

# Reciprocal Compressors

By Robert B. Laine II

The most efficient compressor in service today is one that is frequently being replaced with more compact less efficient machines. Two stage double acting intercooler reciprocating compressors make > 5.5-standard cubic feet of compressed air per brake horsepower (scf/bhp) at 100-psig at sea level and only slightly less volume at 125-psig. This is more than 80 % more air than some two-stage centrifugal compressors for the same power and 20 % more than the best, or most efficient contact cooler rotary screw compressors (wet or lubricated).

Typical sizes ranges from 100 to 500-hp, and most are lubricated, versus oil free; although, many of the TFE ringed (Oil Free) machines remain in operation. These reciprocal compressors are wonderful old machines but are more maintenance intensive than other designs.

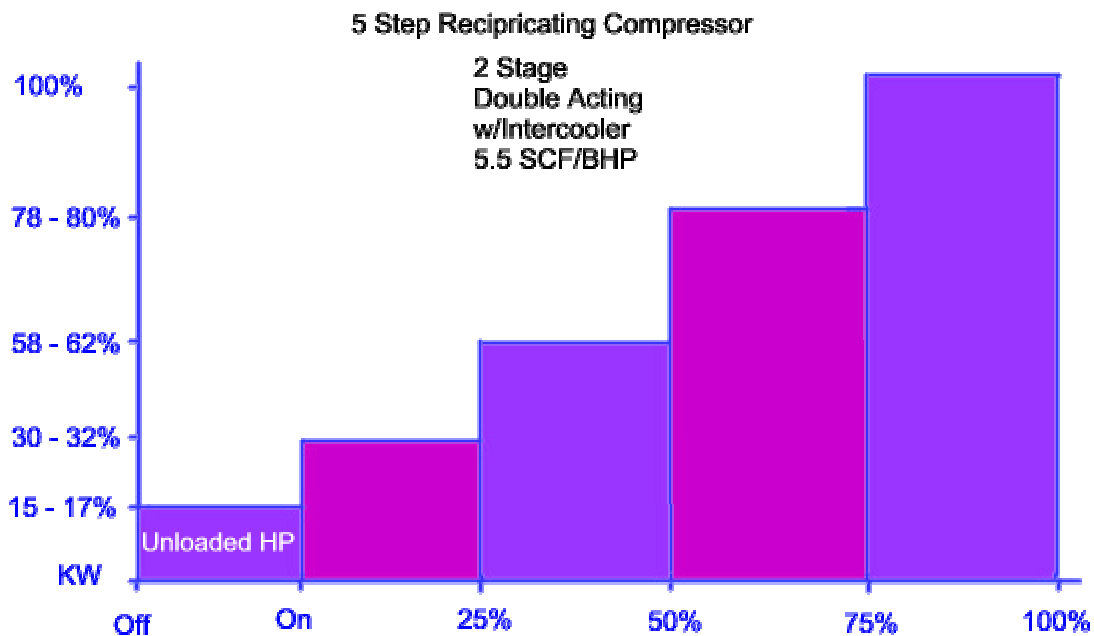
- Valves require frequent repair or replacement once per year,
- Down stream oil contamination if a lubricated design,
- Replacement of rings every two to four years (more frequently if non-lubed),
- Cooling chambers and intercooler cleaning,
- Some parts prove to be difficult to find and expensive, and
- A major overhaul can be very expensive.
- If the compressor has been installed for many years, the foundation may need some repair, which can be a considerable amount of the maintenance budget.

However, there are some major reasons for keeping these old machines that make very good business sense. The extra air per brake horsepower has a greater value than the cost of maintenance.

Added to this, reciprocating compressor maintenance is becoming a lost art, even with the compressor service organizations, especially those that want to sell a new compressor instead of repairing the old one. Some organizations advertise “recip rebuild skills”, but do not have the needed expertise to return the machine to new design performance. The owner also does not have the technical skills to test for performance after repair. Some aftermarket parts, although cheaper, will not provide new machine performance. Frequently those selling the new compressors are from a different profit center or a different company entirely. The new machine salesman will suggest replacing the old maintenance intensive compressor with the latest and greatest with state of the art digital controls with little or no maintenance. Foundation requirements for screws is insignificant and centrifugal compressors will make a lot of air in a relatively small package.

All of these issues and more will cause many companies to throw away perfectly good compressors that will out perform for less operating cost all the competition. Fortunately the art of recip repair, although not on every street corner, is still available. There are those that are aware of which aftermarket parts are critical and should be purchased from the original equipment manufacturer and those that are more than reliable from the aftermarket for a lower capital cost. New reciprocating compressors are very expensive and usually not a very good business decision. But, if the compressor exists with an intact crankcase, more than likely the best decision is to learn how to maintain and operate the recip.

The recip has another very important feature. Screw compressors and for the most part, centrifugal compressors, will not trim efficiently. All will reduce volume if demand in the system decreases, but the power reduction is not linear with the volume. A fully loaded screw will consume 110% of motor nameplate power and greater than 75% of nameplate at 40% volume.



Centrifugal trim is relatively linear from 100% to 85%, but from 85% down, the efficiency deteriorates rapidly. Variable frequency or variable speed screws are somewhat better, but must be very carefully applied in the system to obtain optimum efficiency. Recips trim easily and efficiently. Typically the recip is operated as a two-step (0% or 100%), three step (0%-50%-100%), or five step (0%-25%-50%-75%-100%) and the power will be 5 to 7 percentage points higher than the volume.

Control can be provided by the OEM pneumatic regulator valve or mercury switches depending on the manufacturer or state of the art electro-pneumatic microprocessor. The pneumatic regulator valve has limited flexibility and is maintenance intensive. Mercury switches (Mercoïd®) are easier to manage and apply, but the microprocessor provides the maximum flexibility and is user

friendly. The compressor does not care which step is most frequently used, and the performance is consistent across all steps.

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