KAESER COMPRESSORS®

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CAGI Data Sheets

An apples to apples performance comparison

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It's been almost two decades since the members of the Compressed Air and Gas Institute (CAGI) developed a universal reporting standard for compressors. CAGI is a non-profit organization of competitive companies that manufacture air and gas compressors and related equipment. CAGI seeks to educate end-users to promote effective, safe, and energy efficient uses of compressed air and gases. Prior to the publication of "CAGI Data Sheets," comparing compressor performances across different manufacturers was a difficult task and a numbers game the buyer frequently lost. CAGI's subsequent Performance Verification Program and its Performance Verification Label offer reassurances that claims made by various manufacturers, regardless of CAGI membership, have been independently tested and confirmed.

Today end-users and buyers can be confident that whether using Specific Power Performance or Isentropic Efficiency (the latest addition to CAGI data sheets), the data provided is accurate and proven through an independent third party.

Performance Verification and Data Sheets

CAGI members have worked closely with several standards development bodies such as PNEUROP (CAGI's European counterpart), the International Organization for Standardization (ISO), as well as the US Department of Energy (DOE) to develop key standards for compressed air and gas systems equipment.

Under the Rotary Compressor Performance Verification Program, rotary compressors are tested according to the DOE's Federal Uniform test method for certain lubricated air compressors, as well as ISO 1217 (Annex C for fixed speed compressors and Annex E for variable speed compressors). There are standard forms for participating members to publish their compressor performance information and the values published on the form are then subject to third-party testing and verification.

Kaeser publishes its performance data sheets on dedicated web pages, as do other participating manufacturers. In addition, CAGI publishes the links to the manufacturers' data sheets on its website at www.cagi.org/performance-verification/ data-sheets.aspx.

CAGI data sheets are a huge help in selecting the most energy-efficient compressor. By standardizing the values recorded and how the measurements are taken, it is possible to make clear "apples to apples" comparisons between various models. There are two bottom line numbers to consider on the data sheet. The first is the "Specific Package Input Power at Rated Capacity and Full Load Operating Pressure." This value (expressed in kW/100 cfm) is the measure of, or "shows," how efficiently a compressor package produces compressed air. The lower the value, the more efficient the package is. This is a quick and easy way to see which compressor performs better at the stated conditions. However, not all compressors have the same "Full Load Operating Pressure," and the maximum pressure a compressor can attain may or may not be the pressure at which specific power is determined.

The second and most recent addition to the CAGI data sheet is "Isentropic Efficiency." This line item indicates how well a compressor converts electrical

energy into compressed air energy taking into account both theoretically ideal performance and real world conditions including friction, electrical losses, and pressure drop. With Isentropic Efficiency, the higher the value, the better the compressor's efficiency.

System Considerations

Finally, it is important to understand that while the efficiencies of individual compressors in a system are important, the overall efficiency of a compressed air system is usually more dependent on the sizing of the compressors and how they are controlled. Using the CAGI data sheets, you will find some compressors are a few (or even several) percentage points more efficient than others of the same size. This can generate worthwhile savings and should be a strong consideration in choosing a compressor, especially in larger sizes. But don't overlook the opportunity for even greater electrical power savings (typically 5 – 35% or more) by doing the compressed air system analysis and choosing a correctly sized compressor (or the appropriate combination of compressors) at the correct system pressure, and control them efficiently. With the arrival of the Industrial Internet of Things (IIoT), comprehensive master controls and system integration have the potential to bring significant gains.

CAGI Performance Data Sheets

Below are line-by-line explanations for the fixed speed and variable speed CAGI data sheets. The Federal Uniform Test Method (FUM) is used for 10 - 200 hp, oil injected or oil-lubricated, rotary compressors delivering 35 - 1250 cfm at 75 - 200 psig. For all other units, the data sheets will indicate Federal Uniform Test Method Not Applicable (FUMNA).

