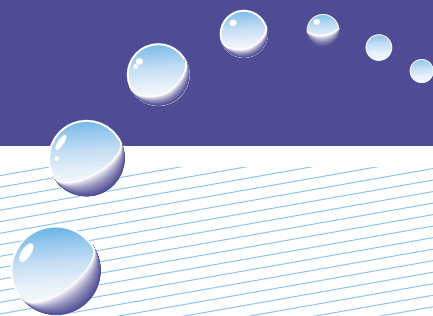




IWAKI

Pneumatic Drive Bellows Pump

FS-80NT

Instruction Manual

⚠ Read this manual before use of product

Thank you for having selected IWAKI's Pneumatic Drive Bellows Pump FS-80NT Series. This instruction manual, which is divided into 5 sections, namely "Safety Section," "Outline Section," "Installation Section," "Operation Section" and "Maintenance Section," deals with the correct handling and operation procedures for the pump. To make maximum use of the pump and to ensure safe and long operation of the pump, please read this manual thoroughly and carefully prior to operating the pump.

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Before use of the FS-80NT series pumps

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This instruction manual should be kept on hand by the end user for quick reference.

If you have any questions, contact us or your nearest dealer.

Before use of the FS-80NT series pumps

Important!

- Use a 3-position 5 port exhaust center type solenoid valve. Make sure inner pressure of both air chambers are equal to air pressure at any time pump is at a stop for the prevention of bellows deformation.
- Composite effective cross section area of exhaust piping should be 41.2 mm² or more. The residual pressure in the air chambers become higher as the cross section area is smaller than the 41.2 mm² and can lead to deformation of the bellows. If it is difficult to secure proper exhaust piping, install a quick exhaust valve.
- Use of the FDC-1 controller is recommended, however, the AC-1, FD, SC controllers are not usable to the FS-80NT series pumps. The electropneumatic regulator is not applicable, either.
- The maximum stroke speed is limited at each supply air range. See the table below.

Supply air pressure (MPa)	0.196 - 0.490	0.490 ~0.588	0.588 ~ 0.686
Max. stroke speed (spm)	200	150	110

- Differential pressure between supply air pressure and exhaust pressure is limited at each range of supply air pressure for the prevention of bellows rupture. See below.

Supply air pressure (MPa)	0.196 - 0.490	0.490 ~0.588	0.588 ~ 0.686
Differential pressure (MPa)	0.37	0.29	0.22

Important Instruction

For the Safe and Correct Handling of the Pump

- Read the "Safety Instructions" sections carefully to prevent accidents involving your customers or other personnel and to avoid damage or loss of other assets. Always follow the instructions and advice found in these sections.
- Observe and abide by the instructions described in this manual. These instructions are very important for protecting pump users from potentially dangerous conditions and situations related with the use of the pump system.
- The symbols relate to the following meanings described below:

 Warning	Nonobservance or misapplication of the contents of the "Warning" section could lead to a serious accident, including death or injury.
 Caution	Nonobservance or misapplication of the contents of the "Caution" section could lead to serious physical injury to the user or serious damage to the product.

Types of Symbols



Indicates that "Warning" or "Caution" must be exercised. Inside this triangle, a concrete and practical image provided as a warning or caution message is depicted.



Indicates a prohibited action or procedure. Inside or near this circle, a concrete and practical image of the activity to be avoided is depicted.



Indicates an important action or procedure which must be performed or carried out without fail. Failure to follow the instructions herein can lead to malfunction or damage to the pump.

Safety section

WARNING

- **Look around**

Make sure there is no one around the pump when connecting the power cable. Any power supply switch is not provided on the pump. Connecting the power cable supplies air to the pump and pump starts operation.



- **Do not remodel pump**

Never try to remodel the pump. Remodeling may be a cause of serious injury or damage. Iwaki takes no responsibility for injury or damage that may result due to any remodeling without first obtaining permission from Iwaki.



- **For specified application only**

Use of the pump in any application other than those clearly specified may result in injury or damage. Use the pump strictly in accordance with the pump specifications and application range.



- **Do not drain**

Never discharge any hazardous liquid, including but not limited to chemical liquid, over the ground or floor in the plant directly. Abide by local regulations when disposing of hazardous substances.



- **Do not touch**

Touching the pump or piping which is extremely hot due to the circulation of a hot liquid may cause severe burns. Arrange adequate hand-protective measures when feeding any liquid at temperatures higher than 50 °C.



CAUTION

- **Do not exceed the specified voltage**

Do not supply any power voltage other than specified one. Otherwise, a fire or electric shock may result.



- **Wear protectors**

Be sure to wear protective gear (protective goggles, cap, mask, acid-resistant gloves) when disassembling, assembling, or maintaining the pump. In addition, clean the pump carefully with pure water before working on the pump.



- **Qualified operator only**

The pump must be operated only by operator(s) who was trained in the safe operation of the pump.



Safety section

CAUTION

- **Power OFF**

Make sure no one turns on the power switch while working on the pump. Be sure to turn off the power switch before starting any maintenance/repair work concerning the pump. If the working site is noisy or dark, display a notice which clearly states "POWER OFF(Maintenance)," near the power switch in order to inform other personnel about the situation. Power ON executed by any other person than the operator/service personnel may result in a serious accident. The operator must take special precautions to avoid accidents.



Power off

- **Storage limit**

Risk of fire and/or health damage. Do not instal or store the pump in explosive atmosphere, dusty place, or corrosive gas (such as chlorine gas).



Prohibited

- **Keep ventilation**

When handling a toxic liquid or odorant, keep your working site ventilation. Always wear protective gear (protective mask, goggles, gloves, etc.).



- **Disposal of used pump**

Disposal of any used or damaged pump must be done in accordance with local laws and regulations. (Consult a licensed industrial waste products disposing company.)



Caution

- **Send-back to Iwaki**

Before sending the pump back to Iwaki, drain the liquid out of the pump and clean thoroughly with water to prevent any accident during transportation.



Caution

- **Pump stroke speed, Supply air pressure, Liquid temperature**

Do not run the pump at a stroke speed higher than the maximum which is shown on the item 4. Specifications. Otherwise, it could lead to deformation or short life of the bellows. The permissible liquid temperature is between 5-60deg.C. The liquid temperature beyond the permissible range can lead to deformation of the bellows.



Caution

Supply air pressure range	0.196 - 0.490 MPa	0.490 ~0.588 MPa	0.588 ~ 0.686 MPa
Max. stroke speed	200 spm	150 spm	110 spm

- **Permissible differential pressure of the bellows**

Do not operate the pump continuously beyond the specified value on the item 4. Specifications. Otherwise, the bellows life become short.



Caution

Supply air pressure range	0.196 - 0.490 MPa	0.490 ~0.588 MPa	0.588 ~ 0.686 MPa
Differantial pressure on bellows	0.37 MPa	0.29 MPa	0.22 MPa

- **Prohibited liquids**

Do not operate the pump with the following liquid.

- Liquid easily crystallizes
- Liquid containing slurry
- Solvent naphtha



Prohibited

Safety section

CAUTION

- **Liquids to be handled with care**

- Stripper
- Solvent-type liquid
- Fuming sulfuric acid
- Fuming nitric acid



Caution

- **Static electricity**

When low electric conductivity liquids such as ultra-pure water and fluor inactive liquid (e.g. Fluorinert™) are handled, the static electricity may generate in the pump, which may cause static discharge and damage pump. Take countermeasures to avoid and remove the static electricity.



- **Ambient temperature**

Use this product between 0 - 40 deg.C. of surrounding temperature.



Caution

- **Stopping pump operation**

- Before stopping pump operation, release the pressure on the discharge side first. Otherwise, the bellows may be deformed due to the residual pressure in the pump discharge side.
- If any valve is provided on the discharge side, do not close the valve upon stopping the pump. The resulting impact pressure may deform the bellows or connecting plate.



Caution

- **Pump at halt**

- Do not supply air to both the right and left air-supply ports at the same time to prevent the bellows from becoming deformed.
- Do not have the pump unused with any chemical in the bellows for a long period. Some chemical can penetrate the bellows and corrode metal material.



