

CENTRIFUGAL COMPRESSORS

By Ryan Montero

SURGE IN COMPRESSORS

Centrifugal compressors are a staple and a workhorse for many modern refining, chemical, and energy related processes. In order to maintain continuous and reliable operation, it is imperative that adequate surge margin is maintained.

When forward flow cannot be maintained, the high pressure discharge reservoir can cause flow in the compressor to reverse and surge will occur. Surge in a compressor is preceded by flow separation from the blade, or “stall”. Stall also occurs on airplane wings; when incidence becomes too great the boundary layer detaches from the wing and lift is no longer generated. In the case of an impeller as the flow decreases and the discharge pressure increases, the flow becomes detached from the airfoil and the impeller no longer imparts work on the gas. The detached boundary layer creates an area of recirculation in the bladed passage. The flow instabilities resulting from the stalled impeller manifest themselves as vibration in the rotor that can cause serious damage, in many cases failure, to compressor components.



Figure 1: Failed Centrifugal Compressor Impeller due to Surge Event

Due to the violent nature of surge events, it is critical to design adequate surge margin into the compressor and maintain it with adequate surge avoidance controls. An operating point, or range, must be established during compressor design; and if any changes are made in operation, they must be evaluated to ensure adequate surge margin.

Typically, surge control algorithms are informed by the compressor curves supplied by the compressor OEM, which will specify a surge line for the compressor. From the surge line, a surge limit line will be created. The surge limit line will decide the minimum flow allowed during operation. A good rule of thumb for adequate surge limit line is about 5% in compressor head or 10% flow, whichever provides greater margin, from the surge line. A surge event can cause irreparable damage to compressors and leave processes that require these machines down for weeks; don't let surge happen to you!

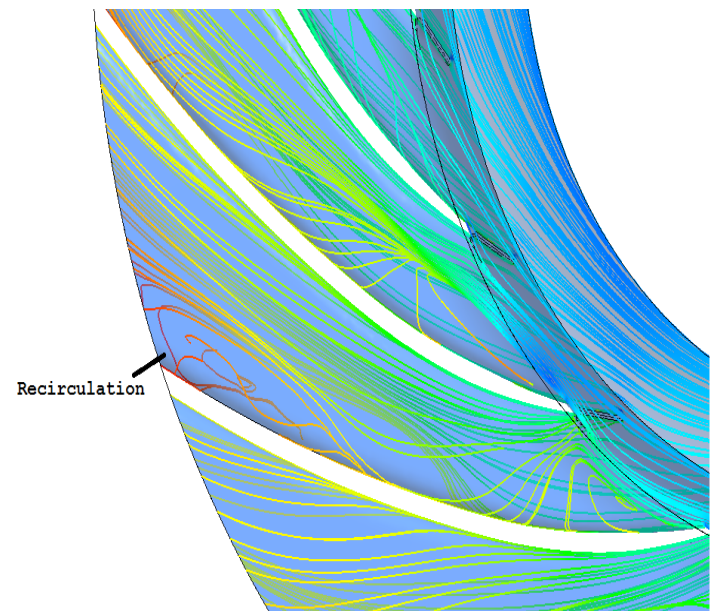


Figure 2: CFD Flow Visualization of Recirculation in a Centrifugal Compressor Blade Passage

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