

**BETTIS**

**OPERATING & MAINTENANCE INSTRUCTIONS**

**DISASSEMBLY & ASSEMBLY**

**FOR THE FOLLOWING MODELS**

**CR-30, CR-30-180, CR-30-SR AND CR-30-SR-180**

**SERIES ACTUATORS**

PART NUMBER: 065843

REVISION: "A"

RELEASE DATE: JANUARY, 1989

REPLACES: SERVICE-014

ECN	DATE	REV LTR		By *	Date
65843	6 January 1989	A	Compiled	BSC	01-11-89
			Checked		
			Approved	RRK	01-11-89
			Approved		

## CONTENTS

SECTION	DESCRIPTION	PAGE
1.0	Introduction .....	2
2.0	Basic Tools .....	2
3.0	General .....	2
4.0	General Disassembly .....	2
5.0	Disassembly – Double Acting Actuators .....	3
6.0	Disassembly – Spring Return Actuators .....	3
7.0	Pre-Assembly Notes .....	4
8.0	Reassembly – Double Acting Actuators .....	4
9.0	Reassembly – Spring Return Actuators .....	6
10.0	Actuator Testing – Double Acting Actuators .....	8
11.0	Actuator Testing – Spring Return Actuators .....	8
12.0	Return To Service .....	9
13.0	Figure 1 - CR30 & CR30-SR Exploded Drawing .....	10
14.0	Figure 2 - CR30 & CR30-SR Exploded Drawing .....	11

## 1.0 **INTRODUCTION**

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis CR-30 double acting and spring return series 90<sup>0</sup> and 180<sup>0</sup> turn "Rack & Pinion" pneumatic actuators.
- 1.2 The maximum recommended service interval for this actuator series is five years.

**COMPLETE ACTUATOR REFURBISHMENT  
REQUIRES THAT THE ACTUATOR BE  
DISMOUNTED FROM THE VALVE**

## 2.0 **BASIC TOOLS**

All tools are American Standard inch. Large adjustable wrench, medium standard screwdriver, small standard screwdriver with edges removed, Allen wrench set, 1/2" drive socket set and non-corrosive leak testing solution.

## 3.0 **GENERAL**

- 3.1 Numbers in parentheses, ( ) indicate the bubble number (reference number) used on the exploded detail drawings Figure No. 1 & 2 and the actuator Parts List.
- 3.2 When removing the seals from seal grooves, use a small screwdriver with the sharp edges rounded off or use a commercial seal removing tool.
- 3.3 Disassembly of the actuator should be done in a clean area on a work bench.
- 3.4 LUBRICATION REQUIREMENTS
  - 3.4.1 Standard and high temperature service (-20<sup>0</sup> F to +350<sup>0</sup> F) use Kronaplate 100. K100 is furnished in the Bettis Service/Seal Kit.
  - 3.4.2 Low temperature service (-50<sup>0</sup> F to +150<sup>0</sup> F) use Kronaplate 50. K50 is not furnished in the Service/Seal Kit.
  - 3.4.3 For distributors of Kronaplate Lubricant in your area, call 800-428-7802.

## 4.0 **GENERAL DISASSEMBLY**

- 4.1 Remove all operating pressure from the actuator.
- 4.2 Remove all plumbing and accessories from the actuator.
- 4.3 The setting of the stop screws should be checked and the settings recorded before the stop screws are loosened or removed.
- 4.4 Remove the actuator from valve and valve mounting bracket.

