Instruction Manual

Silent Flow S - Blower and Exhauster packages

P B S 3 1 1 5 8 2 0 0 0

Unit size

SF 1 S = 3
SF 2 S = 4
SF 3 S = 5

Blower type

NX 5 = 1
NX 8 = 2
NX 12 = 2
SNH817MA = 3
SNH822MA = 1
SNH 825 = 2
SNH 842 = 3

Configuration

Pressure without enclosure = 1
Pressure with enclosure = 2
Pressure with enclosure outdoor = 3
Pressure canalised without enclosure = 4
Pressure canalised with enclosure = 5
Pressure canalised with enclosure outdoor = 6
Vaccuum without enclosure = 7
Vacuum with enclosure = 8
Vacuum with enclosure outdoor = 9

Options

000 ~ ZZZ

Blower speed

(1~L)
(0 = no transmission)

Motor description

Depending of size and blower

01 >> A1 >> ZZ
(0 = No Motor)

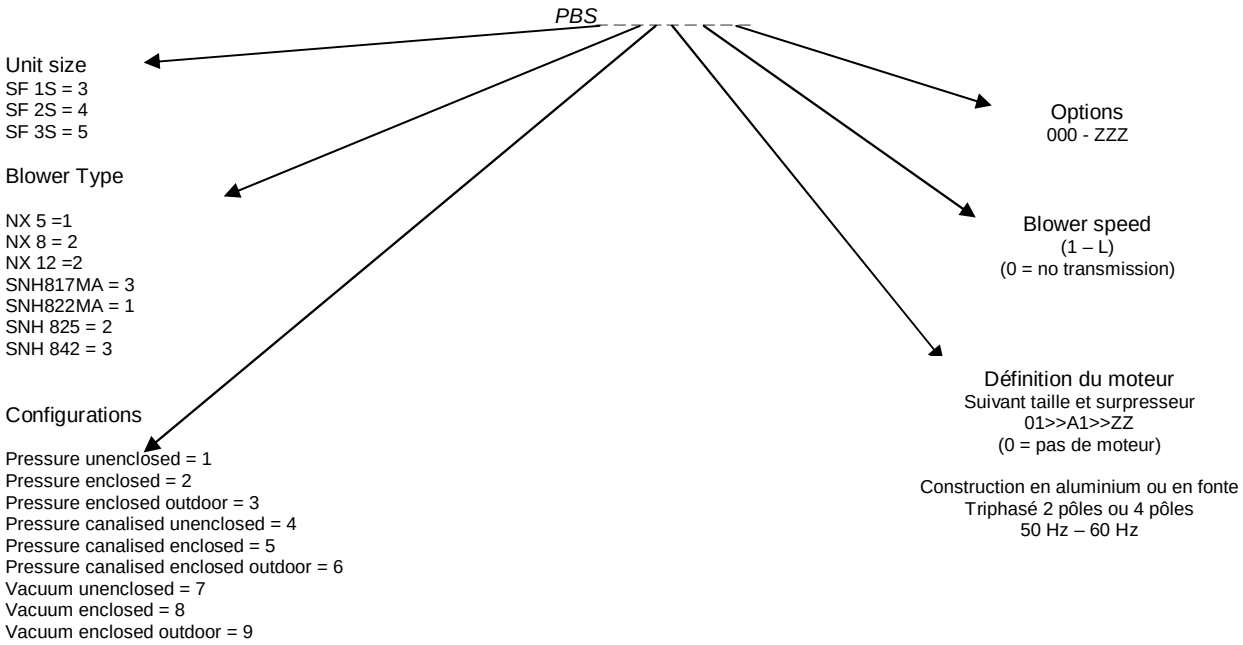
98/37/EC
89/336/EEC
73/023/EEC

Declaration of conformity

We Ingersoll Rand Air Solutions France
Hibon products
2 avenue Jean-Paul Sartre
CS 71013
59447 WASQUEHAL Cedex

declare under our sale responsibility that the product(s)

Standard Pressure Blower System configured using the PBS matrix modular build structure as shown below



To which this declaration relates is in conformity with the following standard(s)
Or other formative document(s)

EN 60204-1	Electrical safety Machines
EN 1012- 1&2	Mechanical safety of vacuum pumps and Compressors
EN292 – 1&	Safety of Machinery
EN61326	Electrical requirements for measurement, control and laboratory use-EMC requirements

(Industrial location Class a Emissions)

Followitng the provitions of

98/37/CE	Machinery Safety Directive
97/23/CE	Pressure Equipment Directive (where applicable)
89/336/CEE	Electromagnetic Compatibility Directive
73/023/CEE	Low Voltage Directive

M. Blondel
Global reliability, warranty and Engineering Manager
Low Pressure Business

Date et Lieu
Wasquehal, 15/02/08

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

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1. INTRODUCTION

1.1. Scope and definitions

This manual provides installation, operation and maintenance instruction for the Ingersoll Rand Pressure Blower and Vacuum Exhauster pumping equipment. You must use this equipment as specified in this manual.

Read this manual before attempting to install and operate this equipment. Important safety information which is highlighted as WARNING and CAUTION instruction. You must obey this instructions. The use of WARNINGS AND CAUTIONS is defined below.

WARNING

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

CAUTION

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

The following IEC warning labels appear on the pump:

Warning refer to accompanying documentation.

Warning hot surfaces.

Warning danger of injuryfrom rotating parts.

Warning noise level exceeds80dbA.

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

1.2. Pressure Blower/ Vacuum Exhauster

The Ingersoll Rand Pressure Blower package is designed for use in applications requiring high volumetric air flow at a low differential pressure. The package can be supplied as a blower, where positive pressure is supplied to the process, or as an exhauster, where vacuum pressure is applied to the process. This package comprises a positive displacement blower, driven by a timing or Vee belt drive, connected to a motor and mounted on a common base frame, which may be housed within an acoustic enclosure. Additional system components such as intake filters, unloading valve and silencers can be specified according to the application.

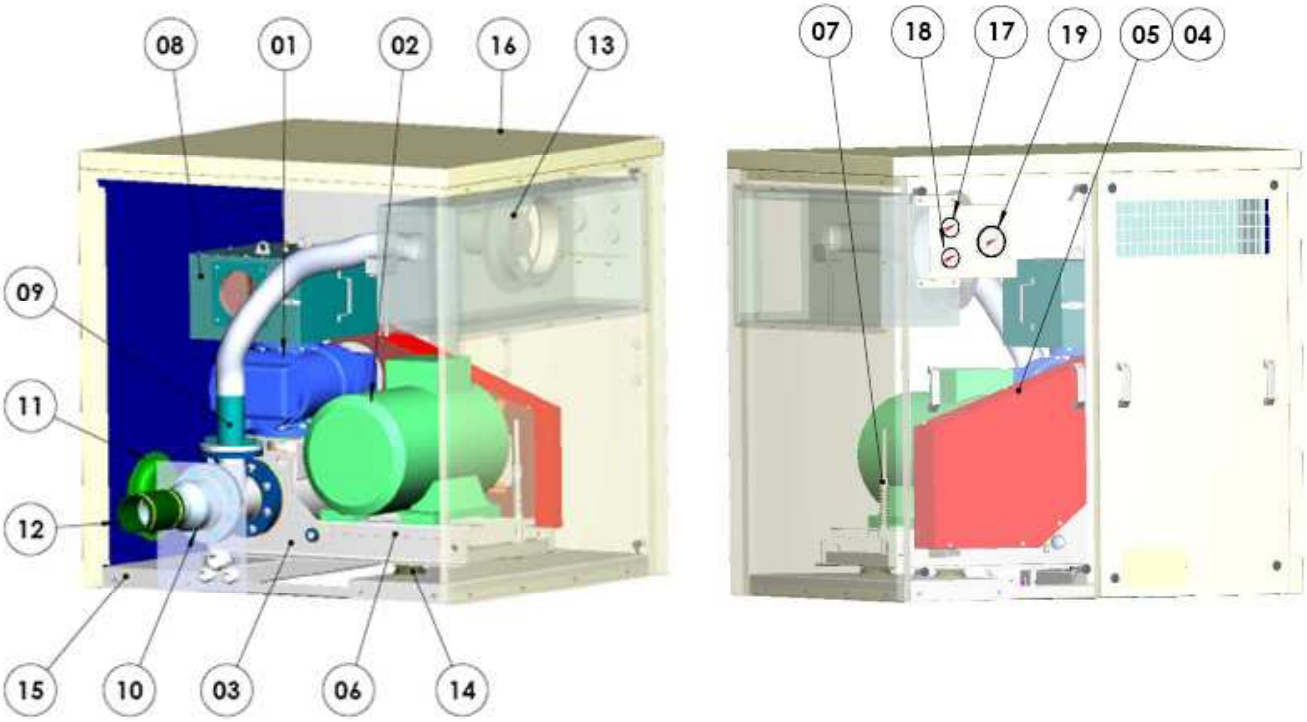
Tables 1 and 2 detail the performance characteristics for medium and high pressure blowers in Unit sizes 1 and 2.

1.3. System configuration

Depending upon your application and requirements, the system supplied to you will be configured with a various options and accessories. The exact configuration of your system is defined by the model number, which is prefixed with the letters PB. The part number matrix is shown on the Declaration of Conformity located on the inside cover of this manual.

