

TubeBundle *Xtruded* – Heated PerfectZero – Heated Sample Gas Line for Emission Monitoring

Application and Technology

The heated sample gas lines of the **TBX-H** series are designed for continuous extractive gas analysis. They transport wet sample gas from the sampling point to the sample conditioning system of a cold-extractive analyzer system or directly to a hot-extractive analyzer or analyzer system.

The primary function of the heated sample line is to keep the sample gas above its water and acid dew points throughout the entire transport path. This prevents uncontrolled condensation, acid formation and the loss of water-soluble or adsorption-prone components.

For continuous emission monitoring systems (CEMS), holding temperatures of 180 °C are therefore commonly used. In sulfur-containing flue gases, the acid dew point can reach approximately 150–155 °C, depending on gas composition, moisture and SO₃/H₂SO₄ content. The elevated holding temperature provides the required safety margin and supports reliable sample gas transport to ensure representative measurements.

The PTFE sample tube is particularly well suited for this purpose. PTFE offers excellent chemical resistance, is hydrophobic and has very low surface interaction. Adsorption and desorption effects are therefore minimized – a key advantage for low measuring ranges and demanding components such as NH₃, HCl or SO₂.

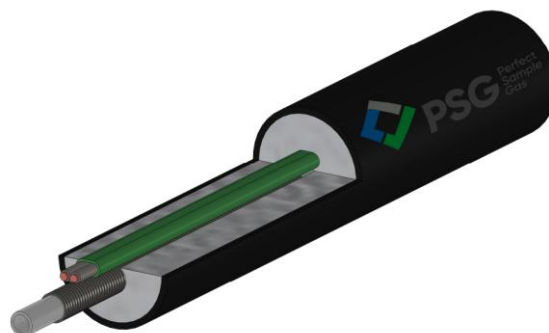
PerfectZero – no CO ingress into the sample gas path

At high continuous operating temperatures, CO emissions can be released from heater, insulation and other line materials. Although PTFE is an excellent material for sample gas service, it is not completely gas diffusion-tight. As temperature increases, gases can permeate through the PTFE wall and enter the sample gas stream.

At holding temperatures of 180 °C or 200 °C in particular, this effect can create an additional background signal in low CO measuring ranges and distort the measured value.

PerfectZero prevents exactly this effect: a flexible metallic diffusion barrier surrounds the PTFE sample tube and fully separates it from the heater and insulation materials.

The result: No CO ingress from the heated sample line.



- ✓ No CO ingress into the sample gas path
- ✓ Replaceable PTFE sample tube
- ✓ Pre-terminated and cut-to-length (parallel heater)
- ✓ 25-30% energy savings vs. standard flexible lines
- ✓ Up to 200 °C holding temperature (60 W/m)
- ✓ Test/calibration gas and power cables can be integrated
- ✓ Standard configurations ex stock
- ✓ Bending radius only 4-5 × outer diameter

The advantages of two line concepts

The flexibility of a traditional hand-made corrugated line – combined with the advantages of a modern extruded line.

This combination forms the basis of the TBX-H platform.

Robust and permanently sealed.

The at least 2 mm thick extruded outer jacket made of PVC or TPU provides reliable protection against moisture, weather and mechanical stress.

Flexible installation.

Bending radius of only 4–5 × outer diameter – a level of flexibility previously associated mainly with traditional hand-made corrugated lines.

Efficient heating.

The PSG CPD heater enables holding temperatures up to 200 °C and, depending on the version, heating circuit lengths up to 150 m with a single power feed. Energy demand is approx. 25–30% lower than with conventional flexible lines.

Up to 450 m in one continuous length.

The TBX-H can be produced in long continuous lengths and stocked on drums.

Cut-to-length and quickly available.

The parallel heater is cut and terminated to the required length only when needed – ideal for stock keeping and short lead times.

Factory-terminated or terminated on site.

Ready for connection from the factory or flexibly terminated using the PSG termination kit in the workshop or on site. Even pre-terminated lines can be shortened later.

