# Q PUMP INSTRUCTIONS
# CeramPump®

ISO 9001

## SAFETY INSTRUCTIONS

Before using any Fluid Metering product, read the following safety instructions, as well as specific product specifications and operating instructions.

**Warning!** Fire, electrical shock or explosion may occur if used near combustibles explosive atmosphere, corrosive air, wet environment or submerged in fluid.

- Turn off the electrical power before checking pump for any problems.
- Connect motor, speed controllers, or any other electrical devices based on Fluid Metering specifications. Any unauthorized work performed on the product by the purchaser or by third parties can impair product functionality and thereby relieves Fluid Metering of all warranty claims or liability for any misuse that will cause damage to product and/or injury to the individual.
- Power cables and leads should not be bent, pulled or inserted by excessive force. Otherwise there is a threat of electrical shock or fire.
- Replace any inline fuses only with fuse rating as specified by Fluid Metering.
- When pump/drive is under operation, never point discharge tubing into face or touch any rotating components of pump.
- In a power down thermal overload cut-in condition, unplug or turn off power to pump. Always allow a cool down period before restarting: otherwise, injury or damage may occur.
- For 30 seconds after power is removed from pump/drive: do not touch any output terminals. Electrical shock may occur because of residual voltage.

**Caution! Fire, electrical shock, injury and damage may occur if not used in accordance with Fluid Metering specifications and operation instructions.**

- Do not put wet fingers into power outlet of unit.
- Do not operate with wet hands.
- Do not operate drive assemblies that require a hard mount (to be bolted down) unless they are mounted per Fluid Metering specifications, if not injury may occur and/or damage to unit.
- Do not touch any rotating pump or motor components: Injury may occur.
- Do not run pump dry, unless designed for that service. Running dry is harmful to the pump, and will cause excessive heating due to internal friction.
- Check pump rotation and inlet/outlet pump port orientation before connecting power to pump. If not, injury may occur.
- When pulling out cords from outlets - do not pull cord, grasp plug to prevent plug damage or electrical shock.
- Fluid Metering Drive Motors become HOT and can cause a burn. **DO NOT TOUCH!**

### INSTALLATION & OPERATING TIPS

**1. CLEAN FLUIDS.** Abrasives in the pumped fluid may damage cylinder and piston surfaces and should, therefore, be avoided. Ceramic piston/cylinder components are more tolerant of suspended solids, except solids that tend to flock and impede the movement of the piston in the cylinder.

**2. COMPATIBLE FLUIDS.** Pump only fluids compatible with materials of construction of the pump head you have selected.

**3. WET OPERATION.** The pumped fluid provides surface cooling and lubrication to the piston and cylinder of your PUMP. Therefore, avoid dry operation (except pumps specifically designated “gas pump”).

**4. FLOW VOLUME AND DIRECTION.** The valveless pumping function is accomplished by the synchronous rotation and reciprocation of the ceramic piston in the precisely mated ceramic cylinder liner. One complete piston revolution is required for each suction/discharge cycle. Flow rate can be changed while the pump is operating or at rest. Moving the pump head position changes the piston stroke length and, in turn, the flow rate. You can make infinite fine flow adjustments between 0-100% flow rate. The flow rate indicator provides for accurate and simple linear calibration. Angular deflection of the cylinder with respect to the zero point on the calibration scale of your Q PUMP controls flow magnitude and direction e.g., with the cylinder pointer at 10 on the left scale, fluid will be passed from the right port to the left port at 100% of the maximum rated volume; with the pointer at 10 on the right scale, fluid will pass from the left port to the right port at maximum rate. Set at 5 on the scale, flow rate will be 50% of maximum; at 4, it will be 40%; at 3, 30%, etc. The flow control setting may be changed (including flow reversal) at any time while the pump is operating or idle. Slightly loosen the two thumb screws and turn the STROKE LENGTH ADJUSTMENT KNOB. Adjustments are made by turning the Flow Control Knob which moves the flow rate indicator along a fixed 20-unit scale linearly calibrated “10-0-10”. The “10” equals 100% flow rate in that direction, “0” equals zero flow. To improve the fine adjustment of the flow rates on Q pumps, there is an optional Dial Indicator Kit which provides for 1000 discrete settings. Retighten thumb screws once the desired setting is reached.

