



SCIEX Dry Pump MSR 90

OPERATOR GUIDE

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1. Safety and compliance

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use. Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions.

The instruction manual is an important safety document that we often deliver digitally. It is your responsibility to keep the instruction manual available and visible while working with the equipment. Please download the digital version of the instruction manual for use on your device or print it if a device will not be available.

1.1. Definition of Warnings and Cautions

For safe operation from the start, read these instructions carefully before you install or commission the equipment and keep them safe for future use.

Read all the safety instructions in this section and the rest of this manual carefully and make sure that you obey these instructions. The equipment must only be operated and maintained by trained personnel in the proper condition and as described in this instruction manual.

Obey local and state requirements and regulations. If you have any questions about safety, operation or maintenance of the device, please contact our nearest subsidiary.

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 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.

1.2. 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:

	<p>Warning/Caution An appropriate safety instruction must be followed or caution to a potential hazard exists.</p>
	<p>Warning - Heavy object Identifies a possible hazard from a heavy object.</p>
	<p>Warning - Dangerous voltage Identifies possible hazards from hazardous voltages.</p>
	<p>Warning - Protective earth (ground) Earth point for electrical equipment.</p>
	<p>WEEE symbol The equipment must be discarded carefully. Obey local and national regulations for disposal of this equipment.</p>
	<p>Warning - Use protective equipment Use appropriate protective equipment for the task.</p>

2. General description

2.1. Overview



WARNING: INCORRECT USE OF EQUIPMENT

Risk of injury or damage to the equipment. Incorrect use of the equipment can cause damage to the equipment or injury to people. The user is responsible for the safe operation, installation and monitoring of the system.



CAUTION: GAS BALLAST INSTALLATION

Risk of damage to the equipment. If water vapour is present within the system or is pumped by the product the gas ballast must be used to prevent damage to the product. The gas ballast should continue to be applied with the pump running, for at least 1 hour after the water vapour source has been removed to enable the pump to dry.

The MSR 90 is a dry, multi-stage roots vacuum pump that offers high pumping speed in a compact form. The pump is connected by a power cord and is designed for use on clean duty applications.

The cord rating is:

Supply voltage (V)	Current (A)	Frequency (Hz)
200 - 240	7	50 or 60

The pump is not designed for use with flammable, corrosive, toxic or other hazardous gases. Gas or oxygen can mix in the pump system.

The dry pump can be used in either transient or steady state gas load conditions. The pump can sustain operation with a maximum continuous power consumption of 850 W. If the gas load causes this value to be exceeded, then the pump will temporarily slow down. If the load is subsequently reduced; or the transient overload protection has recovered, then the pump will return to full speed operation. Refer to [Table: Performance data](#) for information on maximum inlet pressure.

Refer to [Figure: Pump features](#), the system is supplied with a NW40 inlet port (1) and a NW25 exhaust port (10).

The pump mechanism is operated by an electric motor driven by an internal pump controller. The rotational elements of the pumping mechanism are simply supported at the end by lubricated bearings. PFPE lubricant is used and this is contained in both the gearbox and motor ends of the pump module. These are "sealed for life" and the lubricant does not need to be replaced until the pump service interval is reached.

The system is air cooled by a fan installed internally in the pump enclosure. The pump has a thermal protection device that will stop the motor if a thermal overload occurs, for example in high ambient temperatures. You must restart the pump after the pump is cooled down.

The pump is designed to pump the residual gases used in high vacuum systems. The gases are:

- Air
- Oxygen (O₂) < 21% by volume
- Nitrogen
- Krypton
- Argon

- Helium

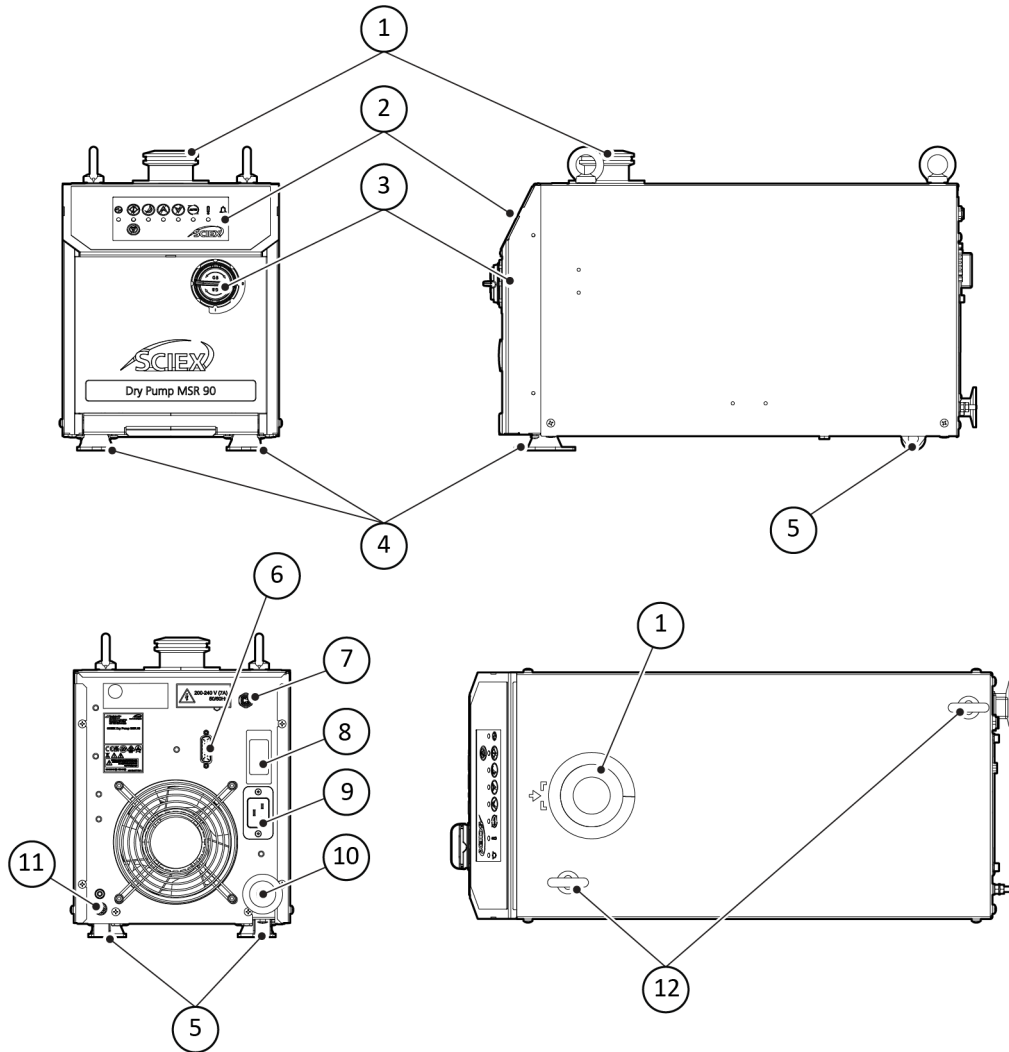
You can use the pump to pump water vapour. You must use the gas ballast when water vapour is pumped. The water vapour must not condense in the pump.

Note:

Make sure that the water vapour does not condense inside the pump.

To use the pump for a gas that is not listed, contact the supplier for advice. Failure to contact the supplier can invalidate the warranty of the pump. Do not use the pump for aggressive or corrosive gases.

