

# Liquid Feed System

## Chemtube<sup>®</sup> 2000 Diaphragm Metering Pump

The Chemtube<sup>®</sup> 2000 Metering Pump is a high capacity, hydraulically actuated, tubular diaphragm metering pump. Designed for long service under the severest conditions, the Chemtube<sup>®</sup> 2000 pump offers accurate metering of a wide variety of chemicals for any process application. Together with other outstanding lines of metering pumps such as the Encore<sup>®</sup> 700 pumps, and the Chemtube<sup>®</sup> 200 low capacity hydraulic diaphragm pump.

### Features

#### Cartridge Valves for a Wide Range of Applications

Suction and discharge valves are designed as cartridges which are compression sealed to the pump head and pipe connection by O-rings. These valves are easily removed for service or replacement by loosening the clampdown bolts. There is no need to remove or disturb the piping connections. Valve materials are available in PVC, Kynar<sup>®</sup>, or 316 SS in either a single or double ball configuration. A special arrangement is available for slurries utilizing a ceramic seat with a polyurethane ball for maximum abrasion resistance.

#### Non-Loss-Motion Stroke Adjustment

The Chemtube<sup>®</sup> 2000 pump utilizes a variable eccentric to provide for a smooth, non-loss-motion stroke adjustment. This results in a sinusoidal fluid velocity profile at all stroke lengths providing reliable, efficient operation with minimum "hydraulic shock" to the pump and piping system thus limiting any vibrations or leakage possibilities in the system. Adjusting the stroke length simply alters the amplitude of the sine wave.

#### Hydraulically Balanced Tubular Diaphragm

The tubular pumping diaphragm design provides a straight through flow path, which is ideal for high flow rates and slurries or high viscosity fluids. An intermediate hydraulic fluid surrounds the tubular diaphragm and is separated from the gearbox hydraulics by a flat disc diaphragm. This isolates the process fluid from the gearbox oil. The tubular diaphragm is also hydraulically balanced (same pressure inside and outside) for accurate feed rates and long service life at high pressures. Standard diaphragms are available in Hypalon<sup>®</sup> or Viton<sup>®</sup> for most chemical applications.

### Operation

The liquid end uses two diaphragms to isolate the process fluid from the hydraulic fluid in the gearbox. The tubular diaphragm, which handles the process fluid is surrounded by a 50/50 water/propylene glycol mixture. A flat disc diaphragm separates the intermediate fluid from the gearbox hydraulic oil. There are no mechanical connections between the two diaphragms and

### Key Benefits

- Long operational life in harsh conditions
- Double simplex capability, two drive units with independent capacity control
- Easy service of suction and discharge
- Choice of three valve materials; PVC, Kynar<sup>®</sup> or 316 SS
- Self adjusting hydraulic refill system
- Integral automatic pressure relief protects the system



the pump drive. Both diaphragms are hydraulically balanced during pump operation. The disc diaphragm is driven by the gearbox oil, which in turn is driven by the reciprocating pump piston. The piston causes the liquid in the intermediate chamber to displace the tubular diaphragm and create pumping action with each piston stroke. Varying the stroke length or speed of the piston changes the capacity of the pump. An internal pressure relief valve protects the pump drive and piping components from an overpressure condition that could be caused by a blocked discharge line or closed valve. An integral air purge valve together with an

oil refill valve maintain the integrity of the hydraulic system under all pumping conditions for consistent accuracy and long, operator-free operation.

## Manual and Automatic Stroke

### Length Control

The Chemtube® 2000 Diaphragm Metering Pump can be controlled by varying the stroke length or stroke frequency.

The following control schemes are available:

- Manual or Remote Manual Control
- Start-Stop Control where the motor is wired into the circuit of a transfer pump, switch, timer or controller
- Flow Proportional Control from a single process variable
- Residual, Compound Loop or Setpoint Control using one or two process variables

### Manual Stroke Length Control

A 10 turn micrometer gives continuous feed rate adjustment over a 10:1 range. A percent scale and vernier indicate stroke length setting to 1 part in 400. Each revolution of the knob changes feed rate by 10%. Stroke length is infinitely adjustable from 0 to 100%.

### Automatic Stroke Length Control

For automatic capacity control via stroke length, NEMA 4X actuator is used in conjunction with either of two process variable controllers. The compact, field retrofittable actuator easily installs on the pump and features local manual override and a window for clear indication of stroke length. Two microprocessor-based controllers are available:

### SCF-SC, Signal Conditioning Unit

The economical SFC-SC gives automatic process control in response to one process variable, typically flow rate.

