PROPORTIONERS

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Date_____

PROPORTIONERS

BACKGROUND

The use of foam to protect improvements and natural resources from the ravages of fire, in addition to its superior extinguishing properties, is becoming the norm for many fire managers. Class "A" foam has the potential to reduce firefighter injuries and the cost of fire suppression. To capitalize on the benefits management will have to be willing to invest in training and adopt the appropriate equipment for the mission.

INTRODUCTION

When using foam from a fire engine, it is desirable to inject the foam concentrate, at a set proportion, directly into the discharge side of the water pump regardless of water flow and pressure. The only way this can be done is with a direct injection type proportioning system. This type of a system will eliminate the following problems associated with batch mixing, eductors, suction-side-regulators, and around-the-pump-proportioners:

For batch mixing:

* Foam proportion can not be conveniently changed while operating--it can be increased by adding more foam concentrate to the water tank
* When refilling a partially used pre-mixed tank of water, dip sticking or gauging is required
* Fire engine can not draw water directly from a nurse tanker or hydrant and make foam solution
* Over time foam solution degrades, tends to lose potency, and does not foam as well

For suction side regulators:

* Incoming water pressure to the pump must be kept below atmospheric pressure (negative pressure) in order to move foam concentrate into the suction of the pump
* Flow must be known to set proportion correctly
* If operating conditions change (flow rate of water or water level in the tank) proportioning rate may change

For around-the-pump-proportioners:

* Flow must be known to set proportion correctly
* They require specific operating conditions to maintain accuracy

For batch mixing, suction side regulator, and around-the-pump-proportioners:

* Corrosion (caused by the foam concentrate cleaning the tank, pump and plumbing)
* Pump priming difficulties
* Water-level gauge troubles
* Foaming in tank
* Use of more foam concentrate than required.
* Problems with pump and valves caused by the foam concentrate washing out lubricants.
* Contamination of the water tank--making water from the tank unusable for other purposes (such as transporting fish or potable water use).

For pump discharge side (inline) eductor proportioners:

* Require specific operating conditions to operate, any change in operating conditions may result in large changes in foam concentrate ratio or may not work at all.
* High pressure loss in flow line, 35% or more.
* Can be sensitive to increased hose lengths and changes in nozzle sizes

These problems can be eliminated by any of the following foam concentrate discharge side proportioners:

I-- Venturi Foam Proportioner by KK Products
II- Direct Injection Proportioner by Hypro Corp.
III Flow-Mix Foam Proportioner by Robwen

Ideally, a discharge side injection proportioner should:

1. Be proportional over the entire range of the water pumps flow capacity and pressure. Once concentrate percent is set it should: (1) not change over the range of the water pump, (2) be proportional down to almost zero flow, and (3) stop flowing when the water is completely shut off.

2. Prevent any chemicals from returning to the water tank or being run through the water pump. This is important because most centrifugal fire pump installations have (if they do not, they should) a continual small bleed back to the tank for pump cooling when water is shut off in the hose line.

3. Inject foam concentrate into the water stream on the discharge side of the water pump in the correct proportion to make foam solution in the desired ratio of concentrate to water. Foam solution should flow directly from the piping system into the hose line with no possibility of the foam solution recirculating and contaminating the water tank, plumbing, and pump.

4. Be low in cost and simple in design; have both very high reliability (infrequent breakdown) and very high

maintainability (if it does not work, can be repaired very quickly).

5. Be able to use different types of class "A" and "B" foam concentrates at up to 1 percent concentration and be able to change percentage while operating.

6. Be able to provide at a minimum a sufficient supply of concentrate to treat a load of water on the engine it's installed.

7. Provide insignificant or no water pressure loss.

8. Maintain accurate foam proportioning (± 10% of the set concentration) across the range of operating flows and pressures of the proportioner. It should perform up to its rated capacity regardless of the type and amount of hose and appliances being used.

The following foam proportioners address, or attempt to address, most of the criteria listed above. They are currently under evaluation by BIFC, Branch of Technical Support, Foam Section.

MODEL MANUFACTURE TYPE

I- The Pro/Protioner---KK Products---Balanced Pressure Pump Foam Proportioner

The PRO/PORTIONER uses no electronic monitors or electronic flow sensing equipment. The main components of the system are a mechanically run positive displacement pump, a flow specific venturi, a pilot-operated relief valve, a check valve, and a needle valve.

Using a proportioning block it meters class A or 1% AFFF foam concentrate from 0.1% up to 1.0% into the discharge of high pressure side of the water pump. Flow ranges with the low flow venturi from 5 GPM to 80 GPM at 1.0%. Flow ranges with the high flow venturi from 25 GPM to 250 GPM at 0.5% and from 25 GPM to 125 GPM at 1.0%. Pressure ranges up to 450 PSI.

PRO/PORTIONERS are available with a choice of power options. Twelve volt DC electric motor units for truck mounted applications when a fixed or running attack must be made with the engine. Two and four cycle engine models can either be mounted on engines or used for applications with portable pumps or when water relays require remote injection of foam concentrate.

The unit that is being evaluated is a model E,J,L,T. E stands for electric motor,12 volt DC/ 30 Amp Max. 1/3 Hp., truck mount; J stands for NPSH Threads Mounted on Remotely Mounted Water Inlet & Outlet; L stands for Low Flow Ranges 5 GPM to 80+ GPM @ .5%, or 1.0%, and pressure range 0 to 300 PSI.; T stands for Eight Gallon

Poly Tank .

The limitations that have been identified without any field trails are:

(1) The pump can be damaged by running dry for only a few seconds. This can occur during priming, flushing (if water pump is not on or out of water), or running out of foam concentrate.

(2) The system requires some sort of auxiliary power supply (unit being evaluated is electric).

(3) System malfunction or component failure can occur without proper instruction and training.

For additional information on the PRO/PORTIONER call, KK Products, 1004 Silhavy Road, Valparaiso, IN. 46383 (800) 537-7553 and refer to the PRO/PORTIONER brochure attachment (1).

MODEL	MANUFACTURE	TYPE
II--FOAMPRO----	**Hypro Corporation----**	**Direct Injection Proportioner**

The FoamPro is a complex electronically controlled proportioning system which utilizes a positive displacement Hypro metering pump to directly inject foam concentrate into the discharge side of the water pump. To control the concentrate pump the system uses an electronic water flow sensor, a pump speed sensor, and the operator control unit (totalizer). These sensors send and receive signals from the micro processor for desired concentrate ratios. FoamPro monitors water flow not pressure. By directly measuring the engine's water flow with a flow sensor, this system is able to maintain the proportion of foam concentrate to water based on volume.

The positive displacement metering pump directly injects a known quantity of concentrate into the water stream with each revolution of the pump shaft. None of the foam is bypassed or recirculated back to the foam tank. This makes for an efficient system by saving power for only the foam concentrate required.

