



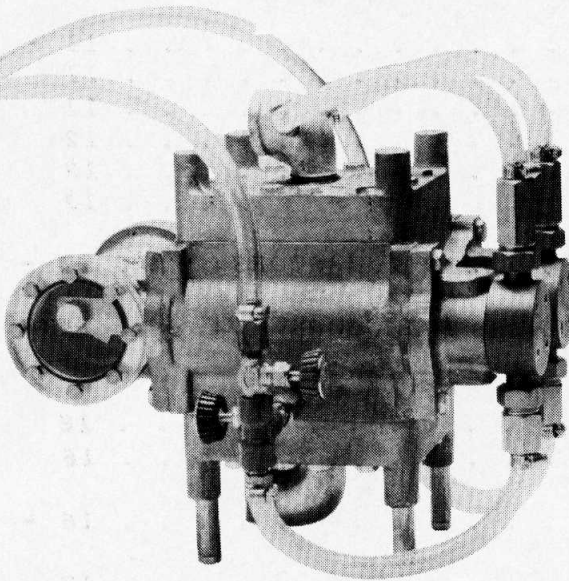
SMITH

cm-2

meaSUREmix

liquid fertilizer

injectors



*** Models**

R-3

R-4

R-6

R-8

*** Installation**

*** Operation**

*** Servicing**

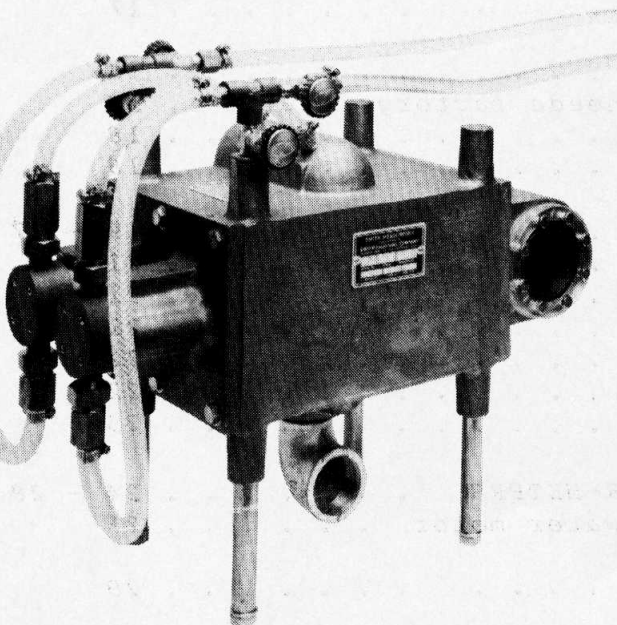


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This manual contains installation, operating, and maintenance instructions for Smith meaSUREmix liquid fertilizer injectors, models R-3, R-4, R-6, and R-8.

CAUTION: THIS MANUAL MUST BE READ THOROUGHLY BEFORE INSTALLATION AND/OR OPERATION OF YOUR INJECTOR. SERIOUS DAMAGE MAY RESULT IF INSTRUCTIONS AND MAINTENANCE PROCEDURES ARE NOT FOLLOWED AS PER THIS MANUAL.

DO YOU HAVE THE CORRECT MODEL INJECTOR

RECOMMENDED WATER FLOW RATES

MODEL NO.	PIPE SIZE	MINIMUM			MAXIMUM		
		USGPM	IGPM	LPM	USGPM	IGPM	LPM
R-3	3/4 NPT	3	2.5	11.4	12	10.0	45.4
R-4	1 NPT	5	4.2	18.9	20	16.6	75.7
R-6	1-1/2 NPT	10	8.3	37.8	40	33.3	151.0
R-8	2 NPT	20	16.6	75.7	100	83.3	378.0

It is imperative that you know what your water flow rate is (usually in GPM) to enable use of the proper model injector for your system. The above table lists the maximum and minimum water flow rates according to pipe size recommended for each model injector. The following lists four different methods of checking your water flow rate if you have not already done so.

1. METER METHOD

If the water supplied to your system flows through a water meter, the flow rate can be obtained easily. Turn on your sprinkler or irrigation system fully. Read the meter at a specific time, allow the meter to run for a period of minutes, and then read the meter again. Since most water meters measure in terms of cubic feet, it will be necessary to convert the difference between beginning and ending meter readings into gallons. The formula for this conversion is:

$$\text{GPM} = 7.5 \times \frac{\text{ending meter reading} - \text{beginning meter reading}}{\text{minutes of test}}$$

NOTE: A trick may be used to obtain the answer quickly by timing the meter for exactly seven and a half minutes. The difference in beginning meter reading and ending meter reading will then be gallons per minute, because the 7.5 cancels out in the formula.

2. OPEN CONTAINER METHOD

If the water supply flows through a single opening, a suitable container can be used to measure the water flow rate. Simply turn on the flow fully, and time how many minutes it takes for the tank to fill. Divide the capacity of the tank in gallons by the number of minutes to obtain flow rate in gallons per minute.

3. SPRINKLER HEAD METHOD

A pressure gage is required to obtain necessary information to estimate the water flow rate of a system with sprinkler heads. The sprinkler system should be operating fully.

- a. Read and record the pressure gage with the sprinkler system operating fully.
- b. Count and record the number of sprinklers operating.
- c. Multiply the flow rate per sprinkler head at the particular pressure.
(Sprinkler head flow rate information for a given pressure can be obtained from the sprinkler head manufacturer or from his sales representative.)

4. METHOD IF SYSTEM USES PUMP

If a pump is utilized in the system, a pressure gage should be installed in the piping. When the system is operating fully, the pressure indicated on the gage should be read and recorded. The pump manufacturer or his sales representative can supply information regarding the flow rate of the pump against the particular pressure.

Once you have calculated your flow rate, it is of utmost importance that the maximum water flow rate for your particular model not be surpassed. If it is, over-revving will cause premature wear and will seriously damage your injector. Likewise, it is just as important that the minimum flow rate be met as inaccurate proportioning may result. Also, if the minimum flow rate is not attained, the unit may stall and not proportion at all.

FLUID TABLE AND RECOMMENDED OPTIONS

Smith Precision Products Co. offers several different option MeASUREmix injectors which are specified according to the type of chemical to be injected. Our injectors are designed for specific groups of chemicals, and for this reason it is important that the correct option be used.

Options C, W, and F are our standard options. Option C, W, and F injectors all contain stainless steel double-ball check valves, a brass priming valve, a stainless steel chemical and dip-tube valve, and various other stainless steel fittings. Option C, W, and F injectors are designed to inject nearly all inorganic commercial fertilizer salts provided they are not acidic in nature. For these standard options, a pH below 5 is considered acidic. Option C, W, and F injectors are designed to inject Phosphoric acid, the one exception to the above.

Option P is our acid option. Option P injectors contain special acid resistant plastic polymers which include PVC chemical and priming valves (See sheet AM-4), PVC fittings, PVC single-ball check valves, PVC inserted injector head, viton o-rings, and various other plastic parts. Option P injectors are designed to inject acids other than Phosphoric. If Sulfuric, Nitric, or Hydrochloric acids are to be injected, and/or the pH of solution is less than 5, an Option P machine is recommended.

Option I should be used for insecticide/fungicide applications. Option I injectors utilize brass and stainless steel chemical and priming valves, stainless steel double ball check valves, and other stainless steel and brass pieces. Option I can be used to replace options C, W, and F, on an intermittent basis.

Various combinations of Option C, W, F, P, and I can be ordered, also depending on the chemical to be injected. In some cases, special high pressure tubing may be required. Contact factory for specifics.

TABLE I

FLUID TABLE

<u>LIQUID</u>	<u>RECOMMENDED OPTION</u>
AMMONIA LIQUOR	C,W,F
AMMONIATED SUPERPHOSPHATE	C,W,F
AMMONIUM NITRATE	C,W,F
AMMONIUM SULFATE	C,W,F
ANHYDROUS AMMONIA	C,W,F
BANROT	I
BENLATE	I
CALCIUM CYANAMID	C,W,F
CALCIUM PHOSPHATE	C,W,F
CAPTAN	I
CHELATED IONS	C,W,F
CHLORDANE	I
COPPER CARBONATE	C,W,F
COPPER SULFATE	C,W,F
DEXON	I
DIAMMONIUM PHOSPHATE	C,W,F
FERBAM	I
FERROUS SULFATE	C,W,F
HYDROCHLORIC ACID	P
KELTHANE	I
KINOPRENE	I
MALATHION	I
MANGANESE SULFATE	C,W,F
METALDEHYDE	I
MURIATE OF POTASH	C,W,F
NITRIC ACID	P
PENTAC	I
PHOSPHORIC ACID	C,W,F
POTASSIUM CHLORIDE	C,W,F
POTASSIUM NITRATE	C,W,F
POTASSIUM PHOSPHATE	C,W,F
POTASSIUM SULFATE	C,W,F
PREMIXES	C,W,F
SEVIN	I
SODIUM MOLYBDATE	C,W,F
SODIUM NITRATE	C,W,F
SULFURIC ACID	P
TEMIK	I
TERRACHLOR	I
TERRAZOLE	I
TRUBAN	I
UREA	C,W,F
ZINC SULFATE	C,W,F

NOTE: THIS TABLE IS DESIGNED TO INDICATE RECOMMENDED OPTION ONLY. CHECK WITH YOUR LOCAL PESTICIDE USE ENFORCEMENT OFFICER TO ENSURE THE CHEMICALS YOU PLAN TO USE ARE LEGAL FOR INJECTOR APPLICATION IN YOUR AREA. THIS IS IMPORTANT AS SOME OF THE LISTED CHEMICAL LIQUIDS MAY BE ILLEGAL FOR INJECTOR APPLICATION IN YOUR AREA.