**5. PISTON SEALS.** The seals that keep your PUMP piston dry are not “just ordinary plastic discs.” They are precisely cut and hot formed from sheets of a chemically inert fluorocarbon, specifically formulated for resistance to wear, abrasion, heat and chemical attack. Each seal possesses an exceptional mechanical memory which allows it to maintain a relatively constant wiping pressure on the piston, compensating for seal wear as it occurs. Properly maintained in clean condition, the original seals on a PUMP may be expected to last the life of the pump. If they are removed for any reason, they should be returned to the factory.

**6. DIAL INDICATOR.** (optional) The Dial Indicator Kit is for fine adjustment and continuous monitoring of your Q PUMP flow rate settings. To adjust Dial Indicator equipped pumps:
1. Loosen thumb screws, turn STROKE LENGTH ADJUSTMENT KNOB, moving cylinder assembly to neutral (zero-flow position).
2. Adjust indicator pointers until they read zero on both dials.
3.You are now ready for fine setting by turning STROKE LENGTH ADJUSTMENT KNOB until you achieve desired flow rate on dial. To prevent system backlash always turn STROKE LENGTH ADJUSTMENT KNOB two turns or one full revolution of large dial beyond desired setting, then adjust back.

**7. 4-20 mA CONTROL** for automatic response to remotely generated 4-20 milliamp signals is standard on V300 controllers. The input can be either grounded or ungrounded. The current source connects to terminal posts mounted on front cover assembly of the STROKE RATE CONTROLLER. Be sure to observe correct polarity.

**8. PRESSURE.** Do not operate pump against head pressures in excess of design specification. Drive arm on piston may bend or break under overload and other irreparable damage may be suffered. Check your fluid circuit before applying power to the pump!

**9. ELECTRICAL PROTECTION.** All OUR PUMPS are positive displacement instruments and should be protected by lowest possible “slo blow” fuse or circuit breaker electrical arrangements. “QV” units come equipped with .75 amp fuses.

**10. NOISE AT HIGH PUMP RATES.** A metallic hammering noise during operation of your pump (particularly high speed units such as QB, QD, QBLDC, and QV) when pumping liquids indicates presence of gas bubbles in the pumping chamber which are reducing pumping capacity and may be damaging cylinder walls. Such bubbles may be traced to 1) a poor seal at the suction fitting, 2) fluid vaporization (cavitation) or, 3) degassing of the fluid.

**a)** To correct suction fitting leaks in stainless steel pump heads, remove fitting and wrap two layers of Teflon tape (standard Lab plumbing variety, 1 to 2 mil thick x 1/2” wide) tightly into the threads of the fitting. Replace fitting in cylinder port, drawing threads tightly on the Teflon tape. (Please see para. 16).

**b)** To eliminate vaporization and degassing noise, reduce suction load. This may be accomplished by: 1) using a 3/8” dia. TUBE ADAPTER on the suction line of the pump head to increase inside diameter of the suction line (use 1/2” dia. TUBE ADAPTER on -3 PHM’s.); 2) reduction of suction lift height; 3) pressurization of suction supply container; 4) locating pump below supply source to permit gravity flow aid; 5) reduce viscosity of fluid by heating or thinning; 6) reduce flow rate by adjusting pump to lower setting on flow scale; 7) install PULSE SUPPRESSORS in suction and discharge lines.

Improvements in noise abatement and pump life can be gained by putting pulse suppression hardware in the plumbing circuits adjacent to the pump suction and discharge ports - particularly with high speed pumps that are plumbed with rigid tubing. Theory holds that if part of a generated pulse is resiliently stored, the part not stored is smaller and thus easier to get into motion; the stored part of the pulse dissipating behind the part that is in motion sustains motion, causing an undulating flow to be transmitted rather than a series of pulses. Result: less noise, less energy used and less agitation of the pumped fluid. So for pulse noise and vibration problems, put a little resilience in your circuit. There are a number of rather easy ways to do it:

**c)** The simplest method is to use resilient tubing between the pump and the fluid circuit. Experiment a bit with standard elastomers - viton, hypalon, gum rubber, soft vinyl or other. Use only unreinforced tubing (reinforcement takes away the resilience). Always shield this type of arrangement so that a possible tube rupture will not endanger people or equipment.

