

# Instruction Manual

## *EXT Compound Molecular Pumps: EXT255H, EXT255Hi and EXT255HVi*

<i>Description</i>	<i>Item Number</i>
<i>EXT255Hi/ISO100</i>	<i>B753-03-000</i>
<i>EXT255H/100CF</i>	<i>B753-02-000</i>
<i>EXT255H/ISO100</i>	<i>B753-01-000</i>
<i>EXT255HVi/ISO100</i>	<i>B753-07-000</i>



# Declaration of Conformity

We, BOC Edwards,  
Manor Royal,  
Crawley,  
West Sussex RH10 2LW, UK

declare under our sole responsibility that the product(s)

EXT Compound Molecular Pumps:

EXT255H/ISO100	B753-01-000
EXT255H/100CF	B753-02-000
EXT255Hi/ISO100	B753-03-000/B753-04-000
EXT255H/ISO100 Port variant	B753-06-000/B753-08-000
EXT255vi	B753-07-000

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

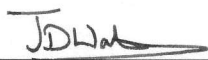
EN ISO12100-2: 2003	Safety of machinery. Basic concepts, general principals for design. Technical principals.
EN61010-1: 2001	safety requirements for electrical equipment for measurement, Control and laboratory use. General requirements.*
EN1012-2: 1997	Compressors and vacuum pumps. Safety requirements. Vacuum pumps.
EN61326: 1997 <sup>†</sup>	Electrical equipment for measurement, control and laboratory use.
+A1: 1998 + A2: 2001 (Industrial Location, Class B Emissions)	EMC requirements.

\* The pumps comply with EN61010-1 (2001) when installed in accordance with the instruction manual supplied with the pumps.

<sup>†</sup> EN61326 Immunity classification is dependent on the controller (see the controller manual for details).

following the provisions of:

73/023/EEC	Low Voltage Directive.
89/336/EEC	Electromagnetic Compatibility Directive.
98/37/EC	Machinery Safety Directive.



Dr J. D. Watson, Technical Director  
Vacuum Equipment and Exhaust Management Product Divisions

1 DECEMBER 2004 SHOREHAM

Date and Place

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

P200-00-360 Issue A

# CONTENTS

Section	Title	Page
1	INTRODUCTION	1
1.1	Scope and definitions	1
1.2	General description	2
1.3	Vent options and vent control	3
2	TECHNICAL DATA	6
2.1	General	6
2.2	Pumping media	6
2.2.1	Pumps without gas purge	7
2.2.2	Pumps with gas purge	7
2.3	Vent gas specification and vent control data	7
2.4	Purge gas specification	7
2.5	Cooling-water	8
2.6	Materials exposed to gases pumped	10
3	INSTALLATION	13
3.1	Unpack and inspect	13
3.2	Typical installation	13
3.3	Connect to the vacuum system	16
3.3.1	Inlet-screen	16
3.3.2	Mechanical fixing	16
3.3.3	Base mounting	17
3.3.4	Inlet connection and orientation	17
3.3.5	Backing connection	18
3.3.6	Interstage connection (EXT255Hi/EXT255HVi only)	18
3.4	Vent-valve connection and control	18
3.5	Purge gas connection	19
3.5.1	Connect the purge gas	19
3.5.2	Recommended purge gas flow	19
3.6	Electrical Installation	19
3.7	Cooling	20
3.7.1	Introduction	20
3.7.2	Forced-air cooling	20
3.7.3	Water-cooling	21
4	OPERATION	22
4.1	Start-up	22
4.2	Stand-by	22
4.3	Shut-down	23
4.4	Safety interlocks and control system	23
4.5	Bakeout	24
5	MAINTENANCE	25
5.1	Introduction	25
5.2	Bearing life	25
5.3	Rotor life	25
5.4	Clean the pump	26

Section	Title	Page
5.5	Fault finding	26
6	STORAGE AND DISPOSAL	31
6.1	Storage	31
6.2	Disposal	31
7	SERVICE, SPARES AND ACCESSORIES	32
7.1	Introduction	32
7.2	Service	32
7.3	Spares	32
7.3.1	ISX inlet-screen	32
7.3.2	Inlet-strainer (EXT255Hi pump only)	32
7.3.3	Interstage-port seal (EXT255HVi pump only)	33
7.3.4	WCX water-cooler	33
7.3.5	Inlet-flange seals	33
7.4	Accessories	33
7.4.1	Installation	33
7.4.2	EXC Controller	33
7.4.3	Pump-to-controller cable	34
7.4.4	EXDC Drive modules	34
7.4.5	BX bakeout band	34
7.4.6	FL20K foreline trap	34
7.4.7	TAV vent-valve and vent-port adaptor	36
7.4.8	ACX air-cooler	36
7.4.9	Vibration isolators	36
7.4.10	PRX purge restrictor	36
7.4.11	VRX vent-restrictor	37
RETURN OF BOC EDWARDS EQUIPMENT		

## Illustrations

Figure	Title	Page
1	Cross-section view of EXT255H pump	4
2	Cross-section view of EXT255HVi pump	5
3	Maximum allowed rate of pressure rise during venting	8
4	EXT255/EXT255Hi dimensions (mm)	11
5	EXT255HVi dimensions (mm)	12
6	Typical pumping system with an EXT255H pump	14
7	Typical pumping system with an EXT255Hi/EXT255HVi pump	15
8	Correct installation of the inlet-screen	16
9	Installation of optional accessories (and spares)	35

## Tables

Table	Title	Page
1	Technical data	9
2	Checklist of items	13
3	Vent-restrictor orifice diameter	19
4	Fault finding	27

## Associated publications

Publication title	Publication Number
EXC Turbomolecular Pump Controllers: EXC100E and EXC100L	D396-20-880
E2M0.7 Rotary Pump	A371-31-880
RV Rotary Vane Pumps	A652-01-880

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# 1 INTRODUCTION

## 1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the BOC Edwards EXT255H, EXT255Hi and EXT255HVi Compound Molecular Pumps. You must use the Pumps as specified in this manual.

The EXT Compound Molecular Pumps are designed for use with a BOC Edwards EXC Controller. Read this manual and the instruction manual supplied with your EXC Controller before you attempt to install or operate the equipment. The EXC Controller contains details of how to set up a pumping system and how to control accessories such as an air-cooler, vent-valve and bakeout band.

Important safety information in this manual 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.

In accordance with the recommendations of EN61010, the following warning symbols may appear on the pump or its accessories:



Caution - refer to accompanying documents.



Caution - hot surface.



Caution - risk of electric shock.



Protective conductor terminal.

The units used throughout this manual conform to the SI international system of units of measurement. Also throughout this manual, wherever flow rates are specified, the abbreviation 'sccm' is used to mean 'standard  $\text{cm}^3 \text{min}^{-1}$ ': this is a flow of  $1 \text{ cm}^3 \text{min}^{-1}$  at an ambient temperature of  $0^\circ\text{C}$  and a pressure of 1013 mbar ( $1.013 \times 10^5 \text{ Pa}$ ).

## 1.2 General description

The EXT255H, EXT255Hi and EXT255HVi pumps are compound vacuum pumps that combine a turbomolecular pump and a drag pump on a single shaft. Refer to Figures 1 and 2, which show the internal structures of the EXT255H and EXT255HVi pumps.

The turbomolecular pump is made from a multi-stage axial-flow turbine which is optimised for operation in molecular flow conditions. The drag pump is made from pumping channels formed by helical grooves. The drag pump is designed for operation at higher pressures than conventional turbomolecular pumps.

The light alloy rotor (13) is machined from one piece to form the angled blades of the turbomolecular pump. The rotor blades rotate between angled stator blades (12) which are supported by spacer rings (11). The rotor and stator blades have an open structure at the pump inlet, and a more closed structure at the outlet. This configuration gives an optimum combination of pumping speed and compression when pumping gases of both high and low molecular weight. For the blades to be effective, their speed must be close to the thermal velocity of the gas. The rotor therefore rotates at up to  $60000 \text{ r min}^{-1}$ .

Gas from the inlet is compressed through each of the bladed stages of the turbomolecular pump and transferred to the drag pump. In the drag pump stages, the gas is further compressed as it is pumped around the channels formed by the helical grooves.

The rotating assembly is supported at the inlet end by a frictionless magnetic bearing (3) and by a precision ceramic ball bearing (8) at the outlet end. The ball bearing is lubricated from an oil reservoir and wick mechanism (9).

All of the pumps are supplied with an inlet-screen (2) fitted in the bore of the inlet-flange. The EXT255Hi pumps are also supplied with an inlet-strainer which fits in the interstage-port. The inlet-screen and inlet-strainer protect the pump against damage which would be caused by debris which enters the pump. The inlet-screen also protects you from the sharp blades in the pump.

All of the pumps have a vent-port you can use to vent the pump and your vacuum system to atmospheric pressure. The vent-port introduces vent gas part way up the pump rotor; this ensures maximum cleanliness. The pump is supplied with a manual vent-valve fitted to the vent-port. As described in Section 3.4, you can replace the manual vent-valve with a TAV5 or TAV6 solenoid-operated vent-valve (available as an accessory: see Section 7).

All of the pumps have a purge-port (Figure 4 or 5, item 3) in the motor and bearing housing chamber. In order to protect the bearing lubricant from the effects of high oxygen concentrations, you can introduce an inert purge gas through the purge-port. You can fit an optional vent-port adaptor and purge restrictor to the purge-port to control the flow rate of the purge gas and to filter the gas supply (see Section 7).

The EXT255Hi pump has an interstage-port, between the turbomolecular and drag pump. You can use the interstage-port to pump a separate chamber of your vacuum system or to back another turbomolecular pump. If the pump operates with an outlet pressure of less than 5 mbar (500 Pa) and an interstage inlet flow of less than 70 sccm ( $1.17 \text{ mbar l s}^{-1}$ ,  $117 \text{ Pa l s}^{-1}$ ), the vacuum performance at the turbomolecular pump-inlet is independent of the interstage operating conditions.



The EXT255HVi pump also has an interstage-port (14). The interstage-port is located in the turbomolecular pumping region of the pump and, together with the higher conductance provided by the larger size interstage-port, enables higher interstage pumping speeds than the EXT255Hi.

Electrical connection between the EXT and the EXC Controller is by a 19-way connector and a pump-to-controller cable. The cable is a separate item and is available in a choice of lengths (see Section 7 for details). If you use an EXC100L controller it is not necessary to buy a separate cable.

The pump may be air-cooled using an optional air-cooler accessory, or water-cooled by passing water through the water-cooler provided. Two ruffled hose connectors are provided for connection of your cooling-water supply and return pipelines. A thermal sensor monitors the temperature of the motor and the pump-body.

