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The right *flow*  
by German engineering.



# EP Critical / Sonic nozzles

Flow measurement elements with highest accuracy

Brochure EPE-167590



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## Flow measurement & calibration

Highest accuracy - up to 0.12 % MV

Flow range from 0.005 up to 2000 m<sup>3</sup>/h

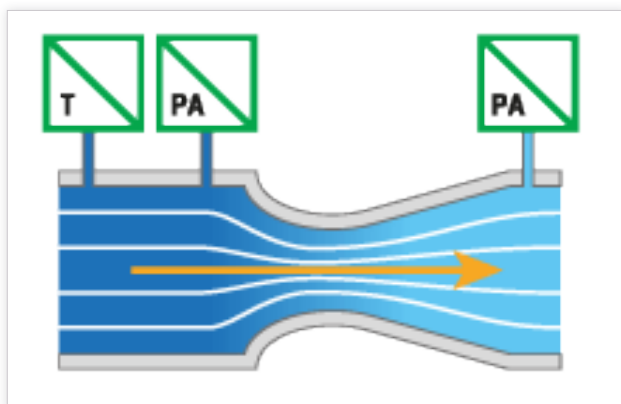
SMF® - SonicMasterFlow® nozzle test bench

### Measurement principle

*Flow with sonic speed through laval nozzles*

When using critically operated laval nozzles, a physical effect is used whereby a critical pressure ratio between the inlet and outlet of the nozzles is reached, at the nozzle throat sonic speed is presented. The sonic speed in the nozzle neck cannot be exceeded even at pressures above the critical pressure ratio, allowing a very precise volume flow to be set with this type of nozzle.

The volume flow can be determined using the calibration data of the individual nozzle and the medium data (density and viscosity, which are dependent on absolute pressure, temperature and humidity). In order to guarantee a stable, constant volume flow, geometric dimensions defined according to DIN EN ISO 9300 are maintained inside the nozzle.



Flow with sonic speed through laval nozzles

### Features & Benefits

- ✓ Highest accuracy - up to 0.12 % MV
- ✓ Rapid reaction times - steady flow within 500 msec
- ✓ Easy handling - only measurement of absolute pressure, temperature and relative humidity necessary
- ✓ Internationally recognized - approved by PTB as calibration standard
- ✓ Best long-term stability - recalibration period up to 10 years for laval nozzles
- ✓ Flexible nozzle setup - nozzles can be combined (on request)

### Applications

- ✓ Calibration of flow meters, e.g. gas meters, LFE, Venturi nozzles, MFM, MFC
- ✓ Periodic calibration tasks, e.g. calibration device for production parts (valves, actuators, air mass meters, etc.)
- ✓ Flow reference without further measurement technology

### Product range

- ✓ Single nozzles in the flow range from 0.005 to 2000 m<sup>3</sup>/h
- ✓ Suitable nozzle holders with sensor connections
- ✓ Nozzle wheel system for combining different nozzles
- ✓ SMF® - SonicMasterFlow® nozzle test bench



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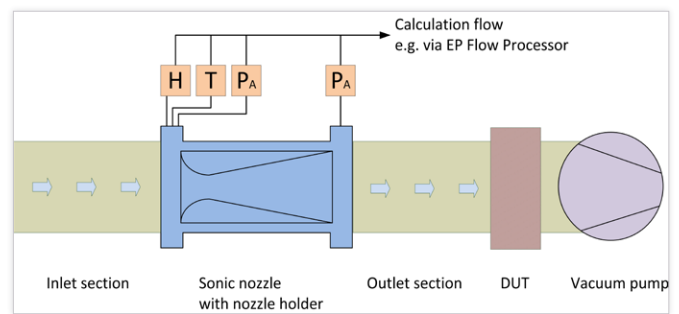
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## Exemplary measurement setup

### Exemplary measurement setup

The critical nozzle is operated by suction with a suitable vacuum pump or by compressed air while maintaining defined inlet sections. Absolute pressure, temperature and humidity are measured in front of the nozzle. The measurement data of the individual sensors are then used for flow calculation, which can be performed e.g. with the EP Flow Processor. Depending on the application, the DUT is integrated into the measurement setup via an airtight connection between the system and the DUT in front of or behind the nozzle. If necessary, an appropriate DUT sensor system is required.



