InPro® 2000 and 465-50 electrodes

Process reliability and highest accuracy in critical processes

Technical data

InPro 2000

(HA, HF, LoT)
465-50

Short description

In most varied types of application as well as under the most difficult process conditions, refillable electrodes with liquid electrolyte have over decades proved to be real problem-solvers. The exceptional performance of the InPro 2000 and 465-50 pH electrodes family is based on high versatility and performance standards, and provides the user with a whole range of outstanding advantages:

- Highest possible reproducibility and measuring performance due to permanent self-cleaning of the diaphragm through pressurizable reference system
- Maximum lifetime due to refillable reference electrolyte
- Highest precision measurement due to automatic temperature compensation based on integrated temperature sensor
- Prevention of contamination and clogging of the diaphragm in sulfide containing process medium due to patented silver-ion trap
- Maximum measuring performance for every need due to an electrode portfolio with a wide range of glass membrane and reference system combinations to suit any specific application
- Best possible protection of the reference system even under the most highly demanding conditions due to bridge electrolyte

Reference electrolyte / refillable liquid electrolytes

Viscolyt (9816)	for general chemical applications
KCl (9823)	for cleaning of the diaphragm with high discharge rate
Friscolyt (9818)	for solvent or protein-bearing process media

For special applications, other electrolytes are available (see p. 6–8).

Housings

InPro 2000 and 465-50 electrodes can be used with stationary and retractable housings.

Contents

METTLER TOLEDO

Specifications

pH range	InPro 2000: 0…14	HA 465-50: 0…14
	InPro 2001: 1…11	465-50: 0…12
	InPro 2002: 1…11	(HF, LoT) 465-50: 1…11
Temperature range °C	InPro 2000: 0…140 (32…284 °F)	(HA) 465-50: 0…130 (32…266 °F)
	InPro 2001: –30…80 (–22…176 °F)	LoT 465-50: –30 80 (-22…176 °F)
	InPro 2002: 0…80 (32…176 °F)	HF 465-50: 0…80 (32…176 °F)
Pressure resistance	up to max. 6 bar (87 psi) overpressure at 130 °C (266 °F)	
Reference system	Argenthal (Ag/AgCl)	
Reference electrolyte	refillable liquid electrolytes:	
	Viscolyt (9816) for general chemical applications	
	KCl (9823) for self-cleaning of diaphragms with high outflow	
	Friscolyt (9848) for solvent- or protein-containing process media	
Diaphragm	1, 2 or 3 ceramic diaphragm(s)	
	Viscolyt: 3 diaphragms Friscolyt: 2 diaphragms KCl: 1 diaphragm	
Glass membrane	InPro 2000 and HA 465-50: alkaline-media resistant glass	
	InPro 2001 and LoT 465-50: low-temperature glass	
	InPro 2002 and HF 465-50: hydrofluoric acid resistant glass	
	Series 465-50: glass resistant to thermal sterilization	
Connector	InPro 2000 series: VarioPin (VP), IP68 Pg 13.5 thread	(HA, HF, LoT) 465-50: S7
EEx certification	II 1/2G EEx ia IIC/T6/T5/T4/T3, SNCH 00 ATEX 3130X for the InPro 2000 series	
FM certification	IS / I, II, III / Div 1 / GR ABCDEFG / T6 for the InPro 2000 series	
PED certification	Pressure Equipment Directive guidelines 97/23/EG, Art. 3, Para. 3, for the InPro 2000 Series	
Silver-ion trap	InPro 2000 series: yes	(HA, HF, LoT) 465-50: with SC designation
Sterilizable	yes	
Autoclavable	InPro 2000 series: yes	465-50 series: no
CIP-compliance	yes	

Ordering information

InPro 2000 Series

- Designed for use in stirred vessels, tanks, open basins and pipes in the chemical industry under harsh process conditions, and now also for up to 6 bar (87 psi) overpressure.
- Optimal measurement performance even in strong alkaline media thanks to a tried and tested special glass membrane for applications in the field of chemical processes.

