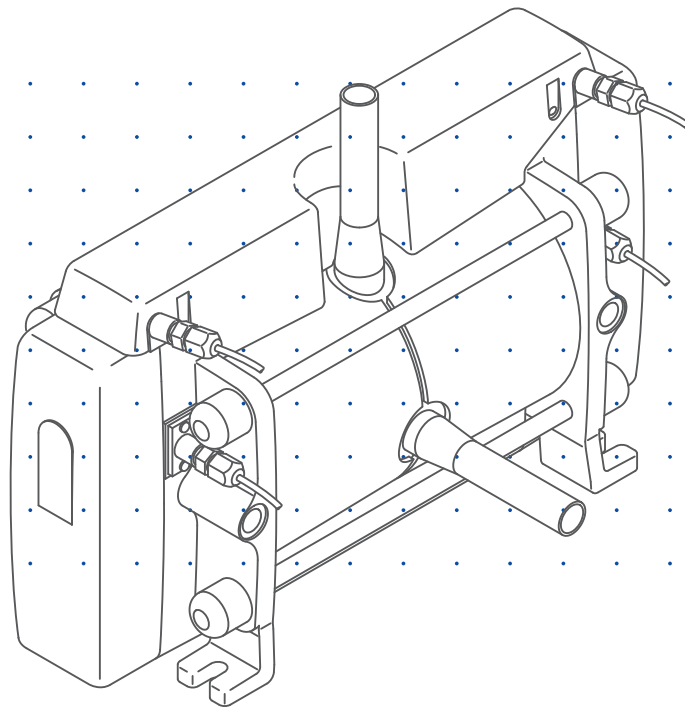



Iwaki Pneumatic Drive Bellows Pump

FLP-60W



Instruction manual

Thank you for choosing our product.

 Please read through this instruction manual before use.

This instruction manual describes important precautions and instructions for the product. Always keep it on hand for quick reference.

Order confirmation

Open the package and check that the product conforms to your order. If any problem or inconsistency is found, immediately contact your distributor.

a. Check if the delivery is correct.

Check the nameplate to see if the information such as model codes are as ordered.



b. Check if the required number of accessories is provided.

<Attached accessories>

Two pair of the straight fittings with plugs.

c. Check if the delivery is damaged or deformed.

Check for transit damage and loose bolts.

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Safety instructions

Read through this section before use. This section describes important information for you to prevent personal injury or property damage.

■ Symbols

In this instruction manual, the degree of risk caused by incorrect use is noted with the following symbols. Please pay attention to the information associated with the symbols.



WARNING

Indicates mishandling could lead to a fatal or serious accident.



CAUTION

Indicates mishandling could lead to personal injury or property damage.

A symbol accompanies each precaution, suggesting the use of "Caution", "Prohibited actions" or specific "Requirement".

Caution marks



Caution



Electrical shock

Prohibited marks



Prohibited



Do not rework or alter

Requirement marks



Requirement



Wear protection



Grounding

Export Restrictions

Technical information contained in this instruction manual might be treated as controlled technology in your countries, due to agreements in international regime for export control.

Please be reminded that export license/permission could be required when this manual is provided, due to export control regulations of your country.

⚠ WARNING



Requirement

Turn off power before work

Risk of electrical shock. Be sure to turn off power to stop the pump and related devices before service is performed. Let other people know about the situation by displaying a notice such as "POWER OFF (Maintenance)" near the power switch.



Requirement

Confirm safety in your working area

Keep away from the pump when turning on power. The pump doesn't have an ON-OFF switch. The pump starts as a power cable is plugged in.



Requirement

Stop operation

If you notice any abnormal or dangerous conditions, suspend operation immediately and inspect/solve problems.



Prohibited

Do not use the pump in any condition other than its intended purpose

The use of the pump in any conditions other than those clearly specified may result in failure or injury. Use this product in specified conditions only.



Do not remodel

Do not modify the pump

Alterations to the pump carries a high degree of risk. It is not the manufacturer's responsibility for any failure or injury resulting from alterations to the pump.



Wear protectors

Wear protective clothing

Always wear protective clothing such as an eye protection, chemical resistant gloves, a mask and a face shield during disassembly, assembly or maintenance work. The specific solution will dictate the degree of protection. Refer to MSDS precautions from the solution supplier.



Requirement

Spill precautions

Ensure protection and containment of solution in the event of plumbing or pump damage (secondary containment).



Caution

Do not touch the pump or pipe with bare hands

Risk of burning. The surface temperature of the pump or pipe rises high along with liquid temperature in or right after operation.



Prohibited

Do not remove covers

Do not remove the right-and-left cylinder head covers or the top-and-bottom covers during operation in order to reduce the risk of personal injury.



Requirement

Depressurize piping before disassembly

Release a pressure from both liquid and air lines before dismantling the pump or removing piping.

⚠ CAUTION

Prohibited

Do not lift the pump by gripping the right-and-left cylinder head covers or the top-and-bottom covers

The pump can drop unintentionally as one of those parts breaks. Hold the pump by the stud bolts to lift it up.



Requirement

Qualified personnel only

The pump should be handled or operated by qualified personnel with a full understanding of the pump. Any person not familiar with the product should not take part in the operation or maintenance of the pump.



Prohibited

Use specified power only

Do not apply any power other than that specified on the nameplate. Otherwise, failure or fire may result. Ensure the pump is properly grounded.



Requirement

Ventilation

Fumes or vapours can be hazardous with certain solutions. Ensure proper ventilation at the operation site.



Prohibited

Do not install or store the pump:

- In a flammable atmosphere.
- In a dusty/humid environment.
- In a corrosive atmosphere.



Prohibited

Do not stand on the pump

Do not use the pump as a platform. Injury or damage may result when the pump turns over.



Requirement

Flushing before operation

Flush the inside of the pump and piping with pure water or the liquid to be delivered before the start of operation.



Requirement

Do not run the pump with the following liquid:

- Liquid that easily crystallizes
- Slurry
- Low conductivity hydrocarbon liquid



Requirement

Use care handling the following liquid:

- Stripper
- Solvent
- Hydrazine
- Fuming sulfuric acid

⚠ CAUTION



Requirement

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 be generated in the pump and may cause static discharge. Take counter-measures to remove the static electricity.



Requirement

Wear part replacement

Follow instructions in this manual for wear part replacement. Do not dismantle the pump beyond the extent of the instructions.



Requirement

Before returning product

Be sure to drain chemicals and clean the inside of the pump before return so that a harmful chemical does not spill out in transit.



Requirement

Observe the maximum stroke rate

Operation above the maximum stroke rate may reduce the life of bellows. See "**Specification**" on page 67 for detail. Set the LPC-1 controller not to run the pump over the limits even under dry running.



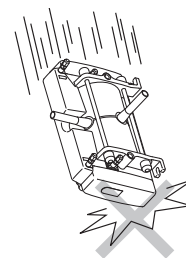
Requirement

Disposal of a used pump

Dispose of any used or damaged pump in accordance with local rules and regulations. If necessary, consult a licensed industrial waste disposal company.

Precautions for use

- During transit:
 - Do not hit/wet the package.
 - Do not place the package lateral/up side down.
 - Do not stack the package on top of another.
- Electrical work should be performed by a qualified electrician. Otherwise, personal injury or property damage could result.
- Do not install the pump:
 - In a flammable atmosphere.
 - In a dusty/humid place.
 - In a corrosive atmosphere.
- Allow sufficient space around the pump for easy access and maintenance.
- Use care handling the pump. Do not drop. An impact may affect pump performance. Do not use a pump that has been damaged to avoid the risk of electrical damage or shock.
- Do not lift the pump by gripping the right-and-left cylinder head covers or the top-and-bottom covers. The pump can drop unintentionally as one of those parts breaks. Hold the pump by the stud bolts to lift it up.
- The pump and controller are not waterproof. Do not operate the pump and controller while wet with solution or water. Failure or injury may result. Immediately dry off the pump and controller if they get wet.
- Do not close discharge line during operation. Solution may leak or piping may break.
- Solution in the discharge line may be under pressure. Release the pressure from the discharge line before disconnecting plumbing or disassembly of the pump to avoid solution spray.
- Wear protective clothing when handling or working with pumps. Consult solution MSDS for appropriate precautions. Do not come into contact with residual solution.
- Do not leave the pump with any chemical in the bellows for a long period. Some chemical gas can penetrate the bellows and corrode metal parts. Run the pump for ten minutes a day for replacing gas when the pump is going to be suspended two or three days.



Overview

Pump characteristics, features and part names are described in this section.

Introduction

Pump structure & Operating principle

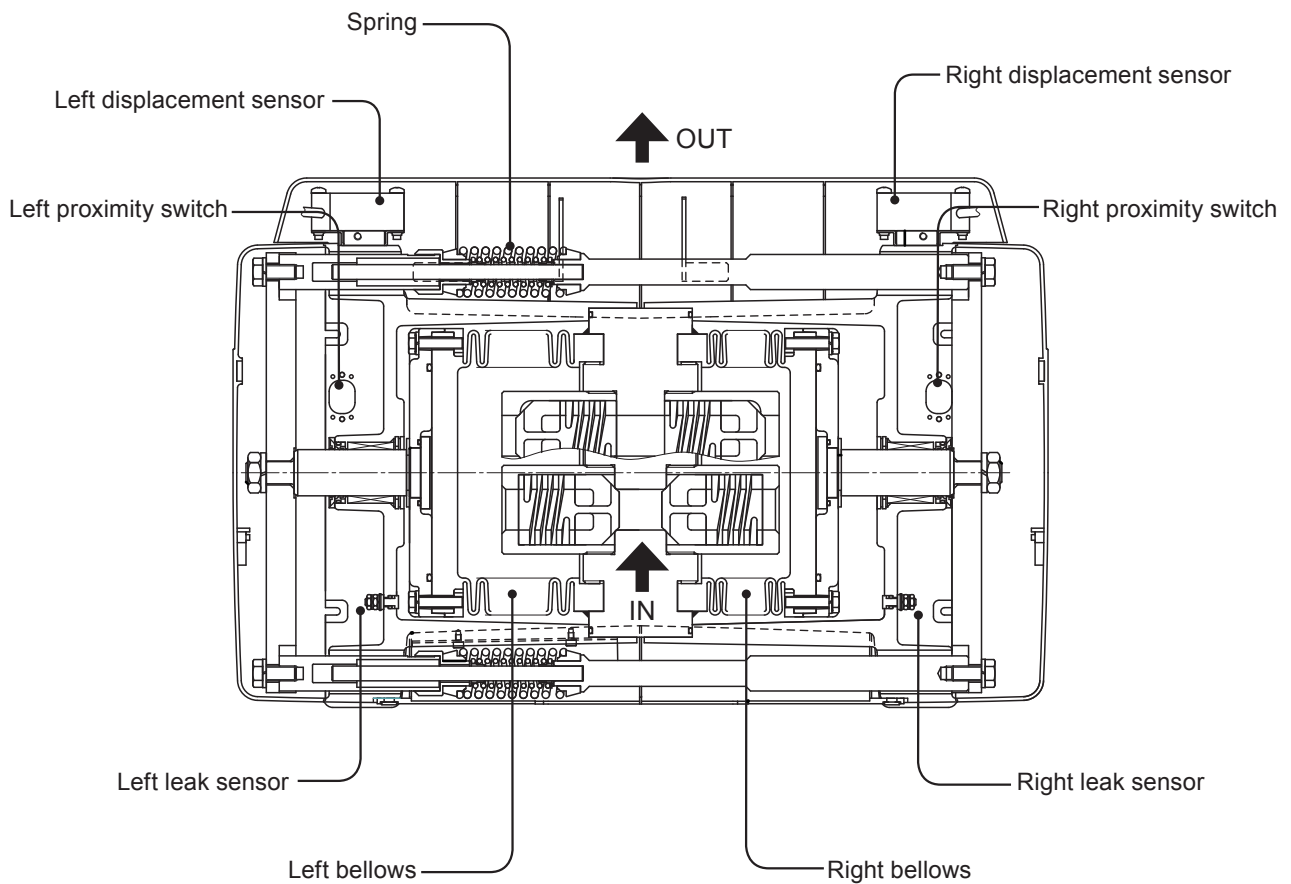
The FLP-60W is a pneumatic drive pump with a pair of bellows and is controlled with the LPC-1 controller. The special design of this pump alone reduces discharge pulsation without the assistance of a dampener, as low as the combination of existing models and a dampener can achieve.

