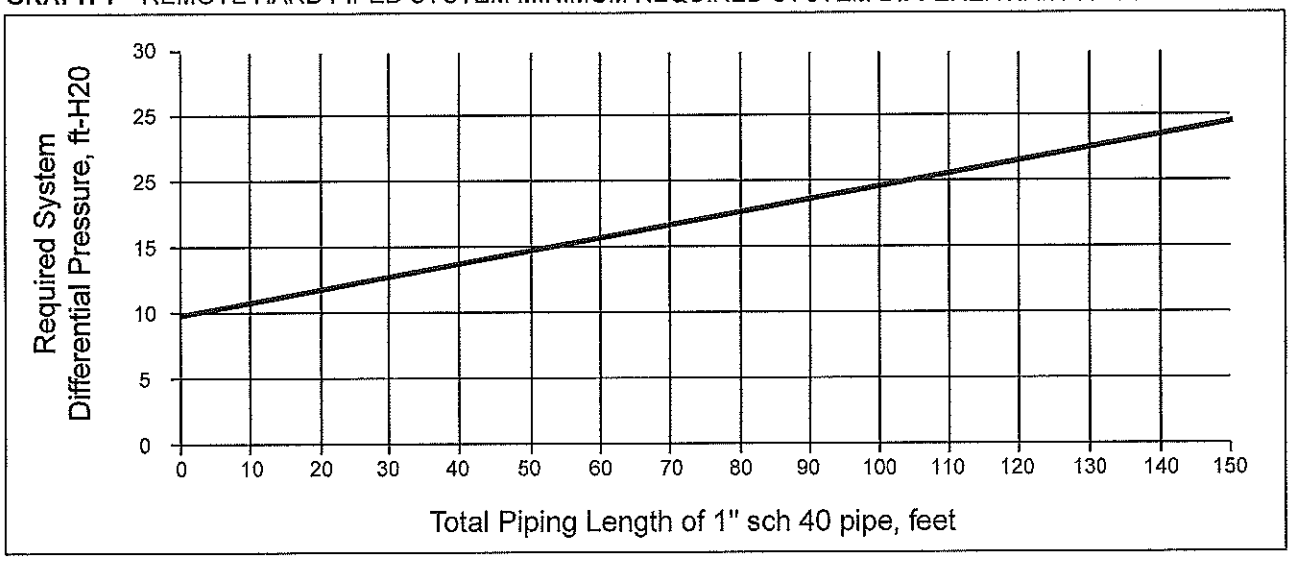
GRAPH 1 – REMOTE HARD PIPED SYSTEM MINIMUM REQUIRED SYSTEM DIFFERENTIAL PRESSURE



The graph above is based on the following: 10 GPM (0.63 l/s) water flow rate, 1" schedule 40 threaded steel pipe, and the following fittings (14 elbows, 2 ball valves, 1 strainer, VSD heat exchanger, and misc. fittings).

HELPFUL CONVERSION FACTORS:

FEET x 0.305 = METERS

FEET of H_2O x 0.43 = Pounds Per Square Inch Differential (PSID)

FEET of H_2O x 2.99 = kPa

"REMOTE" HARD PIPED SYSTEM DETAILS

(Reference Fig. 4)

When connecting the retrofit VSD cooling piping system, it is desirable to minimize the piping length and maximize the available differential pressure at the connection points. Piping length must take into consideration the total length of the piping run that will be required to complete the circuit from inlet to outlet. If the piping must be run overhead, the total length should include all vertical and horizontal pipe runs.

The connection points should provide at least the minimum differential pressure as determined by Graph 1. The most convenient connection points will generally be at or near the chiller's condenser water box (points 3 and 4). The chiller design data can be reviewed to determine the pressure drop across the condenser but it would be better to measure it directly. When measuring pressure drop with a gauge, it is recommended that a single gauge be connected at the two different piping connection locations and the difference be determined mathematically.

If the available pressure differential at or near the condenser water box is less than specified by Graph 1, alternate connection points should be considered. Greater pressure differential is available when the water inlet is connected to the discharge side of the pump (Point 2) and the outlet is piped downstream of the condenser (Point 4).

The greatest available differential pressure in the condenser piping system can be found directly across the main condenser water pump (Points 1 and 2). The cooling piping can be connected in this location if the minimum required differential pressure is not available anywhere else in the condenser piping circuit. Piping to this location will slightly elevate the chiller's entering condenser water temperature.

