

Instruction Manual

Metal Sealed Active Inverted Magnetron Gauge

Description	Item Number
AIM-S-DN40CF AIM Gauge	D146-61-000
AIM-SL-DN40CF AIM Gauge	D146-64-000
AIM-X-DN40CF AIM Gauge	D146-62-000
AIM-XL-DN40CF AIM Gauge	D146-65-000





Declaration of Conformity

We, Edwards,
Manor Royal,
Crawley,
West Sussex, RH10 9LW, UK

declare under our sole responsibility, as manufacturer and person within the EU authorised to assemble the technical file, that the product(s)

Metal Sealed Inverted Magnetron Gauge

AIM-S-DN40CF	D146-61-000
AIM-X-DN40CF	D146-62-000
AIM-SL-DN40CF	D146-64-000
AIM-XL-DN40CF	D146-65-000

to which this declaration relates is in conformity with the following standard(s) or other normative document(s)

EN61010-1: 2001	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. General Requirements
EN 61326-2-3: 2006	Electrical equipment for measurement, control and laboratory Use. EMC requirements. Particular requirements. Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

and fulfils all the relevant provisions of

2006/95/EC	Low Voltage Directive
2004/108/EC	Electromagnetic Compatibility (EMC) Directive

Note: This declaration covers all product serial numbers from the date this Declaration was signed onwards.

Mr L. Marini, Technical Manager

9 December 2009

Date and Place

This product has been manufactured under a quality system registered to ISO9001

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1 Introduction

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards Metal Sealed Active Inverted Magnetron Gauge. Read this manual before attempting to install and operate the gauge.

This manual contains essential safety information which supplements the safety features of the gauge. 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 units used throughout this manual conform to the SI international system of units of measurement.

The following symbol is on the AIM gauge:



Edwards offer European customers a recycling service.

1.2 Description

The AIM Gauge, shown in [Figure 1](#), is an inverted magnetron gauge head and gauge controller in a single compact unit. The gauge operates as a cold cathode ionisation gauge, in which the pressure is measured indirectly as function of the current which flows in a Townsend discharge maintained in the body tube.

Four versions of AIM Gauge are available: the S, SL, X and XL gauges. The X and XL gauges have an extended measurement range (see overleaf) and a linear output characteristic. The SL and XL gauges have a very low external magnetic field and are suitable for use with sensitive analytical instrumentation.

The measurement range of the AIM-S and AIM-SL gauges is 1×10^{-8} to 1×10^{-2} mbar. The measurement range of the AIM-X and AIM-XL gauges is 1×10^{-9} to 1×10^{-2} mbar. The AIM Gauge vacuum connection is a DN40CF flange.

The AIM Gauge requires a 13.5 to 36 V d. C. Power supply; it has a 2 to 10 V d. c. analogue output which is related to pressure. The AIM Gauge is compatible with all of the Edwards AGC's (Active Gauge Controllers) and with the appropriate versions of the Edwards AGD's (Active Gauge Displays). Alternatively, you can use an independent power supply for the AIM Gauge and you can read the AIM Gauge output signal with a voltmeter or analogue-to-digital converter.

We recommend that you do not operate the AIM Gauge unless the pressure in the vacuum system is 1×10^{-2} mbar or lower. A gauge enable signal is used to control the operation of the AIM Gauge; refer to [Section 4.2](#) for more information.

An 8-way electrical connector socket on the AIM Gauge ([Figure 1](#), item 7) is used to connect the AIM Gauge to your AGC, AGD or electrical supply and voltmeter. Electrical cables fitted with suitable connector plugs are available as accessories.

A gauge identification signal is available on the electrical connector; this signal is used by Edwards AGC's to identify which type of Active Gauge is connected.

The AIM Gauge has a set point facility; the set point signal is an open drain transistor (FET) output, which is on when the pressure measured by the Gauge is below a pre-set pressure. You can adjust the pressure at which the set point output goes on; refer to Section 4.4.

Note: If you use an Edwards AGC Controller or AGD Display, the AIM Gauge set point output signal is not used.