pH electrodes for demanding processes

Temperature compensation Pt 100	Shaft length [a] in mm	Order no.
InPro 2000/120/Pt100/9816	120 (4.7")	52 001 426
InPro 2000/120/Pt100/9823	120 (4.7")	52 001 430
InPro 2000/120/Pt100/9848	120 (4.7")	52 001 434
InPro 2000/150/Pt100/9816	150 (5.9")	52 002 179
InPro 2000/150/Pt100/9823	150 (5.9")	52 002 831
InPro 2000/150/Pt100/9848	150 (5.9")	52 001 590
InPro 2000/200/Pt100/9848	200 (7.9")	52 002 192
InPro 2000/250/Pt100/9816	250 (9.8")	52 001 428
InPro 2000/250/Pt100/9848	250 (9.8")	52 001 436

pH electrodes for demanding processes		
Temperature compensation Pt100	**Shaft length [a] in mm**	**Order no.**
InPro 2000/250/Pt100/9823	250 (9.8")	52 001 432
InPro 2000/450/Pt100/9816	450 (17.7")	52 001 738
InPro 2000/450/Pt100/9823	450 (17.7")	52 001 794
InPro 2000/450/Pt100/9848	450 (17.7")	52 001 655
InPro 2001/120/Pt100/9848	120 (4.7")	52 002 756
InPro 2001/250/Pt100/9848	250 (9.8")	52 001 758
InPro 2001/450/Pt100/9848	450 (17.7")	52 002 800

pH electrodes for chemical applications		
Temperature compensation Pt100		
InPro 2002/120/Pt100/9848	120 (4.7")	52 002 291
InPro 2002/250/Pt100/9848	250 (9.8")	52 002 791
with bridge electrolyte		
InPro 2000EB/120/Pt100/9816	120 (4.7")	52 002 756
InPro 2000EB/250/Pt100/9823	250 (9.8")	52 002 510
Temperature compensation Pt1000		
InPro 2000/120/Pt1000/9816	120 (4.7")	52 001 427
InPro 2000/120/Pt1000/9823	120 (4.7")	52 001 431
InPro 2000/120/Pt1000/9848	120 (4.7")	52 001 435
InPro 2000/150/Pt1000/9816	150 (5.9")	52 001 704
InPro 2000/150/Pt1000/9848	150 (5.9")	52 001 749
InPro 2000/250/Pt1000/9816	250 (9.8")	52 001 429
InPro 2000/250/Pt1000/9823	250 (9.8")	52 001 433
InPro 2000/250/Pt1000/9848	250 (9.8")	52 001 437
InPro 2000/450/Pt1000/9816	450 (17.7")	52 001 792
InPro 2000/450/Pt1000/9823	450 (17.7")	52 001 777
InPro 2000/450/Pt1000/9848	450 (17.7")	52 001 666
InPro 2001/150/Pt1000/9848	150 (5.9")	52 002 542

Ordering information

Series: 465-50 with HA, HF, LoT

– Designed for use in stirred vessels, tanks, open basins and pipes in the chemical industry under harsh process conditions, and now also for up to 6 bar (87 psi) overpressure.
– Optimal measurement performance even in strong alkaline media thanks to a well-proven special membrane glass for applications in the field of chemical processes.

pH electrodes		
with high-alkali glass	**Shaft length [a] mm**	**Order no.**
HA465-50-SC-S7/120/9823	120 (4.7")	10 465 4510IG
HA465-50-SC-S7/150/9823	150 (5.9")	10 465 4511IG
HA465-50-SC-S7/250/9823	250 (9.8")	10 465 4512IG
HA465-50-SC-S7/450/9823	450 (17.7")	10 465 4513IG
HA465-50-SC-S7/200/9823	200 (7.9")	10 465 4514IG
HA465-50-SC-S7/250/9840	250 (9.8")	10 465 4515IG
HA465-50-SC-T-S7/450	450 (17.7")	10 465 4517IG
HA465-50-SC-P-S7/120/9848	120 (4.7")	10 465 4519IG
HA465-50-SC-P-S7/250/9848	250 (9.8")	10 465 4522IG
HA465-50-SC-S7/150/9830	150 (5.9")	10 465 4524IG

