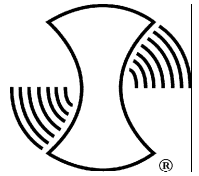


# BETTIS

**Actuators & Controls**

*A Daniel Industries Company*

Bettis Canada Ltd.  
4112 91A Street  
Edmonton, Alberta, Canada T6E 5V2  
Tel: (780) 450-3600  
Fax: (780) 450-1400



**Edmonton**

---

## SERVICE MANUAL No. I-0021

---

**LINEAR GAS / HYDRAULIC**

**GATE VALVE OPERATOR**

CUSTOMER: \_\_\_\_\_

P.O.#: \_\_\_\_\_

W.O.#: \_\_\_\_\_

TAG: \_\_\_\_\_

DATE: \_\_\_\_\_

APPLIES TO OPERATOR MODEL: \_\_\_\_\_

SECTION I LINEAR GAS / HYDRAULIC GATE VALVE OPERATOR

	<u>DESCRIPTION</u>	<u>DWG.NO</u>	<u>PAGE</u>
I	SAFETY WARNINGS .....		4
	DECALS, GAS / HYDRAULIC OPERATING PROCEDURES .....		5
II	OPERATING INSTRUCTIONS .....		6
III	INSTALLATION .....		6
	FIELD INSTALLATION LAYOUT .....	I-0103 .....	8
	FIELD INSTALLATION LAYOUT .....	I-0103-10 .....	9
IV	MECHANICAL STOP ADJUSTMENTS .....		10
V	PRESTART-UP CHECKS .....		11
VI	START-UP CHECKS .....		12
VII	SCHEDULED MAINTENANCE AND TESTING .....		13
VIII	LIMIT SWITCH INSTRUCTIONS .....		15
IX	END OF STROKE ADJUSTMENT INSTRUCTIONS .....		16
X	LINEAR OPERATOR MAINTENANCE .....		16
XI	LINEAR OPERATOR DISASSEMBLY .....		17
XII	LINEAR OPERATOR ASSEMBLY .....		17
	OPERATOR CUTAWAY .....		19
XIII	FLUID MAINTENANCE GUIDE .....		20
XIV	HYDRAULIC FLUID SPECIFICATIONS .....		20
	GAS / HYDRAULIC TANK FILLING .....	I-0021-12 .....	21
XV	OPERATOR REPAIR KITS .....		22
XVI	TROUBLESHOOTING .....		23
XVII	GENERAL SERVICE NOTES .....		24
	GAS / HYDRAULIC OPERATOR BASIC SCHEMATIC .....	I-0021-02 .....	26
	BASIC MANIFOLD ASSEMBLY .....	A-0197 .....	27
	RELAY A324-M .....	C-0032 .....	28
	RELAY A324-DM .....	C-0034-00 .....	29
	WBMC SELECTOR .....	APB0648 .....	30
	SPEED FLOW CONTROL VALVES .....		31
	HANDPUMP .....	A-0181 .....	32
	HANDPUMP SAFETY VALVE .....	APB0815 .....	33
	FILTER.....	A-0182 .....	34

SECTION I LINEAR GAS / HYDRAULIC GATE VALVE OPERATOR

<u>DESCRIPTION</u>	<u>DWG.NO</u>	<u>PAGE</u>
XVIII VH LOCKING BLOCK ADJUSTMENT AND SERVICE .....		35
VH LOCKING BLOCK .....	APB0662 .....	36
MECO REGULATOR .....		37
END OF STROKE VENT VALVE DOWNWARD STROKE .....	C-0081 .....	40
END OF STROKE VENT VALVE UPWARD STROKE .....	C-0083 .....	41
LIMIT SWITCH: HONEYWELL .....		42
FIELD SERVICE REQUEST AND CHECKLIST .....	I-0100 .....	43
XIV NOTES .....		45

SECTION II SPECIFICS FOR PARTICULAR UNIT

# I SAFETY WARNINGS

## 1. OPERATING INSTRUCTIONS (Page 6)

This equipment exhausts gas as part of its operating cycle. Wear hand, ear, and eye protection, and keep sparking devices and open flames away.

## 2. INSTALLATION (Page 7)

For final assembly over stem to valve, lifting lugs are to be used in combination with a two leg sling with on shortening hook to lift the operator only.

## 3. INSTALLATION (Page 7)

Excess operator travel can cause damage to end of stroke (trigger) valve if over-travel occurs and the trigger interferes with the component. The operator's mechanical end stops are preset at the factory for 90° travel.

## 4. START-UP CHECKS (Page 12)

If the unit has a fail or ESD (Emergency Shut Down) position, the failsafe or ESD controls may have to be temporarily disabled, bypassed or overridden by AUTO / MANUAL selector to prevent inadvertent valve operation.

## 5. SCHEDULED MAINTENANCE AND TESTING (Page 13)

DE-PRESSURIZE operator before attempting to service power gas filter. Check tank fluid level or manual operation of handpump.

## 6. END OF STROKE ADJUSTMENT INSTRUCTIONS (Page 16)

Changing operator travel can cause damage to end of stroke (trigger) valve if over travel occurs and trigger strikes component.

## 7. LINEAR OPERATOR MAINTENANCE (Page 16)

Gas / Hydraulic tanks should be drained and flushed if fluid is contaminated with scale, rust, particulates, water, foam, or etc. Flush only with hydraulic fluid. Refill with filtered fluid.

## 8. MECHANICAL STOP ADJUSTMENTS (Page 10)

The upper and lower operator positions must be adjusted to ensure correct operation.

Please refer to the applicable section for details and further information.

## OPERATING PROCEDURE

### 1. MANUAL OPERATION WITH POWER GAS

- A) PRESS UPPER LEFT RELAY HANDLE AND HOLD TO CLOSE LINE VALVE.
- B) PRESS UPPER RIGHT RELAY HANDLE AND HOLD TO OPEN LINE VALVE.

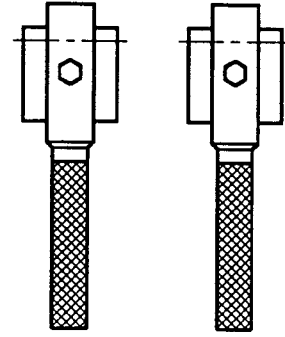
### 2. MANUAL OPERATION WITHOUT POWER GAS

- A) TURN LOWER LEFT VALVE HANDLE AND OPERATE HAND PUMP TO CLOSE LINE VALVE.
- B) TURN LOWER RIGHT VALVE HANDLE AND OPERATE HAND PUMP TO OPEN LINE VALVE.

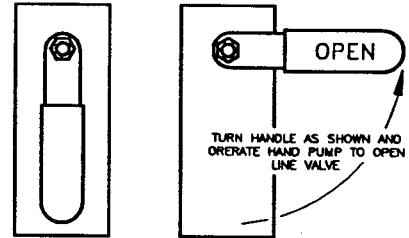
### 3. TO DISARM OPERATOR

- A) SHUT OFF POWER GAS SUPPLY.
- B) PUSH EITHER UPPER RELAY HANDLE HALFWAY TO BLEED PRESSURE.

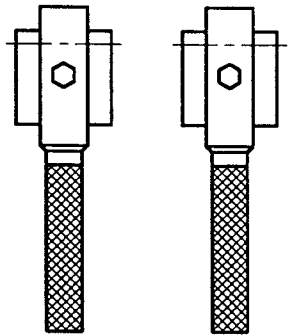
SPB9244-130 REV 1



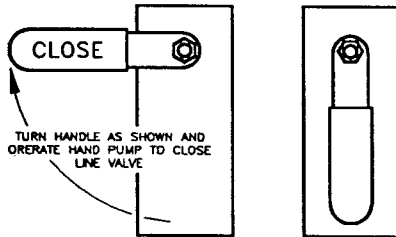
**CAUTION: WITHOUT POWER GAS ONLY**



MADE IN CANADA SPB9244-120 REV 3

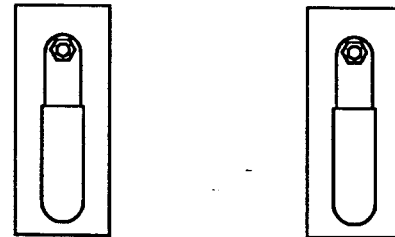
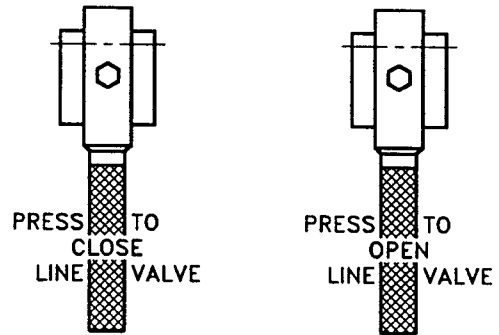


**CAUTION: WITHOUT POWER GAS ONLY**



MADE IN CANADA SPB9244-110 REV 3

**WITH POWER GAS**



MADE IN CANADA SPB9244-100 REV 3

## II OPERATING INSTRUCTIONS

NOTE: Refer to schematic drawing and list of components.  
Refer to "Operating Procedure" diagram which is located inside the control package cover on the unit. (Also reproduced on page opposite)

NOTE: Operating procedures for equipment with automatic switching capability vary with particular applications. Refer to "OWNER'S PROCEDURES" for operators with automatic or remote switching devices.

NOTE: The four valves needed for local manual operation are located on a manifold plate inside the control package compartment. The handpump is located below the control package compartment.

A) WITH POWER GAS or auxiliary nitrogen bottle present, appropriate supply shutoff valves open, and both handles of lower hydraulic switching valves in vertical position against stops:

To Close Line Valve: Press and hold handle on upper left gas switching relay. Release after line valve is closed.

To Open Line Valve: Press and hold handle on upper right gas switching relay. Release after line valve is open.

B) WITHOUT POWER GAS, and with supply shutoff valve closed:

To Close Line Valve: Rotate handle on lower left hydraulic switching valve clockwise against stop. Operate handpump to close valve. Return valve handle to vertical position against stop when line valve is closed.

To Open Line Valve: Rotate handle on lower right hydraulic switching valve counter clockwise against stop. Operate handpump to open line valve. Return valve handle to vertical position against stop when line valve is open.

Placing hydraulic switching valve in mid position at the end of handpump operation will allow the handpump plunger to be returned to lowest position. Return valve handle to vertical position.

C) TO DISARM OPERATOR: Shut off supply valve and press handle on either upper gas switching relay halfway to vent power gas.

## III INSTALLATION

A) FIELD MOUNTING

Refer to typical Gas / Hydraulic Parts List (Gate Valve Operators) on page 19.

CAUTION: Line pressure tends to push valve stem outwards and could open a closed valve unexpectedly. Perform installation and service with valve open if possible.

NOTE: Mounting hardware may be in a separate box on shipping pallet / crate or inside panel cover of unit.

## INSTALLATION continued . . .

**CAUTION:** The operator is typically shipped in the horizontal position with the tops of the Gas / Hydraulic tanks and tubing plugged or capped.

Mounting arrangements vary with particular valve, but are constructed as simply as possible.

In general:

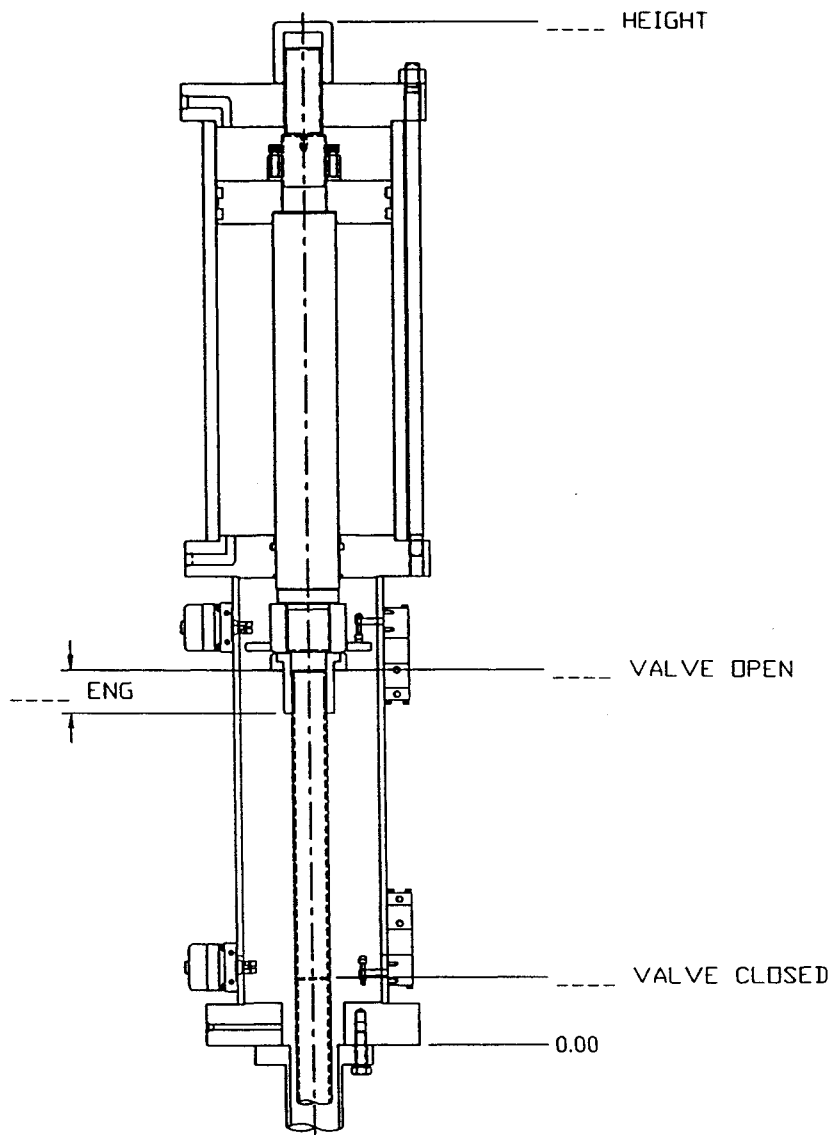
1. Remove any existing gearing from valve after it is in desired position.
2. Position operator with handpump.
3. Install jam nut and or stop nut on valve stem, if applicable.
4. Connect operator to valve stem.
5. Bolt operator to valve.
6. Set operator end stops so operator and not valve stops the travel. Refer to Section III Mechanical Stop Adjustments on page 10.

**NOTE:** Prior to handpumping the unit, reconnect the tubing at the top of the Gas / Hydraulic tanks.

### B) CONNECTIONS

1. User should provide a shutoff valve on supply and size supply lines to ensure draw down when operating valve does not interfere unduly with any pressure sensing devices. Supply lines should be located on top of the pipeline or header to avoid water contamination of hydraulic fluid.
2. In the case of a volume tank with inlet check valve, user should install a relief valve on tank to protect system against supply over pressure or thermal expansion.
3. Electrical connections to junction box are as per schematic and customer's electrical drawing.
4. Conduit connection to limit or pressure switch, if field installed, to comply with all local regulations (seal within 18 inches for explosion proof).
5. Leak tests should be performed upon initial application of low pressure of 100 psi.