**e)** Since each fluid and circuit exhibits differing characteristics, a bit of experimentation may be necessary. The results are usually worth the effort.

**11. FOR BEST LOW FLOW PUMPING RESULTS:** Use a pump having a maximum flow rating as near to the desired flow rate as possible and keep suction and discharge pressures essentially constant (please see para. 13). PUMPS using Low Flow Kits or designated LF are specifically designed for low flow/low dead volume, 1/4-28 flat bottom fittings.

**12. LOW FLOW BUBBLE PROBLEMS.** A common cause of trouble in metering pump applications requiring low flow rates - a few milliliters per minute or less - is the seemingly inevitable gas bubble trapped in the pumping head of the metering pump. It expands on the suction stroke and contracts on the discharge stroke, allowing little, if any, liquid to pass through the pump. Such bubbles, though often attributed to leaks in pump seals, can usually be traced to gases released by the pumped fluid in response to pumping agitation or pressure/temperature changes. When so identified, this potential source of metering pump error can be effectively controlled in most fluid circuits.

The familiar bubbles that form on the inside walls of a tumbler of tap water after it stands for a period of time at room temperature demonstrate the typical liquid degassing that results from pressure reduction (water line pressure to atmospheric) and/or temperature elevation (from ground ambient to air ambient). In this case, the bubbles contain air, hydrogen, carbon dioxide or other gaseous materials carried in the water; only small quantities of vaporized water are present. Some liquids respond to agitation and/or pressure/temperature changes by chemically separating into liquid and gas fractions; others simply vaporize, physically changing from liquid to gaseous form. Examples of liquids releasing gas or changing from liquid to gaseous form in response to agitation and temperature/pressure changes are numerous in the modern technical environment and many techniques have been devised to compensate for or correct their presence. The most common practices for bubble control employ:

**a)** pressure on the suction side of the pump circuit to encourage gas retention in the liquid or,

**b)** natural buoyancy of the bubbles to carry them away from or through the pump head. To apply pressure on the suction side of the pump, locate the pump physically below the supply vessel. Each two feet of elevation difference represents pressure of approximately one pound per square inch (psi). Bubbles that do occur will return to the supply vessel by buoyant lift. This is called a positive suction or flooded suction arrangement. If it is necessary to draw liquid up from the supply vessel to the pump head, negative suction pressure must be contemplated - again, approximately 1 psi per two feet of lift. Most liquids will release some gas when held at negative pressure and since the volume of gas released is generally proportionate to the volume of liquid subjected to the negative pressure, suction line diameter should be kept small for small flows (except heavy, viscous or tacky liquids which require large flow area for mobility). A vertical dead-end extension of the suction line can be provided above the pump suction port to trap line-generated bubbles before they enter the pump. This extension should be liquid filled at the start of a pumping period. Stand the pump vertically by loosening the screws and repositioning the Multi-Position Tilt Stand so that pump is in standing position, or hang the pump vertically by its base key slots. The discharge port should now be above the suction port allowing bubbles that enter the pump head to pass directly through with buoyant assist. Discharge lines should be inclined upward from pump head and bubble traps should be purged as often as necessary to assure liquid flow continuity.

**13. SYSTEM ACCURACY FACTORS.** Several interrelated factors are involved in the exceptional operating accuracy possible in systems using our PUMPS. Of primary concern are the following:

**a)** PUMP DISPLACEMENT precision is based on a simplified positive stroke mechanism which has no secondary linkages to produce stroke to stroke mechanical errors and has no gravity actuated or spring loaded valves to introduce random valve seating errors. The single mechanical linkage component between the PUMP piston and its drive elements is a precision spherical bearing which transforms circular drive motion into elliptical thrust motion (reciprocation). The total mechanical clearance of this linkage is less than 0.1% of the maximum pump stroke length or, approximately 0.0003”. Thus it may be said that PUMP displacement precision (stroke to stroke) is in the order of the mechanical linkage clearance; that is to say, stroke to stroke displacement is reproducible to less than 0.5% within the rated capacity of a given pump model.

b) PUMP VALVING is performed by a flat in the piston which is mechanically aligned with one cylinder port during the suction portion of each stroke and with the other cylinder port during the discharge portion of each stroke. The flat alignment is controlled by the single drive bearing discussed in the preceding sentences. The valve action is therefore mechanically precise, and free of random closure variations.

