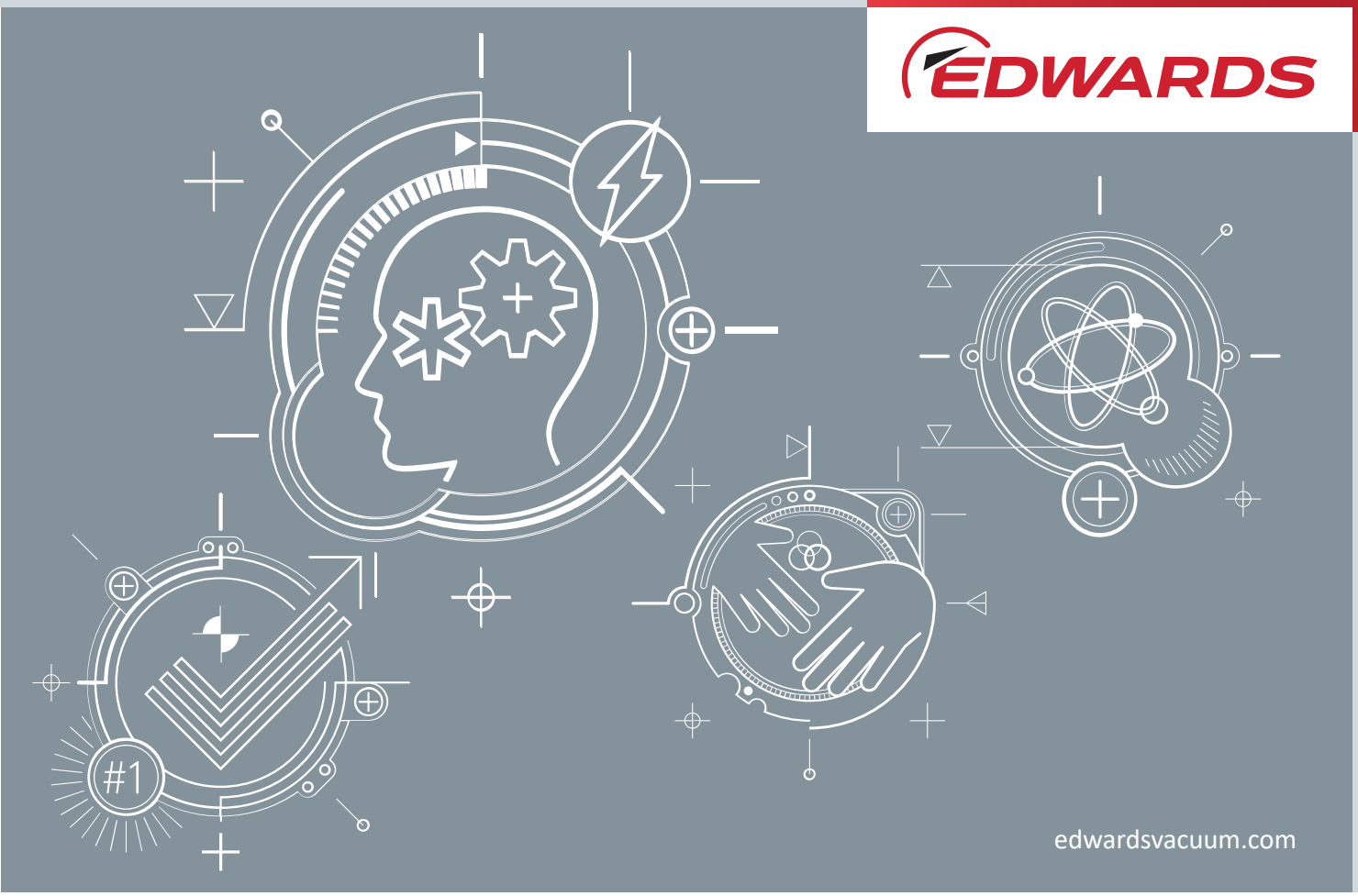

Turbomolecular pumps nEXT730, nEXT930, nEXT1230

INSTRUCTION MANUAL

B8J200880_E

Original instructions

Copyright notice

Published: 7/20/2023

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Product warranty and limit of liability are dealt with in our standard terms and conditions of sale or negotiated contract under which this document is supplied.

You must use this product as described in this manual. Read the manual before you install, operate, or maintain the product.

Associated publications

Publication title	Publication number
Vacuum pump and vacuum system safety	P40040100

Contents

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1. Safety and compliance

1.1 Definition of Warnings and Cautions

Important safety information is highlighted as warning and caution instructions which are defined as follows. Different symbols are used according to the type of hazard.

WARNING:

If you do not obey a warning, there is a risk of injury or death.

CAUTION:

If you do not obey a caution, there is a risk of minor injury, damage to equipment, related equipment or process.

NOTICE:

Information about properties or instructions for an action which, if ignored, will cause damage to the equipment.

We reserve the right to change the design and the stated data. The illustrations are not binding.

1.1.1 Safety symbols

The safety symbols on the products show the areas where care and attention is necessary.

The safety symbols that we use on the product or in the product documentation have the following meanings:

	**Warning/Caution** Risk of injury and/or damage to equipment. An appropriate safety instruction must be followed or a potential hazard exists.
	**Warning - Dangerous voltage** Risk of injury. Identifies possible sources of hazardous electrical shock.
	**Warning - Hot surfaces** Risk of injury. Identifies a surface capable of inflicting burns through contact.
	**Symbol - Protective earth** Identifies an electrical equipment earth (ground) terminal.
	**Warning - Use protective equipment** Risk of injury. Use appropriate Personal Protective Equipment (PPE) when performing the task.
	**Warning - Risk of explosion** Risk of injury or damage to equipment. Identifies a situation that could result in an explosion.

1.2 Trained personnel

“Trained personnel” for the operation of this pump are

- skilled workers with knowledge in the fields of mechanics, electrical engineering and vacuum technology and
- personnel specially trained for the operation of vacuum pumps.

2. Important safety information

2.1 Mechanical hazards

WARNING: EJECTION OF PARTS

If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions.

Mount the pump firmly to the vacuum chamber. Never operate the pump without proper flanging to the vacuum chamber (in bench testing, for example). In case of rotor destruction a sudden twisting of the entire pump is possible. The vacuum chamber must be able to absorb the torque of max. 5 kNm (nEXT730/930) and 9 kNm (nEXT1230) around the rotor's axis of rotation in the event of sudden rotor destruction.

CAUTION: CUTTING AND CRUSHING

When reaching into open flanges there is a risk of cutting and crushing your fingers.

Do not operate the vacuum pump with open flanges. Do not reach into the pump.

When installing the vacuum pump, first mechanically connect the inlets and outlets and then make the electrical connections.

Disconnect the vacuum pump from the power supply before servicing. Only use trained service personnel.

Before servicing, ensure that gas cannot flow through the pump. Only open the pump system when it is under atmospheric pressure.

CAUTION: EJECTION OF PARTS

Ejection of parts through bursting of vacuum system as a result of excessive pressure.

When using the pump with purge gas, protect the purge gas supply such that in the event of a malfunction no overpressure can occur within the system. The pressure in the pump must not exceed 1.4 bar (absolute).

CAUTION: VACUUM

Pulling into the vacuum can cause injury to hands or fingers.

Do not operate the vacuum pump with open flanges.

CAUTION: FALLING PARTS

Errors during transport can cause the pump to fall down.

Transport the pump only in its transport packaging or at the eye-bolts provided for this purpose.

2.2 Electrical hazards

CAUTION: ELECTRICAL SHOCK

Contact with live parts may lead to electrical shock.

The electrical connection may only be carried out by a trained person. Observe the national regulations in the user country, e.g. for Europe EN 50110 - 1. Prior to servicing, disconnect the vacuum pump from the power supply.

Electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components.
Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.

The pump must only be connected to power supplies which meet the requirements for functional extra-low voltages with positive isolation in accordance with IEC 60364-4-41 (or local regulations) (PELV). All interfaces must only be operated with PELV-fed components and devices.

2.3 Thermal hazards

CAUTION: BURNS

Touching hot surfaces may lead to burns.

Handle the pump only when ventilated and cooled down.
Wear suitable protective equipment.

2.4 Danger through materials and substances

WARNING: HAZARDOUS SUBSTANCES

Pumped process gases may escape from the exhaust and leaks in the vacuum system. During servicing, toxic deposits may be present in the pump. The gases, vapours or substances may be hazardous to health.

The pumping of toxic / explosive / flammable / pyrophoric / radioactive / oxidizing / corrosive gases or gas mixtures, as well as oxygen of more than atmospheric concentration (21 %) is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.

2.5 Dangers in connection with safety-related measures and precautions

CAUTION: AUTOMATIC START-UP

The frequency converter is not equipped with its own emergency shut down switch. This may lead to an unwanted pump start-up.

Install an emergency shut down switch in the system. The emergency shut down switch must be

- **present in the building installation**
- **suitably arranged and easily accessible for the user**
- **marked as the disconnecting device for this device.**

3. Overview

A nEXT730, nEXT930 or nEXT1230 pump consists of a turbomolecular pump with a permanently attached motor controller containing drive electronics.

The motor controller controls the electrical supply to the pump. It allows manual adjustment of the standby speed and all other controls can only be operated through the logic interface. To operate the pump, connect it to the customer control equipment and power supply or, alternatively, use the Edwards TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller and the Edwards power supply.

The motor controller drives the brush-less motor in the pump.

The nEXT pumps are supplied with an inlet screen fitted into the centering O-ring for ISO version pumps and into the envelope for CF version pumps. The inlet screen protects the pump against damage that would be caused by debris entering the pump.

The nEXT pumps have a vent port for venting the pump and vacuum system to atmospheric pressure. The pump is supplied with a manual vent valve fitted; this can be replaced with a TAV5 or TAV6 solenoid-operated vent valve. The TAV valve can be directly controlled by the on-board motor controller.

The nEXT pumps have a purge port: an inert purge gas can be introduced to protect the bearing and motor from corrosion. An optional vent port adapter and purge restrictor can be fitted to the purge port to control the flow rate of the purge gas and to filter the gas supply. Additionally this may be used to optimise the performance of the pump, for example with low molecular mass gases.

A forced air cooling kit and a water-cooling block are available as optional accessories to cool the nEXT pumps.

3.1 Ordering information

Table 1 Table Ordering information

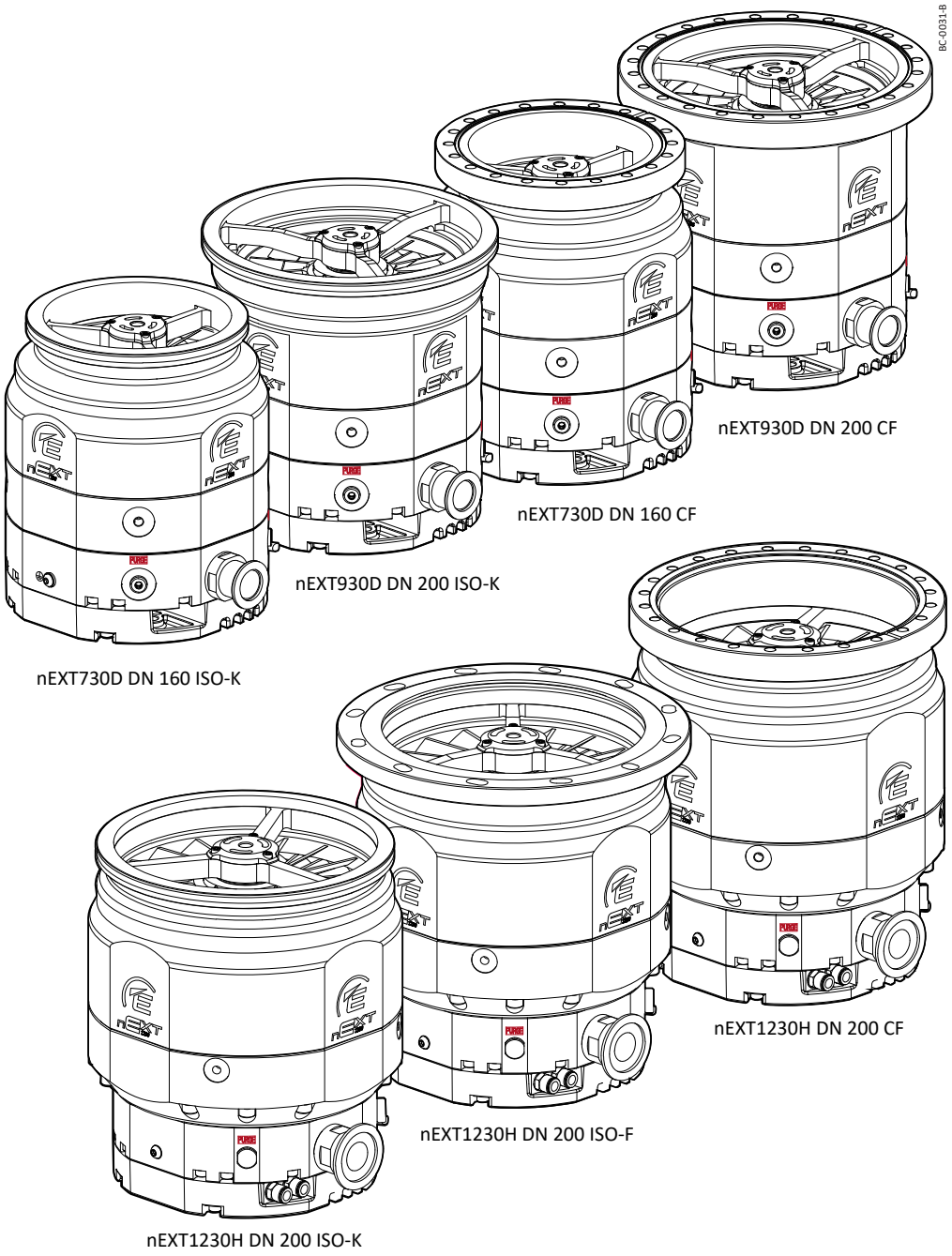
Part No.	Pump name
B8J100300	nEXT730Q ISO-K160 NW25
B8J200300	nEXT730D ISO-K160 NW25
B8J200400	nEXT730D CF160 NW25
B8J400300	nEXT730H ISO-K160 NW25
B8J400400	nEXT730H CF160 NW25
B8K100D00	nEXT930Q ISO-K200 NW25
B8K200D00	nEXT930D ISO-K200 NW25
B8K200F00	nEXT930D CF200 NW25
B8N4A0F00	nEXT1230H CF200 NW40
B8N4A0E00	nEXT1230H ISO-F200 NW40
B8N4A0D00	nEXT1230H ISO-K200 NW40
B8N4A0FU0	nEXT1230H CF200 NW40 INV

Part No.	Pump name
B8N4A0EU0	nEXT1230H ISO-F200 NW40 INV
B8N4A0DU0	nEXT1230H ISO-K200 NW40 INV

nEXT730 and 930 pumps can be mounted in any orientation,
nEXT1230 pumps can be mounted

- horizontally or vertically, with the high-vacuum flange *on top* and in any orientation in between or
- horizontally or vertically, with the high-vacuum flange *on the bottom* and in any orientation in between (INV versions)

Figure 1 nEXT Model overview



3.2 Motor controller

The motor controller contains the drive electronics that controls the pump operation, the TAV vent valve and the air cooler.

CAUTION:

Do not disconnect the pump from the electrical supply until the pump has stopped completely.

There is an auxiliary connector socket in front of the motor controller where the TAV vent valve and the Air cooler can be plugged into. Refer to *Motor controller auxiliary connector socket* on page 53.

There is a USB port (item 9) which is a service port to be used with the Edwards nST2 PC software, using a standard micro-USB cable. This will enable the pump to be configured, monitored and upgraded without disconnecting from the 48 V d.c. supply. This software is available for download from the Edwards' Upgrade website: www.upgrades.edwardsvacuum.com.

The motor controller has seven indicator LEDs that signal the general status, operation, service status of the pump, CAN and serial communication and bearing service status. The LEDs can be used for fault finding if a problem should occur.

The motor controller has a number of built-in safety features to protect the nEXT pumps from damage in the event of sustained high pressure and temperature.

- The electronics constantly monitors the temperature inside the motor controller and the temperature of the bearing inside the pump. If either part becomes too hot, the motor controller reduces the power supplied to the pump motor and the pump speed will drop. If the pump rotational speed reduces below 50% of full speed, the electronics may trip into a Fail condition, depending on the system configuration.
- If the pump inlet pressure increases, the power supplied to the pump motor increases to counteract the gas frictional load. However, when the built-in maximum power limit is reached, the speed of the pump will start to drop. If the pump rotational speed falls below 50% full speed, the electronics may trip into Fail condition, depending on how the system has been configured. Refer to *Timer* on page 17.
- In the event of an electrical supply failure, the controller uses the motor within the pump as a generator. This means the nEXT pumps have their own regenerative supply and do not require a separate battery for emergency power backup. The regenerated energy is used to maintain the electrical supply to the controller and any vent valve or fan attached to the controller connector until the pump speed falls to below 50% of full rotational speed: this will ensure that the vent valve remains shut until below 50% of full rotational speed and will prevent the pump from venting at full speed. It also ensures that the serial link and signals on the parallel interface remain active until the pump speed falls below 50%.

3.3 Operational features

In addition to the basic start and stop commands, the nEXT pumps have several other features that allow pump operation to be tailored to a particular application.

3.3.1 Power limit setting

Select the maximum power that will be drawn by the pump. The more power supplied, the quicker the pump will accelerate to reach full speed.

If the application requires fast cycling or higher gas loads, set the power limit to the maximum value. If ramp time is not important in the application, use a lower power limit, down to a minimum value (refer to *Table: Power limit setting*). Also ensure there is sufficient cooling for the application.

Ensure that the power supply is capable of delivering sufficient power to the nEXT pump. By choosing a lower power limit setting, a smaller power supply may be used. For more information, refer to *Electrical data* on page 40.

3.3.2 Standby speed

In standby mode, the pump rotational speed is lower than the full rotational speed. The default setting for standby speed is 70% of full speed.

To run at standby speed, the pump must also be in the start condition.

If the application does not require the pump to be running at maximum speed at all times, use the standby speed feature rather than switching the pump off. This feature can be used for vacuum system tuning or as a system power saving option.

The standby speed is a user-selectable value (refer to *Standby speed setting* on page 84).

3.3.3 Timer

When the pump is started, an internal timer is automatically started within the motor controller. The default timer setting is 8 minutes.

If the pump fails to reach 50% of full rotational speed within the timeout period, the motor controller will signal a fail and will decelerate the pump to rest. This feature prevents the motor controller from driving the pump at maximum power for a long time. The pump may fail to reach 50% speed if the gas load is too high (for example if there is a leak in the system), if the backing pump fails or if the pump is too hot.

The timeout period is a user-selectable feature (refer to *Timer setting and options* on page 85). If the application requires the pump to ramp up slowly, extend the timeout period. The timer is permanently enabled for ramp-up.

The timer has an additional function; if the pump rotational speed drops below 50% of full speed for any reason, the pump time can be set to recover rather than trigger a fail condition. The timer starts as soon as the speed drops to below 50% full speed. If, during the timeout period, the pump recovers to above 50% full speed then the timer will be reset. If the pump rotational speed fails to recover by the end of the timeout period, the motor controller will trigger a fail condition and will decelerate the pump to rest.

When the pump is shipped, the timer function is enabled, however, it can be disabled. With the timer disabled, the pump will fail and decelerate to rest as soon as pump rotational speed falls below 50%.

3.3.4 Analogue output

The motor controller can produce an analogue output for monitoring system parameters.

- Measured pump rotational speed (default condition)
- Measured link power
- Measured motor temperature
- Measured motor controller temperature
- Measured bearing temperature

The analogue output signal ranges from 0 to 10 V and is directly proportional to the system parameter (refer to *Logic interface* on page 19).

Connect the analogue output to a suitable meter or indicator to display the appropriate system parameter or connect it to the customer control equipment (for example, to operate other components in the pumping system at preset values).

Only one system parameter can be monitored at a time using the analogue output. However, it is easy to configure the controller to monitor a different system parameter (refer to *Analogue signal options* on page 86).

3.3.5 Automatic vent options

The manufacturer's TAV vent valve can be connected directly to the motor controller. The motor controller can provide a number of different venting options and can be configured for both a normally closed and a normally open vent valve.

The motor controller can control the rate of venting. Using this feature the pump can be vented from full rotational speed in a controlled manner that will not damage the pump bearings. Once the pump rotational speed has dropped to below 50% of maximum speed, it is safe to hard vent (open the vent valve fully).

There are many venting options available, including:

- Hard vent when rotational speed drops below 50% speed
- Controlled vent when above 50% speed and hard vent below 50% speed
- Hard vent immediately through a suitable restrictor.

Controlled venting gives the benefit of a quicker ramp down time by controlling the vent rate through a single large orifice across the pump speed range. A full list of the venting options is given in *Vent options, vent valve connection and control* on page 90.

In addition there is a feature that allows a delayed start of the nEXT pump. With this feature, the vent valve can be closed before starting the pump. This allows the backing pump to reduce the pressure in the vacuum system before starting the nEXT pump.

Both a TAV and a cooling fan can be controlled at the same time using the ‘Y’ cable adaptor. No configuration is required.

3.3.6 Normal speed setting

The normal speed is a user-selectable parameter that can be set from 50% to 100% of full rotational speed.

When the pump reaches normal speed, a signal is available on the normal pin of the logic interface connector. This signal can be used to control the application since it shows that pump speed, and therefore vacuum performance, has reached a specific minimum level. The default setting is 80% of full rotational speed. Refer to *Normal speed setting* on page 84 for instructions on altering the normal speed setting.

3.3.7 Electronic braking

The pump has a user selectable electronic braking option that is disabled by default. With this option disabled, the pump will draw power from the electrical supply connected to the pump via the nEXT pump power supply cable when accelerating and running.

Whilst decelerating the pump will coast down and no power will be returned to the electrical supply.

The electronic braking option may be enabled to reduce the pump deceleration time and to recover some energy from the pump. This is only achieved by returning power from the pump to the electrical supply through the nEXT pump power supply cable. The rate at which electrical energy is returned to the supply is regulated to the voltages shown:

Voltage range	Returned electronic braking voltage
Below 43.2V dc. (48V dc. –10%)	Outside working range for pump
43.2V dc. to 50.4V dc.	48 V d.c. + 10%
Above 50.4V dc. (48V dc. +5%)	Outside working range for pump

In order to achieve the fastest electronic braking times there must be somewhere for the returned power to go, such as:

- A supply capable of receiving the returned power
- Other devices sharing the same electrical supply bus with the pump
- A suitable 3 A load when decelerating the pump

3.3.8 Bearing monitoring

In order to ensure maximum reliability and bearing life the nEXT pumps have an integrated system to manage the bearing condition, refer to *Bearing monitoring and conditioning system* on page 120. The pumps have an integrated battery backed real time clock that is constantly monitoring pump storage time.

If the pump is stored without being run for more than 12 months "*Bearing Run in Mode* on page 121" (BRIM) is triggered the next time the pump is started to condition the bearing. Bearing run in mode (BRIM) is a start-up sequence for the pump designed to precondition the bearing to optimise bearing life. The pump goes through a number of speed steps before reaching full speed.

3.4 Logic interface

The motor controller can only be operated through the logic interface. There are three types of signals on the logic interface.

- Control inputs: these are switch-type signals that are used to control the pump
- Status outputs: these outputs identify the status of the system
- Analogue output: this provides a 0 - 10 V output for a number of pump parameters.

The logic interface has been designed to support both serial and parallel control and monitoring, operating through one connector. For serial control either RS232 (default) or RS485 can be selected using the RS485/CAN/RS232 slide switch located on the motor controller (refer to *Connection for serial control and monitoring* on page 73).

The logic interface can be plugged directly into the Edwards TIC Turbo Controller, TIC Turbo Instrument Controller or TAG Controller and then use the functionality that they provide. *Alternatively* the logic interface can be connected to the customer control equipment.

For more information about the logic interface, refer to *Logic interface connector* on page 41.

3.4.1 USB interface

The USB service port is designed to work in conjunction with Edwards nST2 PC software. The primary purpose of this interface is to allow easy configuration of the nEXT pump.

Some operational capabilities are provided, including START/STOP, to enable pump operational checks to be made via the USB service port. However it is not intended as an industrial control interface for unattended machine to machine (M2M) control.

The USB service port will support communications concurrently with the serial interface in the logic interface connector. This enables the pump status and logs to be reviewed, and the pump to be configured while the pump is installed and running.

The USB service port can only be used when the 48V d.c. power is applied.

3.4.2 Parallel control and monitoring

The simple parallel interface is a quick and easy way to control the pump.

This is the same interface used on existing 24 V Edwards Turbo Pumps. The controls that are available to use are start and standby. The system status can be monitored using the normal, fail and analogue output signals.

Refer to *Connect the parallel control and monitoring* on page 72 for more detailed instructions of how to use the parallel interface.

A system operating with only a parallel connection is not capable of adjusting the configuration settings stored in the motor controller (for example, power limit setting or controlled venting options). In this case, all these features would be at their factory default settings. It is possible to manually adjust the standby speed if standby mode is selected, however, the motor controller should be configured separately before fitting the pump to the system. This is covered in more detail in *Parallel control with serial monitoring or serial configuration* on page 21 and *Motor controller configuration (serial configuration)* on page 21.

3.4.3 Serial control and monitoring

The serial communications link provides complete control and monitoring by using just three signal lines.

The serial data lines share the same connector pins as the parallel signals standby and fail. The serial data lines can be configured to provide an RS485 compliant or RS232 compatible interface by setting the position of the RS485/CAN/RS232 slide switch.

The serial enable signal must be linked to 0 V for the system to accept commands from the serial link. This is a safety feature and acts as an interlock. For pure serial control, the parallel start signal will be left unconnected.

The motor controller will still provide the normal and analogue signals on the logic interface connector even when operating under serial control. The status of the normal signal and the value of the system parameter on the analogue output can also be obtained by interrogating the system status via the serial link.

For more information about the serial interface, refer to *Connection for serial control and monitoring* on page 73.

3.4.4 Serial control with parallel monitoring

Normal and analogue signals remain available when using serial control. It is possible to control the pump via the serial link whilst monitoring these signals in the parallel interface.

The serial link uses the same connector pins as the parallel signals standby and fail so these parallel control and monitoring signals are not available. The serial enable signal must be linked to 0 V and the parallel start signal will be left unconnected.

3.4.5 Parallel control with serial monitoring or serial configuration

Use this configuration to operate the pump in parallel control mode, with the option to adjust the configuration settings stored in the motor controller or to monitor operational status of the pump through the serial link or via the USB service port.

If using the USB service port in conjunction with Edwards nST2 PC software, the serial enable signal does not need to be linked to 0 V for the serial communications to take place. Whilst operating under parallel control with the USB service port, all of the parallel control and monitoring signals are available (as described in *Parallel control and monitoring* on page 20), including the standby control line and fail monitoring line.

If using the serial link, the serial enable signal must be linked to 0 V for serial communications to take place. Whilst operating under parallel control with the serial link active, the parallel start control signal is available (as described in *Parallel control and monitoring* on page 20) but the standby control line is not since it is used as a serial data line.

If the serial enable line is deactivated at any time whilst the RS485/CAN/RS232 slide switch is in the RS232 position, the serial link should also be disconnected. Edwards suggests making a special cable for serial communications that includes a link between serial enable and 0 V. This way, serial enable is automatically activated when the cable is connected and then deactivated when the cable is removed.

3.4.6 CAN interface

Contact Edwards for more detail on the CAN interface.

The CAN LED illuminates green when the CAN communication is good and active, and red to indicate an error preventing CAN communication.

3.4.7 Motor controller configuration (serial configuration)

All the configuration settings stored within the motor controller are retained when power to the pump is removed, so that it is possible to use a separate system to configure the motor controller before fitting the pump to the application.

This gives the benefit of tailoring the pump functionality to a customer application and allows the pump to be operated using a simple parallel interface system.

To configure the pump, either use a customer simple serial system via the serial link, or use the Edwards TIC Turbo Controller, TIC Turbo Instrument Controller or TAG Controller. The TICs have a feature which allows storage of a nEXT pump's configuration. The configuration can then be downloaded to another nEXT pump. This is useful when configuring a number of nEXT pumps with the same settings before they are fitted to a system.

The USB service port can also be used in conjunction with the Edwards nST2 PC software to configure the nEXT pump. The configuration can then be downloaded to another nEXT pump, in the same way as it can with a TIC, which is useful when configuring a number of nEXT pumps.

