MOORE

SD503
Issue:8
Date: 5/89

SERVICE INSTRUCTIONS
MODEL 503
THREE MODE
NULLMATIC® CONTROLLER

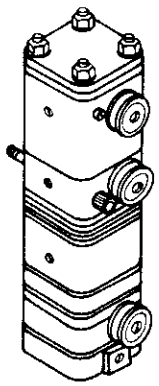
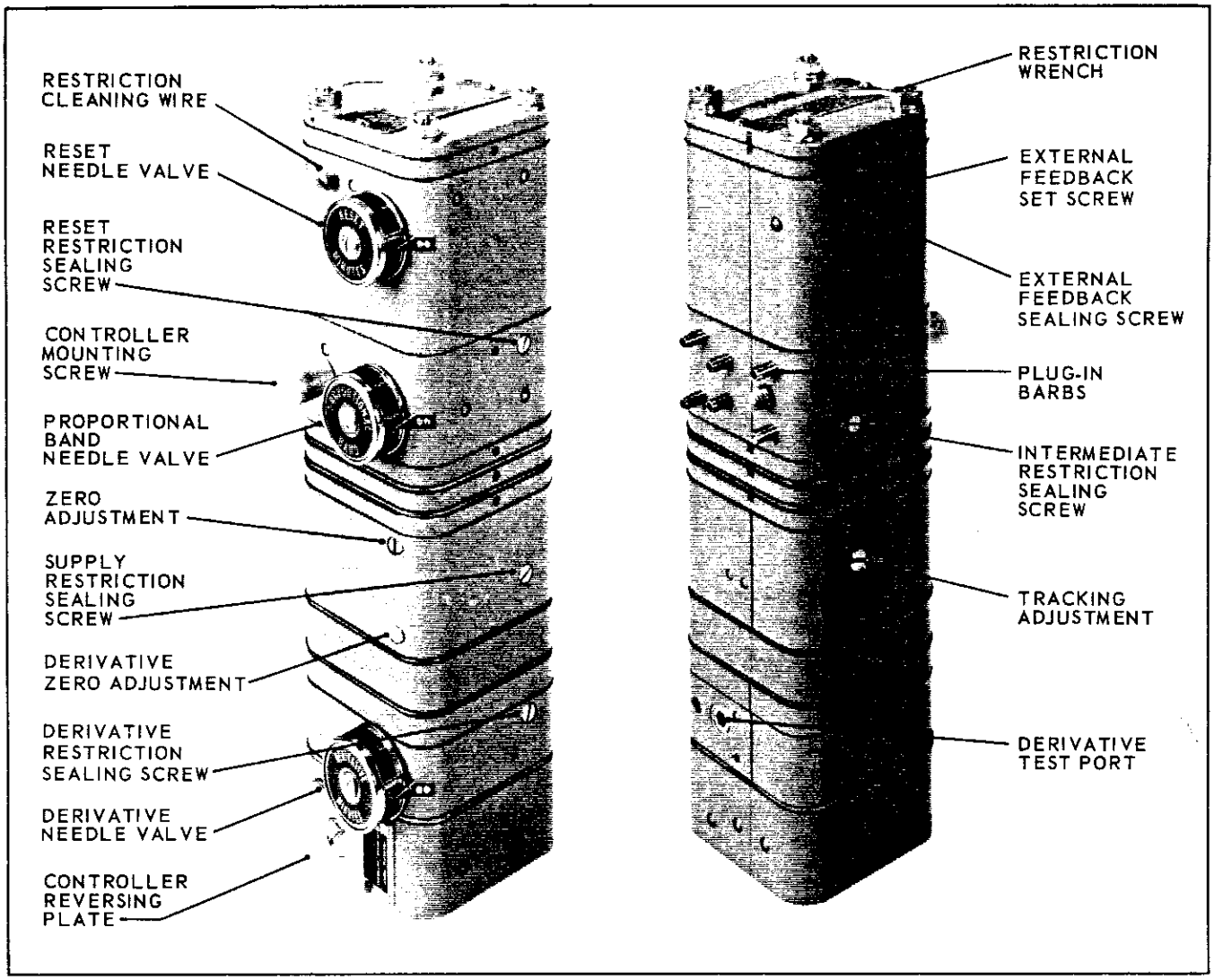


TABLE OF CONTENTS

MOORE PRODUCTS CO., Spring House, Pa. 19477



I. DESCRIPTION

GENERAL INFORMATION

The Series 503 Nullmatic Controller is a three-mode controller with a built-in cut-off relay. The controller operates on the pneumatic "Null" balance principle. It controls the process variable in response to an air pressure signal from the process transmitter. The Model 503 controller incorporates adjustable proportional band (gain), reset and derivative (rate) action.

There are two basic reasons for applying 503 controllers: (1) On applications where the reset bypass feature is desired to facilitate bumpless transfer between control modes; and (2) On processes where it is desirable to locate the controller in the field to minimize the effect of transmission lag.

The derivative action is the first phase of the controller. It receives the process signal and retransmits a modified signal to the throttling and reset phase of the controller. The output of the derivative section leads the process signal changes by the time setting on the derivative knob.

The built-in cut-off relay shuts off the controller output internally and opens a bypass around the reset needle valve. This occurs when the controller is not functioning (e.g., when the control station is in manual). Reset bypass eliminates the reset needle valve time constant and permits manual valve-loading pressure to be impressed instantly in the reset reference chamber. This facilitates bumpless transfer between automatic, manual and various cascade modes of operation by keeping the blocked internal controller output continuously and instantaneously matched to the manual loading pressure.

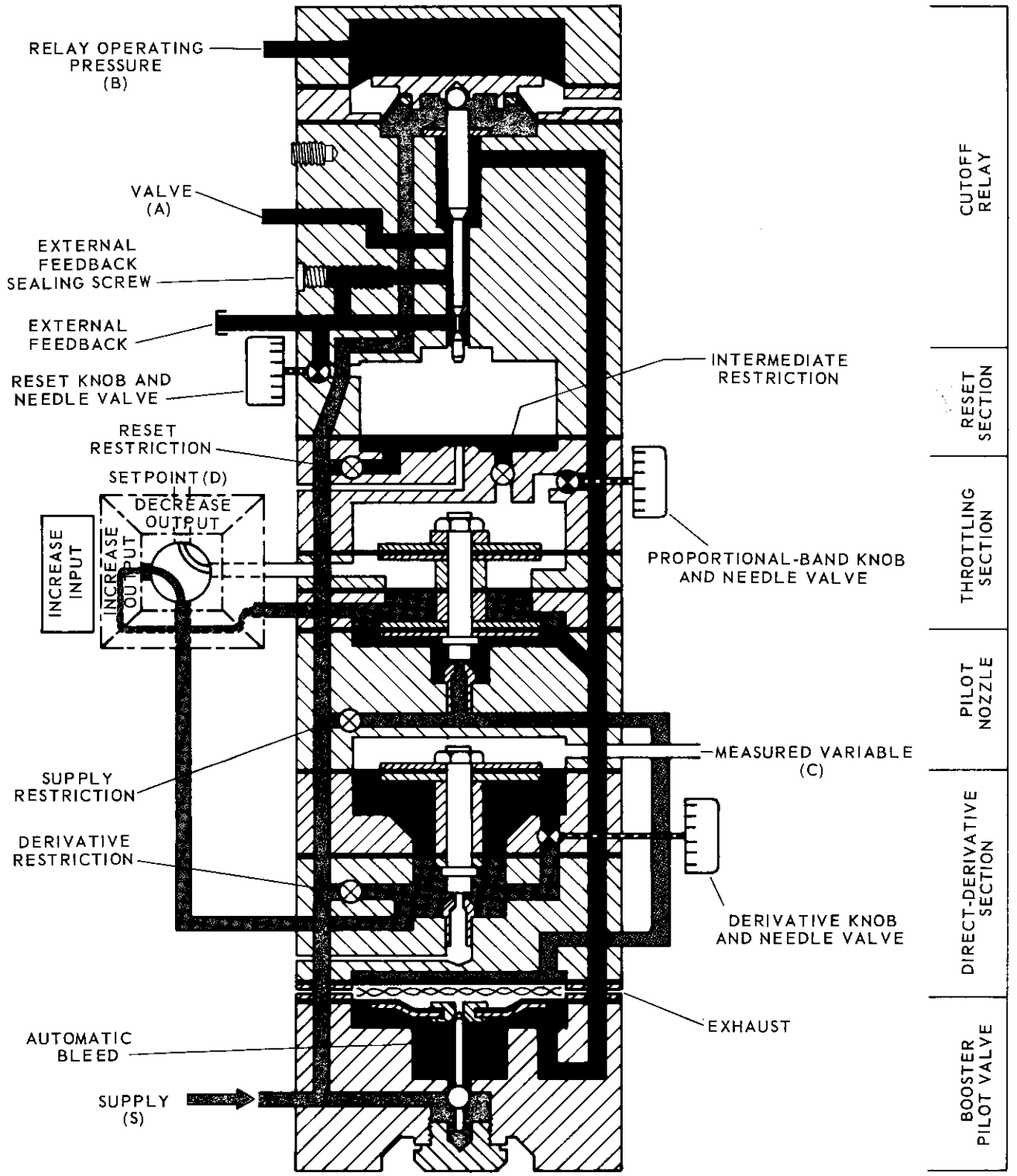
The controller is intended to operate on an output of 3–15 psi from a pneumatic transmitter. However, it is capable of operating at any range under 50 psi. The controller output is normally 3 to 15 psi, but it may be as much as 50 psi for special purposes.