Fixed Speed Units

Line 1: **Name of the manufacturer**

Line 2: **General description of compressor type**

- Model Number
- Date
- Air-cooled: Data should include power required by cooling fan.
- Water-cooled: No cooling fan power required, but may require cabinet fan. Cooling water costs are not included.
- Lubricated/Oil-injected (FUM test method is only for certain size and pressure lubricated compressors)
- Oil-free
- Type: Selectable from a drop-down list (Screw, Vane, Liquid Ring, or Other)
- # of Stages: Single or multi-stage

Line 3: **Rated Capacity at Full Load Operating Pressure:** The volume of air (in acfm) measured at the terminal point of the package, at an agreed upon set of standard inlet conditions (ISO standard conditions) with the compressor operating at the rated pressure (again, measured at the terminal point of the package) stated on line 4. This takes into account all package air losses and pressure drops.

Line 4: **Full Load Operating Pressure:** The pressure at the terminal point of the package where the flow and input power were measured.

Line 5: **Maximum Full Flow Operating Pressure:** The maximum pressure at which full flow can be maintained. It is usually the unload pressure set point for load/unload controls or the pressure at which modulation or other capacity control begins for other control schemes.

Line 6: **Drive Motor Nominal Rating:** A nominal horsepower rating applied by the motor manufacturer. This number is not the maximum

design capability for the motor. To determine the maximum power output that can be continuously sustained for a motor, multiply the nominal horsepower rating by the service factor. Sustained loads below this maximum will not shorten the design life of the motor.

Line 7: **Drive Motor Nominal Efficiency:** The efficiency of the motor at the nameplate rating.

Line 8: **Fan Motor Nominal Rating (if applicable):** A nominal horsepower rating applied by the motor manufacturer. Applies to air-cooled machines and to vent fans on water-cooled machines if used.

Line 9: **Fan Motor Nominal Efficiency (if applicable):** The efficiency of the motor at the nameplate rating.

Line 10: **Total Package Input Power at Zero Flow:** This is commonly referred to as unloaded power. It is the power consumed by the compressor with the inlet valve closed and the sump pressure relieved to its lowest pressure required

Line 11: **Total Package Input Power at Rated Capacity and Full Load Operating Pressure:** The complete input power requirement, in kW, of the compressor package when the compressor is running at the Rated Capacity listed in line 3 and the Full Load Operating Pressure listed in line 4.

This is the power the customer will have to provide to operate the compressor package at these conditions. It includes all efficiency, power factor, and accessory losses. When comparing these numbers between manufacturers, it is important to make certain that power consumption of remote cooler packages is included. Some manufacturers may not count remote cooling packages in this number. This may include remote-mounted air-cooled coolers and closed-loop water-cooling systems. Also, power should be measured on the supply side of remote-mounted variable frequency drive controls.

Line 12: **Specific Package Input Power at Rated Capacity and Full Load Operating Pressure:** The measure of how efficiently the compressor package produces compressed air. It is the power input divided by the flow in units of 100 cfm. A 563 cfm machine that requires 91.58 kW at the rated pressure would have a specific power of 16.3 kW/100 cfm (91.58 ÷ 5.63 = 16.3). Comparing specific power ratings allows users to determine which compressor delivers air at the lowest cost per cfm.

Line 13: **Isentropic Efficiency:** The metric indicating how the actual energy consumption of an air compressor compares to the theoretical energy consumption that an ideal compressor would require to perform the same amount of work. Expressed as a percentage, it indicates the efficiency of a compressor at converting electrical energy into compressed air potential energy.

