



**Instruction Manual
for
The Becker Ball Valve Regulator
(Double-Acting Series)**

Introduction:

The **Becker** Ball Valve Regulator (BVR) is a high capacity regulator designed specifically for natural gas regulation. The **Becker** BVR is built to exacting specifications in order to offer accurate and reliable performance. The BVR is easy to operate, requires minimal maintenance, and is available in a variety of configurations and sizes to fit your specific application. (To best maintain accuracy, efficiency, and safety, all BVR applications should be designed and engineered with the assistance of **Becker Precision Equipment** factory personnel). All **Becker** BVR's are shipped ready for installation and startup without any further adjustment. All instruction manuals supplied with the BVR should be reviewed prior to installation and startup. Only those qualified through training or experience should install, operate, or maintain **Becker** BVR's.

The **Becker** Ball Valve Regulator is comprised of three (3) major components:

1. Control Valve (Ball Valve Type)
2. Throttling Valve Actuator
3. Control Instrumentation

Information about the Ball Valve and the Actuator is covered in this manual. For information about Control Instrumentation, refer to the instruction manual for the specific Control Instrumentation supplied with your Ball Valve Regulator.

Technical Assistance:

Should you have any questions, you may contact your local **Becker Precision** sales representative or **Becker Precision** technical assistance at:

Becker Precision Equipment, Inc.

Attn.: Technical Assistance
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Elk Grove Village, IL 60007 USA

Toll-Free: (800) 323-8844
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Web site: www.bpe950.com

In order to facilitate requests for technical assistance, please have the following information immediately available:

- **BVR Serial Number (see ID tag affixed to BVR actuator)**
- **BVR Model Number (see ID tag affixed to BVR actuator)**
- **Becker Invoice Number (see upper right corner of first page of instruction manual)**

Contents:

Part 1 - Double-Acting Valve Actuators

Technical Specifications	4
Materials of Construction	4

Part 2 - Becker Approved Control Valves

Technical Specifications	5
Leakage Rate Specifications	5

Part 3 - Ball Valve Regulator Maintenance and Inspection

Annual Maintenance and Inspection: 6

- Ball Valve Regulator Stroking Operation 6

Procedure:

- 1. Checking for Proper Valve and Actuator Stroking 6

- Actuator Housing Vent Inspection 6

Procedures:

- 2. Checking Actuator Housing for Venting Gas 7

- 2.a. Valve Stem Seal Leakage Inspection 7

- 2.b. Cylinder Piston Rod Seal Leakage Inspection 7

- Valve Stem Leakage 7

Procedure:

- 3. Valve Stem Seal Replacement 7

5 Year Maintenance and Inspection:

- Actuator Cylinder Seal Leakage Inspection 8

Procedures:

- 4. Checking Tube Seals 8

- 4.a. Checking Piston Seals 8

- 4.b. Checking Tail Rod Seals 9

- Correcting Actuator Cylinder Seal Leakage 9

Procedures:

- 5. Replacing Tube Seals or Piston Seals 9

- 5.a. Replacing Piston Rod Seals 10

- 5.b. Replacing Tail Rod Seals 10

- Ball Valve Regulator "Lost Motion" Inspection 10

Procedures:

- 6. Inspecting for Lost Motion 10

- 6.a. Correcting Lost Motion 10

Maintain As Needed:

- Valve Seat Leakage Check 11

Procedure:

- 7. Correcting Valve Seat Leakage 11

- Actuator Cylinder Lubrication

Procedure: 11

- 8. Applying Cylinder Lubrication 11

- Ball Valve Lubrication 12

Procedures:

- 9. Applying Lubrication to Valve Seats 12

- 9.a. Applying Valve Cleaner/Lubricant to Valve Body Bleed Fitting 12

Part 4 - Above Grade Actuator Installation and Disassembly

Procedures:

- 10. Above Grade Actuator Installation 13

- 10.a. Above Grade Actuator Disassembly (Cylinder Only) 13

- 10.b. Above Grade Actuator Reinstallation (Cylinder Only) 14

- 10.c. Above Grade Actuator Disassembly (Complete Actuator) 14

Part 5 - Below Grade Actuator Disassembly and Reinstallation

Procedures:

- 11. Below Grade Actuator Disassembly (Cylinder Only) 14

- 11.a. Below Grade Actuator Reinstallation (Cylinder Only) 15

- 11.b. Below Grade Actuator Disassembly (Complete Actuator) 15

- 11.c. Below Grade Actuator Reinstallation (Complete Actuator) 15

Part 6 - Appendix

- Drawings:

- 01-5176 Actuator 16

- 01-6793 Above Grade Actuator 17

- 01-6818 Above Grade Ball Valve Regulator 17

- 01-6911 Below Grade Actuator 18

- 01-6799 Below Grade Ball Valve Regulator 18

- 01-6779 Single Rod Cylinder (8"-14" Bore) 19

- 01-6780 Tail Rod Cylinder (8"-14" Bore) 20

- 01-6851 Single Rod Cylinder (4"-6" Bore) 21

- 01-6852 Tail Rod Cylinder (4"-6" Bore) 22

- Maintenance Checklists 23

- Notes 24

- Feedback 25

Part 1: Double-Acting Valve Actuators

Technical Specifications

Actuator Type	<ul style="list-style-type: none"> Pneumatic Crank Arm Design (quarter turn)
Rotation (Output)	<ul style="list-style-type: none"> Fixed 90E (standard) 85E through 95E non-adjustable (available on request)
Installation	<ul style="list-style-type: none"> Indoors or outdoors Vertical or Horizontal Safe in explosion-proof environments
Installation Orientation	<ul style="list-style-type: none"> Left-hand mounting standard (valve and stem are in horizontal position. Actuator is perpendicular to the valve on the left hand side when viewed from upstream) Other orientations available on request
Torque Output Ranges	<ul style="list-style-type: none"> 2250 inch lbs. to 874430 inch lbs. (standard actuators) Higher torque outputs available on request
Operating Temperature Range	<ul style="list-style-type: none"> -20EF to +160EF (standard)
Power Gas Minimum	<ul style="list-style-type: none"> 100 psig (standard) 50 psig (available on request)
Power Gas Maximum	<ul style="list-style-type: none"> 500 psig (actuator models 10H and smaller) 400 psig (actuator models 10L and larger)
Power Gas Filtration	<ul style="list-style-type: none"> 100 Micron nominal Free of excessive moisture Free of excessive liquid hydrocarbons
Power Gas Moisture Requirements	<ul style="list-style-type: none"> < 7 Lb. Per 1.0 mmscf <p>If excessive moisture or hydrocarbon content is present, a Filter Dryer may be necessary. For adequate filtration and elimination of moisture, a Becker Model FD-1500 Filter-Dryer should be installed. Refer to Becker FD-1500 literature to determine if a Model FD-1500 Filter-Drier is necessary. For adequate filtration and elimination of liquid hydrocarbon, a Becker Model FACD-1500 Filter-Deodorizer should be installed.</p>
Power Gas Heat Requirements	<p>If ambient temperatures may fall below the specified temperature range, it is recommended that the Ball Valve Regulator be installed in a heated enclosure. Any heating devices utilized must be rated as "explosion-proof for a hazardous environment." Becker Precision Equipment recommends the use of catalytic heaters when heat is required. The catalytic heater utilizes natural gas fuel and provides a safe, flameless heat.</p>

Materials of Construction

Housing/Linkage	<ul style="list-style-type: none"> Carbon Steel
Torque Arm Bearings	<ul style="list-style-type: none"> DuralonJ (fiberglass weave with TeflonJ coating) in steel shell
Linkage Bearings	<ul style="list-style-type: none"> 316SS spherical bearings
Pneumatic Cylinder Tube	<ul style="list-style-type: none"> Chrome-plated steel
Pneumatic Cylinder Tube Seals	<ul style="list-style-type: none"> Buna-N O-Rings
Pneumatic Cylinder Piston	<ul style="list-style-type: none"> Nodular iron
Pneumatic Cylinder Piston Seals	<ul style="list-style-type: none"> Buna-N U-Cups
Pneumatic Cylinder Piston Rod	<ul style="list-style-type: none"> Chrome-plated hardened steel
Pneumatic Cylinder Piston Rod Bearing	<ul style="list-style-type: none"> DuralonJ (fiberglass weave with TeflonJ coating) in steel shell
Pneumatic Cylinder Piston Rod Seal	<ul style="list-style-type: none"> Polyurethane U-Cup
Pneumatic Cylinder Tail Rod* °	<ul style="list-style-type: none"> Chrome-plated hardened steel
Pneumatic Cylinder Tailrod Bearing* °	<ul style="list-style-type: none"> DuralonJ (fiberglass weave with TeflonJ coating) in steel shell
Pneumatic Cylinder Tailrod Seal* °	<ul style="list-style-type: none"> Buna-N U-Cup
Pneumatic Cylinder Tailrod Static Seal* °	<ul style="list-style-type: none"> Buna-N O-Ring
Actuator Paint/Coating	<ul style="list-style-type: none"> Above Grade Portion standard coating: <ul style="list-style-type: none"> -prime coat epoxy (6-10 mil) -finish coat polyurethane. Below Grade Portion standard coating: <ul style="list-style-type: none"> -Tar SetJ -Coal Tar Epoxy (16 mil) Custom coatings: Epoxy, Polyester, coal tar, and zinc-base coatings may be applied in-plant to customer specifications
Instrumentation Tubing	<ul style="list-style-type: none"> $\frac{3}{8}$" Seamless Tubing 316 SSH
Instrumentation Tubing Fittings	<ul style="list-style-type: none"> Double Ferrule design 316 SS (standard)
<p>Notes:</p> <ol style="list-style-type: none"> *Applicable only to Becker Actuators equipped with Pneumatic Cylinder Tail Rod. °Becker actuators originally supplied with Fisher 3570 have Pneumatic Cylinder Tail Rod. HLarger actuators and quick stroking actuators typically have $\frac{1}{2}$" Seamless Tubing 316 SS. 	