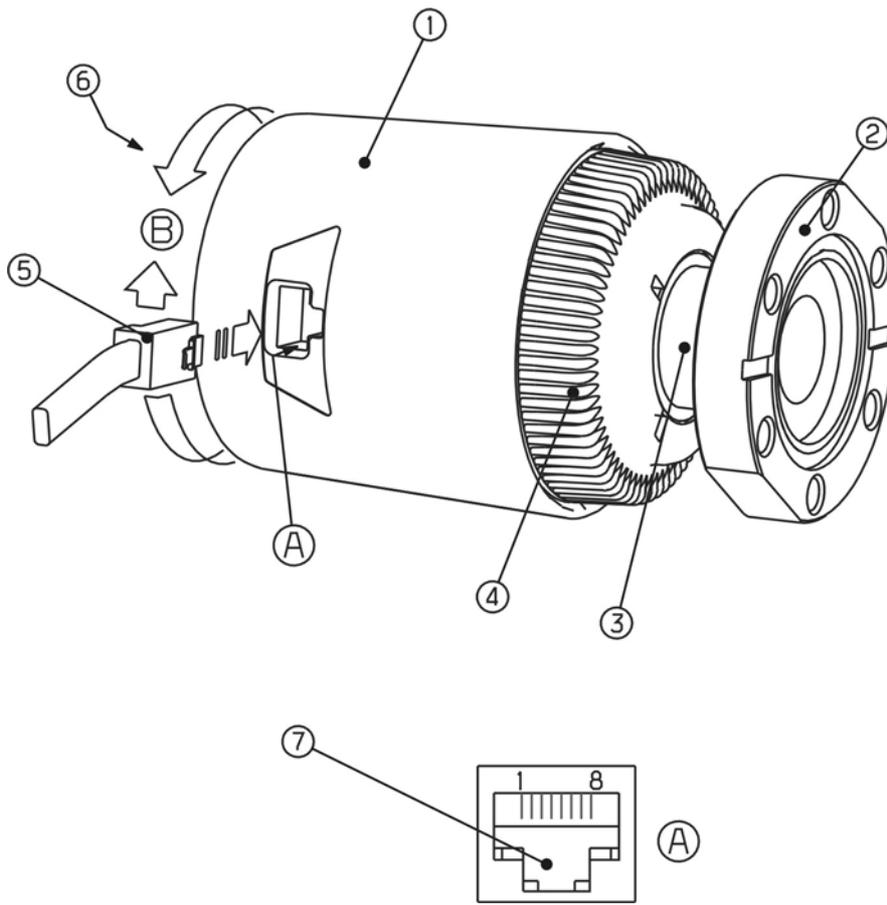
1.3 Gas dependency

The ionisation of the gas in the vacuum system is dependent on both the pressure and the physical properties of the gas. Therefore, the output signal of the AIM Gauge is gas dependent.

The output signal voltage to pressure conversions in Section 4.3 apply for nitrogen and dry air.

Calibration graphs for use with argon, neon, krypton, helium and carbon dioxide are available on request; contact your supplier or Edwards.

Figure 1 - General view of the AIM gauge (showing the DN40CF flange)



- | | |
|-------------------|---|
| 1. End-cap | 5. Cable connector plug |
| 2. Vacuum flange | 6. Set-point potentiometer (on end of item 1) |
| 3. Body tube | 7. AIM gauge connector socket |
| 4. Magnet housing | |

2 Technical data

2.1 Mechanical data

Dimensions	See Figure 2
Mass	
AIM-S/X-DN40CF	1090 g
AIM-SL/XL-DN40CF	1140 g
Volume of gauge tube	26 cm ²
Enclosure rating	IP40 (BS5490) and IP403 (IEC529)

2.2 Performance, operating and storage conditions

Ambient temperature	
Operation	5 to 60 °C
Storage	0 to 70 °C
Ambient humidity (operation)	10 to 90% (non condensing)
Bakeability	300 °C (with electronics removed)
Maximum operating altitude	2000 m (indoor use only)
Maximum internal pressure	+ 6 bar absolute (5 bar gauge)
Pressure measurement range	
AIM-S/SL-DN40CF	1x10 ⁻⁸ to 1x10 ⁻² mbar
AIM-X/XL-DN40CF	1x10 ⁻⁹ to 1x10 ⁻² mbar
Pollution degree	2

