OPERATING INSTRUCTIONS

for the

Pressure Transducer P75

Type 379

Version 1.4 / January 2002 / St

P75BA2E.PM5

Contents

1. Introduction, manufacturer's details

These Operating Instructions describe the function and use of the pressure transducer P75, Type 379. It is part of the transducer and should be kept close to it.

All the information in these Instructions has been drawn up after careful examination but does not represent any warranty of product properties. Alterations in line with technical progress are reserved.

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1.1 Copyright

1.2 Limitations

These Instructions do not apply to the bridge amplifier required for operating the transducer. Any problems which arise during operation or installation have to be resolved with the aid of the appropriate Operating Instructions.

It is evidently necessary that these Instructions have to refer to the operation and function of the bridge amplifier. This does not mean that this replaces the information in the appropriate Operating Instructions. In particular it is essential to observe the safety notes in the original Operating Instructions.

2. General description

The pressure transducer P75 has been specially developed for measuring low pressures in the range of 0 to ±75 mm Hg. The sensor element consists of a rugged and largely inert ceramic diaphragm with a very large overload capacity. The transducer case is metal. The transparent plastic dome can be replaced after releasing four screws. It carries two Luer connections so that it can readily be filled free from air bubbles. The transducer requires for its operation a 5 Volt DC supply; it can therefore only be connected to DC bridge amplifiers. Operation with carrier bridge amplifiers is not possible. The back of the case has a female thread (M5) into which the support rod supplied with it can be inserted.

3. Application range

The pressure transducer P75 is intended for measuring low pressures during tissue perfusion in physiological and pharmacological research laboratoriesm and for cardiovascular experiments. The measuring range 0 to ±75 mm Hg is in the range of venous pressures.

WARNING: the P75 is not intended for use on humans!

4. Unpacking

Care must be taken during unpacking the transducer. Place the carton on a bench before taking out the individual parts. Take care that nothing drops to the floor, especially not the transducer itself. Check the items received against the delivery note. If something appears to be missing, check first the packing material before you make a claim for missing items. Small parts can easily be overlooked inside the packing material.

5. Transport damage

Special care is taken in packing the transducer so that transport damage is largely excluded. If unexpectedly some damage is visible on the transducer when it is received, you should immediately advise the forwarding agent, post office or railway authorities so that the damage can be inspected. Damaged packaging should always be retained as evidence.

6. Components, useful accessories

The transducer is normally delivered with the support rod and with the dome mounted in position. Unless otherwise ordered, a 6-pin round plug is attached to the connecting cable. The pin arrangement corresponds to the HSE standard.

Recommended accessories are a 3-way stopcock and a shut-off stopcock. These stopcocks are fitted on the dome and locked in position as indicated in the illustration. The two stopcocks are used in filling the dome free from air bubbles, for checking the zero during operation and also for flushing the catheter during operation. If you can not mount the P75 with its support rod on an existing apparatus, a further useful accessory is a stand with a suitable bosshead on which the transducer can be mounted at a defined height.