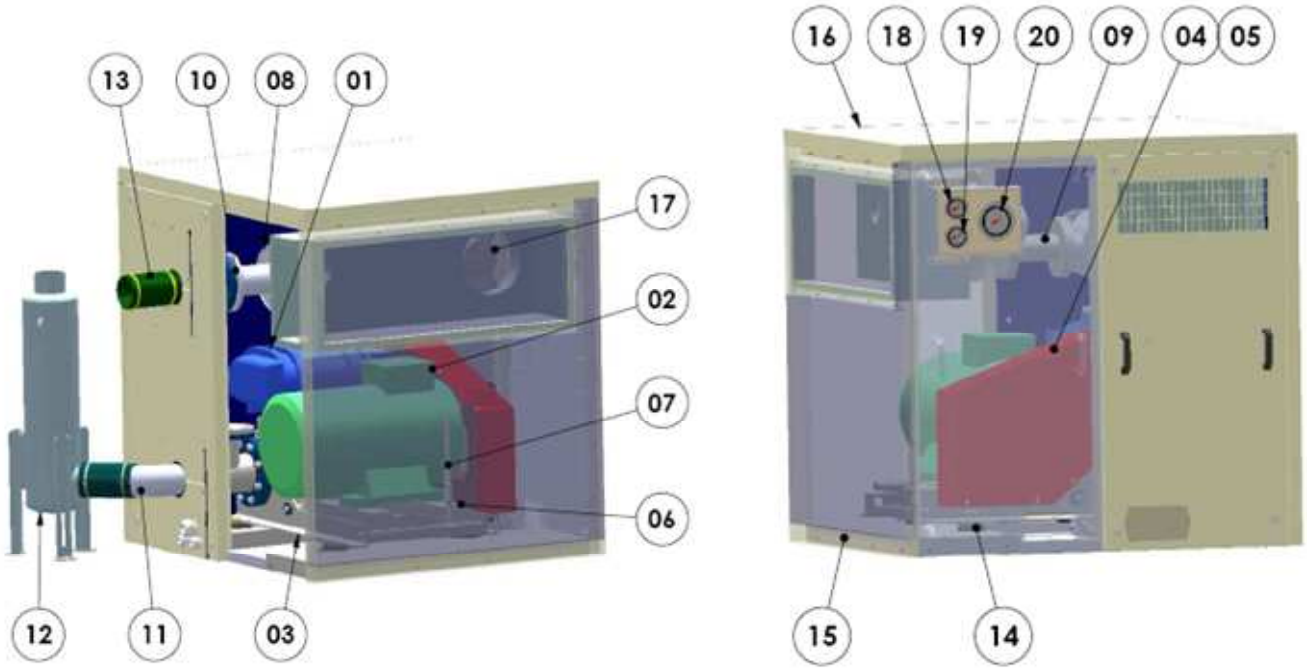
Table 1 - SilentFlow S- Pressure range

Unit size	3		4		5		
Silent Flow type	SF 1_5 S	SF 1_8 S	SF 2_12 S	SF 2_17 S	SF 3_22 S	SF 3_25 S	SF 3_42 S
Flow (m3/h)	1200	1490	2500	3180	4550	4220	5110
Delta P max. (mbar)	1000	1050	1000	1100	800	1100	930
Vacuum max. (mbar abs)	500	500	500	500	500	500	500
Blower	NX 5	NX 8	NX 12	SNH817MA	SNH822MA	SNH825	SNH842



01 Blower	06 Motor arms	11 Unloading valve	16 Acoustic enclosure
02 Motor	07 Tensionning device	12 Flexible connecting pipe	17 Pressure gauge
03 Silencer base frame	08 Filter silencer	13 Air fan	18 Fouling indicator
04 V-belt drive	09 Relief valve	14 Anti vibratory support	19 Temperature gauge
05 Drive guard	10 Non retrun valve	15 Anchor bolt	

Figure 1 - The Pressure Blower package



01 Blower	06 Motor arms	11 Silencer connecting pipe	16 Acoustic enclosure
02 Motor	07 Tensioning device	12 Outlet silencer	17 Fan
03 Silencer base frame	08 Filter silencer	13 Flexible connecting pipe	18 Fouling switch
04 V-Belt drive	09 Relief valve	14 Anti vibratory support	19 Temperature gauge
05 Drive guard	10 No return valve	15 Anchor bolt	20 Pressure gauge

Figure 2 - The Vacuum Exhauster package

1.4. System components

The following sub-sections describe various components and options that may be specified via the standard matrix. Some of these components may not be fitted to your system.

Note: It is possible that non-standard options may also be fitted. Description of the non-standard equipment will be contained in the supplementary instructions supplied with the system.

1.4.1. Blower

The blower is a two or three lobe positive displacement machine manufactured in cast iron. There are a number of capacities available, the correct choice depends upon your application.

1.4.2. Blower base/silencer unit

The blower base incorporates a primary silencer, additional optional silencer stages may also be supplied with the package depending upon the system configuration.

1.4.3. Acoustic enclosure

The acoustic enclosure provides sound attenuation for environments where it is necessary to reduce the sound level to an acceptable level. Removable panels provide access for maintenance and inspections.

The enclosure is equipped with an internal fan for removing warm air generated by the pump and motor. If the enclosure is specified as a ducted version, the warmed enclosure air can be connected to a room air extraction system.

Note: The acoustic enclosure only reduces mechanical noise emitted by the pump body and motor. Silencers on the intake and exhaust are necessary in order to reduced the sound pressure pulses generated by the pump mechanism.

1.4.4. Suction filter

The suction filter acts as an air intake filter and sound attenuator. A disposable filter cartridge removes particulates that would otherwise cause premature wear within the pump.

1.4.5. Silencer (vacuum package)

The exhaust silencer system is comprised of up to three stages. The primary stage is mounted directly to the outlet of the pump, normally within the acoustic enclosure. The secondary stage is mounted downstream of the primary silencer, in the exhaust line. The final stage is an exhaust snubber, located at the end of the exhaust line.

1.4.6. Motor

The electric motor is mounted on the base frame and transmits power to the pump through a pulley and drive belt arrangement. The size of motor fitted to the package will depend upon the desired flowrate of pumped gas and the working pressure differential (inlet and exhaust).

CAUTION
If the pumping application changes e.g. the pressure or flow conditions change, it is important to ensure that the pump and motor power requirements do not exceed their design limits.

1.4.7. Drive

The pump has an indirect drive arrangement. The drive comprises of pulleys mounted to both the motor and pump shafts. Depending upon the blower model, a set of Vee belts or timing belts transmit the power from the motor to the pump.

1.4.8. Non-return valve

The non-return valve ensures that there is no reversal in gas flow when the pump is shut down. The valve is a wafer type with a polymer or metal hinge.

1.4.9. Pressure relief valve

The pressure relief valve ensures that the discharge pressure does not exceed the design limits. It is not a pressure control valve and must not be adjusted to perform this function.

The relief valve is factory pre-set to 10% above your specified discharge pressure.

CAUTION
Do not attempt to adjust the pressure relief valve setting as this may damage the equipment. Adjustment must only be performed qualified by Ingersoll Rand service personnel.

1.4.10. Enclosure lifting base

The mounting base provides a common platform for both the pump and drive motor combination, and the acoustic enclosure. The base incorporates steel channels, allowing the unit to be positioned using a fork-lift truck.

1.4.11. Additional standard components

Other optional components such as pressure gauge, flexible pipeline connections and anti-vibration mounts may also be supplied.

1.4.12. Instrumentation/options

- Unloading valve

Various gauges and switches may also be fitted to the package.

- Enclosure temperature switch
- Inlet temperature gauge
- Discharge pressure switch
- Suction vacuum switch
- Blocked filter switch
- Two set point pressure switch
- Discharge temperature switch and/or gauge

1.5. Limits of use

1.5.1. Performance limits

The following table defines the performance limits for each size of blower that may be installed in this equipment.

Size	Tr/min		P1 (mbar)		P2-P1 (mbar)	P2/P1	T1 (℃)		T2 (℃)	T2-T1 (℃)
	MAX	MIN (1)	MAX	MIN	MAX	MAX	MAX	MIN	MAX	MAX
NX 5	4100	1200	PO+1500	PO-500	1000	2	50	-25	140	120
NX 8	3800	1200	PO+1500	PO-500	1050	2	50	-25	140	120
NX 12	3800	1200	PO+1500	PO-500	1000	2	50	-25	140	120
SNH817MA	3300	1200	PO+1500	PO-500	1100	2	50	-25	140	120
SNH822MA	3300	1200	PO+1500	PO-500	800	2	50	-25	140	120
SNH825	2960	1200	PO+1500	PO-500	1100	2	50	-25	140	120
SNH842	2250	1200	PO+1500	PO-500	930	2	50	-25	140	120

PO: Atmospheric pressureP1: Blower inlet absolutepressureP2: Blower outlet absolute pressure

T1: Blower inlet temperature
T2: Blower outlet temperature
REV MIN: Minimum speed needed for lubrication

Table 2 - Performance Limits

1.5.2. Operational limits

This equipment is not designed or licensed for use in hazardous applications or environments.