**CAUTION:** Ensure the tubing located at the top of the Gas / Hydraulic tanks is reconnected prior to any operation.



NOTE: -ENGAGEMENT IS TYPICAL AND WILL VARY DEPENDING ON THE VALVE  
 -OPERATOR SHIPPED IN OPEN POSITION

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)		
TOLERANCES		
DECIMALS	RMS	FRACTIONS
.X ±0.05	500	XX-X/X ±1/16
.XX ±0.02	250	X-X/X ±1/32
.XXX ±0.005	125	X/X ±1/64
T.I.R. ±0.010	THD ±1 TURN	∠ ±1°

**BETTIS** BETTIS CANADA LTD.  
 Actuators & Controls  
 A Daniel Industries Company

LAYOUT  
 FOR FIELD INSTALLATION OF GVO

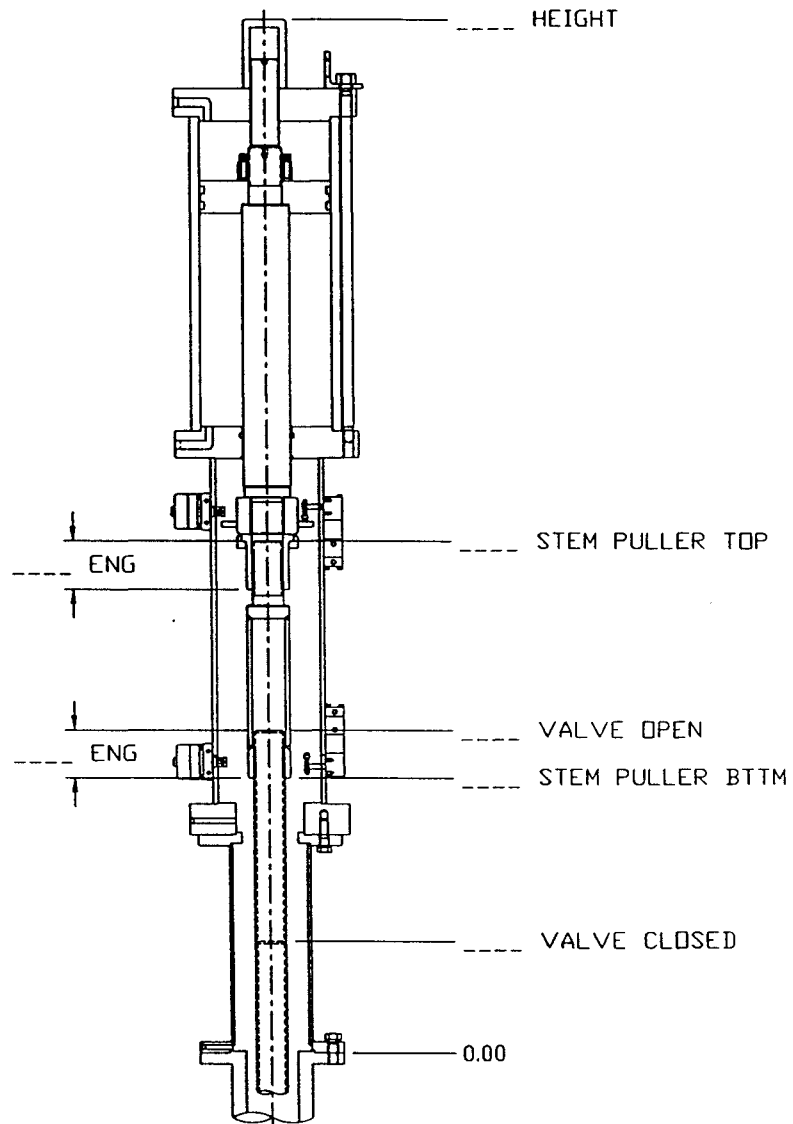
I-0103--DWG_VIEW_00 NOV-04-98	WEIGHT N/A
SCALE 1:15 BY AS	CHK AA-498E-11-10
DATE NOV-04-98	DATE NOV-04-98

REV BY-DATE+REF
MATERIAL/FINISH

BREAK SHARP EDGES  
 CHAMFER FIRST THREAD  
 REMOVE ALL BURRS

V.D. 6051-1-B	DWG. NO. I-0103	REV --
---------------	-----------------	--------





NOTE: -ENGAGEMENT IS TYPICAL AND WILL VARY DEPENDING ON THE VALVE  
 NOTE: -OPERATOR SHIPPED IN OPEN POSITION

REV BY-DATE+REF	UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)		<b>BETTIS</b> BETTIS CANADA LTD. Actuators & Controls A Daniel Industries Company LAYOUT FOR FIELD INSTALLATION OF GVO w/ STEM PULLER	I-0103--DWG_VIEW_10	WEIGHT	N/A
	TOLERANCES DECIMALS RMS FRACTIONS .X ±0.05 500 XX-X/X ±1/16 .XX ±0.02 250 X-X/X ±1/32 .XXX ±0.005 125 X/X ±1/64 T.I.R. ±0.010 THD ±1 TURN / ±1°			NOV-04-98	SCALE 1:20	BY AS
MATERIAL/FINISH	BREAK SHARP EDGES CHAMFER FIRST THREAD REMOVE ALL BURRS			W.D. 6051-1-B	DWG. NO. I-0103-10	REV --

## IV MECHANICAL STOP ADJUSTMENTS

NOTE: Operator is shipped with upper and lower stops set for published valve stroke.

### A) Stop adjustment with valve stem in (up) extended position.

1. Position operator so that it is 10 handpump strokes from the fully retracted position (usual shipping position).
2. Measure the amount of allowable valve stem engagement in stem nut of connector. Measure and mark this engagement on the valve stem.
3. Thread stem nut section of connector on to valve stem, while handpumping the operator downward, until allowable engagement is reached.
4. Handpump operator for upwards travel until it becomes solid.
5. Check connector / stem nut swivel for looseness. If operator is against its' mechanical stop and not pulling the gate against the bonnet, the stem nut section of connector should rotate on the valve stem a few degrees back and forth easily.
6. If not, continue to back off; thread off stem nut from the valve stem, while handpumping the operator upward, until the actuator is solid against its' stop and the stem nut section of swivel has some looseness. Refer to step 5 above.

NOTE: Check valve stem engagement in the stem nut to ensure that it is adequate.

### B) Operators with mechanical end cap stop design.

1. Should the operator reach its mechanical stop and the necessary stem nut looseness cannot be achieved while handpumping, then the mechanical stop on the end cap of the operator will have to be adjusted outward to allow for further operator travel in the upward direction.
2. If the upward operator position is obtained, while handpumping, before the operator stops on its' mechanical stop, then the mechanical stop on the end cap of the operator will have to be adjusted inward to limit operator travel.

### C) Operators with connector stop design.

1. The connector is designed to stop against the cylinder plate to limit operator up stroke.
  - a) Loosen the connector setscrew and thread the connector up / down on the drive rod as required, to obtain the required upper operator position and the necessary stem nut looseness..
  - b) If necessary, loosen the stem nut setscrews and thread the stem nut up / down to adjust the operator / gate valve lower position at down stroke limit.
  - c) Re-tighten setscrews.

## V PRESTART-UP CHECKS

### A) OPERATOR

1. Verify unit has been mounted on valve properly. Gear flange mounting bolts, stem nut, set screw(s) installed and secured.

NOTE: Mounting hardware may be in a separate box on shipping pallet / crate or inside panel of cover of unit.

2. Inspect unit for damaged tubing during shipping or installation.
3. Valve position confirms with indicated position.
4. All switching valves in normal operating position as per DIAGRAM / INSTRUCTIONS.
5. If removed, cover bolts, limit switch / end of stroke mounting bolts have been replaced and secured.
6. Limit switch / end of stroke valve TRIGGER(S), if removed for valve installation, have been replaced and are properly set. SEE APPLICABLE SECTION IN SERVICE MANUAL FOR INSTRUCTIONS.

### B) CONNECTIONS

1. Pneumatic / hydraulic components connected as per SCHEMATIC enclosed or in service manual supplied.
2. Power gas / signal gas connected in identified ports.
3. Electrical connections in junction box terminals are secure.
4. Wiring as per enclosed diagram or service manual supplied.
5. LIMIT SWITCH . . . remove cover . . .
  - a) Ensure wiring will not become tangled or hooked by cams during rotation.

NOTE: 'ZSO\_' actuated at fully open position.  
'ZSC\_' actuated at fully closed position.  
LOWEST 'ZS\_\_' IN STACK IS ZSOA; the one next to operator.

## VI START-UP CHECKS

NOTE: If unit has a fail or ESD position, the ESD side of the controls may have to be disenabled, enabled or overridden by AUTO / MANUAL selector.

To check operation in AUTO or MANUAL mode; temporarily remove the ESD COMPONENT (pilot, solenoid, switching relay) signal line, plug / cap it so it does not bleed the system during check out procedures.

- A) If possible, manually operate unit to full open and close positions by:
- a) handpump on unit
  - b) low pressure (100 psi) power gas applied to supply port.

When each position has been reached, CHECK:

1. Operator stop settings, if adjustment is required SEE APPLICABLE SECTION IN SERVICE MANUAL.
2. Oil levels in tanks. SEE SERVICE MANUAL FOR CORRECT LEVEL FOR EACH POSITION.
3. Limit switch / end of stroke actuated at correct locations.

- B) Power gas supply, CONFIRM power gas supply PRESSURE.

1. Gas / Hydraulic rotary or linear - maximum operating pressure as per tank and operator NAME PLATES or as specified by user.

- C) Leak test by applying power gas supply and at end of stroke manually maintained power gas on system for TWO MINUTES.

CHECK:

1. For leaks at supply points / fittings in supply line.
2. For hydraulic / air leaks at fittings while operator is operating.

- D) To check manual and automatic operation

1. If unit has auto / manual selector place selector in "manual"
2. Open power gas supply valve or apply power gas to unit
3. Manually operate upper relays as per instructions to stroke unit to "open and close" positions. Check to ensure there are no leaks at connections and no exhaust gas / blowby after stroke is completed. During stroking, gas is exhausted but stops when the operator reaches end of stroke.
4. Put selector in "AUTO" position.
  - a) Simulate automatic operation by energizing or de-energizing solenoid(s), and / or switching relays.
  - b) Check for leaks/blowby at exhaust ports of component during operation. Limit switch actuation and end of stroke venting.
  - c) Put operator in normal operating position for ESD / Fail operation check out which follows below.

- E) SHUT OFF POWER GAS SUPPLY, DISARM OPERATOR AS PER INSTRUCTIONS.

1. Replace and disconnect any tubing that was removed or connected to ESD COMPONENT for above test.
2. Remove electrical jumper(s) installed to simulate "AUTO" operation unless required to operate ESD device.

## **START-UP CHECKS continued . . .**

### **F) EMERGENCY SHUTDOWN / FAIL POSITION OPERATION CHECK OUT**

1. Ensure operator is in normal operating position.
2. Apply / remove the required ESD signal to operate the unit.
3. Apply power gas supply to the unit, it should operate to ESD / Fail position.

NOTE: If unit has power gas storage bottle on it, you may want to install a gauge in gauge port of regulator and check the consumption and number of strokes available.

### **G) RESTORE ALL TUBING AND WIRING AS PER FACTORY SHIPPED OR NORMAL OPERATING CONDITIONS.**

## **VII SCHEDULED MAINTENANCE AND TESTING**

A program of scheduled maintenance and operational testing of the operator is recommended.

The following test and maintenance procedure should be performed at least once per year.

1. Drain accumulated moisture and contaminants from gas filter.  
Refer to GENERAL SERVICE NOTES.
2. If step (1) indicates heavy accumulations, drain contaminants from GAS / HYDRAULIC TANKS(S) and check tank levels. Refer to GENERAL SERVICE NOTES regarding TANK LEVELS.

Consider replacing filter element(s) as it may be clogged with contaminants.

3. If line valve position must not be changed, if necessary remove valve stem key to disconnect operator from valve before proceeding.

NOTE: With gate valve operator, decoupling is not recommended.

4. See "OPERATING INSTRUCTIONS" to ensure proper method of operation is followed.
5. Check manual operation with handpump. (if applicable)
  - a) There should be noticeable suction on the suction stroke, decreasing as the pump cylinder fills, indicating suction lines are open and full of fluid.
  - b) Handle effort on the pressure stroke will depend on line pressure and line valve position.
  - c) Pressure stroke should be smooth and feel solid, not spongy, indicating pressure lines are open and full of fluid.
  - d) At the end of operator stroke (line valve open or closed) the handle should stop solid on the pressure stroke, indicating no bypass flow in operator or hydraulic components.
  - e) Test by applying 150 lb force for two minutes to the pump handle provided with the unit.

## SCHEDULED MAINTENANCE AND OPERATIONAL TESTING continued . . .

6. Check manual operation with power gas (if applicable)
  - a) Depress appropriate relay handle. There should be a momentary flow of gas from exhaust port in intermediate position.  
  
NOTE: Some effort (up to 50 lbs) should be required to fully depress handle, indicating adequate supply pressure.
  - b) The operator should stroke smoothly, indicating GAS / HYDRAULIC tank levels are okay and operator mechanicals are okay.
  - c) Fluid returning to the opposite tank during stroking will cause a continuous slight exhaust gas flow from exhaust port, but which stops when the operator reaches end of stroke. This indicates proper relay function and no bypass flow in operator or gas or hydraulic components.
  - d) There should be no leaks of gas or hydraulic fluid.
  - e) Upon releasing relay handle, there should be a momentary rush of gas from exhaust port as gas / hydraulic tank is vented.
7. Operating with power gas, check remote / automatic operation (if applicable).

NOTE: Ensure that adequate pressure and flow of gas, and correct hydraulic fluid levels are present.

- a) Shutoff valve should be open.
- b) There should be no gas leaks.
- c) Hydraulic speed control valves should be partially open.
- d) With appropriate metre or gauge, check for correct signal condition.
- e) Simulate remote or automatic switching.
- f) During stroking of the operator, there should be no signal gas leakage indicating that the signal section of the switching relay is okay.
- g) Test the handpump safety feature. With the handpump handle in place and the handpump in manual mode, while standing well clear, apply power gas manually in the same direction (open / close) as handpump selected and observe for any handpump handle movement.

## VIII LIMIT SWITCH INSTRUCTIONS

NOTE: Operator end stops must be set for valve stroke before attempting following procedure.

CAUTION: Changing operator stroke can cause damage to limit switches and end of stroke valve if over travel occurs and trigger plate strikes component.

PURPOSE: To have trigger plate travel equal distance between limit switches / end of stroke valves.

1. Measure and record the value [A] (to within  $\pm 1/16$ th of an INCH) of full travel or stroke required to fully open and close the valve.
2. Stroke operator so drive rod is in extended position.
3. On the drive rod place the measured value [A] equidistant between the shaft center lines of the upper and lower limit switches. Place a mark [B] on the drive rod at the lower limit of the stroke.
4. Adjust trigger plate to position striking surface at the mark [B]. Tighten set screws.
5. For lower limit switch measure and record the distance [C] from striking surface to limit switch centre line.
6. Return operator to up position.
7. For upper limit switch measure and record the distance [D] from striking surface to limit switch shaft centre line.
8. Measurements [C;D] should agree within  $1/4$ " ; if not repeat step 3 thru 7 above and adjust accordingly.
9. Adjust upper and lower limit switch levers so that  $1/2$ " -  $3/4$ " of travel is available to trigger the switches.
10. Remove limit switch cover(s), adjust cams so they begin to switch. Check motion by hand then by stroking the operator.
11. If insufficient travel to activate switches repeat steps 9 and 10.

## IX END OF STROKE ADJUSTMENT INSTRUCTIONS

NOTE: If component is on operator it must be adjusted before limit switches.

1. Proceed to steps 1 thru 4 above.
2. Stroke operator fully to position that activates trigger valve then, by using the handpump retract it 1/4".
3. Adjust end of stroke valve [trigger valve] trigger screw to touch trigger plate.
4. Stroke operator to full position. Trigger valve should switch and seal properly. If not, try pushing by hand to determine if more trigger screw adjustment is required to operate it. If so, repeat steps 2 thru 4 using more operator stroke to trigger the valve.
5. Proceed to steps 9 thru 11 above to set limit switches.

NOTE: DO NOT loosen or adjust trigger plate position as it will affect the end of stroke valve setting.

## X LINEAR OPERATOR MAINTENANCE

### A) MODEL IDENTIFICATION

Bettis MODEL  $\frac{\quad}{\text{(piston dia)}} \times \frac{\quad}{\text{(stroke)}} \times \frac{\quad}{\text{(rod dia)}} \text{ GVO-HP-DA}$   
 $\frac{\quad}{\text{(inches)}} \quad \frac{\quad}{\text{(inches)}} \quad \frac{\quad}{\text{(inches)}}$

Example: 10 x 16 x 2.50 GVO-HP-DA

### B) GENERAL

The operator is a double acting hydraulic cylinder with the drive rod coupled to the valve stem.

Note that line pressure tends to push stem outwards and operator should be serviced or removed only with valve in up position.

### C) MAINTENANCE

The only service normally expected is soft parts replacement.

### D) TOOLS AND EQUIPMENT

1. A set of standard imperial size wrenches, sockets and hex head sockets.
2. Hammer or impact wrench for piston bolt. Size depends on model.
3. Container, funnel, hose to recover hydraulic fluid.
4. Solvent for cleaning.
5. Sealant for pipe thread reassembly.
6. Lubricant (hydraulic fluid; petroleum grease).
7. Loctite for piston bolt or nut.



## **XI LINEAR OPERATOR DISASSEMBLY**

Consult manufacturer for piston bolt / nut and stay rod nut torque for your model.

**CAUTION:** Line pressure in valve pushes on stem, and could unexpectedly open a closed valve.

1. Shut off power gas supply, disarm automatic controls and bleed off power gas.
2. To replace end stop seal only: stroke piston against stop using handpump, remove end stop cover, replace seal and then replace stop cover.
3. Remove piping and cylinder mounted accessories after marking or noting their positions to facilitate reassembly.
4. Drain oil from cylinder.
5. Remove stay rod nuts and end cap. It is not necessary to remove end stop or cover.
6. Remove piston bolt or nut.
7. Remove cylinder with piston.
8. Remove drive rod from cylinder plate. Remove the drive rod from connector / valve stem and pull it through in order to replace cylinder plate rod seal. (If trigger plate is fastened to drive rod, loosen set screws to allow for removal.)
9. Clean and inspect all parts.

## **XII LINEAR OPERATOR ASSEMBLY**

1. Install wiper and replacement seal in cylinder plate with seal lip facing pressure side.
2. Slide drive rod into cylinder plate. Lubricate area around the rod seal in cylinder plate and the drive rod lower section with petroleum grease before sliding the drive rod through the cylinder plate.

