

Instruction Manual

Digital Active Pirani Gauge (nAPG)



Description	Item Number
nAPG-M RS485 NW16	D026-90-000
nAPG-M RS485 NW25	D026-90-010
nAPG-M RS485 DN16 CF	D026-90-020
nAPG-M RS232 NW16	D026-90-500
nAPG-M RS232 NW25	D026-90-510
nAPG-M RS232 DN16 CF	D026-90-520
nAPG-LC RS485 NW16	D026-91-000
nAPG-LC RS485 NW25	D026-91-010
nAPG-LC RS485 DN16 CF	D026-91-020
nAPG-LC RS232 NW16	D026-91-500
nAPG-LC RS232 NW25	D026-91-510
nAPG-LC RS232 DN16 CF	D026-91-520

Original Instructions





Declaration of Conformity

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

Digital Active Pirani Gauge (nAPG)	D026-9X-XXX
Digital Active Inverted Magnetron Gauge (nAIM)	D146-9X-XXX
Digital Wide Range Gauge (nWRG)	D147-9X-XXX

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

EN61326-2-3: 2013	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
CAN/CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, Control and laboratory use - Part 1: General requirements
UL61010-1, 3 rd Edition	Safety requirements for electrical equipment for measurement, Control and laboratory use - Part 1: General requirements

and fulfils all the relevant provisions of

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2012/19/EU	Waste from Electrical and Electronic Equipment (WEEE) Directive
2011/65/EU	Restriction of Certain Hazardous Substances (RoHS) Directive

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

Mr Larry Marini - Senior Technical Manager

28.02.2017, Eastbourne

Date and Place

This product has been manufactured under a quality management system certified to ISO 9001:2008

Material Declaration

In accordance with the requirements of the Chinese regulatory requirement on the Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products Order No. 32 (also known as 'China RoHS2') and SJ/T 11364 Marking for the Restricted Use of Hazardous Substances in Electronic and Electrical Products:

Product	Product Label	Meaning
nAPG-M RS485 NW16 nAPG-M RS485 NW25 nAPG-M RS485 DN16 CF nAPG-M RS232 NW16 nAPG-M RS232 NW25 nAPG-M RS232 DN16 CF nAPG-LC RS485 NW16 nAPG-LC RS485 NW25 nAPG-LC RS485 DN16 CF nAPG-LC RS232 NW16 nAPG-LC RS232 NW25 nAPG-LC RS232 DN16 CF	D02690000 D02690010 D02690020 D02690500 D02690510 D02690520 D02691000 D02691010 D02691020 D02691500 D02691510 D02691520	 <p><i>This product contains hazardous substances in at least one of the homogeneous materials used which are above the limit requirement in GB/T 26572 as detailed in the declaration table below.</i></p> <p><i>These parts can safely be used for the environmental protection use period as indicated.</i></p>

材料成分声明 Materials Content Declaration

部件名称 Part name	有害物质 Hazardous Substances					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
印刷电路组件 (PCA) Printed Circuit Assembly (PCA)	X	O	X	O	O	O
电缆/电线/连接器 Cable/wire/connector	X	O	O	O	O	O

O: 表示该有害物质在该部件的所有均质材料中的含量低于 GB/T 26572 标准规定的限量要求
O: Indicates that the hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in GB/T 26572.

X: 表示该有害物质在该部件的至少一种均质材料中的含量超出 GB/T26572 标准规定的限量要求
X: Indicates that the hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T26572.

These products are EU RoHS complaint, the following Exemptions apply:

- 6(b) Lead as an alloying element in aluminium containing up to 0.4% by weight
- 6(c) Copper alloy containing up to 4% lead by weight
- 7(a) Lead in high melting temperature type solder (i.e lead based alloys containing 85% by weight or more lead)
 - (c) I Electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezoelectronic devices, or in a glass or ceramic matrix compound
 - 7(c) II Lead in dielectric ceramic in capacitors for a rated voltage of 125 V AC or 250 V DC or higher
- 8(b) Cadmium and its compounds in electrical contacts
- 15 Lead in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages
- 34 Lead in cermet-based trimmer potentiometer elements

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1 Introduction

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Digital Active Pirani Gauge (nAPG). The nAPG must be used as specified in this manual. Read this manual before installing and operating the nAPG.

Important safety information is highlighted as WARNING and CAUTION instructions; these instructions must be obeyed. The use of WARNINGS and CAUTIONS is defined below.



WARNING

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

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

The units used throughout this manual conform to the SI international system of units of measurement.



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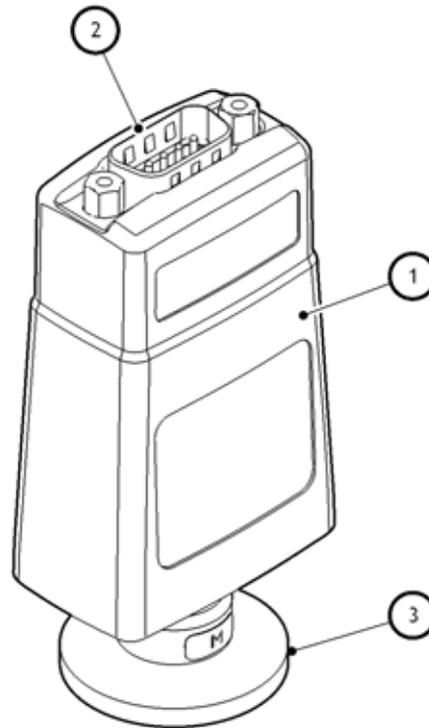
1.2 Description

The nAPG, shown in [Figure 1](#), is a Pirani gauge which measures vacuum pressures in the range 10^{-4} mbar to 1000 mbar. It operates using the principle of thermal conductivity in which the rate of heat loss from a heated filament is dependent on the pressure of gas surrounding the filament. The gauge features a detachable tube which allows a replacement to be fitted in the event of contamination or failure of the filament.

The nAPG is available in a number of variants based on Tube, Flange and Serial communications interface. Tubes are available in two tube versions: the 'M' version can measure pressure down to 10^{-3} mbar and is suitable for general applications; the 'LC' version can measure pressure down to 10^{-4} mbar and is also suitable for use in corrosive applications. Flanges are available in NW16, NW25 and DN16 CF.

All gauge calibration and control functions are carried out over serial communications. The serial communications interface is available in two versions: RS232 for point-to-point systems; RS485 for either point-to-point or multi-drop systems.