4. Technical data

4.1 Operating and storage conditions

Table 2 Operating and storage conditions

Range	Data
Ambient operating temperature range	5 °C to 40 °C
Ambient humidity range	max. 85 % RH (non-condensing)
Maximum operating altitude	4000 m (de-rated above 2000 m)
Ambient storage temperature range	-15 °C to 70 °C

4.2 General technical data

Table 3 Technical data nEXT730, nEXT930

nEXT		730D	730D	930D	930D	730H	730H	730Q	930Q
High-vacuum connection	DN	160 ISO-K	160 CF	200 ISO-K	200 CF	160 ISO-K	160 CF	160 ISO-K	200 ISO-K
Forevacuum connection	DN	25 KF							
Pumping speed for† N_2 Ar He H_2	$l \cdot s^{-1}$	 730 665 820 715	 690 620 760 670	 925 865 905 735	 870 810 840 690	 720 655 850 755	 680 610 790 710	 730 665 820 715	 925 865 905 735
Gas throughput N_2 Ar He H_2	$mbar \cdot l \cdot s^{-1}$	 14 3.5 21 > 14				 4 2.6 7 17		 >40 6.8 >50 >50	
Compression ratio‡ N_2 Ar He H_2		 $> 1 \times 10^{11}$ $> 1 \times 10^{11}$ 1×10^{8} 4×10^{6}				 $> 1 \times 10^{13}$ $> 1 \times 10^{13}$ 5×10^{9} 3×10^{8}		 $> 1 \times 10^{8}$ $> 1 \times 10^{8}$ 1×10^{5} 1×10^{4}	
Ultimate pressure§	mbar	7×10^{-9}	3×10^{-10}	7×10^{-9}	3×10^{-10}	7×10^{-9}	1×10^{-10}	1×10^{-7}	
Maximum permissible forevacuum pressure for N_2	mbar	15				12		6	
Operating speed	min^{-1}	49200							
Run-up time, approximately	min	2.5							
Maximum power consumption	W	500 (default), 600 (maximum)							

nEXT		730D	730D	930D	930D	730H	730H	730Q	930Q
Power consumption at ultimate pressure	W	40							
Type of protection	IP Type 1 (UL 50E)	54 1							
Cooling standard		Convection*						Water*	
Cooling optional		Air or water*						-	
Cooling water connection		plug-in connection for 6x1 hose / alternative G 1/8"							
Cooling water consumption	l/h	60							
Permissible cooling water pressure (bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g))	bar(g)	6							
Permissible cooling water temperature	°C	15 to 35							
Weight	kg	14.6	19.6	15.4	21.7	14.6	19.6	15.4	
Recommended forevacuum pumps		XDS35i or E2M28							
Noise level with convection cooling with radial air cooler	dB(A)	< 40 < 55						< 40 -	
Maximum bake-out temperature of the CF version, -water cooled	°C	100						-	
Purge gas flow	mbar · l · s^{-1} sccm	0.4 24							
Purge gas connection		G 1/8"							
Venting connection		G 1/8"							

nEXT		730D	730D	930D	930D	730H	730H	730Q	930Q
Magnetic field resistance ▪ for an axial magnetic field ▪ for an radial magnetic field	mT	125 10							
Magnetic stray field at ▪ in axial direction ▪ in radial direction	mGauss	400 400							

** Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary.*

§ Please contact the supplier to discuss your specific system details and the necessary achievements for pumping speed, compression ratio and ultimate pressure.

† For some pump classes, different pumping speeds are specified for pumps with ISO and CF flanges, as differences in flange geometry here lead to a difference in performance of > 5%.

‡ The compression ration of a TMP describes the performance of the TMP design for the compression of a gas type at special conditions. The compression data were measured only using the CF flange variants.

Table 4 Technical data nEXT1230

nEXT		**1230H**		
High-vacuum connection	DN	200 CF	200 ISO-F	200 ISO-K
Forevacuum connection	DN	40 KF		
Pumping speed for† N_2 Ar He H_2	$l \cdot s^{-1}$	1250 1150 1350 1150		
Gas throughput N_2 Ar He H_2	$mbar \cdot l \cdot s^{-1}$	9 3 > 20 > 20		
Compression ratio‡ N_2 Ar He H_2		$> 1 \times 10^{11}$ $> 1 \times 10^{11}$ 4×10^{8} 1×10^{7}		
Ultimate pressure§	mbar	$< 5 \times 10^{-10}$	$< 5 \times 10^{-9}$	$< 5 \times 10^{-9}$
Maximum permissible forevacuum pressure for N2	mbar	15		
Operating speed	min^{-1}	42000		
Run-up time, approximately	min	2.5		
Maximum power consumption	W	660 (default), 800 (maximum)		
Power consumption at ultimate pressure	W	50		
Type of protection	IP Type 1 (UL 50E)	54 1		
Cooling standard		Water*		
Cooling optional		Air*		
Cooling water connection		plug-in connection for 6x1 hose / alternative G 1/8		
Cooling water consumption	l/h	60		
Permissible cooling water pressure (bar(g): bar (gauge) is overpressure, i.e. atmospheric pressure = 0 bar(g))	bar(g)	6		
Permissible cooling water temperature	°C	15 to 35		
Weight	kg	32.6	24.9	23.7

nEXT		**1230H**		
Recommended forevacuum pumps		XDS35i or E2M28		
Noise level with convection cooling with radial air cooler	dB(A)	< 44 < 55		
Maximum bake-out temperature of the CF version, water cooled	°C	100	–	–
Purge gas flow	mbar · l · s^{-1} sccm	0.4 24		
Purge gas connection		G 1/8"		
Venting connection		G 1/8"		
Magnetic field resistance ▪ for an axial magnetic field ▪ for an radial magnetic field	mT	160 7.8		
Magnetic stray field at ▪ in axial direction ▪ in radial direction	mGauss	400 100		

** Depending on the ambient temperature, the gas throughput and the type of gas, forced air cooling or water cooling may be necessary.*

§ Please contact the supplier to discuss your specific system details and the necessary achievements for pumping speed, compression ratio and ultimate pressure.

† For some pump classes, different pumping speeds are specified for pumps with ISO and CF flanges, as differences in flange geometry here lead to a difference in performance of > 5%.

‡ The compression ration of a TMP describes the performance of the TMP design for the compression of a gas type at special conditions. The compression data were measured only using the CF flange variants.

4.2.1 Pumping speed curves

Figure 2 Pumping speed curves for nEXT730H

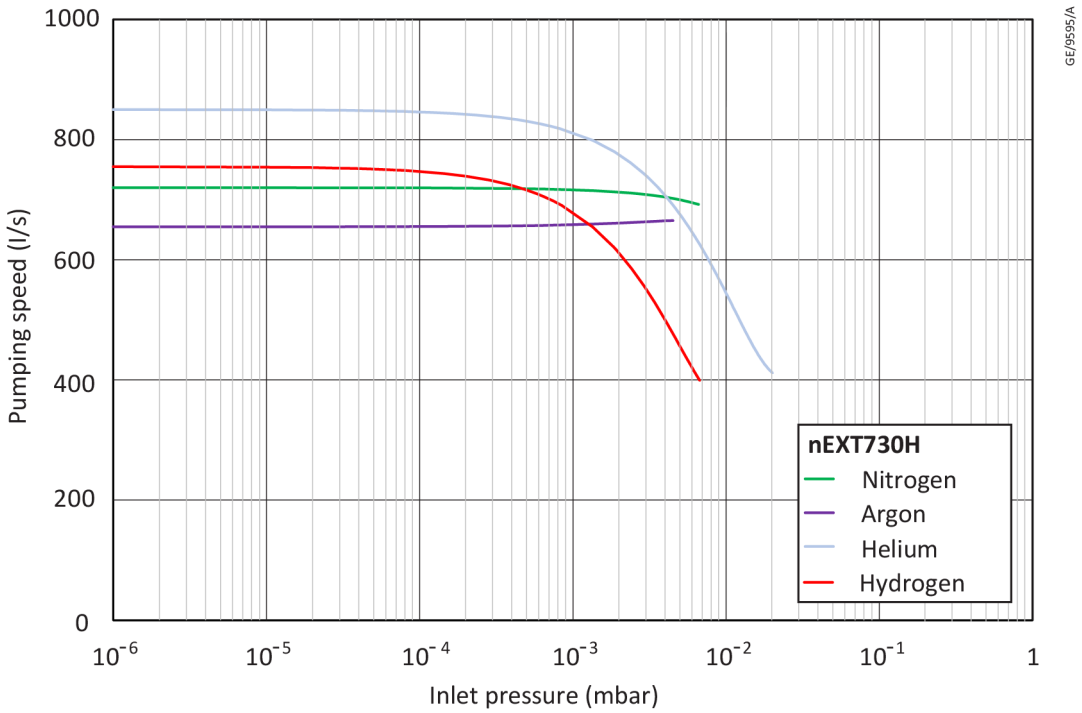


Figure 3 Pumping speed curves for nEXT730Q/730D

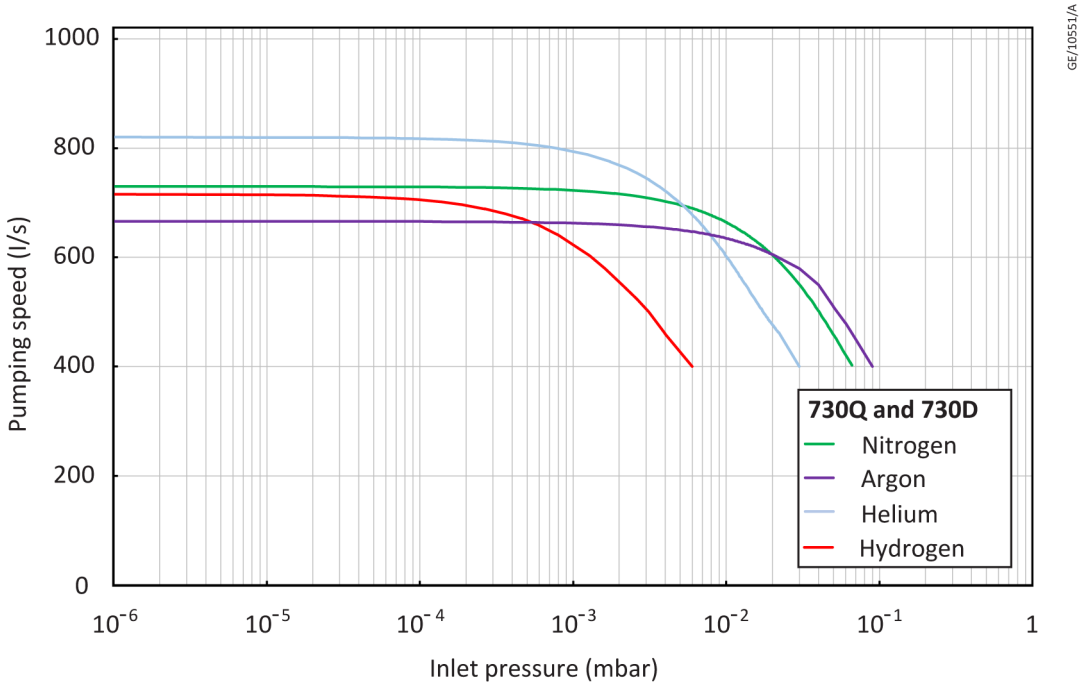


Figure 4 Pumping speed curves for nEXT930Q/930D

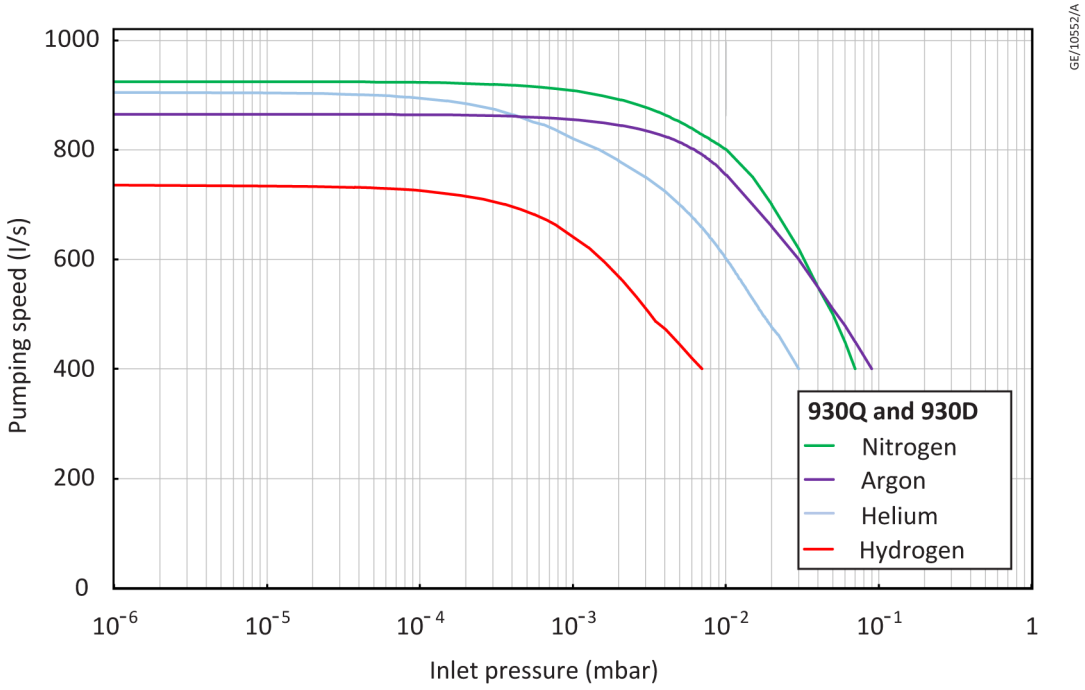


Figure 5 Pumping speed curves for nEXT1230H

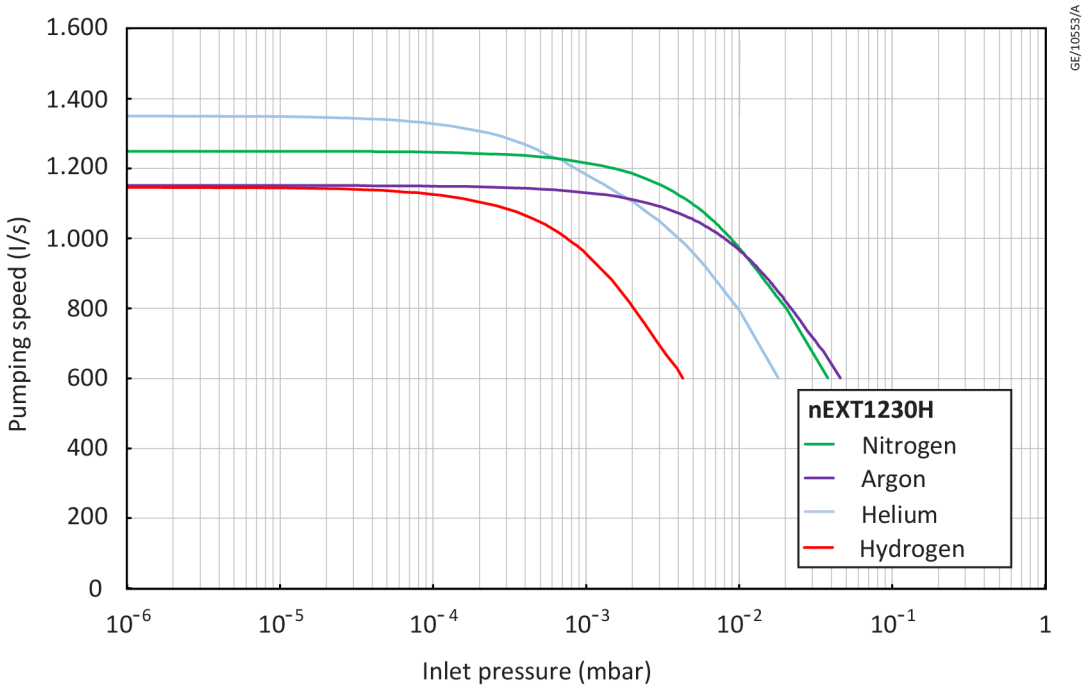
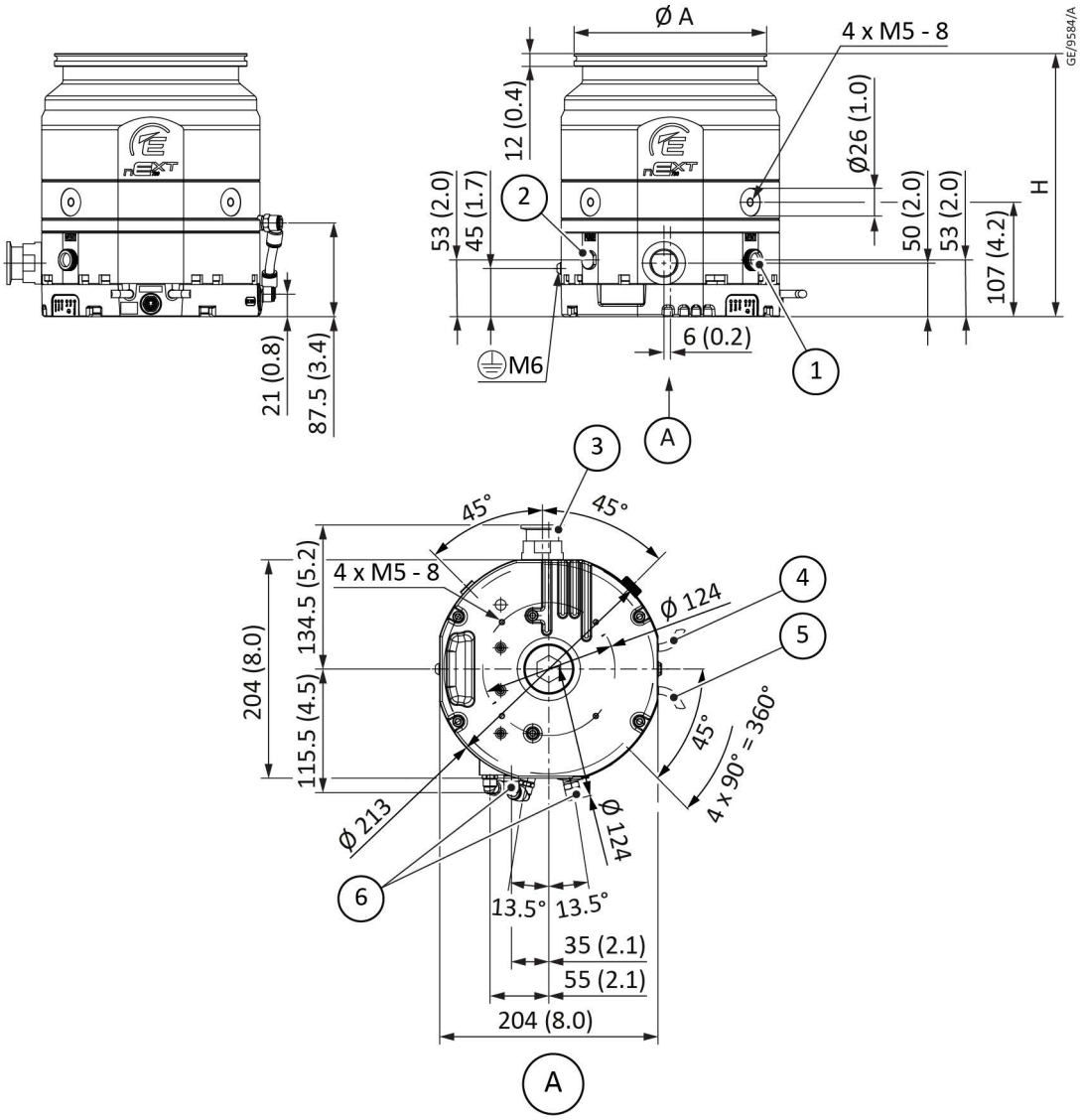


Figure 6 Dimensional drawing for nEXT730/930



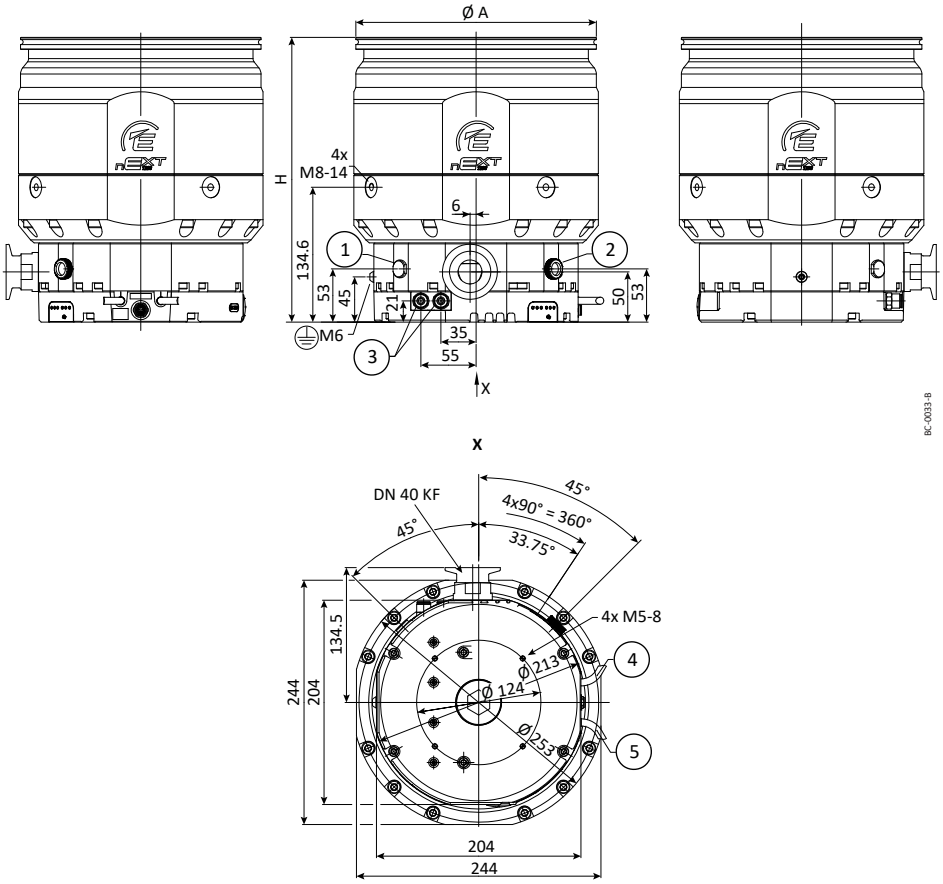
All measurements indicated are shown in mm

1. *VENT G 1/8"*
2. *PURGE G 1/8"*
3. *DN 25 KF*
4. *48 V d.c. power supply cable, 0.6 m long including plug*
5. *Control interface cable, 0.95 m long including plug*
6. *Water cooling, quick coupling for 8 mm hose*

Table 5 Dimensions in mm

	DN	H	A
nEXT730	160 ISO-K	246	180
nEXT730	160 CF	257	202.5
nEXT930	200 ISO-K	241.3	240
nEXT930	200 CF	246.8	254

Figure 7 Dimensional drawing for nEXT1230H



All measurements indicated are shown in mm

1. *PURGE G 1/8"*
2. *VENT G 1/8"*
3. *Water cooling, quick coupling for 8 mm hose*
4. *48 V d.c. power supply cable, 0.6 m long including plug*
5. *Control interface cable, 0.95 m long including plug*

Table 6 Dimensions in mm

	DN	H	A
nEXT1230H	200 CF	320.1	254
nEXT1230H	200 ISO-K	290.1	240
nEXT1230H	200 ISO-F	292.6	285

4.3 Pumping media

WARNING: HAZARDOUS SUBSTANCES

Pumped process gases may escape from the exhaust and leaks in the vacuum system. During servicing, toxic deposits may be present in the pump. The gases, vapours and substances may be hazardous to health.

The pumping of toxic / explosive / flammable / pyrophoric / radioactive / oxidizing / corrosive gases or gas mixtures, as well as oxygen of more than atmospheric concentration (21 %) is generally prohibited. The operator is responsible for assessing the hazard potential of the process media or mixtures.

WARNING:

Vent dangerous gases and gas mixtures safely. Do not expose people to these gases. If pumping hazardous gases or vapours, observe the safety recommendations of the supplier of the gas/vapour.

WARNING:

Do not use the pump to pump mercury vapour and do not allow mercury (for example, from a McLeod gauge) to come into contact with the pump. This may result in corrosion and failure of the pump rotor.

CAUTION:

Do not use the pump to pump particulates or condensable media. Deposition may occur within the pump which will degrade pump performance and reduce the pump life.

Note:

Concentrations of gases may be modified by the compression of the pump.

The pump is designed to pump the gases listed below. To pump a gas not listed, contact the supplier for advice. Failure to contact the supplier may invalidate the warranty of the pump. The pump is not suitable for pumping aggressive or corrosive gases.

Refer to the Edwards Vacuum Pump and Vacuum Safety manual P40040100 for safety information associated with the specification, design and operation of vacuum pumps and vacuum systems.

- Air
- Carbon monoxide
- Neon
- Nitrogen
- Krypton
- Argon
- Carbon dioxide
- Helium
- Hydrogen

The pump can be used to pump oxygen and water vapour, subject to the following conditions:

- Oxygen - The oxygen concentration must be less than 25% by volume.

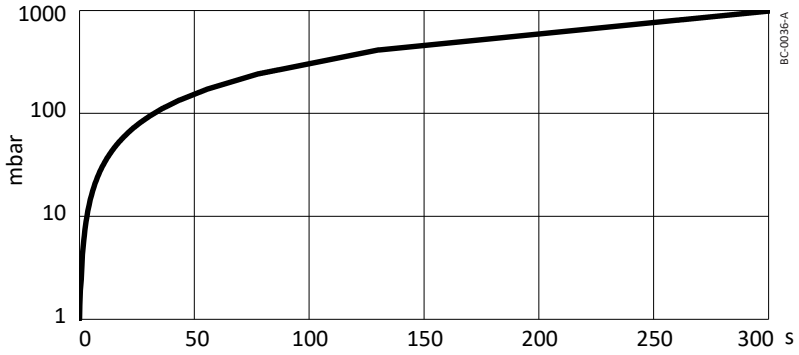
4.4 Vent gas specification and vent control data

Although the pump may be vented to atmosphere, high relative humidity of the air may greatly increase the subsequent pump-down time. To reduce pump-down times vent with dry, clean gases. Refer to *Vent options, vent valve connection and control* on page 90 for a description of the vent options and the vent valve connection and refer to *Controlled venting options* on page 83 for configuring the venting options.