Caution

- **Solenoid valve**

Be sure to use a 3-position 5 port exhaust center type solenoid.



Caution

- **Composite effective cross section area**

Composite effective cross section area should be 41.2 mm² or more.



Caution

- **Air exhaust port**

Do not narrow the air exhaust port (for example by reducing the tube diameter). Otherwise the bellows may be deformed due to the residual pressure.



Caution

- **During pump operation**

- Make sure to fully open both suction and discharge-side valves.



Caution

- **Note for electrode**

The electrode occasionally fails to detect leakage. This comes from operating condition. Contact IWAKI for detail.



Caution

OUTLINE OF PRODUCT

This section deals with operating principle, type and specifications of the pump as an introduction of the pneumatic drive bellows pump.

1. Unpacking and Inspection	6
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3. Identification Codes	7
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1. Unpacking and Inspection



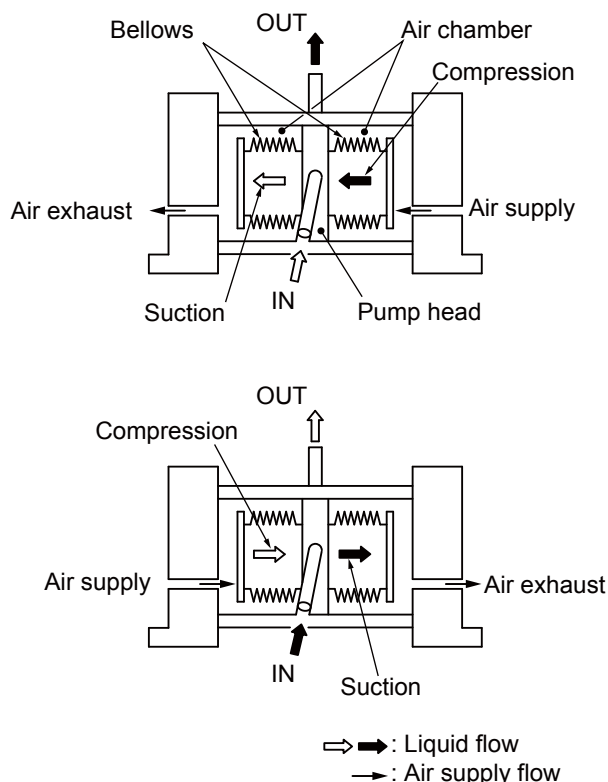
MODEL
MFG. NO.

After unpacking the product, check the following points to ascertain that the product is exactly as you ordered. If you find anything wrong, please contact your dealer.

- [1] Does the model indicated on the nameplate represent what you ordered?
- [2] Has the pump or any part of it been damaged as the result of an accident or mishandling in transit?
- [3] Have all the special accessories, if ordered, been delivered with the pump?

1. Controller
(FDC-1 type)
2. Quick exhaust valve
(Use an aluminium valve which has 0.7 or more pressure resistance)

2. Operation Principle



Suction/compression: Created by bellows stroke

Iwaki's air-driven bellows pumps are made entirely of fluororesin and designed for semiconductor manufacturing and chemical dosing processes.

The pump unit consists of two air chambers and a pair of bellows. These bellows move reciprocally in the air chambers for suction and discharge to pump liquid continuously.

- [1] Liquid is sucked into the pump head through the suction port by the expansion (suction motion) of the bellows.
- [2] The liquid is then pumped through the discharge port by the compression(discharge motion) of the bellows.

3. Identification Codes

FS - 80 N I - 01

(1) (2) (3) (4) (5)

(1) Series code

(2) Maximum discharge volume

80: 80 L/min.

(3) Operating temperature

N: 5 - 60 deg.C

(4) Pump connection port (discharge port/suction port)

T: Tube type connection (Standard)

(5) Special specifications

No symbol : Standard

01 : Special specifications (01, 02……)

4. Specifications

	Item	Specifications		
General Specification	Max. discharge volume (Note 1)	80 ℓ/min		
	Supply air pressure range	0.196-0.490 MPa	0.190-0.588 MPa	0.588-0.686 MPa
	Max. stroke speed	200 spm	150 spm	110 spm
	Permissible differential pressure	0.37 MPa	0.29 MPa	0.22 MPa
	Self-priming ability (Note 2)	1 m		
	Pump connection port	PFA tube (O.D. Ø25 × I.D. Ø22 mm)		
	Supply air connection port	Rc 3/8"		
	Max. air consumption (at max. discharge volume, max. supply air pressure)	1029 Nℓ/min	938 Nℓ/min	787 Nℓ/min
	Wet end material	PTFE, PFA		
	Liquid temp. range (deg.C)	5~60 deg.C		
	Ambient temp.	0~40 deg.C		
	Driving method	External forced switching of driving air		
Proximity switch arrangement	Type	High-frequency type proximity switch		
	Output	NPN DC open/close output		
	Source voltage	DC10V~DC30V		

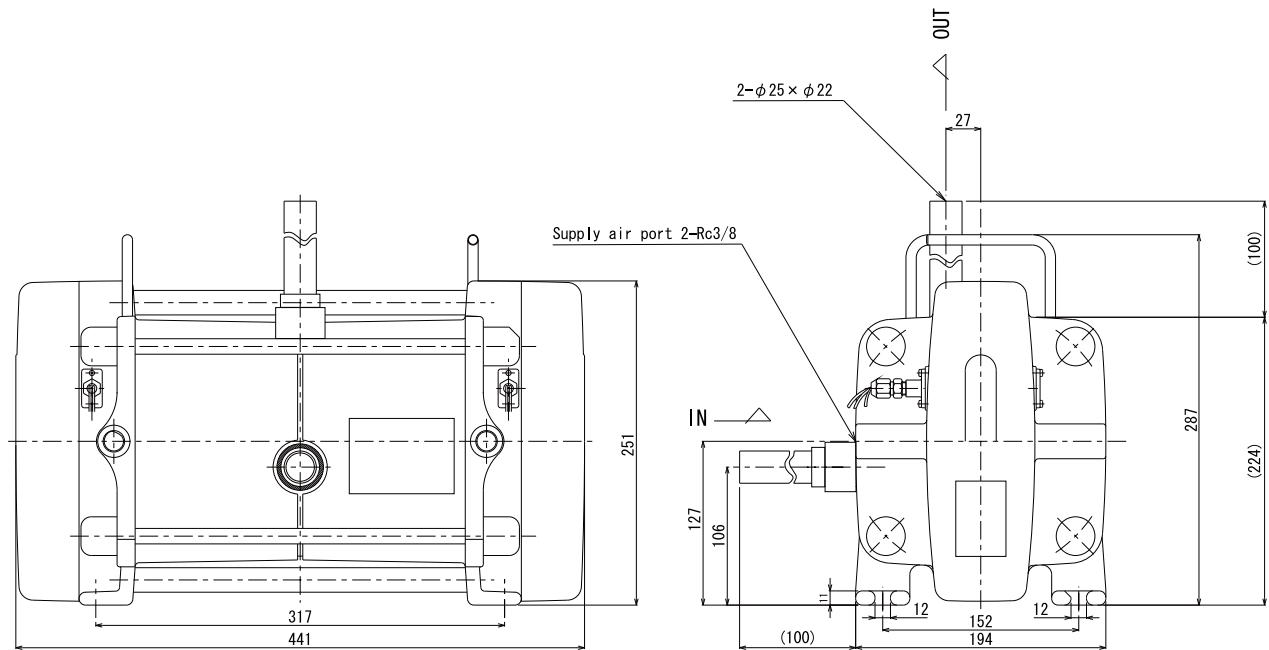
Note 1. The maximum discharge volume is on pumping clean water at room temperature.

Note 2. The self-priming height is on pumping clean water at the maximum stroke speed at room temperature.

