

Instruction Manual



CP25-3 Penning Gauge Heads

Description

Item Number

CP25-3

D145-35-000

 **BOC EDWARDS**

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RETURN OF EDWARDS EQUIPMENT

1 INTRODUCTION

1.1 Scope of this manual

This manual provides installation, operation and routine maintenance instructions for the Edwards CP25-3 Penning gauge heads. Read this manual before attempting to install and operate the unit.

This manual contains essential safety information which supplements the safety features of the unit. Safety procedures are highlighted as WARNING and CAUTION instructions. You must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

WARNING

Warnings are given when failure to observe the instruction could result in injury or death to persons.

CAUTION

Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

The safety markings used on the equipment are:

Refer to
Manual



Electrical
hazard



1.2 General

WARNING

The penning CP25-3 gauge head contains a radioactive isotope in the form of a nickel-63 beta source overlaid with inactive nickel. The nominal activity is 37 kBq which is not hazardous to the operator.

The CP25-3 gauge heads are designed for operation with the Edwards 1000 series of controllers.

The Edwards CP25-3 gauge heads are of a robust construction that can be quickly and easily dismantled for cleaning.

The gauge heads operate on the principle that, at pressures below approximately 100 mbar, the ionisation current flowing between two electrodes varies with pressure. The interior of the gauge head is open to the vacuum system and contains a rod anode surrounded by a cylindrical cathode. A magnetic field is maintained in the gauge head by externally mounted permanent magnets.

A d.c. voltage of 2.3 kV is applied between the anode and cathode. Free electrons are accelerated from the cathode toward the anode and collide with gas molecules causing ionisation. The resulting electrons and positive ions are also accelerated in the electrostatic field and cause further ionisation. The mean path length of each ion is extended as they follow a complex spiral path in the magnetic field. The net ion current flowing between the cathode and anode is detected by the control unit and is a function of the pressure in the gauge head.

The ion current is approximately proportional to pressure from 10^{-2} to 10^{-11} mbar; at higher pressures the current rises at a diminishing rate until it reaches a maximum at approximately 1 mbar. Above this pressure the ion current falls off until discharge is extinguished at about 100 mbar. This characteristic behaviour of the Penning gauge should be noted as it may cause a false pressure indication when the system pressure is above 1×10^{-2} mbar. Pressure dependent switches linked to the Penning gauge reading should be interlocked (commonly by a Pirani gauge signal) to prevent incorrect operation.

Prolonged operation of the Penning gauge head above a pressure of 10^{-2} mbar is not recommended as permanent damage to the anode caused by sputtering may result.

Note: The gauge head output is dependent on the composition of the system gas. The Edwards control units are calibrated for air/nitrogen.

2 TECHNICAL DATA

2.1 Operating conditions

Temperature range	0 to 70 °C
Relative humidity (non condensing)	10 - 90 %
Maximum operating altitude	2000 m

2.2 Performance

Pressure measuring range (mbar)	10^{-2} to 5×10^{-8}
Maximum internal pressure	2 bar absolute

2.3 Mechanical data

Dimensions mm	
Length	117
Lead (integral)	1800
Diameter	63
Internal volume (cm ³)	32.8
Weight including lead	800g
Mounting	NW25
Coupling flange	

2.4 Electrical data

Operating voltage	+ 2300 V at 0.7mA
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2.5 Materials exposed to vacuum

Stainless steel	AISI 304, 347, 321, 302
Soda-Lime-Barium glass	
Fluroelastomer	
Nickel 63	
Nickel	

3 INSTALLATION

3.1 Unpacking and inspection

WARNING

The CP25-3 gauge incorporates magnets. Keep away from heart pacemakers, computers, credit cards and any other magnetically sensitive devices.

Remove all packing materials and protective covers and check the gauge for damage. If the gauge is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the unit together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the gauge.

3.2 Gauge head connections

WARNING

Do not exceed an internal pressure of 2 bar absolute, 1 bar gauge.

WARNING

High voltages exist at the co-axial socket and internal to the gauge. Switch off the control unit before connecting or disconnecting the gauge head.

WARNING

Gauge head must be connected to an earthed system.