## **5.0 DISASSEMBLY - DOUBLE ACTING ACTUATORS**

- 5.1 Refer to Figure Number 1 for disassembly of a double acting actuator.
- 5.2 Note the position or location of the torque plug alignment marks for future reference when actuator is re-assembled.
- 5.3 Remove the stop screw nut (13) from both of the stop screws (10).
- 5.4 Remove the stop screw washer (12) and the stop screw seal from both stop screws (10).
- 5.5 Remove both of the stop screws (10).
- 5.6 Remove the center bar nut (9), center bar washer (8) and the center bar seal (7) from the cylinder end of the actuator.
- 5.7 Remove the cylinder (4).
- 5.8 Remove the piston (3) from the center bar (6).
- 5.9 Remove the center bar (6) by pulling it out the body end.
- 5.10 Push the torque plug (2) thru the housing (1) until the o-ring groove on the exposed end appears from the housing.
- 5.11 Remove the exposed torque plug o-ring (16).
- 5.12 Push the torque plug back thru the housing and out the other side.
- 5.13 Remove all old seals and gaskets.

## **6.0 DISASSEMBLY - SPRING RETURN ACTUATORS**

- 6.1 Refer to Figure No. 2 for disassembly drawing.
- 6.2 The spring in the CR Series Spring Return Actuators is preloaded. Actuator must be disassembled in the following manner.
- 6.3 Note the position or location of the torque plug alignment marks for future reference when actuator is re-assembled.
- 6.4 Loosen the stop screw nut (15) on the housing end and then unscrew and remove the housing stop screw (12).
- 6.5 It is not necessary to remove cylinder stop screw (21) for normal actuator maintenance.
- 6.6 Remove the center bar nut (11) from the spring cylinder end of center bar (7).
- 6.7 Using a (1/2" drive) ratchet and socket on the welded nut, located on the housing end of the center bar (7), rotate the center bar counter-clockwise (CCW). This will cause the spring cylinder end cap (6) or spring cylinder (4) to gradually unscrew from the center bar (7).

- 6.8 Continue to rotate the center bar (7) counter-clockwise (CCW) until the spring preload is eliminated. As the preload is reduced it may be necessary to keep the spring cylinder (4) or the end cap (6) from turning by holding the end cap stop screw nut (15).
- 6.9 After the spring preload is eliminated, unscrew the spring cylinder (4) or the end cap (6) from the center bar (7).
- 6.10 Remove the one piece cylinder (4) and then the spring (19) or if the cylinder and end cap are separate items then remove the spring (19) from the spring cylinder (4), then remove the spring cylinder (4).
- 6.11 Pull piston (3) out of housing (1) and carefully slide the piston off of the center bar (7).
- 6.12 Remove the center bar (7) by pulling it out the body end.
- 6.13 Push the torque plug (2) thru the housing (1) until the o-ring groove on the exposed end appears from the housing.
- 6.14 Remove the exposed torque plug o-ring (18).
- 6.15 Push the torque plug (2) back thru the housing and out the other side.
- 6.16 Remove all old seals and gaskets.

## **7.0 PRE-ASSEMBLY NOTES**

- 7.1 Before starting the assembly of the actuator, all parts should be thoroughly cleaned, inspected and de-burred as necessary. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion.
- 7.2 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.
- 7.3 Coat all seals with lubricant, before installing into the seal grooves. Coat all moving and load bearing surfaces with lubricant before being installed.
- 7.4 As a reference during assembly this procedure was written with the actuator housing position on a work bench and the cylinder end on the left side and the torque plug bore nearest you.

## **8.0 REASSEMBLY - DOUBLE ACTING ACTUATORS**

- 8.1 Install one of the torque plug o-ring seals (16) into the groove on the end of the torque plug (2) having the two depressed radial marks.
- 8.2 Install the torque plug (2) into the housing with the end with the marks up.
- 8.3 Push the torque plug thru the housing until the o-ring groove on the other end appears from the housing.
- 8.4 Install the remaining torque plug o-ring seal into the torque plug o-ring groove.

