



Gate-Pak[®] Injector

Installation & Manual

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Overview

Lubrizol Performance Systems™ has supplied a variety of fluid measurement and control systems for over 35 years. Our traditional market is the gasoline market; specifically the fuel additives sector.

Before the introduction of the **Gate-Pak® Injector**, fuel additives were typically metered into gasoline by metering pumps. While acceptable before the Gate-Pak introduction, metering pumps have inherent problems with leaks, constantly changing calibration, seals that can leak to atmosphere, and no means of proving flow. As fuel additive technology advanced, it became more critical for the exact amount of additive to be injected into the fuel and the elimination of the inherent problems with metering pumps. Thus, the Gate-Pak Injector became and still is the injection system of choice at virtually all the worldwide gasoline marketers.

The Gate-Pak Injector is a simple, piston type metering system with only three moving parts. All wetted parts are either stainless steel or Teflon® and are compatible with the vast majority of chemicals and additives. Each injector is factory tested and calibrated to our customer's specifications. These features combined have made the Gate-Pak Injector highly accurate and highly reliable with very little maintenance.

As discussed above, the precise amount of additive or chemical injected into a product stream is critical. For example, in the case of gasoline additives, if the injection system delivers too little additive, the gasoline will not reach the performance benefits which the gasoline marketer has advertised. Even worse is the reverse case; i.e. the injection system delivers too much additive. This case increases cost by consuming too much additive but also can generate new problems in the engine which can decrease performance. Both can have a major detrimental impact on the marketer. The Gate-Pak Injector provides both the accuracy and reliability that the gasoline marketers require.

To compliment your **Gate-Pak® Injector** system Lubrizol Performance Systems has developed the **Additive Data And Control (ADAC) v2** monitoring system. The **ADAC v2** system is a complete package, consisting of an explosionproof (or Nema 4) hardware and custom software, designed to easily provide accurate additive reports.

Lubrizol Performance Systems manufactures two additional injection systems; the **ABC® Injector** and the patented **Blend-Pak® Plus Injector**. Both provide the accuracy and reliability of the Gate-Pak Injector but add additional features such as meters, alarms, and communications. Also, Lubrizol Performance Systems designs and manufactures **Wild Stream® Blending** systems for blending different grades of gasoline. These systems can also blend oxygenate into gasoline which is becoming more prevalent due to the stricter Clean Air regulations. Please contact your Lubrizol Performance Systems distributor or Lubrizol Performance Systems itself if more information is desired.

Principle of Operation

Note: Please refer to the Gate-Pak® Injector flow diagrams on pages 6 and 7 when reading the following principle of operation.

A Gate-Pak Injector is activated when its pilot solenoid is energized. Usually, this is accomplished by a signal from the electrical pulse transmitter driven by the main product flow stream meter. Timers and pulse generators can also be utilized. Energizing the pilot solenoid valve reverses the additive flow through the four way spool valve forcing the free floating piston in the Gate-Pak Injector's cylinder to move from one end of the cylinder to the other end. This movement from one end to the other defines a measurement stroke. Each measurement stroke always should be completed before the solenoid is de-energized (or energized). Ideally, the piston will be at rest (idle) for a finite time period before the next measurement stroke commences.

To inject the additive into the main product line, the discharge pressure from the Gate-Pak Injector must be greater than the main product line pressure at the injection point plus any line pressure drop from the injector panel to the injection point.

Example:	Gate-Pak pressure drop	40 psi
	Product line pressure at injection point	45 psi
	Line pressure drop between injector and product line	<u>5 psi</u>
	Pressure required at Gate-Pak inlet	90 psi

To ensure additive injection, it is recommended that the pressure be **20-25** psi higher than the minimum required. In the above example, an inlet pressure of **110-115** psi to the Gate-Pak Injector is recommended. Obviously, this means the inlet pressure at the injection point should be 65-70 psi based on the above example.

Caution: Any change in the additive viscosity, piping, product line pressure, etc. will alter the system's pressure dynamics. Therefore, supply pressure to the injector should be based on the highest pressure drop case. This will assure successful operation of the injection system.

Pressure for the additive is typically provided by a small positive displacement pump located at the additive supply tank. Generally, only one pump is necessary to supply sufficient pressure for several Gate-Pak Injectors. The supply pump should be designed to exceed the total demand flow and maximum pressure required from all injectors connected to that supply pump. A rule of thumb for sizing the pump is to determine the maximum additive flow for one minute. Then double the maximum flow and select the pump which comes closest to the required pressure at the doubled flow rate.

Since the transmitter is pacing the Gate-Pak Injector, the selection becomes important to the overall performance. Generally, the Gate-Pak Injector should cycle 15 to 20 cycles per minute providing an injection stroke for each 10 to 50 gallons (50 to 300 liters).

Definitions:

1. One injection **stroke** occurs when the piston moves the length of the cylinder one direction only.
2. One injection **cycle** includes two injection strokes; the free piston travels the length of the cylinder and back to its original starting position.

INSTALLATION

Dirt and foreign matter contribute to a large majority of equipment malfunction problems during start-up. Before starting up an additive system, thoroughly flush the additive supply line. Also, inspect the additive storage tank before filling it with additive. If it is a new tank, check to ensure that all dirt and foreign matter which may have been introduced during its installation is removed. An older tank should be checked for dirt and rust. After start-up, remove and clean the additive supply pump strainer. It is good practice to clean the inlet filters at each Gate-Pak® Injector after the pump strainer is cleaned. When dirt is present, it is strongly recommended that the system is checked often during the following weeks.

CAUTION - Before removing the additive pump inlet strainer, make sure that the supply pump is turned off and that the pump cannot be turned on remotely. ***Always follow your company's safety guidelines when working on the additive equipment.***

If, after initial installation, the Gate-Pak Injector fails to operate, the mounting panel may be loosened to relieve any 'twisting' that may be caused by the mounting arrangement. If the problem continues, loosen the two retaining bolts located on the back of the mounting panel that hold the measurement cylinder assembly. Cycle the unit and tighten the bolts if the unit operates. If the problem persists, please consult the trouble shooting guide located in this manual.

CALIBRATION

All Gate-Pak Injectors are factory calibrated to our customer's specifications. To change calibration, the length of the stroke of the free piston must be changed. Turning the adjusting screw out lengthens the stroke of the piston and increases the amount of additive injected. Turning the adjusting screw in shortens the length of the stroke of the piston and decreases the amount of additive injected.

CAUTION - When the delivered amount is to be decreased, carefully screw in the adjustment rod. If the piston has cycled to a stop against the adjusting rod (solenoid energized), you will immediately feel the adjustment become very tight - **STOP!!** Further adjustment can damage the unit with the pump operating. Cycle the unit, using the panel HOA calibration switch, so the piston completes a stroke and is at rest at the opposite end of the cylinder (solenoid de-energized). Then, the calibration can safely be continued.

Sample Calculation #1

Additive requirement = 1 gallon of additive per 1000 gallons of product
Transmitter resolution = 1 cycle per 40 gallons
 $1000 \text{ gallons (product)} \div 40 \text{ gallons per cycle} = 25 \text{ cycles per 1000 gallons}$
 $1 \text{ gallon (additive)} \div 25 \text{ cycles} = 0.04 \text{ gallons per cycle}$
 $0.04 \text{ gallons} \times 3785 \text{ cc per gallon} = 151.4 \text{ cc per cycle}$

Sample Calculation #2

Additive requirement = 1.5 liters of additive per 1000 liters of product
Transmitter resolution = 1 cycle per 150 liters
 $1000 \text{ liters (product)} \div 150 \text{ liters per cycle} = 6.666 \text{ cycles per 1000 liters}$
 $1.5 \text{ liters (additive)} \div 6.666 \text{ cycles} = 0.225 \text{ liters per cycle}$
 $0.225 \text{ liters} \times 1000 \text{ cc per liter} = 225 \text{ cc per cycle}$

Optional Equipment

Gate-Tek® 5 Monitor

Used when it is necessary to monitor the additive flow. Examples would be injecting a dye into untaxed fuel, or the injection of anti-icing additive into jet fuel. The Gate-Tek 5 is a solid state device that can be mounted on the Gate-Pak® Injector panel in a small explosionproof junction box. The Gate-Tek 5 will require the installation of a device that will indicate product flow. This can be accomplished by a flow switch, pressure switch, valve stem switch, or similar device.

Piston Actuated Switch

Used with a Gate-Tek 5 or an electronic counter to indicate the number of cycles made by the Gate-Pak Injector. The electronic counter may be mounted directly on the Gate-Pak Injector mounting panel.

PDC® - 21 (Pulse divide circuit)

Used to change an existing pulse signal into one that is acceptable to the Gate-Pak Injector. Certain electronic preset additive outputs will not operate the Gate-Pak Injector due to the short duration time; by sending this signal through the PDC-21 we can provide an acceptable 50-50 on-off pulse output. In addition the PDC - 21 may be used to divide an existing transmitter ratio into one that meets requirements.

PDC® - 22 (Dual pulse divide circuit)

Works the same as the PDC - 21, except that it has the ability to provide two separate output pulses - one AC and one DC.

PDC®-23 (Dual pulse divide circuit)

Works the same as the PDC - 21 and PDC - 22, except that it provides two AC output pulses from one input.

PG - 26 (Pulse generator)

Used to provide a simulated transmitter signal when none is available. The PG - 26 can be used when an approximate flow rate is known (as in a pipeline delivery), and no meter is installed in the line. This is accomplished by dividing an incoming AC current (e.g. - 60 cycle per second) by the appropriate divisor to obtain the desired output.

APM - 1 (Additive pressure monitor)

Used to monitor additive supply pump pressure. If the additive supply pressure drops below a set amount, the unit can remove the permissive to load product at the loading rack, or give a warning signal output.

AMS - 684 (Automatic measurement system)

Used to inject additive automatically during a product receipt, where no product meter is available. Operator enters the batch size and arms the unit. When a signal is received that product is flowing, the AMS - 684 will begin to inject additive into the line. If the flow is stopped for any reason the unit will go into a standby condition, and will resume injection when the product flow resumes. The AMS - 684 generates a pulse to simulate a transmitter output pulse.

Precalibrated Scale

Used to give a visual indication of unit calibration per cycle. The scale is mounted directly on the measurement cylinder and uses a mark on the calibration stem for indication.

Calibration Test Kit

Used to field calibrate all Gate-Pak Injectors. The kit contains two 1000 cc graduated cylinders, all the necessary tubing, a spring loaded check valve to simulate system back pressure, and a pressure gauge. Male quick connect fitting allowing for an easy connection to the test valve is available separately.