NULLMATIC CONTROLLER MODEL 503

MOORE

PRESSURES

- SUPPLY
- SETPOINT
- MEASURED-VARIABLE
- RESET-REFERENCE
- RELAY OPERATING
- RESET
- INTERMEDIATE
- EQUALIZING
- PILOT-NOZZLE
- VALVE
- DERIVATIVE-OUTPUT



MODEL DESIGNATION

Controller Function	Model Number	% Proportional Band	Reset Minutes Repeat	Derivative Time Minutes
Std. Proportional Band Std. Reset Std. Derivative (6:1 gain)	503	2–200	.1–50	.05–20
Std. Proportional Band Fast Reset Std. Derivative (6:1 gain)	503F	2–200	.01–5	.05–20
Wide Proportional Band Std. Reset Std. Derivative (6:1 gain)	503W	5–500	.1–50	.05–20
Wide Proportional Band Fast Reset Std. Derivative (6:1 gain)	503FW	5–500	.01–5	.05–20
Std. Proportional Band Std. Reset High Gain Derivative (30:1 gain)	503H	2–200	.1–50	.05–20
Std. Proportional Band Fast Reset High Gain Derivative (30:1 gain)	503FH	2–200	.01–5	.05–20
Wide Proportional Band Std. Reset High Gain Derivative (30:1 gain)	503WH	5–500	.1–50	.05–20
Wide Proportional Band Fast Reset High Gain Derivative (30:1 gain)	503FWH	5–500	.01–5	.05–20

Fast Reset (Suffix "F")

The operating principle of the fast reset controller is identical to that of the conventional controller. Fast reset provides a reset rate 10 times faster than standard. This control action is used on some flow applications and processes with very short time constants.

Wide-Band Controllers (Suffix "W")

The operating principle of the wide proportional band controller is identical to that of the conventional controller. In the wide band controller, however, the preformed diaphragm relationship is 5 to 1. This establishes the maximum proportional band at 500%.

High-Gain Derivative Action (Suffix "H")

Derivative time is the time by which the derivative output leads the input if subjected to a steady change. The ideal derivative arrives at its steady state output ramp instantly or can be expressed as infinite gain. Both the high-gain and standard units arrive at their steady state output ramps after a delay. However, the high-gain derivative unit with a 30:1 gain arrives at the steady state output ramp much more quickly than the standard unit which has a 6:1 gain. High-gain derivative response allows tighter control of slow (long time-constant) processes.

II. PRINCIPLE OF OPERATION

PROPORTIONAL ACTION (See Schematic Diagram)

Assume the reset reference pressure remains fixed at mid-scale and the reset needle valve is closed. The reset reference pressure acts on the reset diaphragm which is part of a 1:1 reproducing relay. Supply air passes through a restriction and out the exhaust nozzle. The diaphragm baffles the nozzle to make the reset pressure equal the reset reference pressure.

If the proportional-band needle valve is closed, the intermediate chamber pressure will equal the reset pressure since they are connected via the intermediate restriction.

The controlled-variable pressure pushes upward on the small center diaphragm and downward on the large diaphragm. The effective area of the large diaphragm is twice that of the small diaphragm. Therefore, controlled variable pressure produces a net force downward. Likewise, the setpoint pressure gives a net force upward.

If the controller variable pressure equals the setpoint, the resultant forces from these two sources cancel each other; and the output will match the reset or intermediate chamber pressure, bringing all forces on the detector stack to balance. If the controlled variable pressure increases 1 psi, the output will increase 1 2 psi. This is because the output acts on the full area of the bottom diaphragm -- whereas the controlled variable acts downward on a net effective area equal to one-half that amount. Thus, with the needle valve closed, the widest proportional band (minimum gain) is established, this proportional band being 200% on standard controllers.

If the proportional band needle valve is wide open and the controlled variable increases above setpoint, the output will increase instantly -- because of the imbalance of forces. The increase in output will directly affect the intermediate pressure, which will further require the output to increase. This regenerating action will continue so that a very small error will produce a large change in output. The wide-open needle valve position, therefore, establishes the minimum band, this minimum band being 2% on standard controllers.

If the proportional band needle valve is open to a setting where its resistance equals that of the intermediate restriction, the following will occur: When controlled-variable pressure increases by 1 psi, the output (by design) will instantly increase by 1 2 psi. The 1 2 psi increase will cause a flow from output through the proportional band valve into the intermediate chamber and through the intermediate restriction to the reset reproducer. Since the restriction and needle valve resistances are equal, the pressure drops will divide equally, resulting in a 1 4 psi increase in the intermediate chamber pressure. This 1 4 psi increase directly increases controller output an additional 1 4 psi; which divides again into a 1 8 psi increase in the intermediate chamber pressure. This action continues until equilibrium is reached – with the output changing a total of 1 psi, and intermediate chamber pressure increasing 1 2 psi. In this instance, a 1 psi change in the controlled variable resulted in a 1 psi change in output. Therefore, this needle-valve opening provides a 100% proportional band. To reverse the action of the controller, the reversing plate may be rotated to interchange the signals.

RESET ACTION

If every process could be controlled with a 2% proportional band (practically on-off), there would be no need for reset action. In practice, however, there is always a limit to how narrow a band may be used without incurring instability. For fast or noisy processes, the band may have to be very wide to avoid instability. With proportional action, if any change in valve pressure is required because of a change in load, the change can be produced only when an error develops between controlled variable and setpoint. Therefore, instead of controlling at setpoint, a control offset will result. In most cases, this is intolerable and reset action is used to eliminate offset.

If the reset needle valve is open, the controller output will continue to change in the corrective direction, ad infinitum if necessary, until the controlled variable is brought exactly on setpoint. When reset is active, the controller comes to equilibrium only when the controlled variable equals the setpoint and when the output, reset, and intermediate pressures are equal to each other (but not necessarily equal to setpoint and controlled variable). If any difference exists between measured variable and setpoint, then because of proportional action, the output will differ from the reset-reference pressure. Due to the resulting flow through the reset valve, the reset pressure will continue to change; thus providing a continuous reinforcing action – until equilibrium ultimately results.

DERIVATIVE (RATE) ACTION

The process variable pressure acts on the upper (input) diaphragm. Due to the difference between the input and output diaphragm areas, a step change in input produces a 6:1 gain on standard controllers or 30:1 gain on high gain units.

The output pressure is connected to the equalizing chamber through the derivative (rate) action needle valve. Therefore, there is a lag between a change in output and a change in intermediate pressure.

In a steady-state condition (with no change in input), the output pressure acts on both sides of the output diaphragm – and output pressure re-balances input pressure directly.

With a continuous ramp change in input pressure, the equalizing pressure will lag the output pressure by a constant amount, proportional to the rate of change in output. Thus, the equalizing pressure will partially re-balance the input, reducing the effective gain. The result is that the output will continuously lead the input by a definite amount, proportional to the rate of change in input.

The time by which the output leads the input is the "derivative time" as set on the derivative (rate) action knob.

III. INSTALLATION

GENERAL

Reversing Plate – Controllers are shipped for reverse action (Inc. Dec.); i.e., an increasing process causes a decreasing controller output. The controller can be changed to direct action (Inc. Inc.) by rotating the reversing plate. The correct controller action for a given installation depends upon the action of the control valve and its effect on the process.

External Feedback – Controllers are shipped set for internal feedback. To alter the controller for external feedback, remove the EXT. FEEDBACK sealing screw and insert the sealing set screw (stored beside the sealing screw) into the EXT. FEEDBACK until it bottoms, sealing the passage (See Fig. 2–1). Replace EXT. FEEDBACK sealing screw. Pipe the external feedback signal into the "EF" port of the control station rear block or field mounting block, whichever applies.

IMPORTANT: When the EXTERNAL FEEDBACK is not used, the "EF" port on the control station or field mounting block MUST be plugged.

MOUNTING

Dimensions – Fig. 3–1 gives mounting dimensions for field mounted controllers.

Location – The controller should be mounted in a reasonably vibration-free location. It can be mounted indoors or outdoors provided the ambient temperature limits of –40°F. and +180°F. are not exceeded.

Position – The controller can be mounted in any position. It should, however, be calibrated in the same position in which it is to be mounted.