Principle of operation

The LPC-1 controller determines and keeps the optimal movement of the bellows with the right-and-left displacement sensors and timely supply-air switching. This mechanism ensures the minimum discharge pulsation at any operating conditions as long as specifications are met.

Supply-air switching

The FLP-60W controller determines a ON/OFF time of the solenoid valves by the input from displacement sensors (ON time) and proximity switches (OFF time).



Features

- **Low discharge pulsation**

Displacement sensors and proximity switches monitor bellows movement for the LPC-1 controller to determine the optimal time to offset flow pulsations one after the other without the support of a dampener.

- **No need for a pressure and a flow sensor**

Displacement sensors and proximity switches alone monitor bellows movement. Need for a pressure and a flow sensor is eliminated.

- **Suitable for high-temperature liquid**

The maximum allowable liquid temperature increases up to 180°C.

- **Increased supply air pressure level**

The maximum allowable supply air pressure increases up to 0.5MPa.

- **Safety design**

The bellows are welded into the pump head to reduce the possibility of a leak. A leak sensor also installed in the air chamber to detects an accidental leak by bellows damage

Operation mode

- **MAN mode (Manual operation)**

Start/Stop of the pump operation with the LPC-1 controller.

- **AUTO mode (Automatic operation)**

Start/Stop of the pump operation with the signal input from user's PLC.

- **Feedback control**

The LPC-1 controller adjusts supply-air pressure to keep a constant flow under pressure fluctuation.

Safety functions

- **Leak detection**

The LPC-1 controller stops the pump upon detecting a leak from bellows.

- **Emergency stop**

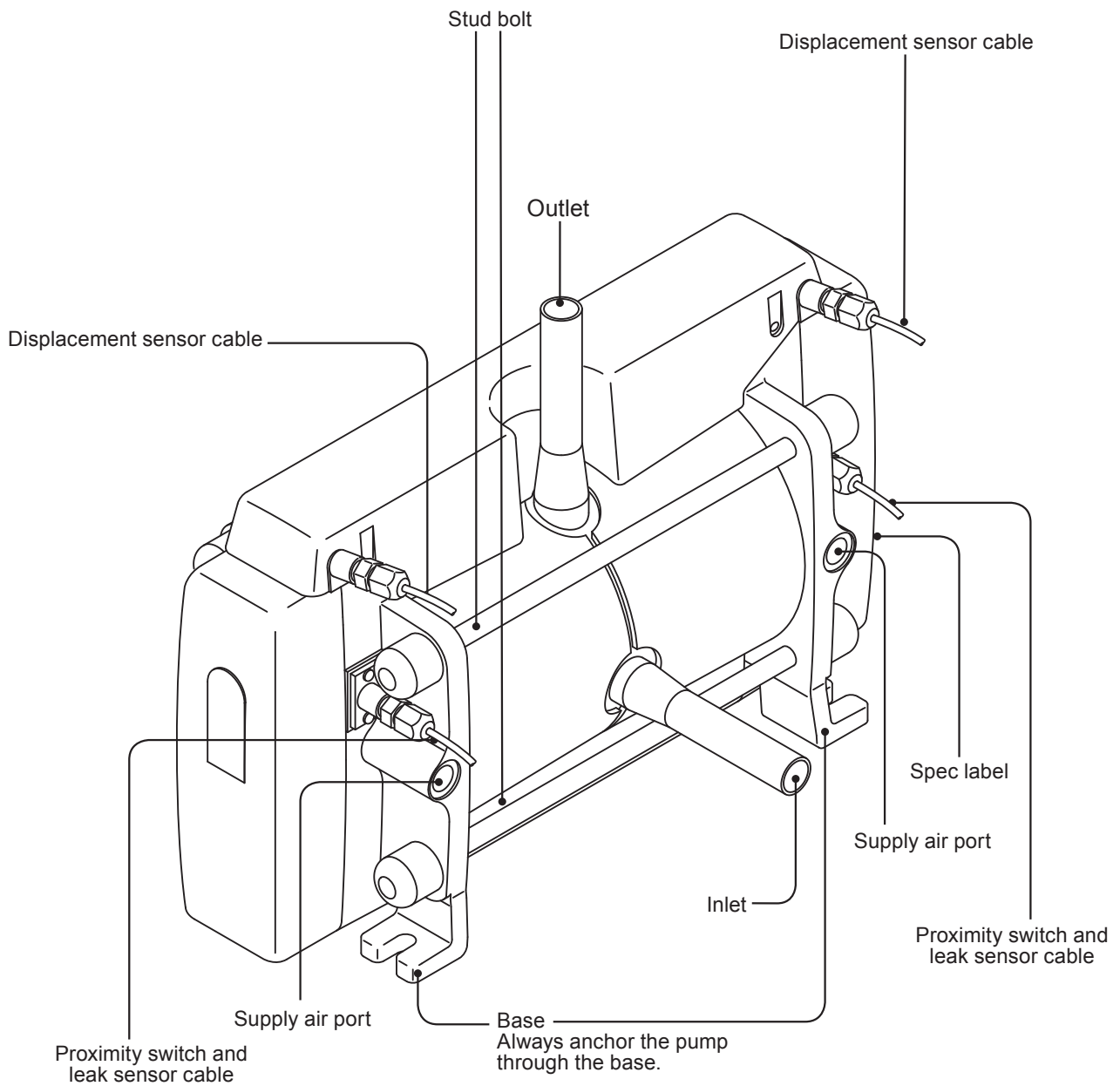
The pump stops at any time when the START/STOP key is pressed and held (2 sec).

- **Interlock**

The LPC-1 controller alarms over-speed operation when a pump runs over the maximum speed and keeps it within the limit (the max speed at each supply air pressure plus 20spm).

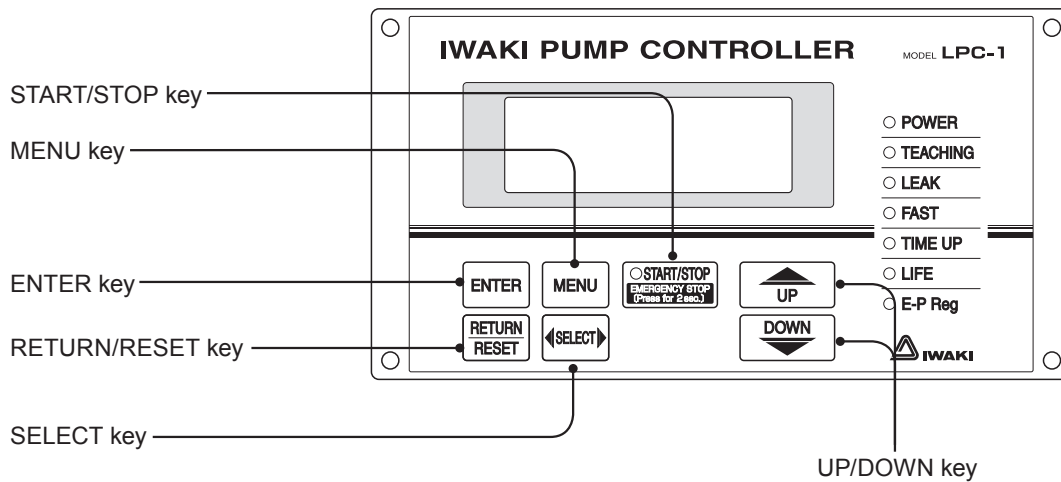
Part names

Pump



*Do not clean the pump or nameplate with a solvent such as benzine or thinner.

■ Control panel



START/STOP key

Used to start/stop the pump in MANU mode. The START/STOP LED lights during operation. The pump stops at any time during MANU or AUTO mode if the key is pressed and held for 2 seconds (emergency stop) and returns to the main menu after 7 seconds.

A push of the START/STOP key will stop the pump in AUTO mode.

MENU key

Used to display the main menu screen (if pushed once) or to point "1. PUMP MODEL" of the main menu (if pushed twice).

ENTER key

Used to determine setting.

RETURN/RESET key

Used to return to a previous menu or to reset an alarm.

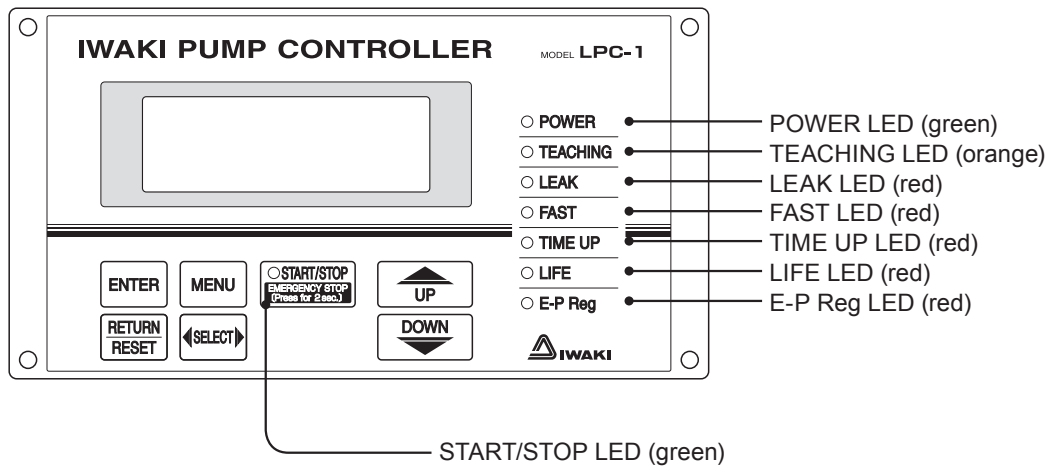
SELECT key

Used to move through menu options and numerical digits or to select "YES" or "NO".

UP/DOWN key

Used to move through menu options, to change numerical values, or to select "YES" or "NO".

■ LEDs



POWER LED

Lights green as powered on.

TEACHING LED

Lights orange when determining origin via by selecting "2. TEACHING".

*The screen will show "TEACHING TIMEOUT!!" and the TEACHING LED will flash when origin was not determined in 10 seconds. In this case reset the alarm condition through "9. ALARM REST" and check for wrong wiring or closed discharge line before retry.

*"TEACHING ABORT!" will be shown on the screen if the MENU or RESET key is pressed during teaching. In this case, teaching is not completed. The controller is not in an alarm condition. Just retry to perform teaching.

LEAK LED

Lights red when the leak sensor detects a leak in the air chamber. The pump stops operation.

