Flexware®

Turbomachinery Engineers

A Veteran & Employee Owned Small Business

Flexware, Inc.
PO Box 110
Grapeville, PA 15634
U. S. A.
Ph (1)-724-493-7906
sales@flexwareinc.com
www.flexwareinc.com

SURGE IDENTIFICATION

The following is the preferred procedure for establishing the location of the surge point.

1) Slowly close the recycle or blow off valve, while monitoring the following parameters:

   a. Blow off or recycle valve position, % open.
   b. Audible sound level at the inlet of the compressor. Listen for a pulsing sound.
   c. Audible sound level at the compressor discharge. Listen for a pulsing sound, a low frequency 0 to 25 Hz.
   d. Compressor suction pressure immediately upstream of the compressor inlet flange. Monitor both the local pressure gage (for low pressure, a water manometer works well) and the pressure transmitter. Watch for a bouncing in the pressure level. Note that the pressure transmitter may not show this unless it is rated as a dynamic device, with a rise time below 0.1 sec. When the dynamic amplitude exceeds 20% of the gage static pressure or the compressor pressure rise, consider the unit to be in surge (Figure 1.1)

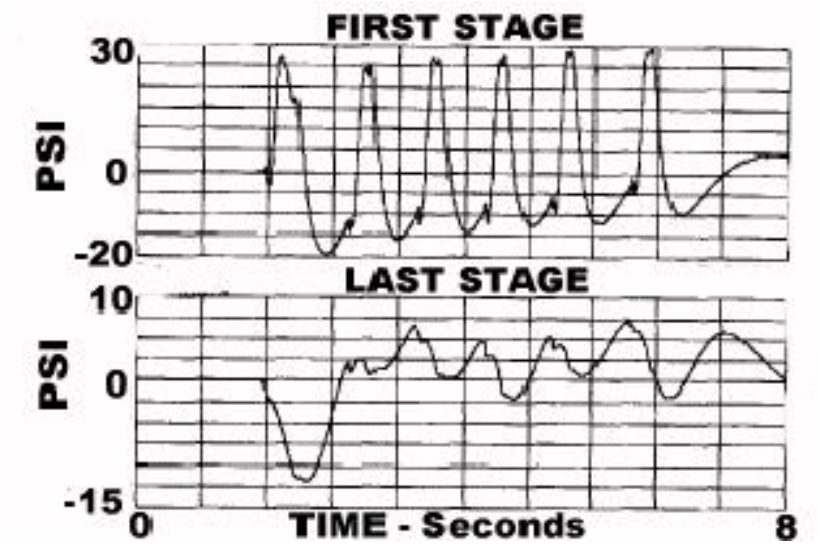

Figure 1.1, Simultaneous Pressure Pulsations During Part-Load Testing at Front and Rear Stages for a 14-stage Air Axial Compressor.

   e. Compressor discharge pressure near compressor discharge flange(see Figures 1.1, 1.2, & 1.3). As the blow off valve is slowly closed, the pressure will rise. Monitor both the pressure gage and the pressure transmitter. Watch for the pressure to bounce (see "d" above). Also watch for any drop in pressure. At the first indication of a drop in pressure (with decreasing flow), consider this to be surge, and record data.

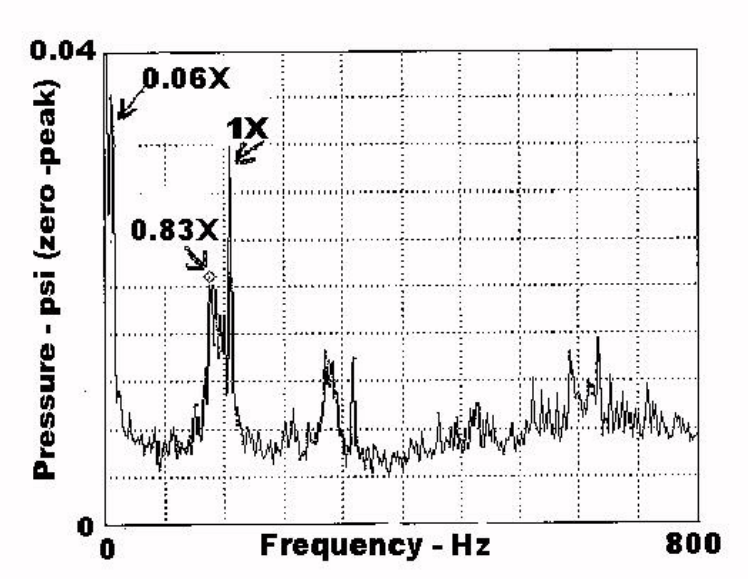

Figure 1.2, Pressure Pulsation - Frequency Spectrum Analysis at Peak of Head Curve for Stage B.