5. Outer Dimensions/Mass

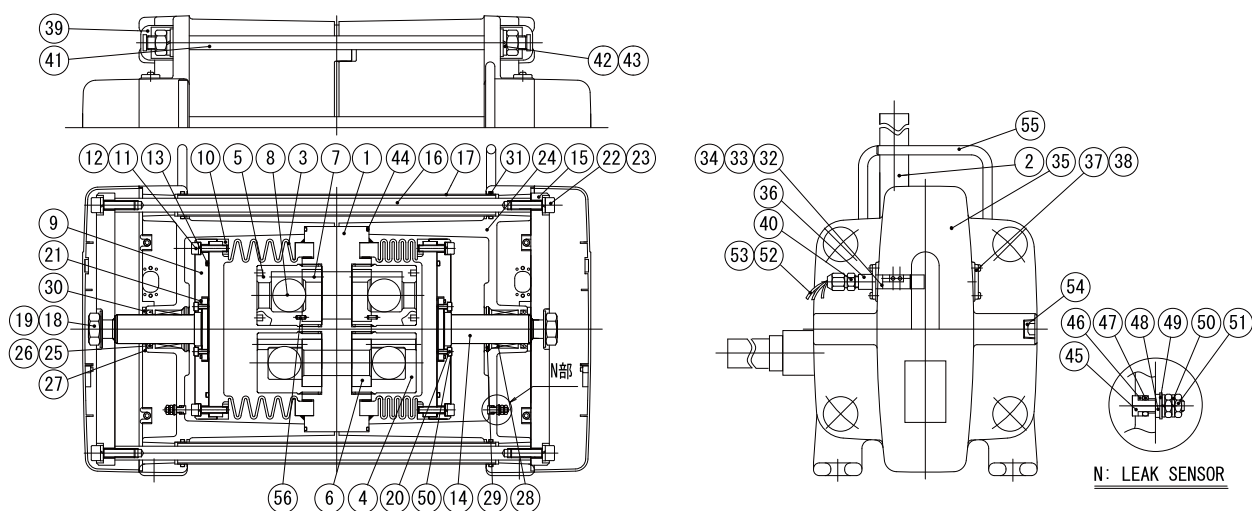
FS-80NT Mass : 23.5kg

Unit : mm



6. Names of Parts and Structure of Pump

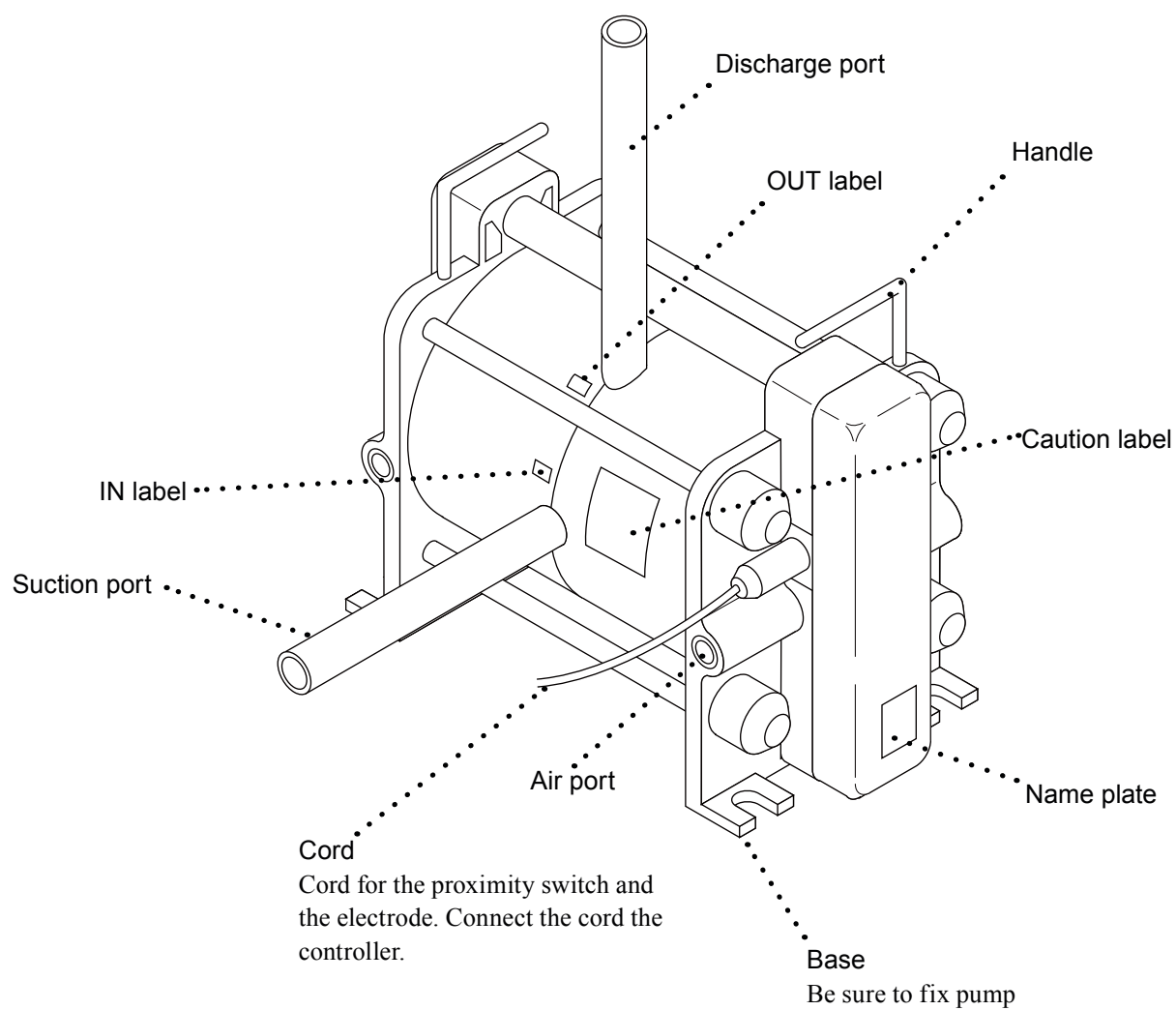
FS-80NT



No.	Parts Name	Q'ty	Material	Remarks	No.	Parts Name	Q'ty	Material	Remarks
1	Pump head	1	PTFE		29	Stop ring	2	Stainless steel	37 Nominal dia.
2	Tube	2	PFA		30	Screw	8	Stainless steel	M3×8 Precoat
3	Bellows	2	PTFE		31	O ring	4	FKM	AS568-116
4	Suction valve case	2	PTFE		32	Proximity switch	2	—	
5	Discharge valve case	2	PTFE		33	Pan head screw	4	Stainless steel	M3×8
6	Suction valve seat	2	PTFE		34	Installed base	2	SUS304	
7	Discharge valve seat	2	PTFE		35	Cylinder head cover	2	PPE	
8	Valve	4	PTFE	1 1/8"	36	Switch holder A	2	PPE	
9	Bellows plate	2	SUS304		37	Switch holder B	2	PPE	
10	Split flange	4	SUS304		38	Pan head screw	8	Stainless steel	M3×6 4F coating
11	Hex. sock. bolt	16	Stainless steel	M6×25	39	Cap	8	PP	
12	Spring washer	16	Stainless steel	M6	40	Joint	2	PP	CP-C8-R1/8
13	O ring	2	FKM	G-110	41	Stud bolt	4	SUS304	PTFE coated
14	Pump shaft	2	SUS304	Hard chrome plated	42	Plate washer	8	Stainless steel	M12
15	Connecting plate	2	SUS304		43	Spring washer	8	Stainless steel	M12
16	Connecting shaft	2	SUS304		44	O ring	2	FKM	AS568-166
17	Shaft cover	2	SUS304	4F coating	45	Leak sensor	4	SUS304	
18	Hex. nut	2	Stainless steel	M16	46	Gasket	4	PTFE	
19	Spring washer	4	Stainless steel	16 Nominal dia.	47	O ring	4	FKM	P-4
20	Hex. sock. bolt	8	Stainless steel	M4×8	48	Gasket C	4	PTFE	
21	O ring	2	FKM	S-48	49	Plate washer	4	Stainless steel	M4
22	Hex. sock. bolt	4	Stainless steel	M8×30	50	Spring washer	16	Stainless steel	M4
23	Spring washer	4	Stainless steel	M8	51	Hex. nut	8	Stainless steel	M4
24	Cylinder head	2	ADC12	4F coating	52	FF cord (black)	2	—	
25	Lip seal	2	Filler charged PTFE		53	FF cord (white)	2	—	
26	O ring	2	FKM	S-30	54	Cap. plug	2	Stainless steel	3/8" 4F coating
27	Packing stopper	2	SUS304		55	Handle	2	SUS304	4F coating
28	Bearing	2	Filler charged PTFE		56	Pin	2	PFA	

7. Description of Body and Label

⚠ Caution When cleaning the pump be careful not to wipe the labels or the pump body with solvent.



