BULLETIN 1C99

Regenerative Turbine Chemical Pumps for the Process Industry

Continuous high pressure pumping of non-lubricating, corrosive, liquefied gasses and liquids at boiling point in severe services.

ROTH PUMP COMPANY

THE ROTH SOLUTION PROVIDES:
Lowest NPSHr ● Lower Motor Speeds
High Temperature Operation ● Reduced Maintenance

The Roth Solution for the Process Industry

Roth Pump Company offers a variety of chemical pumps for improving the operation and efficiency of process systems. All Roth pumps are regenerative turbine pumps. They provide several advantages over centrifugal designs:

- develop higher pressures
- can be run at lower motor speeds
- eliminate cavitation
- operate with lower NPSHr
- deliver specified capacity with input pressure variations
- meet performance with fewer stages
- smaller size

How Roth Turbine Pumps Work

The advantages of Roth turbine pumps over other pump designs are due to Roth's specialized impeller design.

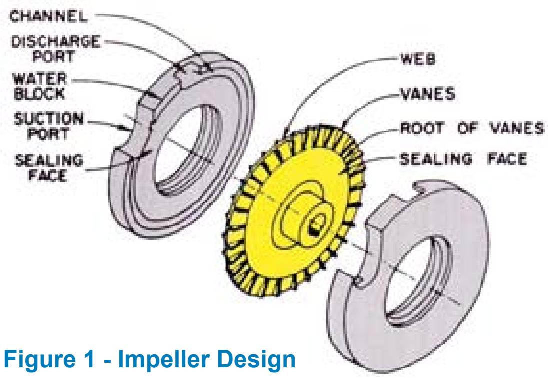


Figure 1 - Impeller Design

The impeller of a Roth regenerative turbine pump has double row vanes cut in the rim (Figure 1). The impeller is machined from solid bar stock and rotates within two liners into which annular channels have been milled.

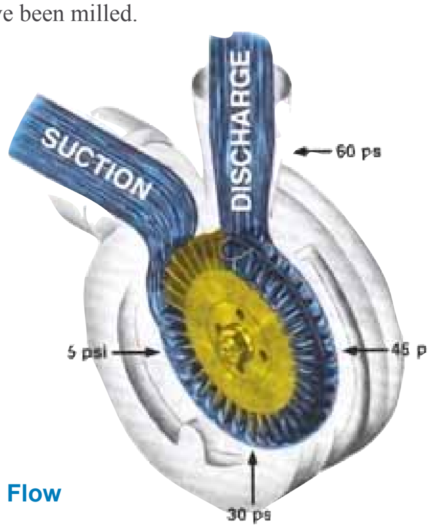


Figure 2 - Flow

Liquid flows in at the suction and is picked up by the impeller vanes (Figure 2) . In completing nearly one revolution in the annular channel, the fluid develops a high velocity and pressure increases dramatically before being sent out the discharge. The liquid re-circulates between the impeller vanes and the annular chamber. Because of this action, the fluid flows in a path like a helical spring laid into each of the annular grooves as the fluid is carried forward (Figure 3). Energy is added to the fluid by a number of vortex impulses in the impeller vanes, as it travels from suction to discharge.

These impulses have the same effect as multi-staging in a centrifugal pump. In a multistage centrifugal pump, the pressure is the result of energy added in each stage. In a turbine pump, pressure is added to the fluid stream by circulating many times through the vanes of a single impeller.

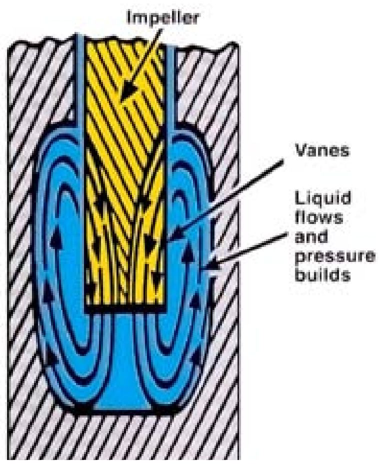


Figure 3 - Vane Action

One of the most remarkable features of the regenerative turbine pump is its performance characteristics when pumping highly volatile liquids. The manner in which the turbine impeller imparts velocity/energy to the fluid, as described above, is quite different from conventional centrifugal or positive displacement designs. The continuous, progressive building of pressure in a regenerative turbine pump essentially eliminates the sudden collapse of bubbles that is destructive cavitation.

A turbine pump can develop about ten times the discharge pressure of a centrifugal type having equal impeller diameter and speed. Pressure increases nearly uniformly around the impeller rim as indicated in Figure 2. At the impeller hub, the pressure is about one half the discharge pressure. This lower pressure, plus suction pressure, is what is seen in the stuffing box. Holes through the impeller keep the impeller centered to reduce wear, prevent unbalanced pressures on the impeller and reduce end thrust on the bearings.

Performance

HEAD AND EFFICIENCY

The performance comparisons between the Roth turbine pump and conventional centrifugal pumps can be seen in the curves shown in Figures 4 and 5. The power required to drive a centrifugal pump decreases as operating head increases because the mass of accelerated liquid decreases, as indicated by the horsepower curve in Figure 4. At 24 GPM, total head is 30 ft. (point A), and power about 0.6 HP (point B) . If the pump is throttled to reduce its capacity to 6 GPM, head increases to 36 ft. (point C), and power drops to about 0.35 HP (point D).

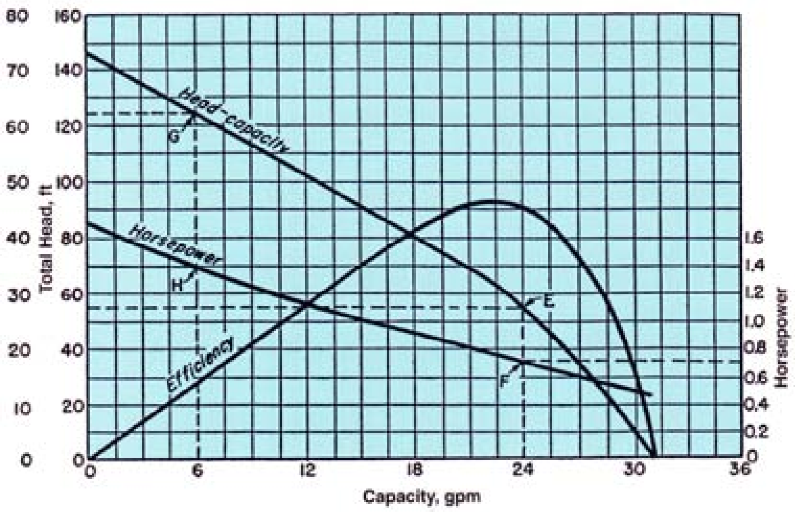


Figure 5 - Regenerative turbine pump performance

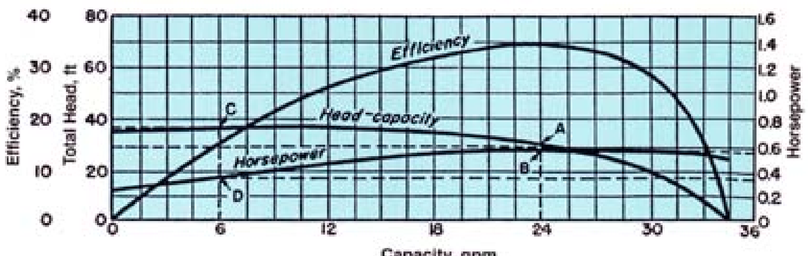


Figure 4 - Centrifugal pump performance

The curves in Figure 5 show how a comparable turbine pump performs. At 24 GPM, its discharge head is about 55 ft. (point E) , and requires about 0.7 HP to drive it (point F). When throttled down to 6 GPM its head goes to 124 ft. (point G) , and its power goes to 1.4 HP (point H).

The curves in Figures 4 & 5 are from tests. The centrifugal pump had a 6-in. impeller and the turbine a 4.25-in. impeller, each running at 1750 rpm. Note : Pumps did not have equal maximum flow characteristics. The centrifugal pump was selected as being close to the maximum flow of the Roth test pump. Figure 5 shows the high head obtained with a small diameter impeller. It also shows the pumps wide operating range.

This range is desirable on many applications where the head may vary greatly or is hard to determine. In Figure 4, the centrifugal pump operates most efficiently at a 30-ft head and 24 GPM. The turbine pump develops a 55-ft head at 24 GPM. If the head increased 5 or 6 ft., the centrifugal pump may not discharge. With a turbine pump this increase in head would cause only a slight decrease in flow but with an increase in power. Power for a turbine pump reaches a maximum at shutoff where it is the lowest on a centrifugal pump. Figure 6 shows overlay comparison of the Roth turbine and centrifugal pump performance.

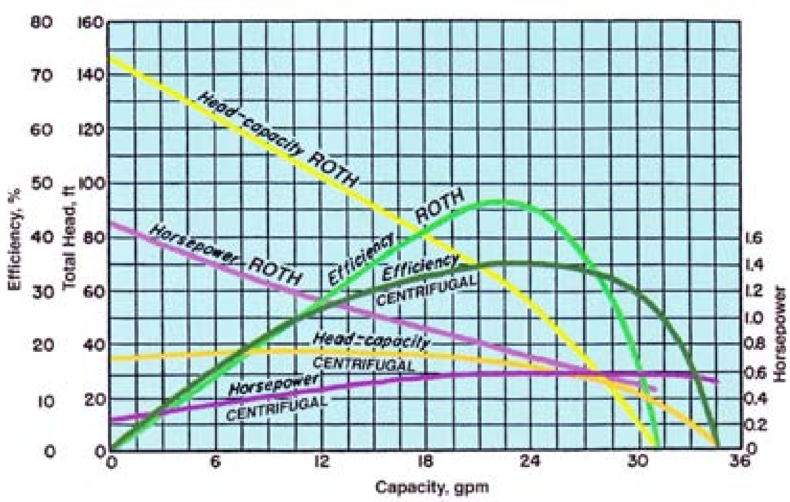


Figure - 6 Direct test comparison of Roth turbine pump with centrifugal pump

Selecting the Roth Pump for Your Application

This bulletin covers Roth Chemical Pumps and Roth One Foot NPSH Process Pumps. All pumps are limited to operating at 3500 RPM. All pumps can be provided in several different materials of construction for use in a wide variety of liquids.

Materials

Table 2 (page 10) lists a sample of liquids that can be pumped with Roth chemical turbine pumps and identifies the material of construction and seal selection.

Approximate selections may be made from the tables in this bulletin by observing the limits on the tables; more precise selections should be taken from the performance curves.

Mechanical

All pumps are provided with a case, frame, shaft, bearings, mechanical seal and lubrication accessories.

Since the shaft loading of the lower capacity pumps is much lower than that of the high capacity pumps mounted on the same frame, there are head limitations placed on some of the higher capacity models to keep shaft deflection within allowable limits.

Mechanical Seals

A variety of mechanical seals are available for use with Roth pumps for various applications, including complete cartridge seals. The seal must be selected to meet the pressure requirements and ability to withstand corrosion. Table 2, page 10 lists the recommended seals for use in the liquid being pumped and a seal selection guide is on page 12.

Current API Plans 11, 21, 22, 52 (non-pressurized reservoir) or 53 (pressurized reservoir) are available on all Roth pumps.

Couplings

All Roth turbine pumps are supplied with spacer type couplings and OSHA approved coupling guards.

Standards

Roth turbine pumps meet or exceed most of the current API 610 standards.

Testing

All Roth chemical pumps are tested for performance.

Roth has the capability to test pumps on either ammonia or propane, if required.

Design Types

Roth chemical pumps are available in Horizontal (Design P) or Vertical In-Line (Design L). Roth One Foot NPSH Process Pumps are available as Horizontal (Design P), Vertical (Design V), Vertical In-Line (Design L) or Vertically Submerged (Design S).

Series

21 Series consists of eight models of single stage regenerative turbine pumps.

22 Series consists of thirteen models of single stage regenerative turbine pumps.

24 Series consists of six models of two stage regenerative turbine pumps based on the 21 series regenerative turbine impellers in series and allowing for interstage losses.

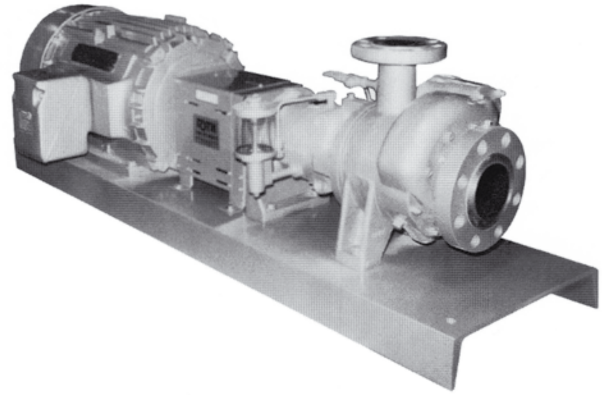
28 Series consists of six models of two stage regenerative turbine pumps based on the 22 series regenerative turbine impellers in series and allowing for interstage losses.

51 Series consists of nine models of single stage regenerative turbine pumps with a low NPSH inducer.

52 Series consists of eleven models of single stage regenerative turbine pumps with a low NPSH inducer.

54 Series consists of five models of two stage regenerative turbine pumps based on the 51 series regenerative turbine impellers in series and allowing for interstage losses. Each pump has a low NPSH inducer.

58 Series consists of nine models of two stage regenerative turbine pumps based on the 52 series regenerative turbine impellers in series and allowing for interstage losses. Each pump has a low NPSH inducer.



There remains some misunderstanding of the elements of net positive suction head (NPSH) in the industry and also a lack of confidence in the application of speed conversion ratios. We have dealt, at length, with these two points in order to establish a basis of mutual agreement for treatment of special cases.

Performance Data

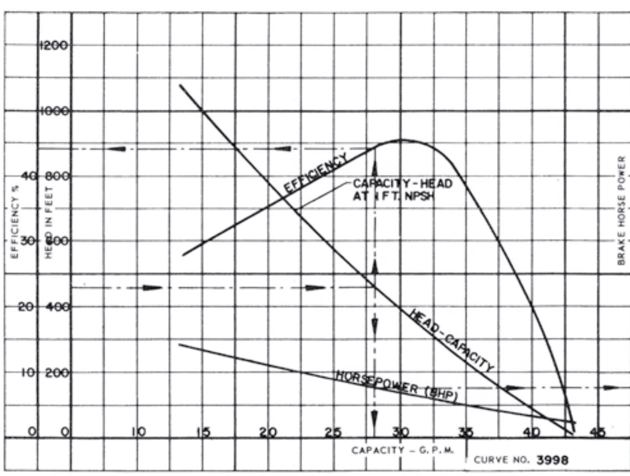
All performance data in this bulletin is graphed on a coordinate system, with the horizontal ordinate scaled from left to right in gallons per minute (GPM), and the vertical ordinate scaled from the vertex upward in feet head of liquid.

Secondary vertical scales are hydraulic efficiency given in percent and power input in brake horsepower.

It will be noted from observing Plate III that the characteristic performance of a regenerative turbine pump displays a very steep head curve, so that an increase of as much as 231 feet of head or 100 PSI of water causes a capacity drop of only 7 GPM of 22% efficiency when operating at peak efficiency.

The characteristic steep curve for regenerative turbine pumps makes it desirable to always give total dynamic head (TDH) first consideration in making a pump selection.

PLATE III



Pump Selection

Knowing the TDH in Feet or Meters use Table 1, page 9 to determine the appropriate table and page number to select the series and model number.

Reading Pump Curve

Using Plate III, assume it is desired to select a pump to supply 25 GPM @ 462 Feet TDH handling a liquid with a specific gravity of 1.0.

1. Find 462 Feet on the "Head in Feet" scale and trace horizontally to the performance curve labeled "Capacity-Head".
2. From that point of intersection, trace vertically downward to the horizontal GPM scale. Capacity at 462 Feet is 28 GPM.

Motor Selection

The vertical line that we traced in step #2 intersected the brake horsepower (BHP) curve directly below the head-capacity condition. Trace a horizontal line from the point of intersection on the BHP curve to the brake horsepower scale at the right side of the graph. The resultant reading is 8 brake horsepower.

Efficiency

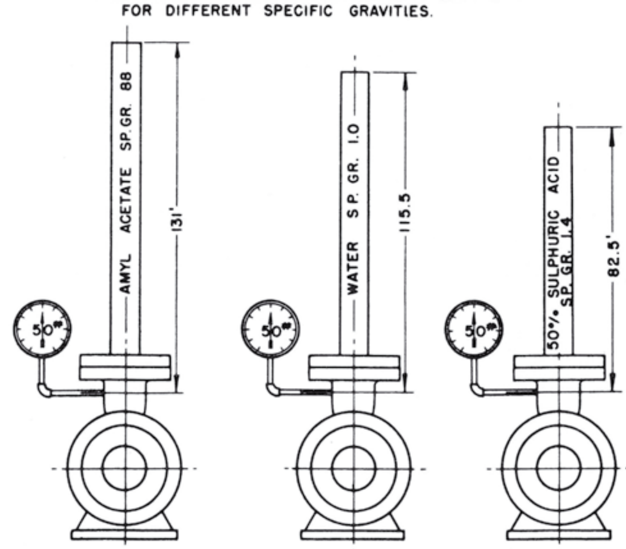
In Plate III the efficiency would be determined by tracing upward from the intersection of 462 Feet head with the "capacity head" to the efficiency curve and then left to the efficiency scale. The reading is 43.5%.

Specific Gravity Conversion

When TDH is given in terms of liquid head, such as feet or meters, the curves may be used without conversion for the pump selection. For BHP multiply the curve reading by the specific gravity.

When the TDH must be developed from a term indicating pressure, such as PSI, kg/cm^2, or atmospheres convert to linear head and divide by specific gravity before selecting from curve.

RELATION OF FEET HEAD TO POUNDS PRESSURE FOR DIFFERENT SPECIFIC GRAVITIES.



Pressure Relief Valves

Where exact capacities are required on continuous service, the usual procedure is to install a pressure operated relief valve in the discharge line, which will permit the surplus capacity to be returned to the source vessel.