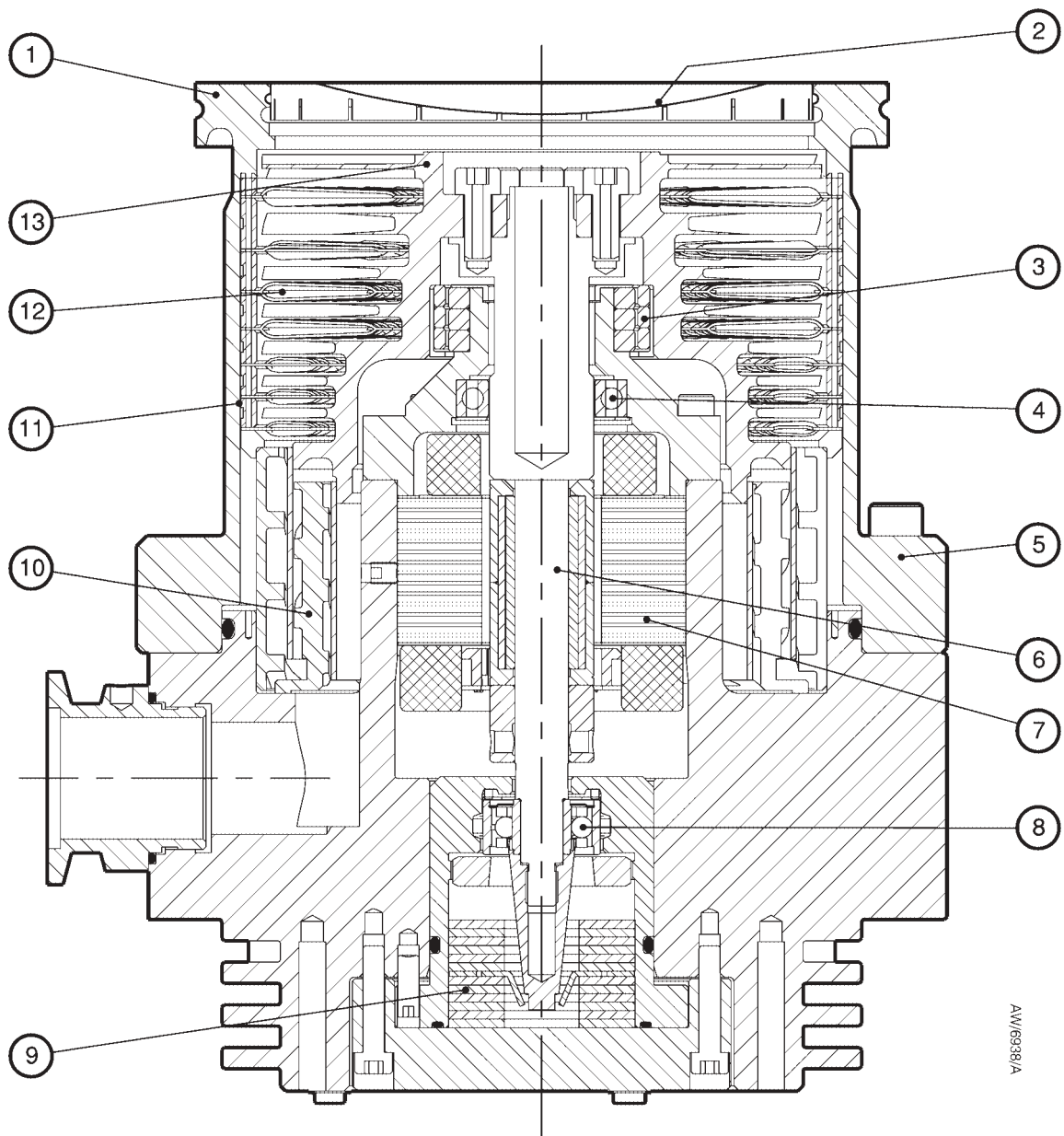
### **1.3 Vent options and vent control**

To maintain the cleanliness of your vacuum system, we recommend that, whenever you switch the pump off, you vent the pump (or vacuum system) when the speed of the EXT pump is between full rotational speed and 50% of full rotational speed. At and above 50% of full rotational speed, the rotor spins fast enough to suppress any backstreaming of hydrocarbon oil from your backing pump.

However, if you vent the pump when it is at full rotational speed and the rate of pressure rise is too high, the pump life may be reduced. We therefore recommend that you either limit the vent rate (see Section 2.3), or only open the vent-valve after the EXT pump speed has fallen to 50% of full rotational speed.

The rate of pressure rise cannot be controlled by the manual vent-valve, so if you use the manual vent-valve, you must only open the vent-valve after the EXT pump speed has fallen to 50% of full rotational speed.

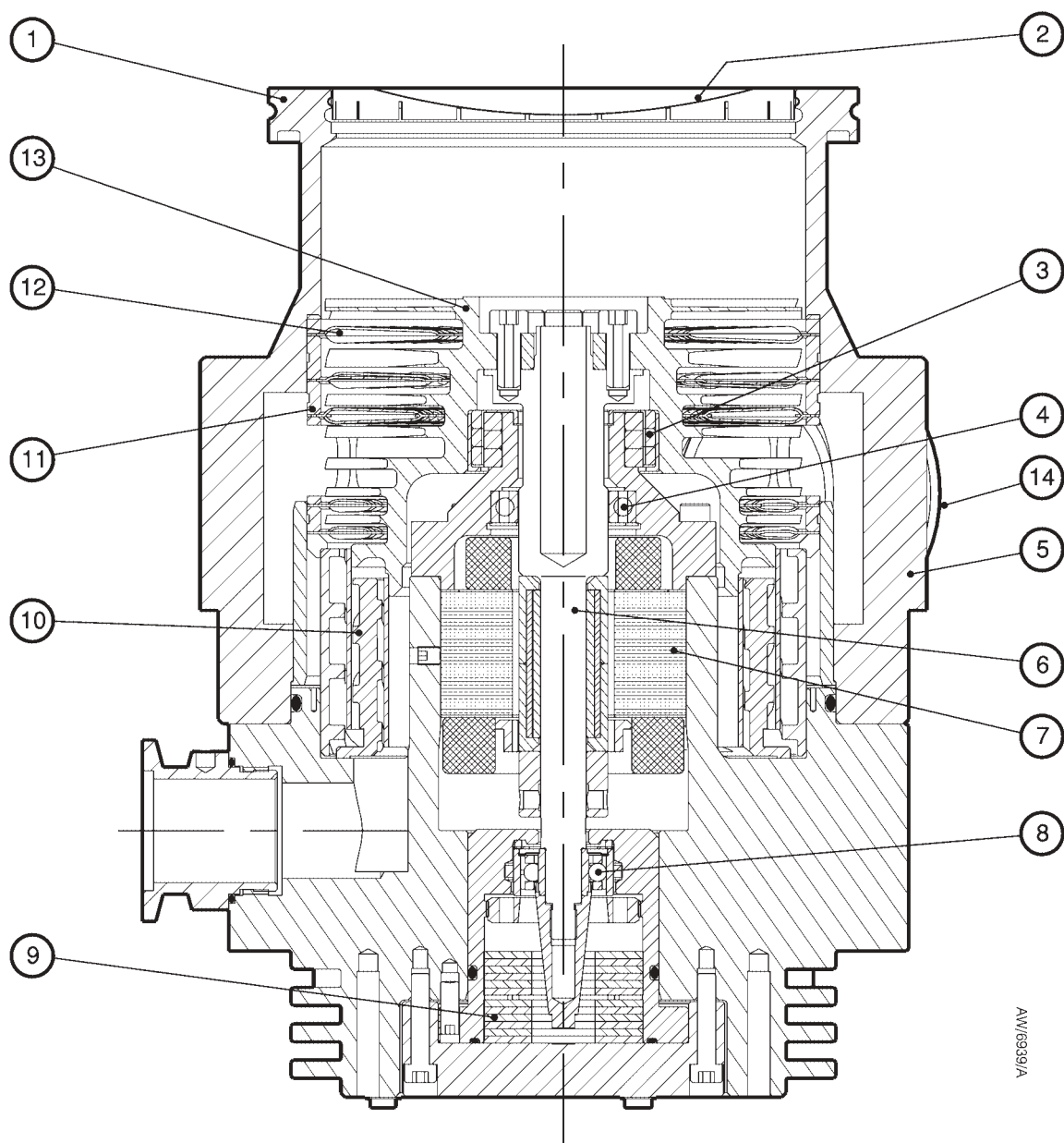
If you use a TAV5 vent-valve, but you cannot limit the rate of pressure rise, you must only open the vent-valve after the speed of the EXT pump has fallen to 50% of full rotational speed. If you use the EXC Controller to control your TAV5 vent-valve, configure the EXC Controller to select this option: refer to Section 3.4 for more information. The EXC Controller is factory set to vent when the EXT pump is at 50% of full rotational speed after you select Stop.



AW/6938/A

- |                     |                  |
|---------------------|------------------|
| 1. Inlet-flange     | 8. Ball bearing  |
| 2. Inlet-screen     | 9. Oil reservoir |
| 3. Magnetic bearing | 10. Drag stage   |
| 4. Safety bearing   | 11. Spacer ring  |
| 5. Envelope         | 12. Stator       |
| 6. Shaft            | 13. Rotor        |
| 7. DC motor         |                  |

Figure 1 - Cross-section view of EXT255H pump



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- |                     |                     |
|---------------------|---------------------|
| 1. Inlet-flange     | 8. Ball bearing     |
| 2. Inlet-screen     | 9. Oil reservoir    |
| 3. Magnetic bearing | 10. Drag stage      |
| 4. Safety bearing   | 11. Spacer ring     |
| 5. Envelope         | 12. Stator          |
| 6. Shaft            | 13. Rotor           |
| 7. DC motor         | 14. Interstage-port |

Figure 2 - Cross-section view of EXT255HV pump

## 2 TECHNICAL DATA

### 2.1 General

Performance	See Table 1
Dimensions	See Figures 4 and 5
Maximum inlet-flange temperature	100 °C
Maximum magnetic field	3.5 mT Horizontal field >7mT Vertical field
Installation category	EN61010 part 1, Category 1
Pollution degree	EN61010 part 1, Category 2
Equipment type	Fixed equipment, for indoor use only

### 2.2 Pumping media

**WARNING**

Vent dangerous gases and gas mixtures safely. Do not expose people to these gases.

**WARNING**

Do not use EXT pumps to pump explosive gas mixtures as the pumps are not suitable for this purpose.

**WARNING**

On EXT255Hi and EXT255HVi pumps, gas pumped through the interstage-port will mix with gas pumped through the pump-inlet. Ensure that the gases will not react or combine to form dangerous gases and substances.

**CAUTION**

Do not use an EXT to pump gases containing more than 20% oxygen unless the pump is gas purged. If you do, the lubricant will polymerise and the pump will fail prematurely.

Note that concentrations of gases may be modified by the compression of the pump.

### 2.2.1 Pumps without gas purge

The pumps are designed to pump the following residual gases normally used in high-vacuum systems :

- Air
- Carbon dioxide
- Carbon monoxide
- Helium
- Krypton
- Neon
- Argon
- Hydrogen
- Ethane
- Butane
- Methane
- Propane

You can use the pumps to pump oxygen and water vapour, subject to the following conditions :

- Oxygen                      The oxygen concentration must be less than 20% by volume.
- Water vapour              You must ensure that vapour does not condense inside the pump; refer to Section 3.7.3.

If you wish to pump a gas not in the list above, contact your supplier for advice. If you do not contact your supplier, you may invalidate the warranty on the pump. The pumps are not suitable for pumping aggressive or corrosive gases.

### 2.2.2 Pumps with gas purge

When purged with an inert gas, the pumps can be used to pump oxygen in concentrations above 20% by volume.

## 2.3 Vent gas specification and vent control data

Although the pump may be vented to atmospheric air, high relative humidity of the air may greatly increase the subsequent pump-down time. To reduce pump-down times you should vent the pump with dry, clean gases.

