OPERATING INSTRUCTIONS
AND
MAINTENANCE MANUAL
FOR

HAMMONDS MODEL 4T-1M+
RETROFITED PUMP

FLUID POWERED
ADDITIVE INJECTOR
SYSTEM

Updated manual with 1M & 1P2 pumps + calibration gauges

Manufactured by:

HAMMONDS TECHNICAL SERVICES, INC.

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SPECIAL NOTICE TO USERS

PLEASE READ CAREFULLY BEFORE INSTALLING EQUIPMENT

This additive injector system is designed to give consistent, dependable performance when operated and maintained according to manufacturer's recommendations. However, being a mechanical device, it is subject to failure from wear, human error and operating environments beyond the control of the system. Because of this fact, it is the responsibility of the operator to make certain that:

A. The system is installed properly.

B. The system is being operated properly.

C. The system is actually running during product transfer.

D. The system is checked after the transfer operation to make certain the proper amount of additive was injected during the operation.

The performing of these checks by the operator eliminates the possibility of product not having the proper additive ratio as required. Therefore, since the manufacturer cannot be present during each transfer operation, the responsibility for checking the performance of the system is that of the operator. Should there be any questions whatsoever, the operator should consult the factory authorized distributor, or the factory directly.

DO NOT TAKE CHANCES
DO NOT GUESS
Be absolutely certain that the system is operating as it should. The user/operator carries the final responsibility to make certain the system is operating properly.

INSTALLATION AND PREPARATION FOR STARTUP

In most cases, the Hammonds fluid powered injector is shipped complete and ready to operate. The system should include appropriate fittings to suit your specific application. Flow direction is marked on additive pumps and check valves. Any and all flow restricting devices such as ON/OFF ball valves, remote panels, sight flow indicators, suction strainers or electrically controlled solenoid valves must be installed on the suction side of additive pumps.

CAUTION: Do Not Attempt To Use This Device Without Understanding And Following Proper Safety Precautions Regarding System Grounding, Fire Safety, And Special Handling For Potentially Dangerous Additives.

Consult your Engineering Department for their specific instructions. Make certain all personnel involved with this system are thoroughly familiar with safe operating practices.

If your system has been purchased "bare," consult your equipment distributor for help in selecting hoses, fittings and other related accessories. Selection of

INSTALLATION RELATIVE TO METERS

Hammonds injectors can be installed at any point in the system. In most terminal operations, it is desirable to meter the additive. Meters, valves or strainers do not affect the system, so it can be placed wherever there is room. In aviation truck applications, it is placed up-stream of the meters, (some have two), it will precisely inject additive to the system, whether a single hose or dual hose fueling is used.

SPACE REQUIREMENTS

The system is designed with easy services in mind. The entire turbine and pump assembly can be removed from the housing without disturbing the system piping. Ample room should be reserved in the installation for this removal, if possible. Also, the operator needs to have visual access to the controls on the pump for calibration.

ON/OFF OPERATION

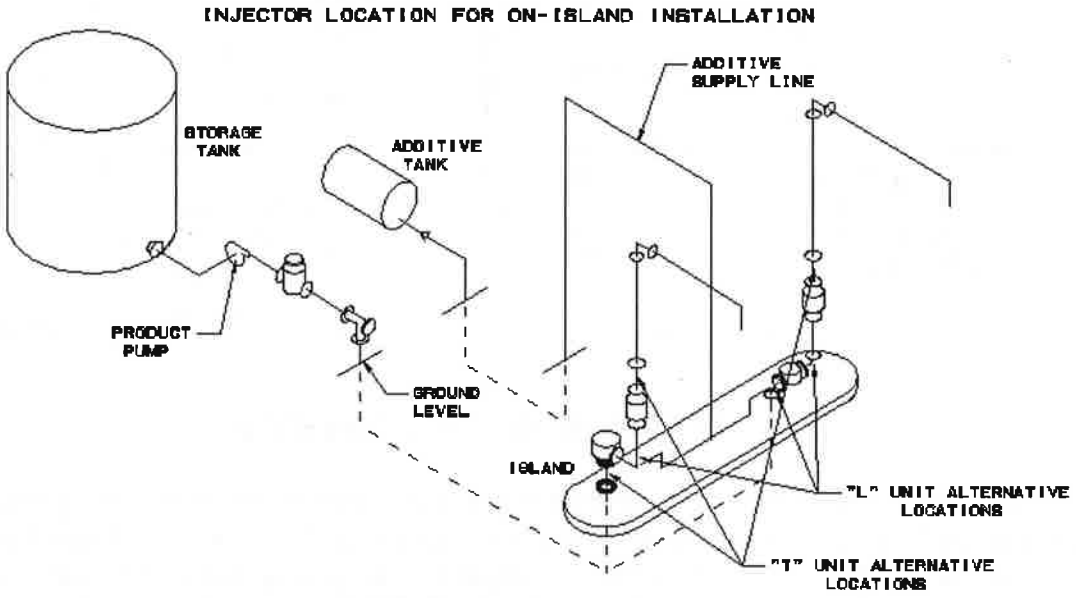
There are two methods for providing ON/OFF operation to the system. One is by using a remote panel that includes a special rotary valve connecting the additive tank and the injector appropriately, and the other (for HAMMONDS DIAPHRAGM PUMPS ONLY) is a simple, 2-position ball valve installed in the additive supply line that connects the additive storage tank and the injector. Preferably, the valve should be located as close to the injector as possible. Turning this valve off for a short duration does not harm the unit in any way, nor does it cause the unit to lose the prime of additive. As soon as the valve is opened, the pump immediately begins injection without any loss of ratio whatsoever.

Caution: NEVER install an on/off valve on the discharge side of any pump. Turning this valve off will block the discharge of the pump, rupturing the diaphragm or plunger seal resulting in an uncontrolled leak of additive and causing catastrophic failure to the pump.

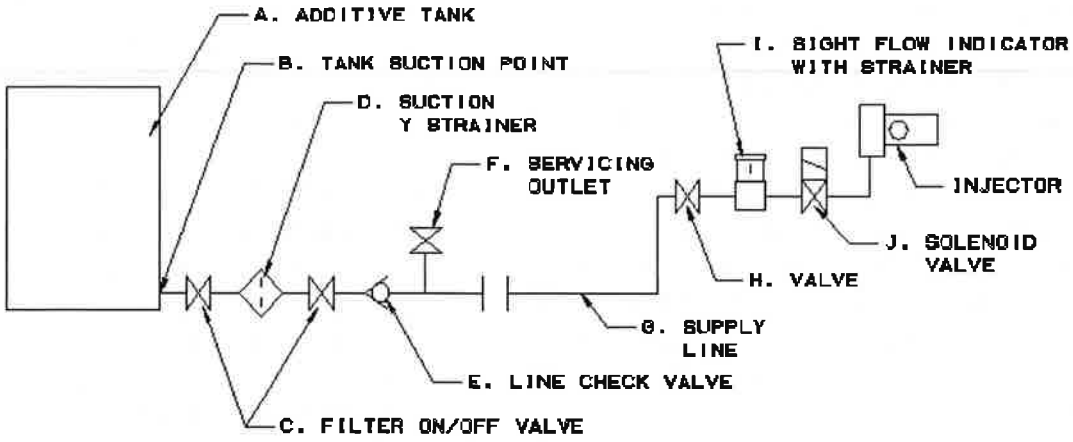
PLACEMENT OF THE ELECTRIC ON/OFF SOLENOID

Some systems use an electric powered on/off solenoid for remote operation of the system. When used, the ideal location for this valve is between the injector and the Calibration Gauge or Sight Flow Indicator. The valve should be placed as close to the injector as possible. In terminal installation, it is not recommended that the valve be placed back at the tank, which is usually a considerable distance from the injector. As with the manual on/off valve, the solenoid valve must NEVER be placed between the injector and the point of injection.

The other option for basic location is on the island itself. In this installation, a unit is usually placed on each of the loading arms, providing for the selective injection of any combination. The unit may be installed at any point from where the pipe exits the ground to where the swivel arm begins for the hose drop. This location offers versatility in that a single injector can be shared by up to four (4) separate users, injecting different additives on demand. There is almost always a convenient "spot" to install the system, either in a 90º elbow or in a short run of straight-line pipe.



Location of the injector at the island is usually handy to existing wiring conduits for card controls, allowing for easy installation of the on/off solenoid. Units can be configured for horizontal or vertical installation.



A. THE ADDITIVE TANK: Additive tanks should be constructed of materials compatible with the additive. Tanks should be new and free from scale, rust and corrosion. Any loose surface material inside the tank will fall into suspension and contaminate the additive after startup. Care should be taken to prevent sandblast sand from entering the tank during the manufacturing process. If water is used for testing, the tank should be dried internally to prevent the formation of rust.

B. TANK SUCTION POINT: Suction should never be taken from the very bottom of the tank. Should foreign material of any kind be present, the line will become plugged, causing either failure or erratic performance of the system. Remember, there are components in every additive system that are sensitive to contamination. Suction should be taken at least 1" off the bottom of the tank to prevent the introduction of foreign sediments off the bottom.