pH electrodes		
with high-alkali glass	**Shaft length [a] mm**	**Order no.**
HA465-50-SC-S7/120/9830	120 (4.7")	10 465 4525IG
HA465-50-SC-S7/250/9830	250 (9.8")	10 465 4526IG
HA465-50-SC-P-S7/150/9848	150 (5.9")	10 465 4531IG
HA465-50-SC-T-S7/120	120 (4.7")	52 001 034
HA465-50-SC-T-S7/150	150 (5.9")	52 001 035
HA465-50-SC-T-S7/200	200 (7.9")	52 001 036
HA465-50-SC-T-S7/250	250 (9.8")	52 001 037
with high-alkali glass and electrolyte bridge		
HA465-50-90-T-S7/120	120 (4.7")	10 465 4157IG
HA465-50-90-T-S7/150	150 (5.9")	10 465 4158IG
HA465-50-90-T-S7/200	200 (7.9")	10 465 4159IG
HA465-50-90-T-S7/250	250 (9.8")	10 465 4160IG
HA465-50-90-T-S7/400	400 (15.8")	11 465 3039IG
HA465-50-90-T-S7/450	450 (17.7")	52 001 038
HA465-50-90-T-S7/120/9846	120 (4.7")	11 465 3079IG
HA465-50-90-T-S7/120/9813	120 (4.7")	11 465 3081IG
with high-alkali glass and electrolyte bridge		
HA465-50-90-T-S7/150/9813	150 (5.9")	11 465 3183IG
HA465-50-90-T-S7/250/9813	250 (9.8")	52 000 717
HA465-50-90-T-S7/250/9823/9823	250 (9.8")	10 465 4527IG
HA465-50-90-S7/120/9823-9823	120 (4.7")	11 465 3077IG
HA465-50-90-S7/150/9823/9823	150 (5.9")	52 001 039
HA465-50-90-S7/200/9823/9823	200 (7.9")	52 001 040
HA465-50-90-S7/250/9823/9823	250 (9.8")	52 001 041
HA465-50-90-S7/450/9823/9823	450 (17.7")	52 001 042
Sterilization-resistant glass		
465-50-S7/120	120 (4.7")	10 465 3456IG
465-50-S7/150	150 (5.9")	10 465 3457IG
465-50-S7/200	200 (7.9")	10 465 3458IG
465-50-S7/250	250 (9.8")	10 465 3459IG
465-50-S7/350	350 (13.8")	10 465 3461IG
465-50-S7/470	470 (18.5")	10 465 4129IG
465-50-S7/550	550 (21.7")	10 465 3465IG
465-50-T-S7/120	120 (4.7")	10 465 4493IG
465-50-T-S7/150	150 (5.9")	10 465 4452IG
465-50-T-S7/200	200 (7.9")	10 465 4488IG
465-50-T-S7/250	250 (9.8")	10 465 4483IG
465-50-SC-P-S7/120/9848	120 (4.7")	10 465 4500IG
465-50-SC-P-S7/150/9848	150 (5.9")	10 465 4501IG
465-50-SC-P-S7/200/9848	200 (7.9")	10 465 4502IG
465-50-SC-P-S7/250/9848	250 (9.8")	10 465 4503IG
465-50-SC-P-S7/350/9848	350 (13.8")	11 465 3175IG
465-50-SC-P-S7/450/9848	450 (17.7")	10 465 4509IG
465-50-SC-P-S7/520/9848	520 (20.5")	11 465 3176IG
465-50-SC-P-S7/550/9848	550 (21.7")	11 465 3177IG
Sterilization-resistant glass and electrolyte bridge		
465-50-90-K9/120	120 (4.7")	10 465 4022IG
465-50-90-T-S7/200	200 (7.9")	10 465 4149IG