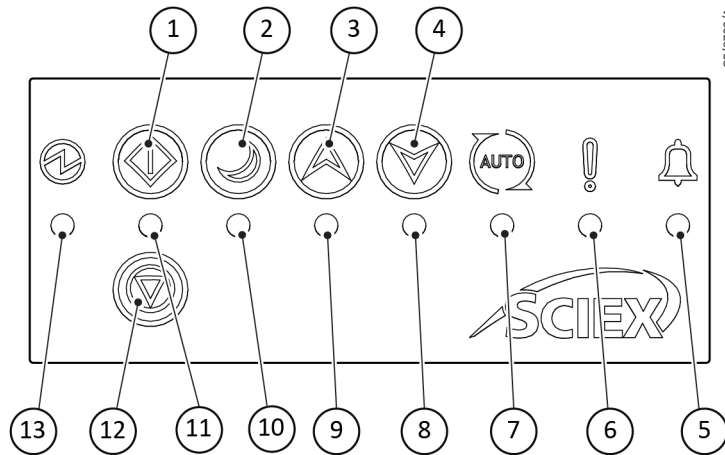
Figure 1 Pump features



- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Inlet port 3. Gas ballast 5. Castors x 2 7. Auxiliary connector 9. Mains connector port 11. Protective earth stud | <ol style="list-style-type: none"> 2. Control dashboard 4. Vibration isolators 6. 15-way D-type connector 8. Mains circuit breaker 10. Exhaust port 12. Lifting eye positions |
|---|---|

2.2. Control panel

Figure 2 Control panel



- | | |
|-----------------------------------|-----------------------------------|
| 1. Start button | 2. Sleep button* |
| 3. Standby increase button | 4. Standby decrease button |
| 5. Alarm indicator LED | 6. Service indicator LED |
| 7. Auto-run indicator LED | 8. Standby decrease indicator LED |
| 9. Standby increase indicator LED | 10. Standby indicator LED |
| 11. Run indicator LED | 12. Stop button |
| 13. Power status LED | |

* Enables STANDBY functionality

2.2.1. Auxiliary connector socket

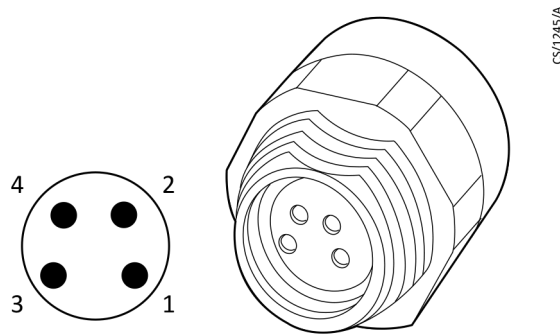
An auxiliary control connection on the rear panel controls an optional inlet valve. This inlet valve can be operated in parallel with the normal pump output signal. Refer to [Figure: Pump features](#), (7). The valve is usually closed and:

- will open when the normal signal becomes active (pump at speed)
- will close when you select the stop button or if there is a fault condition

The reaction time will be in line with the valve selection and the output signal is 24 V d.c. Refer to [Figure: Valve connector](#) for polarity of the connector pins when the connector is energized.

The auxiliary connector is regulated to 24 V d.c. to control the accessories. If the auxiliary load current exceeds the value in [Table: Auxiliary load currents](#), the output will shut down to protect the pump controller. Refer to [Table: Recommended mating connector](#) for the recommended mating plugs.

Figure 3 Valve connector



Pin number	Signal	Polarity
1	Valve 1 - Control output	Positive
2	Valve 2 - Control output	Positive
3	Valve 1 - Return	Negative
4	Valve 2 - Return	Negative

Table 1 Auxiliary load currents

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.)
Output power	2 Channels with 4 watts per channel

Table 2 Recommended mating connector

Mating connector	Phoenix part number
Screw connection, straight	SACC-M 8MS-4CON-M-SW
Solder connection, straight	SACC-M 8MS-4CON-M
Screw connection, right angle	SACC-M 8MR-4CON-M-SW
Solder connection, right angle	SACC-M 8MR-4CON-M

2.3. Logic interface

The logic interface is designed to support the serial control, the parallel control, and the monitor, and to operate through one connector.

The pump controller can be operated through the 15-way D-type logic interface connector. The signals on the logic interface are:

- control inputs: switch type and analogue signals that control the pump.
- status outputs: to identify the status of the system Tab.

For serial control select RS232 or RS485. Refer to the Serial Comms Interface manual.

For control modes refer to [Table: Manual control mode](#).

For logic interface data refer to [Logic interface data](#) on page 26.

2.4. Auto-run

The auto-run setting configures the pump to start automatically when the power is switched on, without any customer intervention.

You can configure the auto-run through serial communications, or with the start or stop button. Push and hold the start or stop button for more than eight seconds to enable or disable the auto-run setting. The auto-run LED displays the auto-run setting.

The pump can be stopped by either manual, parallel or serial control modes when in auto-run mode.

 **Note:**

Refer to [Operation safety](#) on page 23 for guidelines on how to configure different operational modes and any associated warnings to consider.

2.5. Pump controller configuration

The integral pump controller monitors the power and temperature of the pump. The pump controller protects the user and the pump when the pump is operated under sustained high load or in fault conditions.

The pump controller has the control panel and the pump can be operated:

- manually, with the buttons on the user control panel. Refer to [Figure: Control panel](#).
- remotely, through serial communications or digital and analogue process control (parallel), via the 15-way D-type interface connector. Refer to [Connection for remote control and monitoring](#) on page 21.

2.6. Pump controller

The pump controller contains the drive electronics to control the pump operation. The pump controller controls the supply of electric current to the motor as per the operating conditions.

The control panel is installed on the pump controller. The pump can be operated:

- manually, with the buttons on the user interface control panel. Refer to [Figure: Control panel](#).
- remotely, with the serial communications or digital and analogue process control (parallel), through the 15-way D-type interface connector. Refer to [Connection for remote control and monitoring](#) on page 21.

3. Technical data

3.1. Operating and storage conditions

Table 3 Operating and storage conditions

Range	Data
Ambient operating temperature range	5 °C to 40 °C
Ambient operating humidity range	80% up to 31 °C Reducing linearly to 50% at 40 °C
Maximum operating altitude	3000 m
Ambient storage temperature range	-30 °C to 70 °C
Maximum humidity (storage in original packaging)	≤ 95 % RH
Equipment type	Indoor use
Enclosure protection (tested according to IEC 60529)	IP21
Enclosure protection (tested according to UL50e and CSA C22.2 No. 94.2)	NEMA 1

Table 4 Environmental conditions

Pollution	Pollution degree 2
Installation	Installation category II
Altitude restriction	Maximum 3000 m
Area of use	Indoor

Table 5 Mechanical data

Parameter	MSR 90
Mass	30 kg
Inlet connection	NW40
Overall dimensions (L x W x H)	494 x 217 x 301 mm
Maximum tilt angle for operation	± 5°
Maximum tilt angle for transport	30°
Nominal rotational speed	15000 rpm
Outlet connection	NW25

Figure 4 Dimensions

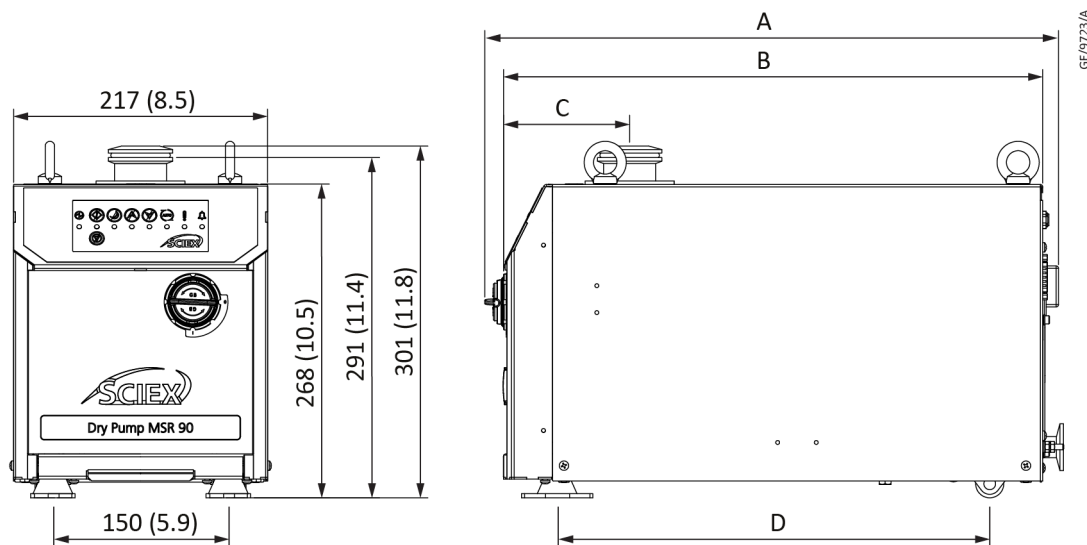


Table 6 Dimensions

Type	Variable dimensions							
	A		B		C		D	
	mm	inch	mm	inch	mm	inch	mm	inch
MSR 90	494	19.45	461	18.15	107	4.21	370	14.56