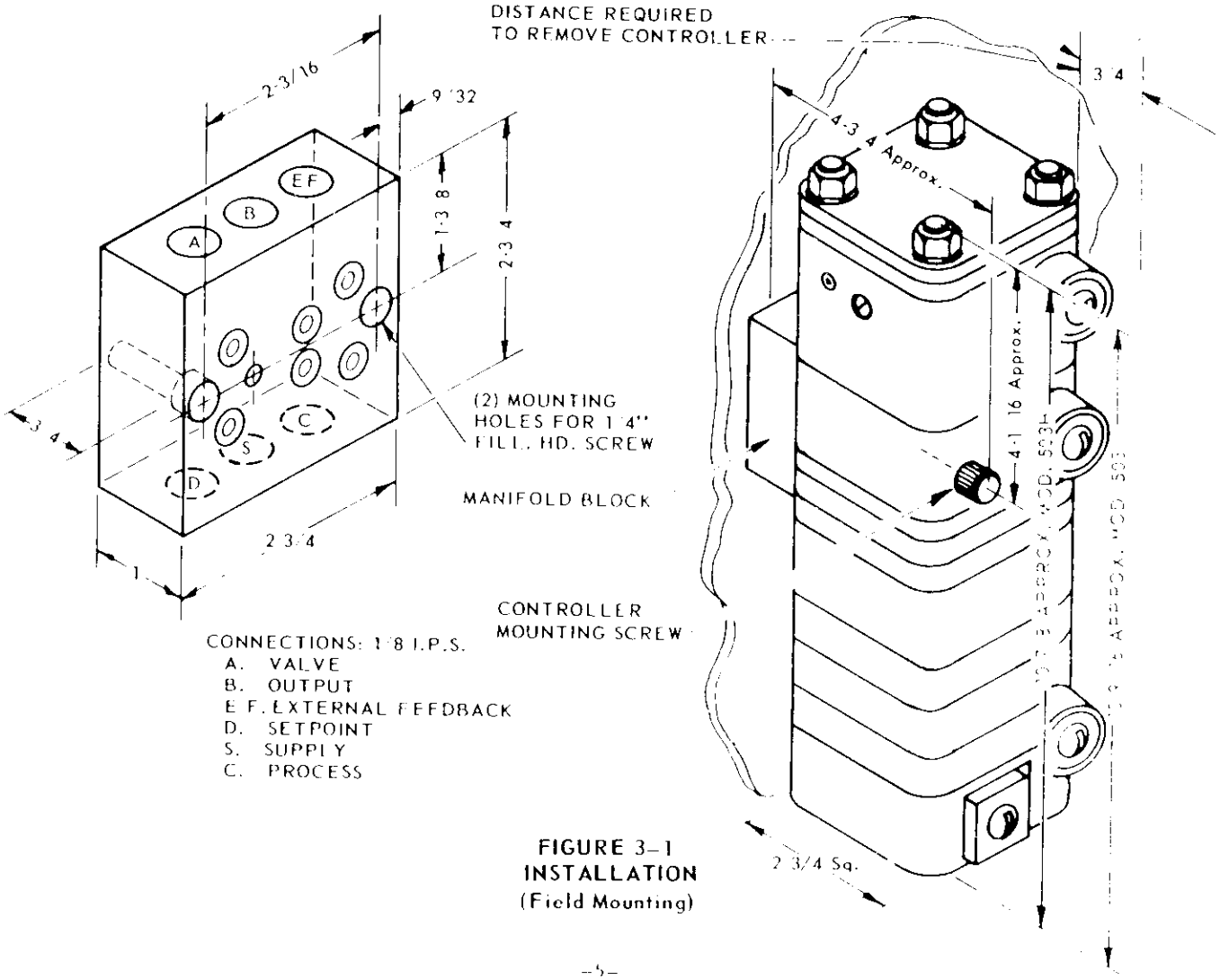


FIGURE 3–1
INSTALLATION
(Field Mounting)

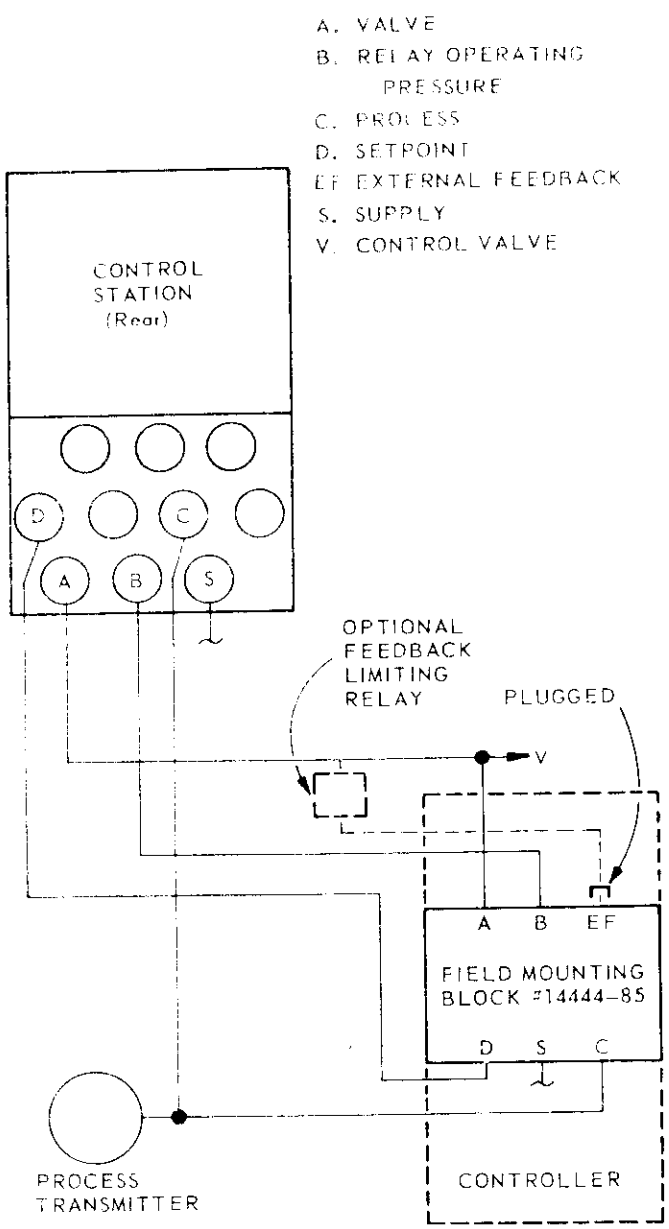


FIGURE 3-2
INSTALLATION PIPING DIAGRAM
SINGLE LOOP
(Field Mounted Controller)

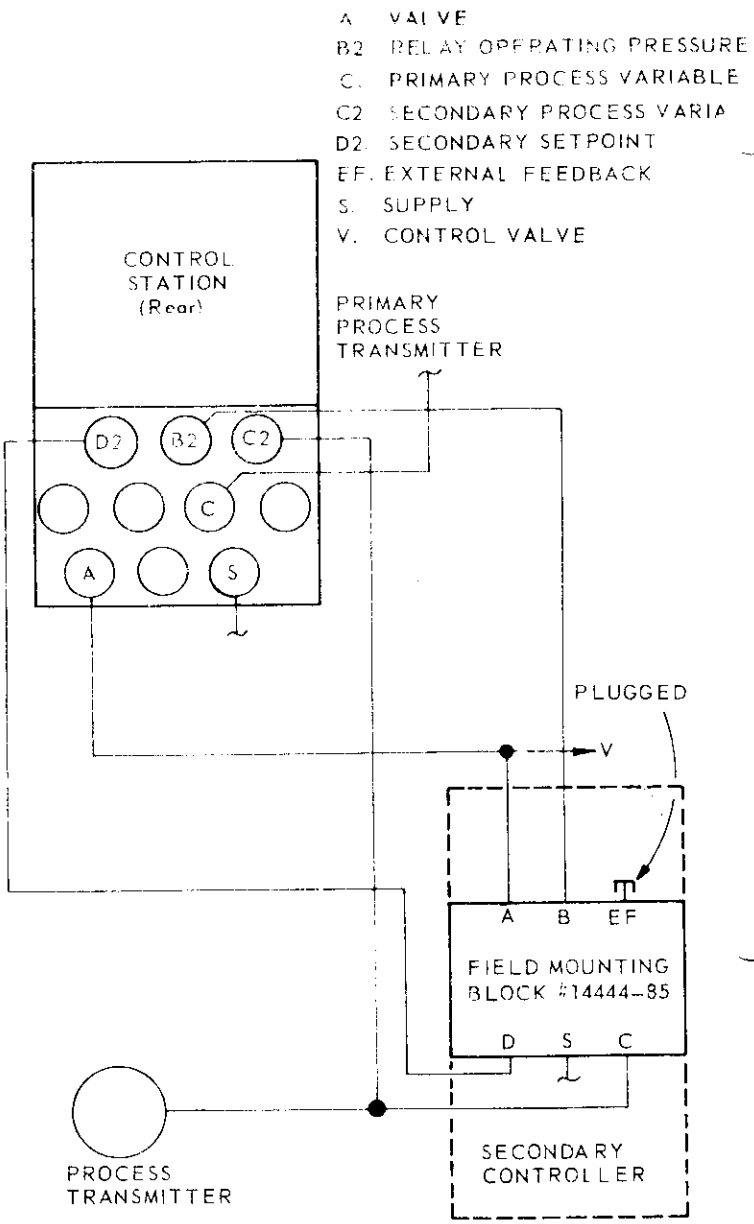


FIGURE 3-3
INSTALLATION PIPING DIAGRAM
CASCADE
(Field Mounted Controller)

PIPING

Figs. 3-1 through 3-3 give the piping connections. Fig. 3-2 shows a field mounted controller used with a single loop control station. Fig. 3-3 shows the field mounted secondary controller for a cascade control station.

Any scale-free piping may be used for connecting the controller; 1 4" O.D. tubing is recommended.

Before connecting the lines, blow them out to prevent foreign material from entering the controller. The connecting lines must be leak-tight. Leak test the lines with a soapless lather.

The length of transmission lines has no effect on operation of the controller other than increasing the lag between controller variable change and controller action.

SUPPLY AIR

The recommended supply

The recommended supply pressure for the conventional 3-15 psig instrument signals is as follows:

Recommended	20 psig
Minimum	18 psig
Maximum Recommended	25 psig

Although the controller is intended to operate in the 3–15 psig range, the process, setpoint, supply and output pressures can be as high as 50 psig.

Air consumption, when the controller is in a balanced condition, is approximately 0.15 scfm. In figuring compressor and filter capacities, follow the general practice of allowing 0.5 scfm for each instrument of any make.

A clean, dry and oil-free air supply should be provided for the controller. A Moore Model 91F60 Filter Regulator will reduce problems associated with dirty instrument air.

When the instrument and its air lines are exposed to freezing temperatures, an air dryer must be installed at the take-off point from the main plant air stream.

IV. CALIBRATION

GENERAL

The controller should be calibrated in the same position as it will be used. The derivative zero must be set before the zero and tracking.

DERIVATIVE ZERO SETTING

1. Set up controller per Fig. 4–1.
2. Open the derivative knob (counter-clockwise).
3. Adjust process pressure (C) to 9 psig.
4. Adjust the DERIVATIVE ZERO to make the "TEST PORT" gauge read 9 psig.

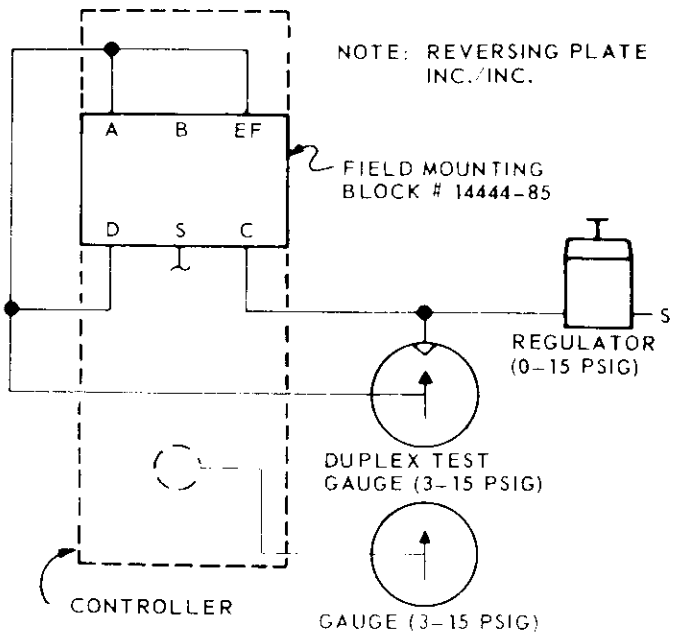


FIGURE 4–1 DERIVATIVE ZERO SETTING

ZERO AND TRACKING

When calibrating the Model 503 controller, it should be mounted in the same position as it will be used.