2.3 Electrical data

Voltage	+13.5 to +36 V d.c.
Max voltage ripple	1 V peak to peak
Max source resistance	50 Ω
Max power consumption	2 W
Electrical connector	FCC68/RJ45 type, 8-way
Pressure output signal	
Range	2 ≤ output ≤ 10 V d.c.
Error range	output < 2 V d.c. or output >10 V d.c.
Impedance	0.1 Ω
Min load impedance	10 kΩ
Max current source	1 mA

Gauge enable		
	Control sense	Active low
	Active level	<1.3 V
	Control impedance	12 k Ω pull up to positive supply
	Set point output external load rating	40 V d.c., 100 mA max
Set point trip level		
	Range	1.8 to 10.0 V
	Minimum load impedance	200 k Ω
	Hysteresis	500 mV
Back EMF suppression diode [*]		
	Min. surge rating	1 A
	Min. reverse voltage rating	100 V
Gauge identification resistance		
	AIM-S/SL-DN40CF	100 k Ω \pm 2%
	AIM-X/XL-DN40CF	110 k Ω \pm 2%

^{*} Required when you use an external d. c. relay connected to the set point output.

2.4 Error monitoring

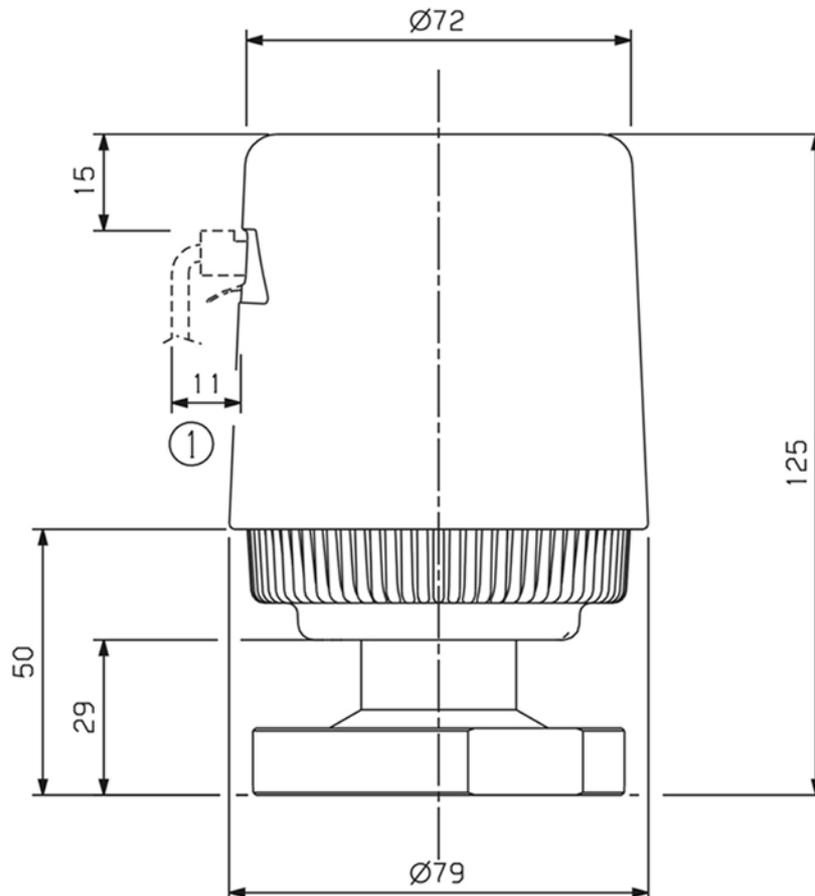
The set-point output is switched off:

- For 0.5 seconds during gauge switch on
- When pressure output signal voltage <1.8 V

2.5 Materials exposed to vacuum

- Stainless steel (AISI 304, 316 and 347)
- Copper
- Ceramic
- Very small amount of copper braze

Figure 2 - Dimensions (mm)



1. Clearance required for electrical cable

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3 Installation

3.1 Unpack and inspect



WARNING

The AIM 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 AIM Gauge. If the AIM Gauge is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the AIM Gauge together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the AIM Gauge if it is damaged.

If the AIM Gauge is not to be used immediately, replace the protective covers.

Store the AIM Gauge in suitable conditions as described in [Section 6](#).