The system uses a "closed-loop" operation which constantly monitors the output of the foam concentrate pump and compares this actual value with the desired output to maintain the specified percentage of foam concentration in the flowing water. Because of this feedback, the system can automatically adjust to variable operating conditions such as changing discharge pressures and foam concentrate viscosity.

In normal operations in automatic mode, water flow is directly measured by the flowmeter, with the foam proportioning corresponding to this flow measurement. The system can also be

operated in a manual mode where the operator inputs a specified water flow onto the system, and foam injection occurs proportional to this "simulated flow" value. This allows the operator to override the flow sensor signal and tell the system how much foam concentrate to inject.

The operator can switch between automatic and manual mode by using the control switches on the totalizer display. The simulated flow rate can also be varied with the switches.

The totalizer readout displays can show current water flow in GPM<, cumulative water flow in gallons, and display and/or change the foam concentrate injection rate in increments of 0.1% even while the system is operating.

The BLM has been field testing two FoamPro units mounted on heavy CAFS engines. The limitations that have been identified with two years of field testing are:

(1) The pump can be damaged by running dry during priming, flushing or if concentrate tank runs dry and tank empty switch fails.

(2) Microprocessor is temperature sensitive (manufacture limits effective use to 150 degree F.). We experienced system failure at 120 degree, once it was allowed to cool down it resumed working.

(3) It is not proportional at water flows less than 25 GPM. Concentrate continues to be injected as if you are flowing 25 GPM even if actual flow is only 10 GPM.

(4) Flow sensor often sticks in the off position, this results in water flow showing 0 GPM on the display and the concentrate pump remaining off. The micro-processor must receive a signal from the flow meter before it can send a command to the concentrate pump to run.

(5) Many wires and connections tying the components together increase the possibility of an electrical failure. This has occurred on several occasions. All exposed wiring should be shielded (in addition to what the manufacture has provided) where it could be walked on or pinched in cabinet doors.

(6) The system is not user friendly if it has a malfunction, which can occur frequently due to the systems complexity. Field operation is straight forward once the operations manual has been read and OJT has been received by the average engineer.

For additional information on the FoamPro proportioner, call Hypro Corporation, FoamPro Department, 375 Fifth Ave. NW, New Brighton,

MN. 55112, (612) 633-9300 or refer to the FoamPro brochure attachment (2).

MODEL MANUFACTURE TYPE

III. FLOW-MIX--- Robwen Incorporated--- Balanced Pressure Bladder Tank Proportioner

The FLO-MIX proportioner is designed to be used on the discharge side of the pump or at any point in a pressure hose line. The standard model is available either as a portable or a built-in. The unit is self powered and, therefore, no external power source is required.

The unit operates by line pressure being exerted on a bladder filled with foam concentrate contained within a pressure tank. The pressure in the tank is created by the flow of incoming water from the discharge side of the water pump. The concentrate is forced through a variable metering orifice down a feed line to the discharge side of a differential valve or venturi. The differential valve or venturi causes a differential pressure lower than incoming line pressure when water is flowing. This lower pressure is a function of water flow rate.

The system can be set for proportioning from 0.1% to 1.0% ratios calibrated in settings of 0.2%. When water flow through the differential valve stops, pressures within the differential valve becomes equal and foam concentrate flow stops.

A modified hand or electric pump, with built in check valves refills a five gallon system within two minutes. The proportioner can be refilled at any time without shutting down the hose line flow. However, during refill no foam concentrate is injected into the hose line.

The FLOW-MIX proportioner is available in 5, 10, and 20 gallon sizes. Other sizes can be specially ordered. It can be mounted almost anywhere on the engine. If servicing of the unit is required, it can be accomplished in the field in approximately forty-five minutes. The unit is self powered, wires and electricity are not needed nor are flowmeters or switches.

The BLM has been evaluating three models of this unit: (1) Model 500 portable Foam Protortioner (2) Model 500 built-in Foam Proportioner and (3) Model 1000 built-in Foam Proportioner. All of the units performed as claimed by the manufacture as long as operating and maintenance requirements are met. With two years of evaluation we have identified several deficiencies:

(1) The bladder developed a leak where it attaches to the container on the outlet/inlet port on a model 500 portable unit. This occurred when the bladder was allowed to run dry and the pressurized water outside of the bladder tried to push

the bladder through the outlet tube. This resulted in a small hole being rubbed into bladder where it made contact with the outlet tube. The manufacture was notified of the problem and solved it by attaching a perforated tube to the outlet. Thus allowing the bladder to collapse around the tube.

Units produced prior to 1989 could develop this problem if the selector valve is left in the foam setting, rather than off, when the bladder is empty of concentrate. Operators should make sure that the bladder is refilled after each use. Units produced after 1989 have been modified to eliminate this problem.

2) The manufacturer recommends that the unit be flushed with clean water after each use. This includes not only the regulator valve assembly but also the refill pump. With out flushing, concentrate residue builds up in small orifices eventually closing them off. A simple diagram (attachment A) is attached to properly plumb in the unit.

3) A spring check valve is required between the refill pump and the three-way selector valve. This will prevent back pressure, from a leaking three-way selector valve, from damaging the diaphragm in the refill pump.

4) The differential pressure valve should be inspected yearly for foreign matter blocking the water way if an in-line strainer is not used.

4) Air can be trapped in the bladder on built-in units mounted in other than an upright position. It is possible to pump air into the bladder when using the electric refill pump that is not primed. Each time the bladder is refilled a pocket of air is pushed into it. Over time this will accumulate, reducing its capacity. To eliminate the air pocket one should leave the selector valve in the foam position with the mixture valve set at 1.0% and pump at least a tank of water. (Air being trapped in the bladder will not affect the proportioners performance, just its concentrate capacity.)

5) The electric diaphragm concentrate refill pump that was provided by the manufacture prior to October 1990 had a poor record of performance. Units installed that lacked a spring check valve on the supply line from the pump to the 3-way valve was causing the diaphragm in the pump to rupture. The reason for this line being pressurized was caused by a leaking 3-way valve.

Recommend this pump be substituted (if the check valve does not solve problem) for a heavy duty type, such as what is used on portable fuel transfer pumps, or use high volume low pressure hand pump.

6) When shutting down the water pump after generating foam be sure to shut the concentrate adjustment valve to the off position. This will prevent an unnecessary flow of concentrate through the differential valve due to higher pressure left in the bladder tank after the water pump is shut off.

For additional information on the FLOW-MIX balanced pressure bladder tank proportioner, call Robwen INC., 1945 Blake Ave., Los Angles, CA. 90039, (213 665-5633. Also refer to the FLOW-MIX brochure attachment (3).

It should be noted that all of the proportioners under evaluation work! What has been identified are problem areas that could result in a system malfunction, either from an operator or mechanical failure.

