



# LOW NPSH INDUSTRIAL PUMPS

**Ideal for industrial applications such as  
deaerator, boiler feed, and absorption machine service**

**Heads up to 600 ft. TDH**

**Capacities to 190 GPM**

**Temperatures up to 350°F**

**Only 1FT NPSH\* required for full curve performance**

**Lowers design height requirements of industrial systems**



*\*One-half foot on 20 GPM models and  
smaller at 1750 RPM.*

**SELECTION OF HOT WATER PUMPS**

The prevailing concern today of engineers selecting pumps for hot water is the Net Positive Suction Head characteristic of the pumps. This concern indicates an alertness to developments in the pump manufacturing industry, and an awareness of the causes of success and failure of pumps in handling feedwater near or above boiling point.

**ROTH PIONEERING**

Roth Pump Co. has been a pioneer in the industry for over ninety years in developing NPSH data on its products for use by engineers. In 1954 it was the first manufacturer of regenerative turbine pumps to publish NPSH data on individual models. At that time the Roth Pump Co. developed and published the first NPSH curves on regenerative turbine pumps in a format now used throughout the industry. It is the only manufacturer of regenerative turbine pumps today with numerous patents designed to improve the NPSH characteristics of its pumps.

**ROTH ONE FOOT NPSH PUMPS**

The Roth Pump Company is the only pump manufacturer in the world today that offers a line of pumps with full performance at one foot NPSH at speeds of both 1750 and 3500 RPM in a range of differential heads up to 600 feet TDH, capacities up to 190 GPM.

All Roth pumps in this bulletin are guaranteed to deliver full rated capacity of boiling water to the boiler with only one foot NPSH.

Roth one foot NPSH pumps were originally developed to pump 230°F deaerated water from the deaerator to the boiler. This original design has now been improved to include high capacity models fully functional at one foot NPSH. The pumps are provided with mechanical seals for temperatures up to 350°F maximum without the use of external cooling.

All Roth one foot NPSH industrial boiler feed pumps are full ball bearing mounted without internal water lubricated bearings.

**WATER PUMPING PROBLEMS**

The problems of pumping water in steam systems mostly relate to temperature. As the temperature approaches boiling point, it becomes possible for ordinary pumps to upset liquid state through pressure drop or additional heat.

**SUCTION LINE PROBLEMS**

Pressure drop can occur in the pipe on the suction side of the pump due to friction loss in the pipe and fittings. Pressure drop across valves and strainers is usually the largest factor. A clogged strainer in the suction line can create enough pressure drop to completely vapor bind the line between the strainer and the pump.

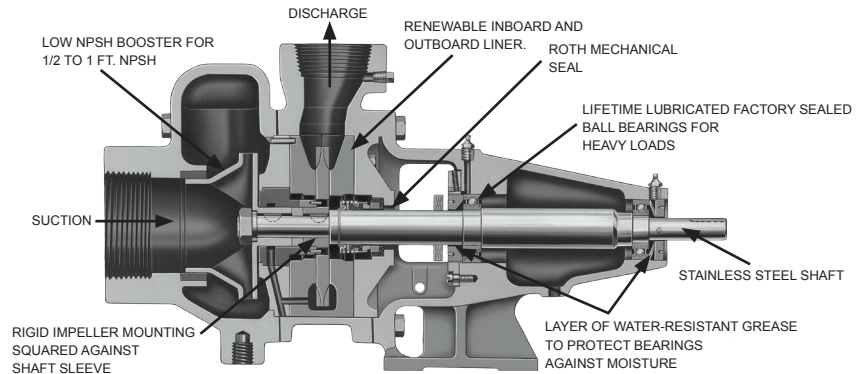
**ELIMINATING SUCTION LINE LOSSES**

Friction loss in the suction line can be virtually eliminated by over-sizing all pipe and fittings.

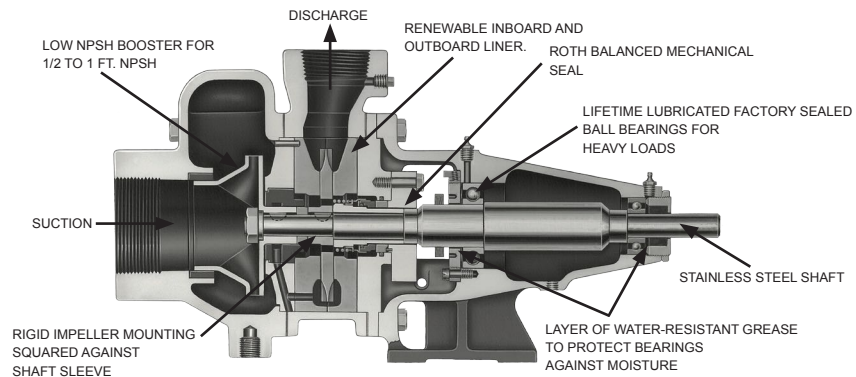
Where liquid velocity can be reduced to 3 feet

Roth patented one foot NPSH industrial pumps depend for their function on the booster impeller that assures 30 ft. suction head to the turbine stage. They depend for their durability on the sealed ball bearings in the mechanical frame.