**NOTE:** Check that wiper and seal were not pushed out or cut when the drive rod was installed.

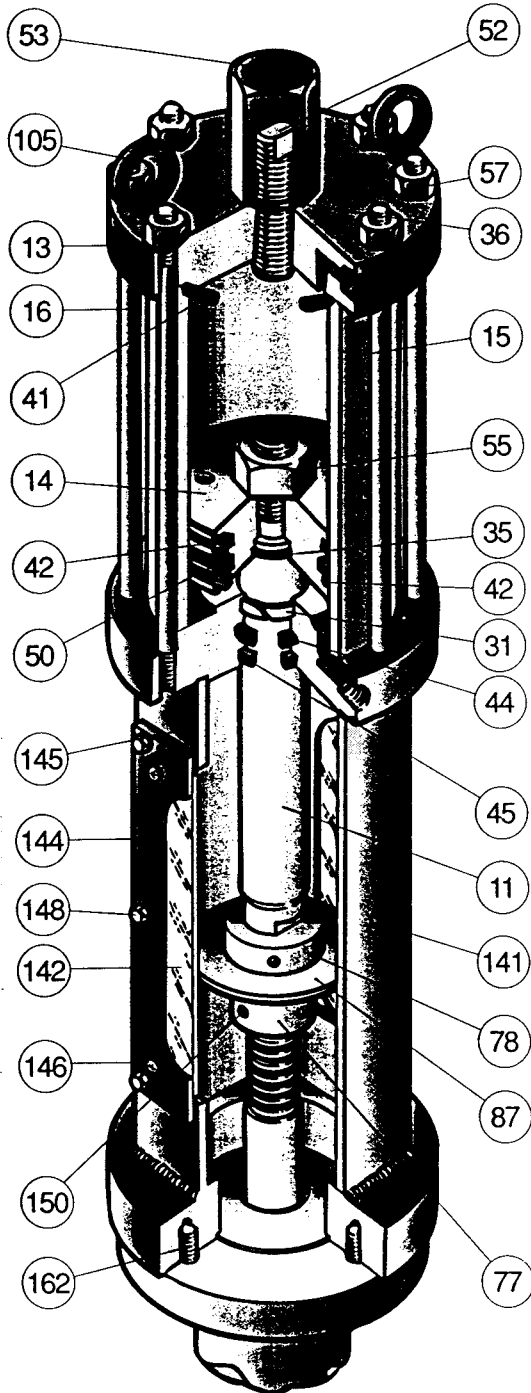
3. Install piston centre o-ring in piston. Grease seal to hold in place.
4. Locate and press piston into cylinder to match drive rod position.
5. Install replacement seals on piston and insert into cylinder using tapered compression tool, or install seals one at a time with each groove in turn protruding from cylinder.

## **LINEAR OPERATOR ASSEMBLY continued . . .**

5. Install cylinder seal on cylinder plate.
6. Lower cylinder with piston over drive rod to contact cylinder plate. Ensure seals are seated in their respective grooves.
7. Tighten and torque piston bolt / nut.
8. Install cylinder seal on end cap and lower onto cylinder.
9. Install and tighten stay rod nuts. TORQUE TO SPECIFICATION.
10. Set operator stops, so that valve stem or gate does not stop travel. If end stop was removed, operator should stop on its own stops.
11. Re-connect cylinder mounted accessories and piping.
12. Check fluid levels and make-up any fluid loss. See gas / hydraulic tank filling levels on page 21.
13. Hydrostatic test with handpump. Refer to “Scheduled Maintenance and Testing” on page 13.
14. Operational test.

## Typical Gas/Hydraulic Parts List (Gate Valve Operators)

Material specifications are typical for operation at -50°F to 150°F (-46°C to 65°C)



Item	Description	Material	Qty	Note
11	Drive Rod	C1045	1	(C)
13	End Cap	ASTM A516-70	1	
14	Piston	ASTM A516-70	1	
15	Cylinder	C1020	1	
16	Tie-Rod	AISI 4140	8	(V)
31	Rod Guide	Molygard	1	
35	Piston Centre			
	O-Ring	Nitrile	1	(Y)
36	End Stop O-Ring	Nitrile	1	(Y)
41	Cylinder O-Ring	Nitrile	2	(Y)
42	Piston Polypak	Molythane	2	(Y)
44	Drive Rod Polypak	Molythane	1	(Y)
45	Wiper	Molythane	1	(Y)
50	Piston Wear Ring	Molygard	1	
52	End Stop	ASTM A193 Gr. B7	1	
53	End Stop Cover	C12L14	1	
55	Piston Nut	ASTM A194 Gr. 2H	1	
57	Tie Rod Nut	ASTM A194 Gr. 2H	8	(V)
77	Stem Nut	C12L14	1	
78	Connector Body	C1020	1	
87	Trigger Plate	ASTM A36 or Aluminum	1	
105	Eyebolt	Gr. 5 Plated	2	
141	Pedestal	ASTM A516-70 Plates/ CSA 44W Structural Tubing	2	
142	Viewplate	Clear Polycarbonate	2	(V)
144	Pedestal Cover	C Steel	2	
145	Viewplate Gasket	Neoprene	2	
146	Viewplate Screw	Gr. 2	8	(V)
148	Pedestal Cover Bolt	Gr. 5	12	(V)
150	Setscrew	Gr. 8	3	(V)
162	Pedestal Capscrew	Gr. 8	8	(V)
<b>Pressure Vessels</b>				
a)	-50°F to 150°F (-46°C to 65°C)	Shell	ASME SA-333 Gr. 6	(**)
		Head	ASME SA-420-WPL6/ ASME SA-516-70	
		Fittings	ASME SA-350-LF2	
b)	-20°F to 150°F (-29°C to 65°C)	Shell	ASME SA-106 Gr.B	
		Head	ASME SA-234-WPB/ ASME SA-516-70	
		Fittings	ASME SA-105/ ASME SA-350-LF2	

**Notes:**

- (C) Chrome Plated
- (N) Not Shown
- (Y) Spare Parts Kit
- (V) Quantity may vary depending on model
- (\*\*) Impact tested as per ASTM A370  
18J average, 14J minimum, -50°F (-46°C), CVN full size

All metal parts coated with corrosion inhibitor  
All specifications are subject to change or upgrade

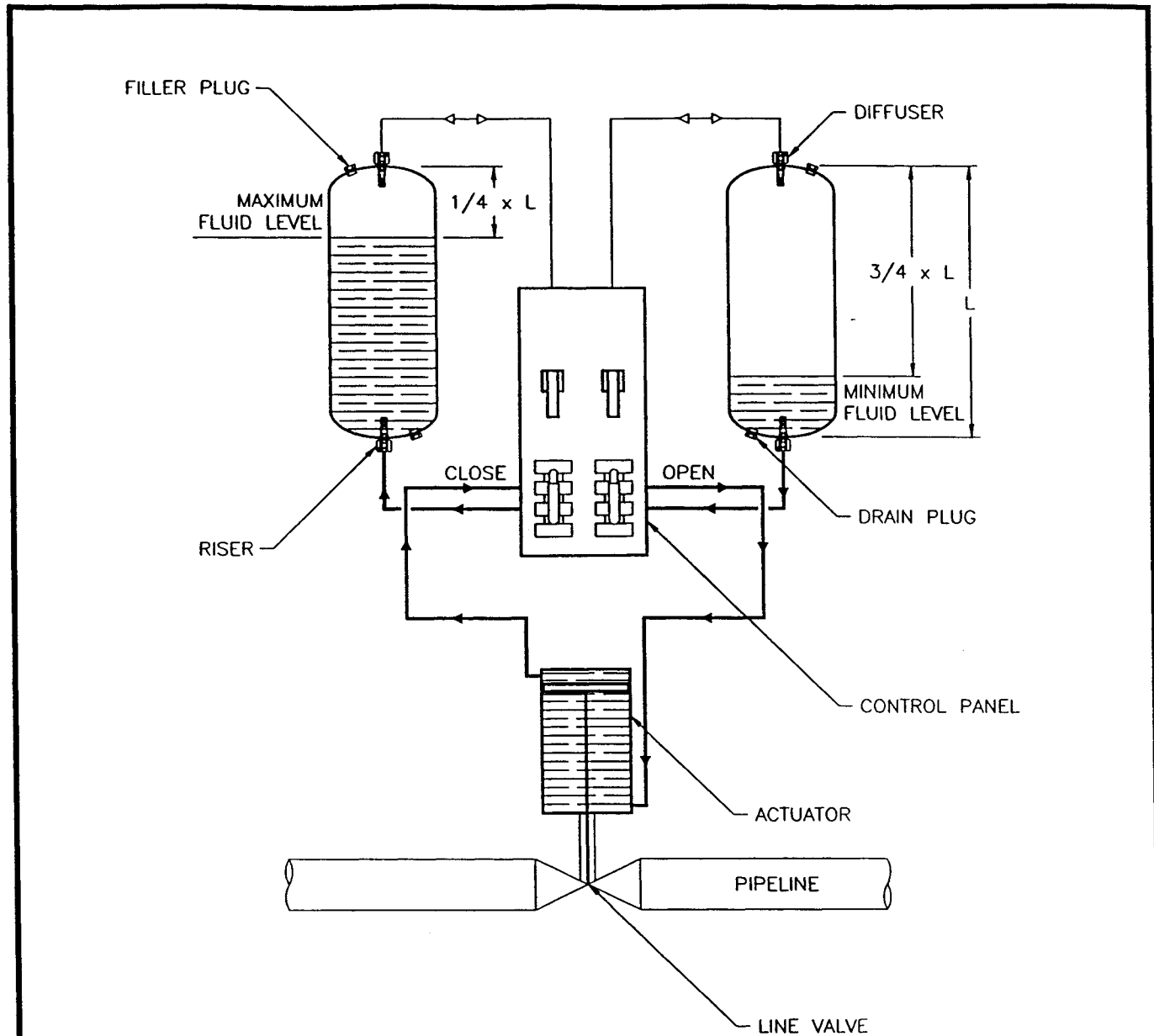
### XIII FLUID MAINTENANCE GUIDE

An aviation grade hydraulic fluid (ESSO UNIVIS or EQUIVALENT) is used in all Bettis operator systems (or per customer request).

1. Do not add automatic transmission fluid or other solvents to the system as it can damage the seals of some internal components. Flush the system with recommended oil only.
2. Operators / systems that cycle up to 2-3 times per week (unit suction / discharge; pig launcher / receiver block valves) should have the oil changed on a YEARLY BASIS.
3. For Gas / Hydraulic systems these items should be performed at least ONCE PER YEAR;
  - a) The power gas filter should be drained of contaminants and if it indicates heavy liquid contamination, the gas / hydraulic tanks should be drained of liquid and levels checked.
  - b) The hydraulic fluid may be filtered to approximately 140 micron nominal and re-used if the contamination is light.
  - c) Levels should be checked and fluid added to make-up the correct level for given line valve / operator position. (See Service Manual Section Gas / Hydraulic Tank Filling.)

### XIV HYDRAULIC FLUID SPECIFICATIONS

Temperature Rating	Low (-50°C to 65°C)	Standard (-20°C to 77°C)
Specific Gravity at 15°C	0.85	0.88
Kinematic Viscosity "centistokes" at -65°F (-54°C) at -40°F (-40°C) at 100°F (38°C) at 212°F (100°C)	2,300 460 14 5	-- 6,000 25 5.6
Viscosity Index	380	200
Pour Point, °C	-60	-50
Flash Point, °C	105	166
Color	Red	Yellow



**NOTE:**

1. AN AVIATION GRADE HYDRAULIC FLUID (ESSO UNIVIS OR EQUIVALENT) IS USED IN ALL "BETTIS" OPERATOR SYSTEMS; OR PER CUSTOMER REQUEST
2. MINIMUM AND MAXIMUM FLUID LEVELS REFER TO CONDITIONS AT FULL OPEN OR CLOSED VALVE POSITION
3. DRAIN ACCUMULATED MOISTURE AND CONTAMINANTS BY PLUGGING BOTTOM TUBE CONNECTION AND LOOSENING RISER FITTING IF DRAIN PLUG NOT AVAILABLE

UPDT TB  
 Δ PO-1998-09-23 @ 6051-1-B  
 REDRAW, UPDT STDS  
 Δ RS-1996-07-17@SERV. MANUAL  
 REVISE NOTE  
 Δ PL-1993-12-29@SERV. MANUAL  
 UPDT FLUID TYPE  
 Δ PL-1993-01-05 @ SALES  
 REDRAWN, UPDT TITLE BLOCK  
 Δ MN-1992-06-04 @ SALES  
 REV BY-DATE+REF

LEGEND	
	POWER GAS
	HYDRAULIC
	ELECTRICAL
	FIELD CONNECTION
	PLUGGED PORT
	SIGNAL
	RETURN
	CLOSED
	INSTRUMENT
	VENT
	OPEN

<b>BETTIS</b> BETTIS CANADA LTD.			
Actuators & Controls A Daniel Industries Company			
TANK FILLING GAS/HYDRAULIC GVO			
SCALE N/A	BY RD	CHK AA-1996-09-25	DATE OCT-01-83
W.D. ---	DWG. NO. I-0021-12	REV 5-	

## XV OPERATOR REPAIR KITS

### BILL OF MATERIALS MASTER LIST

NOTE: Please provide the - MODEL \_\_\_\_\_  
 - SERIAL NO. \_\_\_\_\_

when ordering operator repair parts.

(The W.O. number from Gas / Hydraulic tank tag, pressure vessel serial number and year of manufacture, or this manual, will help if no other identification information is obtainable.)

#### Description - Operator Repair Kit - Minor Soft Parts

<u>Description</u>	<u>Material</u>	<u>Qty</u>
O-Ring Piston Center	Nitrile	1
O-Ring End Stop	Nitrile	1
Polypak Drive Rod	Molythane	1
O-Ring Cylinder	Nitrile	2
Polypak Piston	Molythane	2
Polypak Drive Rod	Molythane	1
Wiper	Molythane	1

#### Description - Operator Repair Kit - Major, add:

<u>Description</u>	<u>Material</u>	<u>Qty</u>
Piston Wear Ring	Molygard	1
Drive Rod Guide	Molygard	1

NOTE: All soft parts from Minor Kit would be included in Major Kit.

#### Description - Control Package Component Repair Kits

See Specific Component drawings in service manual for indicated spare parts. Sold as a kit only.

STAY ROD NUT TORQUE		
CYLINDER	AIR	HYD. (LB-FT)
1/2	40	45
5/8	80	100
3/4	120	150
7/8	160	200
1	240	300
1-1/8	384	480
1-1/4	540	675
1/2 HXSC JACKNUT		100
5/8 HXSC JACKNUT		185
7/8 HXSC JACKNUT		450

## XVI TROUBLE SHOOTING

Of all the system components the OPERATOR itself is the least likely to malfunction, and requires the most time and effort to service. For this reason a thorough effort should be made to pinpoint the source of trouble before proceeding with operator service.

Completion of the operational test steps on pages 13 through 14 should confirm satisfactory operation or indicate the most likely source of a problem.

PROBLEM	POSSIBLE CAUSES	REMEDY
Slow jerky or partial stroke on manually controlled gas powered	<ul style="list-style-type: none"> <li>- Low supply pressure</li> <li>- Shutoff / speed control closed</li> <li>- Dirty gas filter element resulting in insufficient flow and pressure to stroke operator</li> <li>- Contaminated oil; will not flow easily thru lines.</li> <li>- Operator and valve stops not in same position.</li> </ul>	<ul style="list-style-type: none"> <li>- Check and increase</li> <li>- Check and open a few turns</li> <li>- Blow out lines</li> <li>- See section on Maintenance and Operational testing. Disconnect operator from valve if possible.</li> </ul>
Slow or no operation with handpump	<ul style="list-style-type: none"> <li>- Tank oil levels low</li> <li>- Pump suction or discharge check valve malfunction</li> <li>- Speed control or locking valve blockage / malfunction</li> <li>- Dirt, ice in fluid lines</li> </ul>	<ul style="list-style-type: none"> <li>- Make up levels with aviation grade hydraulic fluid (ESSO UNIVIS or EQUIVALENT; or per customer specification).</li> <li>- See GENERAL SERVICE section</li> <li>- Remove tubing at cylinder check for flow when handpump operated.</li> </ul>
Oil leaking from cylinder plate	-Damaged rod seal	-See OPERATOR SERVICE section
Oil leaking from END STOP COVER SEAL	-Damaged seal	-See OPERATOR SERVICE regarding end stop seal replacement
Excessive amounts of oil thru exhaust	<ul style="list-style-type: none"> <li>-High tank levels</li> <li>-Blow by across piston</li> </ul>	<ul style="list-style-type: none"> <li>- Check levels</li> <li>- See MAINTENANCE AND OPERATIONAL TEST Manual operation with handpump</li> </ul>

## XVII GENERAL SERVICE NOTES

Refer to: SCHEMATIC DRAWING(S);  
LIST OF COMPONENTS WITH PAGES 13 AND 14 PRECEDING;  
TESTING AND TROUBLE SHOOTING SECTION;

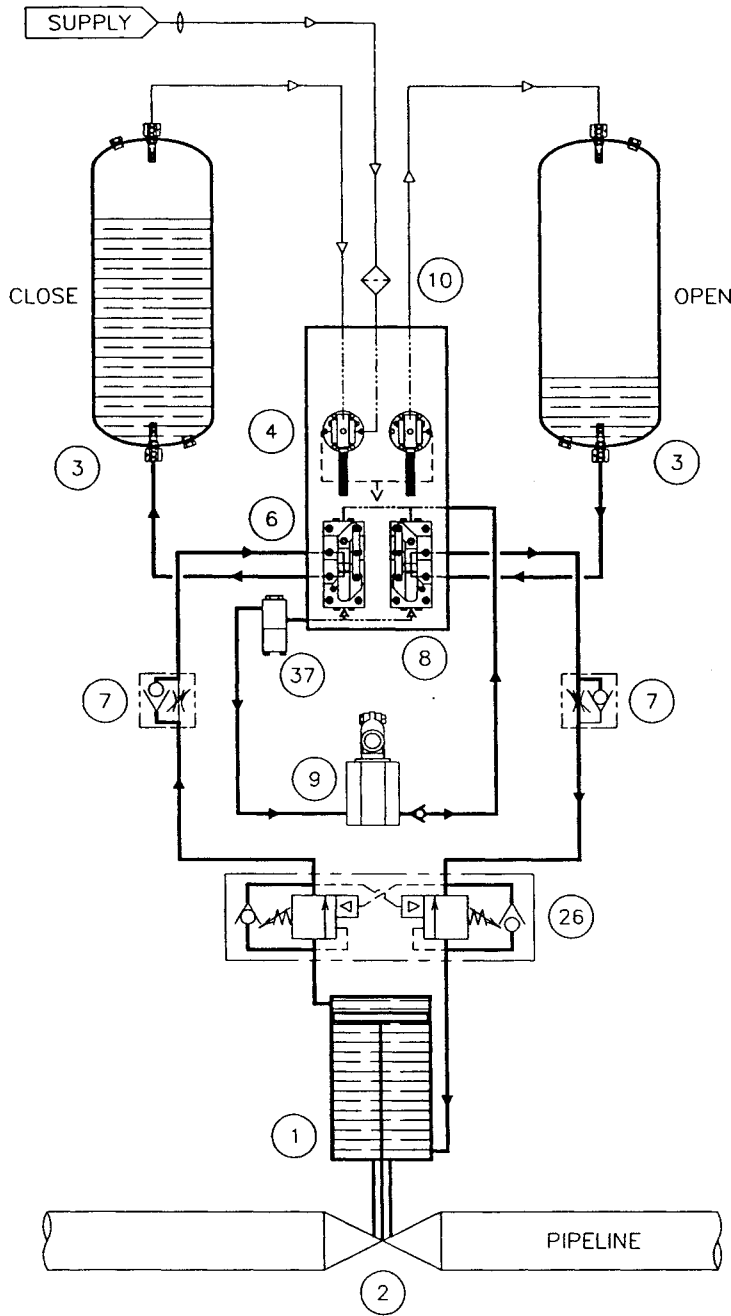
The following pages contain information on the components identified on the schematic drawing of an Bettis Gas / Hydraulic Gate Valve Operator.  
Information on additional optional components as specified by users, is at the end of this manual.  
Please provide operator serial number if ordering spare parts.