Note: Please consult your supplier in case of any difficulty.

3.2 Fit the AIM gauge to the vacuum system

The AIM Gauge can be mounted in any orientation. To avoid the build-up of debris or condensable material in the body tube of the AIM Gauge (which will probably cause pressure measurement errors), we recommend that you install the AIM Gauge vertically as shown in [Figure 2](#).

Use a copper gasket and screws to connect the DN40CF flange of the AIM Gauge to a similar flange on your vacuum system.

If required, you can turn the end-cap (relative to the magnet housing) so that the electrical connection socket is in a convenient position on your system; refer to [Figure 1](#) and use the following procedure: hold the magnet housing (4) and turn the end cap (1) in a clockwise or anti-clockwise direction (arrow B) until the electrical connection socket (7) is in the required position.

3.3 Electrical connections



WARNING

If the AIM Gauge malfunctions, the AIM Gauge pressure output may be incorrect. If such a failure could cause injury to people or damage equipment, you must install a suitable control system to indicate the failure and, if necessary, to close down your process system.

When using a cable longer than 30 m, full compliance with the EN61326 requires an in-line surge suppressor (please refer to [Section 7.3](#)).

3.3.1 Connect to Edwards controllers or AGD display

Connect the AIM Gauge to the controller or display with a cable which is terminated in suitable connectors. Suitable cables are available from Edwards (refer to [Section 7](#)).

3.3.2 Connect to your own supply and control equipment

Note: Do not connect the electrical supply common (pin 2) to the signal common (pin 5). If you do, the AIM Gauge pressure output signal will be inaccurate.

A schematic diagram of the recommended electrical connections to the AIM Gauge is shown in Figure 3.

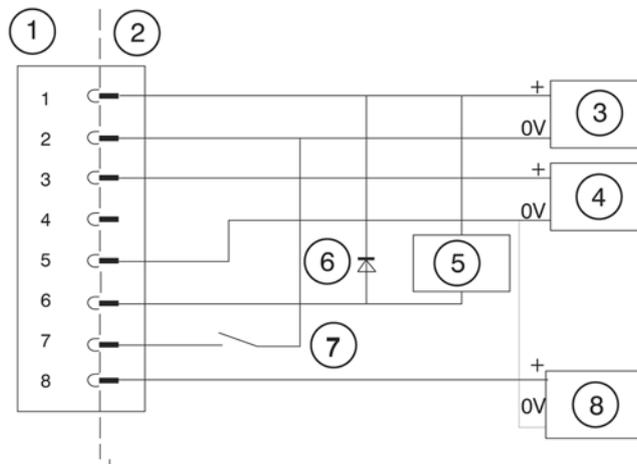
The pins on the AIM Gauge electrical connection socket are used as shown in Table 1. The specification of the electrical supply, d.c. relay and back EMF suppression diode are given in Section 2.

The connection to pin 6 is optional. Make the connection to pin 6 if you want to connect the set-point output signal to a d.c. relay; you must connect a suppression diode between pins 1 and 6 to protect the AIM Gauge from transient voltages generated when the d.c. relay is switched off.

You can connect a voltmeter between pins 5 and 8 to measure the set-point trip level (that is, the voltage at which the set-point output will go on); see Figure 3.

Connect a switch between pins 2 and 7 to enable and disable the gauge (refer to Section 4.2). If you want to measure the gauge identification signal (which identifies the AIM Gauge), measure the resistance between pins 4 and 5.

Figure 3 - Schematic diagram of typical electrical connections



- | | |
|--|--|
| 1. AIM gauge electrical connector socket | 5. D. C. relay (optional) |
| 2. Cable electrical connector plug | 6. Back EMF suppression diode (optional) |
| 3. Electrical supply | 7. Gauge enable switch |
| 4. Voltmeter (pressure signal) | 8. Voltmeter (set-point trip level) |

Table 1 - Pins on the AIM gauge electrical connector socket

Pin Number	Use
1	Electrical supply positive voltage
2	Electrical supply common
3	Pressure measurement output signal
4	Gauge identification signal
5	Signal common
6	Set-point output signal
7	Gauge enable
8	Set-point trip level

4 Operation

4.1 Safety



WARNING

Do not use the AIM Gauge to measure the pressure of explosive or flammable gases or mixtures.