- 8.5 Push the torque plug (2) back into the housing until the ends are flush with the housing. Position the radial marks as they were when disassembled or such that they are in line with:
  - 8.5.1 90° ROTATION ACTUATORS - the upper left and lower right mounting bracket holes.
  - 8.5.2 180° ROTATION ACTUATORS - the upper right and lower left mounting bracket holes.
- 8.6 Install the piston center bar o-ring seal (15) into the piston bore at the piston head end.
- 8.7 Install the piston o-ring seal (14) into OD seal groove on the piston (3).
- 8.8 Insert the center bar (6) end into the piston (3) from the tail end. When the center bar contacts the piston center bar o-ring seal, push lightly while turning the center bar clockwise until the center bar threads are clear of the piston center bar o-ring seal.
- 8.9 Apply a generous quantity of lubricant to the gear teeth on the piston.
- 8.10 Position the gear teeth on the piston so they are facing the torque plug (2).
- 8.11 Insert the piston (3) and center bar (6), piston tail first, into the housing. If the torque plug was properly positioned, the marks on the torque plug should be aligned as indicated below when the back face of the piston head is approximately 1/4" from the face of the housing flange.
  - 8.11.1 90° ROTATION ACTUATORS - 90° to the center bar (6).
  - 8.11.2 180° ROTATION ACTUATORS - parallel to the center bar (6).
- 8.12 Install center bar seal (7) along with a center bar washer (8), countersunk side next to seal, and center bar nut (9) onto the body end of the center bar (6). Screw the nut as far as it will go onto the center bar (6). NOTE: Many actuators use a seal nut in place of the seal washer (8) and the seal (7).
- 8.13 Place the cylinder gasket (5) onto the housing flange.
- 8.14 Apply a light coat of lubricant to the bore of the cylinder (4).
- 8.15 Install the cylinder (4) over the center bar and piston.
- 8.16 Install the remaining center bar seal (7) along with a center bar washer (8), countersunk side next to seal, and center bar nut (9) onto the cylinder end of the center bar (6).
- 8.17 Install both stop screw seals (11) along with the stop screws (10), stop screw washers (12), countersunk side next to the seal, and stop screw nuts (13).
- 8.18 Adjust both stop screws back to the settings recorded in step 4.3 under General Disassembly. If settings were not recorded then adjust the stop screws (10) as follows:
  - 8.18.1 Adjust the housing stop screw so that the marks on the torque plug are 90 degrees to the center bar for 90 degree actuators or parallel to the center bar for 180 degree actuators with air pressure applied to the cylinder pressure port.

- 8.18.2 Tighten the housing stop screw nut (13).
- 8.18.3 Adjust the cylinder stop screw so the marks on the torque plug are parallel to the center bar, for both 90 and 180 degree actuators, with air pressure applied to the housing pressure port.
- 8.18.4 Tighten the cylinder stop screw nut (13).

## **9.0 REASSEMBLY - SPRING RETURN ACTUATORS**

- 9.1 Install one of the torque plug o-ring seals (18) into the groove on the end of the torque plug (2) having the two depressed radial marks.
- 9.2 Install the torque plug (2) into the housing with the end with the marks up.
- 9.3 Push the torque plug thru the housing until the o-ring groove on the other end appears from the housing.
- 9.4 Install the remaining torque plug o-ring (18) seal into the torque plug o-ring groove.
- 9.5 Push the torque plug (2) back into the housing until the ends are flush with the housing. Position the radial marks as they were when disassembled or such that they are in line with:
  - 9.5.1 90° ROTATION ACTUATORS - the upper left and lower right mounting bracket holes.
  - 9.5.2 180° ROTATION ACTUATORS - the upper right and lower left mounting bracket holes.
- 9.6 Install the piston center bar o-ring seal (17) into the piston bore at the piston head end.
- 9.7 Install the piston o-ring seal (16) into OD seal groove on the piston (3).
- 9.8 Insert the center bar (7) end into the piston (3) from the piston tail end. When the center bar contacts the piston center bar o-ring seal, push lightly while turning the center bar clockwise until the center bar threads are clear of the piston center bar o-ring seal.
- 9.9 Apply a generous quantity of lubricant to the gear teeth on the piston.
- 9.10 Position the gear teeth on the piston so they are facing the torque plug (2).
- 9.11 Insert the piston (3) and center bar (7), tail first, into the housing. If the torque plug was properly positioned, the marks on the torque plug should be aligned as indicated below when the back face of the piston head is approximately 1/4" from the face of the housing flange.
  - 9.11.1 90° ROTATION ACTUATORS - 90° to the center bar (7).
  - 9.11.2 180° ROTATION ACTUATORS - parallel to the center bar (7).
- 9.12 Thread the thread seal (8) onto the center bar (7) until it is flush with the housing. Some actuators use a seal nut instead of thread seal (8) and seal washer (9).