3.2. Performance

Table 7 Performance data

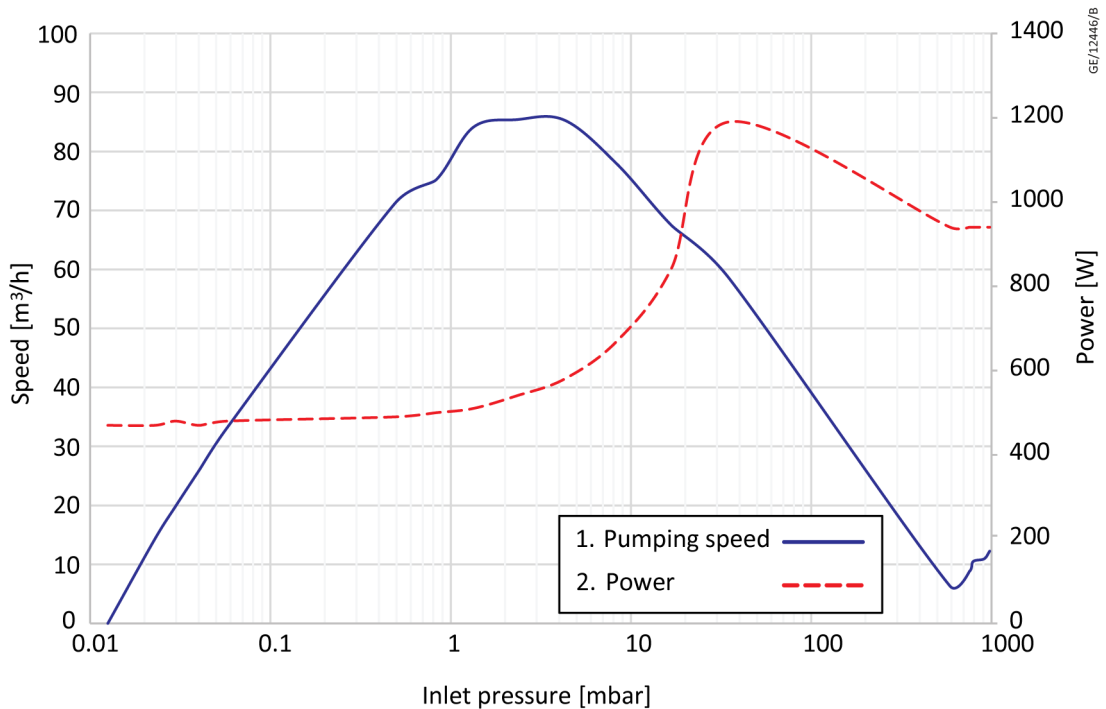
Parameter	Units	MSR 90
Maximum pumping speed with 14.1 mm restrictor embedded *	m ³ /hr	85
Maximum pumping speed at atmospheric pressure *	m ³ /hr	10.7
Ultimate pressure	mbar	0.03
Maximum continuous inlet pressure	mbar	20
Maximum continuous exhaust pressure	mbar(g)	200
Suck-back protection	-	Exhaust valve design
Maximum pressure rise when stopped, no inlet flow or gas ballast flow	mbar	100
Maximum permitted gas ballast inlet pressure (with gas ballast adaptor fitted)	bar(g)	0.5
Gas ballast flow	l/min	25
Maximum water vapor pumping rate (with gas ballast applied)	kg/hr	0.3
Typical ultimate pressure with gas ballast	mbar	< 0.1
Leak tightness (static)	mbar l/s	< 1x10 ⁻⁶

*The pumping speed is measured at standard ambient temperature and pressure. At higher temperatures or different ambient pressures pump performance may be compromised and the rotational speed may drop below nominal.

Table 8 Sound data

Declared dual-number noise emission values in accordance with ISO 4871	
Measured A-weighted emission sound pressure level, L_{pA} at ultimate vacuum 1 m from the pump in free space	55.0 dB(A)
Measured A-weighted emission sound pressure level, L_{pA} at 15 mbar at inlet 1 m from the pump in free space	57.0 dB(A)
Uncertainty, K_{pA}	2.5 dB(A)
Product tested to ISO standard 3744:2010	

Figure 5 MSR 90 performance curve at 250 Hz



1. Pumping speed with gas ballast

2. Power with gas ballast

3.3. Materials exposed to gases pumped

The materials and the components exposed to the gases in the pump are:

- Iron
- Aluminium alloy
- Steel
- Fluoroelastomer (seals)
- PFPE lubricant

3.4. Electrical data

If the pump is operating with a supply voltage below the nominal operating range, example < 200 V, the product will limit the maximum power deliverable to the pump motor. If the application load exceeds the maximum power available, pump rotational speed will be reduced. Refer to [Figure: Speed vs Power graph](#). At lower rotational speeds pumping performance will be impaired; however, the product can still pump down chambers or operate in steady state conditions.

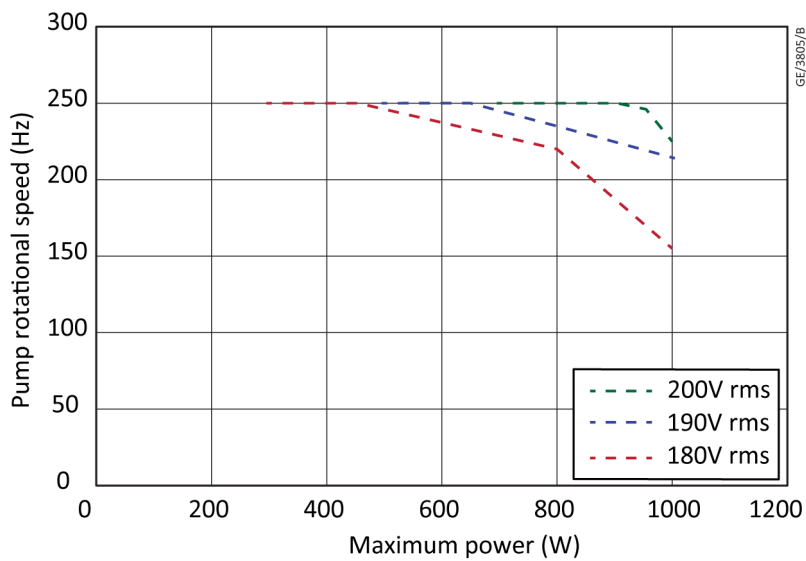
Table 9 Electrical rating for continuous operation

Pump	Supply voltage (V a.c. rms)	Phase	Frequency (Hz)	Input current (A rms)
MSR 90	200 - 240 ± 10%	Single	50 or 60	7.0

Table 10 Recommended regional supply protection

Area	Voltage	Protection rating
UK	230 V	10 A, 250 V a.c. rms
Europe	230 V	10 A, 250 V a.c. rms
US	220 V	10 A, 250 V a.c. rms
Japan	200 V	10 A, 250 V a.c. rms

Figure 6 Speed vs Power graph



4. Installation

4.1. Installation safety



CAUTION: SAFETY INSTRUCTIONS

Follow all safety instructions and take note of all appropriate precautions.



CAUTION: BLOCKED EXHAUST PIPELINE

Risk of damage to equipment. Make sure the exhaust pipeline is not blocked. If an exhaust isolation valve is used, make sure that the pump is not operated with the valve closed.

Possible hazards on the dry pumping system include electricity, process chemicals, and Fomblin® (PFPE) oil:

- Contact us or see sciex.com/support/request-support more information for advice or assistance on installation.
- Do not remove the temporary covers from the system inlet and exhaust until ready to connect.
- Do not operate the system unless the inlet and exhaust are connected to the vacuum and exhaust extraction system.
- Isolate the other components in the process system from the electrical supply to prevent accidental operation.
- Electrical supplies are potentially hazardous energy sources. Lockout and tagout before you do the maintenance.
- Obey all national and local rules and safety regulations when you install the system.
- Tighten the cables, hoses and pipework during installation to prevent a trip hazard.
- Make sure that the installation area is clean and free from debris and contamination before you install the pump.
- Make sure that all facilities given in this manual are available for the system to perform correctly.