It must be noted that the above chemicals are the most common ones that we've run across. There most certainly are many others that are not listed here. It must also be noted that some combinations of the above chemicals are not recommended for solution application through our injectors, as the end product released may be harmful to that particular option. A good rule to follow is to mix like chemicals. Mix Sulfates with Sulfates and Nitrates with Nitrates. DO NOT MIX NITRATES WITH SULFATES. If Phosphoric acid is to be injected, DO NOT MIX WITH ANY SOLUBLE FERTILIZER SALT; inject it separately. (See Sheet AM-7)

HOW TO TELL WHAT TYPE OF CHECK VALVE YOU HAVE

One of the major improvements we have made is in the design of our check valves. We have field tested more different types of check valves than we would like to admit but have come up with a superior design we feel is adequate for nearly all injectable solutions. We call this check valve our "stainless steel double-ball" check valve and as can be seen in Fig. 1, these check valves house two S/S seats and two S/S balls. The double-ball check valve is now standard on all option C, W, and F injectors. These valves are by far superior to any conventional check valve, when used in our injectors, as there are no springs, poppets, rubber or plastic working parts to wear out, stick shut, or restrict flow.

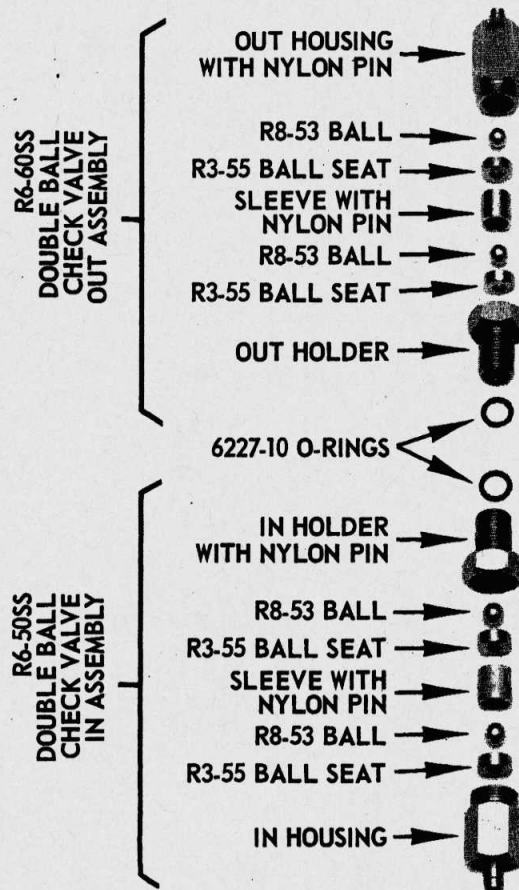


Fig. 1 - Assembly of double-ball check valves

The double-ball check valves can sometimes be repaired by ordering new balls and seats, or using opposite sides of the original seats. However, the sleeve with pin is usually stuck in place, and cannot be easily removed without special tooling. It is best to order exchange check valve assemblies, and not try to repair these critical items.

Smith Precision Products Co., Inc., also offers a single Viton-ball PVC check valve utilized only on option P injectors. These valves are not available under our exchange plan as they are more susceptible to fatigue due to their chemical composition and exposure to highly corrosive solutions.

MAXIMUM WATER FLOW RATE

Open your irrigation system so it will pass the most water per minute that will ever be used. With everything wide open, count the number of revolutions of the crankshaft per minute, as seen through either of the two clear plastic windows. Revolutions per minute, for each machine used, should not exceed:

<u>MODEL</u>	<u>MAXIMUM RPM OF CRANKSHAFT</u>
R-3	240
R-4	180
R-6	160
R-8	100

MINIMUM WATER FLOW RATE

Adjust your irrigation system so it will pass only the least amount of water per minute that will ever be used. Count the revolutions of the crankshaft as before. Revolutions per minute, for each machine used, should never be less than:

<u>MODEL</u>	<u>MINIMUM RPM OF CRANKSHAFT</u>
R-3	60
R-4	45
R-6	40
R-8	20

In certain special cases involving very clean water, meaSUREmix units will usually perform with a minimum RPM of one-half shown in the above table. However, accuracy of injection is not as good at these lower rates, and units run at slower than recommended minimum speed are likely to run jerkily or stall, if an abrasive particle from the water enters the water motor section.

All systems should be so engineered to eliminate as far as practical the water flow restrictions, especially where inlet water pressure is under 50 PSI. It is recommended that all pipes be as large in diameter and as straight as possible, with particular emphasis where long lines are necessary. Items of possible restriction are (if applicable): (1) pump inlet and outlet piping, (2) strainer size, (3) filter size, (4) storage, and/or pressure tanks, (5) back-flow valves, (6) improper hand valves, and (7) relative elevations of all equipment involved.

Should you find that despite all the care you and/or your supplier have taken to specify the correct model of machine has not resulted in your having the right unit, due to the results of the above-described flow tests, contact the factory direct by collect telephone 805-498-6616 for advice. Be prepared to give the model number of your machine, its serial number, and the RPM of the crankshaft test results, both maximum and minimum. You will be connected with an expert who will advise you if a smaller or larger model can be substituted, or whether the machine you have installed can be complemented with a second unit. To avoid delays, red tape, and paperwork, it is best to work with our factory experts when it appears that an incorrect model meaSUREmix may have been installed.

CHOICE OF CHEMICALS

We strongly advise that your choice of chemicals be based on the advice of soil and plant analysis experts. Advice from these men who can analyze your soil and/or plant tissues regularly will bring you the greatest success, and cost the least in the long run. The standard meaSUREmix units are designed to take thin chemical mixes.

INJECTION OF ACIDS

Sometimes a pH problem comes up in the soil, and you may want to inject a weak solution of Phosphoric or Sulfuric Acid to correct this. In case of need, write for our special sheet AM-3 and AM-12 covering this subject. Any standard option meaSUREmix will need to be modified if any acid other than Phosphoric Acid is used. We do not recommend that you use acids other than Phosphoric or Sulfuric, and we wish to emphasize that you do not inject either without first carefully studying our sheets AM-3 and AM-12. ALL ACIDS SHOULD BE INJECTED SEPARATELY, to eliminate corrosive chemical reactions.

PROPORTION SETTING

All meaSUREmix units are permanently set at a definite proportion. This avoids the dangerous possibility of changing the proportion incorrectly and burning plants as a result. The standard proportion for R-3 and R-4 models is 1:100. For R-6 and R-8 models, it is 1:200. Special proportions are available as listed in our price lists, and sheet AM-7. If your injector has a standard proportion, and you want to come out with a special proportion, the original mix can be diluted with water, in accordance with the following tables:

Models R-3 and R-4 with Standard 1:100 Proportion

<u>To obtain:</u>	<u>Mix parts fertilizer:</u>	<u>With parts water:</u>
1:100	Full Strength (Solution)	0
1:125	4	1
1:150	2	1
1:175	4	3
1:200	1	1
1:250	2	3
1:300	1	2

Models R-6 and R-8 with Standard 1:200 Proportion

<u>To obtain:</u>	<u>Mix parts fertilizer:</u>	<u>With parts water:</u>
1:200	Full Strength (Solution)	0
1:250	4	1
1:300	2	1
1:350	4	3
1:400	1	1
1:450	4	5
1:500	2	3

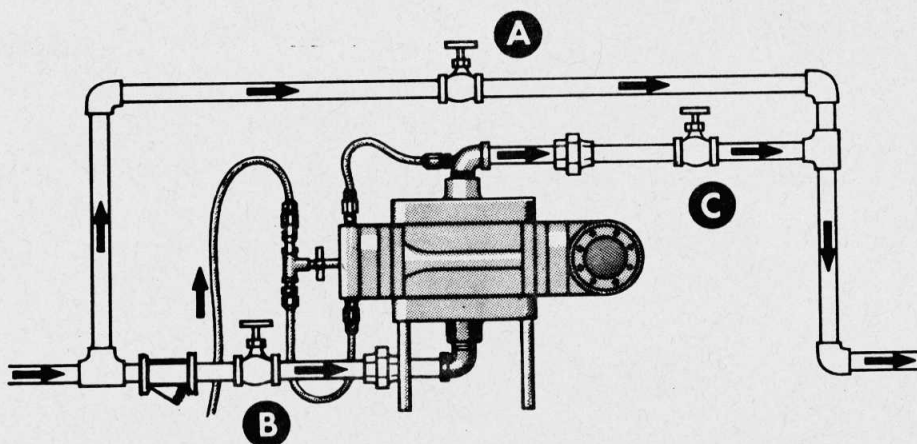


FIGURE 2. Bypass Piping Arrangement

BYPASS PIPING ARRANGEMENT

A bypass piping arrangement, similar to that shown in Figure 2, should be provided in any permanent installation. The bypass arrangement serves two purposes: first, watering can be done at times when fertilizing is not necessary, and second, a meaSUREmix unit can be removed to facilitate repairs, if necessary. If the meaSUREmix model R-3 is used as a portable unit, the bypass arrangement is not necessary, provided that the model R-3 unit is disconnected after use.

For all permanent installations of meaSUREmix units, the bypass arrangement is highly recommended. Figure 2 indicates valves upstream and downstream of the meaSUREmix that can be turned off when the machine is not in use. When pipe line valve A is open, the water bypasses the meaSUREmix provided that valves B and C are closed. During operations, of course, all water used must run through the meaSUREmix with valve A closed and valves B and C open.

