EDWARDS

APG100 Active Pirani Gauge

Description	*Item Number*
APG100 - XM NW16	*D026-01-000*
APG100 - XM NW25	*D026-02-000*
APG100 - XLC NW16	*D026-03-000*
APG100 - XLC NW25	*D026-04-000*

	Instruction Manual	
	D026-01-880 Iss C	Oct 18

Introduction

Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards APG100 Active Pirani Gauge. You must use the APG100 as specified in this manual.

Read this manual before you install and operate the APG100. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. 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 and process.

The following symbols appear on the APG100:

Warning - refer to accompanying documents.

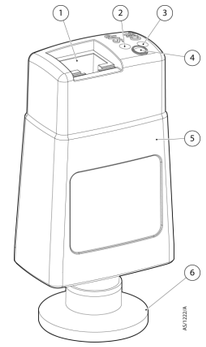
Edwards offer European customers a recycling service.

Description

The APG100 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 APG100 is available in two 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.

A general view of the gauge is shown in Figure 1. The gauge features a detachable tube which allows a replacement to be fitted in the event of contamination or failure of the filament. There are two push-button switches on the top of the gauge. The switch labelled "CAL" is used for atmosphere and vacuum calibration and the switch labelled "S/P" is used to adjust the set-point threshold.



1. Electrical connector
2. Set-point button
3. Cal button
4. Status LED
5. Electronics housing
6. Vacuum flange

Figure 1 - General view of the APG100

Technical Data

Mechanical data

Dimensions	Refer to Figure 2
Mass:	
NW16 versions	85 g
NW25 versions	100 g
Internal volume of tube	5 cm^3
Enclosure rating	IP40

Performance, operating and storage conditions

Measurement range	
APG100-XM	10^{-3} to 1000 mbar
APG100-XLC	10^{-4} to 1000 mbar
Accuracy	
APG100-XM	typically ± 15 % at < 100 mbar
APG100-XLC	typically ± 15 % at < 10 mbar
Ambient temperature	
Operating	5 to 60 °C
Storage	-30 to +70 °C
Bakeout temperature	150 °C (with electronics housing removed)
Humidity	80 % RH up to 31 °C decreasing linearly to 50 % RH at 40 °C and above
Maximum altitude	3000 m (indoor use only)
Maximum internal pressure	10 bar absolute (9 bar gauge)
Filament temperature	100 °C above ambient
Pollution degree	2

Electrical data

Electrical supply type	NEC Class 2 or Limited Power or Limited Energy
Electrical supply voltage	15 to 30 V d.c. nominal 13.5 V minimum, 32 V maximum
Maximum power consumption	1 W
Max inrush current	150 mA
Electrical connector	FCC68 / RJ45 8-way
Pressure output signal	
Range	1.9 to 9.1 V
Error range	output < 1.8 V or output > 9.2 V
Min load impedance	10 kΩ
Max output current	1 mA
Set-point	
Adjustment range	1.8 to 9.2 V
Hysteresis	500 mV
Max external load rating	30 V d.c., 100 mA
Gauge identification resistance	
APG100-XM	36 kΩ
APG100-XLC	43 kΩ

Materials exposed to vacuum

Filament	
APG100-XM	Tungsten / Rhenium
APG100-XLC	Platinum / Iridium
Tube	Stainless Steel 316L & 304L
Filter	Stainless Steel 316L
Other	Glass, Ni, NiFe, PTFE (APG100-XLC only)

Installation

Unpack and inspect

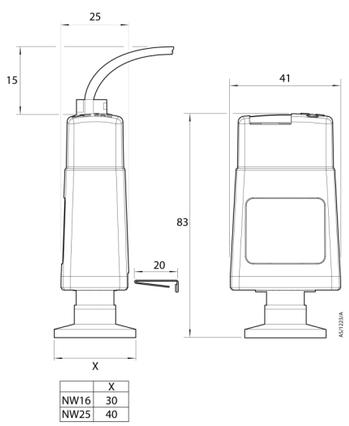
Remove all packing materials and protective covers. Check the APG100. If the APG100 is damaged, notify your supplier and carrier in writing within three days: state the Item Number of the gauge together with your order number and your suppliers invoice number. Retain all packing materials for inspection. Do not use the APG100 if it is damaged.

