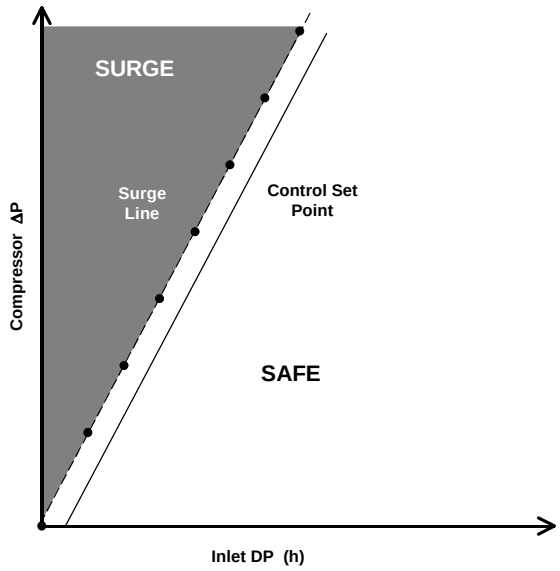
APPLICATION NOTE

YS170 Compressor Surge Control

Overview

Both centrifigal and axial compressors cannot be allowed to operate below the surge limit of the operating conditions. The machinery may be exposed to excessive stress and vibration. If the discharge flow demand is less than the compressor surge limit, some of that flow must be vented or recycled to the inlet to stay above surge.

Surge control requires a method of calculating the point at which the compressor is operating relative to the surge line. The most common method of surge control uses compressor inlet/outlet ΔP and differential pressure across an inlet orifice plate ("h") to represent capacity. When using inlet differential instead of flow, there is a fairly linear relationship between ΔP and h at the surge line with immunity to changes in the inlet conditions, such as temperature, pressure and gas composition.



The graph below plots ΔP vs h at the surge limit for various operating capacities. These points can be determined by compressor testing or analyzing the performance data provided by the manufacturer. Each point on the surge line represents a different speed or inlet pressure.

For a variable speed compressor, there is a maximum ΔP that can be produced for any given speed. If the discharge pressure exceeds the value supported by the maximum ΔP, a flow reversal will occur. If no control action is taken to remedy this low discharge pressure condition, the unstable "surge" condition can cause serious compressor damage.

YS170 Surge Controller

To prevent surge, the compressor must operate in the SAFE area as shown below. The YS170 controller can be programmed for most any process control application, including critical ant-surge control discussed here. The inlet differential pressure measurement is used as a remote set point to the controller. A function generator is applied to plot the surge line. A bias function allows this set point to track in a safe area of the compressor capacity.

The differential pressure transmitter installed across the inlet and outlet of the compressor is the process variable used to modulate the recycle valve, allowing a portion of the discharge flow to be returned to the inlet. A low selector function is used to insure that manual operation by an operator will not permit the output to be adjusted less than the surge controller allows in the automatic mode.

An output rate limiter is applied in the "close" direction only to reduce the speed that the recycle valve can be closed. This allows the controller to be tuned for fast response. The "open" direction is not limited.

A contact input can be used to force the recycle valve fully open whenever the compressor is shutdown. This prevents surge on a compressor "trip" and holds the valve open for startup.