Do not loosen the nut where the lead joins the gauge head as this may cause a vacuum leak. Protect the flange from damage and prevent the ingress of debris at all times.

Gauge heads should be mounted as close as possible to the point at which the pressure is to be measured. Use a short branch tube with an internal diameter no less than that of the gauge head. Long, narrow and angled connections can cause a significant reading error.

The Penning gauge head will operate at any attitude but mounting vertically (with the flange horizontal and facing downwards) is recommended so as to avoid the possibility of debris falling into the gauge head.

3.3 Connection to the vacuum system

The gauge heads terminate in NW25 flanges. To connect to a branch tube terminating in a NW25 flange, a centring ring (with 'O'-ring) and a clamp will be required. The Edwards product codes of these items are listed in Section 7.

3.4 Connection to the control unit

With the control unit power off, plug the lead into the back panel socket, using the optional extension lead if required. Secure the lead to a support a short distance above the gauge head to avoid straining the vacuum connection.

4 OPERATION

WARNING

Do not use these gauge heads to measure the pressure of explosive or flammable gases or gas mixtures. It is possible that the glow discharge will cause ignition of such gases.

WARNING

The internal pressure of the gauge head must not exceed 2 bar absolute (1 bar gauge).

WARNING

Fluoro-elastomer can decompose to hydrofluoric acid when heated above 315 °C.

WARNING

Do not operate gauge when disconnected from vacuum system as high voltages (3 kV) are present inside the gauge tube.

CAUTION

Do not operate penning head above a pressure of 10^{-2} mbar for long periods as the high voltage discharge inside the gauge at these pressures can damage the anode pin and cause severe contamination of the gauge.

WARNING

The CP25-3 gauge incorporates magnets. Keep away from heart pacemakers, computers, credit cards and any other magnetically sensitive devices.

Note: To avoid incorrect readings due to electrical leakage caused by condensation when gauges have been removed from a cold store, gauges should be allowed to stabilise at ambient temperature before use.

4.1 Power on

When the control unit power is switched on a pressure of 10^{-7} mbar, or lower will be indicated until the ionisation discharge has been established within the gauge head. Thereafter the vacuum system pressure will be displayed.

The radio active insert improves the striking performance of the CP25-3 gauge head.

4.2 Calibration for different gases

A correction factor must be applied to the indicated pressure when using gases other than air or dry nitrogen.

A correction factor is of the form

$$\text{True pressure} = \frac{\text{Meter reading}}{\text{Gas Calibration Factor}}$$

Refer to the table below for Gas Calibration Factors. These factors are an average of readings obtained by various observers and should be taken as a guide only.