INSTALLATION SECTION

This “Installation Section” must be thoroughly understood by the user before actually installing the pump. Do not start your installation work unless confirming your understanding of the entire set of descriptions in this section.

<i>1. Before Use</i>	<i>12</i>
<i>2. Installation, Piping, and Wiring</i>	<i>14</i>
<i>2.1 Installation</i>	<i>14</i>
<i>2.2 Liquid Tubing</i>	<i>15</i>
<i>2.3 Air Piping</i>	<i>17</i>
<i>2.4 Wiring</i>	<i>21</i>

1. Before Use

Safety measures should be taken correctly for the pump unit and the entire system. Observe operating cautions and the measures to ensure the safe operation of the system, reading the following description carefully.

To operate this pump, the 3-position 5 port solenoid valve and the FDC-1 type controller are required. In addition, to enhance system safety, a quick exhaust valve must be installed.

No.	Points to be Observed	Description						
1	○ Pump stroke speed: Do not run pump exceeding the max. stroke speed which is shown on the item 4. Specifications.	● If many air bubbles are sucked through pump suction port, the pump is put into state of air locked operation and stroke rate will rise to abnormal levels. Safety measure should be taken so that pump does not run at speeds above max. stroke speed.						
2	○ Supply air pressure must be maintained within specified pressure range which is shown on the item 4.	● In view of pressure resistance of filter and protection of the bellows, keep supply air pressure low as much as possible to ensure safety. ● Any fluctuation in pressure of supplied air causes change in discharge. Attach the reducing valve to stabilize pressure. <table border="1"> <tr> <td>Pump type</td><td>Liquid temperature range</td><td>Supply air pressure range</td></tr> <tr> <td>FS-80NT</td><td>5-60 deg.C</td><td>0.196-0.686 (MPa)</td></tr> </table>	Pump type	Liquid temperature range	Supply air pressure range	FS-80NT	5-60 deg.C	0.196-0.686 (MPa)
Pump type	Liquid temperature range	Supply air pressure range						
FS-80NT	5-60 deg.C	0.196-0.686 (MPa)						
3	○ Liquid temp. range	● Temp. of pumped liquid must be within the range of 5-60 deg.C.						
4	○ Prohibited liquids ⚠ Caution Following liquids must not be used. • Liquids that are easily crystallized • Liquids containing slurry • Low conductivity carbon hydrate liquid	● Service life of valve & bellows is shortened when liquid easily crystallizes or contains slurry. Use of such liquids is not recommended. ● If solvent naphtha is used, electrostatic destruction may be generated between fluororesin & liquid, finally producing pinholes.						
5	○ Liquids to be handled with care · Stripper · Solvent type liquids · Fuming sulfuric acid · Fuming nitric acid	● Some types of strippers may cause cracks in bellows or piping (PFA) at an early stage. (Contact Iwaki for a different warranty period applied for such liquids.) ● Explosion-proof specifications are required to use solvent type liquid. (Contact Iwaki for details.) ● Ventilate a workplace air. Corrosive gas can generate if fuming sulfuric acid or fuming nitric acid is used.						
6	○ When stopping pump operation, do not close discharge valve before releasing all pressure from bellows.	⚠ Caution Stopping pump without releasing pressure in pump discharge side may result in deformation of bellows.						

No.	Points to be Observed	Description
7	Do not suspend pump operation for a long period with any liquid in the pump.	⚠ Caution Suspending pump operation for a long period with any liquid in the pump chamber may cause corrosion of the electrode or other parts due to permeation of the liquid's gas content. (The pump needs to be operated for 10 minutes every day for replacing air.)
8	Do not narrow air exhaust port. (Do not use tubing of smaller diameter than specified.)	⚠ Caution If exhaust port piping of 5 port solenoid valve is extended longer to position other than specification, & air exhaust port is narrowed, bellows may be deformed by force of supply air resulting from imbalance between discharge side pressure & supply air pressure.
9	Do not supply air to both right & left air supply ports at once when pump is stop.	⚠ Caution If air is supplied to either or both side of air chambers while pump operation is suspended, bellows are pressurized & will finally deform. The 3-position 5 port solenoid valve should be used.
10	Do not close the secondary-side air valve as stopping the pump.	⚠ Caution If the secondary-side air valve on the liquid line is closed as the pump stops, impact pressure in the bellows may cause a deformation of the bellows or connecting plate. The secondary-side air valve should be kept open except for drainage.

■ Other precautions to be taken

[1] Surface temperature of pump

⚠ Warning

Wear protective gloves. The temperature of the pump body and the piping surface is almost equal to the liquid temperature.

Model	Liquid temp.	Max. cylinder head surface temp.	Room temp.
FS-80NT	60 deg.C	32 deg.C	23 deg.C

[2] Noise from pump

Exhaust noise accompany pump operation. Apply a protective measure as necessary.

Model	Supply air pressure	Stroke speed	Sound level
FS-80NT	0.490 MPa	200 spm	76 dB(A)
	0.588 MPa	150 spm	
	0.686 MPa	110 spm	

2. Installation, Piping, and Wiring

When perceiving any danger or abnormal condition during installation or set-up work, stop the work.

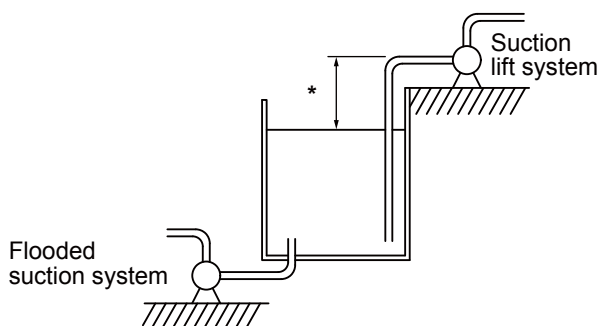
WARNING

Make sure power switch is turned off before installation or piping/wiring arrangement and is not turned on unintentionally. If the working site is noisy or dark, display a notice which clearly states "POWER OFF(MAINTENANCE)," near the power switch in order to inform other personnel about the situation. Power ON executed by any other person than the operator/service personnel may result in a serious accident. The operator must take special precautions to avoid accidents.

Only the operators/service staff who are adequately trained in safe handling procedures should be in charge of the related electric arrangement and control of the power source. Iwaki takes no responsibility for injury to person or damage to assets which results from a failure to observe this instruction. Consult us or your nearest dealer as necessary.

2.1 Installation

[1] Pump installation position



• Flooded suction system

Set the pump as close to the liquid supply tank as possible.

Caution

Arrange piping in a flooded suction system for feeding a liquid at higher temperatures than room temperature or for a liquid circulation system.

• Suction lift system

Have the suction side piping short and thick as much as possible within self-priming capacity and install the pump as close to the liquid supply tank as possible.

* Self-priming capacity

(When pumping clean water at normal temperature at the max. stroke speed)

FS-80NT : 1m

Caution

The self-priming capacity of 1m is on pumping clean water at the max. stroke speed at room temperature. The suction height differs with liquid's characteristics, temperature, or suction pipe length. For detailed information, contact Iwaki.

[2] Installation foundation

Select a flat and rigid foundation (such as a chassis) for installation, to avoid twisting motion or vibration.

[3] Direction of pump

Place the pump with its discharge port upward and suction port horizontally. Use anchor bolts to secure the pump.

[4] Retightening of stud bolts (for the secure air seal)

Tighten the stud bolts on the cylinder head at installation by 20.0N·m of tightening torque.