4.2. Unpack and inspect



WARNING: DAMAGED PUMP

Risk of injury to people or damage to equipment. Do not use the pump if it is damaged. Failure to do so can result in injury to people and/or damage to equipment.



CAUTION: PUMP LIFE

Risk of damage to equipment. Unpack the pump carefully and avoid excessive shock to the pump. Excessive shock will damage the bearings and reduce the life of the pump.

Refer to [Table: Mechanical data](#) for the mass of the pump.

The pump is supplied in a recyclable packaging.

1. Open the cardboard box from the top.
2. Remove the packing material. Keep all the packing materials for use in inspection and if the pump is returned for service.
3. Examine the pump for damage. If the pump is damaged, notify your supplier and the carrier immediately. Give the supplier and the carrier the information that follows:
 - part number of the pump
 - serial number of the pump
 - order number
 - supplier's invoice number
4. Do not use the pump if the pump is damaged.
5. If the pump is not to be used immediately, store the pump in the conditions given in [Storage](#) on page 38.
6. The pump is supplied with sealed inlets and outlet to prevent the entry of dust and vapor. Do not remove the seals until the pump is ready to be installed on the vacuum system.

4.3. Mechanical installation



WARNING: HEAVY OBJECT

Risk of physical injury. Use suitable equipment to lift the pump.



WARNING: LOOSE CABLES/PIPEWORK

Tripping hazard. Make sure that any cables and/or pipe work attached to the pump are fixed carefully to avoid a slip/trip hazard and to prevent any damage to the cable.



WARNING: LIFTING EYE INTEGRITY

Risk of injury or damage to equipment. Make sure that the maximum angle between the paired slings used to lift the system is 45 degrees. Increased angle could compromise the lifting eye integrity.



WARNING: INSTALLATION SAFETY

Risk of injury or damage to equipment. Install the pump in the vacuum system before you connect the pump to the power supply. This will make sure that the pump is not operated causing injury to people, during installation.



WARNING: STATIC PRESSURE

Risk of damage to equipment. Do not step or stand on the pump, it is not designed to withstand large static loads.



WARNING: HEAVY OBJECT

Push-pull hazard with strain injury. Push or pull the pump system only for short distance and over flat surfaces. Lift the system if the floor is uneven or has obstacles.



WARNING: EXHAUST BLOCKAGE

Risk of injury or damage to equipment. A peak pressure of 3 bar(g) can be generated in the pump if the exhaust or pipework attached to the exhaust are blocked.



WARNING: INSTALLATION SAFETY

Risk of injury or damage to the environment. Follow all local legislation when the pump is installed or removed to reduce the impact of the pump on the environment.



CAUTION: CONDENSATE DRAINAGE

Risk of damage to equipment. Use a catchpot to prevent the drainage of condensate back into the system. Condensate that drains back into the system could damage the pump.

Obey the instructions that follow when you install the pump:

- Make sure that there is no blockage to access the pump electrical supply cable or the other controls.
- Make sure that there is a minimum air gap of 100 mm on all sides of the pump to allow effective air circulation.
- Make sure that the system is on a firm and levelled surface that can support the mass of the pump.
- Make sure that the system is installed away from combustible materials.
- Level the pump to a maximum of 5 degrees (measured at the pump inlet).
- You must do a risk assessment of the location and make sure that you can move the pump safely and as per the local and national manual handling guidelines.

To move the pump:

1. Use suitable lifting equipment attached to lifting eyebolts ([Figure: Pump features](#), (13)) to move the dry pump system close to its final operating position. Refer to [Table: Mechanical data](#) for pump mass.
2. Secure the dry pump system with the rubber stand-off and two small castors ([Figure: Pump features](#), (5)).
3. Remove the plastic caps from the inlet and exhaust before you connect the pump to the vacuum system. Use appropriate NW vacuum fittings for connection to the system.

Obey the instructions that follow when you connect the pump to the vacuum system:

- Connect the pump to an exhaust line to minimize the noise and the exhaust emissions.
- Make sure that the pipeline connected to the pump inlet is as short as possible. Make sure that the pipeline has a minimum internal diameter to get maximum pump speeds.
- Put support under the vacuum pipeline to prevent the load on the coupling joints.
- Make sure that the pump exhaust line is not blocked as a pressure of 3 bar(g) can be generated in the exhaust pipework. Connect the pump with appropriate pipework and fittings.
- If necessary, install flexible bellows in the system pipelines to reduce the transmission of the vibration and to prevent the load on the coupling joints. The pressure rating of the bellows must be higher than the highest pressure generated in the system. We recommend that you use the manufacturer's bellows.

- If you use an exhaust extraction system make sure that it is appropriate for use with all pumped process gases. Make sure that the exhaust extraction system is not blocked or obstructed when the pump is in operation.

4.4. Leak test the system



WARNING: SYSTEM LEAK TEST

Risk of injury. Do the leak test of the system after installation. Seal all the leaks found to prevent leakage of dangerous substances out of the system and leakage of air into the system.

We will accept no liability or warranty claims for damages caused from flammable mixtures because of air leaks.

1. Do the leak test of the vacuum system.
2. Seal all the leaks found.

4.5. Electrical installation



WARNING: ELECTRICAL CONNECTION

Risk of electric shock. The electrical installation must be done by a qualified person. Always make the electrical connections to the pump after the pump has been installed on the vacuum system.



WARNING: INSTALLATION SAFETY

Risk of electric shock or damage to equipment. The pump must be electrically installed in accordance with regional and local codes, and must obey the local and national safety requirements.



WARNING: HAZARDOUS VOLTAGE

Risk of electric shock or damage to equipment. The logic interface is 30 V maximum rated PELV and must only be connected to PELV interfaces. Failure to use an correctly rated supply could result in electric shock.

The pump is a cord-connected device and must be installed in accordance with local electrical regulations.

The pump is supplied from a single phase 200 - 240 V a.c. mains supply system. The branch circuit supplying the pump must be protected with a 10 A (200 - 240 V) branch circuit protection.

4.5.1. Connect the electrical supply



WARNING: PROTECTIVE EARTH CONNECTION

Risk of electric shock. Make sure that the pump and electrical cables are suitably protected against earth (ground) faults. We recommend you attach a protective earth (ground) conductor (with a cross sectional area of 2.5 mm²/14 AWG) to the protective earth (ground) stud.



Make the electrical connection to the pump mains connector port (*Figure: Pump features*, (10)) with an appropriate cord set.

The pump must be grounded through the conductor of the mains input connector.

4.6. Connection for remote control and monitoring

To operate the pump with parallel or serial control, the 15-way D-type connector must be used (*Figure: Pump features*, (8)).

Refer to *Figure: Logic interface connections - analogue speed control* for details of the logic interface pins.

5. Commission the pump

To commission the pump:

1. Make sure that the supply voltage is within allowable limits. Refer to [Table: Electrical rating for continuous operation](#).
2. Make sure that all openings to atmospheric pressure in the foreline vacuum system are closed.
3. Connect the power cord.
4. Set the mains circuit breaker ([Figure: Pump features](#), (8)) to ON. Make sure that the power indicator LED ([Figure: Control panel](#), (14)) illuminates. If the LED does not illuminate, contact us.
5. Press the start button ([Figure: Control panel](#), (1)) until the run indicator LED ([Figure: Control panel](#), (13)) begins to flash.
6. When the dry pumping system starts and continues to operate, if an alarm condition is indicated:
 - a. shut down the dry pumping system; refer to [Shut down the pump](#) on page 31.
 - b. refer to [Fault finding](#) on page 36
 - c. if the problem has not been rectified, contact us.
7. After you commission the dry pumping system:
 - a. to continue to operate the system; refer to [Start the pump](#) on page 31.
 - b. to shut down the system; refer to [Shut down the pump](#) on page 31.

6. Operation

6.1. Operation safety



WARNING: DAMAGED PARTS

Risk of electric shock. Do not operate the pump with any parts of the enclosures removed or damaged as there may be a risk of an electric shock.



WARNING: OPERATIONAL SAFETY

Risk of injury or death of people. Do not expose any part of the human body to the vacuum as this could result in injury or death of people.