1. Set up the controller as per Fig. 4–1
2. Set the reversing plate to Inc. Inc.
3. Open the reset knob (0.1 on standard controllers; 0.01 on fast reset models).
4. Open the proportional band knob to 30% on standard controllers; 75% on wide-band controllers.
5. Adjust the regulator to 10% of span.

   NOTE: After each change of the regulator setting, allow ample time for the controller reset action to balance out. This will be longer for standard reset controllers.

6. Adjust the controller's zero screw until the pointers match.
7. Adjust the regulator to 90% of span.
8. If the pointers do not match, adjust the controller's tracking screw. Make a three-fold overcorrection.

   EXAMPLE: If the red pointer is at 90% and the black pointer is at 91%, adjust the tracking screw to move the black pointer to 87%. The amount of overcorrection is approximate and may vary a little between controllers.

9. Adjust the controller's zero screw until the pointers match.
10. Repeat steps 4 and 8 until the pointers match when the regulator is changed from 10% to 90% of span.
11. Set the reversing plate to the original position.

V. TUNING

The following method is only one of many methods of tuning a three-mode controller in a control system.

1. Place station in manual.
2. Open the controller reset needle valve and the derivative needle valve (lowest numerical setting).
3. Bring the process to the desired control point using manual control.
4. Close the controller reset needle valve, trapping the valve pressure in the reset chamber. The derivative needle valve is to remain open.
5. Close the proportional band needle valve (highest setting).
6. Switch to automatic control.
7. Simulate process upset by making a small change in the control point. Look for a sustained process cycle. Continue to decrease proportional band in increments of 1/2, introducing setpoint changes after each

adjustment, until a sustained cycle of constant amplitude first appears.

8. Note the lowest proportional band setting at which the sustained cycling occurs. This is the ultimate proportional band (PBu).

9. Time the process cycle peak to peak in minutes. This is the ultimate period (TU).

10a. For discontinuous processes, where start-up is a problem, wide-band settings prevent overshoot:
Proportional Band PBu x 4
Reset Time Tu x .33 minutes
Derivative Time Tu x .5 minutes

10b. For processes where automatic start-up is not a problem, narrow-band settings give similar response in normal operation, and should be easier to fine tune.
Proportional Band PBu x 2.7
Reset Time Tu x .5 minutes
Derivative Time Tu x .33 minutes

These settings are recommended as a starting point. Fine tuning may be necessary to obtain the response best suited to a particular process.

Direction of derivative adjustment for fine tuning.

1. If process overshoots on start-up or in returning to control point after load change, increase derivative time.

2. If process undershoots, or is slow in returning to control point, decrease derivative time.

VI. MAINTENANCE

GENERAL

Most problems associated with pneumatic instruments can be prevented by using a clean, dry and oil-free air supply. An instrument air filter should be provided for the supply air system. Daily blow-down of the filter dripwell and a periodic check of the filter element are recommended.

Plug-in controllers have additional filtering protection. The plug-in manifold block, either station or field-mounted, has filter screens in the "supply" and "valve" ports. These are 100 mesh screens which stop particles 0.006" or larger. This protects the controller restrictions which are nominally .0115" to .012".

SERVICING

Figs. 6-1 to 6-3 show the items to be serviced.

Cleaning The items that can be cleaned are the filter screens, valve plunger, restrictions, and needles valves.

FILTER SCREENS – The screens are located in the ports of the plug-in manifold or connection block. If a screen is clogged, blow it down in a reverse direction. If the dirt is still not dislodged, loosen it mechanically or chemically and again blow the screen down in a reverse direction.

If the mesh of a screen is damaged, it should be replaced. Use a pointed tool to remove the retaining washer and the screen. When installing a screen, use a new fiber washer to retain the screen at the bottom of its port.

VALVE PLUNGER – Fig. 6-1 shows removal of the valve plunger. The large conical surface is the supply face; the tip is the exhaust face. Use non-abrasives for cleaning. The supply and exhaust seats in the controller should also be cleaned. The supply seat is readily accessible; the exhaust seat can be reached with a tobacco pipe cleaner.

RESTRICTIONS – Fig. 6-2 shows removal of a restriction screw. There are (4) such restrictions in the controller: pilot supply, reset supply, intermediate, and derivative supply. All (4) are identical and are interchangeable. The hex wrench stored at the top of the controller is

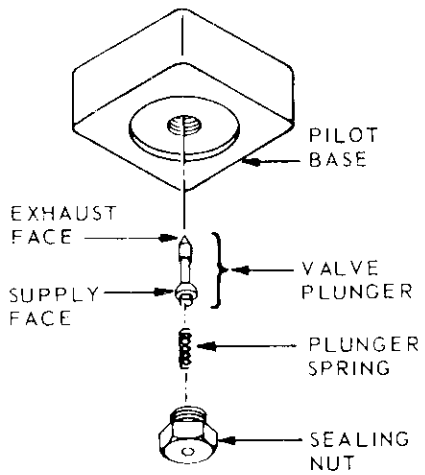


FIGURE 6-1
VALVE PLUNGER

used to remove the restriction screws. They are cleaned with a .010" cleaning wire which is stored at the side of the controller. Stubborn deposits may require solvent softening before the wire can be passed through the orifice. When reinstalling, be sure both the restriction and sealing screws are screwed in tightly.

In addition, there is a restriction in the setpoint barb of the controller. This restriction should not generally get dirty or plugged as the setpoint is a dead-ended chamber. This restriction is cleaned using the .010" cleaning wire.

NEEDLE VALVES – Fig. 6-3 shows removal of a needle valve. There are (3) such valves in the controller: reset, proportional band, and

derivative. These are not all interchangeable. The needle valves and valve bodies have matching identification letters stamped on them. Reset and Derivative have either an "R" or an "RF". Proportional band has a "T".

Use non-abrasives for cleaning. Lubricate the "O" ring on the needle valve before re-installing it. If the valve body was removed, inspect the "O" rings on it, especially the small one at the tip. Lubricate the large "O" ring before re-installing the valve body.

Lubrication

Fig. 6–3 shows the "O" ring that may require lubrication. There is one of these on each of three needle valves. If a needle valve has been removed, its "O" ring should be relubricated. Or, if a needle valve knob moves away from a setting immediately after making the setting, the "O" ring should be relubricated. Otherwise, These "O" rings require no periodic servicing. Vaseline or a Silicone "O" ring lube is recommended.

Other "O" rings in the controller can only be reached by disassembly. Normally, they only require attention at a major overhaul.