You decide.

Applications

CEMS & Process Gas Analysis

For emission and process measurements that combine high holding temperatures of 180–200 °C with precise CO measurement. Typical applications include combustion plants, power plants, cement plants and chemical facilities.

Power Plants & Raw Gas Measurement

CO, NO_x, O₂ and SO₂ provide important information for combustion optimization and for DeNO_x and flue gas cleaning systems. Sulfur-containing flue gases require reliable temperature control above the acid dew point; in SCR/SNCR applications, NH₃ and sulfur-containing components may also be present.

The PTFE sample tube minimizes surface interactions and sample gas losses. PerfectZero additionally prevents CO ingress from heater and insulation materials – ideal for low CO measuring ranges at high temperatures.

PerfectZero Highlights

- ✓ No CO ingress from the heated sample line
- ✓ 180–200 °C for demanding high-end measurements
- ✓ PTFE: chemically resistant, hydrophobic, low adsorption
- ✓ Ideal for low CO measuring ranges and raw gas analysis
- ✓ High-end version of the flexible TBX-H platform

Technical Data

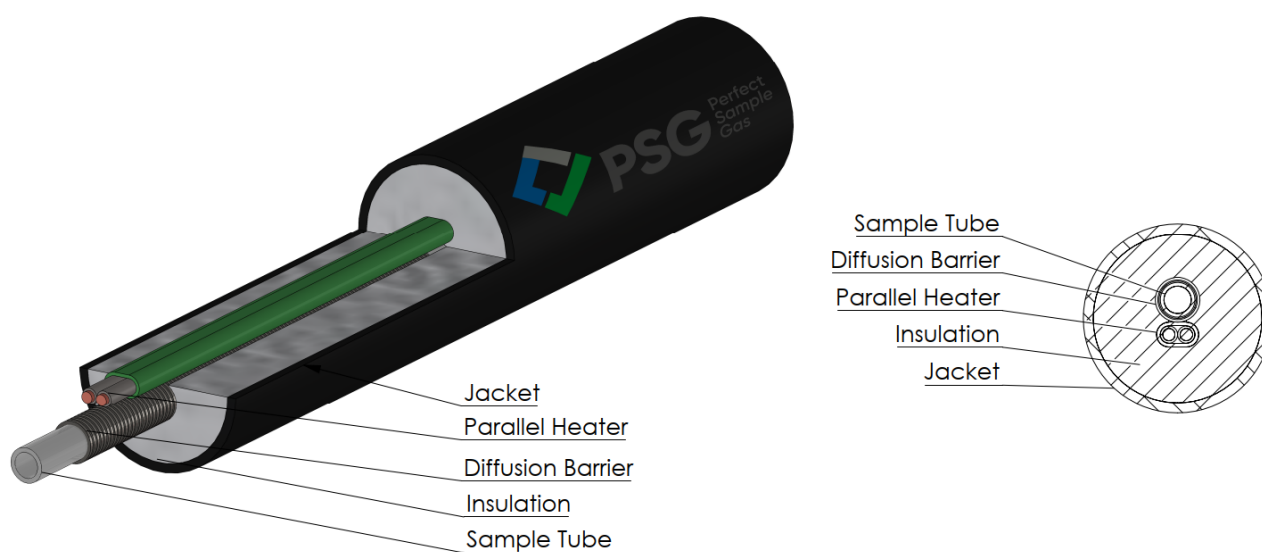
General	
Description	controlled heated sample gas line
Max. Holding temperature	200 °C (60 W/m) 180 °C (45 W/m) <i>180 °C at 45 W/m only achievable at higher ambient temperatures or with additional insulation.</i>
Outer jacket extruded	Standard PVC, Standard PVC Flex Optional TPU, Optional TPU Flex <i>TPU for higher temperature / increased robustness</i>
Insulation	Thermal fleece or Glass fibre fleece
Insulation thickness	10–16 mm depending on application
Heating cable	CPD parallel heater - 45 W/m - 60 W/m
Number of heated sample paths	1 or 2 PTFE / PFA tubes per line
Diffusion barrier	Stainless steel corrugated tube
Sample gas / media tube - material	PTFE or PFA