FAST LED

Lights red at or above the maximum speed at each supply air pressure and stops lighting below that speed.

TIME UP LED

Lights red when neither the right nor left proximity switch does not detect the connecting plate within the set period of time ("TIME UP ALARM"). Stops lighting when detecting the plate in time.

LIFE LED

Lights red when the reciprocation times accumulated in "TOTAL COUNT 1" exceeds the set number of times ("LIFE ALARM").

**"TOTAL COUNT 1" only is available for the LIFE ALARM.

E-P Reg LED

Lights red when:

- The electropneumatic regulator is upset in feedback control (disconnection).
- Power voltage is out of range.
- EEPROM reading/writing failure
- Discharge line pressure does not reach a target rate within 5 seconds.

START/STOP LED

Lights green during operation.

Operating conditions

Pump stroke

Operation over the maximum stroke rate can take in a large amount of air during operation. Set the maximum allowable speed at each supply air pressure range as a fast alarm speed into the LPC-1 controller.

Supply air pressure	0.1-0.2MPa	0.21-0.3MPa	0.31-0.4MPa	0.41-0.5MPa
Maximum stroke rate	160spm	155spm	140spm	120spm

Supply air pressure range

Observe the allowable supply air pressure range at each liquid temperature below.

Liquid temperature	Supply air pressure
5-100°C	0.1-0.5MPa
101-150°C	0.1-0.4MPa
151-180°C	0.1-0.3MPa

*Try to use the minimum allowable supply air pressure to protect the filter and bellows and reduce the risk of solution spray.

*A flow rate changes with supply air pressure. Use a regulator to keep the pressure constant.

*The minimum operating pressure of the solenoid valve should meet the minimum allowable supply air pressure of each range.

Liquid temperature range

Observe the allowable liquid temperature range of 5-180°C. Note sharp temperature fluctuation (heat shock) may reduce the life of the pump. Contact us for detail.

Liquid characteristics

■ Do not run the pump with the following liquid

- Liquid that easily crystallizes
- Slurry
- Low conductivity hydrocarbon liquid

*Crystallization or the delivery of slurry remarkably shorten the lives of valves and bellows.

*Delivery of low conductivity hydrocarbon liquid can cause ESD damage.

■ Use care handling the following liquid:

- Stripper
- Solvent
- Hydrazine
- Fuming sulfuric acid

*Some strippers cause cracks on the PFA bellows and piping, and therefore a warranty period is shortened. Contact us for detail.

Operation and Stoppage

■ During operation

Make sure a suction and a discharge line are fully opened.

■ When stopping the pump

- Before stopping the pump, release discharge line pressure. Otherwise, the bellows may deform.
- Do not close a discharge valve as stopping the pump, or an impact pressure may deform the bellows or check valves.

■ During stoppage

- Always check the specification of the double solenoid valve before installation. Some types (pressure centre types) are designed to pressurize both the right and left air chambers at the same time.
- Do not leave the pump with any chemical in the bellows for a long period. Some chemical gas can penetrate the bellows and corrode metal parts.

Air exhaust port

Do not narrow an air exhaust line (for example by reducing the tube I.D.). Or the residual pressure in the pump may deform the bellows.

**Always observe the minimum composite effective cross-sectional area. Do not extend the air exhaust port too far away from the solenoid valve (SV) or the quick exhaust valve (QEV). Otherwise, increased pipe resistance may break the limit.*

Leak sensors

The sensors occasionally fails to detect leakage depending on operating condition. Contact us for detail.

Ambient temperature

Observe the allowable operating ambient temperature range of 0-40°C.

Pump surface temperature

Risk of burning. The surface temperature of the pump or pipe rises high along with liquid temperature in or right after operation. e.g. cylinder surface temperature rises up to 56°C when liquid temperature is 180°C and ambient temperature is 23°C.

Noise from pump

Exhaust noise accompanies pump operation. Provide noise insulation as necessary. e.g. a noise level rises up to 78.3db (A) at 120spm and 0.5MPa (supply air pressure).

Identification codes

Each code represents the following information.

FLP - 60 W H T 2 - 01

a b a c d e f

a. Series name

FLP-W : Medium & high liquid temperature (low pulsation)

b. Bellows size

c. Allowable liquid temperature range

H : 5-180°C

d. Pump connection (Inlet/Outlet)

T : Tube (standard)

e. Pump head-bellows connection

2 : Welded (standard)

f. Special specifications

No symbol : Standard

01 : Special specifications (01, 02...)

Installation

This section describes the installation of the pump, piping and wiring. Read through this section before work. To operate this pump, a 5-port solenoid valve and LPC-1 controller is needed. Always install QEVs (quick exhaust valves) to secure system safety. Purchase separately.

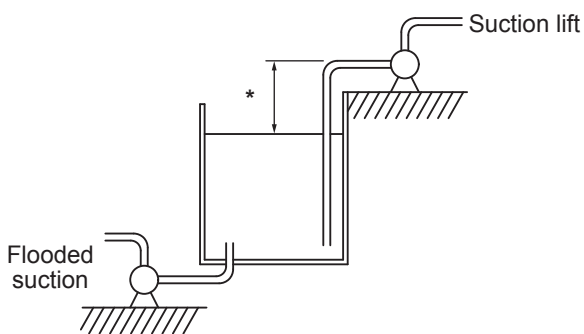
! Points to be observed

Observe the following points when installing the pump.

- Be sure to turn off power to stop the pump and related devices before service is performed.
- Be careful for the power not to be turned on during work.
- If you notice any abnormal or dangerous conditions, suspend operation immediately and inspect/solve problems.
- Do not install the pump in a flammable atmosphere.
- Do not lift the pump by gripping the right-and-left cylinder head covers or the top-and-bottom covers. The pump can drop unintentionally as one of those parts breaks. Hold the pump by the stud bolts to lift it up.

Pump mounting

Mount the pump in flooded suction or suction lift application.



In flooded suction application:

Place the pump as close to the supply tank as possible.
*Flooded suction is recommended for hot liquid transfer or for looped system.

In suction lift application:

Observe the maximum suction lift* (1m). Place the pump as close to the supply tank as possible.

*The suction lift is based on pumping clean water at ambient temperature and the maximum stroke rate, and varies with liquid characteristics, liquid temperature or suction line length. Contact us for detailed information.

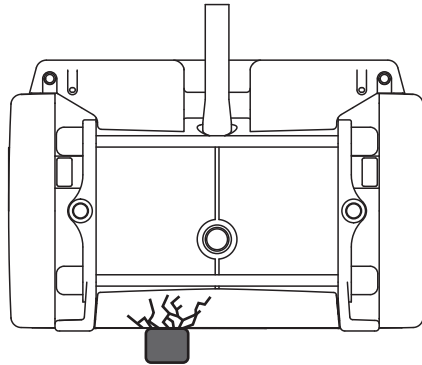
*Have a suction line shortest with the minimum number of bends.

1 Select a location

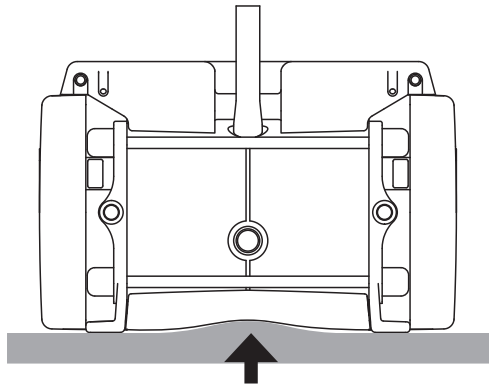
Select a level location, free from vibration, that won't hold liquid. Anchor the pump so it doesn't vibrate. See page 11 as well.

*Flooded suction application is recommended.

*Observe the maximum suction lift (1m) in suction lift application.



*Keep the pump footprint clear so nothing applies stress to the bottom cover. The cover, when deformed, may disturb the reciprocation of a connecting shaft.



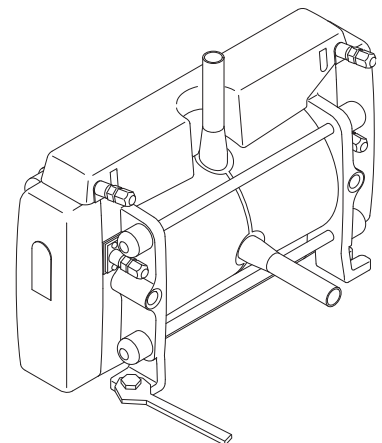
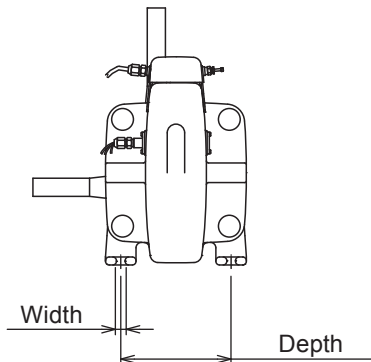
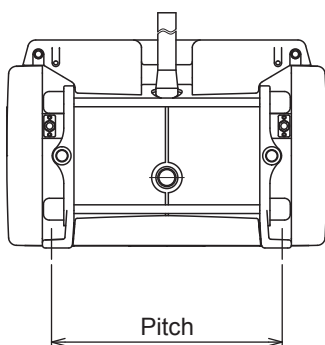
*When mounting the pump on a mounting rail, the rail may apply stress to the bottom cover. The cover, when deformed, may disturb the reciprocation of a connecting shaft.

2 Anchor the pump so it doesn't vibrate

Position the pump upright with the outlet upward and inlet sideways. Provide the pump with four holes (for M10 hex anchoring bolts w/ M10 plate washer) by the following pitch, width and depth.

*Use spring washer as necessary

Pitch	Width	Depth	Hole I.D.
317^{+2}_0 mm	12mm	152 ± 1 mm	M10



3 Retighten the stud bolts

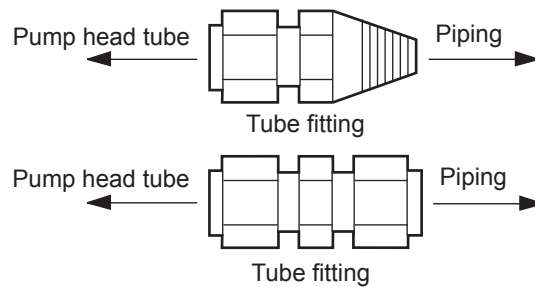
Tighten the stud bolts that are fixing the cylinder heads to 8.3N•m.

NOTE

A leak results in operation if the stud bolts are loose.

Liquid line piping

PFA tubes (I.D. 22mm, O.D. 25mm) are originally equipped to inlet & outlet of the pump. Use applicable tube fittings for the connection with your piping system.



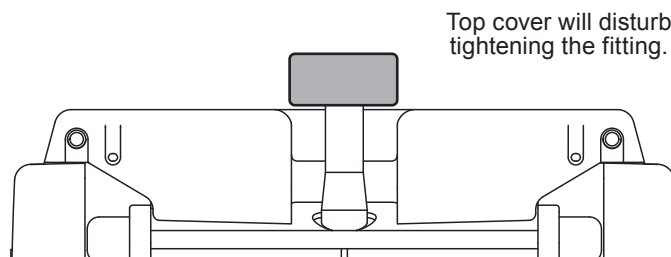
*Select an appropriate tube fitting size. Both discharge- and suction-line I.D. should be larger than the pump outlet & inlet O.D.

*General joints can be used, however, no leakage is allowed under hot liquid transfer or heat cycle.