Table 7 Vent gas specification and vent control

Vent gas specification and control	Reference data
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
Recommended time for rotational speed to reach 50%	> 15 seconds
Maximum allowed rate of pressure rise	Refer to figure below
Maximum allowable vent gas supply pressure	1 bar (gauge), 14.5 psig, 2 x 10^5 Pa

Figure 8 Maximum allowed rate of pressure rise during venting: pressure against time



4.5 Materials exposed to gases pumped

The following materials and component types are exposed to the gases pumped:

- Steel and aluminium alloys
- Fluoroelastomer and O-rings
- Hydrocarbon lubricant
- CFP
- Rare earth magnets
- Silicon nitride

- PTFE

4.6 Purge gas specification

Table 8 Purge gas specification

Purge gas specification	Reference data
Purge 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
Allowable purge gas flow (when required)	20 to 50 sccm (0.33 to 0.84 mbar l s^{-1} or 33 to 84 Pa l s^{-1})
Recommended purge gas flow	25 sccm (0.42 mbar l s^{-1}, 42 Pa l s^{-1})
Maximum allowable purge gas supply pressure	1 bar (gauge); 14.5 psig, 2 x 10^5 Pa

4.7 Water cooling

Table 9 Water cooling block supply requirements

Parameter	Reference data
Quality	Mechanically 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 hr^{-1}
Water temperature range	10 °C to 40 °C
Maximum water pressure	5 bar (gauge), 72.5 psig, 5 x 10^5Pa gauge
Materials exposed to cooling water	Brass and nickel plated brass

Figure 9 Maximum relative humidity to avoid condensation with water cooling

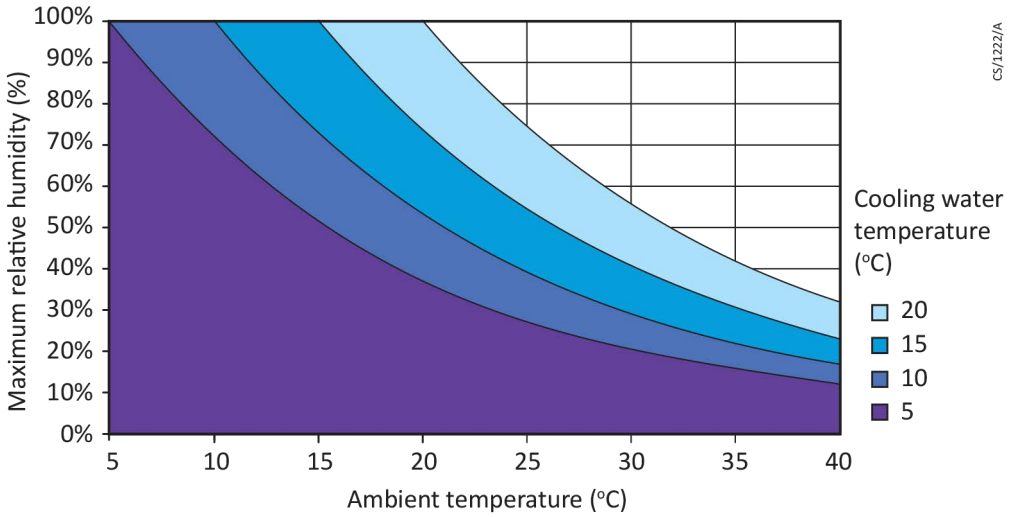


Figure 10 Cooling requirements for nitrogen for nEXT730H

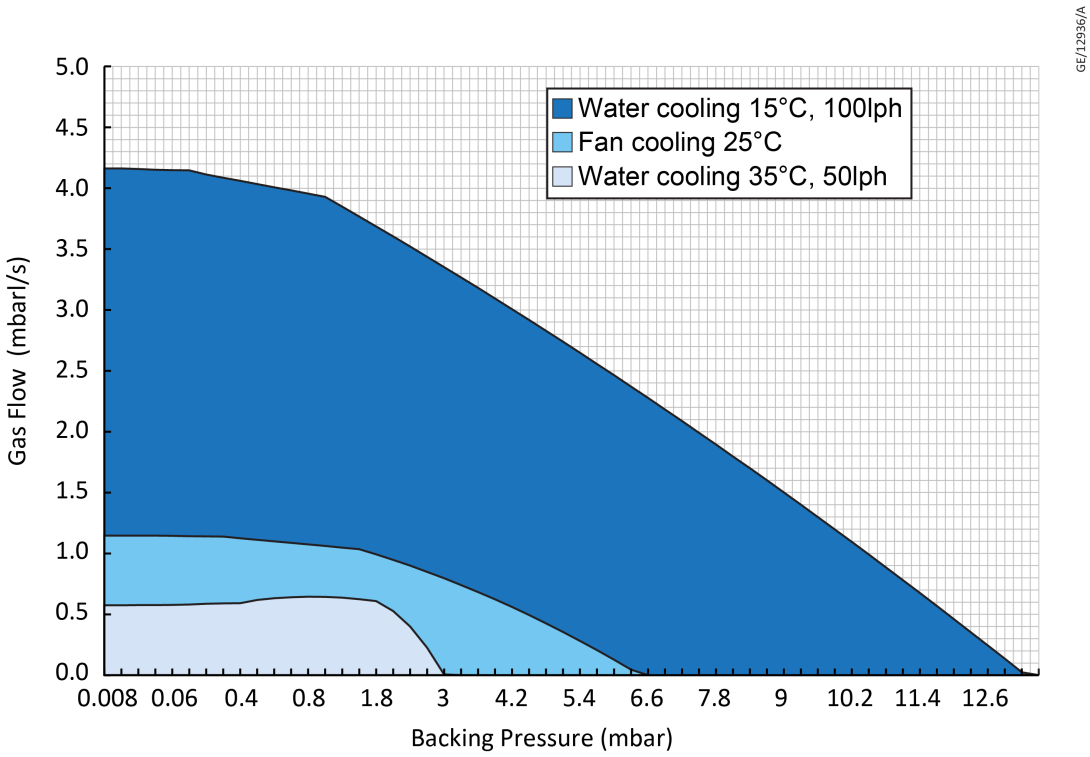


Figure 11 Cooling requirements for argon for nEXT730H

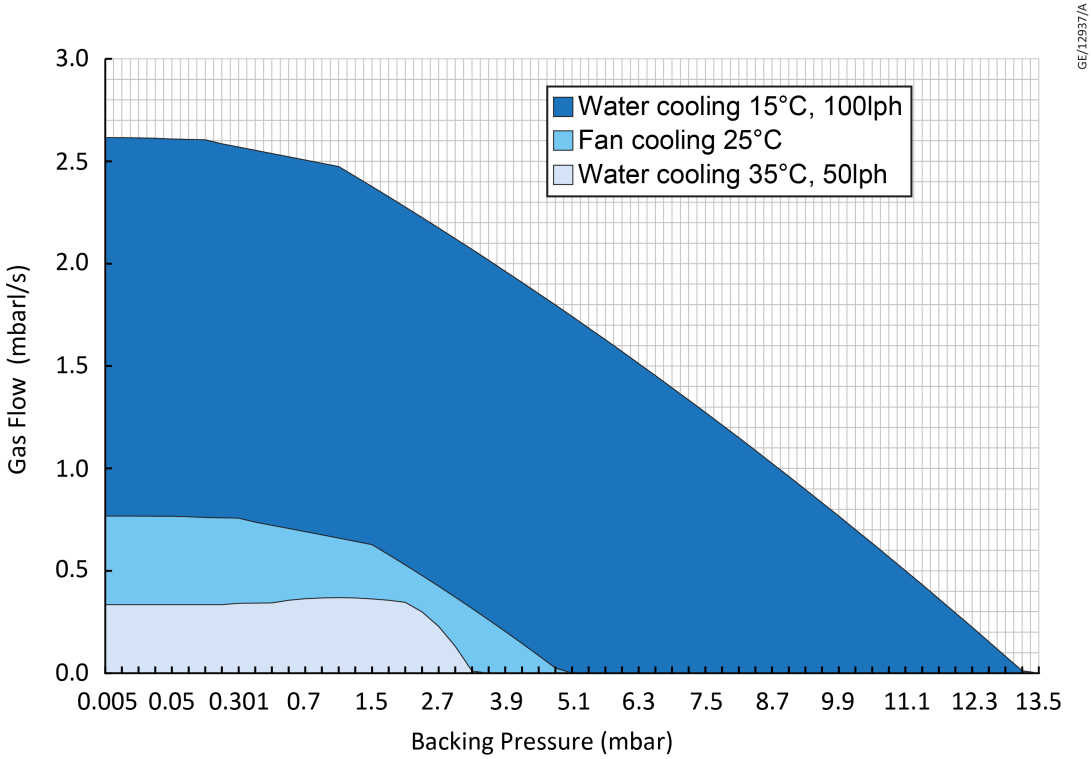


Figure 12 Cooling requirements for nitrogen for nEXT730Q/930Q

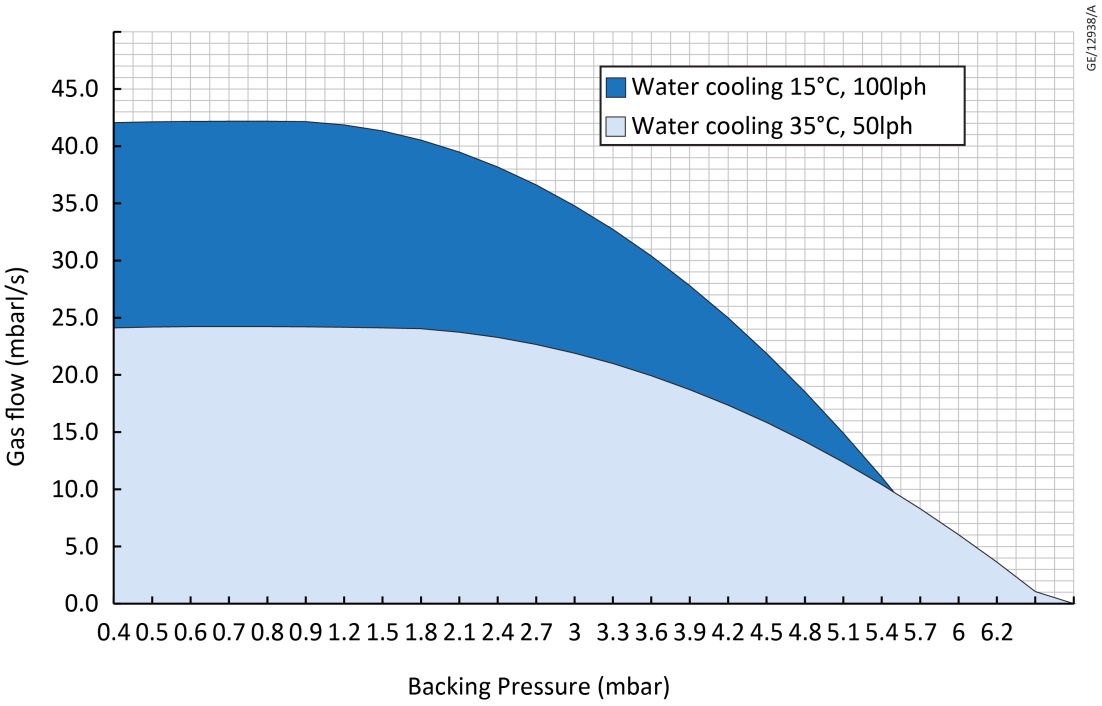


Figure 13 Cooling requirements for argon for nEXT730Q/930Q

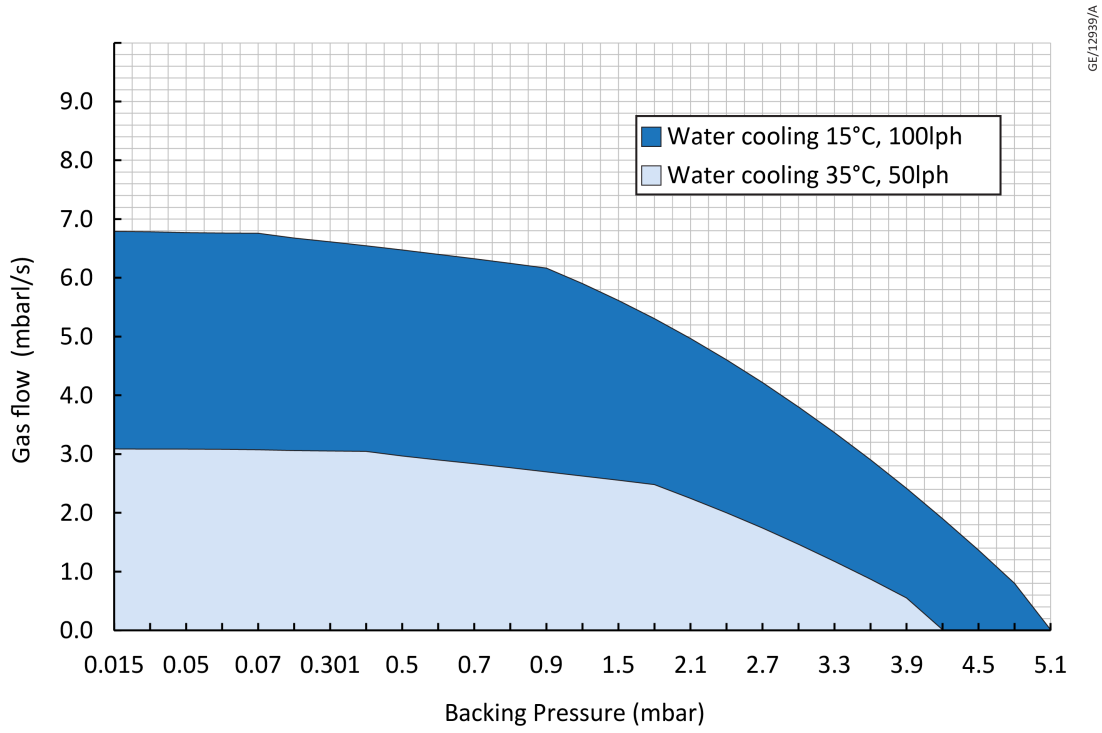


Figure 14 Cooling requirements for nitrogen for nEXT730D/930D

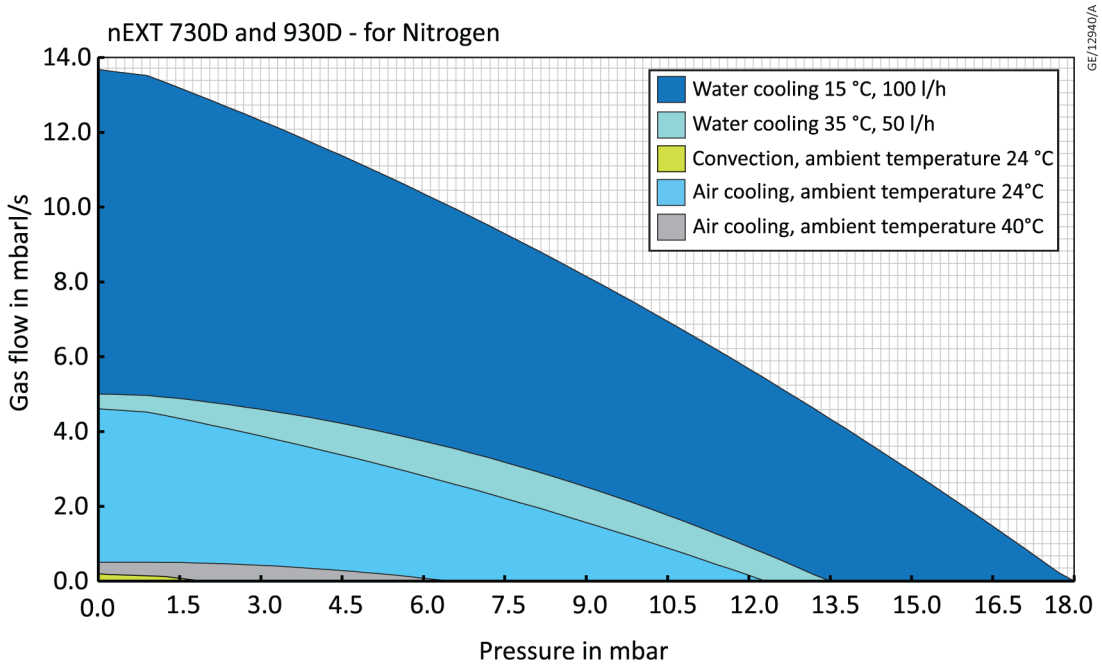


Figure 15 Cooling requirements for argon for nEXT730D/930D

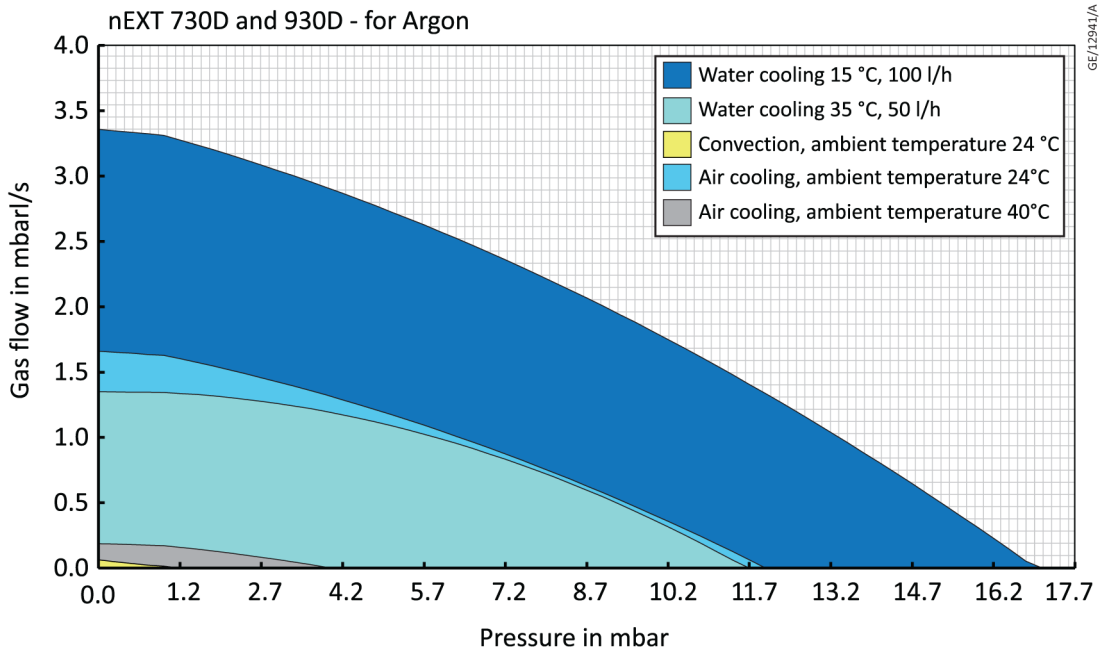


Figure 16 Cooling requirements for nitrogen for nEXT1230H

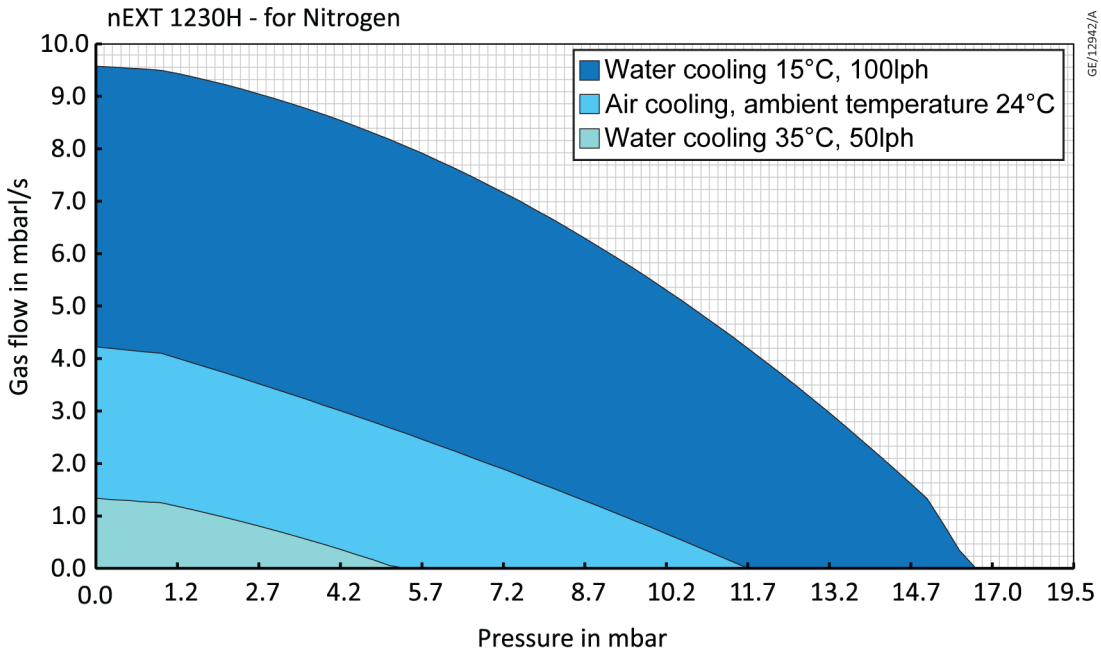
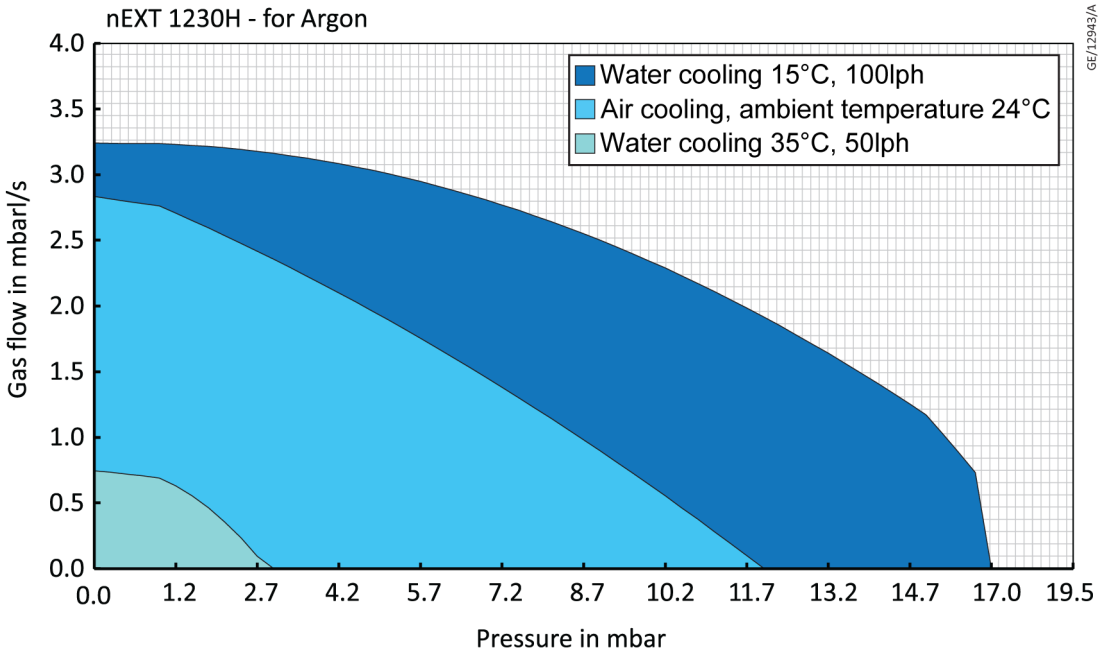


Figure 17 Cooling requirements for argon for nEXT1230H



4.8 Electrical data

The nEXT pumps can be driven by either the customers system or by the Edwards TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller.

If using the customer system, an appropriate, pre-approved, UL/CSA rated 48 V d.c. power supply should be used. The size of the power supply required depends on the application and the power limit configured in the nEXT pump. The power limit setting determines how quickly the pump ramps up and dictates the size of the power supply

required. If serial communications is available, the power limit setting of the nEXT pump can be selected.

Refer to *Table: Logic interface technical data* for the maximum power limit settings for nEXT pumps. If the application requires rapid cycling of the pump, faster ramp times can be achieved if the power supply delivers higher current, up to a maximum in accordance with *Table: Logic interface technical data*.

If the facility to adjust the power limit setting is not available, use a power supply capable of delivering enough current to meet the Edwards factory default power limit setting, shown in *Table: Logic interface technical data*.

4.9 Logic interface connector

nEXT pumps have a 15-way logic interface connector on the end of the logic interface cable. Use a suitable connector mating half (not supplied) to connect the nEXT pump to the customer equipment. Refer to the following table for the connector mating half type.

Table 10 Logic interface technical data

Logic interface item	
Connector*	15-way D-type male
Start and serial enable control inputs:	
Enabled control voltage: low (close)	0 to 0.8 V d.c. (Iout = 0.55 mA nominal)
Disabled control voltage: high (open)	4 to 26.4 V d.c. (internal pull up to 6.4 V nominal)
Standby control input:	
Enabled control voltage: low (close)	0 to 0.8 V d.c. (Iout = 0.29 mA nominal)
Disabled control voltage: high (open)	4 to 26.4 V d.c. (internal pull up to 3.2 V nominal)
Analogue output:	
Output voltage	0 to 10 V d.c. (directly proportional to measured parameter) Motor speed: 0 - 820 Hz (0-100%) for nEXT730/930, 0 - 700 Hz (0-100%) for nEXT1230 Motor power: 0 - 500 W for nEXT730/930, 0 - 660 W for nEXT1230 Motor temperature: 0 - 100 °C Controller temperature: 0 - 100 °C Bearing temperature: 0 - 100 °C
Voltage accuracy	± 0.2 V
Output current	≤ 5 mA for specified accuracy
Normal status output:	
Type	Open collector transistor plus pull up resistor. Refer to *Figure: Interface circuits for nEXT turbo pump controllers*

Logic interface item	
< Normal speed (default 80%)	Off (2.2 kΩ pull up to 12 V d.c.)
≥ Normal speed	On (< 0.8 V d.c. sinking 20 mA)
Current rating	20 mA to 0 V
Voltage rating	28.8 V d.c. maximum external pull up voltage
Fail status output:	
Type	Open collector transistor plus pull up resistor. Refer to *Figure: Interface circuits for nEXT turbo pump controllers*.
Fail	Off (3.3 kΩ pull up to 12 V d.c.)
OK	On (< 0.1 V d.c. sinking 1.7 mA, < 0.8 V d.c. sinking 20 mA)
Current rating	20 mA to 0 V
Voltage rating	28.8 V d.c. maximum external pull up voltage

* *Mating half of connector not supplied.*

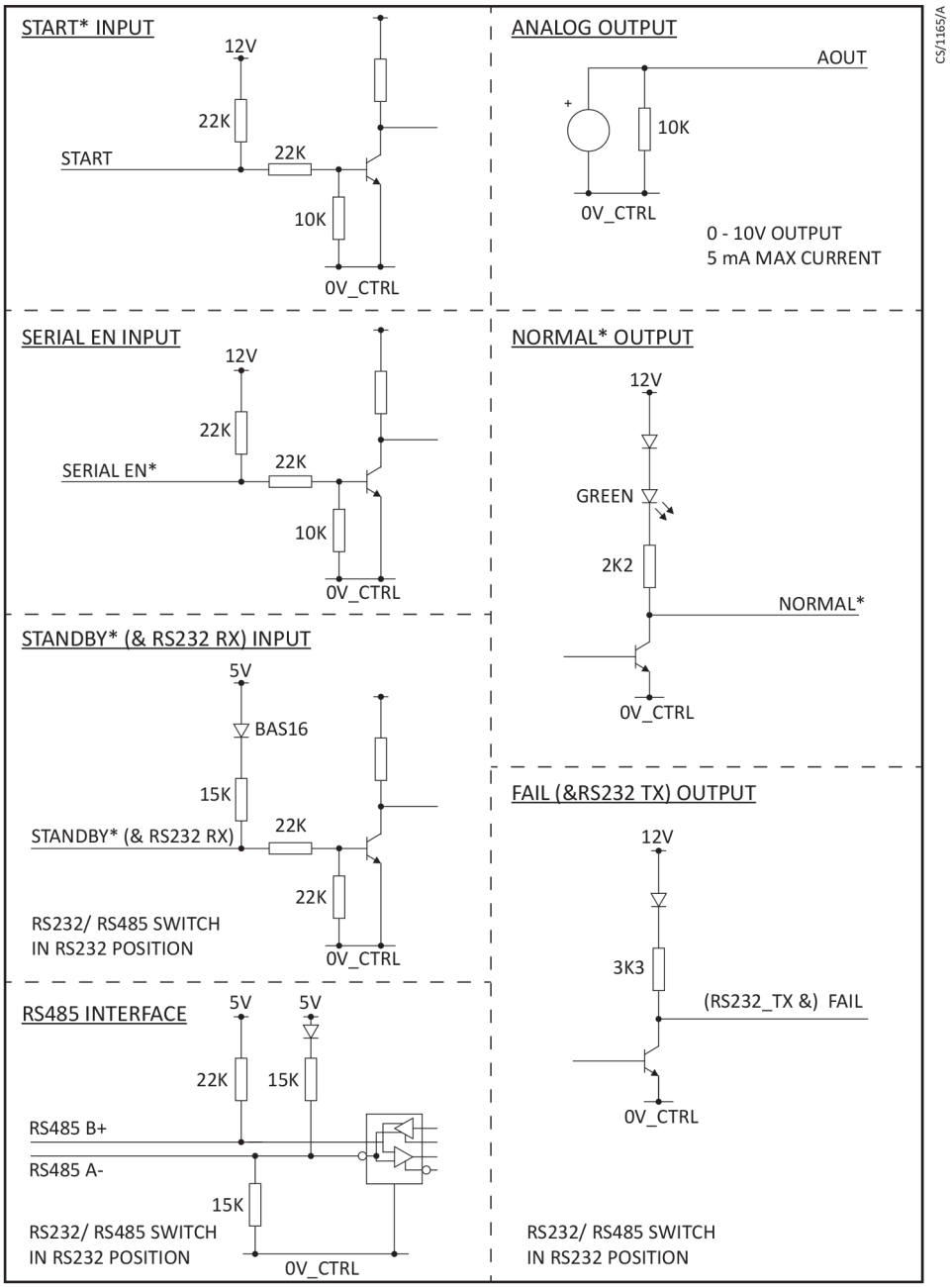
Refer to the following table for Logic Interface connector pins for the electrical connections.

Table 11 Logic interface connector pins

Pin Number	Signal	Polarity	Use
2	0 V Control reference	-	0 V reference for all control and status signals below.
3	START/STOP control input	-	Connect to Pin 2 to start pump.
4	STANDBY control input/ Serial RX/RS485 A-	-	Connect to Pin 2 to enable standby speed when serial enable is inactive and RS485/RS232 switch is in the RS232 position.
5	Serial enable	-	Connect to Pin 2 to enable the serial link.
7	FAIL / Serial TX/RS485 B +	-	Logic high when fail condition exists and serial enable is inactive and RS485/ RS232 switch is in the RS232 position.
9	Analogue output	Positive	0 - 10 V output proportional to measured output
10	Chassis/Screen	-	Screen
12	Chassis/Screen	-	-
15	NORMAL status output	-	Logic low when pump rotational speed is at normal speed or above

Pin Number	Signal	Polarity	Use
8, 13, 14	Electrical supply: 0 V	-	-
1, 6, 11	Electrical supply: 24 V - 48 V d.c.	Positive	-

Figure 18 Interface circuits for nEXT turbo pump controllers



4.10 Serial protocol

The serial interface link is set to 9600 Baud, 8 bits, 1 stop, no parity with no handshaking. The commands are made up from printable ASCII characters. The maximum message size that can be sent is 80 characters, including start and end characters.

Note:

All alphabetical characters must be sent in upper case format. The response may contain lower case characters.

Every complete command message sent will receive a response - either a status code or a data return. The nEXT pump can only process with one message at a time. It will only accept a new message once the response to the previous message has been returned.

If the nEXT pump receives characters that are not framed inside start and stop characters, it will ignore them. Messages with the stop character missing will be discarded with no response when a new start character is received. If the nEXT pump receives an unrecognisable message between the start and stop characters, it will return an appropriate error message.