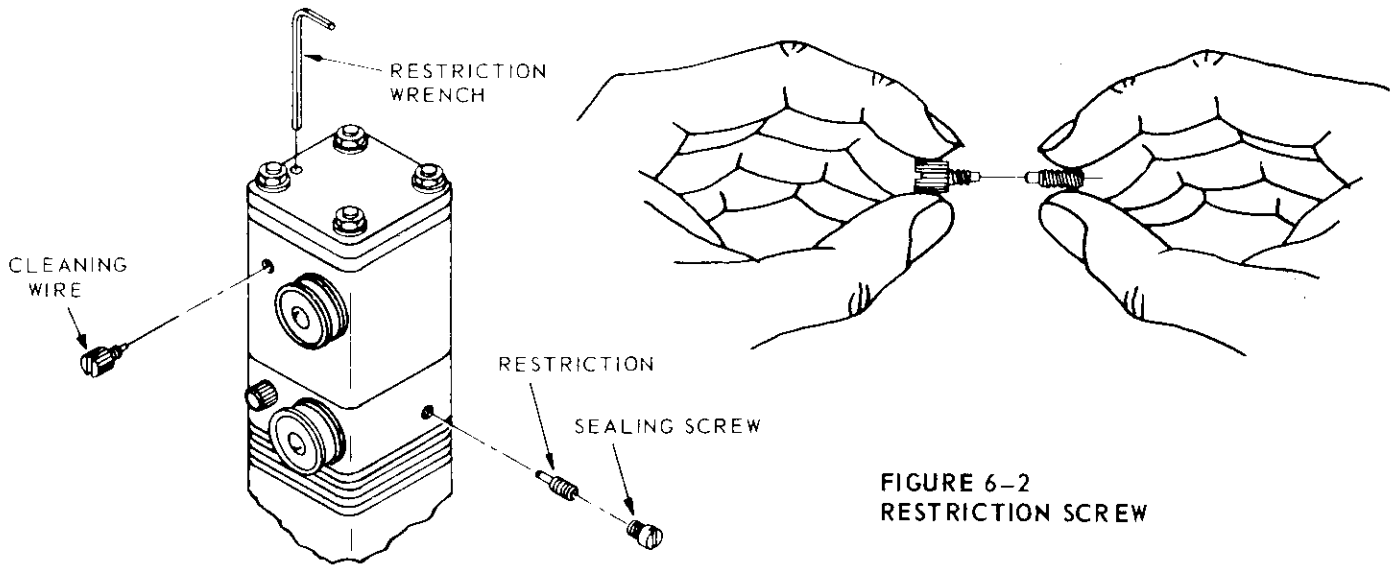


FIGURE 6–2
RESTRICTION SCREW

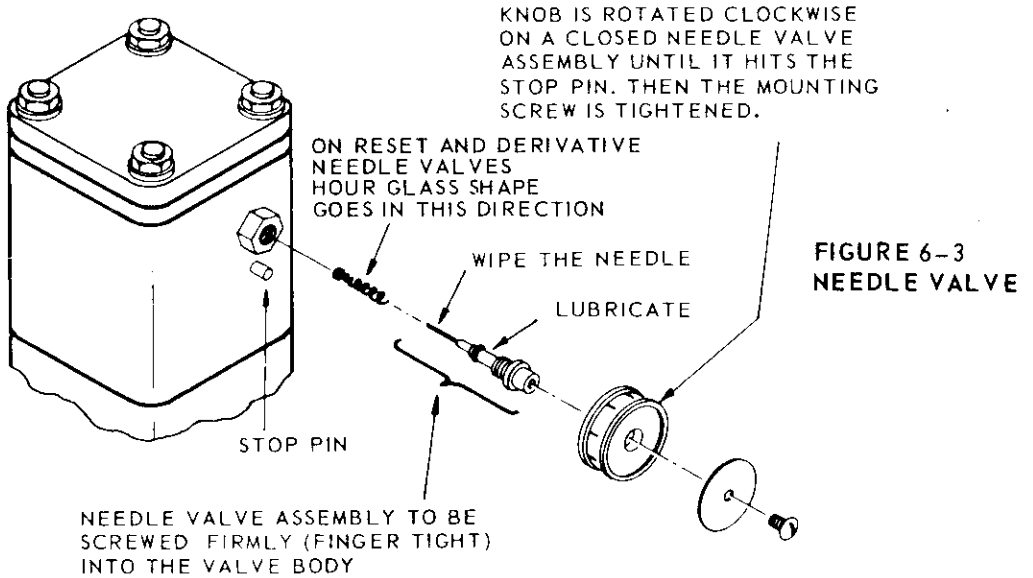


FIGURE 6–3
NEEDLE VALVE

TROUBLE ANALYSIS

The probable causes in the following table are in the order of most to least likely. Most symptoms are difficult to analyze while the controller is operating. They are most readily seen in a test set-up.

SYMPTOM	PROBABLE CAUSE	REMEDY
No output	No supply	Turn on Supply air.
	Controller reversing plate incorrectly set	Set according to control valve action and its effect on the process
	Clogged supply restriction	Clean the restriction
	Clogged derivative restriction (Inc. Inc. controller action only)	Clean the restriction
Output will not increase to a full-scale value	Supply pressure too low	Raise supply pressure to recommended value
	Controller zero adjustment	Calibrate the controller
Output above full-scale and will not decrease	Clogged derivative restriction (Inc. Dec. controller action only)	Clean the restriction
Output will not decrease to a minimum-scale value	Loose supply or reset restriction screws	Tighten the restrictions
On-off controller action	Clogged intermediate restriction	Clean the restriction
	Damaged reset bypass "O" ring	Replace "O" ring
Proportional action radically disagrees with indicated setting	Misadjusted proporational band knob and needle valve	Tighten needle valve finger tight and mount knob against stop with index pointing to the highest number (200% or 500%)
	Clogging intermediate restriction	Clean the restriction
	Coated proportional band needle valve (carbon, etc)	Clean the needle valve and its seat
	Loose proportional band needle valve body	Tighten the body into the controller
	Damaged "O" ring at tip of proportional band needle valve body	Replace "O" ring

SYMPTOM	PROBABLE CAUSE	REMEDY
No reset	Clogged reset or intermediate restrictions	Clean the restrictions
Reset action radically disagrees with indicated setting	Misadjusted reset knob and needle valve	Tighten needle valve finger tight and mount knob against stop with index pointing to the highest number (5 min. or 50 min.)
	Clogging reset restriction	Clean the restriction
	Coated reset needle valve (carbon, etc.)	Clean the needle valve and its seat
	Loose reset needle valve body	Tighten the body into the controller
	Damaged "O" ring at tip of reset needle valve body	Replace "O" ring
	Damaged reset bypass "O" ring	Replace "O" ring
Derivative action radically disagrees with indicated setting	Misadjusted derivative knob and needle valve	Tighten needle valve finger tight and mount knob against stop with index pointing to the highest number (20 min. or 200 min.)
	Clogging derivative restriction	Clean the restriction
	Coated derivative needle valve (carbon, etc.)	Clean the needle valve and its seat
	Loose derivative needle valve body	Tighten the body into the controller
	Damaged "O" ring at tip of derivative needle valve body	Replace "O" ring

DISASSEMBLY

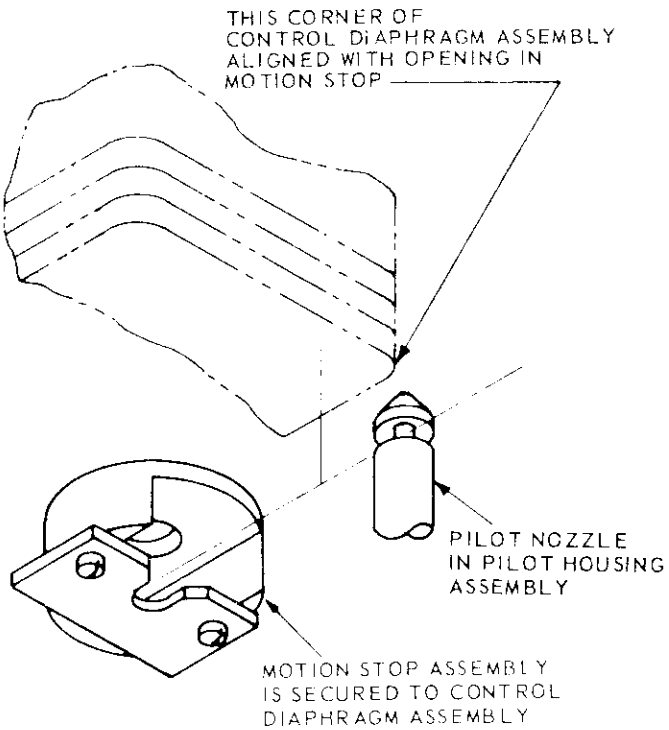
The controller uses a convenient "stack" construction that allows easy and complete disassembly for inspection, cleaning, or replacement of parts. Remove the four nuts; separate the components; and lift the parts off the studs. Experience has shown that a dull table knife works best to separate the components.

Caution

Because of an internal motion stop arrangement, shown in Figure 6–4, the "control diaphragm assembly" and the "pilot housing assembly" must be lifted off the studs before they can be separated from each other. These two assemblies must be slid apart in a certain direction. Otherwise, the pilot nozzle, and possibly the pilot nozzle seat, will be damaged.

To disengage the control diaphragm and pilot housing assemblies from each other, use the procedure that follows:

1. Loosen the control diaphragm assembly from the pilot housing assembly. Do not pry! The diaphragm between these two assemblies must not adhere to the pilot housing assembly.
2. Hold the two parts with the ZERO screw corner facing you.
3. Hold the pilot housing assembly and push the control diaphragm assembly away from you.



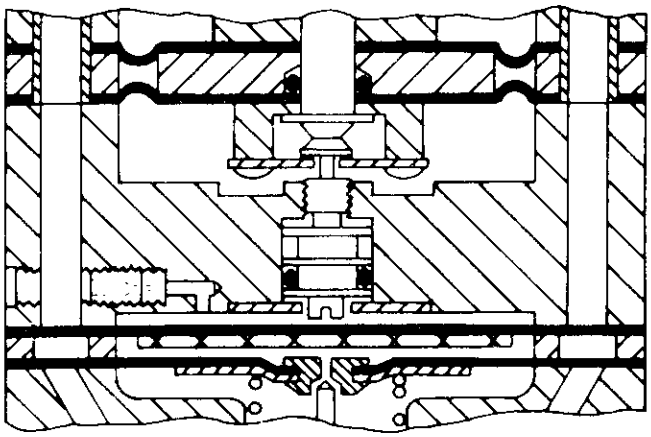


FIGURE 6–4
CONTROL DIAPHRAGM
MOTION STOP

ASSEMBLY

To reassemble the controller, use the parts drawing for the sequence of parts, and align the components by their locating grooves.

If the control diaphragm assembly was disassembled, the motion stop plate must be put back in the correct position. Align the open end of the "U" as shown in Figure 6–4.

The control diaphragm and pilot housing assemblies must be assembled to each other before being placed on the studs. Use the following procedure:

1. Hold the pilot housing assembly so the ZERO adjustment screw faces you.
2. Position the control diaphragm assembly above and behind the pilot housing assembly.
3. Line up the "U" opening of the motion stop plate so that:
   a. the zero adjustment leaf spring can be guided into the opening (above the plate), and
   b. the "U" will engage under the head of the pilot nozzle.
4. Slide the two assemblies together; align their locating grooves; and place them on the studs.

VII. CONVERSIONS

Controllers can be converted from standard to wide proportional band, from standard to fast reset, and vice versa. See the model designation table in Section I for the various three–mode controller configurations.

Use the parts list drawings as an aid while making the conversions and re-calibrate the controller when finished.

The following tabulations list the parts required for conversion.