*Use measures to keep the pump connections free from stress.

NOTE

Do not cut the outlet too short, below the top cover. Or the tube fitting can not be tightened into the outlet.



! Points to be observed

Air blow or flush a suction and a discharge tube to get rid of foreign matters prior to connecting with the pump.

1 Connect a suction and a discharge tube to the pump inlet and outlet via the tube fittings.

Use measures to keep the pump connections free from stress such as weight and thermal expansion/contraction.

NOTE

Be sure to secure each connection to prevent leakage and air ingress.

Suction line

■ Flooded suction

In flooded suction application, observe the minimum suction line I.D. ($\varnothing 22\text{mm}$), the suction line can be laid horizontally to the maximum length (4.4m) with no elbows.

*If five 90° elbows (0.5m resistance at each elbow) are used, the maximum length is shortened to 1.9m.

In suction lift application, observe the maximum suction lift.

*The suction lift differs with the liquid's characteristics, temperature and suction line length. For detailed information, contact us.

■ Filtration (suction line end)

Install a filter or strainer at the suction line end to prevent particles from entering the bellows. The filter or strainer should not increase piping resistance too much (observe the minimum composite effective cross-sectional diameter.).

NOTE

If wafer fragments enter the pump, they may get stuck in the bellows and eventually cause failure. If they clog the pump head valves, the discharge volume may reduce and the pumping operation may become unbalanced.

■ When installing a valve on the suction line:

Use a valve of a flow coefficient (C_v) of 8 or more. Otherwise, a suction-line resistance rises high together with flow pulsation, or the valve may easily be clogged with crystals. Make sure all valves on the suction line are opened to the full during operation.

NOTE

Operating the pump with a suction side valve close, negative pressure increases in the bellows and deforms the bellows inwardly.

Discharge line

■ When installing a valve on the discharge line:

When installing a valve in a discharge line, select a valve with an orifice equal to or larger than pipe I.D. A valve with a small orifice may increase the pipe resistance or easily be clogged with crystals. Always open valves during operation. Do not close the valve until the discharge pressure reaches "0" after the pump is stopped.

NOTE

Do not close a discharge valve right after stopping the pump. Impact pressure may deform the bellows.

■ Filtration (circulation)

Check a filtering area, filtering performance and effects on the flow before selecting a cycle filter. A desired flow may not be obtained if selection is wrong.

NOTE

Wet the filter before use. A desired flow may not be obtained if the filter is dry. Filter dries up if it is unused for a long period. Read the instruction manual of the filter for details.

■ Filtration (discharge line end)

Install a filter or strainer in a discharge line not to release foreign matters or wafer fragments. The filter or strainer should not increase piping resistance too much (observe the minimum composite effective cross-sectional diameter.).

■ Depressurization at pump stop

When stopping the pump, be sure to release discharge pressure by opening the filter, the air vent valve or through a return circuit.

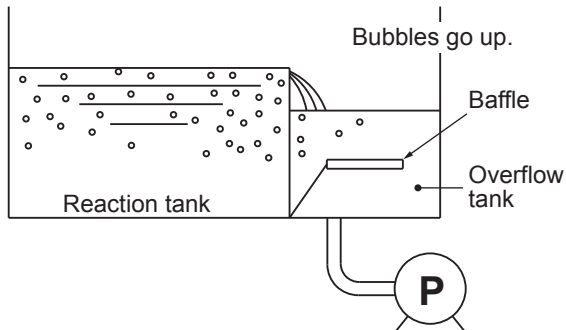
NOTE

Stopping the pump without releasing discharge pressure may deform the bellows.

Degassing

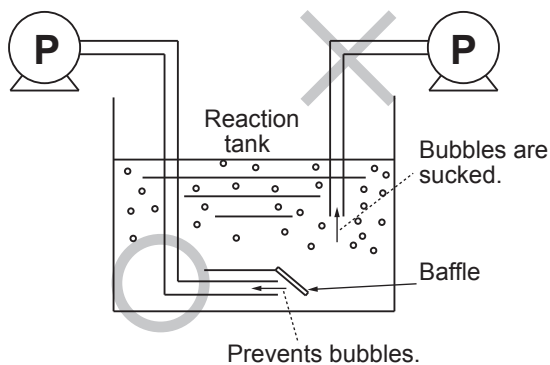
Gas bubbles are generated when a strong acid is fed into the reaction tank or liquid is transferred through a narrow tube. If such bubbles enter the bellows, the pump runs dry, increasing stroke rate or disturbing liquid transfer. Take a proper step for degassing.

Plan A (Install a baffle to remove gas bubbles)



In flooded suction application

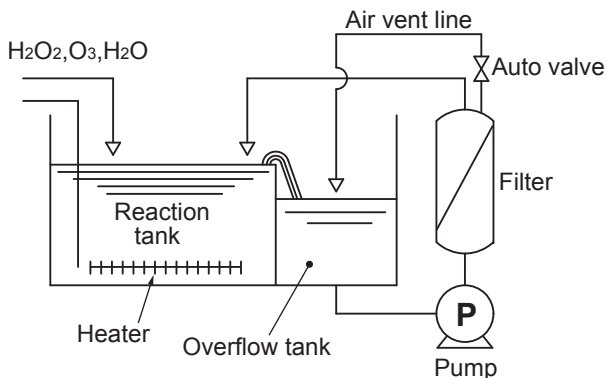
Install a baffle in a overflow tank to separate air from the liquid.



In suction lift application

Install a baffle to the bottom of the reaction tank. And then place the end of suction line under the baffle to suck liquid only.

Plan B (Install an automatic valve)



Periodic degassing

Program an automatic valve to open periodically regardless of dry running. For example, the valve opens for ten seconds every two minutes.

*Some filtering area may be too small to release air.

Select a suitable filter size.

*Program an open time according to the system performance.

Pinpoint degassing

Install an air detector at the pump inlet and set the auto valve to open timely.

Another detector at the pump outlet will help detect bellows rupture.

NOTE

The stroke rate increment is a sign of dry running. Take one of the following step to expel air:

- Raise a pump speed with an open discharge line.
- Stop the pump once. And then restart.
- Empty and then fill the pump in operation.
- Increase the supply air pressure.

Air line piping

Before air piping

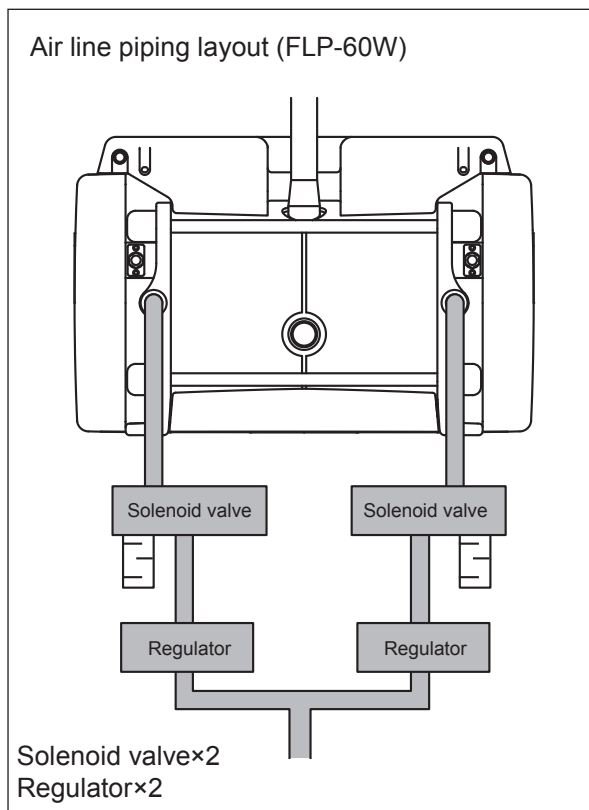
The FLP-60W needs a different supply air system from other Iwaki's pneumatic pumps.

■ Solenoid valve (SV)

Our existing pneumatic pumps use one solenoid valve to supply air to both right-and-left air chambers in turn, but then the FLP-60W needs two 5-port solenoid valves at each air chamber. Plug the normally-open out port and exhaust port of the solenoid valves, or the pump will not run correctly.

■ Regulator

Provide a regulator to each solenoid valve. Use of just one regulator for both the valve can run the pump but then increases pulsation.



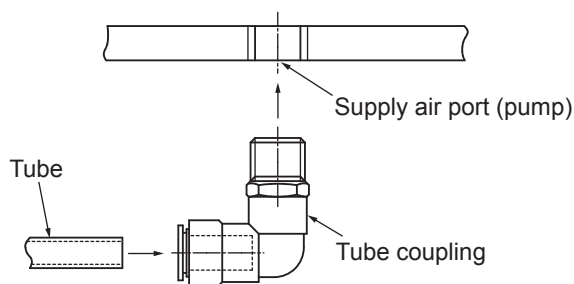
! Points to be observed

Observe the following points when building up a supply air line.

- A fluctuation of supply air pressure affects the stroke rate and the flow rate. Install a regulator to maintain the supply air pressure constant.
- Install a safety valve to observe the supply air pressure range at each liquid temperature range. 0.1-0.5MPa at 5-100°C, 0.1-0.4MPa at 101-150°C and 0.1-0.3MPa at 151-180°C.
- Release the exhaust air into the open air. Narrowing the air exhaust port makes air less likely to be expelled. As a result the bellows may deform inwardly. Select necessary air devices with reference to the air line piping diagram on page 20.
- To reduce exhaust noise, release the exhaust air through the duct of the plant facility to the air, or attach silencers to exhaust ports.
- The air consumption increases as installing two or more pumps and the number of pumps increases. Optimise the air compressor capacity and air line I.D. taking account of composite effective cross-sectional area.
- Supply air should be free from moisture and dust. If the supply air is contaminated with water, oil or dust, the pump may fail in starting. If liquid enters the air chambers, the electrodes may detect it and sounds an alarm.
- Long, narrow or bent supply air tubing prevents air from being expelled from the air chamber, deforming the bellows inwardly, or stroke rate from increasing, reducing a liquid flow.

■ Supply air port I.D.

Supply air port I.D. of the pump is Rc 3/8". Connect an applicable tube coupling to the pump.



NOTE

Secure each connection for the prevention of air leak.

Composite effective cross-sectional area

Composite effective cross-sectional area determines the performance of pressurization and depressurization in the air chambers. Small cross-sectional area prevents the contraction and expansion of the bellows and eventually causes a poor liquid flow and significant pulsation. Always keep the minimum composite effective cross-sectional area required for compression and decompression process separately. See below.

	Minimum composite effective cross-sectional area required
Compression	60mm ²
Decompression	20mm ²

■ Composite effective cross-sectional area required for decompression process

The composite effective cross-sectional area decreases as the number of pneumatic devices increases. Meet the above condition with the combination of a quick exhaust valve (QEV) with a silencer and a joint between the pump and the QEV (or the combination of a SV with a silencer and the air line between the pump and the SV when not using a QEV).

*Directory combine the silencer to the QEV and the QEV to the pump when using a QEV.

■ Composite effective cross-sectional area required for compression process

The composite effective cross-sectional area decreases as the number of pneumatic devices increases. Meet the above condition with the combination of a solenoid valve (SV), a quick exhaust valve (QEV) and the air line between the pump and the SV through the QEV (or the combination of the SV and the air line between the pump and the SV when not using a QEV).

Regulator performance, the air line between the regulator and the SV, and the air line between the compressor and the regulator also affects and compression. See "**Air line piping diagram**" section on page 29 for detail.