In the Isentropic Efficiency equation (η_{isen}), 16.52 is a constant, upper case P_{spec} is specific power, and p2 is the discharge pressure in psig. The exponent .2857 is a constant. The reference pressure for correcting gauge pressure to absolute pressure is 14.5.

$$\eta_{isen} = \frac{16.52 \text{ X } \left(\left(\frac{p_{2+14.5}}{14.5} \right)^{.2857} - 1 \right)}{P_{spec}}$$

Fixed Speed Data Sheet

KAESER COMPRESSORS®

COMPRESSOR DATA SHEET

In Accordance with Federal Uniform Test Method for Certain Lubricated Air Compressors

Rotary Compressor: Fixed Speed

MODEL DATA - FOR COMPRESSED AIR			
1	Manufacturer: **Kaeser Compressors, Inc.**		
2	Model Number: **DSD 125 - 125 psig / 460V/3ph/60Hz**	Date:	**7/1/2020**
	[X] Air-cooled [ ] Water-cooled	Type:	**Screw**
		# of Stages:	**1**
3*	Rated Capacity at Full Load Operating Pressure [a, e]	**595**	acfm [a,e]
4*	Full Load Operating Pressure [b]	**115**	psig [b]
5	Maximum Full Flow Operating Pressure [c]	**125**	psig [c]
6	Drive Motor Nominal Rating	**125**	hp
7	Drive Motor Nominal Efficiency	**96.2**	percent
8	Fan Motor Nominal Rating (if applicable)	**3 / 1**	hp
9	Fan Motor Nominal Efficiency	**89.5 / 82.5**	percent
10*	Total Package Input Power at Zero Flow [e]	**21.6**	kW [e]
11	Total Package Input Power at Rated Capacity and Full Load Operating Pressure [d]	**98.8**	kW [d]
12*	Package Specific Power at Rated Capacity and Full Load Operating Pressure [e]	**16.60**	kW/100 cfm [e]
13	Isentropic Efficiency	**86.47**	Percent

*For models that are tested in the CAGI Performance Verification Program, these items are verified by the third party administrator.
Consult CAGI website for a list of participants in the third party verification program: www.cagi.org

NOTES:
a. Measured at the discharge terminal point of the compressor package in accordance with ISO 1217, Annex C; ACFM is actual cubic feet per minute at inlet conditions.
b. The operating pressure at which the Capacity (Item 3) and Electrical Consumption (Item 11) were measured for this data sheet.
c. Maximum pressure attainable at full flow, usually the unload pressure setting for load/no load control or the maximum pressure attainable before capacity control begins. May require additional power.
d. Total package input power at other than reported operating points will vary with control strategy.
e. Tolerance is specified in ISO 1217, Annex C, as shown in table below:
NOTE: The terms "power" and "energy" are synonymous for purposes of this document.

Volume Flow Rate at specified conditions		Volume Flow Rate	Specific Energy Consumption	No Load / Zero Flow Power
m^3 / min	ft^3 / min	%	%	%
Below 0.5	Below 17.6	+/- 7	+/- 8	+/- 10%
0.5 to 1.5	17.6 to 53	+/- 6	+/- 7	
1.5 to 15	53 to 529.7	+/- 5	+/- 6	
Above 15	Above 529.7	+/- 4	+/- 5	

CAGI Compressed Air & Gas Institute Member

ROT 030.1

12/19 Rev 3 This form was developed by the Compressed Air and Gas Institute for the use of its members participating in the PVP. CAGI has not independently verified the reported data.

Variable Speed Units:

Line 1: **Name of the manufacturer**

Line 2: **General description of compressor type**

- Model Number
- Date
- Air-cooled: Data should include power required by cooling fan.
- Water-cooled: No cooling fan power required, but may require cabinet fan. Cooling water costs are not included.
- Oil-injected Oil-free {Add FUM note from previous}
- Type: Selectable from a drop-down list (Screw, Vane, Liquid Ring, or Other)
- # of Stages: Single or multi-stage

Line 3: **Full Load Operating Pressure:** The pressure at the terminal point of the package where the flow and input power were measured.

Line 4: **Drive Motor Nominal Rating:** A nominal horsepower rating applied by the motor manufacturer. This number is not the maximum design capability for the motor. To determine the maximum power output that can be continuously sustained for a motor, multiply the nominal horsepower rating by the service factor. Sustained loads below this maximum will not shorten the design life of the motor.