STANDARD TO WIDE PROPORTIONAL BAND

Qty.	Description	Part No.
1	Control Diaphragm Ass'y.	14444–55
1	Proportional Band Knob Ass'y.	10880–50

WIDE TO STANDARD PROPORTIONAL BAND

Qty.	Description	Part No.
1	Control Diaphragm Ass'y.	14444–10
1	Proportional Band Knob Ass'y.	10880–45

STANDARD TO FAST RESET

Qty.	Description	Part No.
1	Reset Valve Ass'y.	10880–2
1	Reset Knob Ass'y.	10880–42

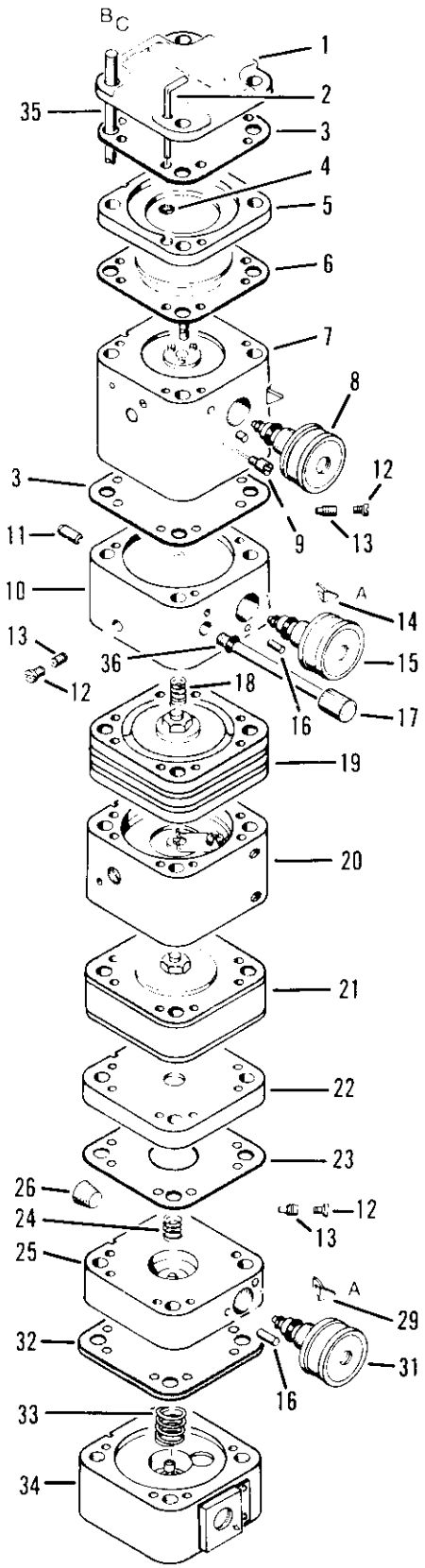
FAST TO STANDARD RESET

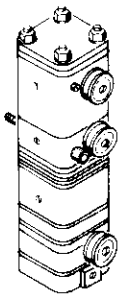
Qty.	Description	Part No.
1	Reset Valve Ass'y.	10880–1
1	Reset Knob Ass'y.	10880–41

MOORE

MODEL SERIES 503
3-MODE COMPACT CONTROLLER

Drawing No. 14581-46PL





MODEL	B/M
503	14581-30S6
503W	14581-33S6

Item	Part No.	Description	Req'd 503	503F	503FW	503W	503FH	503FWH	503H	503WH
1	14444-2	Top Cap	1	1	1	1	1	1	1	1
* 2	3092-33	Allen Wrench	1	1	1	1	1	1	1	1
* 3	14444-16	Diaphragm	2	2	2	2	2	2	2	2
* 4	2938-16	"O" Ring	1	1	1	1	1	1	1	1
5	14444-3	Diaphragm Spacer	1	1	1	1	1	1	1	1
* 6	14444-15	Diaphragm	1	1	1	1	1	1	1	1
7	14444-40	Upper Housing (See Parts Dwg. 14444-40PL)	1	1	1	1	1	1	1	1
8a	10880-61	Fast Reset Knob & Needle Valve (See Parts Dwg. 10880-76A)	—	1	1	—	1	1	—	—
8b	10880-60	Reset Knob & Needle Valve (See Parts Dwg. 10880-76A)	1	—	—	1	—	—	1	1
* 9	1033-22	Cleaning Wire	1	1	1	1	1	1	1	1
10	14444-125	Center Housing (Incl. Items 11, 12, 13, 14 & 16)	1	1	1	1	1	1	1	1
11a	14480-151	Tube	5	5	5	5	5	5	5	5
11b	14444-83	Tube	1	1	1	1	1	1	1	1
*12	14444-28	Sealing Screw	3	3	3	3	3	3	3	3
*13	2900-22	Restriction Screw	3	3	3	3	3	3	3	3
14	14444-47	Pointer	1	1	1	1	1	1	1	1
15a	10880-69P	Proportional Band Knob & Needle Valve (See Parts Dwg. 10880-76A)	—	—	1	1	—	1	—	1
15b	10880-62	Proportional Band Knob & Needle Valve (See Parts Dwg. 10880-76A)	1	1	—	—	1	—	1	—
16	3035-1	Dowel Pin	2	2	2	2	2	2	2	2
17	14444-80	Mounting Screw (Incl. Item 36)	1	1	1	1	1	1	1	1
*18	8106-32	Spring	1	1	1	1	1	1	1	1
*19a	14444-10	Diaphragm (See Parts Dwg. 14444-10PL)	1	1	—	—	1	—	1	—
*19b	14444-55	Diaphragm (See Parts Dwg. 14444-55PL)	—	—	1	1	—	1	—	1
20	14444-72	Pilot Housing (See Parts Dwg. 14444-72PL)	1	1	1	1	1	1	1	1
21a		Derivative Diaphragm (See Parts Dwg. 14444-101PL)	1	1	1	1	—	—	—	—
21b		Derivative Diaphragm (See Parts Dwg. 14444-102PL)	—	—	—	—	1	1	1	1
22	14444-68	Diaphragm Ring	—	—	—	—	1	1	1	1
*23	14444-65	Gasket	—	—	—	—	1	1	1	1
*24	8106-36	Spring	1	1	1	1	1	1	1	1
25	14444-70	Nozzle Housing (Incl. Items 12, 13, 16, 26 & 29)	1	1	1	1	1	1	1	1
26	3240-	Plug	1	1	1	1	1	1	1	1
29	14444-126	Pointer	1	1	1	1	1	1	1	1
31	10880-70P	Derivative Knob & Needle Valve (See Parts Dwg. 10880-76B)	1	1	1	1	1	1	1	1
*32	14444-21	Exhaust Diaphragm	1	1	1	1	1	1	1	1
33	1447-13	Spring	1	1	1	1	1	1	1	1
34	14444-39	Pilot Base (See Parts Dwg. 14444-39PL)	1	1	1	1	1	1	1	1
35a	7307-30	Stud	—	—	—	—	4	4	4	4
35b	7307-11	Stud	4	4	4	4	—	—	—	—
*36	2938-4	"O" Ring	1	1	1	1	1	1	1	1
			ALL							
A	1-6805	#00 x 1/8 Lg. Type "U" Drive Screw	4							
B	1-7303	#1/4 Med. Lockwasher	4							
C	1-7740	#1/4-20 Hex Nut	4							

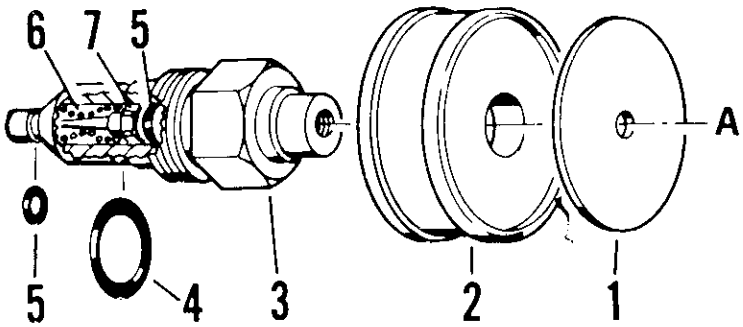
* Recommended on-hand spare parts. Always specify range, serial no., or other nameplate information when ordering Spare Parts.

MOORE

PROPORTIONAL BAND & RESET
KNOB & NEEDLE VALVE ASSEMBLIES

Drawing No. 10880-76A

USED ON:
Model Series 50, 50X2, 501, 502,
503, 507, 508, 509, 55, 55X2, 561, 569, 688



PROPORTIONAL BAND KNOB & NEEDLE VALVE

Item	Part No	Description	Req'd
P/N 10880-62 (STANDARD 2-200)			
1	3092-26	Knob Disc	1
2	10880-45	Knob	1
3	10880-3	Needle Valve Ass'y (Incl. Items 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-46	Comp. Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 x 1/4 Lg. Truss Hd. Screw	1
P/N 10880-69P (WIDE 5-500)			
1	3092-26	Knob Disc	1
2	10880-50	Knob	1
3	10880-3	Needle Valve Ass'y (Incl. Items 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-46	Comp. Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 x 1/4 Lg. Truss Hd. Screw	1

RESET KNOB & NEEDLE VALVE

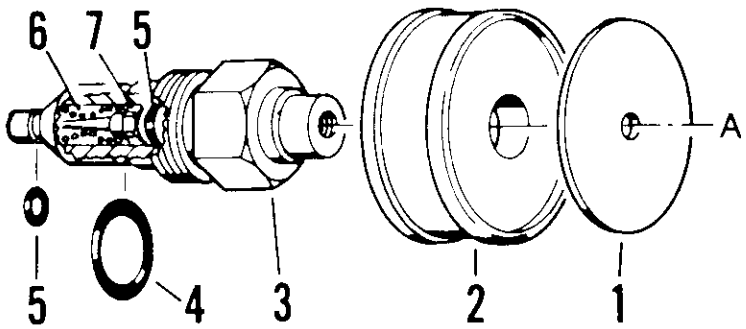
Item	Part No.	Description	Req'd
P/N 10880-60 (STANDARD .1-50)			
1	3850-8	Knob Disc	1
2	10880-41	Knob	1
3	10880-1	Needle Valve Ass'y (Incl. Items 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-8	Comp. Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 x 1/4 Lg. Truss Hd. Screw	1
P/N 10880-61 (FAST .01-5)			
1	3850-8	Knob Disc	1
2	10880-42	Knob	1
3	10880-2	Needle Valve Ass'y (Incl. Items 4 thru 7)	1
*4	2938-3	"O" Ring	1
*5	2938-15	"O" Ring	2
*6	10852-8	Comp. Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 x 1/4 Lg. Truss Hd. Screw	1

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts

MOORE

DERIVATIVE KNOB & NEEDLE VALVE ASSEMBLIES

Drawing No. 10880-768



USAGE	
MODEL SERIES	**PART NO.**
503	10880-70P
508	10880-70P
509	10880-65
569	10880-65
59D	10880-65
59DH	10880-65
59R	10880-65
59DF	10880-68
59RF	10880-68