It must be pointed out that where flow is to be regulated by throttling in the discharge line, care must be taken on installation to avoid the hazard of pump and motor overload. A differential pressure by-pass valve mounted in the discharge line and providing a return of surplus liquid to the source vessel is the best method of protecting the pump and motor from overload.

A less expensive pressure operated relief valve can sometimes be installed in the discharge line for protection against occasional overload situations. If there is a hazard of completely closed valve in the discharge line, the relief valve should be piped back to the source vessel.

A third method of using regenerative turbine pumps in cases where liquid flow must be controlled is the use of a variable speed drive, so that it can be set for the exact capacity required.

Cavitation

Although, in a sense, these capacity loses are due to the vaporization of a part of the liquid at the entrance, true cavitation does not take place in regenerative turbine pumps.

There is no large low pressure area in a turbine pump. Entrance losses are minimized by a series of devices special in Roth pumps. The impeller vanes begin generating pressure in the liquid at a point just inside the suction entrance. Our laboratory observations have resulted in the conclusion that any partial vaporization occurs just inside the suction entrance in the form of very small bubbles, which immediately condense when they reach the impeller.

The special inducers provided in Roth Low NPSH Pumps are designed to function without cavitation handling boiling liquids with One Foot NPSH. As a result these pumps are ideal for all liquids being pumped at or near boiling point. They may also be used to advantage on hydrocarbons with light ends in solution or various other liquids containing gases in solution.

NPSH Definition

Net Positive Suction Head (NPSH) is defined as the net positive absolute pressure at the pump suction. In pumping liquids we are concerned with getting the liquid into the pump in liquid state (i.e. without vaporization). Suction lift, friction losses, and entrance losses all conspire to reduce net pressure and in some cases interfere with the liquid getting to the impeller in liquid phase.

It should be remembered that the boiling point of a liquid is that point at which vapor pressure equals external pressure. Whether this takes place in open or closed vessels there is usually a vapor area in contact with the liquid and a liquid level line. At boiling point the addition of heat or the lowering of external pressure unbalances this equilibrium and results in the vaporization of an amount of liquid.

Also to be considered is that the pumps are liquid handling machines. Although turbine pumps will handle up to 50% entrained gas or vapor and will dispose of the air in suction lines during priming cycle, they are not efficient vapor handling devices. Furthermore there is a great expansion of volume in the conversion from liquid to vapor state, which takes up the inherent pump capacity.

Because of this major consideration of maintaining liquid state during the pumping cycle, it is essential to make an NPSH calculation in applications involving a liquid at or near its boiling point. These applications can be classified in three groups.

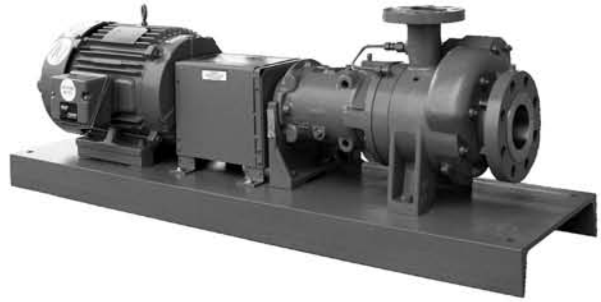
A. Normal liquids at elevated temperatures.

B. Normal liquids in vacuum atmosphere.

C. Normal gases compressed to liquid state.

An example of application A is hot water; of application B is vacuum evaporation of food products; and application C is liquefied petroleum gases and refrigerants.

In each of these groups the vapor pressure and atmospheric pressure are either in balance or approach being in balance. All pumping applications should be checked for classification in A, B, or C. If the application falls into one of these groups an NPSH calculation should be made.



NPSH Calculation

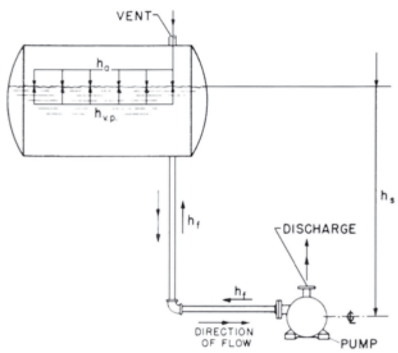
Three general cases may be considered in making an NPSH calculation.

Case I – The liquid level of the supply is above the pump centerline. This is termed static suction head.

Case II – The liquid level of the supply is below the pump centerline. This is suction lift.

Case III – Liquefied gases in refrigerant systems.

PLATE IV



Case I is by far the most common in industrial applications. Hot water or various other liquids are pumped out of a vessel elevated above the pump. In such a case it is usually necessary to consider only four elements in calculating NPSH.

Assume:

Static suction head $= h_s$

Vapor pressure $= h_{vp}$

Atmospheric pressure $= h_a$

Friction loss $= h_f$

All values to be given in pressure absolute and converted to feet of liquid. In the range of capacities involving turbine pumps (up to 200 GPM/45.4 m^3/hr) velocity head need not be considered.

Then in Case I system the following formula applies:

Case I:

$$h_s + h_a - (h_{vp} + h_f) = \text{NPSH}$$

A special variation may be considered.

Case IA. The liquid is in a closed vessel under vacuum or at raised temperatures. In this special case vapor pressure will equal atmospheric pressure.

$$\therefore\ h_s - h_f = \text{NPSH}$$

In planning piping for NPSH problems it is usually desirable to increase the size of the suction piping until friction loss in the suction piping is less than 0.5 feet (0.15 meters) of liquid head.

In some cases h_f may be disregarded in the application. The formula then becomes:

Case I:

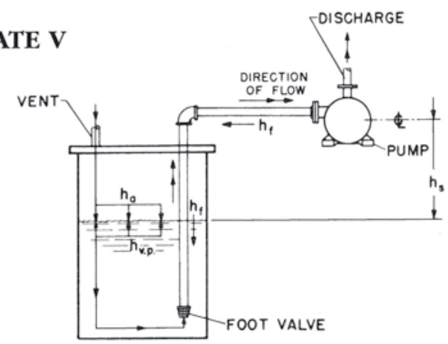
$$h_s + h_a - h_{vp} = \text{NPSH}$$

Case IA:

$$h_s = \text{NPSH}$$

NPSH is identical with static suction head when the boiling point and the suction piping is large enough to keep total friction loss below 0.5 feet (0.15 meters).

PLATE V



Case II can never involve liquids at boiling point, since a negative NPSH condition would result and vaporization would take place. All cases of NPSH calculations involving suction lift must also include liquids below the boiling point. With vapor pressure less than the atmospheric pressure the formula is as follows:

Case II:

$$h_a - h_{vp} - h_s = \text{NPSH}$$

Atmospheric pressure is then the only positive force in Case II. Both vapor pressure and suction lift are negative factors.

Case III is almost a contradiction of the theory of NPSH. Liquid refrigerants are nearly always at boiling point and the supply vessel is elevated above the pump. Static suction heads of four to twelve feet are usually available. However, in this type of system it lowers atmospheric pressure below boiling point and violent bubbling occurs. Insulation of the pump and suction line is frequently omitted. Ambient heat enters the liquid in the pump and raises the vapor pressure, increasing the boiling in all parts of the supply line, pump, and vessel. Due to these phenomena, the pump must frequently handle entrained vapor in such systems.

Since heat is added from atmosphere in the suction pipe and pump vapor pressure is raised above that in the vessel, less than the actual static suction head is available than NPSH at the pump.

It should be recognized that prolonged idle periods will cause a warming of pump and suction line that will cause boiling at start-up. Heavy insulation and prechilling before start-up are recommended in such cases.

Viscosity Conversion

In general, turbine pumps respond to formulae established for centrifugal pumps in making corrections for viscosity. All data shown in this bulletin is based on water at 1 cs.

When selecting a pump for viscosities greater than 1 cs. it is necessary to allow for losses in capacity and head and increase in brake horsepower.

The tables below indicate the percentage of curve capacity and head at various viscosities. The multiplier shown is for use converting job conditions, so that selection may be made directly from the curves.

1750 RPM

CS	SSU	CAPACITY % MULT.	HEAD % MULT.	BHP
1	30	100% - 1.00	100% - 1.00	100%
20	100	82% - 1.22	84% - 1.19	105%
50	250	73% - 1.37	76% - 1.32	120%
100	500	61% - 1.64	63% - 1.59	135%
200	1000	56% - 1.79	54% - 1.86	160%

Values to be applied on performance curves between capacity at peak efficiency and 40% capacity at peak efficiency.

3500 RPM

CS	SSU	CAPACITY % MULT.	HEAD % MULT.	BHP
1	30	100% - 1.00	100% - 1.00	100%
20	100	98% - 1.02	98% - 1.02	122%
50	250	88% - 1.14	86% - 1.16	141%
100	500	77% - 1.30	77% - 1.30	141%
200	1000	64% - 1.57	63% - 1.59	141%

Suitable for heads from 100 ft. up to maximum mechanical load.

Assume 10 GPM of a viscous liquid specific gravity 0.8 and viscosity of 50 cs is required at 347 feet TDH:

Assume a pump at 3500 RPM is required

Multiply 10 GPM by 1.14, equaling 11.4 GPM. Multiply 347 ft. by 1.16 equaling 403 ft. Selecting a model 5133 on curve 3091A – BHP equals 4.0. Multiply 4.0 x 141% x 0.8 equaling 4.5 BHP. Select a 5 HP, 3500 RPM motor.

Speed Conversion

The ratios established for centrifugal pumps and fans apply to the conversion for turbine pumps. Performance curves are given at 1750 and 3500 RPM. Conversion from these basic speeds may be accomplished by the following ratios:

Capacity = V
Velocity = v
Liquid Head = h
Power Input = H

1. $\frac{V_2}{V_1} = \frac{v_2}{v_1}$

The ratio of the capacity at required speed to capacity at basic speed is equal to the ratio of the corresponding speeds.

2. $\frac{h_2}{h_1} = \left(\frac{v_2}{v_1}\right)^2$

The ratio of the head at required speed to the head at basic speed is equal to the square of the ratio of the corresponding speed.

3. $\frac{H_2}{H_1} = \left(\frac{v_2}{v_1}\right)^3$

The ratio of the brake horsepower at required speed to the brake horsepower at basic speed is equal to the cube of the ratio of the corresponding speeds.

For convenience, the above ratios may be transposed as follows:

(1a) $V_2 = V_1 \frac{v_2}{v_1}$

(2a) $h_2 = h_1 \left(\frac{v_2}{v_1}\right)^2$

(3a) $H_2 = H_1 \left(\frac{v_2}{v_1}\right)^3$

Conversion To A Known Speed

Example: A pump is required for 20 GPM @ 200 ft. TDH for 50 cycle electrical current. (Assume sp. gr. 1.0, viscosity 1 cs., and NPSHa equals 1 ft.)

Solution: Find the conversion factors. These will be the same whether conversion is from 3500 to 2900 RPM or 1750 to 1450 RPM.

Capacity multiplier = 0.833

Head multiplier = 0.694

Brake Horsepower multiplier = 0.578

20 GPM divided by 0.833 equals 24.1 GPM

200 ft. divided by 0.694 equals 294 ft.

Select from the performance tables a Model 5143 at 3500 RPM. Brake horsepower required is 5.5.

5.5 x 0.578 = 3.1 BHP.

A 3 HP, 2900 RPM motor is required.

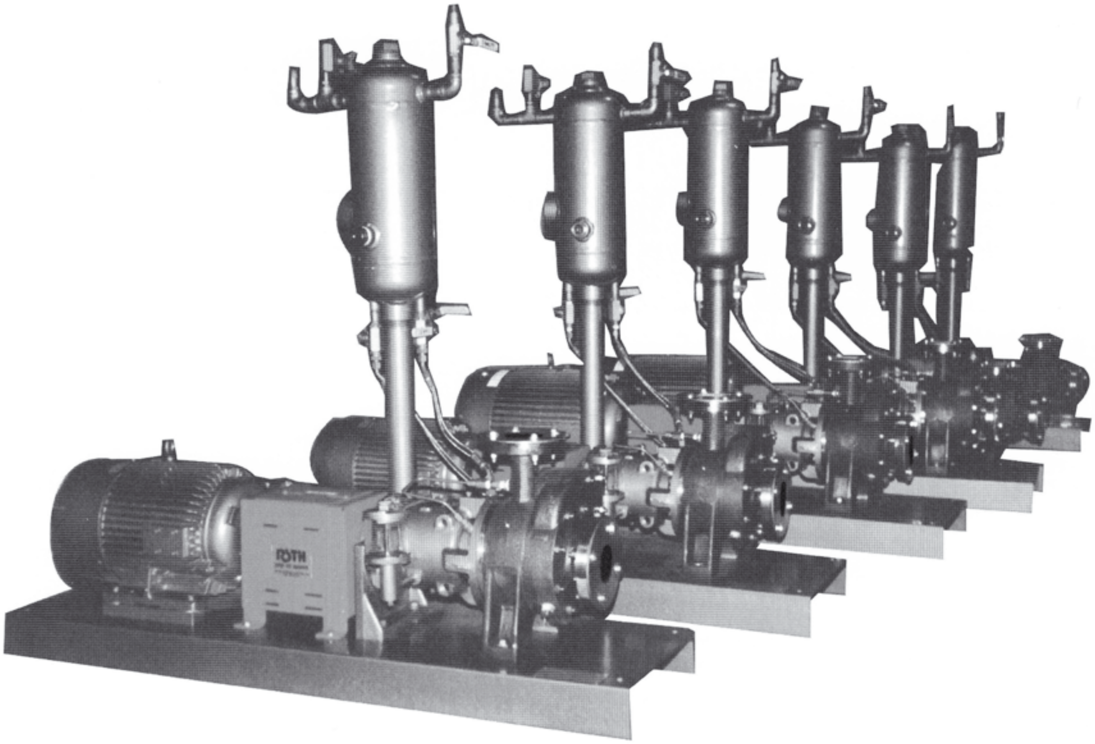


TABLE 1 – PUMP SELECTION

STANDARD PUMPS		Required Head (TDH) in ft (M)												
GPM (m³/hr)		**50 (15.3)**	**100 (30.5)**	**150 (45.8)**	**200 (61.0)**	**300 (91.5)**	**400 (122)**	**500 (153)**	**600 (183)**	**800 (244)**	**1000 (305)**	**1200 (366)**	**1400 (427)**	**1600 (488)**
Up to 10 (2.27)	Table (Page)	4 (13)	4 (13)	4 (13)	5 (14)	5 (14)	5 (14)	5, 7, 8 (14,16,17)	5, 7, 8 (14,16,17)	7, 8 (16,17)	7, 8 (16,17)	9 (18)	9 (18)	9 (18)
Up to 20 (4.54)	Table (Page)	4 (13)	4 (13)	5 (14)	5 (14)	5 (14)	5 (14)	5, 6, 8 (14,15,17)	7, 8 (16,17)	7, 8 (16,17)	7 (16)	9 (18)	9 (18)	9 (18)
Up to 30 (6.81)	Table (Page)	4 (13)	5 (14)	5 (14)	5 (14)	5 (14)	5 (14)	7, 8 (16,17)	7 (16)	7 (16)	9 (18)	9 (18)	9 (18)	9 (18)
Up to 40 (9.08)	Table (Page)	6 (15)	5 (14)	5 (14)	5 (14)	5 (14)	7 (16)	7 (16)	7 (16)	7 (16)	9 (18)			
Up to 60 (13.6)	Table (Page)	6 (15)	6 (15)	7 (16)	7 (16)	7 (16)	7 (16)	7 (16)	7 (16)	7 (16)				
Up to 80 (18.2)	Table (Page)	6 (15)	6 (15)	7 (16)	7 (16)	7 (16)	7 (16)	7 (16)	7 (16)					

LOW NPSH PUMPS		Required Head (TDH) in ft (M)												
GPM (m³/hr)		**50 (15.3)**	**100 (30.5)**	**150 (45.8)**	**200 (61.0)**	**300 (91.5)**	**400 (122)**	**500 (153)**	**600 (183)**	**800 (244)**	**1000 (305)**	**1200 (366)**	**1400 (427)**	**1600 (488)**
Up to 10 (2.27)	Table (Page)	10 (19)	10 (19)	10 (19)	11, 12 (19,20)	11, 12 (19,20)	11 (19)	11, 13, 14 (19,20,21)	11, 13, 14 (19,20,21)	13, 14 (20,21)	13, 14 (20,21)	15 (21)	15 (21)	15 (21)
Up to 20 (4.54)	Table (Page)	10 (19)	10 (19)	10 (19)	11, 12 (19,20)	11, 12 (19,20)	11 (19)	11, 13, 14 (19,20,21)	13, 14 (20,21)	13, 14 (20,21)	13 (20)	15 (21)	15 (21)	15 (21)
Up to 30 (6.81)	Table (Page)	10 (19)	10 (19)	11, 12 (19,20)	11, 12 (19,20)	11 (19)	11 (19)	13, 14 (20,21)	13 (20)	13 (20)	13 (20)	15 (21)	15 (21)	15 (21)
Up to 40 (9.08)	Table (Page)	12 (20)	11, 12 (19,20)	11, 12 (19,20)	11, 12 (19,20)	11 (19)	13 (20)	13 (20)	13 (20)	13 (20)	15 (21)	15 (21)	15 (21)	15 (21)
Up to 60 (13.6)	Table (Page)	12 (20)	12 (20)	12 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	15 (21)	15 (21)	15 (21)	15 (21)	
Up to 80 (18.2)	Table (Page)	12 (20)	12 (20)	12 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	15 (21)	15 (21)	15 (21)		
Up to 100 (22.7)	Table (Page)	12 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	15 (21)	15 (21)	15 (21)		
Up to 140 (31.8)	Table (Page)		13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	13 (20)	15 (21)					