- 9.13 Slip the seal washer (9) onto the center bar with the chamfer facing the thread seal (8).
- 9.14 Thread the center bar nut (10) onto the housing end of the center bar (7). Screw the nut as far as it will go onto the center bar (7).
- 9.15 Place the cylinder gasket (5) onto the housing flange.
- 9.16 Apply a light coat of lubricant to the bore of the cylinder (4).
- 9.17 Place the spring (19) onto the head of the piston (3).
- 9.18 Slip the cylinder (4) over the piston and onto the flange of the housing (1).
- 9.19 Position the cylinder (4) so that the breather port is at the bottom and the stop screw hole is at the top.
- 9.20 Install the center bar nut (11) and tighten.
- 9.21 Insert the stop screw (12) into the housing (1) and thread it in until the stop screw contacts the piston.
- 9.22 Thread the thread seal (13) onto the stop screw (12) until it is flush with the housing.
- 9.23 Thread the stop screw nut (15) onto the stop screw (12) until hand tight.
- 9.24 If removed, insert stop screw (21) into the cylinder (4).
- 9.25 If removed, thread the remaining stop screw nut (15) on to stop screw (21) until hand tight.
- 9.26 Adjust both stop screws (12) and (21) back to the settings recorded in step 4.3 under General Disassembly. Tighten both stop screw nuts (15) securely, while holding the stop screw. If stop screw settings were not recorded then adjust the stop screws as follows:
  - 9.26.1 Adjust the housing stop screw so that the marks on the torque plug are 90 degrees to the center bar for 90 degree actuators or parallel to the center bar for 180 degree actuators.
  - 9.26.2 Tighten the housing stop screw nut (15).
  - 9.26.3 Adjust the cylinder stop screw so the marks on the torque plug are parallel to the center bar, for both 90<sup>0</sup> and 180<sup>0</sup> actuators, with air pressure applied to the housing pressure port.
  - 9.26.4 Tighten the cylinder stop screw nut (13).



## **10.0 ACTUATOR TESTING - DOUBLE ACTING ACTUATORS**

- 10.1 All areas where leakage to atmosphere may occur are to be checked using a leak testing solution.
- 10.2 Before testing for leaks, alternately apply 20 PSIG pneumatic pressure to each of the pressure ports, allowing the actuator to stroke fully in each direction. Repeat this cycle approximately five times to allow the seals and packings to be exercised, resulting in a service ready condition.
- 10.3 Apply 60 to 120 PSIG pressure to the housing pressure inlet port.
- 10.4 Apply a leak testing solution to the following areas:
  - 10.4.1 Cylinder to body joint.
  - 10.4.2 Center bar seal (housing end).
  - 10.4.3 Stop screw seal (housing end).
  - 10.4.4 Torque plug seals.
  - 10.4.5 Cylinder pressure inlet port.
- 10.5 Remove the pressure from the housing port and apply the same pressure to the cylinder pressure inlet port.
- 10.6 Apply a leak testing solution to the following areas:
  - 10.6.1 Center bar seal (cylinder end).
  - 10.6.2 Stop screw seal (cylinder end).
  - 10.6.3 Housing pressure inlet port.
- 10.7 If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the unit must be disassembled and the cause of leakage must be determined and corrected.
- 10.8 If an actuator was disassembled and repaired as a result of this procedure, the above leakage test must be preformed again.
- 10.9 Performance Test - Alternately apply normal operating pressure to each of the pressure inlet ports. The actuator should stroke fully and smoothly in both directions.