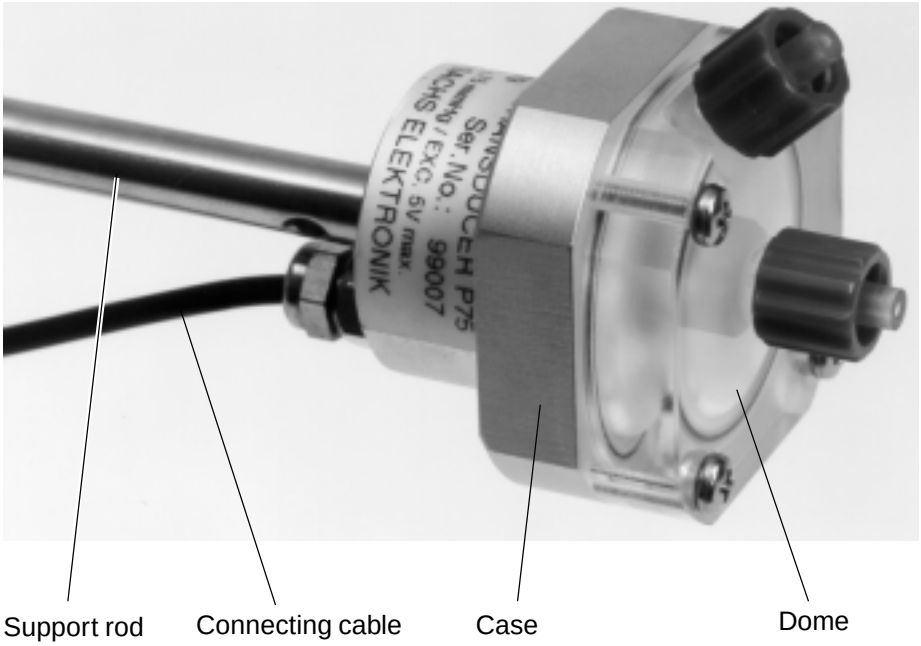

Fig.1: P75

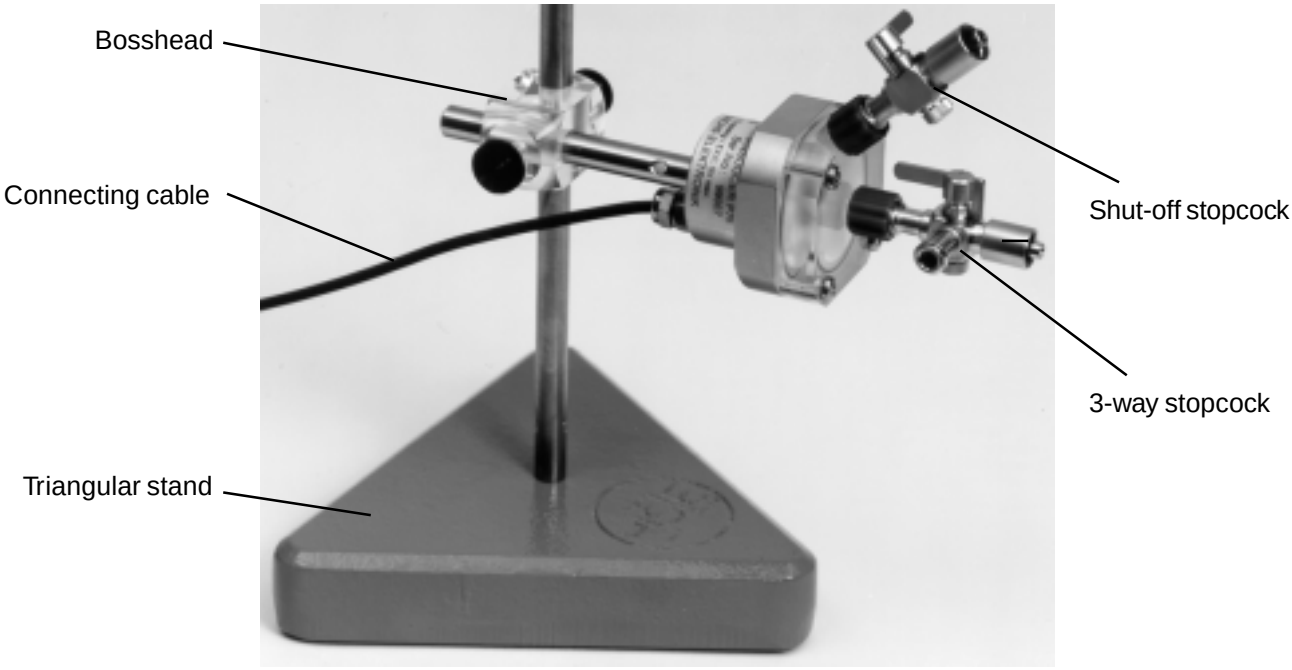

Fig. 2: P75 fitted with stopcocks and mounted on the stand.
Note: stopcocks and stand are additional items and have to be ordered separately.

7. Operation

7.1 Parts required

For operating the P75 the following additional parts are required:

1 shut-off stopcock

1 3-way stopcock

1 tubing to connect the transducer to the measurement point

1 set of mounting parts for fixing the P75 and adjusting it to a defined level, e.g. the stand with bosshead shown above

1 bridge amplifier with a 5 V DC supply. The following HSE amplifiers are suitable for this application: DBA (DC Bridge Amplifier) Type 660, TAM (Transducer Amplifier Module) Type 705/1 or 705/2. Not suitable are carrier frequency amplifiers which employ an AC voltage to energise the bridge, such as CFBA (Carrier Frequency Bridge Amplifier) Type 677.