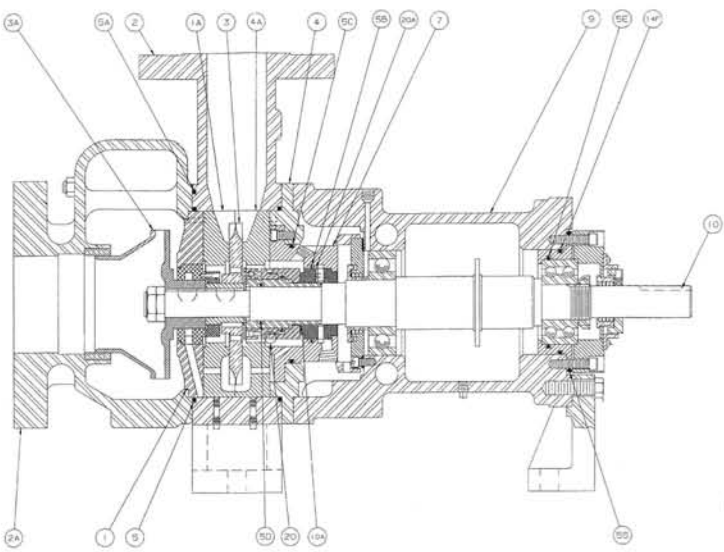
TABLE 2 - LIQUIDS AND MATERIALS OF CONSTRUCTION

Liquid	Specific Gravity	Boiling Point °F (°C)	Identifier (see Table 3)
Acetaldehyde	0.783	68 (20)	SI, SD, SA
Acetate Solvents	0.88	250 (121)	SI, SD, SA
Acetic Acid	1.051	245 (118)	SA, HC
Acetone	0.797	133 (122)	SI, DI, SA, DR
Acrylonitrite	0.8	171 (77)	SI, DI, SA, DR
Alcohol, Butyl (Butanol)	0.81	244 (118)	SI, DI, SA, DR
Alcohol, Denatured	0.8	172 (77)	SI, DI, SA, DR
Ammonia, Anhydrous	0.64	-28 (-33)	SI, DI, SA
Ammonia, Aqueous			SI, DI, SA
n-Amyl Acetate	0.876	299 (148)	SI, DI, SA
Aniline	1.023	364 (184)	SI, DI, SA, DR
Benzene (Benzol)	0.879	176 (80)	SI, DI, DR
Benzoic Acid Solution			SA
Butadiene	0.621	24 (-4)	SI, DI, SA, DR
Butane	0.599	31 (0)	SI, DI, DR
Butene	0.61	21 (-6)	SI, DI, DR
n-Butyl Acetate	0.882	259 (126)	SI, DI, SA, DR
Carbon Dioxide	1.057	-109 (-254)	SA, SI, DI, DR
Carbon Tetrachloride (dry)	1.585	170 (77)	SI, DI, SA, SB
Chlorine Solution			SA, HC
Chloroform	1.474	142 (61)	SI, SB, DI
Chromic Acid Solution			SA, HC
Citric Acid Solution			HC
Cyclohexane	0.779	177 (81)	SI, DI, SA, DR
Diethylamine	0.71	132 (56)	SI, DI, SA, DR
Divinylbenzene	0.929	391 (199)	SA, SI, DI, DR
Ethane	0.446	-128 (-89)	SA, SI, DR
Ethanolamine	1.018	339 (171)	SI, SA, DI
Ether	0.714	94 (34)	SA, DR, SI
Ethyl Acetate	0.883	158 (70)	SA, SB
Ethyl Chloride	0.921	55 (13)	SA
Ethylene Dichloride	1.255	182 (83)	SA, HC
Ethylene Glycol	1.115	387 (197)	DI, SI
Ethylene Oxide	0.882	51 (11)	SA, SI
Freons			SA, SI
Gas Oil	0.86	450 (232)	SA, SI, DI, DR
Gasoline	0.74	140 (60)	SA, SI, SB
Glycerin	1.265	554 (290)	SA, SB
Heptane	0.683	209 (98)	SI, SB
Hexane	0.659	156 (69)	SI, SB
Hydrofluoric Acid			HC
Hydrogen Fluoride	0.988	67 (19)	SA
Hydrogen Sulfide Solution	1.189		SA
Isobutylene	0.6		SI, DI
Isopentane	0.619	83 (28)	SI, DI
Isopropyl Ether	0.715	154 (68)	SA, SI
Jet Fuels	0.82	302 (150)	SI, DI
Kerosene	0.82	302 (150)	SI, DI, DR
Methyl Alcohol (Methanol)	0.792	148 (64)	SI, DI, SA, DR
Methyl Chloride	0.92	-11 (-24)	SI, DI, SA, DR
Methylene Chloride	1.335	104 (40)	SA, SI, DI
Methyl Isobutyl Ketone	0.804	240 (116)	SI, DI, DR
Mineral Spirits	0.785	200 (93)	SI, DI, DB
Monochlorobenzene	1.15		SI, DR, DI, DB
Naphtha	0.77	190 (88)	SI, DI, DR, DB
Nitric Acid	1.502	181 (83)	SA
Nitrochlorobenzene	1.16		SA, SI, DA, DR
n-Pentane	0.626	97 (36)	SI, DI,
Perchloroethylene	1.615	250 (121)	SI, DI
Phenol	1.071	360 (199)	HC, HB, SA
Phosphoric Acid	1.884	500 (260)	HC
Polyethylene	1		SI, SA DI
Propane	0.585	-45 (-43)	SI, DI
Propylene	0.581	-54 (-48)	SI, DI
Propylene Oxide	0.83	63 (17)	SA, SI, DI
Stoddard Solvent	0.78		SI, DI
Styrene	0.906	293 (145)	SI, DI, SA
Sulfuric Acid	1.84		HC
Tetrachloroethylene	1.615		SI, DI
Toluene (Toluol)	0.866	231 (111)	SI, DI, SA
Triethylene Glycol	1.125	549 (287)	SI, DI, SA
Unsymetrical Dimethylhydrazine	0.795	145 (63)	SA
Vinyl Acetate	0.934	162 (72)	SA, FA, SI
Vinyl Chloride	0.912	7 (-14)	SA, HC
Water	1	212 (100)	SA
Whiskey	0.87	275 (135)	SA
Xylene (Xylol)	0.87	275 (135)	SI, DI, SA

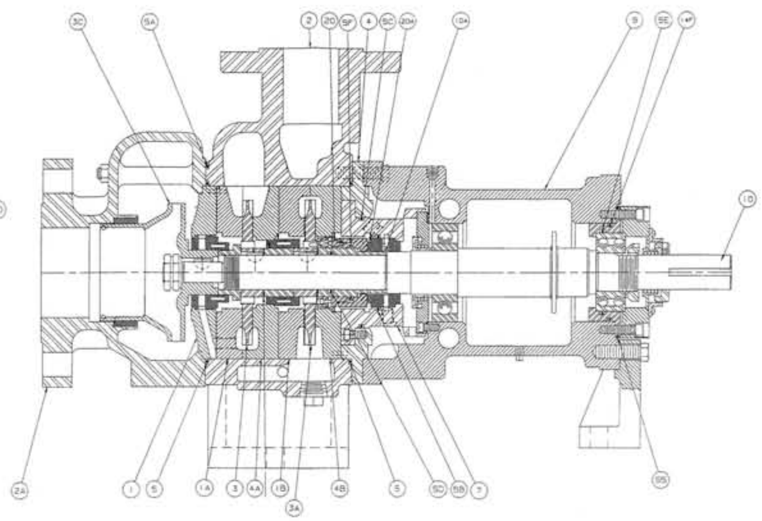
MATERIALS OF CONSTRUCTION

TABLE 3

Identifier	Case Material	Impeller & Liners	Shaft
DB	Ductile Iron	Bronze	416 Stainless Steel
DI	Ductile Iron	Iron	416 Stainless Steel
DR	Ductile Iron	Ni-resist & 416SS	416 Stainless Steel
HC	Hastelloy C	Hastelloy C	Hastelloy C
SA	316 Stainless Steel	316 Stainless Steel	316 Stainless Steel
SB	316 Stainless Steel	Bronze	416 Stainless Steel
SD	316 Stainless Steel	Foundry Association 20	Foundry Association 20
SI	316 Stainless Steel	Iron	416 Stainless Steel
SM	316 Stainless Steel	Monel	Monel
SU	316 Stainless Steel	Iron & 416SS	416 Stainless Steel



Model P51 and P52 Series



Model P54 and P58 Series

TABLE 3a

Detail No.	Part Name	DB	DI	DR	HC	SA	SB	SD	SI	SM	SU
1	O B Cover	CI	CI	CI	HC	316	CI	316	CI	316	CI
1A & 1B	Liner	BR	CI	NR	HC	316	BR	FA20	CI	MO	CI
2 & 2A	Case	DI	DI	DI	HC	316	316	316	316	316	316
3 & 3A	Impeller	BR	DI	416	HC	316	BR	FA20	DI	MO	416
3C	Booster Impeller	DI	DI	DI	HC	316	DI	FA20	DI	MO	DI
4	I B Cover	DI	DI	DI	HC	316	316	316	316	316	316
4A & 4B	Liner	BR	CI	NR	HC	316	BR	FA20	CI	MO	CI
5 & 5A	Case O-Ring	VT	VT	VT	VT	VT	VT	VT	VT	VT	VT
5B, 5C, 5D, 5F	Seal O-Rings	VT	VT	VT	VT	VT	VT	VT	VT	VT	VT
5E, 14F, 55	Bearing Cart O-Rings	BN	BN	BN	BN	BN	BN	BN	BN	BN	BN
7	Seal Cartridge	316	316	316	HC	316	316	AL20	316	MO	316
9	Frame	DI	DI	DI	DI	DI	DI	DI	DI	DI	DI
10	Shaft	416	416	416	HC	316	416	AL20	416	MO	416
10A	Shaft Sleeve	316	316	316	HC	316	316	AL20	316	MO	316

Material Definitions:

AL20 - Alloy 20
BN - Buna
BR - Bronze (85-5-5-5)
CI - Cast Iron
DI - Ductile Iron

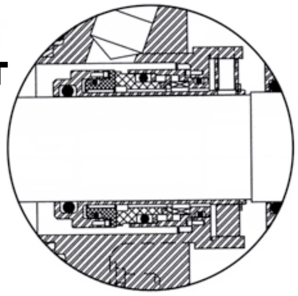
FA20 - Foundry Assoc. 20
HC - Hastelloy C
MO - Monel
NR - Ni-resist

VT - Varies with conditions
316 - 316 Stainless Steel
416 - 416 Stainless Steel

SYSTEMS GUIDE - MECHANICAL SEALS

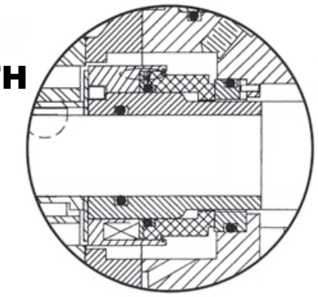
For seal selection on new pumps - do not use for replacement seals.

85T



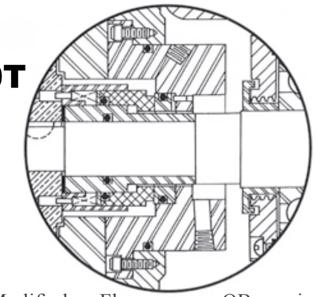
John Crane 5610 Single O-Ring Universal Cartridge Seal. The seal is provided with a discharge to seal API Flush Plan 11.

68TH



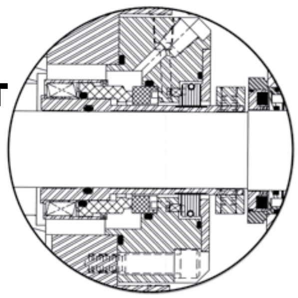
John Crane 8B-1H, single balanced seal with hydropads on the seal rotating face. Seal is provided with a discharge to seal API Flush Plan 11.

50T



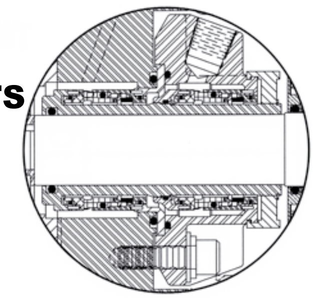
Modified Flowserve QB, single, balanced, multi spring, pusher seal for general service in petrochemical and chemical industry. Seal is provided with a discharge to seal API Flush Plan 11.

98T



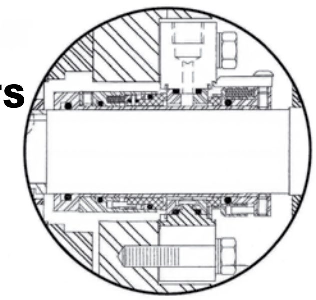
John Crane 1648 single cartridge seal designed to provide low emissions/ leakage for most refinery applications. The seal is provided with a discharge to seal flush API Plan 11.

89TS



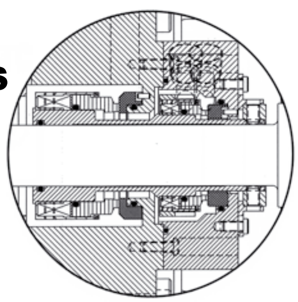
John Crane 5620 Dual O-ring cartridge seal. Seal can preform as a tandem or double seal. Barrier fluid pressure relative to seal chamber pressure (API Plan Flush 52 or 53) determines usage of the cartridge.

85TS



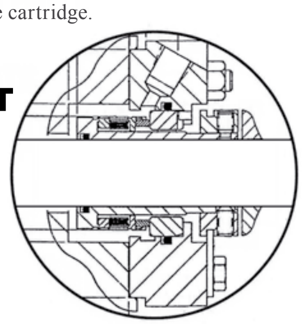
Flowserve P-200, double pusher seal cartridge design. This seal can perform as a tandem or double seal, depending upon if the seal lubrication system is unpressurized (API Flush Plan 52) or pressurized (API Flush Plan 53).

93TS



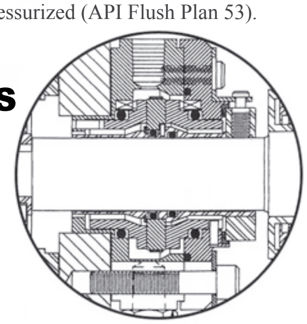
John Crane 2648, dual unpressurized cartridge type “A” O-ring pusher seal. Outboard seal provides additional containment with an API Flush Plan 52.

86T



John Crane EZ-1, single, metal bellows general purpose cartridge seal. Features self-cleaning bellows design. The seal is provided with a discharge to seal flush API Plan 11.

90TS



John Crane 2800E Non-Contacting, Gas Lubricated Seals. A pressurized suitable inert gas is injected between the seals. As the shaft rotates, gas flows into the tip of the spiral groove and is compressed at the sealing dam. Offers highest reliability in sealing volatile fluids with zero emissions to atmosphere.

SYSTEM GUIDE - MECHANICAL SEALS

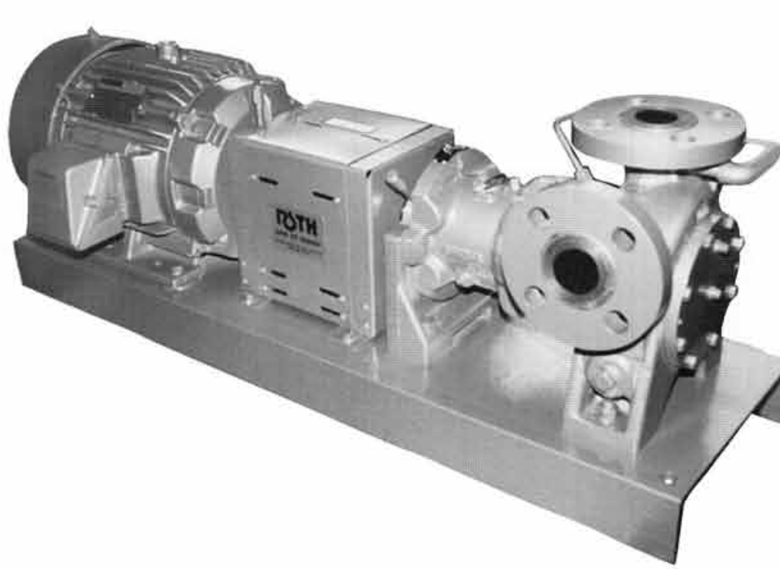
For seal selection on new pumps - do not use for replacement seals.