■ Effective cross-sectional area

1. Pneumatic devices

In the field of pneumatic devices, the term “Effective cross-sectional area” is used to indicate actual air flow. When air is sent through an air line, air cannot flow fully to the actual cross-sectional area due to piping resistance. The air flow increases as effective cross-sectional area becomes larger.

*For detail of effective cross-sectional area at each pneumatic device, see the catalogue issued by each manufacturers.

2. Composite effective cross-sectional area

Pneumatic devices are connected in series with the pump. Composite effective cross-sectional area of the entire system is calculated from the following formula.

$$\frac{1}{S^2} = \frac{1}{S1^2} + \frac{1}{S2^2} + \dots + \frac{1}{Sn^2}$$

S : Composite effective cross-sectional area (mm²)

Sn: Effective cross-sectional area of each pneumatic device (mm²)

See the catalogues issued by device/pipe manufacturers for each effective cross-sectional area.

Effective cross-sectional area on the exhaust side (OUT→EXH)

Quick exhaust valve (QEV-15V): 82mm².

■ Preventive measures against condensation

If condensation is likely to occur in the air lines between the pump and SV, take the following preventive measures.

- Reduce supply air pressure as much as possible (Reduce stroke rate.).
- Provide a heat insulator over the air line.
- Feed the heated and compressed air to the pump. Observe the temperature limits of pipe/tube materials, joints, SV and other component parts.

■ Recommended pneumatic devices

Select pneumatic devices with the following effective cross-sectional area. Note the minimum area of each device changes depending on whether a QEV is used or not.

When a quick exhaust valve is used...

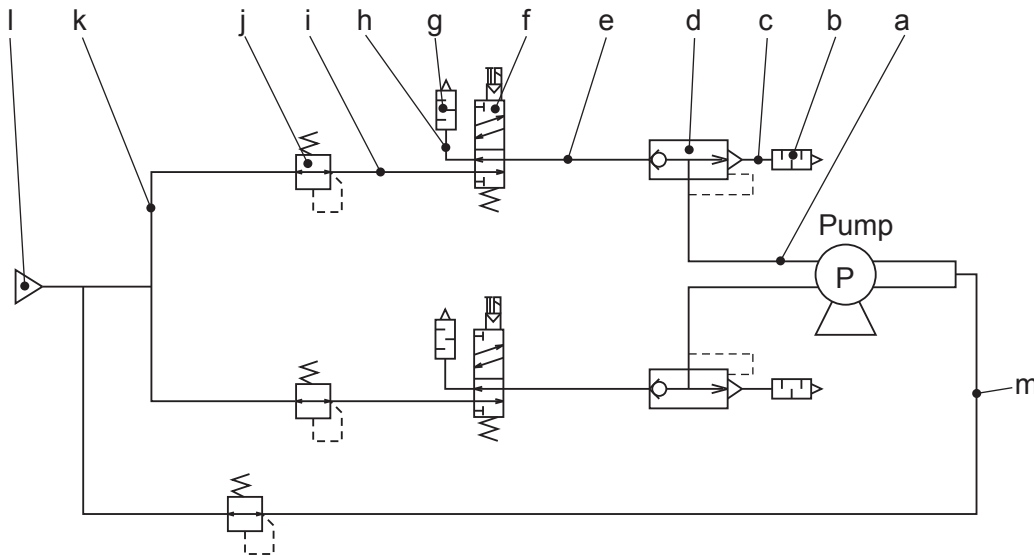
	Exhaust line	Supply air line
QEV (quick exhaust valve)	82mm ²	69mm ²
SV (solenoid valve)	50mm ²	40mm ²
Silencer	90mm ²	-
Air line between the QEV and SV	-	40mm ²

With no quick exhaust valve

	Exhaust line	Supply air line
SV (solenoid valve)	190mm ²	145mm ²
Silencer	90mm ²	-
Air line between the pump and SV	91mm ²	

Air line piping diagram

The diagram below is a general layout of an air-line.



a. Piping between the pump and QEV-15V

The pump has a Rc3/8" female thread and the QEV-15V has a Rc1/2" female thread for supply air line connection. Use a male reduced nipple as necessary.

b. Connection of a silencer (QEV)

Always use the same silencers to both right and left QEVs. Use of the SMC AN40-04 is recommended. Connect the silencer directory to the exhaust port of the QEV-15V.

c. Piping between the QEV-15V and the silencer.

Always mount the silencer directory to the exhaust port of the QEV-15V without any joints.

d. Connection of the QEV-15V

Always use the same quick exhaust valves to both right and left air lines. Use of the QEV-15V is recommended.

e. Piping between the QEV-15V and the SV.

Always use the same pipe length (PFA, 3m or less) to both right and left air lines. When using the QEV, use a PFA tube of 10mm I.D. × 12mm O.D. When the QEV is not available, use a PFA tube of 14mm I.D. × 16mm O.D.

f. Solenoid valve

When the QEV is available: **If supply air pressure is 0.15MPa or more**, use the 5-port 2-position single solenoid valve of the SMC SY9140-5-04-X90 or the CKD 4GB410-15-A-3. **If supply air pressure is below 0.15MPa**, use the 5-port 2-position double solenoid valve of the SMC SY9240-5 or the 5-port 2-position single solenoid valve (external pilot operated type) of the SMC SY9140R-5 or CKD 4GB410-05-K-3.

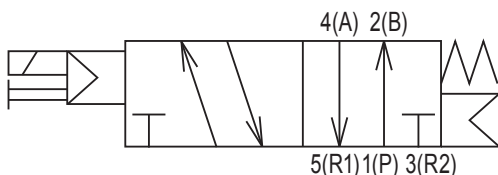
When the QEV is NOT available: Use the 5-port 2-position double solenoid valve of the SMC VFS6200-5F-06.

Plug the normally-open out port 2(B)* and exhaust port 3(R₂)*. They are not used. Connect a supply air line to the normally-closed out port 4(a)*.

*When the SMC 24VDC SY9140-5-04-X90 is used.

*Air is exhausted through a normally-open out port when the pump is stopped.

*Always use the same SV model to both the inlet and outlet air lines.



g. Connection of a silencer (SV)

Use of the SMC AN20-02 (when using a QEV) or the SMC AN40-04 (when not using a QEV) is recommended. Connect the silencer to the normally-closed exhaust port 5 (R₁) of the solenoid valve.

*When the SMC 24VDC SY9140-5-04-X90 is used.

h. Piping between the SV and the silencer.

Do not use a tube for the connection. Use a male reduced bush and directly connect the silencer to the SV.

i. Piping between the solenoid valve and the regulator

Always use the same pipe length (PFA, 2m or less, 10mm I.D. × 12mm O.D.) to both right and left air lines.

j. Connection of a regulator

Always use the same regulator to both right and left air lines. Use of the SMC AR40-04 or CKD W4000-W is recommended. Be sure to keep the same set pressure between the right and left regulators (max allowable deviation is ±0.01MPa). Use the SMC PSE540-04 or the CKD PPE-P10A-H6-B pressure sensor in the regulator and monitor the supply air pressure with the LCP-1 controller. See "**Regulator set pressure confirmation (8. PRESSURE SENSOR)**" page 60 for detail.

k. Connection between the compressor and the regulator

Lay the supply air line shortest with a wider I.D. than regulator inlet (to ensure the minimum effective cross-sectional area.).

l. Connection of an air compressor

Air compressor must keep 0.1MPa or higher than the set pressure of the regulator during pump stop. If the supply air pressure from the compressor is the same or lower than the set pressure, a pressure drop causes discharge pulsation.

*Install an air tank (18L or more) in the purge air line (m) close to the regulator (j) when this condition is not satisfied in anyway. Discharge pulsation can be reduced.

m. Connection of a purge air line

A temperature of the displacement sensor may rise high along with liquid temperature. Connect a purge air line to the pump via the I.D.4mm air port (straight fitting) to deliver the necessary amount of air and keep the sensor temperature to 45°C or below. For example, purge 75NL/min or more to this line when liquid temperature is 180°C.

Electric wiring

Two 5-port double solenoid valves and the LPC-1 controller is required.

! Points to be observed

Observe the following points during wiring work.

- Electrical work should be performed by a qualified electrician. Always observe applicable codes or regulations.
- Do not perform wiring work while the power is on. Otherwise, an electrical shock or short circuit may result. Be sure to turn off power before wiring work.
- Standard proximity switches can not be used when a flammable liquid such as solvent is pumped. The proximity switches must be in explosion-proof specifications. Contact us or your nearest dealer.
- Standard electrodes can not be used when a flammable liquid such as solvent is pumped. A spark in a solvent may cause a fire.

Installation

■ Lead wires

2m displacement sensor lead wires, 1m proximity switch lead wires and 1.8m leak sensor lead wires are originally built in the pump but then other lead wires for the connection between the controller and pneumatic devices are not provided. Purchase separately.

Lead wires	Required spec
LPC-1 controller power lead	24V 2A or more
Connection between the 5-port SV and the LPC-1 controller	24V 0.24A or more

■ Extension of leak sensor wires

Always keep resistance 5kΩ or less. Otherwise, the leak sensor does not work properly.

■ Installation of proximity switch wires

Do not lay on these wires in parallel with the power lead or combine them in a concentric cable (ex. 5 wires cable). Otherwise, system malfunction may result.

■ Extension of proximity switch wires

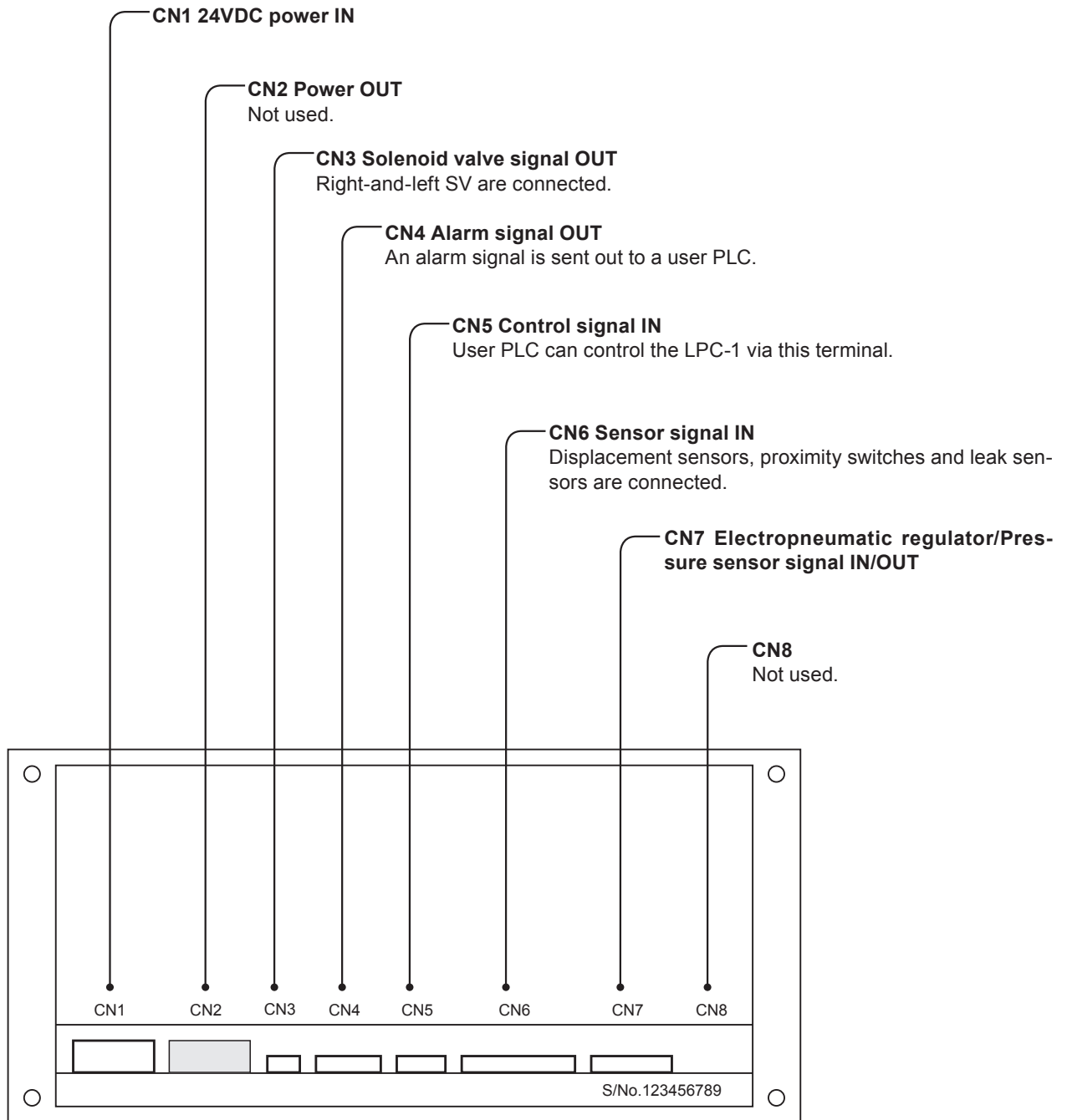
When extending a proximity switch wire, select the following cable spec depending on cable length.