Proportioner Procurement Specifications

The user of engine mounted foam generating equipment in BLM is most often a seasonal firefighter with limited knowledge of technical fire equipment. So it's desirable to have existing and any new systems kept simple, reliable, easy to trouble shoot and maintain. All systems must have the capability of meeting performance needs of the firefighter for the specific mission (fire flow rates less than 4 GPM up to 250 GPM).

The following matrix establishes the pro's and con's of the three proportioners under evaluation. It is designed to help the user and or manager make a logical decision on what type of proportioning system should be purchased and needed procurement specifications.

It should be noted that the only thing in common with the three systems under evaluation is that they inject the concentrate at a desired ratio, proportional to a fluctuating water flow, on the pressure side of the pump.

Make: **Robven, Flame-co, balanced pressure bladder tank system;**

Power required: Water system pressure is used to squeeze the bladder containing foam concentrate. Advantage of this system is that no external power is required other than a pressurized water source.

Flow-rates: 4 GPM to 250 GPM

Maintenance: Because of its simple design, this system requires little maintenance other than routine flushing.

Cost: Depending on the model and size of unit price will vary between $1500.00 and $2,200.00.

Concerns: The bladder tank cannot be recharged while it is in operation: the system is sensitive to a viscosity change in concentrate (a thicker agent will flow less volume due to increased friction).

order info:
1. Type--Balanced Pressure Bladder Proportioning System.
2. Either portable or a built-in system.
3. Capacity--List the size (model or gallon capacity) of the unit
4. Inlet and outlet size of the venturi or differential valve (1.5" or 2.5") and thread type (NPSH, NPT, or vitriolic coupling).
6. Parts list of flushing hardware.
7. The bladder shall have the capability to be

refilled with a manual or mechanical pump.

Order from: Robwen INC., 1945 Blake Ave., Los Angles, CA. 90039, (213) 665-5633.

Make & Type: **KK Products, Pro-Portioner a Balanced Pressure Pump Proportioning system.** An automatic pressure balancing valve regulates the foam concentrate pressure to match the water pressure. A positive displacement pump is used to deliver the concentrate. This system allows maximum efficiency for liquids of varying viscosity and the ability draw from any non-pressurized container.

Power required: The pump is powered either by a 12 volt electric motor or a 2 or 4 cycle gasoline engine or can be mechanically driven.

Flow-rate: The unit has 2 options for water flows--(a) low-flow venturi proportional from 5 GPM to 80 GPM at a 1.0%--(b) high-flow venturi is proportional from 25 GPM to 125 GPM at 1.0%. Not proportional at water flows less than the minimum.

Maintenance: Check oil level in the pump. Don't run pump dry for more than a short time during priming, flushing, or if concentrate runs out. Flush system after each use; be sure that all electrical connections are secure. Check crankcase oil in 4 cycle engine and use proper gas mix for the 2 cycle engine.

Cost: List $3015.00

Other concern: Over-all the system is more complex than the bladder tank unit.

Order info: The options are many, refer to KK Products ordering catalog for desired unit. The unit that is being evaluated by BLM is a LOW-FLOW, ELECTRIC POWERED, STANDARD PIPE THREAD VENTURI-REMOTE MOUNT, WITH A DETACHED 8 GALLON CONCENTRATE TANK.

Order from: KK Products, 1004 Silhavy rooad, Valparaiso, IN. 46383, (800) 537-7553

Type & model: **Hypro Corp, FoamPro, is a direct injection foam proportioning system.** This proportioning system monitors the water stream flow and controls the foam concentrate injection to maintain a specified concentration rate in solution. The major system components are a flow meter, an electronic controller (micro processor), and a variable-speed drive system. A positive displacement pump is used

to deliver the concentrate. This system allows maximum efficiency of pumping liquids of varying viscosity and can draw from any non-pressurize container.

Power required: 12 volt, 25 amps, to run the motor, micro processor, flow sensor, and totalizer

Flow-rate — Range is from 0 to 200 GPM at a 1.0% concentrate ratio. The system is non-proportional at flows less than 20 GPM. This is due to the motors stall speed. In other words it can run only so slow.

Maintenance: Check oil level in pump, don't run pump dry during priming, flushing, or if concentrate runs out; check electrical connections, don't install micro-processor where it will get wet or be exposed to temperatures above 150 F.. Periodically clean the paddle wheel of foreign matter (if totalizer display shows zero flow when water is flowing suspect that the paddle wheel is stuck, open and clean). Flush the system after each use.

If every thing is working this system is user friendly.

Cost: List $4,000.00 plus

Concerns: The system is extremely complex and sensitive to environmental conditions (heat, water, and electrical interference). Recommend using braided steel hoses from concentrate pump to injection point to reduce the possibility of line bursting due to a stuck check valve. To work on the system requires the calling of the factory for technical guidance.

Order info: FOAMPRO proportioning system (Direct injection), with flow totalizer. Order from: Hypro Corporation, FoamPro Department, 375 Fifth Ave, NW, New Brighton, MN. 55112, (612) 633-9300

All of the manufactures are dedicated in providing a useful product and have spent a great deal of time in research and development. Only through actual field tests, comparing one system against another on the same vehicle, can you readily measure the pros and cons between them. The problems and idiosyncrasies, as identified in this paper, are being rectified by the appropriate manufacture.

References:

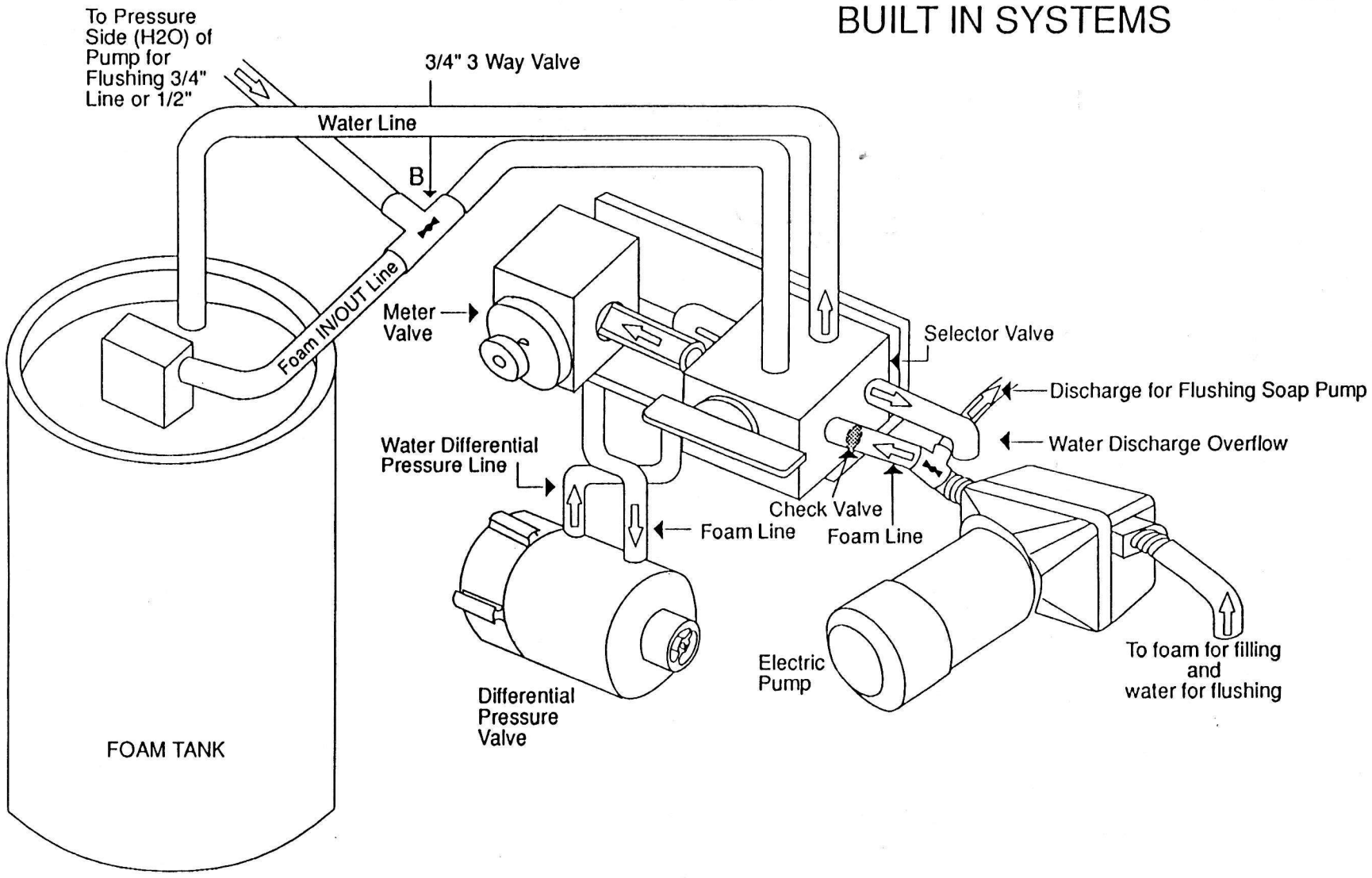
Mckenzie, Dan and Steve Raybould. 1990. Foam Porportioning Systems, USDA, Forest Service, San Dimas Technology and Development Center

Hypro Corporation, FoamPro Department, 375 Fifth Ave. MW, New Brighton, MN. 55112

KK Products, 1004 Silhavy Road, Valparaiso, IN. 46383

Robwen INC., 1945 Blake Ave., Los Angles, CA. 90039

PLUMBING DIAGRAM FOR FLOW-MIX BUILT IN SYSTEMS



ATTACHMENT A

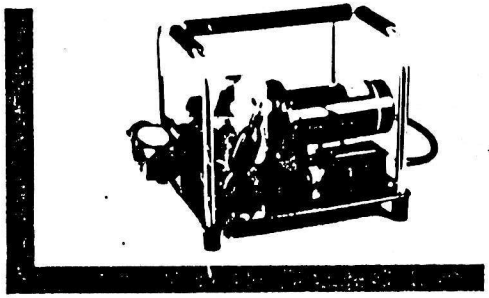
ATTACHMENT 1

the KK PRODUCTS

PRO/PORTIONER

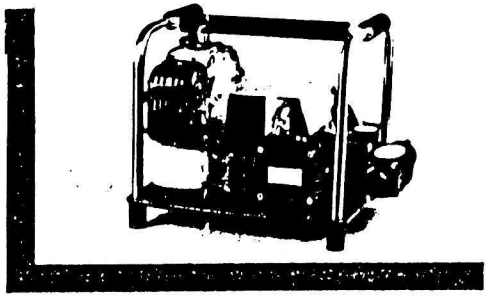
Discharge Side
Foam Injection Systems

POWER OPTIONS



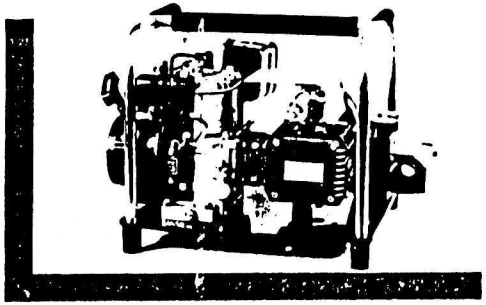
E — ELECTRIC MOTOR

12 Volt DC /30 Amp Max.
No Polarity Requirement
1/3 Horsepower
30 Amp Breaker Switch Included
Truck Mounted
Portable (limited)
Fixed Systems



2 — TWO CYCLE ENGINE

Kawasaki /Model TD-40D
40.2cc /1.65 HP
25:1 Gas Mixture
Totally Portable
May Be Truck Mounted
Two Cycle Efficiency



4 — FOUR CYCLE ENGINE

Kawasaki /Model FA-76D
76cc /1.7 HP
Unleaded Gasoline
Totally Portable
May Be Truck Mounted
Four Cycle Durability

EACH POWER UNIT OPTION INCLUDES

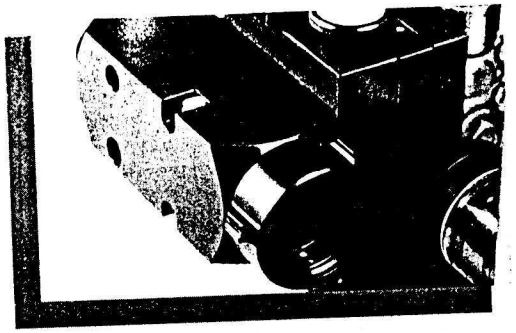
- Positive Displacement Foam Concentrate Pump
- KK Products Exclusive Proportioning Block
- Lightweight Base Plate
- Lightweight Stainless Steel Carrying Cage
- Serviceable Concentrate Filter
- Exclusive Concentrate Flow Indicator
- Simple Squeeze Bulb Prime System
- Inlet (concentrate) Quick Connect Coupling
- Factory Backed Warranties & Service
- Operation and Installation Information

the KK PRODUCTS

PRO/PORTIONER

Discharge Side
Foam Injection Systems

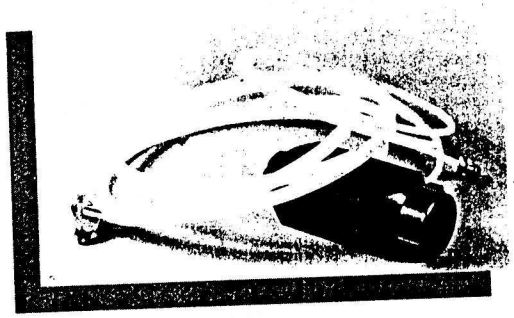
CONNECTION OPTIONS



N — NH Threads On Water Inlet & Outlet

I — NPSH Threads On Water Inlet & Outlet

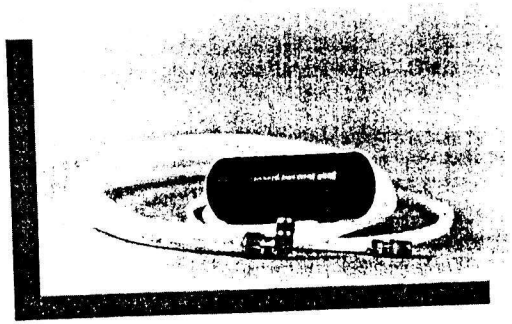
Venturi Unit Mounted Directly On Proportioning Block. For Use With All Portable And Limited Portable Applications.