If the APG100 is not to be used immediately, replace the protective covers. Store the APG100 in suitable conditions as described in Technical Data section.

Fit the APG100 to a vacuum system

WARNING
You must use a Co-seal or trapped 'O' ring carrier to connect an APG100 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 APG100 for safety critical applications. The APG100 is not intended to be fail-safe.



	X
NW16	30
NW25	40

Figure 2 - Dimensions (mm)

The APG100 can be mounted in any orientation however the gauge tubes are individually factory calibrated in nitrogen whilst vertical. For correct pressure indication in your chosen gauge orientation, the gauge should be recalibrated at atmospheric pressure. Edwards recommends mounting the gauge tube vertical in order to minimise the build up of process particulates and condensable vapours within the gauge.

For optimum accuracy it is recommended that both the atmosphere and vacuum adjustment is carried out before use. Refer to the Maintenance section.

To connect the APG100 to your vacuum system:

- Use an 'O' ring / centring-ring or Co-Seal to connect an APG100 with an NW16 or NW25 flange to a similar flange on the vacuum system.
- Use a stepped 'O' ring carrier or Co-Seal to connect an APG100 with an NW16 flange to an NW10 flange.

In accordance with good practice, we recommend that your vacuum system has a secure Earth (ground) connection, and that the tube of the APG100 is electrically connected to the vacuum system.

Connect to an Edwards Controller

The APG100 is compatible with the TIC and ADC digital controllers and the AGD analogue display from Edwards. The controllers will automatically recognise the gauge and display the measured pressure.

To connect to a Edwards controller use a cable which is terminated in suitable connectors. These cables are available from Edwards.

Connect to your own electrical equipment

CAUTION
Do not make any connection to the gauge identification pin (pin 4) as this may cause the gauge to malfunction.

A schematic diagram of the recommended electrical connections to the APG100 is shown in Figure 4. The pins on the electrical connector are used as shown in Table 1. Refer to the Technical Data section for more detailed specifications.

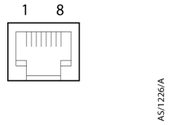
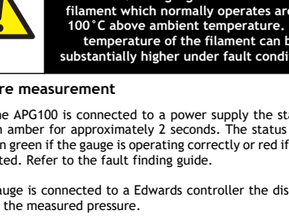


Figure 3 - RJ45 8-way connector

Pin number	Use
1	Electrical supply positive
2	Electrical supply ground (0 V)
3	Pressure measurement output signal
4	Gauge identification
5	Signal ground
6	Set-point output signal
7	Remote calibration input
8	Not connected

Table 1 - Pins on the APG100 electrical connector



1. APG100 electrical connector socket
2. Cable electrical connector plug
3. Electrical supply
4. Voltmeter
5. d.c. relay (optional)
6. Back EMF suppression diode (optional)
7. Remote calibration switch (optional)

Figure 4 - Recommended electrical connections

Do not connect the electrical supply ground (pin 2) to the signal ground (pin 5). If you do, the APG100 output signal will be inaccurate.

When using the APG100 in an electrically noisy environment you should ensure that your measuring equipment is adequately immune to interference. All Edwards controllers have adequate immunity.

The set-point output on pin 6 is an active low open-collector transistor suitable for driving a d.c. relay or control logic. If you connect a relay you must use a suppression diode, to protect the gauge from transient voltages generated when the relay is switched off, as shown in Figure 4.

Make a connection to pin 7 if you require remote calibration. Momentarily (>50 ms) connect pin 7 to pin 2 (ground) to automatically adjust the atmosphere or vacuum reading. Refer to the Maintenance section for the correct procedure.

Operation

WARNING
Do not use the APG100 to measure the pressure of explosive or flammable gasses or mixtures. 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.

Pressure measurement

When the APG100 is connected to a power supply the status LED will turn amber for approximately 2 seconds. The status LED will then turn green if the gauge is operating correctly or red if an error is detected. Refer to the fault finding guide.