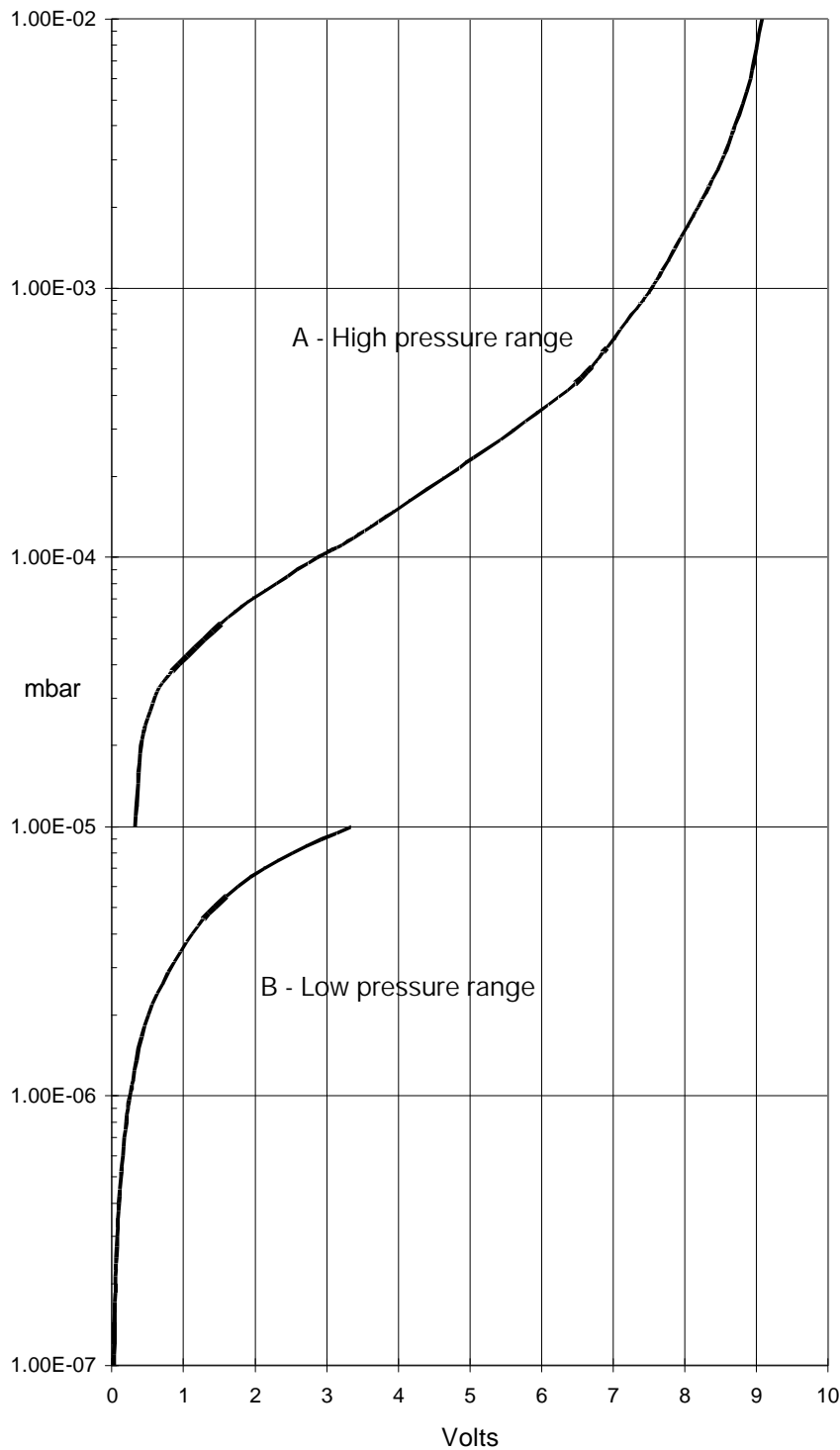
Gas	Factor	Gas	Factor
Air (dry)	1.00	Chlorine	1.30
Ammonia	0.65	Helium	0.18
Argon	1.40	Neon	0.34
Bromine	2.20	Nitrogen	1.0
Carbon dioxide	1.60	Sulphur dioxide	2.1
Carbon monoxide	1.10	Water vapour	1.16
		to	0.58

4.3 Gauge head structure

An exploded view of the CP25-3 is shown in Figure 2.

4.4 Recorder output

A graph showing the pressure dependence of the recorder output of the Edwards 1000 series Penning module is shown in Figure 1.