M — NH Threads On Remotely Mounted Water Inlet & Outlet

J — NPSH Threads On Remotely Mounted Water Inlet & Outlet

Venturi Unit Can Be Remote Mounted Into Apparatus Piping. Unit Must Be Fixed Mounted and Includes All Tubing and Fittings To Use For Remote Installation.



V — 2" Grooved Victaulic Fitting For Remotely Mounted Water Inlet & Outlet

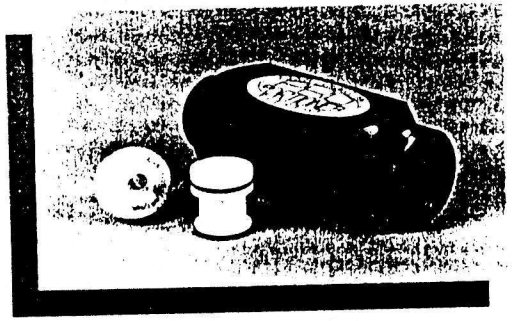
Venturi Unit Can Be Remote Mounted Into Apparatus Piping. Unit Must Be Fixed Mounted and Includes All Tubing, Fittings, and Necessary Hardware For Remote Installation.

the KK PRODUCTS

PRO/PORTIONER

Discharge Side
Foam Injection Systems

FLOW OPTIONS

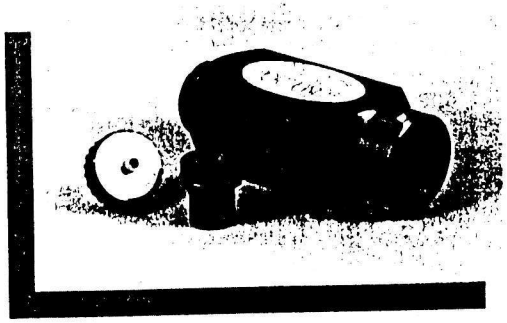


L

FLOW RANGES

- *5 GPM to 80 GPM @ .5%*
  For use with class "A" foams
- *5 GPM to 80 GPM @ 1.0%*
  For use with class "B" foams
- *Pressure Range*
  0 to 300 PSI (Electric)
  0 to 450 PSI (2 and 4 Cycle)

The Low Flow Option Is Ideally Suited For Applications When Pump Pressures And Flows Are Typically Low.
Designed For Portable Pumps And For Installation In Skid Type Units.



H

FLOW RANGES

- *25 GPM to 250 GPM @ .5%*
  For use with class "A" foams
- *25 GPM to 125 GPM @1.0%*
  For use with class "B" foams
- *Pressure Range*
  0 to 300 PSI (Electric)
  0 to 450 PSI (2 and 4 Cycle)

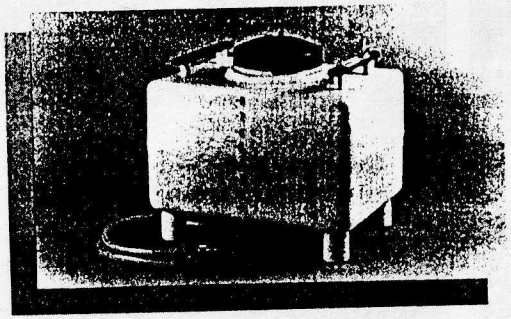
The Higher Flow Option Is Designed For Applications When Higher Typical Flows Are Available.
Designed For Pumper Operations And Higher Flow Portable Applications.

the KK PRODUCTS

PRO/PORTIONER

Discharge Side
Foam Injection Systems

SUPPLY OPTIONS

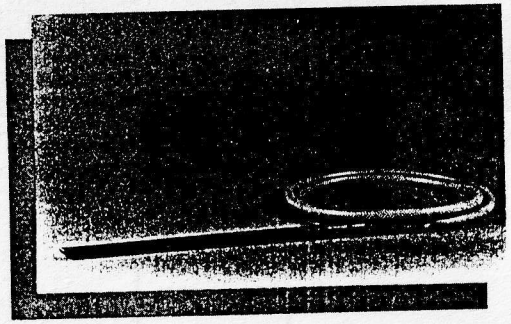


T

Eight Gallon Poly Tank With Fill

Connecting Supply Hose With Quick Connect Coupling

The Supply Tank Option Is Designed For Either Fixed Apparatus Mounting Or Remote Use With Portable Units. An Eight Foot Supply Tube And Quick Connect Coupling Are Standard.

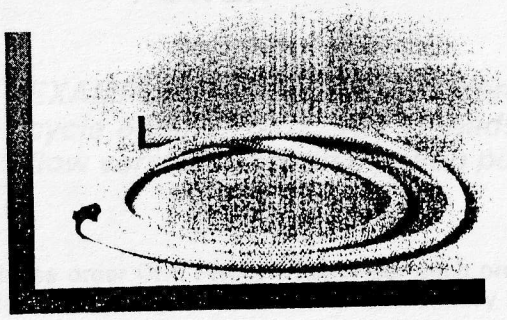


W

Stainless Steel Supply Wand

Connecting Supply Hose

The Stainless Wand and Supply Hose Are Designed Specifically For Portable Use With Any Concentrate Container.



R

Connecting Supply Hose

The Supply Hose Alone Option Is Available For Applications When The Concentrate Tank May Be Built Into The Apparatus.

KK PRO/PORTIONER ORDER SHEET

*The KK Products **PRO**/portioner is ordered by choosing one option from each of the four available categories. Each power option includes the following items: pump, proportioner, base, primer, flow indicator, carrying handle, inlet quick connect, and an inline concentrate strainer.*

POWER OPTIONS

E = ELECTRIC MOTOR
12VDC, 30A MAX.