If the gauge is connected to a Edwards controller the display will indicate the measured pressure.

If the gauge is connected to a voltmeter convert the voltage (V) to pressure (P) using the following equations:

$P = 10^{(V - 6)}$	P in mbar
$P = 10^{(V - 6.125)}$	P in Torr
$P = 10^{(V-4)}$	P in Pa

For example if the measured voltage V = 4 V, then the measured pressure P = 1 x 10^{-2} mbar. Refer to Figures 5 and 6.

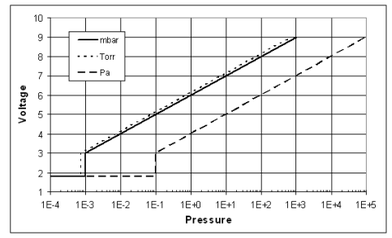


Figure 5 - Voltage to pressure conversion for APG100-XM

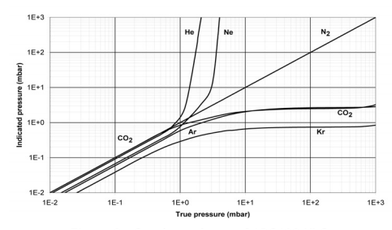


Figure 6 - Voltage to pressure conversion for APG100-XLC

Gas dependency

The APG100 is calibrated for use in nitrogen, and will read correctly with dry air, oxygen and carbon monoxide. For any other gas type a conversion is required in order to obtain the correct pressure reading. Figures 7 and 8 show the conversion for 6 common gases: nitrogen, argon, carbon dioxide, helium, krypton and neon.

If you are using a Edwards TIC controller, the gas calibration data is built into the controller.

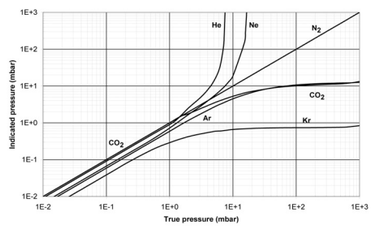


Figure 7 - Gas dependency of APG100-XM

Figure 8 - Gas dependency of APG100-XLC

For pressures below 1mbar a simple calibration factor can be used to correct for different gas types. Gas Calibration Factors (GCFs) for common gases are shown in Table 2.

True pressure = GCF x indicated pressure

Gas	GCF
He	1.1
Ne	1.5
N_2	1.0
Ar	1.7
CO_2	1.0
Kr	2.6

Table 2 - Gas calibration factors below 1 mbar

Set-point adjustment

CAUTION
When the 'S/P' button is pushed the gauge output will change. Do not push the 'S/P' button to adjust the set-point if the change in output could cause a malfunction of your system.

Note: If you use a Edwards Controller the APG100 set-point is not used.

To read the pressure at which the set-point output turns on, push the "S/P" button with an appropriate tool (see Figure 9). The signal output of the gauge will change to indicate the set-point threshold for three seconds after which the output will return to normal.

The set-point has a fixed hysteresis of 500mV. When the measured pressure falls below the set-point pressure the transistor output changes to ON (closed). The transistor output will turn OFF when the measured pressure rises to 500mV above the set-point pressure. An external relay connected as shown in Figure 4 will turn on when the pressure falls below the set-point and turn of when the pressure rises to 500 mV above the set-point.

To adjust the set-point threshold push the "S/P" button and hold it down for more than three seconds. The threshold value will increase steadily. Release the button when you reach the required value. To make finer adjustment release the button just before the required value is reached and immediately push the button as many times as required. Each time you push the button the threshold value will increase by 10mV. If during adjustment the threshold reaches the maximum value (9.2 V) it will jump to the minimum (1.8 V) and increase again.

If you do not need to use the set-point or if you require the set-point to be permanently off, you can adjust the threshold to 1.8V. This will ensure that the set-point does not operate. The APG100 is shipped from the factory with the threshold set to 1.8V.

The set-point can also be used to indicate that the gauge is operating correctly. If you adjust the threshold to 9.2V then the set-point output will be ON as long as the gauge is operating correctly and will turn OFF if an error is detected.