f. Compressor flow rate. Watch for fluctuations in the flow meter differential pressure. Note that an electronic output on the flowmeter will not indicate surge unless the device is rated for dynamic conditions, with a rise time below 0.1 sec. It is best to locally attach a manometer (for low pressure) or differential pressure gage and monitor this. Any dynamic differential pressure in excess of 20% of the nominal (steady state) differential at the given flow rate is to be considered surge, if no other indications (c, d, e, or f) are observed.

g. Compressor vibration level. Pay particular attention to subsynchronous amplitudes. Very small increases or bouncing of amplitudes indicate possible onset of surge. An increase of 20% at the given speed of the overall vibration level, or 0.20 mils increase of the subsynchronous, while alone not a sign of surge, indicates the proximity of an instability. Use extra caution when exceeding these values.

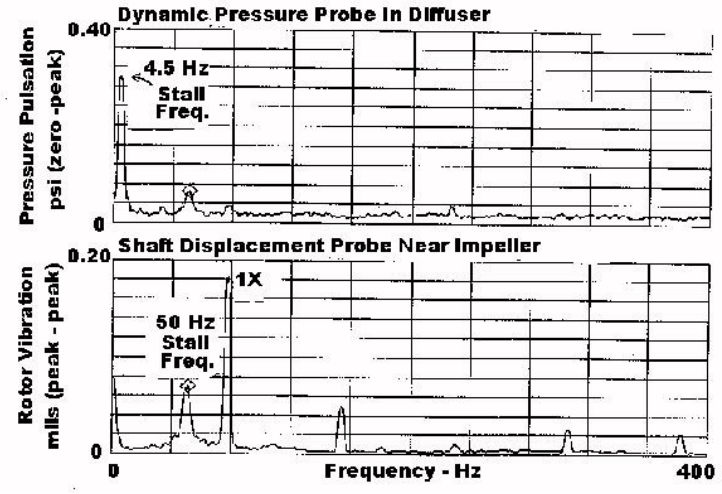

Figure 1.3, Pressure Pulsation and Rotor Vibration Frequency Spectrum after Peak of Head Curve for Stage A.

2). When any of the above items (except the peak head condition, e above) indicates surge, the position of the blow off valve should be immediately noted, and then opened to the full open position.

3). Close the valve back to within a few percent of the point where the instability occurred. Example: The suction pressure began to bounce at blow off valve opening of 79%. The valve is immediately opened to 100% open. The blow off valve is then closed back to 81% open.

4). Additional time period until data is stable and record data to assure the system is stable.

5). Repeat steps 1 through 4 for the other speed lines, or inlet guide vane positions.

6). Record all data for future reference.

Note that the ideal method of detecting the point of aerodynamic instability, is to monitor dynamic pressure probes near the inlet to the impeller and in the diffuser. Flow instability can develop in either location. In some units it appears in the inlet due to flow separation on the inlet of the impeller blades. The position of this point on the compressor head curve generally lines up with the point of peak head. On other units, stall will occur in the diffuser section. This is caused by the inability of the diffuser to overcome the compressor discharge pressure. This event may not fall in line with peak head.

Sophisticated instrumentation is not required to detect surge. The instability usually can clearly be heard and even felt when standing near the compressor. Sometimes the instability is subtle and you must listen very closely.

If you are standing in the compressor discharge area, you may not hear an inlet stall condition. Likewise, if you are in the control room observing the flow and pressure on the slow responding process monitor equipment, you may only see a deep hard surge condition, when it occurs.

Keep in mind that too much surging will eventually cause equipment failure. Surge the equipment hard enough and long enough and something will eventually break. When setting the surge line, the equipment should experience only one or two surge pulses. Allowing the unit to surge any more is only asking for trouble. In order to accomplish this the recycle or blow off valve must have a quick opening (1 to 2 sec.) response and a slow (10-20 sec.) closing time to keep the system stable.

Be safe and assume that the unit is very sensitive to surge and that the machine could easily wreck if surged very much.

Ted Gresh
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