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## **Simplified Acceptance Test of Electric Driven, Low Pressure Turbocompressor Air Blower Package**

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Compressed Air & Gas Institute

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Sponsor:



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Cleveland, Ohio 44115-2851

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# Foreword

(This Foreword is not a part of the CAGI BL 5389 standard, *Simplified Acceptance Test of Electric Driven, Low Pressure Turbocompressor Air Blower Package* )

In 2010, CAGI members were approached by the Consortium for Energy Efficiency (CEE) to address the need for test standards for centrifugal and positive displacement blower packages among the CEE membership, which comprises the electricity provider program administrators. A working group within CAGI's Blower Section formed soon after.

The working group embarked on a standard development project which culminated in the release of the BL 5389 standard in 2013. The standard is intended to eventually become an annex to the ISO 5389 standard, which provides an extremely detailed, complex procedure to test and rate turbocompressor blowers. The new, BL 5389 standard provides an easily integrated, cost effective, yet highly accurate "wire to air" approach to testing. It is applicable to all dynamic blower packages in all industrial and municipal air applications. While the standard is intended for use with all types of turbocompressor blower packages, it will be particularly useful for machines that are manufactured in batches or in continuous production quantities.

Suggestions for improvement of this Code will be welcome. They should be sent to the Compressed Air and Gas Institute, 1300 Sumner Avenue, Cleveland, Ohio 44115. [cagi@cagi.org](mailto:cagi@cagi.org).

# Simplified Acceptance Test of Electric Driven, Low Pressure Turbocompressor Air Blower Package

## 1. Scope

This standard provides a simplified, wire-to-air performance test code applicable to a packaged, low pressure turbocompressor handling atmospheric air. The turbocompressor package may consist of a single stage centrifugal design or a multistage design without intercooling between stages. The package is driven by an electric motor. The coupling between the compressor and the motor is either direct or geared. The drive can be via a conventional electric motor, with or without an inverter, or by a high speed motor with an inverter. The inverter can be integrated into the package or shipped loose. Both the specified gas and the test gas are ambient air.

Within the criteria of ISO 5389, E.5.2.b for compressors with moderate pressure ratio ( $\leq 3$ ) and adherence to Table E.1 for ideal gas behavior, the compression process of the package shall be considered isentropic (adiabatic and reversible). The compressibility factor ( $Z$ ) of the air in this range is equal to 1. In this simplified performance test code, the correction for Reynolds number and Mach number will be considered negligible. For applications where these corrections are not negligible, this standard does not apply.

## 2. Normative references

- ISO 5167-1: *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full – Part 1: General principles and requirements*
- ISO 9300: *Measurement of gas flow by means of critical flow Venturi flow nozzles*
- ISO 5389: *Turbocompressors – Performance Test Code*
- EN60051: *Direct acting indicating analogue electrical measuring instruments and their accessories*
- EN60688: *Electrical measuring transducers for converting ac electrical quantities to analogue or digital signals*

## 3. Symbols and Definitions

### 3.1 Symbols

Symbols in ISO 5389 section 3.1 apply and in addition:

Symbol	Meaning	Unit (English)	Unit (Metric)
e	Specific Power	kW/100 CFM	kW/m <sup>3</sup> /sec

## 3.2. Definitions

In addition to definitions and terms in ISO 5389 section 3.2 and Annex E, the following definitions apply:

### 3.2.1. Pressure ratio ( $\Pi$ ):

Ratio of total outlet pressure measured at the package discharge point to total inlet pressure measured at the package inlet point (i.e. ambient pressure)

$$\Pi = p_2 / p_{\text{amb}}$$

### 3.2.2. Packaged compressor:

Compressor with driver system, variable frequency drive (as applicable), cooling / lubrication system, inlet filter, inlet valve / guide vanes (as applicable), bearing power supply (as applicable), harmonic filter, fully piped and wired internally, including ancillary and auxiliary items of equipment and all power devices that affect power consumption. All equipment that is necessary for the proper functioning of the machine according to the preconditions of the guarantee is included as part of the package

### 3.2.3. Free air delivery (FAD):

Actual volume flow rate of air, compressed and delivered at the package discharge point, referred to conditions of total temperature, total pressure, and composition (e.g. humidity) prevailing at the ambient inlet of the compressor.

$$\text{FAD} = \dot{V}_{\text{amb}} = \dot{m} / \rho_{\text{amb}}$$

### 3.2.4. Specific Power:

Packaged compressor power input per unit of compressor free air delivery

$$\text{Specific Power} = e = P / \dot{V}_{\text{amb}}$$

### 3.2.5. Compressor discharge point ( $T_2, p_2$ ):

Discharge point at the terminal outlet of the package

### 3.2.6. Compressor inlet point ( $T_{\text{amb}}, p_{\text{amb}}$ ):

Inlet point is the point at which ambient air enters the package or, in the case of a non-enclosed package, where air first enters the confines of the machine, probably the air inlet filter

### 3.2.7. Packaged compressor power input (P):

Sum of the electrical power inputs to the prime mover and any ancillaries and auxiliaries driven from the compressor shaft or by a separate prime mover at rated supply conditions, including the effect of all equipment included in the package (e.g. coolant / oil pumps, cooling fan, variable frequency inverter, etc.)