### SFC-PC, Process Control Unit

The SFC-PC is a full featured setpoint controller, which provides more complex automatic control in response to two process variables, typically flow rate and chlorine residual. The SFC-PC can operate in any of four different control modes including residual feedback, compound loop, dual signal feed forward (for dechlorination) and flow proportional. In addition, the SFC-PC can be configured for "center-zero" operation in compound loop mode when a Deox/2000® Dechlorination Analyzer is used.

### Direct mA Input

For remote or automatic control, typically from a SCADA or centralized control system, the optional stroke length controller accepts a direct 4-20 mA control signal. Stroke length position is linear and proportional to the mA input.

### Variable Speed Control or Variable Frequency Control

For precise and accurate feed rate control via stroking speed an SCR for control of a DC motor or a variable frequency drive for inverter duty motor is available. Stroke frequency can be regulated manually by potentiometer setting, or automatically via 4-20 mA process variable input signal (optional). Closed loop speed regulation provides feed rate control accurate to 1% of full scale. Dosing or scaling of a process variable can be accomplished by means of an SFC-SC (Signal Conditioning Unit) used in conjunction with an SCR drive or VFD.

## Technical Data

### Accuracy

Repeatable metering accuracy is  $\pm 1\%$  of full scale, at constant hydraulic conditions, over a 10:1 range.

### Stroke Length

44.5mm (1.75")

### Stroking Speeds

For 60 Hz operation, 4 stroking speeds are available; 36, 72, 96 and 144 strokes/minute. For 50 Hz operation, 5 stroking speeds are available: 30, 60, 80, 120 and 144 strokes/minute.

### Feed Rate Adjustment

Feed Rate is infinitely adjustable from 0 through 100%. A percent scale and vernier indicate stroke length setting in 0.25% increments. Each revolution of the knob changes stroke length by 10%.

### Operating Range

Stroke length is adjustable over a 10:1 range. Stroke frequency is adjustable over a 20:1 range [using an optional SCR (10:1 with VFD)]. Total combined maximum operating turndown can be as high as 200:1. Above 100:1 continuous turndown, total available operating range should be evaluated against specific chemicals being metered.

### Speed of Response

Automatic stroke length control response time is 100 seconds from 0 to 100%. Variable speed control response time is under 3 seconds from 0 to 100%.

### Suction Lift

Flooded suction is recommended. The pump will self-prime with a 1.5m (5ft) of water suction lift (wetted valves, zero backpressure, full stroke and speed, water like solutions). Once primed, the pump will operate with a 1.5m (5ft) of water suction lift.

### Polymer and Slurry Handling Capabilities

Polymer solutions up to 10,000 centipoise (Brookfield Viscometer with No. 2 spindle @ 12 rpm) under any condition. Higher viscosities (up to 20,000 centipoise) with decreased capacity (10-15%). Hydrated lime slurries up to 0.45kgs (3.5lbs) per gallon of water; activated carbon slurries up to 0.13kgs (1.1lbs) per gallon; diatomaceous earth slurries up to 0.20kgs (0.17lbs) per gallon of water.

### Process Fluid Temperature Limits

82°C (180°F) for 316 SS Valves  
65°C (150°F) for Kynar® Valves  
52°C (125°F) for PVC Valves

### Ambient Temperature Limits

-12 to 49°C (10-120°F)

### Materials of Construction

Gear Box and Liquid End Housing: epoxy painted, cast iron

Automatic Actuator Enclosure: epoxy painted, aluminum

Suction and Discharge Valve Housings: clear PVC, Kynar® or 316 stainless steel

Valve Balls: 316 Stainless Steel, TFE, Ceramic, Glass, Polyurethane (for slurry service)

Valve Seats: 316 Stainless Steel, PVC, PDFV, Ceramic, Polyurethane (for slurry service)

**Cartridge Valves** - Cartridge-type suction and discharge valves are utilized for fast service without removing or disconnecting piping. The design includes wide flow paths and four-point guides to control ball rise and assure proper seating.

**Air Purge Valve** - An air purge automatically removes any entrained air from the hydraulic fluid to maintain pumping accuracy.

**Tubular Diaphragm** - The tubular diaphragm provides a straight-through flow path for the process chemical. It is available in Viton® or Hypalon® construction as standard.

**Secondary Diaphragm** - This flat diaphragm separates the hydraulic gearbox oil from the intermediate fluid that surrounds the tubular diaphragm. This provides an extra measure of isolation from the process fluid. This diaphragm also serves to activate the oil refill valve when necessary.

**Optional Diaphragm Leak Detector** - An optional diaphragm leak detector senses the early stages of diaphragm failure. A sensor monitors the intermediate fluid for any change in conductivity, which indicates that either the process chemical or hydraulic oil is mixing with the intermediate fluid due to a diaphragm leak. A remote alarm is initiated to alert the operator.