PART 2: Becker Approved Control Valves

Technical Specifications

Design	<ul style="list-style-type: none"> • Full bore trunnion mounted ball valve • Reduced bore available upon request
Construction	<ul style="list-style-type: none"> • For specific information on valve design and construction refer to individual valve manufacturer's manuals. • Options available for valve construction and trim materials- contact Becker Precision Equipment factory personnel.
WKM Valves	<ul style="list-style-type: none"> • Refer to DynaSeal7 370E-4 Ball Valve Installation, Operation and Maintenance Manual.
Grove Valves	<ul style="list-style-type: none"> • Grove B-5 Ball Valve Installation & Maintenance Manual (Bulletin No. B-IRM 5/95) • Grove Ball Valves (Bulletin No. 209 11/94)
TK Valves	<ul style="list-style-type: none"> • Refer to TK Instruction Manual
Final Control Elements T-BallJ	<ul style="list-style-type: none"> • Refer to Final Control Elements T-BallJ Control Valve literature and Grove Valve literature
Valve Face to Face Dimensions	<ul style="list-style-type: none"> • Per ANSI B16.10
Available Size Ranges	<ul style="list-style-type: none"> • 2" through 30" Standard ANSI sizes • Larger valves available upon request
Available ANSI Ratings	<ul style="list-style-type: none"> • 150 ANSI through 2500 ANSI
Available End Connections	<ul style="list-style-type: none"> • RFFE standard • Weld end • RTJ (ring-joint)
<p>Notes on Becker Approved Control Valves:</p> <ul style="list-style-type: none"> • Becker Precision Equipment has many years of experience in the design of Ball Valve Regulators. While Becker heavily utilizes preferred standard control valves, a differing application or customer preference may dictate the need for an alternate valve. Becker Throttling Actuators can be matched with almost any valve for differing Ball Valve Regulator applications. Consult Becker factory personnel for specific applications. 	
Control Valve Specifications:	
WKM 370E-4	<ul style="list-style-type: none"> • Manufactured to API Spec. 6D
Grove Control B-5	<ul style="list-style-type: none"> • Manufactured to API Spec 6D
TK Valve	<ul style="list-style-type: none"> • Manufactured to API Spec. 6D
Final Control Elements T-BallJ	<ul style="list-style-type: none"> • Manufactured to ANSI B16.34

Leakage Rate Specifications

Control Valve Leakage Class:	
WKM 370E-4	<ul style="list-style-type: none"> • API 6D "Bubble Tight"
Grove Control B-5	<ul style="list-style-type: none"> • API 6D "Bubble Tight"
TK Valve	<ul style="list-style-type: none"> • API 6D "Bubble Tight"
Final Control Elements T-BallJ	<ul style="list-style-type: none"> • ANSI Class IV "0.01% of Valve capacity" for standard service • ANSI Class V for surge control service
<p>Notes on Control Valve Leakage:</p> <p>Regulating valves, or control valves, do not generally require shut-off capability. Regulating valves may experience leakage due to valve modulation and valve seat exposure to high velocity flow (erosion). Becker Full Port Design Ball Valve Regulators are guaranteed to maintain "bubble tight" shutoff (API Class VI) upon initial installation. Regulators equipped with the Final Control Elements T-BallJ exhibit API Class IV shutoff upon initial installation. After years of service, the leakage rate may become excessive and the valve will require rebuilding or replacement. Determination of excessive leakage rate is based on the customer's discretion.</p>	
<p>The leakage rate of a Ball Valve Regulator depends upon several variables:</p> <ul style="list-style-type: none"> • Flow rates • Pressure Drop across control Valve • Length of service • Frequency of service • Quality of gas 	
<p>The following types of valve applications should not exhibit leakage since the valve seats are rarely exposed to erosive flow and should usually maintain API Class VI "bubble tight" shutoff:</p> <ul style="list-style-type: none"> • On-Off Valve Applications • Monitor Regulators (Overpressure Protection) • Relief Valves (Overpressure Protection) • Standby Regulators 	
<p>In the case where positive API Class VI "bubble tight" shutoff must be maintained, Becker advises one of two possibilities:</p> <ul style="list-style-type: none"> • Automation of an upstream block valve • Incorporation of the upstream monitor regulator to provide shutoff 	

PART 3:

Ball Valve Regulator Maintenance and Inspection

It is important to maintain and inspect Becker Precision Equipment Ball Valve Regulators on a regular basis. In the following section, instructions are provided for **Annual**, **5 year**, and **“As-needed”** maintenance and inspection of the BVR. Although Becker designs and manufactures products of the highest quality, all physical components are subject to wear and breakage under normal operating conditions. In order to prevent further damage to the BVR and the surrounding environment, the following maintenance and inspection procedures are recommended:

Annual Maintenance and Inspection

Ball Valve Regulator Stroking Operation

What is considered proper valve & actuator stroking?

When the BVR actuator is stroked from one end of travel to the other, the BVR should exhibit the following:

- Smooth, continuous stroking from one end of travel to the other.
- No stalling or stopping of the actuator in mid-stroke.
- Consistent stroking speed.
- No abnormal noises (scraping, chattering, or metallic sounds).

Procedure 1: Checking for Proper Valve and Actuator Stroking.

How do I check for proper valve and actuator stroking?

1. Maintain full power supply gas at normal pressure.
2. If the BVR is equipped with a **Becker** Manual Control Valve (MCV), stroke the BVR from one end of travel to the other.

3. If the BVR is not equipped with a Manual Control Valve (MCV), the actuator may be stroked by:
 - adjusting the measured variable (VRP-Pilot) and producing a “false signal” or...
 - adjusting the instrument signal (Positioner), or...
 - triggering any override devices installed on the BVR.
4. As the actuator strokes from one end of travel to the other, the linear position indicator scale on the face of the actuator should be monitored for the stroking of the BVR.
5. If the BVR exhibits stroking difficulty or any of the aforementioned unusual characteristics, corrective action is probably necessary (see below).

What causes improper valve and actuator stroking?

- Sticky valves or high torque valves.
- Damaged valves.
- Lost motion in the BVR assembly.
- Damaged actuator cylinder seals.
- Damaged actuator cylinders.
- Obstructions in the body of the valve.

How do I correct any problems associated with improper valve and actuator stroking?

If improper stroking of the valve or actuator is exhibited, then:

- First check the lubrication of the ball valve (refer to **Ball Valve Lubrication [Procedures 9 and 9.a]** on page 12).
- If lubrication of the ball valve does not fix improper stroking, check the lubrication of the actuator cylinder (refer to **Procedure 8: Applying Cylinder Lubrication** on page 11).

Actuator Housing Vent Inspection

An annual inspection of Actuator Housing is recommended to detect venting gas. If the Actuator Housing is venting gas, it is possible that there is a leak in the Valve Stem or the Actuator Cylinder Piston Seal.

**Procedure 2:
Checking Actuator Housing for Venting Gas.**

How do I determine if Actuator Housing is venting gas?

1. Make sure Actuator Cover Plate is installed and securely sealed with Gasket.
2. Make sure all Actuator Access Covers and plates are installed and sealed.
3. Remove Vent Elbow. (All Becker valve actuators are equipped with a single vent port to allow free exchange of air due to normal ambient temperature fluctuations).
4. Put soap bubble across Vent Hole.
5. If venting gas is detected, there is probably a leak in the Valve Stem or Actuator Cylinder Piston Seal. To determine which is the source of the venting gas, follow the inspection instructions listed below (starting with Valve Stem Seal leakage inspection).

**Procedure 2.a:
Valve Stem Seal Leakage Inspection.**

How do I inspect for Valve Stem Seal leakage?

1. Shut off power supply gas.
2. Depressurize actuator
3. Valve Stem Seal leakage allows gas to escape from the pressurized valve body into the BVR Actuator Housing which is normally maintained at atmospheric pressure.
4. Valve Stem Seal leakage will be apparent when gas escapes from the BVR Actuator Housing while power gas is shut off.
5. Minimal degrees of Valve Stem Seal leakage can be visually detected by placing a soap bubble on the vent of the Actuator Access Cover.
6. Greater degrees of Valve Stem Seal leakage may be detected by an audible flow of gas coming from the Actuator Access Cover. If Valve Stem Seal leakage is detected, replace the Valve Stem Seal (refer to **Procedure 3: Valve Stem Seal Replacement** on this page).

If Actuator Housing continues to vent gas and no Valve Stem Seal leakage is detected, there is leakage in the Piston Rod Seal (refer to **Procedure 5.a: Replacing Piston Rod Seals** on page 10).

**Procedure 2.b:
Cylinder Piston Rod Seal Leakage Inspection.**

The following should be performed only when **Procedure 2.a** indicates valve stem leakage.

How do I inspect for Cylinder Piston Rod Seal leakage?

(Including Piston Rod Static Seal)

1. Valve must be in full closed position.
2. Leave cylinder under full power gas.
3. Blow down the valve cavity body. (If the valve exhibits Seat leakage, it may be necessary to isolate the control valve by closing the block valves).
4. Apply soap to the Housing Vent. Any leakage from the Vent indicates Cylinder Rod Seal wear.
5. If there is leakage, replace Piston Rod Seals (refer to **Procedure 5.a: Replacing Piston Rod Seals** on page 10).

Valve Stem Leakage

What is valve stem leakage?

Ball valves utilized by **Becker Precision Equipment** are equipped with stem packing seals. These Valve Stem Seals provide a seal between the valve stem (which protrudes from the valve) and the valve body (which is pressurized). Through abnormal stem side-loading or excessive operation, Valve Stem Seals can deteriorate causing gas to leak through the Stem Seals and into the BVR actuator housing.

What causes valve stem leakage?

Valve stem leakage can be caused by the following:

- Excessive side-loading of the valve stem by the actuator
- Excessive cycling of the BVR.
- Many years of continuous BVR usage.

Valve Stem Seal Inspection

For instructions on Valve Stem Seal inspection, refer to **Procedure 2.a: Valve Stem Seal Leakage Inspection** on this page.

**Procedure 3:
Valve Stem Seal Replacement.**

How can Valve Stem leakage be corrected?

1. Valve Stem leakage necessitates replacement of the Valve Stem Sealing components. (Consult valve manuals or **Becker Precision** factory staff for replacement parts).

2. The COMPLETE BVR actuator must be removed in order to access the Valve Stem Seals.
3. Valve Stem Seal kits are available from **Becker Precision Equipment**.
4. Consult the valve manufacturer's specific instruction manual for stem seal replacement procedures.
5. The BVR should be inspected for lost motion in order to minimize the possibility of premature Valve Stem Seal wear (refer to **Procedure 6: Inspecting for Lost Motion** on page 10).