### 3.2.8. Isentropic Work ( $Y_s$ ):

Isentropic work (head) is the work required to isentropically compress a unit mass of gas from the inlet total conditions (pressure and temperature) to the discharge total pressure.

### 3.2.9. Steady state:

Steady state is defined as the condition in which changes in temperature rise within a five minute interval is less than 0.9°F (0.5°C) and the fluctuation of shaft speed shall not exceed 0.15%.

## 4. Guarantees

### 4.1 General

Customers requiring performance verification per this standard shall specify acceptance per a Class A or Class B test.

It is required that all equipment that is necessary for the proper functioning of the machine according to the preconditions of the guarantee is included as part of the package (see 3.2.2). If it is not practical to include required ancillary and auxiliary items of equipment in testing, their influence on the values stated for the object of the guarantee shall be accurately evaluated and included in the evaluation of acceptance. See Figure 1.

### 4.2 Class A test (Data sheet performance verification)

When a Class A verification test is specified, the data sheet performance and as-tested performance data shall be corrected to the reference preconditions of ambient / package inlet pressure ( $p_{amb}$ ), inlet temperature ( $T_{amb}$ ), and ambient relative humidity per Table 1 below. Compressor guarantee performance shall be per attached data sheet (see Figure 2a, 2b, and 2c). All data sheet performance points shall be verified. This test may be used for compressors manufactured from a pre-designed set of components that comprise a standard offering.

TABLE 1

Reference Conditions		
	Option 1	Option 2
$p_{amb}$	14.7 psia	14.5 psia (100 kPa) (1 bar)
$T_{amb}$	68°F (20°C)	68°F (20°C)
RH	36%	0%

### 4.3 Class B test (Client specified performance verification)

When a Class B verification test is specified, the contract-supplied compressor packages shall be tested at all the contract-specified guarantee points with as-tested performance data corrected to the contract-specified reference preconditions of package inlet (ambient) conditions ( $p_{amb}$ ,  $T_{amb}$ , and RH).

### 4.4 Object of the guarantee

At the operating points and reference preconditions the following three values are guaranteed:

1. The discharge pressure at the outlet of the package. The discharge pressure must be at least equal to the guarantee pressure with zero negative tolerance and a +4% tolerance on work.

2. The measured volume flow rate at the outlet of the package and expressed as Free Air Delivery. The Free Air Delivery must be at least equal to the guarantee flow with zero negative tolerance and a +4% tolerance.
3. The total Specific Power of the package for the delivered flow at the guaranteed discharge pressure. Specific Power requirements can vary by 4%, positive or negative from guaranteed conditions.

Although it is recognized that measurement inaccuracy is a part of any test, no measurement uncertainty tolerances are to be a part of this simplified test. All test data is to be considered absolutely accurate.

## 5. Test Procedure

### 5.1. Test conditions

Prevailing factory ambient conditions will determine test inlet pressure, temperature, and relative humidity and are to be taken as is. Test results will be corrected for these departures from the reference (specified/guaranteed) conditions.

*Note: When the test ambient inlet temperature is much higher (approx. 50°F / 28°C) than the specified/guaranteed ambient inlet temperature, the Machine Mach number departure between test and specified conditions may exceed allowable departure per Table 2 below. Any test modifications to reduce the Machine Mach number departure to within Table 2 limits shall be mutually agreed upon between manufacturer and customer or customer's representative. Figure 3 provides example Machine Mach number values at various air inlet temperatures and impeller tip speeds.*

*Table 2, Allowable Machine Mach Number Departure*

<i>Machine Mach # specified (<math>Mm_{sp}</math>)</i>	<i>Allowable Departure (<math>Mm_t - Mm_{sp}</math>)</i>
<i>0.85 – 1.5</i>	<i>-0.04 to +0.07</i>
<i>0.80</i>	<i>-0.06 to +0.08</i>
<i>0.70</i>	<i>-0.085 to +0.11</i>
<i>0.60</i>	<i>-0.11 to +0.13</i>
<i>0.50</i>	<i>-0.14 to +0.16</i>

### 5.2. Compressor package test

In packages where the compressor is enclosed in a sound attenuating enclosure, all doors and openings shall be positioned as required for field operation in the entirety of the performance data collection process. This ensures that all flow paths, pump and fan losses, and electrical and thermal heating are preserved and represent the actual field running condition.

