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Valve Design for Widely Varying Conditions

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ABSTRACT

The adaptation of an existing valve design to the specific operating conditions (gas, speed, pressure, compression ratio, and clearance volume) of a compressor is usually accomplished by the selection of a valve lift and valve springs.

Even though a particular valve covers a range of applications, in most cases it cannot be used without variations over the full application range of a compressor. For example, this is true on compressors with variable speed or on refrigeration compressors which are driven by two-speed electric motors. In the latter case a wide pressure range at varying pressure ratios with full- or half-speed has to be covered. In addition the use of different refrigerants should be possible.

Designing a valve for such compressors is extremely difficult. The designer has to lay out the valve based on the rather voluminous calculations of valve lift and cylinder pressure diagrams.

The most widely accepted criteria for judging valve performance are pressure losses and valve life. This means that a certain limit for impact velocity of the valve plate (on valve seat and guard) cannot be exceeded over the full range of applications. As per S. Timoshenki, the impact velocity of the plate is a direct indication of the stresses and therefore of the valve life.

An example of a valve design for a refrigeration compressor will be explained where it was possible to cover the full range of compressor applications, including full- and half-speed, with one valve.