

Biffi FCBAX30 Double-Acting Series Pneumatic Actuators

Disassembly and Reassembly



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Section 1: Introduction

1.1 General Service Information

- This service procedure is offered as a guide to enable general maintenance to be performed on Biffi™ FCBA300 double-acting series actuators. The following is a list of general FCBA300 model numbers:

Table 1. FCBA300 Model Numbers

MODEL ⁽¹⁾		
FCBA730	FCBA730-M3	FCBA730-M3HW
FCBA830	FCBA830-M3	FCBA830-M3HW
FCBA930	FCBA930-M3	FCBA930-M3HW
FCBA1030	FCBA1030-M3	FCBA1030-M3HW

Note:

1. Also includes actuator models with -10 and -11 as a suffix.

NOTE:

When the actuator model number has “-S” as a suffix then the actuator is special and may have some differences that may not be included in this procedure.

- Normal recommended service interval for this actuator series is five years.
-

NOTE:

Storage time is counted as part of the service interval.

- This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator.
- Remove all piping and mounted accessories that will interfere with the module(s) that are to be worked on.
- This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- Numbers in parentheses (), indicate the bubble number (reference number) used on the Biffi assembly drawing and actuator parts list.
- This procedure is written using the serial number tag side of the housing (1-10) as a reference and this side will be considered the front side of the actuator. The position indicator (1-50) area of housing (1-10) will be the top of the actuator.
- When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.
- Use a non-hardening thread sealant on all pipe threads.

CAUTION

Apply the thread sealant per the manufacturer's instructions.

- Biffi recommends that disassembly of the actuator should be done in a clean area on a workbench.

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 are provided to assist maintenance personnel to carry out maintenance procedures.

NOTE:

This product is only intended for use in large-scale fixed installations excluded from the scope of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2).

M3: Jackscrew or jackscrew assembly

ES: Extended stop(s)

1.3 General Safety Information

Products supplied by Biffi in its "as shipped" condition are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by well-trained, equipped, prepared and competent personnel.

WARNING

For the protection of personnel working on Biffi actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be given to the WARNINGS, CAUTIONS and NOTES from 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 customer's representative and an authorized Biffi representative.

⚠ WARNING

Electrostatic Charge - An electrostatic charge risk is present on the actuator surface; in case of cleaning, use only antistatic cloth; in case of maintenance, avoid all rubbing/frictions that could electrostatically charge the equipment.

1.4 Biffi Reference Materials

- FCBA300 assembly drawing use part number 129742.
- FCBA300-M3HW assembly drawing use part number 129744.

1.5 Service Support Items

- Service Kit
- Commercial leak testing solution
- Non-hardening thread sealant

1.6 Operating Media

- Recommended to use clean, dry air or inert gas.
- Other gases may be used with direction from Biffi Engineering to evaluate any possible restrictions or modifications which may need to be made for compatibility.

1.7 Lubrication Requirements

- The actuator should be relubricated at the beginning of each service interval using the following recommended lubricants.

NOTE:

Lubricants other than those listed below should not be used without prior written approval of Biffi Product Engineering.

- All temperature services -45.5 to 176.6 °C / -50 to +350 °F use ESL-5 lubricant. ESL-5 lubricant is contained in the module service kit in tubes and the tubes are marked ESL-4, 5 and 10 lubricant.

1.8 General Tool Information

- All threads on FCBA300 Series actuators are Inch Unified and NPT.
- All tools/Hexagons are American Standard inch.
- Suggested tools: Two adjustable wrenches, small standard screwdriver with sharp edges rounded off, medium size standard screwdriver, external snap ring pliers, drive ratchet/deep well socket set and torque wrench up to 339 Nm / 3000 lb-in.

1.9 Actuator Weight

Table 2. Actuator Weight

Actuator Model	Approximate Weight ⁽¹⁾		Actuator Model	Approximate Weight ⁽¹⁾	
	kg	lb		kg	lb
FCBA730	59	130	FCBA930	70.4	155
FCBA730-M3	59.4	131	FCBA930-M3	71.7	158
FCBA730-M3HW	59.6	131.5	FCBA930-M3HW	71.9	158.5
FCBA830	63.5	140	FCBA1030	77.1	170
FCBA830-M3	64.9	143	FCBA1030-M3	78.5	173
FCBA830-M3HW	65.1	143.5	FCBA1030-M3HW	78.7	173.5

Note:

1. Weight is for bare actuator without accessories or valve adaptation.

1.10 Actuator Storage

For applications where the actuator is not placed into immediate service, it is recommended that the actuator be cycled with regulated clean/dry pneumatic pressure at least once per month. Indoor storage, if available, is recommended for all actuators. Care should be taken to plug all open ports on actuator and controls to keep out foreign particles and moisture. Actuators should not be stored in an atmosphere that is harmful to resilient seals. Contact factory for extended storage period.

1.11 Actuator Installation

Since there are many valve and actuator combinations, it is not practical to include detailed instructions for each type. Mountings are designed to be as simple as possible to keep the guess work out of the installation.

Actuators are shipped from the factory with the travel stops adjusted for approximately 90° rotation. Generally, it is necessary to make slight travel stop adjustments once the actuator is installed onto the valve. Refer to the valve manufacturer's recommendations for specific requirements. When the valve has internal stops, the actuator should be adjusted at the same points.

NOTE:

The actual "stopping" should be done by the actuator. If the valve does not have internal stops, adjust the actuator to the full open position. Using this as a reference point, rotate the valve closed and adjust to the valve manufacturer's specifications for total rotation.

Good instrument practices are also recommended. Clean/dry regulated pneumatic pressure is essential for long service life and satisfactory operation. It should be noted that new pneumatic lines often have scale and other debris in them and these lines should be purged of all foreign material.

NOTE:

Scale and debris can damage control valves, solenoids and seals.

1.12 Actuator Start-up

1.12.1 Pre start-up checks

1. Inspect to ensure the unit has been mounted onto valve properly. Gear flange mounting bolts, stem key, set screw(s) are installed and secured.
2. No tubing damaged or accessories dislodged during the shipping or the installation.
3. Indicated position confirms valve position.
4. All switching valves in normal operating position as per schematic/instructions.

1.12.2 Check connections

1. Pneumatic/hydraulic components connected as per schematic enclosed or in service manual supplied.
2. Pneumatic supply connected to the identified ports.
3. Electrical connection terminals are secured.
4. Wiring as per enclosed diagram or service manual supplied.

NOTE:

When actuator is first placed into service, it should be cycled with regulated pneumatic pressure. This is necessary because the seals have been stationary, causing them to take a "set". Therefore, the actuator should be operated through several cycles to exercise the seals so as to achieve a service ready condition.

1.12.3 Speed of operation

The actuator speed of operation is determined by a number of factors, including:

1. Power supply line length
2. Power supply line size
3. Power supply line pressure
4. Control valve and fitting orifice size
5. Torque requirements of the valve
6. Size of the actuator
7. Setting of speed controls
8. Hydraulic manual override (where available)

Due to the interaction of these variables, it is difficult to specify a "normal" operating time. Faster operating time may be obtained by using one or more of the following:

1. Larger supply lines
2. Larger control valve
3. Higher supply pressure *
4. Quick exhaust valves

NOTE: * Not to exceed maximum operating pressure of actuator or control components.