Operation of the equipment outside the specified pressure or flow characteristics may cause serious damage to the pump and motor.

WARNING

Do not use this equipment for pumping toxic, explosive or dangerous gases.

CAUTION

Do not allow fluids or liquid to enter the pump as this will cause permanent damage.

CAUTION

Do not re-circulate gases from the exhaust to the inlet. Otherwise the gas temperature rise will causing the pump to seize.

2. TECHNICAL DATA

2.1. Operating and storage conditions

Ambient (environmental) temperature:	
Operating range	- 10 ^{o} C to 40 ^{o} C
Storage range	- 30 ^{o}C to 70 ^{o} C (non condensing)
Maximum allowable temperature within enclosure	50 ^{o} C
Maximum humidity in operation	90%

2.2. Physical data

Dimensions see figures 3 and 4

Silent Flow type	SF 1_5 S	SF 1_8 S	SF 2_12 S	SF 2_17 S	SF 3_22 S	SF 3_25 S	SF 3_42 S
Power (kW)	45	45	90	90	132	132	132
Weight (kg) with enclosure	900	1035	1640	1880	2505	2535	2700
Weight (kg) without enclosure	700	835	1375	1610	2070	2100	2255
Blower type	NX 5	NX 8	NX 12	SNH817MA	SNH822MA	SNH825	SNH842

Tableau 3 - Silent-Flow série S - Poids et puissance de l'ensemble

Table 3 - Silent Flow Plus Package mass and power

Note: The figure in the table above are maximum values, refer to the system rating plate for exact details of the supplied system.

2.3. Services

Electrical supply

Motor	see the Unit rating plate
Enclosure fan	see the fan motor rating plate

2.4. Interface

Inlet connection	see table 4
Exhaust connection	see table 4

2.5. Performance

see table 1, 2

2.6. Noise level

The following values are free field measurements:

A-weighted decibels 85 dBA (maximum with enclosure)

A-weighted decibels 100 dBA (maximum without enclosure)

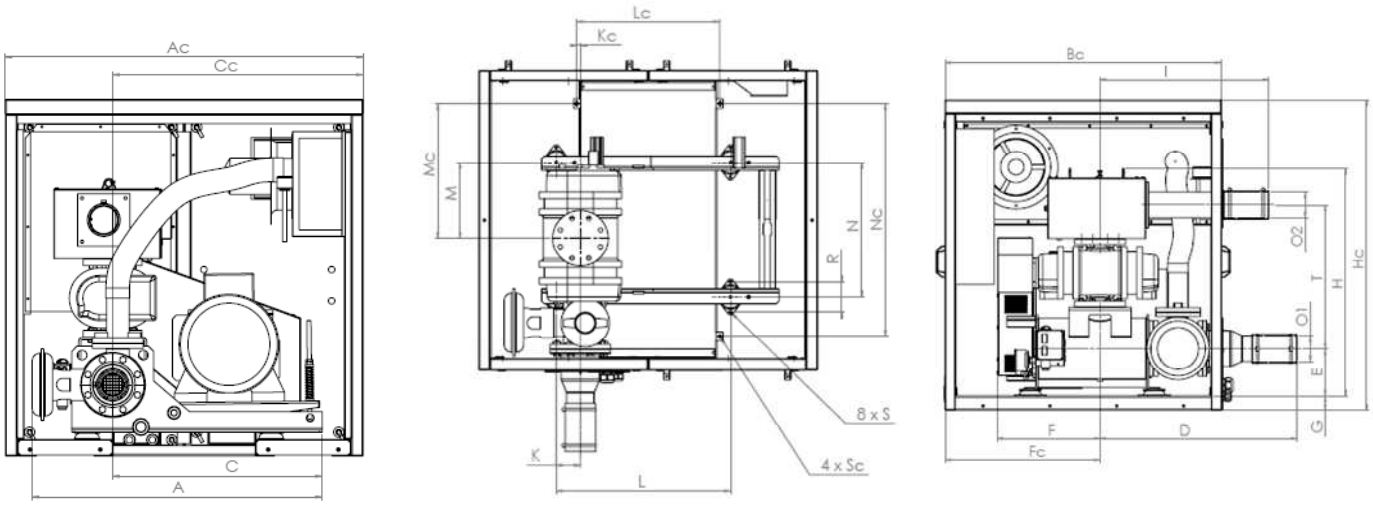
2.7. Vibration

System vibration level < 18 mms^{-1}

2.8. Legislation and standards

The standards and legislation with which this equipment complies are listed in full on the Declaration of Conformity on the inside cover of this manual.

Silent-flow S – Pressure



With enclosure

Taille de l'unité	Type	Ac (mm)	Bc	Cc	D	E	Fc	G	Hc	l*	O1	O2*	Kc	Lc	Mc	Nc	Sc	T*
3	SF 1_5 SCC	1400	1240	980	882	213	695	65	1390	757	114,3	114,3	15,5	591	556	962	14	642
	SF 1_8 SCC	1400	1240	980	882	213	695	65	1390	672	114,3	139,7	15,5	591	556	962	14	707
4	SF 2_12 SCC	1660	1560	1190	1024	224	860	70	1410	917	168,3	168,3	40	800	720	1280	14	762
	SF 2_17 SCC	1660	1560	1190	1024	224	860	70	1410	932	168,3	200 PN10	40	800	720	1280	14	852
5	SF 3_22 SCC	2000	1850	1465	1287	284	1020	90	1890	1057	200 PN10	200 PN10	25	980	880	1750	14	937
	SF 3_25 SCC	2000	1850	1465	1287	284	1020	90	1890	1057	200 PN10	200 PN10	25	980	880	1750	14	1027
	SF 3_42 SCC	2000	1850	1465	1287	284	1020	90	1890	1102	200 PN10	250 PN10	25	980	880	1750	14	1027

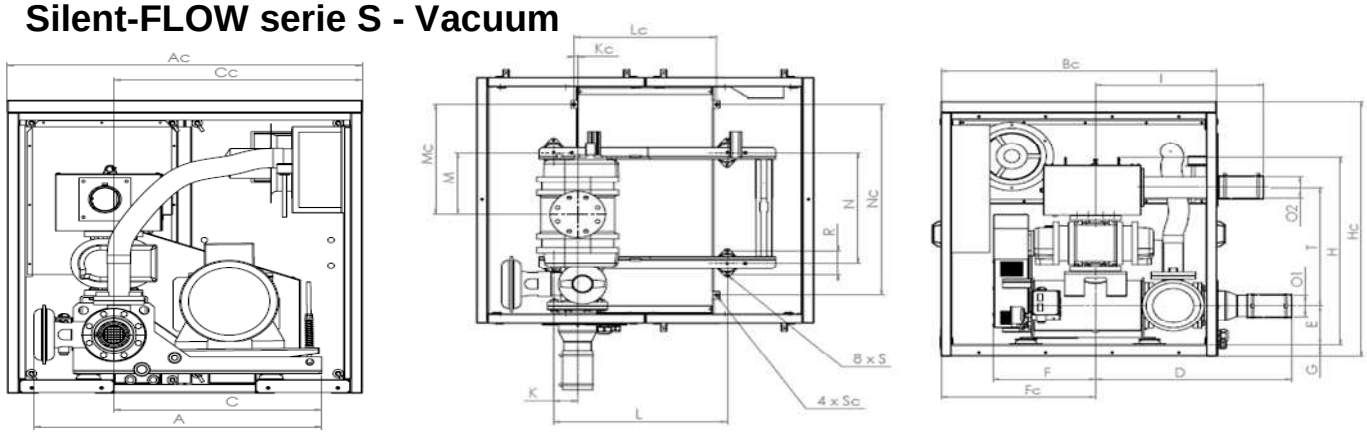
Without enclosure

Taille de l'unité	Type	A (mm)	C	D	E	F	H	l*	O1	O2*	K	L	M	N	R	S	T*
3	SF 1_5 SC	1135	820	882	213	459	1017	737	114,3	114,3	100	720	313	556	124	10,2	642
	SF 1_8 SC	1135	820	882	213	467	1142	672	114,3	139,7	700	720	313	556	124	10,2	707
4	SF 2_12 SC	1315	970	1024	224	552	1210	917	168,3	168,3	150	980	375	700	182	12,2	762
	SF 2_17 SC	1365	970	1024	224	579	1288	932	168,3	200 PN10	150	980	375	700	182	12,2	852
5	SF 3_22 SC	1635	1200	1287	284	719	1538	1057	200 PN10	200 PN10	150	1205	493	891	240	14,5	937
	SF 3_25 SC	1635	1200	1287	284	699	1628	1057	200 PN10	200 PN10	150	1205	493	891	240	14,5	1027
	SF 3_42 SC	1640	1200	1287	284	786	1653	1102	200 PN10	250 PN10	150	1205	493	891	240	14,5	1027