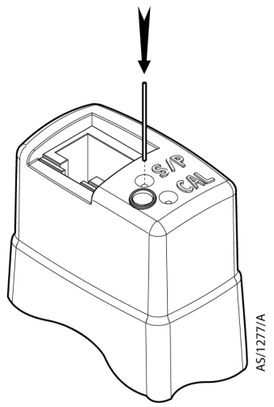


Figure 9 - Adjusting set-point

Error monitoring

If an error occurs during operation of the APG100 then the status LED will turn red to indicate an error and the output voltage will change to indicate the error condition. Error voltages are shown in Table 3 below. The set-point will be disabled as soon as an error is detected. Refer to the fault finding guide.

If you use a Edwards Controller then an error message will be shown on the display.

Error condition	Output (V)	TIC Display	ADC Display	AGC Display
Broken filament or tube removed	9.5	Filament Fail	Err 25	Err E
Calibration error	9.6	Cal Error	Err 26	Err F

Table 3 - Error indication

Bakeout

In some UHV applications it is desirable to bake the vacuum system components in order to achieve a lower base pressure. The tube of the APG100 can be baked to 150°C, but the electronics housing must be removed.

- Referring to Figure 12, remove the electronics housing.
- Bake the tube on your vacuum system. Do not exceed 150°C.
- Allow the tube to cool before refitting the electronics housing.

Atmosphere adjustment

1. Switch on the power supply to the APG100 and allow it to operate at atmospheric pressure for at least 10 minutes. Ensure that the green status LED is lit.
2. Press the 'CAL' button. The status LED will flash and the gauge will automatically adjust to read atmospheric pressure. Do not hold the 'CAL' button down for longer than 5 seconds (see 'Adjustment for new tube' below).

Vacuum adjustment

1. Reduce the system pressure to 1 x 10^{-4} mbar (or below) for the APG100-XM, or to 1x10^{-5} mbar (or below) for the APG100-XLC.
2. Allow the gauge to operate for at least 10 minutes.
3. Press the 'CAL' button. The status LED will flash and the gauge will automatically adjust to read vacuum.

Remote adjustment

The atmosphere and vacuum adjustments can be performed remotely using a switch connected as shown in Figure 4. Follow the procedure described above, but momentarily close the remote switch instead of using the 'CAL' button on the gauge. Edwards controllers use this feature so that the atmosphere and vacuum readings can be automatically adjusted from the front panel of the controller.

Adjustment for new tube

If 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 not required unless a new tube is fitted, and it is always necessary to perform a vacuum adjustment afterwards.

1. Switch on the power supply to the APG100.
2. With the gauge at atmospheric pressure, press the 'CAL' button and hold it down for longer than 5 seconds. The status LED will begin to flash red / green alternately and the gauge will automatically adjust to match the new tube. This may take several seconds.
3. Allow the gauge to operate at atmospheric pressure for at least 10 minutes and then repeat step 2.
4. It is now necessary to perform the vacuum adjustment as described above.

Replace the filter

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

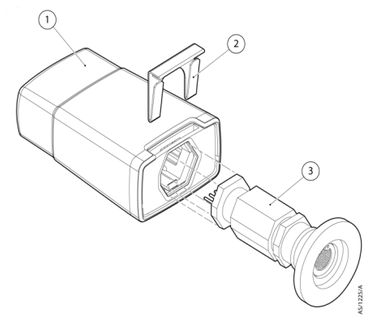
The filter that is fitted inside the vacuum flange of the gauge provides protection from process contamination. With use the filter can become dirty or blocked, and it will be necessary to replace the filter.

Refer to Figure 11 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. Take care not to damage the sealing surface of the vacuum flange or the inside of the gauge tube.
3. Remove and discard the old filter.
4. Refit the filter into the gauge tube and refit the circlip.

4. Fit the replacement tube into electronics housing, noting the correct alignment.
5. Refit the retaining clip.

Whenever a new tube is fitted it is necessary to adjust the gauge to match the new tube. Refer to 'Adjustment for new tube' above.