Control Instrumentation Inspection (Annual)

Becker recommends inspecting control instrumentation annually. Refer to the technical manual included with each specific instrumentation application for further instruction.

5 Year Maintenance and Inspection

Actuator Cylinder Seal Leakage Inspection

(Refer to **Drawings 01-6779, 01-6780, 01-6851, and 01-6852** on pages 19-22).

What is Actuator Cylinder Seal leakage?

Becker Precision Equipment utilizes the highest quality pneumatic cylinders in order to ensure long-life and optimum performance. Over the course of normal operation, the actuator cylinder may wear and ultimately develop leakage through the following sealing mechanisms:

- Tube Seal (O-Rings)
- Piston Seal (U-Cup)
- Piston Rod Seals
- Tail Rod Seals

What causes Actuator Cylinder Seal leakage?

Actuator Cylinder Seal leakage is not extremely common, but can occur causing degradation in the performance of the Ball Valve Regulator. Actuator Cylinder Seal leakage is typically attributed to wear over a very long period of time. However, Actuator Cylinder Seals can wear prematurely due to excessive cycling (caused by Ball Valve Regulator malfunction or improper adjustment). In addition, seal wear can be caused by contaminants or debris in the power gas supply. Some older actuator cylinders may contain rusted carbon steel Tail Rod or Piston Rod Bearings, which can

cause seal leakage. It is important to note that actuator cylinders are sensitive to low temperature effects. Worn actuator cylinders may appear normal, but will exhibit leakage only when ambient temperatures drop to freezing or below.

How do I check for Actuator Cylinder Seal leakage?

Becker recommends the inspection of all Cylinder Seals every 5 years.

Procedure 4: Checking Tube Seals (O-Rings).

1. Pressurize both cylinder top and cylinder bottom with at least 100 psig power supply gas.
2. Apply a leak-check solution around the perimeter of the cylinder tubing wall.
3. Any leakage should be easily visible.
4. Tube Seals should be replaced if ANY leakage is exhibited (refer to **Procedure 5: Replacing Tube Seals or Piston Seals** on page 9).

Procedure 4.a: Checking Piston Seals (U-Cups).

1. The actuator cylinder is equipped with two (2) unidirectional U-Cup Seals that must be checked individually.
2. If EITHER of the Piston Seals is found to exhibit excessive leakage (see table below), BOTH Seals should be replaced (refer to **Procedure 5: Replacing Tube Seals or Piston Seals** on page 9).
3. Reduce power supply gas pressure to 100 psig.
4. Apply 100 psig power supply gas to the cylinder top port and ZERO pressure to the cylinder bottom port.
5. Remove the tubing fitting from the actuator cylinder bottom port.
6. Check for excessive Piston Seal leakage (see table below).
7. Apply 100 psig power supply gas to the cylinder bottom port and ZERO pressure to the cylinder top port.
8. Remove the tubing fitting from the actuator cylinder top port.
9. Check for excessive Piston Seal leakage (see the following table).

TABLE - Excessive Piston Leakage Definition

Ambient Temperature	Excessive Piston Seal Leakage Definition
> +40°F (Warm Conditions)	Soap Bubble across "ZERO" pressure port breaks in five (5) seconds or less
< +40°F (Cold Conditions)	> 10 SCFH measured leakage from "ZERO" pressure port

Checking Piston Rod Seals.

For instructions on Piston Rod Seal inspection, refer to **Procedure 2.b:Cylinder Piston Rod Seal Leakage Inspection** on page 7.

Procedure 4.b:

Checking Tail Rod Seals.

(Includes Tail Rod Static Seal)

1. Pressurize the cylinder top with at least 100 psig power supply gas.
2. Remove Lexan Position Indicator Scale from Actuator Cylinder Topworks Box in order to gain access to Actuator Cylinder Tail Rod Seals.
3. Apply a light grade oil around the Tail Rod Cylinder Seal area.
4. Any leakage should be easily visible.
5. Tail Rod Cylinder Seals should be replaced if excessive leakage is exhibited (refer to **Procedure 5.b: Replacing Tail Rod Seals** on page 10).

Correcting Actuator Cylinder Seal Leakage

Procedure 5:

Replacing Tube Seals (O-Rings) or Piston Seals (U-Cups).

(This procedure DOES NOT require removal of the cylinder from the actuator).

1. Stroke the actuator cylinder to the FULL CLOSED position (fully retracted actuator cylinder).
2. Remove the power supply gas pressure and depressurize all instrumentation, including the actuator cylinder.
3. Remove instrumentation tubing and instrumentation from the actuator cylinder.
4. Make a vertical reference mark between the Actuator Cylinder Bottom Mounting Flange and the Actuator Cylinder Tubing Wall to ensure proper realignment upon reassembly.
5. CAUTION: BE SURE THAT POWER GAS PRESSURE HAS BEEN FULLY VENTED FROM THE

ACTUATOR CYLINDER PRIOR TO LOOSENING TIE-ROD NUTS.

6. Remove Tie-Rod Nuts from the Actuator Cylinder Top Flange.
7. If Tie-Rod Nut seizes and Tie-Rod unscrews, remove entire Tie-Rod.
8. Remove Actuator Cylinder Top Flange and Tubing Wall by lifting straight up.
9. TO PREVENT DAMAGE: DO NOT STRIKE ACTUATOR CYLINDER TUBING WALL WITH ANY OBJECT WHEN REMOVING.
10. Remove any rust, dirt, or foreign material from the Cylinder Tubing Wall and Piston using solvent if needed. DO NOT USE ABRASIVE CLEANING METHODS SUCH AS WIRE BRUSHES OR SAND PAPER.
11. Inspect Actuator Cylinder Tubing Wall for scratches or excessive wear spots. If scratches or wear spots are present on the Tubing Wall, it may need to be replaced.
12. Install new Actuator Cylinder Tube Seals (O-Rings) and/or Piston Seals (U-Cups) as needed.
13. Be careful not to damage replacement seals during installation.
14. Using a clean, lint-free cloth, apply a thin layer of STP7 brand lubricant to the Cylinder Tubing Wall and the Piston Seals.
15. Wipe excess STP7 brand lubricant from the Cylinder Wall and the Piston Seals.
16. Reassemble actuator cylinder and install Tie-Rods and Tie-Rod Nuts.
17. Tighten Tie-Rod Nuts in a crossing pattern, tightening to specified torque ratings (listed below).
18. Reassemble instrumentation and tubing.

TABLE- Specified Actuator Cylinder Tie-Rod Torque

Cylinder Bore	Tie Rod Size	Tie Rod Torque	Piston Rod Seal Kit #	Piston Seal Kit #
4	d -24	28 ft.- lb.	01-6836	01-6819
5	½ - 20	48 ft.- lb.	01-6836	01-6820
6	½ - 20	48 ft.- lb.	01-6837	01-6821
8	e - 18	115 ft.- lb.	01-6837	01-6822
10	¾ - 16	170 ft.- lb.	01-6838	01-6833
12	¾ -16	170 ft.- lb.	01-6839	01-6834
14	f - 14	375 ft.- lb.	01-6840	01-6835

Procedure 5.a:

Replacing Piston Rod Seals.

(This procedure necessitates removal of cylinder from actuator).

1. Stroke the valve actuator to FULL CLOSED position.

2. Remove the power supply gas pressure and depressurize all instrumentation, including the actuator cylinder.
3. Remove actuator cylinder.
4. Follow disassembly procedures for actuator cylinder removal (refer to pages 13 & 14).
5. Remove the Gland Plate from the bottom of the actuator cylinder. Small bore (4", 5", & 6") actuator cylinders are equipped with a Mounting Flange which must be removed.
6. After replacement of all Piston Rod Seals, lubricate assembly with STP7 brand lubricant and reassemble the Gland Plate.

Procedure 5.b: Replacing Tail Rod Seals.

(This procedure DOES NOT require removal of cylinder from actuator).

1. Remove the power supply gas pressure and depressurize all instrumentation, including the actuator cylinder.
2. Actuator may be in any location for Tail Rod Seal replacement.
3. Remove instrumentation tubing and instrumentation from the actuator cylinder.
4. Remove Actuator Cylinder Topworks Box (Older Models will have a Lexan Tube Assembly).
5. Remove Topworks Box Mounting Flange to gain access to the Tail Rod Seals.
6. Remove the Tail Rod Seal Cartridge Assembly and replace all Tail Rod Seals.
7. After replacement of all Tail Rod Seals, lubricate assembly with STP7 brand lubricant and reassemble the Gland Plate.
8. Reinstall Topworks Assembly, instrumentation and instrumentation tubing.

Ball Valve Regulator Lost Motion Inspection

What is Lost Motion?

Becker Precision Ball Valve Regulators are manufactured to exacting tolerances in order to achieve precise, accurate control. Lost Motion occurs when the actuator linkage does not have continuous communication with the ball element of the valve. Continuous cycling of the BVR while in control mode is a common symptom of BVR Lost Motion.

Lost Motion can be defined as wear in the following areas:

- Actuator linkage connections.
- The connection between the actuator and the valve stem.

- The connection between the valve stem and the valve ball.

What causes Lost Motion?

Lost Motion is caused by:

- Excessive cycling of the BVR.
- Normal wear after long service.
- Improper disassembly/assembly.

Procedure 6: Inspecting for Lost Motion.

How do I inspect for Lost Motion?

1. Close the Ball Valve Regulator.
2. Reduce the power supply gas to 10 psig or less.
3. It is advisable to maintain a pressure differential across the valve to prevent the valve from moving.
4. Adjust the measured variable (VRP-Pilots) or the instrument signal (HPP- Positioners) such that the instrumentation & actuator will attempt to OPEN the valve.
5. With the power gas limited to 10 psig, the actuator should have only enough torque to exhibit Lost Motion in the actuator without rotating the valve.
6. Measure the amount of linear movement on the Linear Valve Position Indicator Scale.
7. If the amount of Lost Motion exceeds ¼", then excessive Lost Motion is present and corrective action is recommended (see below).

Procedure 6.a: Correcting Lost Motion.

How can Lost Motion be corrected?