In packages that include an inlet throttling valve or internal guide vanes, the compressor shall operate with the required valve or vane position to develop the operating condition as specified in the data sheet / contract documents. The test shall be conducted with the 'as-supplied' motor / VFD drive system and throttling valve or guide vanes.

The operating condition of the compressor for performance verification testing shall be at the same or greater work and flow as defined and specified by the information in the data sheet / contract documents. This can be expanded to:

$$Y_{s,te} \geq y_{s,g}$$

Or:

$$\frac{k}{k-1} (R_{amb,te}) (T_{amb,te}) (\Pi_{te}^{(k-1/k)} - 1) \geq \frac{k}{k-1} (R_{amb,g}) (T_{amb,g}) (\Pi_g^{(k-1/k)} - 1)$$

The right side of the equation is known from the information of the data sheet / contract documents. The left side of the equation is determined by the test conditions. The combination of rotational speed (or throttle vane / guide vane position) and pressure ratio ( $\Pi_{te}$ ) with prevailing ambient temperature and gas constant is to be chosen such that the equation is satisfied.

During the test, no adjustments other than those required to maintain the test conditions and those required for normal operation of the package as given in the instruction manual shall be made.

Before readings are taken, the package shall be run long enough to insure that steady state conditions are achieved.

*Note: It is recognized that adjustment of the test piping discharge valve (which establishes where the compressor operates on its flow / work characteristic curve) has variation. Ensure steady state conditions are achieved following adjustment.*

*Since power guarantee is specific power, compressor operation within the +4% positive tolerance on flow does not overstate the power consumption. Compressor operation within the +4% positive tolerance on work directly impacts specific power; therefore, when correcting specific power to specified guarantee conditions, corrections for excess work ( $y_{s,te}$ ) shall be made.*

1. Compressor rotational speed
2. Package inlet air temperature
3. Package inlet air pressure. Corrections may be required for a dirty inlet filter as required by the contract specification or agreement between parties.
4. Package inlet air humidity
5. Package outlet air pressure
6. Compressor package power input
7. Volume flow rate at the outlet of the package measured per the recommendations of ISO 5167-1.
8. Inlet guide vane / throttle valve position as applicable

Pressure and temperature measuring instruments shall be located as shown in Figure 1.

Power measurement ( $P_{te}$ ) must include the main drive system input power to the VFD (if applicable) and all auxiliary devices that support the package (see Figure 1). It is preferred to

measure power at a single point, ahead of all power devices needed to support the package. If the machine package receives multiple power feeds, this is the sum of all powers measured individually. Machinery that is tested directly with all needed operating components included and following the prescribed practice of this test is a Type A test. Machinery that is tested where estimates of power consumption are accounted for in other ways is a Type B test. (Note this is different from the Class A and Class B test differentiation in Section 4.)

Where power for the auxiliary devices may be shipped directly to the project site or for other reasons it is not practical to include those components during the test measurements, the manufacturer must account for those devices. The package power will be calculated from the main driver power and all other power consumers.

$$P_{te} = P_{driver} + P_{aux}$$

The following methods are prescribed for accurate accounting of the power consumed by each component of the package:

1. Main drive motor or VFD
  - a. For variable frequency drives, power shall be measured at the input leads to the variable frequency drive.
  - b. For constant speed drives, power shall be measured at the input leads to the motor.
  - c. Where a harmonic filter is used and tested with the package, power shall be measured upstream of the harmonic filter.
2. Components used for cooling / lubrication of oil, water, and air.
  - a. Motor nameplate (HP or kW) rating of any separate fan, pump or other required auxiliary device that is required for a functional package.
3. Motor bearing controller
  - a. Calculated or measured power losses.
4. Local control panel
  - a. Measured power loss.

## **6. Computation of test results**

### **6.1. General**

Test conditions are rarely consistent with the specified conditions. Therefore, before test results and guarantee performance values are compared, corrections shall be applied to the measured values of discharge pressure and the package specific power requirement.

All performance calculations shall be based on the total conditions of the test at the compressor package inlet and package outlet locations.

## 6.2. Verification of work and correction of package discharge pressure

The compressor is to be run at the specified work ( $y_s$ ) as indicated in the data sheets / contract documents to verify discharge pressure guarantee. Thus it needs to be verified that

$$Y_{s,te} \geq y_{s,g}$$

This is

$$\frac{k}{k-1} (R_{amb,te}) (T_{amb,te}) (\Pi_{te}^{(k-1/k)} - 1) \geq \frac{k}{k-1} (R_{amb,g}) (T_{amb,g}) (\Pi_g^{(k-1/k)} - 1)$$

If this condition is not achieved, the discharge pressure guarantee is not met.