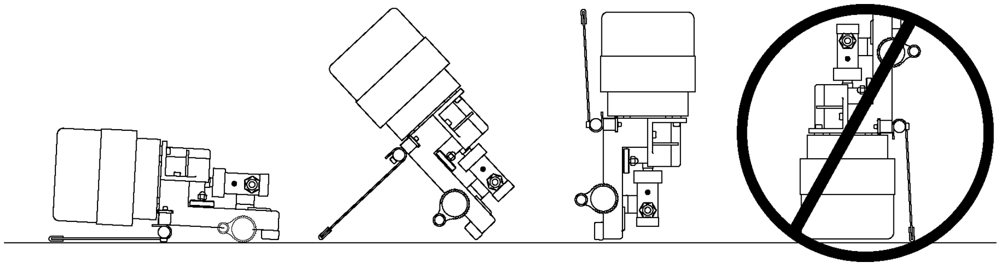
**c)** FLUID SLIP, a term commonly used to describe the migration of fluid around the internal moving parts of gear, lobe and vane pumps, is the volumetric difference between physical component displacement and fluid through-put of a pump system. In the PUMP, slip loss refers to the fluid which passes through the clearance space (approx. 0.0002”) between the piston and the cylinder wall. Since this clearance represents a restrictive passage of essentially constant dimension, it will be readily seen that the slip rate is determined by viscosity, pressure and time: e.g., assuming constant fluid viscosity and pressure, slip will be a smaller factor in a high repetition rate pump (short time per stroke) than in a low repetition rate pump. As viscosity increases and pressure decreases, time (or repetition rate) becomes a less significant contributor to slip loss.

d) STROKE REPETITION RATE is directly related to drive motor speed which in turn is influenced by work load and electrical supply voltage, i.e., motor speed decreases when work load increases and when electrical supply voltage (115 Volts AC) decreases. This motor speed variation may amount to as much as 15% for work load variations between zero discharge pressure and maximum rated discharge pressure. A 10% voltage drop may result in as much as 20% motor speed reduction when the pump is operating against a significant head pressure.

**e)** THE FLOW STABILITY (precision) of a

# IMPORTANT

**RECOMMENDED PUMP MOUNTING FOR MAXIMUM PERFORMANCE**



GOOD    BETTER    BEST    NOT RECOMMENDED

**For maximum pump performance, mount the pump with motor at 12 o'clock and pump head at 6 o'clock position. This orientation will allow air bubbles that enter the pumping chamber to directly exit thru buoyant assist. Discharge lines should be inclined upward from pump head.**

**Fig. 1**

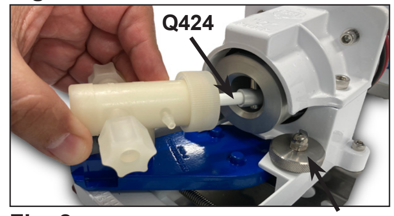
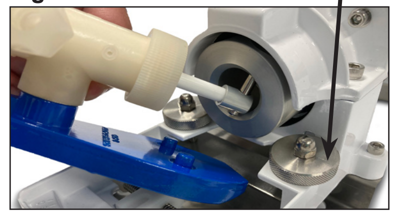



**Fig. 2**

KNURLED NUTS



PUMP is therefore principally related to consistency in fluid slip rate and stroke repetition rate and these functions in turn are related to external system load factors such as viscosity, differential pressure and electric line voltage; i.e., when load factors remain essentially constant, slip rate and repetition rate remain essentially constant; when viscosity increases, fluid slip rate and stroke repetition rate both decrease; when differential pressure increases fluid slip rate increases and stroke repetition rate decreases. In short, PUMP PRECISION is influenced by fluctuations of fluid differential pressures, fluid viscosity and electric line voltage. When these factors are controlled predictably reproducible pumping precision better than 0.5% may be expected.