* dimensions for canalised version only

Figure 3 - Pressure Blower dimensions

Silent-FLOW serie S - Vacuum



With acoustic enclosure

Taille de l'unité	Type	Ac (mm)	Bc	Cc	D	E	Fc	G	Hc	I	J	O1	O2	Kc	Lc	Mc	Nc	Sc	T	U
3	SF 1_5 SVC	1400	1240	980	762	213	695	65	1390	757	123	114,3	114,3	15,5	591	556	962	14	712	45°
	SF 1_8 SVC	1400	1240	980	762	213	695	65	1390	670	123	114,3	139,7	15,5	591	556	962	14	807	45°
4	SF 2_12 SVC	1660	1560	1190	1046	224	860	70	1410	925	194	168,3	168,3	40	800	720	1280	14	840	45°
	SF 2_17 SVC	1660	1560	1190	1046	224	860	70	1410	942	194	168,3	200 PN10	40	800	720	1280	14	858	45°
5	SF 3_22 SVC	2000	1850	1465	1147	284	1020	90	1890	1077	400	200 PN10	200 PN10	25	980	880	1750	14	1067	0
	SF 3_25 SVC	2000	1850	1465	1147	284	1020	90	1890	1077	400	200 PN10	200 PN10	25	980	880	1750	14	1142	0
	SF 3_42 SVC	2000	1850	1465	1147	284	1020	90	1890	1106	400	200 PN10	250 PN10	25	980	880	1750	14	1142	0

Without acoustic enclosure

Taille de l'unité	Type	A (mm)	C	D	E	F	H	I	J	O1	O2	K	L	M	N	R	S	T	U
3	SF 1_5 SV	990	820	762	213	459	1080	757	123	114,3	114,3	100	720	313	556	124	10,2	712	45°
	SF 1_8 SV	1033	820	762	213	467	1215	670	123	114,3	139,7	100	720	313	556	124	10,2	807	45°
4	SF 2_12 SV	1183	970	1046	224	552	1269	925	194	168,3	168,3	150	980	375	700	182	12,2	840	45°
	SF 2_17 SV	1294	970	1046	224	579	1299	712	194	168,3	200 PN10	150	980	375	700	182	12,2	858	45°
5	SF 3_22 SV	1475	1200	1147	284	719	1631	847	400	200 PN10	200 PN10	150	1205	493	891	240	14,5	1067	0
	SF 3_25 SV	1526	1200	1147	284	699	1706	847	400	200 PN10	200 PN10	150	1205	493	891	240	14,5	1142	0
	SF 3_42 SV	1526	1200	1147	284	786	1706	846	400	200 PN10	250 PN10	150	1205	493	891	240	14,5	1142	0

Taille de l'unité	O3 (mm)	V	W	X
3	114,3	200	315	980
4	168,3	235	420	1374
5	219,1	270	470	1734

Figure 4 - Vacuum Exhauster Dimensions

3. INSTALLATION

3.1. Safety

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

WARNING

This equipment must be positioned under good lighting conditions.

- A suitably trained technician must install this equipment.
- Ensure that the installation technician is familiar with the safety procedures which relate to the pumped gases.
- Safely route and secure all cables, hoses and pipes during installation, so that people cannot trip over them. • Vent and purge the process system before you start installation work.
- Check that all the required components are available and of the correct type before you start.
- Isolate the other components in the process system from the electrical supply so that they cannot be operated accidentally.
- The sound power level of systems supplied without an acoustic enclosure may exceed 95dbA under certain conditions. When approaching unenclosed units or if opening doors on systems supplied with acoustic enclosures always wear ear defenders.
- If necessary, contact Ingersoll Rand or your supplier for advice on isolation-valves, or other components suitable for your application and system design.
- Consult the Safety Information booklet, publication number P400-40-100 for further advice on safety issues.

3.2. System design considerations

The inlet and exhaust pipe diameter must be equal too or greater than those on the unit.

Unit size	3		4		5		
Silent Flow type	SF 1_5 S	SF 1_8 S	SF 2_12 S	SF 2_17 S	SF 3_22 S	SF 3_25 S	SF 3_42 S
Inlet connection (for canalised version only)	tube 114,3	tube 139,7	tube 168,3	bride DN200 ISO PN10	bride DN200 ISO PN10	bride DN200 ISO PN10	bride DN250 ISO PN10
Discharge connection	tube 114,3	tube 114,3	tube 168,3	tube 168,3	bride DN200 ISO PN10	bride DN200 ISO PN10	bride DN200 ISO PN10

Table 4 - Process connections

It is recommended that an outlet isolation valve and a pressure gauge fitted in the exhaust line will enable the pressure relief valve to be periodically tested.

3.3. Unpack and inspect

WARNING

All lifting operations must utilise Identified lifting points or lugs and appropriate lifting equipment.

CAUTION

The pump lubricating oil is drained before shipping.

1. Use a forklift truck or overhead crane and slings to place the unit in a convenient position.
2. Remove the plastic wrap which covers the unit. If the unit has an enclosure, remove the side panels to allow access to the 4 holding down bolts.

Note: For overseas export the palatalised unit will be fully enclosed with removable plywood panels.

3. Please keep the panels for re-packing if return shipment for service or repair may be required in the future.
4. Inspect the equipment. If any of the components are damaged, notify your supplier and the carrier in writing within three days; state the item number of the unit together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the unit if it is damaged.
5. Check that you have received all the ordered items. If any of these items is missing, notify your supplier in writing within three days.
6. If the pump is not to be used immediately, replace the packing materials. Store the pump in suitable conditions as described in Section 6.1.

3.3.1. Lifting instruction

If the shipping crate/pallet is to be positioned by crane it may be lifted whilst on its pallet by using strops slung underneath and with a spreader frame or bars overhead to prevent compression loads on the enclosure.

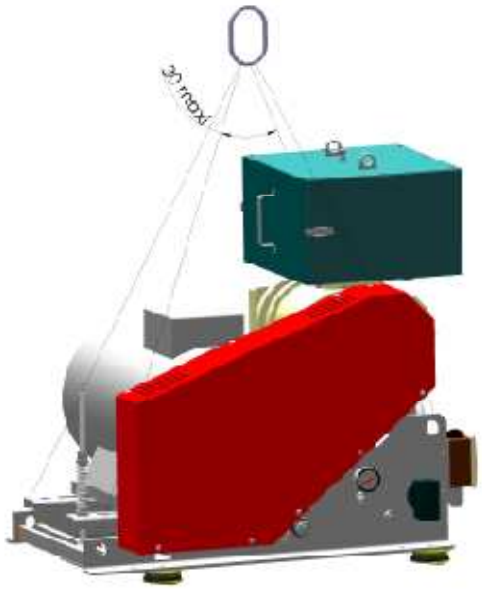


Figure 5 - Lifting the unit without an enclosure fitted

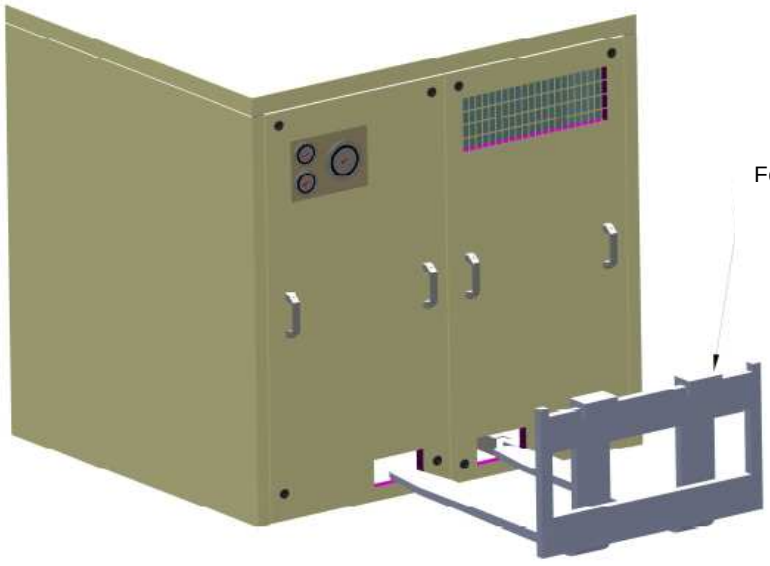


Figure 6 - Lifting the unit with an enclosure fitted

To remove the unit from its pallet:

- If an acoustic enclosure is fitted, remove the forklift way cover
- Release the 4 holding-down bolts attaching the base frame to the pallet cross-members
- Using a fork-lift truck or overhead crane, lift the package as shown in Figures 5 or 6

3.4. Foundation requirements

The unit must be mounted on a solid base. Prepare a concrete foundation at least 150mm thick with outside dimensions at least the same as that of the unit. The foundation surface is to be level and flat to within 2mm.

3.5. Locating the unit

If the unit is to be mounted indoors, ensure that there is sufficient space around the equipment to remove the inspection panels, the pump and motor.

Ensure that there is sufficient room ventilation, especially if the unit's intake is supplied by room air.

