

Owner's Instruction Manual



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MODEL 500 MAGNAVALVE®



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Model 500 MagnaValve

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1. General

The model 500 MagnaValve is a magnetic valve capable of regulating the flow of steel shot in the range of 0-1200 pounds/minute. The magnetic engine has no moving parts but relies on a strong magnetic field to hold or release the shot.

The built-in sensor measures shot density as it is discharged from the bottom of the valve. This measurement is converted to a 0-5 V dc signal for process control.

2. Principle of Operation - Engine

The vertical passage through the valve is the flow path for the shot, sized to flow more than its rated capacity. The upper portion of the valve is the magnetic engine. Located on either side of the bore are two pole pieces of a very powerful permanent magnet. The magnetic field is strong enough to prevent the flow of ferrous media (steel shot).

An electromagnetic coil is mounted on each side of the two pole pieces. When these coils are energized, the permanent magnet field is (perfectly) cancelled and shot will freely flow through the valve. The valve, therefore, acts as a "normally" off flow valve for ferrous media.

To control or regulate the shot flow rate, the coils are energized in a time proportioning manner -- sometimes called duty cycle. If the coils are energized at 50% duty cycle, then the flow rate will be 50% of the valve capacity. The repetition rate is fixed at 8 Hertz (125 msec period). A red LED signals that power is applied to the coil. If the LED is off, then there should be no shot flow. If the LED is on (constantly), then full shot flow rate will occur. If the LED is blinking, then a controlled or regulated intermediate shot flow rate will occur.

The dc current for the coil necessary to perfectly cancel the permanent magnet is established by the valve driver module. An adjustment trim pot on the module is factory set to the dc current (amps) indicated on the valve driver product label. NOTE: this value is only valid at 100% duty cycle when the red LED is constantly on.

3. Principle of Operation - Sensor

The lower portion of the valve is an inductive metal sensor used to detect the amount of ferrous steel shot passing through the engine. The sensor is an oscillator circuit operating at a base frequency of 11,400 Hertz. The oscillator frequency will decrease with increasing flow rate (about 1000 Hertz for full range). This signal is then converted to a 0-5 V dc output signal.

For high accuracy applications the built-in linearity compensator may be used. Additional information is shown later in this manual for its adjustments. The compensator will add (or subtract) offsets at 10% increments.

4. Mechanical Installation

The MagnaValve must be mounted in a vertical position, paying attention to the "flow arrow" decal on the outer housing. Mounting the valve at more than 10° from vertical will promote rapid wear of the internal flow path and may also restrict the maximum flow rate. Mounting the valve in the non-vertical position is not recommended.

Be sure that the valve can be easily removed to clear any debris or contaminants that may become lodged in the valve. A slide gate shut-off above the valve will allow valve removal without the need to empty the shot hopper.

NOTICE: Failure to maintain shot quality may affect valve performance. Excessive dust, fines, broken shot, oil, water, etc., may reduce or completely stop shot flow.

5. Electrical Installation

Refer to the data sheet included with the MagnaValve for wiring instructions. A six conductor (or 3-pair) shielded cable with minimum wire gage AWG 20 must be used. The cable should be placed in a private conduit or seal-tite. Do not allow the cable to be near wiring from motors or other inductive loads since this may cause electrical interference with the sensor output signal.

Verify all wire connections prior to applying power to any system. Observe all local and national electrical wiring codes. Do not operate MagnaValve without all cover plates or junction box lids in place.

6. Operation

Refer to the instruction manual for the shot flow controller for additional operating instructions. The following instructions are valid for use with either the Model 362a shot flow controller or the Model AC shot flow controller.

7. Calibration

7.1 Calibration - Theory of Operation

The Pre-Amp performs signal conditioning (0-5 Vdc) and linearity compensation. The signal conditioner uses an oscillator circuit and inductive sensor to detect metal density (shot flow) and converts this to a 0-5 V dc output signal. The sensor signal is non-linear and a compensator circuit is used to linearize it. The compensator circuit corrects the output signal in 10% increments, starting at 15%, 25%, 35% etc to 95%.

7.2 Calibration - Factory Settings

The MagnaValve is factory pre-set and compensated. The standard range is 0-1200 lbs./min. The valve is factory pre-calibrated at 10% intervals and compensated to achieve an accuracy of 3% or better at 15% - 90% of range.