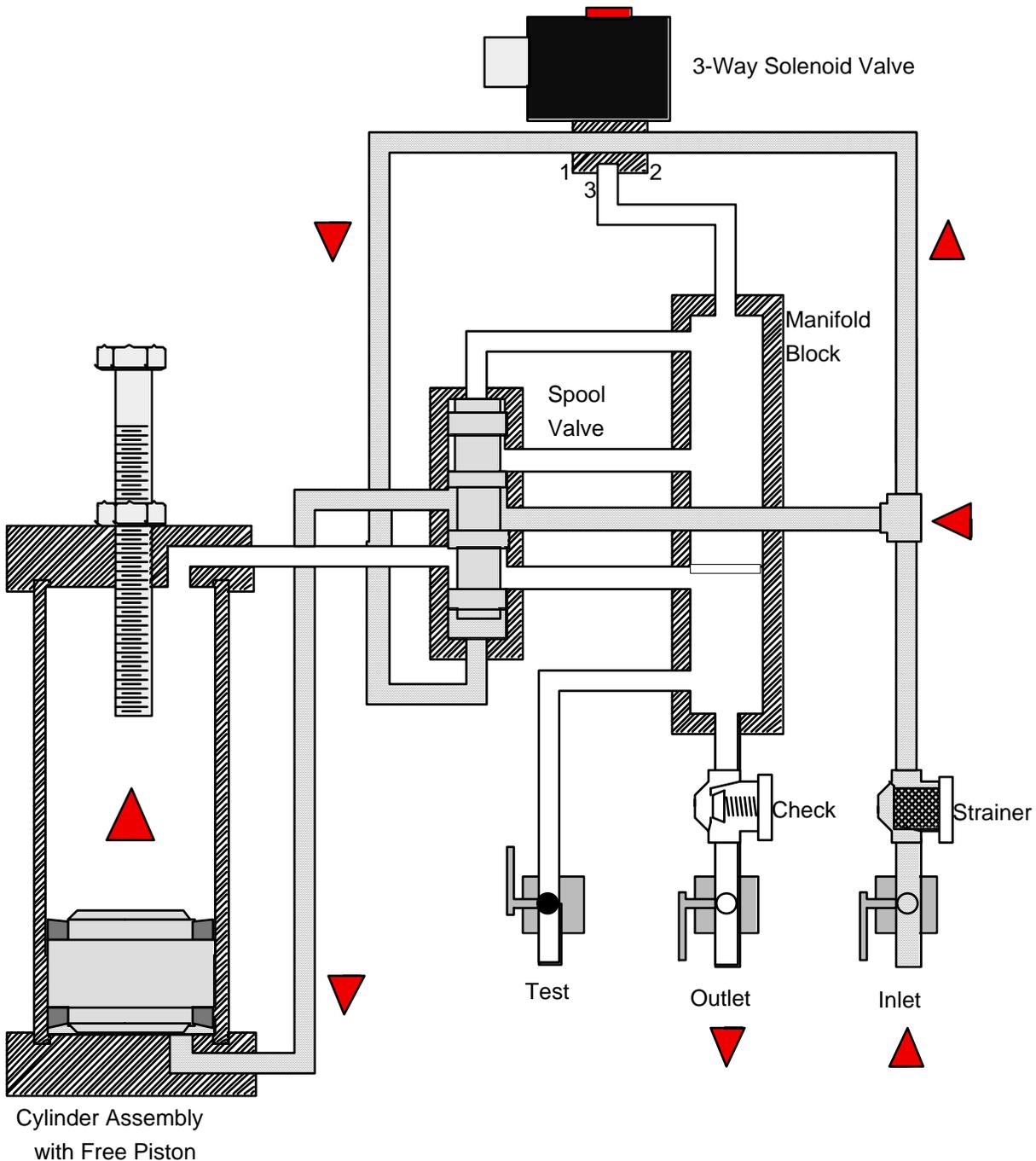
Gate-Pak Technical Data

Model Number	Minimum without piston switch	Minimum with piston switch	Maximum	Maximum Cycles per Minute	Adjustment per Thread per Cycle
EI-0755-1	3 cc	14 cc	54.3 cc	22 - 25	0.603 cc
*EI-1255-1	3 cc	20 cc	140.5 cc	21 - 25	1.677 cc
EI-1256-1	3 cc	20 cc	181.3 cc	21 - 25	1.677 cc
*EI-2005-1	6 cc	40 cc	325.5 cc	15 - 18	5.721 cc
EI-2007-1	6 cc	40 cc	533.5 cc	14 - 16	5.721 cc
*EI-2008-1	6 cc	40 cc	637.5 cc	11 - 13	5.721 cc
*EI-3125-2	6 cc		996.3 cc	14 - 15	13.968 cc

- Notes: 1) The values shown for maximum cycles per minute are based on a product having a viscosity less than 1500 SSU. For viscosities greater than 1500 SSU, please consult the factory.
- 2) The asterisk (*) indicates a nonstandard model Gate-Pak, and are special order only.
- 3) Model numbers are defined by the cylinder diameter and length. The first three digits are the cylinder's diameter expressed in inches. The last digit is the length of the cylinder in inches. Example, 0755 is a cylinder with a diameter of 0.75 inches and a length of 5 inches.

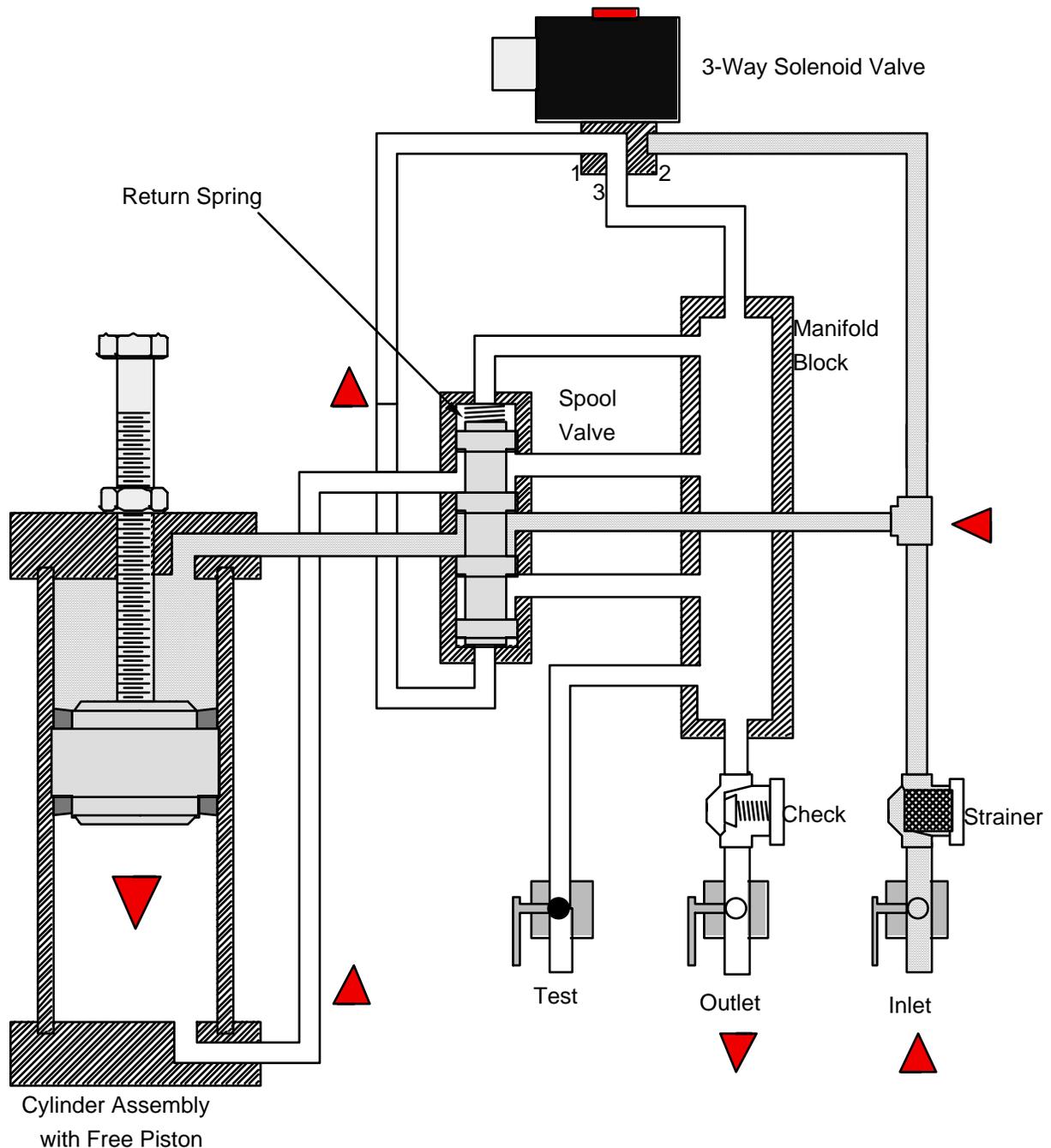
Gate-Pak® in Energized Position

When the three-way solenoid is energized product flows in port 2 and out port 1. From port 1 product flows to the bottom of the spool valve, causing the spool valve to shift position and compress the spring. With the spool valve in this position product flows out of supply line, through the spool valve, and into the bottom of the cylinder. The product pressure is then used to move the piston. As the piston moves, the product in the top of the cylinder is displaced, and forced out of the cylinder. The displaced product then flows through the spool valve, into the manifold block, and out the outlet or test ball valve.

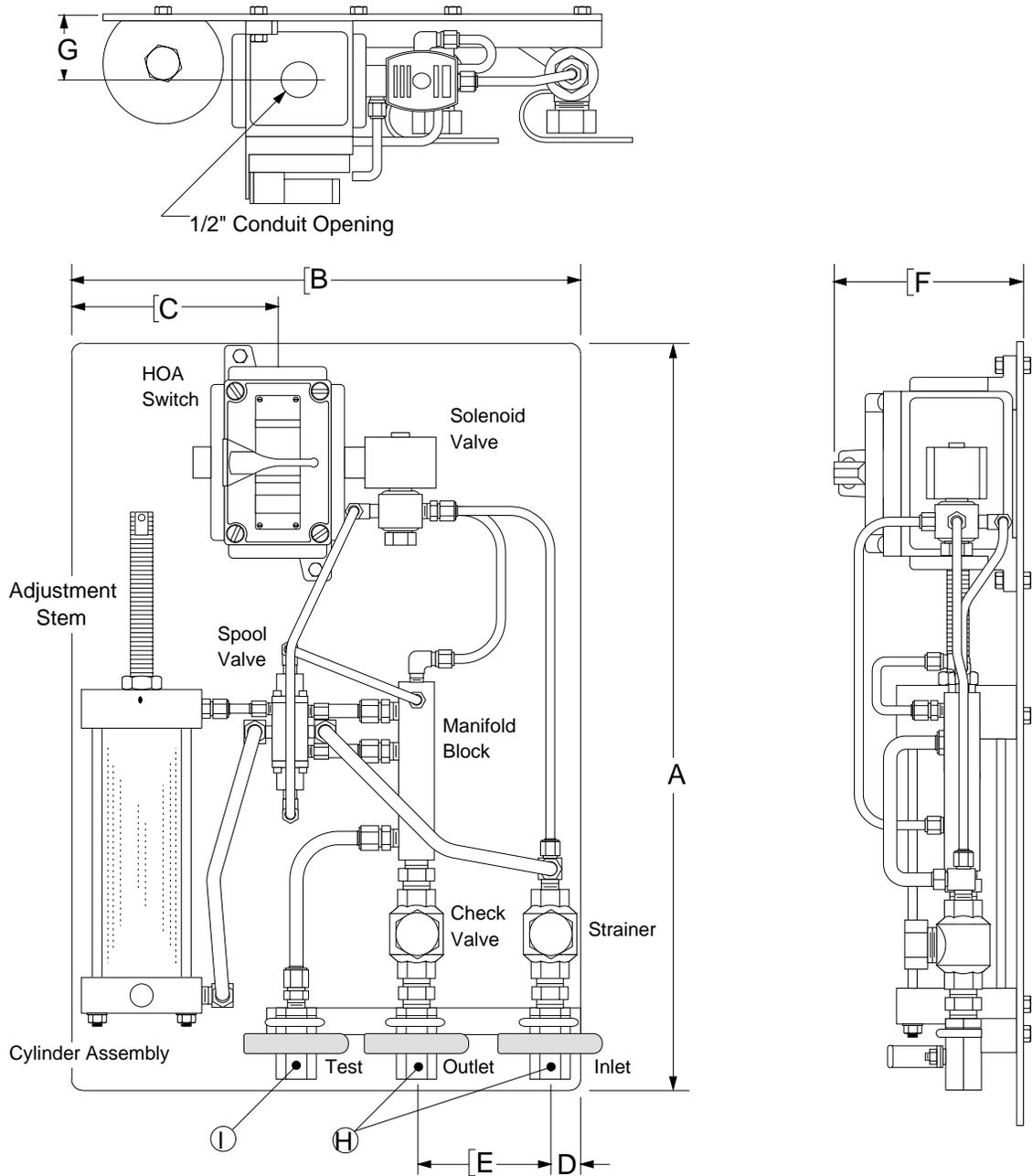


Gate-Pak in De-Energized Position

When the three-way solenoid is de-energized, product flow through the solenoid is blocked and spring pressure is used to shift the spool valve. With the spool valve in this position product flows out of the supply line, through the spool valve, and into the top of the cylinder. Product pressure is then used to move the piston. As the piston moves, the product in the bottom of the cylinder is displaced, and forced out of the cylinder. The displaced product then flows through the spool valve, into the manifold block, and out the outlet or test ball valve.