## MAINTENANCE & REPAIR

**INSTRUCTIONS**

**14. LUBRICATION.** Use a dab of Marine base grease on PISTON DRIVE PIN just before it is inserted into the RADIAL BEARING in the SPINDLE ASSEMBLY does a world of good for the bearing and pin. Piston/Liner sets are all matched sets and are not interchangeable. The piston should never be removed completely from the pump head assembly.

**15. CHANGING THE LIQUID END OF YOUR Q PUMP.** (Figs. 1, 2).

**a)** To remove Q PUMP HEAD MODULE (QPHM):
1. Turn power off.
2. Rotate STROKE LENGTH ADJUSTMENT KNOB to position PUMP HEAD CARRIER Q410-2 all the way to the extreme right or left of scale (Fig. 1).
3. Rotate the SPINDLE ASSEMBLY to place PISTON DRIVE PIN at 3 or 9 o'clock position (facing cylinder head).
4. Loosen two KNURLED NUTS.
5. Lift QPHM and draw gently away from the SPINDLE ASSEMBLY (Fig. 2).
6. Move QPHM up and to the left while slipping DRIVE PIN out of RADIAL BEARING.

**b)** To replace QPHM:
1. With thr PISTON ASSEMBLY extending approximately 1-1/4" from CYLINDER NUT and DRIVE PIN in the 3 or 9 o'clock position, insert PIN into the RADIAL BEARING in the SPINDLE ASSEMBLY.
2. Slide QPHM into position on BASE making sure locator on bottom of CARRIER drops into slotted portion of FOLLOWER on base.
3. Tighten KNURLED NUTS on the ASSEMBLY.

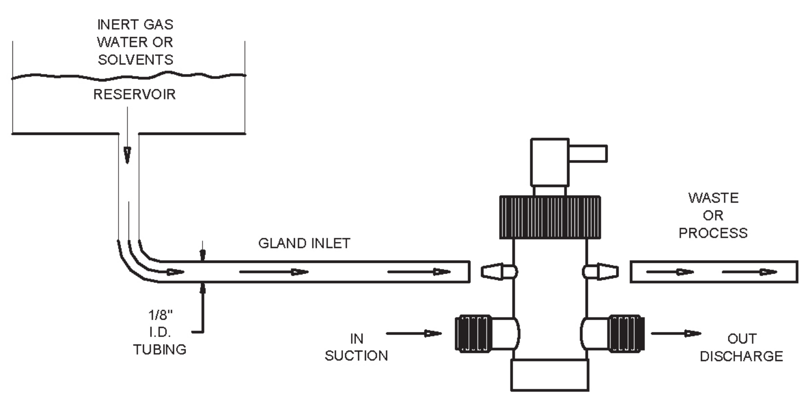
**16. CHANGING FITTINGS ON STAINLESS STEEL PUMP HEADS**

**IMPORTANT!**
Fittings screwed too tightly into stainless steel pump heads will contact port seals and may cause piston/cylinder damage. Use extra layers of Teflon tape on threads when necessary to avoid such excessive penetration.

**17. CLEANING PUMP HEAD.** Routine flushing with solvent before shut-down will suffice for most applications - set pump for maximum stroke and operate until solvent appears clear at discharge port. If periodic teardown for detail cleaning is required, remove parts with care to avoid damage to piston, cylinder and gland. Wipe all parts with lintless oil saturated cloth. Operate by hand after reassembly to assure free movement of parts prior to application of power.

**17.1 CAUTION!** Ceramic piston/cylinder sets are particularly sensitive to neglect and may "freeze" if allowed to dry out without adequate cleansing. Some users fill a loop of flexible tubing with fluid that will thin or neutralize the last fluid pumped. They then connect one end of the tube to the pump suction port, the other to the discharge port. With this loop positioned above the pump head, the ceramic surfaces and seal areas will stay moist and mobile for extended idle periods. If, however, a piston (ceramic or stainless steel) does freeze in the cylinder, DO NOT TRY TO FORCE IT FREE! Be gentle. Try to remove the pump head (refer to para. 15) from the base assembly so that the whole assembly can be soaked in a suitable solvent. If the head is not conveniently removable, the tube loop discussed in the prior paragraph may permit solvent to dissolve the "frozen" residue in reasonable time. Having a spare pump head on hand in case of emergency is always a good idea.