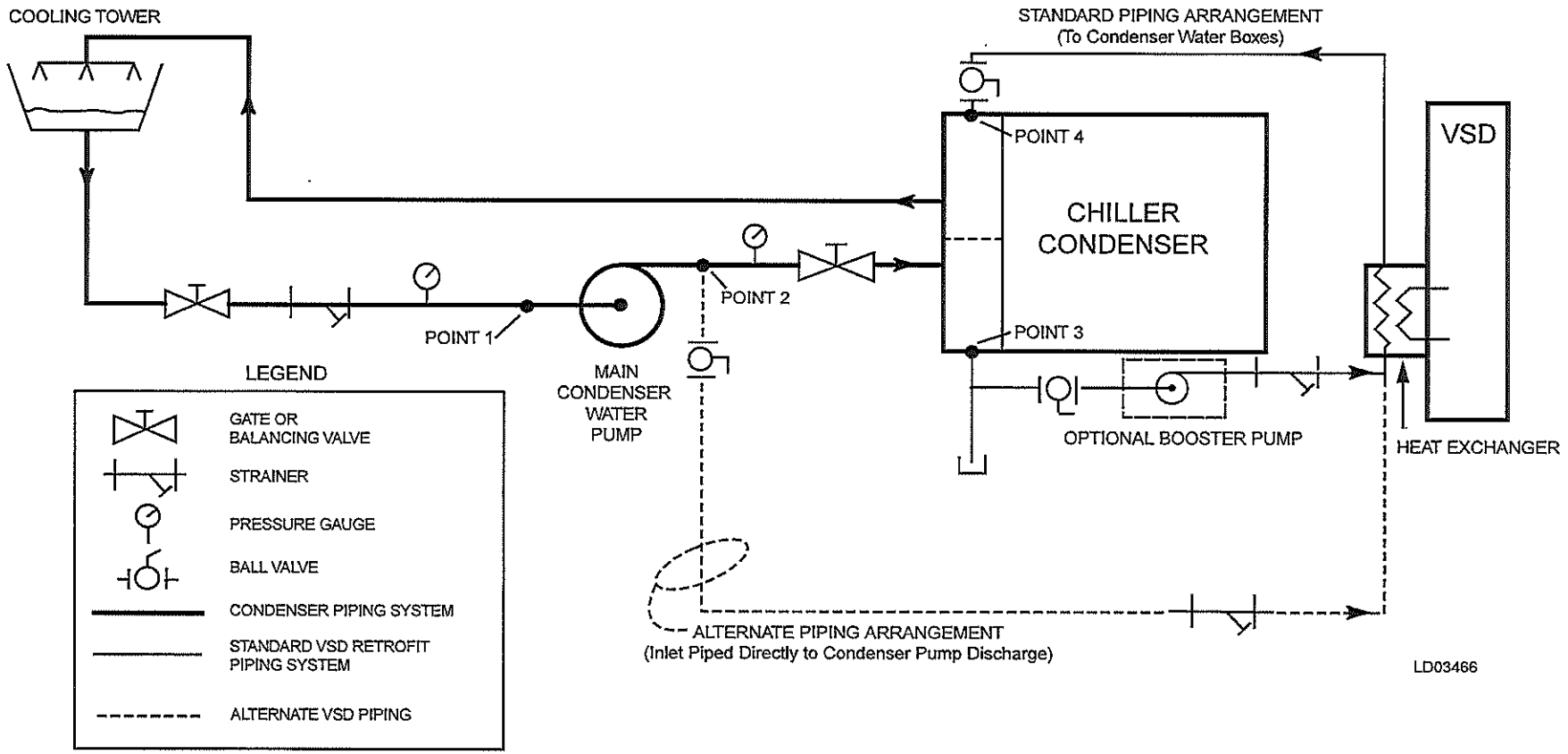


FIG. 4 – CONDENSER LOOP AND VSD PIPING

TABLE 2 – CONNECTION POINT SUMMARY

INLET	OUTLET	DIFFERENTIAL PRESSURE	COMMENTS
3	4	MINIMUM	MOST COMMON
2	4	GREATER	
2	1	MAXIMUM	WILL SLIGHTLY INCREASE CONDENSER WATER TEMP.

WHEN TO USE A BOOSTER PUMP

If it is not practical to connect the cooling piping to a location that provides adequate pressure drop, application of a booster pump should be considered (see Fig. 4). The sum of the available pressure drop at the connecting points and the head produced by the booster pump should meet or exceed the minimum head requirements in table 4 for "local" hose piped systems or graph 1 for "remote" hard piped systems.

The recommended pumps are in-line mounted and the piping connected to them should be rigidly supported and free of bending or twisting forces, which could stress the pump flanges and body. If the booster pump is applied in a "local" hose piped system, it should be connected to rigidly supported hard pipe. Depending on available space, it will probably be easiest to directly couple the pump to the strainer.

Note: The pumps called for in the piping drawings currently shipped with the retrofit VSD kits are no longer recommended. Only the pumps in the following table are recommended! The next revision of the retrofit piping drawings will reflect this change.