Compressor work performed shall be reported in terms of discharge pressure corrected to the specified conditions.

$$P_{2,co} = p_{amb,g} \times \Pi_{co}$$

With the corrected pressure ratio from the following formula:

$$\Pi_{co} = \left( \left( \left( \frac{y_{s,te}}{y_{s,g}} \right) (\Pi_g^{(k-1/k)} - 1) \right) + 1 \right)^{\frac{k}{k-1}}$$

## 6.3. Correction of the FAD

Since the compressor is to be run at the specified work, the compressor rotational speed during factory test will be the same as the specified compressor rotational speed (or, if the speed is not specified, the speed required based on the specified site conditions to meet the specified compressor performance) ( $N_{te} = N_g$ ). Therefore, no correction of FAD is required.

$$\dot{V}_{amb,co} = \dot{V}_{amb,te}$$

## 6.4. Correction of Specific Power

In this simplified method, the complete package is considered to behave according to the similarity laws where the drive train efficiency remains the same from test conditions to specified conditions. Since the compressor is tested at the same rotational speed as specified conditions, package power is corrected by the ratio of inlet densities and any excess work produced (see Note in section 5.2).

$$P_{co} = P_{te} \left( \frac{\rho_g}{\rho_{te}} \right) \left( \frac{y_{s,g}}{y_{s,te}} \right)$$

$$e_{co} = P_{co} / \dot{V}_{amb,co}$$

## **6.5. Comparison with guaranteed values**

The corrected discharge pressure ( $P_{2,co}$ ), FAD ( $\dot{V}_{amb,co}$ ), and Specific Power ( $e_{co}$ ) are to be compared to the guaranteed values. If the values are within the limits as defined in section 4.4, the compressor package passes the test. Otherwise, the compressor fails the test.

## **7. Test report**

At a minimum, the test report shall include the following:

1. Test Summary Page per Figure 4.
2. Test piping arrangement indicating pipe sizes and lengths, pressure and temperature measurement locations, flow measurement arrangement, and valve location(s) and verifying compliance with ISO measurement standards referenced in section 2.
3. Original test logs including all recorded data required for calculations.
4. Detailed sample calculation for one test point.
5. Instrument calibration certificates.

**Figure 1, Package / Test Boundary**

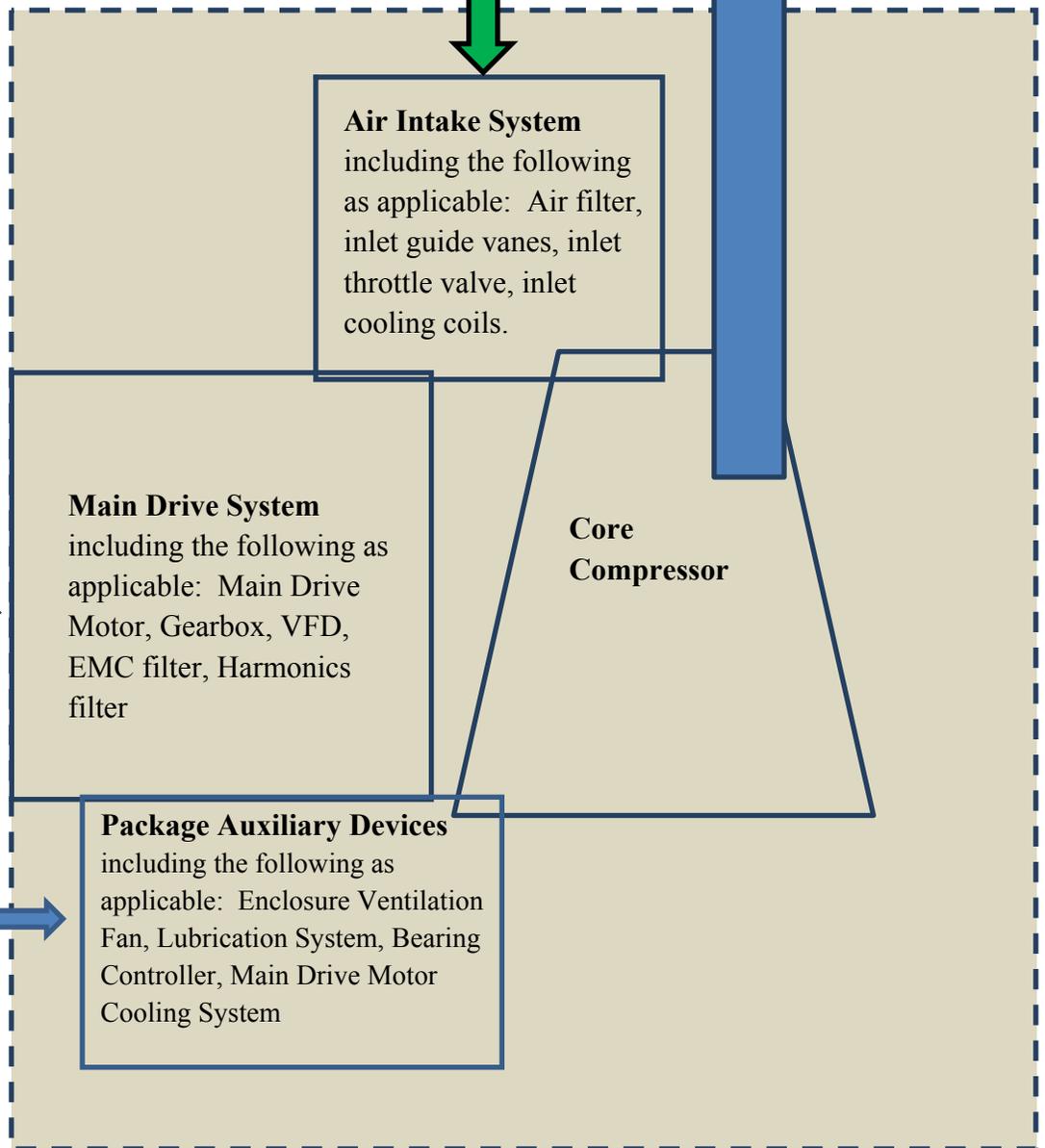
- Static Discharge Pressure: Minimum 2 measuring stations 180° apart located 2 pipe diameters downstream package flange.
- Discharge Temperature: Minimum 2 measuring stations 180° apart, 90° from static pressure.
- Minimum 3 pipe diameters of straight pipe before elbow. If no elbow, minimum 5 pipe diameters of straight pipe before valve elbow.