Slower operating time may be obtained by using flow control valves to meter the exhaust. Excessive exhaust flow metering may cause erratic operation.

1.13 Actuator Operation

1.13.1 Controlled operation

Controlled operation is accomplished by pressurizing and/or depressurizing the appropriate cylinder inlet(s) of a double-acting. Do not exceed pressures indicated on actuator nameplate.

1.13.2 Manual operation

All pressure must be vented or equalized on both sides of the pneumatic piston prior to manual operation.

Section 2: Actuator Disassembly

2.1 General Disassembly

⚠ WARNING

It is possible that the actuator may contain dangerous gas and/or liquids. Ensure that all proper measures have been taken to prevent exposure or release of these types of contaminants before commencing any work.

⚠ CAUTION

Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator name tag.

NOTE:

Before starting the general disassembly of the actuator, it is a good practice to operate actuator with the pressure used by the customer during normal operation. Notate and record any abnormal symptoms such as jerky or erratic operation.

2.1.1 Remove all operating pressure from actuator.

NOTE:

In place of stop screws, the actuator may be equipped with one or two ES (ES = Extended Stops) or M3/M3HW located on outboard end of housing (1-10) and end cap (4-20).

2.1.2 Record the settings of stop screw, ES or M3 jackscrews (6-30) and (4-30) before they are loosened or removed.

2.1.3 To help in correct reassembly, all mating parts should be marked or tagged for ease of reassembly, i.e., cylinder to cylinder adapter, cylinder adapter to housing, housing to torque shaft and housing to housing adapter, etc.

2.2 Pneumatic Cylinder Disassembly

NOTE:

Review Section 2, steps 2.1.1 through 2.1.3 before proceeding with cylinder disassembly.

2.2.1 Remove hex nut (4-40) as follows: FCBA730 through FCBA1030 standard end cap stop screw or extended stop (ES), use step 2.2.1.1. FCBA730 through FCBA1030 with -M3 or -M3HW use step 2.2.1.2.

2.2.1.1 FCBA730 through FCBA1030 end cap stop screw or extended stop screw (ES).

2.2.1.1.1 Loosen and remove hex nut (4-40) and washer (4-90) from stop screw (4-30) located in end cap (4-20).

2.2.1.1.2 Remove stop screw (4-30) from the end cap (4-20).

2.2.1.2 FCBA730 through FCBA1030-M3 or -M3HW.

2.2.1.2.1 Remove retainer ring (12-30) and groove pin (12-20) from optional hex drive hub or from handwheel (12-10).

2.2.1.2.2 Remove optional hex drive hub or handwheel (12-10) from M3 jackscrew (4-30).

2.2.1.2.3 Remove caution tag (12-40) from M3 jackscrew (4-30).

2.2.1.2.4 Loosen and remove hex nut (4-40) from M3 jackscrew (4-30).

NOTE:

For FCBA730 through FCBA1030-M3 or M3HW models, the M3 jackscrew (4-30) cannot be removed now. The M3 used in these models can be removed later in this procedure using step 2.2.7.

2.2.2 Remove housing side hex nut (8-20) from center bar (8-10).

2.2.3 Remove outer end cap (4-20) from outboard end of cylinder (4-10).

NOTE:

ES (4-30) or stop screw (4-30) does not require removal from end cap (4-20) unless replacing with a new ES or stop screw.

2.2.4 Slide cylinder (4-10) over piston (4-50) and remove.

2.2.5 Remove piston (4-50) from center bar (8-10).

NOTE:

The standard non-M3 piston (4-50) is an assembly made up of one roll pin and one yoke pin; do not attempt to disassemble the piston assembly. The M3 piston (4-50) has two targets and four drive screws in addition to the roll pin and yoke pin.

- 2.2.6** On actuator models FCBA830, FCBA930 and FCBA1030, remove cylinder adapter (4-15) from flange of housing (1-10). Model FCBA730 is not equipped with a cylinder adapter (4-15).
- 2.2.7** M3 Jackscrew removal from end cap (4-20).
 - 2.2.7.1** Remove retainer ring (5-60) from M3 adapter (4-55).
 - 2.2.7.2** Remove M3 adapter (4-55) from end cap (4-20).

NOTE:

The M3 adapter will be removed from backside of end cap (4-20) with the M3 jackscrew (4-30).

2.3 Housing Disassembly

NOTE:

Review Section 2 steps 2.1.1 through 2.1.3 before proceeding with housing disassembly.

- 2.3.1** Remove hex nut (6-40) as follows: FCBA730 through FCBA1030 standard housing adapter stop screw or extended stop (ES) use step 2.3.1.1. FCBA730-M3/M3HW through FCBA1030-M3/M3HW use step 2.3.1.2.
 - 2.3.1.1** FCBA730 through FCBA1030 housing adapter stop screw or extended stop screw (ES).
 - 2.3.1.1.1** Loosen and remove hex nut (6-40) and washer (6-90) from stop screw (6-30) located in housing adapter (6-10).
 - 2.3.1.1.2** Remove stop screw (6-30) from housing adapter (6-10).

NOTE:

ES (6-30) or stop screw (6-30) does not require removal from the housing adapter (6-10) unless replacing with a new ES or stop screw.

- 2.3.1.2** FCBA730 through FCBA1030-M3 or M3HW.
 - 2.3.1.2.1** Remove retainer ring (12-30) and groove pin (12-20) from optional hex drive hub or from handwheel (12-10).
 - 2.3.1.2.2** Remove optional hex drive hub or handwheel (12-10) from M3 jackscrew (6-30).
 - 2.3.1.2.3** Remove caution tag (12-40) from M3 jackscrew (6-30).
 - 2.3.1.2.4** Loosen and remove hex nut (6-40) from M3 jackscrew (6-30).

NOTE:

For FCBA730 through FCBA1030-M3/M3HW models, the M3 jackscrew (4-30) cannot be removed now. The M3 used in these models can be removed later in this procedure using step 2.3.9.

- 2.3.2** Remove center bar (8-10) from housing adapter (6-10).
- 2.3.3** Remove housing adapter (6-10) from housing (1-10).
- 2.3.4** Remove the position indicator (1-50) from torque shaft (1-30).
- 2.3.5** Remove retaining ring (2-90) from torque shaft (1-30).
- 2.3.6** Remove thrust washer (2-80) and thrust bearing (2-70) from torque shaft (1-30).
- 2.3.7** Remove the torque shaft (1-30) by pushing it out the bottom of housing (1-10).
- 2.3.8** Remove yoke (1-20) from housing (1-10).
- 2.3.9** Actuator equipped with a M3 or M3HW mounted in the housing adapter (6-10) complete steps 2.3.10.1 and 2.3.10.2.
 - 2.3.9.1** Remove retainer ring (7-60) from M3 adapter (6-55).
 - 2.3.9.2** Remove M3 adapter (6-55) with M3 jackscrew (6-30) from housing adapter (6-10).

Section 3: Actuator Reassembly

3.1 General Reassembly

⚠ CAUTION

Only new seals that are still within the seals expectant shelf life should be installed into the actuator being refurbished.

- 3.1.1** Remove and discard all old seals and gaskets.
- 3.1.2** All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 3.1.3** 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, torque shaft and center bar must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

⚠ CAUTION

Actuator parts that reflect any of the above listed characteristics may need replacement with new parts.