Sample gas / media tube - size	Metric and imperial PSG Standard 4 – 1 media tube 6x1 mm PTFE, replaceable PSG Standard 5 – 1 media tube 8x1 mm PTFE, replaceable <i>Further configurations - see Order Code section</i> <i>Standard variants are available ex stock.</i>
Overall outer diameter	42–60 mm depending on configuration
End termination	PTFE end cap non-ATEX PTFE end cap ATEX PSG
Lead time	Standard – without termination – 2 weeks after order receipt Standard – with termination – 3 weeks after order receipt <i>(depending on capacity utilization, longer lead times may apply)</i> Specials – without termination – 4–6 weeks after order receipt <i>(depending on capacity utilization, longer lead times may apply)</i> Specials – with termination – 6–8 weeks after order receipt <i>(depending on capacity utilization, longer lead times may apply)</i>
Delivery type / delivery form	up to approx. 70 m as a coil in a carton, above this on a wooden drum
Maximum production length	450 m
Technical Data	
Electrical supply	230 / 120 VAC – protection on supply side 400 / 480 VAC – protection on supply side
Ambient temperature (operation)	-20 ... +70 °C (other temperature ranges on request)
Installation / Bending radius	8–10 × outer diameter standard PVC / TPU 4–5 × outer diameter PVC / TPU Flex
Weight	approx. 750 g/m
Max. operating pressure PTFE tube	DN4/6: ~4.0 bara @ 180 °C DN6/8: ~3.5 bara @ 180 °C
Overall outer diameter	42–60 mm depending on configuration
Degree of protection	IP65
Heating circuit length	
CPD Basic, 45 W/m	230 V – 75 m
CPD Basic, 60 W/m	120V – 45 m 230 V – 75 m
CPD Extra, 60 W/m	120V – 62 m 230 V – 120 m 400V – 154 m 480V – 185 m
Options and Accessories	
Additional: cable in the line	see Order Code
Additional: calibration / media tube in outer insulation	see Order Code
Additional: temperature sensor	see Order Code
Additional: temperature controller	see Order Code
Additional: customer-specific printing and color	On request