Vent gas	Dry air, nitrogen, argon or other inert gases
Maximum dew point at atmospheric pressure	- 22 °C
Maximum size of particulates	1 µm
Maximum concentration of oil	0.1 parts per million
Time for rotational speed to reach 50%	>15 sec
Rate of pressure rise	see Figure 3

## 2.4 Purge gas specification

Purge gas	Dry nitrogen, argon or other inert gases
Maximum dew point at atmospheric pressure	-22 °C
Maximum size of particulates	1 µm
Maximum concentration of oil	0.1 parts per million
Allowable purge gas flow (when required)	20 to 100 sccm (0.33 to 1.67 mbar l s <sup>-1</sup> , 33 to 167 Pa l s <sup>-1</sup> )
Recommended purge gas flow	25 sccm (0.42 mbar l s <sup>-1</sup> , 42 Pa l s <sup>-1</sup> )
Maximum allowable purge gas supply pressure	2 bar (gauge) ; 29 psig, 3 x 10 <sup>5</sup> Pa

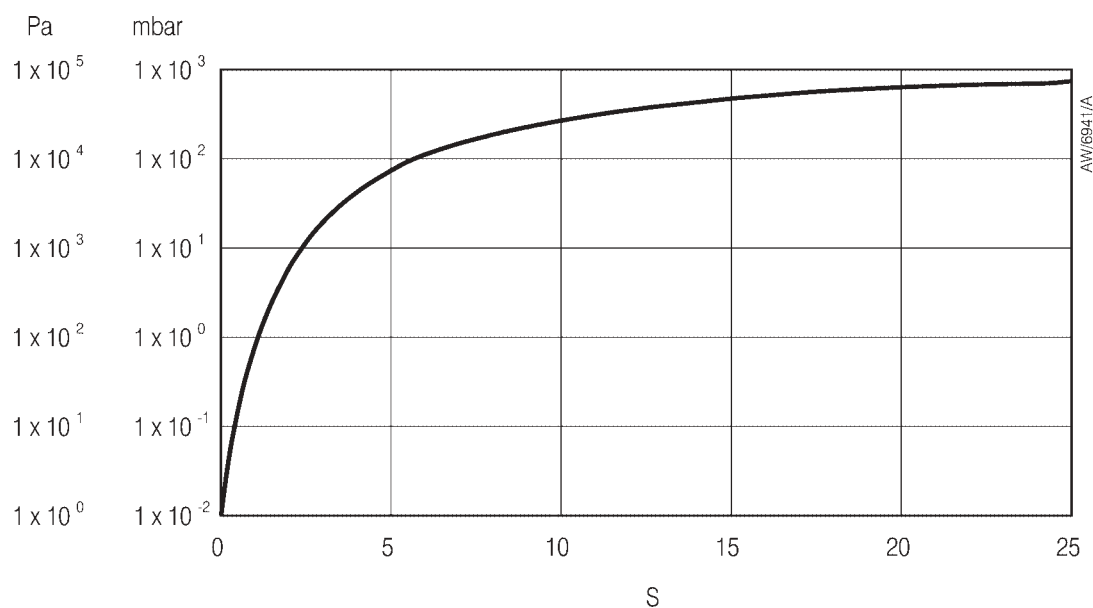


Figure 3 - Maximum allowed rise in backing pressure against time for controlled venting: system pressure (mbar/Pa) against time (s)

## 2.5 Cooling-water

The following cooling water specification corresponds to a typical high-quality drinking water specification. Check with your water supply authority if you are in doubt about the quality of your supply.

Quality	Mechanically clean and optically clear with no deposits or turbidity.
pH value	6.0 to 8.0
Maximum calcium carbonate concentration	75 parts per million
Maximum chloride concentration	100 parts per million
Minimum oxygen concentration	4 parts per million
Minimum water-cooling flow rate ( at 15 °C)	15 l h <sup>-1</sup>
Water temperature	See Table 1
Maximum water pressure	5 bar (gauge), 73.5 psig, 6 x 10 <sup>5</sup> Pa
Materials exposed to cooling water	Nickel plated brass

Parameter	EXT255H	EXT255Hi	EXT255HVi	Notes
Mass				
DN100ISO-K inlet flange	5.6 kg	5.6 kg	6.5 kg	
DN100CF inlet flange	8.2 kg	N/A	N/A	
Inlet-flange	DN100ISO-K/ DN100CF	DN100ISO-K	DN100ISO-K	
Outlet-flange	DN25NW	DN25NW	DN25NW	
Vent-port	1/8 inch BSP	1/8 inch BSP	1/8 inch BSP	
Interstage-port	-	DN25NW	DN40NW	
Purge-flange	DN10NW ▲	DN10NW ▲	DN10NW ▲	
Inlet pumping speed				
N <sub>2</sub> # ‡	220 l s <sup>-1</sup>	220 l s <sup>-1</sup>	195 l s <sup>-1</sup>	Pb < 5 mbar (500 Pa) Qi < 70 sccm (1.17 mbar l s <sup>-1</sup> )(117 Pa l s <sup>-1</sup> )
He # ‡	230 l s <sup>-1</sup>	230 l s <sup>-1</sup>	155 l s <sup>-1</sup>	Pb < 1 mbar (100 Pa) Qi = 0 sccm
H <sub>2</sub> # ‡	180 l s <sup>-1</sup>	180 l s <sup>-1</sup>	100 l s <sup>-1</sup>	Pb < 0.5 mbar (50 Pa) Qi = 0 sccm
Inlet compression ratio				
N <sub>2</sub> # ‡	> 1 × 10 <sup>8</sup>	>1 × 10 <sup>8</sup>	3 × 10 <sup>8</sup>	Pb < 5 mbar (500 Pa)
He # ‡	4 × 10 <sup>5</sup>	2.5 × 10 <sup>5</sup>	2 × 10 <sup>5</sup>	Pb < 2 mbar (200 Pa)
H <sub>2</sub> # ‡	1.6 × 10 <sup>4</sup>	1.1 × 10 <sup>4</sup>	5 × 10 <sup>3</sup>	Pb < 1 × 10 <sup>-2</sup> mbar (1 Pa)
Interstage pumping speed ‡				
N <sub>2</sub> #	-	10 l s <sup>-1</sup>	21 l s <sup>-1</sup>	Pb = 5 mbar (500 Pa) Qi = 240 sccm (4 mbar l s <sup>-1</sup> ) (400 Pa l s <sup>-1</sup> ) Qp = 0 sccm
He #	-	10 l s <sup>-1</sup>	23 l s <sup>-1</sup>	Pb = 5 mbar (500 Pa) Qi = 100 sccm (1.67 mbar l s <sup>-1</sup> )(167 Pa l s <sup>-1</sup> ) Qp = <20 sccm (0.33 mbar l s <sup>-1</sup> )(33 Pa l s <sup>-1</sup> )
Ultimate pressure with rotary vane backing pump *				
DN100ISOK inlet flange	< 5 × 10 <sup>-9</sup>	< 5 × 10 <sup>-9</sup>	< 5 × 10 <sup>-9</sup>	
DN100CF inlet flange	< 5 × 10 <sup>-10</sup>	-	-	
Ultimate pressure with diaphragm backing pump †				
DN100ISOK inlet flange	< 5 × 10 <sup>-8</sup>	< 5 × 10 <sup>-8</sup>	< 5 × 10 <sup>-8</sup>	
DN100CF inlet flange	< 5 × 10 <sup>-8</sup>	-	-	

‡ Pumping speeds are without inlet-screen or inlet-strainer (EXT255Hi/EXT255HVi only). Inlet-screens and inlet-strainers reduce speed by approximately 10%.

# Pb = backing pressure, Qi = flow through the interstage-port (EXT255Hi/EXT255HVi only),

Qp = flow through pump-inlet

\* Ultimate pressure 48 hours after bakeout with Pb < 1 × 10<sup>-2</sup> mbar (1Pa)

† Ultimate pressure 48 hours after bakeout with Pb < 5 mbar (500 Pa)

+ Inlet pressure has risen to 1 × 10<sup>-3</sup> mbar (1 × 10<sup>-1</sup> Pa).

▲ Not supplied - pump supplied with port blanked

Table 1 - Technical data

Parameter	EXT255H	EXT255Hi	EXT255HVi	Notes
Maximum backing pressure +				
N <sub>2</sub>	12 mbar (1200 Pa)	12 mbar (1200 Pa)	12 mbar (1200 Pa)	
He	10 mbar (1000 Pa)	10 mbar (1000 Pa)	10 mbar (1000 Pa)	
H <sub>2</sub>	3 mbar (300 Pa)	3 mbar (300 Pa)	3 mbar (300 Pa)	
Minimum backing pump displacement	0.6 m <sup>3</sup> h <sup>-1</sup>	0.6 m <sup>3</sup> h <sup>-1</sup>	0.6 m <sup>3</sup> h <sup>-1</sup>	
Maximum continuous inlet pressure §				
water-cooling at 15 °C §	2 × 10 <sup>-1</sup> mbar, 20 Pa	2 × 10 <sup>-1</sup> mbar, 20 Pa	2 × 10 <sup>-1</sup> mbar, 20 Pa	
air-cooling at 35 °C §	2 × 10 <sup>-2</sup> mbar, 2 Pa	2 × 10 <sup>-2</sup> mbar, 2 Pa	2 × 10 <sup>-2</sup> mbar, 2 Pa	
Operating attitude	Vertical and upright through to horizontal ±2°			
Nominal rotational speed	60000 r min <sup>-1</sup>	60000 r min <sup>-1</sup>	60000 r min <sup>-1</sup>	
Standby rotational speed	42000 r min <sup>-1</sup>	42000 r min <sup>-1</sup>	42000 r min <sup>-1</sup>	
Starting time to 90% speed				
EXC100E	190 sec	190 sec	190 sec	
EXC120	130 sec	130 sec	130 sec	
EXC300	100 sec	100 sec	100 sec	
Cooling method	Forced-air/ water	Forced-air/ water	Forced-air/ water	
Ambient air temperature (forced-air cooling)	0 - 35 °C	0 - 35 °C	0 - 35 °C	
Water temperature (water-cooling)	10 - 20 °C	10 - 20 °C	10 - 20 °C	
Noise level (at 1 metre)	< 50 dB(A)	< 50 dB(A)	< 50 dB(A)	
Recommended controller	EXC120	EXC120	EXC120	
EXC120 maximum VA input	250 VA	250VA	250VA	with bakeout band
Quiescent power	25W	25W	25W	
Recommended backing pump †	RV3	RV3	RV3	

§ Above this pressure, rotational speed drops below nominal.

+ Inlet pressure has risen to 1 × 10<sup>-3</sup> mbar (1 × 10<sup>-1</sup> Pa).

† A larger backing pump may be required for maximum throughput

Table 1 - Technical data (continued)

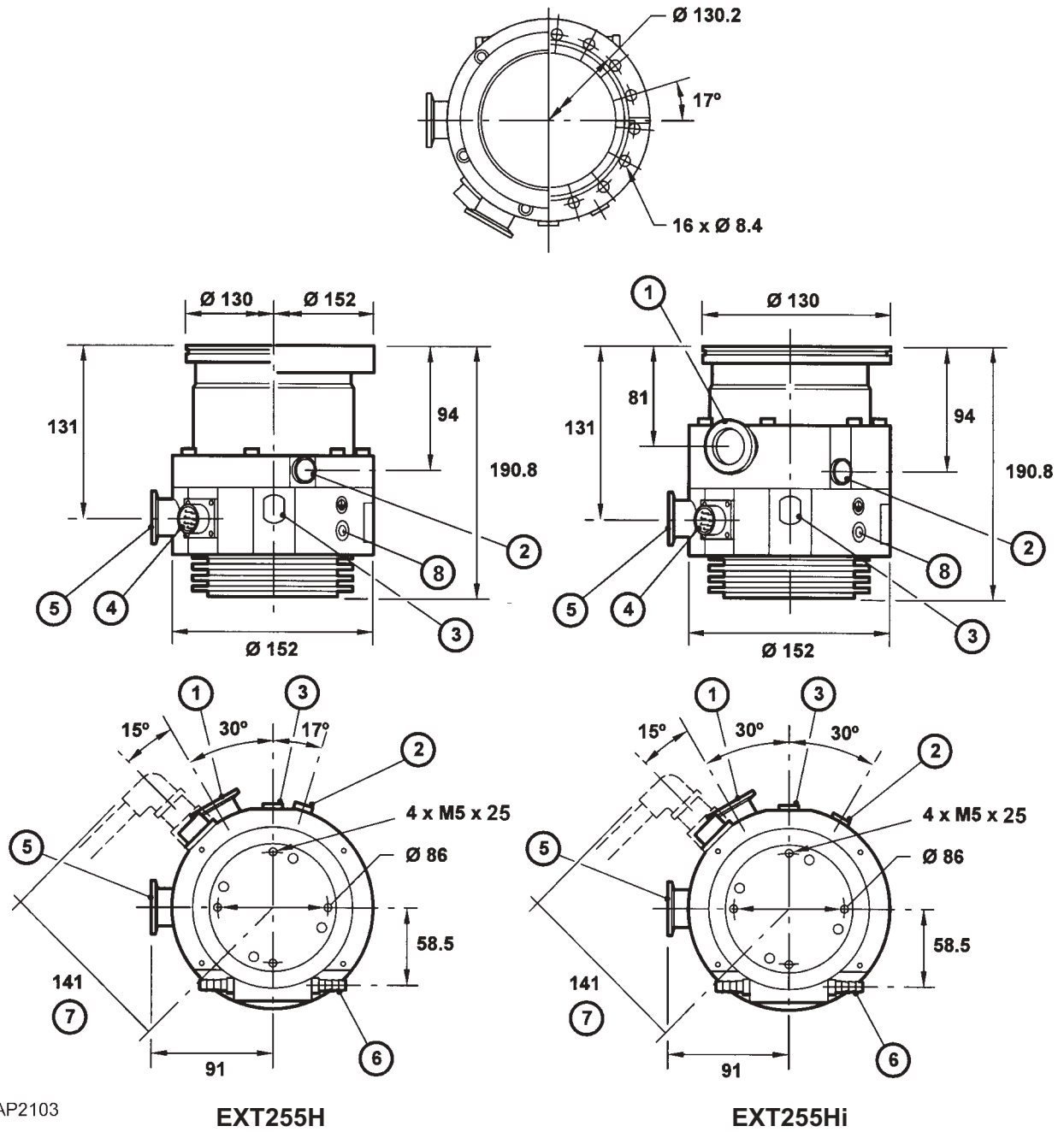
## 2.6 Materials exposed to gases pumped

The following materials and component types are exposed to the gases pumped: aluminium alloys, stainless steels, fluoroelastomer and nitrile 'O' rings, hydrocarbon lubricant, felt, rare earth magnets, silicon nitride, phenolic resin and carbon-fibre reinforced epoxy resin.