① Sketch example measurement setup

### Product range - Critical nozzles

EP Ehrler Prüftechnik manufactures sonic nozzles in the flow range from 0.005 up to 2000 m<sup>3</sup>/h. In addition to the standard range, EP Ehrler Prüftechnik offers customer-specific nozzles which are perfectly designed for your application in accordance to DIN EN ISO 9300\*. Nozzle holders including sensor connections are available for all nozzle sizes for installation in customer applications.

\*) For flow rates less than 0.1 m<sup>3</sup>/h only based on DIN EN ISO 9300.

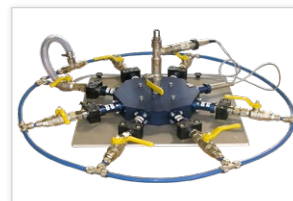


① Examples critical nozzles

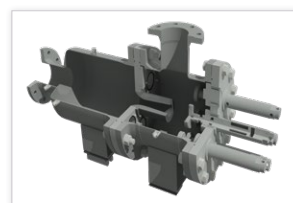
### Product range - Combination of critical nozzles

Several nozzles can be combined to set several volume flows, allowing a high number of different flow rates to be generated rapidly. It is possible to generate e.g. 2<sup>8</sup> = 256 different flow rates using 8 critical nozzles. Binary staggering of the nozzles ensures a uniform coverage of the volume flow range. However, this is not mandatory. For this purpose, EP Ehrler Prüftechnik offers **a nozzle wheel system** in which up to 8 nozzles can be combined as required. These nozzles can be prepared for manual operation via ball valves or for automation via controllable valves.

**SMF® - SonicMasterFlow®** systems are complete nozzle test benches that operate with automatically controlled **nozzle systems in drum, block or register design**. These nozzle systems can also be purchased separately.



① Nozzle wheel



① Nozzle drum



① Nozzle register



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## Ordering information

### Standard product range - Critical nozzles

Item no. critical nozzle	Dia- meter	$Q_v$ [m³/h]*	Tolerance to the reference point**	Critical pressure ratio $r^{***}$	Item no. nozzle holder	Connection nozzle holder
158391	DN16	0.25	± 5 %	0.50	132548	G 1/2
165941	DN16	0.5	± 2.5 %	0.53	132548	G 1/2
152934	DN16	1.0	± 2.5 %	0.55	132548	G 1/2
165951	DN16	2.0	± 2 %	0.57	132548	G 1/2
152939	DN16	4.0	± 2 %	0.59	132548	G 1/2
165952	DN16	8.0	± 2 %	0.61	132548	G 1/2
165953	DN25	16	± 2 %	0.62	148371	G 1
169336	DN40	32	± 2.5 %	0.64	168120	G 2
169337	DN40	64	± 2.5 %	0.66	168120	G 2
142341	On request!	128	± 2 %	0.70	<i>Installation as intermediate flange construction on request!</i>	
142342		256	± 2 %	0.72		
142344		512	± 2 %	0.77		
165914		1024	± 2 %	0.78		

\*) Additional flow rates from 0.005 to 2000 m³/h on request.

\*\*) The exact flow rate  $Q_v$  of the nozzle is determined during calibration and may vary from the reference point within the tolerance during manufacture.

\*\*\*) Experience value for pump design, exact determination of the  $r^*$  value is carried out during nozzle calibration.

### Customized critical nozzles

Tell us your requirements, specifying the desired flow rate and a description of the installation conditions as precise as possible. We will provide you with a free-of-charge, non-binding quotation for the critical nozzle tailored perfectly to your application.



Example nozzle with PTB calibration



Example nozzle holder including sensor

### Calibration options

#### Calibration reports

- ✓ Factory calibration
- ✓ DAkkS calibration
- ✓ PTB calibration



By default, critical nozzles are factory calibrated atmospherically with air. If you require a different type of calibration, please specify this in your inquiry.

#### Additional options

- ✓ Medium: air or other gases
- ✓ Pressure: atmospheric, in certain ranges up to 6 bar or at negative pressure down to 100 mbar (pressure loss)



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