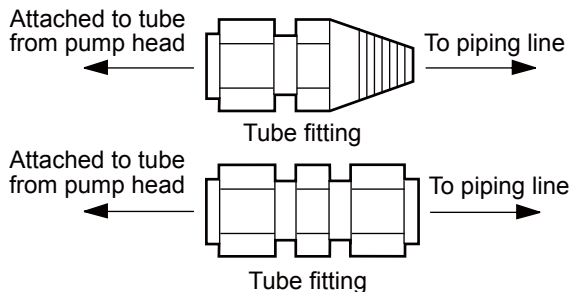
Caution

Make sure that the cylinder head is secured by stud bolts before operation. If the pump runs with the cylinder head loose, liquid or air may leak.

Tightening torque of FS-80NT: 20.0N/m

2.2 Liquid Tubing

The standard tubes for both discharge and suction ports are PFA . Connect the tubes as described below



[1] Pump port diameters and materials

The standard tube of discharge/suction port is PFA. The applicable tubing diameters are as follows.

- Tubing diameters

FS-80NT.....O.D. 25 × I.D. 22 mm

Use suitable tube fittings in diameters to tube bore. (See the figure on the left.)

- Tube bore beyond the tube fitting should be discharge/suction bore or more.

- [2] Air blow or flush tubing to get rid of foreign matter, prior to connecting with the pump.
- [3] Tubing connection should be done such that extra piping load is not applied to the pump. Use pipe supports as necessary to prevent vibration and heat generated along the piping from reaching the pump.
- [4] Pipe joints should be assembled carefully, to prevent liquid leakage, air leakage, and air suction.
- [5] General couplings can be used, however, they must be reliable against leakage within liquid temperature between 5 and 60 deg.C.

2.2.1 Points to be observed in suction pipe arrangement

- [1] Basically the suction pipe should be large in diameter, short in length, and in a flooded suction condition. Determine a height according to the self-priming capacity of the pump in suction lift system, .
 - * The suction height differs with the liquid's characteristics, temperature, and suction pipe length. For detailed information, contact Iwaki.
- [2] Install a filter or strainer on the suction pipe to prevent solid particles from entering the inside of bellows, . Select a filter or strainer of low piping resistance.

Caution

Fragments of damaged wafer chips inside the pump may get stuck in the bellows and eventually cause damage. If solid matter clogs the valves, the discharge volume may be affected because checking function can not work properly.

- [3] When installing a valve on the suction pipe, select a valve with an orifice larger than the inner diameter of pipe. A smaller orifice may result in a larger suction piping resistance and clog with a crystallized substance. Make sure to keep the valve open during pump operation.

Caution

Operating the pump with the suction side valve close, negative pressure increase in the bellows and deform the bellows inwardly.

2.2.2 Points to be observed in discharge pipe arrangement

- [1] A pump discharge load increases as discharge pipe length is longer or pipe has many bends on it. In order to decrease a load, install a dampener which minimizes pulsation. Install a check valve on discharge pipe in riser piping.
- [2] When installing a valve in discharge pipe, select a valve with an orifice whose diameter is larger than that of the inner diameter of pipe. A valve with a smaller diameter may increase the discharge piping resistance or easily be clogged with crystallized substance. Keep the valve open when the pump is in operation. Do not close the valve until the discharge pressure reaches "0" after the pump is stopped.



Caution

Do not close the valve before stopping the pump. The resulting impact pressure may deform the bellows.

- [3] A filter must be selected to meet the pump type.
Filtering area, grain-removing performance, and flow characteristics should be taken into consideration in selecting the filter. Desired flow rate may not be achieved if the selection is wrong.



Caution

The filter should be dampened well before running operation liquid. A desired flow rate may not be achieved if the filter is not dampened well.

The filter dries out if the operation liquid is not supplied for a long time. Make sure to dampen the filter prior to pump operation. Read the instruction manual of the filter for details.

- [4] The piping should be arranged to prevent residual pressure from remaining in the discharge side when the pump is stopped.
(For example, remove residual pressure by fully opening the filter and the air vent valve or arranging a return circuit.)



Caution

Residual pressure on the discharge side at pump stopping may deform the bellows.

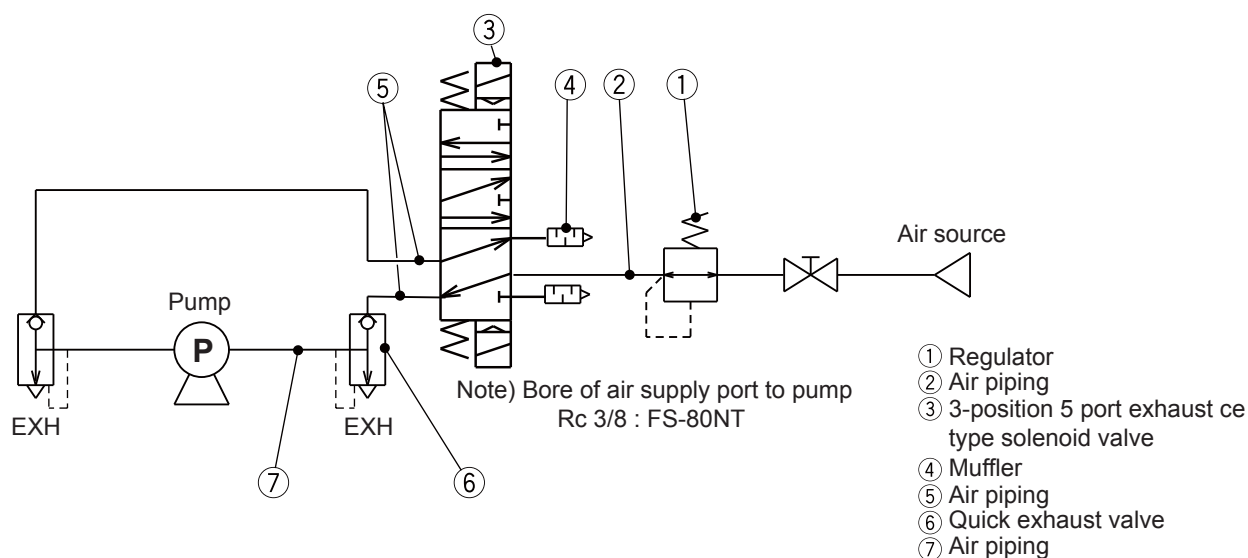
2.3 Air Piping

CAUTION

- Instrument air which is clean and free from moisture and dust should be used as supply air. If water, oil, or dust enter the supplied air, the pump may fail in starting. If water enter the air chambers, the electrode may detect it and sounds an alarm.
- The following troubles may occur with the FS-80NT pumps if the air supply piping is long and narrow.
 - a. The bellows may be deformed inwardly if remaining compressed air is not efficiently released out of the air chamber.
 - b. Discharge may be reduced because the pump can not run faster.

Complete air piping in accordance with the sample arrangement shown on the next page.

2.3.1 Sample air piping



[1] Regulator

Select a regulator on a basis of the air consumption rate of the pump. (Pressure drop should be less than 20KPa.)

Caution

Set the supply air pressure within supply air pressure range in the following table.

Pump type	Liquid temperature range	Supply air pressure range
FS-80NT	5-60 deg.C	0.196-0.686 (MPa)

Caution

Just one single regulator provided can not cover two or more electromagnetic valves, the valve located farthest from the regulator may malfunction due to insufficient delivery of pressure.

[2] Air piping

- 1) The inner diameter of air pipe between the regulator and the electromagnetic valve should be 9.5mm or more for FS-80NT.

[3] Electromagnetic valve

Use table below to select your 5 port solenoid valve.

Model	Necessary effective cross-sectional area	Diameter of port
FS-80NT	85mm ² or larger	Rc 3/8" or larger



Caution

Use the 3-position 5 port exhaust center type solenoid valve.

[4] Muffler

A muffler is installed on the exhaust port of the solenoid valve and quick exhaust valve.

FS-80NT: Select a muffler with an effective cross-section area of 160mm² or larger.

[5] Air piping

Select air pipes between the solenoid valve and pump or quick exhaust valve as specified in the following table.

	FS-80NT
Pipe length shorter than 0.5m	Inner diameter larger than 9.5mm
Pipe length 0.5 to 3m	Inner diameter larger than 11mm or use of quick exhaust valve
Pipe length longer than 3m	Contact Iwaki



Caution

Right and left air pipe length should be the same. Extremely different length can make pulsation big and can damage discharge piping.