The total room ventilation air flow required is calculated as:

$$Q_v = Q_b + N_o \times 30$$

With:

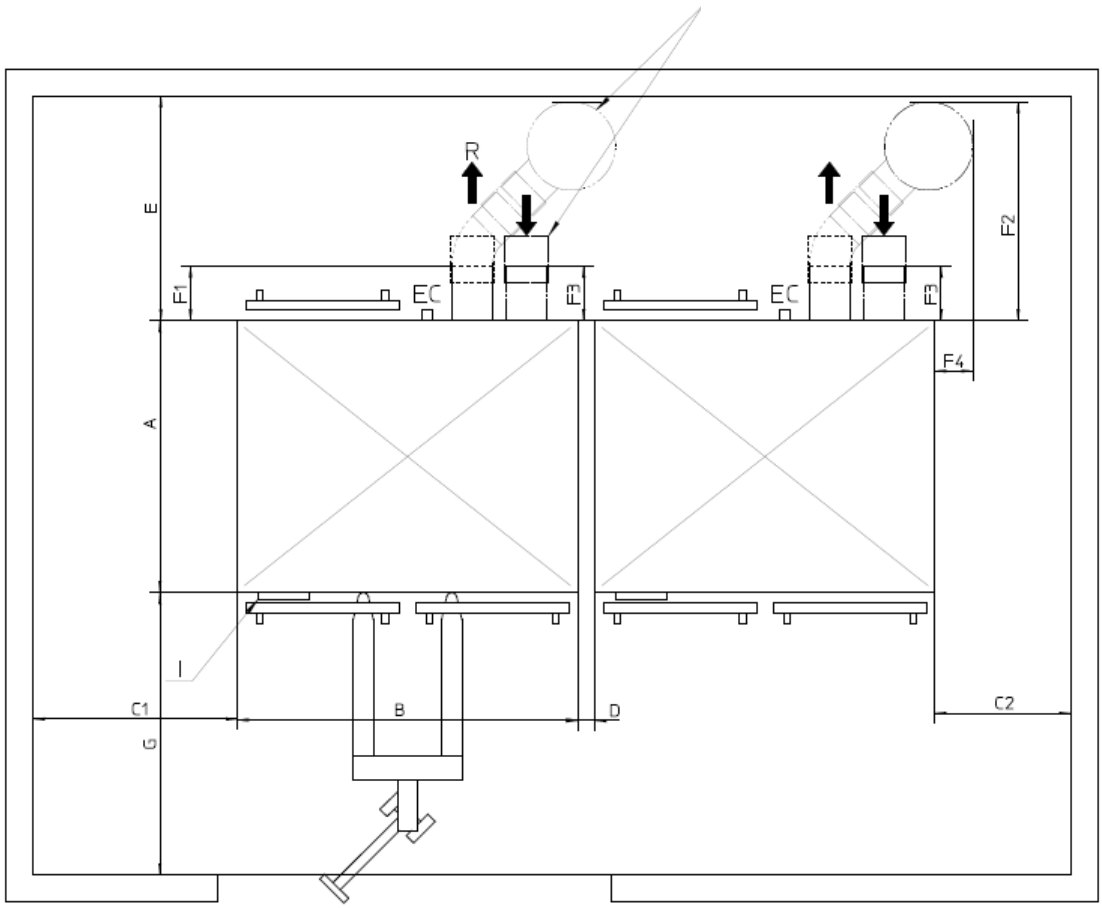
Q_v = Room volumetric flow rate ($m^3 h^{-1}$) of replacement room air required per hour

Q_b = Pump volumetric flow rate ($m^3 h^{-1}$) see tables 1 and 2 (only applicable if unit consumes room air)

N_o = Total power in kW of all motors installed in the room.

Note: The room air velocity should not exceed 4m s^{-1}

Vacuum Version



Unit size	A	B	C1*	C2*	D	E	G	F1	F2	F3	F4
3	1240	1400	750	0	0	750	1400	340	530	130	0
4	1560	1660	750	0	0	1000	1400	330	710	240	85
5	1850	2000	750	0	0	1000	1400	460	555	280	400

Figure 7 - Installation room clearances

* Left or right side access for unit removal is acceptable, use dimension D in place of C if side access from the left is required.

3.6. Mechanical installation

A common frame earth (ground) bond is fitted to this unit, ensure that it is connected to the facility earth point. Ensure also that the blower and ventilation fan motors are connected to the common frame earth.

3.6.1. Unit with an acoustic enclosure

1. Lift the unit as described in section 3.3.1
2. Position and level the unit centrally on the prepared foundations
3. Locate the four anchor bolt-holes in the cross-members of the base frame

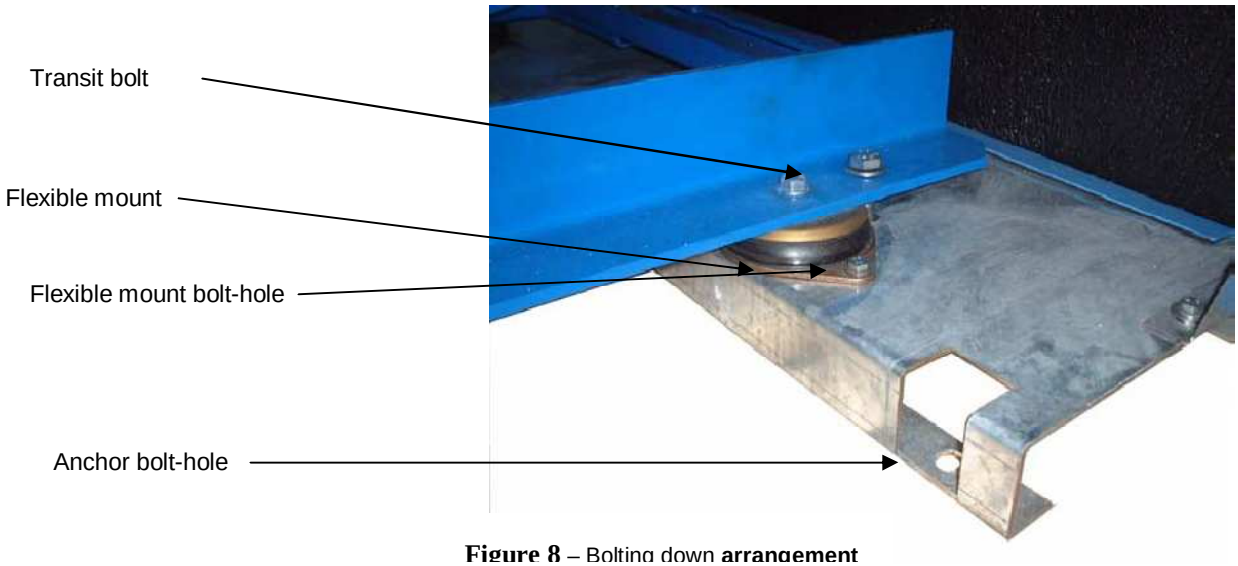


Figure 8 – Bolting down **arrangement**

4. Drill the foundation using the anchor bolt-hole locations as a template and fit 4 off 12mm diameter x 100 mm long expanding bolts with large diameter washers

5. Remove the 4 off transit bolts situated adjacent to the flexible mounts

6. Connect the unit inlet (if a piped inlet) and outlet connections to the system pipework

CAUTION
Do not allow loads to be transmitted from the process pipework to the unit's inlet or outlet connections.

7. Fill the pump casings with oil (ref section 5.6)

8. Check the drive belt tension (ref section 5.3)

3.6.2. Unit without an enclosure

1. Lift the unit as described in section 3.3.1. Fit the four off flexible mounts enclosed in the unit packaging using the M8 hexagon machine screws and washers provided.
2. Position and level the unit centrally on the prepared foundations
3. Drill the foundation using the flexible mount bolt-holes as a template and fit 8 off 6mm diameter x 50 mm long expanding bolts with large diameter washers.
   Unit size 3 : Fit 8 of 10mm diameter x 95 mm long expanding bolts with large diameter washers
   Unit size 4 and 5 : Fit 8 of 12 mm diameter x 130 mm long with large diameter washers
4. Connect the unit inlet (if a piped inlet) and outlet connections to the system pipework.

CAUTION
Do not allow loads to be transmitted from the process pipework to the unit's inlet or outlet connections.

5. Fill the pump casings with oil (ref section 5.6)
6. Check the drive belt tension (ref section 5.3)

3.7. Electrical installation

The installation of this equipment must be performed by skilled technicians familiar with current E.U. and local electrical regulations. The user must ensure that the electrical installation of the package fulfils the requirements of EN 60204-1.

WARNING

Ensure that the electrical installation of the unit conforms with your local and national safety requirements. Ensure all incoming power is connected through a mains isolation switch.

A cable bulk-head gland plate is fitted on the rear panel of the acoustic enclosure providing a secure cable entry location. A common frame earth (ground) bond is fitted to this unit, ensure that it is connected to the facility earth. Ensure also that the blower and ventilation fan motors are connected to the common frame earth.

Note: There are no electrical controls fitted to this unit. It is the customer's responsibility to ensure that the correct hardware and cables are used.

Protection devices and switches shall be so designed and connected as to be "fail safe". Start/stop devices shall be easy to operate, be clearly marked in accordance with EN 418, or IEC 417. The user shall ensure provision of over current protection of the power circuit. The safety system shall be so designed so as not to give rise to a hazardous situation in the case of disturbances such as:

- Short circuit
- External impacts
- Variations in supply voltage
- Electromagnetic fields (see EN 61326)
- Earthing faults.

After a stop caused by the safety devices, restart shall only be possible by the intentional operation of a manual reset. In the case of the loss or partial loss of main or auxiliary power, the compressor shall be brought to a safe condition by the safety system.

3.7.1. Motor connection

Connect the electrical supply from the isolator to the pump motor as described below.