Flow measurement per ISO 5167-1

- Inlet Pressure: (by barometer)
- Relative Humidity
- Inlet Temperature: Minimum 2 measuring stations 180° apart.

Main Drive System  
Input Electrical Power  
(kW) =  $P_{\text{driver}}$

Auxiliary System Input  
Electrical Power (kW)  
=  $P_{\text{aux}}$

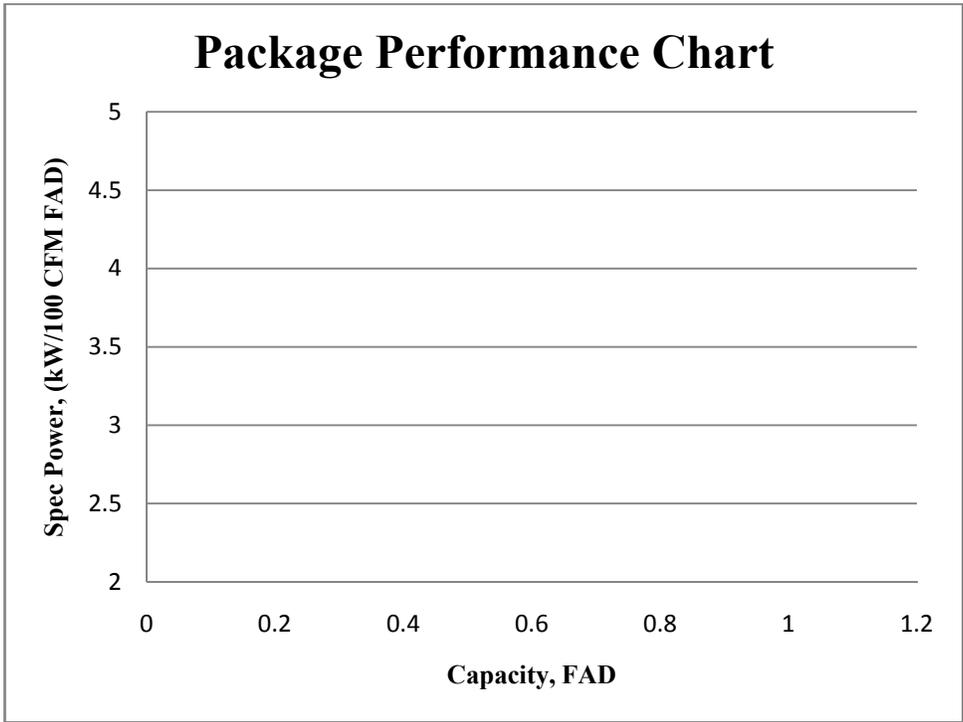


## Figure 2a, Compressor Data Sheet Centrifugal Air Blower Package

MODEL DATA -Option 1 Standard Conditions						
1	Manufacturer	Date:				
2	Model Number: <input type="checkbox"/> Main Drive Motor <input type="checkbox"/> Gearbox <input type="checkbox"/> VFD <input type="checkbox"/> Harmonic Filter	<input type="checkbox"/> Driver Cooling System <input type="checkbox"/> Lubrication System <input type="checkbox"/> Inlet Air Filter <input type="checkbox"/> Inlet Guide Vanes <input type="checkbox"/> Inlet Throttle Valve				
					VALUE      UNITS	
3	Rated Capacity (FAD) at Rated Operating Pressure				cfm	
4	Rated Operating Pressure - $p_2$				psig	
5	Drive Motor Nameplate Rating				HP	
6	Compressor Rated Speed				RPM	
Performance Table <sup>a</sup> (Based on reference inlet conditions of $p_{amb}=14.7$ psia, $T_{amb}=68^\circ\text{F}$ , RH=36%)						
Discharge Pressure $p_2$ (psig) <sup>b</sup>		Delivered Air Flow - FAD (cfm)				
		100% FAD	FAD2	FAD3	FAD4	Lowest Turned Down FAD
14 psig (example)	FAD					
	Specific Power					
	RPM					
12 psig	FAD					
	Specific Power					
	RPM					
10 psig	FAD					
	Specific Power					
	RPM					
8 psig	FAD					
	Specific Power					
	RPM					

**NOTES:**

- a. See CAGI BL 5389 standard for definition of terms and performance guarantees.