1. Lost Motion can typically be eliminated by examining linkage, bearing, and valve stem connections for wear and replacing the affected parts.
2. Contact **Becker Precision Equipment** factory personnel for assistance in determining the location and cause of the Lost Motion.
3. Records of the amount of Lost Motion exhibited by a BVR should be kept annually in order to forecast the need for more in-depth maintenance.

Maintain As Needed

Valve Seat Leakage Check

What is Valve Seat leakage?

Valve Seat leakage is defined as the amount of gas that flows through a valve while it is in the FULL CLOSED position. The American Petroleum Institute (API) has developed specific definitions for valve leakage. **Becker** control valves exhibit the following

leakage classes upon initial installation (see chart below):

Control Valve Leakage Class:

WKM 370E-4	API 6D	Bubble Tight	Standard or Surge Control Service
Grove Control B-5	API 6D	Bubble Tight	Standard or Surge Control Service
TK Valve	API 6D	Bubble Tight	Standard or Surge Control Service
Final Control Elements T-Ball™	ANSI Class IV	0.01% of Valve Capacity	Standard Service
Final Control Elements T-Ball™	ANSI Class V	As defined per ANSI	Surge Control Service

What causes Valve Seat leakage?

Regulating valves may experience leakage after some time in service due to modulation and Valve Seat exposure to high velocity flows (erosion). The leakage rate of a Ball Valve Regulator depends upon several variables:

- Flow rates
- Pressure drop across control valve
- Length of service
- Frequency of service
- Quality of gas

How do I check for Valve Seat leakage?

Individual companies should have their own guidelines for properly checking valve leakage of the Ball Valve Regulator. After years of service, the leakage rate may become excessive and the valve will require rebuilding or replacement. Determination of excessive leakage rate is based on the discretion of the customer. The following types of valve applications should not exhibit leakage since the Valve Seats are rarely exposed to erosive flow and should usually maintain API Class VI “bubble tight” shutoff:

- On-off valve applications
- Monitor regulators (overpressure protection)
- Relief valves (overpressure protection)
- Standby regulators

**Procedure 7:
Correcting Valve Seat Leakage.**

How do I correct Valve Seat leakage?

1. It is important to remember that regulating valves, or control valves, generally do not require shutoff ability. This policy is specific to every operating company.
2. When valve seat leakage becomes excessive, valve seats and/or seals may need to be replaced.
3. In the following instances, the entire valve may need to be replaced:

- Extreme wear of valve components.
- Unavailability of valve parts.
- When valve rebuild costs exceed valve replacement costs.

4. Consult **Becker Precision** factory personnel for information regarding valve rebuild, valve parts, or valve replacement.
5. **Becker** maintains a highly skilled and qualified valve rebuild facility.
6. In the case where positive API Class VI “bubble tight” shutoff must be maintained, **Becker** advises one of two options:
 - Automation of an upstream block valve.
 - Incorporation of the upstream monitor regulator to provide shutoff.

Actuator Cylinder Lubrication

When should actuator cylinders be lubricated?

Actuator cylinders should be lubricated after the discovery of improper Ball Valve Regulator stroking (refer to **Procedure 1: Checking for Proper Valve and Actuator Stroking** on page 6).

What type of lubrication should I use?

100% **STP**® brand lubricant is recommended for lubrication of the valve operator’s cylinder.

**Procedure 8:
Applying Cylinder Lubrication.**

(This procedure DOES NOT require removal of cylinder from actuator).

How do I apply lubrication to the cylinder?

1. Stroke the cylinder to the completely closed (rod retracted) direction by applying up to 100psig gas to the bottom port.
2. Remove tubing from both ports of the cylinder.
3. When the cylinder reaches the end of travel, remove the power gas from the bottom port.
4. Make a vertical mark on the Cylinder Bottom Flange and the tube for line-up when reinstalling.
5. Loosen Tie Rod Nuts from the Top Cylinder Flange and remove them (if Tie Rod loosens along with the nut, remove the entire Tie Rod).
6. Remove Top Cylinder Flange and Cylinder Sleeve by carefully lifting straight up.
7. Remove all dirt and/or rust from the cylinder sleeve and piston (using solvent if necessary).
8. Using a clean, lint-free cloth, apply a thin layer of **STP**® brand lubricant to the Cylinder Tubing Wall and Piston Seals.
9. Wipe excess **STP**® brand lubricant from the Cylinder Wall and Piston Seals.
10. Reassemble and Torque Tie Rods in cross pattern to proper specification.

Ball Valve lubrication

When should ball valves be lubricated?

Valve cleaner/lubricant should be applied only when erratic or difficult valve operation is exhibited. Ball Valve Regulator stroking should be checked before ball valves are lubricated (refer to **Procedure 1: Checking for Proper Valve and Actuator Stroking** on page 6).

What type of lubrication should I use?

It is important to utilize the correct valve cleaner/ lubricant. Improper valve cleaner/lubricant can worsen valve regulator performance and even damage the valve. **Becker** recommends using **Mobilith SHC-220** (or equivalent) for lubrication when necessary. If lubrication does not return valve to normal operation, a valve cleaner/lubricant may be necessary. **Becker** recommends **Sealweld** valve cleaner/lubricant (or equivalent).

Procedure 9: Applying Lubrication to Valve Seats.

How do I apply lubrication to Valve Seats?

1. If the valve is not equipped with Valve Seat lube features, proceed directly to Procedure 9.a.
2. Isolate control valve to be lubricated by closing upstream and downstream block valves.
3. Put control valve to be lubricated in full closed position.
4. Apply lubricant to each Valve Seat lube fitting.
5. Stroke valve from full open to full closed positions approximately 10 to 15 times. If normal valve operation returns, no further service is required.

Procedure 9.a: Applying Valve Cleaner/Lubricant to Valve Body Bleed Fitting.

If applying lubrication to Valve Seats does not provide proper valve operation, it is necessary to lubricate the ball valve directly through the Valve Body Bleed Fitting.

How do I apply valve cleaner/lubricant to Valve Body Bleed Fitting?

1. Isolate control valve to be lubricated by closing upstream and downstream block valves.

2. Put control valve to be lubricated in full open position.
3. Valve cleaner/lubricant should be applied to the body bleed fitting per the following quantities:
 - For 2", 3", or 4" bore valves, apply two (2) tubes.
 - For 6" and 8" bore valves, apply four (4) tubes.
 - For 10" bore valves, apply six (6) tubes.
 - For 12" bore valves, apply eight (8) tubes.

For larger valves, contact **Becker** for proper lubrication amount.

*Note: Valve bore is the first number of the **Becker** regulator model number located on the stainless steel tag attached to the pneumatic actuator cylinder.*

4. Apply ½ of total quantity of valve cleaner/lubricant to body bleed fitting of valve. For valves with one fitting, this fitting is the body bleed port and should be used for lubrication typically 4" bore valves and smaller. For valves with three fittings that are installed above grade, the body bleed fitting is located in the bottom-center of the valve body. For valves with three (3) fittings that are installed below grade, the body bleed fitting is the middle fitting extension which is terminated with a ½" ball valve.
5. Allow 15 minutes for lubricant to take effect and then stroke from full open to full closed position 10 to 15 times.
6. Apply remaining ½ of valve cleaner/lubricant to body bleed fitting.
7. Allow fifteen minutes for cleaner/lubricant to take effect and then stroke valve from full open to full closed position 10 to 15 times.
8. Return valve to service.

Instrumentation Maintenance (as needed)

For "as-needed" instrumentation maintenance instruction, refer to the technical manual supplied with the specific instrumentation application.

PART 4: **Above Grade Actuator Installation and Disassembly.**

Procedure 10: **Above Grade Actuator Installation.**

(Refer to **Drawing No. 01-5176** on page 16).

1. Open valve to FULL OPEN position.
2. Remove existing actuator.
3. Remove Housing Cover plate (G) from actuator. DO NOT REMOVE Outboard Bearing (K) or Torque Arm (L).
4. Scrape and wire brush all corroded areas on Valve Mounting Flange (Q) and Stem (O). Be sure to remove all burrs from Stem. Lubricate Stem with cup grease.
5. Install actuator on Valve Mounting Flange (Q). Apply and tighten nuts on Mounting Studs (N).
6. Loosen all Outboard Bearing Bolts (J) and then re-tighten.
7. Pneumatically traverse cylinder to FULL OPEN position.
8. If Key (E) will not align with Valve Stem (O), turn Connecting Link Stud (C) to shorten or lengthen Connecting Link (A).

Note: Be sure to keep pressure in top of the cylinder while turning Stud.

9. When perfect alignment is obtained, insert Key (E) and tighten Set Screw (P).
10. Lock both connecting Link Jam Nuts (B).
11. Stroke the actuator to the FULL OPEN and FULL CLOSED positions.
12. If the valve does not travel such that the bore of the ball valve is in perfect alignment with the inlet/outlet of the valve, the Actuator Connecting Link (Item No. 9) must be adjusted.
13. Adjust the Connecting Link (Item No. 9) in either the clockwise or counter-clockwise direction to achieve proper alignment of the valve ball. It is imperative that the ball rotate properly to both the FULL CLOSED and FULL OPEN positions in order to provide complete shutoff capabilities.
14. Install Coverplate (G) by aligning hole with Guide Pin (D). Secure all nuts.

Note: Valve actuator is supplied with lubrication in essential areas. In highly corrosive installations, it is advisable to coat all rotating bearing areas with cup grease or similar grease to reduce possibility of corrosion.

Procedure 10.a: **Above Grade Actuator Disassembly (Cylinder Only).**

To remove actuator cylinder ONLY:

(Refer to **Drawing No. 01-6793** on page 17. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6818** on page 17).

1. Depressurize and remove instrumentation tubing lines.
2. Valve may be in any position.
3. Remove Cover Plate (Item No. 5) from Actuator Housing (Item No. 13).
4. Remove the Pin Clamp (Item No. 8) and Torque Arm Pin (Item No.10).
5. Remove Indicator Bar (Item 22-Drawing 01-6793 only).
6. Remove nuts holding Cylinder Flange (Item No. 1) to the Actuator Housing (Item No. 13).
7. Cylinder (Item No. 1) can now be removed from the actuator assembly.