Figure 1 - General view of the nAPG



1. Electronics housing
2. Electrical connector
3. Vacuum flange

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2 Technical data

2.1 Mechanical data

Table 1 - Mechanical data

Parameter	Value
Dimensions	Refer to Figures 2 and 3
Mass	
NW16	85 g
NW25	100 g
DN16 CF	107 g
Internal volume of tube	5 cm ³
Enclosure rating	IP42 (vertical, with the vacuum flange at the bottom) IP40 (all other orientations)

2.2 Performance, operating and storage conditions

Table 2 - Performance, operating and storage conditions

Parameter	Value
Measurement range	
nAPG-M	10 ⁻³ to 1000 mbar
nAPG-LC	10 ⁻⁴ to 1000 mbar
Accuracy	
nAPG-M	± 15 % at < 100 mbar
nAPG-LC	± 15 % at < 10 mbar
Maximum over- pressure	10 bar absolute (9 bar gauge)
Ambient temperature	
Operating	5 to 60 °C
Storage	-30 to +70 °C
Bake-out with electronics removed	150 °C
Filament temperature	-100 °C above ambient
Humidity	80 % RH up to 31 °C decreasing linearly to 50 % RH at 40 °C and above
Maximum altitude	3000 m (indoor use only)
Pollution degree	2

2.3 Electrical data

Table 3 - Electrical data

Parameter	Value
Electrical supply voltage	
Nominal	+15 to +48 V d.c.
Minimum	+14.5 V d.c.
Maximum	+52.8 V d.c.
Max voltage ripple	1 V peak-to-peak
Max source resistance	50 Ω
Maximum power consumption	1 W
Electrical connector	9 way D-type male
Setpoint output	Open collector transistor
Rating	48 V d.c., 100 mA max
Back EMF suppression diode *	
Min. surge rating	1 A
Min. reverse voltage rating	100 V
Gauge identification resistance	
All digital gauges	10 k Ω \pm 2%

* Required when using an external d.c. relay connected to the setpoint output.

2.4 Serial communications

Table 4 - Serial communications

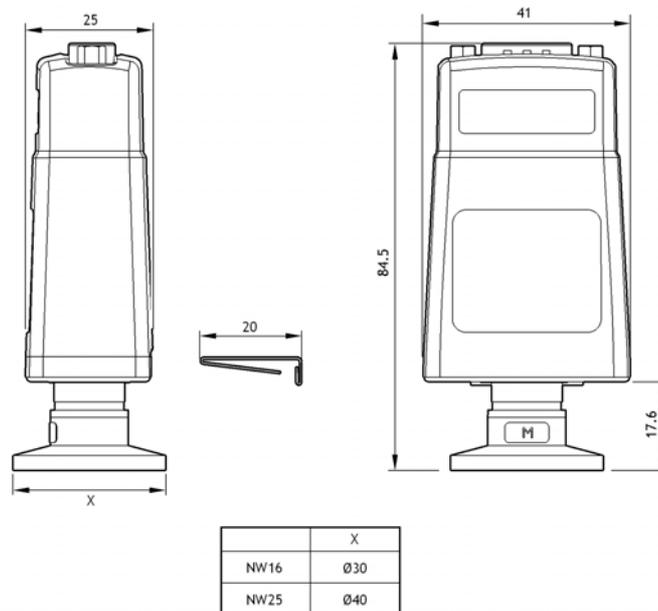
Parameter	Value
RS232 transmit	
Mark	< -8 V (I_{out} max: -8 mA)
Space	> +8 V (I_{out} max: +8 mA)
RS232 receive	
Mark	< +1 V (I_{in} max: -2 mA)
Space	> +2 V (I_{in} max: +2 mA)
Maximum input	\pm 12 V
RS485	
Output differential	> 1.5 V (I_{out} max: \pm 25 mA)
Input differential threshold	> \pm 0.2 V (I_{in} max: \pm 1 mA)
Maximum input	-7 V to +12 V
Bus load	The gauge applies one unit load to the RS485 bus.
Default setup	9600 baud, 8 bits, 1 stop bit, no parity
Maximum baud rate	38400 baud

2.5 Materials exposed to vacuum

Table 5 - Materials exposed to vacuum

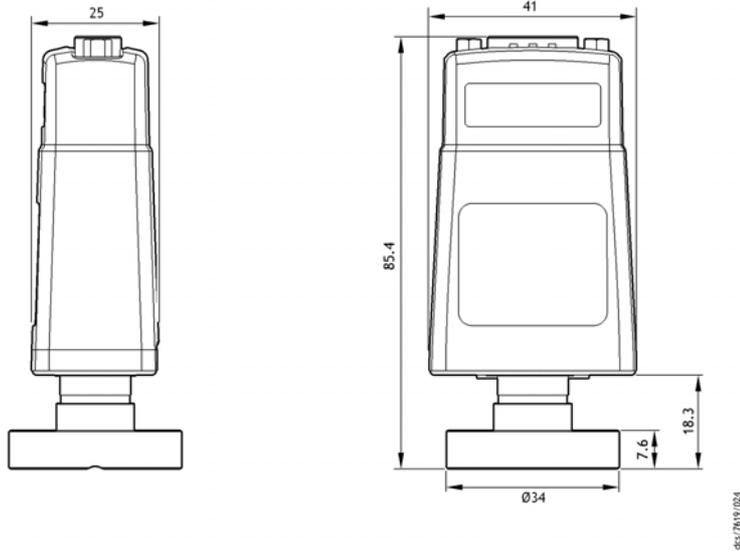
Component	Material
Filament	
nAPG-M	Tungsten / Rhenium
nAPG-LC	Platinum / Iridium
Tube assembly	Stainless Steel
	Nickel
	Nickel plated NiFe
	Glass
	PTFE (nAPG-LC only)

Figure 2 - Dimensions (mm) on the nAPG-NW16 / nAPG-NW25



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Figure 3 - Dimensions (mm) on the nAPG-DN16 CF



3 Installation

3.1 Unpack and inspect

Remove all packing materials and protective covers and check the nAPG.

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

If the nAPG is not to be used immediately, replace the protective covers. Store the nAPG in suitable conditions as described in Section 6.

3.2 Fit the nAPG to the vacuum system

The nAPG can be mounted in any orientation. To avoid the build-up of debris or condensable material in the body tube of the nAPG (which will probably cause pressure measurement errors), Edwards recommend installing the nAPG vertically, as shown in Figures 2 to 3.