- 3.1.4** Installation lubrication instructions
Use the correct lubrication as defined in Section 1.7.
 - 3.1.4.1** Before installation, coat all moving parts with lubricant.
 - 3.1.4.2** Coat all seals with lubricant, before installing into seal grooves.
- 3.1.5** Torque shaft upper bearing and the lower bearing are not recommended as parts that require field replacement. Consult your Biffi service center for torque shaft upper or lower bearing replacement information.
- 3.1.6** FCBAX30 double-acting actuator construction as follows:
 - 3.1.6.1** Standard construction - Cylinder (4-10) or cylinder adapter (4-15) and cylinder (4-10) mounted on the left side of housing (1-10) and housing adapter (6-10) mounted on the right side of housing (1-10).
 - 3.1.6.2** -S inverse construction - Cylinder (4-10) or cylinder adapter (4-15) and cylinder (4-10) mounted on the right side of housing (1-10) and the housing adapter (6-10) mounted on the left side of housing (1-10).

3.2 Housing Reassembly

NOTE:

Review Section 3, steps 3.1.1 through 3.1.6 before proceeding with actuator reassembly.

In Section 3.2 where the step indicates to “lubricate, coat or apply lubricant”, use lubricant as identified in Section 1.7 for lubricating the part being installed.

Actuators equipped with a housing adapter M3 jackscrew (6-30), install M3 per step 3.2.1. Actuators equipped with housing adapter ES or stop screw (6-30), skip step 3.2.1 and continue assembly at step 3.2.2.

3.2.1 M3 jackscrew installation to housing adapter (6-10).

3.2.1.1 Apply a coating of lubricant to outer diameter and inner diameter threads of M3 jackscrew adapter (6-55).

3.2.1.2 Coat O-ring seal (7-65) with lubricant and install into outer diameter seal groove located in the M3 jackscrew adapter (6-55).

3.2.1.3 Apply a light coating of lubricant to the threads of M3 jackscrew (6-30).

3.2.1.4 Install and rotate the M3 jackscrew (6-30) into M3 jackscrew adapter (6-55).

NOTE:

Rotate the M3 jackscrew into the adapter until the inboard end of the jackscrew is up against the adapter.

3.2.1.5 Install M3 jackscrew adapter (6-55) with M3 jackscrew (6-30) into housing adapter (6-10).

3.2.1.6 Install retainer ring (7-60) onto groove in M3 jackscrew adapter (6-55).

3.2.1.7 Install O-ring seal (7-30) onto M3 jackscrew (6-30).

NOTE:

Move the O-ring seal (7-30) down the M3 jackscrew until it is next to the M3 jackscrew adapter.

3.2.1.8 Install hex nut (6-40) onto M3 jackscrew (6-30).

NOTE:

Rotate the hex nut down the M3 jackscrew until it is next to the M3 jackscrew adapter.

3.2.2 Housing Adapter (6-10) ES or stop screw (6-30) installation.

3.2.2.1 Lubricate ES or stop screw (6-30) and install into housing adapter (6-10).

3.2.2.2 Install O-ring seal (7-30) onto ES or stop screw (6-30).

NOTE:

Move the O-ring seal (7-30) down the ES or stop screw until it is next to the housing adapter (6-10).

3.2.2.3 Install washer (6-90) onto ES or stop screw (6-30).

NOTE:

Push the washer down the ES or stop screw until it is next to the housing adapter (6-10).

3.2.2.4 Install hex nut (6-40) onto ES or stop screw (6-30).

NOTE:

Rotate the hex nut down the ES or stop screw until it is next to the housing adapter (6-10).

3.2.3 Apply a coating of lubricant to the torque shaft holes located on each side of housing (1-10).

3.2.4 Coat rod wiper seal (2-20) with lubricant and install in the grooves located in the upper torque shaft "through hole" of housing (1-10).

NOTE:

The cup of wiper seal will be installed facing down into the housing.

3.2.5 Coat u-cup seal (2-40) with lubricant and install into the groove located in the lower torque shaft "through hole" of housing (1-10) - the inner most groove nearest the yoke (1-20).

NOTE:

The cup of rod wiper seal will be installed facing into the housing.

3.2.6 Coat rod wiper (2-60) with lubricant and install into the outer most groove located in the lower torque shaft "through hole" of housing (1-10).

NOTE:

The cup of rod wiper will be installed facing to the outside of housing (1-10).

3.2.7 Apply a generous amount of lubricant to the slots in the arms of yoke (1-20). Coat yoke (1-20) with lubricant and install into housing (1-10).

3.2.8 Insert the yoke key (1-40) into the slot in the torque shaft (1-30).

- 3.2.9** Hold the yoke key (1-40) in position and insert the torque shaft (1-30) into and through housing (1-10) and yoke (1-20).
- 3.2.10** Install thrust bearing (2-70) onto the upper area of torque shaft (1-30).
- 3.2.11** Install thrust washer (2-80) onto the upper area of torque shaft (1-30) on top of thrust bearing (2-70).

NOTE:

A new retaining ring (2-90) is provided in the Biffi FCBA Service Kit.

- 3.2.12** Install the new retaining ring (2-90) into the groove located on the upper area of torque shaft (1-30).

⚠ CAUTION

Verify that retaining ring (2-90) is properly seated in the groove of torque shaft (1-30).

- 3.2.13** Install position indicator (1-50) onto the top of torque shaft (1-30).
- 3.2.14** Rotate the torque shaft (1-30) so that the arms of yoke (1-20) point outward.
- 3.2.15** Coat O-ring seal (5-20) with lubricant and install into inner diameter seal groove located in the center bar hole of housing adapter (6-10).
- 3.2.16** Install hex nut (8-20) onto one end of center bar (8-10).
- 3.2.17** Coat entire length of center bar assembly (8-10) with lubricant including the threads.
- 3.2.18** Insert center bar assembly (8-10) into the center hole of housing adapter (6-10). Slide center bar assembly through housing adapter until center bar assembly nut is flush against the housing adapter (6-10).

⚠ WARNING

Care should be taken during installation of center bar assembly so as to not scratch it or damage the housing adapter O-ring seal (5-20).

NOTE:

Rotate the hex nut down the M3 jackscrew until it is next to the M3 adapter.

- 3.2.19** Recoat center bar assembly (8-10) with lubricant.
- 3.2.20** Coat O-ring seal (7-10) with lubricant and install onto outer diameter flange located on housing adapter end of housing (1-10).

NOTE:

The installation location for O-ring seal (7-10) is defined in step 3.1.6 under standard construction and inverse construction actuators.

- 3.2.21** Install housing adapter (6-10) with installed center bar assembly (8-10) on to the cylinder adapter end of housing (1-10).

3.3 Pneumatic Cylinder Reassembly

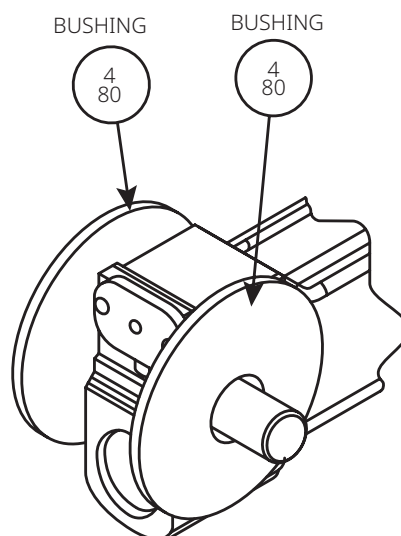
NOTE:

Review Section 3 steps 3.1.1 through 3.1.6 before proceeding with cylinder reassembly.