Refer to *Multi-drop operation* on page 52 for more information about operating the nEXT pumps in multi-drop mode.

4.11 Command set

Table 12 Summary of commands that can be sent to the pump

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Node	!S850	0..99	-	decimal	address	Multi-drop address
	?850					0 = disable multi-drop address
						99 = wild card
Pump type	?S851	8	-	string	chars	Pump type
		10	-	string	chars	DSP software version number
		4	-	string	chars	(D39669610)
						Full speed RPS (820 for nEXT)
Pump control	!C852	0	-	decimal	-	Stop the pump
		1				Start the pump
	?V852	0..1800	-	decimal	RPS	Measured motor speed
		32-bits		hex	flags	System status word
Time setting	!S854	1..30	8	decimal	minutes	Timeout period for both initial ramp up and if speed drops below 50%
	?S854	-	-	-	-	-
Power limit setting	!S855	nEXT730/930: 190..600 nEXT1230: 300..800	500	decimal	Watts	Link power maximum
	?S855	-	-	-	-	-

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Normal speed setting	!S856	50..100	80	decimal	%	Normal speed as a percentage of full speed
	?S856	-	-	-	-	-
Standby speed setting	!S857	55..100	70	decimal	%	Standby speed as a percentage of full speed
	?S857	-	-	-	-	-
Temperature readings	?V859	0..100	-	decimal	°C	Measured motor temperature
		0..100		decimal	°C	Measured motor controller temperature
Link parameter readings	?V860	0..500	-	decimal	0.1 Volts	Measured link voltage
		0..300		decimal	0.1 Amps	Measured link current
		0..15000		decimal	0.1 Watts	Measured link power
Pump run hours	?V862	0..65535	-	decimal	hours	Hours run by pump
Temperature readings 2	?V865	-200..200	-	decimal	°C	Measured motor temperature
		-200..200		decimal	°C	Measured motor controller temperature
		-200..200		decimal	°C	Measured bearing temperature
Factory settings	!S867	1	-	-	-	Reset all configuration options and parameters to the factory settings
PIC software version	?S868	10	-	string	chars	Boot loader software version number (D396696XXX)
Speed control	!C869	0	-	decimal	-	Set target speed to full speed
		1	-	-	-	Set target speed to standby speed

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Timer options	!S870	0	1	decimal	-	Timer = disabled
	?S870	1	-	-	-	Timer = enabled Note that the timer is permanently enabled on ramp-up.
Analogue signal options	!S871	0	0	decimal	-	Analogue output = measured speed
	?S871	1			-	Analogue output = measured power
		2				Analogue output = measured motor temp.
		3				Analogue output = measured control temp.
		4				Analogue output = measured bearing temp.
Electronic braking options	!S872	0	0	decimal		Electronic braking = disabled
	?S872	1				Electronic braking = enabled. Refer to *Electronic braking* on page 19
Close vent valve	!C875	1	-	decimal	-	Closes the vent valve for delayed start and overrides the current vent option. There is no open vent valve command but the stop command (!C852 0) will clear the override.
Valve 1 type	!S877	0	0	decimal	-	Normally Open Valve
	?S877	1				Normally Closed Valve (power cycle is required)
Valve 2 type	!S878	0	0	decimal	-	Normally Open Valve
	?S878	1				Normally Closed Valve (power cycle is required)

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Service status	?V881	32 bits	-	hex	flags	Service status word
Controller run time	?V882	0..999999	-	decimal	hours	Hours run by controller
		0..999999		decimal	hours	Hours until controller service due
Pump run time	?V883	0..999999	-	decimal	hours	Hours run by pump
		0..999999		decimal	hours	Hours until pump service due
Pump cycles	?V884	0..65535	-	decimal	cycles	Cycles run by pump
		0..65535		decimal	cycles	Cycles until pump service due
Bearing run time	?V885	0..999999	-	decimal	hours	Hours run by bearing
		0..999999		decimal	hours	Hours until bearing service due
Vent options 1	!S853	0	0	decimal		Hard vent when < 50% speed if stop or fail
		1				Controlled vent if > 50% speed then hard vent if < 50% speed if stop or fail
		2				If stop, hard vent If fail, hard vent when < 50% speed
		3				If stop, hard vent If fail, controlled vent > 50% speed then hard vent < 50% speed
		4				If fail, hard vent If stop, hard vent when < 50% speed
		5				If fail, hard vent If stop, controlled vent > 50% speed then hard vent < 50% speed
		6				Hard vent if stop or fail

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
		7				Same as option 6
		8				Output is permanently energised (Fan ON)
		9				Do not use
		10				Output is permanently de-energised (Fan OFF)
		11				Do not use
		12				Do not use
		13				Do not use
		14				Hard vent when < 50% speed if stop
		15				Controlled vent if > 50% speed then hard vent if < 50% speed if stop
Vent options 2	?864	0	8	decimal		Hard vent when < 50% speed if stop or fail
		1				Controlled vent if > 50% speed then hard vent if < 50% speed if stop or fail
		2				If stop, hard vent If fail, hard vent when < 50% speed
		3				If stop, hard vent If fail, controlled vent > 50% speed then hard vent < 50% speed
		4				If fail, hard vent If stop, hard vent when < 50% speed
		5				If fail, hard vent If stop, controlled vent > 50% speed then hard vent < 50% speed

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
		6				Hard vent if stop or fail
		7				Same as option 6
		8				Output is permanently energised (Fan ON)
		9				Do not use
		10				Output is permanently de-energised (Fan OFF)
		11				Do not use
		12				Do not use
		13				Do not use
		14				Hard vent when < 50% speed if stop
		15				Controlled vent if > 50% speed then hard vent if < 50% speed if stop.
Bearing Inactivity (Bearing Condition-ing)	?V891	0..999999	8760	decimal	hours	Bearing Conditioning period (12 months)
	?V891	0..8	0	decimal	-	Bearing Conditioning Status 0 – BCON disabled 1 – Phase 1 active 2 – Phase 2 active 4 – Phase 3 active 8 – Phase 4 active
	!C891	0..1	0	decimal	-	0: BCON Cancel 1: BCON Start
Bearing Inactivity (Bearing Replace)	?V892	0..999999	26280	decimal	hours	Bearing Replace due to inactivity threshold period (3 years)

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Bearing inactive time	?V893	0..999999	0	decimal	hours	Bearing inactive time
	!C893	1		decimal		Reset bearing inactivity hours
Real Time Clock	?V895	0..3599996400	UTC	Date and time	sec	This is UTC represented in seconds since start of the year 2000 i.e. since 2000/01/01 00,00,00
Bearing Inactivity (Automatic Bearing Conditioning)	!S896 ?S896	0..1	1	decimal	-	0: BCON Automatic Disable 1: BCON Automatic Enable

4.12 Multi-drop operation

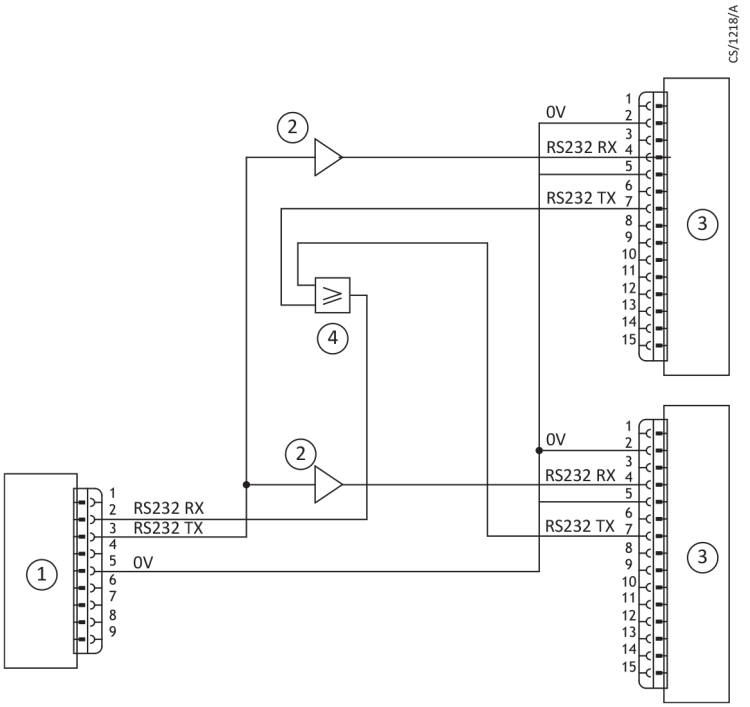
Using multi-drop mode, a single computer system can communicate with more than one nEXT pump. Each nEXT pump must be assigned its own individual address before it can be fitted into a multi-drop system. The command to assign the multi-drop address is sent in standard nEXT message format (as detailed in *Assigning a multi-drop address* on page 87).

The message protocol in multi-drop mode is marginally different to that described for serial messages in single pump systems. The main differences in multi-drop message protocol are detailed below:

- All multi-drop commands, queries or replies have the first character #.
- All commands, queries and replies contain a header containing the address of the node that the message is to, followed by the address of the node that the message is from.
- There is a delimiter character: (colon) which separates the two multi-drop addresses in the header.
- The remainder of the message (command, query or reply) follows the same protocol as already described for single pump systems.
- The wild card address 99 is very useful and means 'any' node.

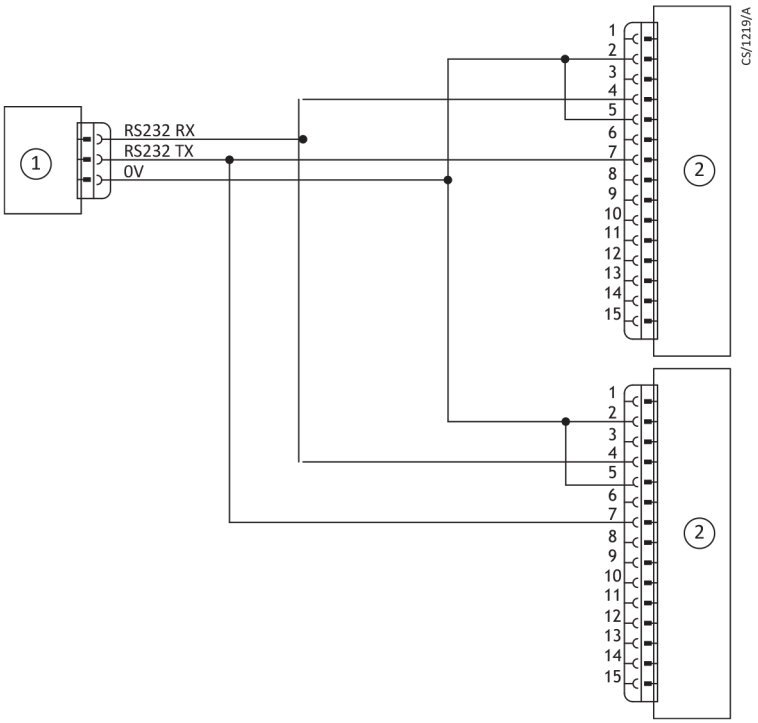
After a nEXT pump has been assigned a multi-drop address, it will ignore any messages in the format for single pumps. An individual nEXT pump will remain silent and ignore all command messages unless the multi-drop address matches its own address.

Figure 19 Conceptual diagram for multi-drop connection using RS232 interface



1. *RS232 interface on control equipment*
2. *Buffer*
3. *nEXT pump*
4. *OR gate*

Figure 20 RS485 multi-drop connection



1. *RS485 interface on control equipment*
2. *nEXT pump logic interface*

4.13 Motor controller auxiliary connector socket

The nEXT pump has a 4-way auxiliary connector socket on the front of the motor controller.

The mating plug for this connector is available pre-fitted to a number of accessories or as an accessory on its own (refer to *Accessories* on page 123).

The connector is intended to power a vent valve and/or fan. The connector is shown in *Figure: Valve connector*, with the polarity of the pins marked when the vent valve or fan are energised.

The auxiliary connector output is regulated to 24 V d.c. to control the accessories, even when the pump is operating from a 48 V d.c. supply and is protected against overload and short circuits. If the auxiliary load current exceeds the value in *Table: Motor controller technical data*, the output will shut down to protect the motor controller.

Table 13 Motor controller technical data

Description	Data
Connector plug	Phoenix part number SACC-DSI-M 8FS-4CON-M12/0.5
Voltage output	24 V d.c. -25%, +10% (18 V d.c. to 26.4 V d.c.)
Current output	750 mA

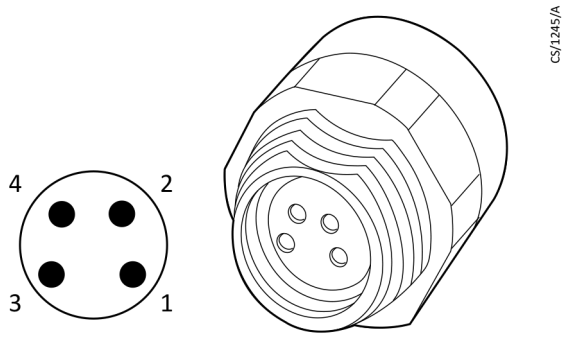
The motor controller connector provides two independently configured and controlled outputs, Aux output 1 and Aux output 2. This enables any combination of fan or vent valve accessory to be connected, configured and controlled appropriately. Aux output 1 is configured via Vent option 1 and Valve 1 type and Aux output 2 is configured via Vent

option 2 and Valve 2 type (refer to *Vent valve control* on page 91). Aux output 1 has default settings for a normally open vent valve and Aux output 2 has default settings for a fan.

Edwards nEXT air coolers and vent valve accessories (refer to *Accessories* on page 123), which have the corresponding connector fitted, are pre-configured to Aux output 1 and Aux output 2 for convenience and to provide plug and play ability. nEXT vent valves are pre-configured to Aux output 1 and the default setting for vent options 1 are appropriate for this type of accessory. nEXT air coolers are pre-configured to Aux output 2 and the default setting for vent options 2 are appropriate for this type of accessory.

Bare wire versions of the nEXT air coolers and vent valve accessories are available, which are not pre-configured. This enables any combination of accessory to be used and independently configured and controlled on Aux output 1 and Aux output 2.

Figure 21 Valve connector



Pin number	Signal	Polarity
1	0V return	Negative
2	Aux output 1	Positive
3	Aux output 2	Positive
4	Chassis	Chassis

4.14 Indicator LEDs

The nEXT pump has seven indicator LEDs. Refer to *Figure: controller view*.

Table 14 Indicator LEDs

LED	Description
Normal LED	This green LED illuminates when the pump rotational speed is above the normal speed setting, irrespective of whether the pump is accelerating or decelerating.
Status LED	This yellow LED flashes with a 50% duty cycle at the rotational frequency of the pump motor. At high speeds it appears continuously illuminated. The LED switches off when the rotational speed is very low or stopped. If a service is due, this LED flashes in a sequence to indicate which service operation is required. Refer to *Fault finding* on page 110.

LED	Description
Alarm LED	This red LED flashes in a sequence to indicate an error code if a FAIL condition is preventing pump operation. The error codes can be used for fault finding as described in *Fault finding* on page 110.
Serial Communications Receive (Rx) LED	This yellow LED flashes briefly whenever activity is detected on the serial link receive line and can be used for fault finding the serial link.
Serial Communications Transmit (Tx) LED	This yellow LED flashes briefly whenever the motor controller is transmitting data on the serial link transmit line and can be used for fault finding the serial link.
CAN Status LED	This bicolour (red and green) LED illuminates green when the CAN communication is good and active, and red to indicate an error preventing CAN communication.
Bearing LED	This blue LED illuminates or flashes when a bearing service activity is due or ongoing. Refer to *Table: Bearing LED*.

Note:

If an external electrical load is connected to the Normal output line, the normal LED may illuminate.

5. Installation

5.1 Unpack and inspect

The pump is supplied in a cardboard box. It is equipped with four M8 boreholes for eye-bolts for transport.

CAUTION: FALLING PARTS

Errors during transport can cause the pump to fall down.

Transport the pump only in its transport packaging or at the eye-bolts provided for this purpose.

WARNING:

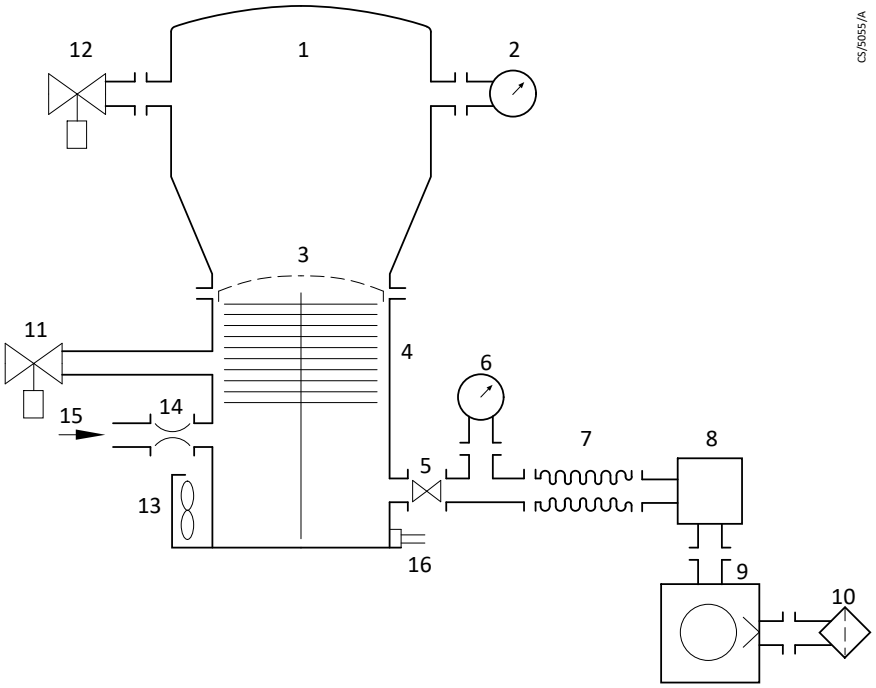
The motor controller cable should not be used as a lifting device. Do not attempt to lift or support the pump using the cable.

1. Where possible, the pump should remain in its sealed bag until it is installed.
2. Take care when unpacking the pump to avoid excessive shocks which could damage the bearings and reduce the life of the pump. The pump is supplied with the inlets and outlet sealed to prevent entry of dust and vapour. Do not remove these seals until ready to install the pump on the vacuum system.
3. Open the cardboard box from the top. Once the box lid is open, remove the upper pieces of foam and cut open the bag.
4. If the pump is damaged, notify the supplier and the carrier in writing within three days; state the item number of the pump together with the order number and the supplier's invoice number. Retain all packing materials for inspection. Do not use the pump if it is damaged.
5. Check that the package contains the items listed in *Table: Checklist of items*. If any of these items are missing, notify the supplier in writing within three days.
6. If the pump is not to be used immediately, store in suitable conditions as described in *Storage* on page 108.
7. It is advised to retain all packing materials for use, should you return the pump for service.

Table 15 Checklist of items

Quantity	Description	Check
1	nEXT730, nEXT930 or nEXT1230 Turbomolecular Vacuum Pump	❑
1	Integral mesh centering ring O-ring seal (ISO variants only. Screen will be fitted to CF pumps.)	❑

Figure 22 Typical pumping system with a nEXT pump



1. *Vacuum system*
2. *High vacuum gauge*
3. *Inlet screen*
4. *nEXT pump*
5. *Backing valve*
6. *Vacuum gauge*
7. *Flexible bellows*
8. *Foreline trap*[*]
9. *Backing pump*[*§]
10. *Mist filter*[*] */ silencer*[§]
11. *Vent valve*
12. *Alternative position for vent valve*
13. *Radial air cooler*
14. *PRX purge restrictor*
15. *Regulated purge gas supply*
16. *WCX water cooler and connections*

[*] for rotary pump

[§] for scroll pump

5.2 Connect to the vacuum system

CAUTION: CUTTING AND CRUSHING

When reaching into open flanges there is a risk of cutting and crushing your fingers.

Do not operate the vacuum pump with open flanges. Do not reach into the pump.

When installing the vacuum pump, first mechanically connect the inlets and outlets and then make the electrical connections.

CAUTION: VACUUM

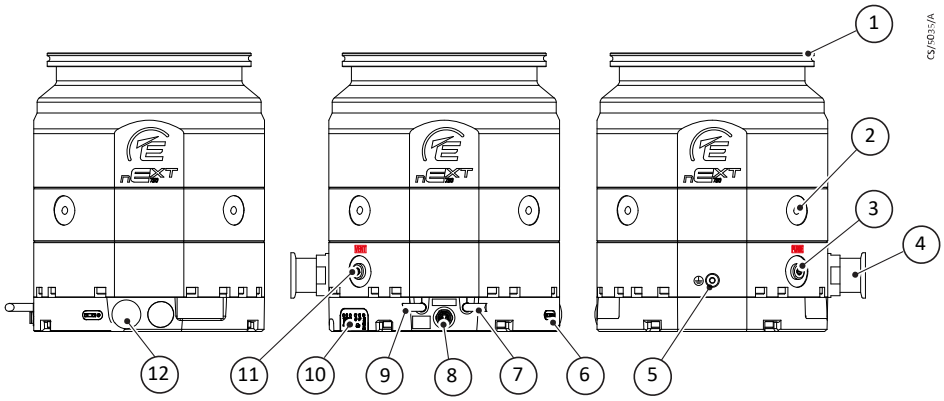
Pulling into the vacuum can cause injury to hands or fingers.

Do not operate the vacuum pump with open flanges.

CAUTION

Ensure that any cabling and or pipe work attached to the pump are routed carefully to avoid causing a slip/trip hazard and to prevent any damage to the cable.

Figure 23 Connections and controls



1. *Inlet flange*
2. *4x Boreholes for transport eyes M8, 14 deep*
3. *Purge port G 1/8", closed with plug screw*
4. *Backing port*
5. *Grounding connection*
6. *Bearing status indication (indicates when bearing service is recommended)*
7. *Control interface*
8. *Accessory connector*
9. *48 V d.c. power supply*
10. *LED indicators on drive unit*
11. *Vent port G 1/8", closed with plug screw*
12. *RS485/CAN/RS232 slide switch, USB connector, Standby speed change buttons*

5.2.1 Remove and replace the inlet screen

The inlet screen is supplied fitted on CF pumps only. Remove the inlet screen only if there is no possibility that debris can fall into the pump. If the inlet screen is removed, the pumping speed will increase by up to 20%.

CAUTION

The rotor blades on the pump are very sharp. The absence or removal of inlet screens or strainers exposes the risk of injury from sharp edges or moving parts.

Care must be taken to avoid foreign objects from entering the pump during installation. The pump is supplied with either an integral mesh centring O-ring seal or a pre-fitted mesh screen. This must be fitted during installation.

In the unlikely event of pump fracture, it is possible that the inlet screen may not trap all of the debris within the pump. Ensure that the system can contain any debris that may escape from the pump.

The screen protects the pump from contamination. Do not remove the inlet screen until the pump is about to be mounted onto the system.

1. To remove the inlet screen from a pump with CF inlet flange, use a bent wire hook or small screwdriver to carefully lever the inlet screen out from the inlet flange.
2. To replace an inlet screen, locate it as centrally as possible over the CF inlet flange and then, with fingers applying equal pressure around the edge of the screen, push it firmly downwards.

If they are not already in place, the tangs must be snapped into the locating groove in the inlet flange using a suitable tool to press them into position.

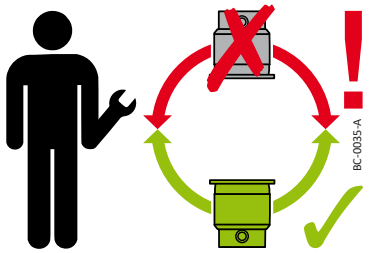
For ISO flanged pumps, Edwards supplies a combination inlet screen/trapped O-ring.

5.2.2 Mounting orientation

nEXT730 and 930 pumps can be mounted in any orientation,
nEXT1230 pumps can be mounted

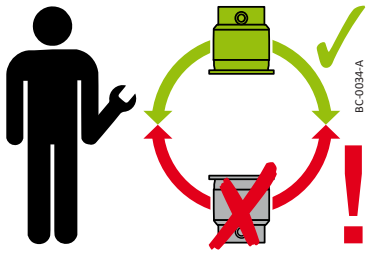
- horizontally or vertically, with the high-vacuum flange *on top* and in any orientation in between or

Figure 24 Mounting orientation for nEXT1230H



- horizontally or vertically, with the high-vacuum flange *on the bottom* and in any orientation in between (INV versions)

Figure 25 Mounting orientation for nEXT1230H INV



NOTICE: PUMP DAMAGE

The pump can be damaged if it is operated in the incorrectly installed orientation.

Observe the sticker on the pump and install the pump only in the permitted orientation.

5.2.3 Mount the pump

WARNING: EJECTION OF PARTS

If the mounting is not sturdy enough, pump blockage could cause the pump to break loose; internal pump components could be thrown in all directions.

Mount the pump firmly to the vacuum chamber. Never operate the pump without proper flanging to the vacuum chamber (in bench testing, for example). In case of rotor destruction a sudden twisting of the entire pump is possible. The vacuum chamber must be able to absorb the torque of max. 5 kNm for the nEXT730/930 and of max. 9 kNm for the nEXT1230 around the rotor's axis of rotation in the event of sudden rotor destruction.

If a pump fails it is likely to eject parts into the vacuum system onto which it is mounted. The customer must ensure that a hazard is not created should this occur.

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.

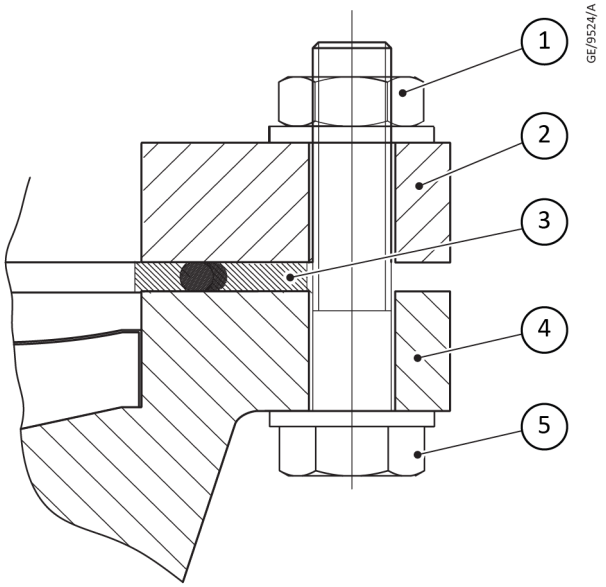
- The inlet connections for the nEXT pumps are either ISO flange or CF flange.
- If the pump has a CF flange, use the copper compression gasket supplied with the pump and use a full complement of bolts to connect the inlet flange of the pump to the vacuum system. Screws with a minimum Grade 8.8 or A2(A4)-70 are necessary. Lubricate and tighten the screws stepwise to a torque of 15^{+2} Nm. Refer to *Figure: Mounting high vacuum CF flange connection with blind hole thread*.
- If the pump has an ISO-K flange, use the Edwards combination inlet screen/trapped O- ring supplied with the pump and use a minimum of
  - 12 *clamps* for the nEXT730/930 with a minimum yield strength of 380 N/mm^2. Tighten the claw clamps with a torque of 20^{+3} Nm. Refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-K flange*.
  - 18 *clamps* for the nEXT1230 with a minimum yield strength of 500 N/mm^2. Tighten the claw clamps with a torque of 27^{+3} Nm. Refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-K flange*.
  - 12 *claws* for the nEXT730/930 with bolts of a minimum ISO class 8.8. Tighten the screws stepwise to a torque of 35^{+5} Nm. Refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with claws*
  - Mounting of the nEXT1230 with claws is not allowed.
- Alternatively, use a rotatable collar and the combined inlet screen and trapped O-ring supplied with the pump to connect the inlet flange of the pump to the vacuum system; use a full complement of minimum ISO class 8.8 bolts. Tighten the bolts stepwise to a torque of 35^{+5} Nm. Refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange*.
- If the pump has an ISO-F flange, use the Edwards inlet screen supplied with the pump, a centering ring with O-ring and use a minimum of 12 bolts M10 (Bolt quality: 8.8 according to EN ISO 898-1 with coating, each torqued to 35^{+5} Nm) to connect the inlet flange of the pump to the vacuum system. Refer to *Figure: Mounting high vacuum ISO-F flange connection with blind hole thread*.

All inlet flange bolts must be re-tightened once the system is under vacuum. Ensure that no torques or other forces are transmitted to the pump from the vacuum system or the associated pipelines.