Seal Design	Seal Manufacture	Roth Designation	Pressure PSIG (Bar)	Temperature ˚F (˚C)
Single Cartridge	John Crane 5610	85T	300 (21)	400 (205)
Single Component	John Crane 8B-1H	68TH	1500 (103.5)	500 (260)
Single Component	Modified Flowserve QB	50T	750 (51.7)	400 (205)
Single Cartridge	John Crane 1648	98T	1000 (69)	500 (260)
Dual Cartridge	John Crane 5620	89TS	300 (21)	400 (205)
Dual Cartridge	Flowserve P-200	85TS	300 (21)	400 (205)
Dual Cartridge	John Crane 2648	93TS	1000 (69)	500 (260)
Single Cartridge	John Crane EZ-1	86T	300 (21)	400 (205)
Double Cartride	John Crane 2800E	90TS	232 (16)	500 (260)

TABLE 4 - ROTH STANDARD PUMPS - 21 SERIES

Single Stage – 1750 RPM at 60 cycles												
		Total Head in Feet (M)										
NPSHr Ft (M)		20 (6.1)	30 (9.2)	40 (12.2)	50 (15.3)	60 (18.3)	80 (24.4)	100 (30.5)	125 (38.1)	150 (45.8)	175 (53.4)	Model Number (Curve Number)
30.0	GPM	4.8	4.6	4.2	3.7	3.3	2.7	1.9				
(9.1)	m^3/hr	1.09	1.05	0.95	0.84	0.75	0.61	0.43				
2.0	GPM	4.6	4.3	3.8	3.4	3.1	2.4	1.7				2129
(0.6)	m^3/hr	1.05	0.98	0.86	0.77	0.7	0.55	0.39				(3385)
	BHP	0.25	0.28	0.29	0.31	0.32	0.38	0.41				
30.0	GPM	8.1	7.5	7.0	6.5	6.1	5.2	4.4	3.5	2.6	1.7	
(9.1)	m^3/hr	1.84	1.7	1.59	1.48	1.39	1.18	1.0	0.79	0.59	0.39	
3.0	GPM	6.4	6.2	6.1	5.9	5.7	5.0	4.2	3.3	2.4	1.5	2129B
(0.91)	m^3/hr	1.45	1.41	1.39	1.34	1.3	1.14	0.95	0.75	0.54	0.34	(1979)
	BHP	0.2	0.25	0.3	0.31	0.35	0.4	0.42	0.5	0.52	0.6	
30.0	GPM	9.2	9.0	7.9	7.1	6.5	5.3	4.3	3.0			
(9.1)	m^3/hr	2.09	2.05	1.8	1.61	1.48	1.2	0.98	0.68			
3.0	GPM	8.2	7.9	7.5	6.9	6.3	5.1	4.0				2131
(0.91)	m^3/hr	1.86	1.8	1.7	1.57	1.43	1.16	0.91				(1981)
	BHP	0.24	0.27	0.3	0.33	0.35	0.45	0.52	0.62			
30.0	GPM	16.0	14.2	13.5	12.8	12.0	10.0	8.0				
(9.1)	m^3/hr	3.63	3.22	3.06	2.91	2.72	2.27	1.82				
3.0	GPM	12.8	12.2	11.8	11.4	10.5	8.5	6.8				2141
(0.9)	m^3/hr	2.91	2.77	2.68	2.59	2.38	1.93	1.54				(3329)
	BHP	0.35	0.36	0.40	0.41	0.42	0.52	0.62				
30.0	GPM	19.4	18.5	18	17.2	16.2	14.2	12.0	9.5			
(9.1)	m^3/hr	4.4	4.2	4.09	3.9	3.68	3.22	2.72	2.16			
3.0	GPM	16.9	16.5	16.4	16.2	15.5	13.8	12.0				2143
(0.9)	m^3/hr	3.84	3.74	3.72	3.68	3.51	3.13	2.72				(3331)
	BHP	0.45	0.48	0.50	0.55	0.60	0.65	0.80	0.90			
30.0	GPM	26.5	25.4	24.1	22.8	21.5	18.9	16.2	12.5			
(9.1)	m^3/hr	6.01	5.76	5.47	5.18	4.88	4.29	3.68	2.84			
7.0	GPM	22.0	22.0	21.8	21.5	20.9						2147
(2.1)	m^3/hr	5.0	5.0	4.95	4.88	4.75						(3335)
3.0	GPM	18.1	18.1	18.0	17.9	17.6	16.5	15.2	12.1			
(0.91)	m^3/hr	4.11	4.11	4.09	4.06	4.0	3.75	3.45	2.75			
	BHP	0.5	0.6	0.7	0.75	0.8	1.0	1.2	1.4			
30.0	GPM	34.0	32.8	30.8	29.0	27.5	25.0	22.0	18.2	14.0		
(9.1)	m^3/hr	7.72	7.45	7.0	6.59	6.25	5.68	5.0	4.13	3.18		
4.0	GPM	25.5	25.4	25.2	24.9	24.0	21.8	18.6				2149
(1.2)	m^3/hr	5.79	5.76	5.72	5.65	5.45	4.95	4.22				(3390)
3.0	GPM	20.2	20.0	19.5	19.0	18.5	17.5	16.2				
(0.91)	m^3/hr	4.59	4.54	4.43	4.31	4.20	3.97	3.68				
	BHP	0.75	0.8	0.9	0.95	1.0	1.2	1.4	1.6	1.8		

API Flush Plan 11 will reduce above flows.



These performance specifications apply to both vertical and horizontal models.

TABLE 5 – ROTH STANDARD PUMPS – 21 SERIES

Single Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		100 (30.5)	150 (45.7)	200 (61.0)	250 (76.3)	300 (91.5)	400 (122)	450 (137)	500 (153)	Model Number (Curve Number)
30	GPM	9.0	7.9	6.9	5.9	5.1	3.6			
(9.1)	m^3/hr	2.0	1.8	1.6	1.3	1.2	0.8			
14	GPM	8.1	7.4	6.7	5.9	5.1	3.6			
(4.3)	m^3/hr	1.8	1.7	1.5	1.3	1.2	0.8			2129
6	GPM	6.6	6.2	5.7	5.2	4.7				(3386A)
(1.8)	m^3/hr	1.5	1.4	1.3	1.2	1.1				
3	GPM	5.7	5.2	4.9	4.5	4.1				
(0.91)	m^3/hr	1.3	1.2	1.1	1.0	0.9				
	BHP	1.5	1.6	1.8	1.9	2.0	2.4			
30	GPM	14.8	13.5	12.1	10.8	9.5	7.1	5.9		
(9.1)	m^3/hr	3.4	3.1	2.7	2.5	2.2	1.6	1.3		
14	GPM	12.6	12.2	11.5	10.3	9.3	6.9	5.7		
(4.3)	m^3/hr	2.9	2.8	2.6	2.3	2.1	1.6	1.3		2129B
12	GPM	11.3	11.0	10.5	10.0	9.2	6.9	5.7		(1980A)
(3.7)	m^3/hr	2.6	2.5	2.4	2.3	2.1	1.6	1.3		
6	GPM	9.0	8.9	8.7	8.4	8.0	6.6	5.5		
(1.8)	m^3/hr	2.0	2.0	2.0	1.9	1.8	1.5	1.2		
	BHP	1.5	1.7	2.0	2.2	2.5	3.1	3.5		
30	GPM	17.5	15.6	13.8	12.1	10.4	7.1	5.6		
(9.1)	m^3/hr	4.0	3.5	3.1	2.7	2.4	1.6	1.3		
14	GPM	15.8	14.9	13.4	11.7	10.0	6.8	5.3		
(4.3)	m^3/hr	3.6	3.4	3.0	2.7	2.3	1.5	1.2		2131
6	GPM	12.8	12.4	11.8	11.0	9.7				(1983B)
(1.8)	m^3/hr	2.9	2.8	2.7	2.5	2.2				
3	GPM	9.9	9.6	9.2	8.8	8.2				
(0.91)	m^3/hr	2.2	2.2	2.1	2.0	1.9				
	BHP	1.7	2.0	2.3	2.8	2.9	3.6	4.0		
30	GPM	30.0	27.0	23.8	21.0	18.0	13.0			
(9.1)	m^3/hr	6.8	6.1	5.4	4.8	4.1	3.0			
14	GPM	30.0	27.0	23.8	21.0	18.0	13.0			2141
(4.3)	m^3/hr	6.8	6.1	5.4	4.8	4.1	3.0			(3330)
9	GPM	17.5	17.0	16.2	15.0	13.5				
(2.8)	m^3/hr	4.0	3.9	3.7	3.4	3.1				
	BHP	2.5	2.8	3.2	3.8	4.3	5.5			
30	GPM	29.6	27.5	25.5	23.7	22.0	18.8	17.2	15.8	
(9.1)	m^3/hr	6.7	6.2	5.8	5.4	5.0	4.3	3.9	3.6	
14	GPM	29.6	27.5	25.5	23.7	22.0	18.8	17.2	15.8	
(4.3)	m^3/hr	6.7	6.2	5.8	5.4	5.0	4.3	3.9	3.6	2142
12	GPM	21.4	21.2	20.8	20.2	19.5	17.3	15.9	14.5	(3344A)
(3.7)	m^3/hr	4.9	4.8	4.7	4.6	4.4	3.9	3.6	3.3	
9	GPM	18.6	18.3	18.0	17.6	17.2	16.0	15.2		
(2.8)	m^3/hr	4.2	4.2	4.1	4.0	3.9	3.6	3.4		
	BHP	2.7	3.1	3.6	4.2	4.7	5.7	6.2	6.7	
30	GPM	38.0	35.6	32.8	29.5	26.8	21.4	19.0	16.5	
(9.1)	m^3/hr	8.6	8.1	7.4	6.7	6.1	4.9	4.3	3.7	
14	GPM	38.0	35.6	32.8	29.5	26.8	21.4	19.0	16.5	2143
(4.3)	m^3/hr	8.6	8.1	7.4	6.7	6.1	4.9	4.3	3.7	(3332A)
9	GPM	22.0	21.8	21.2	20.5	19.5	16.5			
(2.8)	m^3/hr	5.0	4.9	4.8	4.7	4.4	3.7			
	BHP	2.8	3.5	4.0	4.5	5.5	6.5	7.3	7.8	
30	GPM	51.2	49.0	46.2	43.0	40.0	33.0	24.0	25.2	
(9.1)	m^3/hr	11.6	11.1	10.5	9.8	9.1	7.5	6.6	5.7	
14	GPM	51.2	49.0	46.2	43.0	40.0	33.0	29.0	25.2	2147
(4.3)	m^3/hr	11.6	11.1	10.5	9.8	9.1	7.5	6.6	5.7	(3336A)
12	GPM	35.4	34.5	33.2	31.8	30.0	26.0			
(3.7)	m^3/hr	8.0	7.8	7.5	7.2	6.8	5.9			
	BHP	3.9	4.5	5.5	6.4	7.0	9.0	9.8	10.6	

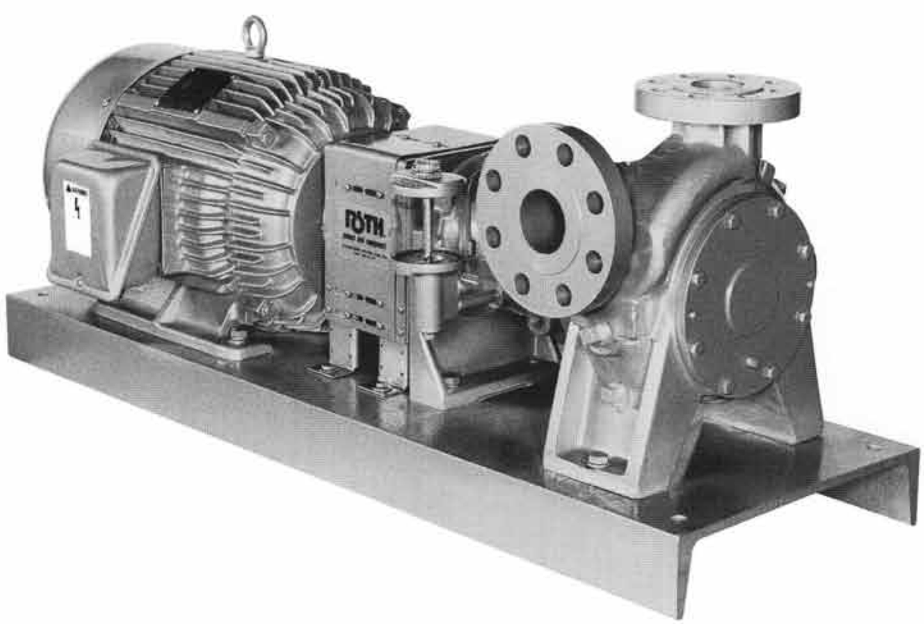
API Flush Plan 11 will reduce above flows.

These performance specifications apply to both vertical and horizontal models.

TABLE 6 – ROTH STANDARD PUMPS – 22 SERIES

Single Stage – 1750 RPM at 60 cycles											
		Total Head in Feet (M)									
NPSHr Ft (M)		40 (12.2)	50 (15.3)	60 (18.3)	80 (24.4)	100 (30.5)	125 (38.1)	150 (45.8)	175 (53.4)	200 (61.0)	250 (76.3)	Model Number (Curve Number)
30	GPM		27.4	26.5	25.0	23.7	22.0	20.7	19.4	18.0	15.5	
(9.1)	m^3/hr		6.2	6.0	5.7	5.4	5.0	4.7	4.4	4.1	3.5	
3	GPM		23.0	22.7	22.4	21.5	20.4	19.0	17.7	16.5	14.0	2256
(0.91)	m^3/hr		5.2	5.2	5.1	4.9	4.6	4.3	4.0	3.7	3.2	(1970)
2	GPM		19.6	19.5	19.4	18.8	18.5	18.0	17.2	15.8		
(0.61)	m^3/hr		4.4	4.4	4.4	4.3	4.2	4.1	3.9	3.6		
	BHP		1.1	1.2	1.4	1.7	2.0	2.2	2.4	2.6	2.9	
30	GPM	33.5	32.4	31.0	28.8	26.5	23.8	21.5	19.5	17.5	13.5	
(9.1)	m^3/hr	7.6	7.4	7.0	6.5	6.0	5.4	4.9	4.4	4.0	3.1	
9	GPM	33.5	32.4	31.0	28.8	26.5	23.8	21.5	19.5	17.5	13.5	
(2.75)	m^3/hr	7.6	7.4	7.0	6.5	6.0	5.4	4.9	4.4	4.0	3.1	
6	GPM	27.8	27.4	26.9	25.8	24.5	22.8	21.0	19.5	17.5	13.5	
(1.83)	m^3/hr	6.3	6.2	6.1	5.9	5.6	5.2	4.8	4.4	4.0	3.1	2258
3	GPM	22.9	22.5	22.3	21.5	20.8	20.5	18.3	17.5	16.1	13.0	(1976)
(0.91)	m^3/hr	5.2	5.1	5.1	4.9	4.7	4.7	4.2	4.0	3.7	3.0	
	BHP	1.2	1.3	1.4	1.6	1.8	2.1	2.4	2.7	2.9	3.5	
30	GPM	41.0	40.0	38.2	35.2	31.7	26.2	19.5				
(9.1)	m^3/hr	9.3	9.1	8.7	8.0	7.2	5.9	4.4				2259
	BHP	1.4	1.5	1.6	1.7	1.9	2.3	2.7				(3629)
30	GPM	48.8	47.0	44.8	40.8	37.0	31.2	26.0	19.2			
(9.1)	m^3/hr	11.1	10.7	10.2	9.3	8.4	7.1	5.9	4.4			2263
	BHP	1.6	1.7	1.8	2.1	2.4	2.8	3.2	3.6			(3633)
30	GPM	79.2	73.2	67.8	56.5	46.8	40.2	23.0				
(9.1)	m^3/hr	18	16.6	15.4	12.8	10.6	9.1	5.2				2267
	BHP	2.1	2.2	2.5	3.0	3.4	3.8	4.6				(3479)
30	GPM	99.0	95.0	90.0	80.0	68.0	53.0	37.0				
(9.1)	m^3/hr	22.5	21.6	20.4	18.2	15.4	12.0	8.4				2269
	BHP	2.6	2.6	3.0	3.6	4.2	5.0	5.9				(3636)
30	GPM	140.0	130.0	124.0	109.0	86.0						
(9.1)	m^3/hr	31.8	29.5	28.1	24.7	19.5						2278
	BHP	4.3	5.0	5.1	6.0	6.8						(1324B)

API Flush Plan 11 will reduce above flows.



These performance specifications apply to both vertical and horizontal models.

TABLE 7 - ROTH STANDARD PUMPS - 22 SERIES

API Flush Plan 11 will reduce flows.