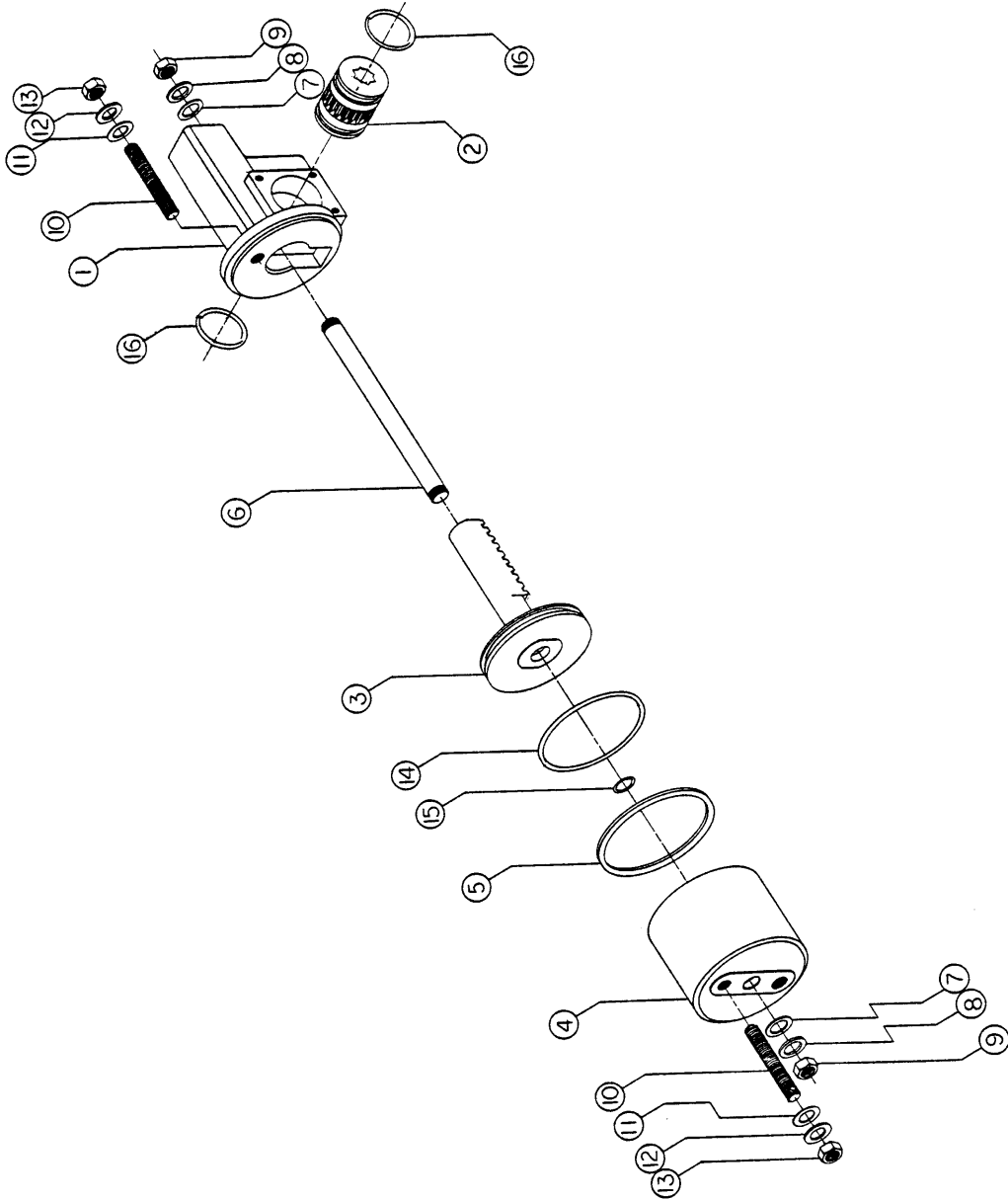
## **11.0 ACTUATOR TESTING - SPRING RETURN ACTUATORS**

- 11.1 All area where leakage to atmosphere may occur are to be checked using a leak testing solution.
- 11.2 Before testing for leaks, alternately apply and release pneumatic pressure equal to the rating of the actuator to the housing pressure port. Repeat this cycle five times to allow the seals and packings to be exercised, resulting in a service ready condition.