WARNING

Never operate the AIM Gauge when it is disconnected from the vacuum system or when there are explosive or flammable gases in the surrounding atmosphere the vacuum system. High voltages (up to 3 kV) are generated inside the body tube of the AIM Gauge; these could cause injury to people or could be a source of ignition.



WARNING

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

4.2 Enable and disable the AIM gauge

CAUTION

Do not operate the AIM Gauge for long periods when the system pressure is above 1×10^{-2} mbar. If you do the anode pin can be damaged and the AIM Gauge can be severely contaminated.

We recommend that you only enable the AIM Gauge when the system pressure is lower than 1×10^{-2} mbar and that you disable the gauge when the system pressure is 1×10^{-2} mbar or higher.

If you have connected the AIM Gauge to an AGC or AGD, refer to the corresponding instruction manual for details of how to enable (switch on) and disable (switch off) the AIM Gauge.

Otherwise, to enable (switch on) the AIM Gauge, connect pin 7 to pin 2 (or to ground). To disable (switch off) the AIM Gauge, disconnect pin 7 from pin 2 (or from ground).

Generally Magnetron Gauges exhibit a delay between switching on and establishment of the discharge. This striking time increases with decreasing pressure. Typical values for a clean gauge are shown overleaf.

Table 2 - Typical values of pressure and striking time for a clean gauge

Pressure	Striking time
10^{-7} mbar	≈ 10 seconds
10^{-8} mbar	≈ 60 seconds
5×10^{-9} mbar	≥ 5 minutes

4.3 Pressure measurement

If you connected the AIM Gauge to an Edwards AGC controller or AGD display, the pressure measured by the AIM Gauge is shown on the display.

If you connected the signal output of the AIM Gauge to a voltmeter, convert the measured voltage to the corresponding pressure value: For AIM-S and AIM-SL gauges refer to [Table 2](#), for AIM-X and XL gauges use the equation:

$$P=10 \left(\frac{7}{8} V - 10.75 \right)$$

where P is the pressure in mbar, and V is the measured voltage.

If necessary, adjust the pressure reading to compensate for the RMM of the gas in your vacuum system (refer to [Section 1.3](#))

4.4 Set-point

Note: *The set-point is not used if you connect the AIM Gauge to an Edwards AGC Controller or AGD display.*

To adjust the voltage at which the set-point output signal goes on, turn the set-point potentiometer, which is accessible through an access hole in the end cap of the gauge: see [Figure 1](#). Turn the potentiometer clockwise to increase the voltage and turn it anticlockwise to decrease the voltage. Refer to [Section 4.3](#) to determine the operating voltage which corresponds to a given pressure.

The AIM Gauge has an error monitoring facility, which ensures that the set-point output signal is off:

- When the gauge is switched off (that is, not enabled)
- For 0.5 seconds immediately after the AIM Gauge is switched on
- When the pressure output signal is out of range, perhaps because the gauge has failed to strike (ignite)

If required you can adjust the potentiometer so that the set-point operating voltage is < 1.8 V (that is, turn the potentiometer fully anticlockwise). This ensures that the set-point output signal is permanently off.

If required, you can use the set-point output signal to indicate when the Gauge is operating correctly; adjust the potentiometer so that the set-point operating voltage is ≥ 10 V (that is, turn the potentiometer fully clockwise). If the gauge is operating normally, the set-point output signal will then be switched on.

Note: *If you adjust the set-point operating voltage to >9.5 V the hysteresis voltage will be >10 V and the set-point output signal may not switch off when the pressure rises; if so, the set-point output signal will only go off when the gauge is switched off (that is, disabled).*

4.5 Baking

Before baking the gauge the electronics module must be removed from the tube. The tube can then be baked to temperatures of up to 300 °C. The rates of temperature rise and fall should not exceed 10 °C per minute.

A lower rate of gas evolution from the gauge walls and hence a lower ultimate pressure will be achieved if the gauge is operated as soon as possible during the cooling phase. It is therefore recommended that the electronics module should be replaced and the gauge switched on when the tube temperature has fallen below 60 °C.