TYPICAL ISOLATION "W" GLAND PUMP HEAD SETUP




GLAND FEED RATE - 2-5 mL/MIN
PRESSURE FEED - GLAND INLET PRESSURE MUST BE LESS THAN 0R EQUAL TO THE MATERIAL BEING PUMPED
GRAVITY FEED - FOR CONTINUOUS OPERATION WE SUGGEST INSTALLING A LEVEL DEVICE SO THE GLAND DOES NOT RUN DRY.

## PUMP HEAD INFORMATION

**THINGS YOU SHOULD KNOW BEFORE ORDERING THE FLUID HANDLING PORTION** (or parts thereof) OF A MODEL Q PUMP, i.e. the removable assembly that is often referred to as the liquid end, the piston/cylinder set, or the Pump Head Module (PHM) assembly. To accommodate the diverse demands of laboratory and industrial pumping applications, our Q PUMPS are arranged to accept interchangeable PHM's with differing chemical and mechanical characteristics. There are a number of these assemblies from which the pump user may select in solving difficult fluid pumping problems. To simplify the selection process, each individual type of fluid handling assembly (piston/cylinder set) is designated by an alpha-numeric code which permits direct identification of pertinent factors.

## Q PUMP DESIGNATIONS

**Example:**

**Q-1-SAN** denotes a sanitary construction pump head assembly having a 1/4" diameter ceramic piston, ceramic cylinder liner and a 316 stainless steel cylinder case.

**PLEASE NOTE:**

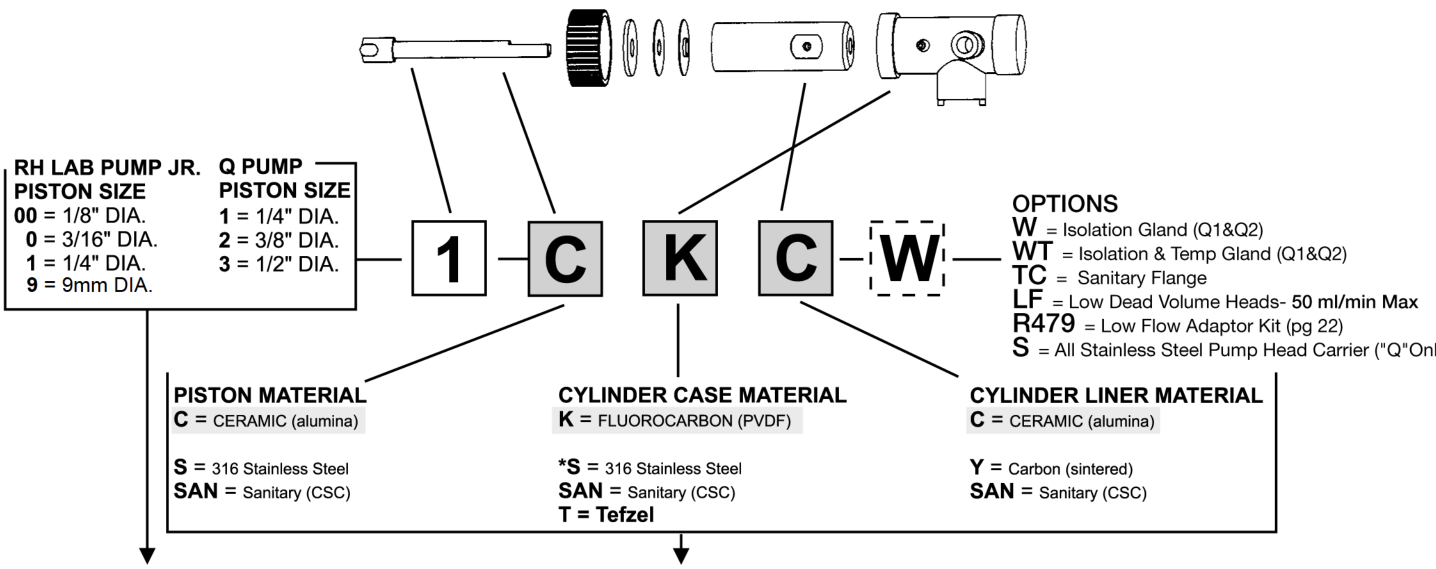
1. When the last three of the above shown categories are not called out, standard materials and construction are implied (CKC).

