

Minimum Allowable Pin Load Reversal

Crosshead pin reversal is a reversal of compression and tension loads at the crosshead pin to connecting rod bushing. Without proper reversing loads, the bushing will not be provided with sufficient lubrication and bushing failure will occur. Pin reversal is defined by two components, degrees and percent. These represent the duration of the reversal and the magnitude of the reversal. Both of these values must meet or exceed minimum values. Ariel's requirements for reversal are 30 degrees of crank rotation, and 25% magnitude. The percent magnitude is defined by the smaller of the tension or compression force divided by the larger of the two. The combined gas plus inertia loading at the crosshead pin is used for the reversal calculations. The inertia load component includes the weights of the piston and rod assembly, balance nut and crosshead with crosshead bushings.



Some smaller frames are rated for lower reversal values, 30 degrees and 15%.

Ariel's Reciprocating Compressor Performance Program provides the reversal values and will flag upon insufficient reversal. A full review for reversal will need to include the range of speed, pressure and any single acting conditions. The multi-run function is an invaluable tool in reviewing reversal values.

The ratio of compression to tension gas rod load can indicate reversal may be of concern. If compression gas rod load is much higher than the tension gas rod load, reversal may be a concern and should be reviewed.

There are several specific situations and configurations that should be reviewed in the multi-run function across the full range of speed, pressure, and load steps for sufficient reversal. These include:

High Pressure Service:

High pressure on smaller bore cylinders operating at lower compression ratios can see a notably higher compression gas rod load than that in tension. Possible solutions include selecting a larger cylinder bore, selecting a tail rod cylinder configuration, or increasing the balance weight (crosshead and balance nut).



Tandem cylinders:

Tandem cylinders may see sufficient reversal at the maximum and minimum speed, while insufficient reversal somewhere in between. Adding balance weight will move this dip in the reversal curve, but not often completely out of the operating speed range. Possible solutions include selecting a larger crank end cylinder bore (then add clearance if needed), increasing the balance weight, or limiting operating speed.

Tandem Cylinders



Single acting cylinders:

Single acting at lower compression ratios results in longer periods of gas rod load in compression. At lower speeds reversal can be insufficient to offset the gas compression load. Possible solutions include increasing the balance weight or limiting the lower end of the speed range.



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