7.2 Fixing the P75 in position

At the back of the P75 a rod is screwed into the metal case which is intended for securing the transducer on a stand or on the experimental setup. The transducer has to be at the right level in order to perform correct zero adjustment and also for exact measurement. Its mounting should be such that the centre of the transducer is as nearly as possible at the same level as the point where the pressure is being measured. If the transducer is too low, the measured pressure is too high, and vice versa.

It is also important that the P75 is mounted so that the side connection of the dome with its shut-off stopcock is directed upwards. When this stopcock is open, the dome fills from the bottom upwards without any bubbles.

7.3 Electrical connection

The electrical connection is made through the connecting cable with the plug suitable for your bridge amplifier. If you do not use any of the HSE bridge amplifier mentioned above, you have to check that the amplifier meets the requirements of the P75 before connecting the transducer.

> **WARNING**: incorrect pin connections, excessive bridge supply voltage or incorrect polarity may damage the electronic sensor of the P75 or destroy it completely!. The same applies when a carrier frequency amplifier is used.

Check first that the bridge supply voltage of the intended amplifier is set to 5 Volt DC, and that the pin connections of the input socket conforms to the connecting plug of the P75. Normally, unless otherwise agreed before shipment, the connecting cable of the P75 carries a 6-pin round plug. The plug pin connections correspond to the HSE standard (see page 7, Fig. 4).

All the above points should be clarified before you connect the plug of the P75 to the bridge amplifier and switch on the instrument.

7.4 Connecting the dome

A 3-way stopcock and a shut-off stopcock should always be fitted to the dome as shown in the illustration (Fig. 2). The 3-way stopcock is mounted on the central Luer cone and secured with the threaded ring. The pressure connection by the connecting tubing is then made on the (male) Luer cone on the opposite side of the 3-way stopcock. The side connection of the 3-way stopcock (female Luer cone) should be horizontal; it remains unconnected. It is required for exact zero adjustment!

> **WARNING**: use only stopcocks whose female Luer cone carries a thread. If a stopcock with a sharp-edged bayonet-type fitting for fixing the Luer connection is used, the plastic nut of the dome is damaged when it is tightened up.

The type of connecting tubing to be used depends on what is being measured. When average pressures (nonpulsatile pressures) are being evaluated, the tubing can be relatively long and the lumen small. However, when measuring pulsatile pressures the tubing should be as short as possible, have a thick wall and a lumen not less than 1 mm. Additionally the tubing material should not be soft but as rigid as possible; polyethylene tubing is very suitable. Silicone tubing would not be suitable. When measuring pulsatile pressures it is also important that the tubing is firmly fixed in position and can not move during measurement; movement of the tubing produces additional pressure fluctuations which lead to incorrect results.

7.5 Bubble-free filling

Correct measurement of a pressure requires a measuring system (connecting tubing, stopcock and dome) which is filled free from bubbles. Measurement of low pressures, in particular, are liable to large errors if the system is not filled completely. The liquid used as filling medium has to be compatible with the wetted materials of the P75. The system should preferentially be filled with saline solution. When measuring the pressure in a perfusion system, for example, the measuring system can be filled with perfusate by opening the stopcock under the pressure in the sysem until tubing and dome are filled. **It is essential that no albumine-containing perfusate passes into the dome**. Albumine adheres strongly to the dome surfaces and is difficult to remove. This can lead to algal growth.

Blood must never be allowed to pass into the dome. In that case use a suitable saline solution as filling medium for the dome and connecting tubing. If blood has passed into the dome it has to be washed out immediately.

Fig. 3 shows the various positions of the 3-way stopcock. Position A (Fig. 3A) is used to flush the connecting tubing. For this operation a syringe filled with saline solution is placed on the female Luer connection. Heparin should be added to the saline solution when measuring blood pressure; this prevents thrombus formation at the end of the catheter.

