

Compressed Air Systems Fact Sheet #8

Evaluating and comparing industrial air compressor capacities and efficiencies can be a daunting task. Standards exist for testing the performance of a compressor, but they have not always been applied in a consistent manner, and performance test results and efficiency ratings are not always published in consistent, standard formats. The result is that purchasers of air compressors can find it difficult to compare the equipment performance.

The Compressed Air and Gas Institute (CAGI), has a long history of developing standards for the compressed air industry. CAGI, has worked closely with their European counterpart Pneurop (European Committee of Compressors, Vacuum Pumps, and Pneumatic Tools), the International Standards Organization (ISO), and other standards development bodies to develop appropriate standards for compressed air and gas systems equipment.

For displacement type compressors, including rotary screw compressors, ISO 1217, Displacement Compressors Acceptance Tests is the recognized performance standard, but it is too complex for performance testing in volume production. CAGI and Pneurop developed Simplified Test Codes which have been incorporated as appendices to ISO 2017. CAGI members publish performance of their products on data sheets based on the Simplified Test Codes.

The data sheets were developed as a standard format for manufacturers to report performance so users can compare performance to aid in the selection of compressed air equipment. There have been minor modifications to align appropriate sheets with the DOE procedures for some rotary compressors. In addition to reporting Package Specific Power, the data sheets have been revised to include Isentropic Efficiency for some types of rotary compressors. To learn more about isentropic efficiency and CAGI's Performance Verification Program, view [CAGI's videos](#) on their website at CAGI.org.

Compressed air system users should be aware that not all manufacturers marketing compressors in the United States are members of CAGI, and some may test their compressors using different standards.

The industry norm for comparison of compressor efficiency is given in terms of bhp/100 acfm (brake horsepower per actual cubic feet per minute) at a compressor discharge pressure of 100 psig. A typical single-stage lubricant-injected rotary screw compressor will have a rating of approximately 22 bhp/100 acfm (referenced to standard inlet conditions). Users need to remember that performance at site conditions will be different from test data because of differences in factors such as ambient temperature, pressure, and humidity.

Even when accurate, consistent efficiency information is available, it may only be specified for full-load operation (i.e., full capacity and specified full-load discharge pressure). Since most systems operate at part-load much of the time, it is also important to compare part-load efficiencies when evaluating the performance of different compressors. The variety of control methods can, however, make this difficult.

When gathering information on compressor performance and comparing different models, users should make sure the compressors have been tested using the same standard, at the same conditions, and that the data is being reported in a consistent manner. Some situations can lead to “apples and oranges” comparisons.

For example:

- Manufacturers may test their compressors under different “standard” conditions. Standard conditions should be at 14.5 psia (1 bar); 68°F (20°C) and dry (0% relative humidity).
- The actual full-load power required by a typical air compressor package will exceed the nominal nameplate rating of the main drive electric motor. Such motors have a continuous service factor, usually 15%, which allows continuous operation at 15% above the nominal rating. Most manufacturers use up to two thirds of the available service factor, so that full-load power will be 10% above the nominal motor rating. It is therefore important to use the bhp rating, not the motor nameplate hp rating, when comparing efficiency ratings in hp/acfm. To include the motor efficiency and all package accessories and losses, use a rating in total kW input per acfm to provide more precise data.
- Manufacturers may use a flange-to-flange rating that does not include inlet, discharge, and other package losses. This can affect overall efficiency by 5% or more.
- Energy consumption for accessory components, such as cooling fan motors, may not be treated consistently.
- Manufacturers may apply ranges or tolerances to performance data.
- Performance is usually based on perfect intercooling, which may not be realized under actual operating conditions. Perfect intercooling requires the air inlet temperature at each stage to be the same, requiring a cooling water temperature approximately 15°F below ambient air temperature. Poor intercooling will adversely affect compressor performance.

The CAGI Performance Verification Program is a long-standing and widely recognized program that enables users of compressed air systems to confidently compare compressor performance. The Performance Verification Program Participant Directory is available at CAGI.org.