**Gear Sets** - Four combinations of worm gear and worm shafts are available to provide stroking speeds of 36, 72, 96, and 144 strokes per minute.

**Motor** - Available with standard induction and variable speed motors (optional) for wider operating ranges and automatic process control.

**Drive Unit** - The stroke length is adjusted through a heavy duty, variable eccentric design that provides for non-loss motion operation.

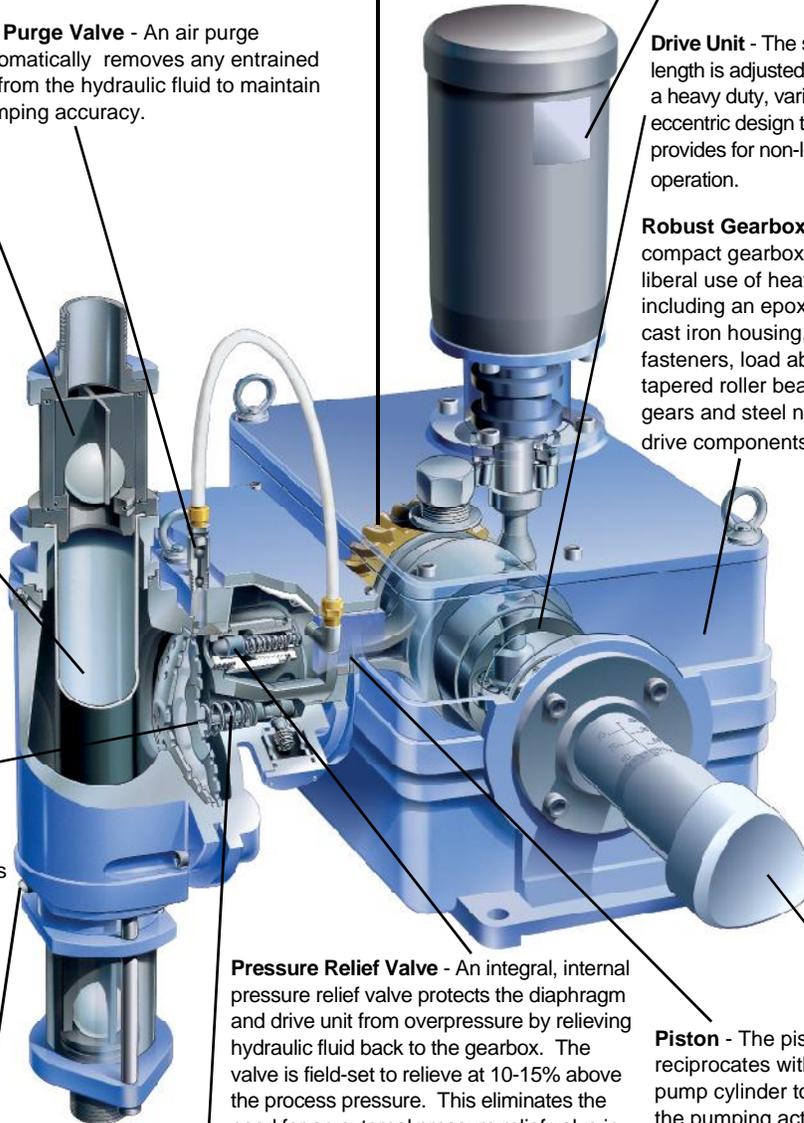
**Robust Gearbox** - The compact gearbox features liberal use of heavy duty parts including an epoxy-painted cast iron housing, 316 SS fasteners, load absorbing tapered roller bearings, robust gears and steel nodular iron drive components.

**Pressure Relief Valve** - An integral, internal pressure relief valve protects the diaphragm and drive unit from overpressure by relieving hydraulic fluid back to the gearbox. The valve is field-set to relieve at 10-15% above the process pressure. This eliminates the need for an external pressure relief valve in the discharge piping system.

**Oil Refill Valve** - The oil refill valve maintains a sufficient volume of hydraulic fluid in the pump chamber to provide proper pump operation. As hydraulic fluid is lost in minute quantities through the air-purge valve and the piston/cylinder interface, the secondary diaphragm will eventually flatten against the rear baffle plate. The oil refill valve senses the position of the diaphragm against the baffle plate and combined with a vacuum condition in the pump chamber allows oil replenishment to the pump chamber. There are no valves to adjust and since two conditions must coexist for the refill valve to operate, overfilling of the pump chamber cannot occur even in the case of excessive suction lift or a blocked suction line.

**Piston** - The piston reciprocates within the pump cylinder to provide the pumping action. A close tolerance fit eliminates the need for piston seals.