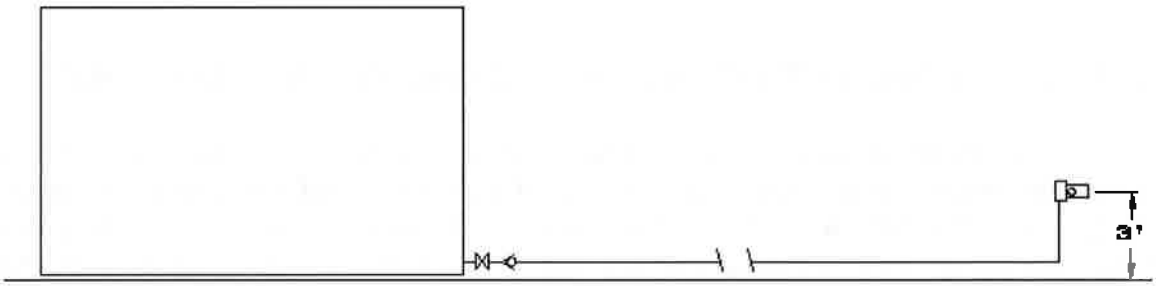
C. FILTER ON/OFF VALVE: A full opening ball valve of at least the diameter of the additive supply line should be placed on either side of the filter or suction Y-strainer. Two valves are necessary in order to clean the strainer without losing the entire line full of additive. This will prevent having to re-prime the system each time the strainer is cleaned.

D. SUCTION Y-STRAINER: A Y-type strainer with a 50-60 mesh screen is ideal for removing most harmful particles from the additive supply. Any smaller mesh will cause excessive friction loss. If the openings are too large, the strainer will do little to protect the system.

E. SUCTION LINE CHECK VALVE:
Notice: This check valve is only used in vary rare occasions. Consult the factory before use. This suction line check valve is used to provide additional insurance that the primed line will not drain back between uses. If the additive supply line is properly installed without leaks, it will remain full even when not in use. This line check valve is suggested as an extra precaution to prevent loss of system prime. The valve should be made of a material compatible with the additive, and have a "feather light" opening pressure. The valve should be a ball type with a synthetic material that is very light, preferably with no spring. The gravity of the material will seat the ball. Consult the

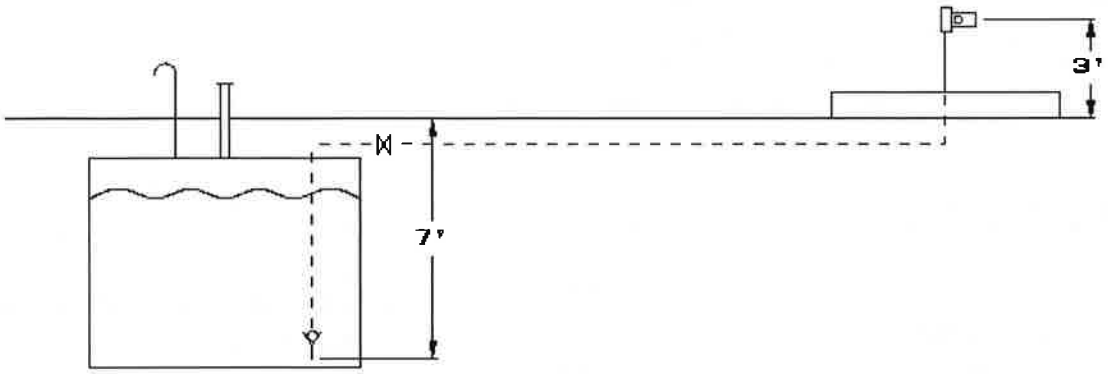
ADDITIVE TANK INSTALLATION

Placement of the additive tank and related supply lines relative to the injector is critical to performance of any additive system. The following illustrations will provide information regarding the various types of tank installations and their connection to the additive injectors. Hammonds injectors offer the greatest flexibility in tank and supply line installation of any additive injection system on the market. Since no pumps or feed mechanisms are necessary, installation goes faster and at less cost. The choice of appropriate components and pipe sizes, along with leak-free installation, will determine if the system works properly and consistently.



OPTION 1 - ABOVE GROUND TANK, ABOVE GROUND DELIVERY LINES

This installation calls for both the tank and the supply lines to be above ground. The bottom of the tank is very close to the ground, and the injector is approximately 3' above ground. Using a 4' diameter tank, this would provide a variable net suction head to the injector of +1' when the tank is full to a worst condition of a -3' when the tank is almost empty. A Y type strainer should be located at the tank. A full opening ball valve located on each side of the strainer, with a light action (less than 1/2 PSI) check valve installed to assist in holding the prime. Install a ball valve just upstream of the Sight Flow Indicator, and if one is to be used, install the solenoid-operated valve between the Sight Flow Indicator and the injector. Use the table listed in the previous section for selection of pipe diameter.



OPTION 4 - BELOW GROUND TANK, BELOW GROUND LINES

This is the most difficult application for a non-pressurized additive supply. In this case, the pump must overcome a negative lift equal to the total distance between the bottom of the tank and the injector above ground.
This is not recommended because fittings and check valves leak. If equipment is installed in this manner it will void the factory warranty.

PREPARATION FOR CALIBRATION AND STARTUP

Before attempting to start the system or make calibration, please read the following information carefully.

During startup and calibration, you will be bleeding the system of air, collecting samples of additive during calibration, and checking for possible leaks throughout the system. Provisions should be made for cleanup of spilled fluid. You will have some losses during these procedures. If the additive being handled is flammable, fire safety precautions should be taken. Since the installation may also be tested at this time, extreme caution should be used in checking for leaks of the mainline. If you wish to set the system up for leak-free testing and calibration with zero spillage, please consult your local distributor or the factory for help in doing so. Hammonds is glad to suggest necessary parts and procedures for "zero spill" startup and calibration.

A WORD ABOUT ADDITIVES

Most additives being used in fuels today have at least some degree of toxicity. Many are very dangerous. Extreme caution should be taken in handling additives. Remember, the additive is placed under pressure when being injected into the line, and when

3. All systems are calibrated at the factory to customer specified requirements. So if adjustments are necessary, they should only be minor. If this is the case, go directly to Step 6.

4. **FOR HAMMONDS PUMPS ONLY:** If you are starting from scratch with your calibration and adjustment, loosen the stroke adjustment locking screws located on the bottom of the pump body directly under the stroke adjustment knob. This will allow the stroke adjustment to be moved.

5. **FOR HAMMONDS PUMPS ONLY:** Adjust the stroke adjustment knobs located on the pump body to approximately 50%. **CAUTION:** Do not turn this adjustment with excessive force. If they are difficult to adjust, simply rotate the shaft coupling just ahead of the pump as you make the adjustment. You will find this makes the adjustment much easier.

6. Lock the stroke adjustment locking screws down firmly.

7. Set the calibration valve (3-way valve) in the bleed or "calibration position." This is done by making certain that the handle on the valve is positioned so that additive will exit through the short open tube.

8. Make certain all product connections going to and from the system are in their proper, locked position to ensure safe, leak free flow of product through the turbine. Check the flow direction arrows located on the turbine housing to ensure that the system is installed properly.

9. At this point, consider the information you will have to gather during the next few steps of the calibration process.

A. What will the flow rate through the unit be?
B. What is the length of time that the calibration will cover?
C. What is the amount of additive in ounces or cc's that you will need to collect based on the time duration of the calibration?

You should have the answers to all these questions before your first calibration trial run. If you alone can do it all, fine; however, it is suggested that you have an assistant give you that information as it will be needed to determine whether the system needs to be increased or decreased in output.

10. Before starting the product supply through the system, make certain everyone understands that you will run the system for, let's say, one (1) minute. Even shorter runs are fine, especially if you are running at high flow rates.

11. Place the measured graduate under the calibration tube. Put on your eye protection!

12. At the command of the timekeeper, or that person watching the flow meter, start the product pump.

13. Give the system a few seconds to gather momentum and flow through the turbine. Notice if the turbine is turning. The coupling between the pump and the turbine housing should be spinning. You may not be able to see the coupling on some models; however, you see the shaft. On enclosed systems, there may be a plug that can be removed on the side of the gearcase mounting in order to view the shaft and coupling.

These are all large, round numbers. You may, for example, only be running at 100 GPM, not 500. Use the same procedure; just change the numbers to fit your application.

No two systems will ever perform exactly the same. For this reason, the procedures given for calibration are general in nature. Obviously, it is impossible to provide a graph or table that would be absolutely accurate in every case. With that in mind, all tables and graphs should be used as general guidelines. Remember, the calculated, timed and measured output that you gather is absolute. Trust your figures and your calculations.

ADDITIVE CHART

GALLONS	135 PPM	270 PPM	1000 PPM
100	1.7 OZ.	3.4 OZ.	12.8 OZ.
200	3.4 OZ	6.9 OZ.	25.6 OZ.
400	6.9 OZ.	13.8 OZ.	51.2 OZ.
500	8.6 OZ.	17.2 OZ.	64.0 OZ.
700	12.0 OZ.	24.0 OZ.	89.6 OZ.
1000	17.2 OZ.	34.5 OZ.	128.0 OZ.

TROUBLESHOOTING THE SYSTEM

The following conditions are given as a means of troubleshooting the system. Each condition lists a number of possible causes. In most cases, trouble can be solved by the use of this section. Please read it carefully before attempting repairs, or making changes in the system.

THE TURBINE IS NOT TURNING

A. Insufficient flow to turn the turbine. A minimum of about 150 GPM must be present to start the system. 200 GPM is the minimum for normal calibrated operation.

B. A rag or some other object is jammed in the line, preventing the turbine from turning.

C. A diverter valve is blocked downstream of the system, blocking the fuel flow through the system.

D. A defueling valve is left open on a truck or hydrant system, starving the turbine for product flow.

E. The pump and turbine have been knocked out of alignment during shipment or installation, causing a binding of the coupling.

