

WHY ASME PTC10 IS NOT SUFFICIENT TO DEFINE THE TESTING OF A HIGH SPEED TURBO BLOWER

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Aerzen USA has been in the turbo blower business for nearly five years. During this time, we have tested the performance of over 300 turbo blowers with almost as many different testing specifications. The most common testing specification has a reference to ASME PTC10-1997 Performance Test Code on Compressors and Exhausters.

PTC10 is a “Code to provide a test procedure to determine the thermodynamic performance of an axial or centrifugal compressor doing work on a gas of known or measurable properties under specified conditions.” PTC10 is also a fine code for testing low pressure, motor driven blowers as long as you only want accurate performance measurement of the blower stage. If you want accurate measurement of the entire high speed turbo blower package, then you need to be careful what you specify.



Aerzen Turbo Blower

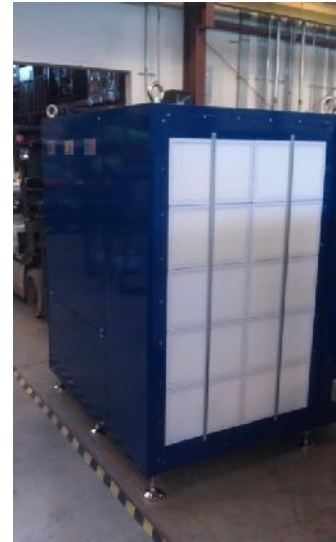
Here are **FIVE REASONS** why PTC10 is not sufficient for specifying the test of a high speed turbo blower.

- 1. PTC10 allows for measuring the flow at the inlet of the blower.**
Assuming that the inlet flow equals the discharge flow is a bad assumption in most cases. Many blower designs, including turbo blowers, utilize air for sealing and cooling; therefore, some of the air that goes in the inlet does not come out the discharge.
- 2. PTC10 does not provide any guidelines for a contractual guarantee.**
In Code paragraph 1.5, “The interpretation of the results relative to any contractual guarantees is beyond the scope of this Code and should be agreed upon in writing prior to the test by the participating parties.” If an Engineer or customer wants to evaluate proposals over a 10 or 20 year lifetime and include performance penalties, PTC10 doesn’t provide this. PTC10 also does not tell you how many performance points are used in the qualification. And finally, PTC10 does not specify the allowable tolerance, if any, for evaluating the final test results against the bid guarantee.
- 3. PTC10 does not discuss or make any reference to the term “Wire-to-Air”.**
The simple definition of “Wire-to-Air” performance is a statement of how many kilowatts it takes to deliver one CFM of air at site conditions for a given blower system. And the blower system is a key reason that PTC10 does not work for turbo blowers. The system in PTC10 (open loop air test) is only a blower stage. The “Wire-to-Air” high speed turbo blower system includes a direct drive PM motor, integral VFD, a blower enclosure with ventilation, cooling systems for controls and VFD, piping and valves as a minimum.
- 4. PTC10 does not show any test arrangements where the blower is inside a box (the enclosure).**
The first effect of the “box” is that without adequate ventilation, the air inside the box will heat up, changing the density downward and increasing the power required to compress the air. The second effect of the box is the inlet filtration required for a high speed turbo. A dirty inlet filter could reduce the inlet pressure at the suction of the turbo blower by as much as 0.3 psi. The result is again a reduction in air density and an increase in power required to compress the air.

Example #1: Assume design conditions inlet: 90 F, 14.5 psia, 50% RH and discharge: 8 psig. If the design ambient temperature is 90 F (temperature measured outside the box) but there is inadequate ventilation and the temperature inside the box goes to 95 F, the air density reduces from 0.071 lb/ft³ to 0.0704 lb/ft³, and the isentropic head increases from 13,758 ft-lb/lb to 13,833 ft-lb/lb. This increase corresponds to a 0.5% increase in the power requirement.

5. Example #2: Same as above but adding a dirty filter loss of 0.3 psi, the air density reduces to 0.0696 lb/ft³ and the isentropic head and power required increases by 6%. **PTC10 would allow a turbo blower test of just the blower core.**

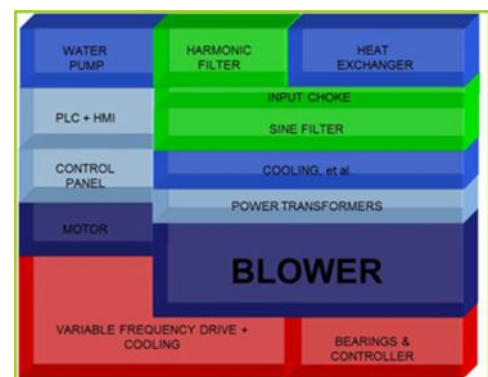
One might find this statement preposterous, and it probably was not the intention of the specifying Engineer; however one could make a strong argument that a specification that states turbo blower testing per PTC10 could be conducted with only the blower core. There have also been specifications written that say a “Wire-to-Air” test per PTC10. This terminology doesn’t make sense, but it’s an attempt by the Engineer to get more than a simple blower core test. But again, there is not enough clarity and a manufacture could provide a blower core test per PTC10 and add in the “estimated” losses associated with other equipment in the “blower system” such as the PM motor and VFD.



Inlet Filter (clean) 0.1 psi loss and (dirty) 0.3 psi loss

ASME PTC13 is still under development and Aerzen is an active participant on this committee. However, until PTC13 is published, how do you write a good specification for performance testing a high speed turbo blower? Here are suggestions:

- A. Refer to PTC10 for the set-up of the test loop and required instrumentation. Specify that flow measurement be taken on the discharge of the blower. PTC10’s specifications for the test loop arrangement and for instrumentation will provide the necessary accuracy for good test results.
- B. Specify all the components that make up the blower system. For a high speed turbo blower, you want to test everything that is in the box; i.e., the turbo blower stage, the PM motor, VFD, local control panel, enclosure, control and VFD cooling systems, the blow off valve, discharge diffuser cone, and discharge expansion joint. Decide whether or not to include the harmonic filter in the blower system test. Do not allow a blower core only test.



Turbo blower system components

- C. Specify the inlet filter pressure loss to be included in both the calculation of the bid guarantee and the actual test results. If you don't ask for this, you might get a guarantee based on zero psi loss which will not represent what you will get at the jobsite.
- D. Specify the allowable tolerance on volume flow, isentropic head and Wire-to-Air power. Manufacturers have different tolerance standards. If you don't specify this, you will get bids that cannot be fairly compared. A good suggestion is testing at +/- 1% on volume flow and isentropic head and a Wire-to-Air Power tolerance of 1%.
- E. Decide how many test points are required to insure you are getting what you paid for. We would suggest that testing more than 4 points is redundant.
- F. Decide if the test will be witnessed and who will pay for the expenses.
- G. Decide if there will be a performance penalty or any other Buyer remedy if the performance promised in the bid guarantee is not met.

Summary: The technology to produce low pressure air, an energy intensive ingredient in the wastewater process, has made significant steps forward in recent years. Unfortunately, the specifications for testing these new sophisticated air producers did not and until ASME PTC13 is completed, much confusion will continue to exist in the marketplace.

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