Two separate methods of bearing mounting are used. Design A is suitable for suction pressures up to 60 PSI. Design C is suitable for suction pressures up to 150 PSI.



Design A above is shown equipped with IT unbalanced mechanical seal with tungsten carbide seat suitable for sealing hot water at temperatures up to 250°F under specific conditions of pressure and service.



Design C above is shown equipped with 50T balanced mechanical seal with tungsten carbide seat suitable for sealing hot water up to 250°F 150 PSI or differential heads of 600 ft. TDH.

**SEAL SELECTION CHARTS**

For Intermittent Service					For Continuous Service				
Stuffing Box Pressure* PSI	Temperature °F				Stuffing Box Pressure* PSI	Temperature °F			
	70°F	212°F	250°F	350°F		70°F	212°F	250°F	350°F
10	1T	1T	1T	114T	10	1T	1T	1T	114T
20	1T	1T	1T	114T	20	1T	1T	1T	114T
40	1T	1T	1T	114T	40	1T	1T	1T	114T
50	1T	1T	1T	114T	50	1T	1T	50T	114T
60	1T	1T	1T	114T	60	1T	50T	50T	114T
75	1T	1T	1T	114T	75	50T	50T	50T	114T
100	1T	1T	50T	114T	100	50T	50T	50T	114T
125	50T	50T	50T	114T	125	50T	50T	50T	114T
150	50T	50T	50T	114T	150	50T	50T	50T	114T

\*Stuffing box pressure equals one-half differential pressure plus suction pressure.

The two tables shown above provide a means of selecting the suitable design (A or C) and seal assembly IT, 50T or 114T for various conditions of pressure, temperature and service. An 85T seal is available for vacuum applications.

per second or less and the suction line is kept at 10 feet length or less very little friction loss is accumulated.

It is recommended that pipe and fitting sizing on the suction side of hot water pumps be based on a velocity of 3 feet per second or less.

**PRESSURE DROP IN THE PUMP SUCTION**

Both centrifugal and regenerative turbine

pumps must increase liquid velocity to provide velocity head.

Any such velocity increase in the suction entrance of the pump before the addition of equivalent pressure results in additional pressure drop. In pump parlance this drop is known as "entrance losses."

The designers of pumps for hot water service must virtually eliminate entrance losses to achieve satisfactory



pump performance. This problem has been completely solved in Roth one foot NPSH pumps.

**DEFINITION OF NPSH**

NPSH (net positive suction head) is defined as the pressure above vapor pressure at the pump suction.

From the above it is seen that a proper calculation of available NPSH takes into consideration elevation of the vessel and friction loss in the suction line.

The required minimum NPSH of the pump must be stated by the manufacturer for the purposes of this calculation.

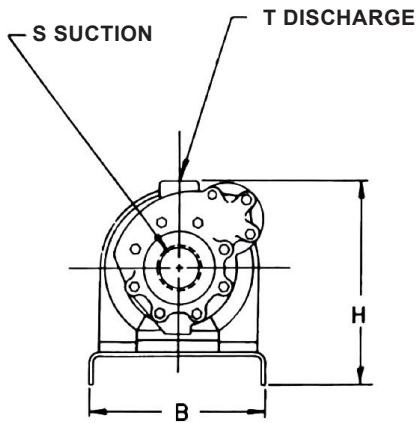
**LIQUID TEMPERATURES**

The practice of theoretically limiting maximum pump operating temperatures in boiler feed systems and condensate return units is fraught with some speculation.