THE TURBINE IS TURNING AND PUMP IS RUNNING, BUT WITH NO OUTPUT

A. Pump is air-locked. In some cases where there is a very long line running from the injector head and the point of injection into the system, there is sufficient air volume to cause the pump to act as a compressor. It is not able to open the valves throughout the system and, therefore, cannot pull a suction of fluid to the pump. Crack the fitting ferrule nut on the discharge side of the calibration valve and allow it to remain

5. Check for leaks at the seal that is located at the exit point of the turbine output shaft as it leaves the turbine housing. This should be at each operation. Leakage at this point usually indicates the mechanical seal inside the turbine housing is leaking. A leak here will usually indicate fuel, and is not only a possible fire hazard; fuel in the bearings of the turbine will quickly wash away lubricant and cause damage to the gearbox.

6. Check the fittings for leakage around the suction filter, if one is used on the pump. Check this fitting each time the filter is changed or cleaned. This would apply to top and bottom of the glass tube used in the Suction Sight Flow Indicator. Make certain there are no leaks in the suction line. A very small leak will either change the operation of the pump, or prevent it from operating altogether.

7. Visually check around the pump head to make certain there is no leaking of additive around the fluid ends. If there is, check the tightness of the head bolts. These screws must be tightened to 40 inch pounds. Under tightening will allow leaks and the diaphragm to work free, reducing the output of the fluid end. Over tightening will damage the diaphragm. An additive leak that appears to be coming from inside the pump power frame under the stroke mechanism usually indicates a ruptured diaphragm.

8. Pump diaphragms or plunger seals require replacement at different intervals, depending on the total hours of service, the speed of the particular installation and the percent of stroke being utilized. As an example, a system that operates eight hours every day is considered continuous duty. If the system is operating at above 120 RPM pump speed, it is considered severe, and finally, if the pump setting is greater than 50% stroke, the diaphragms or plunger seals will experience greater fatigue and, therefore fail sooner than one that is set at 10 - 25% stroke.

Depending on the operating conditions (duty cycle, speed, and % of stroke and pressure); diaphragms or plunger seals can be expected to last from 6 - 18 months. It is recommended that critical duty installations begin initial service by checking the diaphragms or plunger seals after 6 months. Normally, checking only one of the pump heads will give an indication of the condition of others in the system. Examine the diaphragm or plunger seal for wear. If it is in good condition, perform the next examination following nine months of service. If the condition remains good, examine again after twelve months. On a diaphragm, check for signs of breaks in the Teflon surface, cracking or swelling of the rubber backing and failure of the fastener in the rear of the diaphragm. White crazing on the surface of the Teflon face is normal. If any signs of swelling or deformity of the Teflon is seen, the diaphragm must be replaced. Remember, only the Teflon face is resistant to the additive. The rubber backing will soon deteriorate after the Teflon face is broken and leaks additive to the reinforced back.

As a general rule, diaphragms or plunger seals should be replaced every twelve months. Careful monitoring of your installation may reduce or extend that period. You should establish a maintenance schedule that gives reasonable life, and will prevent unexpected failures and unscheduled downtime.

PREVENTATIVE MAINTENANCE SCHEDULE

NOTE: It is important to read the previous pages on preventative maintenance. These intervals are general, and may vary according to individual applications and severity of service.

SERVICE FUNCTION	0-4 HRS DAILY	5-8 HRS DAILY	8+HRS DAILY
Check pump gear oil level	Monthly	Monthly	Monthly
Check additive filter screen	Monthly	Monthly	Monthly
Check system for additive/fuel leaks	Daily	Daily	Daily
Inspect diaphragms/plunger seals	12 Months	6 Months	3 Months
Replace diaphragms/plunger seals	12 Months	As needed	As needed
Check eccentric bearing grease	6 Months	3 Months	Monthly
Check stroke adjustment parts for looseness	Monthly	Monthly	Monthly
Replace stroke adjustment parts	24 Months	As needed	As needed
Disassemble and inspect turbine housing and internal parts	24 Months	12 Months	8 Months