Gate-Pak® Dimensions



Gate-Pak Model	A	B	C	D	E	F	G	H	I
EI-0755-1 thru EI-1256-1	20"	12"	4"	0.75"	3.75"	5.5"	2"	1/4" NPT	3/8" NPT
	51 cm	30 cm	10 cm	2 cm	10 cm	14 cm	5 cm		
EI-2005-1 thru EI-2008-1	22"	14"	5.25"	0.75"	3.25"	5.5"	2"	3/8" NPT	3/8" NPT
	56 cm	36 cm	13 cm	2 cm	8 cm	14 cm	5 cm		

Gate-Pak® Recommended Spare Parts

Models covered by this spare parts listing include the following:

EI-0755-1
EI-1255-1
EI-1256-1
EI-2005-1
EI-2007-1
EI-2008-1
EI-3125-1

Solenoid

- 1) Solenoid repair kit
- 2) Coil

Cylinder Assembly

- 1) Stem seal nut
- 2) Piston seal (2 required)
- 3) Piston loading tool (Used only on EI-0755-1, EI-1255-1 & EI-1256-1)
- 4) End cap gasket (2 required)

Spool Valve

- 1) Large "O" ring
- 2) Small "O" ring
- 3) Spring

Strainer

- 1) Teflon cap seal & guide
- 2) Filter basket

Check Valve

- 1) Teflon cap seal & guide
- 2) Teflon poppet
- 3) Teflon "O" ring
- 4) Spring

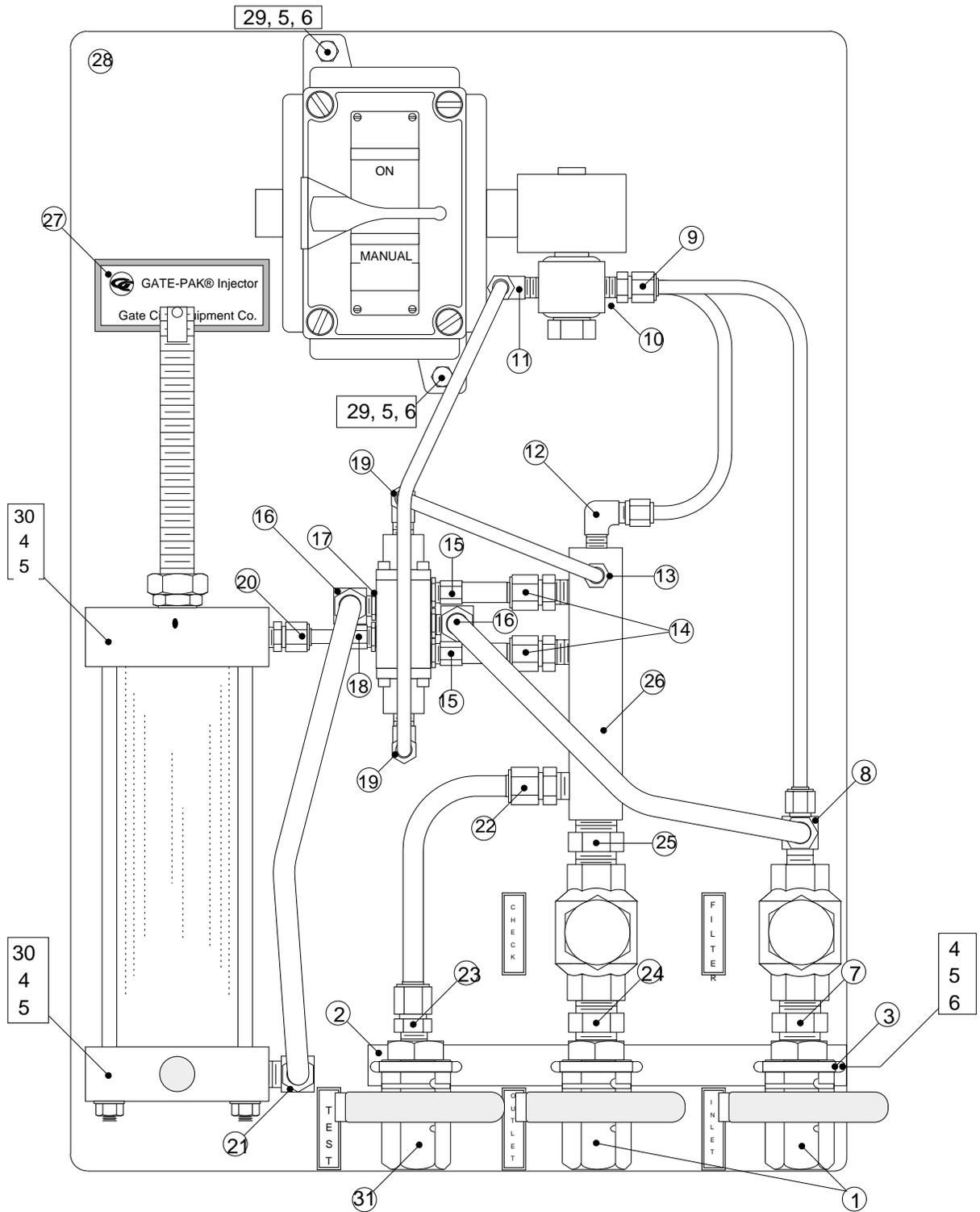
For Gate-Paks with Gate-Tek 5 Monitor

- 1) Gate-Tek 5 module
- 2) Fuses
- 3) Piston switch

For Gate-Paks with Pulse Divide Circuits

- 1) PDC-21 module, PDC-22 module, PDC-23 module

Tube Fittings - Labels - Fasteners - Hardware



*Consult Factory for Tubing

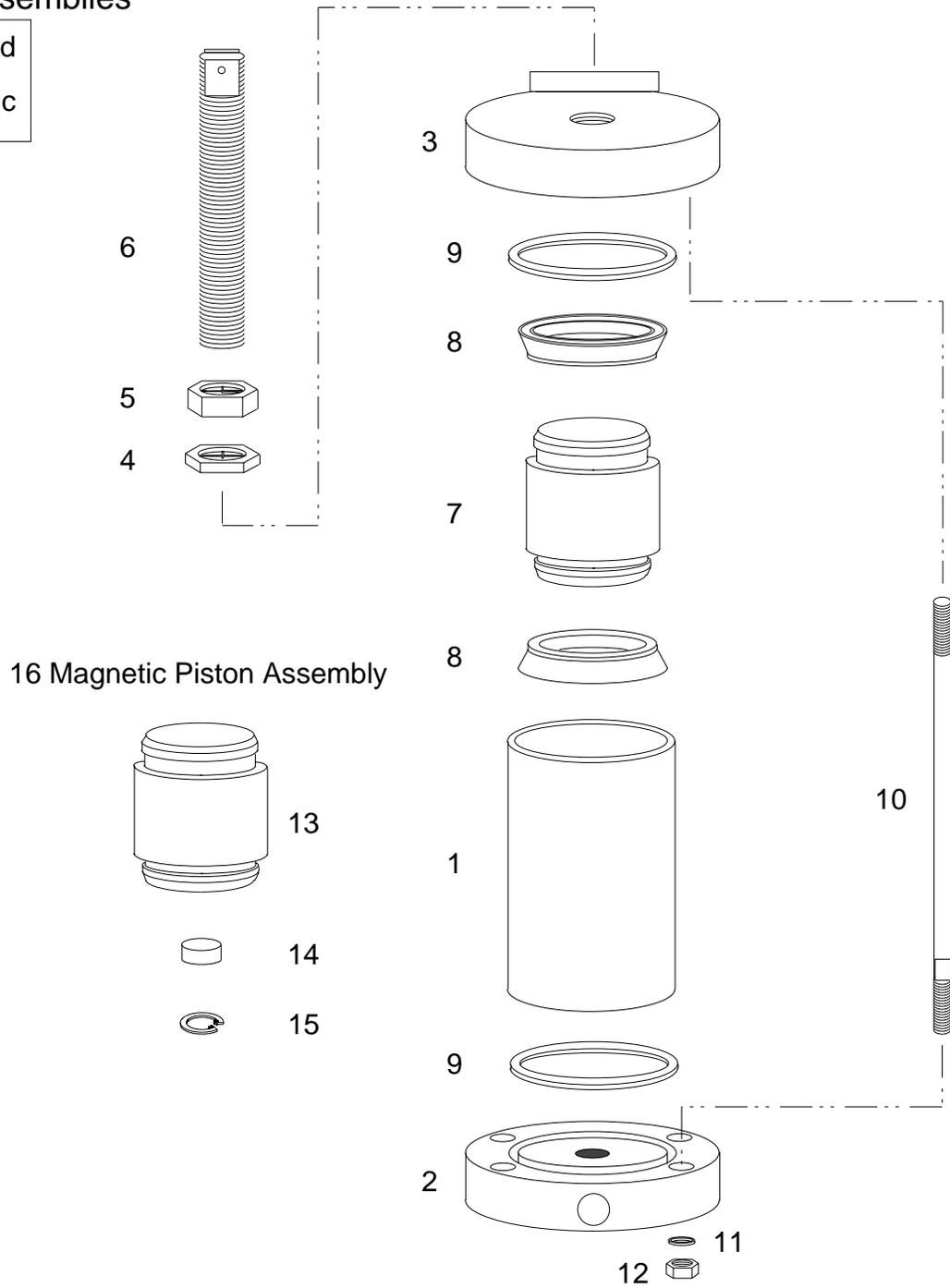
Tube Fittings - Hardware Parts

Part ID	Description	EI-0755-1	Injector Model	
			EI-1255-1 EI-1256-1	EI-2005 EI-2007-1 EI-2008-1
1	Ball Valves(Inlet & Outlet Ports)	10-00735	10-00735	10-00740
2	Ball valve mounting block	10-00760	10-00762	10-00764
3	J-Bolt	10-00180	10-00180	10-00180
4	1/4" SS flat washer	10-00190	10-00190	10-00190
5	1/4" SS lock washer	10-00200	10-00200	10-00200
6	1/4 - 20 SS nut	10-00030	10-00030	10-00030
7	Fitting, Ball valve to Filter	10-00270	10-00270	10-00570
8	Tube fitting, Tee	10-00240	10-00240	10-00540
9	Tube fitting, Solenoid (#2 port)	10-00250	10-00250	10-00250
10	Tube fitting, Solenoid (#3 port)	10-00280	10-00280	10-00280
11	Tube fitting, Solenoid (#1 port)	10-00280	10-00280	10-00280
12	Tube fitting, Manifold	10-00220	10-00220	10-00220
13	Tube fitting, Manifold	10-00250	10-00250	10-00230
14	Tube fitting, Manifold	10-00250	10-00250	10-00521
15	Tube fitting adapter (long)	10-00290	10-00290	10-00590
16	Tube fitting, Spool valve	10-00260	10-00260	10-00560
17	Tru-seal nut	10-00450	10-00450	10-00450
18	Tube fitting adapter (short)	10-00291	10-00291	10-00590
19	Tube fitting, Spool valve	10-00280	10-00280	10-00280
20	Tube fitting, Cylinder (top)	10-00230	10-00230	10-00521
21	Tube fitting, Cylinder (bottom)	10-00220	10-00220	10-00522
22	Tube fitting, Manifold	10-00230	10-00230	10-00521
23	Tube fitting, Test valve	10-00230	10-00230	10-00521
24	Fitting, Ball valve to Check valve	10-00270	10-00270	10-00570
25	Fitting, Check valve to Manifold	10-00270	10-00270	10-00270
26	Manifold Block	10-00170	10-00170	10-00720
27	Label, Model/Serial Number	10-00300	10-00300	10-00300
27a	Label, Check Valve	10-00350	10-00350	10-00350
27b	Label, Filter	10-00340	10-00340	10-00340
27c	Label, Inlet	10-00310	10-00310	10-00310
27d	Label, Outlet	10-00320	10-00320	10-00320
27e	Label, Test	10-00330	10-00330	10-00330
28	Panel, Mounting	10-00010	10-00010	10-00020
29	1/4 - 20 x 1" SS bolt	10-00217	10-00217	10-00217
30	1/4 - 20 x 1/2" SS bolt	10-00215	10-00215	10-00215
31	Ball Valve (Test Port)	10-00740	10-00740	10-00740