WARNING: PUMP TEMPERATURE

Risk of injury. Do not touch the pump inlet manifold or exhaust when the pump is running as the temperatures of these parts could be high. The pump will be warm for some time after the pump has stopped.



WARNING: AUTOMATIC START

Risk of injury or damage to equipment. The system has an auto-run mode which, if configured, is designed to automatically start the pump system once power is applied.



CAUTION: CONDENSATE DEPOSITION

Risk of damage to equipment. Do not use the pump to pump particulates or condensate. Deposition may occur within the pump which can degrade the pump performance and reduce the pump life.



WARNING: HIGH NOISE LEVEL

Risk of hearing damage. If the pump is operated with its inlet open to atmospheric pressure, the noise generated by gas flowing into the pump can be high and exceed 85 dB(A). Continuous operation with the inlet exposed is not within the normal operating conditions of the vacuum pump.

Note:

The control interface is determined by the interface that starts the pump. Once started, the pump can only be stopped by the interface that it was started from, except in auto-run mode. In auto-run mode, the stop button on the user interface panel will override the signal and stop the pump.

Note:

This is an industrial (Class B, Group 1) product as defined by EN55011 and EN61326 in compliance with European Electromagnetic Compatibility (EMC) requirements for EMC emissions. "Group 1" is defined as equipment which does not use RF energy as an intrinsic part of operation or process.

6.2. Operational modes

The pump can be controlled by:

- Manual control mode – with the buttons on the user interface panel.
- Parallel control mode – through the 15-way D-type logic interface connector located on the rear of the pump.
- Serial control mode – through the 15-way D-type logic interface connector located on the rear of the pump.
- Auto-run.

6.2.1. Manual control mode

Refer to *Figure: Control panel* for the pump control functions.

Table 11 Manual control mode

Operation	Button	Status
Apply power	Mains power	The pump will remain off (factory default). The power indicator will illuminate.
Start the pump	Start button	The pump will accelerate up to full running speed. The run indicator will flash while the pump accelerates. The run indicator will remain on when the pump reaches full speed.
Select and de-select the standby speed	Standby mode select button	When engaged, the standby indicator will illuminate and the pump will run at the standby speed setting. The pump is set by default at 70% of full speed.
Increase or decrease the pump speed when in standby mode	Standby speed increase button	The pump speed will increase. The increase standby indicator will remain illuminated when the pump reaches a maximum of 100% of full speed.
	Standby speed decrease button	The pump speed will decrease. The decrease standby indicator will remain illuminated when the pump reaches a minimum of 50% of full speed.
Select and de-select the Auto-run function	Start or stop button (>8 sec)	When engaged, the auto-run indicator will illuminate. The pump will restart automatically after the power has been restored.

Start and stop

Use the buttons (*Figure: Control panel*) to start and stop the pump.

 **Note:**

The stop command does not isolate the pump from the electrical supply.

Standby

In standby mode the pump operates at a reduced speed to improve the service life of the pump.

1. Push the standby button to select standby mode. The pump will initially run at factory default standby speed (70% of full speed).

2. Adjust the speed with the increase and decrease standby speed buttons. The maximum standby speed is 100% of the default run speed and the minimum standby speed is 50% of the default run speed.
A single short push will change the speed by 1% of the default run speed. Hold the button to change the speed by 1% per second.
3. Once adjusted, the pump will return to the new user defined speed each time standby speed is selected.
4. Push the standby button to return to normal run speed.

Soft start and soft stop modes

For most pumps operating under normal laboratory conditions or at ultimate pressure the soft-stop mode or soft-start mode is unlikely to be invoked.

Soft stop:

If the pump is operating within a high ambient temperature the product may enter a soft-stop mode when the off command is sent or stop button is pressed. This protects the product mechanism during the shutdown procedure by enabling the pump to relax back into its stopped state. The soft-stop mode is likely to be activated in ambient temperatures higher than 30 °C. During the soft-stop mode the pump speed is halved and the cooling fan speed is increased to enable controlled cooling of the mechanism. Once a pre-defined temperature level has been met the pump will switch off completely and is then ready for restart.

The soft-stop cool down time period is expected to be < 1 minute in the majority of cases, but could last up to 4 minutes depending upon the ambient temperature and load applied to the pump.

Once the soft-stop process has been activated the pump cannot be restarted until the shutdown is complete.

Soft start:

If the internal pump temperature is above a pre-defined threshold, the pump can not start immediately, when the start command is sent or start button is pressed. Instead, the cooling fan will switch on at full speed to cool the pump and once temperatures are sufficiently low the pump will run up to full speed as normal. The delay to start is expected to be < 1 minute in the majority of cases but may last longer depending upon the ambient temperature of the cooling air and the initial temperature of the pump module.

The soft-start mode can be invoked following a power outage or disconnection of power from the pump.

Table 12 LED indicators

Refer to [Figure: Control panel](#) for LED locations on the pump dashboard.

Description	Function
Power indicator	Indicates that electrical mains supply to the pump is ON.
Run indicator:	Indicates that the pump is running:
LED continuously ON	Pump runs at full speed
LED flashing	When changing speed
LED OFF	Pump is not running
Standby mode indicator	Indicates that the standby mode has been selected.
Standby speed increase indicator	The indicator will blink with every short push of the standby speed increase button. The indicator will remain ON when maximum standby speed has been reached.

Description	Function
Standby speed decrease indicator	The indicator will blink with every short push of the standby speed decrease button. The indicator will remain ON when minimum standby speed has been reached.
Auto-run indicator	Indicates that the auto-run mode has been selected.
Standby indicator LED	Once the standby function is selected the run indicator will flash at 50% duty while the rotational speed is changed. Once steady state running speed has been reached both the run speed and standby indicators will be illuminated.
Service indicator	Indicates that a service interval has been reached.
Alarm indicator	Indicates an alarm has been triggered.

6.3. Logic interface data

The pumps have a 15-way D-type logic interface connector located on the user interface panel ([Figure: Pump features](#), (6)). The logic interface connector can be plugged directly into the 200 W Turbo Instrument Controller (TIC) with an MSR TIC cable and in conjunction with controller extension cables.

For Turbo controller, or Turbo and Active Gauge controller (TAG), a suitable connector mating half must be used (not supplied) to connect the pump to the customer control system. Refer to [Table: Logic interface pins](#) for the electrical connections.

Table 13 Interface technical data

Connector*	15-way D-type (male)
Start, serial enable and remote enable:	
Enable control voltage: low (closed)	0 to 0.8 V d.c. ($I_{OUT} = 0.55$ mA nominal)
Disable control voltage: high (open)	4 to 26.4 V d.c. (internal pull-up to a Thevenin equivalent circuit: 5.3 V and 11 kOhms nominal)
Standby control input:	
Enable control voltage: low (closed)	0 to 0.8 V d.c. ($I_{OUT} = 0.3$ mA nominal)
Disable control voltage: high (open)	4 to 26.4 V d.c. (internal pull-up to a Thevenin equivalent circuit: 2.5 V and 10.3 kOhms nominal)
Analogue and RS485 enable control inputs:	
Enable control voltage: low (closed)	0 to 0.8 V d.c. ($I_{OUT} = 0.55$ mA nominal)
Disable control voltage: high (open)	4 to 26.4 V d.c. (internal pull-up to a Thevenin equivalent circuit: 5.5 V and 11.4 kOhms nominal)
Analogue speed input	0 to 10 V d.c. directly proportional to the motor speed e.g. 0 V = 0 Hz, 10 V = 250 Hz
Voltage accuracy	$\pm 5\%$ full scale
NORMAL status output:	
Type	Open collector transistor plus pull up resistor
< Normal speed (default 80%)	OFF (4.7 k pull up + diode to 12 V d.c.)
> Normal speed	ON (< 0.8 V d.c. sinking 10 mA)
Maximum current rating	10 mA
Maximum voltage rating	28.8 V d.c
FAIL status output:	

Type	Open collector transistor plus pull up resistor
Fail	OFF (4.7 k pull up + diode to 12 V d.c.)
OK	ON (< 0.8 V d.c. sinking 10 mA)
Maximum current rating	10 mA
Maximum voltage rating	28.8 V d.c.
Analogue 10 V reference	+ 10 V d.c. analogue voltage reference unipolar output with diode protection
Voltage accuracy output	± 2% full scale
Current	≤ 5 mA for specified accuracy