"PARALLEL SYSTEM"

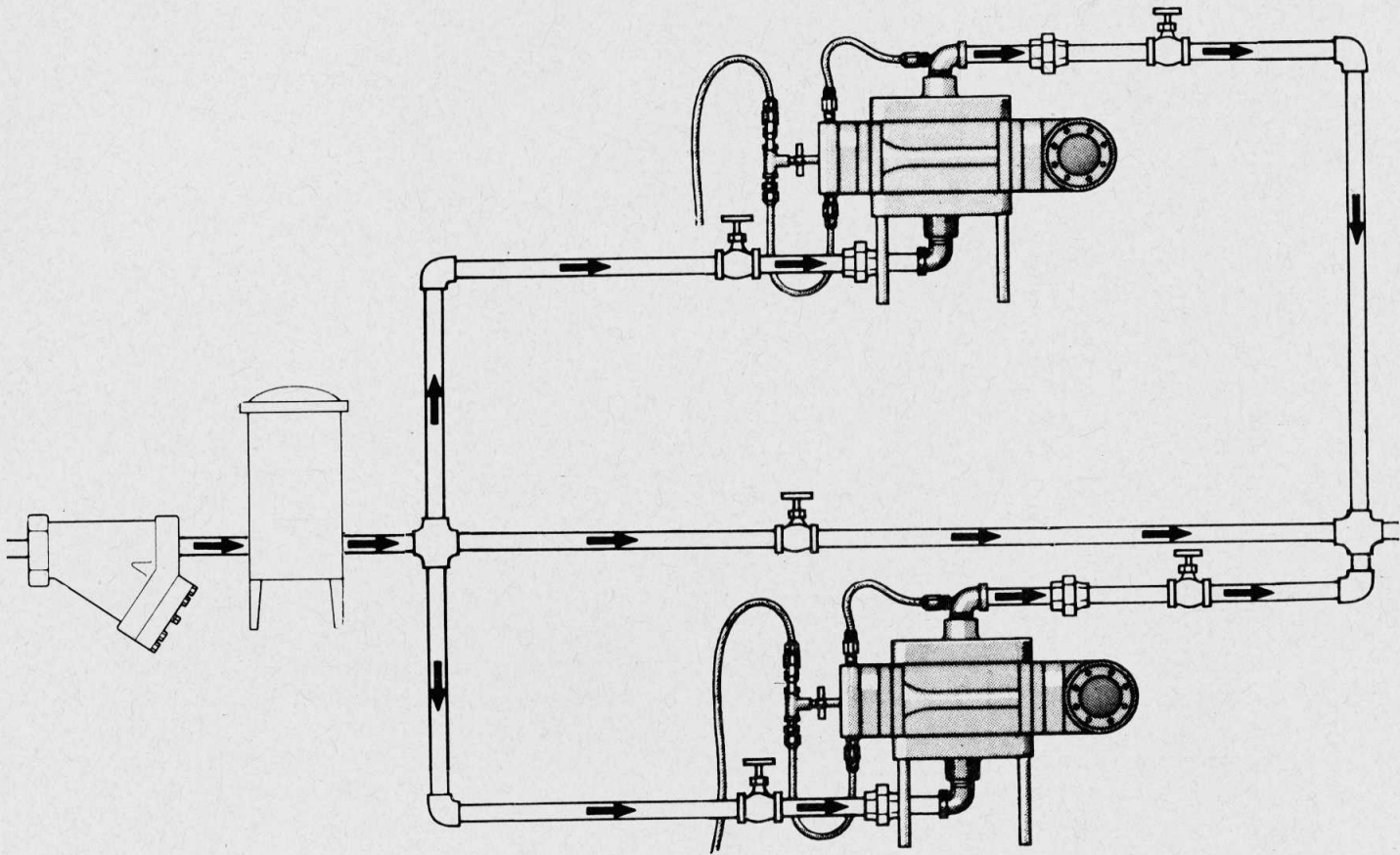


FIGURE 3. Parallel System

PARALLEL SYSTEM

A parallel system can be utilized if your useable flow rate does not coincide with the specified minimum and maximum GPM for a particular unit. For example, an R-4 running parallel with an R-8, increases the useable flow range from 5 to 120 GPM.

PARALLEL SYSTEM WITH AUTOMATIC CUT-OFF

In most well-established irrigation systems, large or small, our assumption has been for many years that the varying demands on the water flow are not gradual, but rather in several definite steps or rates. When these "demand rates" are determined, it is easy to figure out exactly what machines and what flow rates to try through each machine, depending on the available inlet water pressure and the present total pressure drop during regular normal operation of the system.

Any combination of our several meaSUREmix models can be used, but for the sake of argument, let us assume that the pressure in the inlet line, with the system not in operation, is about 80 PSI, and that regardless of how many or how few points of water useage are in operation, the "demand rates" always fall within 5 - 10 GPM or 25 - 45 GPM. Therefore, as an initial experimental setting, the adjustable pressure regulator could be set at about 60 PSI.

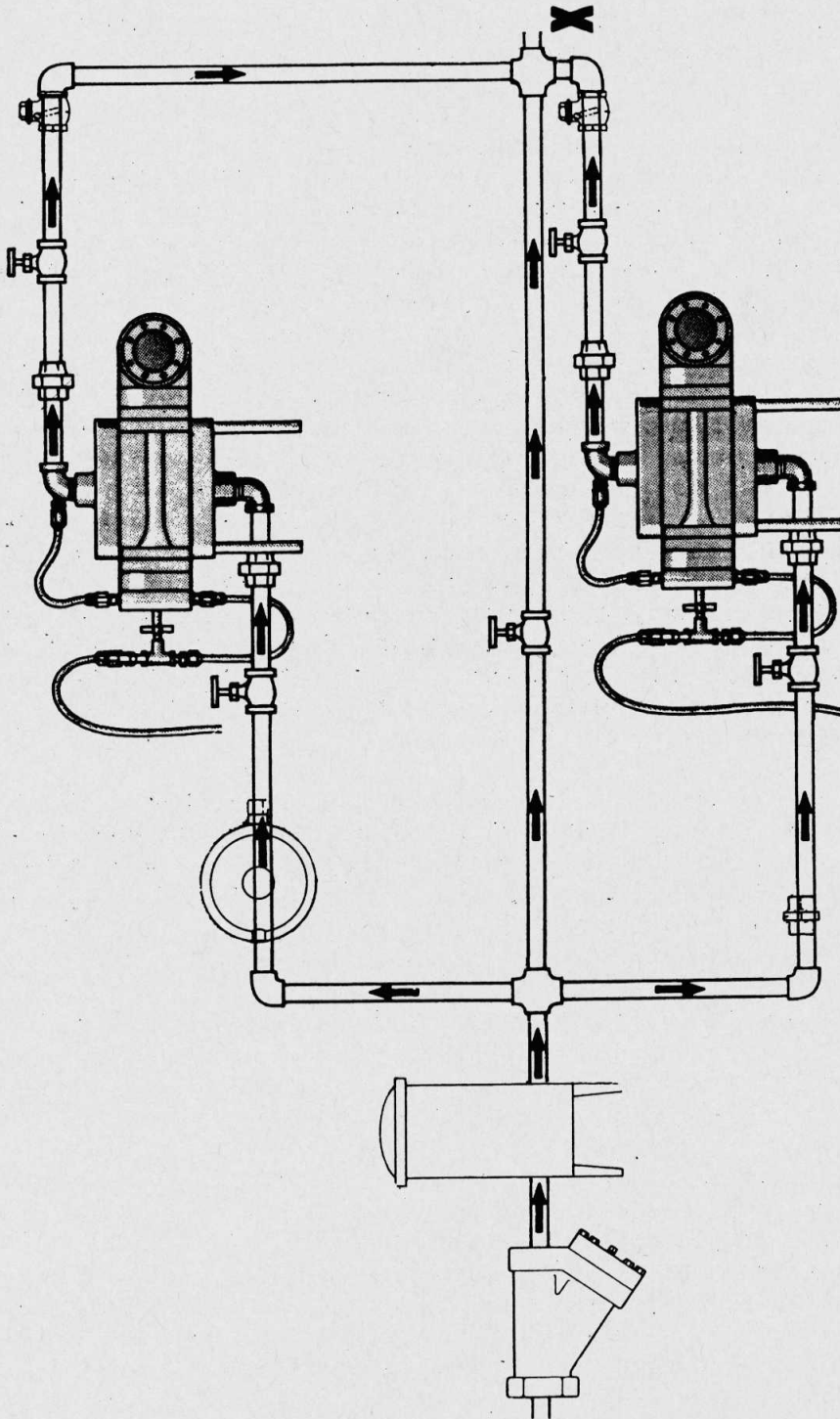
This would mean that as long as the pressure at point "X" were above 60 PSI, the larger machine would not operate. We know that an R-3, operating at maximum flow of 12 GPM, causes a pressure loss of about 15 PSI, and we can guess that the fittings, valves, and small pipe may add another 5 PSI to the total pressure drop at 12 GPM through line "A". Therefore, at any flow rate from 5 to 10 GPM, 100% of the work will be done by the smaller machine. Any flow rate above 12 GPM will mean that the pressure at point "X" will be lower than 60 PSI, and that the flow will begin to pass through both machines at the same time. No flow over 12 GPM can pass through the "DOLE" control, regardless of how high the pressure is, so it is safe to assume that during the entire range of operation, the small meaSUREmix will never be running too fast.

At the bottom end of the high flow "demand rate", 25 GPM, theoretically, 12 GPM would be going through the R-3, and 13 GPM would be going through the R-6. The R-3 would constantly run at 12 GPM throughout the high flow "demand rate", while the R-6 would be speeding up or slowing down. This would, however, in no way affect the proportioning, which would be constant, regardless of how many machines were in operation or how fast they were going.

If, during the transition from high to low flow, there were a tendency for the larger machine to turn off and on, the back flow check valves would eliminate the possibility of water hammer damaging the working parts of either meaSUREmix.

Since every installation is different, there are far too many variables for this explanation to be any more specific. All adjustments, installation of special equipment, and sizing of piping must be the responsibility of the user who must fully comprehend the above theorectical system in order to make it work out correctly. As always, Smith Precision will be happy to assist you on a theoretical basis only, but cannot be responsible for success or failure of the piping system. As previously mentioned, several combinations of units are possible, and they do not necessarily have to be unlike machines. There are several users that are successfully using parallel systems, all of which had to be built and adjusted on a trial and error basis, which they feel was well worth the extra effort due to increased reliability and flexibility.

