Product Application and General Engineering Information for Articulating Piston Compressors and Vacuum Pumps

This document is intended to serve as a guideline to the general limitations and possible variations that are to be considered with articulated compressors and vacuum pumps. It is not possible to list all of the variations nor should the limitations in all cases be considered absolute.

When any doubt exists, pass on all available facts to the factory, at which point all applicable experience, test data, and the like will be utilized to provide specific answers to specific questions.

While oil-less compressors can be as durable as lubricated machines of like capacity and horsepower, they probably are more sensitive to ambient dirt and temperature extremes. The unit should always be located in the most favorable conditions regarding dirt and temperature. If surrounding conditions involve abnormal dirt, special provisions have to be made such as piping clean air to intakes or other than standard air filters. Never allow oil to enter cylinder heads. A good intake filter trap is generally required for vacuum pump applications.

Ambient temperatures should not range more than 0°F (-18°C) to 95°F (35°C), particularly for any sort of continuous operation. The low end of the temperature range has primarily to do with the unit starting for it can operate at temperatures as low as -60°F (-51°C). Above 95°F, the bearing grease will tend to break down when exposed to long periods of operation at elevated temperatures. Obviously, with intermittent operation, higher temperatures can be tolerated. Life capability can be qualified for high temperature operation. Good judgment factors are very much involved when considering extremes of ambient temperature.

Input voltage is important, particularly on single phase motors. It must not vary more than +/- 10% of the nameplate voltage. Three phase motors, however, inherently operate most satisfactorily on a wide range of voltage.

When checking voltage, measurement should be taken at the compressor motor, not a distance away since many factors can contribute to line voltage drop.

Intermittent operation is generally defined as operation with a 10 minute “on” cycle and 20 minutes off. This can be stretched to 20 minutes on and 40 minutes off. An “on” cycle of 30 minutes would be considered continuous, unless the “on” cycle occurred every 1 _ hours or less frequently. Ambient temperature plays an important part here and good judgment should be used.

In general, the compressor is considered to be running continuously if the “on” cycle exceeds 30 minutes and it does not cool down completely during the “off” period.

Excessive “on-off” cycling is to be avoided at all times (no more than 6 starts per hour). Each time the unit starts, heat is generated by the motor. Also, a shock condition occurs when a component part is static and an instant later is turning or moving at full RPM and working against a load.

Tank-less or pressure switch units should never be used unless an adequate reservoir such as an air receiver or very long air lines are involved.

Operating life is an often asked question. The answer must consider all the variations involved with the specific application. There is a basis upon which to start: considering a unit operating in a clean atmosphere, not exposed to ambient temperatures exceeding 95^{o}F, adequate input voltage, not exceeding maximum rated continuous operating pressure (measured at compressor discharge), the average useful life of rings and valves is considered to be 5,000 – 6,000 operating hours. “Useful” life is considered to mean that at the end of 5,000 – 6,000 hours, the compressor CFM output will be approximately 10% - 20% less than when brand new. “Useful” life can certainly vary depending on how closely the compressor is sized to the application requirement as well as any abnormal circumstances.

Replacement of rings, valves and appropriate gaskets will restore original CFM output. This is considered to be a “minor overhaul”. Items such as cylinder heads, crankcase, motor stator and rotor, etc. are considered to have indefinite life.

The one exception to the 5,000 – 6,000 hours statement concerns two-stage compressors. The second stage piston rings which are considered to have a “useful” life of approximately 1,500 hours. This is partly due to the higher pressure gradient across the rings resulting in more blow-by and partly due to a somewhat higher wear rate than normal rings.

Replacement of the piston and rod assembly is considered a “major overhaul” and all things being normal, 10,000 to 12,000 hours is the average life expectancy.

As stated, operating hours are subject to variation depending upon actual usage. It goes without saying that intermittent operation results in longer calendar life in terms of years. The following conditions will detract from expected life:

1. High ambient temperatures – poor ventilation.
2. Higher than rated pressure.
3. Excessive cycling.
4. Ambient cleanliness.
5. Too low or high input voltage.

The following will add to expected life:

1. Lower than rated operating pressure.
2. Intermittent operation with infrequent cycling.
3. Good ventilation and temperatures not exceeding 70°F (21°C) – 80°F (27°C).
4. Clean ambient environment.
5. Adequate input voltage.

In addition, some models can be expected to give longer life than others. Units with the shorter strokes as well as vacuum pumps can be expected to give as much as 50% greater average bearing life.

Normal manufacturing tolerances, many of which are held to .0005" (.0127 mm) or similar, result in variations from one unit to another. When a unit is checked on the production line, it must achieve a minimum flow and maximum wattage input and pressure output. All things being normal, minimum acceptable flow on the production line will not exceed 5% less than listed in the published catalog or datasheet for the product at the rated pressure.

Articulating piston compressors and vacuum pumps are very versatile and reliable when properly applied. Careful consideration of the factors discussed in this paper will help achieve customer satisfaction and long compressor life.

The original version of this article was written in 1968 by Bell & Gossett employee Lee Wilson Glen Hatten, Product Manager – Monroe, Gardner Denver Thomas, Inc. edited and updated the article in 2006 to make it applicable today. Our thanks to both men for their contributions. Thomas Products Division of Gardner Denver, Inc. is the world leader in oil-free pumps and compressors for the OEM market. Combined Fluid Products Co. is a leading source of vacuum pumps, compressors, blowers, air knives, and filters and may be contacted at 800-521-2083 or sales@combinedfluidproducts.com .