WARNING

A co-seal or trapped O-ring carrier must be used to connect a nAPG to a vacuum system if the pressure is likely to exceed atmospheric pressure. Standard centring rings are not suitable for use above atmospheric pressure.



WARNING

Do not use the nAPG for safety critical applications. The nAPG is not intended to be fail-safe.

CAUTION

Where protection against fluid ingress is required, ensure that the gauge is installed vertically, with the vacuum flange at the bottom. For all other mounting orientations the gauge has no protection against fluid ingress and should be installed where fluids cannot enter the gauge.

Use an O-ring / centring ring or co-seal and clamp to connect the NW16 or NW25 flange of the nAPG to a similar flange on the vacuum system.

Use a stepped O-ring carrier or co-seal to connect an NW16 flange of the nAPG to an NW10 flange on the vacuum system.

Use a copper gasket and screws to connect a DN16 CF flange of the nAPG to a similar flange on the vacuum system.

In accordance with good practice, it is recommended that the vacuum system has a secure Earth (ground) connection, and that the tube of the nAPG is electrically connected to the vacuum system.

3.3 Electrical connections



WARNING

Ensure that the gauge is installed in accordance with all national and local safety regulations. Ensure that all wiring is safely secured to eliminate trip hazards.



WARNING

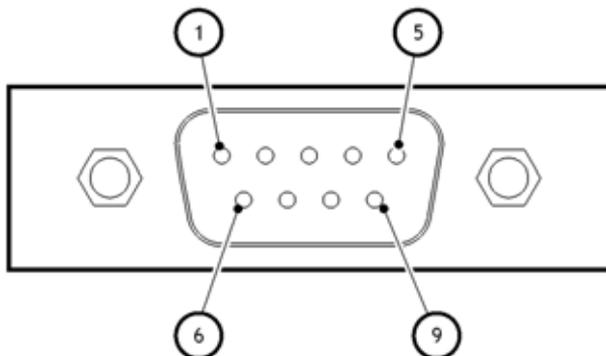
If the nAPG malfunctions, the pressure measurement may be incorrect. If such a failure could cause injury to people or damage equipment, install a suitable control system to indicate the failure and, if necessary, to close down the process system.

3.3.1 Connect to customer supply and control equipment

A schematic diagram of the recommended electrical connections to the nAPG is shown in Figure 5.

The pins on the nAPG electrical connection socket are used as shown in Table 6. The specification of the electrical supply, d.c. relay and back EMF suppression diode are given in Section 2.

Figure 4 - D-type 9-way male connector



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Table 6 - Pin identification

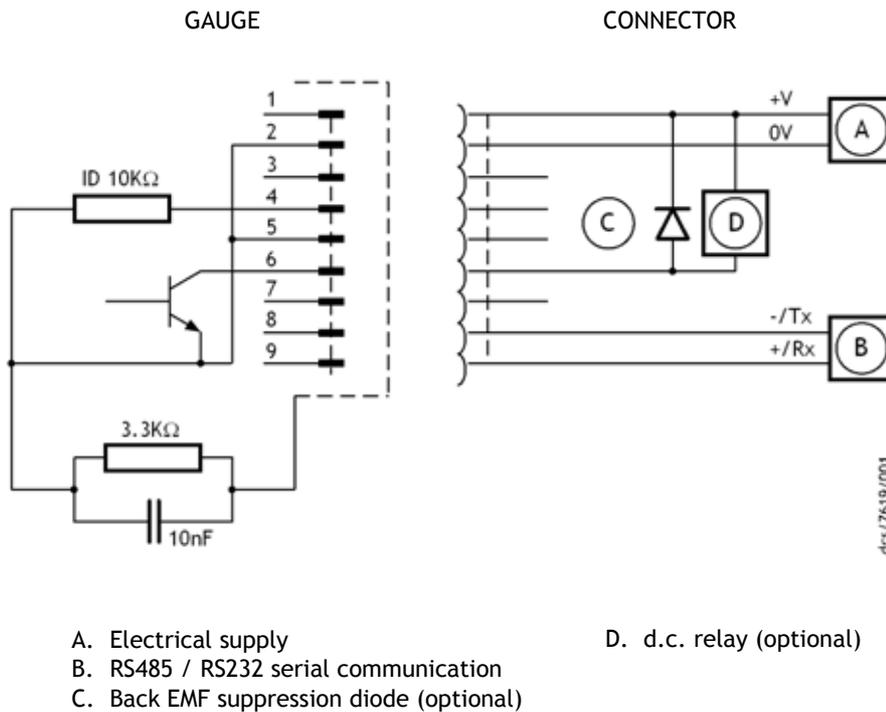
Pin number	Connection
1	Supply positive
2	Supply common
3	Not connected
4	ID resistor
5	RS485 / RS232 common
6	Setpoint output
7	Not connected
8	RS485 Negative / RS232 Transmit
9	RS485 Positive / RS232 Receive

Connections to pins 4 and 6 are optional.

The value of the ID resistor is determined by measuring the resistance between pins 4 and 5. All serial gauges are identified by a 10 kΩ resistor as full gauge identification is carried out over serial communications.

The setpoint output on pin 6 is an active low open-collector transistor suitable for driving a d.c. relay or control logic. If connecting a relay a suppression diode must be used to protect the gauge from transient voltages generated when the relay is switched off, as shown in Figure 5.

Figure 5 - Recommended electrical connections



3.3.2 Connecting the serial interface

The nAPG has one of two serial communications protocols built in, RS232 or RS485. Either interface can be used to for point-to-point communication with a single gauge from the digital gauge range. The RS485 interface can be used to for multi-drop communication with multiple gauges from the digital gauge range.

3.3.2.1 Connecting RS232

The RS232 interface uses two lines for data transfers and an additional line as a signal common. Hardware handshaking is not implemented. The connector pin out is not compatible with standard computer serial leads and these must not be used.

It is recommended that shielded cable be used for the interface to reduce interference problems and the length of the RS232 link should be less than 10 metres. For longer links, either install line drivers or use RS485.

3.3.2.2 Connecting RS485

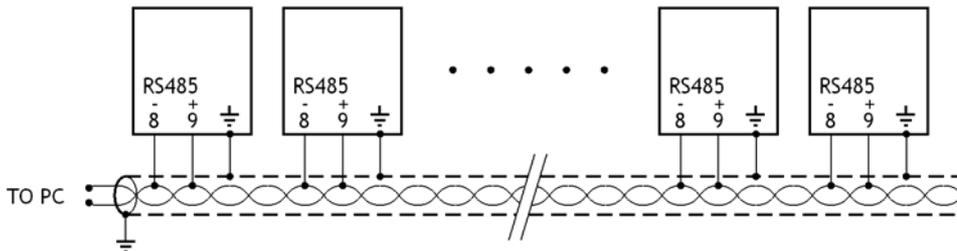
The RS485 interface uses two lines for differential data transfers. Multiple gauges from the digital gauge range, and other RS485 compatible Edwards products, can be connected to the same serial bus, refer to [Figure 6](#).