Mounting position	nEXT730		nEXT930		nEXT1230		
	160 ISO-K	160 CF	200 ISO-K	200 CF	200 ISO-K	200 ISO-F	200 CF
Mounting high vacuum ISO-F flange connection ▪ with clearance hole, refer to *Figure: Mounting high vacuum ISO-F flange connection with clearance hole* ▪ with blind hole thread, refer to *Figure: Mounting high vacuum ISO-F flange connection with blind hole thread*	-	-	-	-	-	Yes	-
Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange, refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange*	Yes	-	Yes	-	Yes	-	-
Mounting high vacuum flange ISO-K flange at ISO-K flange, refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-K flange*	Yes	-	Yes	-	Yes	-	-
Mounting high vacuum flange ISO-K flange at ISO-F flange with claws, refer to *Figure: Mounting high vacuum flange ISO-K flange at ISO-F flange with claws*	Yes	-	Yes	-	Not Permitted*	-	-
Mounting high vacuum CF flange connection ▪ with clearance hole, refer to *Figure: Mounting high vacuum CF flange connection with clearance hole* ▪ with blind hole thread, refer to *Figure: Mounting high vacuum CF flange connection with blind hole thread*	-	Yes	-	Yes	-	-	Yes

** Mounting of the nEXT1230 with claws is not allowed.*

Figure 26 Mounting high vacuum ISO-F flange connection with clearance hole

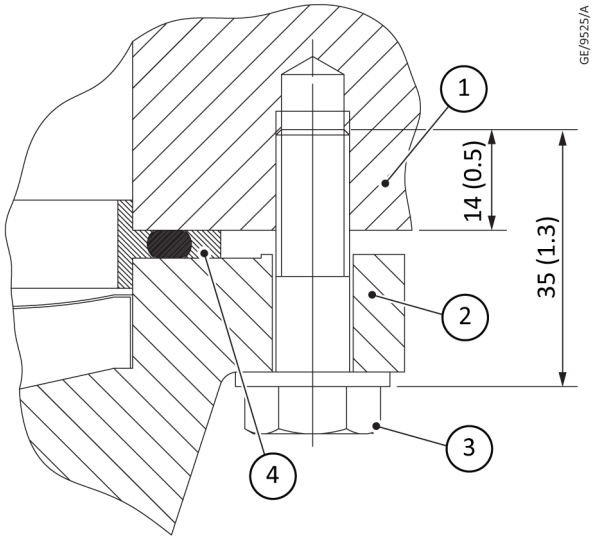


1. *Nut*
2. *ISO-F flange*
3. *Vacuum sealing disk consisting of centering ring and O-ring with outer support ring*
4. *ISO-F flange*
5. *Bolt*

nEXT	**1230**
Flange	**DN 200 ISO-F**
Number of bolts	12 x M10x50
Minimum bolt strength, yield strength	>640 N/mm^2
Bolt quality	8.8
Fastening torque	35^{+5} Nm

The fastening torque levels apply to lubricated threads.

Figure 27 Mounting high vacuum ISO-F flange connection with blind hole thread

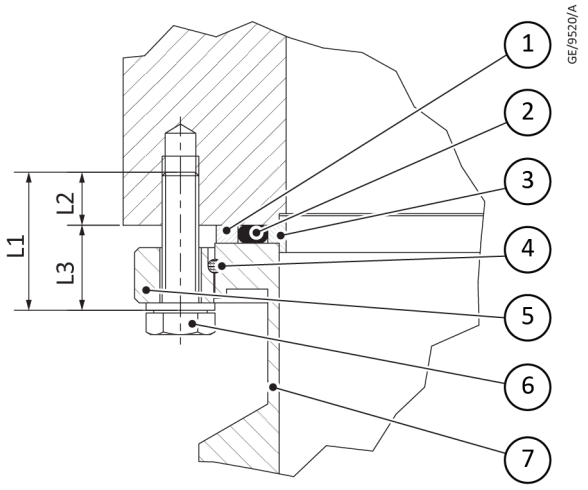


1. *ISO-F flange*
2. *ISO-F flange*
3. *Bolt*
4. *Centering ring*

nEXT	**1230**
Flange	**DN 200 ISO-F**
Number of bolts	12 x M10x35
Minimum bolt strength, yield strength	>640 N/mm^2
Bolt quality	8.8
Fastening torque	35^{+5} Nm

The fastening torque levels apply to lubricated threads.

Figure 28 Mounting high vacuum flange ISO-K flange at ISO-F flange with collar flange

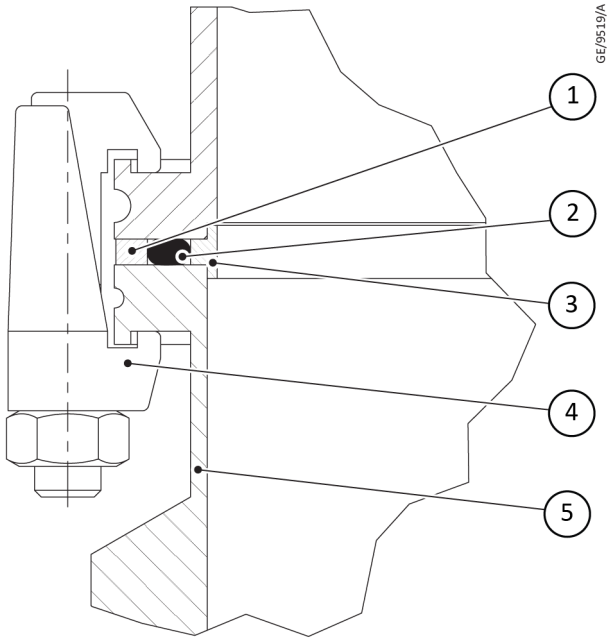


1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Retaining ring*
5. *Collar flange*
6. *Bolt with washer*
7. *Pump housing with ISO-K flange*

nEXT	**730/930**		**1230**
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**
Number of bolts	8 x M10	12 x M10	12 x M10
Minimum bolt strength, yield strength	> 640 N/mm^2		
Minimum screw in depth L2 for steel for aluminium L3	 13 mm 18 mm 23 mm		
Recommended bolts - ISO 4014 for steel flanges for aluminium flanges	 M10x40 M10x45		
Bolt quality	8.8		
Fastening torque	35^{+5} Nm		

The fastening torque levels apply to lubricated threads.

Figure 29 Mounting high vacuum flange ISO-K flange at ISO-K flange

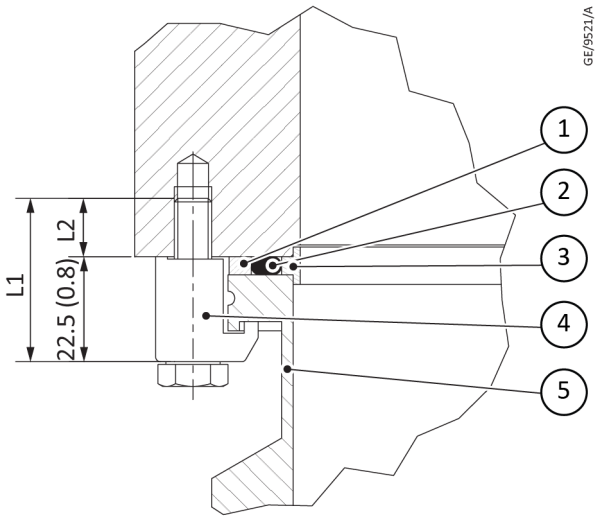


1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Clamp*
5. *Pump housing with ISO-K flange*

nEXT	**730/930**		**1230**
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**
Number of clamps	12 x M10	12 x M10	18 x M10
Fastening torque	20^{+3} Nm	20^{+3} Nm	27^{+3} Nm

The fastening torque levels apply to lubricated threads.

Figure 30 Mounting high vacuum flange ISO-K flange at ISO-F flange with claws



1. *Outer ring*
2. *O-ring*
3. *Centering ring*
4. *Claw with bolt*
5. *Pump housing with ISO-K flange*

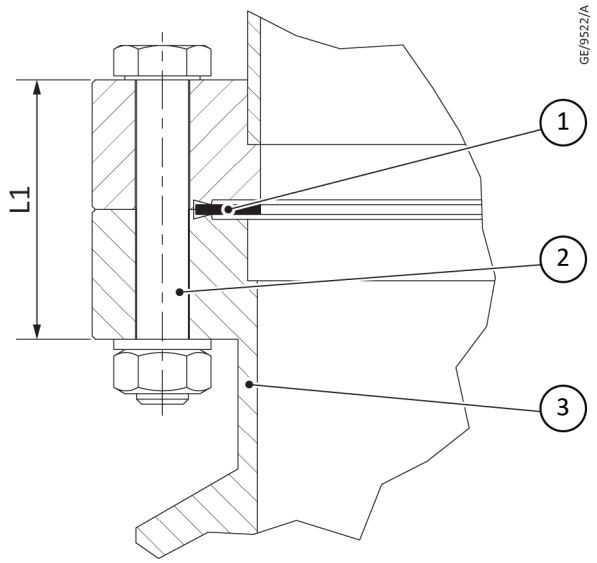
nEXT	**730/930**		**1230**
Flange	**DN 160 ISO-K**	**DN 200 ISO-K**	**DN 200 ISO-K**
Number of clamps	12 x M10		not permitted
Minimum bolt strength, yield strength	> 640 N/mm^2		
Minimum screw in depth L2 for steel for aluminium	 13 mm 18 mm		
Recommended bolts - ISO 4014 for steel flanges for aluminium flanges	 M10x35 M10x40		
Bolt quality	8.8		
Fastening torque	35^{+5} Nm		

The fastening torque levels apply to lubricated threads.

Note:

Mounting of the nEXT1230 with claws is not allowed.

Figure 31 Mounting high vacuum CF flange connection with clearance hole

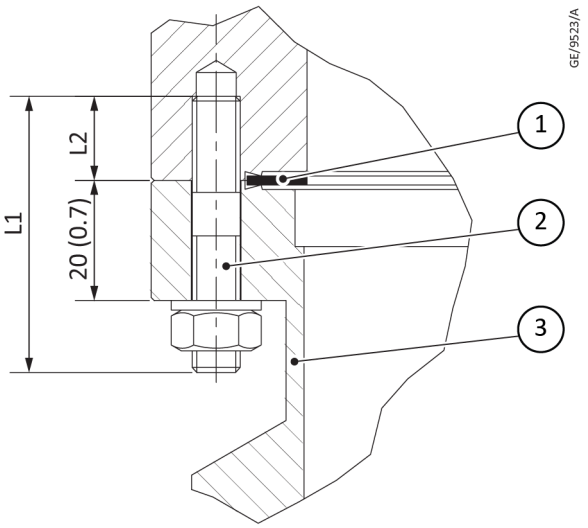


1. *Copper gasket*
2. *Bolt with washer and nut*
3. *Pump housing with CF flange*

nEXT	**730/930/1230**	
Flange	**DN 160 CF**	**DN 200 CF**
Number of bolts	20 x M8	24 x M8
Minimum bolt strength, yield strength	> 450 N/mm^2	
Recommended bolts - ISO 4014 L1	M8x55 44	M8x60 49
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	
Fastening torque	15^{+2} Nm	

The fastening torque levels apply to lubricated threads.

Figure 32 Mounting high vacuum CF flange connection with blind hole thread



1. *Copper gasket*
2. *Stud bolt with washer and nut*
3. *Pump housing with CF flange*

nEXT	**730/930/1230**	
Flange	**DN 160 CF**	**DN 200 CF**
Number of bolts	20 x M8	24 x M8
Minimum bolt strength, yield strength	> 450 N/mm^2	
Minimum screw-in depth for steel	12 mm	
Recommended bolts for steel flanges - DIN 835 L1	M8x30 46	M8x30 51
Bolt quality stainless steel bolts	8.8 or A2(A4)-70	
Fastening torque	15^{+2} Nm	

The fastening torque levels apply to lubricated threads.

5.2.4 Backing port connection

The pump is suitable for use with Edwards Rotary Vane, Scroll or diaphragm backing pumps. System performance may depend upon which pump is used. Contact Edwards when selecting an appropriate backing pump for the application.

WARNING:

Ensure safe ducting of the backing line if oil mist or hazardous substances are present.

CAUTION:

The pump must not be operated or vented from a positive pressure gas supply when the backing line is restricted or blocked.

NOTICE:

Do not use the pump with a backing pressure below 5 x 10^{-4} mbar (5 x 10^{-2} Pa). Lower backing pressures will increase the evaporation rate of the lubrication reducing the bearing life.

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

5.3 Purge gas connection

5.3.1 Recommended purge gas flow

The recommended purge gas flow for typical applications is 25 sccm (0.42 mbar l s^{-1}, 42 Pa l s^{-1}).

The flow rate of the purge gas must be limited to the allowed range. To limit the flow rate, use a flow controller or a pressure regulator and calibrated flow restrictor. The PRX10 purge restrictor accessory (refer to *Accessories* on page 123) is suitable for this purpose.

5.3.2 Connect the purge gas

Connect a purge gas supply to protect the pump.

1. To supply a purge gas to the pump, remove the plug fitted in the purge port.
2. To fit a vent port adaptor (refer to *Accessories* on page 123).
3. Connect the purge gas supply to the vent port adaptor.

5.4 Electrical installation

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

Do not remove the motor controller from the pump. There are no user-serviceable parts.

CAUTION: ELECTRICAL SHOCK

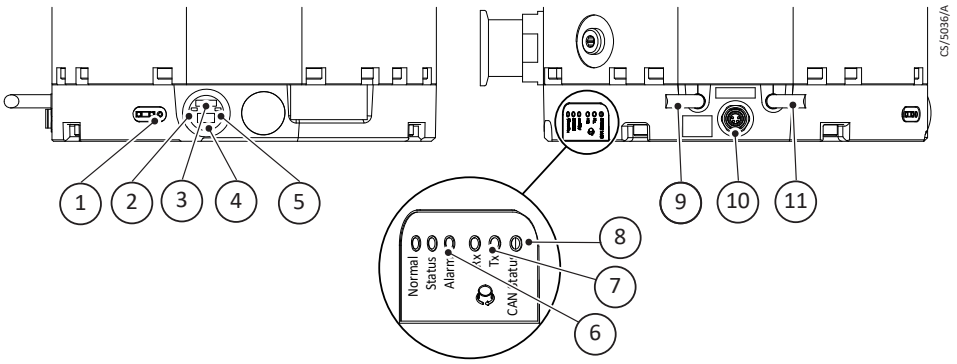
Contact with live parts may lead to electrical shock.

The electrical connection may only be carried out by a trained person. Observe the national regulations in the user country, e.g. for Europe EN 50110 - 1. Prior to servicing, disconnect the vacuum pump from the power supply.

Electrical shock due to interruption of the protective conductor system. In the event of a fault, life-threatening voltages may be present on electrically conductive components.
Before commissioning, check the resistance of the earthing cable and the suitability of the assigned overcurrent protection device.

The nEXT pump can be controlled using the Edwards TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller or a customer system. The nEXT pump can be powered by the Edwards power supply or by a customer power supply via the nEXT pump power supply cable.

Figure 33 Controller view



1. *Bearing LED (indicates when bearing service is recommended)*
2. *Standby increase button*
3. *RS485/CAN/RS232 slide switch*
4. *USB connector*
5. *Standby speed decrease button*
6. *Pump status LEDs*
7. *Serial receive/transmit LEDs*
8. *CAN status LED*
9. *nEXT pump power supply interface*
10. *Accessory connector*
11. *nEXT pump logic interface*

5.4.1 Earth (ground) connections

Edwards recommend fitting a separate earth (ground) conductor. Refer to *Figure: Connections and controls*. The impedance between the pump body and the earth connection point must be < 0.1 Ω.

5.4.2 TIC or TAG logic interface connections

If an Edwards TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller are used to control the pump, the nEXT pump logic interface cable connects directly into the back of the TIC or TAG, and the nEXT pump is powered separately using the Edwards power supply or alternatively the customer power supply connected to the pump via the dedicated nEXT pump power supply cable.

The RS485/CAN/RS232 slide switch must be in the RS232 position if either the TIC or TAG is to be used to control the nEXT pump.

5.4.3 Connect the logic interface to control equipment

To operate the pump using your own control system, use suitable connector mating half (not supplied) to connect the control equipment to the connector on the logic interface cable.

5.4.4 Connect the electrical supply

CAUTION:

This product requires a separate power supply (not included). The power supply should be adequately protected against a hazardous live condition (for example, in case of a short circuit).

CAUTION:

Incorporate a suitable Emergency Stop Switch in the electrical supply. Locate the switch in an easily accessible position and mark it as the emergency disconnecting device for the pump. Failure to do so will result in not being able to switch off the pump in an emergency.

CAUTION:

Incorporate a suitable fuse or current limiting device in the 48 V d.c. supply line to the pump. If this is not done and a fault develops, the pump may develop a hazardous surface temperature or present a fire hazard.

Refer to *Table: Logic interface technical data* for suitable fuse ratings.

CAUTION:

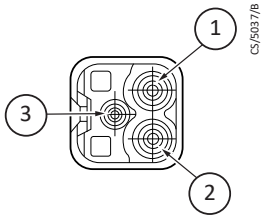
Do not exceed the maximum supply voltage. Excessive supply voltage will cause permanent damage to the control electronics and may result in a mechanical hazard in some failure conditions.

The electrical supply provided for the nEXT pump must meet the requirements of UL61010-1 and EN61010-1. Ensure that hazardous voltages as defined in UL61010-1 and EN61010-1 cannot be present on the electrical interface to the nEXT pump.

The nEXT pump 0 V is not referenced to earth (ground). Ensure that there is only one path between 0 V and earth. Multiple connections between 0V and earth must be avoided in order to avoid unexpected offset voltages on control and status signals and possible problems with serial communications. If no other connection is present between 0 V and earth, the connection should be made at the power supply. Be aware that other electrical equipment connected to the system could introduce a connection between 0 V and earth, for example a personal computer or measuring equipment.

To operate the nEXT pump using the customer's own electrical supply, use a suitable connector mating half (not supplied) to connect the electrical supply to the connector on the pump power supply cable.

Figure 34 Power supply connector



1. *+48V DC Supply*
2. *0V Supply*
3. *Chassis*

5.5 Connect the parallel control and monitoring

Connections for parallel control and monitoring must be made using a suitable mating half that is not supplied.

NOTICE:

If using the normal and fail lines to drive the coils of d.c. relays, include a back EMF suppression diode in parallel with each relay coil to protect the pump.

1. Connect the customer control equipment to the control input pins of the customer logic interface mating half. Refer to *Table: Logic interface connector pins*, which identifies the logic interface connector pins.
   The control inputs are Start and Standby speed. To activate either of these control inputs, connect the control input pin to the 0 V control reference. To start the pump, connect pin 3 (Start / Stop) to pin 2 (0 V Reference). To stop the pump, break the connection between pin 3 and pin 2. To put the pump into standby, connect both pin 4 (Standby) and pin 3 (Start / Stop) to pin 2 (0 V reference).

   Note:

   Serial enable is also a control input but is not required in a system operating purely under parallel control. Make sure that there is no connection to serial enable (pin 5).

   Note:

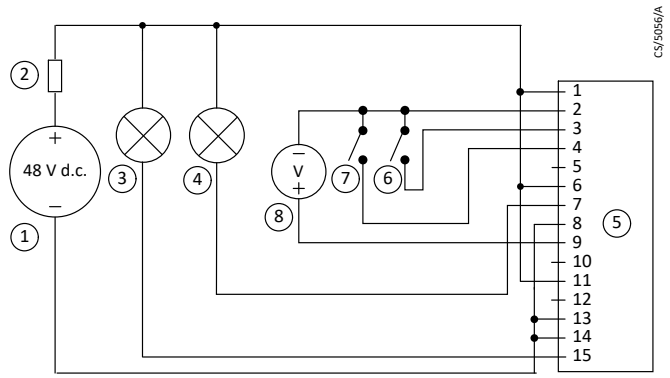
   The RS485/CAN/RS232 slide switch must be in the (default) RS232 position to use the standby or fail parallel interface signals, refer to Connect the serial interface to the customer control equipment on page 74.

2. To monitor analogue output, connect the customer control equipment to the pump analogue output (pin 9) and to pin 2 of the customer logic interface mating half. When the pump is shipped, the analogue output is configured to monitor pump rotational speed. To monitor other parameters, re-configure the nEXT pump using commands over the Serial Interface. Refer to *Connection for serial control and monitoring* on page 73 for further details.
3. To monitor the normal status output, connect the customer control equipment to the normal status output (pin 15) and to pin 2 of the customer logic interface mating half.
   The output can be used to control other devices in the pumping system. The output can drive a low power relay of up to 24 V d.c. coil rating (up to 20 mA).

4. To monitor the fail status output, connect the customer control equipment to the fail output (pin 7) and to pin 2 of the customer logic interface mating half.
   The output can be used to control other devices in the pumping system. The output can drive a low power relay of up to 24 V d.c. coil rating (up to 20 mA).

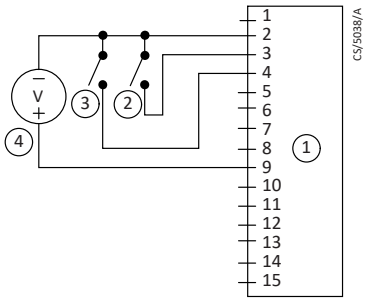
Electrical supply connection to pins 1, 6 and 11 is not required for the nEXT pump as it has a dedicated pump power supply cable. The fuse is only required if a 48V d.c. electrical supply is connected to the logic interface cable. Connections to the electrical supply via pins 1, 6 and 11 is required if indicators for either the normal speed or the system OK status are required.

Figure 35 Logic interface connections - parallel control



1. *Optional 48 V d.c. electrical supply*
2. *Optional fuse*
3. *Optional indicator - normal speed*
4. *Optional indicator - system OK*
5. *nEXT pump logic interface*
6. *Start switch*
7. *Optional standby switch*
8. *Optional voltmeter to monitor analogue output*

Figure 36 Simplified logic interface connections - parallel control



1. *nEXT pump logic interface*
2. *Start switch*
3. *Optional standby switch*
4. *Optional voltmeter to monitor analogue output*

5.6 Connection for serial control and monitoring

The serial interface allows the nEXT pump to be controlled and to be interrogated as to its operational status using a number of serial commands or the nST2 PC software. There is also a multi-drop mode that allows for the connection of more than one nEXT pump to a single serial port on the control system.

5.6.1 Connect the serial interface to the customer control equipment

The serial interface is available in RS485 or RS232 options which can be selected using the slide switch located adjacent to the main power lead.

To adjust the slide switch, toggle the slide switch using a small tool. The motor controller default setting is RS232 serial interface. Be sure to replace the round seal to ensure the IP rating of the pump is still achieved.

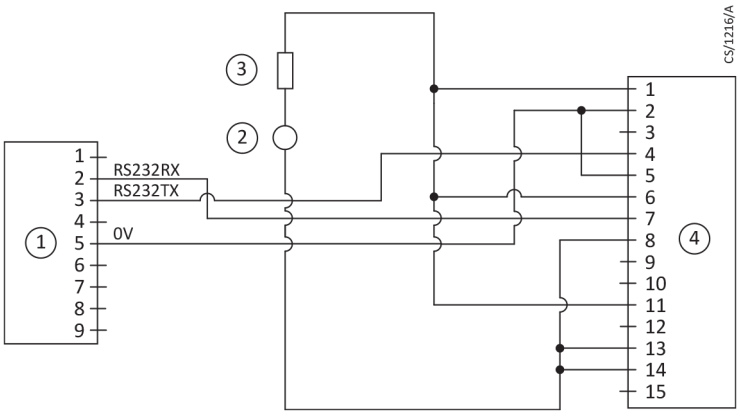
CAUTION:

When connecting the pump to a PC, note that the 0 V pin on the RS232 connector may be connected to earth through the PC. If this is the case, ensure that the 0 V rail of the 48 V d.c. supply is not also connected to earth at some other point such as at the power supply. If the 0 V rail of the 48 V d.c. supply will not be connected to earth at the PC, an opto-isolated interface to the PC should be used.

The nEXT pump can connect directly to the RS485 or RS232 serial input on the control equipment or a PC as shown in *Figure: Logic interface connections - RS232 serial control* and *Figure: Logic interface connections - RS485 serial control*. In this configuration the PC is the serial link master and the nEXT pump is the slave. The distance over which the serial link will work is dependent on any difference in voltage between the 0 V at the sending and receiving end. If the 0 V reference at the receiving end is within 0.3 V of the 0 V Control Reference pin on the nEXT pump control connector, then the serial link should be capable of operating at distances up to 6 m. An interface circuit external to the nEXT pump may be required for longer distances.

The software in the nEXT pump is capable of operating with several pumps connected to a single serial link master. This is referred to as multi-drop mode. The RS485 option is recommended for multi-drop mode. With the RS232 option selected, some additional hardware will be required to link several nEXT pump units to a single serial link master. A concept drawing of one possible arrangement is shown in *Figure: Conceptual diagram for multi-drop connection using RS232 interface*. Conversely when the RS485 option is selected, connecting several nEXT pumps to a single master becomes a simple wiring exercise as shown in *Figure: RS485 multi-drop connection*.

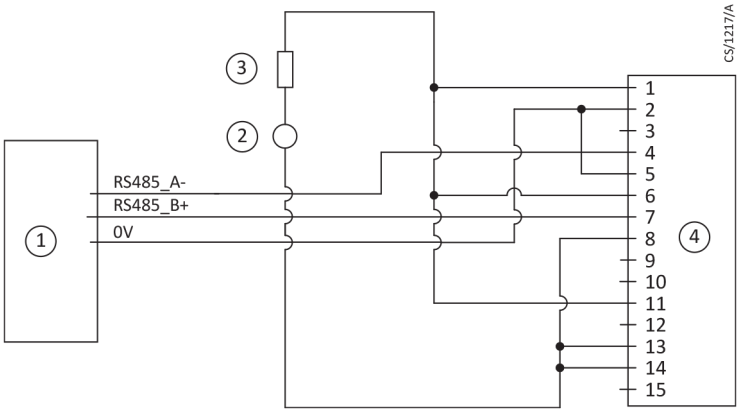
Figure 37 Logic interface connections - RS232 serial control



1. *RS232 interface on control equipment*
2. *Optional 24 V d.c. electrical supply*
3. *Fuse*
4. *nEXT pump logic interface*

Electrical supply connection to pins 1, 6 and 11 is not required for the nEXT pump as it has a dedicated pump power supply cable. The fuse is only required if a 48 V d.c. electrical supply is connected to the logic interface cable.

Figure 38 Logic interface connections - RS485 serial control



1. *RS485 interface on control equipment*
2. *Optional 24 V d.c. electrical supply*
3. *Fuse*
4. *nEXT pump logic interface*

5.6.2 Serial enable

To send a serial message over the serial link, serial enable must first be activated.

Link the serial enable input signal (pin 5) to pin 2 of the customer logic interface mating half.

Edwards recommends incorporating this link into the serial communications cable so that the serial enable is only activated when the serial cable is connected. When the cable is removed, serial enable will become inactive.

Serial enable acts as an interlock for start commands sent over the serial interface. If the pump is running in serial control mode (having been sent a serial start command) and the serial enable subsequently becomes inactive, the pump will trigger a fail condition

and will decelerate to rest. To clear this fail condition, re-activate the serial enable and send a serial stop command.

5.7 Connection for mixed parallel and serial operation

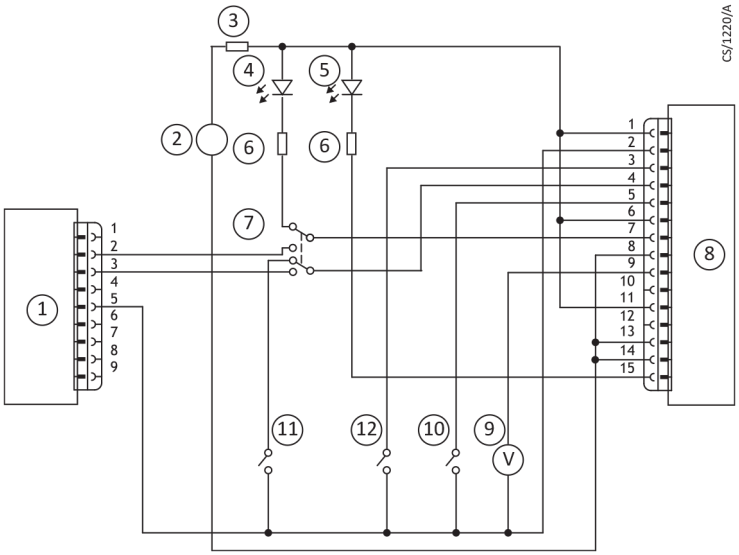
The pump can be controlled using parallel interface control inputs, and at the same time monitor various pump parameters using the serial interface or the USB service port using the Edwards nST2 PC software. Alternatively, the pump can be controlled using commands sent over the serial interface while at the same time monitoring the normal signal and analogue output over the parallel interface.

Figure: Logic interface connection - mixed parallel and serial operation shows a schematic diagram of a system that demonstrates how to do this. This connection is a hybrid of the parallel and serial connection which are described in detail in *Connect the parallel control and monitoring* on page 72 and *Connection for serial control and monitoring* on page 73 respectively. Many of the options described in those sections are available in mixed parallel and serial operation but note that whilst serial enable is active to enable the serial link, the parallel standby and fail signals are not available. The multi-drop connection shown in *Figure: Logic interface connection - mixed parallel and serial operation* can also be used with mixed parallel and serial operation.