- b. Discharge pressure shall be in -2 psig increments starting at max. rated operating pressure.  
A total of 4 discharge pressures shall be tabulated.
- c. Intermediate data points (FAD 2, 3, and 4) are nominal equal spacing between 100% and Minimum Flow (Lowest Turned Down FAD)
- d. Specific Power (kW/100 cfm)



**Plot from data on datasheet**

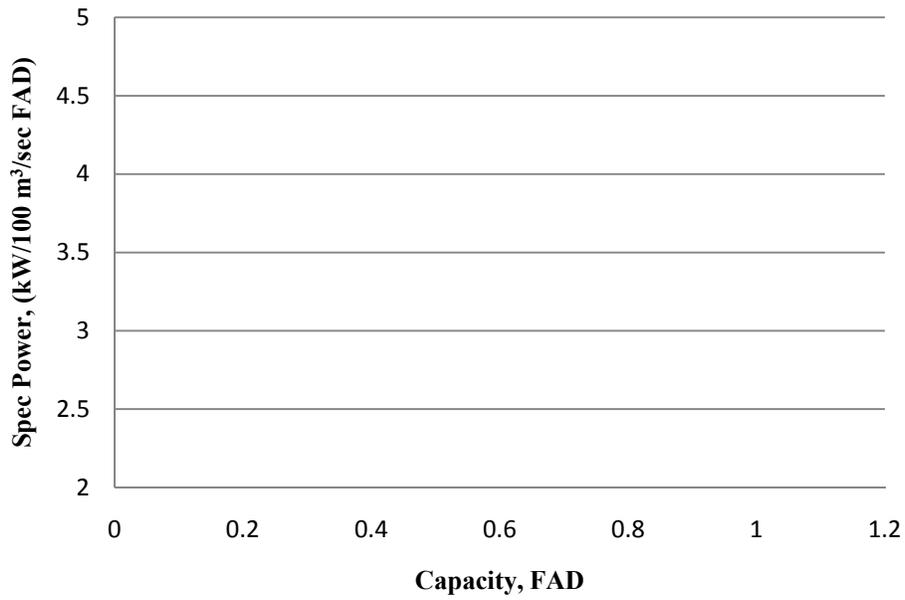
## Figure 2b, Compressor Data Sheet Centrifugal Air Blower Package

MODEL DATA -Option 2 Standard Conditions					
1	Manufacturer	Date:			
2	Model Number: <input type="checkbox"/> Main Drive Motor <input type="checkbox"/> Gearbox <input type="checkbox"/> VFD <input type="checkbox"/> Harmonic Filter	<input type="checkbox"/> Driver Cooling System  <input type="checkbox"/> Lubrication System <input type="checkbox"/> Inlet Air Filter <input type="checkbox"/> Inlet Guide Vanes <input type="checkbox"/> Inlet Throttle Valve			
			VALUE	UNITS	
3	Rated Capacity (FAD) at Rated Operating Pressure			m <sup>3</sup> /sec	
4	Rated Operating Pressure - p <sub>2</sub>			bar abs	
5	Drive Motor Nameplate Rating			kW	
6	Compressor Rated Speed			RPM	
Performance Table <sup>b</sup> (Based on reference inlet conditions of p <sub>amb</sub> =1 bar abs, T <sub>amb</sub> =20°C, RH=0%)					
Discharge Pressure p <sub>2</sub> (bar gauge) <sup>b</sup>		Delivered Air Flow - FAD (m <sup>3</sup> /sec)			
		100% FAD	FAD2	FAD3	FAD4
1 barg (example)	FAD				
	Specific Power				
	RPM				
0.9 barg	FAD				
	Specific Power				
	RPM				
0.8 barg	FAD				
	Specific Power				
	RPM				
0.7 barg	FAD				
	Specific Power				
	RPM				