<u>ITEM NO.</u>	<u>COMPONENT</u>
1	<u>Bettis LINEAR OPERATOR</u> Operates gate valves. Refer to "Operator Service".
3	<u>GAS / HYDRAULIC TANKS</u> For pressure transfer. Refer to I-0021-12 on page 21. Drain accumulated moisture and contaminants. An aviation grade hydraulic fluid (ESSO UNIVIS or a suitable equivalent) is used in all Bettis operator systems; or per customer request.
4	<u>Bettis RELAY MODEL 324-M</u> Lever operated to direct power gas to GAS / HYDRAULIC TANK. Soft parts replacement is required. Refer to cutaway drawing and parts list.
5	<u>Bettis RELAY MODEL 324-DM</u> Lever or diaphragm operated to direct power to GAS / HYDRAULIC TANK. Soft parts replacement is required. Refer to cutaway drawing and parts list.
6	<u>Bettis HYDRAULIC SELECTOR VALVE</u> Lever operated to select flow direction of hydraulic fluid. Drain GAS / HYDRAULIC TANK below selector valve level if valve must be removed. Refer to cutaway drawing and parts list.
7	<u>SPEED FLOW CONTROL VALVE</u> A variable orifice restriction which allows for independent control of opening and / or closing speed.
8	<u>MANIFOLD CHECK VALVES</u> Prevents interflow between tanks. Refer to A-0197 on page 27.
9	<u>Bettis HANDPUMP</u> Manual operation without power gas. Plunger seal and wiper may be easily replaced. Specify model number when ordering.
10	<u>GAS FILTER</u> Power gas filtration and liquids dropout. Blow down moisture and contaminants as required. Filter element may be replaced. Refer to cutaway drawing and parts list.
12	<u>REGULATOR</u> Provide signal gas for devices operating at 700 kPa (100 psi). On some models the seat block may be rotated to bring a new seating surface into use.



**GENERAL SERVICE NOTES continued . . .**

<u>ITEM NO.</u>	<u>COMPONENT</u>
13	<u>RELIEF</u> Signal gas overpressure protection.
15	<u>END OF STROKE VALVE (trigger valve; N.O. relay)</u> Cam operated at end of stroke to vent power gas. Normally only soft parts replacement is required. Refer to cutaway and parts list.
17	<u>LIMIT SWITCH</u> Electrical indication of valve status. Consult limit switch bulletin for service and adjustments. Specify make and model when ordering parts.
26	<u>LOCKING VALVE</u> Locking valve maintains operator and line gate valve in position by holding fluid in the cylinder after power gas is vented. Provide model and serial number if requesting spares or assistance.
37	<u>HANDPUMP SAFETY VALVE</u> Protection against handpump actuation when accidentally operating with power gas with open or close hydraulic selector valve positioned in handpump mode.



LIST OF COMPONENTS:

- (1) OPERATOR
- (2) LINE VALVE
- (3) GAS/HYDRAULIC TANK
- (4) 3-WAY VALVE, MANUAL
- (6) SELECTOR VALVE
- (7) SPEED CONTROL VALVE
- (8) CHECK VALVE
- (9) HANDPUMP
- (10) FILTER
- (26) LOCKING BLOCK
- (37) HANDPUMP SAFETY VALVE

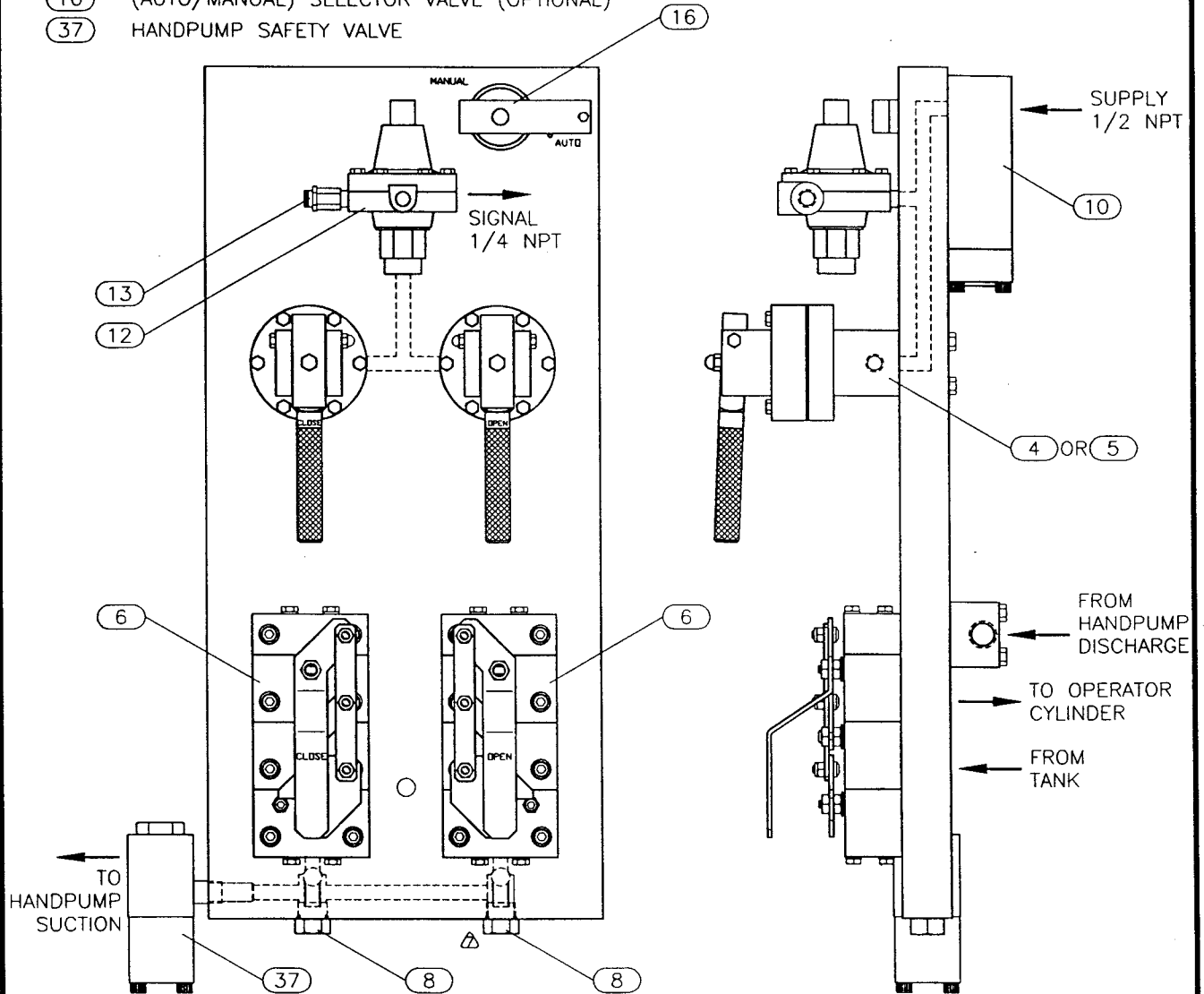
UPDT TITLE BLOCK, PANEL AND SV-06  
 RB-1998-06-08 @ 06053  
 UPDT TITLE BLOCK  
 RS-1996-07-17@SERV. MANUAL  
 REDRAWN CAD  
 KN-1993-12-28@SERV. MANUAL  
 REV BY-DATE+REF

LEGEND	
	POWER GAS
	HYDRAULIC
	ELECTRICAL
	FIELD CONNECTION
	PLUGGED PORT
	SIGNAL
	RETURN
	CLOSED
	INSTRUMENT
	VENT
	OPEN

**BETTIS** BETTIS CANADA LTD.  
 Actuators & Controls  
 A Daniel Industries Company  
 GAS/HYDRAULIC GVO OPERATOR  
 TWO WAY MANUAL  
 SHOWN IN POWER GAS MODE

SCALE	N/A	BY	RD	CHK	DATE	OCT-01-93
W.D.	---	DWG. NO.	I-0021-02	REV	3-	

ITEM	DESCRIPTION
4	3-WAY VALVE (MANUAL)
5	3-WAY VALVE (MANUAL/PILOT)
6	SELECTOR VALVE
8	CHECK VALVE (BALL, SPRING, PLUG, O-RING)
10	FILTER
12	PRESSURE REGULATOR (OPTIONAL)
13	RELIEF VALVE (OPTIONAL)
16	(AUTO/MANUAL) SELECTOR VALVE (OPTIONAL)
37	HANDPUMP SAFETY VALVE



UNLESS SPECIFIED OTHERWISE  
ALL DIMENSIONS INCHES [mm]

ADD CHECK VALVE DETAIL  
 △ RB-1998-04-01 @ 06053  
 ITEM No. 37 WAS 20 IN ERROR  
 △ RS-1998-01-27 @ 06053-1-B  
 REDRAW, UPDT STDS  
 △ RS-1997-10-23 @ 06053-1-B  
 SHOW P-1-DD BOWL  
 △ RS-1995-03-29 @ A.S. REQ

REV BY-DATE+REF

TOLERANCES  
 XXX ±0.5 [±10]  
 XX ±0.2 [±5]  
 X ±0.1 [±2]

**BETTIS** BETTIS CANADA LTD.

Actuators & Controls  
 A Danal Industries Company

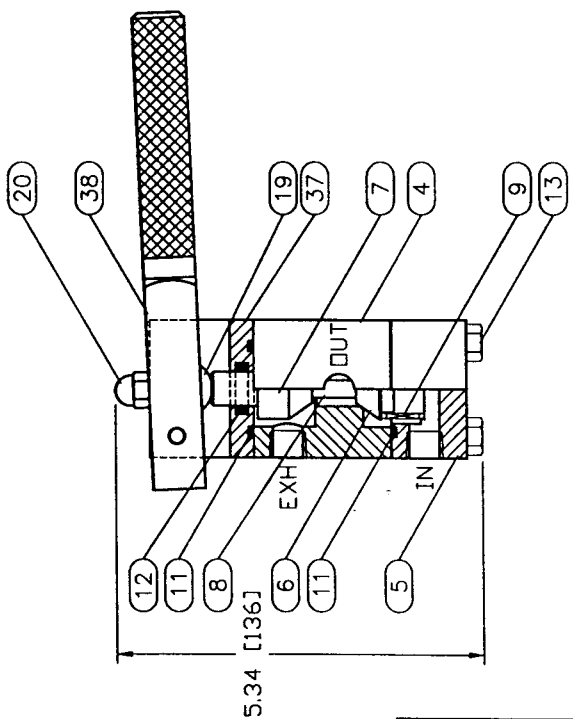
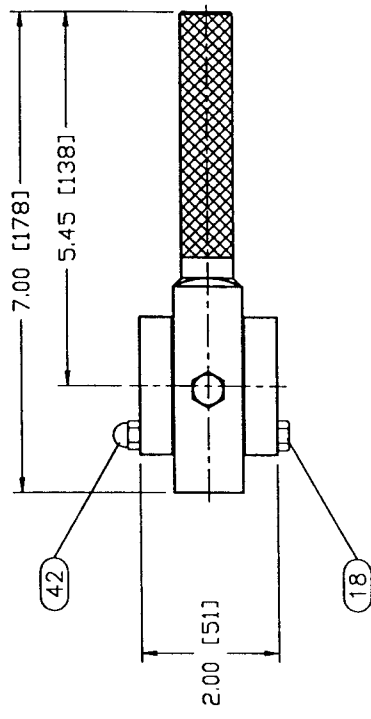
TYPICAL MANIFOLD ASSEMBLY  
 FOR GAS/HYDRAULIC OPERATOR

A-0197--DWG\_VIEW\_00  
 APR-01-98

SCALE	1:5	BY	EB	CHK	AP-1980-01	DATE	JUN-10-91
W.D.	---	DWG. NO.	A-0197	REV	7-		

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
4	324-004	UPPER BODY	AL 6061-T6	1	
5	324-005	LOWER BODY	AL 6061-T6	1	
6	324-006	POPPET, LOWER	PVC	1	(Y)
7	324-007	POPPET, UPPER	PVC	1	(Y)
8	324-008	POPPET SPACER	DOWEL PIN	1	
9	324-009	SPRING	SS	1	
11	324-011	O-RING, BODY	BUNA N	2	(Y)
12	324-012	O-RING, POPPET	BUNA N	1	(Y)
13	324-013	CAPSCREW, BODY	HXHC GR. 5 ZN.PL	4	
18	324-018	CAPSCREW, OPERATOR	HXHC GR. 5 ZN.PL	1	
19	324-019	ROUNDHEAD PUSH BOLT	RHSN GR. 5 ZN.PL	1	
20	324-020	NUT, LEVER	GR. 5 ZN.PL	1	
37	324-037	*M* CYLINDER PLATE	AL 6061-T6	1	
38	324-038	*M* LEVER	AL 6061-T6	1	
42	324-042	NUT, OPERATOR	GR. 5 ZN.PL	1	
--	700-106	NAMEPLATE, SPECIAL TRIM	SS 304	1	

NOTE: (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-A324-M FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE RECOMMENDED MAXIMUM 20 PSIG BACK PRESSURE AT EXHAUST PORT FOR MANIFOLD MOUNTING, LOWER BODY (S) OMITTED FOR STANDARD USE, NAMEPLATE OMITTED



SPECIFICATIONS:  
 PORTS: 1/4 NPT  
 SERVICE: AIR, SWEET GAS, < 5% H2S SOUR GAS  
 TEMP. RATING: -50°C THRU 120°C  
 MASS: 2.2 LBm (1.0 kg)  
 MAWP: 1500 PSIG

**BETTS** BETTS CANADA LTD.  
 Actuators & Controls  
 A Daniel Industries Company  
 MODEL A324--M SWITCHING RELAY  
 (3-WAY, 2-POSITION)

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)

UPDT LOGO  
 AS-1998-04-28 @ 6053-1-B  
 EDITORIAL CORRECTION  
 RS-1996-12-03 @ SALES  
 UPDT STDS, ADD NAMEPLATE  
 VL-1996-04-01 @ 7482-1-B  
 REDRAW CAD, UPDT BDM  
 JY-1992-12-18 @ SALES

REV BY--DATE+REF

TOLERANCES  
 XXX ±0.5 [+10]  
 XX ±0.2 [+5]  
 X ±0.1 [+2]

SCALE 3:8 BY TS CHK  
 DATE NOV-01-80  
 DWG. NO. C-0032 REV 6-

C-0032--DWG\_VIEW\_00  
 APR-28-98 WEIGHT SEE ABOVE

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NDTE
2	324-002	DIAPHRAGM PLATE	AL 6061-T6	1	(Y)
3	324-003	CYLINDER PLATE	AL 6061-T6	1	
4	324-004	UPPER BODY	AL 6061-T6	1	
5	324-005	LOWER BODY	AL 6061-T6	1	(Y)
6	324-006	POPPET, LOWER	PVC	1	(Y)
7	324-007	POPPET, UPPER	PVC	1	(Y)
8	324-008	POPPET SPACER	SS 304	1	
9	324-009	SPRING	SS 302	1	
10	324-010	DIAPHRAGM	FAIRPRENE/TFE	1	(Y)
11	324-011	O-RING, BODY	NITRILE	2	(Y)
12	324-012	O-RING, POPPET	NITRILE	2	(Y)
13	324-013	CAPSCREW, BODY	SS 304	4	
14	324-032	CAPSCREW, CAP	SS 304	6	
18	324-018	CAPSCREW, OPERATOR	SS 304	1	
19	324-019	ROUNDHEAD PUSH BOLT	RHSN GR 5 ZN PL	1	
20	324-020	NUT, LEVER	GR 5 ZN PL	1	(Y)
28	324-028	PLUNGER	PVC	1	
35	324-035	DIAPHRAGM CAP	AL 6061-T6	1	
38	324-038	'M' LEVER	AL 6061-T6	1	
42	324-042	NUT, OPERATOR	SS 304	1	