The pump cannot be controlled using both the parallel and serial interfaces simultaneously. For example, if the pump is started by sending a start command over the serial interface, the pump cannot then be stopped by using the start /stop switch on the parallel interface. The pump will ignore the state of the start / stop switch on the parallel interface. To stop the pump, send a serial stop command. Only when the serial stop command has been received by the pump can any commands sent via the parallel interface be acted on.

Similarly, if the pump is started using the start switch on the parallel interface, the pump cannot then be stopped by sending a stop command over the serial interface. The pump will ignore any start or stop commands received over the serial interface. To stop the pump, use the parallel stop switch. Only when the pump has been stopped using the parallel interface switch will any start or stop commands be accepted via the serial interface.

Figure 39 Logic interface connection - mixed parallel and serial operation



1. *RS232 interface on control equipment*
2. *Optional 24 V d.c. electrical supply*
3. *Fuse*
4. *Optional LED indicator - system OK*
5. *Optional LED indicator - normal speed*
6. *Current limit resistor for LED*
7. *Optional serial link selector*
8. *nEXT pump*
9. *Optional voltmeter*
10. *Optional serial enable switch*
11. *Optional standby switch*
12. *Start switch*

5.8 Cooling

5.8.1 Cooling requirements

NOTICE:

Ensure that the pump is adequately cooled to prevent damage to the rotor and bearing.

When using alternative cooling arrangements other than the standard Edwards cooling accessories, ensure cooling is not solely directed or ducted onto the pump controller.

If the pump will be located inside an enclosure, ensure that there is adequate ventilation so that the ambient temperature around the pump does not exceed 40 °C.

Note:

During operation, if the temperature of any surface of the pump is higher than 50 °C, the cooling is inadequate and should be increased. Pump performance may be affected if you do not cool the pump and nEXT motor controller adequately.

Edwards recommends that, wherever possible, the pump is cooled by forced air cooling or water cooling.

Select the cooling type required according to the ambient temperature:

- Natural convection cooling – only for nEXT730D, nEXT930D, nEXT730H and nEXT930H:
  For some light pumping duties, with an ambient air temperature less than 25 °C, natural convection cooling may be adequate to cool the nEXT pump.
- Forced air cooling – option:
  The ambient air temperature must be 5 °C to 40 °C when using forced air cooling. Ensure that there is an adequate supply of cooling air to the pump.
- Water cooling – standard for nEXT730Q, nEXT930Q and nEXT1230H, option for nEXT730D, nEXT930D, nEXT730H and nEXT930H:
  Use water cooling with higher load applications or when using a flange heater (CF variants only). When using water cooling, ambient air temperature must be less than 40 °C and the water temperature must be between 10 °C and 40 °C.

Refer to *Figure: Cooling requirements for nEXT730H*, *Figure: Cooling requirements for nEXT730Q/930Q*, *Figure: Cooling requirements for nEXT730D/930D* and *Figure: Cooling requirements for nEXT1230H* for further performance information.

5.8.2 Forced air cooling

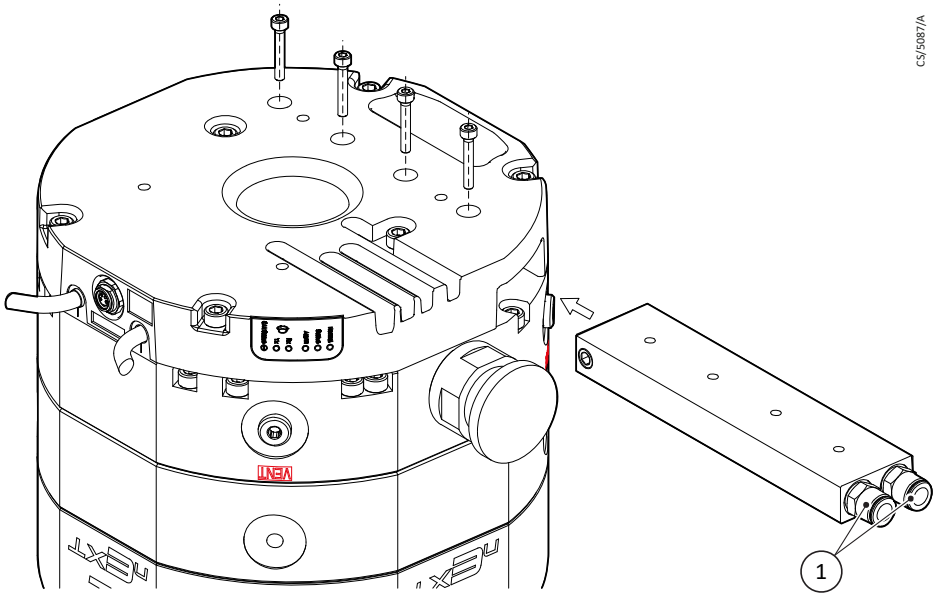
The customer controller can be configured to drive an air cooler only if commands can be sent via the serial interface or an Edwards TIC Turbo and Instrument Controller or Turbo Controller.

Air cooling accessories are available for nEXT pumps. Fit the air cooler as described in the instruction manual supplied with it. If an alternative fan is used for air cooling, ensure that the flow rate is above 100 m^3h^{-1} (60 cfm).

The air cooler can be powered by a customer external power supply, the Edwards TIC Turbo and Instrument Controller, the TIC Turbo Controller or the nEXT Controller. Plug the connector into the socket at the side of the controller.

5.8.3 Water cooling

Figure 40 Attaching the water cooling



1. *Hose connections for 6x1 hose*

The nEXT1230H pump has a built-in cooling water block as standard. The nEXT730Q and nEXT930Q has a built-in water cooling system.

For nEXT730D, nEXT930D, nEXT730H and nEXT930H: Attach the cooling water block to the pump with four M4 screws, tightening torque is 3^{+1} Nm.

Connect the cooling water hoses.

The hose connections may be unscrewed and removed to make use of the integrated G 1/8" threads.

Ensure that the water supply is constant and within the quality, temperature and flow rate limits specified in *Table: Water cooling block supply requirements* on page 35.

NOTICE:

In the event of coolant failure, the pump must be allowed to cool down to ambient temperature before restartings.

NOTICE:

Condensation may occur if a water cooling block is used in high humidity environments. Protect the pump and other equipment by considering the design of the installation.

Pipes in the water cooling circuit may become blocked if the cooling water contains too much calcium carbonate or if it contains particles that 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. If in doubt, check the quality of the cooling water supply and, if necessary, provide treatment and filtration.

Either of the two push fit connectors on the water cooler can be used for the water supply or return connections.

6. Configuration

Before operating the pump, configure the motor controller settings so that they are suitable for the application.

If the system is designed to operate with parallel control and monitoring, there is no facility to change the majority of the motor controller settings once the pump is installed on the system.

The pump is supplied with all settings at factory default values, as shown in *Table: Summary of commands that can be sent to the pump*. If any of the motor controller settings are to be changed, change them before installing the pump on the system.

The pump can be configured using the customer serial comms over the serial interface. *Configure the pump using serial commands* on page 80 details the commands that will be needed to configure the motor controller. Alternatively use the Edwards TIC Turbo and Instrument Controller, TIC Turbo Controller or TAG Controller. Further information regarding this is detailed in *Configure the pump using a TIC* on page 88. The Edwards nST2 PC software can also be used to configure the pump, either via the serial interface or via the USB service port.

Note:

The standby speed may be adjusted using the button on the motor controller as described in Standby speed setting on page 84.

If the pump is operated with parallel control and monitoring and the controller settings will not be reconfigured, go straight to *Before starting the pump* on page 89.

6.1 Configure the pump using serial commands

Refer to *Table: Summary of commands that can be sent to the pump* for a summary of the full set of serial commands, parameter ranges and factory defaults for each setting.

Message structure on page 81	The message structure and command set are the same for RS485 and RS232 options. To communicate a message to the nEXT pump, the characters must be sent in a specific order. If the message does not conform to the correct structure it will be ignored and no reply will be sent.
Command and reply table definitions on page 81	Explanation of the command and reply characters.
Power limit setting on page 82	The pump is supplied with a default power limit. If this limit is not suitable for the application, change it to any value between the maximum and minimum setting.
Powering a fan from the motor controller on page 83	A fan can be powered from the nEXT motor controller on auxiliary output 2.
Controlled venting options on page 83	If the motor controller is used to automatically control a vent valve, there are a number of venting options available.

Standby speed setting on page 84	The pump can be run at standby speed rather than full rotational speed. The standby speed is a user-configurable option and can be set to any value between 55% and 100% full rotational speed.
Normal speed setting on page 84	The normal speed is a user-configurable setting and can be set to any value between 50% and 100% full rotational speed.
Timer setting and options on page 85	The timeout period is a user-configurable option and can be set to any value from 1 to 30 minutes.
Analogue signal options on page 86	The analogue output can be used to monitor one of five different parameters.
Electronic braking options on page 86	The pump is supplied with the electronic braking disabled by default.
Factory settings on page 87	The nEXT pump can be re-configured to its original factory settings with one serial command.
Assigning a multi-drop address on page 87	Each individual pump must be programmed with its own multi-drop address via a point-to-point connection before introduction into a multi-drop network.

6.1.1 Message structure

The message structure and command set are the same for RS485 and RS232 options. To communicate a message to the nEXT pump, the characters must be sent in a specific order. If the message does not conform to the correct structure it will be ignored and no reply will be sent.

The correct structure to use is as follows:

- a valid start character, either a '!' character for a store operation or a '?' character for a query operation, followed by
- a command, which will be an upper case alphabetical character, followed by
- an object number, comprising three decimal digits, followed by
- for some commands only, a data field, comprising a sequence of characters separated from the object number by a space, followed by
- a terminating carriage return.

The message protocol in multi-drop mode is marginally different, refer to *Multi-drop operation* on page 52.

6.1.2 Command and reply table definitions

Explanation of the command and reply characters.

Table 16 Command abbreviations

Abbreviation	Meaning
cr	Carriage return character
chars	Characters
d	Decimal ASCII character*
h	Hexadecimal ASCII character

Abbreviation	Meaning
r	Returned error code - refer to *Command set error codes* on page 113
sp	Space character
string	May have several ASCII characters
X	Multi-drop decimal ASCII character[§]

[*] *Fields showing multiple d characters are to indicate typical length. All data fields have a maximum of 5 decimal characters (prefixed by a minus number for negative numbers).*

[§] *Fields showing multiple X characters are to indicate maximum length and not fixed length.*

Typical setting command:

Command	*!*	*S*	*8*	*5*	*5*	*sp*	*d*	*d*	*d*	*cr*

Typical setting reply:

Reply	*	*S*	*8*	*5*	*5*	*sp*	*r*	*cr*

Typical query command:

Command	*?*	*S*	*8*	*5*	*5*	*cr*

Typical query reply:

Reply	*=*	*S*	*8*	*5*	*5*	*sp*	*d*	*d*	*d*	*cr*

6.1.3 Power limit setting

The pump is supplied with a default power limit. If this limit is not suitable for the application, change it to any value between the maximum and minimum setting.

Table 17 Power limit setting

	Maximum value setting	Minimum value setting	Default power setting
nEXT730/930	600 W	190 W	500 W
nEXT1230	800 W	300 W	500 W

Send the command as follows (where the 'd' characters represent the value in Watts that will be set. For example, to set the limit to 500 W, type 500).

Command	*!*	*S*	*8*	*5*	*5*	*sp*	*d*	*d*	*d*	*cr*

The reply will be in the following format:

Reply	*	*S*	*8*	*5*	*5*	*sp*	*r*	*cr*

The Power Limit Setting is now stored in memory within the nEXT pump.

To check what power limit is set, send a query as follows:

Command	*?*	*S*	*8*	*5*	*5*	*cr*

The reply will be in the following format:

Reply	*=*	*S*	*8*	*5*	*5*	*sp*	*d*	*d*	*d*	*cr*

6.1.4 Powering a fan from the motor controller

A fan can be powered from the nEXT motor controller on auxiliary output 2.

Send the following command:

Command	*!*	*S*	*8*	*6*	*4*	*sp*	*8*	*cr*

The reply will be in the following format:

Reply	***	*S*	*8*	*6*	*4*	*sp*	*r*	*cr*

The permanently enabled fan setting is now stored in memory within the nEXT pump.

When the pump is shipped, it is set up to run a vent valve. Send a query to find out what the setting is as follows:

Command	*?*	*S*	*8*	*6*	*4*	*cr*

The reply will be in the following format:

Reply	***	*S*	*8*	*6*	*4*	*sp*	*d*	*cr*

If the character 'd' is 8, then the fan is enabled. If it is anything else, configure the motor controller to run the fan.

6.1.5 Controlled venting options

If the motor controller is used to automatically control a vent valve, there are a number of venting options available.

Refer to *Table: Vent valve options* for available venting options and refer to *Table: Valve types* for available valve types.

To set a vent option on auxiliary output 1 send the following command, (where the character 'd' refers to the option number shown in *Table: Vent valve options*):

Command	*!*	*S*	*8*	*5*	*3*	*sp*	*d*	*cr*

The reply will be in the following format:

Reply	***	*S*	*8*	*5*	*3*	*sp*	*r*	*cr*

The venting option is now stored in memory within the nEXT pump.

To check what venting option is set, send a query as follows:

Command	*?*	*S*	*8*	*5*	*3*	*cr*

The reply will be in the following format:

Reply	*=*	*S*	*8*	*5*	*3*	*sp*	*d*	*cr*

To set the valve type on auxiliary output 1, send the following command, (where the character 'd' refers to the option number shown in *Table: Valve types*):

Reply	*!*	*S*	*8*	*7*	*7*	*sp*	*d*	*cr*

The reply will be in the following format:

Reply	***	*S*	*8*	*7*	*7*	*sp*	*d*	*cr*

The valve type is now stored in memory within the nEXT pump, but a power cycle is required before the auxiliary 1 output circuitry adjusts to the stored request.

To check the venting option that is set, send a query as follows:

Reply	*?*	*S*	*8*	*7*	*7*	*cr*

The reply will be in the following format:

Reply	*=*	*S*	*8*	*7*	*7*	*sp*	*d*	*cr*

6.1.6 Standby speed setting

The pump can be run at standby speed rather than full rotational speed. The standby speed is a user-configurable option and can be set to any value between 55% and 100% full rotational speed.

When the pump is shipped, it is configured with a standby speed of 70% full rotational speed.

The standby speed setting can be changed using the STDBY+ and STDBY- push buttons located on the motor controller (shown in *Figure Controller view* on page 70) or by using a serial command. If using the buttons, each button press will adjust the speed by 15 Hz (1%).

To change the standby speed setting using a serial command, send the following command (where the characters 'd' represent the value as a percentage of full rotational speed):

Command	*!*	*S*	*8*	*5*	*7*	*sp*	*d*	*d*	*d*	*cr*

The reply will be in the following format:

Reply	***	*S*	*8*	*5*	*7*	*sp*	*r*	*cr*

The Standby Speed is now stored in memory within the nEXT pump.

To check what Standby Speed is set, send a query as follows:

Command	*?*	*S*	*8*	*5*	*7*	*cr*

The reply will be as follows:

Reply	*=*	*S*	*8*	*5*	*7*	*sp*	*d*	*d*	*d*	*cr*

6.1.7 Normal speed setting

The normal speed is a user-configurable setting and can be set to any value between 50% and 100% full rotational speed.

When the pump is shipped, it is configured with a normal speed of 80% full rotational speed.

To change the normal speed setting, send the following command (where the characters 'd' represent the value as a percentage of full rotational speed):

Command	*!*	*S*	*8*	*5*	*6*	*sp*	*d*	*d*	*d*	*cr*

The reply will be as follows:

Command	*	S	8	5	6	sp	r	cr

The normal speed is now stored in memory within the nEXT pump.

To check what normal speed is set, send a query as follows:

Command	?	S	8	5	6	cr

The reply will be as follows:

Reply	=	S	8	5	6	sp	d	d	d	cr

6.1.8 Timer setting and options

The timeout period is a user-configurable option and can be set to any value from 1 to 30 minutes.

When the pump is shipped, it is configured with a default timeout period of 8 minutes. Refer to *Timer* on page 17 for a full description of timer functionality.

To change the timer setting, send the following command (where the characters 'd' represent the timeout period in minutes):

Command	!	S	8	5	4	sp	d	d	cr

The reply will be as follows:

Reply	*	S	8	5	4	sp	r	cr

The Timer setting is now stored in memory within the nEXT pump.

To check what time-out period is set, send a query as follows:

Command	?	S	8	5	4	cr

The reply will be as follows:

Reply	=	S	8	5	4	sp	d	d	cr

The timer is permanently enabled during ramp-up, however it is optional whether to have it enabled at other times. When the pump is shipped, the Timer is enabled by default.

To disable the timer, send the following serial command:

Command	!	S	8	7	0	sp	0	cr

The reply will be as follows:

Reply	*	S	8	7	0	sp	r	cr

The state of the timer option is stored in memory within the nEXT pump.

To enable the timer again, send the following serial command:

Command	!	S	8	7	0	sp	1	cr

The reply will be as follows:

Reply	*	S	8	7	0	sp	r	cr

To check whether the timer is enabled or disabled, send the following query:

Command	*?*	*S*	*8*	*7*	*0*	*cr*

The reply will be as follows (where d=0 means disabled and d=1 means enabled):

Reply	*=*	*S*	*8*	*7*	*0*	*sp*	*d*	*cr*

6.1.9 Analogue signal options

The analogue output can be used to monitor one of five different parameters.

Table 18 Analogue signal options

Option number	Description of analogue output number
0	Measured pump rotational speed. This is the factory default setting.
1	Measured link power
2	Measured motor temperature
3	Measured motor controller temperature
4	Measured bearing temperature

To configure the analogue output, send the following command (where the character ‘d’ denotes the option number.

Command	*!*	*S*	*8*	*7*	*1*	*sp*	*d*	*cr*

The reply will be as follows:

Reply	***	*S*	*8*	*7*	*1*	*sp*	*d*	*cr*

The analogue output signal setting is now stored in memory within the nEXT pump.

To check which analogue output signal setting is enabled, send a query as follows:

Command	*?*	*S*	*8*	*7*	*1*	*cr*

The reply will be as follows:

Reply	*=*	*S*	*8*	*7*	*1*	*sp*	*d*	*cr*

6.1.10 Electronic braking options

Refer to *Electronic braking* on page 19 for a full description of the electronic braking feature. To enable Electronic Braking, send the following serial command:

Command	*!*	*S*	*8*	*7*	*2*	*sp*	*1*	*cr*

The reply will be as follows:

Reply	***	*S*	*8*	*7*	*2*	*sp*	*r*	*cr*

The state of the Electronic Braking option is stored in memory within the nEXT pump.

To disable the Electronic Braking again, send the following serial command:

Command	*!*	*S*	*8*	*7*	*2*	*sp*	*0*	*cr*

The reply will be as follows:

Reply	*	S	8	7	2	sp	r	cr

To check whether electronic braking is enabled or disabled, send the following query:

Command	?	S	8	7	2	cr

The reply will be as follows (where d=0 means disabled and d=1 means enabled):

Reply	=	S	8	7	2	sp	d	cr

6.1.11 Factory settings

The nEXT pump can be re-configured to its original factory settings with one serial command.

To reset the motor controller to factory settings, send the following command:

Command	!	S	8	6	7	sp	1	cr

The reply will be as follows:

Reply	*	S	8	6	7	sp	r	cr

The factory settings are restored in the memory within the nEXT pump. A Power cycle may be required if either valve type setting was previously configured to a non-default setting.

6.1.12 Assigning a multi-drop address

Each individual pump must be programmed with its own multi-drop address via a point-to- point connection before introduction into a multi-drop network.

When the nEXT pump is shipped, multi-drop mode is disabled by default.

Send the following command to assign a multi-drop address (where the 'd' characters represent the address):

Command	!	S	8	5	0	sp	d	d	cr

Note:

The address can be any decimal number from 1 to 98. The address number 0 is used to disable multi-drop mode. The address number 99 is reserved as a wild card and is used in the query set up detailed later.

The reply will be as follows:

Reply	*	S	8	5	0	sp	r	cr

The multi-drop address is stored within the nEXT pump.

A query can be sent to the pump to find out if it has a multi-drop address. Send the following command:

Command	?	S	8	5	0	cr

If the reply is as follows, the pump has multi-drop mode disabled:

Reply	=	S	8	5	0	sp	0	cr

If the pump already has a multi-drop address, there will be no reply. Communicate with the pump in multi-drop message protocol. Refer to *Multi-drop operation* on page 52 for more information about multi-drop mode and multi-drop message protocol.

Use the following query (using wild card address 99 which means 'any' node) to find out the multi-drop address of the nEXT pump:

Command	*#*	*9*	*9*	*:*	*9*	*9*	*?*	*S*	*8*	*5*	*0*	*cr*

The reply will be as follows, where dd denotes the multi-drop address of the pump:

Reply	*#*	*9*	*9*	*:*	*9*	*9*	*=*	*S*	*8*	*5*	*0*	*sp*	*d*	*d*	*cr*

Multi-drop mode can be disabled by assigning the pump an address 0. To do this, send the following command (where dd denotes the multi-drop address of the pump and XX denotes the address of the node that is sending the command):

Command	*#*	*d*	*d*	*:*	*x*	*x*	*1*	*S*	*8*	*5*	*0*	*sp*	*0*	*cr*

The reply will be as follows:

Reply	*#*	*x*	*x*	*:*	*d*	*d*	***	*S*	*8*	*5*	*0*	*sp*	*0*	*cr*

Once multi-drop mode is disabled, the pump will no longer respond to multi-drop commands.

6.1.13 Configure the pump using a TIC

The nEXT pump can be configured using the Edwards TIC Turbo and Instrument Controller or TIC Turbo Controller.

Refer to *TIC or TAG logic interface connections* on page 70.

It is possible to set the following parameters of the nEXT pump using the TIC:

- Power limit setting
- Vent options and vent type, including running a fan from the motor controller
- Standby speed setting
- Normal speed setting
- Timer settings - both enabling/disabling the timer AND setting the time-out period
- Electronic braking options
- Factory default settings

For information on how to perform these settings, refer to the TIC Turbo and Instrument Controller or TIC Turbo Controller Instruction Manuals.

Note:

It is not possible to configure the Analogue Output Options using the TIC. There is also no facility within the TIC to assign a multi-drop address to the nEXT pump.

7. Operation

7.1 Before starting the pump

Before starting the pump the vent valve must be closed and pre-start sequence completed.

7.1.1 Close the vent valve

The vent valve can be closed manually, by using the customer control system or by TAV solenoid valve.

1. If using a manual vent valve, turn it clockwise to close it.
2. If using the customer control system to drive a vent valve, make sure that the vent valve is closed.
3. If driving a TAV solenoid valve from the motor controller, the TAV valve will automatically shut when the pump is started.
4. If using the TIC to operate the vent valve, refer to *Operation with a TIC or TAG* on page 98.

Note:

The backing pump and nEXT pump can be started at the same time. The nEXT pump will not be damaged and can operate as an effective baffle, however if the vacuum system is large (100 litres or larger) it will be more efficient to allow the backing pump to reduce system pressure to 10 mbar before starting the nEXT pump. In this case it will be necessary to close the vent valve in advance of starting the backing pump.

When using the motor controller to control a TAV solenoid valve and operating with parallel control and monitoring, the valve cannot be shut in advance of starting the nEXT pump because the facility to send the appropriate serial command is not available. If the facility to send serial commands is available a delayed start can be performed. Refer to *Delayed start with serial control* on page 94.

7.1.2 Pre-start sequence

Complete the pre-start sequence to check that the pump is ready for operation.

Note:

If the motor controller has been configured to drive a fan, the fan will automatically start when power is supplied to the nEXT pump.

1. Turn on the appropriate cooling device (fan or cooling water supply).
2. Start the backing pump.
3. Switch on the power supply to the pump. Check that the three normal, status and alarm LEDs on the motor controller light up for approximately 0.5 seconds and then extinguish.
4. Check that the bearing LED is off.

If the LEDs do not light up as expected, or if the red or yellow LEDs begins to flash a repeated sequence or if the red LED is lit, refer to *Fault finding* on page 110. If the bearing LED is lit or flashing refer to *Bearing monitoring and conditioning system* on page 120.

7.2 Vent options, vent valve connection and control

Note:

If manually venting the pump when it is at full rotational speed and the subsequent rate of pressure rise is too high, the pump life may be reduced. When using the manual vent valve supplied, it is recommended to either limit the vent or only open the vent valve after the pump speed has fallen to 50% of full rotational speed. Do not vent from the backing line as this may lead to contamination. If venting into the vacuum system and using an oil sealed rotary backing pump, select a point upstream of the pump, to prevent oil back-streaming from the backing line. Table: Vent restrictor orifice diameter if venting the vacuum system chamber 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 Vent gas specification and vent control data on page 34.

To maintain the cleanliness of the vacuum system, venting the pump (or vacuum system) is recommended whenever switching the pump off.

7.2.1 Manual vent valve

Edwards recommends that the manual vent valve is opened only after the pump speed has fallen to 50% of full rotational speed.

A manual vent valve is supplied with the nEXT pump. It is not possible to accurately control the rate of pressure rise using the manual vent valve so take care not to open it too quickly.

7.2.2 TAV5 or TAV6 solenoid vent valve

The TAV solenoid valves can be purchased as accessories and come either pre-wired with an auxiliary connector fitted or as a bare-wire option.

Both 'Normally Closed' and 'Normally Open' valves are available, refer to *Accessories* on page 123.

Venting may be accomplished by one of the following means, and by using the procedure below:

- Use the TAV solenoid vent valve in the manual vent valve position.
- Use the TAV solenoid vent valve connected to a convenient flange on the vacuum system.
- Use an alternative vent valve, with an appropriate restriction, connected to the vacuum system.

When using the TAV vent valve, the pump may only be hard vented when it is at full speed if the vacuum system has a volume of 5 litres or more.

If the volume of the vacuum system is less than 5 litres, incorporate a suitable vent restrictor and vent the pump when it is at full speed, or use the controlled venting option. *Table: Vent restrictor orifice diameter if venting the vacuum system chamber*

gives an indication of the appropriate orifice size to be fitted to the vent valve for given vacuum system volumes in order that the rate of pressure rise remains within the limits shown in *Vent gas specification and vent control data* on page 34.

Note:

If a vent restrictor is used, the time required to vent the vacuum system may be unacceptably long. The time may be reduced by using a vent valve without a vent restrictor and waiting until the pump speed has fallen to 50% of full rotational speed before opening the vent valve.

7.2.3 Vent valve control

The TAV solenoid valve can be controlled by the nEXT motor controller or by an Edwards TIC Turbo Instrument Controller.

The nEXT controller can control the rate of venting, using the vent valve options in *Table: Vent valve options*. Using this feature the pump can be vented from full rotational speed in a controlled manner that will not damage the pump bearings. Once the pump rotational speed has dropped to below 50% of maximum speed it is safe to hard vent (open the vent valve fully) provided the backing pump is left on and the backing valve is open.

To use the nEXT controller function, the nEXT turbo pump controller has a 4-pin auxiliary connector socket on the side of the pump, as circled in , which the vent valve with the auxiliary connector fitted is plugged into.

The controller is capable of controlling a number of different venting options. These are defined in *Table: Vent valve options*.

The controller is capable of accommodating both normally open and normally closed vent valve types. These are defined in *Table: Valve types*. A power cycle is required after making a change to the valve type, before the auxiliary output circuitry adjusts to accommodate the requested change.

Table 19 Vent valve options

Option number	Description of vent function
0	Vent valve opens fully below 50% full rotational speed for either a stop command or fail condition.*
1	Controlled venting from 100% to 50% full rotational speed and then vent valve opens fully below 50% for either a stop command or fail condition.
2	If a stop command is received, vent valve fully opens immediately. In a fail condition, vent valve opens fully below 50% full rotational speed.
3	If a stop command is received, vent valve fully opens immediately. In a fail condition, controlled venting from 100% to 50% full rotational speed and then vent valve opens fully below 50%.
4	In a fail condition, vent valve fully opens immediately. If a stop command is received, vent valve opens fully below 50% full rotational speed.

Option number	Description of vent function
5	In a fail condition, vent valve fully opens immediately. If a stop command is received, controlled venting from 100% to 50% full rotational speed and then vent valve opens fully below 50%.
6	Vent valve fully opens immediately for either a stop command or a fail condition.
7	Same as option 6
8	Auxiliary output is permanently energised (Fan).§
9	Do not use
10	Auxiliary output is permanently de-energised (Fan).
11	Do not use
12	Do not use
13	Do not use
14	Vent valve opens fully below 50% full rotational speed for a stop command.
15	Controlled venting from 100% to 50% full rotational speed and then vent valve opens fully below 50% for a stop command.

* *This is the factory default setting for Vent Option 1.*

§ *This is the factory default setting for Vent Option 2 to enable cooling fan behaviour.*

Table 20 Valve types

Option number	Description of valve type
0	Normally open vent valve*
1	Normally closed vent valve

* *This is the factory default setting for Valve 1 type and Valve 2 type.*

When the pump is shipped, the controller is configured with the factory default Vent option 1 set to 0 and the Valve 1 type set to 0, as detailed in *Table: Vent valve options* and *Table: Valve types*. The controller can be configured to one of the other venting options provided commands can be sent via the serial interface, an Edwards TIC Turbo and Instrument Controller, TIC Turbo Controller, or the Edwards nST2 PC software can be used via the USB serial port.