pH electrodes		
Sterilization-resistant glass and electrolyte bridge	**Shaft length [a] mm**	**Order no.**
465-50-90-T-S7/120	120 (4.7")	10 465 4495IG
465-50-90-S7/170	170 (6.7")	11 465 3011IG
465-50-90-T-S7/120/9849	120 (4.7")	11 465 3026IG
with special glass membrane		
HF465-50-T-S7/450	450 (17.7")	11 465 3174IG
LoT465-50-T-S7/120/9848	120 (4.7")	10 465 4164IG
LoT465-50-T-S7/150/9848	150 (5.9")	10 465 4173IG
LoT465-50-T-S7/250/9848	250 (9.8")	11 465 3053IG
ORP electrodes		
Pt4865-50-SC-T-S7/120	120 (4.7")	10 565 3087IG
Pt4865-50-SC-T-S7/150	150 (5.9")	10 565 3088IG
Pt4865-50-SC-T-S7/200	200 (7.9")	10 565 3089IG
Pt4865-50-SC-T-S7/250	250 (9.8")	10 565 3090IG
Pt4865-50-SC-T-S7/450	450 (17.7")	52 001 043
Pt4865-50-SC-S7/120/9848	120 (4.7")	10 5653 138IG
Pt4865-50-SC-S7/150/9848	150 (5.9")	10 565 3137IG
Pt4865-50-SC-S7/170/9848	170 (6.7")	11 565 3038IG
Pt4865-50-SC-S7/200/9848	200 (7.9")	10 565 3139IG
Pt4865-50-SC-S7/250/9848	250 (9.8")	10 565 3140IG
Pt4865-50-SC-P-S7/450/9848	450 (17.7")	11 565 3041IG
ORP electrodes with electrolyte bridge		
Pt4865-50-90-S7/120/9823-9823	120 (4.7")	52 001 044
Pt4865-50-90-S7/150/9823-9823	150 (5.9")	52 001 045
Pt4865-50-90-S7/200/9823-9823	200 (7.9")	52 001 046
Pt4865-50-90-S7/250/9823-9823	250 (9.8")	52 001 047
Pt4865-50-90-S7/450/9823-9823	450 (17.7")	52 001 048
Pt4865-50-90-T-S7/120/9848-9848	120 (4.7")	10 565 3579IG
Pt4865-50-90-T-S7/150	150 (5.9")	52 001 457
Pt4865-50-90-T-S7/450	450 (17.7")	11 565 3045IG

Accessories

Cables (open ends) for InPro 2000 electrodes	
Standard temperature (–20…80 °C/–4…176 °F)	
VP6-ST/ 3 m (9.8 ft)	52 300 108
VP6-ST/ 5 m (16.4 ft)	52 300 109
VP6-ST/10 m (32.8 ft)	52 300 110
High temperature (–30…140 °C/–22…284 °F)	
VP6-HT/ 3 m (9.8 ft)	52 300 112
VP6-HT/ 5 m (16.4 ft)	52 300 113
VP6-HT/10 m (32.8 ft)	52 300 114
Cables (open ends) for 465-50 electrodes	
AS9/ 1 m (3.3 ft)	10 001 0102
AS9/ 3 m (9.8 ft)	10 001 0302
AS9/ 5 m (16.4 ft)	10 001 0502
AS9/10 m (32.8 ft)	10 001 1002

Buffer solutions	Order no.	Order no.	Order no.
	1 x 250 ml	**6 x 250 ml**	**1 x 1000 ml**
pH 4.01 (red)	51 340 057	51 340 058	51 340 228
pH 7.00 (green)	51 340 059	51 340 060	51 340 229
pH 9.21 (blue)	51 300 193	51 300 194	51 340 230
Redox-Puffer + 220 mV	51 340 065	51 340 081	51 319 021
Redox-Puffer + 468 mV	51 340 066		

Refill electrolyte	Order no.	Order no.	Order no.
	1x 250 ml	**6x 250 ml**	**6x 30 ml**
Viscolyt 9816	51 340 235	51 340 236	–
Friscolyt 9848	51 340 053	51 340 054	–
3 mol/l KCl 9823	51 340 049	51 340 050	–
LiCl in Ethanol 9830	–	–	51 319 051
Calcolyt 9840	51 319 039	51 319 040	–
KNO_3 9813	51 340 047	51 340 234	–

Cleaning solutions	Order no.	Order no.	Order no.
	1 x 250 ml	**6 x 250 ml**	**1 x 1000 ml**
Electrode cleaning solution	51 340 068	51 340 069	51 319 041
Diaphragm cleaning solution	51 340 070	51 340 082	–
Regeneration solution	51 340 073 (1 x 25 ml)		
Reactivation solution	51 319 053 (6 x 30 ml)		