In Section 3.3 where the step indicates to “lubricate, coat or apply lubricant”, use lubricant as identified in Section 1.7 for lubricating the part being installed.

- 3.3.1** Coat one O-ring seal (5-10) with lubricant and install onto outer diameter flange located on cylinder/cylinder adapter end of housing (1-10).
- 3.3.2** Actuators equipped with cylinder adapter (4-15), models FCBA830-SR, FCBA930-SR and FCBA1030-SR (including M3/M3HW models), do steps 3.3.2.1 and 3.3.2.2.
 - 3.3.2.1** Install cylinder adapter (4-15) onto housing flange with the stepped outer diameter wof cylinder adapter (4-15) facing away from housing (1-10).
 - 3.3.2.2** Install one O-ring seal (5-15) onto stepped diameter of cylinder adapter (4-15).
- 3.3.3** Coat all areas of piston (4-50) with lubricant.
- 3.3.4** Coat rod bushing (5-50) with lubricant and install into the internal rod bushing groove located in the head of piston (4-50).
- 3.3.5** Coat rod T-seal (5-25) with lubricant and install in the internal seal groove in the head of piston (4-50).
- 3.3.6** Coat piston seal (5-40) with lubricant and install into outer diameter seal groove of piston (4-50).
- 3.3.7** Coat piston bearing (5-45) with lubricant and install into outer diameter bearing groove of piston (4-50).
- 3.3.8** Install two bushings (4-80) onto piston assembly (4-50), refer to Figure 1.

Figure 1. Bushing Installation



- 3.3.9** With the piston head facing away from housing (1-10), install piston assembly (4-50) onto center bar assembly (8-10).
- 3.3.10** Carefully slide piston assembly (4-50) along center bar assembly (8-10) until the yoke pin engages the slots of yoke (1-20).

CAUTION

Check to determine that both bushings (4-80) are installed between the arms of yoke (1-20) and the piston assembly (4-50). Refer to Figure 1.

NOTE:

While holding the center bar assembly, flush against the housing adapter (6-10), push piston assembly (4-50) into housing (1-10) as far as the piston will travel.

- 3.3.11** Apply a coating of lubricant to entire bore of cylinder (4-10).
- 3.3.12** Cylinder (4-10) installation
- 3.3.12.1** For FCBA830, FCBA930 and FCBA1030 models (including M3/M3HW models), install the lubricated cylinder (4-10) over the piston and up against the O-ring seal on the stepped diameter flange of cylinder adapter (4-15).
- 3.3.12.2** For FCBA730 models, install the lubricated cylinder (4-10) over the piston and up against the O-ring seal on the flange of housing (1-10).
- 3.3.13** Coat O-ring seal (5-20) with lubricant and install into inner diameter seal groove located in the center bar hole of end cap (4-20).

NOTE:

Actuators equipped with an end cap M3 jackscrew (4-30) pre-install M3 into end cap (4-20) per step 3.3.14 and then install pre-assembled end cap into cylinder (4-10) per step 3.3.15. Actuators equipped with housing adapter ES or stop screw (4-30) skip step 3.3.15 and continue assembly at step 3.3.17.

- 3.3.14** M3 jackscrew installation to end cap (4-20).
- 3.3.14.1** Apply a coating of lubricant to outer diameter and inner diameter threads of M3 jackscrew adapter (4-55).
- 3.3.14.2** Coat O-ring seal (5-65) with lubricant and install into outer diameter seal groove located in the M3 jackscrew adapter (4-55).
- 3.3.14.3** Apply a light coating of lubricant to the threads of M3 jackscrew (4-30).
- 3.3.14.4** Install and rotate the M3 jackscrew (4-30) into M3 jackscrew adapter (4-55).

NOTE:

Rotate the M3 jackscrew into the adapter until the inboard end of the jackscrew is up against the adapter.

3.3.14.5 Install M3 jackscrew adapter (4-55) with M3 jackscrew (4-30) into end cap (4-20).

3.3.14.6 Install retainer ring (5-60) into exposed outer diameter groove in M3 jackscrew adapter (4-55).

3.3.14.7 Install O-ring seal (5-30) onto M3 jackscrew (4-30).

NOTE:

Move the O-ring seal (5-30) down the M3 jackscrew until it is next to the M3 jackscrew adapter.

3.3.14.8 Install hex nut (4-40) onto M3 jackscrew (4-30).

NOTE:

Rotate the hex nut down the M3 jackscrew until it is next to the M3 jackscrew adapter.

3.3.15 End cap outer diameter seal installation

3.3.15.1 For FCBA830, FCBA930 and FCBA1030 models, install O-ring seal (5-15) onto the outer diameter of end cap (4-20).

3.3.15.2 For FCBA730 models, install O-ring seal (5-10) onto the outer diameter of end cap (4-20).

3.3.16 Install end cap (4-20) onto center bar (8-10) and into cylinder (4-10). Position the end cap (4-20) so that the inlet port is at the bottom and the ES, cylinder stop screw or M3 jackscrew (4-30) is at the top of the actuator.

⚠ WARNING

If step 3.3.17 is not completed as described, the center bar O-ring seals (5-20) may become a source of pressure leakage and cause the actuator to fail.

3.3.17 Install the second hex nut (8-20) onto the cylinder end of center bar (8-10). Adjust the two hex nuts (8-20) such that the approximate same number of threads is exposed on the ends of the center bar (8-10).

⚠ WARNING

Do not allow end cap (4-20) to rotate during center bar tightening. The end cap must maintain the position as described in step 3.3.16. M3 jackscrew must be installed to be in alignment with the target located on the piston assembly (4-50). If the M3 does not contact the target during M3 adjustments the groove pin (12-20) is subject to failure.

3.3.18 Torque tighten center bar assembly (8-10) to 316 Nm / 233 lbf-ft.

3.3.19 End cap (4-20) ES or stop screw (4-30) installation.

3.3.19.1 Lubricate ES or stop screw (4-30) and install into end cap (4-20).

3.3.19.2 Install O-ring seal (5-30) onto ES or stop screw (4-30).

NOTE:

Move the O-ring seal (5-30) down the ES or stop screw until it is next to the end cap (4-20).

3.3.19.3 Install washer (4-90) onto ES or stop screw (4-30).

NOTE:

Push the washer down the ES or stop screw until it is next to the end cap (4-20).

3.3.19.4 Install hex nut (4-40) onto ES or stop screw (4-30).

NOTE:

Rotate the hex nut down the ES or stop screw until it is next to the end cap (4-20).

3.3.20 M3 hex drive hub or handwheel (12-10) installation as follows:

3.3.20.1 Install hex drive hub (12-10) or handwheel (12-10) onto M3 jackscrews (4-30) and (6-30). Align the "hole" of the drive hub with the "hole" located in the outboard end of M3 jackscrew (4-30) and (6-30).