If the valve type is set to normally open, the controller only energises or shuts the TAV solenoid valve when it receives a start command. Prior to that, the valve will be in the 'open' vent state. If the vacuum system is a large system, allow the backing pump to reduce the pressure in the system to an acceptable level before starting the nEXT pump. In this case, send a command via the serial interface to close the vent valve before sending a start command – this is known as a delayed start.

If the valve type is set to normally closed and either vent options 14 or 15 are used, the controller will ensure that the TAV solenoid valve will only 'open' upon receipt of a stop command. Therefore there is no need to send the delayed start command.

If the nEXT pump is being controlled with an Edwards TIC Turbo and Instrument Controller or TIC Turbo Controller, the TAV solenoid valve can be driven from the TIC. Refer to the TIC Instruction Manuals for more information.

7.2.4 Alternative valve connected to the vacuum system

When using another vent valve, ensure that a suitable vent restrictor is fitted to the vacuum system to limit the rate of pressure rise.

Refer to *Table: Vent restrictor orifice diameter if venting the vacuum system chamber* for information about vent restrictor sizes. If a suitable vent restrictor is not fitted, open the vent valve only after the speed of the pump has fallen to 50% of full rotational speed.

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

7.3 Operation with parallel control and monitoring

7.3.1 Start the pump with parallel control

CAUTION:

Do not operate the pump with its rotor exposed. Before operating the pump it must first be connected to the vacuum system. If the pump is operated with its rotor exposed, the pump rotor can cause injury as it rotates at very high speeds and the rotating blades might not be visible.

WARNING:

Do not move the pump whilst it is running. The gyroscopic forces generated by this movement can cause excessive use of the back-up bearing and may result in catastrophic failure of the pump.

CAUTION:

When power is restored following a power cut, the pump will restart automatically. The pump must remain connected to the vacuum system to prevent risk of injury.

In parallel control the pump will accelerate to full operating speed when started.

Start the nEXT pump by linking the start/stop control input to the 0 V control reference on the logic interface connector.

The green indicator on the motor controller will illuminate when the pump reaches normal speed. This is 80% of full rotational speed by default but a different value may have been selected to suit the application.

7.3.2 Run the pump at standby speed with parallel control

If the pump is running below or above standby speed it will accelerate or decelerate until standby speed is reached.

1. To run the nEXT pump at standby speed, link the standby control input to the 0 V control reference on the logic interface connector.
2. To return the pump to full speed, disconnect the standby control input from the 0 V control reference on the logic interface connector.

7.3.3 Stop the pump with parallel monitoring

WARNING:

After power to the pump has been switched off, either through emergency or as a requirement, the rotor will continue to spin at very high speeds. The rotor possesses considerable mechanical energy until it slows down/stops.

CAUTION:

Do not remove the controller from the pump until the pump is completely at rest. The exposed electrical pins may pose a potential hazard. The user could also be exposed to a back e.m.f. from the pump and potentially damage the controller.

With parallel control the pump rotor will decelerate to rest when stopped.

Stop the nEXT pump by disconnecting the start/stop control input from the 0 V control reference on the logic interface connector.

7.3.4 Parallel monitoring

Analogue output, normal signal and fail signal parameters can be monitored.

Refer to *Connect the parallel control and monitoring* on page 72 for instructions on how to monitor these signals.

7.4 Operation with serial control and monitoring

7.4.1 Delayed start with serial control

When using a TAV solenoid valve controlled by the motor controller, it can be closed before starting the nEXT pump. This allows the backing pump to reduce the pressure in the vacuum system.

To close the vent valve, send the following command:

Command	*!*	*c*	*8*	*7*	*5*	*sp*	*1*	*cr*

The reply will be in the following format:

Reply	*	*c*	*8*	*7*	*5*	*sp*	*r*	*cr*

Note:

This command overrides the current vent option and closes the vent valve. There is no open vent valve command but, when a stop command is sent to the pump, the override is cleared.

7.4.2 Start the pump with serial control

CAUTION:

Do not operate the pump with its rotor exposed. Before operating the pump it must first be connected to the vacuum system. If the pump is operated with its rotor exposed, the pump rotor can cause injury as it rotates at very high speeds and the rotating blades might not be visible.

WARNING:

Do not move the pump whilst it is running. The gyroscopic forces generated by this movement can cause excessive use of the back-up bearing and may result in catastrophic failure of the pump.

CAUTION:

When power is restored following a power cut, the pump will restart automatically. The pump must remain connected to the vacuum system to prevent risk of injury.

In serial control the pump will accelerate to full operating speed when started.

To start the pump, send the following command over the serial communications link

Command	*!*	*c*	*8*	*5*	*2*	*sp*	*1*	*cr*

The reply will be in the following format:

Reply	*	*c*	*8*	*5*	*2*	*sp*	*1*	*cr*

The green indicator LED will illuminate when the pump reaches normal speed. This is 80% of full rotational speed by default but a different value may have been selected to suit the application.

7.4.3 Run the pump at standby speed with serial control

If the pump is running below or above standby speed it will accelerate or decelerate until standby speed is reached.

To run the nEXT pump at standby speed, send the following command over the serial communications link:

Command	*!*	*c*	*8*	*6*	*9*	*sp*	*1*	*cr*

The reply will be in the following format:

Reply	*	*c*	*8*	*6*	*9*	*sp*	*r*	*cr*

To return the pump to full speed, send the following command:

Command	*!*	*c*	*8*	*6*	*9*	*sp*	*0*	*cr*

The reply will be in the following format:

Reply	*	*c*	*8*	*6*	2	*sp*	*r*	*cr*

7.4.4 Stop the pump with serial control

On successful receipt of the stop command, the pump rotor will decelerate to rest.

To stop the nEXT pump, send the following command over the serial communications link:

Command	*!*	*c*	*8*	*5*	*2*	*sp*	*0*	*cr*

The reply will be in the following format:

Reply	*	*c*	*8*	*5*	*2*	*sp*	*r*	*cr*

7.4.5 Monitor temperature readings with serial control

The temperatures of the pump motor, rotor and the internal electronics of the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	6	5	sp	*cr*

The reply will be as follows, where the first number is the motor temperature and the second number is the motor controller temperature and the third number is the rotor temperature, all measured in °C:

Reply	=	*v*	*8*	6	5	*sp*	*d*	*d*	*d*	*;*	*d*	*d*	*d*	*;*	*d*	*d*	*d*	*cr*

7.4.6 Monitor link parameter readings with serial control

The internal voltage, current and motor power of the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	*6*	*0*	*cr*

The reply will be in the following format (where the first number refers to link voltage (measured in 0.1 Volts – i.e. divide the number by 10 to get an answer in Volts), the second number refers to link current (measured in 0.1 Amps) and the third number refers to link power (measured in 0.1 Watts):

Reply	=	*v*	*8*	*6*	*0*	*sp*	*d*	*d*	*d*	*;*	*d*	*d*	*d*	*;*	*d*	*d*	*d*	*d*	*d*	*cr*

7.4.7 Monitor measured motor speed with serial control

The measured rotational speed of the motor inside the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	*5*	*2*	*cr*

The reply will be in the following format, where the first returned number refers to motor rotational speed in revolutions per second (Hz):

Reply	=	*v*	*8*	*5*	*2*	*sp*	*d*	*d*	*d*	*d*	*;*	*h*	*h*	*h*	*h*	*h*	*h*	*h*	*h*	*cr*

Note:

The second return number is a 32-bit system status word (set of 8 hexadecimal characters) which is useful for fault finding. Refer to Fault finding on page 110.

7.5 Mixed parallel and serial operation

In mixed parallel and serial operation the pump may receive commands from both serial and parallel interfaces.

To understand how these commands control the pump, refer to *Figure: Logic interface connection - mixed parallel and serial operation*. The pump will power up with 'None in Control'. From this state a parallel start signal or a serial start command may be received, resulting in the pump moving to parallel control mode or serial control mode respectively. Serial start commands will only be received if the serial enable line is active.

The state of the serial enable line may be switched between active and inactive whilst in mixed parallel and serial operation. The primary function of the serial enable line is to enable the serial link. It has no direct effect on the control mode. The pump will receive and respond to serial commands whenever the serial enable line is active, and conversely will not receive or respond to serial commands when the serial enable line is inactive.

Availability of the parallel standby and fail signals depends on the state of the serial enable line and the position of the RS485/CAN/RS232 switch as described in *Table: Serial enable matrix*.

Table 21 Serial enable matrix

Switch	Serial enable active	Serial enable inactive
RS232	Standby and fail lines are used for RS232 data.	Standby and fail lines are used for parallel Standby control and fail indication.
	Parallel standby control and fail indication are disabled.	Serial communications are disabled.
RS485	Standby and fail lines are used for RS485 data.	Standby and fail lines are in (RS485) high impedance state.*
	Parallel standby control and fail indication are disabled.	Serial communications are disabled.

** Pump target speed will switch between run speed and standby speed in response to any data driven onto the RS485 bus by other devices connected to the bus. Activation of the parallel start line not recommended with the RS485/CAN/RS232 switch in RS485 position and serial enable Inactive. Deactivation of the serial enable line is not recommended with the pump running following a start from the parallel start line when the RS485/CAN/RS232 switch is in the RS485 position.*

In parallel control mode, the pump will not accept serial stop commands but will accept all other serial commands. When serial enable is active, the pump will run at standby speed if it has been commanded to do so by a serial standby command. When Serial enable is inactive and the RS485/CAN/RS232 switch is in RS232 position, the pump will run at standby speed when the parallel standby line is active.

In serial control mode, the state of the parallel Start line will be ignored but the serial enable line provides an interlock function as shown in *Figure: Serial and parallel control flowchart*. This interlock function only operates with serial start commands and

therefore only in serial control mode. In serial control mode, the pump cannot be commanded to standby speed by the standby line, instead a serial standby command must be used.

The parallel normal and analogue output signals provide valid pump status information at all times under mixed parallel and serial operation. The analogue output voltages are described in *Table: Logic interface technical data*.

Figure 41 Serial and parallel control flowchart

7.6 Operation with a TIC or TAG

The nEXT pump can be connected directly to the TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller.

Instructions on the setup and operation with the TIC Turbo Instrument Controller, TIC Turbo Controller or TAG Controller can be found on CD ROM part number P45000000, which is supplied with the TIC or TAG.

7.7 Decelerating and venting

Allow the pump to decelerate before venting.

The system may be vented in accordance with the advice given in *Vent options, vent valve connection and control* on page 90.

CAUTION:

Do not open a manual vent valve until the pump rotational speed has fallen below 50%, otherwise the rate of pressure rise may be too high, which could damage the pump. In an emergency only, open the vent valve quickly to decelerate the pump rotor in the shortest possible time.

If using the motor controller to control a TAV solenoid valve, there is a 2-second delay between either a stop command being received or a fault condition being detected and the vent valve opening. This delay allows time for gauges, valves and other equipment to be switched off before venting occurs.

The green indicator LED on the motor controller will extinguish as rotational speed drops below normal speed. At very low speeds, the yellow indicator LED will flash and will extinguish when the pump has stopped.

The deceleration time can be improved by using the electronic braking feature, refer to *Electronic braking options* on page 86.

7.8 Operation at extreme conditions

7.8.1 Operation with high inlet pressure

If the nEXT pump inlet pressure rises, the power supplied to the pump motor will increase to counteract the gas frictional load.

The pump rotational speed will remain constant until the peak power level is reached; beyond this level, the speed of the pump will start to reduce.

If the pump speed falls to below 50% of full rotational speed, the timer will start if it is enabled. If the speed does not recover to above 50% speed before the timeout period expires, the pump will shut down and display a fail signal. If the timer is disabled, the pump will immediately shut down and display a fail signal if the speed drops below 50% of full rotational speed. Refer to *Electrical data* on page 40 for the maximum power delivered to the pump and to , for maximum allowable inlet pressure.

7.8.2 Operation at high temperatures

Temperature sensors within the pump mechanism and electronics are monitored by an internal system.

If the system detects that any internal temperatures are too high, the power supplied to the pump motor is reduced; the pump may not therefore be able to maintain full rotational speed if it is too hot.

If the pump speed falls to below 50% of full rotational speed, the timer will start if it is enabled. If the speed does not recover to above 50% speed before the timeout period expires, the pump will shut down and display a fail signal. If the timer is disabled, the pump will immediately shut down and display a fail signal if the speed drops below 50% of full rotational speed. Refer to *Table: Operating and storage conditions* for pump operating ranges and *Cooling* on page 77 for advice on pump cooling.

7.8.3 Protection against over-speed

Control software within the motor controller regulates the pump rotational speed and prevents the pump operating above its normal full rotational speed.

In the unlikely event of a failure of this control software, the motor controller has a built-in safety circuit that checks whether the pump is running at over-speed. If an over-speed condition is detected, the motor controller automatically shuts down power to the pump motor and slows it down to rest. The motor controller will signal a fail condition if over-speed has been detected.

If the pump appears to be running at over-speed, switch it off and consult Edwards or the supplier.

7.8.4 Electrical supply failure

If the electrical supply to the nEXT pump fails when the pump is rotating, the pump motor is used as a generator.

WARNING:

If the power supply fails when the pump is running, the rotor could continue to spin for approximately 30 minutes. The control circuit may not give any indication that the rotor is still running.

CAUTION:

If the parallel start control signal on the logic interface connector is set to start, the pump may automatically restart when the electrical supply is restored after an electrical supply failure. Ensure that people cannot be injured by the rotating blades of the pump.

The regenerated power is used to maintain the output signals on the logic interface (such as the normal signal and serial communications), to power the indicator LEDs on the motor controller and to maintain power at the motor controller auxiliary outputs (to control the vent valve and/or fan, if fitted). The regenerated power is also available at the power supply interface connector, but only when electronic braking is enabled (refer to *Electronic braking* on page 19). This could be used to power other instruments through short power interruptions. The minimum voltage of this supply will be 48 V d.c. - 15 % (40.8 V) provided that the external load is not excessive and it can be sustained at that minimum voltage when operating from supply voltages above 48 V d.c. -20% and below 48 V d.c. +5%.

As the pump rotational speed decreases, the motor's ability to generate power also decreases until it is no longer able to maintain power to the logic interface or LEDs. This will occur at speeds below 50% full rotational speed. In this case, there will be no indication of pump rotational speed yet the rotor may still be turning.

When the power is reinstated after a power failure, the behaviour of the pump will depend on the control mode at the time of failure (parallel or serial) and the length of time the pump was without power. *Table: Behaviour of a pump when the power is re-instated after an electrical supply failure* shows a number of scenarios.

Table 22 Behaviour of a pump when the power is re-instated after an electrical supply failure

Length of power failure	Control mode	Behaviour of pump
Power is reinstated before pump rotational speed falls below 50%	Either parallel or serial control mode	Regenerative power maintains all output signals during the power failure. The pump will ramp to its designated speed as quickly as possible after the power has been restored.
Power is reinstated after pump rotational speed falls below 50% but before re-generative power ceases	Either parallel or serial control mode, timer disabled	Regenerative power maintains all output signals during the power failure. As the timer is disabled, the motor controller will go into fail condition as soon as speed falls below 50% and will display flashing error code 0. When the power is reinstated, the pump will not ramp up until the error is cleared. To clear the error, send a stop command (either parallel or serial, depending on the control mode), then send a start command to ramp the pump up to the designated speed.
	Either parallel or serial control mode, timer enabled	Regenerative power maintains all output signals during the power failure. If power is reinstated before the timer period expires, the pump will ramp up to its designated speed as quickly as possible. If the timer period expires, the motor controller will go into fail condition and will display flashing error code 3. As above, when the power is reinstated, the pump will not ramp up until the error is cleared. To clear the error, send a stop command (either parallel or serial, depending on the control mode), then send a start command to ramp the pump up to the designated speed.
Power is reinstated after pump rotational speed falls below 50% and the regen-erative power ceases	Either parallel or serial control mode	Regenerative power ceases and fails to maintain output signals. When power is reinstated, the pump with parallel control will automatically restart if the start control on the logic interface is set to start. The pump with serial control will require a new start command to ramp the pump up to the designated speed. Any fail signals that were triggered during the regenerative power period are lost when the power is reinstated.

7.9 Bakeout

If the pump (and the vacuum system) are heated, the degassing process will speed up and the pump will reach ultimate vacuum in the shortest possible time. The pump may only be heated on the flange with the flange heaters provided for this purpose from the accessories. Heating the pump will also prevent condensation of vapours inside the pump.

CAUTION:

Do not touch the flange heater or surrounding surfaces during the bakeout process as they will be hot.

NOTICE:

Pumps with ISO flanges are not suitable for bakeout, only pumps with CF flanges must be used. When baking the pump to above 70 °C at the inlet flange, the pump must be water cooled to prevent damage to the bearing lubricant.

The Edwards flange heater may be used to heat the pump (refer to *Accessories* on page 123). Fit the appropriate band around the pump CF inlet flange. When baking the pump or the system, make sure that the temperature of the inlet flange does not exceed the values specified in .

When baking the vacuum system, if the temperature of the system exceeds 200 °C, put a radiation shield between the system and the 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 desired.

7.10 Shut down the pump manually

Note:

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

Use this procedure to shut down a basic, manually-controlled pumping system with a manual vent valve.

1. Turn off the pump, but keep the backing-pump on and backing valve open.
2. When speed has fallen to 50%, open the vent valve.
3. When the pump reaches standstill, the vent valve and backing valve may be closed and backing pump switched off.

8. Maintenance

WARNING:

When removing the pump, ensure personal protective equipment is used to safeguard against damage from failed components and possible accumulation of hazardous material that may have been pumped. Check that the pump is vented to atmosphere and at a safe temperature. Be wary of possible spillages, sharp edges and debris. Removal of the pump inlet screen will always expose the risk of injury from sharp edges.

WARNING:

Allow the pump rotor to stop and then disconnect the motor controller before you remove the pump from your vacuum system for maintenance or fault finding procedures.

Table 23 Maintenance

Bearing maintenance on page 103	The bearing must be replaced when it reaches the end of its service life. This is typically after 35,000 hours.
Rotor life on page 104	The fatigue life of nEXT Turbomolecular pump rotors is typically 40,000 to 50,000 cycles. As a precautionary measure, Edwards recommends that pumps are returned for a major service (rotor replacement) after 20,000 cycles of acceleration to full speed and back to a stop, or after ten years of use, whichever occurs first.
Cleaning the pump on page 104	If the inside of the pump is contaminated, it may not be possible to achieve the specified ultimate vacuum performance, or pump-down times may increase.
Decoding service status words on page 104	The service status may be accessed directly via the serial link. This method of accessing service status will give the most complete picture of current and future service requirements and will allow preventative maintenance activities to be scheduled.
Controller run time on page 106	The run hours and recommended service time of the controller on the nEXT pump can be monitored.
Pump run time on page 106	The run hours and recommended service time of the rotor in the nEXT pump can be monitored.
Pump cycles on page 106	The number of start-stop cycles completed and the number remaining until the next service is due can be monitored.
Bearing run time on page 107	The run hours and recommended service time of the bearing in the nEXT pump can be monitored.

8.1 Bearing maintenance

The bearing must be replaced when it reaches the end of its service life. This is typically after 35,000 hours.

When the bearing needs replacing, Edwards recommends:

- Send the pump to an Edwards Service Centre for a bearing replacement.
- Purchase a bearing service kit and replace the bearing on-site (refer to *Bearing on-site maintenance* on page 120).

8.2 Rotor life

The fatigue life of nEXT Turbomolecular pump rotors is typically 40,000 to 50,000 cycles. As a precautionary measure, Edwards recommends that pumps are returned for a major service (rotor replacement) after 20,000 cycles of acceleration to full speed and back to a stop, or after ten years of use, whichever occurs first.

8.3 Cleaning the pump

WARNING:

Clean the external surfaces of the pump in a well ventilated location. When using 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.

NOTICE:

Do not attempt to clean any parts of the pump other than 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 pump is contaminated, it may not be possible to achieve the specified ultimate vacuum performance, or pump-down times may increase.

In these circumstances the pump must be returned to an Edwards Service Centre where the pump will be dismantled and cleaned. Refer to *Return the equipment or components for service* on page 119.

Any organic solvent can be used to clean the external surfaces of the pump. Edwards recommend the use of non-CFC solvents such as isopropanol or ethanol. Only a minimal amount of a cleaning solution is required which is suitable for the contaminants on the pump surfaces.

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

8.4 Decoding service status words

The service status may be accessed directly via the serial link. This method of accessing service status will give the most complete picture of current and future service requirements and will allow preventative maintenance activities to be scheduled.

A summary of the current pending service status is provided in response to the service status command:

Command	*?*	*v*	*8*	8	1	*cr*

The reply will be as follows:

Reply	=	*v*	*8*	8	1	*sp*	h	h	h	h	h	h	h	h	*cr*

The service status word is made up of 8 hexidecimal digits. To decode this word, convert each digit into a 4-digit binary number in the same manner as the system status word, which is described in *Decoding system status words* on page 116.

Each binary digit (bit) represents a flag that is either active (state 1) or not active (state 0). To help decode the service status word, each bit is numbered (starting with 0 for the least significant to 31 for the most significant) as shown in *Decoding system status words* on page 116. The meaning of each bit in the service status word is given in *Flashing service codes* on page 114.

Table 24 Service flags

Bit number	Status flag	Active flag means
0	Reserved	-
1	Bearing service due	Set when hours until bearing service due = 0 or bearing replace required due to inactivity per bit 9 below
2	Pump service due	Set when hours until pump service due = 0 or cycles until pump service due = 0
3	Controller service due	Set when hours until controller service due = 0
4	Reserved	-
5	Reserved	-
6	Reserved	-
7	Service due	Service is due, or underway per bit 12 below. Specific operation required should be determined by checking the bits above, and 10 and 11 below
8	Bearing conditioning required flag	Set on exceeding Bearing Run In Mode (BRIM) inactive period, typically 1 year. Cleared on full BRIM completion, provided no step forward, or these three conditions: 1) TMP start while bit 8 or 9 set, but without full BRIM enabled. 2) BRIM disable while bit 8 or 9 set, whether or not BRIM underway. 3) TMP stop while BRIM underway.
9	Bearing replace required flag	Set on exceeding Bearing Replace (BR) inactive period, typically 3 years. Cleared on BR confirm.
10	Bearing conditioning required	Per bit 8, but suppressed if bit 11 or 12 set
11	BR required	Per bit 9, but suppressed if bit 12 set
12	Bearing conditioning running	Set if Bearing conditioning is presently running, from start to Post Ramp (PR) commence

Bit number	Status flag	Active flag means
13	Bearing conditioning automatic enable	Set if Bearing conditioning is automatically enabled on bit 8 or 9 set. Typically enabled by default
14	Bearing conditioning enabled	Set if Bearing conditioning is presently enabled, refer to *Bearing run in mode* on page 121.
15-31	Reserved	-

8.5 Controller run time

The run hours and recommended service time of the controller on the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	8	*2*	*cr*

The reply will be as follows, where the first number is the hours run by the controller and the second is the number of hours until service is recommended:

Reply	*=*	*v*	*8*	8	*2*	*sp*	*d*	*d*	*d*	*d*	d	d	;	d	d	d	d	d	d	*cr*

Note that the number of hours until the next service is due is estimated by the controller based on the operating conditions of the pump and therefore may reduce at more or less than 1 hour per hour. The dominant factor in extending controller life is reduced pump temperature.

8.6 Pump run time

The run hours and recommended service time of the rotor in the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	8	4	*cr*

The reply will be as follows, where the first number is the start-stop cycles completed by the pump and the second is the number of start-stop cycles until service is recommended:

Reply	*=*	*v*	*8*	8	4	*sp*	*d*	*d*	*d*	*d*	d	d	;	d	d	d	d	d	d	*cr*

8.7 Pump cycles

The number of start-stop cycles completed and the number remaining until the next service is due can be monitored.

Send the following query:

Command	*?*	*v*	*8*	8	4	*cr*

The reply will be as follows, where the first number is the start-stop cycles completed by the pump and the second is the number of start-stop cycles until service is recommended:

Reply	=	*v*	*8*	8	4	*sp*	*d*	*d*	*d*	*d*	d	d	;	d	d	d	d	d	d	*cr*

8.8 Bearing run time

The run hours and recommended service time of the bearing in the nEXT pump can be monitored.

Send the following query:

Command	*?*	*v*	*8*	8	5	*cr*

The reply will be as follows, where the first number is the hours run by the bearing and the second is the number of hours until service is recommended:

Reply	=	*v*	*8*	8	5	*sp*	*d*	*d*	*d*	*d*	d	d	;	d	d	d	d	d	d	*cr*

9. Storage

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 12 months.

Use the following procedure to store the pump.

1. Place protective covers over all ports, the main inlet, inter-stage exhaust, 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, preferably not exposed to atmospheric air until required for use. When required, prepare and install the pump as described in *Installation* on page 56.

10. Disposal

WARNING:

In the unlikely event of a failure of the pump rotor, there may be some dust created from the rotary components inside the pump touching each other. In this event use appropriate personal protective equipment when handling and disposing of the pump and ensure that all pump inlets and outlets are capped off before disposal.

Take appropriate action to avoid inhalation of any particulates which may be present in the pump. Do not incinerate the pump.

A HS2 form must be completed if returning the pump to us.

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

Particular care must be taken with any components that have been contaminated with dangerous process substances.

Take appropriate action to avoid inhalation of any particles that may be present in the pump.

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

11. Fault finding

Table 25 Fault finding

Symptom
The controller LEDs do not flash for 0.5 seconds when system switched on on page 110
The pump does not rotate after a parallel start command is supplied on page 110
The pump does not rotate after a serial start command is sent on page 110
The pump does not respond in multi- drop mode on page 111
The green Normal LED does not light or the pump is not rotating at full speed or the pump fails whilst running on page 111
Ultimate pressure cannot be reached on page 111
The pump is very noisy or there is excessive vibration or both on page 112
No serial comms on page 112
Fail signal or standby signal not working on page 112
Yellow service LED is flashing a repeated sequence on page 113
The red alarm LED is on on page 113
The red alarm LED is flashing on page 113
Blue bearing LED is flashing a repeated sequence on page 113
Blue bearing LED is lit on page 113
Pump is not accelerating to full speed on page 113
Any other problems on page 113

Fault	**The controller LEDs do not flash for 0.5 seconds when system switched on**
Cause	**The electrical supply has failed.**
Remedy	Ensure that the electrical supply is switched on and the fuses (and current limiting devices) have not been tripped.
Cause	**The pump rotor is spinning.**
Remedy	The LEDs may not flash if the pump is rotating.

Fault	**The pump does not rotate after a parallel start command is supplied**
Cause	**Check that the electricity supply is on and whether the fail output is active.**
Remedy	If there is a fail signal, check whether the red alarm LED is flashing. If it is, refer to *Flashing error codes* on page 114. If power is supplied, there is no fail signal and the rotor still does not rotate then there is a fault with the pump.

Fault	**The pump does not rotate after a serial start command is sent**
Cause	**Check whether the pump returns a reply to the start command.**
Remedy	If there is no reply then perform the checks given under *No serial comms* on page 112 otherwise perform the checks under *The pump does not rotate after a serial start command is sent* on page 110.

Fault	The pump does not respond in multi- drop mode
Cause	**The multi-drop is disabled.**
Remedy	Make sure the pump has a multi-drop address and that commands are sent using the multi-drop protocol.

Fault	The green Normal LED does not light or the pump is not rotating at full speed or the pump fails whilst running
Cause	**The inlet pressure is too high.**
Remedy	Reduce the pumping load or check for a gross leak into the system.
Cause	**The pump is running too hot.**
Remedy	▪ Increase the cooling to the pump. Change from air cooling to water cooling (refer to *Table: Technical data nEXT730, nEXT930* and *Table: Technical data nEXT1230* for maximum inlet pressure and cooling requirements). ▪ Increase cooling water flow or decrease the water temperature or do both. ▪ Check that external heat sources (such as system bakeout heaters) are not excessive.
Cause	**The rotor does not rotate freely.**
Remedy	The pump bearings may be damaged. Contact the supplier or us.

Fault	Ultimate pressure cannot be reached
Cause	**Pressure is limited by water vapour.**
Remedy	Bake the system and pump.
Cause	**The vacuum gauges are contaminated.**
Remedy	Clean or replace the vacuum gauges.
Cause	**Pumping speed is insufficient due to poor conductance between the pump and the gauge or the chamber is too large.**
Remedy	Increase the conductance or reduce the volume.
Cause	**Inlet pressure is > 0.5 mbar (50 Pa).**
Remedy	If the interstage inlet pressure is too high, inlet pressure at the turbomolecular inlet is increased; ensure that the interstage inlet pressure is < 0.5 mbar (50 Pa).
Cause	**The backing pressure is > 10 mbar ($1x10^3$ Pa).**
Remedy	The backing pressure may be too high. Check for backing pipeline leaks. If the throughput is high, a larger backing pump may be required.
Cause	**The high vacuum area of the system is contaminated.**
Remedy	Clean the high vacuum system.
Cause	**Check the rest of the system for leaks and contamination.**
Remedy	If found, repair the leaks and clean the contamination.