Wire length	Wire spec
Shorter than 30m	0.3mm ² or more
30m or longer	100Ω/km or less (conductor resistance)

■ Preventative measures against noise

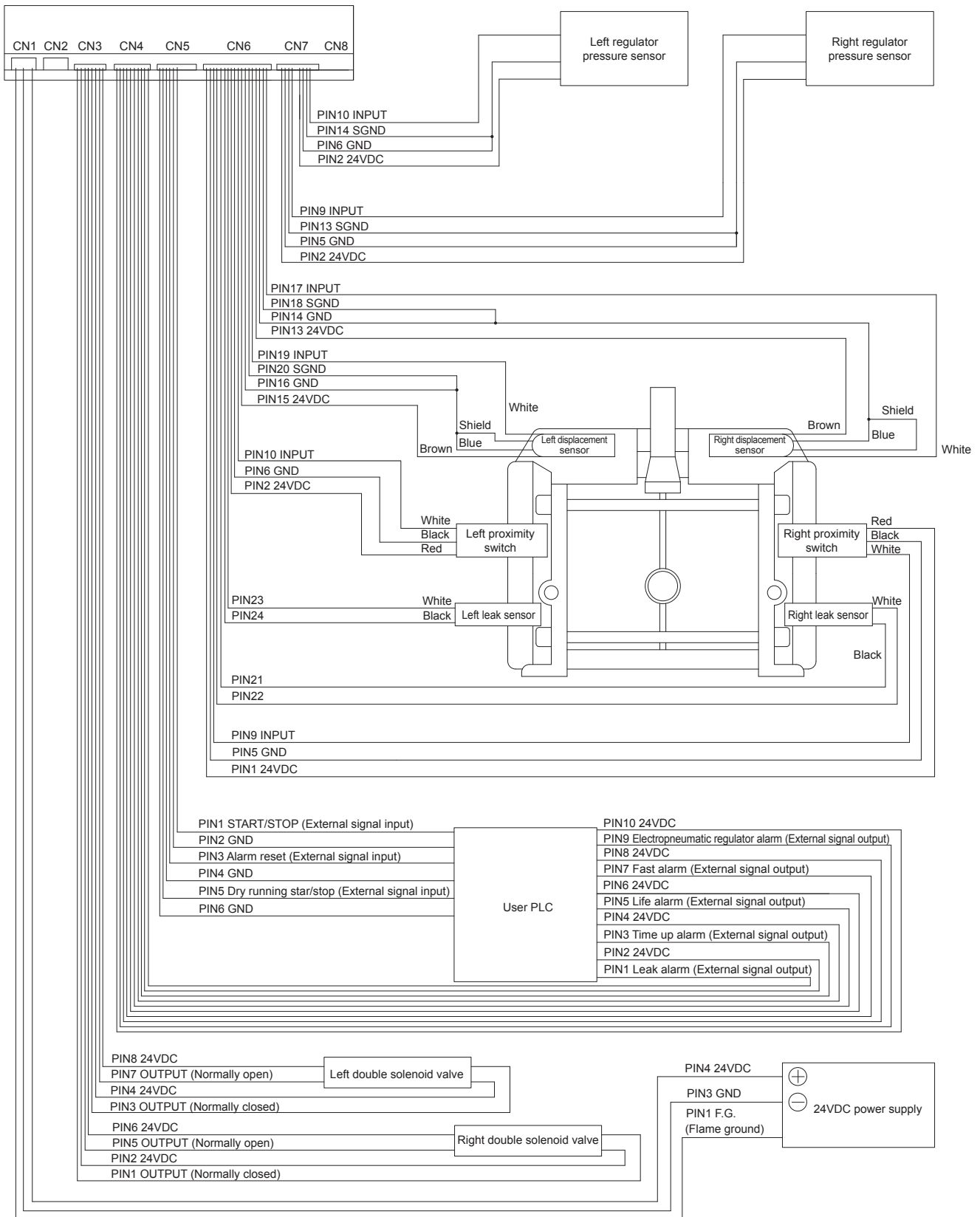
- Install a line filter in the AC power line.
- Provide a surge killer such as the CR or diode to inductive loads such as a solenoid valve and relay.
- Do not lay signal leads near the power lead.
- The shielded wire of the power lead should be connected to the F.G terminal of the 24VDC power supply.
- The shortest power lead is optimal.
- Do not share a power supply with a noise source such as an inverter or a motor.

Wiring diagram (LPC-1)



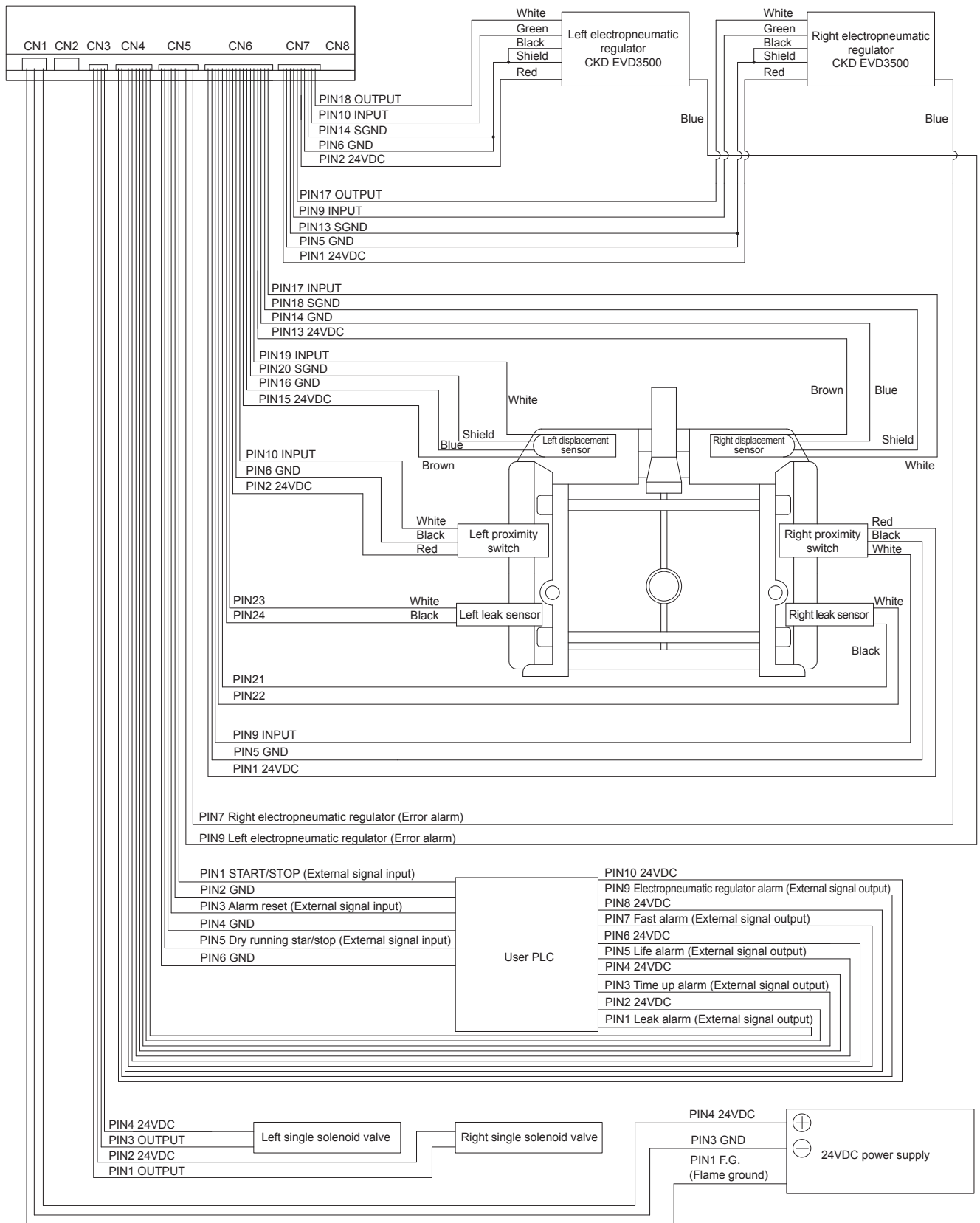
Wiring diagram (operation with a double solenoid valve)

See the next page for use of a single solenoid valve.



Installation

Wiring diagram (feedback control with a single solenoid valve)



End terminals

■ Power line

CN1 Power voltage input (controller)



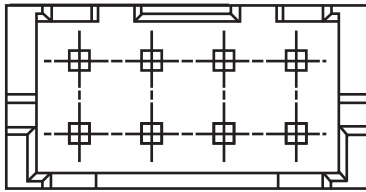
Connector #	CN1
Connector manufacturer	JST
Housing	VHR-4N
Contact	SVH-21T-P1.1
Applicable power lead	AWG #22-#18

Pin #	Assignment
1	F.G. (Flame Ground)
2	N.C. (Not used)
3	GND
4	+24V in (24VDC power input)

*Capacity of the 24VDC power supply must be 2A or more.

