



SAFE PIPING DESIGN FOR PRESSURE RELIEF VALVES: REACTION FORCES AND DISCHARGE STREAM

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1. OVERVIEW

The installation of a high pressure, high-volume pressure relief valve must be carefully designed in order to ensure reliable operation and the safety of personnel when the valve operates and to prevent environmental damage from the discharge stream.

Competent engineering personnel must be engaged to design or review each installation. Operation and safety procedures and policies for each installation must be clearly established and implemented by the user. This engineering bulletin provides guidelines for design of a safe and reliable installation. Except as noted, these guidelines apply both to the Oteco, Inc. Pressure Relief Valve (which utilizes a shear pin) and to the Oteco, Inc. Reset Relief Valve.

The design of inlet and discharge piping must take into account the pressure to which the piping will be subjected and the reaction forces exerted by fluid flow and pressure. Discharge piping can be subjected to pressures which approach the pressure at the valve inlet port. Reaction forces can cause piping which is not adequately anchored to whip violently when the valve operates. Fluid discharged when the valve operates must be routed to a safe location with respect to both personnel and the environment. Consideration must also be given to the orientation of the valve and to pressure pulsations in the fluid system.



2. INSTALLATION GUIDELINES

2.1 PRESSURE RATING OF THE DISCHARGE LINE

Fluid flow in piping is accompanied by pressure drop. The pressure drop in a run of piping is increased by the length of the run, by roughness of the pipe walls, by obstructions (valves), and by changes in direction (elbows).

If the discharge line downstream of the relief valve is of appreciable length or if it has several changes of direction, the portion of the line nearest the valve can be subjected to a pressure nearly equal to the pressure at the valve inlet. For this reason, Oteco, Inc. recommends that the piping from the relief valve to the discharge nozzle be of the same pressure rating as the piping between the valve inlet and the system being protected.

2.2 REACTION FORCES AND ANCHORING OF RELIEF VALVE PIPING

Fluid under pressure exerts a reaction force upon the piping which contains it. A fluid stream exerts a reaction force upon the piping through which it flows. These reaction forces can be of high magnitude. Moreover, the reaction force due to flow can fluctuate wildly as kicks (gas pockets within the liquid stream) move through the piping and the relief valve. Unless the piping is securely anchored, it can whip violently as the reaction force fluctuates. Such uncontrolled movement of the piping can result in bodily injury or death. The support structure and the manner in which the piping is attached to the structure must be adequate to control movement of the piping under all conditions of pressure and flow. Relief discharge piping should be self-draining to prevent standing fluid in the discharge side of the relief valve. Standing fluid in the discharge line can result in damage to the pressure relief valve components and could prevent the proper operation of the pressure relief valve.

Computation of reaction forces and design of piping supports are subjects beyond the scope of this engineering bulletin. Qualified engineering personnel must be engaged to perform these tasks.

2.3 THE DISCHARGE STREAM: PERSONNEL AND ENVIRONMENTAL CONSIDERATIONS

The discharge stream must be piped to a location, which is safe with respect to both personnel and the environment. With regard to personnel, consideration must be given to splash as well as to direct impingement of the stream.

2.4 PREFERRED VALVE ORIENTATION

Oteco, Inc. recommends that the Pressure Relief Valve and the Reset Relief Valve be installed with the stem axis vertical. Relief discharge piping should be self-draining to prevent standing



fluid in the discharge side of the relief valve. Standing fluid in the discharge line can result in damage to the pressure relief valve components and could prevent the proper operation of the pressure relief valve.

2.5 EFFECTS OF EXCESSIVE PULSATION

Excessive pressure pulsation at the valve inlet port can fatigue the shear pin of the Pressure Relief Valve, causing the valve to operate at a pressure significantly below the nominal relief pressure.

WARNING – Personnel must be alert to the possibility of unexpected operation of the pressure relief valve due to fatigue of the shear pin. Never place yourself in a position in which you may be exposed to bodily injury if the valve operates. Unless you have personally verified that the appropriate block valves or pump controls have been tagged and locked and that all pressure has been bled from the valve inlet port, you cannot safely assume that the valve cannot operate.

2.6 A PIPING PITFALL

A serious piping error, which has been discovered in some installations, is the return of the relief valve discharge line to the pump suction line, rather than directly to the suction tank. Such a configuration may expose the suction line to a pressure far in excess of its rating. See Section 2.1.