7.6 Zero adjustment

Zero adjustment (on the bridge amplifier) is used to correct inaccuracies in the sensor system at pressure = zero. Measuring errors caused by incorrectly positioning the pressure transducer (see above) should not be corrected by zero adjustment.

Zero adjustment has to be performed before each measurement, and should if necessary be repeated during longer series of measurements. Ensure that bridge amplifier and pressure transducer are at their operating temperature during zero adjustment.

Set the 3-way stopcock so that the dome is connected to the open branch of the 3-way stopcock (Fig. 3: **C**). This produces pressure equilibration with the surrounding atmosphere. The measuring diaphragm is relaxed and goes into its zero position. Now check the pressure indication on your measuring instrument and adjust the zero if necessary. Follow the operating instructions of your equipment.

This completes the zero adjustment. Now return the 3-way stopcock to the previous measuring position (Fig. 3: **B**). Note that the pressure transducer is in the measuring position during zero adjustment!

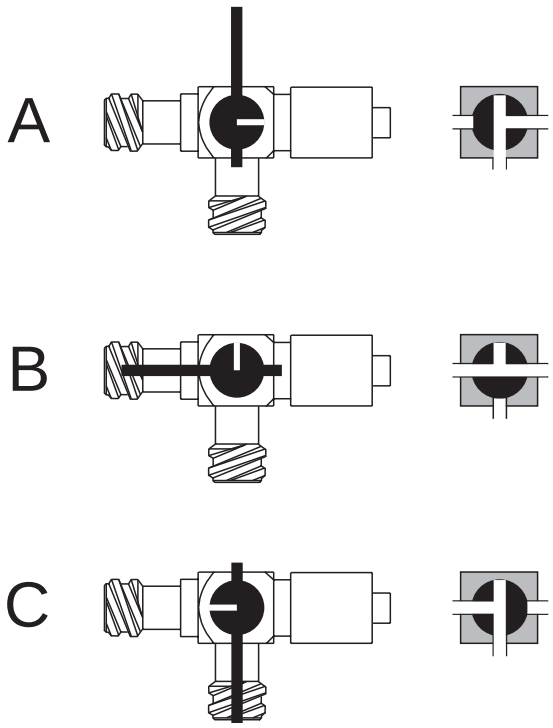

Fig. 3: Positions of 3-way stopcock and the ports in the stopcock key.

7.7 Calibration

The pressure transducer P75 is factory calibrated during manufacture in accordance with the details in the technical data. Calibration before or during use allows the sensitivity of the complete measurement chain to be properly matched. The measurement chain can take different forms. It consists essentially of pressure transducer, bridge amplifier, and pressure indication, recorder and/or data acquisition system by PC and appropriate software. Calibration is absolutely essential in order to obtain accurate measurements which can be evaluated. Regular calibration is also important in order to recognise any instrumental errors which may arise.

During calibration, a known pressure (e.g. 10 mm Hg) is applied to the pressure transducer instead of the measured pressure; the pressure indication is then adjusted by altering the gain of the bridge amplifier. Calibration therefore requires a very precise pressure standard which provides the necessary calibration pressure (e.g. HSE KAL 84H).

PLEASE NOTE: the most accurate results are obtain when selecting the calibration pressure as close as possible to the measured pressure. Example: calibrate at 10 mm Hg if your pressure is of the order of 12 mm Hg; much less suitable would be a calibration pressure of 100 mm Hg, for example.

Switch on the measurement chain and wait until all components have reached their operating temperature (after 1 to 30 minutes depending on the measurement chain). Then perform a zero adjustment (see above). Apply the pressure from the standard pressure source to the free end of the shut-off stopcock; then close the 3-way stopcock (Fig. 3: **A**) and open the shut-off stopcock. Now check the pressure indication and if necessary make the appropriate corrections to the amplifier gain. Proceed as indicated in the instrument Operating Instructions.

After calibration has been completed, check that the pressure transmission system (dome, stopcocks, connecting tubing) is still free of air bubbles. If in doubt, wash out the system again to remove any bubbles which may have entered the system.