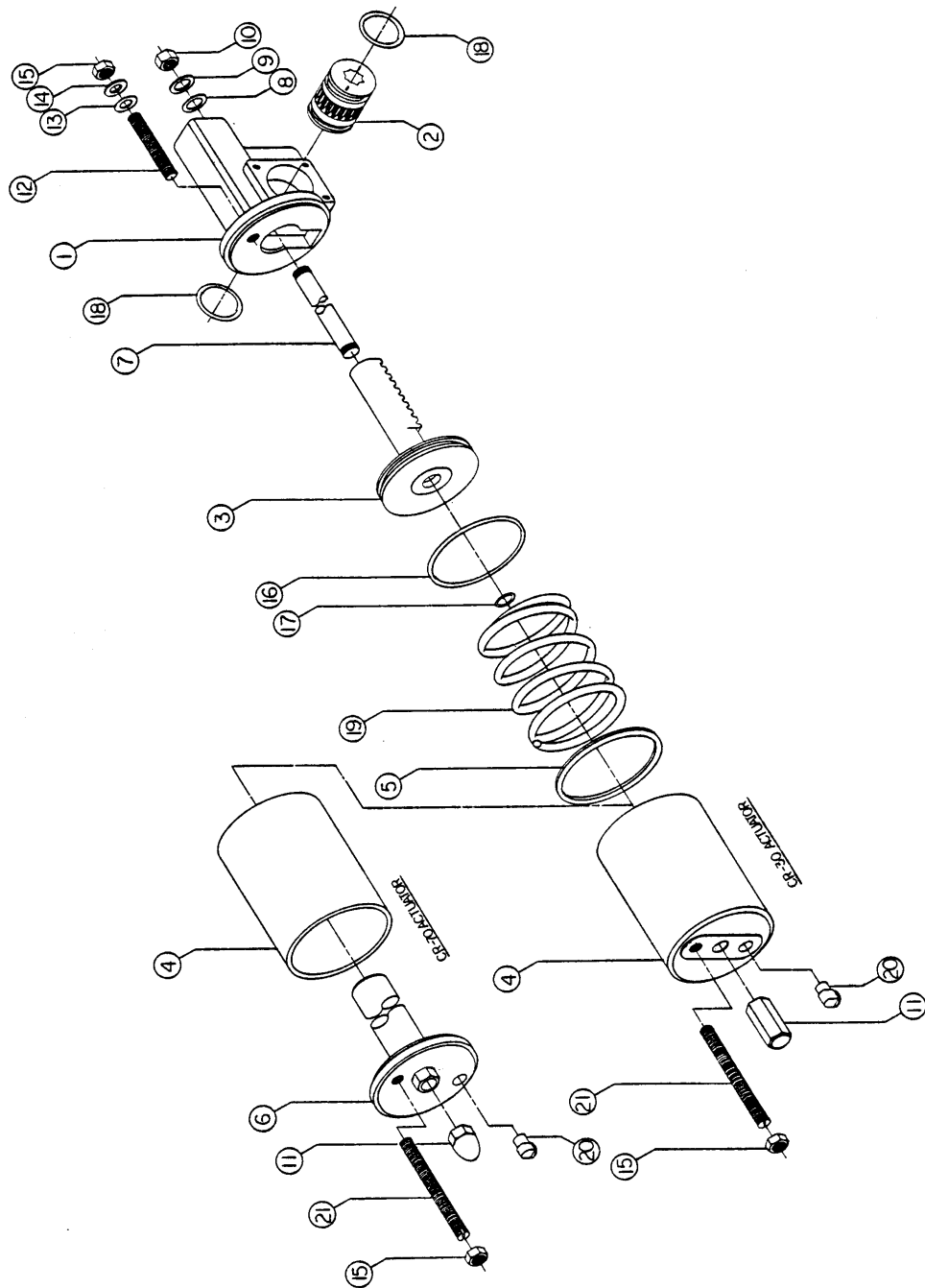
- 11.3 Apply pneumatic pressure equal to the rating of the actuator to the housing pressure inlet port.
- 11.4 Apply a leak testing solution to the following areas:
  - 11.4.1 Cylinder to housing joint.
  - 11.4.2 Center bar seal and nut (housing end).
  - 11.4.3 Stop screw seal (housing end).
  - 11.4.4 Torque plug seals.
  - 11.4.5 Cylinder pressure inlet port.
- 11.5 If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the unit must be disassembled and the cause of leakage must be determined and corrected.
- 11.6 If an actuator was disassembled and repaired as a result of this procedure, the above leakage test must be preformed again.
- 11.7 Performance Test - Alternately apply normal operating pressure to the housing pressure inlet port. The actuator should stroke fully and smoothly in both directions. A small amount of unevenness, during the stroking of the actuator, should be of minimum concern. This is caused by the "buckling" of the spring and the resulting friction with the cylinder wall. Should unevenness or jerkiness become too great, it will be necessary to isolate the cause and make repairs.