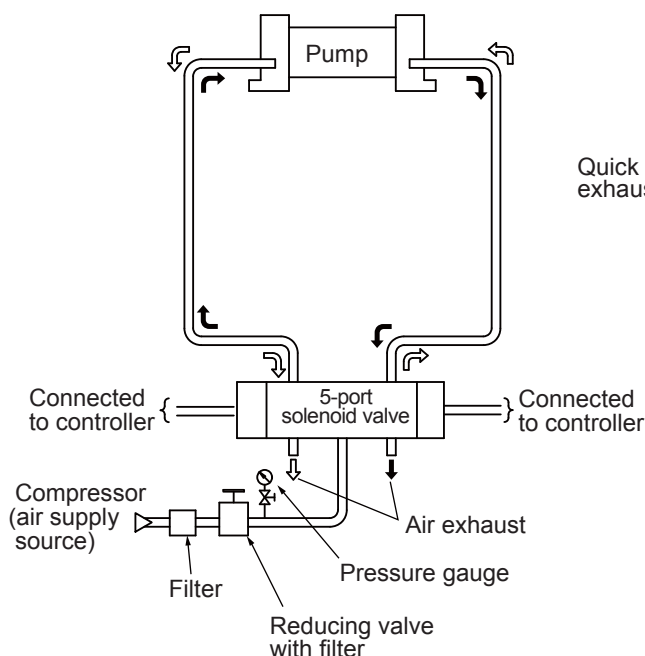
[6] Quick exhaust valve

As shown in Figure 1, the air exhausted out of the pump flows out of the system via the exhaust port of the electromagnetic valve. (Fig. 1)

Depending upon the type of liquid applied, some permeated gas may mix with the exhaust air. (The inside of the electromagnetic valve may be corroded by such permeated gas, becoming useless to the system.) In such a case, install a quick exhaust valve between the pump and the electromagnetic valve. The air will be exhausted through the exhaust port of the quick exhaust valve, as shown in Figure 2. (A limited amount of air will be exhausted through the electromagnetic valve.) The quick exhaust valve should be installed in a position close to the pump (within a distance of 0.5m), if possible, mount it directly to the supply air port. (Fig. 2)

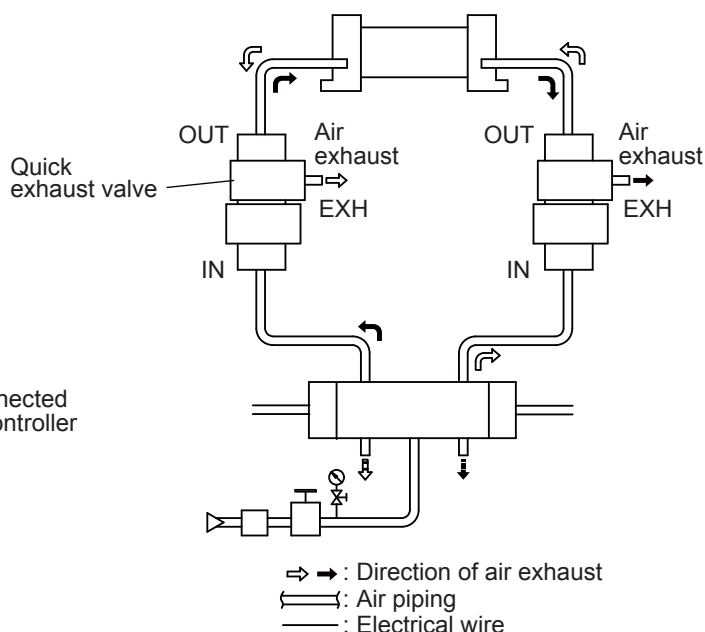
• Direction of air exhaust

Fig.1 Air Exhaust Without Quick Exhaust Valve



3-position 5 port exhaust center solenoid valve

Fig. 2 Air Exhaust With Quick Exhaust Valve



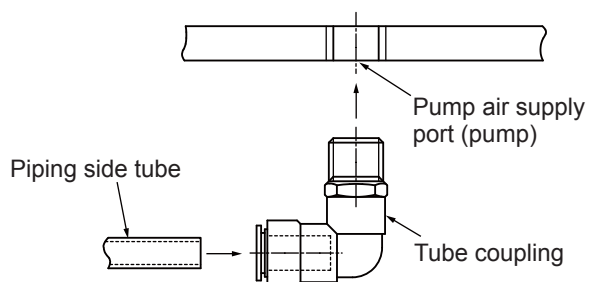
* The quick exhaust valve has the directions of IN, OUT, and EXH. (The direction symbols are stamped on the valve.) The piping should be made as shown in Fig. 2.

[7] Air piping

The air piping between the quick exhaust valve and the pump should be decided according to the following table.

	FS-80NT
Piping length	0.5m or less
Pipe inner diameter	9.5 mm or more

2.3.2 Points to be observed in air piping



[1] Diameter of pump connection port

The diameter of the connection port on the air supply side is as follows.

* Connection port diameter

FS-80NT: Rc 3/8"

[2] Install a relief type reducing valve.

Fluctuation of supply air pressure results in fluctuation of the pump stroke rate as well as discharge volume. Install a reducing valve to maintain the air pressure at a fixed level.

[3] Install a safety valve.

Install a safety valve to keep the supply air pressure within the supply air pressure range below.

Pump type	Liquid temperature range	Supply air pressure range
FS-80NT	5-60 deg.C	0.196-0.686 (MPa)

[4] Installation of air exhaust port

The exhaust ports of the air circulation system and the electromagnetic valve must be installed in correct positions so that the exhaust air is released into the open air.

⚠ Caution

Narrowing the air exhaust port may block the air exhaust out of the pump. As a result the bellows may be deformed inwardly. Determine the necessary air devices with reference to the sample air piping described in 2.3.1. on page 17.

[5] Measure to minimize exhaust noise

To minimize the noise of air exhaust, connect the exhaust port with a duct or attach a silencer on the exhaust port.

[6] Installation of multiple pumps

The air consumption of pumps (the total consumption by all pumps installed) increases in relation to the compressor capacity. The diameter of the pipe must be determined taking into consideration the total number of pumps.

2.3.3 Effective cross-sectional area

[1] Effective cross-sectional area

In the field of pneumatic devices, the term “Effective cross-sectional area” is used to indicate the capacity to allow air to flow freely. When air is sent through a pipe, the air cannot run totally through the actual cross-sectional area of the pipe due to the negative effect of the piping resistance. The defacto cross-sectional area which serves the air flow is called the effective cross-sectional area. (The value increases with the capacity which allows air or fluid to flow freely.)

- For each effective cross-sectional area value of a pneumatic device, refer to the catalogue of each device issued by the manufacturer.

[2] Determination of composite effective cross-sectional area

Air devices are connected in series with the pump. It is necessary to determine the composite effective cross-sectional area of the entire system from each effective cross-sectional area of each device. (Determination of the effective cross-sectional area on the air exhaust side.)

Composite effective cross-sectional area is determined from the following formula.

$$\frac{1}{S^2} = \frac{1}{S_1^2} + \frac{1}{S_2^2} + \text{-----} + \frac{1}{S_n^2}$$

S: Composite effective cross-section area

Si: Effective cross-sectional area of each part

Effective cross-sectional area of air device/air pipe: See the catalogue issued by each manufacturer.

Required composite effective cross-sectional area
FS-80NT type S=41.2mm² or larger

Confirm that the composite effective cross-sectional area of the actual air piping is the above mentioned or larger.

2.3.4 Preventive measures against condensation

If condensation is likely to occur in the pipe between the pump and electromagnetic valve, take the following preventive measures.