DN100ISO-K

DN100CF



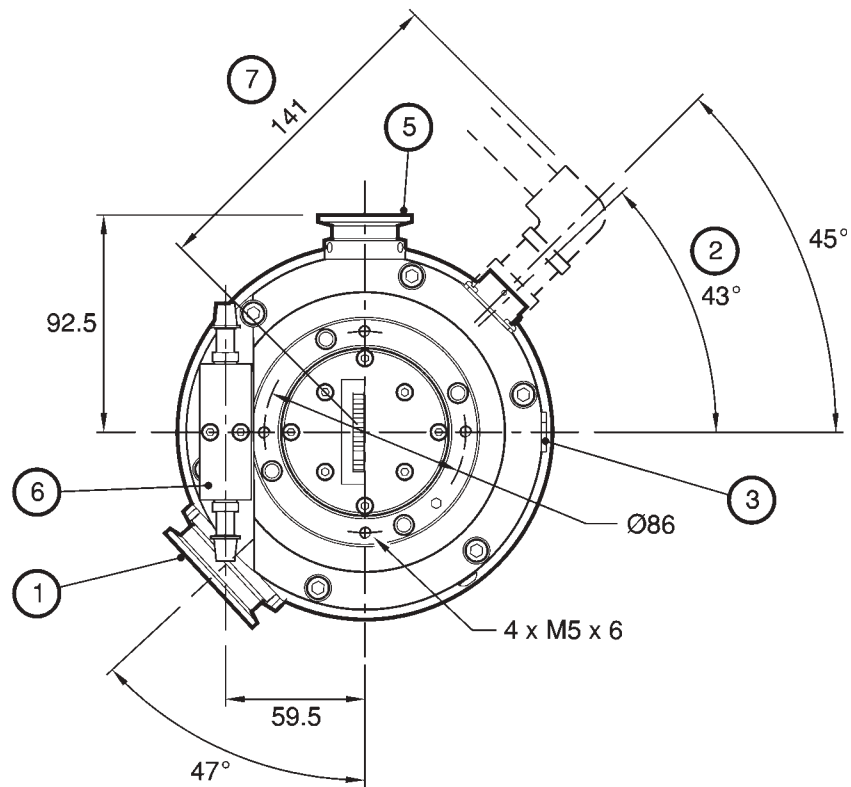
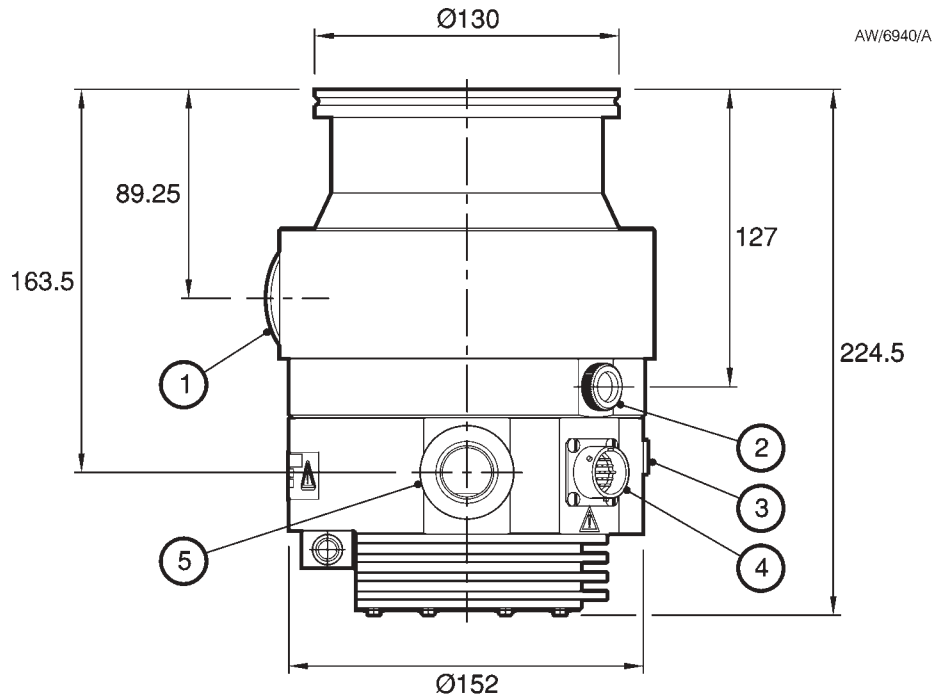
AP2103

EXT255H

EXT255Hi

- |                                    |  |
|------------------------------------|--|
| 1. Interstage-port (EXT255Hi only) | 5. Backing-port                              |
| 2. Vent-valve                      | 6. Cooling-water connectors                  |
| 3. Purge-port                      | 7. Allowance for right-angle cable connector |
| 4. Electrical supply connector     | 8. Earth (ground) bonding point              |

Figure 4 - EXT255H/EXT255Hi dimensions (mm)



- |                                |  |
|--------------------------------|--|
| 1. Interstage-port             | 5. Backing-port                              |
| 2. Vent-valve                  | 6. Cooling-water connectors                  |
| 3. Purge-port                  | 7. Allowance for right-angle cable connector |
| 4. Electrical supply connector | 8. Earth (ground) bonding point              |

Figure 5 - EXT255HV dimensions (mm)

### 3 INSTALLATION

**WARNING**

Safely route all vacuum, vent/purge gas and cooling-water pipelines, and all electrical cables and wires, so that people cannot trip over them.

#### 3.1 Unpack and inspect

The pump is packed to prevent damage in transit. Take care when you unpack the pump to avoid excessive shocks which could damage the bearings and reduce the life of the pump. The pump is supplied with the inlet and outlet sealed to prevent entry of dust and vapour. Do not remove these seals until you are ready to install the pump on your vacuum system.

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

Check that your package contains the items listed in Table 2. If any of these items is missing, notify your supplier in writing within three days.

Qty	Description	Check (✓)
1	EXT turbomolecular pump	<input type="checkbox"/>
1	Inlet seal (trapped 'O' ring, Co-Seal or copper compression gasket)	<input type="checkbox"/>
1	Inlet-strainer (EXT255Hi only, fitted in the interstage-port)	<input type="checkbox"/>
1	Interstage seal (EXH255HV only, fitted in the interstage-port)	<input type="checkbox"/>

Table 2 - Checklist of items

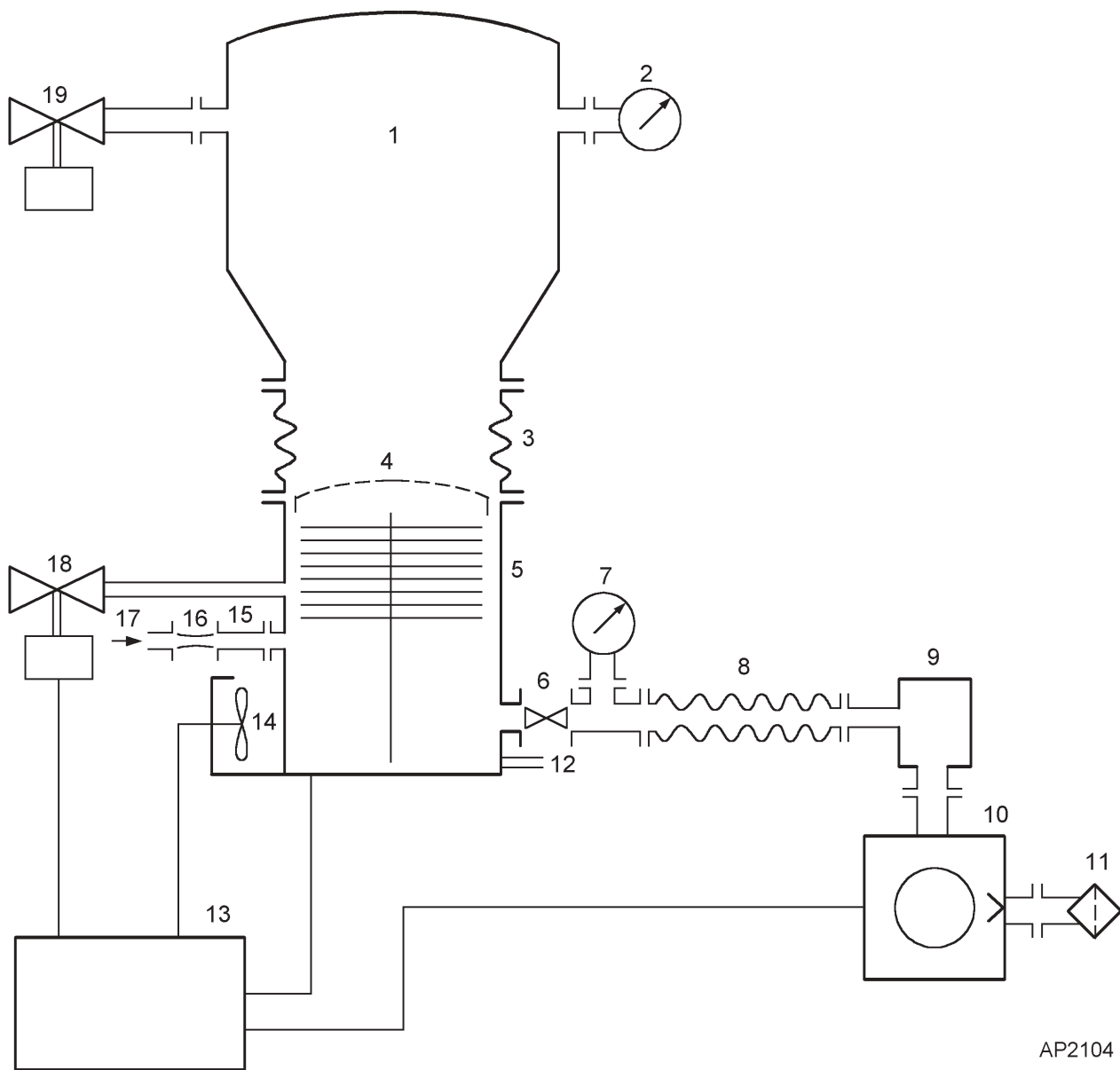
If the pump is not to be used immediately, store the pump in suitable conditions as described in Section 6.1.

Do not discard the packing materials; retain them to repack the pump when you return it for service.