Item	Part No.	Description	Req'd
P/N 10880-65 (.05-20)			
1	3537-12	Disc	1
2	10880-43	Knob	1
3	10880-1	Needle Valve Assy. (Incl. Items 4 thru 7)	1
* 4	2938-3	"O" Ring	1
* 5	2938-15	"O" Ring	2
* 6	10852-8	Valve Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 X 1/4 Lg. Truss Hd. Screw	1
P/N 10880-68 (FAST .01-5.0)			
1	3537-12	Disc	1
2	10880-42	Knob	1
3	10880-2	Needle Valve Assy. (Incl. Items 4 thru 7)	1
* 4	2938-3	"O" Ring	1
* 5	2938-15	"O" Ring	2
* 6	10852-8	Valve Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 X 1/4 Lg. Truss Hd. Screw	1
P/N 10880-70P (.05-20)			
1	3537-12	Disc	1
2	14444-74	Knob	1
3	10880-1	Needle Valve Assy. (Incl. Items 4 thru 7)	1
* 4	2938-3	"O" Ring	1
* 5	2938-15	"O" Ring	2
* 6	10852-8	Valve Spring	1
7	10852-59	Friction Washer	1
A	1-1192	#6-32 X 1/4 Lg. Truss Hd. Screw	1

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

PARTS LIST

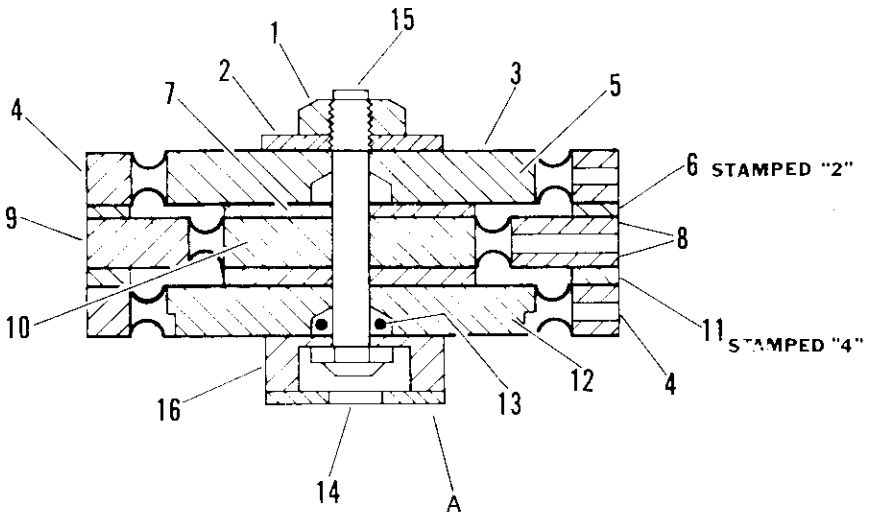
MOORE

CONTROL DIAPHRAGM ASSEMBLY
COMPACT CONTROLLER
2-200% PROPORTIONAL BAND

Drawing No. 14444-10PL

P/N 14444-10 Issue 5

USED ON:
Model Series 501, 502, 503, 507, 508



Item	Part No	Description	Req'd
1	3821-32	Jam Nut	1
2	3092-40	End Plate	1
* 3	14444-12	Diaphragm	4
4	14444-5	Diaphragm Ring	2
5	4551-5	Diaphragm Spacer	1
6	14444-44	Diaphragm Ring	1
7	14444-32	Diaphragm Spacer	2
* 8	14444-11	Diaphragm	2
9	14444-7	Diaphragm Ring	1
10	4551-6	Center Spacer	1
11	14444-4	Diaphragm Ring	1
12	14956-924	Diaphragm Spacer	1
*13	2938-1	"O" Ring	1
14	14278-14	Stop Plate	1
15	14444-30	Rod	1
16	14278-12	Stop Bracket	1
A	1-0650	#4-40 x 1/4" Lg. Truss Hd. Screw	2

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

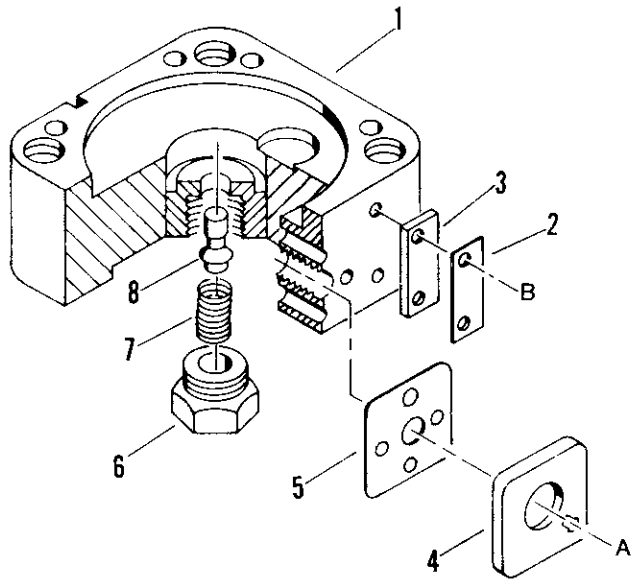
MOORE

PILOT BASE ASSEMBLY
COMPACT CONTROLLER

Drawing No. 14444-39PL

P/N 14444-39 Issue 2

USED ON:
Model Series 501, 502, 503, 507, 508



Item	Part No.	Description	Req'd
1	14444-41	Pilot Base	1
2	3850-43	Nameplate	1
3	12740-162	Spacer	1
4	3850-13	Reversing Plate	1
*5	3092-3	Gasket	1
*6	14444-20	Sealing Screw	1
*7	2155-7	Spring	1
*8	14444-33	Valve Plunger	1
A	1-3240	#1/4-20 x 1/2 Lg. Oval Hd. Screw	2
B	1-6824	#0 x 3/16 Lg. Type "U" Drive Screw	2

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

MOORE PRODUCTS CO.
SPRING HOUSE, PA. 19477

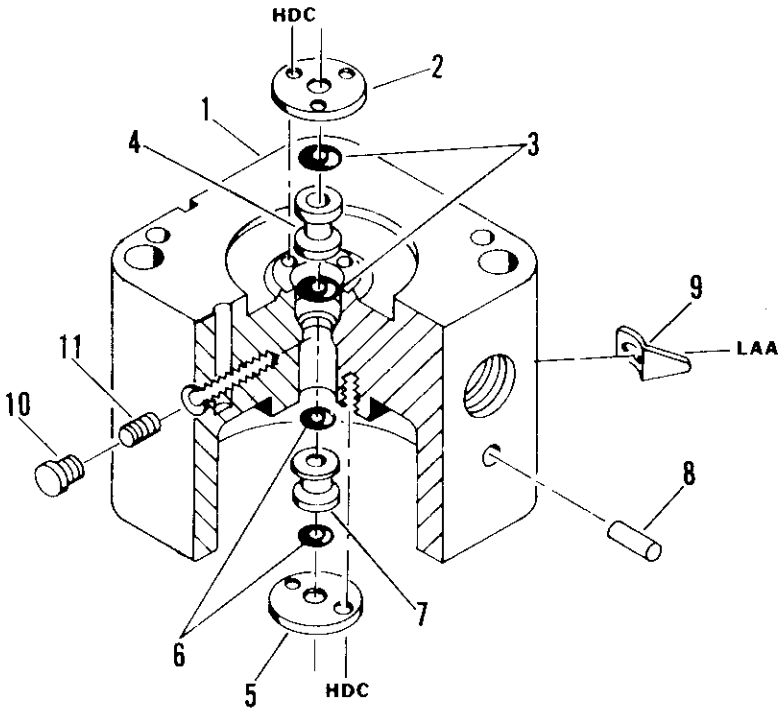
PARTS LIST

UPPER HOUSING ASSEMBLY
COMPACT CONTROLLER

From Drawing
No. 14444–40PL

P/N 14444–40

USED ON:
Model Series 502, 503



Item No.	Part No.	Description	Req'd.
1	14444–27	Upper Housing (incl. Items 8 & 9)	1
2	14278–27	Upper Retaining Ring	1
*3	2938–148	"O" Ring	2
4	14278–20	Upper "O" Ring Spacer	1
5	14444–13	Lower Retaining Ring	1
*6	2938–147	"O" Ring	2
7	14278–21	Lower "O" Ring Spacer	1
8	3035–1	Pin	1
9	14444–47	Pointer	1
*10a	14444–28	Sealing Screw (incl. 10b)	1
*10b	14444–120	Washer	1
*11	2900–26	Sealing Screw	1

Code	Hardware	Req'd.
HDC	#2–56 x 1/4 Lg. Pan. Hd. Screw	5
LAA	#00 x 1/8 Lg. Drive Screw	2