8. Maintenance

Maintenance of the P75 consists essentially of keeping the dome clean and ensuring that the stopcocks move easily. If the dome is dirty, it can be taken off for cleaning after releasing the 4 fixing screws. Take care during reassembling that the O-ring (30 x 1.5 mm) lies in the scheduled groove.

Regular maintenance;

- ❑ Wash dome and stopcocks with distilled water after each experiment
- ❑ Any blood which has passed into the dome must be washed out as quickly as possible. Do not wait until it adheres to the wall.
- ❑ External contamination on case and connecting cable should be wiped off, using e.g. a cloth moistened with water. With strongly adhering contamination a little detergent can be added to the water (e.g. RBS-35 or 50 or Mucasol).
- ❑ Do not wipe the dome dry; you would produced scratches.
- ❑ Ensure that no liquid passes into the transducer case.

WARNING: never immerse the P75 into liquid !

9. Technical details

9.1 Construction and function of the sensor

The sensor converts the pressure signal into a proportional electrical voltage.

The pressure applied at the dome acts on the ceramic sensor diaphragm which deflects by a few micrometers. The back of the ceramic diaphragm has an electrically conducting coating and acts as moving electrode of a plate capacitor. The change in capacity cause by the diaphragm deflection is converted into a proportional voltage by an electronic circuit integrated in the sensor.

The capacitive measuring principle meets the highest demands for resolution and reproducibility. Together with the hysteresis-free behaviour of the sensor and because of the ceramic material used (Al2O3) it forms the basis for very good technical data with excellent long-term stability. Despite its high sensitivity the sensor is a very rugged device. When the measuring range is exceeded, the diaphragm comes up against a stop so that overloads up to 50 times the measuring range (= 4000 mm Hg) are permitted without damaging the sensor.

9.2 Pin connections

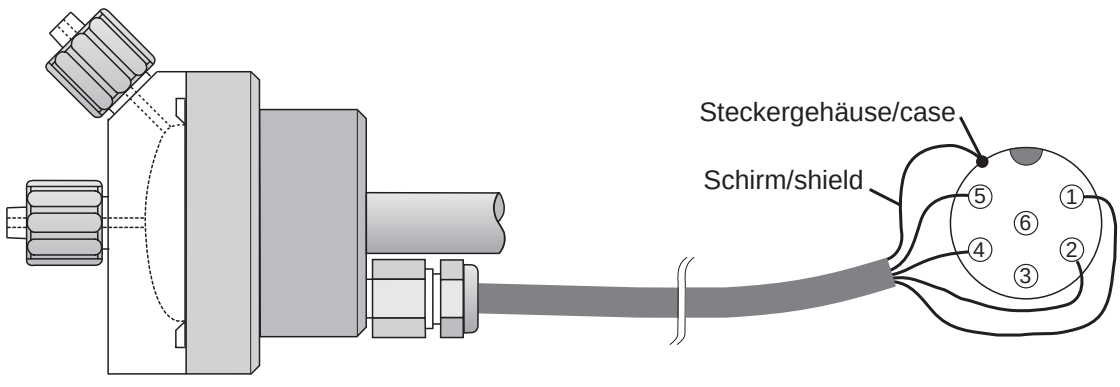

Fig. 4: Electrical connection and pin connections (HSE standard)
Note: a different plug can be fitted if ordered.

Fig. 4 shows the electrical connection of the P75 with the standard plug. Unless otherwise specified, a 6-pin miniature round plug with HSE connection is fitted. If the fitted plug does not suit your amplifier, you can fit a suitable plug according to Table 1, either yourself or by a qualified technician. The appendix (Section 12) lists a large number of other plugs with their pin connections for various bridge amplifiers. Table 1 gives the pin connections and the functions of the individual connections, as well as the wire colour codes.

Table 1:

Wire colour	Function	Pin No. [1])
white	supply + (5V)	1
brown	supply - (0)	5
green	signal +	4
yellow	signal -	2
braiding [2])	EMC screen	plug case

[1]) pin connection to HSE standard (6-pin round plug), pins 3 and 6 not used
[2]) the cable shield is connected internally inside the P75 to the metal case

If you fit another plug, it is essential to ensure that the connection of cable shield to plug case is as short as possible.