## **12.0 RETURN TO SERVICE**

- 12.1 On the spring return actuator if removed, place or reinstall the breather (20) into the cylinder port hole.
- 12.2 Reinstall the actuator to the valve mounting bracket and valve.
- 12.3 Reinstall any piping and accessories that were removed.
- 12.4 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up at this point and tested for proper operation and replaced if found defective.



12.0 FIGURE NO. 1 - CR30, CR70, CR30-180 & CR70-180



13.0 FIGURE NO. 2 - CR30-SR, CR70-SR, CR30-SR-180 & CR70-SR-180

**World Area Configuration Centers (WACC) offer sales support, service, inventory and commissioning to our global customers. Choose the WACC or sales office nearest you:**

***NORTH & SOUTH AMERICA***

19200 Northwest Freeway  
Houston, TX 77065  
USA  
T +1 281 477 4100  
F +1 281 477 2809

Av. Hollingsworth,  
325, Iporanga Sorocaba  
SP 18087-105  
Brazil  
T +55 15 3238 3788  
F +55 15 3228 3300

***ASIA PACIFIC***

No. 9 Gul Road  
#01-02 Singapore 629361  
T +65 6501 4600  
F +65 6268 0028

No.1 Lai Yuan Road  
Wuqing Development Area  
Tianjin 301700  
P.R.China  
T +86 22 8212 3300  
F +86 22 8212 3308

***MIDDLE EAST & AFRICA***

P. O. Box 17033  
Dubai  
United Arab Emirates  
T +971 4 811 8100  
F +971 4 886 5465

P. O. Box 10305  
Jubail 31961  
Saudi Arabia  
T +966 3 340 8650  
F +966 3 340 8790

24 Angus Crescent  
Longmeadow Business Estate  
East P.O. Box 6908; Greenstone  
1616 Modderfontein, Extension 5  
South Africa  
T +27 11 451 3700  
F +27 11 451 3800

***EUROPE***

Berenyi u. 72- 100  
Videoton Industry Park,  
Building #230  
Székesfehérvár 8000  
Hungary  
T +36 22 530 950  
F +36 22 543 700

For complete list of sales and manufacturing sites, please visit  
[www.emersonprocess.com/valveautomationlocations](http://www.emersonprocess.com/valveautomationlocations)  
Or contact us at [info.valveautomation@emerson.com](mailto:info.valveautomation@emerson.com)

[www.emersonprocess.com/bettis](http://www.emersonprocess.com/bettis)

©2016 Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. Bettis is a mark of one of the Emerson Process Management family of companies. All other marks are property of their respective owners.

The contents of this publication are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

**BETTIS™**



**EMERSON™**  
Process Management