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

Printed in U.S.A. 11/77

MOORE PRODUCTS CO.
SPRING HOUSE, PA. 1947/

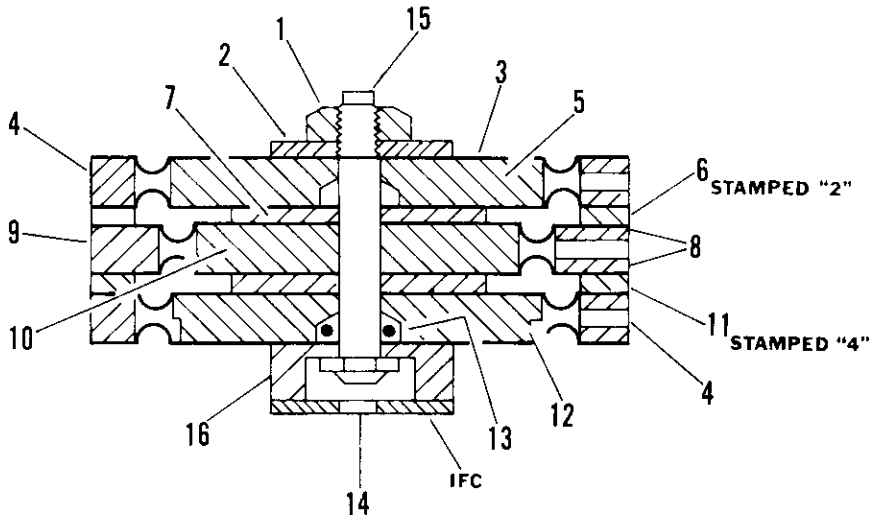
PARTS LIST

CONTROL DIAPHRAGM ASSEMBLY
COMPACT CONTROLLER
5–500% PROPORTIONAL BAND

From Drawing
No. 14444–55PL

P/N 14444-55, Issue 3

USED ON:
Model Series 501W, 502W, 503W, 507W, 508W



Item No.	Part No.	Description	Req'd.
1	3821–32	Jam Nut	1
2	3092–40	End Plate	1
*3	14444–12	Diaphragm	4
4	14444–5	Diaphragm Ring	2
5	4551–5	Diaphragm Spacer	1
6	14444–44	Diaphragm Ring	1
7	14444–32	Diaphragm Spacer	2
*8	14444–54	Diaphragm	2
9	14444–53	Diaphragm Ring	1
10	4551–51	Center Spacer	1
11	14444–4	Diaphragm Ring	1
12	14956–924	Diaphragm Spacer	1
*13	2938–1	"O" Ring	1
14	14278–14	Stop Plate	1
15	14444–30	Rod	1
16	14278–12	Stop Bracket	1

Code	Hardware	Req'd.
IFC	#4–40 x 1/4 Lg. Truss Hd. Screw	2

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

Printed in U.S.A. 11/77 Supersedes 7/77

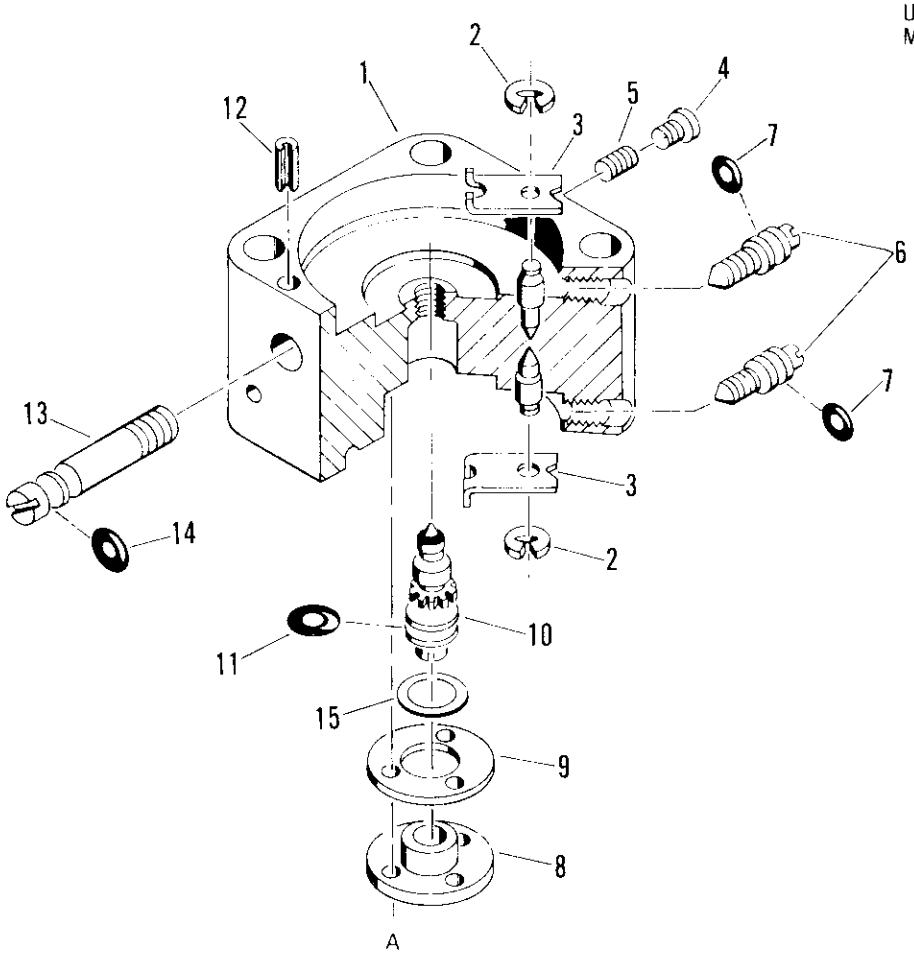
MOORE

PILOT HOUSING ASSEMBLY
3-MODE COMPACT CONTROLLER

Drawing No. 14444-72PL

P/N 14444-72S3

USED ON:
Model Series 503, 508



Item	Part No	Description	Req'd
1	14444-71	Pilot Ring	1
* 2	7044-1	Retaining Ring	2
3	8051-42	Spring	2
* 4	14444-28	Sealing Screw	1
* 5	2900-22	Restriction Screw	1
6	8051-41	Adjusting Screw	2
* 7	2938-5	"O" Ring	2
8	14278-42	Nozzle Stop	1
* 9	8106-24	Gasket	1
10	14278-13	Nozzle	1
*11	2938-2	"O" Ring	1
12	8179-2	Roll Pin	1
13	14444-19	Adjusting Screw	1
*14	2938-4	"O" Ring	1
15	14278-40	Bowed Washer	1
A	1-0953	#5-40 x 5/16 Lg. Flat Hd. Screw	3

* Recommended On-Hand Spare Parts. Always Specify Range, Serial No. or Other Nameplate Information When Ordering Spare Parts

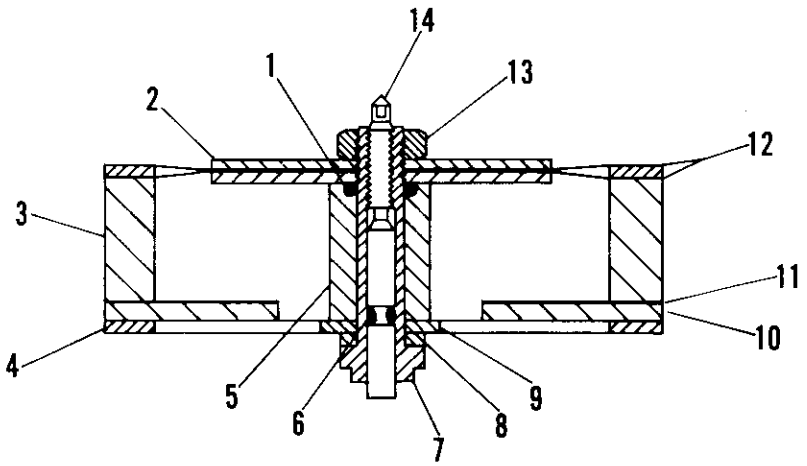
MOORE

HI-GAIN DERIVATIVE DIAPH. ASSY.
COMPACT CONTROLLER

Drawing No. 14444-101PL

P/N 14581-30 ISS. 10
P/N 14581-80 ISS. 6

USED ON:
Model Series 503, 508



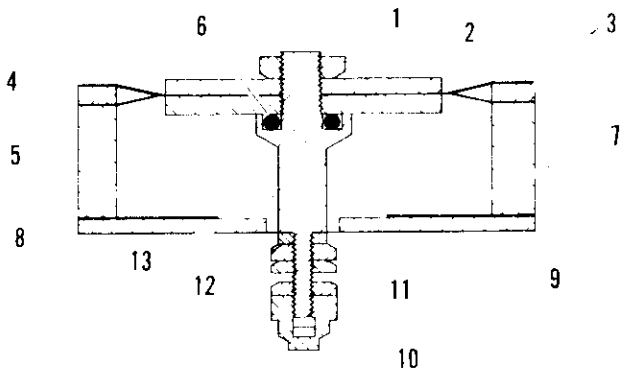
Item	Part No.	Description	Req'd
1	2938-1	"O" Ring	1
2	1447-7	Disc	2
3	14444-57	Reduction Ring	1
4	14444-46	Diaphragm Ring	2
5	14444-60	Spacer	1
6	2938-15	"O" Ring	1
7	14444-61	Pilot Base	1
8	3537-5	Spacer	1
9	2881-16	Spring Seat	1
10	14444-64	Diaphragm Ring	1
11	14444-65	Gasket	1
12	14444-49	Diaphragm	4
13	3821-32	Jam Nut	1
14	14444-79	Nozzle Seat Assy.	1

MOORE

HI-GAIN DERIVATIVE DIAPH. ASSY.
COMPACT CONTROLLER

Drawing No. 14444-102PL

USED ON:
Model Series 503, 508



Item	Part No	Description	Req'd
1	3821-32	Jam Nut	1
2	1447-7	Disc	2
* 3	14444-49	Diaphragm	2
4	14444-46	Diaphragm Ring	1
5	14444-57	Reduction Ring	1
* 6	2938-2	"O" Ring	1
* 7	14444-65	Gasket	1
8	14444-66	Diaphragm Ring	1
* 9	14444-67	Diaphragm	1
10	8106-51	Nozzle Seat	1
11	8106-52	Locknut	3
12	8106-53	Washer	1
13	14444-69	Rod	1

* Recommended On Hand Spare Parts. Always Specify Range, Serial No., or Other Nameplate Information When Ordering Spare Parts.

Siemens Energy & Automation	INSTRUCTION ADDENDUM

SDA503-100
Rev. 1
March 2004

Model 503 Compact Nullmatic™ Controller Additional Specifications

INVOLVED INSTRUCTION

Service Instruction SD503, Rev. 8 and earlier

DISCUSSION

The following specifications amend those provided in the body of SD503.

Standard Operating Range: ..... 3-15 psig for setpoint, process, and output

Max. Operating Pressure: ..... 50 psig for setpoint, process, and output

Supply Pressure: ..... Normal – 20 psig
Minimum – 3 psig above maximum output

Over-Pressure Protection: ..... 100 psig on any connection

Ambient Temperature Limits: ..... -40 to 180 deg F (-40 to 82 deg C)

■