Table 3 - Pressure and voltage characteristics for nitrogen and dry air: AIM-SL and AIM-S gauges

Pressure mbar	Output voltage	Pressure torr
1.0×10^{-8}	2.00	7.5×10^{-9}
2.4×10^{-8}	2.50	1.8×10^{-8}
5.8×10^{-8}	3.00	4.4×10^{-8}
8.1×10^{-8}	3.20	6.1×10^{-8}
1.1×10^{-7}	3.40	8.3×10^{-8}
1.5×10^{-7}	3.60	1.1×10^{-7}
2.1×10^{-7}	3.80	1.6×10^{-7}
2.9×10^{-7}	4.00	2.2×10^{-7}
4.0×10^{-7}	4.20	3.0×10^{-7}
5.4×10^{-7}	4.40	4.1×10^{-7}
7.3×10^{-7}	4.60	5.5×10^{-7}
9.8×10^{-7}	4.80	7.4×10^{-7}
1.3×10^{-6}	5.00	9.8×10^{-7}
1.7×10^{-6}	5.20	1.3×10^{-6}
2.2×10^{-6}	5.40	1.7×10^{-6}
2.8×10^{-6}	5.60	2.1×10^{-6}
3.6×10^{-6}	5.80	2.7×10^{-6}
4.5×10^{-6}	6.00	3.4×10^{-6}
5.6×10^{-6}	6.20	4.2×10^{-6}
6.9×10^{-6}	6.40	5.2×10^{-6}
8.4×10^{-6}	6.60	6.3×10^{-6}
1.0×10^{-5}	6.80	7.5×10^{-6}
1.2×10^{-5}	7.00	9.0×10^{-6}
1.4×10^{-5}	7.20	1.1×10^{-5}
1.7×10^{-5}	7.40	1.3×10^{-5}
2.0×10^{-5}	7.60	1.5×10^{-5}
2.4×10^{-5}	7.80	1.8×10^{-5}
2.9×10^{-5}	8.00	2.2×10^{-5}
3.5×10^{-5}	8.20	2.6×10^{-5}
4.3×10^{-5}	8.40	3.2×10^{-5}
5.7×10^{-5}	8.60	4.3×10^{-5}
7.9×10^{-5}	8.80	5.9×10^{-5}
1.2×10^{-4}	9.00	9.0×10^{-5}
1.9×10^{-4}	9.20	1.4×10^{-4}
3.3×10^{-4}	9.40	2.5×10^{-4}
6.7×10^{-4}	9.60	5.0×10^{-4}
1.7×10^{-3}	9.80	1.3×10^{-3}
3.6×10^{-3}	9.90	2.7×10^{-3}
1.0×10^{-2}	10.00	7.5×10^{-3}

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5 Maintenance

5.1 Introduction



WARNING

Do not disconnect the electronics and magnet housing from the body tube when the body tube is connected to the vacuum system. If there is a plasma discharge in the vacuum system near the body tube, the body tube can become electrically charged.



WARNING

Disconnect the AIM Gauge before you remove the AIM Gauge from the vacuum system. High voltages are generated inside the AIM Gauge.

The internal components of the AIM Gauge are shown in [Figure 4](#). The AIM Gauge is designed so that you can clean these components, or use the spares listed in [Section 7](#) to replace these components. Refer to the following sections for details of the maintenance procedures which you should do when necessary.

5.2 Replace the body tube

Refer to [Figure 4](#) and use the following procedures to replace the body tube.

5.2.1 Remove the AIM gauge from the vacuum system

1. Switch off the AIM Gauge electrical supply and ensure that the vacuum system is at atmospheric pressure.
2. Disconnect the cable connector plug ([Figure 1](#), item 5) from the AIM Gauge and remove the AIM Gauge from the vacuum system.

5.2.2 Fit the new body tube

1. Hold the magnet housing (1) and turn the body tube (6) anticlockwise (when viewed from the vacuum flange) to unlock the bayonet fitting. Remove the body tube from the magnet housing.
2. Slide the new body tube into the magnet housing (1) (as shown by arrow B).
3. Hold the magnet housing (1) and turn the body tube (6) clockwise (when viewed from the vacuum flange) to lock the bayonet fitting (as shown by arrow C).