Procedure 10.b: **Above Grade Actuator Reinstallation (Cylinder Only):**

To reinstall the actuator cylinder ONLY:

(Refer to **Drawing No. 01-6793** on page 17. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6818** on page 17).

1. If the Connecting Link (Item No. 9) has not been removed, proceed to step 5.
2. DO NOT ADJUST THE LENGTH OF THE CONNECTING LINK (Item No. 9).
3. Reinstall the Actuator Jam Nut (Item No. 2); Rod Clevis (Item No. 3) and entire Connecting Link (Item Nos. 4, 7, 9, [also Item Nos. 22 and 23 on **01-6793**]).
4. Be sure to match the original installed position of the Rod Clevis. It is recommended to count the number of exposed threads on the Cylinder Piston Rod to achieve agreement.
5. Reinstall the Actuator Cylinder (Item No. 1) and bolts which attach to the Actuator Housing (Item No. 13) and tighten nuts.
6. Reinstall the Torque Arm Pin (Item No. 10) and Pin Clamp (Item No. 8).
7. Reinstall instrumentation tubing lines and pressurize.

8. Stroke the actuator to the FULL OPEN and FULL CLOSED positions.
9. If the valve does not travel such that the bore of the ball valve is in perfect alignment with the inlet/outlet of the valve, the Actuator Connecting Link (Item No. 9) must be adjusted.
10. Adjust the Connecting Link (Item No. 9) in either the clockwise or counter-clockwise direction to achieve proper alignment of the valve ball. *It is imperative the ball rotate properly to both the FULL CLOSED the FULL OPEN position.*

**Procedure 10.c:
Above Grade Actuator Disassembly
(Complete Actuator).**

To remove COMPLETE actuator from the valve:

(Refer to **Drawing No. 01-6793** on page 17. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6818** on page 17).

1. Depressurize and remove instrumentation tubing lines.
2. Valve may be in any position.
3. Remove Cover Plate (Item No. 5) from housing.
4. Loosen Set Screw (Item No. 12) which holds Square Key (Item No. 16) in place.
5. Remove Nuts (Item No. 21) from Valve Adapter Plate Studs (Item No. 20).
6. COMPLETE actuator may now be removed from valve.

PART 5: Becker Below Grade Actuator Disassembly and Reinstallation

**Procedure 11:
Below Grade Actuator Disassembly
(Cylinder Only).**

To remove actuator cylinder ONLY:

(Refer to **Drawing No. 01-6911** on page 18. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6799** on page 18).

1. Depressurize and remove instrumentation tubing lines.
2. Valve should be in the FULL CLOSED position.
3. Remove Access Covers (Item Nos. 11 and 22 on **01-6799**); or Lexan Cover and Indicator Frame (Item Nos. 11 and 24 on **01-6911**) from Actuator Housing (Item No. 13).
4. Remove one of the Tru-Arc Rings (Item No. 4) from the Rod Clevis Pin (Item No. 7).
5. Remove the Rod Clevis Pin (Item No. 7) by pushing it through the Rod Clevis (Item No. 3).
6. Remove bolts/nuts holding Cylinder Flange (Item No. 1) to the Actuator Housing (Item No. 13).
7. Cylinder (Item No. 1) can now be removed from the actuator assembly.

It is important to mark the position of the Rod Clevis (Item No. 3) on the Cylinder Rod. The Rod Clevis (Item No. 3) must be exactly at its original position when reassembled.

**Procedure 11.a:
Below Grade Actuator Reinstallation
(Cylinder Only).**

To reinstall the actuator cylinder ONLY:

(Refer to **Drawing No. 01-6911** on page 18. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6799** on page 18).

1. Be sure to match the original installed position of the Rod Clevis (Item No. 3). It is recommended to count the number of exposed threads on the Cylinder Piston Rod to achieve agreement.
2. Tighten the Jam Nut (Item No. 2).
3. Reinstall the Actuator Cylinder (Item No.1) without tightening bolts/nuts.
4. Reinstall the Rod Clevis Pin (Item No. 7) by pushing it through the Rod Clevis (Item No. 3).
5. Reinstall the Tru-Arc Rings (Item No. 4) to the Rod Clevis Pin (Item No. 7).
6. Reinstall the Lexan Cover and the Indicator Frame (Item Nos. 11 and 24 on **01-6911**); or Access Covers (Item nos. 11 and 22 on **01-6799**).
7. Reinstall Access Plate from Actuator Housing (Item No.16).
8. Reinstall instrumentation tubing lines and pressurize.
9. Stroke the actuator to the FULL OPEN and FULL CLOSED positions.
10. If the valve does not travel such that the bore of the ball valve is in perfect alignment with the in-

let/outlet of the valve, the Rod Clevis (Item No. 3) must be adjusted.

11. Remove the Actuator Cylinder (Item No. 1) and turn the Rod Clevis (Item No. 3) in either the clockwise or counter-clockwise direction to achieve proper alignment of the valve ball.
12. *It is imperative the ball rotate properly to both the FULL CLOSED the FULL OPEN position.*

Procedure 11.b: Below Grade Actuator Disassembly (Complete Actuator).

To remove COMPLETE actuator from the valve:
(Refer to **Drawing No. 01-6911** on page 18. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6799** on page 18).

1. Valve may be in any position.
2. Excavate below grade portion of the Ball Valve Regulator.
3. Disconnect valve lubrication lines and "knee brace" between actuator and valve.
4. Remove Cover Plate (Item No. 5) from Actuator Housing (Item No. 13).
5. Loosen the Set Screw (Item No. 12) which holds the Square Key (Item No. 16) in place.
6. Remove Nuts (Item No. 21) from Adapter Plate Studs (Item No. 20).
7. Remove COMPLETE actuator assembly from valve.

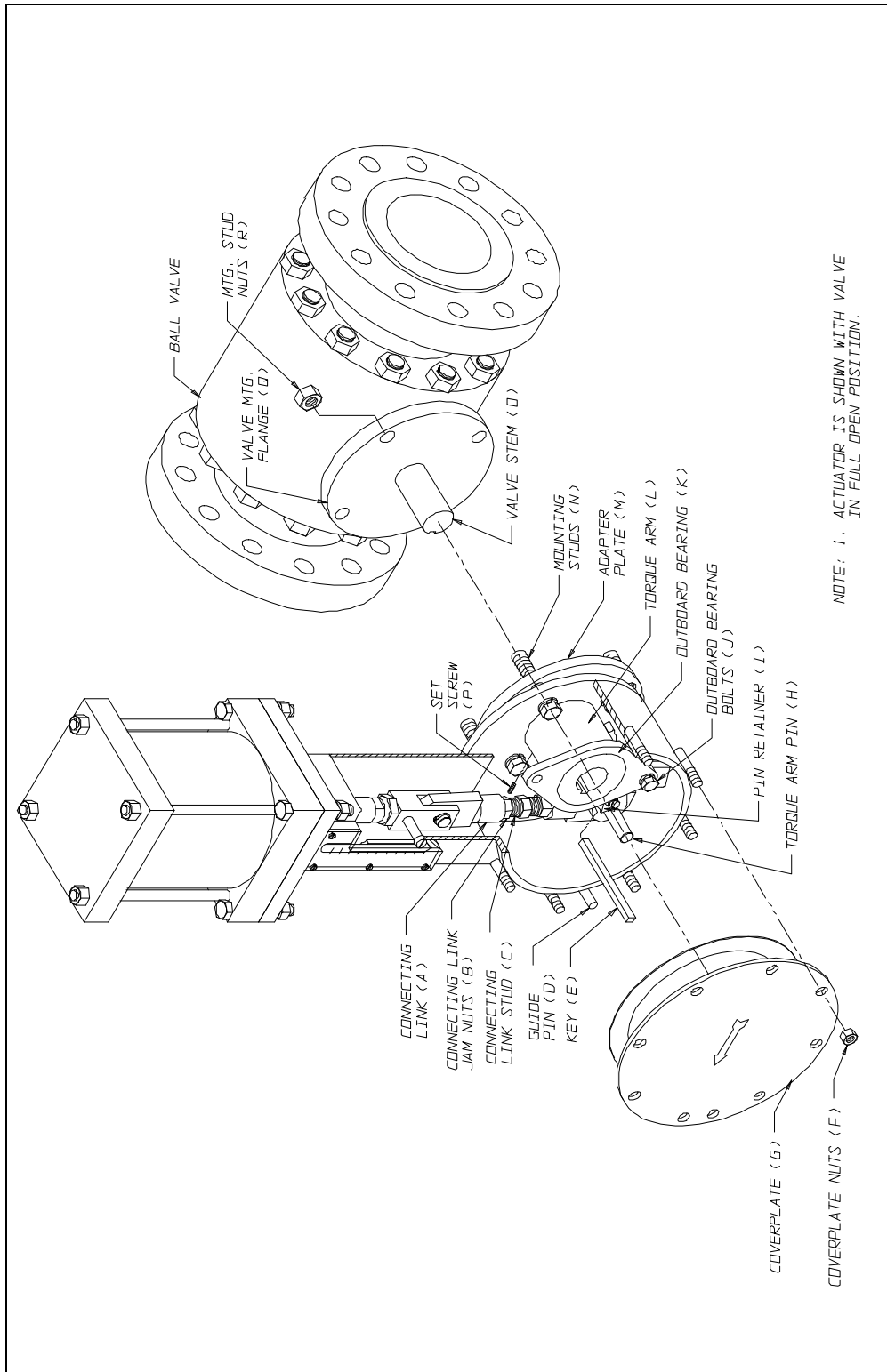
Procedure 11.c: Below Grade Actuator Reinstallation (Complete Actuator).