CAUTION

All of the ground connections are tied together. If differences exist in the local ground voltage, damage could occur. If the gauges being connected are liable to experience different ground potentials, a suitable RS485 isolator should be connected between them.

It is recommended that shielded twisted pair cable be used for the interface to reduce interference problems and the length of the RS485 link should be less than 1000 metres. Long links may require the addition of 120 Ω terminating resistors at each end of the link to improve communications reliability.

Figure 6 - RS485 and ground connections between multiple gauges



4 Operation

4.1 Safety



WARNING

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



WARNING

Never operate the nAPG when it is disconnected from the vacuum system or when there are explosive or flammable gases in the surrounding atmosphere or the vacuum system. The gauge contains a heated filament which normally operates around 100 °C above ambient temperature. The temperature of the filament can be substantially higher under fault conditions. This could cause injury to people or could be a source of ignition.



WARNING

When measuring the pressure of gases of high molecular weight, the pressure indicated can be below the true pressure. Ensure that the nAPG is not over-pressurised when using heavy gases.



WARNING

Use the gauge only for its intended purpose as described in this instruction manual.

4.2 Serial communications

The nAPG is a digital gauge. All gauge controls and pressure measurements are carried out over serial communications.

The communications to the gauge operate on a master / slave principle. The gauge is the slave and will only transmit a message in response to one sent to it. The master, a PC for example, must always start the conversation.

A conversation consists of a message to the gauge and its response back. Having sent a message to the gauge, wait for the reply before continuing.

There are two basic types of message sent to the gauge:

- Command sending information to the gauge (!)
- Query requesting information from the gauge (?).

All messages end with a carriage return.

Refer to the digital gauge range Serial communications manual (D026-91-880) for full details of the serial command protocol and message format.

Refer to [Section 8](#) for a quick reference guide to serial commands supported by this gauge.

4.2.1 Set baud rate - !C780

The gauge baud rate can be set to 9600, 19200 or 38400. The command reply is returned at the current baud rate before the gauge baud rate setting is updated.

The default gauge set up is 9600 baud.

This command can be locked to prevent accidental adjustment.

4.2.2 Multi-drop mode

Multi-drop mode is only supported by RS485 gauges and is enabled when a node address is assigned to a gauge. In multi-drop mode, commands and queries are only responded to when prefixed by a multi-drop header with a valid destination address. Replies are returned to the source address. Node addresses "00" and "99" have special meaning and should be used as described below:

Wildcard "99" addressed messages should only be used with a single gauge in multi-drop mode where its node address is unknown. Use with multiple gauges will result in comms collisions and no valid reply will be received.

Broadcast "00" addressed messages can be used with multiple gauges in multi-drop mode where all gauges require the same command to be performed - e.g. Baud rate setting. No reply will be sent and no alternate message confirmation will be provided.

Refer to the digital gauge range Serial communications manual (D026-91-880) for full details of the serial command protocol and message format. This includes further information on multi-drop mode and gauge responses.

4.2.2.1 Set node address - !750

The gauge node can be set to a value between 00 and 98. It can be read back with the read node address query. Assigning a node address of 00 disables multi-drop mode, and assigning a node address between 01 and 98 enables multi-drop mode. The command reply is returned from the current node address before the gauge node address setting is updated.

The default gauge set up is node address 00 - multi-drop disabled.

This command can be locked to prevent accidental adjustment.

4.2.2.2 Read node address - ?750

The read gauge node address query returns the gauge multi-drop node address. This query can be used with the multi-drop wildcard "99" node address prefix, on a point-to-point serial connection, when the actual gauge node address setting is unknown.

4.2.2.3 Auto-enumerate - !C781

The gauge node can be automatically set to a value between 01 and 98. This command disables all comms replies and uses the gauge setpoint output as a message receipt flag. The gauge comms replies can be re-enabled when the validity of the assigned node address is confirmed.

Refer to the digital gauge range Serial communications manual (D026-91-880) for full details of the auto enumeration process.

This command can be locked to prevent accidental adjustment.

4.3 Gauge identification

All serial gauges are identified by a single value of ID resistor and this is 10 k Ω . All further gauge identification is carried out over serial communications.

4.3.1 Read wildcard identification - ?S0

The read wildcard identification query is consistent across all Edwards products that support serial communications and returns the hardware version, software version and user programmable gauge name.

4.3.2 Read gauge identification - ?S751

The read gauge identification query returns the hardware version, software version and user programmable gauge name.

4.3.3 Set gauge name - !S751

The gauge name can be set to a value between 0000 and 9999. It is read back as part of the gauge identification query.

This command can be locked to prevent accidental adjustment.

4.3.4 Read gauge serial number - ?S790

The read gauge serial number query returns the gauge serial number.

4.4 Pressure measurement

For optimum accuracy it is recommended that both atmosphere and vacuum adjustments are carried out before use. Refer to [Section 4.6.2](#) for atmosphere adjustment and [Section 4.6.3](#) for vacuum adjustment.

4.4.1 Read gauge pressure - ?V752

The read gauge pressure query returns the measured pressure in the selected gas type and pressure units and the gauge status. Refer to [Section 4.11](#) for details of the gauge status bits.

The default gauge set-up is Nitrogen / Air and Pascal.

4.4.2 Acknowledge gauge errors - !S752

Gauge errors are acknowledged and are cleared by sending the Acknowledge gauge errors command to the gauge. Gauge errors that are still active cannot be cleared and will remain active until the cause of the error state is removed. Digital gauge errors are returned in the gauge status and can be read when the gauge pressure is queried. Refer to [Section 4.11](#) for details of the gauge status bits.

4.4.3 Set Pressure units - !S755

Gauge pressure units can be set to mbar, Pascal or Torr. The selected gauge pressure units are returned in the gauge status that is displayed when the gauge pressure is read.

This command can be locked to prevent accidental adjustment.