1. Remove the cover from the motor terminal box.
2. Fit a suitable strain relief cable-gland and nut to the entry hole, then pass the supply cable through the cable- gland and tighten the gland. The cable-gland you use must be rated to provide seal protection of IP55 (in IEC 529) or better to the terminal-box.
3. Ensure that the links are correctly configured for your installation.

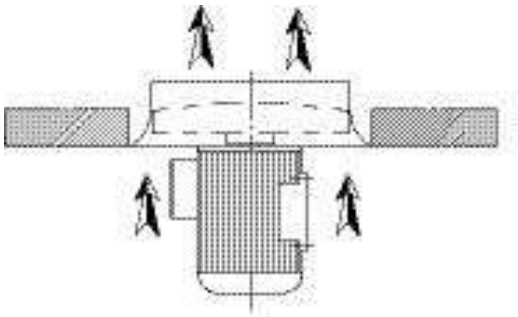
Note: Configuration details are supplied inside the motor terminal box.

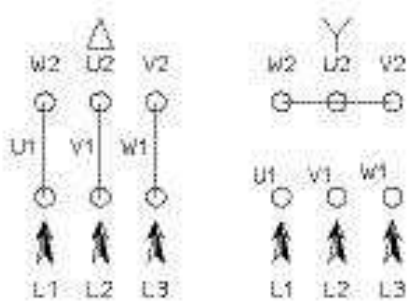
4. Connect the phase conductors of the supply cable to the terminals. We recommend that you use ring crimp connectors.
5. Connect the earth (ground) wire to the earth (ground) terminal. We recommend the use of ring crimp connectors. Check that a motor to frame ground bond is installed and connected.
6. Tighten the cable-gland nut strain-relief screws.
7. Refit the terminal box cover.
8. Check the direction of rotation is correct by momentarily starting the motor.

Note: The rotation direction arrow is located on the pump, above the drive shaft pulley.

3.7.2. Enclosure fan connection

The enclosure ventilation fan is factory wired to the local termination block.





Motor connection

It is recommended that the ventilation fan operates for a further ten minutes after the pump is shut-down to remove residual heat from the enclosure.

3.7.3. Instrument switches

If optional instrument switches are fitted to the unit, these should be wired into your control system. The switch contacts are type SPDT (normally closed & normally open) contact. Data sheets are provided as supplementary instructions to this manual.

3.7.4. Over current protection

Separate and appropriately rated over current protection devices for the blower and enclosure fan motors must be provided and installed by the user.

Note: Refer to the Unit/motor rating plates to confirm the exact voltage and current requirements for motors supplied with your unit.

4. OPERATION

4.1. Introduction

This unit is not supplied with a electrical control box or motor starters. The following sections only provides a guide for the correct operation of this unit. Some of the components are optional and may not be fitted to your system, or additional components may be supplied as non-standard options.

If in doubt, please refer to Ingersoll Rand applications specialists for further information or guidance.

WARNING

Before starting the unit, ensure that the enclosure panels and drive belt guards are in position and secured.

CAUTION

Some surfaces of the package (such as the discharge line) may become very hot during normal operation. Ensure that additional guarding is fitted as necessary to prevent accidental skin contact.

4.2. Pre-start conditions

a) Check pump oil level (both end cases). See section 5.6

b) Check drive belt tension. See section 5.3

c) Electrical power and control is available

d) Process line isolation valves are open

4.3. Normal start sequence (initial operation)

1. Connect to the process and make sure that the valves are opened. If the machine suction side is piped, it is advisable that a metal inlet strainer is fitted on the suction side during system commissioning. The strainer will trap any debris and impurities that might come through the process lines (see figure 10). After 15 minutes of initial operation, clean the strainer and after a further 24 hours, remove it and replace with a spacer.

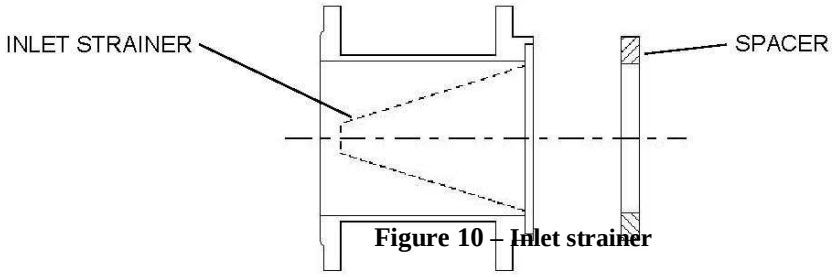


Figure 10 – Inlet strainer

Note: An Inlet strainer or spacer is not normally provided with the standard package. Please contact Ingersoll Rand sales if you require either these items.

2. Start the enclosure fan motor (if fitted) and then start the blower motor

4.4. Normal running

• Check that the unloading valve closes after approximately 30 seconds (if supplied)

• Check that the pressure relief valve is not opening under normal conditions

• Check that the suction filter gauge indicator does not show red

4.5. Shutdown sequence

1. Stop the blower motor.

2. After a further 10 minutes, stop the enclosure ventilation fan motor.

3. Isolate from the process system (if appropriate).

4.6. Alarm conditions

The following alarm conditions may be applicable to your system. Any alarm condition should illuminate a warning lamp or shutdown the unit, as required.

- Enclosure temperature switch activated
- Inlet filter switch activated
- Vacuum or pressure switch activated
- Discharge temperature switch activated

4.7. Emergency stop

An emergency stop button should be provided within your control circuit. Activation of the emergency stop should remove all power from the unit and prevent the unit from being re-energised until a manual reset button is pressed.

5. MAINTENANCE

The following routine maintenance schedule should be adopted to maintain the unit in full operating condition. Major servicing of the component parts (i.e. pump overhaul) will require the component to be removed from the unit; the instructions for such procedures are outside of the scope of this manual and it is advised that any such activity is performed by Ingersoll Rand service personnel.

WARNING

There are no safety interlocks on the cabinet panels. Ensure that the electrical supply is isolated and locked out, before starting any maintenance work.

5.1. Safety information

WARNING

Please follow the safety instructions given below.

Observe the following guidelines when carrying out maintenance on your unit:

- Ensure that maintenance is performed by a suitably trained technician. Obey your local and national safety requirements.
- Ensure that the installation technician is familiar with the safety procedures which relate to the pumped gases.
- Check that all the required parts are available and are of the correct type before you start work.
- Isolate the pump and other components from the electrical supply so that they cannot be operated accidentally.
- Allow the pump to cool (so that it is at a safe temperature for skin contact) before you start maintenance work.
- If cleaning becomes necessary for any reason, ensure that only non-flammable solutions are used. Avoid the use of solvents which may congeal and obstruct internals, or lead to corrosion.

5.2. Maintenance plan

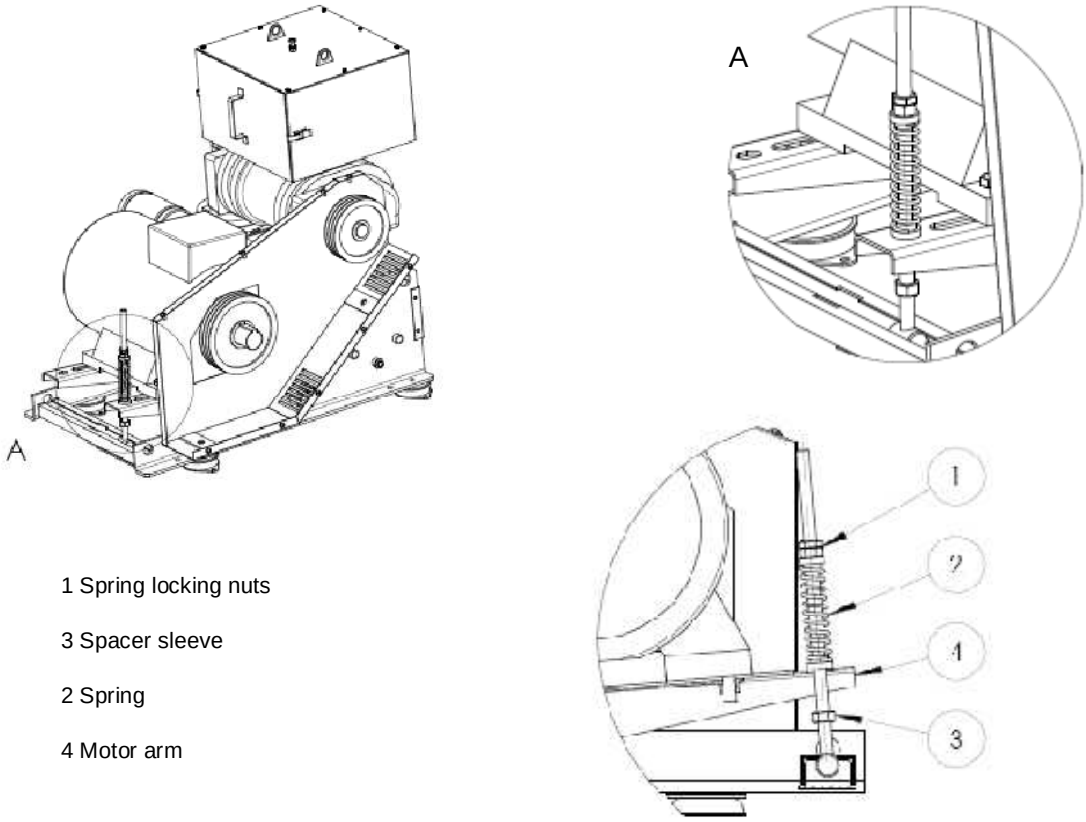
More frequent maintenance may be required if the unit is used to pump abrasive gases and vapours, or if the pump is operated continuously at the extremes of its performance or environment limits. If necessary, adjust the maintenance plan according to your experience.