PSG Standards (Stocked Configurations)

Common basis: 230 V · 60 W/m · 10 mm Thermal fleece · Auxiliary tube 6×1 mm PTFE

Series	TBX-H			TBX-H PerfectZero	
Configuration	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5
Sample gas path	6×1 + 8×1 mm PTFE	6×1 + 8×1 mm PTFE	6×1 + 8×1 mm PTFE	6×1 mm PTFE + PerfectZero barrier	8×1 mm PTFE + PerfectZero barrier
Heating cable	CPD Basic	CPD Extra	CPD ATEX Extra	CPD Basic	CPD Basic
Outer jacket	PVC	PVC	Ex² PVC	PVC Flex	PVC Flex
Holding temperature	200 °C	200 °C	180 °C	200 °C	200 °C

Further standard and special configurations: see Order Code.

Technical Drawings


Structure of the TBX-PerfectZero line · Subject to change

Order Code

The part number consists of the fixed prefix **TBX-Z1-XXXX-XXX-XXXXXXXX-XXXXXXXX-XXXX** (product line TB-Xtruded PerfectZero) and the code positions 1–20.

Pos 1 · Process tube 1			
11	6×1 mm PTFE – diffusion-tight barrier	12	6×1 mm PFA – diffusion-tight barrier
21	8×1 mm PTFE – diffusion-tight barrier	22	8×1 mm PFA – diffusion-tight barrier
51	¼×0.035" PTFE – diffusion-tight barrier	91	¼×0.062" PTFE – diffusion-tight barrier
92	¼×0.062" PFA – diffusion-tight barrier	ZZ	Special tube

Pos 2 · Process tube 2			
00	none	11	6×1 mm PTFE – diffusion-tight barrier
12	6×1 mm PFA – diffusion-tight barrier	21	8×1 mm PTFE – diffusion-tight barrier
22	8×1 mm PFA – diffusion-tight barrier	51	¼×0.035" PTFE – diffusion-tight barrier
91	¼×0.062" PTFE – diffusion-tight barrier	92	¼×0.062" PFA – diffusion-tight barrier
ZZ	Special tube		

Pos 3 · Heating cable			
000	no heating cable	EP1	ELP/PFA 60 BOT · 60 W/m · 230 V · max. 180 °C
PB1	CPD Basic · 60 W/m · 230 V · max. 200 °C	PB2	CPD Basic · 60 W/m · 120 V · max. 200 °C
PE1	CPD Extra · 60 W/m · 230 V · max. 200 °C	PE2	CPD Extra · 60 W/m · 400 V · max. 200 °C
PE3	CPD Extra · 60 W/m · 120 V · max. 200 °C	PE4	CPD Extra · 60 W/m · 480 V · max. 200 °C
PM1	CPD EMI · 45 W/m · 230 V · max. 180 °C	PM2	CPD EMI · 45 W/m · 120 V · max. 180 °C
PP1	CPD Plus · 40 W/m · 230 V · max. 200 °C	PP3	CPD Plus · 60 W/m · 230 V · max. 200 °C
PX1	CPD ATEX · 60 W/m · 230 V · max. 180 °C	PX2	CPD ATEX Extra · 60 W/m · 230 V · max. 180 °C
PX3	CPD ATEX · 60 W/m · 120 V · max. 180 °C	PX4	CPD ATEX Extra · 60 W/m · 120 V · max. 180 °C
ZZZ	Special heating cable		

Pos 4 · Auxiliary tube 1 in the insulation			
00	none	11	6×1 mm PTFE
12	6×1 mm PFA	21	8×1 mm PTFE
22	8×1 mm PFA	31	10×1 mm PTFE
32	10×1 mm PFA	41	12×1 mm PTFE
42	12×1 mm PFA	51	¼×0.035" PTFE
61	3/8×0.062" PTFE	62	3/8×0.062" PFA
71	1/2×0.062" PTFE	81	12×2 mm PTFE
91	¼×0.062" PTFE	92	¼×0.062" PFA
ZZ	Special tube		

Pos 5–7 · Auxiliary tubes 2–4 in the insulation	
—	Codes identical to auxiliary tube 1 (Pos 4)

Pos 8 · Auxiliary cable 1 in the insulation			
0	no auxiliary cable	1	3× 2.5 mm²
2	PT100 cable 4× 0.75 mm²	3	5× 2.5 mm²
4	Thermocouple cable Type K (2× 0.22 mm²)	5	Data cable 2× AWG 18, twisted/shielded
6	3× AWG 14 (black / white / green)	7	Thermocouple cable Type J (2× 0.22 mm²)
Z	Special cable		

Pos 9–16 · Auxiliary cables 2–9 in the insulation

—	Codes identical to auxiliary cable 1 (Pos 8)
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Pos 17 · Insulation

0	no insulation (processing fee only)	1	Thermal fleece 10 mm
2	Thermal fleece 14 mm	3	Thermal fleece 16 mm
4	Thermal fleece customer-specific thickness	5	Glass fibre fleece 10 mm
6	Glass fibre fleece 14 mm	7	Glass fibre fleece 16 mm
8	Glass fibre fleece customer-specific thickness		

Pos 18 · Extruded Flex

1	Standard extruded jacket (smooth)	2	extruded flexible line
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Pos 19 · Outer jacket

0	no outer jacket	1	PVC
2	Ex² PVC + PE	3	TPU
4	Ex² TPU + PE	5	ATEX4 PVC antistatic
Z	Special outer jacket		

Pos 20 · Documentation

D	Standard digital	X	ATEX in 1 paper copy
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