5.2.3 Refit the AIM gauge to the vacuum system

Refit the AIM Gauge to the vacuum system as described in [Section 3.2](#) and refit the cable connector plug to the socket on the AIM Gauge ([Figure 1](#), item 7).

5.3 Replace the electrode assembly

CAUTION

Always apply an anti seizing compound to the threads before screwing the threaded cap to the body tube.

Refer to [Figure 4](#) in the following procedure.

1. Remove the AIM Gauge from the vacuum system as described in [Section 5.2.1](#).
2. Remove the body tube from the AIM Gauge as described in [Step 1](#) of [Section 5.2.2](#).
3. Clamp the body tube in a securely mounted vice utilising the flats provided on the outer diameter of the DN40CF flange.
4. Fit a 27 mm socket to the threaded cap (2) using a torque wrench, then turn it anticlockwise to unscrew the threaded cap from the body tube (6) and remove the anode assembly (4) and the copper gasket (5).
5. Use circlip pliers to remove the circlip (9) from the vacuum flange end of the body tube (6), then remove the cathode tube (8) and the cathode plate (7).
6. Fit the new cathode plate (7) and cathode tube (8) into the body tube and secure with the circlip (9).
7. Fit the new gasket (5) and anode assembly (4) into the body tube (6) ensure that the orientation of the anode assembly is correct.
8. Apply a small amount of an anti seizing compound to the threads.
9. Refit the threaded cap (2) to the body tube. Locate the 27 mm socket on the collar. Using the torque wrench, turn the collar clockwise to a torque of 50 N.M.
10. Refit the body tube (6) to the magnet housing (1) as described in [Step 2](#) and [3](#) of [Section 5.2.2](#). Refit the AIM Gauge to the vacuum system as described in [Section 5.2.3](#).

5.4 Replace the electronics and magnet housing

The magnet housing and end-cap contain the AIM Gauge control electronics. Replace the complete unit as described below.

1. Remove the AIM Gauge from the vacuum system.
2. Remove the body tube from the AIM Gauge.
3. Dispose of the old magnet housing and end cap (refer to [Section 6](#)).
4. Fit the body tube to the new magnet housing and end-cap. Refit the AIM Gauge to the vacuum system.