4.5 Gas dependency

The nAPG is calibrated for use in Nitrogen, and will read correctly with dry air, Oxygen and Carbon Monoxide. For any other gas type an internal conversion is applied in order to indicate the correct pressure reading. Figure 7 and Figure 8 show the equivalent pressure readings for six common gases: Nitrogen, Argon, Helium, Carbon Dioxide, Neon and Krypton. The gas conversion is carried out by the gauge at the time of measurement and the pressure reading is returned in the selected gas type.

Figure 7 - nAPG-M Equivalent pressure readings for six common gases

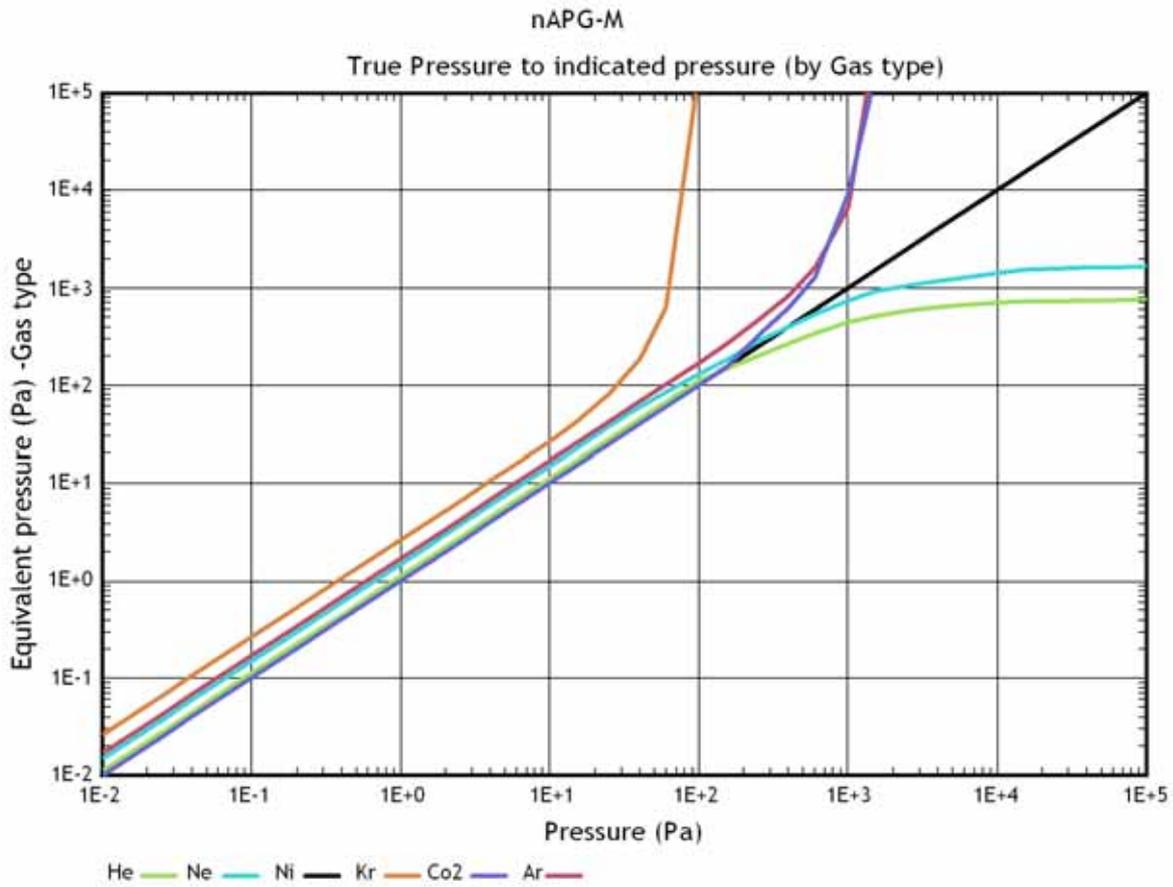
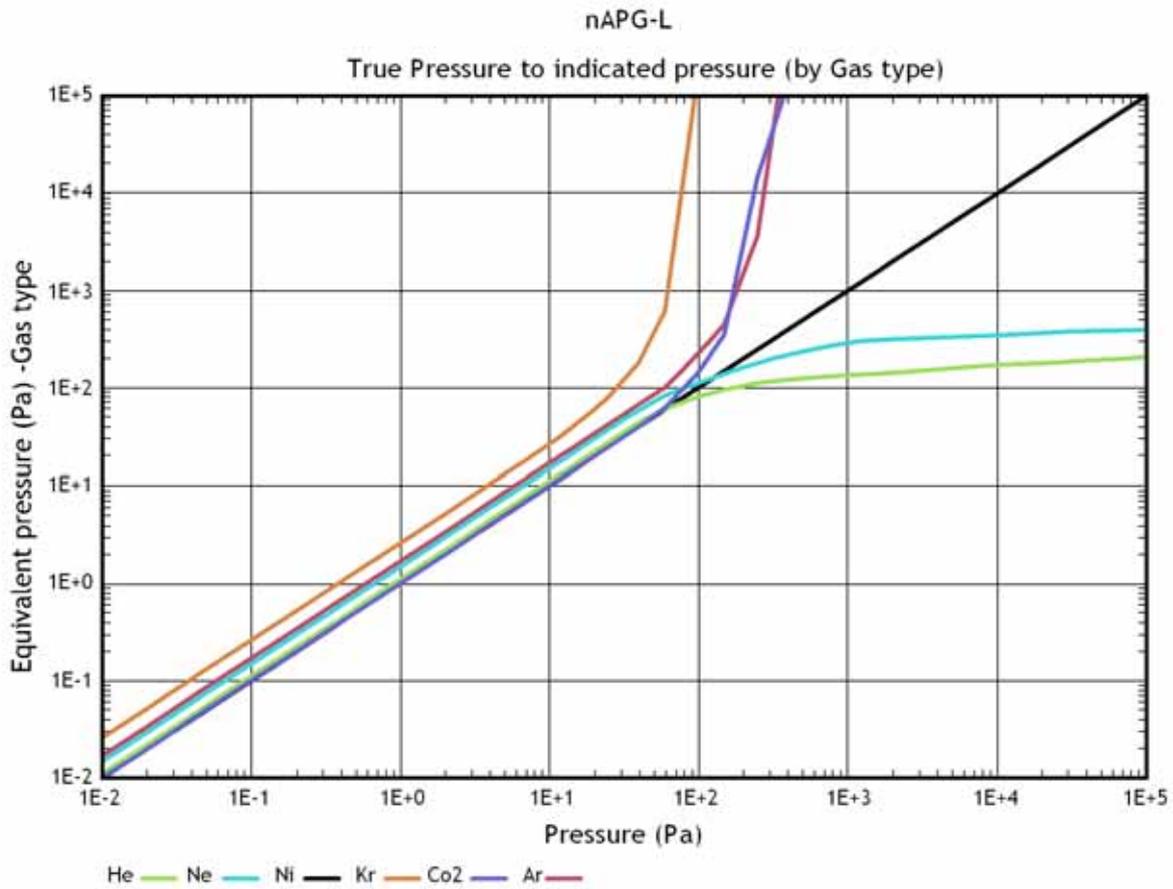


Figure 8 - nAPG-L Equivalent pressure readings for six common gases



4.5.1 Set gas type - !S756

Gauge gas type can be set to Nitrogen, Argon, Helium, Carbon Dioxide, Neon or Krypton. The selected gauge gas type is returned in the gauge status and can be read when the gauge pressure is queried.