For systems with a design working pressure of up to 145 PSIG (1000 kPa), the following Grundfos pumps are recommended:

TABLE 3 – BOOSTER PUMP SELECTION

MFG. MODEL	MFG. PART NUMBER	YORK P/N	FLOW RATE	HEAD @ RATED FLOW	POWER	VOLTS/HZ/PH
UP26-96BF	52.7223 36	026-34469-000	10 GPM	15 ft-H_2O	1/12 HP	115/60/1
1" flange kit for UP26-96BF	51.9652	026-34471-000				
UPS 32-60FB	Not Available	Not Available	0.63 l/s	33 kPa	90 W	230/50/1

Note: *The 50 Hz booster pump is not stocked in the Parts Distribution Center due to uncertainty of demand and variability related to pipe connection sizes and type. It should be available locally in most countries with 50 Hz power.*

For systems with a design working pressure of greater than 145 PSIG (1000 kPa) call the service marketing department for pump recommendations.

TABLE 4 – HOSE PIPED MINIMUM DIFFERENTIAL PRESSURE

SYSTEM TYPE	MINIMUM REQUIRED DIFFERENTIAL PRESSURE
"Local" Hose Piping up to 30 feet (9.2 m)	9 ft-H_2O/3.9 PSID/26.9 kPa

Piping Example 1

Description – The pressure readings taken on the job site indicate the following pressures (Reference Fig. 4). Piping from the VSD enclosure to the condenser water box connections will require 100 feet (30.5 m) of pipe.

POINT 1	POINT 2	POINT 3	POINT 4
50 Ft.– H_2O	100 Ft.– H_2O	80 Ft.– H_2O	70 Ft.– H_2O
150 kPa	299 kPa	239 kPa	209 kPa

Solution – Since the total piping length required is greater than 30 feet (9.2 m), the system must be hard piped using the "remote" piping kit and field supplied piping. From Graph 1, we find that the differential pressure required for 100 feet (30.5 m) of pipe is 19 ft-H_2O (56.8 kPa). The differential pressure available across the condenser water box (points 3 and 4) is only 10 ft-H_2O (29.9 kPa). Therefore, it cannot be piped directly across the water boxes.

At this point, two options are available:

1. Alternate piping connections – Site measurements indicate that it will require an additional 40 feet (12.2 m) of pipe, to connect the inlet water to the discharge of the main condenser water pump (point 2) for a total piping length of 140 feet (42.7 m). Graph 1 indicates that 23 ft-H_2O (68.8 kPa) differential pressure is required for a total pipe length of 140 feet (42.7 m). Since a differential pressure of 30 ft-H_2O (90 kPa) is available by piping between the pump discharge (point 2) and the downstream water box (point 4), the installation of a booster pump is unnecessary.

2. Use of the booster pump – The sum of the standard booster pump head 15 Ft-H_2O (44.9 kPa) and the available pressure differential across the water boxes 10 ft-H_2O (29.9 kPa) is 25 ft-H_2O (74.8 kPa). Since this is greater than the required pressure differential of 19 ft-H_2O (56.8 kPa), the booster pump can be applied. In addition to the cost of the pump, application of the booster pump complicates the piping, wiring, and maintenance of the installation.

OTHER PIPING CONSIDERATIONS / RECOMMENDATIONS:

PIPING CONNECTIONS

For most installations, it will be most convenient to connect the cooling water piping to the condenser water box, nozzle, or adjacent piping. The cooling water inlet connection should **not be taken off the bottom** of the water box, unless a dip tube extends up into the water box (as in factory mounted installations). Otherwise, dirt and debris will collect at the bottom of the water box and may eventually clog the supply line. If a bottom connection is used without a dip tube, the addition of a dirt leg will reduce the pickup of debris and sediment, but it may still be prone to clogging.

The factory supplied vent and drain line connections could be as small as ½" (12.7 mm) NPT. This small size contributes significant pressure drop. This may be an issue for any system with marginal pressure drop. The use of vents and drains for piping connections also prohibits them from being used as originally intended unless an additional valve is added for that purpose. For units requiring a micropanel retrofit, it may also be desirable to use the vent connections for the installation of entering and leaving condenser water sensors.

An existing thermometer or pressure gauge tap in nearby piping may be a more suitable connection point. In order to obtain an acceptable connection point for the inlet piping, it may be necessary to isolate and drain the condenser water piping. Mounting a 1" (25.4 mm) weld-o-let on the **side** of the water box, nozzle, or piping is preferable to either the top (because of potential for becoming air bound) or the bottom (because of the potential for clogging). If the water boxes are ASME coded vessels; code welding procedures and re-stamping of the water box will be necessary.

AIR VENTING

Many piping arrangements have the potential to become air bound. Remote installations with overhead risers are particularly susceptible. For this reason, it is recommended that an automatic float/vent be added to a "T" connector at the highest point in the system. For