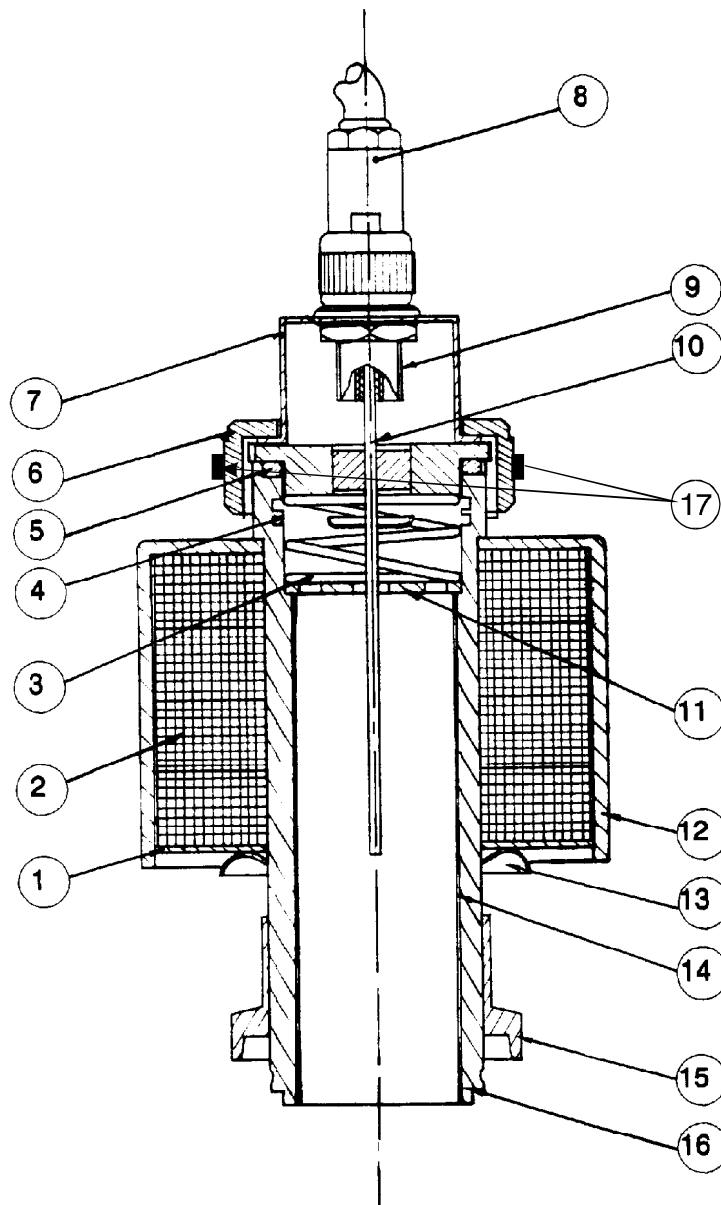


Pressure mbar	Voltage
1.5×10^{-2}	9.260
1.4×10^{-2}	9.238
1.2×10^{-2}	9.159
1.0×10^{-2}	9.080
6.0×10^{-3}	8.916
4.0×10^{-3}	8.695
3.0×10^{-3}	8.520
2.0×10^{-3}	8.182
1.0×10^{-3}	7.535
8.0×10^{-4}	7.261
6.0×10^{-4}	6.911
4.0×10^{-4}	6.356
3.0×10^{-4}	5.047
2.0×10^{-4}	3.373
1.0×10^{-4}	2.875
8.0×10^{-5}	2.298
6.0×10^{-5}	1.630
4.0×10^{-5}	0.759
3.0×10^{-5}	0.536
2.0×10^{-5}	0.406
1.0×10^{-5}	0.321
1.0×10^{-5}	3.341
8.0×10^{-6}	2.521
6.0×10^{-6}	1.765
4.0×10^{-6}	1.122
2.0×10^{-6}	0.504
1.0×10^{-6}	0.252
9.0×10^{-7}	0.228
8.0×10^{-7}	0.204
7.0×10^{-7}	0.177
6.0×10^{-7}	0.155
5.0×10^{-7}	0.126
4.0×10^{-7}	0.102
3.0×10^{-7}	0.078
2.0×10^{-7}	0.051
1.0×10^{-7}	0.027
5.0×10^{-8}	0.012
0.0×10^{-8}	0.000

Range A

Range B

Figure 1 - Penning module recorder output graph



KEY

- | | | | |
|----|----------------------|----|---------------------------|
| 1 | Magnetic plane | 2 | Magnets (4) |
| 3 | Spring | 4 | Radioactive insert |
| 5 | 'O'-ring | 6 | Plastic nut |
| 7 | Earth cap | 8 | Lead assembly |
| 9 | Connector | 10 | Anode assembly |
| 11 | Cathode plate | 12 | Moulded cover |
| 13 | Starlock washer | 14 | S/S sleeve |
| 15 | Muff coupling | 16 | Body tube |
| 17 | Nut retaining screws | | |

Figure 2 - CP25-3 penning gauge head, exploded view

5 MAINTENANCE

WARNING

High voltages exist at the co-axial socket and internal to the gauge. Switch off the control unit and unplug the gauge head before dismantling or handling the head.

WARNING

When cleaning the gauge head the radioactive insert must not be handled or abraded. It is recommended that gloves should be worn when cleaning the gauge head. Refer to Figure 2 , item 4 for position.

CAUTION

When cleaning the gauge head, note that some solvents, such as acetone, will damage the plastic casing.