9.3 Frequency response

Fig. 5 shows the frequency response of the P75. The measurements were made with different tubing connections to the pressure source. Stopcocks as shown in Fig. 2 were used. Great care was taken during the measurement that no bubbles remained in the system. The graphs indicate that when using short tubing (b: 150 mm) correct measurement can be expected from 0 to about 8 Hz. With appreciably longer tubing (a: 500 mm) the measuring range is reduced to about 4 Hz. Measurement above these frequencies produces increases in amplitude which peak at the corresponding resonant frequencies and then fall off again. In the presence of air bubbles the graphs are displaced towards lower frequencies, depending on the position and size of the bubbles.

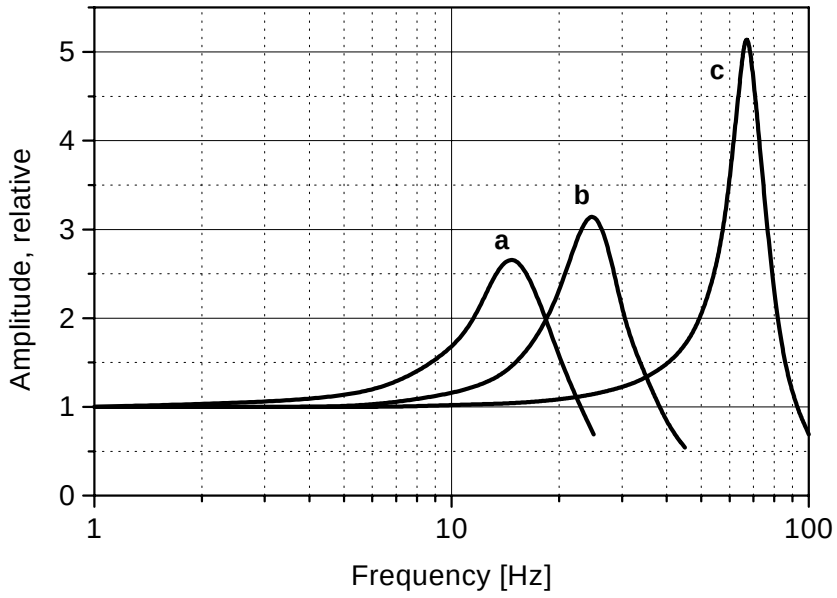

Fig. 5: Frequency response of the P75 for different connections to the measurement point
a: polyethylene tubing ID=1 mm, OD=2 mm, L=500 mm; **b**: polyethylene tubing ID=1 mm, OD=2 mm, L=150 mm; **c**: metal tube ID=1.4 mm IF, L=55 mm

9.4 Technical data

General data:

Designation:	pressure transducer P75, Type 379
Order No.:	37-0-00078
Range:	-75 to +75 mmHg (-100 to +100 cmH_2O)
Volume displacement:	0.06 mm^3/10 mmHg
Linearity:	±0.15 mmHg
Long-term drift:	±0.04 mmHg
Overload capacity:	-760 to 4000 mmHg
Measurement medium:	all gases and liquids which do not attack polycarbonate, NBR and ceramic
Working temperature range:	0 - 50 °C
Zero drift:	±0.04 mmHg/10 °C over 0 - 50 °C
Sensitivity (signal voltage):	1 mV/mm Hg, nominal
Sensitivity drift:	±0.04 mV/10 °C (±0.04 mmHg/10 °C) over 0 - 50 °C
Frequency range:	without dome 0 - 200 Hz; with dome see graph in Section 9.3

Electrical data:

Supply:	5 V (4.5 - 5.5 V) DC
Current taken:	15 mA approx.
Output resistance:	300 Ohm nominal
Connecting cable:	approx. 1.5 m long with 6-pin Binder plug (HSE system)
Suitable amplifiers:	any bridge amplifier which provides the necessary supply voltage, e.g. HSE PLUGSYS modules TAM-A or TAM-D Type 705, DBA type 660 or BPA Type 675

Mechanical data:

Pressure connections:	Luer cone, male
Dimensions, transducer:	40 mm x 40 mm x 35 mm, without pressure connections
Mounting support rod:	D = 8 mm, L = 70 mm