Gate-Pak Cylinder Assembly

* Complete Assemblies

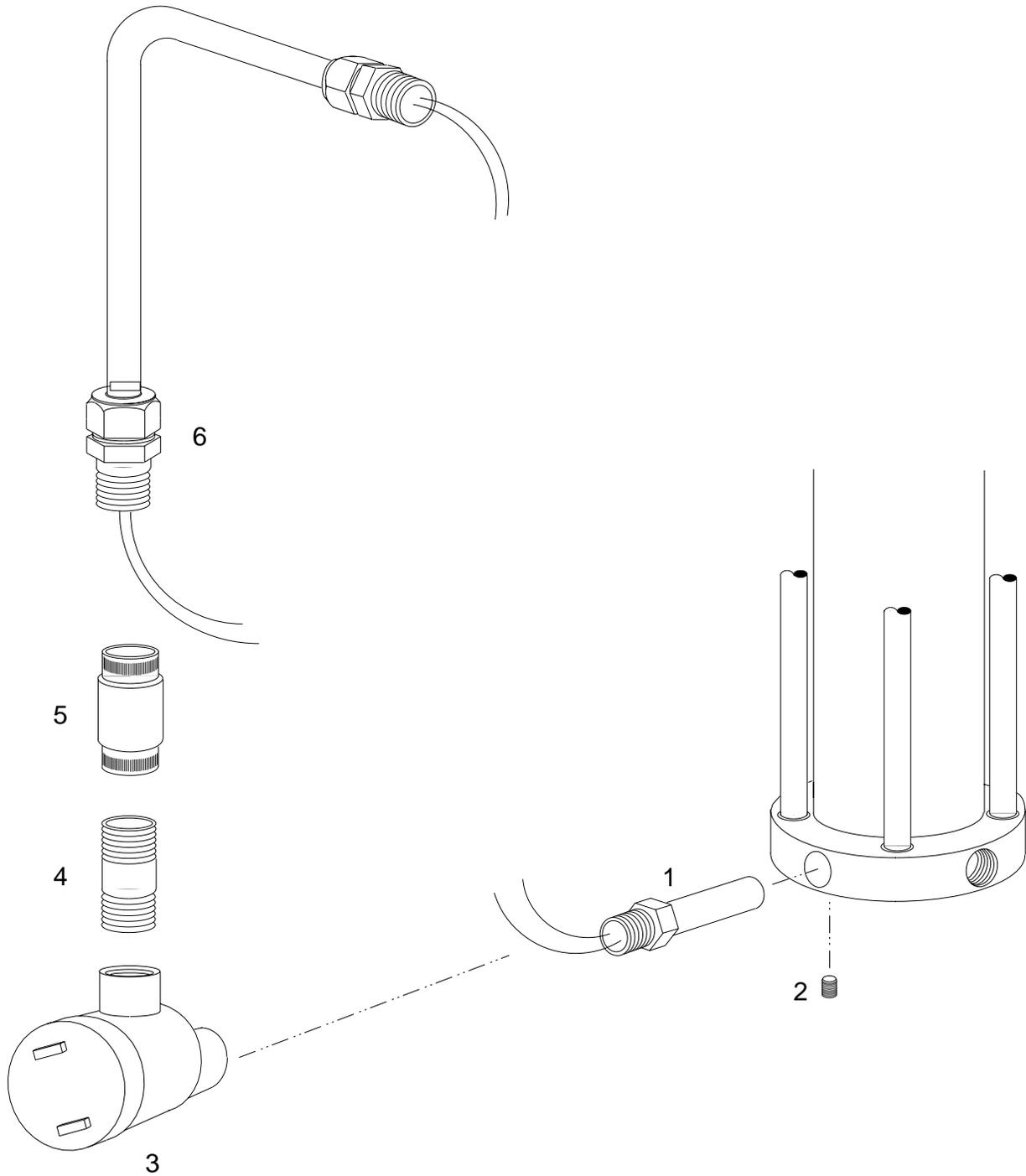
17- Standard
18- Magnetic



Cylinder Assembly Parts

<i>Part ID</i>	<i>Description</i>	<i>EI - 0755</i>	<i>EI - 1255/6</i>	<i>EI - 2005/7/8</i>
1	Cylinder - 5 inch length	10-00380	10-00630	10-00737
	- 6 inch		10-00620	
	- 7 inch			10-00739
	- 8 inch			10-00745
2	Bottom end cap	10-00416	10-00651	10-00765
3	Top end cap	10-00390	10-00640	10-00750
4	Adjustment stem seal nut	10-00450	10-00450	10-00810
5	Adjustment stem lock nut	10-00455	10-00455	10-00820
6	Adjustment stem-5 inch cylinder	10-00690	10-00690	10-00795
	- 6 inch		10-00700	
	- 7 inch			10-00800
	- 8 inch			10-00805
7	Piston	10-00410	10-00660	10-00770
8	Piston seals	10-00420	10-00670	10-00780
9	End cap gasket	10-00430	10-00680	10-00790
10	Connecting rod - 5 inch cylinder	10-00370	10-00370	10-00733
	- 6 inch cylinder		10-00620	
	- 7 inch cylinder			10-00739
	- 8 inch cylinder			10-00745
11	1/4" lock washer	10-00200	10-00200	10-00200
12	1/4-20 silicone bronze nut	10-00460	10-00460	10-00460
13	Piston, button magnet	10-00411	10-00661	10-00771
14	Magnet, button	10-00412	10-00951	10-00951
15	Retaining ring, button magnet	10-00413	10-01011	10-01011
16	Magnetic piston assembly	10-01045	10-01055	10-01065
17	Cylinder assembly -5 inch length	10-03505	10-03515	10-03535
	- 6 inch		10-03525	
	- 7 inch			10-03545
	- 8 inch			10-03555
	Piston plunger tool (not shown)	10-00830		
	Piston guide tool (not shown)	10-00840	10-00850	Not Required

Piston Switch Assembly



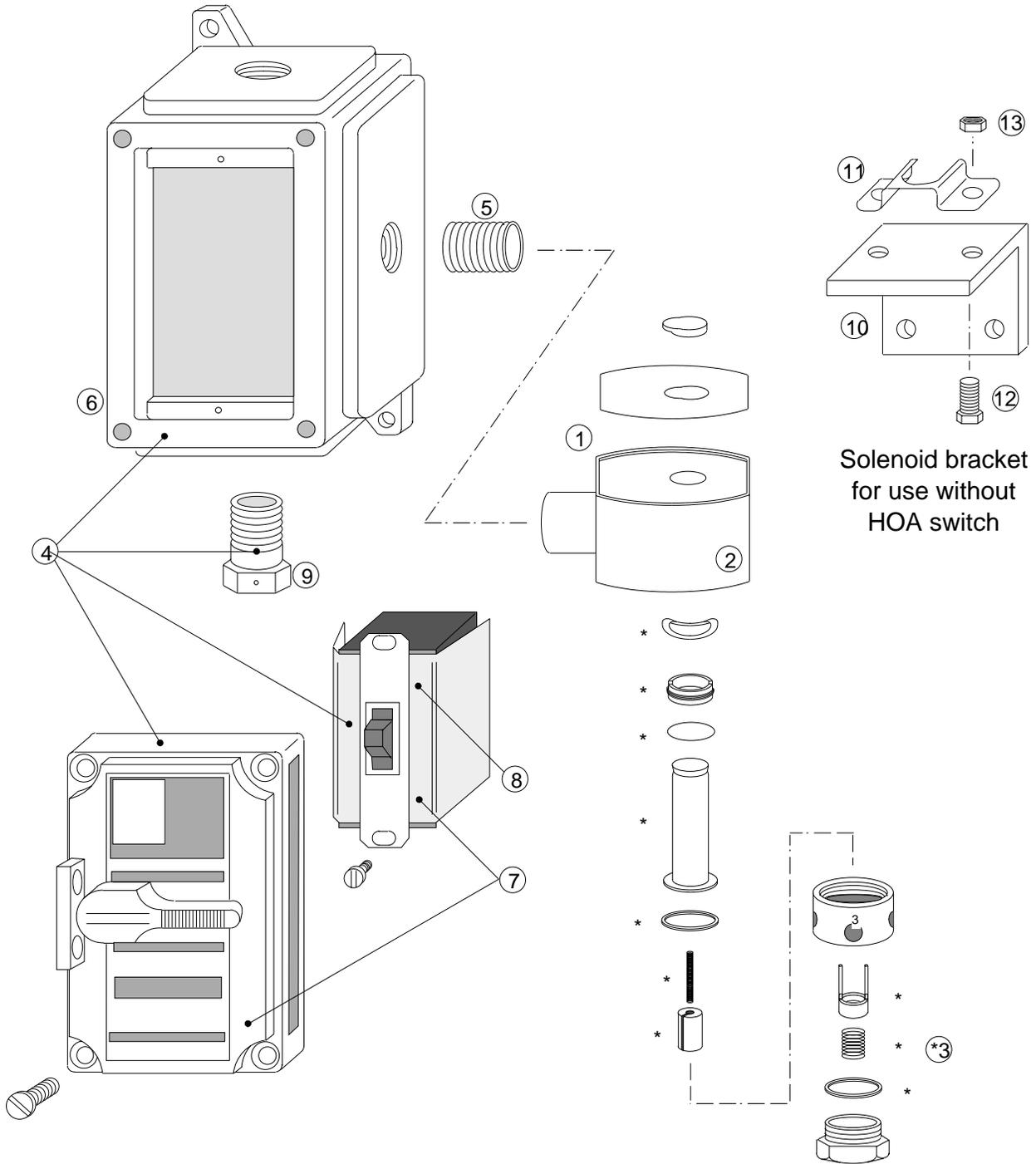
Piston Switch Assembly Parts

<i>Part ID</i>	<i>Description</i>	<i>Injector Model</i>		
		<i>EI - 0755</i>	<i>EI - 1255/6</i>	<i>EI - 2005/7/8</i>
1	Piston switch, button magnet	10-01101	10-01101	10-01102
2	Set screw	10-01103	10-01103	10-01104
3	Piston switch J-box	10-01170	10-01170	10-01170
4	J-box to slip union nipple	10-01180	10-01180	10-01180
5	Slip union	10-01190	10-01190	10-01190
6	MI cable	10-01200	10-01200	10-01200
7*	Gate-Tek 5 module, plug in, (120 VAC)	10-01255	10-01255	10-01255
	Gate-Tek 5 module, plug in, (240 VAC)	10-01256	10-01256	10-01256
	Gate-Tek 5 circuit board	10-01300	10-01300	10-01300
8*	Base Socket- Gate-Tek/PDC module plug in	10-01257	10-01257	10-01257
9*	PDC-21 module(120 VAC)	10-01433	10-01433	10-01433
	PDC-21 module(240 VAC)	10-01436	10-01436	10-01436
10*	PDC-22 module (120 VAC)	10-01440	10-01440	10-01440
	PDC-22 module (240 VAC)	10-01445	10-01445	10-01445
11*	PG-26 module (120 VAC)	10-01450	10-01450	10-01450
12*	PG-26 module (240 VAC)	10-01455	10-01455	10-01455
13*	PDC-23 (120 VAC)	10-01447	10-01447	10-01447
	PDC-23 (240 VAC)	10-01448	10-01448	10-01448

**Indicates an item not shown*

As of June 1, 1994 all Gate-Pak® electronic modules will be supplied in the plug-in module design. Earlier obsolete units may require the base socket (item 8 - PN 10-01257)when replacing existing field units.