1. Electronic housing
2. Retaining clip
3. Gauge tube

Figure 12 - Replacement of gauge tube

Fault finding guide

Symptom	Possible cause	Remedy
LED not lit	Incorrect electrical supply voltage. Supply polarity reversed.	Check electrical supply and connections
Pressure reading incorrect	Vacuum leak	Leak check vacuum system
	Tube has drifted and requires adjustment	Perform the atmosphere and vacuum adjustments
	Tube contaminated	Replace the tube
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
	Wrong type of tube is fitted	Check that correct type of tube is fitted (M or LC)
	New tube has been fitted	Perform 'Adjustment for new tube'
	Tube has drifted outside permissible limits and can no longer be adjusted	Replace the tube
Gauge indicates broken filament	Tube is missing	Fit the tube and remove then re-insert the electrical connector
	Wrong type of tube is fitted	Check that correct type of tube is fitted (M or LC)
	Filament is broken	Replace the tube

Table 4 - Fault finding information

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

Spares

Spare	Item Number
Replacement electronics housing	
APG100-XM	D026-01-800
APG100-XLC	D026-03-800
Replacement tube	
APG100-XM NW16	D026-01-801
APG100-XM NW25	D026-02-801
APG100-XLC NW16	D026-03-801
APG100-XLC NW25	D026-04-801
Replacement Filter Kit	D026-01-805

Accessories

The cables for use with the APG100 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 m	3 feet	D400-01-010
3 m	10 feet	D400-01-030
5 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

Maintenance

Atmosphere and vacuum adjustment

Every APG100 is individually adjusted before shipment, however thermal conductivity gauges can drift with time or as contamination builds up on the filament. Use the procedures outlined below to adjust the atmosphere and vacuum settings of the gauge. The frequency with which they should be repeated will vary depending on the level and nature of the contamination associated with the process.

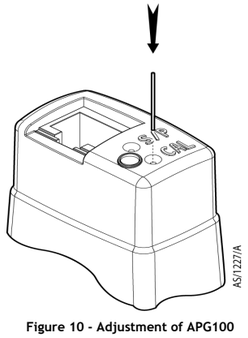
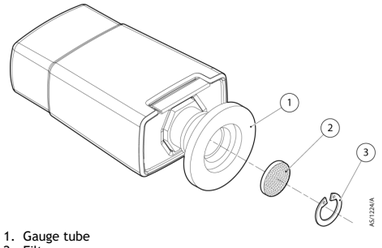


Figure 10 - Adjustment of APG100



1. Gauge tube
2. Filter
3. Circlip

Figure 11 - Replacement of filter

Replace the gauge tube

If the gauge tube has become severely contaminated so that atmosphere or vacuum adjustment cannot be achieved, or if the filament is broken, then you can fit a replacement tube to the gauge.

Refer to Figure 12 and follow this procedure to replace the gauge 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 from side of gauge.
3. Pull the tube from the electronics housing.

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.

Storage and Disposal

Dispose of the APG100 and any components safely in accordance with all local and national safety and environmental requirements.

Alternatively, you may be able to recycle the APG100 and cables: contact Edwards or your supplier for advice (also see below).

The APG100 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 APG100 and cables at the end of the product's life. Contact Edwards for advice on how to return the APG100 and cables for recycling.

Particular care must be taken if the APG100 has been contaminated with dangerous process substances.

Spares and Accessories

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 centres employ Service Engineers who have undergone comprehensive Edwards training courses.

Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must send us a completed Declaration of Contamination of Vacuum Equipment and Components - Form HS2. The HS2 form tells us if any substances found in the equipment are hazardous, which is important for the safety of our employees and all other people involved in the service of your equipment. The hazard information also lets us select the correct procedures to service your equipment.

We provide instructions for completing the form in the Declaration of Contamination of Vacuum equipment and Components - Procedure HS1.

Download the latest documents from www.edwardsvacuum.com/HSForms/, follow the procedure in HS1, fill in the electronic HS2 form, print it, sign it, and return the signed copy to Edwards.

Note: If we do not receive a completed HS2 form, we will not accept the return of the equipment.