2. If **SAN** is designated in the last category, the preceding three categories will be designated CSC as required by FDA specifications.

3. Piston seals made of an inert material, Rulon AR, are used in all type Q PUMP HEADS except high speed pumps fitted with stainless steel pistons (these use Rulon J seals) and sanitary (SAN) pump heads which require virgin Teflon (T) seals. Specify AR, J or T after the pump head code designation to order pump heads assembled with seals other than standard seals.

4. Ceramic cylinder liners should be used with ceramic piston only.

# Pump Head Materials Configuration




| PUMP HEAD MODULE CODES | | | | |
|---|---|---|---|---|
| **PISTON SIZE CODE** | **MATERIALS OF CONSTRUCTION** | | | |
| | CKC | CSC | SAN | CTC |
| Q0 | - | - | - | - |
| Q1 | - | - | - | - |
| Q2 | - | - | - | - |
| Q3 | - | - | - | - |
| **WETTED PARTS** | CERAMIC PVDF | CERAMIC 316 SS | CERAMIC TEFLON | CERAMIC TEFZEL |
| **MAX. TEMP** | 212°F | 350°F | 350°F | 212°F |
| **OPTIONS** | | | | |
| LF | CF | CF | CF | CF |
| W | - | - | - | - |
| WT | - | - | - | - |
| TC | - | - | - | - |
| R479 | - | - | - | - |
| S ("Q" Only) | - | - | - | - |

See Materials of Construction section in the Fluid Metering catalog for more information on wetted parts *316 Stainless Steel cylinder cases accept ¼ NPT male fittings.

When ordering specify: Piston Size Code + Material of Construction + Option Code (Q1+CKC+W = Q1CKC-W

Add Option Code + Cost to Pump Module for complete price and part number.