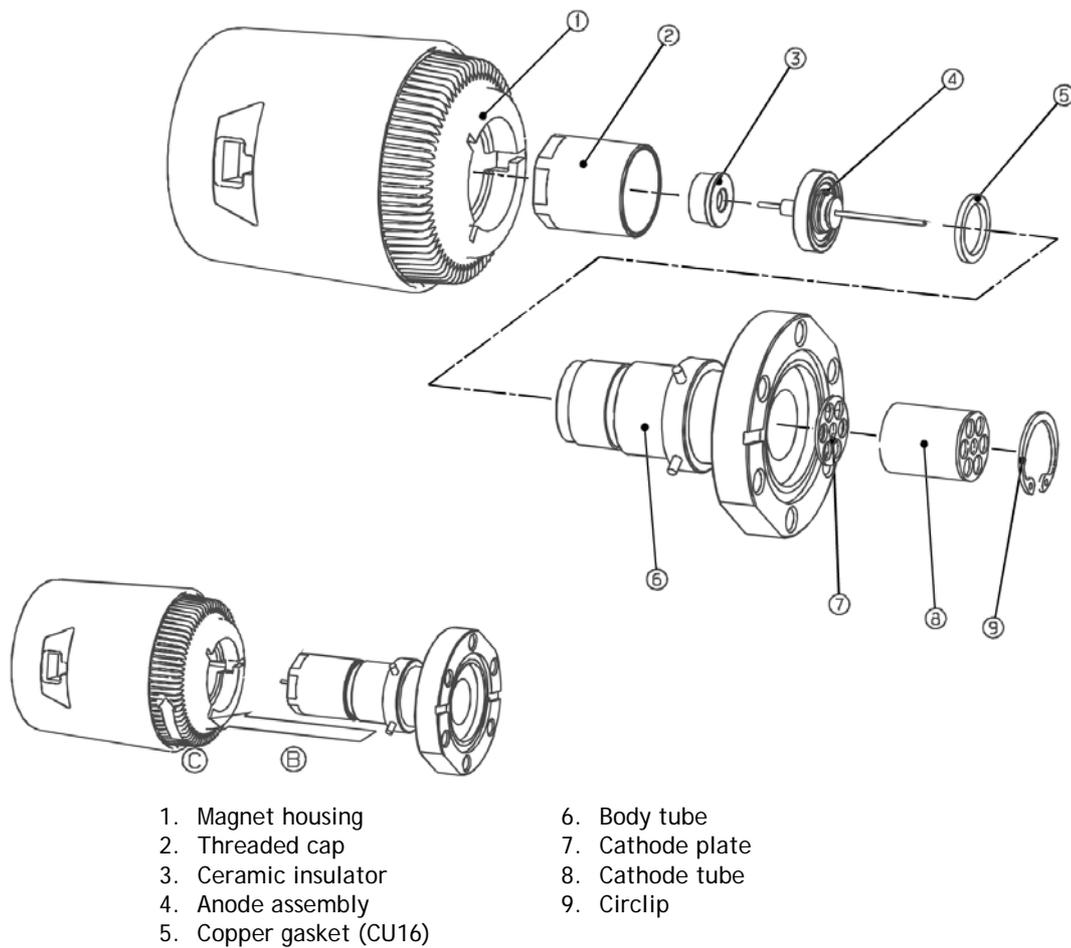
5.5 Clean the internal components

Refer to [Figure 4](#) in the following procedure.

1. Remove the internal components from the magnet housing.
2. Degrease the cathode plate (7), cathode tube (8), body tube (6) and anode assembly in a suitable degreasing agent.
3. Thoroughly soak the components in a suitable laboratory detergent.
4. Rinse the components in clean water to remove the detergent.
5. Rinse the components in methanol to remove all of the water, then thoroughly dry the components.

6. Refit the components in the magnet housing.

Figure 4 - Exploded view of the AIM gauge



5.6 Fault finding

If the AIM Gauge does not operate correctly, ensure that the electrical connections are correct (refer to [Section 3](#)) and ensure that your electrical supply is suitable for the AIM Gauge (refer to [Section 2](#)).

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6 Storage and disposal

6.1 Storage

Return the AIM Gauge to its protective packaging and store the AIM Gauge in clean dry conditions until required for use. Do not exceed the storage temperature conditions specified in [Section 2](#).

When required for use, prepare and install the AIM Gauge as described in [Section 3](#).

6.2 Disposal

Dispose of the AIM Gauge and any components safely in accordance with all local and national safety and environmental requirements.

Alternatively, you may be able to recycle the AIM Gauge and/or cables; contact Edwards or your supplier for advice (also see below).

The AIM Gauge and associated cables are within the scope of the European Directive on Waste Electrical and Electronic Equipment, 2002/96/EC. Edwards offer European customers a recycling service for the AIM Gauge / cables at the end of the product's life. Contact Edwards for advice on how to return the AIM Gauge/cables for recycling.

Particular care must be taken if the AIM Gauge has been contaminated with dangerous process substances or if the AIM Gauge has been overheated or has been in a fire.

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7 Spares and accessories

7.1 Introduction

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

When you maintain this Edwards product, we recommend you use only Edwards maintenance and service kits.

Order spare parts and accessories from your nearest Edwards company or distributor. When you order, 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 Spares

Electronics and Magnet Housing

AIM-S	D146-41-800
AIM-SL	D146-44-800
AIM-X	D146-42-800
AIM-XL	D146-45-800
AIM-DN40CF body tube	D146-61-801
Electrode assembly kit*	D146-61-802

* *The Electrode assembly kit contains one each of the following components: Cathode plate, Cathode tube, Circlip, Copper gasket and an Anode assembly.*

7.3 Accessories

The cables suitable for use with the AIM Gauge are as follows. These cables are supplied with 8-way male electrical connectors on both ends.

Cable length		Item Number
0.5 m	18 inches	D400-01-005
1.0 m	3 feet	D400-01-010
3.0 m	10 feet	D400-01-030
5.0 m	15 feet	D400-01-050
10 m	30 feet	D400-01-100
15 m	50 feet	D400-01-150
25 m	80 feet	D400-01-250
50 m	150 feet	D400-01-500
100 m	325 feet	D400-01-999
Surge suppressor		D400-06-000

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