Solenoid Assembly

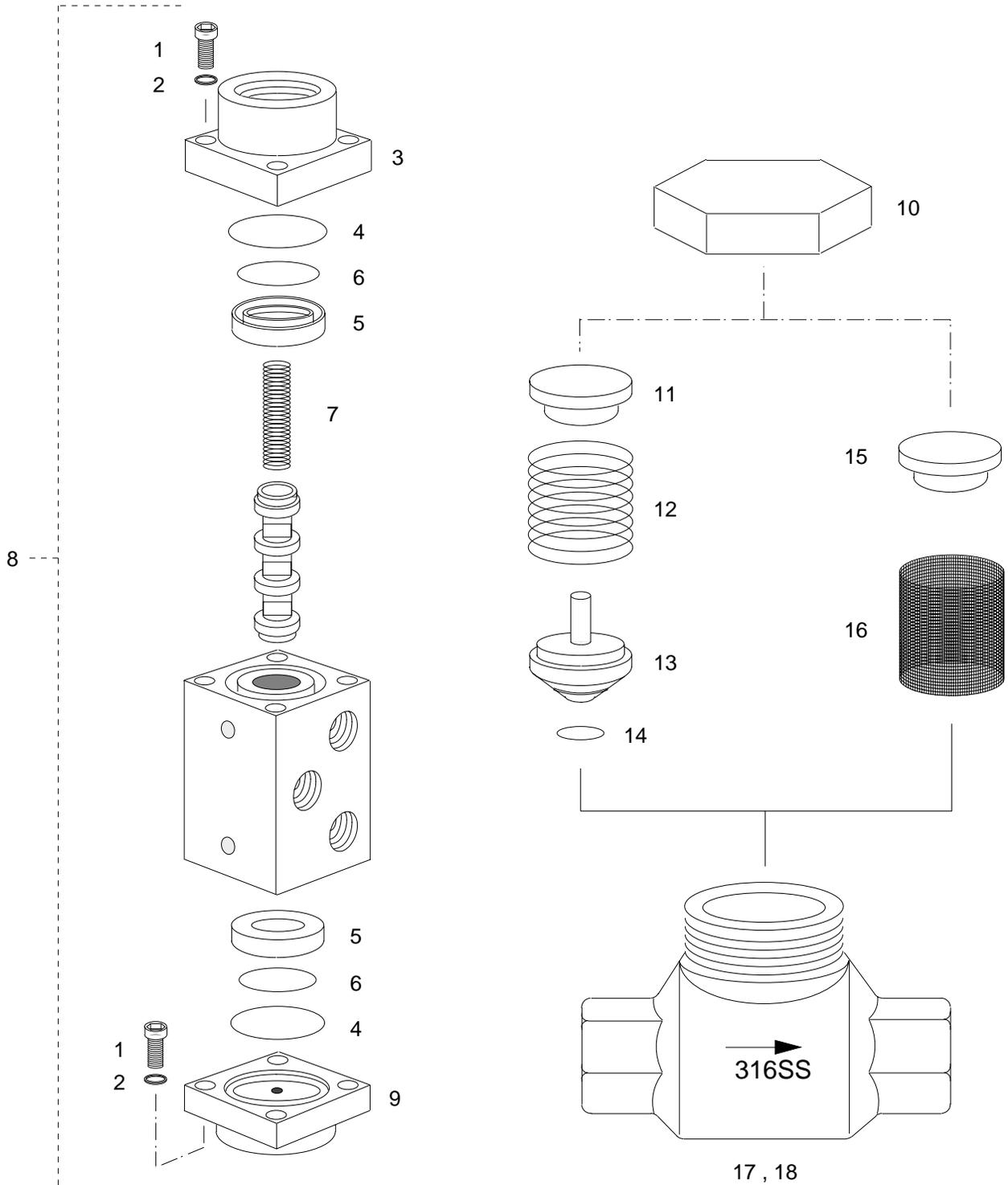


Solenoid Assembly Parts

<i>Part ID</i>	<i>Description</i>	<i>Part Number</i>
1	Solenoid Assembly (Black Body)	10-00161
	Solenoid Assembly (Green Body)	10-00160
2	Solenoid Coil - 120 VAC(Black Body)	10-00163
	Solenoid Coil - 120 VAC(Green Body)	10-00162
	Solenoid Coil - 240 VAC(Black Body)	10-00165
	Solenoid Coil - 240 VAC(Green Body)	10-00164
3	Solenoid Repair Kit(Black Body)	10-00167
	Solenoid Repair Kit(Green Body)	10-00166
4	HOA Switch Assembly (Items 14, 8, 9, 6)	10-00495
5	1/2" Nipple Galvanized	10-00500
6	Enclosure, Explosionproof	10-00490
7	Cover and switch assembly	10-00480
8	HOA switch only	10-00470
9	Breather/Drain valve	10-00860
10	Solenoid mount bracket	10-00870
11	Solenoid mount	10-00880
12	Solenoid mount bolt	10-00210
13	Solenoid mount nut	10-00030
14	Cover only	10-00485

All Gate-Pak® Injectors manufactured after June 1, 1993 use the Asco Red Hat II solenoid which uses the molded coil (black body). Gate-Pak Injectors all use the same size solenoid (in either the Green or Black body).

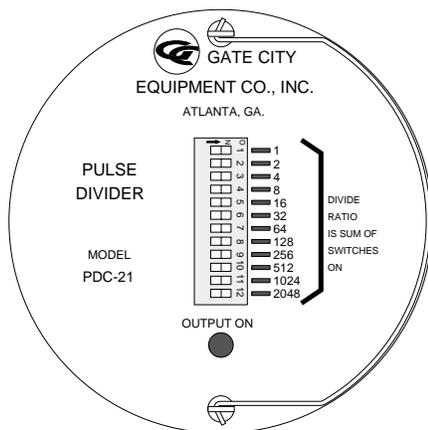
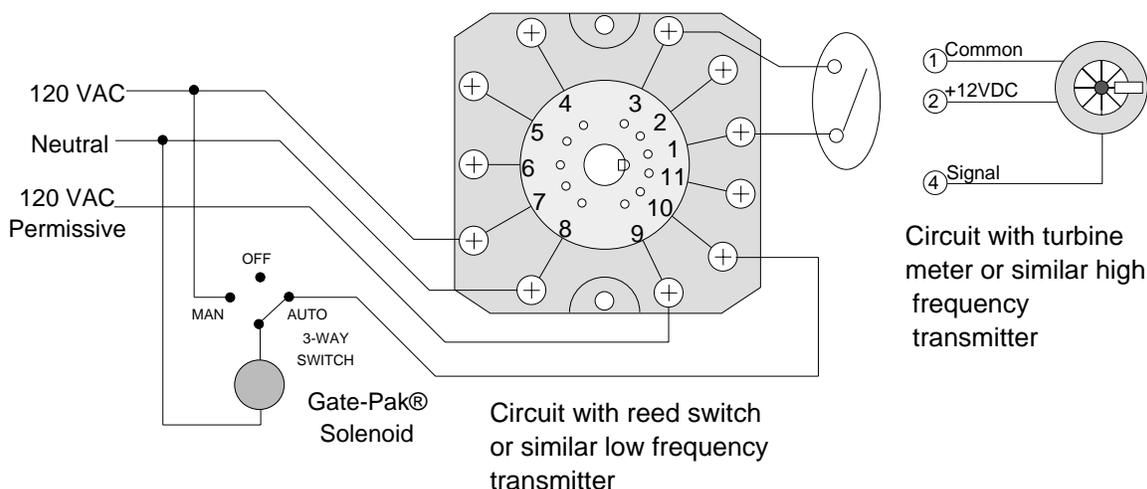
Spool Valve - Check Valve - Strainer Parts



Spool Valve - Check Valve - Strainer Parts List

<i>Part ID</i>	<i>Description</i>	<u>Injector Model</u>		
		<i>EI - 0755</i>	<i>EI - 1255/6</i>	<i>EI - 2005/6/7</i>
1	Socket head screw	10-00131	10-00131	10-00131
2	Lock washer	10-00132	10-00132	10-00132
3	Top end cap	10-00133	10-00133	10-00133
4	Large "O" ring - Teflon	10-00129	10-00129	10-00129
5	"O" ring sleeve	10-00135	10-00135	10-00135
6	Small "O" ring - Teflon	10-00139	10-00139	10-00139
7	Spring	10-00137	10-00137	10-00137
8	Spool valve assembly	10-00140	10-00140	10-00140
9	Bottom end cap	10-00138	10-00138	10-00138
10	Check/Strainer top	10-00090	10-00090	10-00090
11	Check valve guide and seal cap	10-00100	10-00100	10-00100
12	Check valve spring	10-00130	10-00130	10-00130
13	Check valve poppet	10-00110	10-00110	10-00110
14	Check valve "O" ring - Teflon Encapsulated	10-00120	10-00120	10-00120
15	Strainer seal cap	10-00080	10-00080	10-00080
16	Strainer basket	10-00070	10-00070	10-00070
17	Strainer housing	10-00050	10-00050	10-00050
18	Check housing	10-00060	10-00060	10-00060
19	Strainer assembly	10-02000	10-02000	10-02000
20	Check assembly	10-03000	10-03000	10-03000

PDC-21 Pulse Divide Circuit



Switches	
No.	Divisor
A 1	1
2	2
3	4
4	8
5	16
6	32
B 1	64
2	128
3	256
4	512
5	1024
6	2048

Divide Example:

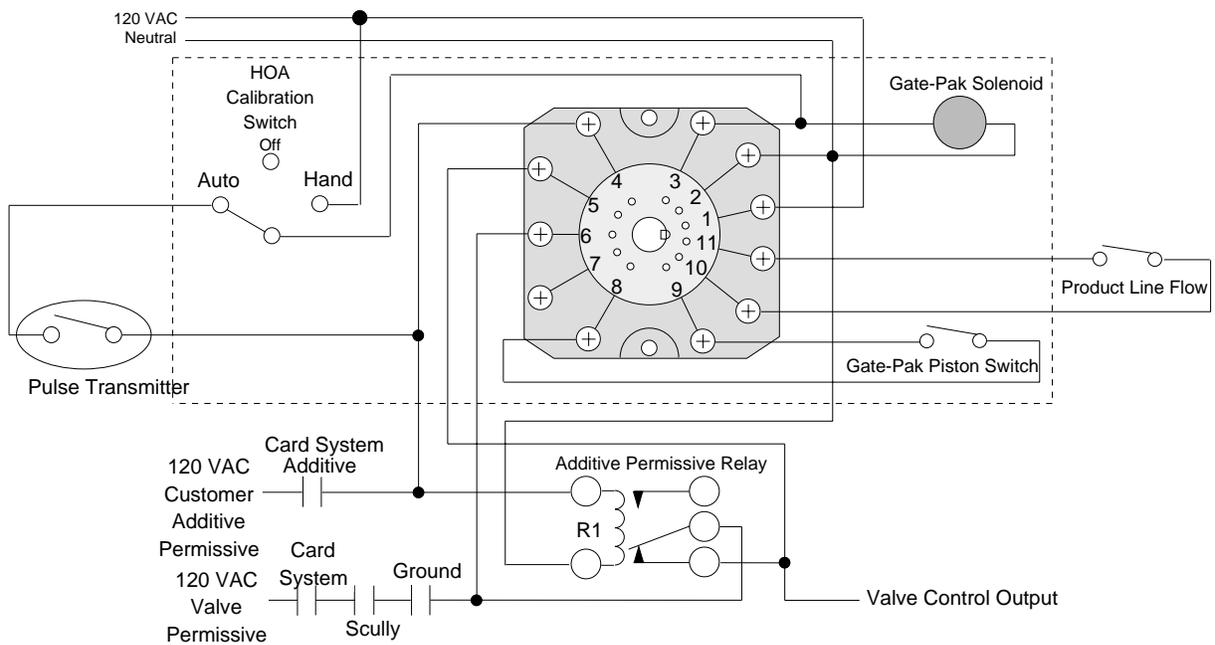
To get 1 output pulse for every 40 input pulses turn on switches 6A & 4A.

$$\begin{aligned} 6A - 32 \\ 4A - 8 \\ \hline 40 \end{aligned}$$

Installation Instructions

1. Do not apply external power to TB-1 thru TB-4.
2. TB-7 and TB-8 are internal power and must be 110 VAC.
3. TB-9 is the permissive power input.
4. TB-10 is the switched Triac output which may be 10 VAC to 250 VAC max. 8 amps.
5. TB-1 and TB-2 are internal power for transmitters if needed.
6. TB-3 is input from pulse transmitter switch. Max. of 100 pulses per second.
7. TB-4 is input from turbine meter or high frequency transmitter. Max. 5000 pulses per second.
8. Do not use both input 3 and input 4 at the same time.
9. Electronic circuitry is completely isolated from the case.
10. TB-5 and TB-6 is a dry reed switch contact closure equal to the input.
Example: 1 pulse per gallon input on terminals 1 & 3, terminals 5 & 6 will give 1 pulse per gallon output for a data system or other use. Max. power is 3 watts.
11. For DC wiring use shielded cable, grounded to terminal TB-1.

Gate-Tek®5 Plug-In Module Wiring



Electrical Connections

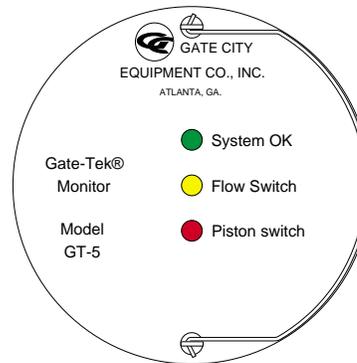
- TB1 120 VAC
- TB2 Neutral
- TB3 Gate-Pak Solenoid-output/pulse Transmitter Input
- TB4 Reset
- TB5 Permissive Release Contact Normally Open
- TB6 Permissive Common
- TB7 Permissive Release Contact Normally Open

- TB8 Piston Switch
- TB9 Piston Switch Common
- TB10 Line Flow Switch
- TB11 Line Flow Switch Common

Installation Note: All components within the dashed lines are Gate-Pak mounted. The pulse transmitter, line flow switch, and the additive permissive relay supplied by customer.

*TB5 and TB7 are switched Triac outputs which may be 10 VAC to 250 VAC, 8 amps with a minimum of 5 watts.

