Application Note to the Field	Why Use Relief Valves?
Application Note Number: 0108-1	**Date:** August 7, 2001; Revised Dec. 2023

Positive displacement pumps, which include gear pumps, should not be deadheaded, as this can cause the pump, piping or other system components to break immediately. The exception to this for gear pumps is when the viscosity is so low that the fluid slipping backwards through the pump is actually relieving it (giving the fluid somewhere to go). This should not be relied upon for pump protection, as the pump will most likely still fail after some time, but for different reasons.

What typically causes gear pumps to mechanically fail (excepting those failures due to heat or as directly related to the chemical) is torque, which is the result of the combination of differential pressure and viscosity. When the total torque exceeds the value that the weakest component can transmit, that part fails, which will eventually cause the pump to fail.

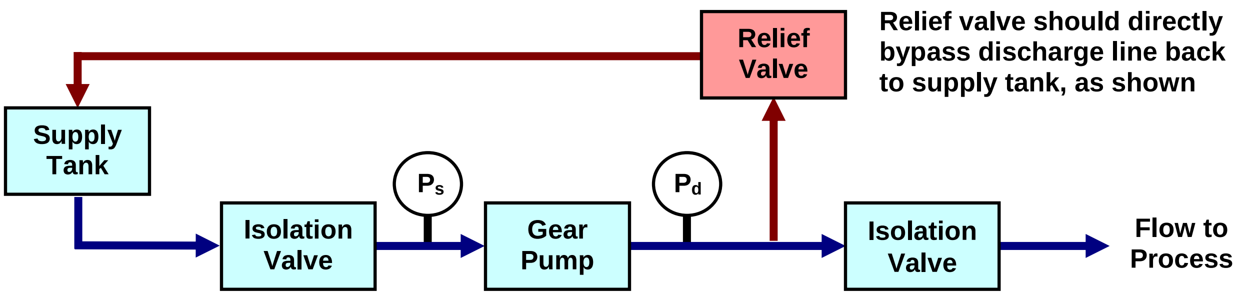
It is important to understand that gear pumps do not actually *make* pressure, but rather move fluid. The pressure is a result of resistance to the fluid flowing through the piping system and/or some external source. If you have a moderately viscous fluid (for the sake of argument let's say 10 cP), you have negated almost all slip, and since the gear pump is attempting to positively displace the fluid from the suction to the discharge side, the pressure will spike. Theoretically, a closed valve offers infinite resistance, so likewise, the pressure would attempt to go to infinity. Needless to say, this cannot happen, so as the pressure rapidly rises, there will come a point at which the total torque is enough to break something. Usually the idler gear (if Teflon, Ryton or Carbon) will have a tooth or teeth sheared off, or the drive shaft or a key will fail in shear at a stress concentration point such as the end of a keyway or a retaining ring groove. In the case above, the pump would be failing somewhere on the way up the rising torque curve. It is difficult to predict at exactly what pressure and to what part a failure would occur in a particular application. This is because materials of construction have varying strengths, there are differences in torque ratings based on pump size, and because viscosity plays a role in overall torque.

A good analogy to the above is that if we assume a Newtonian (and therefore incompressible) fluid, deadheading is equivalent to jamming a steel bar into the gears of the running pump. It has to come to more of an abrupt stop than it can without suffering from "deceleration trauma." In systems run by PLC's, it is common for the valve after the pump to be shut when the pump power is cut off. If the pump is not allowed sufficient time to slow to a stop by itself, you are stopping the pump by once again "putting the steel bar into it." While this may not break it right away, as the pump may be mostly stopped already, damage is cumulative.

In order to prevent the above, Liquiflo recommends the use of pressure relief valves downstream of our pumps and before any other valves (or devices that might shut off flow). We manufacture two such valves in ½-inch and 1-inch sizes, and in 316 SS and Alloy-C. *These valves are meant to protect the pumps only and are not to be used as control or throttling valves, or in place of ASME rated safety relief valves.* While every effort is made to ensure that they are leak free (past the valve seat and to the return piping – there should be no leaking to the valve exterior), they were not originally intended to be "bubble tight."

In the event of a fluid with a viscosity lower than that of water at 70°F (how they are tested), there may be some weeping past the internal seal.

As a general rule, Liquiflo recommends that relief valves be piped back to the supply tank, not the pump suction (see diagram below). This is to ensure that should the pump be left running in a relieved condition, it does not overheat. Overheating might occur when heat added as mechanical energy does not have enough opportunity to dissipate before being fed back into the pump. Since it is now entering at an elevated temperature and then having yet more energy added, it could turn into a "runaway" condition (viscosity falls as temperature rises, slip increases and there is more running contact, or friction, etc.). If the supply tank is of insufficient size, fluid heat capacity is low, etc., there may still be a problem, but it is much less likely.



Nine standard Liquiflo Relief Valve models are available, depending on the body material, the port size and the pressure setting range (see table below). The relief valves are factory preset to discharge at the inlet pressures shown in the table. Different pressure settings (within the Pressure Setting Range) can be specified when ordering. Each model has the feature of being field-adjustable to any pressure setting within its respective range. The design features of the Liquiflo Relief Valve are shown on the following page.

Liquiflo Standard Relief Valves – Models & Specifications

Model #	Material	Port Size & Type	Pressure Setting Range (PSIG)		Factory Setting (PSIG)	Approximate Flow @ 25 PSI over Factory Setting *	
			Min	Max		USGPM	LPM
RV1000-LP	316 SS	½" NPT	25	65	50	5.8	22
RV1000	316 SS	½" NPT	50	135	100	7.5	28
RV1000-HP	316 SS	½" NPT	75	200	150	8.9	34
RV1001-LP	Alloy-C	½" NPT	25	65	50	5.8	22
RV1001	Alloy-C	½" NPT	50	135	100	7.5	28
RV1001-HP	Alloy-C	½" NPT	75	200	150	8.9	34
RV2000-LP	316 SS	1" NPT	25	75	50	19	72
RV2000	316 SS	1" NPT	50	175	100	25	95
RV2001	Alloy-C	1" NPT	50	175	100	25	95

LP = Low Pressure **HP** = High Pressure

***** Test Conditions: Water @ 70°F; discharge to atmospheric pressure (0 PSIG).

LIQUIFLO RELIEF VALVE – Design Features