2 = 2 CYCLE ENGINE
25:1 fuel mix
40.2cc

4 = 4 CYCLE ENGINE
76cc

CONNECTION OPTIONS

N = 1-1/2" NH THREADS
mounted on unit

M = 1-1/2" NH THREADS
with remote mount kit
(includes tubing & fittings)

I = 1-1/2" NPSH THREADS
mounted on unit

J = 1-1/2" NPSH THREADS
with remote mount kit
(includes tubing & fittings)

V = 2" VICTAULIC PIPE FITTING
FOR REMOTE MOUNT
(includes tubing & fittings)

FLOW OPTIONS

L = LOW FLOW VERSION
5 GPM to 80 GPM @ .5%
5 GPM to 80 GPM @ 1%

H = HIGH FLOW VERSION
25 GPM to 250 GPM @ .5%
25 GPM to 125 GPM @ 1%

SUPPLY OPTIONS

T = 8 Gallon Polyethylene Tank
(includes supply hose and
outlet quick connect fitting)

W = PICK-UP WAND
(includes supply hose and
outlet fitting)

R = SUPPLY HOSE
(includes outlet fitting)

*To Order a **KK PRO**/portioner: Write Your Choice Of One Option From Each Category In The Boxes Below.*

POWER	*CONNECTION*	*FLOW*	*SUPPLY*

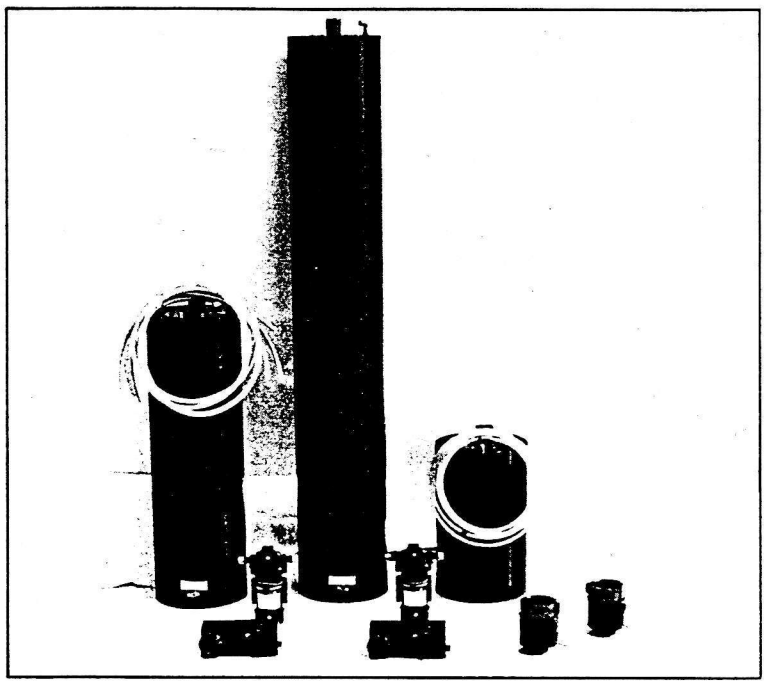
*EXAMPLE: The following ordered **PRO**/portioner will have a 2 cycle engine, 1-1/2" NH Threads mounted on the unit, the low flow version, and an 8 gallon polyethylene tank.*

2	N	L	T
POWER	CONNECTION	FLOW	SUPPLY

Please order ONE *PRO/portioner* per each order form. To order multiple units, you may either request additional forms or make copies of this one.
Mail all orders to: KK Products, 1004 Silhavy Road, Valparaiso, IN 46383 (219) 465-1266 (800) 537-7553 FAX (219) 464-7155

ATTACHMENT 2

FLOW-MIX™
BUILT-IN FOAM PROPORTIONER



3 — MODELS AVAILABLE TO FIT YOUR APPARATUS

MODEL 500	5 GALLON
MODEL 1000	10 GALLON
MODEL 2000	20 GALLON

SYSTEM DESCRIPTION

The ROBWEN Inc., Flow Mix Built-In Foam Proportioner, is a fully self-contained, positive pressure, foam concentrate to water proportioner. The Flow Mix Built-In requires no outside electrical source for power as it operates totally from the pressure generated by the flow of water through the connected hose line.

The Built-In design incorporates the use of a differential pressure valve that supplies water pressure around a bladder type tank containing the foam concentrate. Regardless of the flow rate. Flow Mix engineers have assured automatic and extremely high proportioning accuracy through the combined use of an adjustable, precision metering valve and positive water pressure. For operator convenience, an easy to use, operational selector valve is utilized providing OFF, FOAM, and REFILL positions. When refilling, the selector valve is placed in the REFILL position and the electric pump activated. (Primary water flow is unaffected during the procedure.)

The ROBWEN Inc., Flow Mix Built-In Foam Proportioner, has been designed using guideline criteria established by the U.S. Forest Service and the Bureau of Land Management (BLM). Wildland or AFFF type foam is satisfactory for use in the system.

FEATURES

Self Contained • Positive Pressure • No Outside Power Required • Precision Proportioning
Precise Adjustable Metering • Aids Reduction In Water Damage
Supplies Foam To Any Water Line Length • No Leveling Required

ROBWEN, INC. 1945 BLAKE AVENUE, LOS ANGELES, CALIFORNIA 90039 • 213-665-5633 • FAX 213-665-2588

FLOW-MIX™

MODEL 500
FOAM PROPORTIONER

Foam initially described as a fire suppression agent was patented in England about 1877. Since then advances have been reported in 1904, 1936, 1950, 1974, 1978, and recently in 1987.

Class B foams, the A-FFF type have been used on fuel fires such as JP-4, gasoline and diesel fuel for many years. Recently, Class A foams have been found to increase the fire suppression efficiency of water three to five times on both wildland and Class A structure fires.

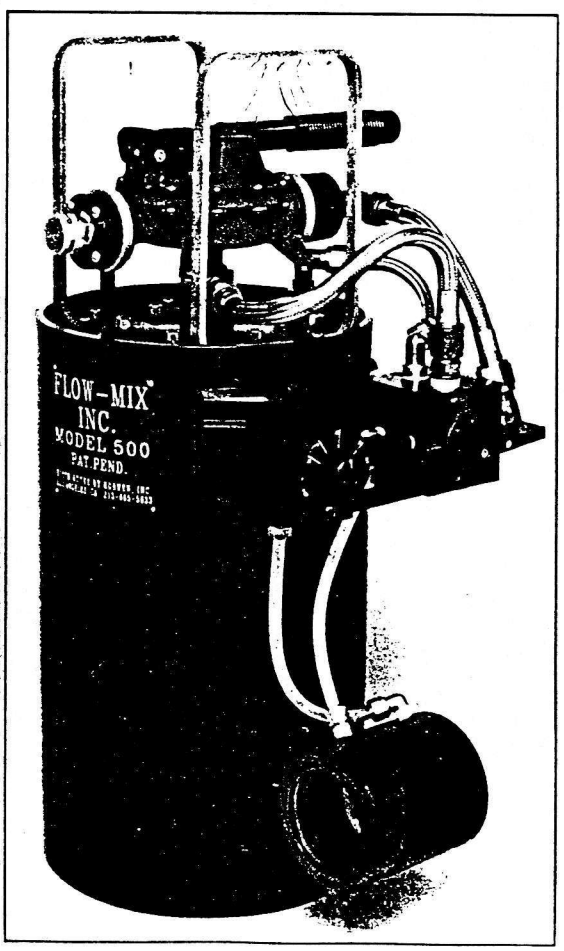
One problem experienced by the fire service in foam use has been injection of the agent into the hose line. To address this problem we have designed the Flow Mix Model 500 Proportioner which eliminates most, if not all, problems experienced with eductor systems.