Operation	Frequency	Refer to section
Check the belt tension	first 30 minutes	5.3
Check condition of the belts	first 24hrs	5.5
Check the oil levels	weekly	5.6
Check the inlet filter is not blocked	weekly	check gauge
Drain and replace the pump oil	first 200hrs / 2 wks	5.7
Check condition of the drive belts and tension	1000hrs / 6 wks	5.5
Check the enclosure air vents are not blocked	1000hrs / 6 wks	visual
Test the pressure relief valve	1000hrs / 6 wks	5.9
If the discharge temp > 120oC drain and replace the blower oil	4000hrs / 6 months	5.7
Grease the drive belt tension rod	8000hrs / yearly	n/a
Check drive pulleys for wear	8000hrs / yearly	visual
Drain and replace the blower oil	8000hrs / yearly	5.7
Replace filter cartridges	yearly	5.8
Inspect the non return valve	yearly	5.10
Replace drive belts	yearly	5.5
Inspect acoustic foam	yearly	5.11
Replace pump bearings and seals and gaskets (Standard service)	3 years	Contact Ingersoll Rand

Table 5 - Maintenance plan

5.3. Check drive belt tension

For units 3, 4 , 5, the drive belts are maintained under the correct tension by the weight of the motor. As the V-belts wear it will be necessary to periodically check that the motor arm don't seat on the nut. (see figure 11 - right hand view)



1 Spring locking nuts

3 Spacer sleeve

2 Spring

4 Motor arm

Figure 11 – Check drive belt tension

5.4. Drive pulley alignment

Visually check that the motor and pump pulleys are correctly aligned using a long straight edge or steel rule. Alignment is correct when all points A,B,C,D touch the straight edge. It is also important that the pulleys are positioned as close as possible to the motor and pump casings, to avoid excessive loads on the shaft bearings. If necessary, correct the misalignment by adjusting the motor.

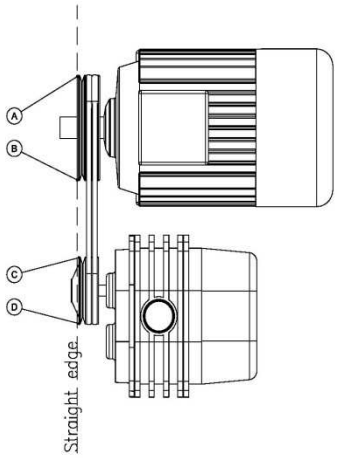


Figure 12 – Drive pulley alignment

5.5. Drive belt inspection

Visually inspect the drive belts for signs of wear. If any of the belts show significant wear or are cracked replace all the belts as a complete set.

To replace the drive belts, remove the locking nuts and spring tension nut on the tension rod. Lift the motor mounting plate and remove the belts. Fit a new set of belts and refit the locking nuts and tension spring.

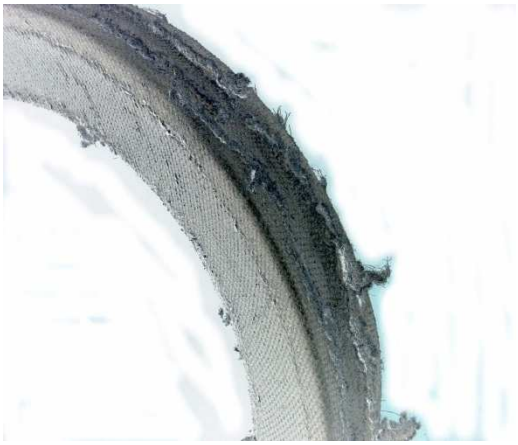


Figure 13 – Drive belt inspection

5.6. Check oil levels

The pumps have two oil cases, one at the drive end and one at the non drive end (except on the S2H22-52 series which are grease lubricated at the drive end). The oil levels should be checked when the pump is not running. The normal level should be the middle of the sight glass. Use HIBON LUBE.

Blower type	Drive end oil capacity (l)	Non drive end oil capacity (l)
NX 5	0,8	1,25
NX 8	1,5	2,1
NX 12	1,5	2,1
SNH817MA	1,8	1,5
SNH822MA	1,8	1,5
SNH825	4	3
SNH842	4	3

Table 6 - Oil case capacities

Note: Ingersoll Rand Material Safety Data Sheets for some of the oils and greases referenced in this publication are available upon request.

5.7. Pump oil draining

WARNING

Allow the pump to cool to room temperature before draining the oil.

- Unscrew the filler plug
- Unscrew the drain plug.
- Drain the oil into a suitable container
- Replace the drain plug
- Fill with correct grade of oil to mid-way on the indicator glass
- Replace filler plug

A Filling plug
B Drain plug
C Oil level sight glass

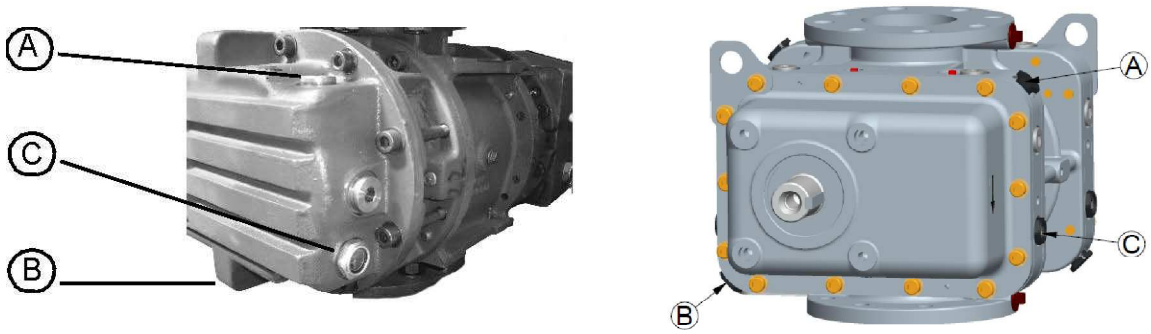
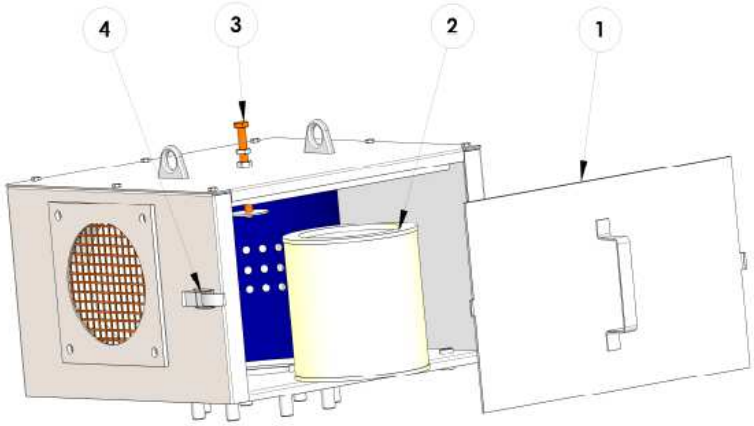


Figure 14 - Blower oil filling and drain points (For SNH version at left and NX version at right)

5.8. Filter cartridge replacement

5.8.1. Pressure blower

Open the door retaining clips on the access door (if applicable). Remove the filter element retaining nuts. Remove the filter cartridge and refit the new cartridge as shown below.

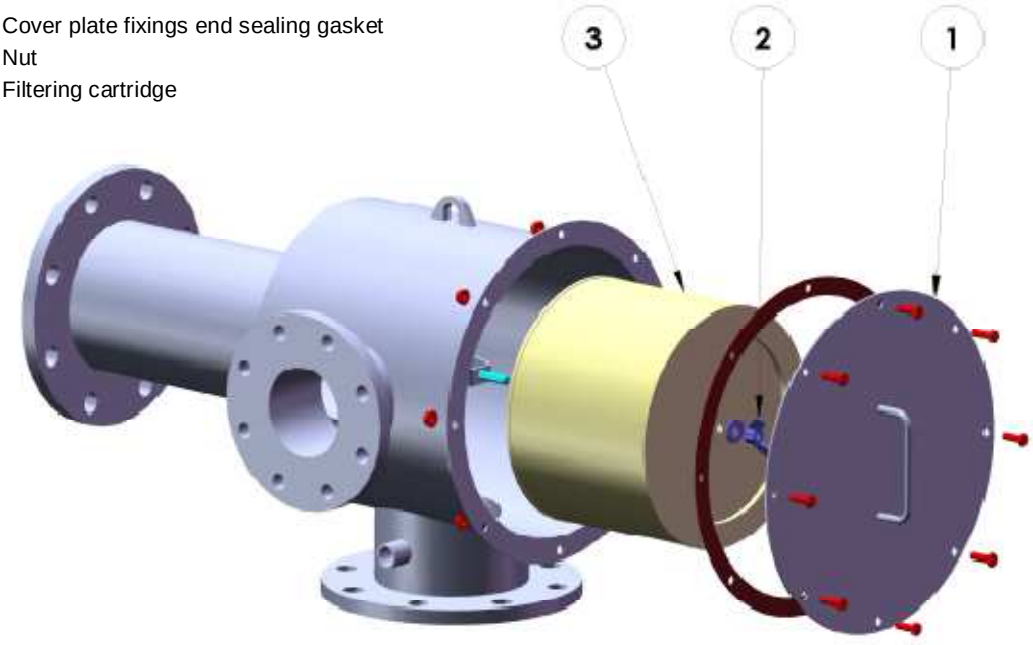


1) Access door
2) Filter cartridge
3) Fitting screw
4) Cips

Figure 15 - Pressure blower filter cartridge replacement

5.8.2. Vacuum exhauster

1. Cover plate fixings end sealing gasket
2. Nut
3. Filtering cartridge



1. Refer to the figure 16 above. Remove the cover plate fixings and the sealing gasket (1).
2. Unscrew the nut (2) and remove it.
3. Install a new filtering cartridge (3) and replace the nut (2) to maintain it in position.
4. Replace the cover plate fixings and the sealing gasket (1).