3.3.20.2 Install caution tag (12-40) onto M3 jackscrews (4-30) and (6-30).

3.3.20.3 Install retainer ring (12-30) and groove pin (12-20) into the hex drive hub (12-10) or handwheel (12-10).

3.3.21 Adjust both M3 jackscrews (4-30) and (6-30) back to setting recorded in Section 2, General Disassembly. Tighten both M3 jackscrew hex nuts (4-40) and (6-40) securely, while holding M3 jackscrews in position.

Section 4: Actuator Testing

4.1 Actuator Testing

- 4.1.1** 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.
- 4.1.2** All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution.

WARNING

Pressure is not to exceed the maximum operating pressure rating listed on the serial number tag (20).

- 4.1.3** All leak testing will use the customer's normal operating pressure or the actuator name tag normal operating pressure (NOP).

NOTE:

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

- 4.1.4** Before testing for leaks, apply and release the pressure listed in step 4.1.3 to both sides of the piston. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 4.1.5** Apply the pressure listed in step 4.1.3 to the housing side of the piston and allow the actuator to stabilize.
- 4.1.6** Apply a leak testing solution to the following areas:
 - 4.1.6.1** Cylinder to housing joint on FCBA730 or cylinder to cylinder adapter to housing joints on FCBA830, FCBA930 and FCBA1030 actuator models.
 - 4.1.6.2** On the outboard end of housing adapter (6-10) at the center bar hex nut. Checks the center bar to housing O-ring seal (5-20).
 - 4.1.6.3** Housing adapter stop screw/ES/M3 jackscrew O-ring seal (7-30).
 - 4.1.6.4** Torque shaft (1-30) to housing (1-10) interface. Checks rod wiper seals (2-20).
 - 4.1.6.5** End cap (4-20) port "hole". Checks the piston to cylinder seal (5-40) and piston to center bar seal (5-25).
 - 4.1.6.6** Housing adapter (6-10) to housing (1-10) joint. Check O-ring seal (7-10).
- 4.1.7** Apply the pressure listed in step 4.1.3 to the end cap inlet port and allow the actuator to stabilize.

- 4.1.8** Apply a leak testing solution to the following areas:
 - 4.1.8.1** Cylinder to end cap joint. Checks O-ring seal (5-10) on FCBA730 or checks O-ring seal (5-15) on FCBA830, FCBA930 and FCBA1030 actuators.
 - 4.1.8.2** Housing adapter (6-10) inlet port hole. Checks the piston to cylinder seal (5-40) and piston to center bar seal (5-25).
 - 4.1.8.3** End cap stop screw or M3 jackscrew O-ring seal.
 - 4.1.8.4** Remove pressure from pressure inlet port in the end cap (4-20).
- 4.1.9** If an actuator was disassembled and repaired as a result of this procedure, the above leakage test must be performed again.
- 4.1.10** Shell Pressure Test: Optional pressure test can be performed on a PED certified actuator by applying pressure to both sides of the piston simultaneously for a period of two (2) minutes. If any leakage occurs across a static seal, the unit must be disassembled and the cause of leakage determined and corrected.

 WARNING

The actuator's main pressure bearing parts will be tested in controlled conditions in accordance with the requirement of PED by pressuring both sides of the piston to avoid damage and over torquing of the actuator components. If further future testing in the field is necessary, Biffi should be contacted for guidance.

- 4.1.11** After the actuator is installed back on the valve, all accessories should be hooked up and tested for proper operation, and replaced, if found defective.

Section 5: Field Conversions

5.1 High Temperature Service (-10 TRIM)

- 5.1.1 Disassemble and reassemble actuator per section, Section 1 through Section 4, using new -10 (high temperature) Service Kit.

5.2 Low Temperature Service (-11 TRIM)

- 5.2.1 Disassemble and reassemble actuator per section, Section 1 through Section 4, using new -11 (low temperature) Service Kit.

5.3 Add an Extended Stop (ES) to Housing Adapter (6-10)

NOTE:

Prior to disassembly, review all of Sections 1, 2 and 2.1.

- 5.3.1 Stop screw (6-30) removal from housing adapter (6-10).
 - 5.3.1.1 Loosen and remove hex nut (6-40) and washer (6-90) from stop screw (6-30) located in housing adapter (6-10).
 - 5.3.1.2 Remove stop screw (6-30) from housing adapter (6-10).
-

NOTE:

Prior to reassembly, review all of Sections 3 and 3.1.

- 5.3.2 ES (6-30) installation into housing adapter (6-10).
 - 5.3.2.1 Lubricate ES (6-30) and install into housing adapter (6-10).
 - 5.3.2.2 Install O-ring seal (7-30) onto ES (6-30).
-

NOTE:

Move the O-ring seal (7-30) down the ES until it is next to housing adapter (6-10).

- 5.3.2.3 Install washer (4-90) onto ES or stop screw (4-30).

NOTE:

Push the washer down the ES or stop screw until it is next to the housing adapter (6-10).

5.3.2.4 Install hex nut (6-40) onto ES (6-30).

NOTE:

Rotate the hex nut down the ES until it is next to housing adapter (6-10).

5.4 Add an Extended Stop (ES) to Cylinder End Cap (4-20)

NOTE:

Prior to disassembly, review all of Sections 1 and 2.

5.4.1 Stop screw (4-30) removal from end cap (4-20)

5.4.1.1 Loosen and remove hex nut (4-40) and washer (4-90) from stop screw (4-30) located in end cap (4-20).

5.4.1.2 Remove stop screw (4-30) from end cap (4-20).

5.4.2 ES (4-30) installation

5.4.2.1 Lubricate ES (4-30) and install into end cap (4-20).

5.4.2.2 Install O-ring seal (5-30) onto ES (4-30).

NOTE:

Move the O-ring seal (5-30) down the ES until it is next to the end cap (4-20).

5.4.2.3 Install washer (4-90) onto ES (4-30).

NOTE:

Move the washer (4-90) down the ES until it is next to the end cap (4-20).

5.4.2.4 Install hex nut (4-40) onto ES (4-30).

NOTE:

Rotate the hex nut down the ES until it is next to the end cap (4-20).

5.5 Add an M3 Jackscrew to Housing Adapter (6-10)

NOTE:

This section can also be used to add an M3 to the cylinder end cap (4-20) at the same time as the M3 is added to the housing adapter (6-10). When an M3 is only being installed into housing adapter (6-10), skip step 3.3.14 during installation. For single M3 addition to cylinder end cap (4-20), use Section 5.6.

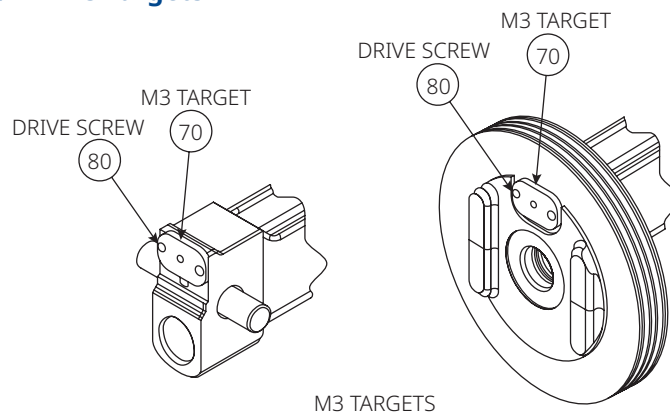
- 5.5.1 Prior to disassembly, review all of Section 1.
- 5.5.2 Disassemble the actuator per Section 2.1, Section 2.2, steps 2.2.2 through 2.2.5 and Section 2.3, steps 2.3.2 and 2.3.3.
- 5.5.3 Prior to actuator reassembly, review all of Sections 3.1, 3.2 and 3.3.
- 5.5.4 If new M3 housing adapter (6-10) is not pre-assembled with the M3, then assemble M3 to the housing adapter (6-10) per Section 3.2 step 3.2.1.