SYSTEM DESCRIPTION

The ROBWEN Inc., Flow Mix Model 500 Foam Proportioner, is a fully self-contained, positive pressure, foam concentrate to water proportioner. The Flow Mix Model 500 requires no outside electrical source for power as it operates totally from the pressure generated by the flow of water through the connected hose line.

The Model 500 design incorporates the use of a differential pressure valve that supplies water pressure around a bladder type tank containing the foam concentrate. Regardless of the flow rate (see flow rate specification) Flow Mix engineers have assured automatic and extremely high proportioning accuracy through the combined use of an adjustable, precision metering valve and positive water pressure. For operator convenience, an easy to use, operational selector valve is utilized providing OFF, FOAM, and REFILL positions. When refilling, the selector valve is placed in the REFILL position and the hand pump activated. Refilling requires approximately 2 minutes and primary water flow is unaffected during the procedure.

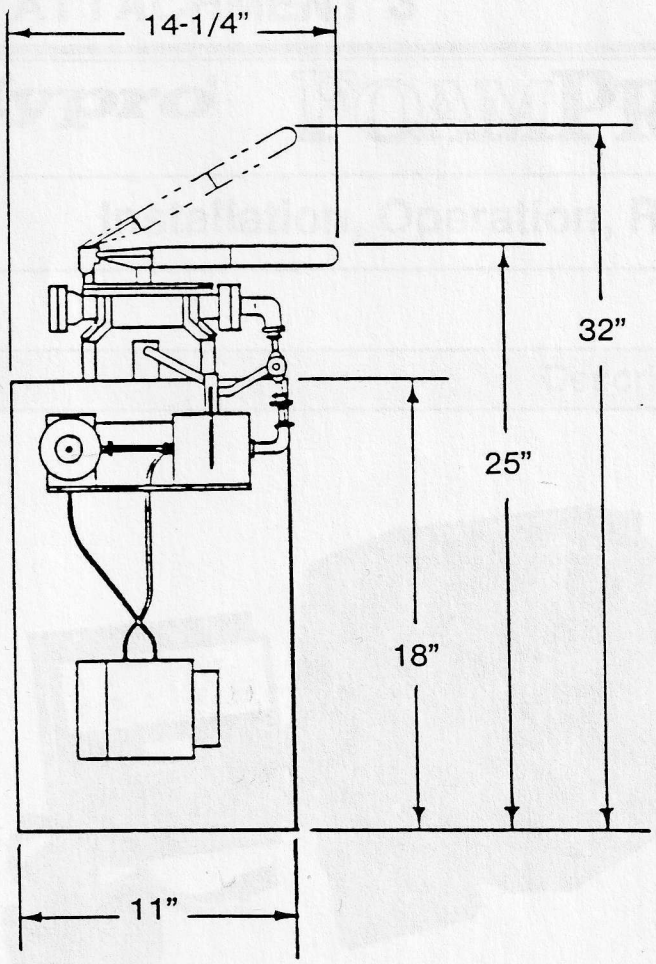
The ROBWEN Inc., Flow Mix Model 500 Foam Proportioner, has been designed using guide-line criteria established by the U.S. Forest Service and the Bureau of Land Management (BLM). Wildland or AFFF type foam is satis-factory for use in the system.

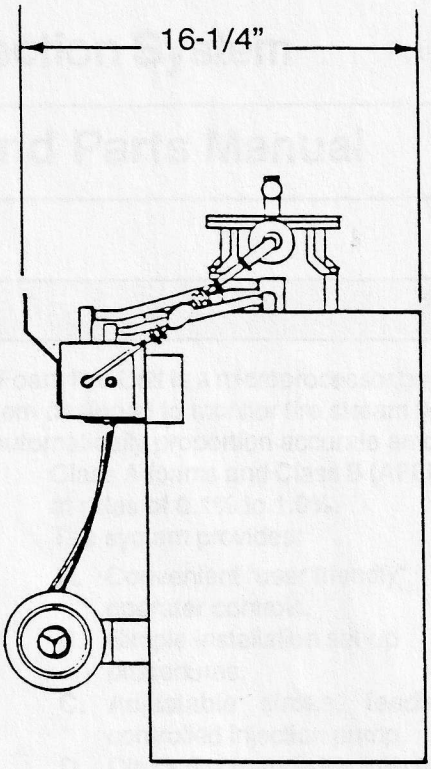


FEATURES

- **Self Contained**
- **Positive Pressure**
- **No Outside Power Required**
- **Can Be Attached In Hose Line Anywhere**
- **Aids Reduction In Water Damage**
- **Precision Proportioning**
- **Precise Adjustable Metering**
- **Supplies Foam To Any Water Line Length**
- **No Leveling Required**

ROBWEN INC.





SPECIFICATIONS

Height	Pump Handle Extended	32"
	Pump Handle Closed	25"
	Drum Height (Canister)	18"
Weight		50 lbs.
Diameter		11"
Depth - Front to Back		16¼"
Proportioner Range		0 to 1% Infinitely Variable
Flow Range		3 GPM to 120 GPM
Capacity		5 Gallons
Selector Valve		3 Way - OFF/FOAM/REFILL
Max. Pressure Drop		@ 120 GPM - 15 PSI
Material		Anodized 606 1-T651 Aluminum