Gate Tek-5 Module



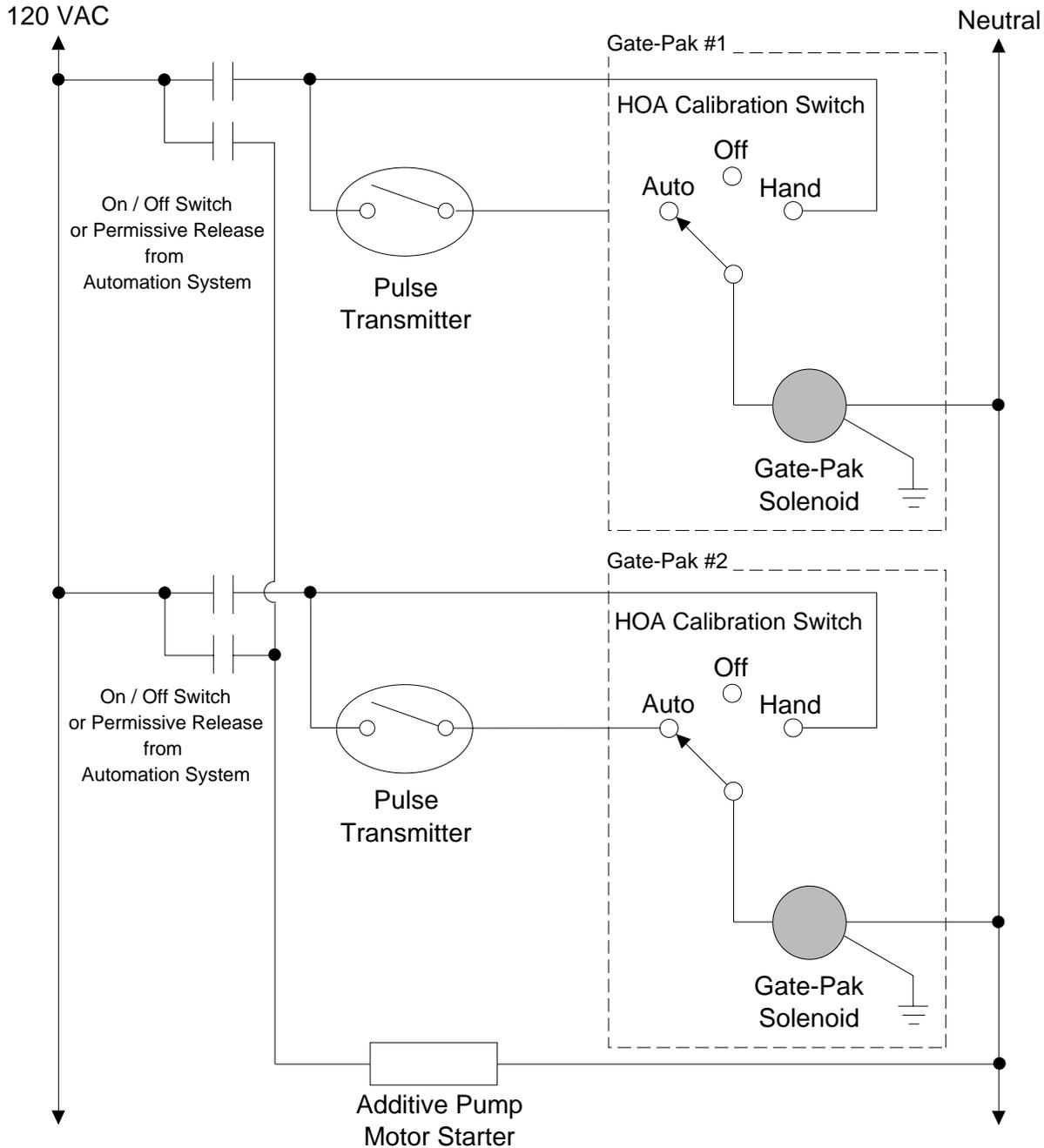
LED Indicators

Green - When on system is in a permissive condition.

Red - Goes on when the piston switch is closed. During normal operation the LED will go on and off at the same rate as the pulse input.

Amber - Comes on when the line flow switch closes.

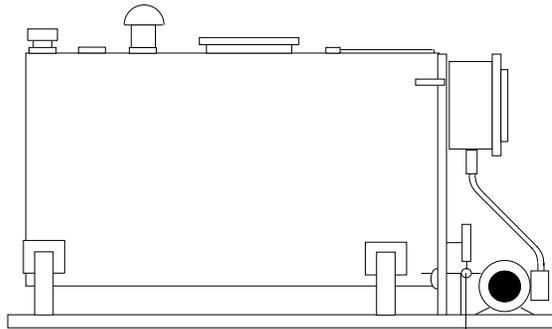
Typical Wiring for Gate-Pak® Injector with 3-Way Switch



Note 1: Manual input on HOA (Hand-Off-Auto) three-way switch may be wired to 120/240 VAC continuous for Gate-Pak manual operation (calibration) without requiring a system permissive. Wired as shown would require a system permissive to manually operate any Gate-Paks.

Note 2: The signal for the chemical pump should only go to the motor starter coil, and not directly to the motor.

Typical Additive System Layout

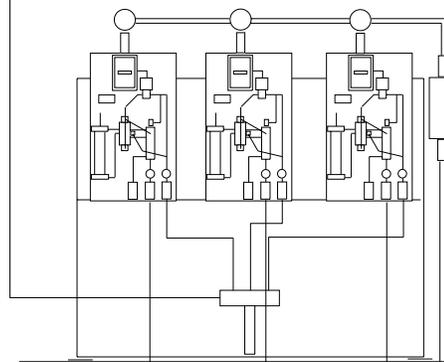


Additive tank assembly complete with pump and motor, motor starter, pump by-pass and pressure gauge.

Additive supply line to Gate-Paks.

Rack Mounted Gate-Paks(optional)
Mounting of Gate-Paks may be by customer at the load rack.

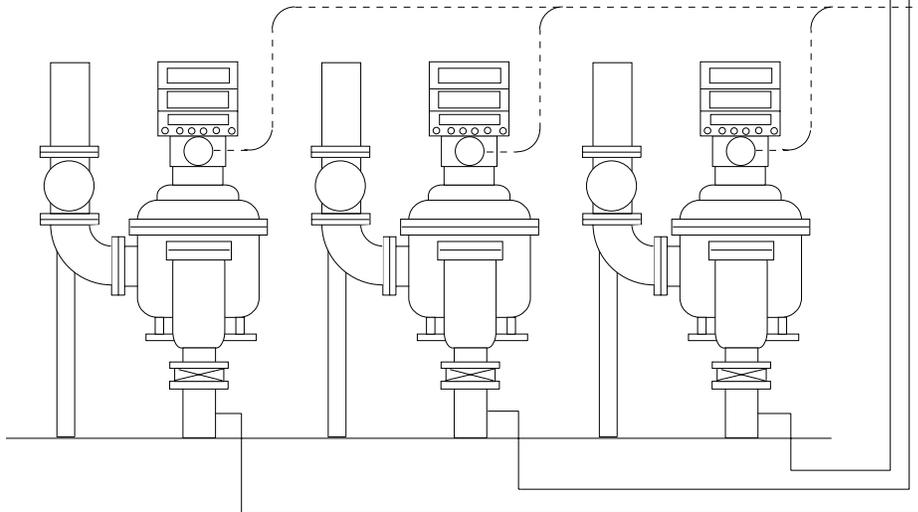
Additive supply lines to and from the Gate-Paks may be above or below the grade.



See typical additive rack dimensional drawing.

Electrical connection diagrams per system design.

Typical Load Rack Arrangement

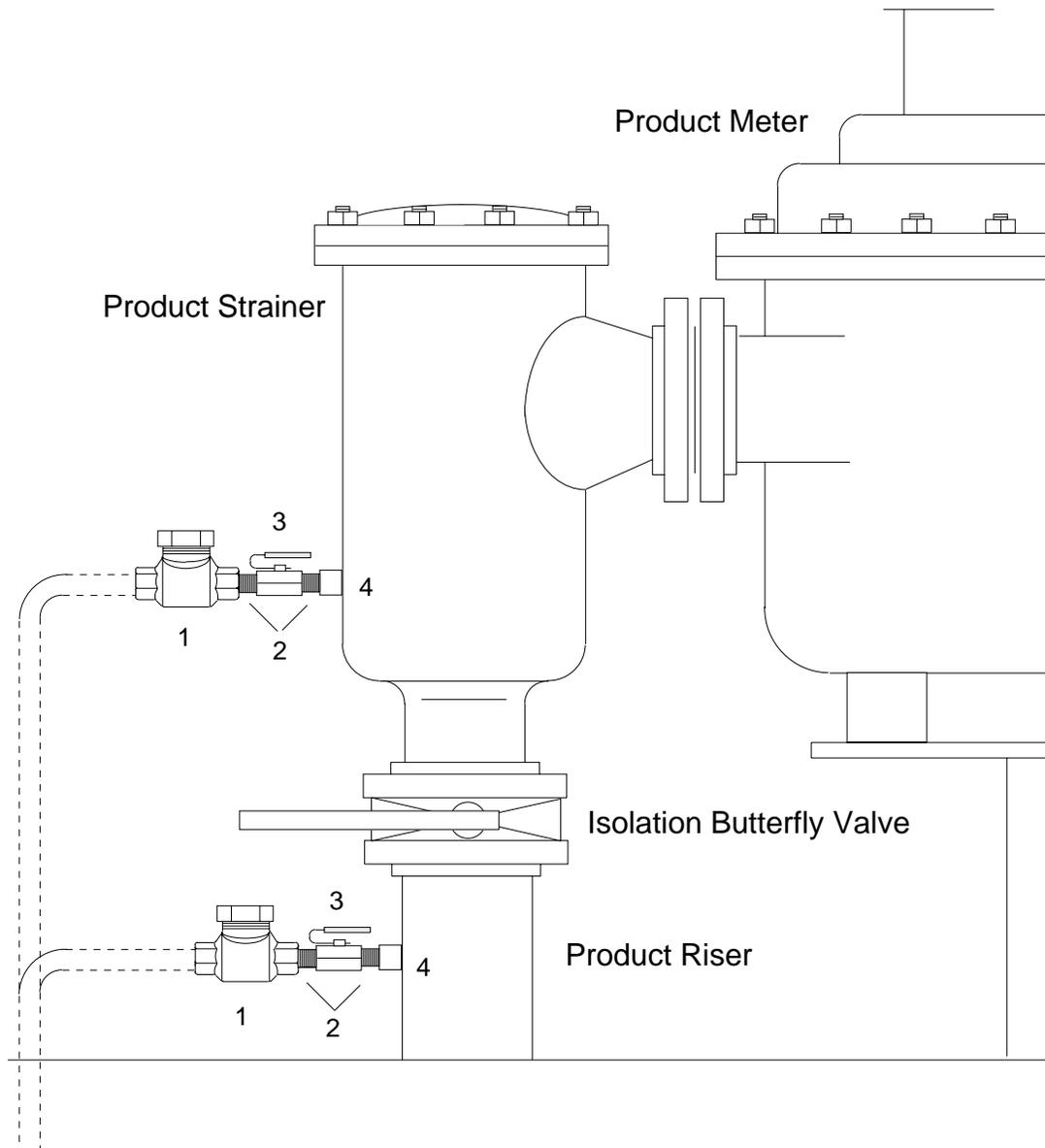


Transmitter Signals

Additive supply lines from Gate-Paks.

See points of injection for line connections.

