a piston T-seal with two back-up rings. The replacement seal for this location is a Bettis D-ring seal (no back-up rings are required). The D-ring seal is directly interchangeable with the T-seal.

- 10.13 Coat D-ring seal (4-50) with lubricant and install into the piston external seal groove with the flat side of the D-ring installed down into the seal groove.
- 10.14 If removed, install the stop screw (1-90) into outer end cap.
- 10.15 Apply a light coat of lubricant to the bore of cylinder (2-10).

CAUTION: If needed when installing cylinder (2-10), hammer on end of cylinder only with a non metallic object.

- 10.16 Install end of cylinder (2-10) over piston (2-20) and onto inner end cap (2-40). **NOTE:** When installing cylinder over the piston seal, tilt cylinder 15° to 30° degrees to piston rod (2-70).
- 10.17 Apply lubricant to o-ring seal (4-30) and install into outer diameter seal groove of outer end cap (2-30).
- 10.18 Install outer end cap (2-30) onto tie bars (2-60) and slip inside cylinder (2-10).

- 10.19 Install tie bar nuts (2-100) onto two tie bars (2-60), using them to draw the entire cylinder components into position.

CAUTION: While the tie bar nuts are being tightened, do not allow tie bars to rotate.

- 10.20 Alternately torque tie bar nuts (2-100) until a final torque of 150 ±15 foot pounds has been achieved.

- 10.21 Apply lubricant to o-ring seals (6-60) and install into stop screw nuts (1-100).

- 10.22 Adjust blind end cap stop screw (1-90) back to setting recorded in section 5.

NOTE: Side (faces) of tie bar nut assembly (2-100) must be parallel before stop screw nut can be installed.

- 10.23 Install stop screw nut (1-100) onto outer end cap (2-30) and over stop screws (1-90).

- 10.24 Install breather (27)/(1-270) and elbow fitting (26)/(1-260) into one the pneumatic cylinder end of housing (1)/(1-10).

11.0 **ACTUATOR TESTING**

NOTE: The following actuator test procedure is to be done off of the mechanism that the actuator operates.

- 11.1 Leak Test - General - A small amount of leakage may be tolerated. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable.

- 11.2 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution.

NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.

- 11.3 All leak testing will use 65 psig pressure or the pressure used by the customer to operate the actuator during normal operation.

WARNING: Pressure is not to exceed the maximum operating pressure rating listed on the actuators name tag.

- 11.4 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.

- 11.5 Apply 65 psig pressure to the pressure port in the inner end cap (2-40).

- 11.6 Apply a commercial leak testing solution to the following areas:

- 11.6.1 Joint between inner end cap (2-40) and cylinder (2-10). This checks cylinder to inner end cap o-ring seal.

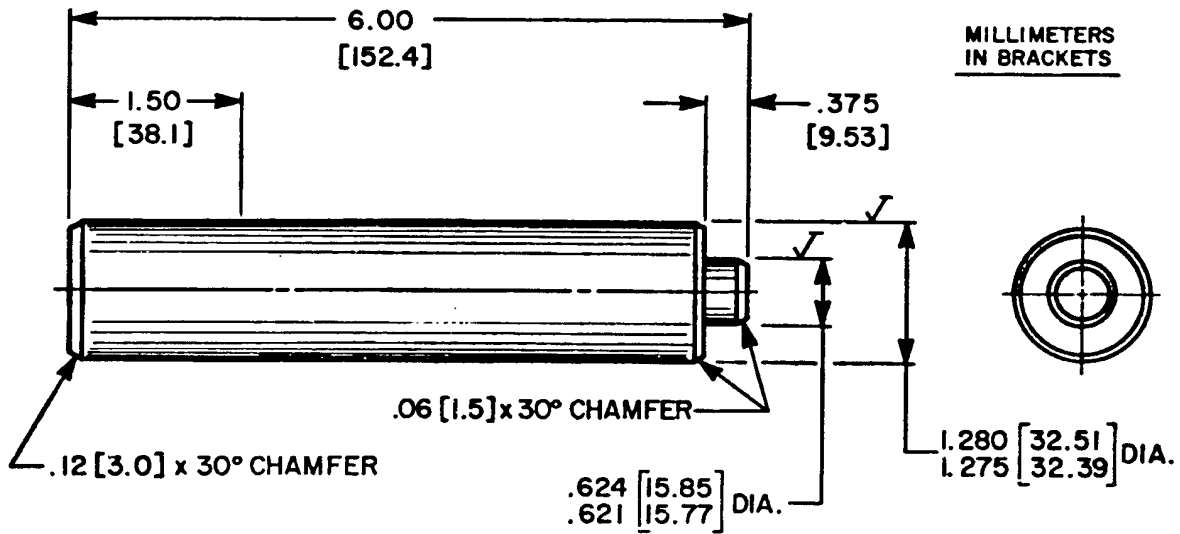
- 11.6.2 The inlet port hole in outer end cap (2-30). This checks piston seal (4-50), o-ring seals (4-10) and (4-20).
- 11.6.3 Remove pressure from the inner end cap (2-40) pressure inlet port.
- 11.7 Apply 65 psig pressure to the pressure port in outer end cap (2-30) and allow the actuator to stabilize.
- 11.8 Apply a commercial leak testing solution to the following areas:
 - 11.8.1 Joint between outer end cap (2-30) and cylinder (2-10). This checks cylinder to inner end cap o-ring seal.
 - 11.8.2 Joints around tie bar nuts (2-100), stop nut (2-140).
 - 11.8.3 Remove pressure from the pressure inlet port.
- 11.9 If an actuator was disassembled and repaired, the above leakage test must be performed again.

12.1 RETURN TO SERVICE

- 12.1 Re-install piping and accessories that were removed.
- 12.2 After the actuator is mounted on the valve all accessories, including solenoid valves, pressure switches, etc., should be hooked up and tested for proper operations and replaced, if found defective.
- 12.3 The actuator is ready to return to service.

RAIL ALIGNMENT TOOL FOR TR/TRQ ACTUATORS

PART NUMBER 064899



TOOL STYLE AND WRENCH SIZE TABLE				
ITEM NO.	WRENCH SIZE	ITEM QTY.	DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
1-90	1-1/4"	2	Stop Screws	Open End or Adjustable
1-100	2-3/4"	2	Stop Screw Nut	Open End or Adjustable
1-170	3/4"	24	Hex Cap Screws	Socket
1-190	3/16"	2	Socket Cap Screws	Allen
1-200	9/16"	4	Pipe Plug	Allen
1-420	3/4"	4	Socket Cap Screw	Allen
2-60	3/4"	2	Tie Bars	Open End or Adjustable
2-70	1-3/4"	1	Piston rod	Crows Foot (1)
2-100	2-1/8"	2	Seal Nut (Tie Bar Nut)	Crows Foot (1)
2-140	9/16"	2	Fabricated Piston Screw	Hex Socket (2)
3-30	1-1/2"	1	Stop Screw Stud	Open End or Adjustable

- (1) No alternate style wrench style recommended or wrench placement is not provided.
- (2) Only required when actuator is equipped with a fabricated piston.