*Class A Foam Concentrate

Other configurations available upon request

Printed in U.S.A. 2.5M

Flameco - Jim Hawkes
1199 Shoreline #260
Boise, Idaho 83702
(208) 384-1497

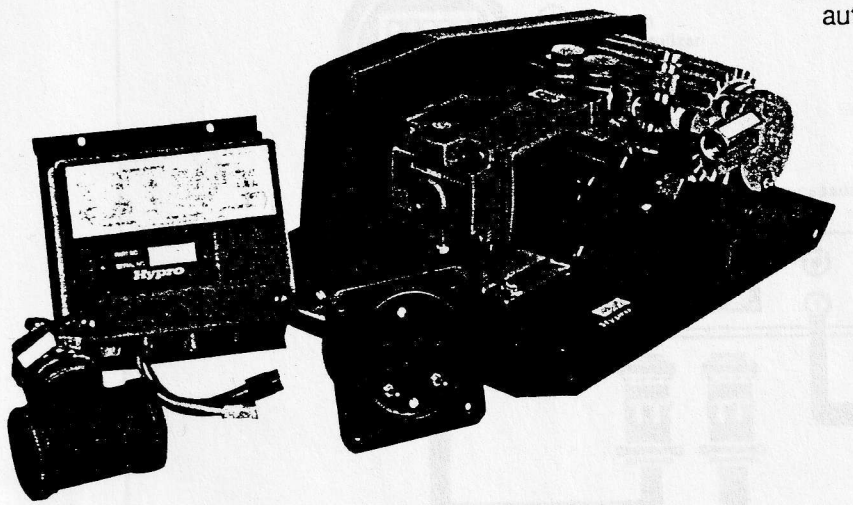
ROBWEN INC. 1945 Blake Avenue • Los Angeles, California 90039 • (213) 665-5633

ATTACHMENT 3

Hypro® **FOAMPRO™ Injection System** Form 600FP

Installation, Operation, Repair And Parts Manual 3-89

Description



The Hypro Foam Pro Unit is a microprocessor based foam system designed to monitor fire stream flow and automatically proportion accurate amounts of Class A foams and Class B (AFFF) foams. at rates of 0.1% to 1.0%.

The system provides:

A. Convenient "user friendly" operater controls.
B. Simple installation set-up procedures.
C. Adjustable stroke, feedback controlled injection pump.
D. Direct discharge-side injection.
E. Capability to change foam concentration rate while operating.
F. Failsafe protection.
G. Modular packaging with built-in diagnostic features.
H. Optional totalizer display module.

General Safety Information

1. Use a pressure relief device on the discharge side of the pump to prevent damage from pressure build-up when the pump discharge is blocked or otherwise closed and the power source is still running. Pressure unloader valve usage is specifically recommended.

2. Do not pump at pressures higher than the maximum recommended pressure.

3. Maximum liquid temperature is 180°F.

4. Make certain that the power source conforms to the requirements of your equipment.

5. Provide adequate protection in guarding around the moving parts such as the shaft and pulleys.

6. Disconnect power before servicing.

7. Release all pressure within the system before servicing any component.

8. Drain all liquids from the system before servicing any component.

9. Secure the discharge lines before starting the pump. An unsecured line may whip, causing personal injury and/or property damage.

10. Check hose for weak or worn condition before each use. Make certain that all connections are tight and secure.

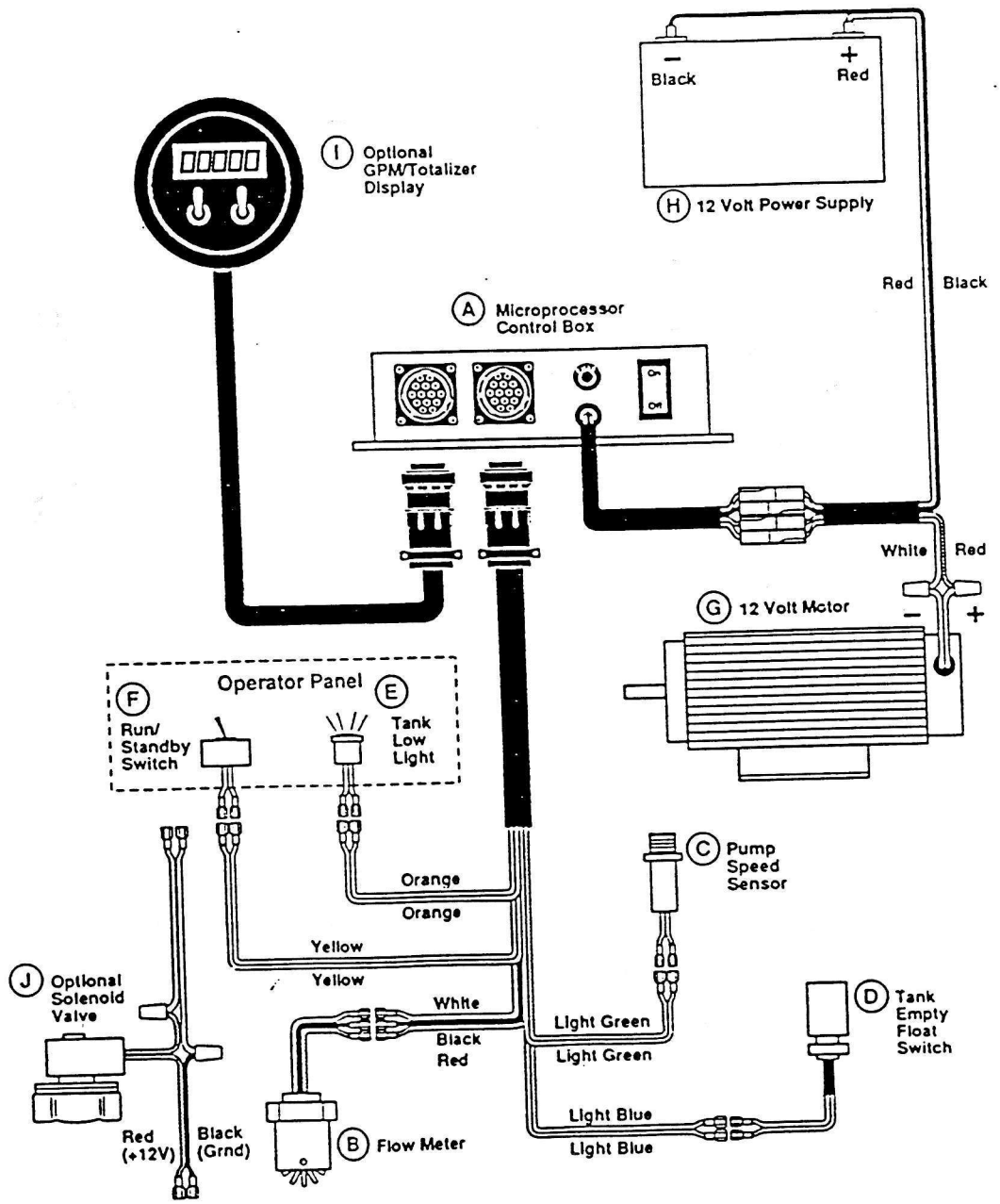
11. Periodically inspect the pump and the system components. Perform routine maintenance as required (see Maintenance section).

    WARNING: RISK OF ELECTRIC SHOCK!

    WARNING: DO NOT HANDLE A PUMP OR PUMP MOTOR WITH WET HANDS OR WHEN STANDING ON A WET OR DAMP SURFACE, OR IN WATER.

12. Use only pipe, hose and fittings rated for the maximum PSI rating at which the unloader operates.

Electrical Hookup



Plumbing Hookup