**NOTES:**

- a. See CAGI BL 5389 standard for definition of terms and performance guarantees.
- b. Discharge pressure shall be in -0.1 barg increments starting at max. rated operating pressure.  
A total of 4 discharge pressures shall be tabulated.
- c. Intermediate data points (FAD 2, 3, and 4) are nominal equal spacing between 100% and Minimum Flow (Lowest Turned Down FAD)
- d. Specific Power (kW/100 m<sup>3</sup>/sec)

## Package Performance Chart



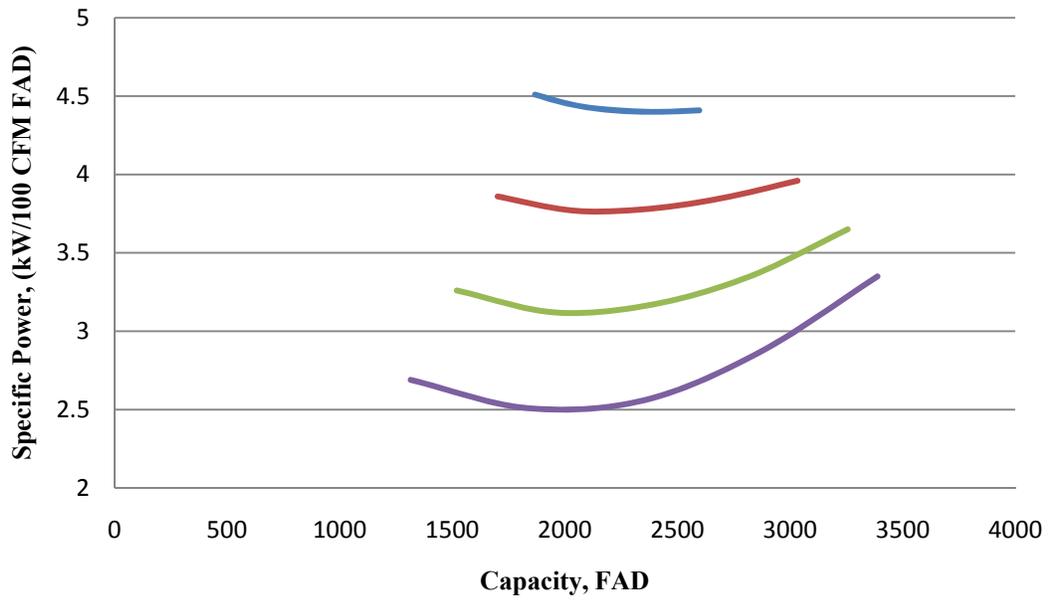
**Figure 2c, Example Datasheet  
Centrifugal Air Blower Package**

MODEL DATA -Option 1 Standard Conditions							
1	Manufacturer					Date:	
2	Model Number:						
	<input type="checkbox"/>	Main Drive Motor	<input type="checkbox"/>	Driver Cooling System	<input type="checkbox"/>	Lubrication System	
	<input type="checkbox"/>	Gearbox	<input type="checkbox"/>	Inlet Air Filter	<input type="checkbox"/>	Inlet Guide Vanes	
	<input type="checkbox"/>	VFD	<input type="checkbox"/>	Inlet Throttle Valve			
	<input type="checkbox"/>	Harmonic Filter					
					VALUE	UNITS	
3	Rated Capacity (FAD) at Rated Operating Pressure						cfm
4	Rated Operating Pressure - p <sub>2</sub>						psig
5	Drive Motor Nameplate Rating						HP
6	Compressor Rated Speed						RPM
Performance Table <sup>a</sup> (Based on reference inlet conditions of p <sub>amb</sub> =14.7 psia, T <sub>amb</sub> =68°F, RH=36%)							
Discharge Pressure p <sub>2</sub> (psig) <sup>b</sup>		Delivered Air Flow - FAD (cfm)					
		100% FAD	FAD2	FAD3	FAD4	Lowest Turned Down FAD	
14 psig (example)	FAD	2597	2415	2232	2050	1867	
	Specific Power	4.41	4.4	4.41	4.44	4.51	
	RPM	28460	28080	27748	27454	27208	
12 psig	FAD	3034	2701	2368	2035	1702	
	Specific Power	3.96	3.85	3.78	3.77	3.86	
	RPM	28474	27401	26509	25819	25310	
10 psig	FAD	3256	2822	2388	1954	1520	
	Specific Power	3.65	3.35	3.17	3.12	3.26	
	RPM	28486	26492	24937	23861	23162	
8 psig	FAD	3389	2870	2352	1833	1315	
	Specific Power	3.35	2.87	2.56	2.51	2.69	
	RPM	28495	25422	23076	21598	20671	