Line 5: **Drive Motor Nominal Efficiency:** The efficiency of the motor at the nameplate rating.

Line 6: **Fan Motor Nominal Rating (If applicable):** A nominal horsepower rating applied by the motor manufacturer. Applies to air-cooled machines and to vent fans on water-cooled machines if used.

Line 7: **Fan Motor Nominal Efficiency:** The efficiency of the motor at the nameplate rating.

Line 8: **Input Power:** The complete input power requirement, in kW, of the compressor package when the compressor is running at the Capacity listed in line 8 and the Rated Operating Pressure listed in line 3. This is the power the customer will have to provide to operate the compressor package at these conditions. It includes all efficiency, power factor, drive, and accessory losses. When comparing these numbers between models, it is important to make certain that power consumption of remote cooler packages is included. Some manufacturers may not count remote cooling packages in this number. This may include remote-mounted air-cooled coolers and closed-loop water-cooling systems. Also, power should be measured on the supply side of remote-mounted variable frequency drive controls.

The data points are listed from maximum to minimum. A minimum of five points must be listed.

Capacity: The number of cfm measured at the terminal point of the package, at an agreed upon set of standard inlet conditions (ISO standard conditions) with the compressor operating at the rated pressure (again, measured at the terminal point of the package) stated on line 3. This takes into account all package air losses and pressure drops.

The data points are listed from maximum to minimum. A minimum of five points must be listed.

Specific Power: This is the measure of how efficiently a compressor package produces compressed air. It is the power input divided by the flow in units of 100 cfm. A 563 cfm machine that requires 91.58 kW at the rated pressure would have a specific power of 16.3 kW/100 cfm (91.58 ÷ 5.63 = 16.3). Comparing specific power ratings allows users to determine which compressor delivers air at the lowest cost per cfm.

Line 9: **Total Package Input Power at Zero Flow:** This is commonly referred to as *unloaded* power. It is the power consumed by the compressor with the

inlet valve closed and the sump pressure relieved to its lowest pressure required. A value of zero means that the compressor stopped the drive motor due to the unlimited starting capabilities of variable speed drives.

Line 10: **Isentropic Efficiency:** The metric indicating how the actual energy consumption of an air compressor compares to the theoretical energy consumption that an ideal compressor would require to perform the same amount of work. Expressed as a percentage, it indicates the efficiency of a compressor at converting electrical energy into compressed air potential energy.

For variable speed compressors, this single value is computed based on weighing the isentropic efficiency values at various specified percentages of full load:

25% of 40% load, 50% of 70% load, and 25% of 100% load. Thus providing a single value for comparison representing the proper application of a variable speed compressor in that load range from 40 to 100%.

In the Isentropic Efficiency equation (η_{isen}), 16.52 is a constant, upper case P_{spec} is specific power, and p2 is the discharge pressure in psig. The exponent .2857 is a constant. The reference pressure for correcting gauge pressure to absolute pressure is 14.5.

$$\eta_{isen} = \frac{16.52 \text{ X } \left(\left(\frac{p_{2+14.5}}{14.5}\right)^{.2857} - 1\right)}{P_{spec}}$$

Line 11: **Performance Graph:** Graphical representation of the Specific Power and Capacity (line 8). The Y-Axis (specific power) has a scale of 10.00 - 35.00 with additional increments of +5 kW/100 cfm for values higher than 35.00. The X-Axis (capacity) has a scale of 0 to 25% over the maximum capacity.

The graph gives the performance curve which is useful in comparing overall performance and efficiency at a glance. The rules for scaling enable a fair comparison of graphs for similar sized compressors.