Figure 16 – Vacuum exhauster filter cartridge replacement

5.9. Testing the pressure relief valve

To test the pressure relief valve the process line should be fitted with an exhaust isolation valve and pressure gauge. With the unit running, slowly close the isolation valve until the pressure relief valve begins to lift. Check that the pressure gauge reading matches the pressure relief valve setting. The relief valve pressure setting is factory set at 10% above the specified discharge pressure (see the unit's rating plate for discharge pressure).

5.10. Inspection of the non-return valve

Disconnect the process line and remove the non-return valve. Visually inspect the valve seat and check the operation of the hinged flap. Replace if there are any signs of cracking or damage to the hinge or flap.

5.11. Inspection of the acoustic foam

Remove the acoustic enclosure panels and visually inspect the surface of the acoustic foam for signs of wear of deterioration. If defects are noticed, call Ingersoll Rand Service centre for repair or replacement.

5.12. Fault finding

The following table provides a guide to solving some common problems.

Symptom	Possible cause	Action
The machine fails to start or seizes.	The rotors are touching.	Visually check for signs of damage.
	Considerable overload applied to machine.	Check pressure and temperature.
	Foreign matter has entered the machine. Machine seized.	Inspect condition of rotors and casing. Return to Ingersoll Rand Service centre
	Belt alignment defective.	Check and readjust. Refer to section5.3/5.4
Machine emits high noise.	Rotors touching.	Visually check for signs of damage.
	Excessive gear clearance.	Consult Ingersoll Rand Service.
	Excessive bearing clearance.	Consult Ingersoll Rand Service.
	Rotors unbalanced.	Carryout complete rotor/housing cleaning. Check clearances.
Machine overheating.	Suction filter blocked	Clean or replace filter. Refer tosection 5.8
	Excessive differential pressure.	Check valve circuit and calibration. Refer to section 5.9
	Oil level or viscosity too high.	Replace oil or readjust level. Refer to section 5.6
	Clearance between rotors or rotors and casings excessive.	Consult Ingersoll Rand Service.
	Cover vent blocked. Defective fan.	Clean. Repair/replace fan.
Oil in gas stream.	Oil level too high.	Reestablish normal level after purging.
	Sealing rings deteriorated.	Refer tosection5.6 Consult Ingersoll Rand Service
Shaft seals leak	Lip seal damaged	Consult Ingersoll Rand Service
Low volume flow	Suction Filter blocked.	Clean or replace filter. Refer to section 5.8
	Pump operating outside its specified duty	Consult Ingersoll Rand Sales
	Clearances have become excessive due to wear	Visually check for signs of damage. Return to Ingersoll Rand Service centre
Absorbed power too high	Pump operating outside its specified duty	Consult Ingersoll Rand Sales
	Differential pressure has increased due to blocking of suction filter	Replace filter. Refer to section5.8
After stopping the blower runs in reverse.	Non-return valve defective.	Replace valve

Table 7 - Fault finding

6. STORAGE AND DISPOSAL

6.1. Storage

In order to maintain a satisfactory service life of the unit, the following procedures should be adopted during storage:

1. Prepare the system for storage by:
    a. Wipe clean and dry all surfaces especially those where condensation may have formed
    b. Inspect the pump for oil leakage and cap all openings with covers or blanks
2. Store the unit in a dry, even temperature compound or in an air conditioned and humidity controlled environment.
3. For storage more than six weeks:
4. Fill the pump end casings with protection oil (see table 9) up to the sight glass and turn the machine over manually a few revolutions.
5. Spray protection oil into the compression chamber, after removing the inlet filter cartridge.
6. Turn the machine over a quarter-turn every two weeks to prevent degradation of the bearings.
7. When removing the unit from storage inspect the equipment, including panel seals, for signs of deterioration, renew any defective parts.

Before re-commissioning, drain the pump end casings of the protective oil and clean the compression chamber with a suitable solvent. Refill the pump end casings with fresh lubricating oil**.**

External parts	Internal parts
MobilMobilarma778	MobilMobilarma523or 524
Esso Rust ban 324	EssoLub MZ20W/20
Shell V Product 9703	Shell Ensis motor oil 20

Table 8 - Protection oils

6.2. Disposal

Dispose of the pump, deposits removed from the pump, used pump oil, grease, used filter elements and any components safely and in accordance with all local and national safety and environmental requirements.

WARNING

Care must be taken if disassembling the pump or disposing of used components. In particular, care should be taken with fluoro elastomer products (e.g. seals) which may have decomposed as the result of being subjected to high temperatures. Care must be taken to ensure that components that have been exposed to oil must be disposed of as hazardous waste.

7. SPARES AND ACCESSORIES

7.1. Introduction

Ingersoll Rand products, spares & accessories are available from Ingersoll Rand companies in Belgium, Brazil, Canada, France, Germany, Hong Kong, Italy, Japan, Korea, Switzerland, UK, USA and a worldwide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive Ingersoll Rand training courses.

Order spare parts and accessories from your nearest Ingersoll Rand company or distributor. When you order, state for each part required:

- Model number of your equipment
- Unit serial number
- Item number and description of part

Return of Ingersoll Rand Equipment - Procedure

(Form HS1)

Introduction

Before you return your equipment you must warn your supplier if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (HS2) on the next page and send it to your supplier before you dispatch the equipment. If you do not, your supplier will assume that the equipment is dangerous and he will refuse to accept it. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

Guidelines

Take note of the following guidelines:

- Your equipment is **'uncontaminated'** if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is **'contaminated'** if it has been used with any dangerous substances.
- If your equipment has been used with radioactive substances, you must decontaminate it before you return it to your supplier. You must send independent proof of decontamination (for example a certificate of analysis) to your supplier with the Declaration (HS2). Phone your supplier for advice.
- We recommend that contaminated equipment is transported in vehicles where the driver does not share the same air space as the equipment.

PROCEDURE

Use the following procedure:

1. Contact your supplier and obtain a Return Authorisation Number for your equipment.
2. Turn to the next page(s), photocopy and then complete the Declaration (HS2).
3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories which will be returned to your supplier. Drain all fluids and lubricants from the equipment and its accessories.
4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.
6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20" x 35"); contact your supplier if you cannot meet this requirement.
8. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.
10. Fax or post a copy of the Declaration (HS2) to your supplier. The Declaration must arrive before the equipment.
11. Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.
12. Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package.

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

Return of Ingersoll Rand Equipment – Declaration

(Form HS2)

Return Authorisation Number:

You must: Know about all of the substances which have been used and produced in the equipment before you complete this Declaration• Read the Procedure(HS1) on the previous page before you attempt to complete this Declaration •Contact your supplier to obtain a Return Authorisation Number and to obtain advice if you have any questions •Send this form to your supplier before you return your equipment

Equipment model Serial Number _____

_____

Has the equipment been used, tested or operated?

yes O Go to Section 2

no O Go to Section 4

Are any of the substances used or produced in the equipment

• Radioactive yes O no O

• Biologically active yes O no O

• Dangerous to human health and safety? yes O no O

If you have answered 'no 'to all of these questions , go to Section 4.

Your supplier will not accept delivery of any equipment that is contaminated with radioactive substances, unless you:
•Decontaminate the equipment
•Provide proof of decontamination

YOU MUST CONTACT YOUR SUPPLIER FOR ADVICE BEFORE YOU RETURN SUCH EQUIPMENT

Substance name	Chemical symbol	Precautions required (for example, use protective gloves, etc.)	Action required after spillage or human contact
1			
2			
3			
4			
5			
6			

Reason for return and symptoms of malfunction:_____

_____

If you have a warranty claim:

• who did you buy the equipment from?

_____

• give the supplier's in voice number _____

Print your name:_____ Print your job title:

_____

Print your organisation:_____

Print your address:_____

Telephone number: _____Date of equipment delivery: _____

I have made reasonable enquiry and I have supplied accurate information in this Declaration. I have not with held any information.
I have followed the Return of Ingersoll Rand Equipment Procedure (HS1) on the previous page.

Signed: _____ Date _____

NOTES