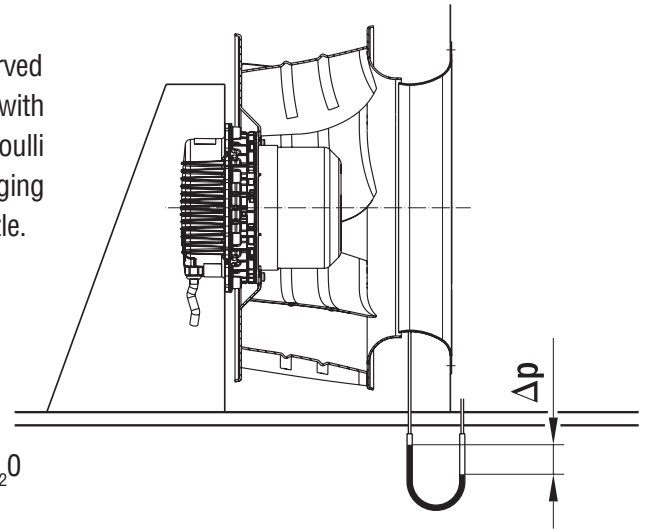


AIRFLOW MEASUREMENT USING INSTRUMENTED INLET RINGS

ebm-papst offers a simple airflow measurement technique for backward-curved centrifugal fans using modified versions of the inlet rings (IR) typically used with these fans to maximize performance. The technique is based on the Bernoulli and Continuity equations, which allow calculation of flow through a converging nozzle based upon measurement of the static pressure drop across the nozzle.

The applicable equation is of the form $Q = 9.36k \cdot \sqrt{\rho_s / \rho} \cdot \Delta P$, where:

Q	=	airflow in CFM
k	=	nozzle calibration factor
ΔP	=	static pressure drop across the nozzle in inches H ₂ O
ρ_s	=	standard air density of .075 lbs/ft ³
ρ	=	actual air density in lbs/ft ³



The calibration factor “k” has been empirically determined for each IR at standard air density of .075 lbs/ft³. Large variations from this air density can effect the measurement and can be taken into account using the ρ_s / ρ ratio, otherwise this term can be dropped from the equation.

Two types of instrumented inlet rings are available for each impeller size. One type uses a single pressure tap positioned near the discharge end of the IR. The 2nd type uses four pressure taps spaced along the circumference of the IR, connected with tubing to form a piezometer ring. The piezometer ring averages the static pressure measurements around the circumference of the IR to provide a more accurate flow measurement in case of uneven pressure distribution around the inlet. In either case, the customer connection on the inlet ring is to a single pre-mounted tube connector, suitable for pneumatic tubing with an internal diameter of 4mm. This connection should run to the low pressure side of a differential pressure transducer (DPT), while the pressure tap in front of the IR is connected to the high pressure side of the DPT. If the DPT is mounted near the front of the IR but out of the airstream, then the high pressure tap on the DPT is suitable and no additional pressure tap is needed.

INSTRUMENTED INLET RINGS

Find Instrumented Inlet Ring Part Number

Using Table 1, find the proper instrumented inlet ring P/N based on the impeller size and type (e.g., 3D EC). Choose either the P/N for the IR with a single pressure tap or for the version with multiple taps connected in a piezometer ring. In cases where there are multiple listings for a single impeller size, please discuss the choice of the correct inlet ring with an ebm-papst applications engineer.

Table 1:

Inlet rings with measuring device to determine air flow for backward curved centrifugal fans					
Part no. with 1 pressure tap	Part no. with piezometer ring	Size (mm)	k-value	Dimensions see	Impeller & fan type
25002-2-4013	25001-2-4013	250	69	96359-2-4013	2D AC/EC
25040-2-4013	25030-2-4013	250	67	25020-2-4013	2D EC
28002-2-4013	28001-2-4013	280	88	96360-2-4013	2D AC/EC
28040-2-4013	28030-2-4013	280	87	28020-2-4013	2D EC
31100-2-4013	31080-2-4013	310	120	31050-2-4013	3D AC/EC
31110-2-4013	31090-2-4013 ⁽¹⁾	310	103	31051-2-4013	3D AC/EC
31060-2-4013	31040-2-4013	310	108	31020-2-4013	2D EC
35600-2-4013	35580-2-4013	355	155	35560-2-4013	3D AC/EC
35610-2-4013 ⁽¹⁾	35590-2-4013 ⁽¹⁾	355	138	35561-2-4013	3D AC/EC
35540-2-4013	35530-2-4013	355	141	35520-2-4013	2D EC
54515-2-4013	54500-2-4013	400	183	54476-2-4013	3D AC/EC + 2D AC
40040-2-4013	40030-2-4013	400	161	40020-2-4013	2D EC
54514-2-4013	54510-2-4013	450	217	54478-2-4013	2D AC/EC
64015-2-4013	64005-2-4013	450	214	63045-2-4013	3D AC/EC
45040-2-4013	45030-2-4013	450	225	45020-2-4013	2D EC
54518-2-4013	54516-2-4013	500	265	54480-2-4013	2D EC
64025-2-4013	64002-2-4013	500	283	63072-2-4013	3D AC/EC
64030-2-4013	64001-2-4013	560	350	63071-2-4013	3D AC/EC
64040-2-4013	64000-2-4013	630	480	63070-2-4013	3D AC/EC

subject to alterations

⁽¹⁾ short inlet ring

Select Pressure Transducer Range

It's important to the accuracy of the flow measurement to select a differential pressure transducer (DPT) with a range appropriate to the expected pressure differential. It's best to choose a DPT with a range that only exceeds the maximum expected pressure differential by a small safety margin. Excessive range will impact the flow measurement accuracy because the DPT accuracy is typically specified as a percent of full scale.

To find the proper pressure transducer range:

1. Determine the maximum CFM flow rate expected from the fan over its operating range as installed in the application. If this info isn't available, use the free airflow as provided in the fan specification.
2. Use Chart 1 to find the pressure differential in inches w.g. for the given flow and impeller size.
3. Select a differential pressure transducer with an appropriate range based on the pressure differential determined in step 2.

INSTRUMENTED INLET RINGS

*Chart 1 -
Pressure Differential vs Air Flow for Available Impeller Sizes*