9.5 Spares and additional accessories

Designation	Description	Part No.	Order No.
Spare dome	dimensions 40 mm x 40 mm x 26 mm	T18428/M	
Sealing ring for the dome	O-ring 30 x 1.5 mm	U40101	
Support rod, short	length L = 70 mm, D = 8 mm	T15017	
Support rod, long	length L = 160 mm, D = 8 mm	T15009	
3-way stopcock	stopcock with Luer lock thread, Type 9560 R		69-0-00006
Shut-off stopcock	stopcock with Luer lock thread, Type 9500		69-0-00005
Tubing	catheter with luer lock connections male/female ID = 1 mm, OD = 2 mm, length L = 20 cm	S16028	
Tubing	as above but length L = 50 cm	S16097	
Stand	cast iron base (130 mm x 130 mm x 130 mm) with column (D = 8 mm, L = 320 mm) and bosshead		26-0-00010

10. Conversion table for pressure units

1	mmHg	= 0.133	kPa	= 13.6	mm WC	= 1.33	mbar
7.5	mmHg	= **1**	kPa	= 102	mm WC	= 10	mbar
0.736	mmHg	= 0.098	kPa	= **10**	mm WC	= 0.98	mbar
0.75	mmHg	= 0.1	kPa	= 10.2	mm WC	= **1**	mbar

Pressure units:

mmHg = millimetre mercury column = torr
mm WC = millimetre water column
kPa = kilo Pascal
mbar = millibar

11. CE conformity

CE

This product and accessories conform to the requirements of the Low-Voltage Guideline 73/23/EWG as well as the EMC Directive 89/336/EWG and are accordingly marked with the CE symbol. For conformity with the standard it is essential that the details in these Instructions are strictly observed during operation.

12. Connecting plugs and pin connections for various bridge amplifiers

Cable to Transducer

	male couplers for Mark V	male couplers for Mark VII DBA, TAM PLUGSYS	female	female	male	male	male	male BPA PLUGSYS	male IPH PLUGSYS
user	HSE (old version with bayonet lock)	HSE HELLIGE	STATHAM	GRASS	BECKMAN	GOULD	NIHON-KOHDEN	HSE	HSE
supplier: model:	PREH 5 pin male 71 430-050	BINDER 6 pin male 09-0321-00-06	CANNON 4 pin female WK-4-21C 1/4	CANNON 6 pin female WK-6-21C 1/4	AMPHENOL 5 pin male 97-3106A-14S-5P639 (+ pull relief: 97-3057-1007)	GOULD 12 pin male 11-5407-50	NIHON-KOHDEN 5 pin male IRC 13P-5P (N K : 5310067)	BINDER 8 pin male 09-0571-00-08	LEMOSA REDEL 6 pin male PLG.M06.GLLB
front view:									
Excitation +	1	1	1	1	C	9	3	6	1
Excitation –	4	5	4	4	D	8	4	7	3
Signal +	2	4	2	2	A	11	2	3	2
Signal –	3	2	3	3	B	12	5	1	4
Shield	5	case	case	6	E	case	1	case	6

Cable to Transducer

	male 	male			male 		
user	**HARVARD**	**HEWLETT PACKARD**	**HEWLETT PACKARD**	**WPI**	**Ugo Basile**	**LETICA**	
supplier: model:	**BINDER** 7 pin male 680	12 pin male	**TWINAX**	8 pin	**ECTA** 7 pin male		
front view:							
Excitation +	2	B	D	1	c	1	
Excitation –	4	A	E	4	d	3	
Signal +	7	C	A	2	a	4	
Signal –	5	D	B	3	b	5	
Shield	6 zero –	1	F	7	g	–	

13. Reply form

Please take a few minutes of your time in order to write to us on any difficulties in understanding the Operating Instructions or in the use of the device. With your feedback you will help to improve our products and the system documentation and make them more user-friendly.

Please tell us

☞ where you have found mistakes,

☞ where the arrangement was not clear and what you did not understand,

☞ and where you would like to see improvements.

Many thanks for your kind assistance.
Yours HUGO SACHS ELEKTRONIK-
HARVARD APPARATUS GmbH

Your name _____

Organisation _____

Street _____

Town _____

Phone/Fax _____

eMail _____

Please send this sheet or a copy to:

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