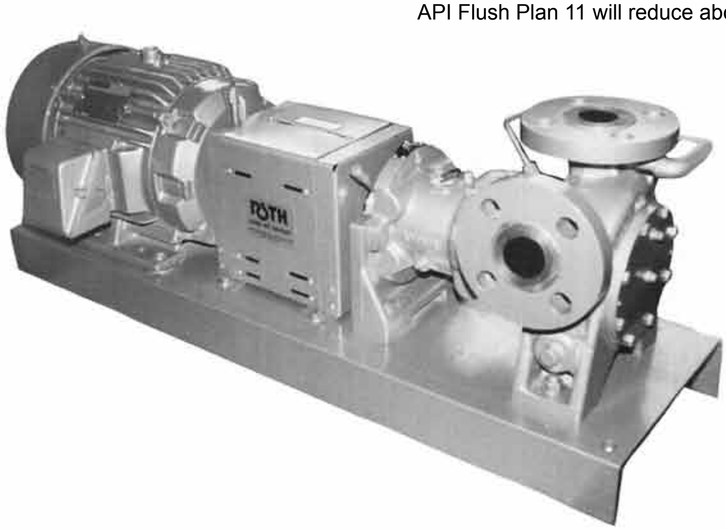
Single Stage – 3500 RPM at 60 cycles

		Total Head in Feet (M)								
NPSHr Ft (M)		100.0 (30.5)	200.0 (61.0)	300.0 (91.5)	350.0 (107)	400.0 (122)	500.0 (153)	600.0 (183)	700.0 (214)	Model Number (Curve Number)
30	GPM	16.6	14.8	12.7	11.5	10.3	8.0			
(9.1)	m^3/hr	3.7	3.4	2.9	2.6	2.3	1.8			
9	GPM	14.2	13.0	11.4	10.4	9.5				2228D
(2.8)	m^3/hr	3.2	3.0	2.6	2.4	2.2				(3635)
	BHP	3.5	3.7	4.1	4.5	4.9	5.5			
30	GPM		18.2	15.6	14.4	13.2	11.0	8.9		
(9.1)	m^3/hr		4.1	3.5	3.3	3.0	2.5	2.0		
14	GPM		15.0	13.5	12.6	11.8				2229B
(4.3)	m^3/hr		3.4	3.1	2.9	2.7				(3608)
9	GPM		13.0	11.9	11.2	10.5				
(2.8)	m^3/hr		3.0	2.7	2.5	2.4				
	BHP		3.9	4.9	5.1	5.6	6.2	6.9		
30	GPM		18.3	15.8	14.5	13.2	10.5	7.7		
(9.1)	m^3/hr		4.2	3.6	3.3	3.0	2.4	1.7		
14	GPM		17.0	15.2	13.9	12.7	10.0			
(4.3)	m^3/hr		3.9	3.4	3.2	2.9	2.3			2229D
9	GPM		15.2	13.9	12.9	11.8				(3637A)
(2.8)	m^3/hr		3.4	3.2	2.9	2.7				
6	GPM		11.7	10.5	9.6	9.0				
(1.8)	m^3/hr		2.7	2.4	2.2	2.0				
	BHP		3.8	4.7	5.0	5.4	6.2	6.9		
30	GPM	35.5	31.3	28.0	26.5	25.0	22.0	19.2		
(9.1)	m^3/hr	8.1	7.1	6.4	6.0	5.7	5.0	4.3		
12	GPM	26.7	26.1	25.2	24.4	22.1				
(3.7)	m^3/hr	6.1	5.9	5.7	5.5	5.0				2253
9	GPM	24.1	23.7	23.0	22.4	21.6				(3476A)
(2.8)	m^3/hr	5.5	5.4	5.2	5.1	4.9				
6	GPM	20.8	20.6	20.5	20.2	20.0				
(1.8)	m^3/hr	4.7	4.7	4.7	4.6	4.5				
	BHP	3.8	4.9	5.9	6.5	7.0	8.0	9.0		
30	GPM	34.2	30.8	28.0	26.5	25.0	22.3	19.8	17.4	
(9.1)	m^3/hr	7.8	7.0	6.4	6.0	5.7	5.1	4.5	3.9	
14	GPM	34.2	30.8	28.0	26.5	25.0	22.3	19.8	17.4	
(4.3)	m^3/hr	7.8	7.0	6.4	6.0	5.7	5.1	4.5	3.9	2254
12	GPM	23.9	23.0	22.0	21.3	20.6				(3436A)
(3.7)	m^3/hr	5.4	5.2	5.0	4.8	4.7				
9	GPM	20.5	19.1	18.0	17.5	17.0				
(2.8)	m^3/hr	4.7	4.3	4.1	4.0	3.9				
	BHP	5.4	6.5	7.5	8.0	8.6	9.8	11.2	12.3	
30	GPM	56.8	50.2	44.6	41.5	38.7	33.0	27.5		
(9.1)	m^3/hr	12.9	11.4	10.1	9.4	8.8	7.5	6.2		
14	GPM	44.8	42.5	39.8	39.0	35.0	31.0	26.0		
(4.3)	m^3/hr	10.2	9.6	9.0	8.9	7.9	7.0	5.9		2255
9	GPM	31.7	31.5	31.0	30.5	29.9				(3638A)
(2.8)	m^3/hr	7.2	7.1	7.0	6.9	6.8				
6	GPM	22.6	22.5	21.5	21.0	20.2				
(1.8)	m^3/hr	5.1	5.1	4.9	4.8	4.6				
	BHP	5.8	7.2	8.5	9.1	9.8	11.6	12.7		
30	GPM	57.0	51.0	45.8	43.5	41.0	36.7	32.5	28.5	
(9.1)	m^3/hr	12.9	11.6	10.4	9.9	9.3	8.3	7.4	6.5	
20	GPM	43.5	42.5	40.8	39.5	38.0	35.0	31.7	28.0	
(6.1)	m^3/hr	9.9	9.6	9.3	9.0	8.6	7.9	7.2	6.4	2256
14	GPM	40.5	39.5	38.5	37.5	36.5	34.0			(1975A)
(4.3)	m^3/hr	9.2	9.0	8.7	8.5	8.3	7.7			
9	GPM	33.2	32.8	32.2	31.8	31.4				
(2.8)	m^3/hr	7.5	7.4	7.3	7.2	7.1				
	BHP	7.0	8.8	10.4	11.4	12.3	14.0	15.8	17.5	
30	GPM	66.0	61.3	55.8	53.5	51.0	46.2	42.0		
(9.1)	m^3/hr	15.0	13.9	12.7	12.1	11.6	10.5	9.5		
20	GPM	49.8	48.4	46.4	45.2	44.0	41.0	38.0		
(6.1)	m^3/hr	11.3	11.0	10.5	10.3	10.0	9.3	8.6		2258
14	GPM	41.2	40.3	39.1	38.4	37.5				(1973A)
(4.3)	m^3/hr	9.4	9.1	8.9	8.7	8.5				
	BHP	8.0	10.2	12.8	14.1	15.5	18.2	20.5		
30	GPM	98.3	93.8	87.0	83.0	78.2	66.2			
(9.1)	m^3/hr	22.3	21.3	19.7	18.8	17.7	15.0			2263
14	GPM	59.9	58.8	57.2	56.0	54.1				(3630)
(4.3)	m^3/hr	13.6	13.3	13.0	12.7	12.3				
	BHP	7.8	10.2	13.4	15.0	16.6	20.0			

TABLE 8 - ROTH STANDARD PUMPS - 24 SERIES

Two Stage – 3500 RPM at 60 cycles									
		Total Head in Feet (M)							
NPSHr Ft (M)		400 (122)	450 (137)	500 (153)	600 (183)	700 (214)	800 (244)	900 (275)	Model Number (Curve Number)
30	GPM	4.2	3.7	3.2	2.4				
(9.1)	m^3/hr	1.0	0.8	0.7	0.5				
6	GPM	3.3	2.8	2.2					
(1.83)	m^3/hr	0.7	0.6	0.5					2428
3	GPM	2.7	2.3						(1946)
(0.91)	m^3/hr	0.6	0.5						
	BHP	2.8	3.0	3.2	3.6				
30	GPM	6.2	5.8	5.3	4.5	3.7	3.0		
(9.1)	m^3/hr	1.4	1.3	1.2	1.0	0.8	0.7		
6	GPM	5.8	5.5	5.1	4.3	3.5			2429
(1.83)	m^3/hr	1.3	1.2	1.2	1.0	0.8			(1943)
3	GPM	4.9	4.6	4.3	3.8	3.3			
(0.91)	m^3/hr	1.1	1.0	1.0	0.9	0.7			
	BHP	3.0	3.3	3.5	4.0	4.5	5.0		
30	GPM	11.7	10.9	10.2	8.7	7.3	6.0		
(9.1)	m^3/hr	2.7	2.4	2.3	2.0	1.7	1.4		
9	GPM	9.8	9.3	8.9	7.7	6.4			
(2.75)	m^3/hr	2.2	2.1	2.0	1.7	1.5			
6	GPM	8.2	7.8	7.4	6.4	5.3			2429B
(1.83)	m^3/hr	1.9	1.8	1.7	1.5	1.2			(1940)
3	GPM	6.8	6.4	6.0					
(0.91)	m^3/hr	1.5	1.5	1.4					
	BHP	4.8	5.1	5.3	5.8	6.2	6.5		
30	GPM	8.6	7.9	7.1	5.6	4.3			
(9.1)	m^3/hr	2.0	1.8	1.6	1.3	1.0			
6	GPM	7.8	7.0	6.2	4.6				2430
(1.83)	m^3/hr	1.8	1.6	1.4	1.0				(1947)
3	GPM	7.4	6.7	5.9	4.2				
(0.91)	m^3/hr	1.7	1.5	1.3	1.0				
	BHP	4.0	4.2	4.5	5.2	6.0			
30	GPM	16.3	15.4	14.4	12.7	11.0	9.4	7.9	
(9.1)	m^3/hr	3.7	3.5	3.3	2.9	2.5	2.1	1.8	
6	GPM	12.6	12.3	11.9	11.1	10.0	8.5	7.0	2433
(1.83)	m^3/hr	2.9	2.8	2.7	2.5	2.3	1.9	1.6	(1945)
3	GPM	9.8	9.6	9.4	8.9	8.1	7.0		
(0.91)	m^3/hr	2.2	2.2	2.1	2.0	1.8	1.6		
	BHP	5.0	5.4	5.8	6.7	7.5	8.3	9.2	
30	GPM	19.6	18.3	17.0	14.6	12.2	10.1	8.0	
(9.1)	m^3/hr	4.4	4.2	3.8	3.3	2.8	2.3	1.8	
9	GPM	18.2	17.3	16.2	14.0	11.7	9.4		2441
(2.75)	m^3/hr	4.1	3.9	3.7	3.2	2.7	2.1		(1948)
6	GPM	14.5	13.9	13.3	12.1	10.8			
(1.83)	m^3/hr	3.3	3.2	3.0	2.8	2.5			
	BHP	6.1	6.5	7.0	8.0	9.0	10.1	11.2	

API Flush Plan 11 will reduce above flows.

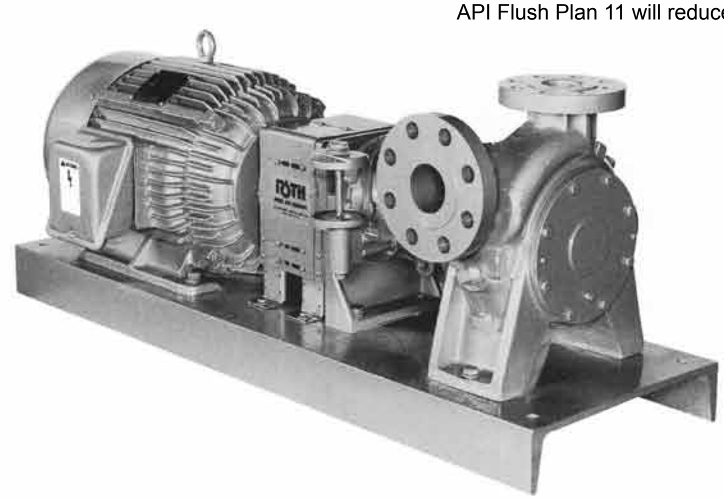


These performance specifications apply to both vertical and horizontal models.

TABLE 9 – ROTH STANDARD PUMPS – 28 SERIES

Two Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		450 (137)	500 (153)	600 (183)	700 (214)	800 (244)	900 (275)	1000 (305)	1200 (366)	Model Number (Curve Number)
30	GPM	16.4	15.7	14.2	12.8	11.4	10.1	8.8		
(9.1)	m^3/hr	3.7	3.6	3.2	2.9	2.6	2.3	2.0		
12	GPM	10.2	9.8	9.1	8.3	7.6				
(3.75)	m^3/hr	2.3	2.2	2.1	1.9	1.7				2829D
9	GPM	9.2	8.9	8.1						(1966)
(2.75)	m^3/hr	2.1	2.0	1.8						
	BHP	7.2	7.6	8.5	9.3	10.1	10.9	11.7		
30	GPM	26.4	25.1	22.8	20.7	18.7	16.8	15.0	11.7	
(9.1)	m^3/hr	6.0	5.7	5.2	4.7	4.2	3.8	3.4	2.7	
14	GPM	25.5	24.6	22.8	20.7	18.7	16.5	15.0	11.7	
(4.3)	m^3/hr	5.8	5.6	5.2	4.7	4.2	3.7	3.4	2.7	2853
9	GPM	23.7	23.1	21.8	20.1	18.3	16.4	14.7		(1960A)
(2.75)	m^3/hr	5.4	5.2	4.9	4.6	4.2	3.7	3.3		
6	GPM	19.8	19.6	19.0	18.2	17.2	15.9	14.4		
(1.83)	m^3/hr	4.5	4.4	4.3	4.1	3.9	3.6	3.3		
	BHP	10.4	11.0	12.3	13.5	14.9	16.2	17.5	19.9	
30	GPM	28.5	27.6	25.8	24.0	22.4	20.8	19.3	16.5	
(9.1)	m^3/hr	6.5	6.3	5.9	5.4	5.1	4.7	4.4	3.7	
12	GPM	26.0	25.4	24.1	22.8	21.5	20.0	18.6	15.7	2854
(3.7)	m^3/hr	5.9	5.8	5.5	5.2	4.9	4.5	4.2	3.6	(3967A)
9	GPM	23.2	22.8	21.8	20.8	19.7	18.7	17.5	15.1	
(2.75)	m^3/hr	5.3	5.2	4.9	4.7	4.5	4.2	4.0	3.4	
	BHP	15.0	16.0	17.0	18.0	19.0	20.0	21.0	25.0	
30	GPM	46.4	44.5	41.0	37.6	34.3	31.4	28.4	22.8	
(9.1)	m^3/hr	10.5	10.1	9.3	8.5	7.8	7.1	6.4	5.2	
14	GPM	41.0	40.0	38.0	36.0	33.6	31.0	28.4	22.8	
(4.3)	m^3/hr	9.3	9.1	8.6	8.2	7.6	7.0	6.4	5.2	2855
9	GPM	37.4	36.9	35.8	34.4	32.5	30.2	27.7		(1969A)
(2.75)	m^3/hr	8.5	8.4	8.1	7.8	7.4	6.9	6.3		
6	GPM	32.2	31.8	30.9	29.8	28.4	27.0	25.2		
(1.83)	m^3/hr	7.3	7.2	7.0	6.8	6.4	6.1	5.7		
	BHP	15.0	16.0	18.0	20.1	22.2	24.3	26.4	30.5	
30	GPM	50.6	49.0	46.2	43.5	40.6	38.0	35.2	30.2	
(9.1)	m^3/hr	11.5	11.1	10.5	9.9	9.2	8.6	8.0	6.9	
20	GPM	41.0	40.6	39.6	38.2	36.4	33.7	31.1	25.5	
(6.1)	m^3/hr	9.3	9.2	9.0	8.7	8.3	7.6	7.1	5.8	2856
12	GPM	29.2	29.1	28.9	28.5	27.5	26.0	24.5	21.0	(3968)
(3.7)	m^3/hr	6.6	6.6	6.6	6.5	6.2	5.9	5.6	4.8	
	BHP	20.0	20.7	22.2	23.5	25.0	26.3	28.0	31.0	
30	GPM	61.5	59.9	56.7	53.7	50.9	48.1	45.2	39.8	
(9.1)	m^3/hr	14.0	13.6	12.9	12.2	11.6	10.9	10.3	9.0	2858
14	GPM	48.5	48.3	47.7	46.9	45.7	44.4	42.8	38.4	(1984A)
(4.3)	m^3/hr	11.0	11.0	10.8	10.6	10.4	10.1	9.7	8.7	
	BHP	20.0	21.0	23.0	25.2	27.5	29.3	31.5	36.2	

API Flush Plan 11 will reduce above flows.



These performance specifications apply to both vertical and horizontal models.

TABLE 10 – ROTH LOW NPSH PUMPS – 51 SERIES

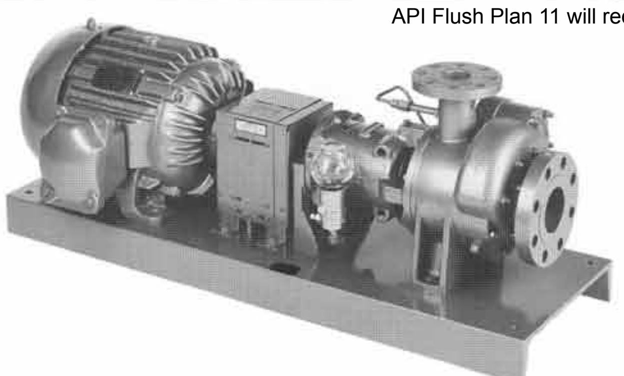
Single Stage – 1750 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		20 (6.1)	30 (9.2)	40 (12.2)	60 (18.3)	80 (24.4)	100 (30.5)	125 (38.1)	150 (45.8)	Model Number (Curve Number)
0.5	GPM	8.1	7.6	7.0	6.1	5.2	4.4	3.5		5129B
(0.15)	m^3/hr	1.84	1.73	1.59	1.39	1.18	1.0	0.79		(4045)
	BHP	0.22	0.28	0.30	0.34	0.40	0.42	0.50		
0.5	GPM	14.7	13.8	12.8	11.2	9.5	8.0	6.3		5141
(0.15)	m^3/hr	3.34	3.14	2.91	2.55	2.16	1.82	1.43		(4049)
	BHP	0.32	0.33	0.35	0.39	0.44	0.48	0.57		
0.5	GPM	15.7	14.8	14.0	12.8	11.6	10.6	9.4	8.2	5142
(0.15)	m^3/hr	3.56	3.36	3.18	2.91	2.63	2.41	2.13	1.86	(4050)
	BHP	0.29	0.31	0.37	0.46	0.59	0.69	0.80	0.90	
0.5	GPM	19.9	18.9	18.0	16.1	14.4	12.7	10.7	8.6	5143
(0.15)	m^3/hr	4.52	4.29	4.09	3.65	3.27	2.88	2.43	1.95	(4051)
	BHP	0.35	0.40	0.44	0.53	0.62	0.77	0.80	0.89	
1	GPM	28.5	27.7	26.0	22.8	19.4	15.8	11.0		5147
(0.3)	m^3/hr	6.47	6.29	5.91	5.17	4.41	3.59	2.50		(4053)
	BHP	0.50	0.58	0.62	0.80	0.98	1.15	1.36		
1	GPM	36.1	35.0	33.4	29.5	24.5	20.8	16.8	13.0	5149
(0.3)	m^3/hr	8.20	7.95	7.59	6.70	5.56	4.72	3.81	2.95	(4055)
	BHP	0.61	0.70	0.81	0.99	1.10	1.21	1.39	1.50	
1	GPM	43.8	41.8	40.4	37.3	34.3	30.6	27.8	24.5	5151
(0.3)	m^3/hr	9.95	9.45	9.18	8.47	7.79	6.95	6.31	5.56	(4057)
	BHP	1.10	1.20	1.34	1.63	1.95	2.20	2.40	2.60	

API Flush Plan 11 will reduce above flows.

TABLE 11 – ROTH LOW NPSH PUMPS – 51 SERIES

Single Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		100 (30.5)	150 (45.7)	200 (61.0)	300 (91.5)	400 (122)	500 (153)	600 (183)	700 (214)	Model Number (Curve Number)
1	GPM	10.2	9.2	8.3	6.8	5.4				
(0.31)	m^3/hr	2.3	2.1	1.9	1.5	1.2				5129
	BHP	1.4	1.5	1.7	2.0	2.3				(3093A)
1	GPM	16.2	15.1	14.1	12.2	10.3	8.6			
(0.31)	m^3/hr	3.7	3.4	3.2	2.8	2.3	2.0			5129B
	BHP	1.5	1.7	2.0	2.6	3.2	3.8			(3094A)
1	GPM	18.1	16.7	15.2	12.6	10.2	8.0	5.9		
(0.31)	m^3/hr	4.1	3.8	3.4	2.9	2.3	1.8	1.3		5131
	BHP	1.7	2.0	2.2	2.8	3.3	3.9	4.5		(3092A)
1	GPM	32.0	31.6	28.6	23.4	19.0	14.5	10.5		
(0.31)	m^3/hr	7.3	7.2	6.5	5.3	4.3	3.3	2.4		5141
	BHP	2.8	3.0	3.3	4.3	5.5	6.3	7.2		(3096A)
1	GPM	30.3	28.1	26.2	22.6	19.5	16.8	14.4	12.1	
(0.31)	m^3/hr	6.9	6.4	5.9	5.1	4.4	3.8	3.3	2.7	5142
	BHP	2.7	3.1	3.6	4.7	5.7	6.7	7.7	8.7	(3973)
1.00	GPM	44.0	41.5	38.5	33.2	28.4	23.8	18.0		
(0.31)	m^3/hr	10.0	9.4	8.7	7.5	6.4	5.4	4.1		5143
	BHP	3.5	3.7	4.2	5.5	6.5	7.8	9.2		(3087A)
1	GPM	53.8	52.3	50.0	43.0	35.5	28.0			
(0.31)	m^3/hr	12.2	11.9	11.3	9.8	8.1	6.4			5147
	BHP	4.3	5.0	5.7	7.3	9.0	11.0			(3090A)

API Flush Plan 11 will reduce above flows.