■ Single solenoid valve

CN3 SV output (controller)



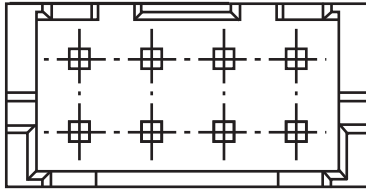
1 3 5 7
2 4 6 8

Connector #	CN3
Connector manufacturer	JST
Housing	PHDR-8VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

Pin #	Assignment
1	Right SV control output
2	24VDC
3	Left SV control output
4	24VDC
5	Not used
6	Not used
7	Not used
8	Not used

■ Double solenoid valve

CN3 SV output (controller)



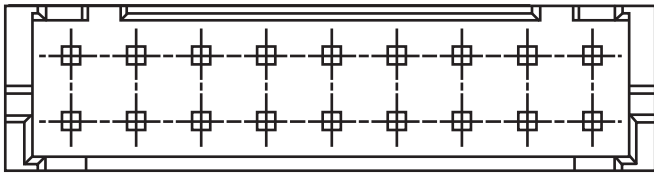
1 3 5 7
2 4 6 8

Connector #	CN3
Connector manufacturer	JST
Housing	PHDR-8VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

Pin #	Assignment
1	Right SV control output (Normally closed)
2	24VDC (Normally closed)
3	Left SV control output (Normally closed)
4	24VDC (Normally closed)
5	Right SV control output (Normally open)
6	24VDC (Normally open)
7	Left SV control output (Normally open)
8	24VDC (Normally open)

■ User PLC

CN4 Alarm output (controller)



1 3 5 7 9 11 13 15 17
2 4 6 8 10 12 14 16 18

Connector #	CN4
Connector manufacturer	JST
Housing	PHDR-18VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

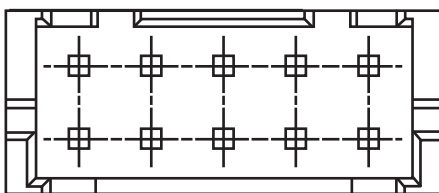
Pin #	Assignment
1	Leak alarm
2	24VDC
3	Time up alarm
4	24VDC
5	Life alarm
6	24VDC
7	Fast alarm
8	24VDC
9	Electropneumatic regulator
10	24VDC

*Pin 11-18 are not used.

Output spec

Output type	Open collector
Max output current	50mA
Max applied voltage	30V
Insulation	Photocoupler isolation
Withstand voltage	500VAC/min (Breaking current: 0.5mA or below)
Insulation resistance	50MΩ or more (500VDC)

CN5 Control signal input (controller)



1 3 5 7 9
2 4 6 8 10

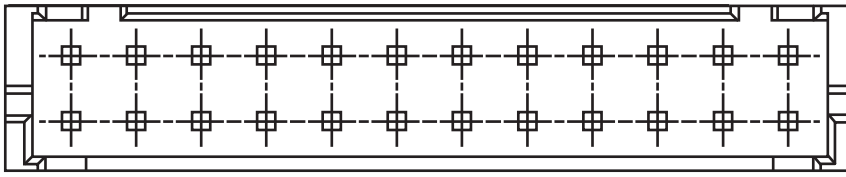
Connector #	CN5
Connector manufacturer	JST
Housing	PHDR-10VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

Pin #	Assignment
1	START/STOP
2	GND
3	Alarm reset
4	GND
5	Dry running start/stop
6	GND
7	Electropneumatic regulator error
8	GND
9	Not used
10	Not used

*Pin 9 and 10 are not used. Use the combination of pin 1 & 2, 3 & 4, and 5 & 6 at each purpose (assignment).

■ Proximity switch/Displacement sensor/Leak sensor

CN6 Sensor input (controller)



1 3 5 7 9 11 13 15 17 19 21 23
2 4 6 8 10 12 14 16 18 20 22 24

Connector #	CN6
Connector manufacturer	JST
Housing	PHDR-24VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

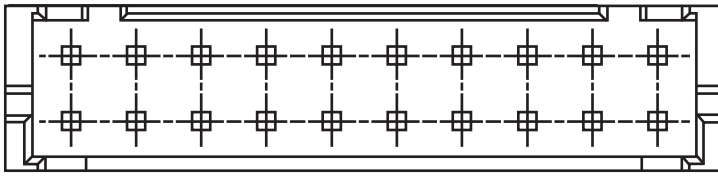
Pin #	Assignment
1	Right proximity switch 24VDC
2	Left proximity switch 24VDC
3	Not used
4	Not used
5	Right proximity switch GND
6	Left proximity switch GND
7	Not used
8	Not used
9	Right proximity switch input
10	Left proximity switch input
11	Not used
12	Not used
13	Right displacement sensor 24VDC
14	Right displacement sensor GND
15	Left displacement sensor 24VDC
16	Left displacement sensor GND
17	Right displacement sensor input
18	Right displacement sensor SGND
19	Left displacement sensor input
20	Left displacement sensor SGND
21	Right leak sensor (black lead)
22	Right leak sensor (white lead)
23	Left leak sensor (black lead)
24	Left leak sensor (white lead)

*Pin 18 and 20 are to be connected with shield wires of the right and left displacement sensors.

*Miswiring of the proximity switch results in burnout.

■ Electropneumatic regulator or Pressure sensor

CN7 Electropneumatic regulator/pressure sensor input/output (controller)



1 3 5 7 9 11 13 15 17 19
2 4 6 8 10 12 14 16 18 20

Connector #	CN7
Connector manufacturer	JST
Housing	PHDR-20VS
Contact	SPHD-001T-P0.5
Applicable power lead	AWG #26-#22

Pin #	Assignment
1	Right electropneumatic regulator/pressure sensor 24VDC
2	Left electropneumatic regulator/pressure sensor 24VDC
3	Not used
4	Not used
5	Right electropneumatic regulator/pressure sensor GND
6	Left electropneumatic regulator/pressure sensor GND
7	Not used
8	Not used
9	Right electropneumatic regulator/pressure sensor input
10	Left electropneumatic regulator/pressure sensor input
11	Not used
12	Not used
13	Right electropneumatic regulator/pressure sensor SGND
14	Left electropneumatic regulator/pressure sensor SGND
15	Not used
16	Not used
17	Right electropneumatic regulator/pressure sensor output
18	Left electropneumatic regulator/pressure sensor output
19	Not used
20	Not used

*Use electropneumatic regulators for feedback control, otherwise use pressure sensors.

*Connect the earth wire of the right pressure sensor to pin 5 & 13 and that of the left pressure sensor to pin 6 & 14 when not using the electropneumatic regulators.

Operation

This section describes pump operation and programming. Run the pump after pipework and wiring are completed.

Before operation

Always check the following items before the first-time operation or resuming operation after a long period of stoppage.

- 1** Check if electric wiring is made correctly.
Check the wiring of proximity switches, leak sensors, solenoid valves, displacement sensors and electropneumatic regulators (pressure sensors).

NOTE

A proximity switch may break. Always ensure correct wiring.

- 2** Check if air piping is made correctly.

- 3** Check if the pump is anchored securely.

- 4** Check if liquid piping is made correctly.

- 5** Check if a suction and a discharge line is open.

- 6** Check for a liquid level in the supply tank.

- 7** Check if the filter is wet.

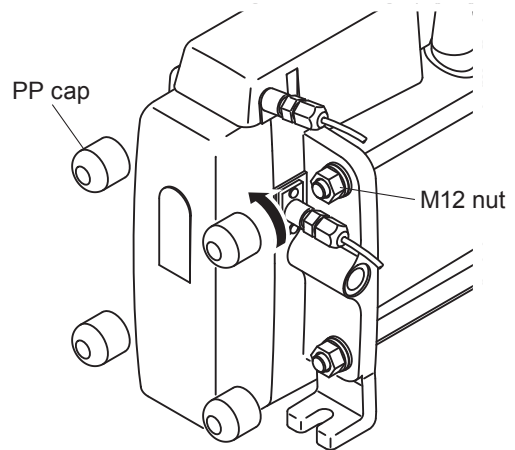
NOTE

See manufacturer's manual for the handling of filter.

8 Tighten stud bolts.

Stud bolts may loosen during storage or transit due to temperature fluctuation. Loose stud bolts can cause an air leak from the joint of the cylinder head and pump head. Be sure to tighten the stud bolts to 8.3N•m before operation.

*Unscrew the PP caps by turning anticlockwise and tighten the M12 nuts.



Programming menu

Operation at each mode is individually set and controlled by the LPC-1 controller. Make proper setting to ensure optimal operation. The controller will show version information for 3 seconds after power is turned on and then nine main-menu options. Sub-menu options will be available at each main-menu options.

Menus	Setting	References
1. PUMP MODEL	Pump model selection	44 page
2. TEACHING	Start of teaching (displacement sensors)	45 page
3. PUMP DRIVE	Start of operation in MANU mode	46 page
4. SETTING	Operational behaviour at each mode	51 page
1. QUANT.CONST.CTRL	Feedback control	
1. FLOW.QUANTITY	Target flow rate	52 page
2. E-P REGURATOR	Starting air pressure and the top/bottom pressure limits	53 page
3. 1 shot d CAPA	Liquid volume per shot	54 page
2. ALARM	Alarm output	54 page
1. TIME UP ALARM	Time setting for the detection of the connecting plate	
2. FAST ALARM	spm setting for speed compensation	
3. LIFE ALARM	Pump-shot setting for a reminder of the end of service life	
3. SET VALUE CONFIRM	Setting confirmation	56 page
1. STROKE LENGTH	Stroke length confirmation	
2. PUMP MODEL	Pump model confirmation	
3. MANU or AUTO	Manual/Auto model confirmation	
4. DRIVE MODE	Drive mode confirmation	
4. RESET ALL DATA	Return to the default setting	57 page
5. KEY PROTECT	Keypad lock for the prevention of erroneous operation	58 page
1. PROTECT	Activation	
2. PROTECT CANCEL	Deactivation	
6. TOTAL COUNT	Total number of shots confirmation/cancellation	59 page
1. TOTAL COUNT1	Confirmation of TOTAL COUNT1	
2. TOTAL COUNT2	Confirmation of TOTAL COUNT2	
3. COUNT RESET1	Cancellation of TOTAL COUNT1	
4. COUNT RESET2	Cancellation of TOTAL COUNT2	
5. COUNT RESET3	Confirmation of TOTAL COUNT3	
7. MANU or AUTO	Selection between manual and automatic modes	46,49 pages
8. PRESSURE SENSOR	Monitoring of the supply air pressures by the right-and-left pressure sensors in the regulators or the supply air lines.	60 page
9. ALARM RESET	Alarm output cancellation with the LED out	61 page

Basic key operation

Operation control or setting with keypad operation.

■ Main menu

The main menu has 9 options. Move the cursor between the options with the UP and DOWN keys and push the ENTER key to make a selection. The sub-menu options also can be selected in the same way. The following shows the steps to enter the AUTO mode through basic key operation.

```
>1. PUMP MODEL
2. TEACHING
3. PUMP DRIVE
4. SETTING
```

```
5. KEY PROTECT
6. TOTAL COUNT
7. MANU or AUTO
8. PRESSURE SENSER
```

```
9. ALARM RESET
```

- 1** Move the cursor to "7. MANU or AUTO" with the UP and DOWN keys.

```
5. KEY PROTECT
6. TOTAL COUNT
>7. MANU or AUTO
8. PRESSURE SENSER
```

- 2** Push the ENTER key. A sub-menu option will show up.

```
MANU or AUTO
[MANU] AUTO
```

- 3** Use the select key to choose "MANU" or "AUTO".

The start/stop of the pump is controlled by the LPC-1 controller in MANU mode or a user PLC in AUTO mode.

- 4** Push the ENTER key to determine the setting.

```
MANU or AUTO
AUTO SET OK!
```

Pump operation

The start/stop of the pump is controlled by the LPC-1 controller in MANU mode or a user PLC in AUTO mode.

! Points to be observed

Before operation in your system, conduct a trial run with pure water (or chemical liquid) to flush out particles or to measure metal ion level.