FIGURE 4.



OPERATION GUIDELINES

DIRTY WATER

The meaSUREmix liquid fertilizer injector is driven by piped irrigation water, and its precision internal components are designed to be lubricated by that water. Just as it is important to keep clean lubricating oil in your automobile engine (which is why most engines have oil filters), so it is also important to be sure only clean water passes through your injector. The usual piped-in water may be considered clean; however, occasional breaks in the water mains, or the continued use of old water mains may allow an occasional shot of sand, gravel, mud, or pipe scale to run through your unit. Such abrasive material will cause serious damage to the water motor section. This possibility is prevented by installing a Y-type in-line strainer.

Should you be pumping water from a lake, pond, or well, and plan to use this water source to operate your meaSUREmix, it is very important to note that most water from these sources has, at least at certain times, some fine silt in it, which can pass right through the holes in a strainer screen and will not settle-out in a holding tank or a dirt trap. This silt causes extremely fast wear, particularly in the crankshaft, and connecting rod bushings, as it always has a tendency to penetrate and build up inside minute working clearances, and can actually be invisible to the naked eye.

In terms of cost, dirty water can cause repairs costing as high as 50% of the price of a new meaSUREmix, per year. Under proper conditions, average cost of upkeep and repairs should not exceed 10% of the new price, per year. Filter manufacturer's representatives are listed in the telephone directory. If you decide to purchase a filter, insist upon "25 micron" cartridges. Write for our sheet AM-2 which discusses this subject in more detail.

DIRTY FERTILIZER

The meaSUREmix is surprisingly wear-resistant to "dirty fertilizer" (that is, undissolved salts, pieces of leaves, twigs, etc., that have fallen into the fertilizer container). However, such solutions may clog the check valves, and require frequent cleaning, which is an unnecessary waste of labor. Further, when the check valves are clogged, the injector does not proportion correctly; and if badly clogged, it will not inject at all. To solve this problem, use a completely soluble fertilizer when making the mix. Another way to keep the check valves from clogging is to install a dip tube strainer on the end of the dip tube. If a dip tube strainer is being used, it too can be clogged. The operator should be aware of this possibility, and should check the strainer frequently. Sometimes, it is a good idea to keep a spare dip tube strainer so that fertilizing can proceed while one is being cleaned.

When properly primed, as described on page 13 under NORMAL OPERATION, your injector can create a near-perfect suction and will lift solutions up through the dip tube from an open container and inject the solution into the water discharge, against pressures as high as 150 psi (or even higher with special modification).

DO'S and DONT'S

To guard against check valve trouble, there are four conditions which should be avoided:

1. Mounting the solution container so high that the level of chemical in solution is higher than the elevation of the discharge pipeline.
2. Leaving the dip tube immersed in chemical solution while the injector is not being used for several hours.
3. Leaving the chemical and dip tube valve open while the injector is not being used for several hours.
4. Closing the valve in the inlet line to the injector without closing the valve in injector outlet line (see piping diagram on page 7).
5. Not backflushing the meaSUREmix as per instructions in this manual.

Any one or all of these things happening at the same time, over a certain time limit, will probably cause the fertilizer concentrate to very slowly feed by gravity through the dip tube, chemical and dip tube valve "S", the check valves, into the water discharge line, and into the water motor. Then when the meaSUREmix is started, the fertilizer accumulations may cause it to sieze, and growing plants will be slugged with undiluted liquid concentrate, and they WILL BE BURNED. Therefore, ALWAYS HAVE THE TOP OF THE FERTILIZER SUPPLY CONTAINER WELL BELOW THE LEVEL OF THE LOWEST PART OF THE WATER DISCHARGE LINE. This will prevent any possibility of plant burning, and will also be an insurance against fertilizers or other injected chemicals from entering into the water motor section of the injector. (See pages 24-28 in this manual, and sheet AM-1.)

PRESSURE LEFT IN MEASUREMIX

In some applications, it may be thought desirable to stop operations by closing a valve in the water discharge line, thus leaving the injector under full water pressure. If this is done for prolonged periods of time, water under pressure can slowly leak back through the check valves, through opened valve "S", and down the dip tube into the fertilizer supply container, thus diluting the mix. Through careful experimentation under actual field conditions, we have designed check valves which we feel are the best for use under all conditions, and are far superior to spring-loaded or rubber types which eventually clog, wear, or imbed themselves with insoluble particles. However, to avoid any possibility of water leakage, it is desirable to remove the dip tube from the chemical container, and/or close hand valve "S", after operations are completed for the day, or any time the machines will be left idle for a few hours.

BACK-FLOW PREVENTION DEVICES

If you use water piped to your installation, you may be required by law, to install some kind of a back-flow prevention device, ahead of the water inlet to your meaSUREmix. Laws on such devices vary greatly, depending upon your location. Information on the proper device for use in your area can usually be obtained from the company that sends you your water bills.

It is our desire to stress at this point that the meaSUREmix, although commonly used very successfully with many other chemicals, was originally intended for the injection of non-toxic plant nutrients, only. We cannot accept any responsibility for the use of these units with insecticides, fungicides, or any other chemicals that may be potentially injurious to human, animal, or plant life.

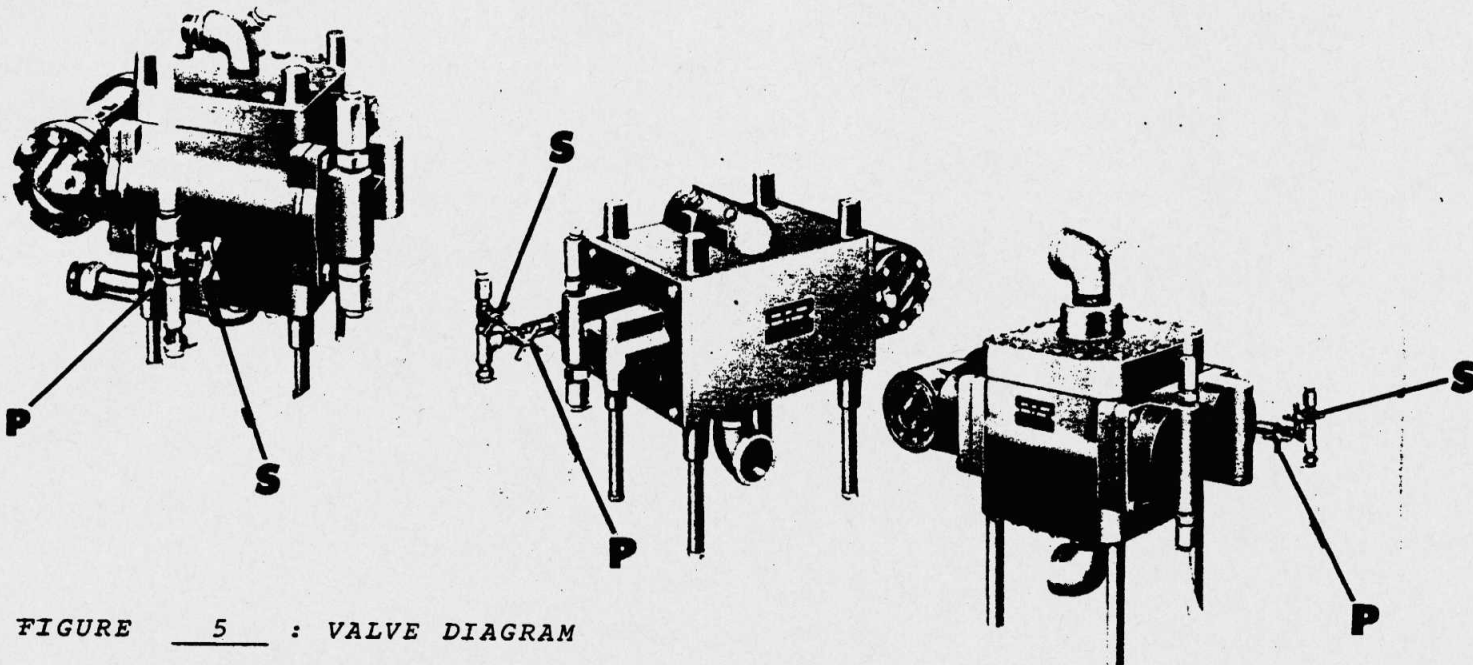


FIGURE 5 : VALVE DIAGRAM

NORMAL OPERATION FOR OPTION C, W, I, F, AND P INJECTORS

START-UP PROCEDURE: After the machine is installed in the pipeline, or connected with hoses, start-up procedure is as follows:

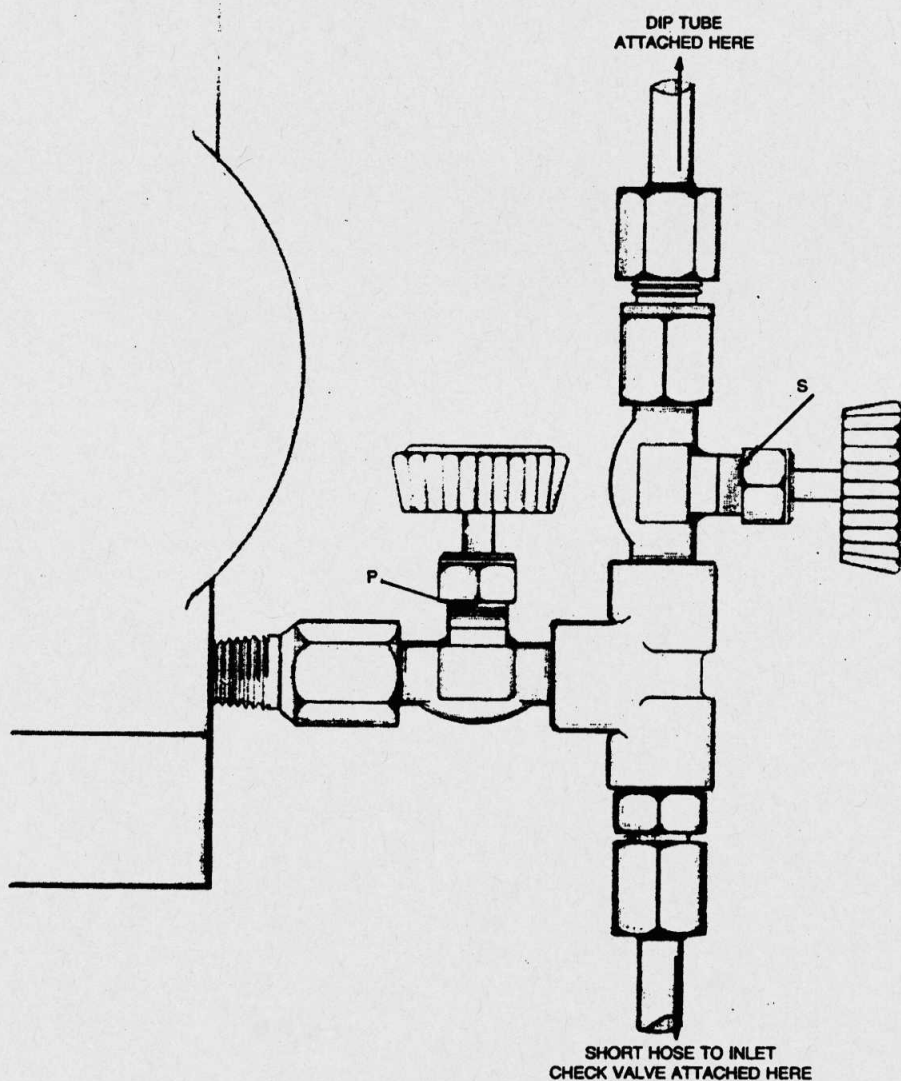
- (1) Be sure that the chemical and dip tube valve "S" and the main priming valve "P" are both closed.
- (2) Open water supply valves so that water is flowing through the meaSUREmix. Be sure the crankshaft is turning inside the clear-plastic window.
- (3) Check to be sure the dip tube is in the solution container, and that there is plenty of liquid in the container.
- (4) Open priming valve "P". Water under pressure will run through the injector head, priming the injector pump. Let the machine run this way for 30 to 60 seconds.
- (5) Leaving priming valve "P" open, also open chemical and dip tube valve "S". Water will run down the dip tube, forcing all air out of it.
- (6) As soon as the water reaches the end of the dip tube that is in the liquid fertilizer container, close the priming valve "P".
- (7) The injector should now begin to work, and if the fertilizer solution is colored, you can watch it coming up the dip tube, running through the short tube connecting to the "IN" check valve, and then running through the short tube near the top of the machine, connected to the "OUT" check valve, and in the end, running into the water that discharges from your meaSUREmix.

NOTE: See Sheet AM-4 for proper use of three-way valve used in all option P injectors.

SHUT-DOWN PROCEDURE:

- (1) Allow water to flush the injector system of nutrient or other chemical solutions by opening the priming valve "P" with the machine still running. Then close the chemical and dip tube valve "S". Allow the meaSUREmix to run for 30 to 60 seconds.
- (2) Close priming valve "P" and stop the water flow by closing any necessary valves in your water system.
- (3) Remove dip tube from solution container.

NORMAL OPERATION FOR OPTION P INJECTORS



START-UP AND SHUT-DOWN PROCEDURE FOR OPTION P INJECTORS

START-UP AND PRIMING PROCEDURE

- (1) Be sure that the chemical and dip tube valve "S" and the main priming valve "P" are both closed.
- (2) Open water supply valves so that water is flowing through the meaSUREmix. Be sure the crankshaft is turning inside the clear-plastic window.
- (3) Check to be sure the dip tube is in the solution container, and that there is plenty of liquid in the container.
- (4) Open priming valve "P". Water under pressure will run through the injector head, priming the injector pump. Let the machine run this way for 30 to 60 seconds.
- (5) Leaving priming valve "P" open, also open chemical and dip tube valve "S". Water will run down the dip tube, forcing all air out of it.
- (6) As soon as the water reaches the end of the dip tube that is in the liquid fertilizer container, close the priming valve "P".
- (7) The injector should now begin to work, and if the fertilizer solution is colored, you can watch it coming up the dip tube, running through the short tube connecting to the "IN" check valve, and then running through the short tube near the top of the machine, connected to the "OUT" check valve, and in the end, running into the water that discharges from your meaSUREmix.

SHUT-DOWN PROCEDURE:

- (1) Allow water to flush the injector system of nutrient or other chemical solutions by opening the priming valve "P" with the machine still running. Then close the chemical and dip tube valve "S". Allow the meaSUREmix to run for 30 to 60 seconds.
- (2) Close priming valve "P" and stop the water flow by closing any necessary valves in your water system.
- (3) Remove dip tube from solution container.

OPERATION AFTER PROLONGED SHUT-DOWN

The meaSUREmix works best when used regularly (once per week or more often.) If the machine is not in use over a prolonged period of time, the water in the water motor section may evaporate, and salts and other impurities may deposit in the close clearances of the water motor. In this event, the meaSUREmix may become stuck, and refuse to operate.

It is very strongly suggested that if this should happen, you refer immediately to pages 24-28 in this manual: HOW TO CLEAN MEASUREMIX WATER MOTOR-METERS IN MODELS R-3, R-4, R-6, and R-8. MeaSUREmix units that were purchased some time ago, but not installed until recently, may have the same problem. Every machine is thoroughly tested at the factory using ordinary water as a test fluid; evaporation during shipment and storage can cause the same thing to happen to a brand new or a rebuilt equal-to-new exchange meaSUREmix.

NORMAL SERVICING

No periodic oiling, greasing, or adjusting is ever required. The meaSUREmix is designed to eliminate as much servicing as humanly possible. Most will operate over long time periods without even requiring the replacement of parts. The strainer or filter in the water supply line, if there is one, or the dip tube strainer, if you have one of those, will probably require more attention than the meaSUREmix itself, because they may have to be cleaned at intervals.

SUGGESTED O-RING CHANGE

The meaSUREmix was designed for clean water and clean nutrient solutions, to handle water flow rates within published limits. Machines operated under these ideal conditions should give several years of trouble-free service. The problem is that there are too few installations where conditions are 100% perfect. Probably the most critical replacement part item is the "O-Ring for Injector Piston". We suggest that all meaSUREmix users make a point of replacing this item on a regular basis, at least six months after the machine has first been placed in service, and from then afterwards at intervals determined by the condition of the first o-ring. An extra o-ring to fit your machine was sent with it, originally. The part number can be found in the following table, referring to the model number and set proportion stamped on the meaSUREmix label plate:

TABLE 2. PART NUMBERS OF O-RINGS FOR INJECTOR PISTONS

<u>SET PROPORTION</u>	<u>MODEL R-3</u>	<u>MODEL R-4</u>	<u>MODEL R-6</u>	<u>MODEL R-8</u>
1:50	6227-12	--	6227-19	--
1:100	6227-9*	6227-12*	6227-13	--
1:150	6227-7	6227-10	6227-11	--
1:200	6227-6	6227-9	6227-10*	6227-15*
1:300	--	6227-7	6227-8	6227-12
1:400	--	6227-6	6227-8	6227-11
1:500	--	6227-8	6227-6	6227-10

* Standard size for particular model

Once you are sure you have the proper replacement o-ring, and six months of use have passed, follow the illustrated procedure starting on page 21 to install it. After the used o-ring is removed, study it carefully. If the inside is flattened, this indicates normal wear and probably means that you should continue to replace the o-ring every six months, or less. If the o-ring has enlarged, this means you are using a chemical that attacks the o-ring. In such an event, contact the factory, giving names of chemicals used. We may be able to provide an especially-compounded o-ring more resistant to attack. If the inside is scratched, this means that the fertilizer solution is dirty and o-rings should probably be replaced more frequently than every six months. Further, it might be wise to work out a way to clean up the fertilizer, or to use a dip tube strainer. If the o-ring appears to be in new condition, you can probably forget about it for the next two years, unless you make a change in your nutrient or other chemical solutions in that time period. However, although these longer intervals between o-ring changes are possible, it is a wise decision to change the o-ring semi-annually or sooner, to insure injected chemicals do not enter the water motor section.

THE MOST IMPORTANT WARNINGS

DIRTY WATER

If there is any question about rust, scale, sand, silt, or other abrasives in your water (vegetable matter such as algae is not abrasive), BE SURE to use a strainer or filter. This precaution DEFINITELY will make the difference between the success or failure of your machine, which is a costly capital investment. With clean water, your investment will be well repaid through labor savings and better plants. WITH DIRTY WATER, YOU WILL HAVE NOTHING BUT TROUBLE. GETTING THE WATER CLEAN IS YOUR RESPONSIBILITY. Just as automobile engines wear fast with dirty lubrication oil, and are expensive to repair, so meaSUREmix units wear fast with dirty water and they also are expensive to repair. If you are not willing to take on the responsibility of keeping your water clean, it is best to return your meaSUREmix for credit as soon as possible.

COLD WEATHER

If the meaSUREmix is allowed to freeze, the water inside will turn to ice and expand, causing serious warping and even cracking of some internal and external parts. Any time you find the plastic windows broken after cold weather, additional damage should be suspected. Unfortunately, such damage can only be corrected at the factory by remachining warped parts and replacing cracked ones. Therefore, keep meaSUREmixes at a temperature above +32 (0°C.) AT ALL TIMES.

WATER INLET CONNECTION

This MUST be at the bottom. If it is at the top through error, liquid chemicals will enter the water motor section and cause unnecessary corrosion, expensive to correct. Additionally, the crank-throw bolts in the crankshaft assembly may fatigue and cause mechanical damage, as the machine would be running backwards, and the injected chemicals would be passing through the water motor, corroding it.