Suitable housings		
Electrode shaft length [a]	**Designation**	**Insertion length [h]**
120 mm (4.7")	InFit 764 e	70 mm
120 mm (4.7")	InFit 763 e	400 – 4000 mm
150 mm (5.9")	InFit 763 e	400 – 4000 mm
150 mm (5.9")	InFit 764 e	100 mm
200 mm (7.9")	InFit 764 e	150 mm
250 mm (9.8")	InTrac 776 e	70/100 mm
	InTrac 796-M or P	75 mm
	InFit 764 e	100 mm
450 mm (17.7")	InTrac 776 e	200 mm

For pipe installations, the above housings can be used in combination with InFlow 76X Flow-through housings.

Selection guide	HA 465-50-SC-T-S7	HA 465-50-SC-S7/9823	HA 465-50-90-T-S7	HA 465-50-90-S7/9823/9823	LoT 465-50-T-S7-9848	HF 465-50-T-S7	PI 4865-50-SC-T-S7	PI 4865-50-90-S7/9823/9823	465-50-SC-P-S7
pH range	0…14	0…14	0…14	0…14	1…11	1…11	mV	mV	0…12
Temperature range °C	0…130	0…130	0…130	0…130	-30…80	0…80	0…130	0…130	0…130
Temperature range °F	32…266	32…266	32…266	32…266	-22…176	32…176	32…266	32…266	32…266
Silver-ion-trap	✔	✔	–	–	–	–	✔	–	✔
Reference electrolyte	Viscolyt	KCl	Viscolyt	KCl/KCl	Friscolyt	Viscolyt	Viscolyt	KCl/KCl	Friscolyt
Applications									
Chemical processes generally sulfide containing media in particular	✔						✔		
Boiler feed water, pharmaceutical processes, and at increased risk of diaphragm clogging		✔							
Chemical processes in the presence of gases such as chlorine and hydrogen			✔						
Problematic chemical processes requiring bridge electrolyte				✔				✔	
Cooling water, blood plasma fractionation, and other low temperature applications					✔				
Process media containing hydrofluoric acid						✔	✔		
Applications in biotechnological processes, in particular in protein containing media									✔
Chemical process media mainly based on organic solvents		9830*		9830*				9830*	
Sugar processing, citric acid production and at other $CaCO_3$ precipitation risks				9840*				9840*	
Media containing gypsum or metal oxide, with risk of sulfate precipitation				9902*				9902*	
Photo industry, latex paint industry and other media containing Hg^{2+}, Cu^{2+}, Ag^{+} or Pb^{2+} ions sensitive to Cl^{-} ions				9813*				9813*	

* KCl to be replaced by the specified electrolyte.

Reference electrolyte

A variety of different electrolytes are available to cover the widest range of applications in the chemical industry.

Designation		Order no. 1 x 250 ml	Order no. 6 x 250 ml
9816 Viscolyt	most frequently used CP electrolyte with limited outflow and therefore long refill intervals	51 340 235	51 340 236
9823 KCl	classic electrolyte with high electrolyte outflow for improved diaphragm cleaning	51 319 023	51 319 024
9848 Friscolyt	used for media with protein / organic solvents content, and in low-temperature applications	51 340 053	51 340 054
9830 LiCl in ethanol	used in chemical processes containing organic solvents	51 340 052	51 319 051
9840 Calcolyt	used where there is a risk of calcium carbonate precipitation	51 319 039	51 319 040
9813 KNO_3	used as bridge electrolyte where chloride ions interfere	51 340 047	51 340 234