CAUTION

Solvents may produce fumes that are both toxic and /or flammable. Such solvents should only be used in a well ventilated area away from electronic equipment or flames.

In normal use the gauge heads do not require routine maintenance. However, if unstable or incorrect pressure readings are seen, and the cable connection to the control unit is sound, contamination of the gauge head may be suspected. Dismantle, inspect and clean it as described below.

5.1 Dismantling. Refer to Fig 2.

- 5.1.1 Switch off the power supply to the Control unit and disconnect the lead to the gauge.
- 5.1.2 Dismantle the union at the pumping system port and detach the gauge head.

- 5.1.3 Hold the gauge vertically with the electrical connection uppermost, unscrew the nut retaining screws and remove the plastic nut and the earth cap.
- 5.1.4 Carefully lift out the anode assembly and the 'O'-ring.
- 5.1.5 Invert the gauge head to remove the compression spring and cathode disc.
- 5.1.6 If necessary remove the stainless steel sleeve from the aluminium body.

5.2 Cleaning

- 5.2.1 Gently abrade the anode rod with fine (grade 100) glass paper until any contaminant is removed and a shiny metal surface is obtained. Take care not to bend the rod.
- 5.2.2 Similarly abrade the cathode disc and the stainless steel sleeve.
- 5.2.3 Do not abrade the aluminium body. This should be thoroughly washed in a suitable solvent (for example, acetone) and dried thoroughly using lint free cloth.
- 5.2.4 Wash all the cleaned components in three or four changes of pure acetone or a proprietary organic solvent and allow to dry thoroughly.

After cleaning, handle the components only with clean tools or lint free gloves.

5.3 Re-assembly

- 5.3.1 Slide the stainless steel sleeve into place in the body
- 5.3.2 With the radioactive insert uppermost, replace the cathode disc and insert the compression spring.
- 5.3.3 Position the 'O'-ring on the anode assembly and locate the anode into the connector (press fit).
- 5.3.4 Carefully insert the anode rod through the aperture in the cathode plate until the 'O'-ring locates in its sealing groove at the top of the gauge head body, compressing the spring.
- 5.3.5 Ensure that the surfaces are mating correctly, then screw down the plastic nut until it is hand tight and replace and tighten the retaining screws.

5.4 Fault Location

Indication	Possible cause	Action
Head fails to strike	Gross electrode contamination Faulty connection Low voltage	Clean electrode Remake connection Check supply voltage
Unstable pressure reading	Contaminated Faulty connection	Clean electrodes Remake connection
High sensitivity	Contamination Fine leak on 'O'-ring seal.	Clean electrodes Clean and remake seal
Low sensitivity	Anode rod mis-aligned or bent Contamination	Re-align anode rod by visual inspection from vacuum end, to be central in the hole in the cathode plate. Adjust as necessary. Clean electrodes
Meter records full scale at all pressures.	Short circuit	Check for short circuit between the Anode and Cathode and between the connectors on the cable.

6 STORAGE AND DISPOSAL

6.1 Storage

Store the instrument in a cool dry place.

6.2 Disposal

The CP25-3 should be returned to Edwards for servicing or disposal (or disposed of in accordance with the relevant ionising radiation regulations).

7 SPARES AND ACCESSORIES

7.1 Introduction

Edwards products, spares and accessories are available from Edwards companies in Belgium, Brazil, Canada, France, Germany, Great Britain, Hong Kong, Italy, Korea, Japan, Switzerland, U.S.A., and a world wide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive Edwards training courses.

Order spare parts and accessories from your nearest Edwards company or distributor. When ordering, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of part

7.2 Accessories

The following extension leads are compatible with the CP25-3 gauge heads.

Description	Item number
CP25K Gauge head extension lead 5 m	D368-13-005
CP25K Gauge head extension lead 15 m	D368-14-015
CP25K Gauge head extension lead 30 m	D368-14-030
Gauge head adaptor cable for connecting CP25EK gauge head to Edwards Penning module D385-03-040	D368-37-002
NW25 fluoro-elastomer 'O'-ring	H021-24-035
NW25 centring ring and 'O'-ring	C105-14-395
NW25/25 clamping ring	C105-14-401