NOTE: (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-A324-DM FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE RECOMMENDED MAXIMUM 20 PSIG BACK PRESSURE AT EXHAUST PORT FOR MANIFOLD MOUNTING, LOWER BODY (S) OMITTED

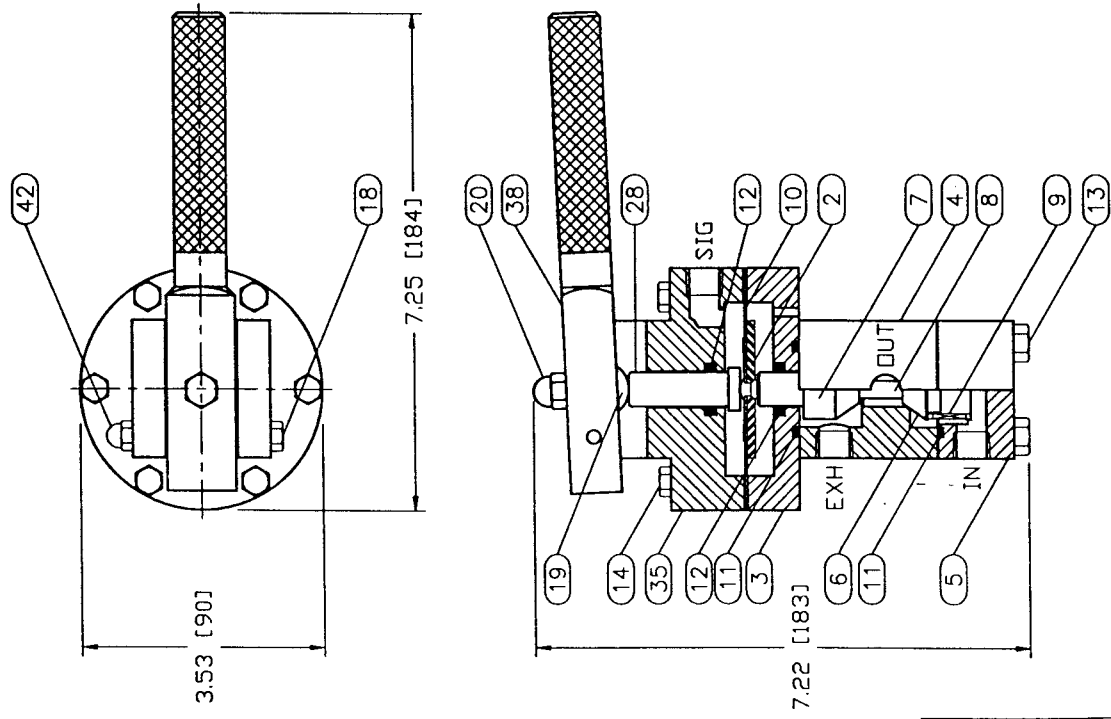
SPECIFICATIONS:  
 PORTS: 1/4 NPT  
 SERVICE: AIR, SWEET GAS, <5% H2S SOUR GAS  
 TEMP. RATING: -50°C THRU 120°C  
 MASS: 3.7 LBm [1.7 kg]  
 MAWP: 1500 PSIG [10,300 kPa]  
 MAX. SIGNAL: 150 PSIG NOMINAL RATIO 12:1

**BETTS** **BETTS CANADA LTD.**  
*Actuators & Controls*  
*A David Buller Company*  
 MODEL A324-DM SWITCHING RELAY  
 (3-WAY, 2-POSITION, N.C.)  
 ASSEMBLY, DATA AND DIMENSIONS

C-0034--DWG_VTEW_00	WEIGHT	SEE ABOVE
APR-28-98	CHK	DATE JAN-15-81
SCALE 3:8	BY TS	DWG. NO. C-0034-00
REV BY-DATE+REF		REV 6-

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES [mm]  
 UPDT LOGO  
 AS-1998-04-28 e 6053-1-B  
 UPDT STDS  
 RS-1995-12-07@SALES REQ  
 UPDT BOM  
 JY-1992-12-18@SALES REQ  
 UPDT TITLEBLOCK  
 KN-1992-06-11@SALES REQ

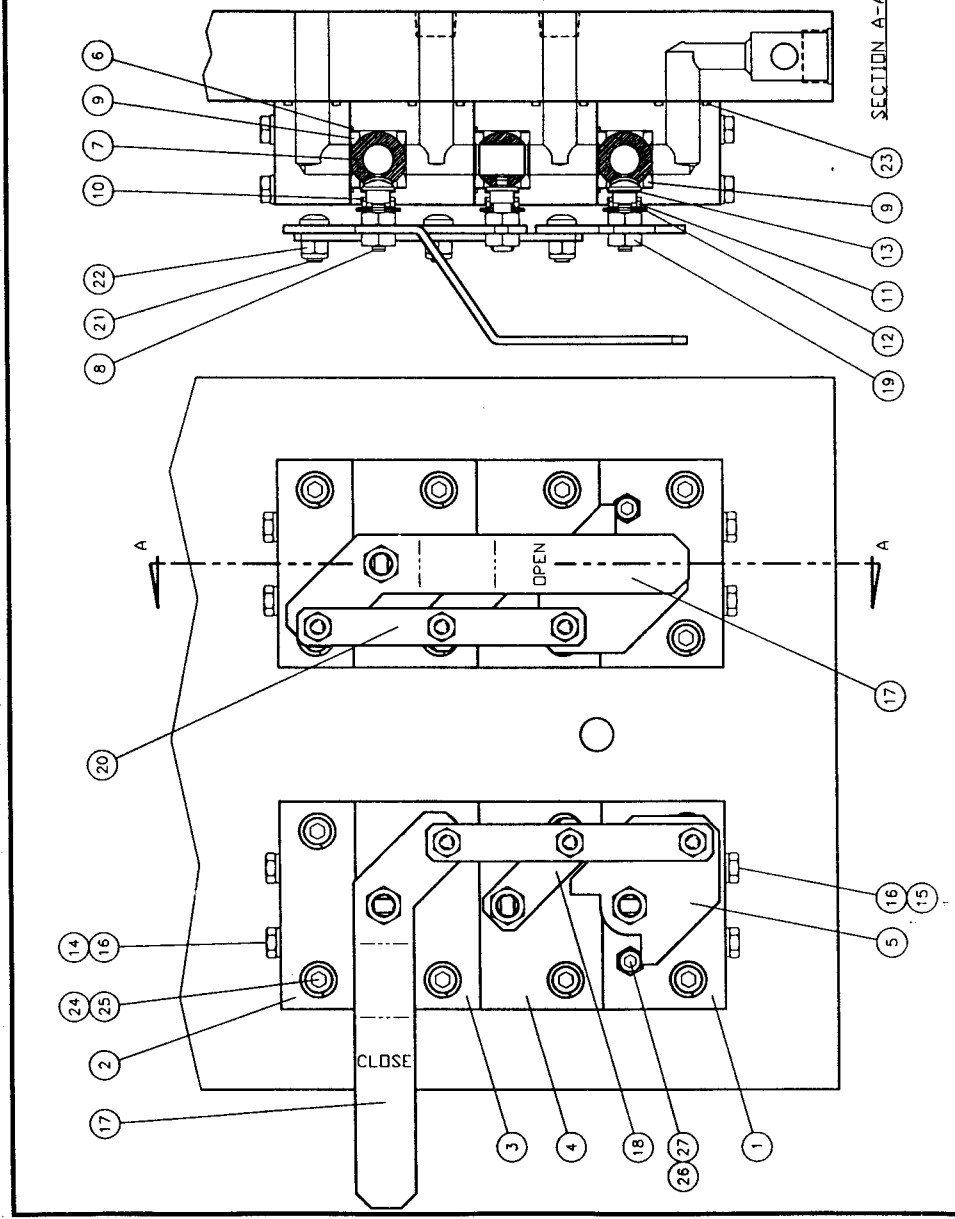
TOLERANCES	XXX ±0.5 [±10]
	XX ±0.2 [±5]
	X ±0.1 [±2]



DWG. NO. C-0034-00

ITEM	DESCRIPTION	MATERIAL	QTY	NOTE
1	END BODY	AL 6061-T6	2	
2	END CAP	AL 6061-T6	2	
3	DRILLED CENTER BODY	AL 6061-T6	2	
4	TAPPED CENTER BODY	AL 6061-T6	2	
5	VALVE MANIFOLD STOP	A366 ZN/PL	2	
6	O-RING, VALVE	NITRILE	6	(Y)
7	BALL	SS 302/316	6	(Y)
8	STEM	17-4 PH H1150	6	(Y)
9	SEAT	DELFIN	12	(Y)
10	STEM PACKING	25% GFT	6	(Y)
11	PACKING FOLLOWER	SS 302/316	6	(Y)
12	BELLEVILLE WASHER	SS 302	12	
13	THRUST WASHER	25% GFT	6	(Y)
14	CAPSCREW VALVE	HYLC SS 304	8	
15	CAPSCREW VALVE	HYLC SS 304	8	
16	LOCKWASHER	HLCK SS 304	16	
17	HANDLE, "CLOSE"/"OPEN"	A366 ZN/PL	1/1	(1)
18	LEVER	A366 ZN/PL	4	
19	JAM NUT, VALVE	HEXJ GR 5 ZN/PL	12	
20	CONNECTING ROD	A366 ZN/PL	2	
21	SCREW, CONNECTING ROD	SIRM SS 304	2	
22	LOCKNUT, CONNECTING ROD	HEXL NYLON/SS	6	
23	O-RING, MANIFOLD	NITRILE	8	(Y)
24	CAPSCREW, MANIFOLD	HYSC SS 304	16	
25	LOCKWASHER	HLCK SS 304	16	
26	CAPSCREW, STOP	HYSC SS 304	2	
27	NUT, STOP	HEXN SS 304	2	

NOTE:  
 -QTY ABOVE IS PER SET (LEFT AND RIGHT HAND)  
 -(1) LEFT HANDLE "CLOSE", CV, RIGHT HANDLE "OPEN" CCW  
 -(Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-WBMC



**BETTS BETTS CANADA LTD.**  
 1000 Lakeshore Dr.  
 Aurora, Ontario

WBMC SELECTOR VALVES, "OPEN" AND "CLOSE", ASSEMBLY

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)

UPDT LOGO  
 AS-1998-04-28 # 6052-1-B  
 AS-1998-04-28 # 6052-1-B  
 AS-1998-01-27 # 6051-1-B

REV. BY-DATE-REF

TOLERANCES  
 XXX ±0.5 (±10)  
 XX ±0.2 (±5)  
 X ±0.1 (±2.5)

SCALE 1:2 BY DY CKM  
 APR 28-98  
 APR 28-98

WEIGHT 132 LB

DATE FEB-12-96

DWG NO. APB0648

REV 2-

DWG. NO. APB0648

# Flow Control Valves

## Series F and FS

### Colorflow Series F and FS Flow Control Valves

These valves provide precise control of flow and shutoff in one direction, and automatically permit full flow in the opposite direction.

A two-step needle allows fine adjustment at low flow by using the first three turns of the adjusting knob; the next three turns open the valve to full flow, and also provide standard throttling adjustments.

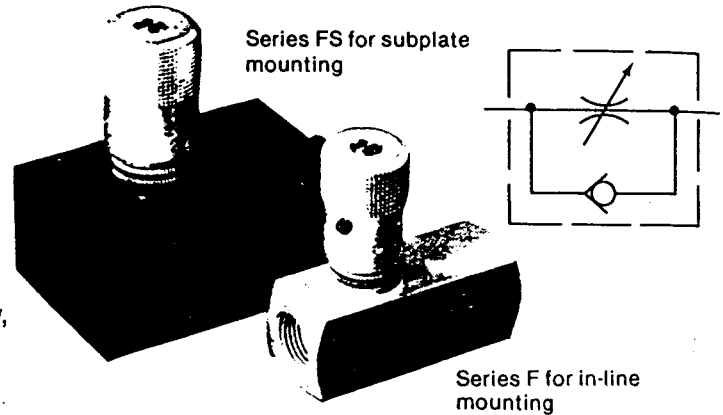
The exclusive "Colorflow" color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting.

Available in brass for air and oil applications.

Maximum operating pressure:

Brass: Models F, inline only: 2000 PSI (140 Bar),  
max. except Model F1600 only: 500 PSI  
(35 Bar) max.

Steel: Inline 200-820 Sizes: 5000 PSI  
Inline 1020-3220 Sizes: 3000 PSI  
Subplate All Sizes: 3000 PSI



Cracking Pressure, for return check poppet:  
5 PSI (0.4 Bar)

Poppet material: Brass F200 through F800  
Soft seal. All others: Solid metal poppet.

Needles: Standard needle on all models: Fine  
needle optional on Models F400, 600, 620, 820

### Quick Reference Data Chart

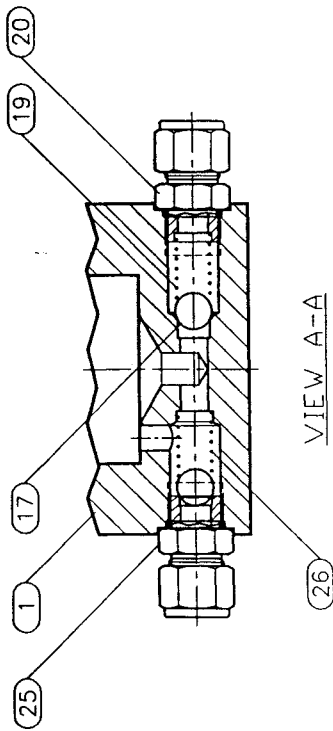
Model Number	Free Flow Rate, Max. GPM (L/M)	Free Flow Orifice Area in <sup>2</sup>	Free Flow C <sub>v</sub>	Orifice Area, Effective Control Flow, in <sup>2</sup>	Effective Control Flow C <sub>v</sub>	Port Size (in.) And Threads
F200 *	3 (11)	0.023	0.53	0.0102	0.230	1/8 NPTF
F400 *	5 (19)	0.068	1.56	.0194	.433	1/4 NPTF
FS400 *						1/4
F620 *						9/16-18 UNF (SAE 6)
F600 *	8 (30)	0.099	2.27	.0344	.787	3/8 NPTF
FS600 *						3/8
F820 *						3/4-16 UNF (SAE 8)
F800 *	15 (57)	0.224	5.11	.0427	.976	1/2 NPTF
FS800 *						1/2
F1020 *						7/8-14 UNF (SAE 10)
F1200 *	25 (95)	0.348	7.95	.1080	2.470	3/4 NPTF
FS1200 *						3/4
F1220 *						1-1/16-12 UN (SAE 12)
F1600 *	40 (151)	0.453	10.35	.2300	5.250	1 NPTF
FS1600 *						1
F1620				.3070	7.000	1-5/16-12 UN (SAE 16)
F2000	70 (265)	0.855	19.52	.2300	5.250	1-1/4 NPTF
F2020	70 (265)	0.855	19.52	.3710	8.470	1-5/8-12 UN (SAE 20)
F2400	100 (379)	0.955	21.82	.2300	5.250	1-1/2 NPTF
F2420	100 (379)	0.955	21.82	.3710	8.470	1-7/8-12 UN (SAE 24)
F3200	150 (568)	1.046	23.90	.2300	5.250	2 NPTF
F3220	150 (568)	1.046	23.90	.6010	13.410	2-1/2-12 UN (SAE 32)

\*Coast Guard Acceptance-Steel.