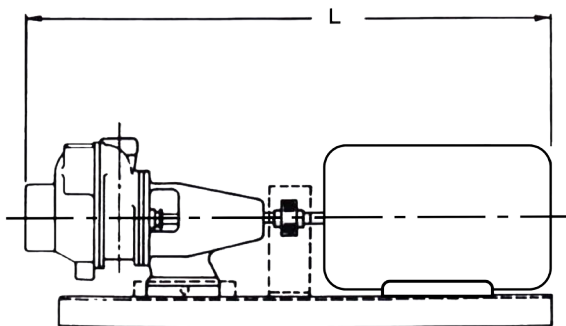
In most steam systems it is not possible to guarantee that the return water will not at some time reach boiling point. This can occur through steam trap failure in open position allowing live steam to return with the condensate. It can also be caused in units equipped with preheat equipment by high setting by operator, or failure of temperature regulating device.

The specification of return water temperature at some point below boiling normally represents an average condition but not always possible extremes.

**OUTLINE DRAWING**



Drg. No. 2386



The use of Roth one foot NPSH pumps ensures full specified capacity and head under adverse conditions of 212°F or higher with only one foot static head available to the pump.

**DEAERATION NPSH**

Normal deaerating temperature is 227°F. This is above boiling point and is accomplished in a pressure vessel.

The pressure in the vessel is developed from the vapor pressure of the water at this temperature which is about 5 PSI gauge. There is consequently no pressure over vapor pressure in the vessel.

**DEAERATION VESSEL ELEVATION**

Most deaerators utilize a column or dome over the storage vessel where the deaerating takes place through spray or tray devices. The height of this column plus the necessary static suction head of the vessel above the pump have resulted in overall deaerator heights up to ten feet or more in the past.

The introduction of Roth low NPSH boiler feed & deaerator pumps makes it possible to reduce overall deaerator height to 5 feet or less.

The storage vessel may be mounted less than one foot above floor beside the pump. The pump will deliver full capacity without vapor bind or capacity reduction as long as there is unimpeded flow from the liquid level one foot above the pump center.

**DESIGN FEATURES**

Roth low NPSH boiler feed pumps are center suction, end mounted ball bearing construction.

A booster stage ahead of the regenerative turbine impeller serves as a substitute for the static head normally required on boiling liquid service. This device assures full 30 foot NPSH performance by the regenerative turbine impeller under all conditions of one foot NPSH or better.

**BALL BEARINGS**

The two ball bearings are neoprene sealed, factory lubricated. They are protected against moisture penetration from bearing breathing by a layer of waterproof grease over the outer membrane of each bearing.

Due to the compact construction and heavy stainless steel shaft the use of internal liquid lubricated bearings has been avoided. The pumps have an expected service life exceeding designs based on liquid lubricated bearings.

Standard low NPSH boiler feed pumps are provided with mechanical seals with tungsten carbide seats suitable for 250°F water. Mechanical seals are also available for vacuum service with use of an 85T seal. With the use the 114T Seal Roth low NPSH boiler feed pumps can handle liquid temperatures up to 350°F without the use of external liquid or air cooling.

**DIMENSIONS IN INCHES**

**55 SERIES**

Motor Frame	B	H	L	T	S
56, 143T-145T	10	13	30	1 1/4	2
182T-184T	12	14	34	1 1/4	2
213T-215T	12	14	36	1 1/4	2

**MODELS 5650-5654**

Motor Frame	B	H	L	T	S
56, 143T-145T	12	15	34	1 1/4	2
182T-184T	12	15	38	1 1/4	2
213T-215T	12	15	40	1 1/4	2
254T	12	16	44	1 1/4	2

**MODELS 5655-5668\*, 6658-6661**

Motor Frame	B	H	L	T	S
56, 143T-145T	12	15	35	2	3
182T-184T	12	15	40	2	3
213T-215T	12	15	42	2	3
254T	12	16	45	2	3

**MODELS 5669-5678\*, 6663-6678**

Motor Frame	B	H	L	T	S
56, 143T-145T	12	17	41	2	4
182T-184T	12	17	41	2	4
213T-215T	12	17	43	2	4
254T	12 3/4	17	46	2	4

**MODELS 5771-5774**

Motor Frame	B	H	L	T	S
143T-145T	12	17	44	1 1/2	3
182T-184T	12	17	46	1 1/2	3
213T-215T	15	17	46	1 1/2	3

**MODELS 5775-5780**

Motor Frame	B	H	L	T	S
182T-184T	12	19	46	3	4
213T-215T	12	19	46	3	4
254T-256T	15	30	50 1/2	3	4

**MATERIAL MODEL SUFFIX:**

- SF= Standard Fitted with iron liners and bronze impeller
  - BF= Bronze Fitted with bronze liners and bronze impeller
  - BC= Cast iron liners and 416 stainless steel impeller
  - BI= Bronze liners and 416 stainless steel impeller
- Cast iron case and 416 stainless steel shaft is standard for all pumps