#### 3.2 Typical installation

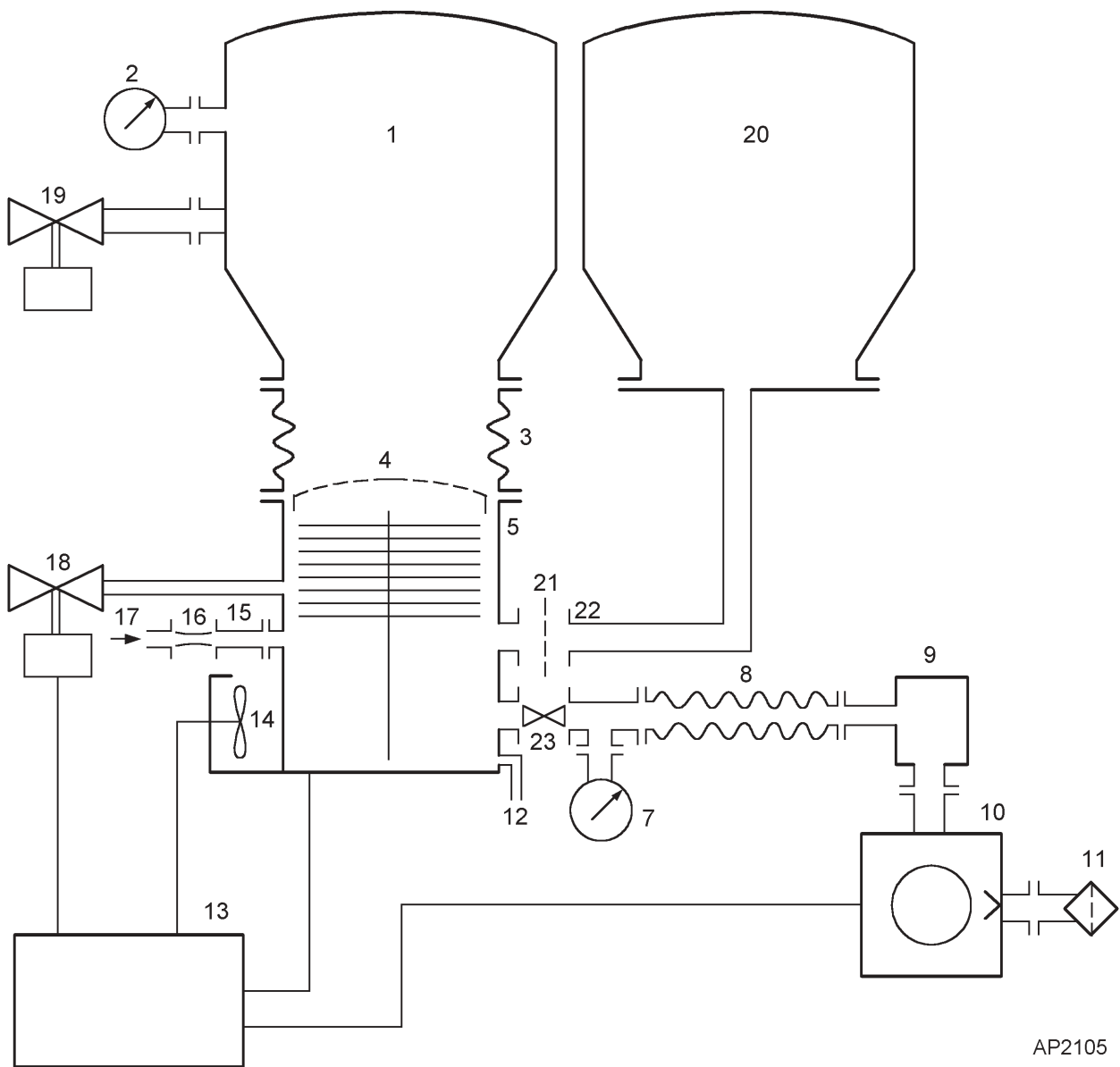
A typical pumping system with an EXT255H pump is shown in Figure 6. A typical pumping system with an EXT255Hi or EXT255HV pump is shown in Figure 7. When necessary, purge the EXT pump with inert gas as described in Section 3.5.

The accessories available for these EXT pumps are detailed in Section 7; the accessories are shown in Figure 9.



- |                       |                              |   |
|-----------------------|------------------------------|---|
| 1. Vacuum system      | 7. Vacuum                    | 13. EXC controller                      |
| 2. High-vacuum gauge  | 8. Flexible bellows          | 14. Air-cooler                          |
| 3. Vibration isolator | 9. Foreline trap             | 15. Vent port adaptor                   |
| 4. Inlet-screen       | 10. Rotary backing-pump      | 16. PRX10 purge restrictor              |
| 5. EXT pump           | 11. Mist filter              | 17. Regulated purge gas supply          |
| 6. Backing valve      | 12. Cooling-water connectors | 18. Vent-valve                          |
|                       |                              | 19. Alternative position for vent-valve |

Figure 6 - Typical pumping system with an EXT255H pump



- |                       |                              |   |
|-----------------------|------------------------------|---|
| 1. Vacuum chamber 1   | 8. Flexible bellows          | 16. PRX10 purge restrictor              |
| 2. High-vacuum gauge  | 9. Foreline trap             | 17. Regulated purge gas supply          |
| 3. Vibration isolator | 10. Rotary backing-pump      | 18. Vent-valve                          |
| 4. Inlet-screen       | 11. Mist filter              | 19. Alternative position for vent-valve |
| 5. EXT pump           | 12. Cooling-water connectors | 20. Vacuum chamber 2                    |
| 6. Not used           | 13. EXC controller           | 21. Inlet-strainer                      |
| 7. Vacuum gauge       | 14. Air-cooler               | 22. Interstage-port                     |
|                       | 15. Vent port adaptor        | 23. Backing valve                       |

Figure 7 - Typical pumping system with an EXT255Hi/EXT255HVi pump

### 3.3 Connect to the vacuum system

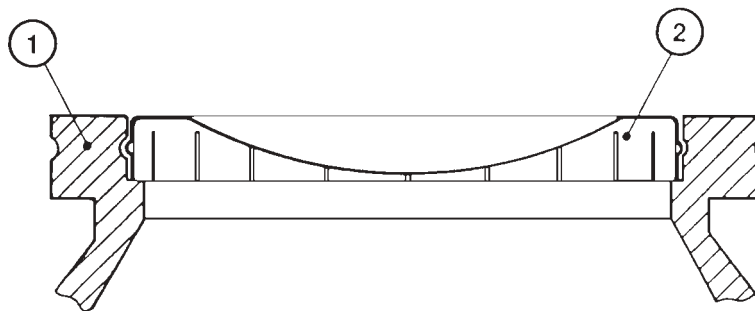
#### WARNING

Install the pump in the vacuum system before you connect the EXC Controller. This will ensure that the pump cannot operate and injure people during installation.

#### 3.3.1 Inlet screen

Do not remove the inlet-screen unless you can be sure that there is no danger that debris can fall into the pump. In order to avoid the danger of injury from the rotor blades, do not remove the inlet-screen until you are ready to mount the pump onto your system. If the screen is removed, the pumping speed will increase by approximately 10%.

To remove the inlet-screen carefully extract it from the inlet-flange using a bent wire hook. To replace a screen which has been removed, install it as shown in Figure 8, with the BOC Edwards logo uppermost. Ensure that the dimples on the rim of the screen engage in the groove in the pump flange. If necessary, gently bend the tabs of the screen outwards to ensure a tight fit.



AG/0059/A

1. EXT inlet-flange
2. Inlet-screen

Figure 8 - Correct installation of the inlet-screen

#### 3.3.2 Mechanical fixing

#### WARNING

Do not operate the EXT pump until it is securely fixed. If the pump seizes, the stored energy of the rotor can cause rapid movement of the pump, which may cause damage and injury to people.

There are two ways in which the EXT pump can be securely fixed. Ideally, the EXT pump should be securely fixed by its inlet-flange to a rigid, firmly fixed vacuum system: see Section 3.3.4. If this is not possible because of the nature of the vacuum system, the base of the EXT pump must be securely fixed to a firm support: see Section 3.3.3.

### 3.3.3 Base mounting

Ensure that the base of the pump is securely fixed to a firm support (refer to Figures 4 and 5 for the fixing hole details). If the pump supports the weight of the vacuum system, the mass of the vacuum system must be no more than 20 kg.

You must also ensure that your mounting method meets the following requirements, so that the EXT pump will remain secure in the event of a pump seizure:

- The support mounting must be able to withstand a destructive torque of 620 Nm.
- Fit cap-head fixing screws through the tapped fixing-holes in the base of the pump (see Figures 4 and 5): use M5 screws.
- The fixing screws must comply with ISO 898-1, with a strength class of 12.9 (nominal tensile strength 1200 MPa).
- The fixing screw engagement length must be 6 mm or more.
- Tighten the fixing screws to a torque of 12 Nm (1.22 kgf m).

### 3.3.4 Inlet connection and orientation

The EXT pump can be fixed to the vacuum system by the inlet-flange. The pump can be mounted in any attitude from vertical and upright through to horizontal ( $\pm 2^\circ$ ). If the pump is mounted horizontally and you use a rotary vane pump to back the EXT pump, the backing port must point vertically downwards ( $\pm 20^\circ$ ) to reduce the risk of contamination from the backing pump oil.

Make sure that the pump-inlet and all components fitted to the pump-inlet are clean and dust-free. If the pump-inlet is not kept clean, the pump-down time may be increased.

The inlet-connection of the EXT pump is a CF flange or an ISO flange:

- If the pump has a CF flange, use the copper compression gasket supplied with the pump and use a full complement of bolts to connect the inlet-flange of the pump to the vacuum system.
- If the pump has an ISO flange, use the BOC Edwards trapped 'O' ring supplied with the pump and use a minimum of four claw clamps to connect the inlet-flange of the pump to the vacuum system. Ensure that each claw clamp is tightened to a torque of 10 Nm or more.

Alternatively, use a rotatable collar and the trapped 'O' ring supplied with the pump to connect the inlet-flange of the pump to the vacuum system; use a full complement of bolts with the rotatable collar.

Ensure that no torque or other forces are transmitted to the pump from the vacuum system or the associated pipelines.

If necessary, fit an inlet vibration isolator between the pump-inlet and the vacuum system: refer to Section 7.4.9 for the Item Numbers, and refer to the instruction manual supplied with the vibration isolator for installation details. If you fit a vibration isolator, you must securely fix the base of the EXT pump as described in Section 3.3.3.

*Note: The first time you pump down the system to vacuum, you must re-tighten the bolts which secure the inlet-flange.*

### 3.3.5 Backing connection

Use suitable vacuum tubing and connectors to connect the NW flange of the backing-port to your backing-pump. If necessary, use flexible pipe or bellows to reduce the transmission of vibration from the backing-pump to the EXT pump.

We recommend that you use a BOC Edwards RV backing-pump. The backing-pump can also be controlled by the EXC Controller (EXC120 EXC300). The minimum size of the backing-pump required is given in Table 1. You may have to use a larger backing-pump if you run the pump at a high inlet pressure or high throughput, or if you purge the pump with more than 25 sccm ( $0.42 \text{ mbar l s}^{-1}$ ,  $42 \text{ Pa l s}^{-1}$ ) of purge gas. The EXT255H is also suitable for use with diaphragm backing-pumps although the effect of high backing pressure on the pump's performance and cooling requirements should be noted (see Table 1 and Section 3.7).

Do not use the EXT pump with a backing pressure below  $5 \times 10^{-4} \text{ mbar}$  ( $5 \times 10^{-2} \text{ Pa}$ ). Lower backing pressures will increase the evaporation rate of the lubricating oil and so will reduce the life of the bearings.

### 3.3.6 Interstage connection (EXT255Hi/EXT255HVi only)

The EXT255HVi pump is supplied with an interstage-port seal, and the EXT255Hi pump is supplied with a combined inlet-strainer/interstage-port seal; leave the inlet-strainer in the interstage-port, unless you are sure that debris cannot be drawn into the interstage-port.

Use the seal supplied and suitable vacuum tube and connectors to connect the interstage-port to your vacuum system or to the outlet flange of another turbomolecular pump (if you use the EXT255Hi or EXT255HVi pump to back another turbomolecular pump).

## 3.4 Vent-valve connection and control

When you design your system and when you install a vent-valve, take note of the information in Sections 1.3 and 2.3. You can vent the EXT pump and your vacuum system by any of the following methods:

- Use the manual vent-valve supplied. Take care not to open the manual vent-valve too quickly.
- Use a TAV5 or TAV6 solenoid vent-valve accessory (see Section 7) in place of the manual vent-valve.
- Use a TAV5 or TAV6 solenoid vent-valve connected to a convenient flange on your vacuum system.
- Use an alternative valve connected to your vacuum system.