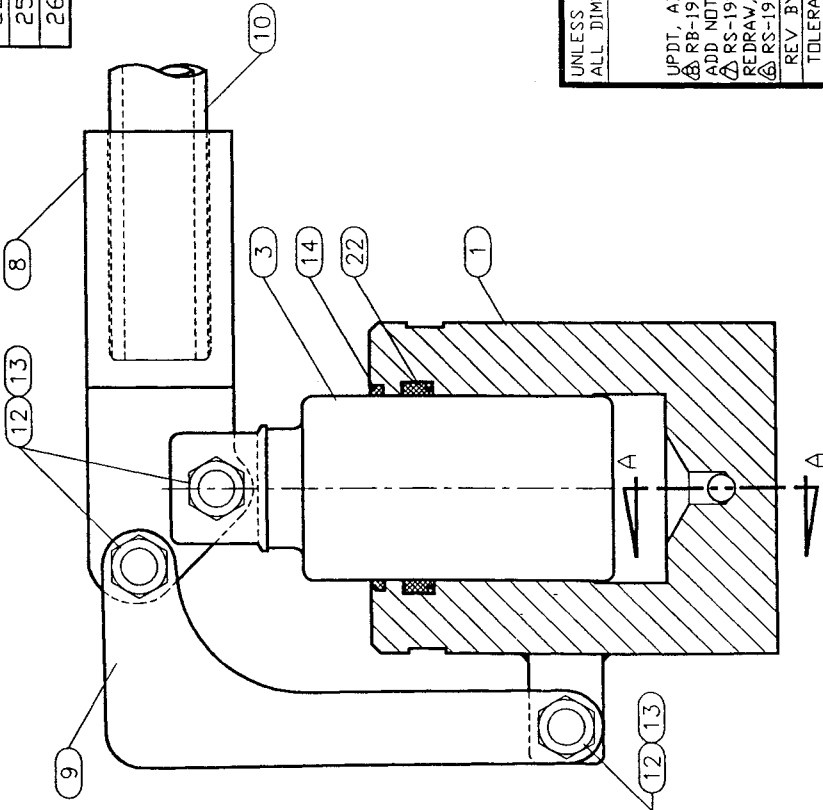
ITEM	DESCRIPTION	DWG./PART NO.	MATERIAL	QTY	NOTE
1	BODY	AP-0138	AISI C1020	1	
3	PISTON	AP-0139	AISI C1045 CH.PL	1	
4	BOOT	AP-0136	NITRILE	1	(H)
8	LEVER ASSEMBLY	AP-0073	AISI 1020	1	
9	LINK	AP-0129	CS	2	
10	HANDLE	AP-0128	CS	1	
11	HANDLE RING	AP-0076	CS	2	(H)
12	PIN	HXHC 1/2NC X 2	GR 5	3	
13	LOCKNUT	HEXN 1/2NC	GR 5	3	
14	WIPER	#959-25	MOLYTHANE	1	(Y)
17	BALL	1/2 DIA	STEEL CH.PL	2	
19	DISCHARGE SPRING	AP-0077	SS 302	1	
20	DISCHARGE ADAPTER	AP-0140	SS 316	1	
22	SEAL	#1870-2500-375	MOLYTHANE	1	(Y)
25	SUCTION ADAPTER	AP-0130	SS 316	1	
26	SUCTION SPRING	AP-0141	SS 302	1	

NOTE:

- 1) (H) NOT SHOWN; (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-HP-X eg. HP-14, HP-9 OR HP-3
- 2) FASTENERS AND SERVICE TOOLS ARE ANSI/INCH SIZE
- 3) ITEM 17 AND 26 NOT USED IN CONJUNCTION WITH G/H PANEL AS ITEM 8 IN PANEL SERVES AS SUCTION CHECK VALVE



VIEW A-A



UNLESS SPECIFIED OTHERWISE  
ALL DIMENSIONS INCHES (mm)

UPDT, ADD BOOT  
 RB-1998-04-01 @ 06053  
 ADD NOTE No. 3  
 RS-1998-01-26 @ 06051-1-B  
 REDRAW, UPDT STDS, HP WAS HV  
 RS-1996-11-27 @ SALES

REV. BY-DATE+REF

TOLERANCES  
 XXX ±0.5 (+10)  
 XX ±0.2 (+5)  
 X ±0.1 (+2)



**BETTS** BETTIS CANADA LTD.

Actuators & Controls

A Daniel Industries Company

HANDPUMP SERIES HP

A-0181--DWG\_V1EV\_00

APR-01-98

SCALE 2:5

BY RD

CHK

DATE

MAR-03-83

REV 8-

DWG. NO. A-0181

DWG. NO.

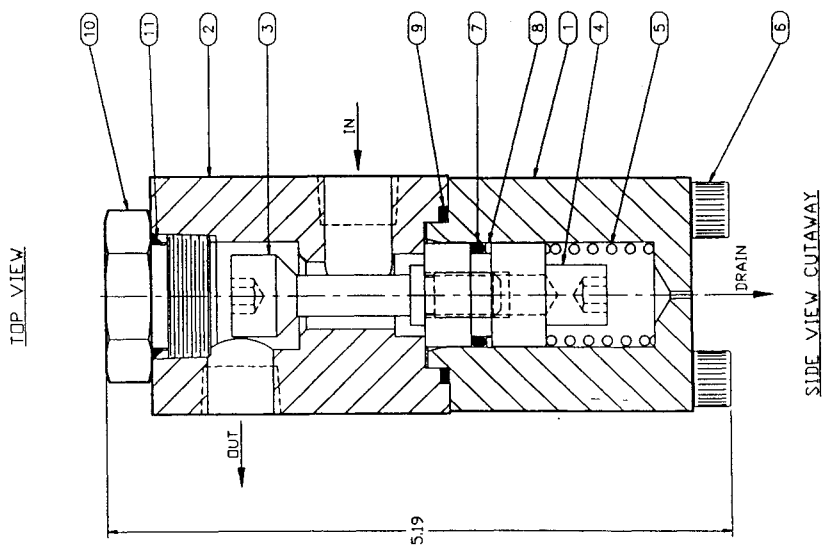
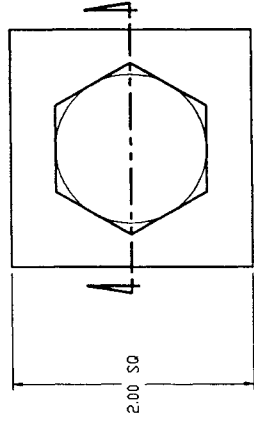
A-0181



ITEM	PART NO	DESCRIPTION	MATERIAL	QTY	NOTE
1	905-421	LOWER BODY	AL 6061-T6	1	
2	905-422	UPPER BODY	AL 6061-T6	1	
3	905-423	POPPET	SS 316	1	
4	905-424	PISTON	AL 6061-T6	1	
5	905-408	SPRING	SS 304	1	
6	905-410	CAPSCREW, HEX SOCKET	SS 304	4	
7	905-427	O-RING, PISTON	NITRILE	1	(Y)
8	905-428	BACK-UP RING, PISTON	NITRILE	1	(Y)
9	905-429	O-RING, BODY	NITRILE	1	(Y)
10	905-430	HEX PLUG	AL 7075-T6S1	1	(Y)
11	905-432	O-RING, PLUG	NITRILE	1	(Y)

NOTE:  
 - (Y) RECOMMENDED SPARE PARTS REPAIR KIT PART NO. SPRK-SV06T2  
 - FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE

INSTALLATION: GAS HYDRAULIC UNITS  
 - INSTALL BETWEEN CONTROL PANEL (IN) AND HANDPUMP  
 - SUCATION PORT (OUT).  
 - ENSURE DRAIN HOLE IS FACING DOWN.  
 - TIGHTEN HANDPUMP LINKAGE BOLTS TO 10 FT-LB FOR OPTIMUM PERFORMANCE.  
 - OPERATIONAL TEST: RAM RISE  $\leq 1/4"$  @ 750 PSI SUPPLY.



UPDT LOGO  
 45-1998-04-28 # 6053-1-B  
 MISSING LABEL (ITEM 1)  
 VL-1995-12-0187482-1-B  
 REDRAWN ON CAD  
 APPROVAL: HCL #008057-RLD  
 REV BY: DATE: REF:

TOLERANCES	
DECIMALS	FRACTIONS
X ±0.05	XX-XX/X ±1/16
XX ±0.02	X-X/X ±1/32
XXX ±0.005	X/X ±1/64
T.I.R. ±0.010	THD ±1 TURN
	∠ ±1°

BREAK SHARP EDGES  
 CHAMFER FIRST THREAD  
 REMOVE ALL BURRS

**BETTS BETTS CANADA LTD.**  
 10000 10th Avenue  
 Edmonton, Alberta T6E 1K1  
 CANADA

HANDPUMP SAFETY VALVE  
 SV-06 TYPE 2, ASSEMBLY

APB0815-DWG  
 APR-28-98

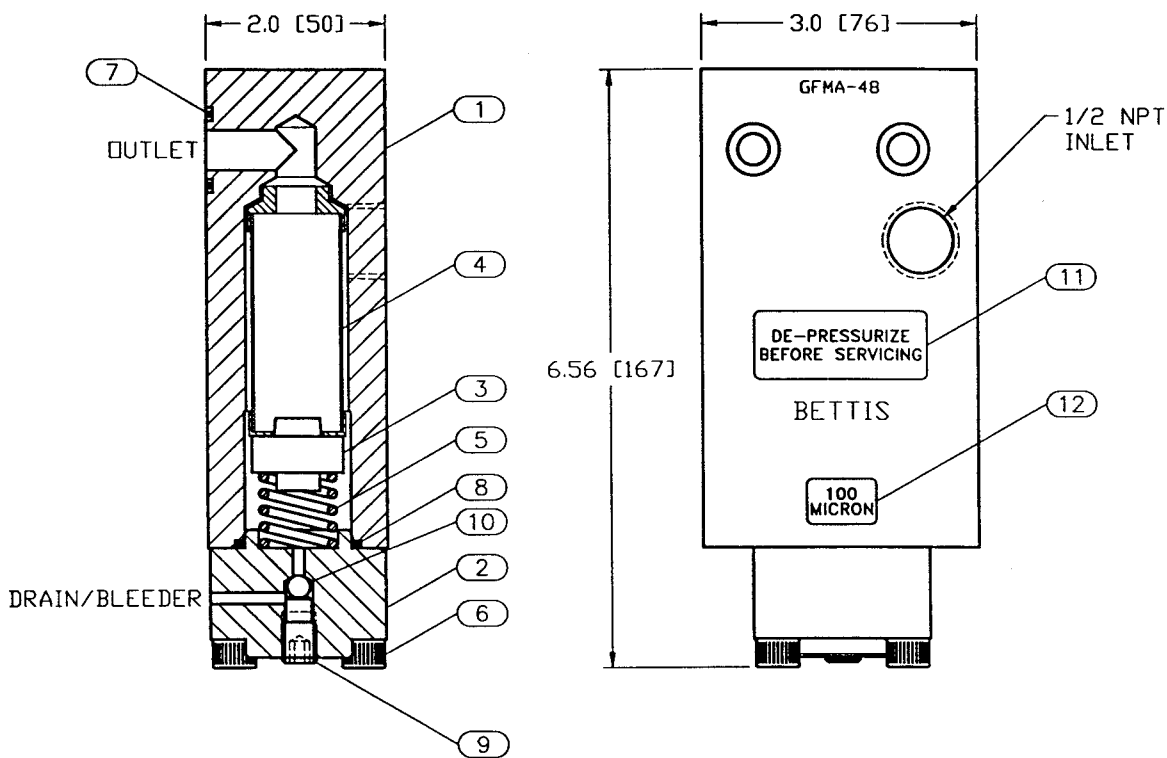
SCALE 1:1 BY AG  
 DATE FEB-25-91

WEIGHT 1.85 LB  
 V.D. 09009-R&D DWG NO. APB0815 REV 6-

DWG. NO. APB0815

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
1	907-001	BODY	AL 6061-T6	1	
2	907-002	CAP	AL 6061-T6	1	
3	907-003	BUTTON	AL 6061-T6	1	
4	907-024	FILTER, 75 MICRON	SS 303/./304	1	(Y)
5	907-005	SPRING	SS 302	1	
6	907-007	BOLT	SS 304	4	
7	907-009	O-RING, OUTLET	VITON	1	(Y)
8	907-010	O-RING, CAP	VITON	1	(Y)
9	907-014	BLEEDER PLUG	SS 304	1	
10	907-015	BLEEDER BALL	SS 440C	1	
11	907-006	DECAL (DE-PRESSURIZE...)	VINYL	1	
12	907-051	DECAL (100 MICRON)	VINYL	1	

NOTE: (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-GFMA FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE



UNLESS SPECIFIED OTHERWISE  
ALL DIMENSIONS INCHES [mm]

UPDT LOGO  
 ⚠ AS-1998-04-28 @ 6053-1-B  
 UPDT SS 303/./304 FILTER  
 ⚠ RS-1998-01-29 @ 06051-1-B  
 REDRAW, +TOOLS, DECAL  
 ⚠ RS-1995-11-30 @ SALES  
 REDRAW, +DIM'S, w/ BLEEDER  
 ⚠ VL-1994-12-14 @ SALES

REV BY-DATE+REF

TOLERANCES  
 XXX ±0.5 [±10]  
 XX ±0.2 [±5]  
 X ±0.1 [±2]



**BETTIS**

BETTIS CANADA LTD.

Actuators & Controls

A Daniel Industries Company

CUTAWAY ASSEMBLY AND DIMENSIONS  
 GFMA-48  
 GAS FILTER

A-0182--DWG\_VIEW\_00  
 APR-28-98

WEIGHT 1.42 LB

SCALE 1:2 BY EB

CHK *Mure v4.2 f.*

DATE JUN-10-91

W.D. ---

DWG. NO. A-0182

REV 7-

## XVIII VH LOCKING BLOCK ADJUSTMENT AND SERVICE

- A) Scope:  
This document describes field inspection and rebuild of the series VH1 and VH2 Hydraulic Valve. Some models do not include or require the relief valve components, in which case references to these components should be ignored.
- B) Reference Drawing:  
APB0662 LOCKING BLOCK SERIES VH, ASSEMBLY.
- C) Materials:
1. Spare parts kit (P.N. SPRK-VH2 or SPRK-VH1). When ordering kits, specify the serial and / or reference numbers found on the operator as well as the model number on the VH series valve.
  2. Vaseline.
- D) Dismantling and inspection:

The valve body may be left in place or removed for the following:

1. Drain oil as required, note the position of the relief valve adjust screws and remove all parts from the block except relief valve seat inserts, NPT plugs and tube fittings.
2. Inspect the following items in the body:
  - a) poppet seats, relief valve seat inserts for smooth undamaged surface.

NOTE: Relief valve seat inserts have been installed with "PST" or equivalent pipe sealant at the factory.

- b) piston bores for smooth, unscratched surface.
3. Remove all o-rings and inspect the following on the parts:
  - a) piston subassembly for tight piston-to-spring rod threaded joint (compress spring for visual examination).

NOTE: The joint has been torqued to 10 ft.lb and blue "Loctite" has been applied at the factory.

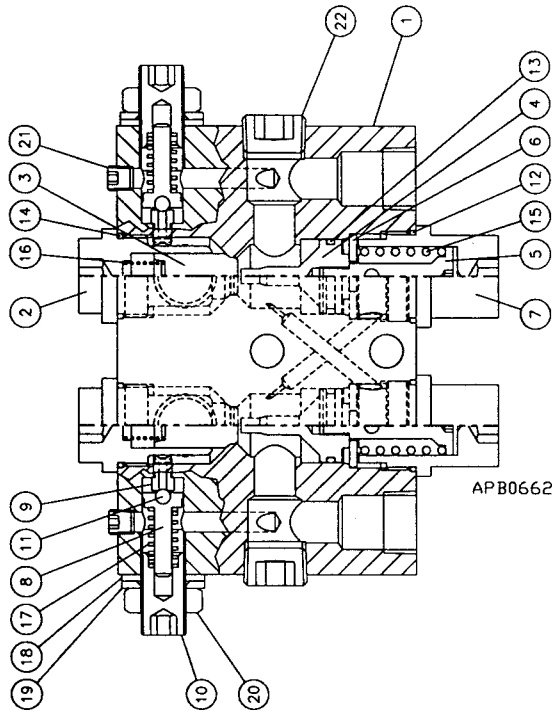
- b) piston OD for smooth finish.
  - c) springs for corrosion, breakage or distortion.

- E) Rebuild:
- a) Clean any accumulations of dirt or sediment (removal of NPT plugs may be required).
  - b) Install new soft parts with vaseline lubricant. Re-install all parts into the body.
- F) Adjustment of relief valves:  
Set relief valve adjust screws approximately (to position noted at disassembly). With tank ports open, apply pressure to the cylinder ports (C1 and C2 in turn) to set the corresponding relief valves. Raise pressure slowly until a small flow is seen from the tank port (after flooding the tank side of the body as necessary). Adjust the relief valve adjust screw as required.