This command can be locked to prevent accidental adjustment.

4.6 Gauge adjustments

The nAPG can be adjusted for atmosphere and vacuum when set to a gas type of Nitrogen. Gauge adjustments are not supported in other gas types.

4.6.1 Adjustment for new tube - !S761 0

When a replacement tube is fitted to the gauge, it will be necessary to adjust the gauge to match the new tube. Note that this is only required when a new tube is fitted.

- Switch on the power supply to the nAPG and allow it to operate at atmospheric pressure for at least 10 minutes.
- Trigger the new tube adjustment by sending the tube calibration command to the gauge. The gauge will be automatically adjusted for the new tube and this may take several seconds.
- The status of the gauge during this adjustment is displayed in the gauge status that is returned when the gauge pressure is read. The calibration in progress bit will be cleared when the adjustment is complete.
- It is always necessary to perform atmosphere and vacuum adjustments afterwards for optimum accuracy.

This command can be locked to prevent accidental adjustment.

4.6.2 Atmosphere adjustment - !S761 1

For optimum accuracy it is recommended that atmosphere adjustment is carried out before use.

- Switch on the power supply to the nAPG and allow it to operate at atmospheric pressure for at least 10 minutes.
- Trigger the atmosphere adjustment by sending the calibrate command to the gauge.
- The output of the gauge will be automatically adjusted to read atmosphere.

This command can be locked to prevent accidental adjustment.

4.6.3 Vacuum adjustment - !S761 1

For optimum accuracy it is recommended that vacuum adjustment is carried out before use.

- Reduce the system pressure to 1×10^{-4} mbar (or below) for the nAPG-M, or to 1×10^{-5} mbar (or below) for the nAPG LC and allow it to operate at that pressure for at least 10 minutes.
- Trigger the vacuum adjustment by sending the calibrate command to the gauge.
- The output of the gauge will be automatically adjusted to read vacuum.

This command can be locked to prevent accidental adjustment.

4.6.4 Clear calibration - !S760

The atmosphere and vacuum adjustments can be cleared by sending the clear calibration command to the gauge. The atmosphere and vacuum adjustments on the gauge will be returned to factory default.

This command can be locked to prevent accidental adjustment.

4.7 Setpoint

The setpoint output is an open collector transistor that is activated based on the gauge pressure reading. The setpoint thresholds are set and read in the gauge gas type and pressure units. When the gauge gas type or pressure units are changed, the setpoint thresholds are automatically updated.

The setpoint output is turned OFF (open) when the gauge pressure reading is above the high threshold and turned ON (closed) when below the low threshold. The high and low thresholds allow for programmable hysteresis. No additional hysteresis is added by the gauge.

If the low threshold is set higher than the high threshold, then the high threshold is updated at the same time to the same value. Equally, if the high threshold is set lower than the low threshold, then the low threshold is updated at the same time to the same value.

When both thresholds are set below the operating range of the gauge, then setpoint operation will be disabled.

The gauge setpoint output state is also returned in the gauge status and can be read when the gauge pressure is queried.

4.7.1 Set setpoint thresholds - !S754

The gauge setpoint thresholds can be set to pressure values between 1.0×10^{-10} and 9.9×10^{-6} and these will be in the gauge gas type and pressure units. If the gas type or pressure units are changed, then the setpoint thresholds will be automatically updated for the new settings. The gauge setpoint thresholds can be read back with the read gauge setpoint threshold query.

This command can be locked to prevent accidental adjustment.

4.7.2 Read setpoint thresholds - ?S754

The read gauge setpoint threshold query returns the setpoint threshold pressure in the gauge gas type and pressure units.

4.8 Gauge parameter control

4.8.1 Set gauge command lock - !S753

Gauge commands can be locked to prevent accidental adjustment by sending the command lock command to the gauge. When the gauge command lock is set, changes to gauge parameters are prohibited and attempts to adjust them will return a gauge state error.

4.8.2 Return to default settings - !S757

The gauge pressure units, gas type and setpoint thresholds can be reset to gauge defaults by sending the return to defaults command to the gauge.

This command can be locked to prevent accidental adjustment.

4.9 Gauge run parameters

A counter is provided to monitor the run hours of the gauge and this information can be used to aid in determining the best service interval for the gauge tube based upon the specific process environment.

4.9.1 Read internal temperature - ?V759

The read internal temperature query returns the internal temperature of the gauge processor in degrees Celsius.

4.9.2 Read run hours - ?V769

The read run hours query returns the number of hours the gauge has been operating.

4.9.3 Reset run hours - !C769

The gauge run hours counter can be reset zero by sending the reset run hours command to the gauge.

This command can be locked to prevent accidental adjustment.

4.10 Response error codes

The error codes returned in the case of command or query failure are consistent across all Edwards products that support serial communications:

Table 7 - Response error codes

Error code	Meaning
0	Acknowledge - no error
1	Invalid command for object ID
2	Invalid query / command
3	Missing parameter
4	Parameter out of range
5	Invalid command in current state
6	Data checksum error
7	EEPROM read or write error
8	Operation timeout
9	Invalid config ID

Refer to the digital gauge range Serial communications manual (D026-91-880) for full details of the serial command protocol and message format. This includes further information on command error codes.