About the Author

Werner Rauer is the Product Manager for oil-injected and oil-free screw compressors at Kaeser Compressors, Inc. With over 30 years in the industry, Werner has gained extensive experience trouble shooting air systems large and small and a deep knowledge of effective compressed air system design. An active leader in the Compressed Air and Gas Institute (CAGI), he helped develop the widely used CAGI compressor performance data sheets and supported the development and implementation of ISO 11011 and EA4 - the new generation of compressed air energy audit standards. He also chairs CAGI's Engineering Committee for rotary/positive displacement compressors. Werner has a degree in Mechanical Engineering, has completed the DOE Compressed Air Challenge I and II, is a CAGI Certified Compressed Air System Specialist, and is a Master Certified System Specialist through Kaeser's Factory Training Program.

Variable Speed Data Sheet

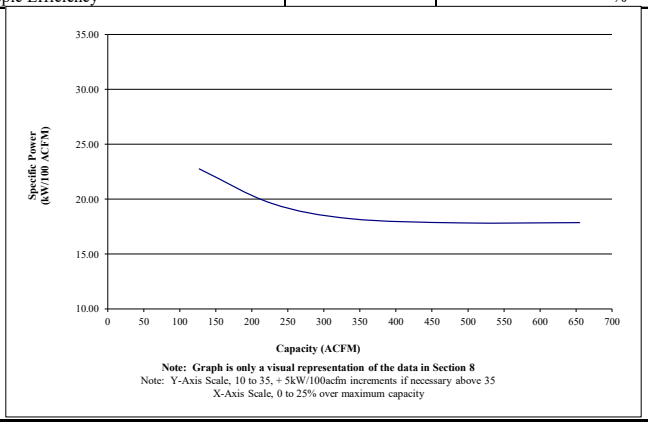
COMPRESSOR DATA SHEET

KAESER COMPRESSORS

In Accordance With Federal Uniform Test Method for Certain Lubricated Air Compressors

Rotary Compressor: Variable Frequency Drive

MODEL DATA - FOR COMPRESSED AIR

1	Manufacturer: **Kaeser Compressors, Inc.**			
2	Model Number: **SFC 90 - 125 psig / 460V/3ph/60Hz**		Date:	**07/01/20**
	[X] Air-cooled [ ] Water-cooled		Type:	**Screw**
			# of Stages:	**1**
3*	Full Load Operating Pressure[b]	**125**	psig[b]	
4	Drive Motor Nominal Rating	**125**	hp	
5	Drive Motor Nominal Efficiency	**96.2**	percent	
6	Fan Motor Nominal Rating (if applicable)	**3 / 1**	hp	
7	Fan Motor Nominal Efficiency	**89.5 / 82.5**	percent	
8*	Input Power (kW)	Capacity (acfm)[a,d]	Specific Power (kW/100 acfm)[d]	
	117.0	**655**	**17.86**	
	87.4	**490**	**17.84**	
	61.4	**337**	**18.22**	
	44.7	**228**	**19.61**	
	28.9	**127**	**22.76**	
9*	Total Package Input Power at Zero Flow[c, d]	**0.0**	**kW**	
10	Isentropic Efficiency	**82.88**	%	
11				

Note: Graph is only a visual representation of the data in Section 8
Note: Y-Axis Scale, 10 to 35, + 5kW/100acfm increments if necessary above 35
X-Axis Scale, 0 to 25% over maximum capacity

*For models that are tested in the CAGI Performance Verification Program, these items are verified by the third party administrator
Consult CAGI website for a list of participants in the third party verification program: www.cagi.org

NOTES:

a. Measured at the discharge terminal point of the compressor package in accordance with ISO 1217, Annex E; ACFM is actual cubic feet per minute at inlet conditions.
b. The operating pressure at which the Capacity (Item 8) and Electrical Consumption (Item 8) were measured for this data sheet.
c. No Load Power. In accordance with ISO 1217, Annex E, if measurement of no load power equals less than 1%, manufacturer may state "not significant" or "0" on the test report.
d. Tolerance is specified in ISO 1217, Annex E, as shown in table below:
NOTE: The terms "power" and "energy" are synonymous for purposes of this document.