If you use the manual vent-valve, you must open the vent-valve only after the EXT pump speed has fallen to 50% of full rotational speed.

Do not vent from the backing line. If you vent into your vacuum system, select a point upstream of the pump, to prevent oil backstreaming from the backing line.

If you use the TAV5 or TAV6 vent-valve we recommend that you control it from the EXC controller.



Table 3 gives an indication of the appropriate orifice size to be fitted to the vent valve for given vacuum system volumes in order that the vent rate is kept within the limits given in Section 2.3.

Vacuum system volume (l)	Orifice diameter (mm)
< 20	≤ 1.0
< 10	≤ 0.7
< 5	≤ 0.5
< 2	≤ 0.35

Table 3 - Vent-restrictor orifice diameter (with atmospheric pressure at the inlet of the vent-valve)

### 3.5 Purge gas connection

#### 3.5.1 Connect the purge gas

If you want to supply a purge gas to the pump, fit a vent port adaptor (see Section 7.4.7) in place of the blank plug (Figure 4 or 5, item 3). Connect your gas supply to the purge port.

You must limit the flow rate of the purge gas to the allowed range, also specified in Section 2.4. To limit the flow rate, use a flow controller or a pressure regulator and calibrated flow restrictor. The PRX10 purge restrictor accessory (see Section 7.3) is suitable for this purpose. Adjust the PRX10 as described in the instruction manual supplied with the accessory.

#### 3.5.2 Recommended purge gas flow

The recommended purge gas flow for typical applications is 25 sccm ( $0.42 \text{ mbar l s}^{-1}$ ,  $42 \text{ Pa l s}^{-1}$ ). This flow will protect the pump when you pump oxygen in concentrations above 20% by volume.

### 3.6 Electrical installation

Always make the electrical connections to the EXT pump after the pump has been installed on your vacuum system.

The EXT pump should be electrically bonded to earth (ground) using the connection provided (Figure 4 or 5, item 8).

The EXC Controller provides the electrical supply to the EXT pump through the multiway pump-to-controller cable. Connect and lock the bayonet-connectors at the ends of the cable to the mating connectors on the pump and the EXC Controller.

The EXC Controller is designed to allow a pumping system to be configured in a variety of ways, from a basic manually-operated system to a fully automatic system with remote control. Refer to the instruction manual supplied with the EXC Controller to complete the electrical installation.

## 3.7 Cooling

### 3.7.1 Introduction

**CAUTION**

You must cool the pump by forced-air or water-cooling to prevent damage to the bearing lubricant.

We recommend that wherever possible, you cool the pump by forced-air or water-cooling.

You must use water-cooling in any of the following operating conditions:

- Backing pressure >10 mbar (1000 Pa).
- Backing pressure > 8 mbar (800 Pa) and interstage flow > 30 sccm (0.5 mbar l s<sup>-1</sup>, 50 Pa l s<sup>-1</sup>).
- Backing pressure > 5 mbar (500 Pa) and interstage flow > 80 sccm (1.3 mbar l s<sup>-1</sup>, 130 Pa l s<sup>-1</sup>).
- Ambient temperature > 35 °C.
- When you use a bakeout band.

In all other operating conditions, you can use forced-air cooling. If you use forced-air to cool the pump, you must ensure that there is an adequate supply of cooling-air to the pump.

During operation, if the temperature of any surface of the pump is higher than 50 °C, the pump is too hot and you must increase the cooling.

### 3.7.2 Forced-air cooling

An air-cooler accessory is available for the EXT pumps (refer to Section 7). Fit the air-cooler as described in the instruction manual supplied with it. If you wish to use an alternative fan for air-cooling, ensure that the flow rate is above 70 m<sup>3</sup> h<sup>-1</sup> (40 cfm)

### 3.7.3 Water-cooling

The cooling-water supply must comply with the specification given in Section 2.5. Pipes in the water-cooling circuit may become blocked if the cooling-water contains too much calcium carbonate or if it contains particulates which are too large. Corrosion of the water-cooling circuit may occur if there is too little calcium carbonate and oxygen in the water. Good quality drinking water is usually suitable for water-cooling. If in doubt, you must check the quality of your cooling-water supply and, if necessary, provide treatment and filtration.

Connect the cooling-water supply to the water-cooler on the pump as described below. Either of the two ruffled connectors on the water-cooler can be used for the water supply or return connections.

1. Push reinforced hose (approximately 6 mm internal diameter) over the ends of the ruffled hose connectors on the water-cooler on the pump.
2. Attach the hose with strong hose clips and make sure that they are tightened securely.

Alternatively, unscrew the ruffled hose connectors and remove them from the water-cooler and make direct connections to the  $\frac{1}{8}$  BSP female threaded fittings on the water-cooler.

You must turn off the cooling-water supply when you switch off the pump to prevent condensation of vapours inside the pump. The EXC Controller (EXC120 and EXC300) can operate a solenoid-valve for this purpose.

If you want to remove the pump for maintenance, and you do not want to break the cooling-water circuit, unscrew the two M4 cap-head fixing-screws and remove the water-cooler from the pump. Make sure that there is a layer of thermal contact grease on the water-cooler before you refit it to the pump.

## 4 OPERATION

### WARNING

Do not disconnect the pump-to-controller cable when the EXT pump is operating. If you do, there may be a risk of injury or death by electric shock.

### WARNING

Do not operate the pump unless it is connected to your vacuum system. If you do, the pump rotor can cause injury. The pump rotor rotates at very high speeds and you may not be able to see that the pump is rotating.

### WARNING

Do not expose any part of your body to vacuum. If you do, you may be injured.

### 4.1 Start-up

Use the procedure below to start up a basic, manually-controlled pumping system with a manual vent-valve and an end user version EXC Controller (for example, EXC120 or EXC300). Refer to the EXC instruction manual where the backing pump and accessories are automatically controlled by the EXC Controller.

1. Turn the manual vent-valve clockwise to close it.
2. Turn on the cooling-water supply (if water-cooling is used).
3. Start the backing-pump.
4. When the vacuum system pressure is approximately 10 mbar ( $1 \times 10^3$  Pa) or less, press the Start/Stop button on the EXC Controller to start the EXT pump.
5. The pump will then accelerate to full operating speed. The pump rotational speed is shown by the LED speed indicator on the front panel of the EXC Controller.

*Note: The first time you pump down the system to vacuum, you must re-tighten the bolts which secure the inlet-flange: refer to Section 3.3.4.*

### 4.2 Stand-by

You can press the Standby button on the EXC Controller to operate the EXT pump at reduced rotational speed. Select Standby before or after Start-up, for any of the following reasons:

- To extend pump-bearing life and still maintain adequate vacuum pumping performance (for example, when you leave a system under vacuum over holiday periods).
- To increase system pressure or to extend the maximum inlet pressure range of the pump where this suits a particular process.

### 4.3 Shut-down

*Note: In an emergency only, open the vent-valve quickly to decelerate the pump rotor in the shortest possible time.*

Use the procedure below to shut down a basic, manually-controlled pumping system with a manual vent-valve and an end user version EXC Controller (for example, EXC120 or EXC300). Refer to the EXC Controller instruction manual where the backing-pump and accessories are automatically controlled by the EXC Controller.

1. Close the valve in the backing-line connecting the EXT pump to the backing-pump.
2. Switch off the backing-pump.
3. Press the Start/Stop button on the EXC Controller to switch off the EXT pump.
4. When the EXT pump rotational speed has fallen to below 50% of full rotational speed, turn the manual vent-valve anticlockwise to open it. Ensure that the rate of pressure rise does not exceed the allowed rate of pressure rise, otherwise you can damage the pump: refer to Sections 1.3 and 2.3.
5. If water-cooling is in use, turn off the cooling-water supply.

### 4.4 Safety interlocks and control system

The pump protection and safety interlock features are listed below. Refer to the instruction manual supplied with the EXC Controller for a full description of these features (note that references to LED's and buttons do not apply to OEM versions of the EXC controller):

- The EXC Controller monitors the temperature of the EXT pump and the electrical power consumption of the pump. If the EXC Controller detects excessive power consumption or temperature, the rotational speed of the pump motor is reduced until the power and temperature return to normal
- If the rotational speed is reduced to 50% of nominal speed, then the pump is stopped immediately (or after a user defined time delay) and the Fail LED on the EXC Controller lights
- If pump rotational overspeed is detected by the EXC Controller, the pump is stopped immediately and the FAIL LED on the EXC Controller lights.

If the Fail LED lights, switch off the backing-pump immediately and vent the EXT pump. Once the EXT pump has stopped, rectify the cause of the failure (refer to Section 5.5), press the EXC Controller Start/Stop button to reset the Fail condition, and restart the EXT pump. If the pump is hot, allow sufficient time for it to cool before you restart it.

## 4.5 Bakeout

### CAUTION

When you bake the EXT pump to above 70 °C at the inlet-flange, you must cool the pump by water-cooling, to prevent damage to the bearing lubricant.

If you heat your EXT pump (and your vacuum system), you will speed up the degassing process so that the pump will reach ultimate vacuum in the shortest possible time. If you heat the pump, this will also prevent condensation of vapours inside the pump.

You can use the BOC Edwards BX bakeout band to heat the pump (refer to Section 7). Fit the band around the pump, just below the inlet-flange. When you bake the pump or the system, make sure that the temperature of the inlet-flange does not exceed 100 °C.

If you bake your vacuum system and the temperature of the system exceeds 200 °C, you must put a radiation shield between the system and the EXT pump. This radiation shield will reduce the heat radiated onto the pump rotor.

Typically, a bakeout of four hours is long enough to remove water condensation from the pump. However, the bakeout time will depend on the amount of condensation in the pump and the vacuum system, and the ultimate pressure you want to achieve.

## 5 MAINTENANCE

### WARNING

Allow the pump-rotor to stop, then disconnect the EXC Controller before you remove the pump from your vacuum system for maintenance or fault-finding procedures.

### 5.1 Introduction

The maintenance operations for the EXT Turbomolecular pumps are described in the following sections. The ISX inlet-screen, the WCX water-cooler, the inlet-strainer, interstage-port seal and inlet-flange seals are available as spares (refer to Section 7). Fit the ISX inlet-screen as described in Section 3.3.1. Fit the WCX water-cooler as described in Section 3.7.2.

### 5.2 Bearing life

When supplied, the pump contains sufficient lubricant to supply the bearings for life. No routine maintenance is therefore required between bearing replacements. The bearings are not user-serviceable. The bearings will need to be replaced when they reach the end of their service life. This is typically more than 20,000 hours, but may be less; this depends on the type of pumping duty on which the pump is used.

When the bearings need replacement, we recommend that you exchange your pump for a factory reconditioned replacement. Alternatively, you can send your pump to a BOC Edwards Service Centre to have the bearings replaced.

When you return EXT pumps to BOC Edwards Service Centres please use the procedure included at the end of this manual. However, the instruction to drain all fluids does not apply to the lubricant in the EXT pump oil-reservoirs.

### 5.3 Rotor life

The life of the EXT pump rotor is typically 40,000 to 50,000 cycles (of acceleration to full speed, and then deceleration to a stop). The pump rotor is not user-serviceable.

We therefore recommend that you exchange your pump for a factory reconditioned replacement every 20,000 cycles, or 10 years of use, whichever occurs first. Alternatively, you can send your pump to a BOC Edwards Service Centre for a major service (which will include rotor replacement).

When you return EXT pumps to BOC Edwards Service Centres please obey the procedure included at the end of this manual. However, the instruction to drain all fluids does not apply to the lubricant in the EXT pump oil-reservoirs.

## 5.4 Clean the pump

### WARNING

Clean the external surfaces of the EXT pump in a well-ventilated location. When you use cleaning solutions and solvents to clean the pump, observe all precautions specified by the manufacturer. Avoid inhalation of any particulates which may be present in the pump.

### CAUTION

Do not attempt to clean any parts of the EXT pump other than the external surfaces. Organic solvents may damage internal pump components. Do not use abrasive materials to clean any part of the pump.