4.11 Gauge status bits

The gauge status is returned with every pressure reading as 16 bits of ASCII encoded HEX:

"F"				"F"				"F"				"F"			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Table 8 - Gauge status bits

BIT	Status Flag	Meaning
0	Gauge Err	Gauge specific error active*
1	-	Not applicable to this gauge
2	SPOP ON	Setpoint On or Off
3	Gauge LK	Gauge parameters Locked
4	Pressure units	Gauge pressure units: 1=mbar, 2=Pa (Default), 3=Torr
5		
6	FlashEE Err	All stored parameters and calibrations defaulted
7	Calibrating	Calibration in progress - pressure reading invalid
8	-	Not applicable to this gauge
9	-	Not applicable to this gauge
10	Pir Fil Err	Pirani filament failure
11	-	Not applicable to this gauge
12	Gas type	Gauge Gas type: 0=N ₂ (default), 1=Ar, 2=He, 3=CO ₂ , 4=H, 5=Ne, 6=Kr
13		
14		
15	-	Not applicable to this gauge

* Gauge specific errors are bits 6 to 11 inclusive

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5 Maintenance

The internal components of the nAPG gauge are shown in [Figure 9](#). The nAPG gauge is designed so that the components can be replaced using the spares listed in [Section 7.3](#). Refer to the following sections for details of maintenance procedures that should be performed when necessary.

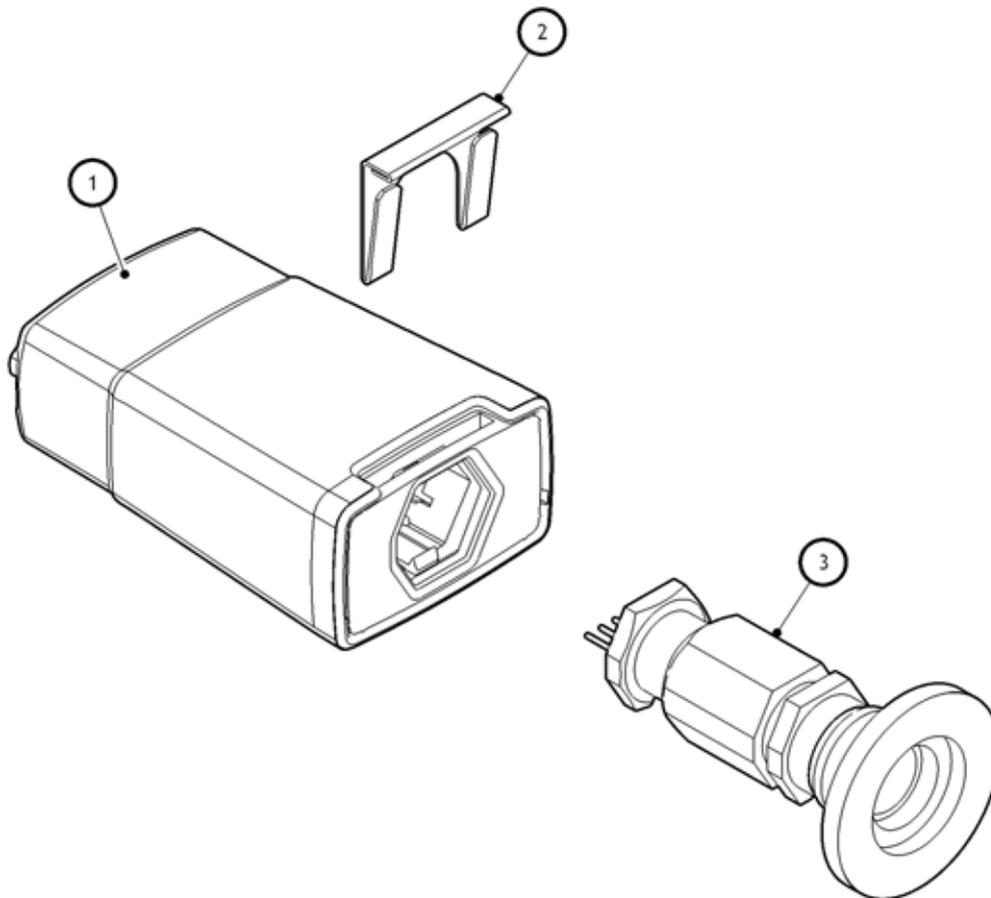
5.1 Replace the body tube

Refer to [Figure 9](#) and follow this procedure to replace the gauge body tube.

1. Unplug the electrical cable, vent the vacuum system to atmospheric pressure and remove the gauge from the vacuum system.
2. Pull the retaining clip (2) from side of gauge and pull the tube (3) from the electronics housing (1).
3. Fit the replacement tube (3) into electronics housing (1), noting the correct alignment, and refit the retaining clip (2).
4. Refit the gauge to the vacuum system as described in [Section 3.2](#) and reconnect the electrical cable.

Whenever a new tube is fitted it is necessary to adjust the gauge to match the new tube. Refer to [Section 4.6.1](#).

Figure 9 - Fitting the body tube assembly



doc:7619/015

5.2 Replace the filter

CAUTION

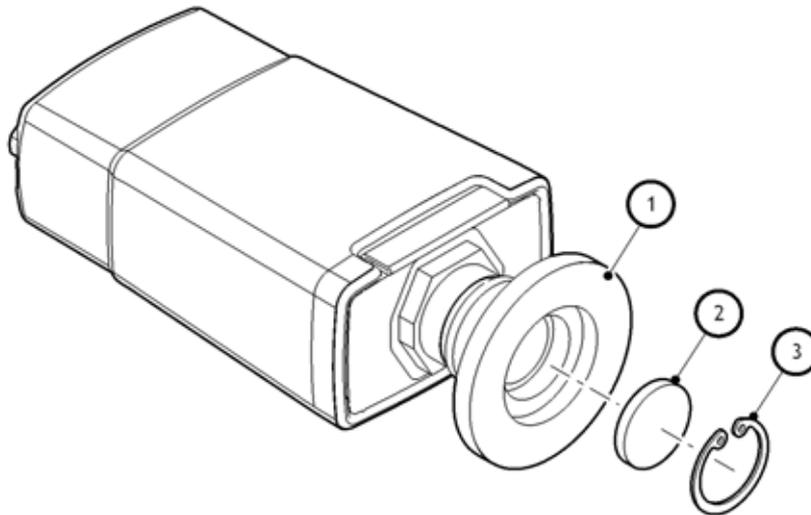
Do not clean the interior of the gauge tube as you can damage the filament.

The filter that is fitted inside the vacuum flange of the gauge provides protection from process contamination. With use the filter can become dirty or blocked, and it will be necessary to replace the filter.

Refer to [Figure 10](#) and follow this procedure to replace the filter.