**NOTES:**

- See CAGI BL 5389 standard for definition of terms and performance guarantees.
- Discharge pressure shall be in -2 psig increments starting at max. rated operating pressure.  
A total of 4 discharge pressures shall be tabulated.
- Intermediate data points (FAD 2, 3, and 4) are nominal equal spacing between 100% and Minimum Flow (Lowest Turned Down FAD)
- Specific Power (kW/100 cfm)

## Package Performance Chart Example



**Figure 3, Machine Mach Number Example**

<b>Temp F</b>	<b>a</b>	<b>U2</b>	<b>Mm</b>	<b>U2</b>	<b>Mm</b>	<b>U2</b>	<b>Mm</b>
20	1072	900	0.840	1000	0.933	1100	1.026
40	1094	900	0.823	1000	0.914	1100	1.006
60	1116	900	0.807	1000	0.896	1100	0.986
80	1137	900	0.792	1000	0.880	1100	0.968
100	1158	900	0.777	1000	0.864	1100	0.950

a= speed of sound, ft/sec

U2 = impeller tip speed, ft/sec

Mm = Machine Mach # = U2/a

**Figure 4, Test Summary Report**

	Symbol	Unit (English)	Unit (Metric)	Ref Section	Numerical Values				
<b>AS TESTED VALUES</b>									
Test Number					1	2	3	4	5
Test Period start/end		Mins.	Mins.						
Compressor Speed	$N_{te}$	RPM	RPM						
Amb. Gas Constant	$R_{amb,te}$	ft-lbf/lbm-R	J/(kmol-K)	3.2					
Ratio of Spec. Heats	$k_{te}$	None	None	3.2					
Ambient / Pack. Inlet Temp.	$T_{amb,te}$	deg F	deg C	3.2.6					
Ambient / Pack. Inlet Pressure	$p_{amb,te}$	psia	bar abs	3.2.6					
Pack. Disch. Press.	$p_{2,te}$	psia	bar abs	3.2.5					
Pack. Disch. Temp.	$T_{2,te}$	deg F	deg C	3.2.5					
Isentropic Work	$y_{te}$	ft-lbf/lbm		5.2					
Free Air Delivered	$\dot{V}_{amb,te}$	cfm	m <sup>3</sup> /s	3.2.3					
Driver System Input Power -Type B test	$P_{driver}$	kW	kW	5.2					
Aux. Powers (calc.) - Type B test	$P_{aux}$	kW	kW	5.2					
Total Input Power	$P_{te}$	kW	kW	5.2					
Specific Power	$e_{te}$	kW/cfm	kW/m <sup>3</sup> /sec	3.2.4					
<b>SPECIFIED / GUARANTEED CONDITIONS</b>									
Compressor Speed	$N_g$	RPM	RPM						
Amb. Gas Constant	$R_{amb,g}$	ft-lbf/lbm-R	J/(kmol-K)	3.2					
Ratio of Spec. Heats	$k_g$	None	None	3.2					
Ambient / Pack. Inlet Temp.	$T_{amb,g}$	deg F	deg C	3.2.6					
Amb. / Pack. Inlet Pressure	$p_{amb,g}$	psia	bar abs	3.2.6					
Pack. Disch. Press.	$p_{2,g}$	psia	bar abs	3.2.5					
Isentropic Work	$y_g$	ft-lbf/lbm		5.2					
Free Air Delivered	$\dot{V}_{amb,g}$	cfm	m <sup>3</sup> /s	3.2.3					
Pack. Input Power	$P_g$	kW	kW	3.2.7					
Specific Power	$e_g$	kW/cfm	kW/m <sup>3</sup> /sec	3.2.4					
<b>CORRECTED TO SPECIFIED CONDITIONS</b>									
Free Air Delivered	$\dot{V}_{amb,co}$	cfm	m <sup>3</sup> /s	6.3					
Pack. Disch. Press.	$p_{2,co}$	psia	bar abs	6.2					
Pack. Input Power	$P_{co}$	kW	kW	6.4					
Specific Power	$e_{co}$	kW/cfm	kW/m <sup>3</sup> /sec	6.4					
<b>COMPARISON TO GUARANTEE</b>									
Free Air Delivered	$\dot{V}_{amb}$	cfm	m <sup>3</sup> /s	4.4	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail
Pack. Disch. Press.	$p_2$	psia	bar abs	4.4	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail
Specific Power	$e$	kW/cfm	kW/m <sup>3</sup> /sec	4.4	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail	Pass/Fail