These performance specifications apply to both vertical and horizontal models.

TABLE 12 - ROTH LOW NPSH PUMPS - 52 SERIES

Single Stage – 1750 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		50 (15.7)	75 (22.8)	100 (30.5)	125 (38.1)	150 (45.7)	200 (61)	250 (76.2)	300 (91.5)	Model Number (Curve Number)
0.5	GPM	14.4	13.4	12.2	11.2	10.1	8.3	6.5		
(0.15)	m^3/hr	3.3	3.0	2.8	2.5	2.3	1.9	1.5		5252
	BHP	0.79	0.81	1.0	1.0	1.2	1.4	1.6		(4061)
0.5	GPM	16.6	15.8	14.8	13.8	12.7	10.5	8.3		
(0.15)	m^3/hr	3.8	3.6	3.4	3.1	2.9	2.4	1.9		5253
	BHP	0.8	0.9	1.0	1.2	1.3	1.6	1.9		(4062)
1	GPM		16.7	15.5	14.3	13.3	11.4	9.8	8.2	
(0.31)	m^3/hr		3.8	3.5	3.2	3.0	2.6	2.2	1.9	5254
	BHP		1.2	1.4	1.4	1.6	1.9	2.2	2.5	(4063)
1	GPM	29.0	26.7	24.8	23.2	21.5	18.9	16.7	14.5	
(0.31)	m^3/hr	6.6	6.1	5.6	5.3	4.9	4.3	3.8	3.3	5256
	BHP	1.3	1.5	1.6	1.7	1.9	2.4	2.8	3.2	(4065)
1	GPM	32.7	30.3	27.7	25.5	23.5	19.5	16.5		
(0.31)	m^3/hr	7.4	6.9	6.3	5.8	5.3	4.4	3.7		5258
	BHP	1.4	1.6	1.9	2.1	2.4	2.9	3.5		(4067)
1.00	GPM	47.0	42.5	38.5	35.0	31.2	23.9	15.7		
(0.31)	m^3/hr	10.7	9.6	8.7	7.9	7.1	5.4	3.6		5263
	BHP	1.6	1.9	2.3	2.5	2.9	3.8	4.9		(4069)
1	GPM	77.5	65.5	56.0	50.0	42.5	30.0			
(0.31)	m^3/hr	17.6	14.9	12.7	11.3	9.6	6.8			5267
	BHP	2.1	2.8	3.5	4.1	4.8	6.0			(3874)
1	GPM	61.0	57.0	54.0	50.0	47.5	41.5	36.0		
(0.31)	m^3/hr	13.8	12.9	12.3	11.3	10.8	9.4	8.2		5268
	BHP	2.2	2.5	3.0	3.5	4.0	5.0	5.5		(3877)
1	GPM	95.0	87.0	80.0	72.0	66.0	54.0			
(0.31)	m^3/hr	21.6	19.7	18.2	16.3	15.0	12.3			5269
	BHP	3.2	4.0	4.9	5.5	6.0	7.5			(4010)
1	GPM	102.0	98.0	95.0	90.0	80.0				
(0.31)	m^3/hr	23.2	22.2	21.6	20.4	18.2				5278
	BHP	6.5	7.5	8.0	9.0	10.0				(4070)

API Flush Plan 11 will reduce above flows.

TABLE 13 - ROTH LOW NPSH PUMPS - 52 SERIES

Single Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		100 (30.5)	150 (45.7)	200 (61.0)	300 (91.5)	400 (122)	500 (153)	600 (183)	800 (244)	Model Number (Curve Number)
1	GPM	14.4	14.3	14.1	13.5	12.5	11.2	9.6		
(0.31)	m^3/hr	3.3	3.2	3.2	3.1	2.8	2.5	2.2		5229B
	BHP	3.8	4.0	4.2	4.7	5.0	5.7	6.3		(3100A)
1	GPMr	39.0	37.0	36.0	32.0	29.0	26.0	24.0	19.0	
(0.31)	m^3/hr	8.9	8.4	8.2	7.3	6.6	5.9	5.4	4.3	5253
	BHP	3.5	4.0	4.7	6.0	7.2	8.3	9.4	11.5	(3975)
1	GPM	56.5	54.5	52.0	47.5	43.5	39.8	36.0	29.3	
(0.31)	m^3/hr	12.8	12.4	11.8	10.8	9.9	9.0	8.2	6.7	5256
	BHP	7.0	7.8	8.8	10.4	12.4	14.0	15.8	17.2	(3104A)
1	GPM	65.5	63.8	62.0	58.2	54.5	50.5	46.7	36.5	
(0.31)	m^3/hr	14.9	14.5	14.1	13.2	12.4	11.5	10.6	8.3	5258
	BHP	8.5	10.0	11.0	13.6	16.0	18.4	20.7	25.0	(3106A)
1	GPM	99.0	98.0	97.0	93.0	88.0	80.0	71.0	50.0	
(0.31)	m^3/hr	22.5	22.2	22.0	21.1	20.0	18.2	16.1	11.3	M5263
	BHP	8.0	9.0	10.5	13.5	17.0	20.0	24.0	33.0	(5762)
1	GPM	175	167	158	140	121	101			
(0.31)	m^3/hr	39.7	37.9	35.9	31.8	27.5	22.9			M5267
	BHP	18.0	20.0	22.0	26.2	30.0	34.0			(3978)
1	GPM	121	117	116	111	105	95	85		
(0.31)	m^3/hr	27.5	26.6	26.3	25.2	23.8	21.6	19.3		M5268
	BHP	21.0	21.5	22.0	23.5	25.0	29.0	33.0		(3977)
1	GPM	189	186	183	174	159	146	130		
(0.31)	m^3/hr	42.9	42.2	41.5	39.5	36.1	33.1	29.5		M5269
	BHP	28.5	29.0	29.5	32.5	36.0	41.0	44.0		(3979)

API Flush Plan 11 will reduce above flows.

These performance specifications apply to both vertical and horizontal models.

TABLE 14 - ROTH LOW NPSH PUMPS - 54 SERIES

Two Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		200 (61)	250 (76)	300 (92)	400 (122)	500 (153)	600 (183)	700 (214)	800 (244)	Model Number (Curve Number)
1	GPM	8.2	7.6	7.2	6.2	5.3	4.5	3.7	3.0	
(0.31)	m³/hr	1.9	1.7	1.6	1.4	1.2	1.0	0.8	0.7	5429
	BHP	1.8	2.0	2.4	2.8	3.4	3.9	4.3	5.0	(3111A)
1	GPM	14.9	14.2	13.3	11.7	10.2	8.8	7.4	6.1	
(0.31)	m³/hr	3.4	3.2	3.0	2.7	2.3	2.0	1.7	1.4	5429B
	BHP	3.0	3.8	4.1	4.8	5.5	5.8	6.2	6.5	(3112A)
1	GPM	12.4	11.3	10.4	8.0	7.1	5.6	4.3		
(0.31)	m³/hr	2.8	2.6	2.4	1.8	1.6	1.3	1.0		5430
	BHP	2.5	2.8	3.0	4.0	4.6	5.0	5.5		(3113A)
1	GPM	20.5	19.4	18.4	16.3	14.5	12.6	11.0	9.4	
(0.31)	m³/hr	4.7	4.4	4.2	3.7	3.3	2.9	2.5	2.1	5433
	BHP	3.5	3.8	4.0	4.8	5.4	6.5	7.5	8.0	(3114A)
1	GPM	25.5	23.8	22.4	19.5	17.0	14.6	12.4	10.4	
(0.31)	m³/hr	5.8	5.4	5.1	4.4	3.9	3.3	2.8	2.4	5441
	BHP	4.6	5.0	5.2	6.0	7.0	8.0	9.0	10.0	(3115A)

API Flush Plan 11 will reduce above flows.

TABLE 15 - ROTH LOW NPSH PUMPS - 58 SERIES

Two Stage – 3500 RPM at 60 cycles										
		Total Head in Feet (M)								
NPSHr Ft (M)		400 (122)	500 (153)	600 (183)	800 (244)	1000 (305)	1200 (366)	1400 (427)	1600 (488)	Model Number (Curve Number)
1	GPM	12.3	11.2	10.1	8.0	6.0	4.0			
(0.31)	m³/hr	2.8	2.5	2.3	1.8	1.4	1.0			5828B
	BHP	7.0	7.4	7.9	8I8	9.9	11.0			(3117A)
1	GPM	24.2	22.6	21.2	18.6	16.0				
(0.31)	m³/hr	5.5	5.1	4.8	4.2	3.6				5851
	BHP	6.8	8.5	9.5	11.0	13.0				(3119A)
1	GPM	30.0	29.0	27.2	24.0	21.1	17.9	15.2	11.0	
(0.31)	m³/hr	6.8	6.6	6.2	5.5	4.8	4.1	3.5	2.5	5853
	BHP	9.0	11.0	12.0	14.5	16.8	19.4	22.4	25.0	(3120A)
1	GPM	55.0	49.8	47.5	43.5	39.8	36.0	33.0	29.3	
(0.31)	m³/hr	12.5	11.3	10.8	9.9	9.0	8.2	7.5	6.6	5856
	BHP	14.5	19.0	20.8	24.8	28.0	31.6	35.0	38.4	(3985)
1	GPM	64.0	61.0	58.5	53.5	49.3	44.2	40.0	35.8	
(0.31)	m³/hr	14.5	13.8	13.2	12.1	11.2	10.0	9.1	8.1	5858
	BHP	22.5	23.5	25.0	29.5	33.5	37.5	42.0	47.0	(3124A)
1	GPM	90.0	84.0	81.0	72.0	63.0	54.0	44.0	34.0	
(0.31)	m³/hr	20.4	19.1	18.4	16.3	14.3	12.3	10.0	7.7	5863
	BHP	28.0	29.0	32.0	37.0	43.0	50.0	56.0	63.0	(3980)
1	GPM	131.0	121.0	118.0	100.0	85.0	64.0			
(0.31)	m³/hr	29.8	27.5	26.8	22.7	19.3	14.5			5867
	BHP	44.0	48.0	53.0	60.0	68.0	78.0			(3982)
1	GPM	109.5	106.0	103.0	96.0	88.0	80.0	70.0	58.0	
(0.31)	m³/hr	24.8	24.1	23.4	21.8	20.0	18.2	15.9	13.2	5868
	BHP	44.0	45.0	47.0	50.0	58.0	66.0	74.0	82.0	(3983)
1	GPM	165	159	152	137	122	105			
(0.31)	m³/hr	37.4	36.1	34.5	31.1	27.7	23.8			5869
	BHP	59.0	61.0	65.0	72.0	82.0	95.0			(3984)

API Flush Plan 11 will reduce above flows.

These performance specifications apply to both vertical and horizontal models.

Table 16 – FLANGE DIMENSIONS (see pages 22 through 29)

Model Number	(S) Suction 300# R.F. Flange inches (cm)	(T) Discharge 300# R.F. Flange inches (cm)	Q Dimension inches (cm)	R Dimension inches (cm)	N Dimension inches (cm)
2128-2149	1-1/2 (3.81)	1-1/2 (3.81)	5 3/16 (13.3)	2 1/2 (6.3)	5 1/2 (14.0)
2228B-2278	3 (7.62)	2 (5.08)	6 5/16 (15.9)	3 5/8 (9.0)	8 1/2 (21.6)
2428-2441	1-1/2 (3.81)	1-1/2 (3.81)	6 3/8 (16.2)	2 1/2 (6.3)	6 3/8 (16.2)
2828B-2861	2-1/2 (6.35)	2 (5.08)	7 3/8 (18.9)	3 1/2 (8.9)	8 (20.3)
5128-5151	2 (5.08)	1-1/2 (3.81)	5 13/16 (14.9)		6 3/8 (16.2)
5228-5253	2 (5.08)	1-1/2 (3.81)	5 7/8 (15.1)		8 3/8 (21.4)
5254-5258	3 (7.62)	2 (5.08)	7 13/16 (19.9)		8 3/8 (21.4)
5263-5269	4 (10.16)	2 (5.08)	9 7/8 (25.1)		8 3/8 (21.4)
5428-5441	2 (5.08)	1-1/2 (3.81)	5 11/16 (14.4)		6 3/8 (16.2)
5828-5853	2 (5.08)	1-1/2 (3.81)	7 5/8 (19.4)		8 (20.3)
5855-5861	3 (7.62)	2 (5.08)	9 11/16 (24.6)		8 (20.3)
5863-5869	4 (10.16)	2 (5.08)	11 13/16 (30.0)		8 (20.3)

FLANGES

All Roth Chemical Pumps have 300# R.F. Suction and Discharge flanges as standard.

Suction and Discharge flange ratings for 300# R.F. are as follows:

ASME/ANSI B16.5 (1988) 316 Stainless Group 2.2 Specification No. A351 Grade CF3M-Type 316 Class 300 Pressure/Temperature Limits

-20°F to 100°F	720 PSIG	-29°C to 38°C	49.64 Bar
200°F	620 PSIG	93°C	42.74 Bar
300°F	560 PSIG	149°C	38.61 Bar
400°F	515 PSIG	204°C	35.50 Bar

Maximum hydrostatic test: 1100 PSIG

ASME/ANSI B16.42 (1987) Ductile Iron Class 300 Pressure/Temperature Limits

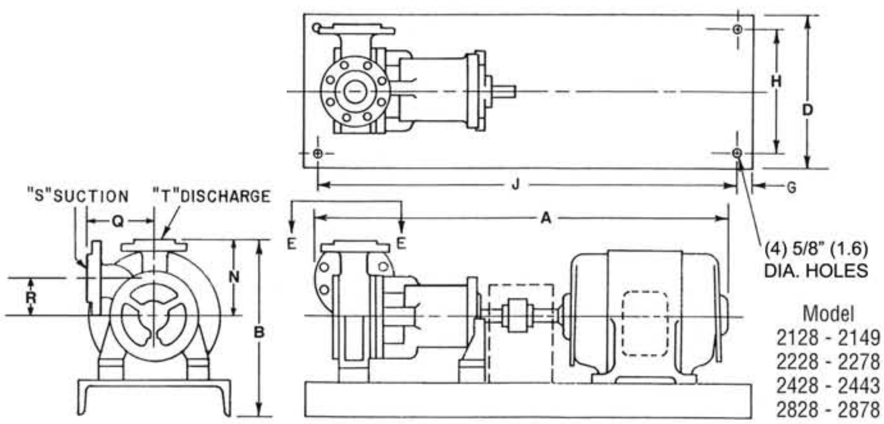
-20°F to 100°F	640 PSIG	-29°C to 38°C	44.12 Bar
200°F	600 PSIG	93°C	41.36 Bar
300°F	565 PSIG	149°C	38.95 Bar
400°F	525 PSIG	204°C	36.19 Bar

Maximum hydrostatic test: 900 PSIG

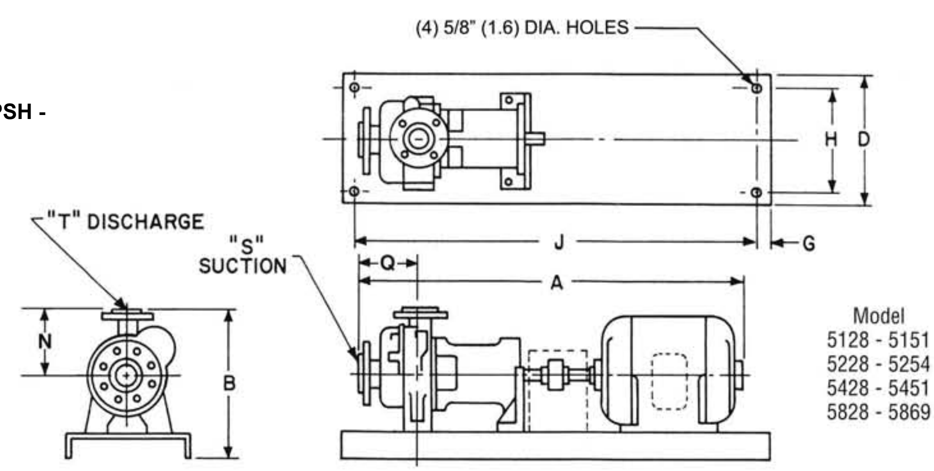
DESIGN P - STANDARD AND LOW NPSH

(Not to be used for construction unless certified.)