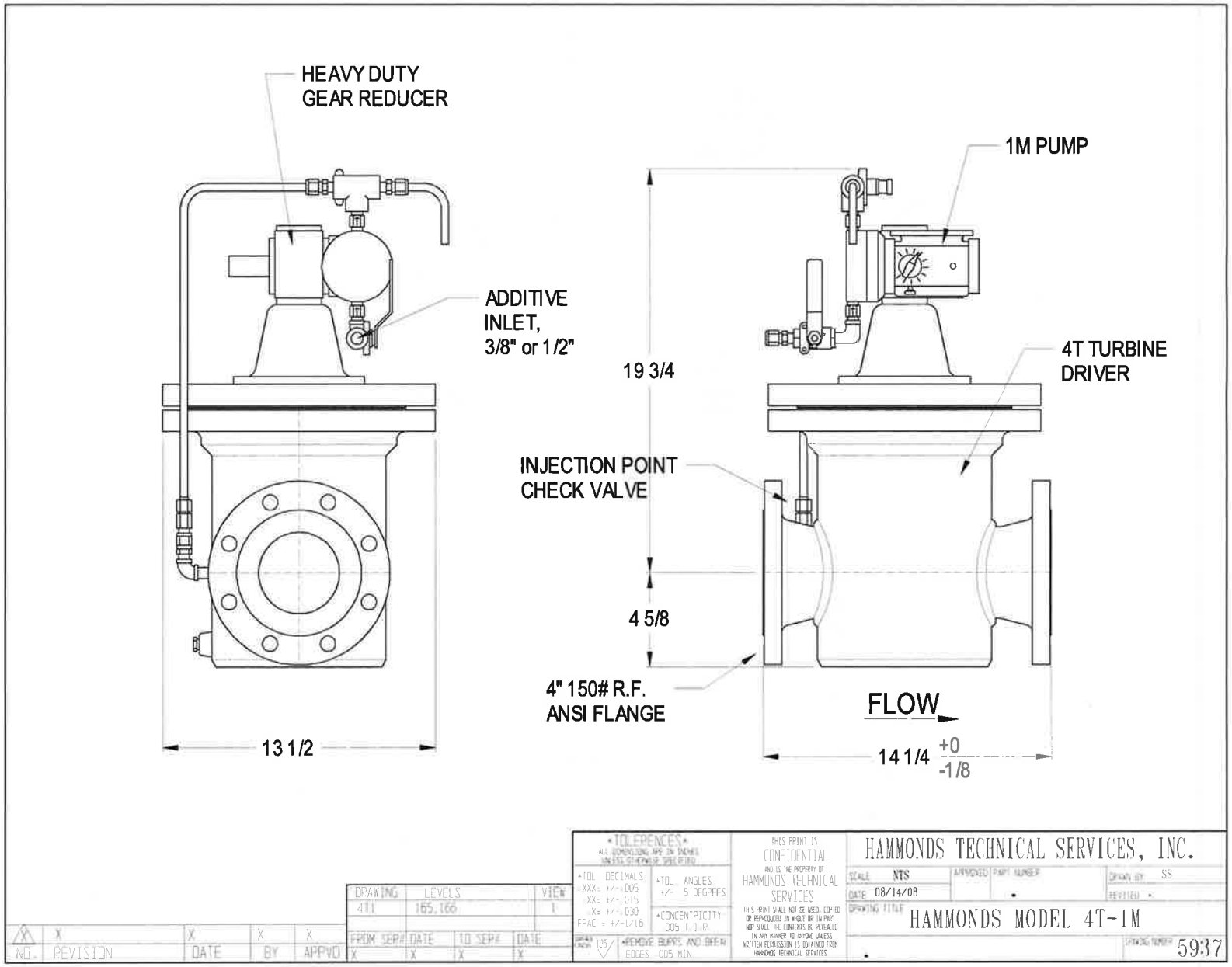
DESICCANT DRYER

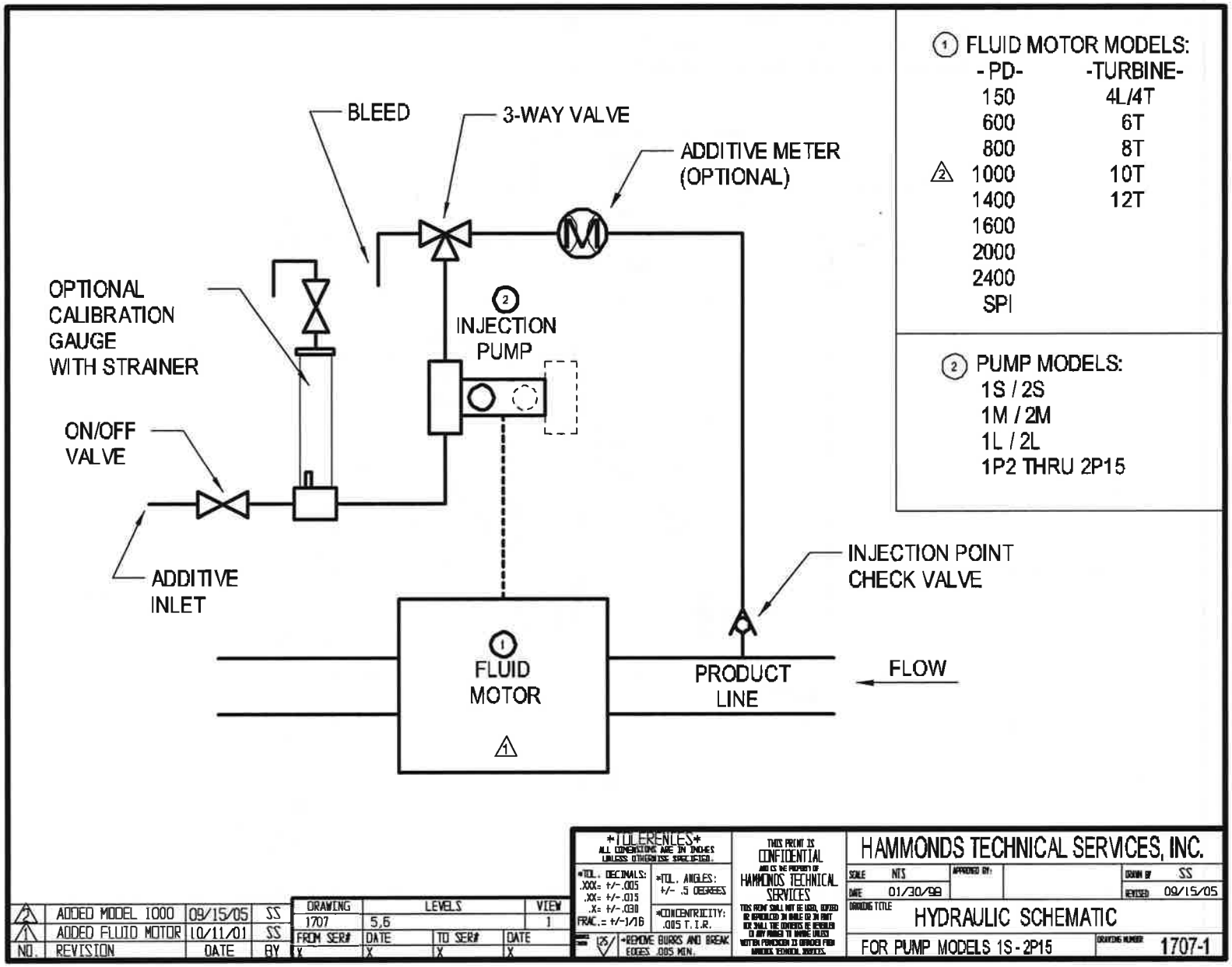
Your Hammonds additive system may include a custom additive tank. The additive tank may come equipped with a desiccant dryer cartridge. These units come in several different sizes.

Most systems come equipped with the standard 3/4" cartridge. This unit is attached to the tank via a short length of black rubber hose. The cartridge has a housing constructed of a clear poly material and is filled with a blue colored desiccant crystal. All these units are shipped from the factory with a small yellow cap on the unattached end of the cartridge.

Some systems may come equipped with a large canister measuring approximately 2" diameter and 10" in length. These units perform the same function, just on a larger scale. Due to their greater capacity, they last longer between service. These units are sealed from the factory by a small, plastic plug which is located either on the bottom or one side of the canister.

The purpose of all desiccant dryers is simply to remove moisture from the air as the system breathes. All tanks or portable sources of additive supply must be vented to atmosphere in order for the


HEAVY DUTY
GEAR REDUCER
ADDITIVE
INLET,
3/8" or 1/2"
1M PUMP
4T TURBINE
DRIVER
19 3/4
INJECTION POINT
CHECK VALVE
4 5/8
4" 150# R.F.
ANSI FLANGE
FLOW
13 1/2
14 1/4 +0 -1/8
HAMMONDS TECHNICAL SERVICES, INC.
HAMMONDS MODEL 4T-1M
5937


BLEED
3-WAY VALVE
ADDITIVE METER (OPTIONAL)
OPTIONAL CALIBRATION GAUGE WITH STRAINER
INJECTION PUMP
ON/OFF VALVE
ADDITIVE INLET
INJECTION POINT CHECK VALVE
FLUID MOTOR
PRODUCT LINE
FLOW
1 FLUID MOTOR MODELS:
- PD- -TURBINE-
150 4L/4T
600 6T
800 8T
2 1000 10T
1400 12T
1600
2000
2400
SPI
2 PUMP MODELS:
1S / 2S
1M / 2M
1L / 2L
1P2 THRU 2P15
ADDED MODEL 1000 09/15/05 SS
ADDED FLUID MOTOR 10/11/01 SS
NO. REVISION DATE BY
DRAWING 1707
LEVELS 5,6
VIEW 1
FROM SER# DATE TO SER# DATE
TOLERENCES
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.
*TOL. DECIMALS: .XXX= +/-.005 .XX= +/-.015 .X= +/-.030 FRAC.= +/-1/16
*TOL. ANGLES: +/- .5 DEGREES
*CONCENTRICITY: .005 T.I.R.
*REMOVE BURRS AND BREAK EDGES .005 MIN.
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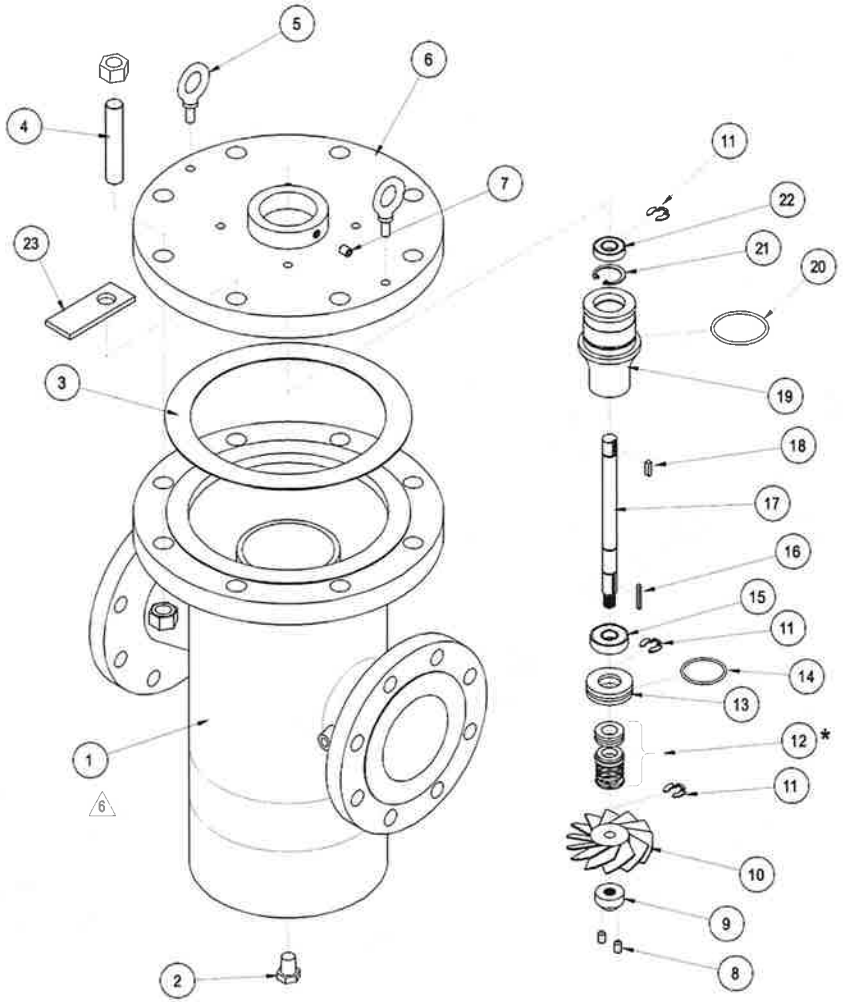
HAMMONDS TECHNICAL SERVICES, INC.
SCALE NTS
APPROVED BY:
DRAWN BY SS
DATE 01/30/98
REVISED 09/15/05
DRAWING TITLE
HYDRAULIC SCHEMATIC
FOR PUMP MODELS 1S-2P15
DRAWING NUMBER 1707-1



	ITEM	PART NO.	QTY.	DESCRIPTION
	1	162049	1	4T HOUSING, 4" 150# RF, CS
7	2	151005	6	1/4" PIPE PLUG
	3	271139	1	GASKET
	4	881279	8	3/4-10 x 4" STUD / NUT SET
	5	101394	2	LIFT EYE
	6	162048	1	4T FLANGE
	7	882072	1	SET SCREW
	8	881010	2	SET SCREW
2	9	162103	1	SPINNER, NOSE
	10	882015	1	ROTOR
	11	881007	3	SNAP RING
	12	881009	1	MECHANICAL SEAL (STANDARD)
1	*12	883052	1	MECHANICAL SEAL, HD (OPT)
3	*12	141050	1	MECHANICAL SEAL, BUNA (OPT)
	13	162046	1	SEAL ADAPTER
	14	884119	1	O-RING, VITON (STANDARD)
5		881518	1	O-RING, BUNA-N (OPTION)
	15	881369	1	BEARING
	16	162025	1	KEY, 1/8" SQ. x 7/8"
	17	162045	1	SHAFT
	18	162087	1	KEY, 1/8" SQ. x 3/4"
	19	162044	1	4T BEARING HOUSING
	20	884120	1	O-RING, VITON (STANDARD)
5		881519	1	O-RING, BUNA-N (OPTION)
	21	881520	1	SNAP RING
	22	881063	1	BEARING
4	23	103626	1	GROUND LUG, COPPER (OPT)

ASSEMBLY NOTE: BEFORE ASSEMBLING GEARBOX / PUMP TO FLANGE #6, INSTALL TURBINE ASSY. INTO HOUSING, KEEPING IT CENTERED. INSTALL STUDS & NUTS #4. CHECK ROTOR #10 CLEARANCE BY ROTATING SHAFT #17 BY HAND WHILE CAREFULLY TIGHTENING STUD NUTS EVENLY IN A CRISSCROSS MANNER. IF BINDING OF ROTOR OCCURS, MOVE FLANGE SLIGHTLY IN ONE DIRECTION UNTIL SHAFT ROTATES EASILY BY HAND WITH NO SCRAPING SOUND. AFTER TIGHTENING ALL NUTS, MAKE CERTAIN THAT THE SHAFT ROTATES EASILY BY HAND.
INSTALL GEARBOX / PUMP TO FLANGE.