To reinstall the COMPLETE actuator on the valve:

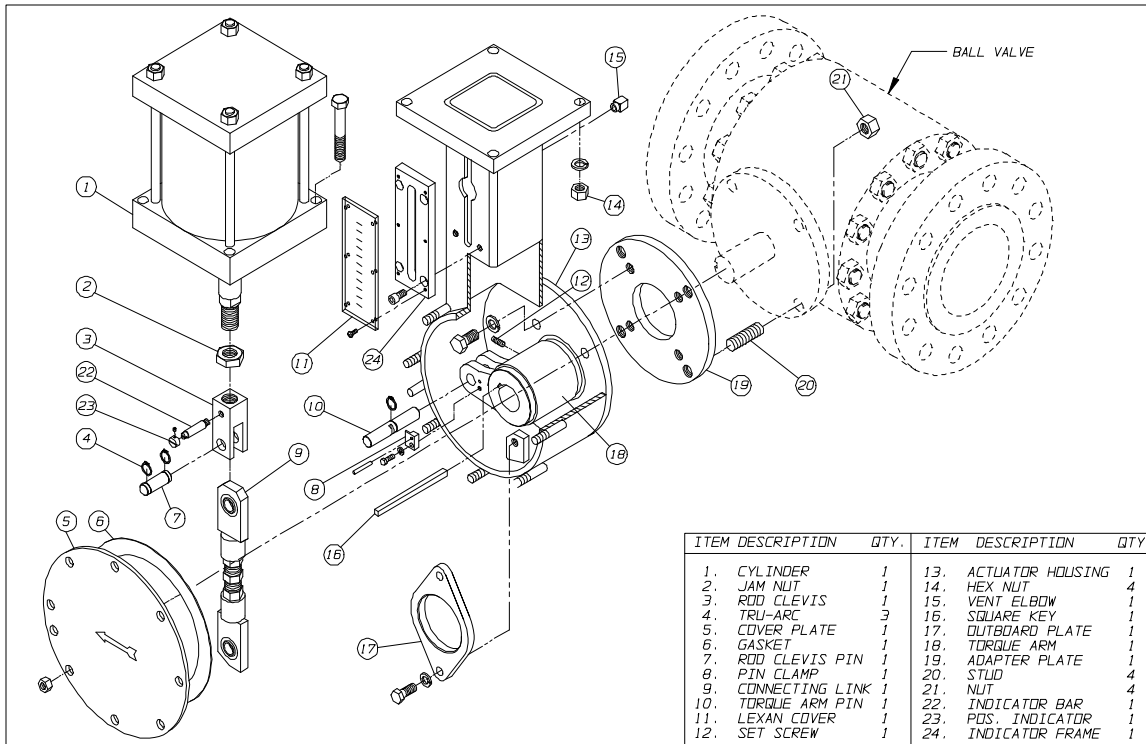
(Refer to **Drawing No. 01-6911** on page 18. If unit is equipped with Tail Rod Cylinder, refer to **Drawing No. 01-6799** on page 18).

1. Valve must be in FULL OPEN position.
2. Fit COMPLETE actuator onto valve stem.
3. Loosen all Outboard Bearing Bolts and re-tighten.
4. Install Nuts (Item No. 21) onto Valve Adapter Plate Studs (Item No. 20) and tighten.
5. Connect valve lubrication lines and "knee brace" between actuator and valve
6. Reinstall Square Key (Item No. 16).
7. If keyways do not align, the position of the Clevis must be readjusted:
 - a. Remove Torque Arm Pin (Item 10).
 - b. Stroke actuator towards closed position.
 - c. Rotate the Connecting Link (with Clevis) one full rotation in desired direction.
 - d. Stroke the actuator to the FULL OPEN position.
 - e. Reinstall the Torque Arm Pin and Key.
8. Reinstall Set Screw (Item No. 12) which holds Square Key in place.
9. Tighten the Clevis Jam Nut.
10. Reinstall instrumentation tubing lines and pressurize.
11. Stroke the actuator to the FULL OPEN and FULL CLOSED positions.
12. If the valve does not travel such that the bore of the ball valve is in perfect alignment with the inlet/outlet of the valve, the Rod Clevis (Item No. 3) must be adjusted.
13. Remove the Actuator Cylinder (Item No. 1) and turn the Rod Clevis (Item No. 3) in either the clockwise or counter-clockwise direction to achieve proper alignment of the valve ball.
14. *It is imperative the ball rotate properly to both the FULL CLOSED the FULL OPEN position.*

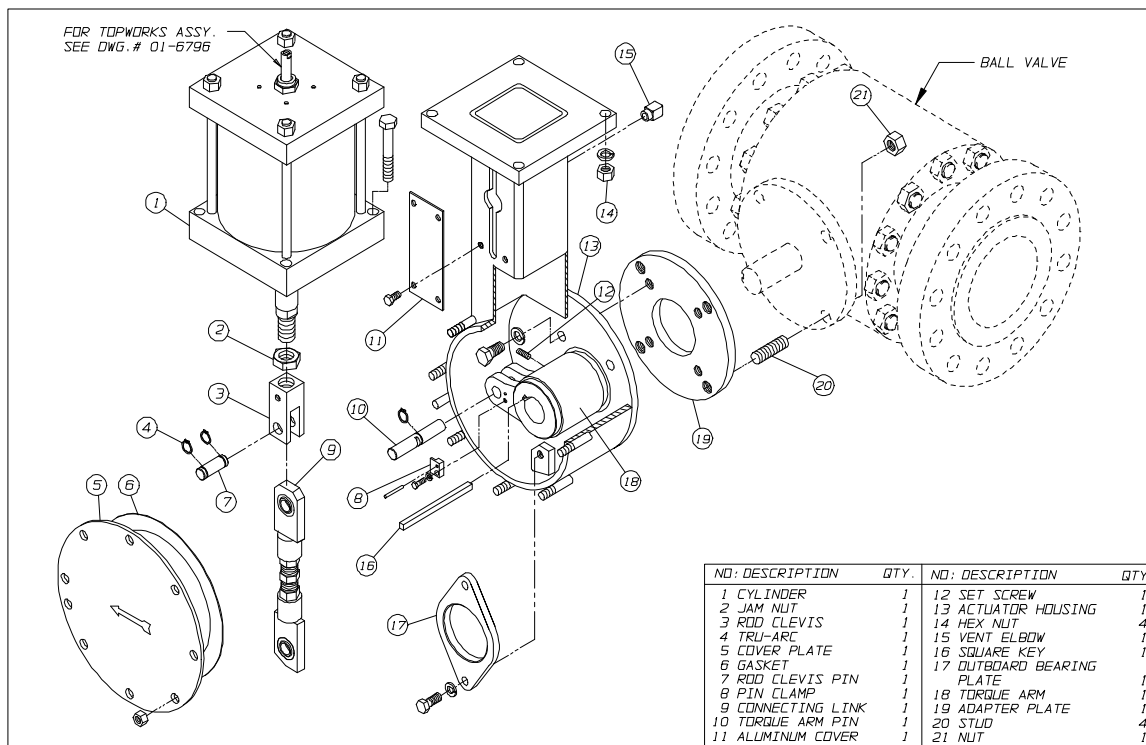
Part 6: Appendix



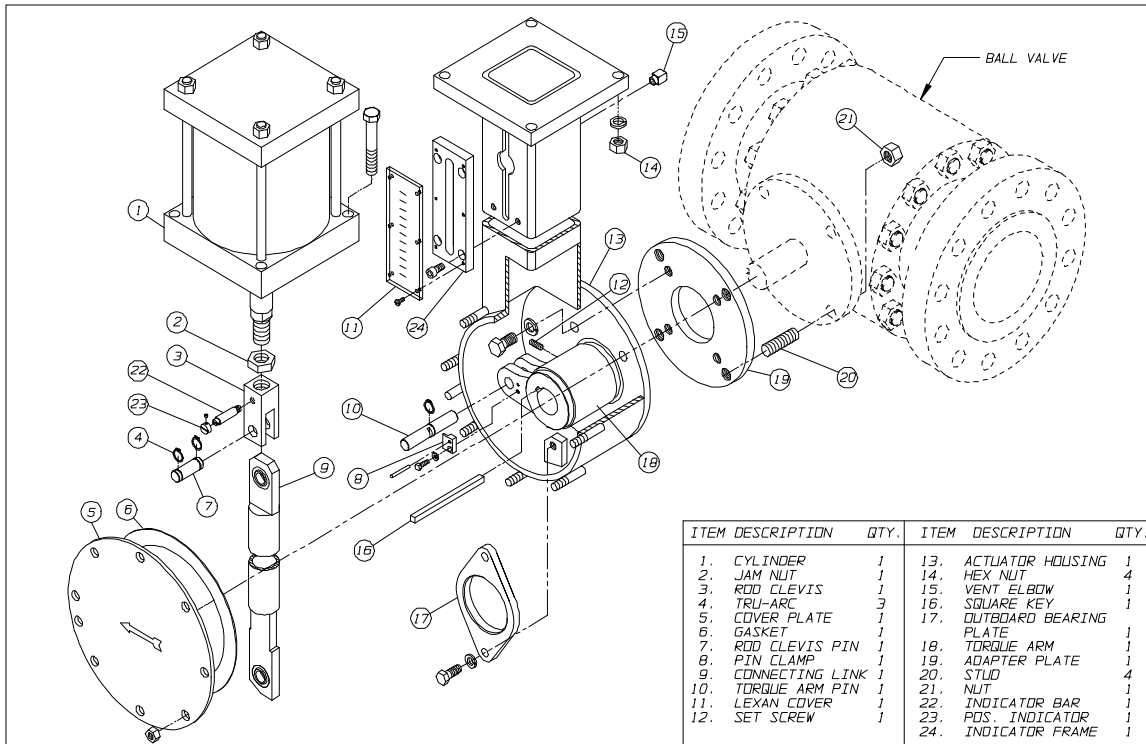
Drawing 01- 5176: Field Installation for Above Grade Actuator