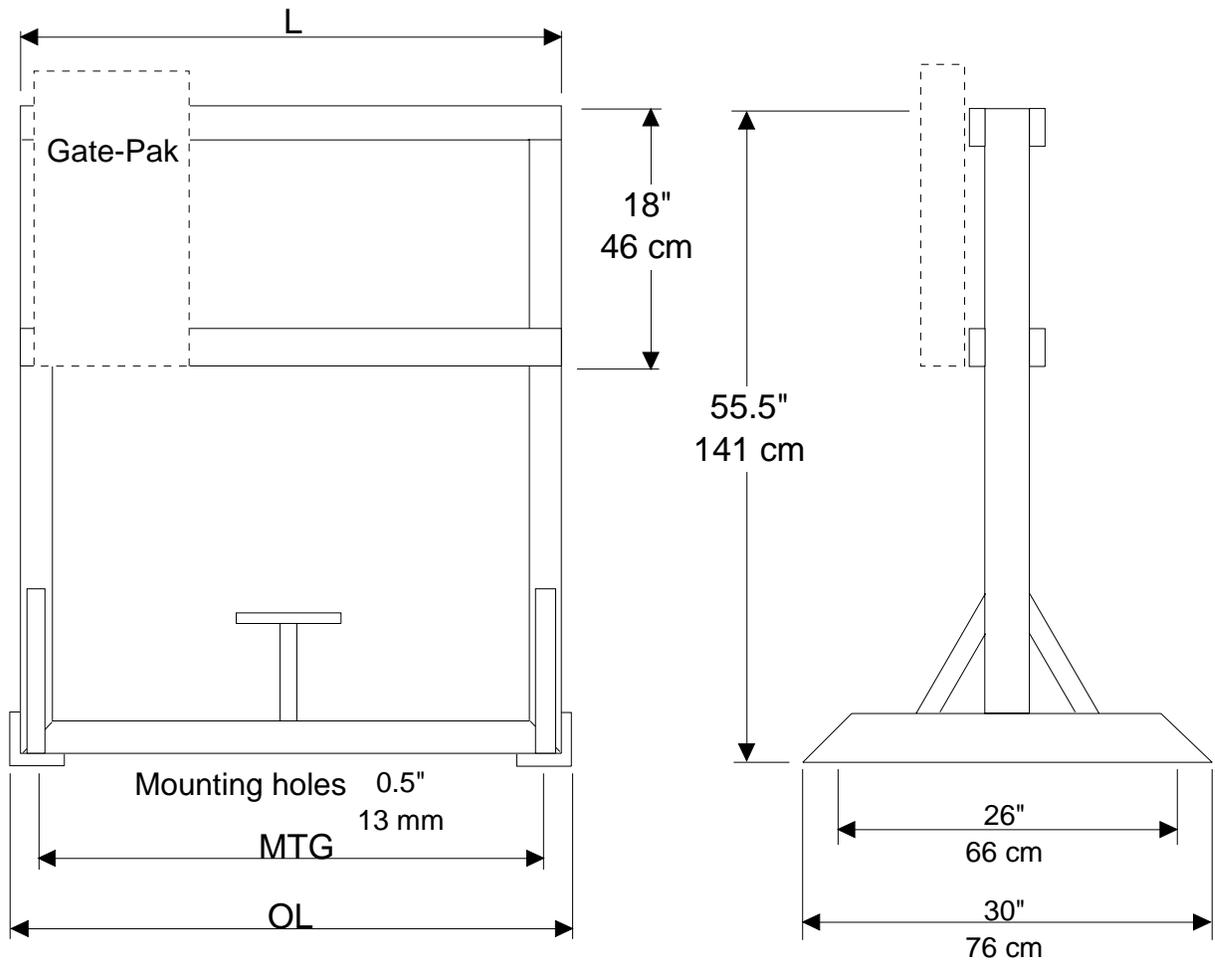
Typical Injection Points



Parts Description

- 1 - Check Valve (Lubrizol Performance Systems part number 10-03000)
- 2 - Pipe Nipple 1/2" Sch 80 X 1-1/2"
- 3 - 1/2" Ball Valve (Lubrizol Performance Systems part number 10-20090)
- 4 - 1/2" 2000# 1/2 Coupling (weld in place at injection point)

Typical Gate-Pak® Mounting Rack



Size	L	OL	MTG
4 Unit	30" 76 cm	30.5" 77 cm	26" 66 cm
6 Unit	45" 114 cm	45.5" 116 cm	41" 104 cm

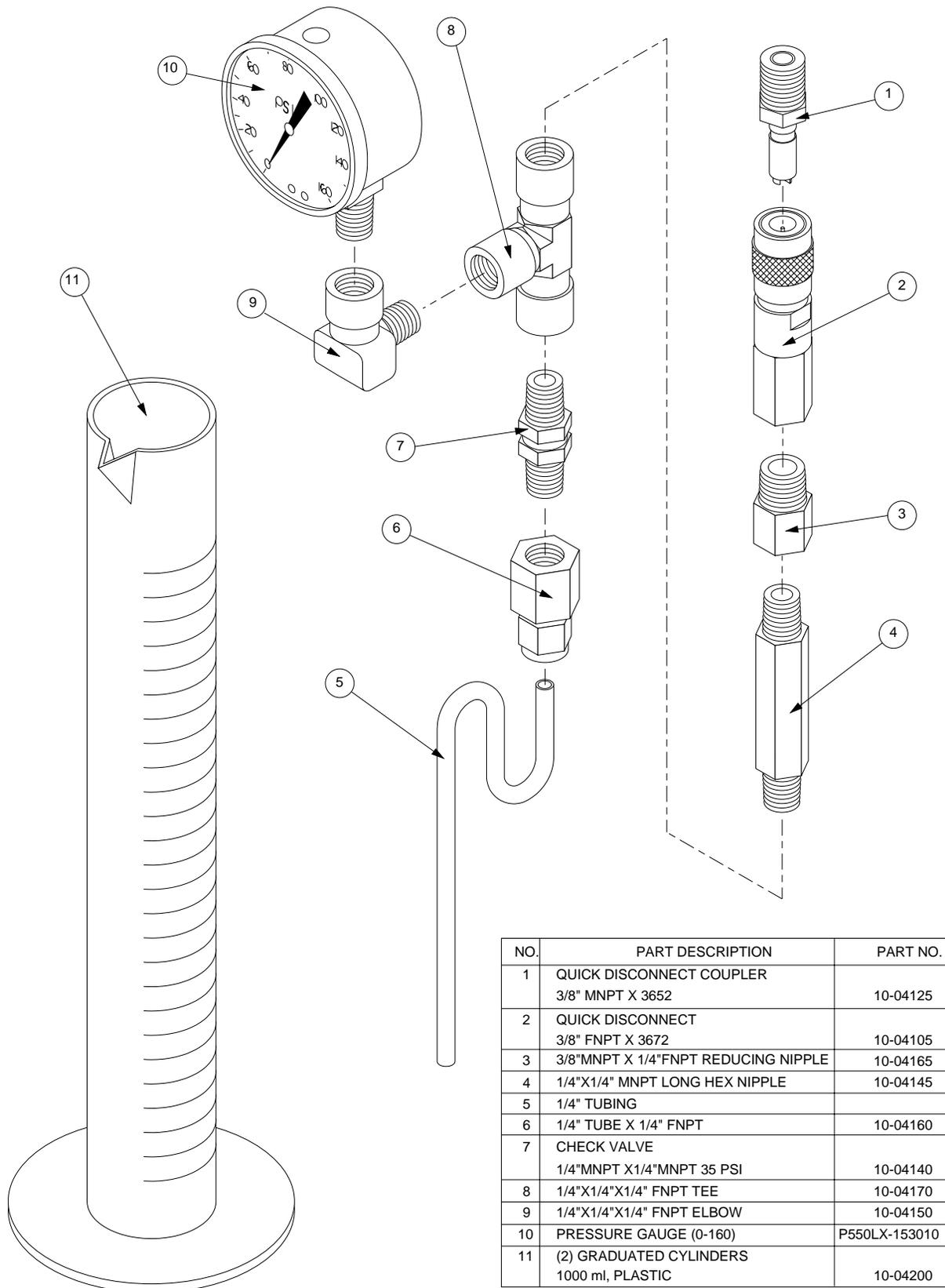
Consult factory for :

Special Applications

Electrical Arrangements

Additive Supply Inlets / Outlets

Gate-Pak® Calibration Test Kit



Additive System Maintenance Procedure

The overall system should be taken into account during maintenance routines not just the individual injector. The system includes the following:

- a) Storage vessel.
- b) Pump suction line from storage vessel.
- c) Additive supply pump(s).
- d) Additive supply line(s) from pump(s) to individual injectors.
- e) Individual additive injectors.
- f) Additive injection lines from individual injectors to specific product lines.
- g) Injection points in the product lines.
- h) Control circuits, to activate the particular additive system.
- i) Permissive circuits to activate the additive control circuits.
- j) Permissive data in customer automation system cards, to properly activate the additive system.
- k) Product meter transmitter outputs, providing 50% duty cycle pulse.
 - i) From mechanical PD meter outputs.
 - ii) From electronic set-stop controllers.
- l) Electrical wiring from individual product meter transmitter pulse source to the specific injector.

Failure of any of these parts can result in failure to properly inject the proper amount of additive into the proper product stream.

On initial installation, inspection should be done to assure that the additive piping from a particular injector to a specific product is connected with the specific product pulse signal.

- a) Inspect piping from injector to injection point on product line, if possible.
- b) Assure that any “hot tap” connections are complete, including removal of the “coupon” for final connection to the product stream.
- c) If visual inspection of piping is not possible, consider a check by opening the additive line at the injection point to assure proper injection to product.
- d) Check the electrical connections by having one truck load a specific volume of one product at a time.
 - i) If the automation card is properly programmed, the additive system will be energized.
 - ii) To check for proper product pulse to injector: Close injector OUTLET valve and accumulate additive through open TEST valve into calibrated cylinder. This will assure electrical connection to specific injector, and verify calibration.
 - iii) To check total injection system for the particular injector, and possibly as a last resort, open the injection line at the injection point, and repeat the above.
- e) Repeat Step d) for each product and each loading position.

Additive System Maintenance Schedule

Description	Frequency
Check additive storage tank level.	By policy, and when pump noise is greatly increased, or the system pressure is below normal.
Observe additive supply pump pressure and sound.	On initial start-up, for reference, and on routine (daily) tank farm/rack walk-through.
Adjust additive system by-pass pressure valve.	When pump pressure is significantly lower than normal, and pump sound is normal.
Remove, inspect, and clean pump suction strainer.	When pump pressure is significantly lower than normal (initial), or pump noise is greatly increased.
Observe Gate-Pak for leaks.	On routine (daily) tank farm/rack walk-through.
Observe Injector operation, by sound and touch.	On initial start-up, for reference, and on routine rack walk-through.
Test unit.	By policy as a minimum, and anytime unit operation is questioned.
Calibrate individual unit.	By policy as a minimum, and anytime output of individual unit is questioned.
Calibrate additive system, with trucks.	By policy, and anytime the total output of the system is questioned.
Lubricate pump. a) Pump fitted with lubrication fitting for shaft b) Use a good grade of bearing grease. c) Do not over lubricate?	Periodically.
Lubricate pump motor, (with lubricating plugs). Procedure: a) Stop motor. b) If in a hazardous location, purge area of hazardous atmosphere or particles. c) Wipe clean all grease fittings (Filler and drain.) d) Remove filler and drain plugs. e) Free drain hole of any hard grease (use piece of wire if necessary. f) Add grease using a low pressure grease gun. Use grease equivalent to Chevron SRI-2 for motor bearings. Fill the cavity to 1/3 to 1/2 full through the lubricating provisions on the bell housing. Do not over lubricate! g) EXCEPT for hazardous locations, start motor and let it run for approximately 30 minutes with drain plug removed. For hazardous location motors, motors are not to be run without plugs when in presence of hazardous atmosphere. h) Stop motor, wipe off any drained grease, and replace filler and drain plugs. i) Motor is ready for operation.	Annually.

Individual Gate-Pak® Injector Test Procedure

NOTE: OVERALL CONDITION OF ADDITIVE SYSTEM SHOULD BE OBSERVED PRIOR TO THIS PROCEDURE.

The following statement should be followed whenever a line or valve is opened to atmosphere. It will not be repeated for each application.

TAKE APPROPRIATE SAFETY PRECAUTIONS FOR HANDLING THE ADDITIVE AND OPENING A PRESSURIZED SYSTEM.

<u>Step</u>	<u>Description</u>
1.	Start additive supply pump by placing pump motor controller HOA switch in Hand position. Observe pump operation for normal operation. a) Pump sound. b) Pump discharge pressure. c) Leaks.
2.	Make sure electrical power is ON to the injector system to be tested.
3.	Turn HOA switch to OFF (handle center position).
4.	Close INLET valve.
5.	Connect Calibration Test device, if so fitted, and place container under TEST valve, or Test device outlet. a) Open TEST valve. b) Some additive may be discharged, but any flow should stop. c) If flow continues, close OUTLET valve; flow should stop. This indicates the unit check valve and the injection point check valve, if so equipped, are leaking. d) Close TEST valve. e) Repair check valve(s), and repeat test.
6.	Close OUTLET valve.
7.	Open INLET valve.
8.	With container under valve, open TEST valve. I. If flow occurs beyond an initial spurt and line drainage, one or more part(s) of the injector are failing. Turn HOA switch to HAND (handle down position) and then OFF (center position), to cycle the unit. If the flow continues, proceed to Step 8 IA. A) Solenoid valve , which has an upper and lower seat. It can leak if foreign matter gets into either seat. See page 18, Item 3, for an exploded view of the valve seals. a) The lower seal can be inspected without removing tubing and fittings. This is accomplished by removing the large hex nut/plug on the bottom of the valve.

There are small springs in the lower and upper assemblies; be careful not to lose either of them.