***CF** = Consult factory for details

# V300 STROKE RATE FOR CONTROLLER
## FOR MODELS QV, Q2V, QVG50, & RHV

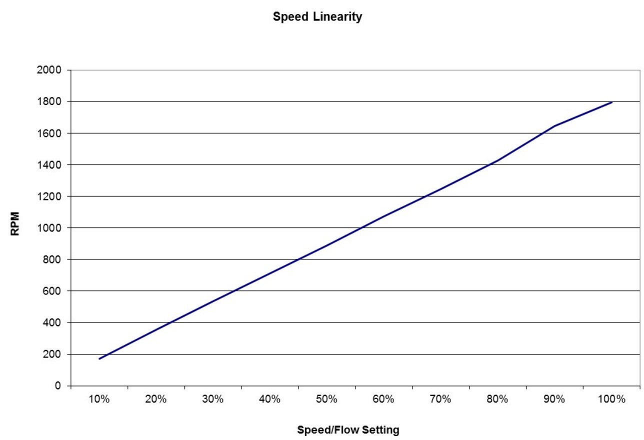
## General Description

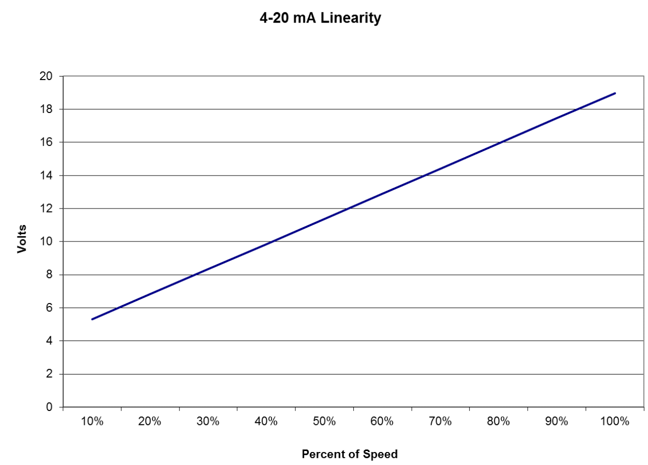
The V300 Stroke Rate Controller provides precision flow control for our variable speed "V" Series pumps. The V300 accomplishes this by varying the pump stroke rate from 5% to 100% of the drive's rated speed range of 90 to 1800 Strokes per Minute (SPM) or 5-50 strokes. The complete pump system consists of the V300 Controller and a variable speed "V" Series Pump. The V300 and pump are connected via a single cable (standard length is 4 meters while optional extension cables up to 20 meters are readily available).

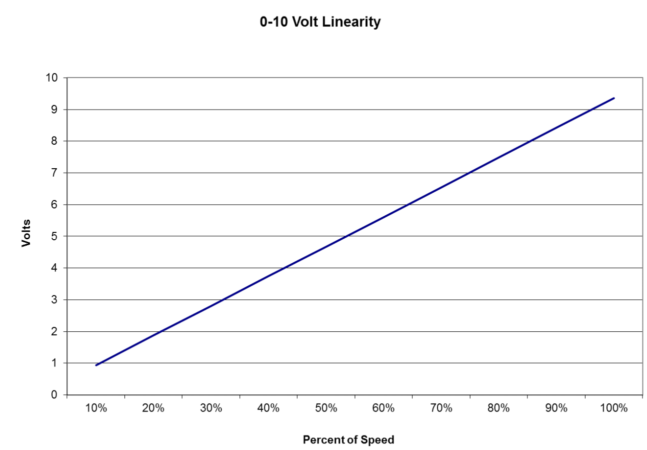
The pump is comprised of a 90V DC pump drive module (PDM) with integrally mounted pump head module (PHM), and is available in two configurations, QV and RHV, to accommodate our full range of pump head sizes.

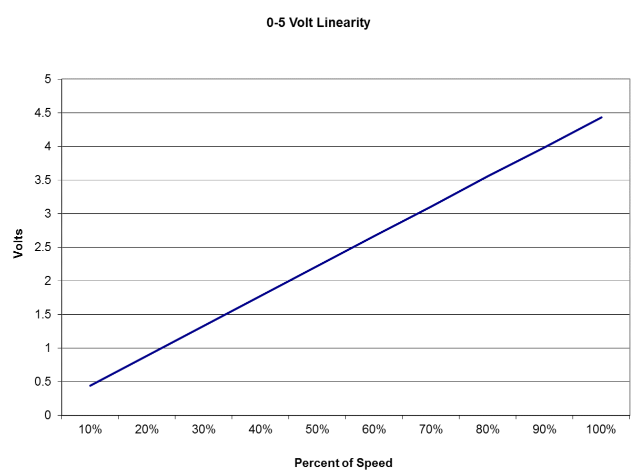
## V300 Features:

- 3 1/2 Digit LCD displays percent of Flow/ Speed.
- Selectable Manual or Analog flow rate control.
- Manual setting of flow rate with 0.1% adjustability
- Analog Input selectable 4-20 mA, 0-5 VDC, and 0-10 VDC input for communication with proces instrumentation
- Start, Stop, and Reverse Flow while main taining flow settings.Current fold back eliminates stalled motor/ electronics damage.
- Universal Power accepts 100-240V AC 50/60 Hz
- Quick connections for power, analog input, and pump modules.
- Rugged, Anodized Aluminum Enclosure designed for bench-top or wall mounting.



**PARTS ORDERS**

**MINIMUM ORDER APPLIES FOR DOMESTIC or FOREIGN** (Invoice price exclusive of shipping)

**SHIPPING**

**Parts orders will be shipped via United Parcel Service or U.S. Postal Service unless other means are specified.**

**ALL PRICES ARE QUOTED IN U.S. DOLLARS, FOB SYOSSET, NY - Subject to change without notice.**

**For Additional Information Call - Toll Free 800-223-3388 or email us at: pumps@fluidmetering.com**

fluid metering

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