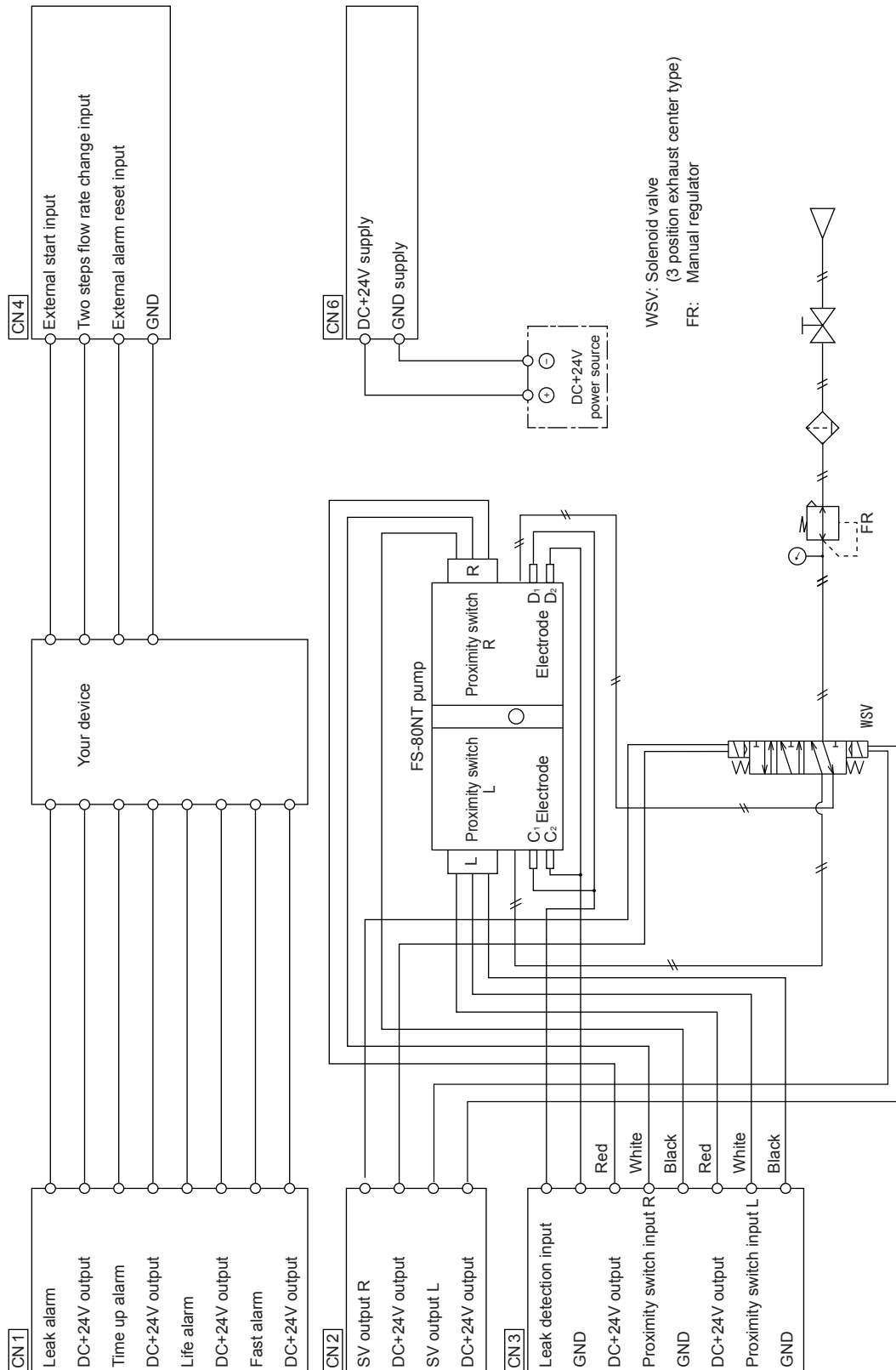
- Reduce supply air pressure as much as possible. (Reduce pump stroke speed)
- Arrange a heater (or heat insulator) system over the piping.
- Feed heated compressed air to the pump. Observe the temperature limits of the pipe joints, electromagnetic valve, and other component parts when heating the pipe or compressed air.

2.4 Wiring

The 3-position 5 port exhaust center type solenoid valve and the FDC-1 controller are required for the operation of this pump. For wiring, refer to the instruction manual of the FDC-1 controller.

2.4.1 Wiring with the AC-1 controller

The following diagram shows the connection diagram of the FS-80NT and the FDC-1 controller. Refer to instruction manual for further information.



Note 1: Electro-pneumatic regulator can not be used.

Note 2: When using the solenoid valve with 3 wire, connect it to CN2 through SV output R/L and either DC+24V outputs.

[1] Wiring for proximity switch

 Caution

The proximity switches of the FS-80NT has three wires: black, white, and red. Improper wiring may cause the proximity switch burn. Carry out the wiring carefully and accurately.

- ▶ Connect the wires (black, white, and red) of proximity switch R with terminals CN3 of the controller.
- ▶ Connect the wires (black, white, and red) of proximity switch L with terminals CN3 of the controller.

Wire color	Specification
Black	0 V
White	Output
Red	Power voltage (DC10V - DC30V)

 Warning

Standard proximity switches cannot be used when a flammable liquid such as solvent is used. Pumping of flammable liquid, the proximity switch should be in explosion-proof specifications. Ask Iwaki or your dealer.

[2] Wiring for electrode

Connect the two wires (white and black, approximately 1.8m), which extend from both the right and left sides of the pump, with controller terminals CN3.

- ▶ Join right and left white wires and connect it with controller terminal CN3.
- ▶ Join right and left black wires and connect it with controller terminal CN3.
- Never connect the white and black wires. This will result in electrical conduction between the two lines.

 Warning

The use of an electrode is prohibited when a flammable liquid such as solvent is pumped. Sparking of the electrode in a solvent application may cause a fire.

[3] Wiring for solenoid valve

Connect the cord of the solenoid valve with the controller terminal CL2. Refer to instruction manual of solenoid valve for detail information.

 Caution

Be careful about the +/- polarity in wiring. Improper polarity selection may result in breakage.

Note:

The 'normal-open' side should be installed on the proximity switch R side and 'normal-closed' on the proximity switch L side. The pump does not run if this connection is incorrect. To run the pump, interchange the air piping of the solenoid valve or interchange the wires of proximity switches R and L.

2.4.3 Wiring instructions

[1] Extension of electrode wire

Control the resistance value to $5\text{k}\Omega$ or lower, including the attached lead wire (about 1.8m in length).

Any resistance larger than $5\text{k}\Omega$ may result in inability to stop the pump. (Because detection by the auto-stop alarm will not be available due to the valve in excess of the detection range of the controller when the bellows is damaged.)

[2] Wiring of proximity switch

Separate the wires of the proximity switch from the power line or other high-voltage cable. They should not be installed in the same duct or in the same cable tube, otherwise the switch may malfunction. When extending the wire, if it is not extended beyond 30m, use a wire of 0.3mm^2 or above. If the extension is for more than 30m, use wire with a conductive resistance of $100\Omega/\text{km}$ or less.

OPERATION SECTION

Pump operation shall be limited to the range covered by and described in this instruction manual. Use of the pump in a different method or procedure that is not described in this instruction manual is prohibited. Iwaki takes no responsibility for injury to person or damage to assets which results from a failure to observe this instruction. Contact Iwaki, an Iwaki branch office, or an Iwaki distributor as necessary.

1. Preparation	26
2. Pump Operation	26
3. Points to Be Observed in Operation	27

1. Preparation

Carry out the following preparatory steps when starting the pump operation for the first time after installation or after a long-time suspension of the pump operation.

- [1] Confirm that the electric wiring has been conducted correctly. (Wiring for proximity switch and electromagnetic valve.)

 Caution

Improper wiring may cause burned proximity switch.

- [2] Confirm that the air piping has been connected correctly. Check for loose couplings.

- [3] Confirm that the pump has been fixed firmly in place.

- [4] Confirm that there is no loose coupling along the liquid piping.

- [5] Confirm the valves on the suction and discharge piping are fully opened.

- [6] Confirm that the tank or bath has been filled with liquid.

 Caution

Never fail to conduct a trial run with pure water. Confirm that the trial run indicates no abnormal condition before starting the practical operation of the pump.

- [7] Confirm that the filter has been well dampened.

 Caution

Follow the description in the instruction manual of the filter.