NO.	REVISION	DATE	BY	APPVD
7	WAS QTY. 1	06/08/15	SS	X
6	WAS FLAT PLATE	05/18/12	SS	X
5	ADDED O-RING OPT	07/15/10	SS	X
4	ADDED GROUND LUG	09/11/09	SS	X
3	ADDED BUNA SEAL	05/24/05	SS	X
2	WAS 882008	12/17/01	SS	X
1	ADDED H.D. SEAL	04/11/01	SS	X

DRAWING	LEVELS	VIEW
4TEV	1-4	1

FROM SER#	DATE	TO SER#	DATE
X	X	X	X

TOLERANCES ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED
*TOL. DECIMALS. XXX: +/- .005 XX: +/- .015 X: +/- .030 FRAC: +/- 1/16
*TOL. ANGLES +/- 5 DEGREES
*CONCENTRICITY .005 T.I.R.
SURFACE FINISH 125 *REMOVE BURRS AND BREAK EDGES .005 MIN

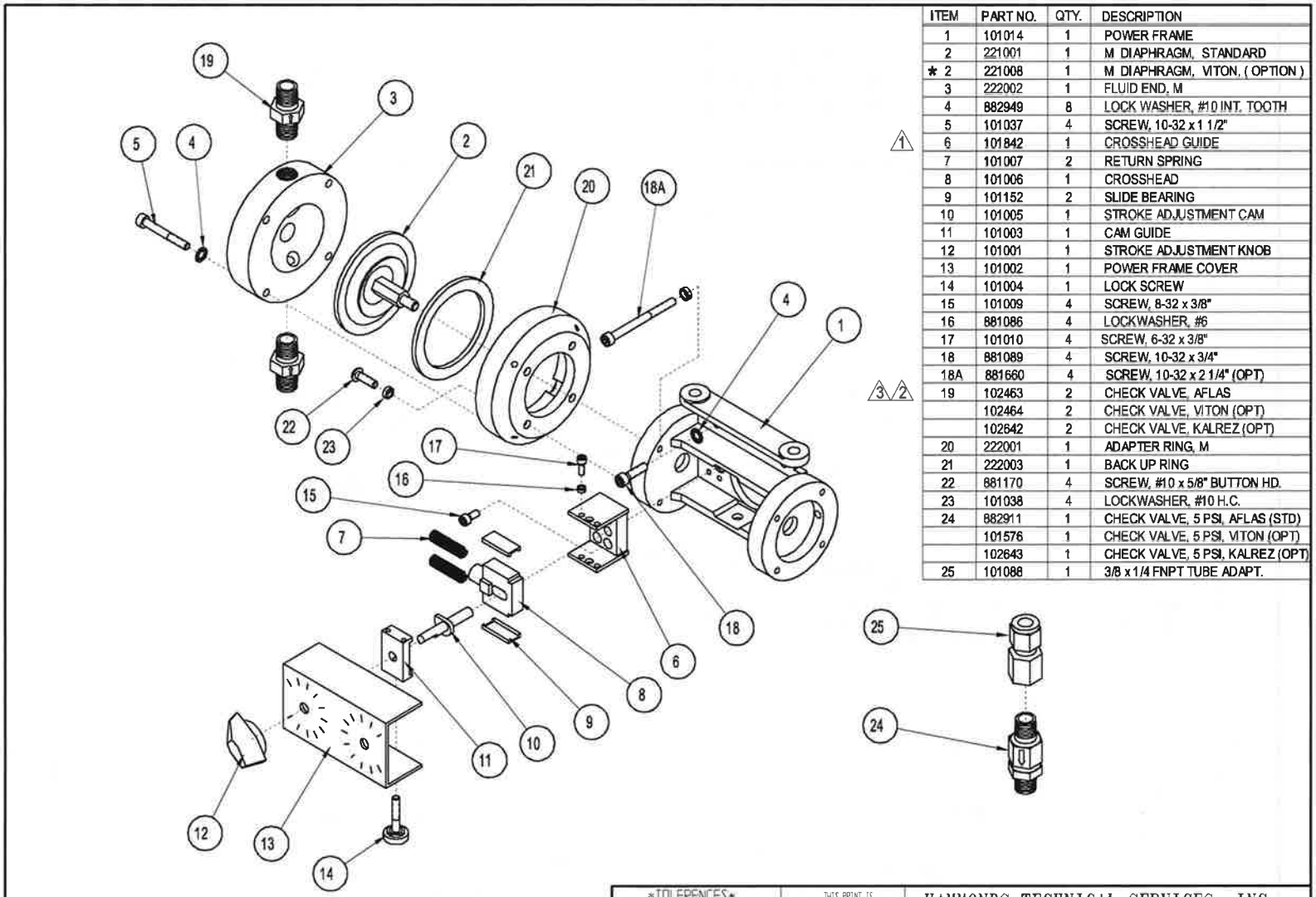
HAMMONDS TECHNICAL SERVICES, INC.

SCALE	NTS	APPROVED BY		DRAWN BY	SS
DATE	05/07/91			REVISED	06/08/15

DRAWING TITLE: 4T TURBINE DRIVE

MAT'L: CARBON STEEL

DRAWING NUMBER: 1188



ITEM	PART NO.	QTY.	DESCRIPTION
1	101014	1	POWER FRAME
2	221001	1	M DIAPHRAGM, STANDARD
* 2	221008	1	M DIAPHRAGM, VITON, (OPTION)
3	222002	1	FLUID END, M
4	882949	8	LOCK WASHER, #10 INT. TOOTH
5	101037	4	SCREW, 10-32 x 1 1/2"
1 6	101842	1	CROSSHEAD GUIDE
7	101007	2	RETURN SPRING
8	101006	1	CROSSHEAD
9	101152	2	SLIDE BEARING
10	101005	1	STROKE ADJUSTMENT CAM
11	101003	1	CAM GUIDE
12	101001	1	STROKE ADJUSTMENT KNOB
13	101002	1	POWER FRAME COVER
14	101004	1	LOCK SCREW
15	101009	4	SCREW, 8-32 x 3/8"
16	881086	4	LOCKWASHER, #6
17	101010	4	SCREW, 6-32 x 3/8"
18	881089	4	SCREW, 10-32 x 3/4"
18A	881660	4	SCREW, 10-32 x 2 1/4" (OPT)
3 2 19	102463	2	CHECK VALVE, AFLAS
	102464	2	CHECK VALVE, VITON (OPT)
	102642	2	CHECK VALVE, KALREZ (OPT)
20	222001	1	ADAPTER RING, M
21	222003	1	BACK UP RING
22	881170	4	SCREW, #10 x 5/8" BUTTON HD.
23	101038	4	LOCKWASHER, #10 H.C.
24	882911	1	CHECK VALVE, 5 PSI, AFLAS (STD)
	101576	1	CHECK VALVE, 5 PSI, VITON (OPT)
	102643	1	CHECK VALVE, 5 PSI, KALREZ (OPT)
25	101088	1	3/8 x 1/4 FNPT TUBE ADAPT.

NO.	REVISION	DATE	BY	APPVD
3	WAS #101933	03/15/04	SS	X
2	SOFT SEAT CHK VLV	09/03/02	SS	X
1	WAS #101008	08/99	SS	X

DRAWING	LEVELS	VIEW
INJECTOR	10,12,14,16,18,20,24	1
	28,30,39-41,67-76,129	

FROM SER#	DATE	TO SER#	DATE
X	X	X	X

TOLERENCES
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED.