STANDARD -



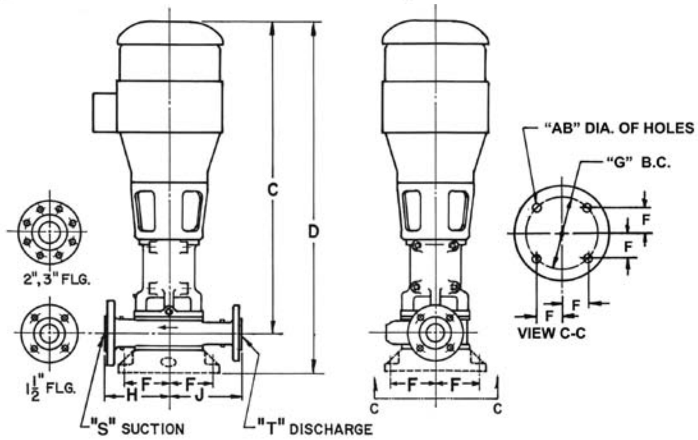
LOW NPSH -



DESIGN P – STANDARD AND LOW NPSH

NEMA Std Frame Size	Standard Model Dimensions - inches (cm)						Low NPSH Model Dimensions - inches (cm)					
	A	B	D	G	H	J	A	B	D	G	H	J
	Standard Series 2128 - 2149						Low NPSH Series 5128 - 5151					
143T-145T	29 1/2	13 7/8	12	7/8	10	25 3/8	33	15 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(75)	(35.3)	(30.5)	(2.2)	(25.4)	(64.5)	(83.8)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	31 5/8	13 7/8	12	7/8	10	28 1/4	35	15 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(80.2)	(35.3)	(30.5)	(2.2)	(25.4)	(71.8)	(88.9)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	34 1/4	13 7/8	12	7/8	10	28 1/4	37	15 1/8	15	1 1/4	12	43 1/2
(132S-132M)	(87.25)	(35.3)	(30.5)	(2.2)	(25.4)	(71.8)	(94)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
254T-256T	39 1/4	14 7/8	12	7/8	10	39 1/4	42	16 1/8	15	1 1/4	12	49 1/2
(160M-160L)	(99.7)	(37.8)	(30.5)	(2.2)	(25.4)	(99.1)	(106.7)	(40.9)	(38.1)	(3.2)	(30.5)	(125.7)
284T-286T							45	16 13/16	15	1 1/4	12	49 1/2
(180M-180L)							(114.3)	(42.7)	(38.1)	(3.2)	(30.5)	(125.7)
	Standard Series 2228 - 2278						Low NPSH Series 5228 - 5254					
143T-145T	32 5/8	18 3/16	15	1 1/4	12	28 1/4	35	18 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(82.8)	(46.2)	(38.1)	(3.2)	(30.5)	(71.8)	(88.9)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	34 5/8	18 3/16	15	1 1/4	12	28 1/4	37	18 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(87.9)	(46.2)	(38.1)	(3.2)	(30.5)	(71.8)	(94)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	37 1/2	18 3/16	15	1 1/4	12	38 1/4	40	18 1/8	15	1 1/4	12	49 1/2
(132S-132M)	(95.2)	(46.2)	(38.1)	(3.2)	(30.5)	(97.2)	101.6	(46)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T	42 5/8	18 3/16	15	1 1/4	12	38 1/4	45	18 11/16	18	1 1/4	15	57 1/2
(160M-160L)	(108.3)	(46.2)	(38.1)	(3.2)	(30.5)	(97.2)	(114.3)	(47.5)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T	43 7/8	19	15	1 1/4	12	43 1/2	45	19 1/2	18	1 1/4	15	57 1/2
(180M-180L)	(108.9)	(48.3)	(38.1)	(3.2)	(30.5)	(110.5)	(114.3)	(49.5)	(45.7)	(3.2)	(38.1)	(146.1)
							Low NPSH Series 5255 - 5269					
143T-145T							36	18 1/8	15	1 1/4	12	43 1/2
(90S-90L)							(91.4)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T							38	18 1/8	15	1 1/4	12	43 1/2
(100L-112M)							(96.5)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T							41	18 1/8	15	1 1/4	12	49 1/2
(132S-132M)							(104.1)	(46)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T							46	18 11/16	18	1 1/4	15	57 1/2
(160M-160L)							(116.8)	(47.5)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T							47	18 7/8	18	1 1/4	15	57 1/2
(180M-180L)							(119.4)	(48)	(45.7)	(3.2)	(38.1)	(146.1)
	Standard Series 2428 - 2443						Low NPSH Series 5428 - 5451					
143T-145T	30	14 11/16	12	7/8	10	25 3/8	34	15 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(76.2)	(37.3)	(30.5)	(2.2)	(25.4)	(64.5)	(86.4)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	32 1/8	14 11/16	12	7/8	10	28 1/4	36	15 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(81.6)	(37.3)	(30.5)	(2.2)	(25.4)	(71.8)	(91.4)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	34 3/4	14 11/16	12	7/8	10	28 1/4	39	15 1/8	15	1 1/4	12	43 1/2
(132S-132M)	(88.3)	(37.3)	(30.5)	(2.2)	(25.4)	(71.8)	(99)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
254T-256T	39 3/4	15 11/16	12	7/8	10	38 1/4	44	15 1/8	15	1 1/4	12	49 1/2
(160M-160L)	(101)	(39.8)	(30.5)	(2.2)	(25.4)	(97.2)	(111.8)	(38.4)	(38.1)	(3.2)	(30.5)	(125.7)
	Standard Series 2828 - 2878						Low NPSH Series 5828 - 5854					
143T-145T	34 1/4	18	12	7/8	10	28 1/4						
(90S-90L)	(87)	(45.7)	(30.5)	(2.2)	(25.4)	(71.8)						
182T-184T	36 1/2	18	12	7/8	10	28 1/4	39	18 1/2	15	1 1/4	12	43 1/2
(100L-112M)	(92.7)	(45.7)	(30.5)	(2.2)	(25.4)	(71.8)	(99.1)	(47)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	39 1/8	18	12	7/8	10	38 1/4	42	18 1/2	15	1 1/4	12	49 1/2
(132S-132M)	(99.4)	(45.7)	(30.5)	(2.2)	(25.4)	(97.2)	(106.7)	(47)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T	44	18	12	7/8	10	38 1/4	46	19	18	1 1/4	15	57 1/2
(160M-160L)	(111.8)	(45.7)	(30.5)	(2.2)	(25.4)	(97.2)	(116.8)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T	45 1/4	18 1/2	15	1 1/4	12	43 1/2	48	19	18	1 1/4	15	57 1/2
(180M-180L)	(114.9)	(47)	(38.1)	(3.2)	(30.5)	(110.5)	(121.9)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
							Low NPSH Series 5855 - 5869					
182T-184T							41	18 1/2	15	1 1/4	12	43 1/2
(100L-112M)							(104.1)	(47)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T							44	18 1/2	15	1 1/4	12	49 1/2
(132S-132M)							(111.8)	(47)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T							49	19	18	1 1/4	15	57 1/2
(160M-160L)							(124.5)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T							50	19	18	1 1/4	15	57 1/2
(180M-180L)							(127)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)

DESIGN L – STANDARD (Not to be used for construction unless certified.)



Dimensions - inches (cm)

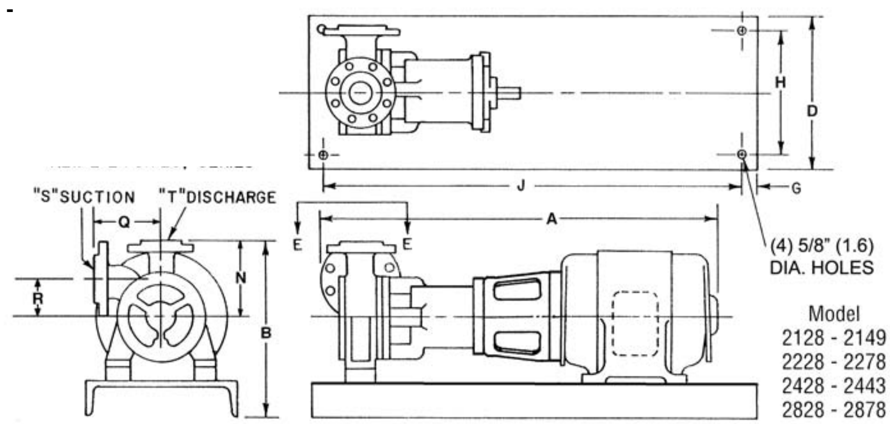
Pump Size	S	T	F	H	J	Flg. Rating	G	AB
L21 Series	1 1/2 (3.1)	1 1/2 (3.1)	2 3/4 (6.9)	5 5/8 (14)	6 3/8 (16)	300# RF	7 1/4 (19.7)	3/4 (1.9)
L2228-L2254	1 1/2 (3.1)	1 1/2 (3.1)	3 3/4 (9)	7 1/2 (19)	7 1/2 (19)	300# RF	10 1/2 (26.7)	7/8 (2.2)
L2255-L2278	2 1/2 (6.3)	2 1/2 (6.3)	4 (9)	7 1/2 (19)	7 1/2 (19)	300# RF	10 1/2 (26.7)	7/8 (2.2)

Dimensions - inches (cm)

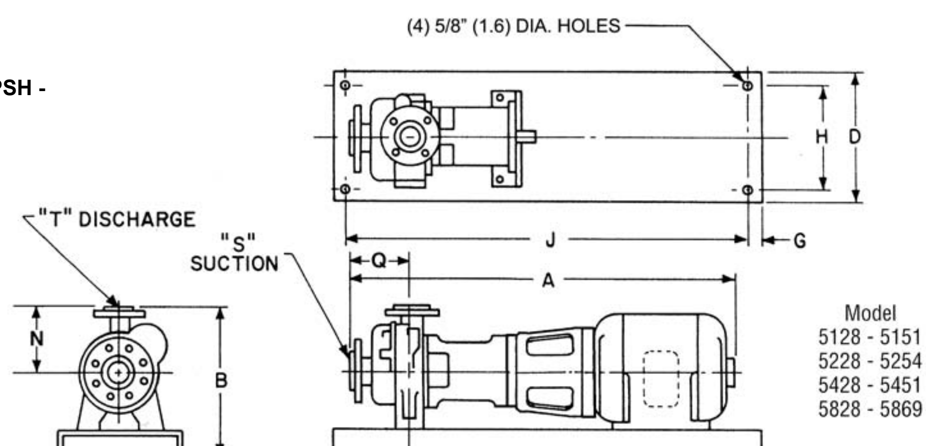
L21 Series			L22 Series		
Motor Frame Sizes NEMA C Face (IE55)	C	D	Motor Frame Sizes NEMA C Face (IE55)	C	D
143TC - 145TC (90SC - 90CC)	27 (68)	31 (78)	143TC - 145TC (90SC - 90CC)	29 (73)	33 (83)
182TC - 184TC (100LC - 122MC)	29 (73)	34 (86)	182TC - 184TC (100LC - 122MC)	31 (78)	37 (94)
213TC - 215TC (132CC - 132MC)	33 (83)	37 (94)	213TC - 215TC (132CC - 132MC)	34 (84)	40 (101)
254TC - 256TC (160MC - 160LC)	37 (94)	41 (104)	254TC - 256TC (160MC - 160LC)	38 (96)	44 (111)
284TC - 286TC (180MC - 180LC)	39 (99)	43 (109)	284TC - 286TC (108MC - 180LC)	41 (104)	47 (119)

DESIGN R - STANDARD AND LOW NPSH - (Not to be used for construction unless certified.)

STANDARD -



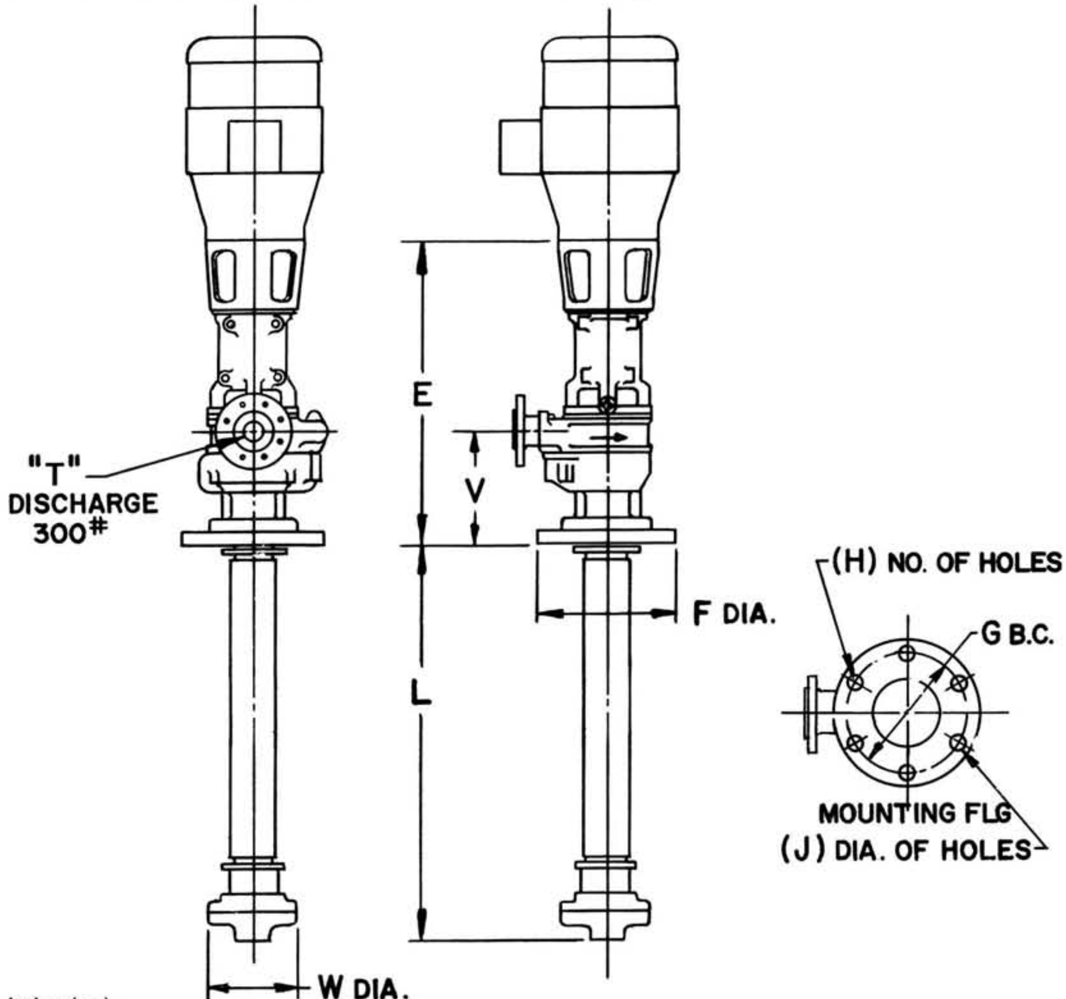
LOW NPSH -



DESIGN R - STANDARD AND LOW NPSH

NEMA Std Frame Size	Standard Model Dimensions - inches (cm)						Low NPSH Model Dimensions - inches (cm)					
	A	B	D	G	H	J	A	B	D	G	H	J
	Standard Series 2128 - 2149						Low NPSH Series 5128 - 5151					
143T-145T	29 1/2	13 7/8	12	7/8	10	25 3/8	33	15 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(75)	(35.3)	(30.5)	(2.2)	(25.4)	(64.5)	(83.8)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	31 5/8	13 7/8	12	7/8	10	28 1/4	35	15 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(80.2)	(35.3)	(30.5)	(2.2)	(25.4)	(71.8)	(88.9)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	34 1/4	13 7/8	12	7/8	10	28 1/4	37	15 1/8	15	1 1/4	12	43 1/2
(132S-132M)	(87.25)	(35.3)	(30.5)	(2.2)	(25.4)	(71.8)	(94)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
254T-256T	39 1/4	14 7/8	12	7/8	10	39 1/4	42	16 1/8	15	1 1/4	12	49 1/2
(160M-160L)	(99.7)	(37.8)	(30.5)	(2.2)	(25.4)	(99.1)	(106.7)	(40.9)	(38.1)	(3.2)	(30.5)	(125.7)
284T-286T							45	16 13/16	15	1 1/4	12	49 1/2
(180M-180L)							(114.3)	(42.7)	(38.1)	(3.2)	(30.5)	(125.7)
	Standard Series 2228 - 2278						Low NPSH Series 5228 - 5254					
143T-145T	32 5/8	18 3/16	15	1 1/4	12	28 1/4	35	18 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(82.8)	(46.2)	(38.1)	(3.2)	(30.5)	(71.8)	(88.9)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	34 5/8	18 3/16	15	1 1/4	12	28 1/4	37	18 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(87.9)	(46.2)	(38.1)	(3.2)	(30.5)	(71.8)	(94)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	37 1/2	18 3/16	15	1 1/4	12	38 1/4	40	18 1/8	15	1 1/4	12	49 1/2
(132S-132M)	(95.2)	(46.2)	(38.1)	(3.2)	(30.5)	(97.2)	101.6	(46)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T	42 5/8	18 3/16	15	1 1/4	12	38 1/4	45	18 11/16	18	1 1/4	15	57 1/2
(160M-160L)	(108.3)	(46.2)	(38.1)	(3.2)	(30.5)	(97.2)	(114.3)	(47.5)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T	43 7/8	19	15	1 1/4	12	43 1/2	45	19 1/2	18	1 1/4	15	57 1/2
(180M-180L)	(108.9)	(48.3)	(38.1)	(3.2)	(30.5)	(110.5)	(114.3)	(49.5)	(45.7)	(3.2)	(38.1)	(146.1)
							Low NPSH Series 5255 - 5269					
143T-145T							36	18 1/8	15	1 1/4	12	43 1/2
(90S-90L)							(91.4)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T							38	18 1/8	15	1 1/4	12	43 1/2
(100L-112M)							(96.5)	(46)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T							41	18 1/8	15	1 1/4	12	49 1/2
(132S-132M)							(104.1)	(46)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T							46	18 11/16	18	1 1/4	15	57 1/2
(160M-160L)							(116.8)	(47.5)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T							47	18 7/8	18	1 1/4	15	57 1/2
(180M-180L)							(119.4)	(48)	(45.7)	(3.2)	(38.1)	(146.1)
	Standard Series 2428 - 2443						Low NPSH Series 5428 - 5451					
143T-145T	30	14 11/16	12	7/8	10	25 3/8	34	15 1/8	15	1 1/4	12	43 1/2
(90S-90L)	(76.2)	(37.3)	(30.5)	(2.2)	(25.4)	(64.5)	(86.4)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
182T-184T	32 1/8	14 11/16	12	7/8	10	28 1/4	36	15 1/8	15	1 1/4	12	43 1/2
(100L-112M)	(81.6)	(37.3)	(30.5)	(2.2)	(25.4)	(71.8)	(91.4)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	34 3/4	14 11/16	12	7/8	10	28 1/4	39	15 1/8	15	1 1/4	12	43 1/2
(132S-132M)	(88.3)	(37.3)	(30.5)	(2.2)	(25.4)	(71.8)	(99)	(38.4)	(38.1)	(3.2)	(30.5)	(110.5)
254T-256T	39 3/4	15 11/16	12	7/8	10	38 1/4	44	15 1/8	15	1 1/4	12	49 1/2
(160M-160L)	(101)	(39.8)	(30.5)	(2.2)	(25.4)	(97.2)	(111.8)	(38.4)	(38.1)	(3.2)	(30.5)	(125.7)
	Standard Series 2828 - 2878						Low NPSH Series 5828 - 5854					
143T-145T	34 1/4	18	12	7/8	10	28 1/4						
(90S-90L)	(87)	(45.7)	(30.5)	(2.2)	(25.4)	(71.8)						
182T-184T	36 1/2	18	12	7/8	10	28 1/4	39	18 1/2	15	1 1/4	12	43 1/2
(100L-112M)	(92.7)	(45.7)	(30.5)	(2.2)	(25.4)	(71.8)	(99.1)	(47)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T	39 1/8	18	12	7/8	10	38 1/4	42	18 1/2	15	1 1/4	12	49 1/2
(132S-132M)	(99.4)	(45.7)	(30.5)	(2.2)	(25.4)	(97.2)	(106.7)	(47)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T	44	18	12	7/8	10	38 1/4	46	19	18	1 1/4	15	57 1/2
(160M-160L)	(111.8)	(45.7)	(30.5)	(2.2)	(25.4)	(97.2)	(116.8)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T	45 1/4	18 1/2	15	1 1/4	12	43 1/2	48	19	18	1 1/4	15	57 1/2
(180M-180L)	(114.9)	(47)	(38.1)	(3.2)	(30.5)	(110.5)	(121.9)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
							Low NPSH Series 5855 - 5869					
182T-184T							41	18 1/2	15	1 1/4	12	43 1/2
(100L-112M)							(104.1)	(47)	(38.1)	(3.2)	(30.5)	(110.5)
213T-215T							44	18 1/2	15	1 1/4	12	49 1/2
(132S-132M)							(111.8)	(47)	(38.1)	(3.2)	(30.5)	(125.7)
254T-256T							49	19	18	1 1/4	15	57 1/2
(160M-160L)							(124.5)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)
284T-286T							50	19	18	1 1/4	15	57 1/2
(180M-180L)							(127)	(48.3)	(45.7)	(3.2)	(38.1)	(146.1)

DESIGN S – LOW NPSH (Not to be used for construction unless certified.)