GENERAL MAINTENANCE INSTRUCTIONS

Since the meaSUREmix is normally quiet during operation, any knocking sound is a warning that repairs may be required, soon. However, a brand new machine sometimes squeaks, until it is "broken in", a process that may take quite a long time, depending upon how much the machine is used. Also, normally functioning check valves may rhythmically click with every suction stroke of the injection piston.

If a meaSUREmix will not operate, be sure that water is getting to the machine. If a water strainer screen or filter is plugged, the flow of water can be shut off almost completely. Similarly, a plugged dip tube strainer will prevent fertilizer from being injected properly. Therefore, the first step of any maintenance or repairs procedure is to remove and clean strainer screen, or replace filter cartridges.

HOW TO TELL IF YOUR MACHINE NEEDS FACTORY REPAIRS

If the crankshaft (seen through the plastic window) turns freely when water is run through the machine, you can probably make any necessary repairs easily.

If the crankshaft will not turn, or if it turns with a jerky, uneven motion at water flow rates within rating, or if a knocking sound is heard, the meaSUREmix should probably be sent to the factory for repairs. (Consult pages 24 - 28 in this manual.)

EXCHANGE PLAN

Should factory repairs be required, the meaSUREmix can be sent to the factory, where reconditioning is done, and the unit returned in just a few days. Under our exchange plan, you do not have to be without a machine while the repairs are being made. We will provide a guaranteed factory-reconditioned exchange meaSUREmix, before you ship your machine to us. You simply return your used machine for credit, using the same shipping crate. The amount you pay is the cost to repair your machine to the equal-to-new condition, as it will then be in the exchange plan for another customer. All exchange, repaired, or new meaSUREmixes are always shipped complete, with all valves, tubing, elbows, etc., unless otherwise requested.

COST OF FACTORY REPAIRS

It is our normal policy, which is followed in every case unless we receive contrary instructions from our customers, to repair every meaSUREmix so that it is in EQUAL-TO-NEW condition. We can do less, and that will cost less, but slightly worn parts left in place may cause a premature second return for factory repairs, and can cause the proportioning to be weaker than it should be.

If you can do without your machine long enough to send it in for a cost estimate, we will make one without charge and do no work without your prior approval. We can give you a net cost range if you decide on an exchange unit. No machines are alike when they come in for repairs. Some have always been mistreated more than others. To keep repair costs down, follow our instructions, and see that your workers do the same.

TROUBLE SHOOTING PROCEDURES FOR MAKING YOUR OWN REPAIRS

(See pages 24 - 28 in this manual.)

Because meaSUREmix units are expensive to repair at the factory, and because an inefficient or inoperative machine is detrimental to plant growth, we are listing below repairs that the average user can usually make himself. These instructions assume that the crankshaft is turning freely, but that too little or no chemical solution is being injected.

FIRST STEP. Make certain that any strainers or filters in the water line or on the end of the dip tube are clean. Make sure that there is nothing else to restrict the flow of liquid fertilizer in the dip tube.

SECOND STEP. Review the priming procedure as described under "NORMAL OPERATION FOR OPTION C, W, AND F INJECTORS" on page 13. Your operators may not be following this correctly.

THIRD STEP. Look for air bubbles in the dip tube and in the lower short tube that runs to the underneath "IN" check valve. If bubbles are present in either of these tubes, there is an air leak somewhere in the tube and fitting system. Examine the tubes to see if they have holes caused by rough treatment, such as deterioration of the plastic from which the tubes are made. Holes in tubing can usually be easily located, as the air bubbles will start at these holes. Replace tubing as necessary.

FOURTH STEP. If air bubbles appear to originate where tubes connect to stainless steel fittings, try to tighten these joints. With most units, the joint is kept tight by a small stainless steel strap clamp. Remove clamp, pull off tubing, cut off about one-half inch of the end, replace tubing and clamp. The tubing has probably deteriorated and become somewhat hard. The strap clamp, properly tightened, will probably keep the injector system going until you have time to order new tubing.

AIR BUBBLES IN THE TOP SHORT TUBE RUNNING FROM TOP "OUT" CHECK VALVE TO WATER DISCHARGING FROM THE MEASUREMIX, DO NOT CAUSE TROUBLE. WORRY ONLY ABOUT AIR BUBBLES IN DIP TUBE OR LOWER SHORT TUBE.

Occasionally, air leaks develop around the stems of the priming valve "P" or the chemical and dip tube valve "S". These can sometimes be stopped by carefully tightening the packing nut that the valve stem comes out of. Sometimes, the valve or valves have to be replaced.

Sometimes, particularly at very low water flow rates, some air remains in the dip tube strainer (if you have one). If all else fails here, remove the dip tube strainer and see if the meaSUREmix works without it. If it does work, then you will either have to leave the dip tube strainer off, or turn the dip tube strainer upside down by looping the dip tube and wiring the strainer in the upside down position.

FIFTH STEP. Having rid the injector system of air bubbles in one way or another, it is now wise to check the meaSUREmix for accuracy, to make certain that there is not other trouble that you should fix. Sometimes troubles come in groups of 2 or 3 at a time.

There are several complicated ways of checking a meaSUREmix for accuracy of proportion. Your Soil and Plant Lab analyst may suggest one of these, but we have found that in the majority of cases, a simple "stroke-count" method can be employed, which you can make yourself, with nothing more expensive than a kitchen-type measuring cup that is graduated in ounces.

Fill the measuring cup with water and put the dip tube in this cup. With the meaSUREmix started up properly and running, look at the clear plastic window and count the number of revolutions of the crankshaft to take up one cup of water (8 ounces). For the smaller R-3 and R-4 machines, the check can be made quicker by counting strokes per ounce. The following table shows stroke count that should be attained at various proportion settings for each model of meaSUREmix.

STROKES (REVOLUTIONS) OF CRANKSHAFT PER UNIT VOLUME FOR VARIOUS MODELS

<u>PROPORTION</u>	<u>MODEL R-3</u>	<u>MODEL R-4</u>	<u>MODEL R-6</u>	<u>MODEL R-8</u>
	<u>Strokes per ounce</u>	<u>Strokes per ounce</u>	<u>Strokes per cup (8 oz.)</u>	<u>Strokes per cup (8 oz.)</u>
1:50	8	--	12	--
1:100	16*	8*	25	--
1:150	24	12	37	--
1:200	32	16	50*	12*
1:300	--	24	75	18
1:400	--	32	100	24
1:500	--	--	125	31

*Indicates standard proportion
for particular model.

Should you have a very special meaSUREmix having a proportion not listed above, contact the factory for proper stroke-count information.

If you count less strokes than necessary, your meaSUREmix is obviously in excellent condition, injecting at greater than 100% efficiency. However, if you count more strokes than the table shows for your particular model and proportion, injection is at less than 100% efficiency, and something else is wrong in the injector system. The next step is replacing the o-ring for the injector piston.

SIXTH STEP. O-ring for injector piston replacement necessitates the removal of the tubing connecting to the check valves and unscrewing the 4 or 6 bolts holding the injector head onto the cylinder block. Then pull the injector head off. Remove the used o-ring and replace with a new one, according to the following detailed instructions illustrated by figures 7 through 11.

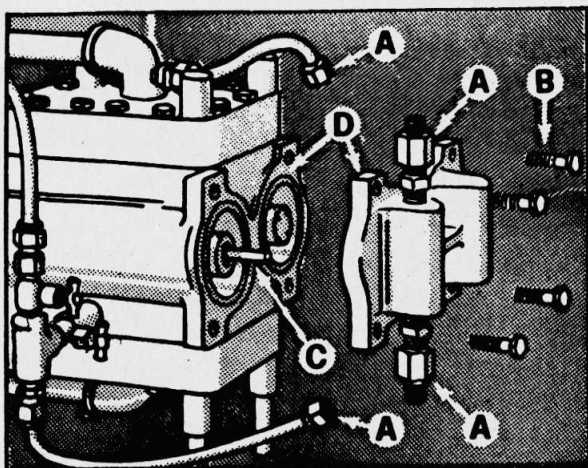


Figure 7

Removal of Injector Head

- a. Remove tubing on check valves (A).
- b. Remove the bolts (B) in the injector head.
- c. Pull out injector head, tapping lightly with hammer only if necessary.
- d. Inspect injector piston (C) for score marks or wear. Run fingers over piston to see if it feels rough or wavy. If it does, order a new piston. Give serial number of unit when ordering.
- e. Clean surface of housing and injector head (D).

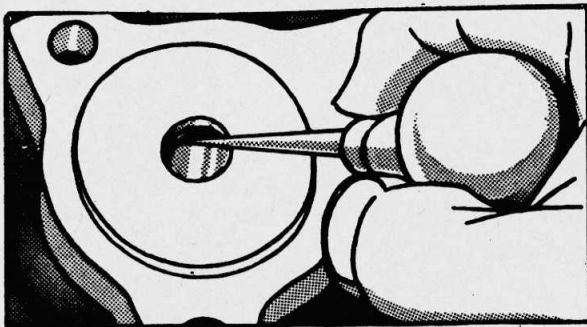


Figure 8

Removal of o-ring

- f. Use penknife, safety pin, ice pick, or any sharp metal tool to remove o-ring from groove in injector head. Be careful not to scratch groove or chamber. Make sure groove and piston chamber are clean.