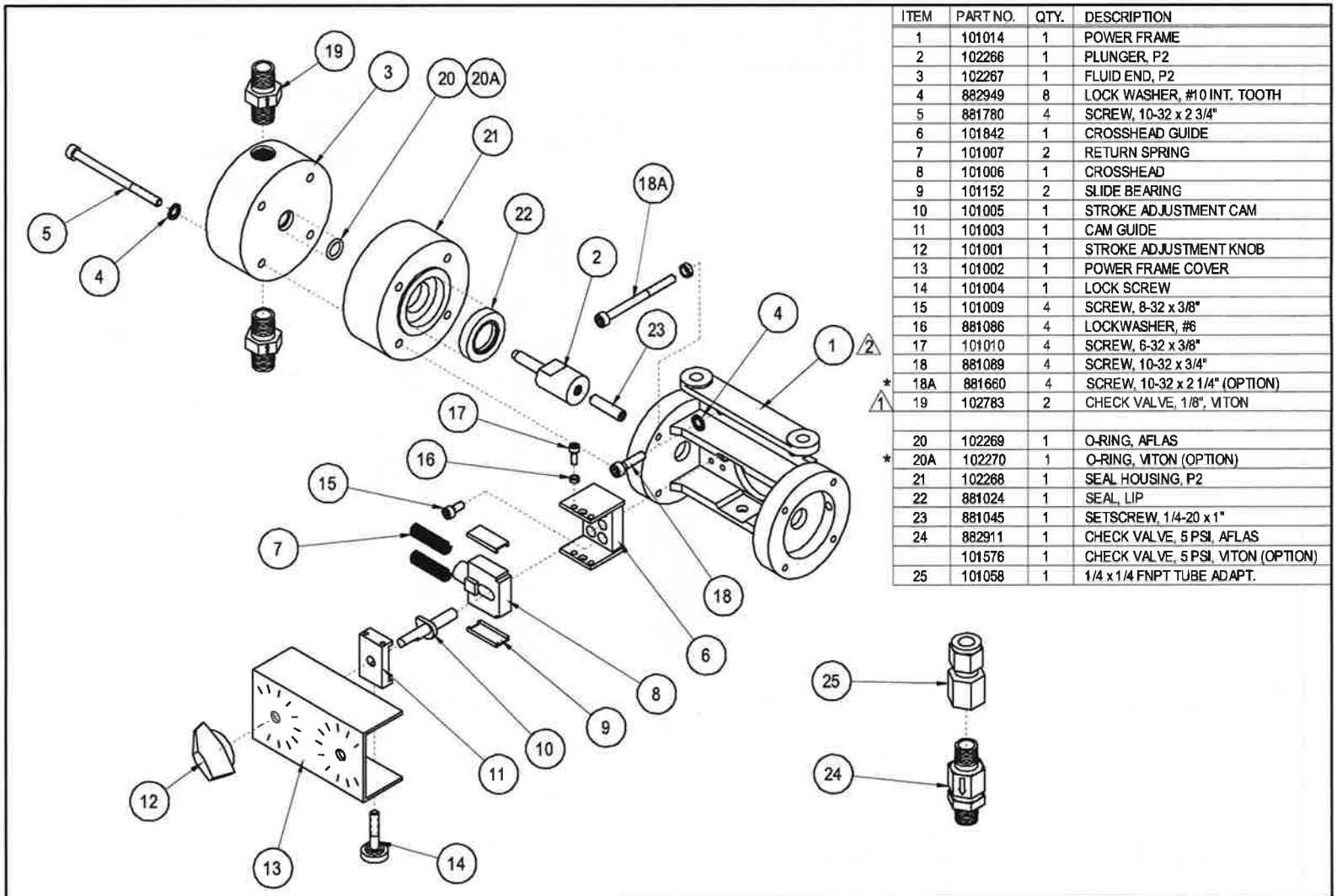
*TOL. DECIMALS: .XXX= +/-.005, .XX= +/-.015, .X= +/-.030, FRAC.= +/-1/16
*TOL. ANGLES: +/- .5 DEGREES
*CONCENTRICITY: .005 T.I.R.
SURFACE FINISH 125
*REMOVE BURRS AND BREAK EDGES .005 MIN.

HAMMONDS TECHNICAL SERVICES, INC.

SCALE	APPROVED	PART NUMBER	DRAWN BY
NTS			SS
DATE 10/01/87			REVISED 03/15/04

DRAWING TITLE: HAMMONDS 1M PUMP ASSEMBLY

DRAWING NUMBER: 0593



ITEM	PART NO.	QTY.	DESCRIPTION
1	101014	1	POWER FRAME
2	102266	1	PLUNGER, P2
3	102267	1	FLUID END, P2
4	882949	8	LOCK WASHER, #10 INT. TOOTH
5	881780	4	SCREW, 10-32 x 2 3/4"
6	101842	1	CROSSHEAD GUIDE
7	101007	2	RETURN SPRING
8	101006	1	CROSSHEAD
9	101152	2	SLIDE BEARING
10	101005	1	STROKE ADJUSTMENT CAM
11	101003	1	CAM GUIDE
12	101001	1	STROKE ADJUSTMENT KNOB
13	101002	1	POWER FRAME COVER
14	101004	1	LOCK SCREW
15	101009	4	SCREW, 8-32 x 3/8"
16	881086	4	LOCKWASHER, #6
17	101010	4	SCREW, 6-32 x 3/8"
18	881089	4	SCREW, 10-32 x 3/4"
* 18A	881660	4	SCREW, 10-32 x 2 1/4" (OPTION)
1 19	102783	2	CHECK VALVE, 1/8", VITON
20	102269	1	O-RING, AFLAS
* 20A	102270	1	O-RING, VITON (OPTION)
21	102268	1	SEAL HOUSING, P2
22	881024	1	SEAL, LIP
23	881045	1	SETSCREW, 1/4-20 x 1"
24	882911	1	CHECK VALVE, 5 PSI, AFLAS
	101576	1	CHECK VALVE, 5 PSI, VITON (OPTION)
25	101058	1	1/4 x 1/4 FNPT TUBE ADAPT.

NO.	REVISION	DATE	BY	APPVD
2	WAS #102463	02/20/08	SS	X
1	WAS #101933	03/15/04	SS	X

DRAWING	LEVELS
INJECTOR	10,12,14,16,18,20,24,28, 30,39-41,89,90,202-205

FROM SER#	DATE	TO SER#	DATE
X	X	X	X

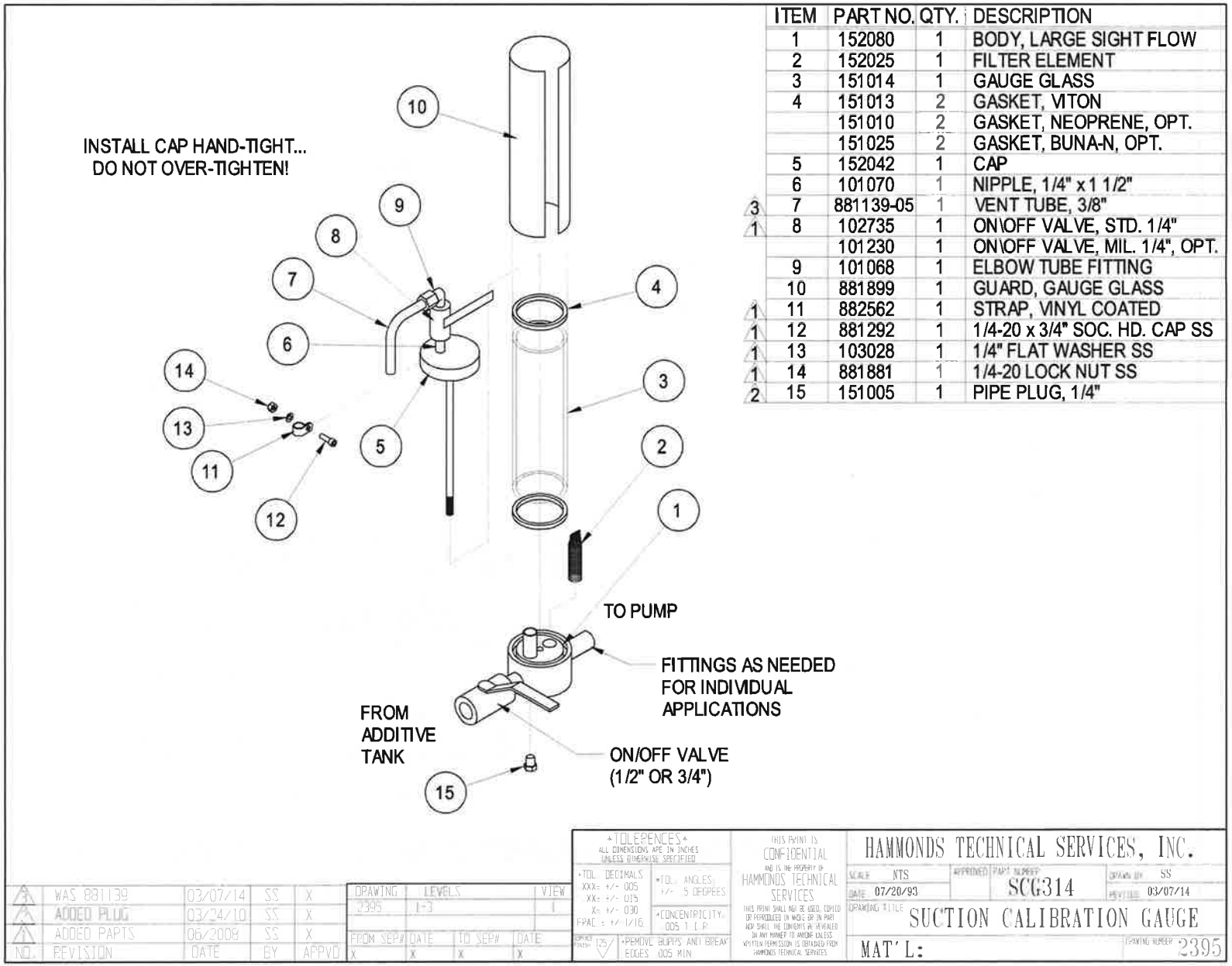
TOLERENCES
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED
*TOL. DECIMALS: .XXX= +/-.005 .XX= +/-.015 .X= +/-.030 FRAC.= +/-1/16
*TOL. ANGLES: +/- .5 DEGREES
*CONCENTRICITY: .005 T.I.R.
125 *REMOVE BURRS AND BREAK EDGES .005 MIN.

HAMMONDS TECHNICAL SERVICES, INC.