⚠ WARNING

The M3 cannot be installed on a standard FCBA actuator unless the M3 targets are installed on the piston assembly as shown in Figure 2. If the M3 is operated with a piston that does not have a target, the groove pin (12-20) is subject to failure.

- 5.5.5 Add the M3 targets to the piston assembly (4-50) per Figure 2, M3 Targets.

Figure 2. M3 Targets



- 5.4.3 Reassemble the actuator per Section 3.2, steps 3.2.14 through 3.2.20, Section 3.3, steps 3.3.1 through to the end of Section 4.

5.6 Add an M3 Jackscrew to Cylinder Outer End Cap (4-20)

- 5.6.1 Prior to disassembly, review all of Section 1.
- 5.6.2 Disassemble the actuator per Section 2.1, Section 2.2, steps 2.2.2 through 2.2.5.
- 5.6.3 Prior to actuator reassembly, review Sections 3.1, 3.2 and 3.3.
- 5.6.4 If new M3 outer end cap (4-20) is not pre assembled with the M3, then assembly M3 to the outer end cap (4-20) per Section 3.3 step 3.3.14.

WARNING

The M3 cannot be installed on a standard FCBA actuator unless the M3 targets are installed on the piston assembly as shown in Figure 2. If the M3 is operated with a piston that does not have a target, the groove pin (12-20) is subject to failure.

- 5.6.5 Add the M3 targets to the piston assembly (4-50) per Figure 2, M3 Targets.
- 5.6.6 Install the assembled M3 outer end cap (4-20) per Section 3.3, steps 3.3.1 through 3.3.13 and steps 13.3.15 through to the end of Section 4, Actuator Testing.

5.7 Add M11 Override Cylinders and Pump Package

Consult factory for further information.

Section 6: Troubleshooting

6.1 Fault Insertion

In the unlikely event of a fault developing, the following Fault Location Table is provided to assist the service engineer to perform troubleshooting. This table is designed to cover as wide a range of Biffi actuators as possible. Reference to equipment not supplied should be ignored.

Table 3. Fault Location Table

Symptom	Potential Causes	Remedy
Erratic movement	Irregular supply of operating medium	Check operating medium for consistent supply pressure and correct as necessary.
	Inadequate lubrication	Dismantle, relubricate and reassemble.
	Worn parts	Dismantle. Visually inspect for significant wear. Actuator replacement may be required.
	Defective valve	Consult the valve OEM's documentation.
Short stroke	Incorrectly set stops (valve and/or actuator)	Check the position of the travel stops and readjust as necessary.
	Hardened grease	Dismantle, remove any hard grease, relubricate and reassemble.
	Debris left in the cylinder or housing during maintenance	Disassemble cylinder assembly to remove debris. Reassemble cylinder assembly as necessary.
	Defective valve	Consult the valve manufacturer's documentation.
Apparent lack of torque	Inadequate supply pressure	Ensure supply pressure is above the minimum operating pressure of the actuator and that output torque produced at supply pressure exceeds valve torque demand.
	Incorrect speed control settings	Adjust speed controls to increase flow.
	Exhaust port blocked	Remove and clean the exhaust port silencers and replace.
	Pipe work blocked, crushed or leaking	Examine the pipe work for blockages, crushed pipe or leakage. Clear or replace as necessary.
	Defective controls	Examine the controls, refurbish or renew as necessary. Refer to component manufacturer's documentation.
	Defective piston seal	Dismantle the cylinder assembly, remove the defective piston seal. Fit new seal and reassemble.
	Defective rod seal	Dismantle the cylinder assembly, remove the defective rod seal. Fit new seal and reassemble.
	Defective housing seal	Dismantle the housing assembly, remove the defective seal. Fit new seal and reassemble.
	High valve torque or valve seized	Consult the valve OEM documentation.

6.2 Operational Test

6.2.1 Full Stroke Test

The "Full Stroke Test" ("On-line") must be performed to satisfy the PFD_{AVG} (average probability of failure on demand) value. The full stroke test frequencies will be defined by the final installer to achieve the defined SIL level.

6.2.1.1 Procedure

6.2.1.1.1 Stroke the actuator/valve assembly to complete open/close cycles with complete closing of the valve.

6.2.1.1.2 Verify the open/close cycles functioned correctly (e.g., check locally, or automatically via Logic solver, the correct movement of the actuator/valve).

6.2.2 Upon successful completion of the above described Full Stroke Test procedure, the "Test Coverage" can be considered 99%.

6.2.3 6.2.2 Partial Stroke Test (when requested)

The "Partial Stroke Test" ("On-line") can be performed to improve the PFD_{AVG} value and to satisfy PFD_{AVG} value. A typical partial stroke value is 15% of the stroke and the recommended test interval is about every one to three months.

6.2.3.1 Procedure

6.2.3.1.1 Operate the actuator/valve assembly for No° 1 open/close cycles 15% of the stroke.

6.2.3.1.2 Verify the partial stroke test functioned correctly (e.g., check locally, or automatically via logic solver, or via the PST system the correct movement of the actuator/valve was 15% of the stroke).

NOTE:

The above test is only applicable on systems equipped with a partial stroke feature.

Section 7: Removal and Decommissioning

WARNING

Always follow safe work practices to remove and disassemble an FCBA and FCBB Series actuator.

The below basic 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 a customer's authorized representative and an authorized Biffi representative.

CAUTION

Make sure the actuator is isolated before removing from valve. Turn OFF the power medium and bleed off all pressure first, including storage tank (if present). Next, bleed off pilot pressure, disconnect: pneumatic pressure supply, pilot tubing and electrical wiring (if equipped).

Before starting the disassembly, a large area should be created around the actuator so as to allow any kind of movement.

Separate the parts composing the actuator according to their nature (e.g., metallic and plastic materials, fluids, etc.) and send them to differentiated waste collection sites, as provided for by the laws and provisions in force.

1. Drain tanks and remove tubing from actuator. Remove accessories (if equipped) and controls from actuator.
2. Remove all equipment mounted on top of actuator (limit switches, end of stroke valve and relevant pneumatic/electric connection, etc.).
3. Remove mounting bolts and actuator is ready to be removed from valve. For complete actuator tear down, refer to Section 2 of the manual.

Section 8: Document Revision

Table 4. Revision Overview

Rev	Date	ECN	Description	By *
1	July 2020	Released	Updated	N/A
2	March 2022	N/A	Added Warning for Electrostatic Charge	N/A
3	August 2024	N/A	Added ATEX Safety Instructions for Use in (Potential) Explosive Atmosphere	Massimiliano Franco

Notes:

* Signatures on file at Biffi Italia s.r.l.