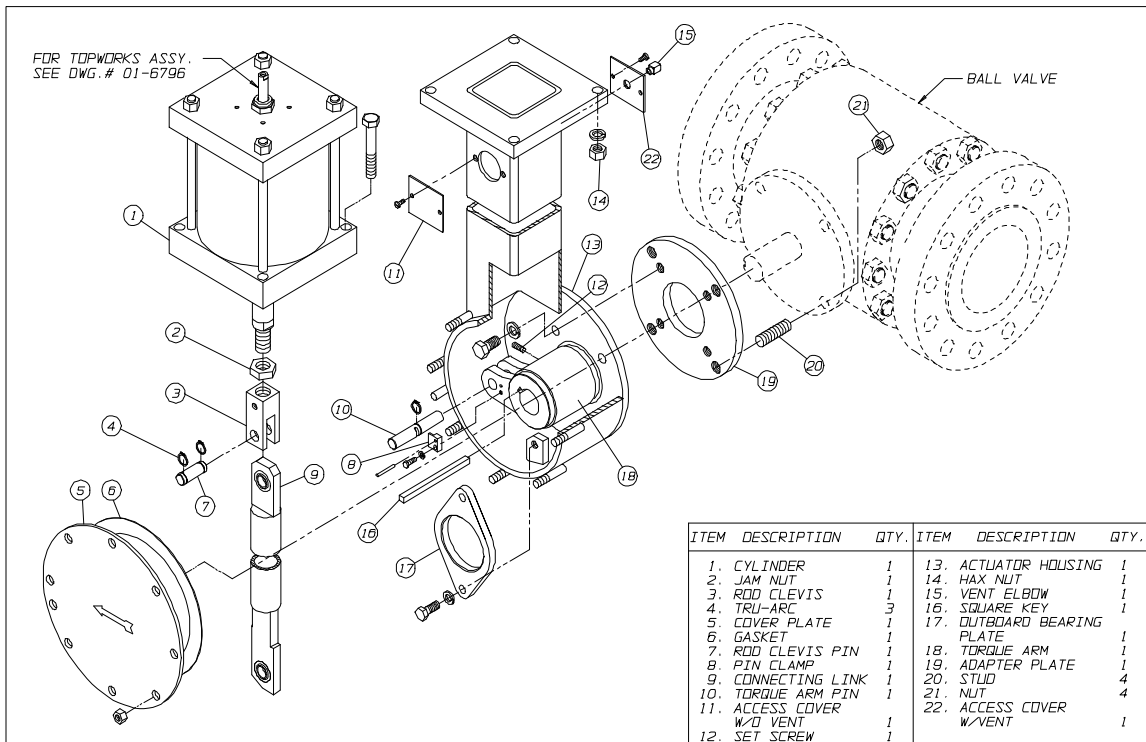
Drawing 01-6793: Above Grade Ball Valve Regulator with Single Rod Cylinder
(Instrumentation installed below the Cylinder)



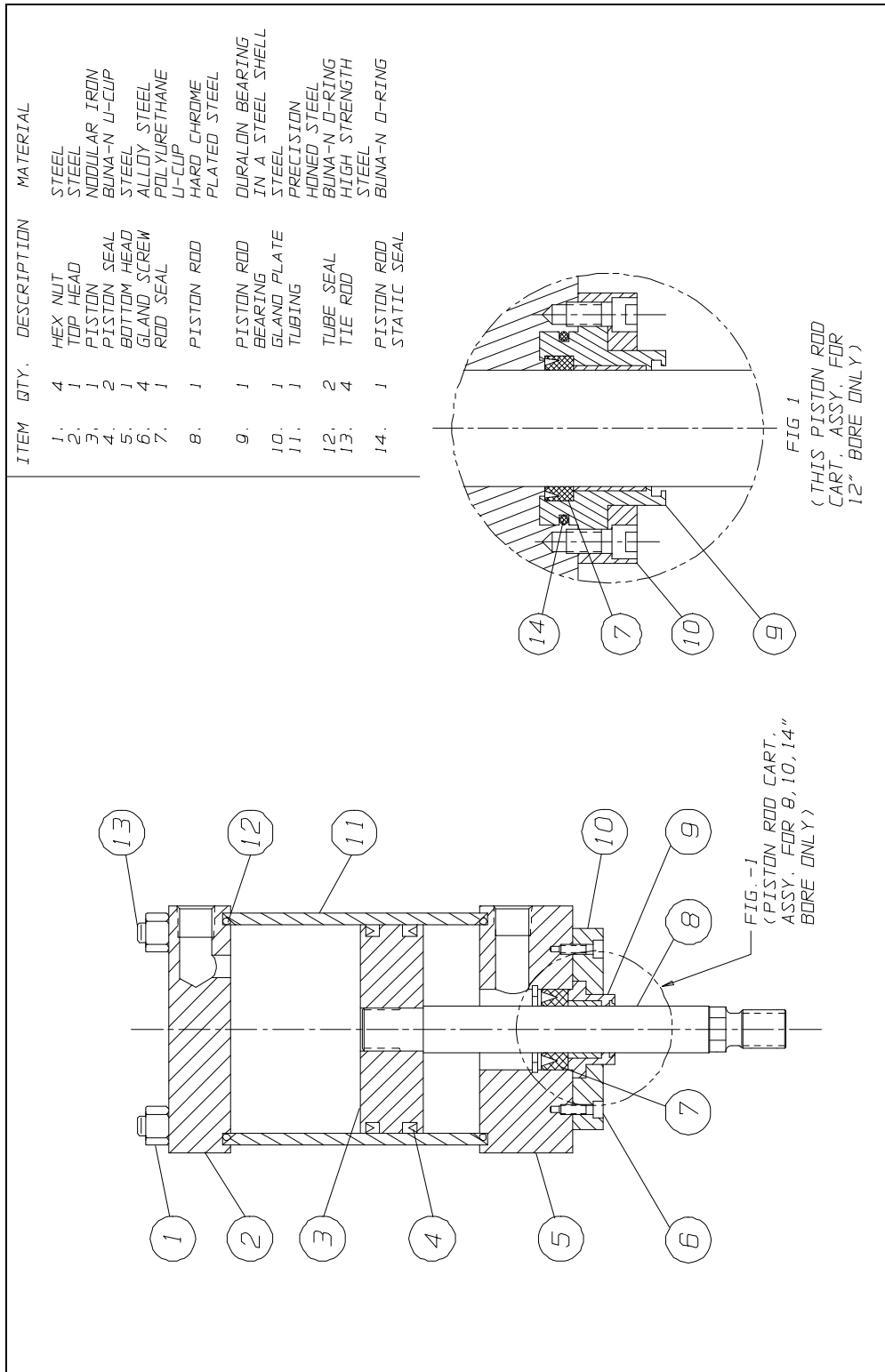
Drawing 01-6818: Above Grade Ball Valve Regulator with Tail Rod Cylinder
(Instrumentation installed above the Cylinder)

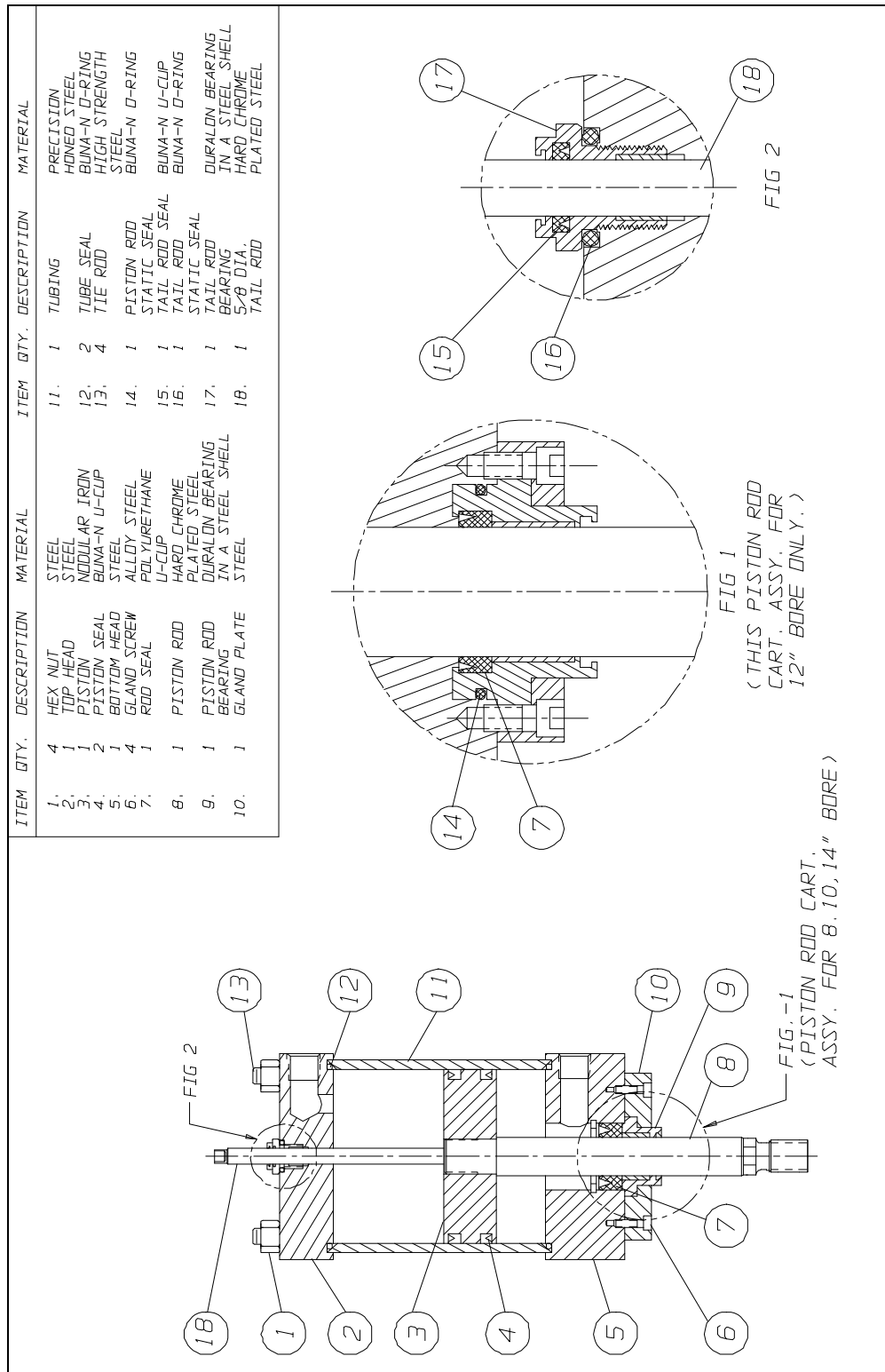


Drawing 01-6911: Below Grade Ball Valve Regulator with Single Rod Cylinder
(Instrumentation installed below the Cylinder)