The MagnaValve Pre-Amp is used to condition the flow rate signal and transmit it to the shot flow controller as a 0-5 Vdc signal. The linearity compensator circuit performs output correction in 10% increments for high accuracy performance. The Pre-Amp is factory calibrated and should not require any customer attention. The full-scale

output of the Pre-Amp is 5.00 Vdc. The Model 500 MagnaValve is normally factory calibrated to 0-1200 lbs/min. flow rate range.

Other flow rates may be used when special conditions prevail; however, we recommend the standard range of 0-1200 because all production valves are pre-calibrated to that range. An emergency request for a spare valve calibrated to the standard range is usually handled within 24 hours. A non-standard calibration may require one week to allow access to the calibration.

The span adjustment affects the entire range of shot flow rate and it should not be changed unnecessarily. Once the Pre-Amp span is set correctly for full scale other flow rates must be rechecked. Settings of 15%, 25%, etc., are recommended since this is the mid-point of each compensation range. If the individual compensation points must be revised, adjust the appropriate trimpot or perform a complete valve re-calibration. The following procedure describes the calibration process.

7.3 Calibration Procedure Summary

Range:
Controller full-scale range
Pre-Amp full-scale range

Span:
Controller span
Pre-Amp span

Calibrate:
Run catch and weigh test with no-compensation
Select either + or - compensation
Install compensation values at 15%,25% etc. trim pots
Run catch and weigh test with compensation

7.4 Calibration - Procedure

7.4.1 Calibration - Procedure – Range

7.4.1.1 Calibration - Procedure - Range - Pre-Amp

7.4.1.1.1 The full-scale flow range is the maximum flow, in pounds per minute, required for the installation. To set the full-scale value into the Pre-Amp, use the following procedure:

7.4.1.1.2 Turn the Pre-Amp selector switch to position two. (position one is fully CCW). Position two is used to confirm proper zero setting of the Pre-Amp display and transmits a true 0.00 Vdc output signal. If the Pre-Amp display does not show zero while the selector switch is in this position then adjust the *display zero* trimpot.

7.4.1.1.3 Turn the pre-amp selector switch fully CW. This forces a 5.00 Vdc output signal and a corresponding full scale reading into the Pre-Amp display. To change the value of the display reading turn the *coarse* and *fine* full scale display adjustment trimpots.

7.4.1.2 Calibration Procedure – Range - Controller

The shot flow controller input receives the 5.00 Vdc Pre-Amp output signal and normally displays a full-scale of 1200 lbs/min. The controller display range **must** be matched to agree with the Pre-Amp full-scale range.

To change the shot flow display:

7.4.1.2.1 Place the controller in the Local mode (not Remote mode).

7.4.1.2.2 Turn controller *setpoint* knob to 100% full CW.

7.4.1.2.3 Push and hold *display* toggle switch to right.

7.4.1.2.4 Adjust controller display *full scale* until display reads 1200.

Note: If the remote mode operation (from PLC etc.) is to be used shift to remote mode and apply 10.00 Vdc to remote setpoint command input.

7.4.1.2.5 Adjust the *display F.S.* trimpot if required.

7.4.2 Calibration - Span

7.4.2.1 Calibration - Span - Controller:

NOTE: This step must be preformed before making any changes to the Pre-Amp span, even if the Pre-Amp span has not been properly verified. This step is actually a synchronization of the gain of the controller to match the gain of the Pre-Amp. It assures that when the shot flow controller receives a 5.00 Vdc input signal from the Pre-Amp output that it gets amplified by a factor of x2 for a 10.0 Vdc presentation to the controller internal display and re-transmission to its recorder output terminal. The actual display value at the Pre-Amp (see above for Pre-Amp range adjust) -is not the important feature of this step. The 5.00 Vdc calibration signal is the important feature, and it is ALWAYS available when the Pre-Amp selector switch is in the fully CW position, regardless of where the Pre-Amp display range has been set. This step could be performed with a "battery box" set to 5.0 Vdc, but it is convenient to borrow the calibration voltage from the Pre-Amp.

7.4.2.1.1 The shot flow control front panel "span" adjust must be set to match the MagnaValve "*span*". This is achieved with the shot flow controller front panel *span* adjust. A full-scale Pre-Amp output signal is transmitted to the shot flow controller and the controller *span* is adjusted for the proper value in the controller display. Set the

Pre-Amp selector switch to the full CW position. The Pre-Amp will now show its full-scale value in its display and transmit a 5.00 Vdc signal to the shot flow controller input.

CAUTION: The Auto – Zero must be disabled or it will attempt to suppress the controller display reading. The 362 Controller auto-zero switch is located inside the controller and is labeled "run-bypass". Place it in the bypass position for this procedure. The AC controller auto-zero switch is on its front panel. The blue blinking LED for Auto-zero will stop while it is disabled.