The data in this table refers to the parent document (VCIOM-13238-EN).

Appendix A: List of Tables

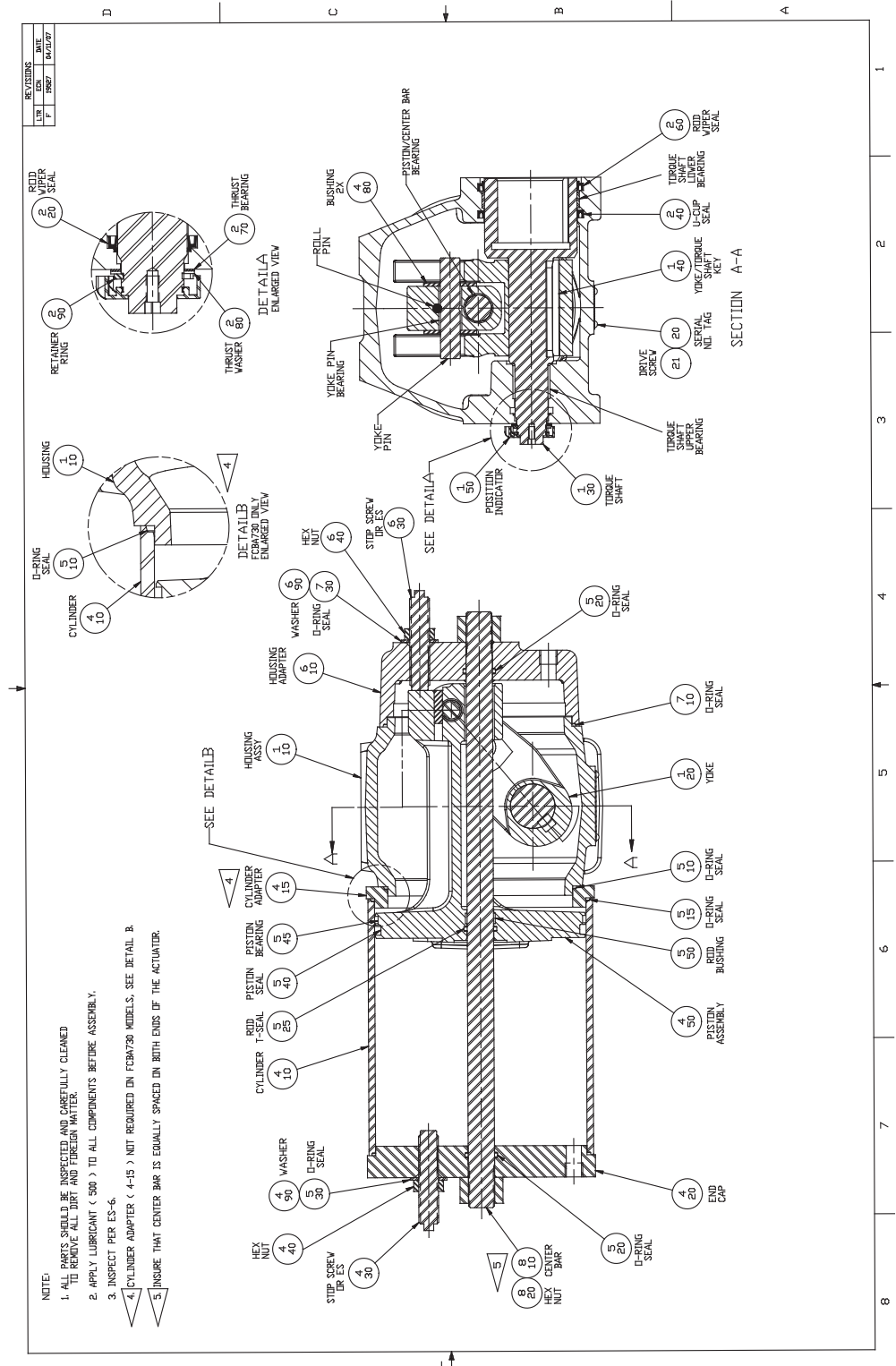
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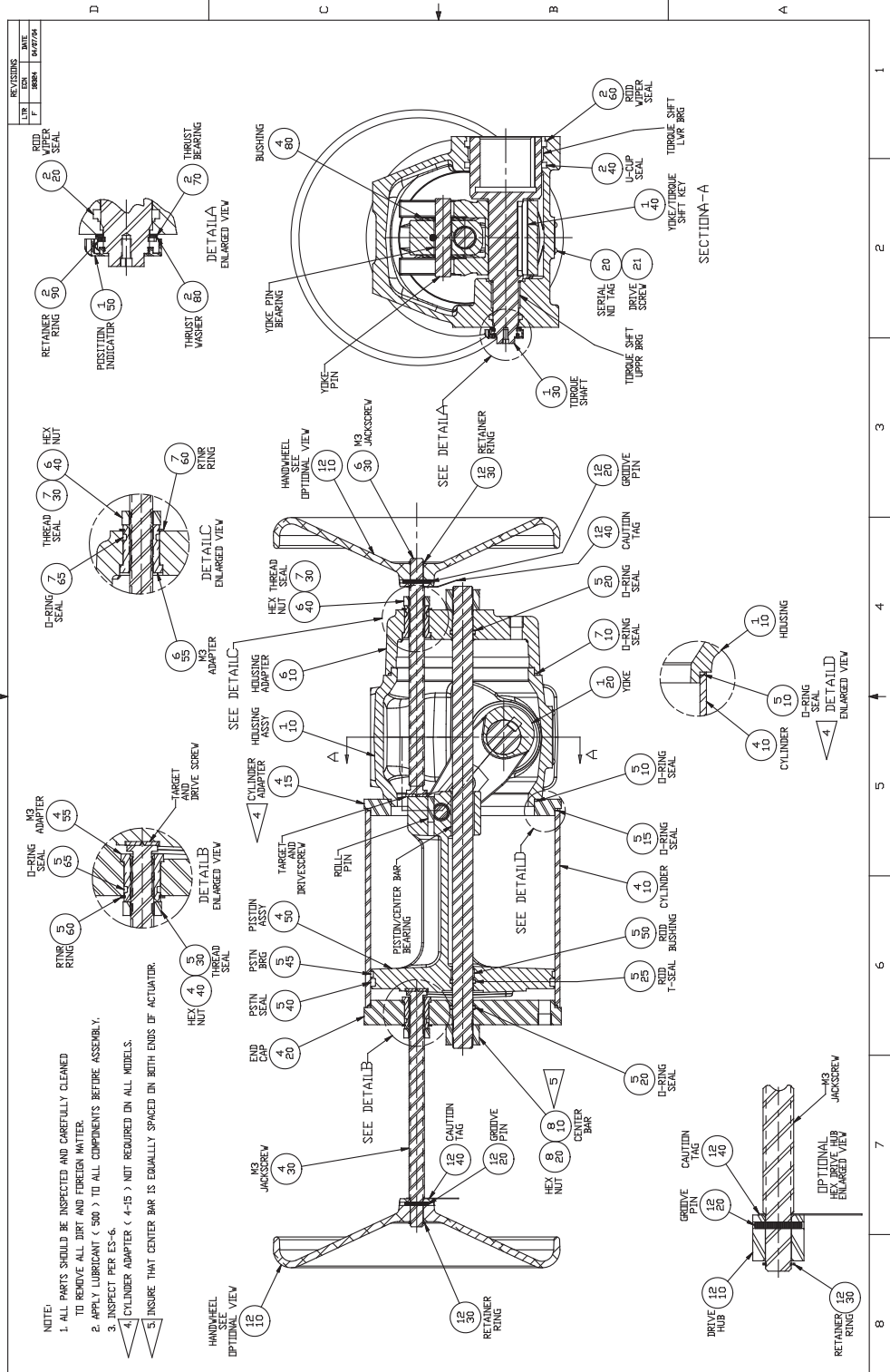
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Appendix C: List of Drawings