Electrolyte bridge

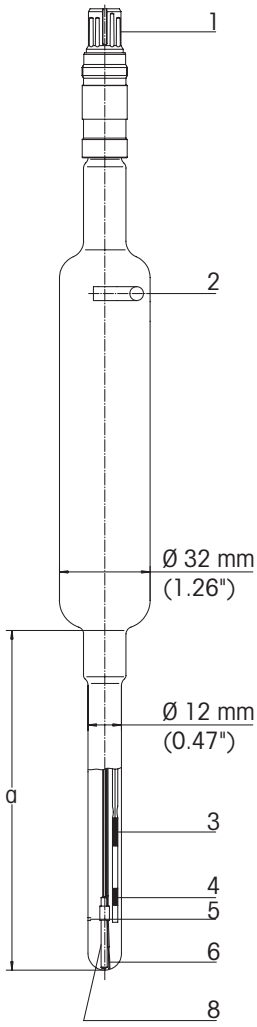
Bridge-type electrodes (-90-) offer optimal protection of the reference element in the most difficult applications. They are equipped with two concentric electrolyte chambers for bridge and reference electrolyte respectively, separated by an internal diaphragm.

Transmitters

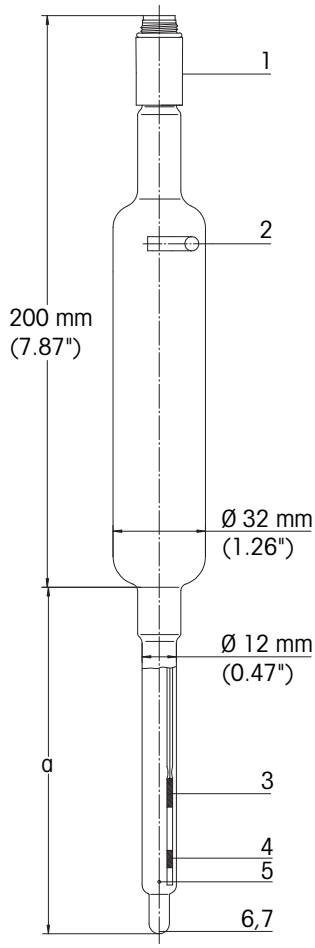
A wide range of transmitters can be offered to complete the METTLER TOLEDO measurement system, including a 4 wire version for universal AC/DC power supply, or alternatively in 2-wire versions, with HART®, FOUNDATION Fieldbus or Profibus® communication, of standard or explosion-proof (EEx) design.

Drawing

InPro 2000



HA, HF, LoT 465-50



1 Connector
Provides a safe industrial connection, allowing rapid demounting and remounting during maintenance procedures.

2 Electrolyte refill opening
The necessary refill interval depends on the number of diaphragms, their porosity, electrolyte viscosity (temperature-dependent) and the applied pressure difference. Examples of electrolyte outflow per 24 hours at ΔP 2 bar and 25 °C (77 °F):

3 M KCl:	2 ml per diaphragm
Viscolyt:	0.15 – 0.3 ml at 3 diaphragms
Friscolyt:	0.3 – 0.6 ml at 3 diaphragms

3 Reference elements
Argenthal reference elements deliver stable potential and therefore reliable pH values at temperatures up to 130 °C. (266 °F)

4 Argenthal with SC The additional patented silver-ion trap efficiently protects the diaphragm from silver sulfide precipitations in sulfide-containing media.
Equithal reference elements have up to 10 times shorter response times in processes with rapidly changing temperatures.

5 Ceramic diaphragm(s)
Through their pores, ceramic diaphragms provide the required liquid junction between the measurement solution and the reference element via the reference electrolyte.465-50 sensor versions are available with 1, 2 or 3 diaphragms, but in the chemical process industry predominantly those with 3 diaphragms (-T-) are used

6 pH sensitive glass
HA high-alkali glass assures reliable measurements over the whole range pH 0 – 14.
LoT glass is particularly suitable for measurements at low temperatures (down to minus 30 °C (-22 °F).
HF glass offers increased resistance against media containing hydrofluoric acid (see table):

at pH 2 and 20 °C: (68 °F)	HF < 300 ppm
at pH 3 and 20 °C:	HF < 1000 ppm
at pH 4 and 20 °C:	HF < 6000 ppm
at pH > 5:	no F^- concentration limit

7 Platinum ring
Applicable to redox sensors.

8 Temperature sensor
The built in temperature sensor (Pt 100 or Pt 1000) is located behind the pH glass and allows for the automatic compensation.

Notes

Notes

METTLER TOLEDO Market Organizations

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