* Mating half of connector not supplied

Table 14 Logic interface pins

Pin number	Signal	Polarity	Use
1	Analogue speed enable-control input	-	Connect to pin 2 (0 V) to enable analogue speed control via pin 9.
2	0 V control reference	-	0 V reference for all control and status signals listed within this table.
3	Start/Stop – control input	-	Connect to pin 2 (0 V) to start the pump system.
4	Standby – control input/ serial-RX/RS-485 A-	-	Connect to pin 2 (0 V) to enable standby speed when the serial enable control input is inactive.
5	Serial enable – control input	-	Connect to pin 2 (0 V) to enable serial communications.
6	RS-232/RS-485 – control input	-	Default configuration is RS-232 with pin 6 disconnected. Connect to pin 2 (0 V) to enable RS-485 serial communications.
7	Fail – status output/Seri- al-TX/RS-485 B+	-	Logic high when a fail/fault condition exists and the serial enable control input is inactive.
8	0 V control reference	-	0 V reference for all control and status signals listed within this table.
9	Analogue speed – control input	-	0-10 V analogue input: 0 V = 0% speed; +10 V = 100% speed
10	Chassis/Screen	-	Screen
11	+10 V analogue reference – Control output	Positive	+10 V analogue voltage reference output: 5 mA; unipolar output, diode protected.
12	Chassis/Screen	-	Screen
13	Not connected	-	Unused control pin
14	Remote – control input	-	Connect to pin 2 (0 V) to enable remote control via parallel or serial control modes.
15	Normal – status output	-	Logic low when the pump rotational speed is at normal speed or above.

6.4. Parallel control and monitoring



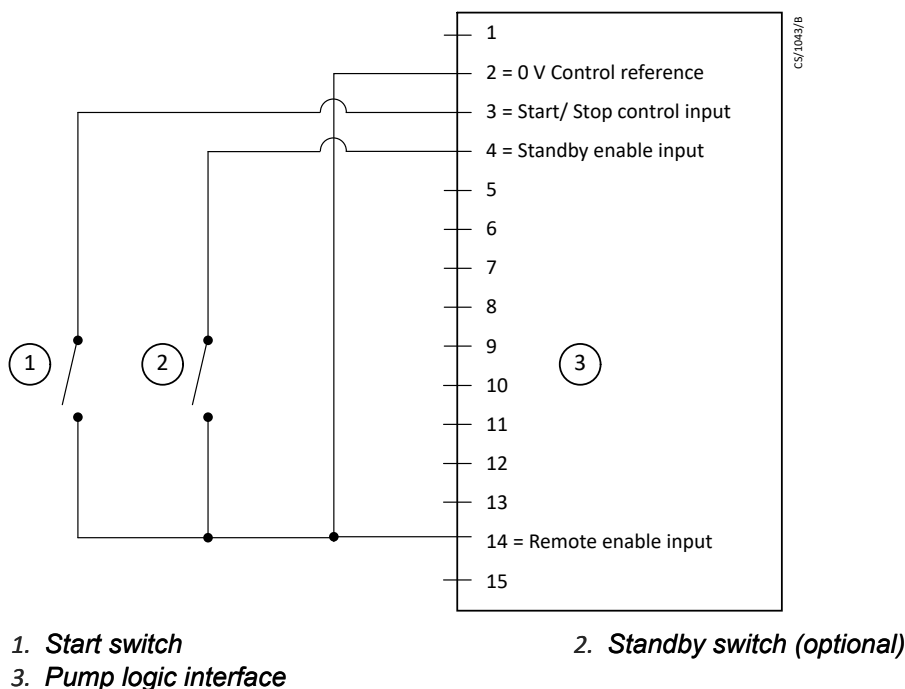
CAUTION: EMF RISK

Risk of damage to equipment. If you use 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.

Connect the control equipment to the control input pins of the logic interface mating half. Refer to [Table: Logic interface pins](#) to identify the logic interface connector pins. The control inputs are:

- Start
 - Standby speed
 - Analogue speed
- A. To activate the control inputs, connect the relevant control input (pin 14) to the 0 V control reference.
 - B. The NORMAL output can go down up to 100 mA when you control an external relay coil with an external coil voltage of + 24 V d.c. The external + 24 V voltage source must be referenced to the common control voltage of the pump control system, i.e. pin 2 of the 15-Way D-Type customer interface connector. Alternatively, if the NORMAL output is connected to + 10 V reference output of the control system, i.e. pin 11 of the 15-Way D-Type connector, a 4.7 kOhm pull-up resistor is recommended to be kept in the current rating of + 10 V reference rail.
 - C. The FAIL output can go down up to 100 mA when you control an external relay coil with an external coil voltage of + 24 V d.c. The external + 24 V voltage source must be referenced to the common control voltage of the pump control system, i.e. pin 2 of the 15-Way D-Type customer interface connector. Alternatively, if the FAIL output is connected to + 10 V reference output of the control system, i.e. pin 11 of the 15-Way D-Type connector, a 4.7 kOhm pull-up resistor is recommended to be kept in the current rating of + 10 V reference rail.

Figure 7 Logic interface connections - parallel control



6.5. Analogue speed control

The analogue speed input is a process control source which enables the pump to run at variable operating speeds. This speed control source is an alternative to standby speed control.

Figure 8 Logic interface connections - analogue speed control

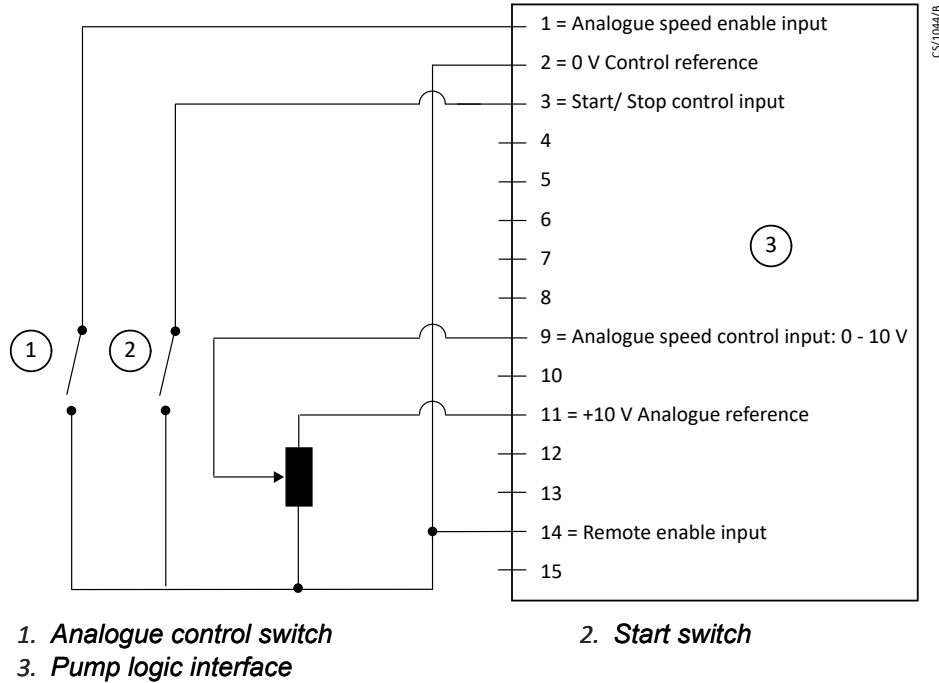
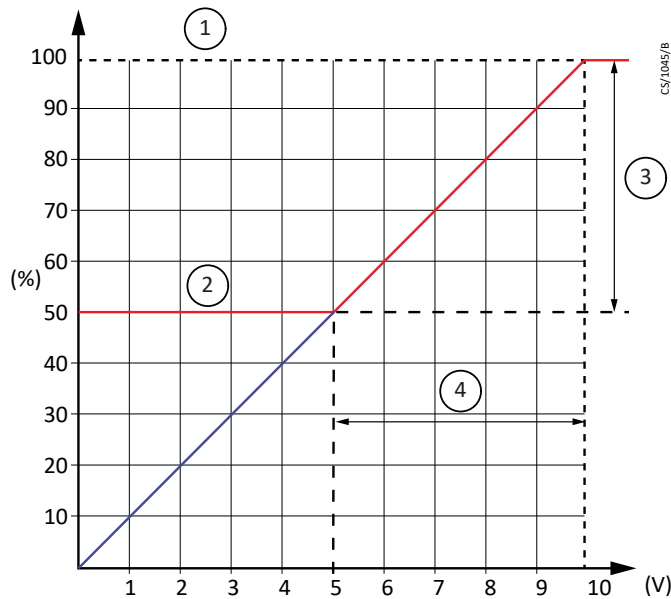


Figure 9 Analogue speed control



1. Upper speed clamp - Maximum standby setting = 250 Hz
2. Lower speed clamp - Minimum standby speed setting = 125 Hz
3. Active speed range - 50% to 100% (125 Hz to 250 Hz)
4. Active voltage range - 5 V to 10 V

Note:

0.1 V = 1% of default run speed.

Voltages below 5 V will result in a clamped speed of 50% of full speed.