C.1 Part Number 129742, FCBA300 Assembly Drawing



C.2 Part Number 129744, FCBA300-M3HW Assembly Drawing



Appendix D: Safety Instructions for Use in (Potential) Explosive Atmosphere



D.1 Intended Use

The actuator series have been designed to comply with the explosion safety requirements in the Ex-standards EN IEC 60079-0:2018, EN ISO 80079-36, EN ISO 80079-37:2016 and EN 1127-1:2019. These standards contain the requirements for non-electrical equipment in potentially explosive atmospheres.

The actuators comply with the constructional safety type "c" requirements. The actuators are designed for gas group IIB or IIC and dust group IIIC applications and are applicable in temperature classes T6 to T3 depending on model. The Equipment Protection Level is Gb for gas and Db for dust, so the actuators can be used in Ex classified hazardous zones 1/21.

D.2 ATEX Marking

Complete ATEX Marking:

  II 2 G Ex h IIB or IIC T6 to T3 Gb
II 2 D Ex h IIIC T85 °C to T200 °C Db

Ambient Temperature Ranges (T_{amb}):

- Standard Temperature: -29 to 93 °C / -20 to 200 °F
- Low Temperature: -40 to 65 °C / -40 to 150 °F
- High Temperature: -18 to 176 °C / 0 to 350 °F
- Special Low Temperature *: -60 to 100 °C / -76 to 212 °F

NOTES:

1. The minimum and maximum temperatures can vary according to the project design (gasket, O-rings and grease used), as well as other certifications within the given range. Please refer to the special conditions for safe use.
 2. Hazardous area is likely to occur in normal operation occasionally in greater than 10 and less than 1000 hours/year.
 3. * Not applicable for all products and available with Carbon Steel (CS) material.
-

D.3 Safety Instructions

1. Before the installation, please carefully read the service instructions. Biffi is not responsible for damages caused by operations not complying with the instructions contained in such manuals.
2. All the operations shall be done by a trained and qualified operator. All maintenance operations must be performed in accordance with the instructions detailed in the maintenance manual.
3. The assembly cannot be installed and used in classified areas as zone 0 to 20, mines (group I).
4. The equipment shall be installed in a place where the risk of lightning is covered by the relevant industrial code of practice.
5. Assembly, disassembly and maintenance is only allowed at the actuator, when at the time of the activity, there are no explosive mixtures.
6. During maintenance operations, the user must take all appropriate measures to prevent risks related to the toxicity of substances, using appropriate protective equipment (e.g., gloves, goggles, face mask), according to the extent provided the technical and organizational point of use and the recommendations provided in the specifications of the used substances.
7. All the mechanical components do not have ignition sources during the normal working process. The user shall check periodically the vibration presences and/or abnormal noises and it must stop the unit immediately, check the causes and contact the manufacturer.
8. Actuators do not have an inherent ignition source due to electrostatic discharge, but explosion hazards may be present due to the discharge of static electricity from other valve assembly components.
 - a. To avoid personal injury or property damage, make sure that the valve is grounded to the pipeline before placing the valve assembly into service.
 - b. Use and maintain alternate shaft-to-valve body bonding, such as a shaft-to-body bonding strap assembly.
 - c. The equipment must be earthed through an anti-loosening and anti-rotation device. The user must regularly check the effectiveness of the ground connection.
 - d. A warning is present into the label: "Potential Electrostatic Charging Hazard".
9. When equipment is installed in a hazardous area location (potentially explosive atmosphere), prevent sparks by proper tool selection and avoiding other types of impact energy.
10. It is under end user responsibility to avoid the explosive mixture inside the actuator.
11. To avoid increasing dust explosion risk, periodically clean dust deposits from all equipment.
12. Proper care must be taken to avoid generation of static electricity on the non-conductive external surfaces of the equipment (e.g., rubbing of surfaces, etc.).

13. The paint protection must not exceed 200 µm if the actuator is used in a group IIC atmosphere. For group IIA or IIB atmospheres, the paint protection must not exceed a thickness of 2 mm / 0.08 in.
14. For single-acting actuators, it is necessary to use safe air and to convey by a piping inlet/exhaust of the cylinder outside of the Ex-zone (Safe Area).
15. After maintenance operations are carried out, perform a few actuator operations to check that its movement is regular and that there is no air/oil leakage through the seals/gaskets.
16. It is under end user responsibility to make sure the electrical equipment installed on the actuators have a separated ATEX evaluation and they are designed according to the ATEX Directive and they are suitable for the installation zone, group of gas, temperature class, maximum surface temperature, EPL and range of temperature.
17. It is forbidden to use this equipment in a different way if it is not included in the instruction manual. Biffi is not responsible for damages caused by an improper and/or dangerous use.

D.4 Maximum Temperatures

WARNING

The actuator's surface temperature is dependent upon process operating conditions. Personal injury or property damage caused by fire or explosion, can result if the actuator's surface temperature exceeds the acceptable temperature for the hazardous area classification. To avoid an increase of instrumentation and/or accessory surface temperature due to process operating conditions, ensure adequate ventilation, shielding or insulation of these actuator components installed in a potentially hazardous or explosive atmosphere.

Table D-1. Ambient and ATEX Temperatures

Temperature			Valid Actuator Trim
Ambient Range	ATEX Class	TX (ATEX Surface Temperature)	
-29 to 75 °C / -20 to 167 °F	T6	T85 °C / T185 °F	Standard Temperature Trim
-29 to 90 °C / -20 to 194 °F	T5	T100 °C / T212 °F	
-29 to 93 °C / -20 to 200 °F	T4	T103 °C / T217 °F	
-40 to 65 °C / -40 to 150 °F	T6	T75 °C / T167 °F	Low Temperature Trim
-18 to 125 °C / 0 to 257 °F	T4	T135 °C / T275 °F	High Temperature Trim
-18 to 176 °C / 0 to 350 °F	T3	T186 °C / T367 °F	
-60 to 75 °C / -76 to 167 °F	T6	T85 °C / T185 °F	Special Low Temperature Trim *
-60 to 90 °C / -76 to 194 °F	T5	T100 °C / T212 °F	
-60 to 100 °C / -76 to 212 °F	T4	T110 °C / T230 °F	

Notes:

1. * Not applicable for all products and available with Carbon Steel (CS) material.
2. The specified values are valid with condition: Maximum cycle frequency of actuator is less than 1 Hz at a maximum of 50 cycles per hour and at maximum load.
3. The upper temperature limit can differ according to the soft seal used. Refer to the scope of supply.

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