SCALE	NTS	APPROVED	PART NUMBER	DRAWN BY	SS
DATE	06/20/95			REVISED	02/20/08

DRAWING TITLE HAMMONDS 1P2 PUMP

DRAWING NUMBER 4567



ITEM	PART NO.	QTY.	DESCRIPTION
1	152080	1	BODY, LARGE SIGHT FLOW
2	152025	1	FILTER ELEMENT
3	151014	1	GAUGE GLASS
4	151013	2	GASKET, VITON
	151010	2	GASKET, NEOPRENE, OPT.
	151025	2	GASKET, BUNA-N, OPT.
5	152042	1	CAP
6	101070	1	NIPPLE, 1/4" x 1 1/2"
3 7	881139-05	1	VENT TUBE, 3/8"
1 8	102735	1	ON\OFF VALVE, STD. 1/4"
	101230	1	ON\OFF VALVE, MIL. 1/4", OPT.
9	101068	1	ELBOW TUBE FITTING
10	881899	1	GUARD, GAUGE GLASS
1 11	882562	1	STRAP, VINYL COATED
1 12	881292	1	1/4-20 x 3/4" SOC. HD. CAP SS
1 13	103028	1	1/4" FLAT WASHER SS
1 14	881881	1	1/4-20 LOCK NUT SS
2 15	151005	1	PIPE PLUG, 1/4"

NO.	REVISION	DATE	BY	APPVD
3	WAS 881139	03/07/14	SS	X
2	ADDED PLUG	03/24/10	SS	X
1	ADDED PARTS	06/2008	SS	X

DRAWING	LEVELS	VIEW
2395	1-3	1

FROM SERV	DATE	TO SERV	DATE
X	X	X	X

TOLERENCES
ALL DIMENSIONS ARE IN INCHES
UNLESS OTHERWISE SPECIFIED

*TOL. DECIMALS
XXX= +/- .005
XX= +/- .015
X= +/- .030
FRAC = +/- 1/16

*TOL. ANGLES
+/- 5 DEGREES

*CONCENTRICITY
.005 T.I.R.

SURFACE FINISH 125

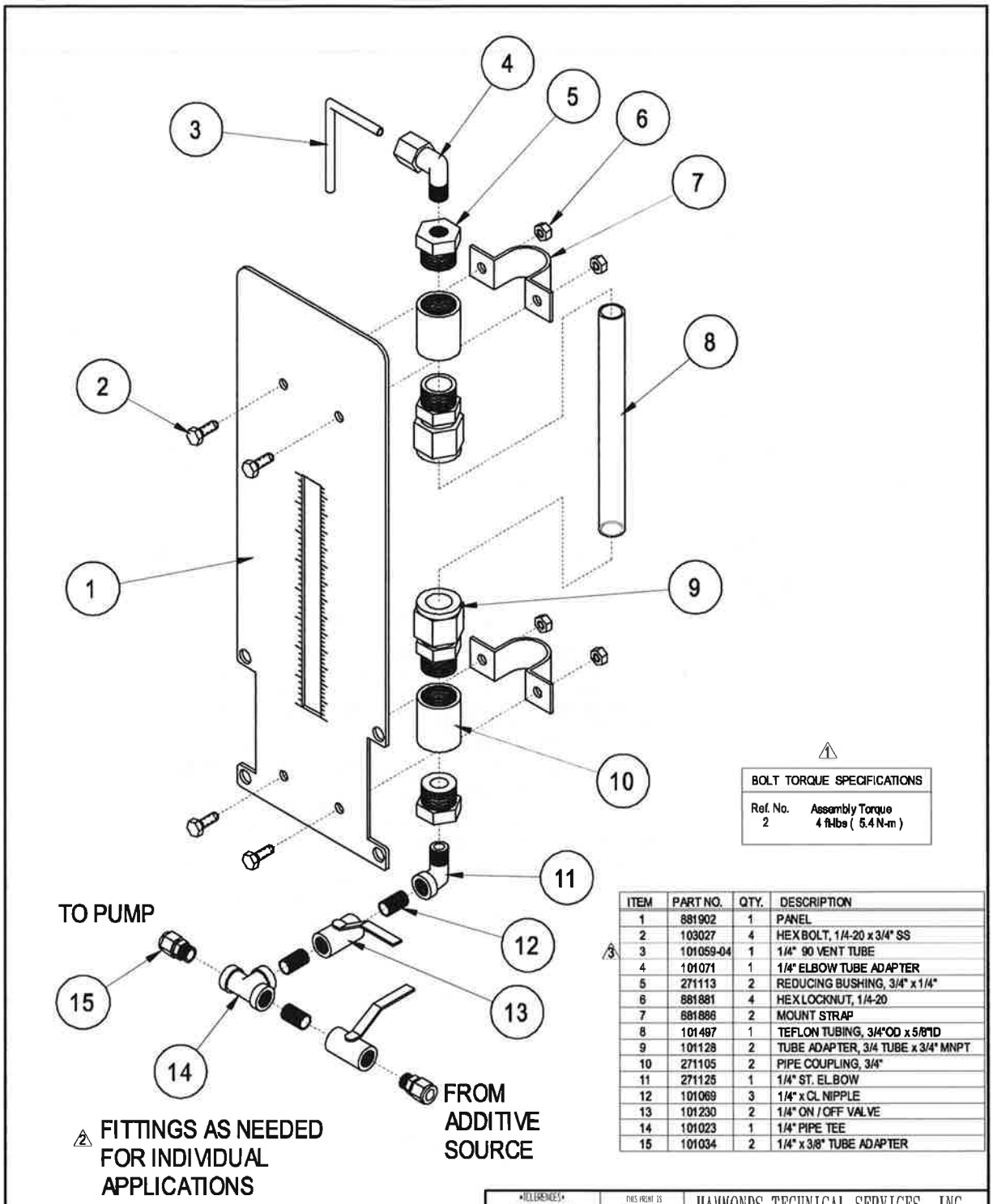
*REMOVE BURRS ANTI BREAK EDGES .005 MIN

HAMMONDS TECHNICAL SERVICES, INC.

SCALE	APPROVED	PART NUMBER	DRAWN BY
NTS		SCG314	SS
DATE 07/20/93			REVISED 03/07/14

DRAWING TITLE: SUCTION CALIBRATION GAUGE

MAT'L: DRAWING NUMBER 2395



⚠1

BOLT TORQUE SPECIFICATIONS	
Ref. No.	Assembly Torque
2	4 ft-lbs (5.4 N-m)

ITEM	PART NO.	QTY.	DESCRIPTION
1	881902	1	PANEL
2	103027	4	HEX BOLT, 1/4-20 x 3/4" SS
⚠3 3	101059-04	1	1/4" 90 VENT TUBE
4	101071	1	1/4" ELBOW TUBE ADAPTER
5	271113	2	REDUCING BUSHING, 3/4" x 1/4"
6	881881	4	HEX LOCKNUT, 1/4-20
7	881886	2	MOUNT STRAP
8	101497	1	TEFLON TUBING, 3/4"OD x 5/8"ID
9	101128	2	TUBE ADAPTER, 3/4 TUBE x 3/4" MNPT
10	271105	2	PIPE COUPLING, 3/4"
11	271125	1	1/4" ST. ELBOW
12	101069	3	1/4" x CL NIPPLE
13	101230	2	1/4" ON / OFF VALVE
14	101023	1	1/4" PIPE TEE
15	101034	2	1/4" x 3/8" TUBE ADAPTER

NO.	REVISION	DATE	BY
⚠1	WAS 101059	02/17/14	SS
⚠2	ADDED NOTE	01/15/10	SS
⚠3	ADD BOLT TORQUE	11/01/06	SS

DRAWING	LEVELS		VIEW
CAL	20-23		1
FROM SER#	DATE	TO SER#	DATE
X	X	X	X

REFERENCES

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HAMMONDS TECHNICAL SERVICES, INC.

SCALE: NTS | APPROVED BY: | SCG112 | DRAWN BY: SS

DATE: 04/10/00 | REVISED: 02/17/14

DRAWING TITLE: SUCTION CALIBRATION GAUGE

MAT'L: | DRAWING NUMBER: 3964

GEAR REDUCER MAINTENANCE

HUB CITY WORM GEAR SPEED REDUCERS
LUBRICATION & INSTALLATION INSTRUCTIONS — SINGLE & DOUBLE REDUCTION

⚠ CAUTION

ALL HUB CITY WORM GEAR SPEED REDUCERS ARE SHIPPED DRY. OIL MUST BE ADDED PRIOR TO OPERATION.