CAGI Compressed Air & Gas Institute
Member

Volume Flow Rate at specified conditions		Volume Flow Rate	Specific Energy Consumption	No Load / Zero Flow Power
m^3 / min	ft^3 / min	%	%	%
Below 0.5	Below 17.6	+/- 7	+/- 8	+/- 10%
0.5 to 1.5	17.6 to 53	+/- 6	+/- 7	
1.5 to 15	53 to 529.7	+/- 5	+/- 6	
Above 15	Above 529.7	+/- 4	+/- 5	

ROT 031.1

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Fixed Speed Data Sheet

COMPRESSOR DATA SHEET

Federal Uniform Test Method for Certain Air Compressors Not Applicable

Rotary Compressor: Fixed Speed

	MODEL DATA - FOR COMPRESSED AIR		
1	Manufacturer: **Kaeser Compressors, Inc.**		
2	Model Number: **DSG 140-2A - 125 psig / 460V/3ph/60Hz**	Date:	**7/1/2020**
	[X] Air-cooled [ ] Water-cooled	Type:	**Screw**
	[ ] Oil-injected [X] Oil-free	# of Stages:	**2**
3*	Rated Capacity at Full Load Operating Pressure [a, e]	**576**	acfm[a,e]
4	Full Load Operating Pressure [b]	**115**	psig[b]
5	Maximum Full Flow Operating Pressure [c]	**125**	psig[c]
6	Drive Motor Nominal Rating	**125**	hp
7	Drive Motor Nominal Efficiency	**96.2**	percent
8	Fan Motor Nominal Rating (if applicable)	**7.5**	hp
9	Fan Motor Nominal Efficiency	**91**	percent
10*	Total Package Input Power at Zero Flow[e]	**23.6**	kW[e]
11	Total Package Input Power at Rated Capacity and Full Load Operating Pressure[d]	**114.7**	kW[d]
12*	Specific Package Input Power at Rated Capacity and Full Load Operating Pressure[e]	**19.93**	kW/100 cfm[e]

*For models that are tested in the CAGI Performance Verification Program, these items are verified by the third party administrator.
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NOTES:
a. Measured at the discharge terminal point of the compressor package in accordance with ISO 1217, Annex C; ACFM is actual cubic feet per minute at inlet conditions.
b. The operating pressure at which the Capacity (Item 3) and Electrical Consumption (Item 11) were measured for this data sheet.
c. Maximum pressure attainable at full flow, usually the unload pressure setting for load/no load control or the maximum pressure attainable before capacity control begins. May require additional power.
d. Total package input power at other than reported operating points will vary with control strategy.
e. Tolerance is specified in ISO 1217, Annex C, as shown in table below:
NOTE: The terms "power" and "energy" are synonymous for purposes of this document.

Volume Flow Rate at specified conditions		Volume Flow Rate	Specific Energy Consumption	No Load / Zero Flow Power
m^3 / min	ft^3 / min	%	%	%
Below 0.5	Below 17.6	+/- 7	+/- 8	+/- 10%
0.5 to 1.5	17.6 to 53	+/- 6	+/- 7	
1.5 to 15	53 to 529.7	+/- 5	+/- 6	
Above 15	Above 529.7	+/- 4	+/- 5	

Member

ROT 030.2

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Technology Meets Tradition

Our compressed air heritage is built on a century of manufacturing experience. Generations of quality craftsmanship guide our engineering principles of efficiency, reliability, and serviceability.

This tradition of excellence also drives new technology development. Advances in airend design, controls, and system design ensure our customers can meet the daily challenges of their manufacturing operations.

Each Kaeser product is designed with the future in mind, but we never lose sight of our roots. Technology needs may change from year to year, but the need for quality and reliability will always remain.



KAESER COMPRESSORS®

Built for a lifetime.

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