6.6. Hardware configuration

Use the 15-way D-type connector ([Figure: Pump features](#), (6)) and configure the signal to enable the analogue speed control source:

- Connect the analogue speed enable control input (pin 1) to the 0 V control reference (pin 2).
- Connect a suitably calibrated analogue voltage source (0 to +10 V) to the analogue speed control input (pin 9).

As an alternative, connect the output of a potentiometer referenced to the pump reference voltage (pin 11) to the analogue speed control input (pin 9). Refer to [Figure: Logic interface connections - analogue speed control](#). The 0 V rail of the external voltage source must be connected to the 0 V control reference (pin 2) of the pump controller.

6.7. Operational modes

- A +10 V input results in a mechanical running speed which is equal to 100% of the default run speed, that is 250 Hz.
- The minimum running speed provided by the analogue speed control source is clamped at the minimum standby speed setting (approximately 50% of the default run speed).
- The maximum running speed provided by the analogue speed control source is clamped by the maximum standby speed setting (100% of the default run speed).

6.8. Start the pump



CAUTION: EXHAUST PIPELINE BLOCKAGE

Risk of damage to equipment. Do not operate the pump if the exhaust pipeline is restricted or blocked as the pump will not operate correctly and may be damaged.

To start the pump:

1. Make sure that the vacuum system isolation valve is closed (if fitted).
2. Make sure that the mains supply to the pump is isolated.
3. Connect a recommended lead to the electrical socket on the pump. Refer to [Figure: Pump features](#).
4. Supply the power.
5. Start the pump with the applicable control source that follows:
 - use the start button in manual control mode.
 - use the start/stop control input in parallel control mode
 - use start command in serial control mode
6. Open the vacuum system isolation valve, if installed.

6.9. Shut down the pump



WARNING: PUMP SUPPLY ISOLATION

Risk of injury. Do not remove the inlet connections until the pump has been allowed to stop rotating and the power and gas supply has been isolated. The pump can take up to three minutes to stop completely.



CAUTION: ELECTRICAL SUPPLY

Risk of damage to equipment. Do not disconnect the pump from the electrical supply until the pump has stopped completely.

The pump can be shut down with either the front panel controls or the 15-way D-type connector in either parallel or serial control mode.

 **Note:**

If the pump is to be shut down for storage, remove any process gases by running on a gas ballast for at least one hour.

To shut down the pump:

1. Close the gas ballast.
2. Close the vacuum system isolation valves to prevent suck-back into the vacuum system (where fitted).
3. Stop the pump system with the appropriate control source.
 - use the stop button in manual control mode.
 - use the start/stop control input in parallel control mode.
 - use stop command in serial control mode.
4. Isolate the mains supply.

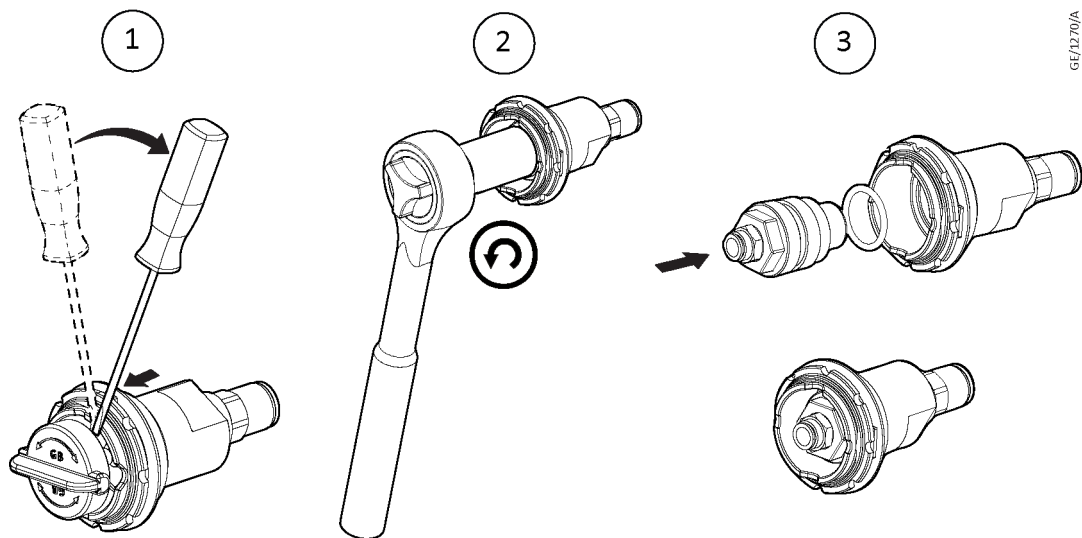
If the pump is to be stored, we recommend you either keep the pump under vacuum or fill the pump with dry nitrogen to prevent condensation in the pump. To keep the pump under vacuum, we recommend you seal the inlet and run the pump for at least 20 seconds.

6.10. Restart the pump

If the pump is automatically shut down because of an alarm condition, correct the alarm condition before you start the pump. To restart the pump, refer to [Start the pump](#) on page 31.

If water vapour is present within the system, or will be pumped by the product, the gas ballast must be used to prevent damage to the product. The gas ballast should continue to be applied with the pump running, for at least 1 hour after the water vapour source has been removed to enable the pump to dry.

6.11. Gas ballast adaptor fit



The manually operated gas ballast knob can be replaced by a gas ballast adaptor which enables external electrically actuated valves or a controlled gas supply to be used through a 1/4 inch push fit connector. To install the gas ballast adaptor:

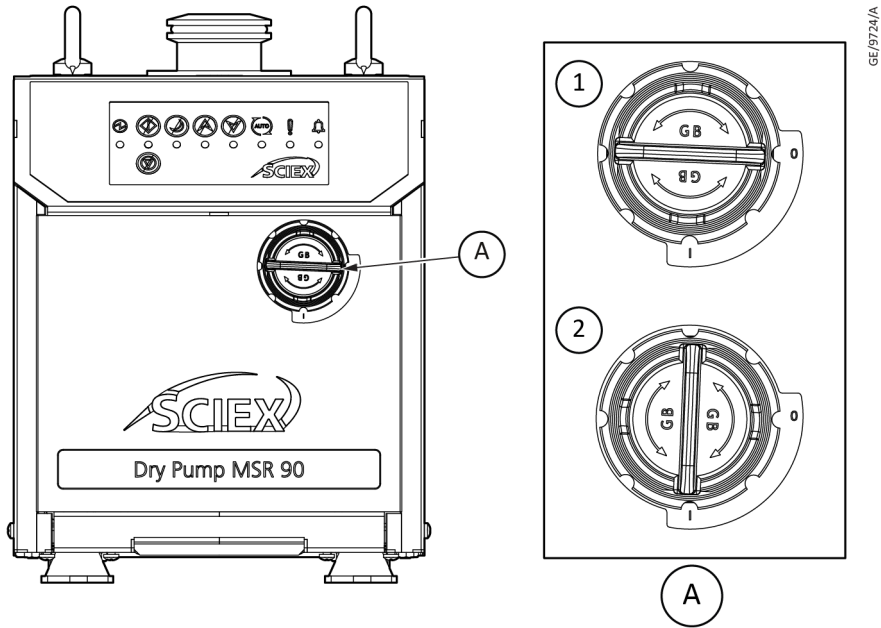
1. The gas ballast knob must be pulled out from gas ballast spindle by flat headed screwdriver or any similar tool can be used to lever the fitting free. To help position the tool underneath the knob it may be necessary to partially rotate the knob in-between notches.
2. Once the GB knob has been removed the internal valve can be extracted using an 21 mm socket wrench.
3. The adaptor can now be installed using a 21 mm socket wrench. Make sure that a clean O-ring is assembled onto the adaptor before you start installation.