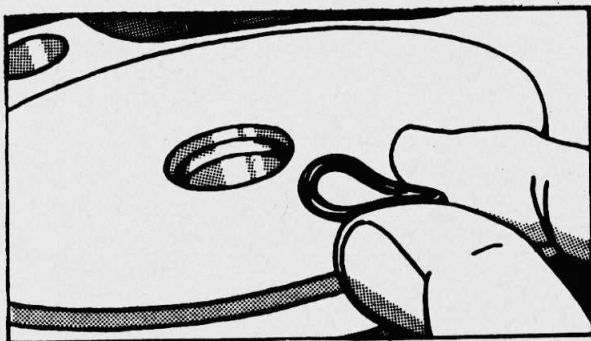


Figure 9

Placement of o-ring

- g. To install o-ring, pinch it with forefinger and thumb until it bends, as shown. Place it in the ring groove and push down and in. O-ring will start into groove but will need help. Never use an o-ring that has been pierced in removing from chamber.

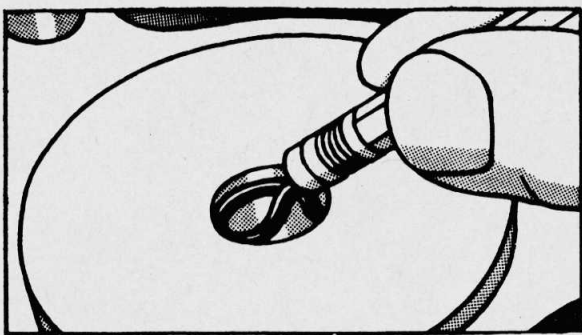


Figure 10.

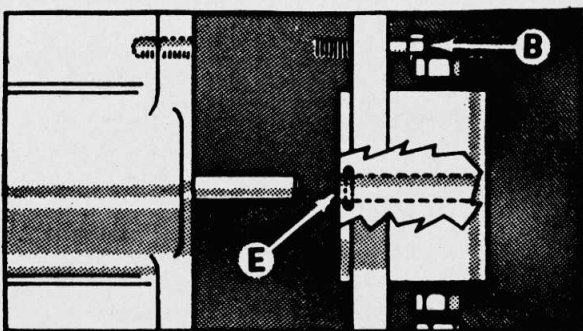


Figure 11.

Positioning of o-ring

- h. Use the head of a nail, eraser end of pencil, or any blunt tool to push down on the o-ring after you have one edge started in the groove. If the o-ring should go past the groove, remove it with nail head and try again. When in place, insert pencil into chamber and rotate around surface of ring to make sure it is in place. Apply grease or oil to injector piston (C) to insure easy assembly to unit.

Reassembly of Injector Head

- i. Place injector head so injector piston is in chamber (E) and push gently inward. Hold in place with hand and insert one of the bolts (B) on opposite side of chamber end with fingers. Then, when in place, install the others. Hand tighten all bolts with equal amount of pressure. Before tightening bolts with a wrench, make certain that the crankshaft turns over freely. Serious damage may result if the injector head is not reinstalled properly.

SEVENTH STEP. With the injector piston o-ring replaced, check once again for accuracy, and if it is still below 100% efficiency, the problem is probably in the check valves. Here, your best bet is to order an exchange set from the factory. While you are waiting for these to be received, you may want to see if you can repair your used check valves. They may be plugged with deposits, such as chemical crystals, vegetable matter, or other materials. Assume that to be the cause of the problem, first. Remove the check valve assembly marked "IN", from underneath the injector head, and the assembly marked "OUT", from the top of the injector head. These screw in and out like a large bolt. They do not have tapered threads, and do not require force much more than "hand-tight" to seal against the o-ring (6227-10), at the bottom of each threaded hole in the injector head. Over-tightening can cause problems (see pages 24 - 28 in this manual).

Take the check valve assemblies and soak them in Phosphoric Acid for a few hours. Rinse with water and carefully remove chemical deposits. Then, replace the check valves, making sure that the one marked "IN" goes underneath, and that the one marked "OUT" goes on top. There is a 6227-10 o-ring at the bottom of each check valve hole in the injector head, as mentioned before. It is black in color, and probably very flat. If one or both of these came out when the check valves were removed, be sure they are replaced. Check the machine for accuracy again. If still below 100% efficiency, check valves are probably deteriorated inside. Wait for the replacement valves you have ordered.

Some check valve assemblies can be taken apart and inspected to determine the condition of their internal parts. We advise against doing this, as it can be a tricky operation. However, in case you want to do this, we are showing an exploded view of the double-ball check valve assembly. The single-ball check valve assemblies used in Option "P" cannot be taken apart.

One thing to remember is that, besides the water motor piston portion of your unit, the only other moving parts are the balls housed inside the check valves. Hence, if your unit is turning over and running, but not proportioning, the problem will most certainly be with the check valves.

SMITH PRECISION has been manufacturing meaSUREmix injectors since 1950. During this time, most users have been very pleased with the equipment. However, with thousands in use all over the world, some users have had trouble. We have been able to trace the most common trouble causes, and are listing them for your information:

COMMON TROUBLE CAUSES

1. USING MACHINES AT A HIGHER WATER FLOW RATE than recommended in our literature. This causes fast wear of expensive crankshaft parts as well as reducing your water pressure too much. Double check the water flow rate as soon as your machine is installed.
2. USING MACHINES AT A LOWER WATER FLOW RATE than recommended in our literature. This does not cause fast wear, but it results in inaccurate proportioning and at very low flow rates, machines will not work at all. Again, check the water flow rate as soon as your injector is installed.
3. USING WATER CONTAINING SAND AND/OR SILT, without first providing proper strainer or filter protection for your machines as described in the manual, causes fast wear that is expensive to correct.
4. ALLOWING CHECK VALVES TO BECOME PLUGGED-UP with liquid fertilizer deposits. Check valves can be easily cleaned. Badly plugged check valves cause expensive wear to other parts.
5. PUTTING CHECK VALVE PARTS TOGETHER IMPROPERLY, after taking them apart for inspection or cleaning. Be sure you notice how the parts go together, while taking check valves apart. Improperly assembled check valves cause expensive wear to other parts.
6. NEGLECTING TO FOLLOW OPERATING INSTRUCTIONS which are simple, and carefully outlined in the manual.
7. FAILURE TO CORRECT SMALL LEAKS IN PLASTIC TUBING. Tubing is inexpensive, and sometimes requires replacement.
8. O-RING FOR INJECTION PISTON MUST BE REPLACED OCCASIONALLY. In average service, replace o-ring every six months. They cost only 50¢.

HOW TO CLEAN MEASUREMIX WATER MOTOR-METERS

1. Sometimes the above machines tend to "stick" or stop altogether.

If not due to excessive wear of internal parts or a clogged strainer or filter, the cause of this can be improper operation, disuse for a long period of time, algae or other impurities in the water, clogged fittings, or not changing the o-ring(s) at recommended intervals. Any one, all, or some of these factors will cause minute particles to accumulate in the close clearances between the water motor pistons and their respective bores in the cylinder block.

However, before blaming the trouble on the machine itself, check your piping system. Be suspicious of old galvanized pipe. Check your strainer and/or filter, including pumping system, if used: if these are clogged, naturally the meaSUREmix will not run properly.

2. If the problem has not originated in the piping system, it could very well be due to deposits in the water motor section of your meaSUREmix. Frequently, distilled water will dissolve or soften these deposits to the extent that the meaSUREmix will be able to again operate normally. Therefore, as a first step to "un-stick" a "frozen" machine, we recommend that it be filled with distilled water. Plug the water inlet at the bottom, and let the machine stand for a day or two.

3. If the above does not free the water motor pistons, repeat the procedure using hot distilled water or a weak solution of Phosphoric Acid. If possible, try connecting the machine directly to a hot water spigot. (Water hotter than 150°F. may damage your machine.)

4. DO NOT RUN A HIGH FLOW OF WATER THROUGH THE MEASUREMIX IN AN ATTEMPT TO FREE THE WATER MOTOR. FORCING THE MACHINE TO TURN OVER AGAINST INTERNAL FRICTION WILL ONLY DAMAGE THE WORKING PARTS AND MAKE REPAIRS MORE EXPENSIVE.

5. If these remedies fail, the meaSUREmix will have to be dismantled. Unscrew the four or six bolts holding the crankshaft housing assembly to the cylinder block. The crankshaft housing assembly is the part that has the two plastic windows at its sides.

WARNING: BEFORE REMOVING THE CRANKSHAFT HOUSING ASSEMBLY, MARK ITS TOP. IT MUST NOT BE PUT BACK UPSIDE DOWN OR THE CRANK THROW BOLTS INSIDE MAY UNSCREW DURING OPERATION AND CAUSE THE MACHINE TO STALL.

Pull the crankshaft housing straight away from the machine. If it will not pull out, remove the injector head at the opposite end after first disconnecting the plastic tubing. Remove the injector piston assembly or assemblies, and then, using a piece of wood or other soft material and a hammer, drive the water motor pistons out toward the crankshaft housing assembly side, a little at a time, equally on both sides. Support the crankshaft assembly to keep it from falling as you drive the pistons out. Avoid letting the crank housing hang unsupported, as this would put weight on the water motor pistons, damaging them.

If you remove the throw bolts and remove the crankshaft housing first, to facilitate this operation, do not overtighten them during reassembly. They must be carefully installed, just snug. Remember that there is a right and a left hand-threaded throw bolt and that they are stamped accordingly.

Drive one water motor piston about 1/4 of an inch; then, drive the other one about the same amount. Keep alternating, back and forth, until the crankshaft housing assembly with rods and pistons can be pulled all the way off. It is helpful to have someone hold the crankshaft assembly during this operation. Be careful that the water motor pistons do not hit anything after they are removed, as if they do, they may get damaged by being badly nicked, dented, or scratched.

Once the water motor pistons have been removed, it will be easy to spot the deposits that have caused the trouble. They must be removed, not only from the pistons, but also from the walls of the cylinders.

6. Several methods can be used to remove deposits, depending on what kind of deposits are discovered and what materials are most readily available for removing them. Among these, one can use very fine emery cloth or sandpaper, a sponge, or steel wool and soap or detergent.

If steel wool is used, small pieces of this material can break off and adhere to the surface of the pistons or cylinders, where they would rust, and consequently cause the same problem you are trying to remedy. The same holds true with the use of sandpaper or emery cloth.

