WHAT HAPPENS IF….

What happens if a valve in the compressor discharge line is closed or restricted and no safety relief valve is present?

One or more of the following will occur:

- The discharge pressure will rise causing the horsepower to rise. The motor will overload and trip out.
- The discharge pressure will rise causing the discharge temperature to rise. The high discharge temperature will cause failure of the piston rings, valves, and packing.
- The discharge pressure will rise until the compressor's volumetric efficiency limit is reached. This could result in a discharge pressure of about 15 times suction pressure (higher for two-stage units).
- The discharge pressure will rise and the weakest component will fail.

Predicting which event will occur first or how quickly they will develop is difficult. System piping, the gas, vapor pressure, ambient temperature, motor size and wiring, and the general condition of the compressor will all have an effect. Assume that both pressure and temperature will be well above the maximum limits of the compressor if this situation occurs.

Obviously a relief valve **must** be installed in the discharge line of every Blackmer compressor to prevent a hazardous or expensive failure. A relief valve should also be considered at the first stage discharge of two-stage compressors. Here are other items to consider:

- Periodically check the relief valve (and other system components) to ensure that they are functioning properly.
- Install a second relief valve set at a pressure slightly higher than the primary relief valve. (Rupture disks may be used for this purpose but seldom are since they will not reseat when the pressure falls to normal values.)
- Install a pressure switch in the discharge line set at a pressure below the relief valve setting. In this case the pressure switch will trip before the relief valve, providing a signal to stop the compressor. If the pressure switch fails, the relief valve will then open.
- Install pressure gauges to monitor system pressures.
- In addition to the above devices, a high discharge temperature switch and properly sized motor overload heaters will provide some protection.

What happens if the compressor is allowed to run beyond the normal vapor recovery point?

One or more of the following will occur:

- The suction pressure will decrease causing the compression ratio and discharge temperature to rise. High discharge temperature will cause failure of the piston rings, valves, and packing.
- The suction pressure will decrease until the volumetric efficiency limit of the compressor is reached. For a single stage compressor, the suction pressure could fall to as little as 7% of the discharge pressure (15 compression ratios). Two-stage compressors can reduce the suction pressure even further.
- The suction pressure may fall below atmospheric pressure. A single-stage compressor may reduce the suction pressure to as little as 0.23 bara (3 psia) depending on the discharge pressure.
- The suction pressure may fall below atmospheric pressure and the crankcase oil will be drawn into the cylinder. If enough oil is lost, the bearings will fail.
- The suction pressure may fall below atmospheric pressure and air may be drawn into the cylinder (if the compressor is not fitted for vacuum suction conditions), possibly creating an explosive mixture.
- The suction pressure may fall below atmospheric pressure, preventing draining of liquid from liquid traps. The liquid may then accumulate to excessive levels and enter the compressor.

Predicting which situation will occur first or how quickly it will develop is difficult. System piping, the gas, vapor pressure, ambient temperature, motor size and wiring, and the general condition of the compressor will all have an effect. The maximum discharge temperature during this type of operation will vary tremendously. Assume that the temperature will rise above the 177°C (350°F) rating of the compressor. Also assume that the suction pressure will eventually fall below atmospheric pressure.

The point at which the Vapor Recovery process ‘ends’ is seldom precisely defined and often changes depending on the ambient temperature. Missing it slightly is usually no cause for concern as the scenarios listed above will take some time to develop. Here are some items to consider:

- Proper training of personnel in the system’s operation.
- Always have trained personnel present during transfer operations (this is a requirement in NFPA #58).
- Install a low suction pressure switch. Set the switch to trip when the suction pressure falls to near atmospheric pressure if this is to be used as a backup alarm or shutdown device. If this switch is to be used to signal the ‘end’ of the vapor recovery operation, change its setting depending on the season.
- Install a timer to stop the compressor after a preset time of operation.
- Install a high discharge temperature switch.
- A low oil pressure switch may prevent expensive damage to the compressor.
- Install pressure gauges to monitor system pressures.

What happens if liquid enters the trap, the trap's float rises to block the compressor suction and the compressor continues to run?

or

What happens if the suction line is blocked by a closed valve or clogged strainer and the compressor continues to run?

One or more of the following will occur:

- The suction pressure may fall below atmospheric pressure and the crankcase oil will be drawn into the cylinder. If enough oil is lost, the bearings will fail.
- The suction pressure will decrease causing the compression ratio and discharge temperature to rise. High discharge temperature will cause failure of the piston rings, valves, and packing.
- The suction pressure will decrease until the volumetric efficiency limit of the compressor is reached. For a single stage compressor, the suction pressure could fall to as little as 7% of the discharge pressure (15 compression ratios). Two-stage compressors can reduce the suction pressure even further.
- The suction pressure may fall below atmospheric pressure. A single-stage compressor may reduce the suction pressure to as little as 0.23 bara (3 psia) depending on the discharge pressure.
- The suction pressure may fall below atmospheric pressure and the crankcase oil will be drawn into the cylinder. If enough oil is lost, the bearings will fail.
- The suction pressure may fall below atmospheric pressure and air may be drawn into the cylinder (if the compressor is not fitted for vacuum suction conditions), possibly creating an explosive mixture.

Damage to the rings, valves and packing due to temperature and loss of crankcase oil due to the very low suction pressure can start quickly since the volume of the suction piping is so small in this situation. Fortunately, the sound of the compressor and the falling suction pressure are clear signals to the operator. Here are additional items to consider:

- Proper training of personnel in the system's operation.
- Always have trained personnel present during transfer operations (this is a requirement in NFPA #58).
- Install a liquid level switch in the trap to stop the compressor in the event of high liquid level.
- Install a low suction pressure switch between the trap and the compressor. Set the switch to trip when the suction pressure falls near atmospheric pressure.
- Install a low oil pressure switch to stop the compressor before extensive damage occurs.
- Install a high discharge temperature switch to stop the compressor or sound an alarm.
- Install pressure gauges to monitor system pressures.