APPROXIMATE OIL CAPACITIES — WORM GEAR REDUCERS
SERIES 130 THRU GW100

SERIES	MOUNTING POSITION	NOTES	QUANTITY (Pints) Shaft Output	Hollow Bore Output	Drop Bearing
130	Worm Top		0.44	0.44	N/A
	Worm Bottom		0.38	0.38	N/A
	Vertical Input		0.31	0.31	N/A
	Vertical Output	---	0.31	0.31	N/A
W150	Worm Top		1.50	1.44	N/A
	Worm Bottom		1.00	1.00	N/A
	Vertical Input		1.00	1.00	N/A
	Vertical Output	---	1.00	1.00	N/A
180	Worm Top		.88	.81	N/A
	Worm Bottom		0.81	0.75	N/A
	Vertical Input		0.63	0.63	N/A
	Vertical Output	---	0.63	0.63	N/A
210	Worm Top		1.50	1.38	N/A
	Worm Bottom		1.25	1.12	N/A
	Vertical Input		1.00	1.00	N/A
	Vertical Output	---	1.12	1.00	N/A
W240	Worm Top		3.00	2.88	N/A
	Worm Bottom		2.50	2.50	N/A
	Vertical Input		2.00	2.00	N/A
	Vertical Output	---	2.00	2.00	N/A
260	Worm Top		3.00	2.75	N/A
	Worm Bottom		2.38	2.25	N/A
	Vertical Input		2.00	1.88	N/A
	Vertical Output	---	2.12	1.88	N/A
300	Worm Top		7.00	6.50	N/A
	Worm Bottom		5.25	5.25	N/A
	Vertical Input		4.25	4.25	N/A
	Vertical Output	---	4.50	4.50	N/A
320	Worm Top		4.75	4.00	7.50
	Worm Bottom		4.00	3.63	5.50
	Vertical Input		3.12	2.75	4.50
	Vertical Output	---	3.12	2.75	5.00 Vertical Down 3.00 Vertical Up
380	Worm Top		7.38	6.50	8.50
	Worm Bottom		6.38	6.12	7.00
	Vertical Input	***	4.63	4.38	5.75
	Vertical Output	---	4.38	4.12	6.00 Vertical Down 4.00 Vertical Up
W420	Worm Top		7.00	7.00	12.00
	Worm Bottom		9.50	9.50	12.00
	Vertical Input	***	8.00	8.00	12.00
	Vertical Output	---	8.00	8.00	12.00
450	Worm Top		7.00	5.20	9.00
	Worm Bottom		4.80	4.00	5.70
	Vertical Output	---	3.80	3.00	5.80 Vertical Down 3.80 Vertical Up
520	Worm Top		10.60	7.30	14.50
	Worm Bottom		7.50	5.10	9.30
	Vertical Output	---	5.50	3.80	9.40 Vertical Down 5.50 Vertical Up

SERIES	MOUNTING POSITION	NOTES	QUANTITY (Pints) Shaft Output	Hollow Bore Output	Drop Bearing
GW60	Worm Top		19.50	19.50	27
	Worm Bottom		20.50	20.50	27
	Vertical Output	---	20	20	27
GW70	Worm Top		35	35	40
	Worm Bottom		32.75	32.75	40
	Vertical Output	---	20.75	20.75	40
GW80	Worm Top		48	48	63
	Worm Bottom		51.25	51.25	63
	Vertical Output	---	28.75	28.75	63
GW100	Worm Top		72	72	102
	Worm Bottom		80	80	102
	Vertical Output	---	40	40	102
W300	Worm Top		N/A	0.70	N/A
	Worm Bottom		N/A	0.40	N/A
	Vertical Output	---	N/A	0.40	N/A
W50B	Worm Top		N/A	3.20	N/A
	Worm Bottom		N/A	2.00	N/A
	Vertical Output	---	N/A	3.50	N/A
W516	Worm Top		5.25	5.25	N/A
	Worm Bottom		2.75	2.75	N/A
	Vertical Output	---	2.60	2.60	N/A

*** This quantity of oil will fill the unit to the centerline.
Factory modifications required to provide sealed top bearing.
No modifications needed on Series 380 if quill-type C-Flange is mounted up.

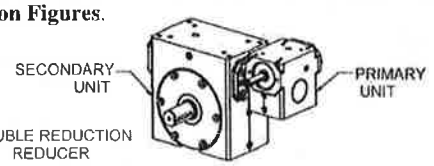
--- This quantity of oil will fill the unit to the centerline.
Factory modifications required to provide grease pack and Nilos ring at top bearing.

⚠ CAUTION

Always check for proper oil level after filling. Capacities vary somewhat with model and mounting position. Oil should rise to bottom edge of Oil Level Plug (2) hole. Do not overfill.

SPECIAL INSTRUCTIONS FOR DOUBLE REDUCTION REDUCERS:

The Primary Unit and the Secondary Unit each have independent oil reservoirs. Each unit must be filled to the specified level of oil as noted in **Mounting Position Figures**.



If the final mounting position of the Double Reduction Reducer is such that either the input shaft of the Primary Unit or the Input (High Speed) shaft of the Secondary Unit is in a vertical position, consult the factory for special lubrication instructions.

SPECIAL INSTRUCTIONS FOR DROP BEARING REDUCERS:

When Drop Bearing unit is positioned Output Vertical-Up or Output Vertical-Down an adequate amount of lubrication must be supplied to the upper Bearing through Grease Fitting (4X). All Drop Bearing units are equipped with Double Seals on the Output Shaft. Periodically the Pipe Plugs (5X) should be removed, a Grease Fitting inserted in one hole, and enough grease injected to purge all of the old grease from between the seals.

⚠ CAUTION

Excessive setscrew torque may cause damage to the output sleeves in hollow bore units. Please refer to the following table for recommended tightening torque.

SIZE	RECOMMENDED TORQUE
1/4 NC	87 LB. - IN.
5/16 NC	165 LB. - IN.
3/8 NC	290 LB. - IN.

⚠ WARNING

For safe operation and to continue the unit warranty, when installing, reinstalling, or replacing a factory installed fastener for servicing purpose, or to accommodate the mounting of guards, shields or other light load imposing devices, or for mounting the unit, it becomes the responsibility of the purchaser or user to properly determine the quality, grade of fastener, thread engagement, load carrying capacity, tightening torque, and the means of torque retention.

COUPLINGS — Flexible couplings to input and output shafts are recommended because they minimize bearing and gear wear caused by slight misalignment. Follow coupling manufacturer's recommendations for installation and shielding.

SHEAVES AND SPROCKETS — When mounting sheaves or sprockets, the center of the load should be located as close to the reducer as possible. Excessive overhung loading could result in early failures of bearing or shaft. Refer to the general catalog or contact your local distributor for overhung load ratings. Follow manufacturer's recommendations for installation and shielding.

⚠ CAUTION

Test run unit to verify operation. If the unit being tested is a prototype, that unit must be of current production configuration.

RUN-IN PERIOD — A new unit will not operate at maximum efficiency during the run-in period. Increased current draw or heat rise may be seen during this time.

PREVENTATIVE MAINTENANCE — Keep shafts and vent plug clean to prevent foreign particles from entering seals or gear case. Inspect periodically for oil leaks.

⚠ CAUTION

Mounting bolts, coupling fasteners, and other power transmitting devices should be routinely checked to ensure that all parts of the unit are firmly anchored to provide proper operation (loose fasteners can cause alignment problems and excessive wear). Check end play in shafts. Noticeable movement might indicate service or parts replacement is necessary.

⚠ CAUTION

If the unit cannot be located in a clear and dry area with access to an adequate cooling air supply, then precautions must be taken to avoid ingestion of contaminants such as water, and to avoid a reduction of cooling ability due to exterior contaminants.

HUB CITY has Sales Offices and a network of Industrial Power Transmission Distributors that can serve your needs world wide. Check the Yellow Pages for one near you or contact the factory sales office.

IMPORTANT INFORMATION:

In the event of the resale of this Worm Gear Speed Reducer (unit), in whatever form, resellers/buyers will include the following language in a conspicuous place and in a conspicuous manner in a written agreement covering such sale:

The manufacturer makes no warranty or representations, express or implied, by operation of law or otherwise, as to the merchantability or fitness for a particular purpose of the goods sold hereunder. Buyer acknowledges that it alone has determined that the goods purchased hereunder will suitably meet the requirements of their intended use. In no event will manufacturer be liable for consequential, incidental, or other damages.

Resellers/buyers agree to include this entire document, including the warnings and cautions listed herein, in a conspicuous place and in a conspicuous manner to instruct users on the safe usage of the product

ELECTRIC MOTOR AND HYDRAULIC MOTOR AND PUMP INSTALLATION INSTRUCTIONS
For "C" Flange and Hydraulic Flange Units

1. Be sure all of the paint and masking have been removed from the face and pilot of the flange. Check the bore (input or output) to be sure it contains an adequate amount of anti-seize compound, which is normally installed at the factory. This compound will inhibit fretting corrosion between the motor or pump shaft and the unit bore.
2. Install the key (if round bore) to the maximum depth of the keyway provided in the bore.
3. Align keyways or splines of motor or pump and bore of unit and install motor or pump into frame.
4. **CAUTION:** HUB CITY "C" flange reducers and Hydraulic Flange Reducers are designed to accept motors with shafts that do not exceed the maximum specified by the N.E.M.A. or SAE standards. If the motor or pump shaft bottoms out before the motor or pump flange seats against the reducer flange face, the motor or pump shaft length must be adjusted to N.E.M.A. or SAE standards.
5. Secure the motor or pump to the unit. Capscrews and lockwashers are provided with "C" flange units.
6. Tightening torques for mounting bolts are provided in the chart below.

CAPSCREW TIGHTENING TORQUE
Grade 5 Capscrews (dry, without lubricant)

Capscrew Size	Tightening (Ft. - Lbs.)		Capscrew Size	Tightening (Ft. - Lbs.)
1/4 NC	8		1/2 NC	71
5/16 NC	16		5/8 NC	143
3/8 NC	29		3/4 NC	251

A Parts List and Print for your Drive is available upon request. To obtain the proper Parts List and Print, you must accurately furnish the Assembly Number, Model Number, Ratio, Style and Shipping Code as shown on the tag attached to the Gear Drive. For assistance, phone or write your Industrial Power Transmission Distributor, or the Factory Sales Office.