6.12. Gas ballast operation

Gas ballast is operated by a black plastic knob that may be positioned to either position 0 (which means the gas ballast is closed), position 1, or any other elevated rim result that feeds air to the pumping mechanism with a flow of approximately 25 slm.

If water vapour is present within the system, or will be pumped by the product, the gas ballast must be used to prevent damage to the product. The gas ballast should continue to be applied with the pump running, for at least 1 hour after the water vapour source has been removed to enable the pump to dry.

Figure 10 Gas ballast open-close



1. Position 0 (gas ballast is closed)

2. Position 1 (gas ballast is open)

7. Maintenance and service

7.1. General maintenance

The system requires no user maintenance. Maintenance must be done by trained personnel. The frequency of the maintenance depends on the process and can be adjusted according to the user experience. Refer to [Maintenance plan](#) on page 34 for the maintenance schedule.

We recommend a monthly visual inspection of the dry pump system. Check that the electrical supply cord, hoses and pipelines connected to the pump are in good condition and are secured properly.

7.2. Maintenance plan

More frequent maintenance may be required if the pump is used to pump aggressive gases or vapours, solvents, organic substances and acids, or if the pump is operated continuously at high operating temperature.

Table 15 Maintenance plan

Operation	Frequency (months)	Service indicator	Reference
Inspect and clean the inlet strainer	12	No	Inspect and clean the inlet strainer on page 34
Inspect and clean the external fan cover if required	12	No	Clean the external fan grill on page 34
Electrical safety check	60	No	Electrical safety check on page 34

7.3. Inspect and clean the inlet strainer

Whenever the pump is disconnected from the vacuum system or annually:

- Remove the inlet strainer from the pump inlet, refer to [Figure: Pump features](#).
- Clean the pump inlet and remove the debris that may have accumulated.
- Examine the inlet strainer. If necessary, clean it with a cleaning solution suitable for the substances pumped.
- Install the inlet strainer before you reconnect the pump to the vacuum system. Refer to [Mechanical installation](#) on page 18.

7.4. Clean the external fan grill

If the fan cover is not kept clean, the air flow over the pump can be restricted and the pump may overheat.

To clean the fan grill:

1. Switch off the pump and disconnect from the electrical supply.
2. Use a dry cloth and a soft brush to remove dirt and deposits on the fan cover.

7.5. Electrical safety check

Test the earth continuity and the insulation resistance of the pump system in accordance with local regulations for the periodic test of electrical equipment.

The earth continuity must be less than 0.1 Ω and the DC insulation resistance greater than 1.0 M Ω . If the pump fails any of these tests, contact an Field Service Employee (FSE).

7.6. Service

7.6.1. Return the equipment or components for service (SCIEX)

When returning the pump for service or for any other reason, you must complete the required forms provided to you for Declaration of Contamination of Vacuum Equipment and Components. The completed 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.

8. Fault finding

A list of fault conditions and their possible causes is provided to assist in basic troubleshooting. If you are not able to rectify a fault, call your supplier or sciex.com (request-support) for advice.

Fault	The pump has failed to achieve the required performance
Cause	The vacuum fittings are dirty or damaged.
Remedy	Make sure that the vacuum fittings are clean and scratch free.
Cause	There is a blockage or high pressure in the exhaust line.
Remedy	Make sure that the exhaust valves fitted are not closed when the pump is in operation.
Cause	The motor controller is current limiting the supply.
Remedy	If the alarm indicator LED (<i>Figure: Control panel</i> , (5)) flashes, the pump has high current load, possibly from a high inlet pressure/flow. Adjust the inlet pressure/flow until the pump performance recovers.
Cause	The pump performance is different at the working application load.
Remedy	The pump does not have a flat performance curve. Peak pumping speed can vary with inlet pressure and gas load. Check the actual performance against the performance curve shown in <i>Technical data</i> on page 13.
Cause	Blocked rotors
Remedy	When the pump gets hot and if debris may have been ingested or condensed within the pump, the rotors may be stuck. Let the pump cool down to room temperature, restart and then once the pump is operational, run it with the gas ballast applied for at least 2 hours to try and clear any internal blockages. If the problem persists it is recommended that you contact supplier for further information and advice.
Cause	The pressure measurement technique or gauge head is not suitable or gives an incorrect indication of pressure.
Remedy	Make sure that the vacuum measurement equipment is calibrated and updated. The correct gauge range must be selected for the application. Contact us for further assistance on gauge selection, if required.
Fault	The pump is noisy
Cause	The pump is contaminated with solid particles.
Remedy	Contact us or the supplier for further information.
Fault	The pumping speed is poor or pump down time is too long
Cause	The pipeline connections are too small in diameter.
Remedy	Make sure that the pipework has sufficient conductance (user's responsibility) and the pump performance is not compromised.
Cause	There is a leak in the system.
Remedy	Do the leak test of the pump system in accordance with the requirements specified in <i>Table: Performance data</i> .

Cause **The motor controller is current limiting the supply.**
Remedy Adjust the inlet pressure/flow until the pump performance recovers.

Cause **The pump chamber is too big.**
Remedy Make sure that the chamber size does not exceed the limits specified in [Table: Mechanical data](#).

8.1. Alarm indicator codes

When the fail condition becomes active, the red alarm indicator shows a flashing sequence.

- If the error light is on continuously, this indicates a problem has been found with the embedded software. In this case, switch the power supply on and off.
- If the indication is not cleared, a software download may be required. In this case, contact us or the supplier.
- If the alarm indicator is flashing, identify the error flash code. Refer to [Table: Flashing error codes](#).

 **Note:**

There is a sufficient off period between each subsequent cycle repetition to 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 16 Flashing error codes

Error flash position	Error flash sequence	Comment	Actions
0	s-s-s-s-s	Overload timeout	Check if the pump is not under constant high pressure or the inlet or outlet is not blocked.
1	L-s-s-s-s	Controller software error	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
2	s-L-s-s-s	Controller failed internal configuration and calibration operation	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
3	s-s-L-s-s	Acceleration timeout	Check if the pump is under constant high pressure or the inlet or outlet is blocked.
4	s-s-s-L-s	Over-current trip activated, or other hardware fault	Switch power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
5	s-s-s-s-L	Self test fault	Switch the power to the pump off and on and see whether the error code appears again. If it does, contact us or the supplier.
6	s-s-s-s-L	Serial control mode interlock	Re-activate the serial enable and send a serial command to clear the error code.

9. Storage



WARNING: INHALATION HAZARD

Risk of asphyxiation. Do not burn the fluoroelastomer seals and O-rings.



CAUTION: LUBRICATION TRANSFER

Risk of damage to equipment. Install blanking plates to seal the vacuum inlet and outlet port. The pumps must be stored in a horizontal configuration to prevent possible lubrication transfer.

To store the pump:

1. Shut down the pump. Refer to [Shut down the pump](#) on page 31.
2. Disconnect the pump from the electrical supply.
3. Place and secure protective covers over the inlet and outlet ports.
4. Store the pump in a clean and dry condition until required for use.
5. When necessary, prepare and install the pump. Refer to [Installation](#) on page 17.

10. Disposal



WARNING: CONTAMINATION HAZARD

Risk of toxic exposure and acid burns. Identify, contain and safely dispose of contaminated items.

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

Dry pump system materials suitable for recycling include cast iron, steel, PTFE, stainless steel, aluminium, zinc alloy, nickel, mild steel, ABS and polyamide.

Take particular care with:

- Fluoroelastomers which may have decomposed as the result of being subjected to high temperatures.
- Components which have been contaminated with dangerous process substances.