Dimensions – inches (cm)

	Design S Low NPSH Models S5128-S5151								
NEMA Std. Frame	T	E	F	G	H	J	L	V	W
143TC – 145TC (90SC – 90CC)	1 1/2 (3)	21 7/8 (55)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 7/8 (15)	5 7/8 (15)
182TC – 184TC (100LC – 122MC)	1 1/2 (3)	22 5/8 (57)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 7/8 (15)	5 7/8 (15.00)
213TC – 215TC (132CC – 132MC)	1 1/2 (3)	23 5/8 (60)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 7/8 (15)	5 7/8 (15)
	"L" Dimension may be supplied in 23 1/2" (59.7 cm) increments, plus 4" (10.1cm) for each additional booster."								

	Design S Low NPSH Models S5228-S5254								
NEMA Std. Frame	T	E	F	G	H	J	L	V	W
143TC – 145TC	1 1/2	24 1/8	13 1/2	11 3/4	8	3/4	27 1/4	6 15/16	5 7/8
(90SC – 90CC)	(3)	(61)	(34)	(29)	8	(2)	(61)	(17)	(15)
182TC – 184TC	1 1/2	24 7/8	13 1/2	11 3/4	8	3/4	27 1/4	6 15/16	5 7/8
(100LC – 122MC)	(3)	(63)	(34)	(29)	8	(2)	(61)	(17)	(15)
213TC – 215TC	1 1/2	25 5/8	13 1/2	11 3/4	8	3/4	27 1/4	6 15/16	5 7/8
(132CC – 132MC)	(3)	(65)	(34)	(29)	8	(2)	(61)	(17)	(15)
254TC – 256TC	1 1/2	25 5/8	13 1/2	11 3/4	8	3/4	27 1/4	6 15/16	5 7/8
(160MC – 160LC)	(3)	(65)	(34)	(29)	8	(2)	(61)	(17)	(15)
	"L" Dimension may be supplied in 21 1/4" (53.9 cm) increments, plus 7" (17.8cm) for each additional booster."								

DESIGN S – LOW NPSH

Dimensions – inches (cm)

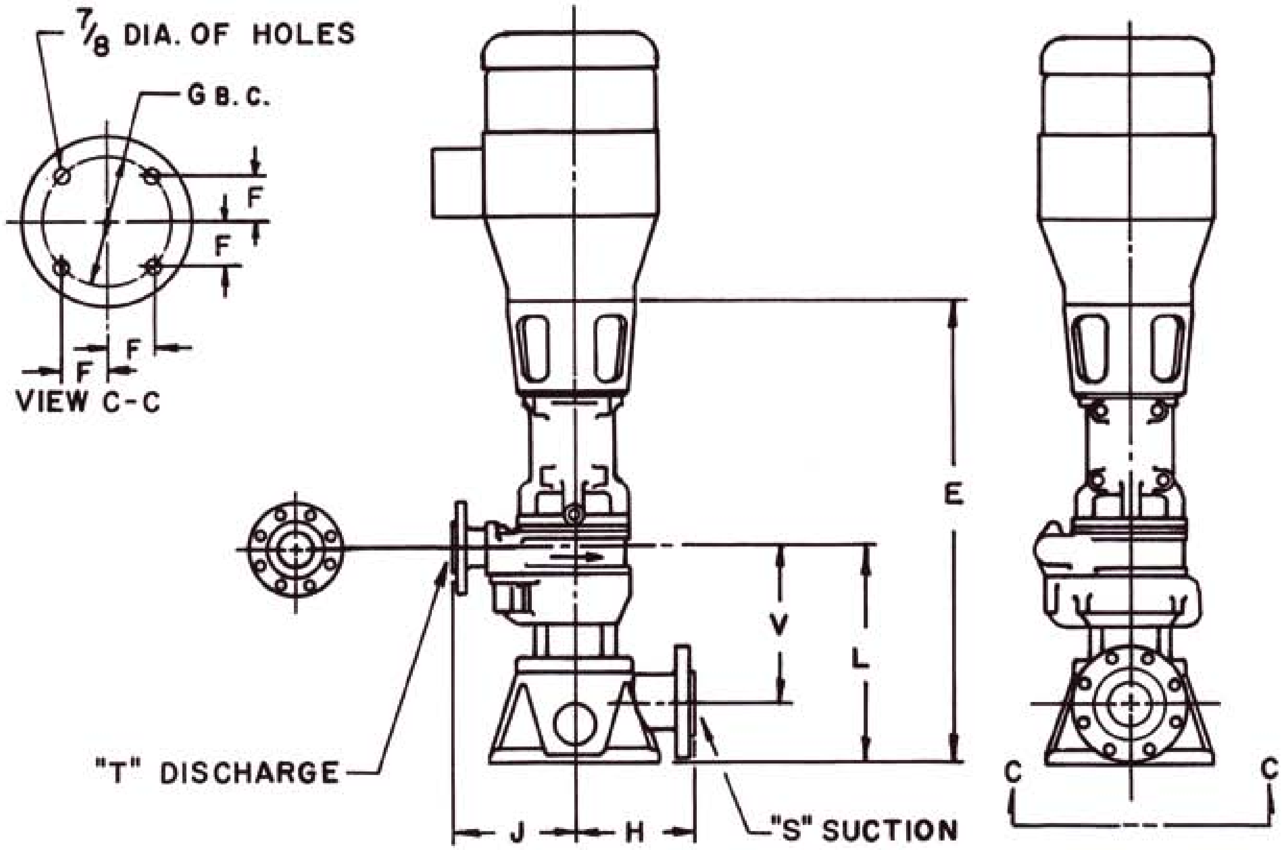
	Design S Low NPSH Models S5255-S5261								
NEMA Std. Frame	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**	**W**
143TC – 145TC (90SC – 90CC)	2 (5)	26 (65)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	8 (19)	8 (20)
182TC – 184TC (100LC – 122MC)	2 (5)	26 (67)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	8 (19)	8 (20)
213TC – 215TC (132CC – 132MC)	2 (5)	27 (68)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	8 (19)	8 (20)
254TC – 256TC (160MC – 160LC)	2 (5)	27 (68)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	8 (19)	8 (20)
	"L" Dimension may be supplied in 21 1/4" (53.9 cm) increments, plus 7" (17.8cm) for each additional booster."								

	Design S Low NPSH Models S5428-S5443								
NEMA Std. Frame	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**	**W**
143TC – 145TC (90SC – 90CC)	1 1/2 (3)	23 1/8 (58)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 11/16 (14)	5 7/8 (15)
182TC – 184TC (100LC – 122MC)	1 1/2 (3)	23 7/8 (60)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 11/16 (14)	5 7/8 (15)
213TC – 215TC (132CC – 132MC)	1 1/2 (3)	24 5/8 (62)	11 (28)	9 1/2 (24)	8 8	3/4 (2)	27 1/4 (61)	5 11/16 (14)	5 7/8 (15)
	"L" Dimension may be supplied in 23 1/2" (59.7 cm) increments, plus 4" (10.1cm) for each additional booster."								

	Design S Low NPSH Models S5851-S5854								
NEMA Std. Frame	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**	**W**
143TC – 145TC (90SC – 90CC)	1 1/2(3 (3)	25 7/8 (65)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	7 5/8 (19)	7 7/8 (20)
182TC – 184TC (100LC – 122MC)	1 1/2 (3)	26 5/8 (67)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	7 5/8 (19)	7 7/8 (20)
213TC – 215TC (132CC – 132MC)	1 1/2 (3)	27 3/8 (69)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	7 5/8 (19)	7 7/8 (20)
254TC – 256TC (160MC – 160LC)	1 1/2 (3)	27 3/8 (69)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	7 5/8 (19)	7 7/8 (20)
	"L" Dimension may be supplied in 21 1/2" (54.6 cm) increments, plus 7" (17.7cm) for each additional booster."								

	Design S Low NPSH Models S5855-S5861								
NEMA Std. Frame	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**	**W**
143TC – 145TC (90SC – 90CC)	2 (5)	27 7/8 (70)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	9 11/16 (24)	7 7/8 (20)
182TC – 184TC (100LC – 122MC)	2 (5)	28 5/8 (72)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	9 11/16 (24)	7 7/8 (20)
213TC – 215TC (132CC – 132MC)	2 (5)	29 5/8 (75)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	9 11/16 (24)	7 7/8 (20)
254TC – 256TC (160MC – 160LC)	2 (5)	29 5/8 (75)	13 1/2 (34)	11 3/4 (29)	8 8	3/4 (2)	27 1/4 (61)	9 11/16 (24)	7 7/8 (20)
	"L" Dimension may be supplied in 21 1/2" (54.6 cm) increments, plus 7" (17.7cm) for each additional booster."								

DESIGN V - LOW NPSH (Not to be used for construction unless certified.)



Dimensions – inches (cm)

	Design V Low NPSH Models V5128-5147								
NEMA Std. Frame	**S**	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**
143T – 145T (90S – 90C)	2 (5)	1 1/2 (3)	26 (66)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 3/4 (29)	7 3/8 (18)
182T – 184T (100L – 122M)	2 (5)	1 1/2 (3)	26 3/4 (68)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 3/4 (29)	7 3/8 (18)
213T – 215T (132C – 132M)	2 (5)	1 1/2 (3)	27 1/2 (69)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 3/4 (29)	7 3/8 (18)
254T – 256T (160M – 160L)	2 (5)	1 1/2 (3)	27 1/2 (69)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 3/4 (29)	7 3/8 (18)
284TS – 286TS (180M – 180L)	2 (5)	1 1/2 (3)	28 1/4 (71)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 3/4 (29)	7 3/8 (18)

	Design V Low NPSH Models V5228-5254								
NEMA Std. Frame	**S**	**T**	**E**	**F**	**G**	**H**	**J**	**L**	**V**
143T – 145T (90S – 90C)	2 (5)	1 1/2 (3)	28(71) (71)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 7/16 (21)	11 13/16 (30)	7 7/16 (18)
182T – 184T (100L – 122M)	2 (5)	1 1/2 (3)	28 3/4 (73)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 7/16 (21)	11 13/16 (30)	7 7/16 (18)
213T – 215T (132C – 132M)	2 (5)	1 1/2 (3)	29 1/2 (75)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 7/16 (21)	11 13/16 (30)	7 7/16 (18)
254T – 256T (160M – 160L)	2 (5)	1 1/2 (3)	29 1/2 (75)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 7/16 (21)	11 13/16 (30)	7 7/16 (18)
284TS – 286TS (180M – 180L)	2 (5)	1 1/2 (3)	30 1/4 (76)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 7/16 (21)	11 13/16 (30)	7 7/16 (18)

DESIGN V – LOW NPSH

Dimensions – inches (cm)

	Design V Low NPSH Models V5255-5261								
NEMA Std. Frame	S	T	E	F	G	H	J	L	V
143T – 145T (90S – 90C)	3 (7)	2 (5)	30 (76)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	14 3/16 (36)	9 13/16 (25)
182T – 184T (100L – 122M)	3 (7)	2 (5)	30 3/4 (78)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	14 3/16 (36)	9 13/16 (25)
213T – 215T (132C – 132M)	3 (7)	2 (5)	31 1/2 (80)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	14 3/16 (36)	9 13/16 (25)
254T – 256T (160M – 160L)	3 (7)	2 (5)	31 1/2 (80)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	14 3/16 (36)	9 13/16 (25)
284TS – 286TS (180M – 180L)	3 (7)	2 (5)	32 1/4 (82)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	14 3/16 (36)	9 13/16 (25)
	Design V Low NPSH Models V5428-5443								
NEMA Std. Frame	S	T	E	F	G	H	J	L	V
143T – 145T (90S – 90C)	2 (5)	1 1/2 (3)	27 1/4 (69)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 9/16 (29)	7 3/16 (18)
182T – 184T (100L – 122M)	2 (5)	1 1/2 (3)	28 (71)	3 23/32 (9)	1 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 9/16 (29)	7 3/16 (18)
213T – 215T (132C – 132M)	2 (5)	1 1/2 (3)	28 3/4 (73)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 9/16 (29)	7 3/16 (18)
254T – 256T (160M – 160L)	2 (5)	1 1/2 (3)	28 3/4 (73)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 9/16 (29)	7 3/16 (18)
284TS – 286TS (180M – 180L)	2 (5)	1 1/2 (3)	29 1/2 (75)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	6 3/8 (16)	11 9/16 (29)	7 3/16 (18)
	Design V Low NPSH Models V5828-V5854								
NEMA Std. Frame	S	T	E	F	G	H	J	L	V
143T – 145T (90S – 90C)	2 (5)	1 1/2 (3)	29 3/4 (75)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	13 1/2 (34)	9 1/8 (23)
182T – 184T (100L – 122M)	2 (5)	1 1/2 (3)	30 1/2 (77)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	13 1/2 (34)	9 1/8 (23)
213T – 215T (132C – 132M)	2 (5)	1 1/2 (3)	31 1/4 (79)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	13 1/2 (34)	9 1/8 (23)
254T – 256T (160M – 160L)	2 (5)	1 1/2 (3)	31 1/4 (79)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	13 1/2 (34)	9 1/8 (23)
284TS – 286TS (180M – 180L)	2 (5)	1 1/2 (3)	32 (81)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	13 1/2 (34)	9 1/8 (23)
	Design V Low NPSH Models V5855-V5861								
NEMA Std. Frame	S	T	E	F	G	H	J	L	V
143T – 145T (90S – 90C)	3 (7)	2 (5)	32 1/4 (82)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	16 1/16 (40)	11 11/16 (29)
182T – 184T (100L – 122M)	3 (7)	2 (5)	33 (83)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	16 1/16 (40)	11 11/16 (29)
213T – 215T (132C – 132M)	3 (7)	2 (5)	33 3/4 (96)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	16 1/16 (40)	11 11/16 (29)
254T – 256T (160M – 160L)	3 (7)	2 (5)	33 3/4 (96)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	16 1/16 (40)	11 11/16 (29)
284TS – 286TS (180M – 180L)	3 (7)	2 (5)	34 1/2 (87)	3 23/32 (9)	10 1/2 (26)	8 1/4 (21)	8 (20)	16 1/16 (40)	11 11/16 (29)

ROTH PUMP COMPANY

History

Since 1932, Roth Pump Company has been at the forefront in developing innovative, high quality pumps and systems. Recognized for its technical excellence, comprehensive customer support and exacting manufacturing standards, Roth has become a global provider of highly reliable pumps and pumping systems.

Location

Located in Rock Island, Illinois, Roth Pump Company is centrally located for delivery of pumps and systems to the entire United States. Roth can also provide quick response to all international customers.

Design and Engineering

Good design means good pumps. Roth engineering has built its reputation on the field performance of the pumps it has designed and delivered over the years. Quality, performance and durability are designed into all Roth pumps.

Roth Pump uses state of the art solid modeling software. This is an excellent tool for checking the fit and function of mating parts, and speeds the manufacturing response to customer special design orders.

Through pioneering design, Roth Pump has maintained the engineering edge in delivering technically superior pumps that result in lower installation and maintenance costs.

Manufacturing

Roth Pump has an extensive manufacturing capability in the 75,000 square foot shop floor. Over 98% of machined components are manufactured at our plant. We utilize both cutting-edge CNC equipment as well as traditional machines to produce parts with very close tolerances in a variety of standard and exotic metals. Our computer aided manufacturing capability assures that the exact design specifications are produced every time. Each employee is involved in continuous improvement efforts through every step of the manufacturing process to insure our customers satisfaction.

Testing

All Roth Pumps are factory tested. Roth takes the testing of their pumps beyond the recommendations of the Hydraulic Institute, which require adjustments by the user for actual applications. Roth conducts performance tests with water at ambient temperature for basic data, but also tests with boiling water, ammonia, or propane, when required to verify NPSHr, seal integrity, and the specified operating head.

Quality Assurance

At Roth Pump Company, quality assurance is an integral part of the total process for engineering and manufacturing pumps that meet customers requirements. We are able to closely control the quality of all manufactured components because of our in-house manufacturing capability and exacting requirements on suppliers. Every part is inspected by both our inspection department as well as the machine operator. Each pump is assembled to customer specifications by experienced assemblers. Then each pump or system is put through a series of tests to assure conformance to our high quality standards before it leaves the plant. This attention to quality has given Roth Pump the reputation it has throughout the industry for quality products.

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