If the residue of particles is not removed carefully after sanding, the pistons will again stick. Therefore, it is absolutely necessary to very carefully wipe or flush the areas that have been cleaned, until all the loose material or particles have been removed.

BE CAREFUL. SAND OR CLEAN ONLY ENOUGH TO REMOVE THE DEPOSITS. DO NOT SCRATCH THE SURFACE. SAND THE PISTONS AND THE CYLINDERS LENGTHWISE, ONLY.

When the water motor pistons and their respective bores are clean, you should be able to slide the pistons back and forth freely and smoothly, full length. Starting the pistons in the bores can sometimes be difficult, but never hammer or otherwise force the pistons into place.

REMEMBER THAT THIS PROCEDURE WILL NOT REMEDY A WORN OUT MACHINE DUE TO AGE OR JUST PLAIN GENERAL ABUSE. IF BUSHINGS AND/OR OTHER MOVING PARTS ARE WORN, THE MEASUREMIX WILL NOT FUNCTION PROPERLY NO MATTER HOW CLEAN IT IS. CERTAIN ADVERSE CONDITIONS CAN COMPLETELY RUIN ANY NEW PIECE OF EQUIPMENT IN A VERY SHORT TIME NO MATTER HOW WELL MADE IT IS. HOWEVER, MOST GENERALLY, REPAIRS CAN BE MADE IN THE FIELD, ON SMITH MEASUREMIXES, VERY EASILY. CONTACT THE FACTORY FOR ADDITIONAL INFORMATION AND INSTRUCTIONS.

7. Replace the crank assembly with rods and pistons. Tighten the four or six bolts on the crank housing. Remove one of the plastic windows, and, using a socket wrench or a specially bent box wrench on the throw bolt, turn the crank over several times. If there is no resistance to movement, "jerkiness", or "scratchy spots", the meaSUREmix is ready to be reassembled and put to work. Otherwise, the machine has not been thoroughly cleaned or the bushings and other internal moving parts require replacement. Also, it could be that the crank housing is not in proper alignment with the cylinder block: position the crank housing at the point of least resistance to movement of the water motor pistons, using the same procedure as in (9) below.
8. Replace the injector piston assembly or assemblies, making sure that the piston assembly can move up, down, and sideways, slightly, after the retainer plate has been fully tightened.
9. Note the condition of the injector piston o-ring(s) in the injector head at this time. As they are indispensable for good operation while fertilizing, it would be a good idea to replace them anyway, whether necessary or not. Only Nitrile or Viton compounds are satisfactory for this service, and these o-rings can be easily acquired from the factory in the proper size required. Do not use just any o-ring. Be sure you have the right compound required for your particular fertilizers and/or other chemicals.

NEVER RUN THE MACHINE WITHOUT INJECTOR PISTON O-RINGS, OR WITH WORN OUT O-RINGS, SINCE THIS WILL LET FERTILIZER INTO THE WATER MOTOR, CAUSING IT TO BIND-UP IN A SHORT PERIOD OF TIME. THE WATER MOTOR IS INTERNAL, COMPLETELY SEPARATE FROM THE INJECTION SYSTEM, AND THE O-RING ASSURES THAT THE FERTILIZER WILL ONLY GO THROUGH THE EXTERNAL INJECTION SYSTEM. THE EXTERNAL SYSTEM RESISTS CHEMICALS. THE INTERNAL SYSTEM DOES NOT.

Replace the injector head, but tighten the bolts hand-tight, only. While turning the crank with a wrench as described earlier, note the points of resistance to movement. Lightly tap the injector head with a hammer to cause it to move very slightly, one way, then another, up, down, and sideways, until the "position of least resistance" is discovered. Then, tighten the bolts firmly to hold the injector head in this position.

10. Replace the tubing, and start using the meaSUREmix. Check for leaks and air bubbles, and tighten tubing clamps or replace tubing, accordingly. Resistance to flow through the external injection system fittings can cause the machine to "stick" or operate improperly. When you remove the tubing, check all the fittings, as well as the check valves, for proper flow. This can be easily accomplished by removing the tubing from the top elbow and blowing through it, forcing the check valves to seal as they would during normal operation. If air does go through the check valves backwards, this indicates worn or dirty check valves, bad tubing, or worn injector piston o-rings. Be sure to check the R6-42 fitting(s) in the top elbow/water outlet for blockage at this time.

11. WHY WE WROTE THIS SHEET: Occasionally customers in distant areas of the country have problems and want to send their machines to us for repair. Truck freight is expensive and takes a lot of time. We want you to know how to do repairs yourself to save time and money. The simplicity of general repairs to our units can be best understood through reading our maintenance and service manual, as well as parts price lists. Copies are sent free upon request.

12. REMEMBER: These instructions are primarily for machines that once worked fine, have been out of service for a period of weeks or months, and then, are found to be stuck. This could mean even a new machine that you bought and did not get around to using for several weeks or months. A meaSUREmix that sticks or stalls in normal weekly or daily service can very seldom be made to operate correctly by cleaning the water motor section. This is why we cannot overstress the importance of reading and following all procedures as recommended by the factory. The great majority of all machine failures, unfortunately, is due to negligence and abuse.

13. STRAINER OR FILTER TROUBLE: If you have a water strainer or filter in the water inlet line and it becomes clogged with dirt, it can cause the meaSUREmix to stall. If you have a strainer or filter, open it and examine the screen or cartridges, before you do a lot of work on your meaSUREmix. (See Sheet AM-2 for filter recommendations.)

Our Model R-3 with the 3/4-inch inlet and outlet has a built-in strainer, located under the inlet hose washer. This is the only model that has a built-in strainer. Remove the hose washer to inspect and clean the strainer element.

14. DIRTY WATER: The usual piped-in water may be considered clean; however, occasional breaks in the water mains, or the continued use of old water mains, may allow an occasional shot of sand, gravel, mud, or pipe scale to run through your machine, damaging or "sticking" the water motor section.

WELL WATER SHOULD ALWAYS BE FILTERED before it passes through any meaSUREmix. The same applies to water coming from lakes, ponds, and streams. Sources such as these will always deliver water containing very fine silt at one time or another. Silt is extremely damaging to the water motor section because it is so very abrasive.

Very fine silt will not settle out of the water in a storage tank in sufficient quantities to not cause damage to the machine as the water passes through it.

Always use a strainer or a filter in the inlet line to the meaSUREmix. As oil lubricates the engine in a car, the water passing through a meaSUREmix lubricates its internal moving parts, and must be kept clean. The Smith meaSUREmix has been proven to stand up to most general abuse; however, by following the suggested procedures of operation and, in this case, filter or strainer protection, your machine can last an indefinite period of time.

15. FERTILIZERS AND ACIDS INSIDE WATER MOTOR: Beware of blue or white deposits inside the water motor section, caused by the presence of injected chemicals in contact with the internal brass parts. The Smith meaSUREmix water motor is designed to be run on clean, pure water only. The chemicals are not supposed to come in contact with its brass parts, ever. So, avoid running the machine backwards; do not allow acid to mix with fertilizer prior to running them through the injector, as even very minute quantities of acid in a barrel or drum of fertilizers can produce certain chemical reactions in the nutrient before it reaches the injection chamber which are extremely damaging (see sheet AM-3). If any acid must be injected at the same time as fertilizer, use the appropriate double injector (see sheet AM-7); do not use a single injector for this purpose unless you can inject the acid separately. (Phosphoric Acid can be injected through a standard stainless steel option injector; all other acids require the plastic option "P".)

Use the recommended option injection system for your particular chemical requirements. Replace the injector piston o-ring regularly. Always back-flush the injection system to prevent fertilizer crystal build-up in the check valves, tubing, and especially the injector piston chamber. Always turn the red-handled chemical and dip tube valve off when you shut down the meaSUREmix, to prevent siphoning from the fertilizer tank.

AVAILABLE LITERATURE

<u>CHECK</u>	<u>NUMBER</u>	<u>PRICE LISTS</u>
()	12K	Price list, meaSUREmix injectors and auxiliary equipment
()	M-1	Parts price list for R-3 meaSUREmix injectors
()	M-2	Parts price list for R-4 meaSUREmix injectors
()	M-3	Parts price list for R-6 meaSUREmix injectors
()	M-4	Parts price list for R-8 meaSUREmix injectors
()	M-5	Parts price list for R-12, R-16, R-24 meaSUREmix injectors
()	M-6	Parts price list for Option P meaSUREmix injectors

LITERATURE AVAILABLE

()	AM-1	How to obtain longer running life for your injector
()	AM-2	Sand and silt problems
()	AM-3	Injection of acid
()	AM-4	Start-up and shut-down procedures for Option P meaSUREmix injectors
()	AM-5	Backflow valve problem
()	AM-6	How to check water flow rate
()	AM-7	Versatility of two-injector options
()	AM-8	New-style injector head assemblies for R-12, R-16, R-24 meaSUREmix injectors
()	AM-9	Agricultural application where total water flow does not pass through meaSUREmix
()	AM-10	Parallel system with automatic cut-off
()	AM-11	Show flyer describing R-3, R-4, R-6, and R-8
()	AM-12	Fluid table

CATALOGS AND MANUALS

()	CM-1	Catalog of meaSUREmix injectors
()	CM-2	Installation, operation, servicing of R-3, R-4, R-6, and R-8 meaSUREmix injectors
()	CM-3	Installation, operation, servicing of R-12, R-16, R-24 meaSUREmix injectors
()	CM-4	How to clean meaSUREmix water motor: supplement to owner's manual

AUXILIARY EQUIPMENT

()	AE-1	The Smith in-line strainer with a view
()		Flow Control valves
()		Various in-line filters

Place a check mark beside any of the literature described above, and we will send it, free, to the address you indicate below:

Name _____

Company Name _____

Address _____

Zip Code _____