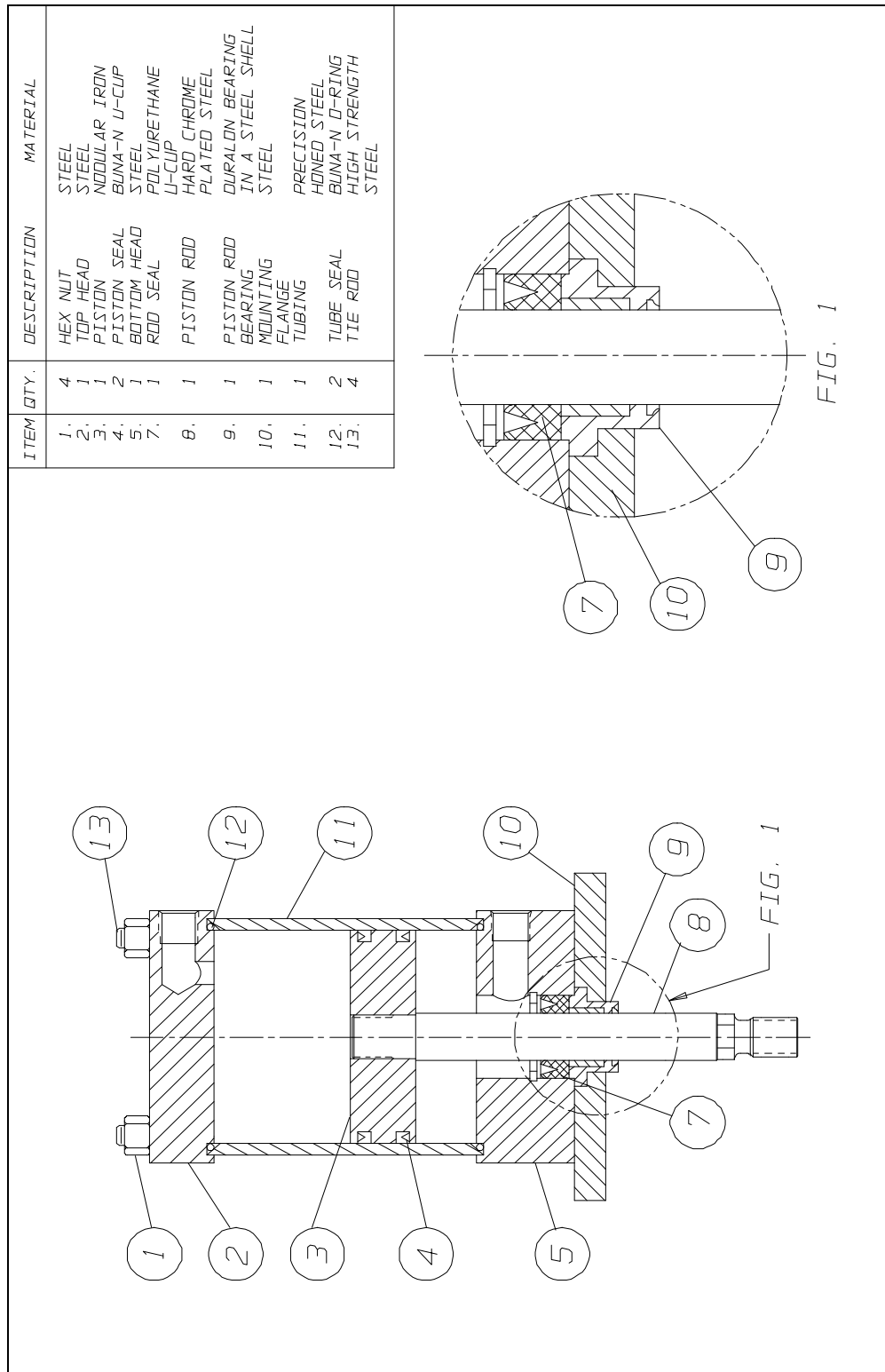


Drawing 01-6799: Below Grade Ball Valve Regulator with Tail Rod
(Instrumentation installed above the Cylinder)

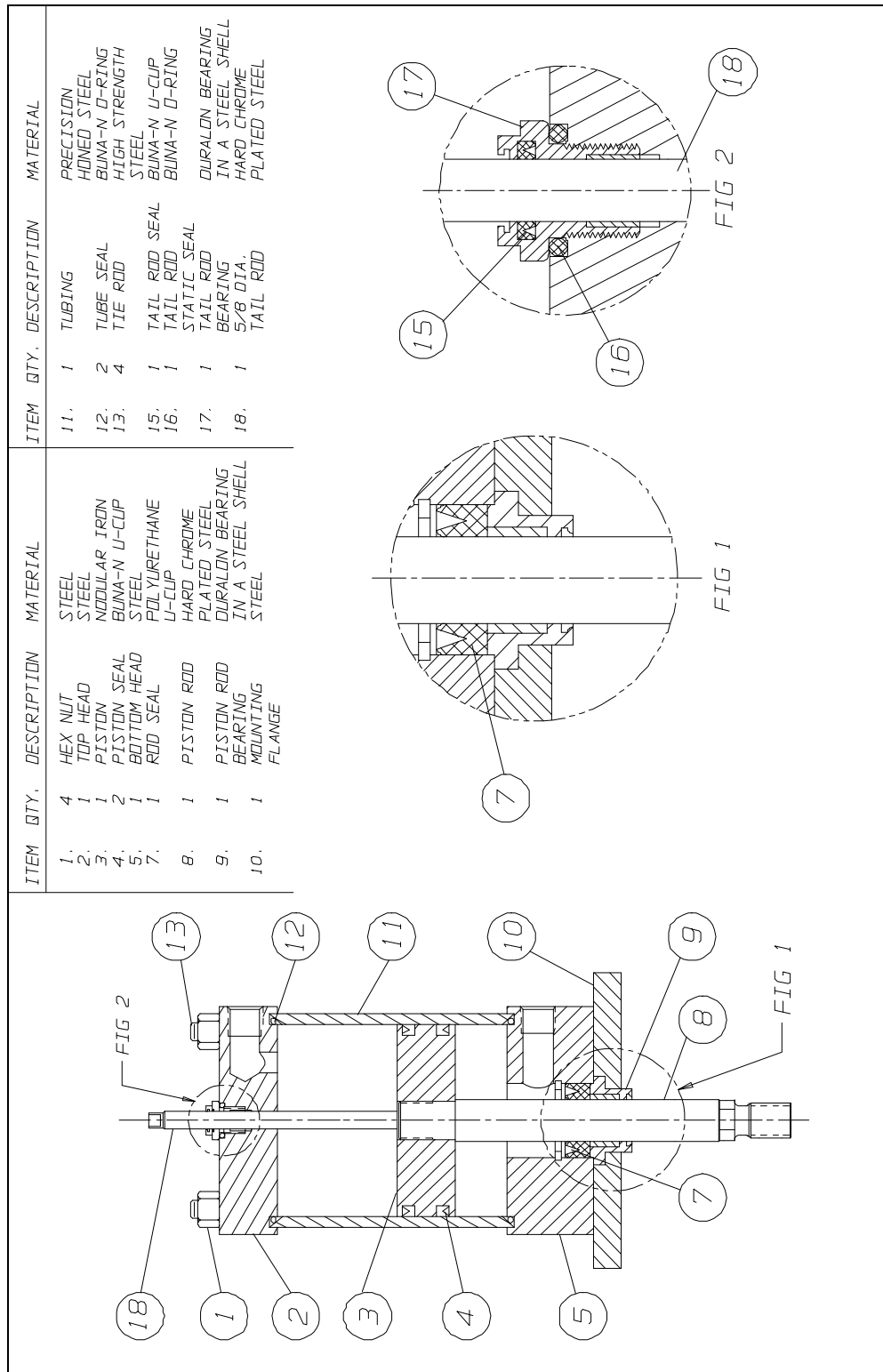




Drawing 01- 6780: Tail Rod Cylinder (8"-14" Bore)



Drawing 01- 6851: Single Rod Cylinder (4" - 6" Bore)



Drawing 01-6852: Tail Rod Cylinder (4"-6" Bore)

Ball Valve Regulator (Double-Acting) Recommended Annual Maintenance Checklist

(Includes Ball Control Valve and Actuator)

Refer to Part 3 of Instruction Manual for the Becker Ball Valve Regulator (Double-Acting Series)

1. _____ **Ball Valve Regulator Stroking Operation**
Refer to Procedure 1, Page 6
2. _____ **Actuator Housing Vent Inspection**
Refer to Procedure 2, Page 7
3. _____ **Valve Stem Seal Leakage Inspection**
Refer to Procedure 2.a, Page 7
4. _____ **Cylinder Piston Rod Seal Leakage Inspection**
Refer to Procedure 2.b, Page 7
5. _____ **Control Instrumentation Inspection**
Refer to technical manual included with each specific instrumentation application for further instruction

Ball Valve Regulator (Double-Acting) Recommended 5 Year Maintenance Checklist

(Includes Ball Control Valve and Actuator)

Refer to Part 3 of Instruction Manual for the Becker Ball Valve Regulator (Double-Acting Series)

1. _____ **Perform Ball Valve Regulator (Double-Acting) Recommended Annual Maintenance**
Refer to *Ball Valve Regulator (Double-Acting) Recommended Annual Maintenance Checklist*
2. _____ **Checking Tube Seals (O-Rings)**
Refer to Procedure 4, Page 8
3. _____ **Checking Piston Seals (U-Cups)**
Refer to Procedure 4.a, Page 8
4. _____ **Checking Tail Rod Seals**
Refer to Procedure 4.b, Page 9
5. _____ **Inspecting for Lost Motion**
Refer to Procedure 6, Page 10
6. _____ **Control Instrumentation Inspection**
Refer to technical manual included with each specific instrumentation application for further instruction

Ball Valve Regulator (Double-Acting) Recommended “As Needed” Maintenance Checklist

(Includes Ball Control Valve and Actuator)

Refer to Part 3 of Instruction Manual for the Becker Ball Valve Regulator (Double-Acting Series)

1. _____ **Valve Seat Leakage Check**
Refer to Procedure 7, Page 11
2. _____ **Actuator Cylinder Lubrication**
Refer to Procedure 8, Page 11
3. _____ **Ball Valve Lubrication**
Refer to Procedure 9, Page 12

Feedback

In an effort to best serve the needs of our customers, Becker requests any comments, thoughts, or suggestions you may have regarding this manual. Simply write your comments in the space provided and return to Becker via fax or mail to Becker at the address indicated below.

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