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
1	910-200	BODY	AL 6061-T6	1	
2	910-210	POPPET RETAINER	AL 7075-T651	2	
3		POPPET	URETHANE 700	2	(Y)
4	910-214	PISTON	AL 6061-T6	2	
5	910-216	SPRING ROD	AL 7075-T651	2	
6	910-218	SPRING SEAT	AL 7075-T651	2	
7	910-220	PISTON RETAINER	AL 7075-T651	2	
8	910-222	POPPET, R.V.	AL 6061-T6	2	
9	910-224	SEAT INSERT, R.V.	SS 304	2	
10	910-226	ADJUSTMENT SCREW, R.V.	AL 7075-T651	2	
11	910-230	BALL, R.V.	NITRILE	2	(Y)
12	910-232	O-RING, PISTON RETAINER	NITRILE	2	(Y)
13	910-234	O-RING, PISTON	NITRILE	2	(Y)
14	910-236	O-RING, POPPET RETAINER	NITRILE	2	(Y)
15	910-238	SPRING, PISTON	SS 302	2	
16	910-240	SPRING, POPPET	SS 302	2	
17	910-242	SPRING, R.V.	SS 302	2	
18	910-244	THREDESEAL	CS/NITRILE	2	(Y)
19	910-246	WASHER, THREDESEAL	CS ZN:PL	2	
20	910-248	NUT, JAM	CS ZN:PL	2	
21	910-250	PLUG	CS ZN:PL	2	
22	910-252	PLUG	CS ZN:PL	2	

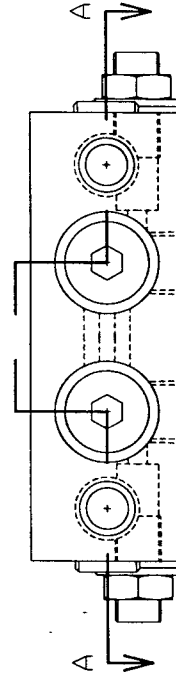
NOTE:  
 1. (Y) RECOMMENDED SPARE PARTS/REPAIR KIT  
 2. REFERENCE DIMENSIONAL DWG C-0230

SPECIFICATIONS:	
PORTS:	3/4 NPT FEMALE
MEDIA:	HYDRAULIC FLUID
MAX. WORKING PRESSURE:	2160 PSI (147 BARg)
TEMPERATURE RATING:	-50°F TO +150°F (-46°C TO +65°C)
FLOW RATING:	50 GPM @ 150 PSI TOTAL ΔP
CRACKING PRESSURE:	32 PSI
PILOT RATIO:	4:1
INTEGRAL RELIEF VALVE:	300 - 1200 PSI
ADJUSTMENT RANGE:	600 PSIG
STD SETTING (CAP SIDE):	600 x (CAP:ROD RATIO) PSIG
STD SETTING (ROD SIDE):	



SECTION A-A

APB0662



DWG. NO. APB0662

UNLESS SPECIFIED OTHERWISE  
 ALL DIMENSIONS IN INCHES (DIM)

UPDT TB  
 PD-1998-09-23 # 6051-1-B  
 PD-1998-09-23 # 6051-1-C  
 DT-1998-11-05#009-6-R  
 UPDATE POPPET, POPPET RETAINER,  
 VERSION 2 BODY  
 DT-1993-08-10#009-6-R

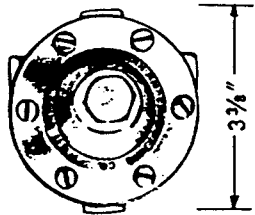
REV. BY: DATE: REF.  
 XX 40.5 (110)  
 XX 40.2 (43)  
 X 40.1 (62)

**BETTS** BETTS CANADA LTD.  
 A Fluid Motion Company  
 7000 Highway 70  
 Unit 100, Langley, B.C.  
 V3A 2K6, Canada  
 TEL: 604-885-1100  
 FAX: 604-885-1101

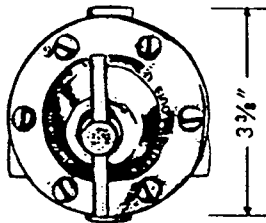
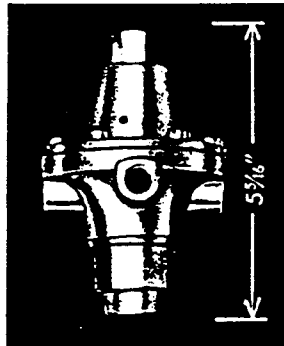
APB662--DWG\_VIEV\_00 WEIGHT 10.0 LB  
 SEP-23-98  
 SCALE 1:2 BY AG  
 V.O. 05468-1-T DWG. NO. APB0662 DATE MAY-15-92  
 REV 4-

# MECO INDUSTRIAL REGULATORS

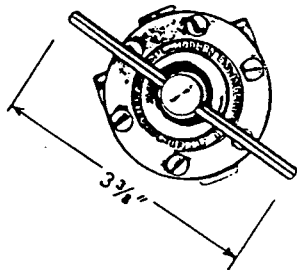
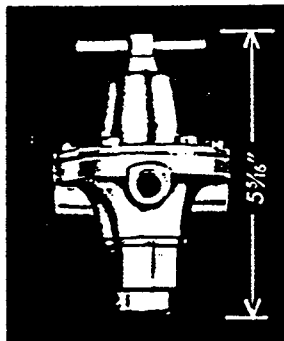
## Type "P" HIGH PRESSURE REGULATORS for gas pressures to 6000 psi



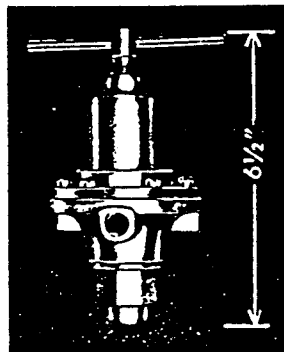
STYLE P-1DA/B465



STYLE P-1DC/B481



STYLE P-1DD/B373



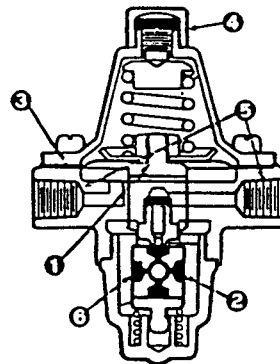
With the advance of varied mechanical apparatus, operated by compressed air or other gases, industry needs dependable regulation to lower receiver pressures to working pressures for the operation of pneumatic feeds and controls.

Backed by more than half a century of research and experimentation, P Industrial Regulators are designed to fill numerous industrial compressed air or gas pressure control needs.

Regulation is accurate and pressure control is uniform under constant or interrupted gas flow. All P Industrial Regulators will reduce inlet pressures of 6000 PSI or less to outlet pressures of 5 to 500 PSI.

Our engineering department is at your service to help develop the appropriate regulator should you fail to find such shown.

### SPECIAL FEATURES!



① **Dia-Blok construction**—features the diaphragm being positively connected to the regulator seat block by means of a yoke. Thus, any pressure on the diaphragm results in the diaphragm and seat moving the same distance at exactly the same time, thereby providing long seat life.

② **Multi-Seat Block**—features a square block containing four extruded non-combustible seats which can be easily revolved from one seat to another, whenever a seat needs to be changed in the regulator.

③ **Stainless Steel Diaphragms**—feature minimized pressure fluctuation within the regulator by their extremely long life and ability to maintain constant elasticity. Thousands of diaphragms have been known to last 25 years or more, without replacing.

④ **Tee-Handle or Slotted Adjusting Screws**—feature two available means of adjustment that can be had on all of the P Industrial Regulators, with the exception of Series 8370.

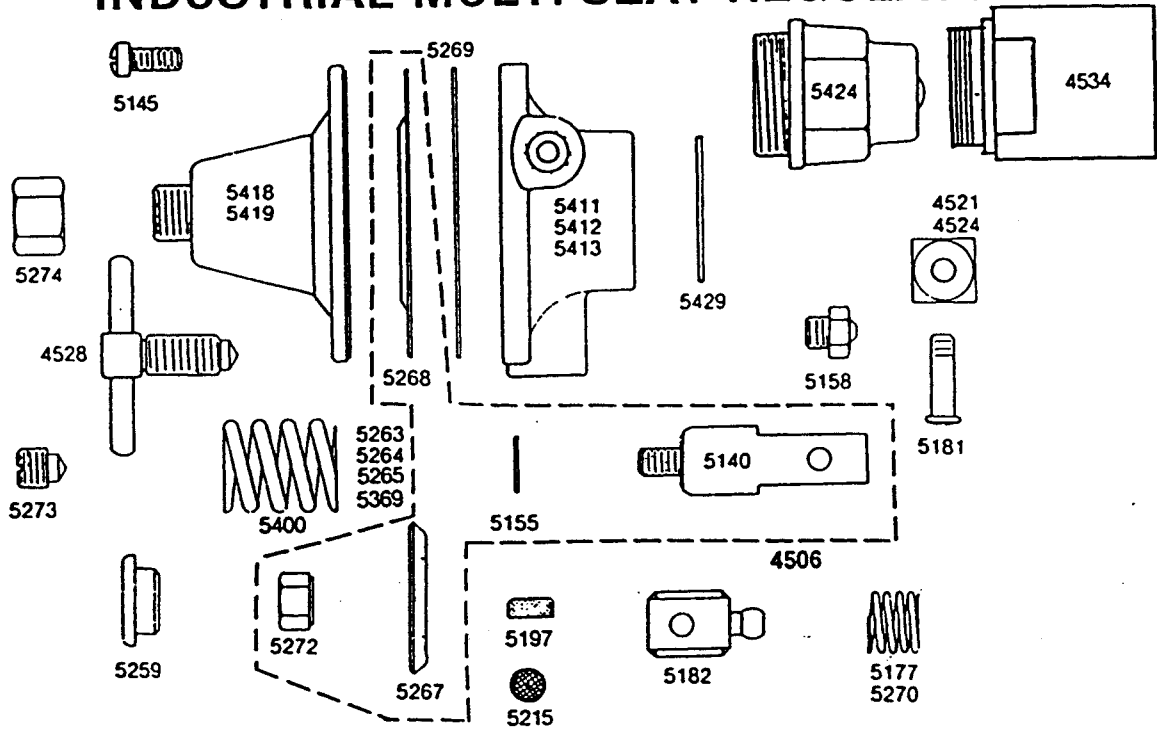
⑤ **Inlets and Outlets**—feature the possibility of either right hand or left hand inlet or straight through and right hand, left hand, bottom or top outlet—or a combination of them.

⑥ **Various Seating Materials**—feature a choice of either Nylon or Kel-F, depending on gas service used.

No special tools or skill are required to change seats in the P Industrial Regulators. A change of seats is an adjustment—not a repair job. Seat material, which varies with gases used, is shown in the specification table.



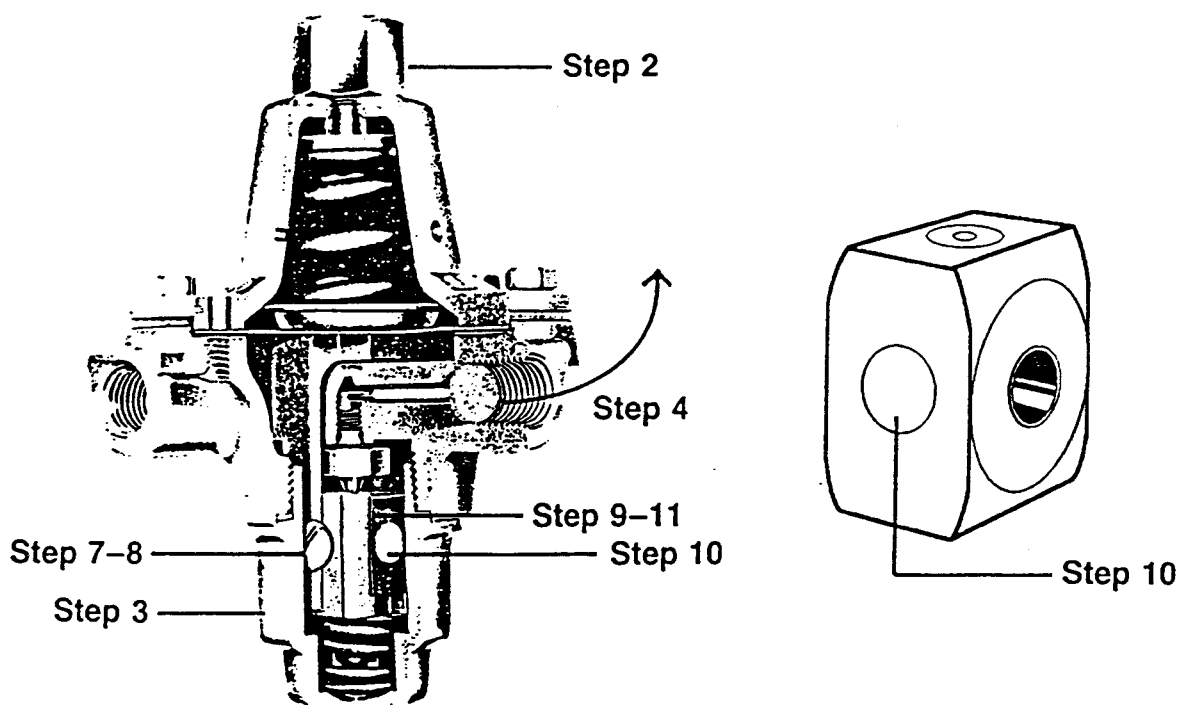
# TYPE P-30, P-50, P-125, P-150, & P-225 INDUSTRIAL MULTI-SEAT REGULATOR



Stock No.	Description
4506	Diaphragm-Yoke Assembly .....
4521	Seat Block with White Nylon Seats.....
4524	Seat Block with Kel-F Seats for CO <sub>2</sub> .....
4528	Adjusting Screw Assembly .....
4534	ENVIRO-CAP, Water Heated Back Cap Assembly .....
5140	Yoke (Part of 4506) .....
5145	Bonnet Screw 6 required, Pkg. 12.....
5155	Yoke Gasket, Teflon, Pkg. 12 (Part of 4506).....
5158	Nozzle with 5/64" Orifice, Pkg. 6.....
5177	Rear Spring, for over 500 PSI Inlet Pressure, Standard .....
5181	Yoke Clamping Screw, Pkg. 6 .....
5182	Yoke Guide .....
5197	Filter Screen, pkg. 6 .....
5215	Sintered Filter, pkg. 12, Standard.....
5259	Spring Button.....
5263	Compression Spring for 30 PSI Pressure (Red) .....
5264	Compression Spring for 125 PSI Pressure (Green) .....
5265	Compression Spring for 150 PSI pressure (Purple).....
5267	Diaphragm Plate (Part of 4506).....
5268	Stainless Steel Diaphragm (Part of 4506) .....
5269	Diaphragm Gasket, Pkg. 6 .....
5272	Diaphragm Plate Nut (Part of 4506).....
5273	Slot Type Adjusting Screw.....
5274	Protection Cap for Slot Adjusting Screw.....
5369	Compression Spring for 50 PSI pressure (Black).....
5400	Compression Spring for 225 PSI pressure (Grey) .....
5411	Body, 1 inlet, 2 outlets P-1-DA.....
5412	Body, 1 inlet, 3 outlets P-1-DC.....
5413	Body, 2 inlets, 2 outlets P-1-DD.....
5418	Bonnet, for "T" Type Adjusting Screw .....
5419	Bonnet, for Slotted Type Adjusting Screw .....
5423	Allen Head Adj. Screw.....
5424	Back Cap.....
5429	Back Cap Gasket, Teflon, Pkg. 12 .....

## Instructions for Changing Seat Blocks in MECO Type "P" Industrial Regulators

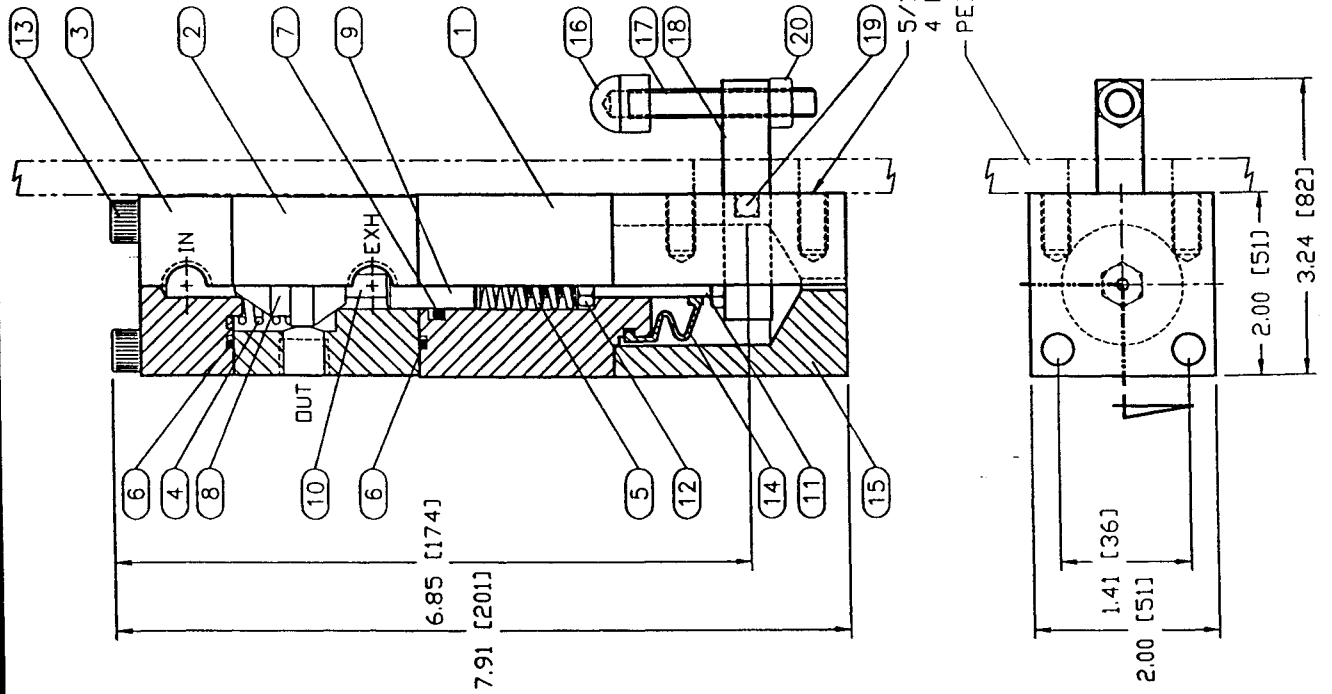
(average time required: 12 to 15 minutes)



1. Remove Type P Industrial Regulator from system.
2. Turn adjusting screw (clock-wise) in, approximately half way.
3. Clamp backcap of Type P Regulator in jaws of a vise; firmly, but not too tight!
4. Obtain a short length of steel pipe, or steel rod threaded  $\frac{1}{4}$ " NPTM, and insert this into the inlet of the regulator to use as a lever.
5. Remove the regulator from the backcap (held in vise); turning the regulator counter-clockwise, by striking the steel pipe or rod with the heel of the hand.
6. Remove regulator from backcap, which is still clamped in the vise, using care not to lose the backcap spring, located in the bottom of the backcap.
7. Place regulator yoke and seat block assembly on a flat, steady surface, such as a work bench with the yoke clamping screw pointed up.
8. Holding the regulator bonnet in one hand; remove the yoke clamping screw with a standard screw driver; counter-clockwise.
9. Hold seat block between thumb and forefinger and pull completely out from the prongs of the regulator yoke.
10. Remove seat block from yoke guide and turn seat block until an unused (undented) seat surface is found.
11. Slip seat block back into the seat guide with the unused seat surface facing regulator nozzle.
12. Hold seat block with thumb and forefinger and insert into the prongs of the regulator yoke; lining up the hole in the yoke guide with the threaded hole in the yoke.
13. Grasp regulator in one hand; insert yoke clamping screw into yoke and yoke guide (enclosing seat block), and tighten yoke clamping screw with screw driver; clockwise.
14. Blowout interior of regulator with clean shop air.
15. Check backcap gasket for possible wear and replace with new gasket if required.
16. Remove backcap spring from backcap; blow out interior of backcap with clean shop air and replace spring.
17. Insert regulator into backcap, (held in vise), and turn clockwise, tightening regulator onto the backcap with the aid of the steel pipe or rod that was screwed into the regulator inlet.
18. Remove steel pipe or rod that was used as a lever and retain in tool box for future use.
19. Replace regulator into system, making sure all connections on inlet and outlet are tight.
20. Turn regulator adjusting screw counter-clockwise until no tension is found. Pressurize system with downstream valve closed.
21. Turn regulator adjusting screw in (clock-wise) until 38 PSI is registered on the downstream side of the system; then back adjusting screw off; removing tension (counter-clockwise); this procedure making a good nozzle impression in the regulator seat, for correct operation.
22. Open downstream valve to bleed off gas trapped in regulator.
23. Regulator is now seated correctly and ready for use.

ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
1	906-051	UPPER BODY	AL 6061-T6	1	
2	906-002	CENTER BODY	AL 6061-T6	1	
3	906-003	LOWER BODY	AL 6061-T6	1	
4	906-004	LOWER SPRING	SS 302	1	
5	906-005	UPPER SPRING	CR VAN	1	
6	906-006	O-RING, BODY	NITRILE	2	(Y)
7	906-007	O-RING, PLUNGER	NITRILE	1	(Y)
8	906-008	POPPET	PVC	1	(Y)
9	906-009	PLUNGER	PVC	1	(Y)
10	906-010	POPPET SPACER	SS 304	1	
11	906-011	CAPSCREW, PUHSROD	SS 304	1	
12	906-012	NUT, PUSHROD	SS 304	1	
13	906-013	CAPSCREW, BODY	SS 304	4	
14	906-014	BOOT	NITRILE	1	
15	906-020	TRIGGER LEVER BODY	AL 6061-T6	1	
16	906-023	TRIGGER BALL	NYLON	1	
17	906-024	TRIGGER ADJ SCREW	SS 304	1	
18	906-030	LEVER, 1/4 WALL MTG	C1018 CF	1	
19	906-010	PIVOT PIN	SS 304	1	
20	650-280	NUT, TRIGGER JAM	SS 304	1	

NOTE: (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-ES-04 FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE



SPECIFICATIONS:  
 PORTS: 1/4 NPT Cv: 1.5  
 SERVICE: AIR, SWEET GAS, <5% H2S SOUR GAS  
 TEMPERATURE RATING: -46°C TO 65°C  
 MASS: 3.0 LBm (1.4 kg)  
 MAWP: 150 PSIG (1030 kPa)  
 MAX. PRESSURE EXH. PORT: 30 PSIG

**BETTIS** **BETTIS CANADA LTD.**

Actuators & Controls  
 A Daniel Mannes Company  
 MODEL ES-04 V2 (BOOT ADDED)  
 (3-WAY CAM OPERATED)  
 FOR GVO DOWNWARD STROKE  
 ASSEMBLY AND SPECIFICATIONS

UNLESS SPECIFIED OTHERWISE ALL DIMENSIONS INCHES (mm)	
UPDT PART NO	MC-1998-11-02 e 6051-1-B
UPDT TB	PO-1998-09-23 e 6051-1-B
	+BOOT, V2
	RS-1996-03-21 e CC19960219
	REDRAW, REPL MISSING DRG
	RS-1996-02-19 e SALES REQ
REV BY-DATE+REF	
TOLERANCES	XXX ±0.5 (±10)
	XX ±0.2 (±5)
	X ±0.1 (±2)

SCALE 1:2 BY DH [CHK] DATE OCT-20-83  
 V.D. --- DWG. NO. C-0081 REV 4-

DWG. NO. C-0081



ITEM	PART NO.	DESCRIPTION	MATERIAL	QTY	NOTE
1	906-001	UPPER BODY	AL 6061-T6	1	
2	906-002	CENTER BODY	AL 6061-T6	1	
3	906-003	LOWER BODY	AL 6061-T6	1	
4	906-004	LOWER SPRING	SS 302	1	
5	906-005	UPPER SPRING	CR VAN	1	
6	906-006	O-RING, BODY	NITRILE	2	(Y)
7	906-007	O-RING, POPPET	NITRILE	1	(Y)
8	906-008	POPPET	PVC	1	(Y)
9	906-009	PLUNGER	PVC	1	(Y)
10	906-010	POPPET SPACER	SS 304	1	
11	906-011	CAPSCREW, PHSROD	GR 5 PL	1	
12	906-012	NUT, PUSHROD	SS 304	1	
13	906-013	CAPSCREW, BODY	SS 304	4	
14	906-014	BOOT	NITRILE	1	
15	906-020	TRIGGER LEVER BODY	AL 6061-T6	1	
16	906-023	TRIGGER BALL	NYLON	1	
17	906-024	TRIGGER ADJ SCREW	SS 304	1	
18	906-030	LEVER, 1/4 WALL MTG	C1018 CF	1	
19	906-010	PIVOT PIN	SS 304	1	
20	906-XXX	NUT, TRIGGER JAM	SS 304	1	

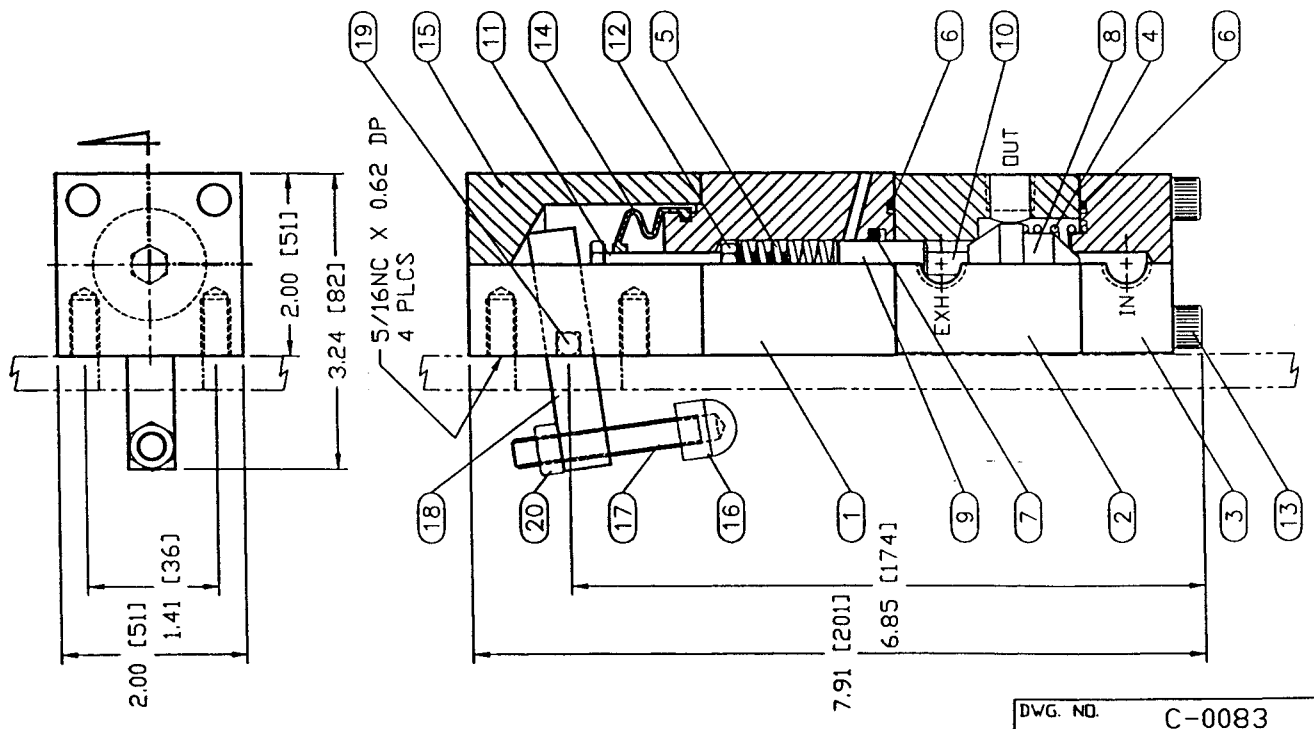
NOTE: (Y) RECOMMENDED SPARE PARTS, PART NO. SPRK-ES-05 FASTENERS AND MAINTENANCE TOOLS ARE ANSI/INCH SIZE

SPECIFICATIONS:  
 PORTS: 1/4 NPT Cv: 1.5  
 SERVICE: AIR, SWEET GAS, <5% H2S SOUR GAS  
 TEMPERATURE RATING: -50°C TO 65°C  
 MASS: 3.0 Lbm (1.4 kg)  
 MAWP: 150 PSIG (1030 kPa)  
 MAX. PRESSURE EXH. PORT: 30 PSIG

**BETTIS** BETTIS CANADA LTD.  
 Actuators & Controls  
 A David Buller Company

MODEL ES-05  
 (3-WAY CAM OPERATED)  
 INVERTED FOR GVO UPWARD STROKE  
 ASSEMBLY AND SPECIFICATIONS  
 C-0082--DWG\_VIEW\_C-0083

UPDT TB	BY	RS	CHK	DATE
REV. BY-DATE-REF	1:2	---	AK/2/24	JAN-18-96
TOLERANCES	SCALE	---	DWG. NO.	REV
XXX ±0.5 (±10)	1:2	---	C-0083	1-
XX ±0.2 (±5)				
X ±0.1 (±2)				



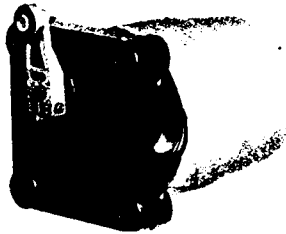
UNLESS SPECIFIED OTHERWISE  
 ALL DIMENSIONS INCHES (mm)

UPDT TB  
 PD-1998-09-23 e 6051-1-B  
 REV. BY-DATE-REF



DWG. NO. C-0083

# Installation and service instructions for CX Weather-sealed, Explosion-proof Switches



## GENERAL INFORMATION

Sealed construction for CX explosion-proof switches provides protection from the entry of water, dust and oil as defined in NEMA 1, 3, 3R, 4, 12 and 13. In addition to the above, the sealed construction of the 80CX provides protection against corrosion, dust and water as defined in NEMA 4X\*.

These explosion-proof and weather-sealed switches are also protected from flammable hydrocarbon atmospheres, metal dust, coal dust and grain dust as defined in NEMA 7 Class I groups C & D and 9 Class II groups E, F and G. CX listings beginning with numbers 14, 16, 24, 26, 36 or 84 (e.g. 14CX1) also meet NEMA Class I Group B\*.

**\*Application Note:** Enclosures are based, in general, on the broad definitions outlined in NEMA standards. Therefore, it will be necessary for the user to determine that a particular enclosure is adequate when exposed to the specific conditions that might exist in intended applications. Except as might otherwise be noted, all references to products relative to NEMA enclosure types are based on MICRO SWITCH evaluation only.

**IMPORTANT:** Switches without shaft restoring force do not have overtravel stops. On switches with potentiometers, use care to insure that overtravel does not exceed 125° in the application and during set-up.

## LEVER POSITIONING

Loosen the screw with a 9/64 inch hexagon key wrench, move the lever to the desired position and securely tighten the screw until the "teller tab" can no longer be moved by hand. Then tighten the screw another 1/8 to 1/4 turn to assure that the lever is tight on the shaft. Hexagon key wrenches are provided in adjusting tool set LSZ4005 for this purpose.

## CAM ADJUSTMENT

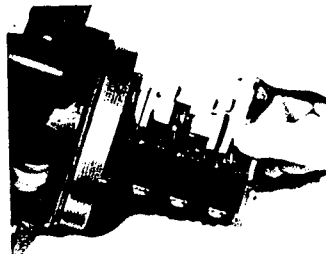
Pretravel, overtravel, and actuation sequencing can be adjusted and/or modified in the field. No tools are required.

### To Adjust Plunger Types:

1. Lift cam follower.
2. Turn cam wheel to be adjusted to desired position. Each notch on the wheel represents a change in operation point of 0,116 mm (.0045 in.). Moving the cam wheel in the direction away from the base housing advances the operate point. Pretravel **decreases** and overtravel thereby **increases**. When positioning cams, be sure the cam follower is allowed to utilize the full rise of the cam. This is required to provide adequate overtravel and release travel of the basic switches.

**IMPORTANT:** Do not use the set screw in the cam follower to adjust travel characteristics.

3. Release cam wheel.
4. Release cam follower.



### To Adjust Rotary Types:

1. Lift cam follower.
2. Move cam wheel axially to disengage teeth on wheel from teeth on shaft disc.
3. Turn cam wheel to desired position. Turning in direction of shaft rotation advances operate point. Pretravel **decreases** and overtravel thereby **increases**. Each notch on the cam wheel represents an operating point change of 7°20'. The symbols on the cam wheel simplify changing rotation from clockwise to counterclockwise to center neutral, or vice versa. If the switch operates on clockwise and counterclockwise rotation, the pointer on the cam follower lines up with symbol  $\Delta$  or symbol  $\nabla$  on the cam wheel. When symbol  $\Delta$  lines up, pretravel of 15° max. is obtained. When symbol  $\nabla$  lines up, 80° max. pretravel is obtained. Operation is in the direction of the inclined surface of the symbol when  $\Delta$  or  $\nabla$  lines up with the pointer on the cam follower.
4. When cam wheel has been rotated to desired location, release cam wheel to engage with mating shaft disc.
5. Release cam follower.



### CX Wiring Methods

MICRO SWITCH recommends that conduit be installed per NEC articles 501-4 and 501-5.



**FIELD SERVICE REQUEST**

To assist in providing service/assistance with your equipment the following information is requested:

A) **CONTACT/RESPONSIBLE**

NAME \_\_\_\_\_ COMPANY \_\_\_\_\_

POSITION \_\_\_\_\_ SITE/PROJECT IDENTIFICATION \_\_\_\_\_

PHONE \_\_\_\_\_ FAX \_\_\_\_\_ PAGER \_\_\_\_\_

B) **VALVE OPERATOR:**      ROTARY       LINEAR/GATE

MODEL \_\_\_\_\_ SERIAL NUMBER \_\_\_\_\_

- APPLICATION:
- MAINLINE BLOCK/LINEBREAK ESD
  - MAINLINE VALVE STATION BYPASS
  - UNIT SUCTION/DISCHARGE BLOCK
  - METER STATION SHUT IN/H<sub>2</sub>S SHUT IN
  - PIG LAUNCHER/RECEIVER
  - \_\_\_\_\_

C) **PROBLEM IDENTIFIED DURING:**

- INSTALLATION     COMMISSIONING       OPERATION       MAINTENANCE

D) **PROBLEM IDENTIFIED AS:** \_\_\_\_\_

(If operator/valve travel is open/closed fully or partially, How far?) \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

... continued

E) CHECK LIST FOR OFTEN-OVERLOOKED CAUSES

- TANK FLUID LEVELS ARE CORRECT FOR OPERATION
- POWER GAS OF SUFFICIENT PRESSURE AND FLOW IS PRESENT
- ESD/LINEBREAK SYSTEM IS RESET
- OPERATOR TRAVELS FULLY AND SMOOTHLY
  - SPEED CONTROLS ARE MORE THAN 25% OPEN
  - CORRECTLY MOUNTED ON VALVE, ie. VALVE OPEN/OPERATOR OPEN/STOPS SET
  - EXHAUSTS NOT RESTRICTED OR VENTED TO HEADER SYSTEM w/ BACK-PRESSURE
  - ALL RELAYS AND SOLENOIDS ARE SWITCHING
  - CONFIRM SIGNALS ARE BEING APPLIED AND REMOVED AS REQUIRED

F) IDENTIFY COMPONENT(S) THAT MAY CAUSE THE PROBLEM

LIST ANY ADJUSTMENTS THAT WERE MADE BY OTHERS \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

G) CONDITIONS UNDER WHICH PROBLEM OCCURS

<u>FLOWLINE</u>	<u>OPERATOR GAS SUPPLY</u>
PIPELINE PRESSURE ____ psi[kPa]	FROM PIPELINE ____ psi[kPa]
DIFFERENTIAL ACROSS VALVE ____ psi[kPa]	FROM FUEL GAS LINE ____ psi[kPa]
PIPELINE RATE OF DROP ____ psi[kPa]/minute	
OTHER/WEATHER _____	

H) REQUIREMENTS

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