7.4.2.1.2 Adjust the controller *span* trimpot until it matches the controller display reading to the Pre-Amp display reading.

7.4.2.2 Calibration Procedure - Span - Pre-Amp

To properly set the *span* of the Pre-Amp, a catch and weigh test must be performed. This is tedious and should only be done if absolutely necessary. The MagnaValve has been factory calibrated and a calibration sheet should accompany the valve upon shipment. If a different full-scale range or confirmation of calibration accuracy is needed the following procedure should be used:

7.4.3 Catch and Weigh Tests

7.4.3.1 Catch and Weigh Test Procedure

7.4.3.1.1 Place the Pre-Amp selector switch in the *Run* (fully CCW) position.

7.4.3.1.2 Place the Pre-Amp *polarity* switch in its center position.

7.4.3.1.3 Place the shot flow controller *servo* switch on.

7.4.3.1.4 Place the shot flow controller *auto-zero* switch on.

7.4.3.1.5 Place the shot flow controller in the *Local* or *Remote* mode, as desired.

7.4.3.1.6 Perform the 10% increment series of catch and weigh tests and fill in the column marked actual pounds in the following table (be sure the Pre-Amp polarity switch is off):

SET	ACTUAL CATCH
180	
300	
420	
540	
660	
780	
900	
1020	
1140	
1200	

7.4.3.2 Select either + or - Compensation

7.4.3.2.1 If the catch amounts are less than expected, you will need to select positive (+) polarity compensation.

7.4.3.2.2 If the catch test amounts are more than expected then you must select negative (-) polarity compensation. Only one polarity can be chosen for entire range.

7.4.3.3 Install Compensation Values

The compensation values can now be installed into the Pre-Amp. This is accomplished by using the Pre-Amp selector switch and the nine (9) linearity compensator trimpots. Each trimpot has a corresponding red LED. Only one trimpot will be active at a time, as indicated by its LED.

7.4.3.3.1 Rotate the Pre-Amp selector switch to position three. The 15% LED should be lighted. Adjust the 15% trimpot until the value in the Pre-Amp display corresponds to the catch value.

7.4.3.3.2 Continue this procedure for the remaining values through 95% and then return the Pre-Amp selector switch to the RUN position.

CAUTION: During this time various output signals will go from the Pre-Amp to the shot flow controller input. The auto-zero feature of the controller will attempt to "zero" these values. This is not a concern at the present time. Before running additional catch and weigh trials always be sure that the shot flow controller display is resting at ZERO.

7.4.3.4 Catch and Weigh Test - Confirmation

It will be necessary to repeat the above procedure to confirm calibration accuracy. Repeat the tests for all 10 segments. Additional adjustments to a single segment may be made if it is necessary.

8. Description of 12-Position Pre-Amp Switch

The Pre-Amp selector switch is normally placed in the RUN position (fully CCW rotation) and this sends the actual flow rate signal to the pre-amp display. To aide calibration and compensation this switch is also used to send pre-set voltages into the display.

POSITION	%	VOLTAGE	"FLOW" (assuming 0-1200 Lb/min range)
1 Run	-	Actual	Actual
2 Zero	0	0.00	ZERO
3	15	0.75	180
4	25	1.25	300
5	35	1.75	420
6	45	2.25	540
7	55	2.75	660
8	65	3.25	780
9	75	3.75	900
10	85	4.25	1020
11	95	4.75	1140
12	100	5.00	1200

9. Maintenance and Trouble Shooting

Occasional cleaning of the MagnaValve may be necessary to prevent build-up of dust or other contaminants. If the valve is unable to achieve a requested shot flow rate the controller will supply a 100% duty cycle control signal to the valve and the red LED will be constantly on. The shot flow rate controller low alarm light will be on. These symptoms indicate that the valve is starved and the system is either out of shot or a blockage has occurred.

10. Spare Parts

The only spare parts recommended for the MagnaValve is a spare valve driver module. The valve driver module is located on the back side of the Model 500 MagnaValve behind the finned heat radiator. A product label on the module will identify its model number and setting of the correct 100% duty cycle dc coil current. Replacement

valve driver modules are supplied with calibration instructions necessary to adjust the proper dc current.

11.Help

IF IN DOUBT.....CALL FOR HELP

TELEPHONE.....USA.....1-574-256-5001

FAX.....USA.....1-574-256-5222

END OF MANUAL