If the inside of the EXT pump is contaminated, it may not be possible to achieve the specified ultimate vacuum, or pump-down time may increase. In these circumstances, you should return the pump to a BOC Edwards Service Centre, where the pump will be dismantled and cleaned. Use the procedure given in the forms at the end of this manual to return the pump.

You can use any organic solvent to clean the external surfaces of the EXT pump. We recommend that you use non-CFC solvents, such as isopropanol or ethanol. Use a cleaning solution which is suitable for the contaminants on the pump surfaces.

For environmental reasons, keep wastage of cleaning solutions and solvents to a minimum.

## 5.5 Fault finding

Refer to Table 4 for the possible causes of faults and for the recommended actions to rectify faults. Table 4 is applicable to a basic, manually controlled pumping system with an EXC Controller configured for local (manual) operation.

Note that if you use an EXDC Pump Drive Module to control the EXT pump, or if you use an EXC Controller configured for remote operation to control the EXT pump, some of the checks and actions in Table 4 may not apply to your system.

Refer to the fault finding section of the instruction manual supplied with your EXDC Pump Drive Module or EXC Controller for further fault finding information.



Symptom	Check	Action
The pump does not rotate. After pressing start - Fail LED not lit.	<p>Is the EXC Controller power LED lit?</p> <p>Is the EXC Controller Start/Stop LED flashing?</p>	<p>If not, check that the electrical supply is on, check that the switch at the rear of the EXC Controller is on, check the fuse in the rear of the EXC Controller.</p> <p>If all of the above are OK then the EXC Controller is faulty. Consult BOC Edwards or your supplier</p> <p>If so, check that the correct links are made on the EXC Controller logic interface (refer to the instruction manual supplied with the EXC Controller).</p> <p>Check that any system interlocks are correctly made (refer to the instruction manual supplied with the EXC Controller).</p> <p>Check that the pump-to-controller cable is connected.</p> <p>If you have made all of the above checks and cannot identify the cause of the fault, consult BOC Edwards or your supplier.</p>
	Is the EXC Controller first speed indication LED lit?	If not, the EXC Controller is faulty. If lit, then the EXT pump is faulty. Consult BOC Edwards or your supplier.
The EXC Controller trips into Fail - at any speed.	Are the system interlocks correctly connected?	Ensure that the system interlocks do not open after the EXT pump has started.

Table 4 - Fault finding

Symptom	Check	Action
The EXC Controller trips into Fail during the ramp-up and before 50% speed is reached.	Is the inlet pressure too high? Is the backing pressure too high?	If so, reduce the pumping load, or check for a gross leak into the system.
	Is the EXT pump running too hot?	Increase the cooling-water flow or decrease the water temperature or do both. You may need to change from air-cooling to water-cooling. (Refer to Section 2 for maximum inlet pressure and cooling requirements). Check that external heat sources (such as system bakeout heaters) are not excessive.
	Does the rotor rotate freely?	If not, the EXT pump-bearings are damaged. Consult BOC Edwards or your supplier.
	Is the timer set incorrectly?	Increase the timer setting (refer to the instruction manual supplied with the EXC Controller). If the EXC Controller still trips into Fail consult BOC Edwards or your supplier.
The EXC Controller trips into Fail after 50% speed has been reached - the first two speed LEDs are lit.	Is the pressure too high?	If so, reduce the pumping load or check for a gross leak into the system.  If the high gas load is temporary, configure the EXC Controller to delay the Fail trip on 50% speed and set an appropriate delay time (refer to the instruction manual supplied with the EXC Controller).
	Is the EXT pump running too hot?	Increase the cooling-water flow or decrease the water temperature or do both. You may need to change from air-cooling to water-cooling.
	Does the EXT pump rotor rotate freely?	If not, the EXT pump-bearings are damaged. Consult BOC Edwards or your supplier.

Table 4 - Fault finding (continued)

Symptom	Check	Action
The EXC Controller trips into Fail - all the speed LEDs are lit.	-	Consult BOC Edwards or your supplier.
Ultimate pressure cannot be reached.	<p>Is the pressure limited by water vapour ?</p> <p>Are any of the vacuum gauges contaminated ?</p> <p>Is the pumping speed insufficient (due to poor conductance between the pump and the gauge or too large a chamber) ?</p> <p>Is the interstage inlet pressure &gt; 0.2 mbar (20 Pa) ?</p> <p>Is the backing pressure &lt; 12 mbar (1200 Pa)?</p> <p>Is the high-vacuum area of the system contaminated ?</p> <p>Check the rest of your system for leaks and contamination.</p> <p>Remove the pump from the system and test the ultimate pressure of the pump alone (see Section 2 for specification).</p>	<p>Bake the system and pump.</p> <p>If so, clean or replace them.</p> <p>Increase the conductance or reduce the volume.</p> <p>If the interstage inlet pressure is too high, inlet pressure at the turbomolecular inlet is reduced; ensure that the interstage inlet pressure is &lt; 0.2 mbar (20 Pa).</p> <p>Check for backing line leaks. If the backing pressure is too high, you may need a larger backing-pump.</p> <p>If so, clean the high-vacuum system.</p> <p>If found, clean the contaminated areas and repair the leaks.</p> <p>If poor, check the pump for contamination and if necessary return the pump as described in Section 5.4. Leak-check the pump. If the leak rate &gt; <math>1 \times 10^{-7}</math> mbar l s<sup>-1</sup> (<math>1 \times 10^{-5}</math> Pa l s<sup>-1</sup>), consult BOC Edwards or your supplier.</p>

Table 4 - Fault finding (continued)

<b>Symptom</b>	<b>Check</b>	<b>Action</b>
The EXT is very noisy or there is excessive vibration or both.	Is the pump rotational speed the same as the resonant frequency of the attached system ?	If so, change the natural frequency of your system or isolate the pump using flexible bellows.
	Is the vibration being transmitted from the rotary pump ?	If so, fit flexible bellows or a vibration isolator in the backing line.
	Is the noise irregular and getting progressively worse ?	If so, a bearing is defective. Consult BOC Edwards or your supplier.
	Is the EXT making a constant high-pitched noise ?	If so, the rotor is out of balance. Consult BOC Edwards or your supplier.
None of the above.	-	Consult BOC Edwards or your supplier.

Table 4 - Fault finding (continued)

## 6 STORAGE AND DISPOSAL

### 6.1 Storage

Use the following procedure to store the pump.

1. Place protective covers over the inlet, outlet, interstage (EXT255Hi/EXT255HVi only), purge and vent ports.
2. Place the pump in its packing materials. For fastest pump-down when the pump is put back into service, seal the pump inside a plastic bag together with a suitable desiccant.
3. Store the pump in cool, dry conditions until required for use. When required, prepare and install the pump as described in Section 3.
4. Keep the pump upright at all times to prevent the drainage of oil from the bearing reservoir.
5. Avoid long-term storage if possible. When long-term storage is necessary, the pump should be set up and run for at least eight hours every six months.

### 6.2 Disposal

#### WARNING

In the unlikely event that the rotor fails, dust may be generated from the carbon fibre reinforced components in the pump. If the rotor has failed:

- Wear the appropriate personal protective equipment (gloves, a dust-proof mask which covers the nose and mouth, an apron or overalls, and safety glasses or goggles) when you handle the pump.
- Ensure that the pump inlet, outlet, and vent-, interstage- and purge-ports are all blanked off/sealed before you dispose of the EXT pump.

Dispose of the EXT Turbomolecular Pump and any components and accessories safely in accordance with all local and national safety and environmental requirements.

Take particular care with any components which have been contaminated with dangerous process substances.

Take appropriate action to avoid inhalation of any particulates which may be present in the pump.

Do not incinerate the pump. The pump contains phenolic and fluorosilicone materials which can decompose to very dangerous substances when heated to high temperatures.

## 7 SERVICE, SPARES AND ACCESSORIES

### 7.1 Introduction

BOC Edwards products, spares and accessories are available from BOC Edwards companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, USA and a world-wide network of distributors. The majority of these employ service engineers who have undergone comprehensive BOC Edwards training courses.

Order spare parts and accessories from your nearest BOC 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 the part

### 7.2 Service

BOC Edwards products are supported by a world-wide network of BOC 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 rebuilt is returned with a full warranty.

Your local Service Centre can also provide BOC Edwards engineers to support on-site maintenance, service or repair of your equipment.

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

### 7.3 Spares

#### 7.3.1 ISX inlet-screen

An inlet-screen is fitted to your pump as supplied to prevent damage from the entry of debris into the pump. The Item Numbers of replacement inlet-screens are given below. Select the inlet-screen according to the pump inlet-flange size.

<b>Flange size</b>	<b>Inlet-screen</b>	<b>Item Number</b>
DN100ISO-K/DN100CF	ISX100	B580-51-001

#### 7.3.2 Inlet-strainer (EXT255Hi pump only)

The EXT255Hi pump is supplied with an inlet-strainer for the interstage-port. The Item Number of a replacement inlet-strainer is given below.

<b>Interstage-port size</b>	<b>Item Number</b>
DN25NW	A223-06-067

### 7.3.3 Interstage-port seal (EXT255HVi pump only)

The EXT255HVi pump is supplied with a fluoroelastomer 'O' ring seal for the interstage-port. The Item Number of a replacement interstage-port seal is given below.

<b>Interstage-port size</b>	<b>Item Number</b>
DN40NW	C105-16-395

### 7.3.4 WCX water-cooler

A water-cooler is fitted to your pump as supplied. The Item Number of a replacement water-cooler is given below.

<b>Water-cooler</b>	<b>Item Number</b>
WCX500	B580-61-001

### 7.3.5 Inlet-flange seals

EXT pumps are supplied with an inlet seal. The Item Numbers of replacement seals are given below.

<b>Inlet-flange</b>	<b>Inlet seal</b>	<b>Item Number</b>
DN100ISO-K	ISO100 trapped 'O' ring, fluoroelastomer	B271-58-171
DN100CF	Copper compression gasket (pack of 5)	C082-00-008

## 7.4 Accessories

### 7.4.1 Installation

The accessories available for use with the EXT turbomolecular pumps are described in the following Sections. Figure 9 shows how the accessories are fitted to an EXT pump.

### 7.4.2 EXC Controller

The BOC Edwards EXC Controllers provide the facilities necessary for operating a pumping system based on an EXT255H, EXT255Hi or EXT255HVi pump. The Item Numbers of the EXC Controllers are given below.

<b>Controller</b>	<b>Voltage</b>	<b>Item Number</b>
EXC100E	90 - 264 V a.c.	D396-20-000
EXC100L	90 - 264 V a.c.	D396-22-000
EXC120	90 - 264 V a.c.	D396-16-000
EXC300	90 - 132/180 - 264 V a.c.	D396-14-000

### 7.4.3 Pump-to-controller cable

You must fit a pump-to-controller cable between an EXC Controller and the EXT pump. A cable is not supplied with the EXT Pump or the EXC Controller (except EXC100L). The following cables are available:

Cable	Length	Item Number
Pump-to-controller	1 m	D396-18-010
Pump-to-controller	3 m	D396-18-030
Pump-to-controller	5 m	D396-18-050

### 7.4.4 EXDC Drive Modules

Fit an EXDC Drive Module as an alternative to an EXC Controller and pump-to-controller cable.

Drive Module	Item Number
EXDC80	D396-40-000
EXDC160	D396-41-000

### 7.4.5 BX bakeout band

A BX bakeout band accelerates the degassing of the pump to enable it to achieve lower pressures. It may also be used to protect the pump from condensation of contaminants. The bakeout bands are available in 110-120 V or 220-240 V versions and may be powered from a rear panel socket on the EXC Controller.