Cause	**The inlet pressure is poor.**
Remedy	▪ Remove the pump from the system and test the ultimate pressure of the pump alone (refer to *Table: Technical data nEXT730, nEXT930* and *Table: Technical data nEXT1230*). ▪ If inlet pressure is poor, check the pump for contamination and refer to *Table: Technical data nEXT730, nEXT930* and *Table: Technical data nEXT1230*. ▪ Leak test the pump. If the leak rate > $1x10^{-7}$ mbar l s^{-1} ($1x10^{-5}$ Pa l s^{-1}), contact the supplier or us.
Fault	**The pump is very noisy or there is excessive vibration or both**
Cause	**The pump rotational speed is the same as the resonant frequency of the attached system.**
Remedy	Change the natural frequency of the system or isolate the pump using flexible bellows.
Cause	**The vibration is being transmitted from the rotary backing pump.**
Remedy	Fit flexible bellows or a vibration isolator in the backing line.
Cause	**The noise is irregular and getting progressively worse.**
Remedy	There is a defective bearing. Contact the supplier or us.
Cause	**The pump is making a constant high pitched noise.**
Remedy	The rotor is out of balance. Contact the supplier or us.
Fault	**No serial comms**
Cause	**No electrical supply, loss of serial link.**
Remedy	Check that the electrical supply is on, that the serial link is connected and that the serial enable line is active.
Cause	**Slide switch is not in the correct position for RS232 or RS485.**
Remedy	▪ Check that the electrical supply is on, that the serial link is connected and that the serial enable line is active. ▪ Left for RS485, right for RS232. ▪ Right for parallel control and monitoring.
Cause	**Incorrect baud rate and node address.**
Remedy	Check baud rate and, if operating in multi-drop mode, the node address matches those of the pump.
Cause	**Check that the red light is not on or flashing.**
Remedy	If LED is on, perform the checks against the red alarm LED symptoms
Fault	**Fail signal or standby signal not working**
Cause	**The serial enable line is inactive.**
Remedy	Must be disconnected or driven high for use of standby and fail lines.

Cause	Slide switch is not in the correct position for RS232 or RS485.
Remedy	Left for RS485, right for RS232. Right for parallel control and monitoring.

Fault	Yellow service LED is flashing a repeated sequence
Cause	A service is required.
Remedy	See *Flashing service codes* on page 114.

Fault	The red alarm LED is on
Cause	Normal during the software upgrade process. At other times indicates a problem has been detected in the FLASH memory.
Remedy	If during software upgrade then complete the upgrade process. Otherwise cycle power and if this does not help then perform a software upgrade.

Fault	The red alarm LED is flashing
Cause	A fail condition has become active.
Remedy	Note the position of the long flashes within the series of 6 flashes to work out the error code. Look up the flashing error code in *Flashing error codes* on page 114 and follow the advice given.

Fault	Blue bearing LED is flashing a repeated sequence
Cause	A bearing service due to inactivity is required.
Remedy	See *Flashing inactivity service codes* on page 115

Fault	Blue bearing LED is lit
Cause	Bearing run in mode (BRIM) is running.
Remedy	Wait until BRIM is finished. This may take 4.3 hours. We recommend not to cancel BRIM.

Fault	Pump is not accelerating to full speed
Cause	Bearing run in mode (BRIM) is running.
Remedy	Wait until BRIM is finished. This may take 4.3 hours. We recommend not to cancel BRIM, refer to *Bearing run in mode* on page 121.

Fault	Any other problems
Cause	Fault conditions other than the ones previously mentioned.
Remedy	Contact the supplier or us.

11.1 Command set error codes

Error codes that may be returned for serial control and monitoring.

Table 26 Command error codes

Returned error code	Meaning
0	No error
1	Invalid command for object ID
2	Invalid Query/Command
3	Missing parameter
4	Parameter out of range
5	Invalid command in current state - e.g. serial command to start/stop when in parallel control mode

11.2 Flashing service codes

Whenever a service is required the standard once per revolution flash on the yellow status LED is replaced with a service flash code.

Table 27 Flashing service codes

Service flash code	Comments	Actions
LED on 3sec LED off 1sec	Bearing service recommended	It is recommended that the bearing is replaced. Refer to *Bearing maintenance* on page 103.
LED on 3sec LED off 3sec	Pump service required	The turbo impeller or controller has reached its expected life. It is recommended that the pump is returned to our service centre for service. Refer to *Bearing maintenance* on page 103.

11.3 Flashing error codes

Whenever a fail condition becomes active, the red alarm lights continuously or shows a flashing sequence.

If the error light is on continuously, this indicates a problem with the embedded software. In this case, try cycling the power. If cycling the power does not clear the indiwill be required. Contact the supplier or Edwards. If the alarm LED is flashing, identify the error flash code and consult the table in *Decoding system status words* on page 116.

There is a sufficient off period between each subsequent cycle repetition to clearly mark the start of a new flash sequence. The duration of a long flash (L) is equal to 3 times the duration of a short flash (0.5 s).

Table 28 Flashing error codes

Error flash position	Error flash code	Comments	Actions
0	ssssss	The speed fell below 50% of full rotational speed with the Timer disabled.	Check whether the pump is too hot or whether the inlet pressure is too high.
1	Lssss	Controller internal software mismatch.	Cycle the power to the pump and see whether the error code appears again. If it does, contact us or the supplier.
2	sLssss	Controller failed internal configuration and calibration operation.	Cycle the power to the pump and see whether the error code appears again. If it does, contact us or the supplier
3	ssLsss	Failure to reach or maintain half full speed within the timer setting value.	Check whether the pump is too hot or whether the inlet pressure is too high.
4	sssLss	Overspeed or overcurrent trip activated, or other hardware fault.	Cycle the power to the pump and see whether the error code appears again. If it does, contact us or the supplier.
5	ssssLs	Pump internal measurement system disconnected or damaged.	Cycle the power to the pump and see whether the error code appears again. If it does,contact us or the supplier.
6	sssssL	Serial enable becomes inactive following a Serial Start command.	Re-activate Serial Enable and send a Serial Stop command to clear the error code.

Note:

The alarm LED error flash sequence is capable of signaling multiple fail conditions. For example, error flash code sLssLs signifies both error 2 (controller failed internal configuration and calibration operation) and error 5 (pump internal measurement system disconnected or damaged).

11.4 Flashing inactivity service codes (blue bearing LED)

Whenever an inactivity service is required the blue bearing LED will show a flashing sequence as detailed in the table below.

Table 29 Flashing inactivity service codes

Inactivity service flash code	Comments	Actions
LED on 0.25s LED off 0.75s	Bearing conditioning recommended	The pump has been stored or has not been run for more than a year. It is recommended that the bearing conditioning is performed.
LED on 0.25s LED off 0.25s	Bearing service recommended	The pump has been stored or has not been run for more than 3 years. It is recommended that the bearing is replaced.

11.5 Decoding system status words

When using the serial communications link, additional information that may be useful for fault finding is available to be accessed. When sending a query to monitor measured motor speed, the pump also returns a System Status Word.

The send command is as follows:

Command	*?*	*v*	*8*	*5*	*2*	*cr*

The reply will be as follows, where the first returned number refers to motor rotational speed in revolutions per second (Hz) and the second part is the system status word::

Reply	*=*	*v*	*8*	*5*	*2*	*sp*	*d*	*d*	*d*	*d*	*;*	*h*	*h*	*h*	*h*	*h*	*h*	*h*	*h*	*cr*

The System Status Word returned is made up of 8 hexadecimal digits. To decode this word, convert each digit into a 4-digit binary number. Follow the example below:

2	2	8	3	0	0	2	2
↓	↓	↓	↓	↓	↓	↓	↓
0 0 1 0	0 0 1 0	1 0 0 0	0 0 1 1	0 0 0 0	0 0 0 0	0 0 1 0	0 0 1 0

is provided as an aid.

Table 30 Hexadecimal conversion table

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11

Hexadecimal	Binary	Decimal
C	1100	12
D	1101	13
E	1110	14
F	1111	15

Each binary digit (bit) represents a flag that is either active (state 1) or not active (state 0). To help decode the System Status Word, each bit is numbered (starting with 0 for the least significant to 31 for the most significant) as shown below.

contains a list of the lower 16 status flags that will be useful for fault finding. The upper 16 status flags are reserved by us.

Binary digits																															
0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Bit numbers																															

Table 31 Status flags

Bit number	Status flag	Active flags means
0	Fail	Fail status condition active
1	Stopped speed	Below stopped speed
2	Normal speed	Above normal speed
3	Vent valve closed	Vent valve energised
4	Start	Start command active
5	Serial enable	Serial enable active
6	Standby	Standby active
7	Half full speed	Above 50% full rotational speed
8	Parallel control mode	Exclusive control mode selection
9	Serial control mode	Exclusive control mode selection
10	Invalid Controller software	Controller internal software mismatch
11	Controller upload incomplete	Controller failed internal configuration and calibration operation
12	Timer expired	Failure to reach or maintain half full speed within the timer setting value
13	Hardware trip	Overspeed or overcurrent trip activated
14	Thermistor error	Pump internal temperature measurement system disconnected or damaged
15	Serial control mode interlock	Serial enable has become inactive following a serial Start command

The system status word used in the example above was obtained with the pump at rest. By decoding the word, we can learn more about the state of the pump.

Table 32 Example decoding of system status words

Bit number	Status of bit (in example)	Indication
0	0	The pump has not failed
1	1	The pump is at rest
2	0	Speed is below normal speed
3	0	The vent valve is open
4	0	There is no active start command
5	1	Serial enable is active
6	0	Standby is not active
7	0	Speed is below 50% of full rotational speed
8	0	The pump is not in parallel control mode
9	0	The pump is not in serial control mode
10	0	There is no controller internal software mismatch
11	0	Controller passed internal configuration and calibration operation
12	0	The timer has not timed out
13	0	Overspeed and overcurrent trip not activated
14	0	Pump internal temperature measurement system is fine
15	0	Serial enable has not become inactive during serial control

11.6 Service information

If using the serial communications link, additional information about the pump, such as pump type and internal controller software versions, can be accessed. This information is particularly useful for service personnel to determine the model of the pump.

Send the following query to find out pump type:

Command	*?*	*s*	*8*	*5*	*1*	*cr*

The reply is as follows, where String 1 is the pump type, String 2 is the DSP software version number and String 3 is the designated full speed of the pump (in revolutions per second):

Reply	*=*	*s*	*8*	*5*	*1*	*sp*	*String 1*	*;*	*String 2*	*;*	*String 3*	*cr*

Send the following query to find out the PIC software version:

Command	*?*	*s*	*8*	*6*	*8*	*cr*

The reply is as follows, where String 1 is the PIC software version number:

Reply	*=*	*s*	*8*	*6*	*8*	*sp*	*String 1*	*cr*

12. Service

Note:

Our policy is to provide support for product after obsolescence through various options including maintenance, repair, enhancement and replacement. Support will be available for several years after product obsolescence and in compliance with any applicable legislation. We will always undertake appropriate actions to ensure support is maintained and, where support is no longer possible, will ensure this is communicated to all affected customers with a suitable notice period.

Our products, spares and accessories are available from our companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, U.S.A and a world-wide network of distributors. The majority of these centres employ Service Engineers who have undergone our comprehensive training courses.

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

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

Our products are supported by a world-wide network of our 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.

The local Service Centres can also provide our engineers to support on-site maintenance, service or repair of equipment. For more information about service options, contact our nearest Service Centre or the company.

12.1 Return the equipment or components for service

Before you send your equipment to us for service or for any other reason, you must complete a Declaration of Contamination Form. The 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.

If you are returning equipment note the following:

- If the equipment is configured to suit the application, make a record of the configuration before returning it. All replacement equipment will be supplied with default factory settings.
- Do not return equipment with accessories fitted. Remove all accessories and retain them for future use.
- The instruction in the returns procedure to drain all fluids does not apply to the lubricant in pump oil reservoirs.

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

NOTICE:

If we do not receive a completed form, your equipment cannot be serviced.

12.2 Bearing monitoring and conditioning system

To ensure maximum reliability and bearing life nEXT pumps have an integrated system to manage the bearing condition. The status is indicated by a blue LED on the pump.

The pumps have an integrated battery-backed real time clock that is constantly monitoring pump storage time.

The TMP motor controller when powered uses its processor and when unpowered the real time battery backed clock to monitor the TMP inactivity time. Inactivity time refers to both when the TMP is unpowered and when the TMP is powered but at rest. When inactivity time exceeds:

- the pre-defined period of 12 months, a bearing conditioning is required and "Bearing Run in Mode" (BRIM) will commence at the next pump start.
- the pre-defined period of 3 years, a bearing replacement is required. The customer will be alerted by the major service due indicator on the STATUS LED (yellow) and on the Bearing LED (blue). Once the bearing is replaced and the major service reset, a bearing conditioning will be required and will commence at the next pump start.

When the BRIM process completes, the TMP runs to full speed and normal TMP process can resume.

You can check the TMP inactive time (storage duration) and reset BRIM status via:

- TIC – browsing to the „Service menu“, „Brg Inactive“ will display the TMP inactive time. See TIC user manual for more details
- nST2 – See nST2 user manual for more details.

The purpose of recording the inactive bearing time is to maximize the life of the installed ball bearing. If the bearings are inactive for a long time, the homogeneity of the grease distribution deteriorates, which leads to short-term local overheating of the grease in the bearing when the pump is directly started up to nominal speed. This can lead to decomposition or evaporation of the grease. This grease is then no longer available for the running time of the bearing and ultimately leads to earlier failure of the ball bearing. The Bearing Run In Mode (BRIM), on the other hand, restores the homogeneity of the grease distribution by gently restarting the pump.

12.3 Bearing on-site maintenance

The bearing of the nEXT pump can be serviced on-site by any service engineer trained by us.

The following service tool kits and service parts are available.

Table 33 Service tool kits

Service tool kit	Item number
Bearing exchange tool kit nEXT730/930	B8J200845
Bearing exchange tool kit nEXT1230	B8M200845

Table 34 Service kits

Service kit	Item number
Bearing kit nEXT730/930	B8J200827
Bearing kit nEXT1230	B8M200827

12.4 Bearing run in mode

Bearing run in mode (BRIM) is a start-up sequence for the pump designed to precondition the bearing to optimise bearing life. The pump goes through a number of speed steps before reaching full speed.

The BRIM process last around 4.3 hours and the LED indicates when this is running.

BRIM mode can be cancelled by sending a stop signal and then start signal to a pump currently running the BRIM process. This is NOT recommended and may invalidate the warranty.

BRIM mode is either triggered:

- automatically by the pump
- manually through nST2
- manually through the TIC, or
- by pressing both speed adjustment push buttons (located behind the service cover) simultaneously for 2s on the pump.

Table 35 Bearing LED

LED is not lit while pump is powered on	No bearing conditioning required
LED is flashing 0.25 s ON and 0.75 s OFF	Pump has been stored for more than 12 months, BRIM is required and will start on the next pump start
LED is permanently ON	BRIM is running
LED is flashing 0.25 s ON and 0.25 s OFF	Pump has been stored for more than 3 years, bearing replacement is required

12.4.1 Service counter reset

After completing a bearing change, reset the service interval in order to schedule the next service and reset the status LED. The service counter reset is described in the manual for the service tool kit.

13. Spares

NOTICE:

Use of spares, not supplied by us, may result in reduced reliability and performance and will invalidate product warranty.

13.1 Inlet screen

Inlet screens are fitted to the pumps as supplied to prevent damage from the entry of debris into the pump.

Table 36 Inlet screens

Flange Size	Item Number
DN 160 CF coarse	B80000823
DN 160 CF fine	B80000824
DN 200 CF coarse	B8J200809
DN 200 CF fine	B8J200810

13.2 Inlet flange seals and integrated inlet screens

The pumps are supplied with an inlet seal.

Table 37 Inlet flange seals and integrated inlet screens

Flange size	Inlet flange seal	Item number
DN 160 ISO-K	ISO 160 trapped O-ring with integrated coarse inlet screen	B80000825
DN 160 ISO-K	ISO 160 trapped O-ring with integrated fine inlet screen	B80000826
DN 200 ISO-K	ISO 200 trapped O-ring with integrated coarse inlet screen	B8J200807
DN 200 ISO-K	ISO 200 trapped O-ring with integrated fine inlet screen	B8J200808

14. Accessories

Air cooler on page 123	The air cooler is available with a pre-wired connector which connects directly to an auxiliary port on the controller.
Water cooler on page 124	A water cooler can be fitted to the pump if the water supply is suitable.
Flange heater on page 124	A nEXT flange heater 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.
TAV vent valve *TAV5 and TAV6 vent valves* on page 124	24 V d.c. TAV solenoid-operated vent valve options available for system venting; these are either normally open (N/O) or normally closed (N/C).
VRX vent restrictor on page 125	Use a VRX fixed orifice vent restrictor to restrict the flow of vent gas into the pump.
Vent port adaptor on page 125	The vent port adaptor has a 1/8 inch BSP male thread that can be screwed into both the vent port and purge port, making them suitable for NW10 fittings.
PRX purge restrictor on page 125	The PRX10 is a modified DN10NW centring ring that filters the purge gas and restricts its flow rate to the recommended flow of 25 sccm. A vent port adaptor must be fitted to the purge port in order to connect a purge restrictor to the pump.
Interface cable on page 126	An interface cable connects the nEXT pump to a PC. Serial commands are then used to control and monitor the nEXT pump.
nST2 PC program on page 126	The nST2 PC program is PC-based software that can be used with the nEXT pump either via the serial interface or via the USB service port.
Auxiliary connector on page 126	Enables the use of accessories that do not come prewired with a mating plug. Cable length is 1.5 m.
Auxiliary extension cable on page 126	The cable extends the distance of the accessory to the pump and benefits from a right angled plug to accommodate installation where space is limited. Cable length is 0.2 m.
Auxiliary 'Y' cable adaptor on page 127	Enables either a TAV vent valve and a cooling fan, two cooling fans, or 2 TAV vent valves to be operated at the same time. The two sockets of the Y-cable are wired in parallel so either connector can be used in exactly the same way as the auxiliary connector on the pump itself.
EPS 800 power supply on page 127	The EPS 800 can be fitted to the pump or utilized as a benchtop unit.

14.1 Air cooler

The air coolers are available with a pre-wired connector which connects directly to an auxiliary port on the controller.

An air cooler can be fitted to the pump - refer to *Forced air cooling* on page 78 to check the suitability of air cooling in a particular application. The air coolers are pre-wired to Vent Option 2 and the default is set to Always On (option 8).

Table 38 Air cooler

Air Cooler	Current draw	Item number
nEXT730/930 Air cooler kit	150 mA	B8J200800
nEXT1230 Air cooler kit	150 mA	B8J200801

14.2 Water cooler

A water cooler can be fitted to the nEXT730/930 pump if the water supply is suitable. The nEXT1230 pump has a built-in water cooler.

Refer to *Forced air cooling* on page 78 to check the suitability of the water cooling supply.

Table 39 Water cooler

Water Cooler	Item Number
nEXT730/930 water cooler	B8J200820

14.3 Flange heater

A nEXT flange heater 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 flange heaters are available in 110 V and 240 V versions.

Note:

The flange heater is only for use with CF variants.

Table 40 Flange heater

Flange heater	Item Number
nEXT730 (110 V) flange heater	B58052775
nEXT730 (240 V) flange heater	B58052776
nEXT930 (110 V) flange heater	on request
nEXT930 (240 V) flange heater	on request
nEXT1230 (110 V) flange heater	on request
nEXT1230 (240 V) flange heater	on request

14.4 TAV5 and TAV6 vent valves

24 V d.c. TAV5 and TAV6 solenoid-operated vent valve options available for system venting; these are either normally open (N/O) or normally closed (N/C).

The valves are available with either a wired connector which connects directly to the auxiliary port on the controller or as a bare wire option.

TAV5 vent valves have an 0.5 mm diameter orifice and are suitable for venting small vacuum systems of < 5 litres. TAV6 vent valves have an 1.0 mm diameter orifice and are suitable for venting bigger vacuum systems.

The vent valves are pre-wired to Vent Option 1 and that the default is set to fully vent at 50% (option 0). 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 the vacuum system. The vent port adaptor allows the vent port or the purge port to be used with any suitable NW10 fitting.

Table 41 TAV vent valve and vent port adaptor

Product	Item Number
nEXT TAV5 kit N/C connector fitted (0.3 m)	B8G200835
nEXT TAV5 kit N/C bare wire (3 m)	B58066040
nEXT TAV5 kit N/O connector fitted (0.3 m)	B8G200834
nEXT TAV5 kit N/O bare wire (3 m)	B58066010
nEXT TAV*6* kit N/O bare wire (3 m)	B58066020

14.5 VRX vent restrictor

Use a VRX fixed orifice vent restrictor to restrict the flow of vent gas into the pump.

Table 42 VRX vent restrictor

Vent restrictor	Orifice diameter (mm)	Item number
VRX10	0.1	B58066021
VRX20	0.2	B58066022
VRX30	0.3	B58066023
VRX50	0.5	B58066024
VRX70	0.7	B58066025

14.6 Vent port adaptor

The vent port adaptor has a 1/8 inch BSP male thread that can be screwed into both the vent port and purge port, making them suitable for NW10 fittings.

Table 43 Vent port adaptor

Vent port adaptor	Item Number
Vent port adaptor NW10 - 1/8 inch BSP male	B58066011

14.7 PRX purge restrictor

The PRX10 is a modified DN10NW centring ring that filters the purge gas and restricts its flow rate to the recommended flow of 25 sccm. A vent port adaptor must be fitted to the purge port in order to connect a purge restrictor to the pump.

Table 44 PRX purge restrictor

Item	Item Number
PRX10 purge restrictor	B58065001

14.8 Interface cable

An interface cable connects the nEXT pump to a PC. Serial commands are then used to control and monitor the nEXT pump.

Table 45 Interface cable

Item	Item Number
nEXT Interface cable	B80000808

14.9 nST2 PC program

The nST2 PC program is PC-based software that can be used with the nEXT pump, either via the serial interface or via the USB service port.

It can be used to control, monitor, configure and data log the nEXT pump, and also to view service status, reset service intervals and upgrade the software embedded in the motor controller.

This software is available for download from the Edwards upgrades website: www.upgrades.edwardsvacuum.com

14.10 Auxiliary connector

Enables the use of accessories that do not come prewired with a mating plug. Cable length is 1.5 m.

Table 46 Auxiliary connector

Item	Item Number
nEXT auxiliary connector	B8G200839

14.11 Auxiliary extension cable

The cable extends the distance of the accessory to the pump and benefits from a right angled plug to accommodate installation where space is limited. Cable length is 0.2 m.

Table 47 Auxiliary extension cable

Item	Item Number
nEXT auxiliary extension cable	B8G200836

14.12 Auxiliary 'Y' cable adaptor

Enables either a TAV vent valve and a cooling fan or two cooling fans or 2 TAV vent valves to be operated at the same time. The two sockets of the Y-cable are wired in parallel so either connector can be used in exactly the same way as the auxiliary connector on the pump itself.

Table 48 Auxiliary extension cable

Item	Item Number
nEXT auxiliary ‘Y’ cable adaptor	B8G200837

14.13 EPS 800 power supply

The EPS 800 is a power supply unit for powering the nEXT turbomolecular pumps.

The EPS 800 can be fitted to the pump or utilized as a benchtop unit.

Table 49 EPS 800 power supply

Item	Item Number
EPS 800	B8J200819
Mains cable, 3 m CA-3-LD EU	B8J200829
Mains cable, 3 m CA-3-LD US	B8J200830
Mains cable, 3 m CA-3-LD UK	B8J200831
Extension cable nEXT, 3 m (between pump and power supply)	B8J200824

Item	Item Number
Extension cable nEXT, 5 m (between pump and power supply)	B8J200825
Bracket for mounting the EPS 800 to the pump (washers and bolts enclosed)	B8J200832

P20010287C

EU Declaration of Conformity

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The product specified and listed below

- *Turbomolecular Pumps with Integrated Frequency Converter*

Type Designation	Part Numbers	Description	
nEXTa1x f1f2 NW f3f4	B8xxxxxxx	a1	= Pumping speed
	x = A to Z or 0 to 9	f1	= Flange type
a1 = 730 or 930 or 1230		f2	= High Vacuum flange
x = blank, D, iD, iiD, H, iH, iiH, Q		f3	= Fore-Vacuum flange
f1 = ISO-K or ISO-F or CF		i	= Interstage port
f2 = 100 to 250		ii	= 2 Interstage ports
f3 = 16, 25 or 40		INV	= Inverse – Upside Down
f4 = blank or INV		D	= Standard
		H	= High Compression
		Q	= High Throughput

Is in conformity with the relevant requirements of European CE legislation:

2006/42/EC	Machinery directive *Note: The safety objectives of the Low Voltage Directive 2014/35/EU were complied with in accordance with Annex 1 No. 1.5.1 of this directive.*
2014/30/EU	Electromagnetic compatibility (EMC) directive Class B Emissions, Industrial Immunity
2011/65/EU	Restriction of certain hazardous substances (RoHS) directive as amended by Delegated Directive (EU) 2015/863

Based on the relevant requirements of harmonised standards:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010+A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Directives and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-07-19*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Ian Keech – VP Engineering, Scientific Vacuum Division
Burgess Hill

Rene Rose Stueber – General Manager
Product Company Cologne

P20010287C

Declaration of Conformity

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This declaration of conformity is issued under the sole responsibility of the manufacturer.

- *Turbomolecular Pumps with Integrated Frequency Converter*

Type Designation	Part Numbers	Description	
nEXTa1x f1f2 NW f3f4	B8xxxxxxx	a1	= Pumping speed
	x = A to Z or 0 to 9	f1	= Flange type
a1 = 730 or 930 or 1230		f2	= High Vacuum flange
x = blank, D, iD, iiD, H, iH, iiH, Q		f3	= Fore-Vacuum flange
f1 = ISO-K or ISO-F or CF		i	= Interstage port
f2 = 100 to 250		ii	= 2 Interstage ports
f3 = 16, 25 or 40		INV	= Inverse – Upside Down
f4 = blank or INV		D	= Standard
		H	= High Compression
		Q	= High Throughput

The object of the declaration described above is in conformity with relevant statutory requirements:

Supply of Machinery (Safety) Regulations 2008
The objectives of the Electrical Equipment (Safety) Regulations 2016 are governed by Annex 1 1.5.1 of this regulation.

Electromagnetic Compatibility Regulations 2016
Class B Emissions, Industrial Immunity

Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

Relevant designated standards or technical specifications are as follows:

EN 1012-2:1996 +A1:2009	Compressors and vacuum pumps. Safety requirements. Vacuum pumps
EN 61010-1:2010+A1:2019	Safety requirements for electrical equipment for measurement, control and laboratory use. General requirements
EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements

This declaration, based on the requirements of the listed Statutory Instruments and EN ISO/IEC 17050-1, covers all product serial numbers from this date on: *2023-07-19*

You must retain the signed legal declaration for future reference
This declaration becomes invalid if modifications are made to the product without prior agreement.

Signed for and on behalf of Edwards Ltd

Ian Keech – VP Engineering, Scientific Vacuum Division
Burgess Hill

Rene Rose Stueber – General Manager
Product Company Cologne

ADDITIONAL LEGISLATION AND COMPLIANCE INFORMATION

RoHS (EU, UK): Material Exemption Information
This product is compliant with the following Exemptions
Annex III:

- 6(a) **Lead** as an alloying element in steel for machining purposes and in galvanised steel containing up to 0.35 % lead by weight
- 6(b) **Lead** as an alloying element in aluminium containing up to 0.4% by weight
- 6(c) Copper alloy containing up to 4% **lead** by weight

REACH (EU, UK)
This product is a complex article which is not designed for intentional substance release. To the best of our knowledge the materials used comply with the requirements of REACH. The product manual provides information and instruction to ensure the safe storage, use, maintenance and disposal of the product including any substance based requirements.

Article 33.1 Declaration (EU, UK)
This product contains Candidate List Substances of Very High Concern above 0.1%ww by article as clarified under the 2015 European Court of Justice ruling in case C-106/14.

- Lead (Pb)
  This substance is present in certain steel / aluminium brass components.

Additional Applicable Requirements

The product is in scope for and complies with the requirements of the following:

2012/19/EU	Directive on waste electrical and electronic equipment (WEEE)
Product is certified to CSA-C22.2 No.61010-1-12	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
Product is certified to UL61010-1 3rd Edition	Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements
cTUVus Certificate No.	CU 72191743

The product is certified by TÜV Rheinland of North America which is a “Nationally Recognized Testing Laboratory” (NRTL) for USA and Canada.

材料成分声明

China Material Content Declaration

	有害物质 Hazardous Substances					
部件名称 Part name 	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr VI)	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
铸铝及铝合金制品 Aluminium alloys	X	O	O	O	O	O
钢合金制品 Steel alloys	X	O	O	O	O	O
铜管管件 Brass pipe fitting	X	O	O	O	O	O

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

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

This product has been manufactured under a quality management system certified to ISO 9001:2015

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