2. Pump Operation

During the trial run of the pump, flush the unit and piping at the same time.
(For pump operation using the FDC-1 controller, refer to the instruction manual of the FDC-1.)

2.1 Starting pump

- [1] Supply air to the pump.

- Set the regulator to a specified supply air pressure.

 Caution

Set the supply air pressure within supply air pressure range.

Pump type	Liquid temperature range	Supply air pressure range
FS-80NT	5-60 deg.C	0.196-0.686 (MPa)

- Open the air supply valve.

 Caution

Adjust the supply air valve so that the pump can not run at the speed exceeding the specified max. stroke rate. Refer to Outline of product 4. Specification.

- [2] Operate the FDC-1 controller to start the pump. Refer to the FDC-1 instruction manual for detail.

2.2 Stopping pump

- [1] Operate the FDC-1 controller to stop the pump. Refer to the FDC-1 instruction manual for detail.
- [2] Make sure the discharge-side valve is open when stopping the pump.

Caution

Do not close the discharge-side valve right after stopping the pump.

- [3] Make sure the system does not allow residual pressure on the discharge side at pump stopping.

2.3 Adjustment of discharge amount(Output)

- [1] The discharge amount of the pump shall be adjusted by changing the degree of opening the air supply valve as well as the air flow rate.

3. Points to Be Observed in Operation

Pay attention to the following points during operation.

Upon detecting any abnormal condition, stop the pump immediately and refer to "Causes of Trouble and Troubleshooting."

No.	Inspection Point	Remarks
1	Is pump stroke speed at specified level?	Stroke speed must be within specified one. (Note 1)
2	Is air pressure kept Normal?	Supplied air must be maintained within specified one.
3	Is air volume enough?	
4	Is there any leakage in sealed section of air piping or liquid piping?	
5	Is supply air clean?	

Note 1. Allowable max. stroke rate depends on supply air pressure.
(See Outline of product 4. Specifications.)

MAINTENANCE SECTION

Handling, maintenance and inspection of the pump shall be limited to the range covered by and described in this instruction manual. Handling of the pump beyond the range covered by this instruction manual is prohibited. Iwaki takes no responsibility for injury to person or damage to assets caused from a failure to observe this instruction. Contact Iwaki, an Iwaki branch office, or an Iwaki distributor as necessary.

<i>1. Causes of Troubles and Troubleshooting</i>	<i>29</i>
<i>2. Maintenance and Inspection</i>	<i>31</i>
<i>3. Consumable Parts</i>	<i>31</i>

1. Causes of Trouble and Troubleshooting

Trouble	Causes	Countermeasures	Inspection and check points
Pump does not operate.	Faulty selection of solenoid valve.	① Inspect and repair or replace.	a Use a quick exhaust valve if corrosive gas influences.
	Improper wiring or disconnection in proximity switch	① Inspect and correct wiring. ② Replace if burned.*	a Check if the three wires are arranged as described in the manual. b Check air piping and wiring.
	Bellows are damaged.	① Replace the bellows.*	a Check if supply air pressure is lower than the specification. b Check if pump stroke speed is lower than the specification. c Check if liquid temperature is lower than the specification. d Check if residual pressure is removed before pump stop. e Check if air pipe is too narrow/ long. f Check if suction pipe is narrowed.
	Increased discharge pressure in liquid filling pipe.	① Inspect the filter and replace it.	a Check filter for clogging, dry-up, or air elimination. b Check if filter is well dampened.
	Discharge side valve is closed.	① Open discharge-side valve.	
	Supply air pressure or air volume is too low.	① Set back to initial set value. (Reset)	a Set pressure higher than min. operation pressure for solenoid valve. b Secure a diameter and air flow rate in consideration of the number of pumps installed..
	Malfunction of electrode	① Remove the water content from the wet surface of the pump and the air.	a. Take measures to protect the pump from getting wet.
Pump operates but no liquid discharge.	Valve is clogged with foreign matter.	① Install a filter on the suction piping. Try to have pressure loss low.	a Check if the pump operation is unbalanced or not.
	Wear of valve and valve seat	① Replace the pump head and bellows unit*	
	Any suction side valve is closed.	① Open the suction-side valve.	a Check if valve route is blocked with crystallized substance

Note: Repair works marked by * are conducted by Iwaki.

Trouble	Causes	Countermeasures	Inspection and check points
Discharge volume is reduced.	Supply air pressure or air volume is reduced. Increased discharge pressure Wear of valve or valve seat due to clogged valve with foreign matter. Insufficient NPSHa (Net positive suction head available)	① Set back to initial set value or review air flow rate. ① Review discharge conditions. ① Replace pump head.* ① Check suction conditions.	a Secure a diameter and air flow rate in consideration of the number of pumps installed. a Check filter for clogging or dry-up. b Check if air is removed from the filter well. c Check if discharge-side valve is open. a Install pump guard filter or the like on pump suction pipe. a Check if suction pipe is too narrow or too long.
Liquid leaks.	Bellows are damaged.	① Replace the pump head and bellows unit.*	a Check if supply air pressure is lower than the specification. b Check if pump stroke speed is lower than the specification. c Check if liquid temperature is lower than the specification. d Check if residual pressure is removed upon pump stop. e Check if air pipe is narrow and long. f Check if suction pipe is narrowed.
Excessive air consumption	Wear of lip seal Stud bolt is not secured.	① Replace lip seal* ① Retight stud bolts	a. Retighting should be in accordance with specified torque on 2.1 Installation [4].
Pump function is not balanced.	Wear of valve or valve seat Faulty switchover of solenoid valve	① Replace the pump head and bellows unit.* ① Inspect and repair or replace.	a Set supply air pressure higher than min. operation pressure of electromagnetic valve.
High vibration or noise level	Pump fixation is loose. Pump stroke speed is excessively high.	① Secure the pump by tightening anchor bolts. ② Set pump stroke speed lower than the specification.	a Lower supply air pressure or reduce air flow.

Note: Repair works marked by * are conducted by Iwaki.

2. Maintenance and Inspection

WARNING

- **Wear protectors**

Make sure to wear protective gear (protective goggles, cap, mask, etc.) when carrying out maintenance and inspection work.

- **Release pressure out of piping**

Residual pressure in the piping may force the liquid and cause an unexpected accident. Release the residual pressure before starting the work.

- **Power OFF**

Make sure no one turns on the power switch while work is being done on the pump. Be sure to turn off the power switch before you start any maintenance/repair work concerning the pump. If the working site is noisy or under conditions of low visibility, you should display a notice which clearly states "Power OFF (Maintenance) " near the power switch in order to inform other personnel about the situation. Power ON executed by any other person than the operator/service personnel may result in a serious accident. The operator must take special precautions to avoid accidents.

2.1 Periodic inspection

[1] Check to ensure stroke speed is not lowered. (At least once a month.)

The stroke speed may be lowered due to air leakage causing an air consumption increase. Such a condition may be attributed to the wear of the lip seal. Replace the lip seal as necessary.

* This repair work shall be conducted by Iwaki.

[2] Check valve assembly and bellows. (At least once a month.)

Valve assembly and bellows are included in consumable parts and need to be replaced when operating time reaches their estimated life span or their performance deteriorates. (Life span at each consumable part differs with liquid to be transferred and operating condition.)

* This repair work shall be conducted by Iwaki.

[3] Operation of the pump after a long suspension

Supply air to the pump (approx. 0.196MPa) and confirm there is no air leakage from the pump discharge port before restarting the pump.

3. Consumable Parts

The consumable parts shown below must be replaced when it reaches the time to be replaced or when performance deteriorates remarkably, whichever comes first. The replacement must be done by IWAKI.

FS-80NT

No.	Parts name	Q'ty	Time to be replaced
1, 2, 3, 4, 5, 6, 7, 8	Pump head & bellows unit	1	One year(when continuous operation)
25	Lip seal	2	

Note1: The time to be replaced is just a rough guide and is not warranted. Actual life span depends on operational condition.

Note2: Q'ty is the number of parts which is attached to the pump.

Note3: Refer to page 9 "6. Names of Parts and Structure of Pump" for parts No.



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