The seal is between the legs of the “milk stool”, and seats in the center. The opening that is sealed is circular, and will leave a slight indentation in the seal. On inspection, you may find foreign material, or a mark in the seat that allows leak-by. If so, install a repair kit. If the seal appears to be satisfactory, proceed to the next step.

b) **The upper seal** can be inspected by removing the connected tubing pieces, and unscrewing the valve from the mounting. Make the same inspection as a) above. Be careful when replacing the valve that the port numbers are upright, and in the proper sequence.

B) **Cylinder piston seal.** You can trouble-shoot and determine whether the upper or lower seal is leaking by, but if one seal is leaking, you should replace both seals.

To access the piston and seals:

- a) Loosen tubing fitting, Item #20 and 21 on Page 12.
- b) Remove tubing between these fittings.
- c) Remove nuts from cylinder rods.
- d) Remove mounting bolt, Item #30, Page 12.
- e) Remove cylinder.
- f) Push piston from cylinder.
- g) Replace piston seals. Be sure the shiny spring on the seal is facing **away** from the piston body.
- h) Using the Piston Guide Tool, install the piston into the cylinder.
- i) Reverse the removal procedure to assemble the unit.

C) **Four way spool valve.** The spool valve has no dynamic seals; the seal is provided by the clearance between the spool and body, in the range of 50 millionths of an inch. The spool and body are mated, and if the valve leaks by, it must be replaced. The material of construction is a hardened grade of stainless steel, and failure is very rare.

If the spool valve is replaced, be sure to use the sealing nuts on the body tubing fittings. The fittings will not seal into the body, and any attempt to do so may distort the body, causing the spool to bind.

THE ABOVE ITEMS SHOULD CURE ANY LEAK-BY.

9. With container under valve, and TEST valve open, turn HOA switch to ON position.

I. Flow should discharge in a spurt, and then stop. If no flow occurs, check the following :

A. **Pump** should be operating normally, with normal system pressure indicated.

- a) Pump not running; turn pump motor controller HOA switch to HAND.
- b) Pump running, but making unusual noise.
 - i) Check additive storage tank for sufficient level.
 - ii) Inspect pump suction strainer; clean as necessary and replace.
- c) Pump pressure is low.
 - i) Check that pressure gauge is functional.
 - ii) Adjust system pressure by-pass valve to restore pressure to normal.

- B. **Solenoid valve** may not be functional.
- a) Expect “clicking” sound of solenoid plunger striking stop when HOA switch is turned to HAND.
 - b) If no sound, check that power to HOA switch is energized, either from automation system, or independent circuit.
 - c) If power is available and you still have no indication of solenoid valve operation, replace solenoid coil. See Page 18 for exploded view of valve.
- C. **Inlet strainer** may be plugged.
- a) Close INLET valve.
 - b) Open TEST valve.
 - c) **Carefully** remove Strainer top, Item 10, Page 18.
 - d) Remove strainer basket, Item 16, Page 18.
 - e) Clean as required.
 - f) Replace basket, seal cap, and strainer top.
- D. **Cylinder assembly** may be out of alignment.
- a) Unit is tested at Lubrizol Performance Systems™, but the cylinder assembly may be come out of alignment during shipment, causing stress on the spool valve body sufficient to prevent the spool from moving.
 - b) Loosen cylinder end caps mounting bolts, Item 30, Page 10.
 - c) Gently move the cylinder assembly.
 - d) Cycle unit by moving HOA switch from ON to OFF and back, until flow begins.
 - e) If flow starts, tighten bolts.
- E. **Four way spool valve** may not be functional.
- a) Spring may be broken.
 - i) Close INLET valve.
 - ii) Remove tubing between fittings #19 and #11, Page 10.
 - iii) Remove bottom end cap, Item #9. Page 28.
 - iv) Spool should drop out of valve body. (If it does not, proceed to b).
 - v) Remove spring pieces.
 - vi) Replace spring.
 - vii) Re-assemble, reversing above steps.
 - b) Spool does not drop out of valve body.
 - i) Remove tubing between fittings #19 and #13, Page 10.
 - ii) Remove top cap, Item #3, Page 18.
 - iii) Press spool & spring out of body using gentle pressure on the top of the spool. Do not force. Do not scratch or mar sides of the valve body.
 - iv) If you cannot press spool out, you may have to remove the valve body, either to clean up with a solvent or to replace completely.
 - v) If body is removed, **retain seal nuts**, Item 17, Page 10, with the tube fitting.
 - vi) Replace spring or spool valve, as appropriate, and re-assemble reversing the above steps.
- F. **Other** problem areas may include:
- a) Supply line blockage, such as foreign matter in the pipe.
 - b) Solenoid valve plugged with foreign matter; see Item IA above for disassembly of the valve.

Individual Gate-Pak Unit Calibration Procedure

IT IS RECOMMENDED THAT TEST PROCEDURE BE COMPLETED PRIOR TO CALIBRATION.

<u>Step</u>	<u>Description</u>
1.	Determine desired dosage rate per cycle, in c.c. or ml. values. Have container, graduated in c.c. or ml., available.
2.	Start additive supply pump by placing pump motor controller HOA switch in Hand position.
3.	Initiate the test electrical power to the Injector system to be tested.
4.	Turn HOA switch to the OFF (center) position.
5.	Connect Calibration Test Device, if so fitted, and place container under TEST valve, or Test Device outlet.

The following statement should be followed whenever a line or valve is opened to the atmosphere. It will not be repeated for each application.

TAKE APPROPRIATE SAFETY PRECAUTIONS FOR HANDLING THE ADDITIVE AND OPENING A PRESSURIZED SYSTEM.

6. Close OUTLET valve.
7. Open INLET valve.
8. **Calibration:** With container under valve, open TEST valve.
 - A) Turn HOA switch to ON (handle down) position.
 - a) Allow all additive to drain from TEST outlet.
 - B) Turn HOA switch to OFF (center) position.
 - a) Allow all additive to drain from TEST outlet.
 - C) This completes **one (1) cycle.**
 - D) Repeat A and B for 10 cycles, or the maximum cycles your calibrated container will hold.
 - E) Divide the volume in the container by the number of cycles, to obtain the volume per cycle.
 - F) If calibration is within acceptable range, repeat A through E, to confirm calibration. If adjustments must be made, proceed to Step 9, below.
9. **Adjust calibration setting:**
 - A) Determine amount of adjustment required.
 - a) Compare the required calibration with the actual, to determine the volume per cycle adjustment required.
 - b) Using the Gate-Pak Technical Data chart on Page 5 of the manual, determine the approximate number of turns of the Adjustment Stem required.

- B) Turn HOA switch to OFF position. **Be sure TEST valve is open.** This will place piston at bottom of the cylinder.
- C) Close INLET valve.
- D) Loosen adjustment stem lock nut and Seal nut, Items #5 and #4, Page 12.
 - a) Anticipate some additive seepage around the stem threads.
- E) If increasing the volume, turn the adjustment stem **counter-clockwise**, the number of turns or partial turns determined in Step 9 A b.
- F) If decreasing the volume, turn the adjustment stem **clockwise**, the number of turns or partial turns determined in Step 9 A b.

CAUTION: If strong resistance is encountered in turning the adjustment stem, **STOP.** Resistance should be minimal if the piston is at the bottom of the cylinder. Check that Items B and C were done in sequence.

- G) When adjustment stem setting is complete, tighten Items #4 and #5, Page 12.
- H) Repeat Steps 8 and 9 until calibration is satisfactory and repeatable.

Gate-Tek 5 Monitor Test Procedure

The Gate-Tek 5 is a monitoring device, so to test, we must by-pass some of the devices to assure the unit shows failure from the proper test. You will need to see the face of the Gate-Tek 5 module, or the edge of the Gate-Tek 5 board, to observe the operation of the LED lights.

<u>Step</u>	<u>Description</u>
--------------------	---------------------------

NOTE: If this test follows Gate-Pak[®] Test procedure, Items 1 and 2 will have been done.

1. Start additive supply pump by placing pump motor controller HOA switch in Hand position.

Observe pump operation for normal operation.
 - a) Pump sound.
 - b) Pump discharge pressure.
 - c) Leaks.
2. Initiate the permissive power to the injector system to be tested.
 - a) GREEN LED light should illuminate.
3. Turn HOA switch to OFF (handle center position).
4. Close OUTLET valve.
5. Connect Calibration Test device, if so fitted, and place container under TEST valve, or Test device outlet.
6. Open TEST valve.
 - a) RED LED should illuminate, if not already illuminated.
7. Turn HOA switch to HAND (handle down position).
 - a) RED LED light should go out.
8. Close TEST valve.
9. Turn HOA switch to OFF (handle center position).
 - a) RED LED light should stay off.
 - b) In four (4) seconds, GREEN LED light should go out.
10. Reset Gate-Tek 5.
 - a) If card system is used, remove and reinstall card.
 - b) Remove permissive from system and restore, to reset Gate-Tek 5.
11. Open TEST valve, allow piston to move.
 - a) RED LED light should illuminate.
12. Close TEST valve.
13. Turn HOA switch to HAND (handle down position).
 - a) RED LED light should remain illuminated.
 - b) In four (4) seconds, GREEN LED light should go out.

14. Reset system.

TO TEST THE PRODUCT FLOW DEVICE, THE DEVICE MUST BE ENERGIZED, WITH NO PRODUCT FLOWING.

15. Activate the product flow device, with no product flowing, and thus no transmitter signal generated.
 - a) AMBER LED light will illuminate.
 - b) In twenty-five (25) seconds, the GREEN LED light will go out.

THE GATE-TEK 5 CONTROL CIRCUITS ARE **NORMALLY OPEN** TRIAC CONTACTS, BETWEEN TERMINALS TB-5 & 6, AND TB-6 & 7.

TO TEST THESE OUTPUT SIGNALS, OBSERVE THE STATE OF THESE CONTACTS, OR THE DEVICE(S) CONNECTED TO THEM, WHENEVER THE **GREEN LED LIGHT IS NOT** ILLUMINATED. THE CONTACTS SHOULD BE OPEN.

A MINIMUM LOAD OF 25 WATTS MUST BE CONNECTED TO THE OUTPUT TO BE ABLE TO READ AN OPEN CONTACT WITH A VOLT METER.

Trouble Shooting Guide

The following trouble shooting guide is for reference only. If any maintenance work creates a potentially hazardous situation, such as exposing an open circuit, STOP!, and review the situation with a responsible company employee. Your company safety and maintenance guidelines should not be circumvented in any maintenance work.

Problem	What to look for:
When calibrating - additive flows without visible force	a) Loss of pressure at additive pump b) Dirty filter on inlet side of the additive panel (item 16 page 18)
When calibrating - additive does not indicate a cyclic flow of injects and injects and then dribbles	a) Check seal on free piston (item 8, page 12) b) Check 3-way solenoid for failure to seal. If dribble occurs with solenoid energized - check the bottom seat. If dribble occurs with solenoid de-energized check the top seat (refer to page 16)
Failure to flow - assumes good pump pressure and clean filter	a) Usually an electrical problem - the solenoid is not receiving the transmitters signal. While the main product is flowing - listen for the solenoid to "click" check the following: i) Check the transmitter leads with a voltmeter - with the product meter running, disconnect the power supply and check it with the OHM meter. ii) A pulse divide circuit (PDC-21 or PDC-22) may have been installed to convert the transmitter resolution - check the output to the solenoid (refer to page 20) iii) If a good signal is received at the solenoid, then check the solenoid for coil failure. iv) Assuming electrical devices are working and the solenoid "clicks" - remove, dismantle, and inspect the solenoid valve for damage and/or foreign matter. v) After checking the above to no avail, the four way spool valve may be stuck and should be checked. The valve is spring loaded on one side only. Remove the end cap (item 9, page 18) and use a pencil, or a similar instrument, to see if the spool will shift against the spring - if not, remove and carefully clean the spool body. Do not use an abrasive on the spool!
Erratic calibration - assume good pump pressure and clean filter	a) Check the spool valve - some additives may form a deposit inside the spool valve preventing the spring from shifting the spool - this condition can occur when the unit is used seasonally or sets for long periods - remove spool and clean b) If the transmitter On/Off time is less than 40/60, it is possible that the time is not enough for the cycle to be completed.

Note: *If the spool valve does not shift freely, check the fittings and panel for damage. DO NOT TIGHTEN the spool valve fittings to stop a leak. The spool valve body fittings are straight threads and the seal is made with a seal nut. When inserting a fitting into the spool valve, the fitting should only be hand tightened and then the seal nut should be tightened to make the seal. In the event of a leak - tighten the seal nut only!*

Notes