1. Unplug the electrical cable, vent the vacuum system to atmospheric pressure and remove the gauge from the vacuum system.
2. Use circlip pliers to remove the retaining circlip (3). Take care not to damage the sealing surface of the vacuum flange (1) or the inside of the gauge tube.
3. Remove and discard the old filter (2).
4. Refit the filter (2) into the gauge tube and refit the circlip (3).

Figure 10 - Replace the filter



dc3/7619/017

5.3 Fault finding

Table 9 - Fault finding

Symptom	Possible cause	Remedy
No Reply to communications	Incorrect electrical supply voltage or supply polarity reversed.	Check electrical supply and connections.
	Incorrect communications interface or serial comms connections reversed.	Check communications interface and connections.
	Incorrect baud rate selected.	Check all supported baud rates.
	Incorrect multi-drop address selected.	Check gauge node address setting by using the wildcard node address on a point-to-point communications connection.
	Communications collisions due to multiple gauges connected on a point-to-point system, or duplicate node address on a multi-drop system.	Check each gauge node address setting by using the wildcard node address on a point-to-point communications connection.
	Replies disabled during auto-enumeration.	Ensure replies enabled.
Pressure reading incorrect	Vacuum leak.	Leak check vacuum system.
	Incorrect pressure units selected.	Check pressure units setting.
	Incorrect gas type selected.	Check gas type setting.
	New tube has been fitted.	Perform 'Adjustment for new tube'.
	Wrong type of tube is fitted.	Check that correct type of tube is fitted (M or LC).
Gauge indicates calibration error	Adjustment has been attempted at an inappropriate pressure.	Repeat the adjustment but make sure that the pressure is at atmosphere or good vacuum.
	Tube has drifted outside permissible limits and can no longer be adjusted.	Replace the tube.
Gauge indicates FlashEE error	Gauge parameters have been defaulted	Set user parameters and perform tube, atmosphere and vacuum adjustments.

5.4 Calibration service

A calibration service is available for all Edwards gauges. Calibration is by comparison with reference gauges, traceable to National Standards. Contact Edwards for details.

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6 Storage and disposal

6.1 Storage

Return the nAPG to its protective packaging and store the nAPG in clean dry conditions until required for use. Do not exceed the storage temperature conditions specified in [Section 2.2](#).

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

6.2 Disposal

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

Alternatively, the nAPG and / or cables may be able to be recycled; contact Edwards or supplier for advice (also see below).

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

Particular care must be taken if the nAPG has been contaminated with dangerous process substances.

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7 Service and spares

7.1 Introduction

Edwards products and spares are available from Edwards companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, 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.

When maintaining this product, Edwards recommends using only Edwards maintenance and service kits.

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

- Model and Item Number of the equipment.
- Serial number.
- Item Number and description of the part.

7.2 Service

Edwards products are supported by a world-wide network of Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination; service exchange; repair; rebuild and testing to factory specifications. Equipment which has been serviced, repaired or built is returned with a full warranty.

Local Service Centres can also provide Edwards engineers to support on-site maintenance, service or repair of equipment.

For more information about service options, contact the nearest Service Centre or other Edwards company.

7.3 Spares

Table 10 - Spares

Spares	Item number
Replacement electronics housing	
nAPG-M RS232	D026-90-800
nAPG-M RS485	D026-90-801
nAPG-LC RS232	D026-91-800
nAPG-LC RS485	D026-91-801
Replacement tube	
nAPG-M NW16	D026-01-801
nAPG-M NW25	D026-02-801
nAPG-LC NW16	D026-03-801
nAPG-LC NW25	D026-04-801
nAPG-M DN16 CF	NRD7-11-000
nAPG-LC DN16 CF	NRD7-13-000
Replacement filter kit	D026-01-805

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8 Serial command quick reference guide

Table 11 - Serial command quick reference guide

ID	Object	Operations & Config ID	Parameter	Notes	Lockable
0	Wildcard gauge type	?S0		Read gauge identity: Hardware version; Software version; Name	
750	Node address (RS485 build only)	!S750	nn	Set Node Address: 00 = Multi-drop disabled (default) 01-98 = Multi-drop enabled	✓
		?S750		Read Node Address	
751	Gauge type	!S751	nnnn	Set gauge name: 0000 to 9999	✓
		?S751		Read gauge identity: Hardware version; Software version; Name	
752	Gauge control	!S752	n	Acknowledge gauge errors: 1 = Acknowledge	
		?V752		Read gauge pressure: pressure; status bits	
753	Gauge command lock	!S753	n	Set gauge command lock: 0 = editable 1 = locked	
754	Setpoint	!S754 0;	n.nE±nn	Set high setpoint threshold: 1.0e-10 to 9.9e+06 must be >= Low threshold	✓
		?S754 0		Read high setpoint threshold	
		!S754 1;	n.nE±nn	Set low setpoint threshold: 1.0e-10 to 9.9e+06 must be <= High threshold	✓
		?S754 1		Read low setpoint threshold	
755	Pressure units	!S755	n	Set pressure units: 1 = mbar 2 = Pascal (default) 3 = Torr	✓
756	Gas type	!S756	n	Set gas type: 0 = Nitrogen / Air (Default) 1 = Argon 2 = Helium 3 = Carbon Dioxide 4 = Neon 5 = Krypton	✓
757	Return to defaults	!S757	n	Reset all user settings to default: 1 = reset setpoints, gas type and pressure units	✓
759	Internal temperature	?V759		Read internal temperature	

Table 11 - Serial command quick reference guide (continued)

ID	Object	Operations & Config ID	Parameter	Notes	Lockable
760	Clear calibration	!S760	n	Clear Atm and Vac calibration: 1 = reset to factory default	✓
761	Pirani calibration	!S761 0;	nnnn	Trigger Tube Calibration 1234 = password protection	✓
		!S761 1;	n	Calibrate Atm or Vac: 1 = calibrate at current pressure	✓
769	Run hours	!C769	nnnn	Clear all Run hours counters 1234 = password protection	✓
		?V769		Read gauge run hours: Run hours	
780	Baud rate	!C780	n	Set baud rate: 4 = 9600 (default) 2 = 19200 1 = 38400	✓
781	Auto-enumerate (RS485 build only)	!C781	n	Auto-enumerate node address: 0 = Off - replies enabled 1 = On - replies disabled 2 = Auto - replies disabled and node address randomised	✓
790	Serial number	?S790		Read gauge serial number	

Please refer to the digital gauge range Serial communications manual (D026-91-880) for full details of the serial command protocol and message format.