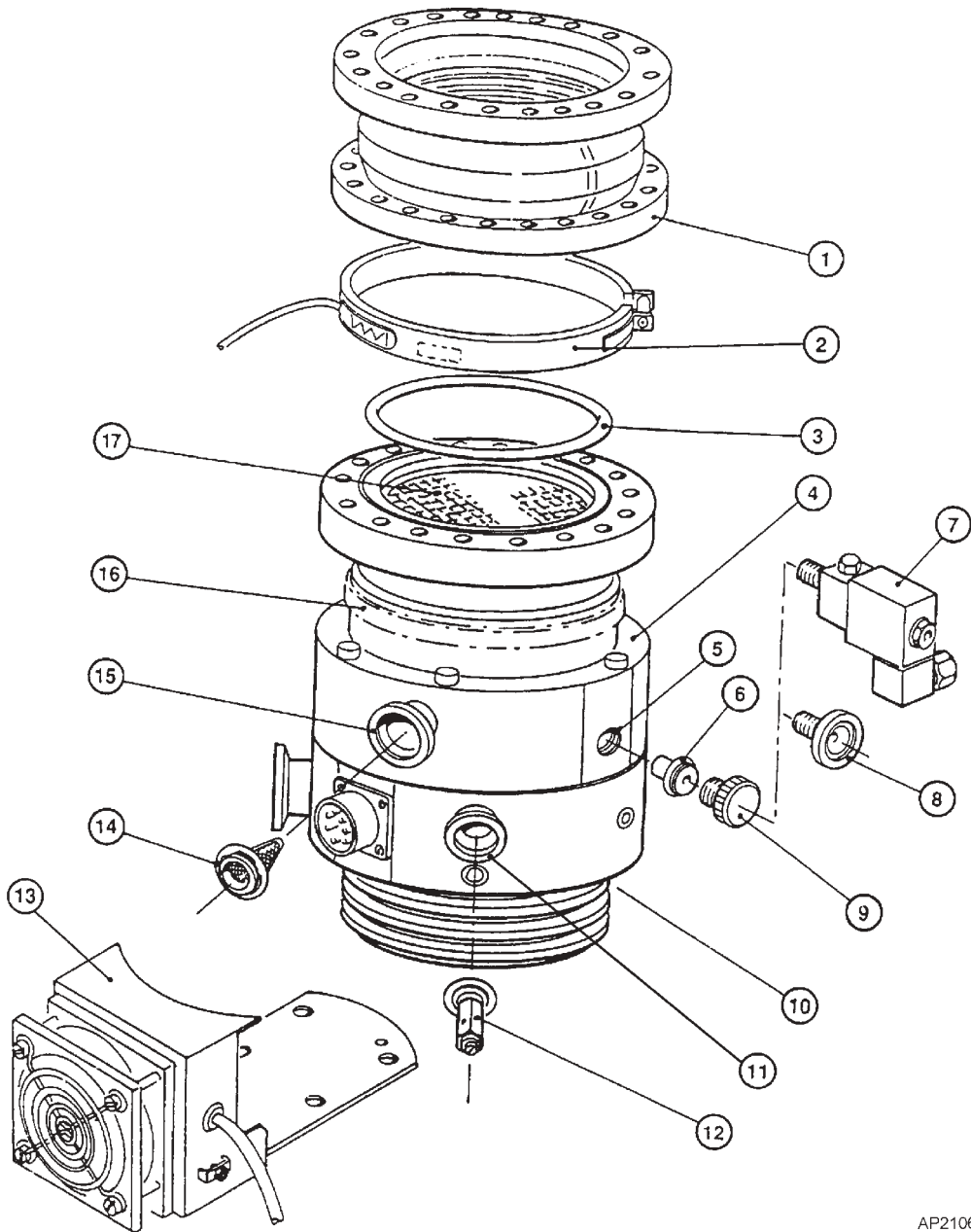
Pump	Bakeout band	Item Number
EXT255H/Hi	BX250 (110 V)	B580-52-041
	BX250 (240 V)	B580-52-061

### 7.4.6 FL20K foreline trap

The foreline trap minimises oil vapour backstreaming from the backing pump and is recommended where the highest system cleanliness is required.

Foreline trap	Item Number
FL20K	A133-05-000





AP2106

- |                                 |   |                                |
|---------------------------------|---|--------------------------------|
| 1. Vibration isolator           | 6. VRX vent-restrictor                          | 11. Vent port adaptor          |
| 2. Bakeout band                 | 7. Solenoid vent-valve                          | 12. Purge restrictor           |
| 3. Inlet-flange seal (supplied) | 8. DN10NW adaptor                               | 13. Air-cooler                 |
| 4. EXT255Hi pump                | 9. Manual vent-valve (supplied)                 | 14. Inlet strainer (supplied)* |
| 5. Vent-port                    | 10. Water-cooler (on opposite side of the pump) | 15. Interstage-port †          |
|                                 |   | 16. Bakeout band position      |
|                                 |   | 17. Inlet-screen (supplied)    |

\* EXT255Hi only

† EXT255Hi/EXT255HVi only

Figure 9 - Installation of optional accessories (and spares): EXT255Hi shown

#### 7.4.7 TAV vent-valve and vent-port adaptor

Two solenoid-operated vent-valves are available for system venting. The valves are 24 V d.c., normally-open, and can be driven automatically from the EXC Controller. The solenoid-valve is fitted in place of the manual-valve, or alternatively can be fitted with an adaptor (supplied with the valve) and be used with any suitable NW10 flanged port on your vacuum system.

The vent-port adaptor allows the vent-port or the purge-port to be used with any suitable NW10 fitting: see Figure 9, item 8 and item 11.

Product	Item Number
TAV5 vent-valve	B580-66-010
TAV6 vent-valve	B580-66-020
NW10- <sup>1</sup> / <sub>8</sub> inch BSP male adaptor	B580-66-011

#### 7.4.8 ACX air-cooler

An ACX air-cooler can be fitted to the EXT pump. However, please refer to Section 3 to check the suitability of air-cooling in a particular application.

Pump	Air-cooler	Item Number
EXT255H/Hi	ACX250H	B580-53-160

#### 7.4.9 Vibration isolators

In applications where the small amount of vibration generated by the turbomolecular pump is a problem, a vibration isolator can be fitted. The isolator consists of two special flanges separated by a flexible bellows and a rubber, anti-vibration, outer collar. The isolator required depends on the pump inlet-flange size.

Inlet-flange size	Item Number
DN100ISO-K	B580-20-000

#### 7.4.10 PRX purge-restrictor

A modified DN10NW centring-ring is available to filter the purge gas and restrict its flow rate to the recommended flow of 25 sccm. The restrictor is suitable for all EXT pumps fitted with a purge-port.

Purge-restrictor	Flange size	Item Number
PRX10	NW10	B580-65-001

### 7.4.11 VRX vent-restrictor

Use a VRX fixed orifice vent-restrictor to restrict the flow of vent gas into the EXT pump. Refer to Section 3.4 for information on the selection of the correct VRX vent-restrictor.

<b>Vent-restrictor</b>	<b>Orifice diameter (mm)</b>	<b>Item Number</b>
VRX10	0.1	B580-66-021
VRX20	0.2	B580-66-022
VRX30	0.3	B580-66-023
VRX50	0.5	B580-66-024
VRX70	0.7	B580-66-025

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## Return of BOC Edwards Equipment - Procedure

### INTRODUCTION

Before returning your equipment, you must warn BOC Edwards if substances you used (and produced) in the equipment can be hazardous. This information is fundamental to the safety of our Service Centre employees and will determine the procedures employed to service your equipment.

**Complete the Declaration (HS2) and send it to BOC Edwards before you dispatch the equipment.** It is important to note that this declaration is for BOC Edwards internal use only, and has no relationship to local, national or international transportation safety or environmental requirements. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable laws.

### GUIDELINES

- Equipment is '**uncontaminated**' if it has not been used, or if it has only been used with substances that are not hazardous. Your equipment is '**contaminated**' if it has been used with any substances classified as hazardous under EU Directive 67/548/EEC (as amended) or OSHA Occupational Safety (29 CFR 1910).
- If your equipment has been used with radioactive substances, biological or infectious agents, mercury, polychlorinated biphenyls (PCB's), dioxins or sodium azide, you must decontaminate it before you return it to BOC Edwards. You must send independent proof of decontamination (for example a certificate of analysis) to BOC Edwards with the Declaration (HS2). Phone BOC Edwards for advice.
- If your equipment is contaminated, you must either:
  - Remove all traces of contamination (to the satisfaction of laws governing the transportation of dangerous/hazardous substances).
  - Or, properly classify the hazard, mark, manifest and ship the equipment in accordance with applicable laws governing the shipment of hazardous materials.

**Note: Some contaminated equipment may not be suitable for airfreight.**

### PROCEDURE

1. Contact BOC Edwards and obtain a Return Authorisation Number for your equipment.
2. Complete the Return of BOC Edwards Equipment - Declaration (HS2).
3. If the equipment is contaminated, you must contact your transporter to ensure that you properly classify the hazard, mark, manifest and ship the equipment, in accordance with applicable laws governing the shipment of contaminated/hazardous materials. As the person offering the equipment for shipment, it is your responsibility to ensure compliance with applicable law. **Note: Equipment contaminated with some hazardous materials, such as semiconductor by-products, may not be suitable for airfreight - contact your transporter for advice.**
4. Remove all traces of hazardous gases: pass an inert gas through the equipment and any accessories that will be returned to BOC Edwards. Where possible, drain all fluids and lubricants from the equipment and its accessories.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached) with blanking flanges or, for uncontaminated product, with heavy gauge tape.
6. Seal equipment in a thick polythene/polyethylene bag or sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
8. Fax or post a copy of the Declaration (HS2) to BOC Edwards. The Declaration must arrive before the equipment.
9. Give a copy of the Declaration (HS2) to the transporter. You must tell your transporter if the equipment is contaminated.
10. Seal the original Declaration in a suitable envelope: attach the envelope securely to the outside of the equipment package, in a clear weatherproof bag.

**WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.**

## Return of BOC Edwards Equipment - Declaration

Return Authorisation Number:

You must:

- Know about all of the substances which have been used and produced in the equipment before you complete this Declaration
- Read the Return of BOC Edwards Equipment - Procedure (HS1) before you complete this Declaration
- Contact BOC Edwards to obtain a Return Authorisation Number and to obtain advice if you have any questions
- Send this form to BOC Edwards before you return your equipment

**SECTION 1: EQUIPMENT**

Equipment/System Name \_\_\_\_\_

Part Number \_\_\_\_\_

Serial Number \_\_\_\_\_

Has the equipment been used, tested or operated ?

 YES  Go to Section 2    NO  Go to Section 4

**IF APPLICABLE:**

Tool Reference Number \_\_\_\_\_

Process \_\_\_\_\_

Failure Date \_\_\_\_\_

Serial Number of Replacement Equipment \_\_\_\_\_

**SECTION 2: SUBSTANCES IN CONTACT WITH THE EQUIPMENT**
**Are any substances used or produced in the equipment:**

- Radioactive, biological or infectious agents, mercury, poly chlorinated biphenyls (PCBs), dioxins or sodium azide? (if YES, see Note 1) YES  NO
- Hazardous to human health and safety? YES  NO

**Note 1 :** BOC Edwards will not accept delivery of any equipment that is contaminated with radioactive substances, biological/infectious agents, mercury, PCB's, dioxins or sodium azide, unless you:

- Decontaminate the equipment
- Provide proof of decontamination

**YOU MUST CONTACT BOC EDWARDS FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT**

**SECTION 3: LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT**

Substance name	Chemical Symbol	Precautions required (for example, use protective gloves, etc.)	Action required after a spill, leak or exposure

**SECTION 4: RETURN INFORMATION**

Reason for return and symptoms of malfunction \_\_\_\_\_

- If you have a warranty claim:
- who did you buy the equipment from ? \_\_\_\_\_
  - give the supplier's invoice number \_\_\_\_\_

**SECTION 5: DECLARATION**

Print your name: \_\_\_\_\_ Print your job title: \_\_\_\_\_

Print your organisation: \_\_\_\_\_

Print your address: \_\_\_\_\_

Telephone number: \_\_\_\_\_ Date of equipment delivery: \_\_\_\_\_

I have made reasonable enquiry and I have supplied accurate information in this Declaration. I have not withheld any information, and I have followed the Return of BOC Edwards Equipment - Procedure (HS1).

**Note: Please print out this form, sign it and return the signed form as hard copy.**

Signed: \_\_\_\_\_ Date \_\_\_\_\_

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