**Stroke Adjust Knob** - A 10-turn micrometer-type stroke adjuster to obtain precise and highly repeatable feed rate settings. A percent scale and vernier indicate stroke length in 0.25% increments. Feed rate is infinitely adjustable from 0 to 100%. Automatic stroke length control is available with a motor-operated positioner.



## Technical Data (continued)

### Materials of Construction (continued)

Valve Seals: Hypalon® or Viton®

Tubular Diaphragm: Hypalon® or Viton®

Mounting Base: Plastic

### Electrical Requirements

Standard induction motor arrangement is 1725 rpm, 115/230 Volts, 50/60 Hz, single phase, TEFC, UL Listed, CSA Approved. Motors with other electrical characteristics are available as an option. The optional diaphragm leak detector requires 115 Volts, 50/60 Hz. Resistivity adjustable from 1,000 to 100,000 ohms. NC/NO relay rating 13 Amps @ 120 Volts. Optional automatic stroke length actuator has 3 alarm contacts (high, low, actuator disengaged) N.O. rated 5 Amps @ 250 Volts.

### Accessories

Several control panel options with Stainless steel NEMA 4X enclosures, including VFD, SCR speed controllers are available to suit installation requirements.

Also choose from Back Pressure Valves, Antisiphon Valves, Main Connections, Strainers, Pulsation Dampeners, Calibration Chambers, Solution Tanks, Mixers, Liquid Level Switches, Slurry Flushing Systems and numerous Mounting Accessories.

### PM Kit Packages

PM kits contain original Products replacement parts most susceptible to wear. They facilitate scheduled maintenance and help maintain equipment in good working order, eliminating equipment breakdowns and costly downtime.

Capacity Specification and Motor Selection

Piston Size inches	60 Hz 1725 RPM			50 Hz 1450 RPM			Maximum Discharge Pressure PSI/(Bar)								Connection Cartridge Valves
	Stroke Frequency stroke/ min.	Capacity *		Stroke Frequency stroke/min.	Capacity		Motor Horsepower @ 1725 RPM - Induction (Variable Speed)								
		gph	lph		gph	lph	Simplex				Double Simplex				
							1/2 (3/4)	3/4 (1)	1 (1-1/2)	1-1/2 (2)	2 (3)	1 (1/1/2)	2 (3)	3 (5)	
2 (50.8 mm)	36	46	175	30	38	144	200 (14)	X	X	X	X	200 (14)	X	X	1" NPT R1 or 1" Soc.
	72	92	350	60	77	291	120 (8)	180 (12)	200 (14)	X	X	150 (10.3)	200 (14)	X	
	96	123	467	80	103	390	90 (6)	130 (9)	180 (12)	200 (14)	X	X	150 (10.3)	200 (14)	
	144	185	700	120	154	583	60 (4)	90 (6)	120 (8)	180 (12)	200 (14)	X	100 (7)	200 (14)	
	X	X	X	144	185	700	60 (4)	90 (6)	120 (8)	180 (12)	200 (14)	X	100 (7)	200 (14)	
2.5 (63.5 mm)	36	79	299	30	66	249	125 (7)	X	X	X	X	125 (8.6)	X	X	1-1/2" NPT R1 or 1-1/2" Soc.
	72	158	598	60	132	498	70 (5)	105 (7)	125 (8.6)	X	X	75 (5)	125 (8.6)	X	
	96	211	799	80	176	666	50 (3.4)	75 (5)	105 (7)	125 (8.6)	X	X	75 (5)	125 (8.6)	
	144	317	1200	120	264	1000	35 (2)	50 (3.4)	70 (5)	105 (7)	125 (8.6)	X	50 (3.4)	125 (8.6)	
	X	X	X	144	317	1200	35 (2)	50 (3.4)	70 (5)	105 (7)	125 (8.6)	X	50 (3.4)	125 (8.6)	
3 (76.2 mm)	36	132	500	30	110	416	75 (5)	X	X	X	X	75 (5)	X	X	2" NPT R2 or 2" Soc.
	72	264	1000	60	220	833	40 (2.7)	65 (5)	75 (5)	X	X	50 (3.4)	75 (5)	X	
	96	352	1333	80	293	1110	30 (2)	45 (3)	60 (4)	75 (5)	X	X	50 (3.4)	X	
	144	528	2000	120	440	1667	20 (1.4)	30 (2)	40 (2.7)	60 (4)	75 (5)	X	30 (2)	75 (5)	
	X	X	X	144	528	2000	20 (1.4)	30 (2)	40 (2.7)	60 (4)	75 (5)	X	30 (2)	75 (5)	

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