Pump model selection

Select a pump model which comes under the control of the LPC-1 controller.

- 1** Select "1. PUMP MODEL" and push the ENTER key.

```
>1. PUMP MODEL
2. TEACHING
3. PUMP DRIVE
4. SETTING
```

- 2** Select "FLP-60W" and push the ENTER key.

"FLP-60W SELECT OK!" appears on the screen.

*Always choose a correct model. Otherwise, malfunction results.

*The controller refuses the start of operation and asks for the selection if a model hasn't been selected, yet.

```
>1. FLP-60W 5. FLP-***
2. FLP-*** 6. FLP-***
3. FLP-*** 7. FLP-***
4. FLP-*** 8. FLP-***
```

- 3** Check if the selection is correct and push the ENTER key.

The main menu shows up.

```
PUMP SELECT
FLP-60W SELECT OK!
```

Teaching

The right-and-left displacement sensor measures the stroke length of the pump to determine the origin position (0 stroke length) during teaching behaviour. Teaching is necessary to keep synchronization between the pump and the controller.

NOTE

- The pump will not work properly if teaching is not performed.
- After teaching is performed, select "4. SETTING" (main-menu), "3. SET VALUE CONFIRM" (sub-menu) and then "1. STRIKE LENGTH" to check the measured stroke length. The length should be within the range of about 20-21mm if it is done correctly. Other length such as 500mm suggests miswiring of the displacement sensors.
- Measured stroke length changes depending on operation conditions due to existence of a spring in the connecting shaft. But then it will not adversely affect the pump operation as long as the origin position is determined.

1 Select "2. TEACHING" and push the ENTER key.

```
1. PUMP MODEL
>2. TEACHING
3. PUMP DRIVE
4. SETTING
```

2 Use the UP and DOWN key (or the SELECT key) to chose "YES" and push the ENTER key.

The bellows starts to move from the centre to the left until the right proximity switch detects the right connecting plate and stops for 1 second, and then starts to move to the right until the left proximity switch detects the left connecting plate and stops for 1 second. Again moves to the left and stops for 1 second and then return to the centre as finishing this teaching behaviour.

*The LPC-1 controller with default setting automatically performs teaching in advance of the first-time operation.

The right display will show up with "TEACHING LED" on during teaching behaviour.

```
TEACHING START?

[YES] NO
```

The right display will show up with "TEACHING LED" off when teaching is completed successfully.

```
TEACHING MODE
TEACHING . . . . .
```

```
TEACHING MODE
TEACHING OK!
```

The right display will show up with "TEACHING LED" flashes when the right (or left) proximity switch does not detect the right (or left) connecting plate within 10 seconds during teaching.

```
TEACHING MODE
TEACHING  TIMEOUT!!
```

The right display will show up with "TEACHING LED" off when the MENU or RESET key is pressed during teaching. Push any key other than the START/STOP key to return to the main menu.

```
TEACHING MODE
TEACHING  ABORT!!
```

- 3** Push the ENTER or MENU key if teaching is completed successfully.

Manual operation

Run or stop the pump by the LCP-1 controller and key operation.

■ Operation start

- 1** Select "7. MANU or AUTO" in the main menu and push the ENTER key.

```
5. KEY PROTECT
6. TOTAL COUNT
>7. MANU or AUTO
8. PRESSURE SENSOR
```

- 2** Select "MANU" and push the ENTER key.

```
MANU or AUTO
[MANU]  AUTO
```

```
MANU or AUTO
MANU SET OK!
```

- 3** Push the ENTER key or the MENU key.
The main menu shows up.

4 Select "3. PUMP DRIVE" in the main menu and push the ENTER key.

```
1. PUMP MODEL
2. TEACHING
>3. PUMP DRIVE
4. SETTING
```

5 Use the UP and DOWN key (or the SELECT key) to choose "YES" and push the ENTER key if feedback control is required. Or choose "No".

See page 52 for feedback control. When "No" is chosen, the controller returns to the main menu.

```
QUANTITIY CONSTANCY
CONTROLLED?

[YES] NO
```

6 Use the UP and DOWN key (or the SELECT key) to choose "YES" and push the ENTER key to start operation.

- The display changes depending on whether feedback control is chosen or not.
- Pushing the START/STOP key with the main menu display, the pump starts to run in the chosen way once this setting is completed.

When feedback control is selected...

```
LOW PULSE DRIVE
QUANTITY CONST
      START?
[YES] NO
```

When feedback control is not selected...

```
LOW PULSE DRIVE

      START?
[YES] NO
```

■ Operation stop

Points to be observed

- Before stopping the pump, release the pressure from the discharge line. Otherwise, the bellows may deform.
- Do not close a discharge valve as stopping the pump. An impact pressure may deform the bellows or a connecting plate.

1 Push the START/STOP key.

2 Select "YES" and push the ENTER key.

The display changes depending on whether feedback control is chosen or not. The main menu shows up when the pump stops.

When feedback control is selected...

```
LOW PULSE DRIVE
QUANT. CONTST. CTRL.
      STOP?
[YES]          NO
```

When feedback control is not selected...

```
LOW PULSE DRIVE
      STOP?
[YES]          NO
```

NOTE

If you notice any abnormal or dangerous conditions, suspend operation immediately and inspect/solve problems. See "**1. Troubleshooting**" as necessary.

AUTO operation

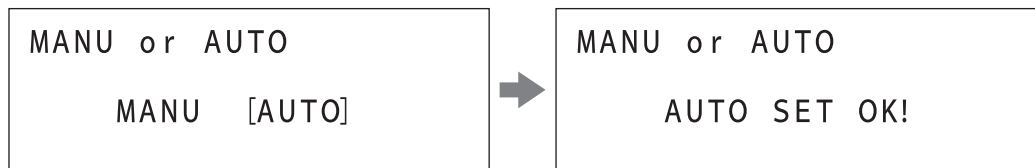
Run or stop the pump with the external signal (Pin5 dry running start/stop signal) from user LPC-1.

- 1** Select "7. MANU or AUTO" in the main menu and push the ENTER key.

5. KEY PROTECT
 6. TOTAL COUNT
 >7. MANU or AUTO
 8. PRESSURE SENSOR

- 2** Select "AUTO" and push the ENTER key.

The controller returns to the main manu.



- 3** Select "3. PUMP DRIVE" and push the ENTER key.

1. PUMP MODEL
 2. TEACHING
 >3. PUMP DRIVE
 4. SETTING

- 4** Use the UP and DOWN key (or the SELECT key) to choose "YES" and push the ENTER key if feedback control is required. Or choose "No".

- The display changes depending on whether feedback control is chosen or not.
- After this setting is completed, the pump runs at any time when the pin 5 dry running start/stop signal is entered.

*AUTO operation can be stopped by key operation. See page 46 for detail.

When feedback control is selected...

QUANTITIY CONSTANCY CONTROLLED?
 [YES] NO



LOW PULSE DRIVE
 QUANT. CONTST. CTRL.
 SET OK!!

When feedback control is not selected...

QUANTITIY CONSTANCY CONTROLLED?
 YES [NO]

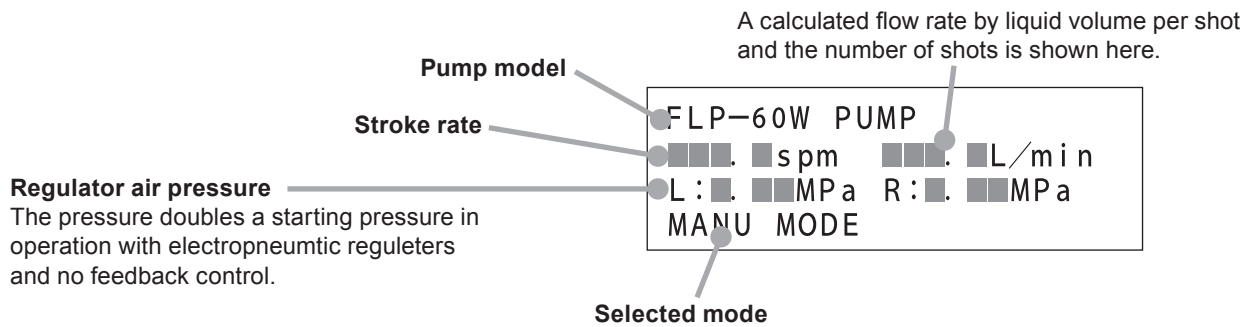


LOW PULSE DRIVE
 SET OK!!

Display information

■ Operation display

*Push the RETURN/RESET key to turn off the Alarm LED if it lights.



■ Total count display

Total number of pump shots will be shown if the DOWN key is pressed once. A push of the UP key calls back the operating display.



Speed compensation (AUTO mode)

The LPC-1 controller reduces pump speed to the compensation speed (the maximum stroke rate at each supply air pressure plus 10spm) when it exceeds the fast alarm speed (the maximum stroke rate above plus 20spm).

*The controller changes the SV to meet the compensation speed with or without input from the proximity switches.

■ External input for compensation speed operation

In AUTO mode, input of the external signal (dry running start/stop signal) from user PLC to the LPC-1 controller can adjust the pump speed to the compensation speed. Note teaching behaviour is automatically made right before speed compensation.

*Speed compensation will work when the pump speed exceeds the fast alarm speed.

*Always input the dry running start/stop signal while the PIN1 START/STOP signal is inputted.



Operation programming

Select "4. SETTING" for programming the feedback control (1. QUANT.CONST.CTRL), alarm output behaviour (2. ALARM), setting/mode confirmation (3. SET VALUE CONFIRM) and defaulting the LPC-1 (4. RESET ALL DATA).

- 1** Select "4. SETTING" in the main menu and push the ENTER key.

Sub-menu options will appear.

```
1. PUMP MODEL
2. TEACHING
3. PUMP DRIVE
>4. SETTING
```

- 2** Select one of the options according to programming to be made and push the ENTER key.

Each selection will show further options.

```
SETTING
>1. QUANT. CONST. CTRL
2. ALARM
3. SET VALUE CONFIRM
```



```
QUANT. CONST. CTRL
>1. FLOW QUANTITY
2. E-P REGURATOR
3. 1shot d CAPA
```

Feedback control (4. SETTING: QUANT. CONST. CTRL)

Program a target flow rate, the set pressure of the electropneumatic regulator and liquid volume per shot.

■ Target flow setting

Set a target flow rate to the LPC-1 controller.

- 1 Select "1. QUANT. CONST. CTRL" (feedback control setting) in the sub menu and push the ENTER key.

Further options will show up.

```
SETTING
>1. QUANT. CONST. CTRL
  2. ALARM
  3. SET VALUE CONFIRM
```



```
QUANT. CONST. CTRL
>1. FLOW QUANTITY
  2. E-P REGURATOR
  3. 1shot d CAPA
```

- 2 Select "1. FLOW QUANTITY" (target flow rate setting) and push the ENTER key.

```
QUANT. CONST. CTRL
>1. FLOW QUANTITY
  2. E-P REGURATOR
  3. 1shot d CAPA
```

- 3 Set a target flow rate and push the ENTER keys.

The target flow rate is set to 20.0mL/min with default setting. Move between digits with the SELECT key and change numerical values with the UP and DOWN keys.

*Observe the possible maximum discharge capacity at each supply air pressure (See the attached performance curves.). Otherwise, malfunction may result.

```
FLOW QUANTITY
```

```
Qt= 20.0 L/min
```



```
FLOW QUANTITY
```

```
SET OK!
```

- 4 Push the ENTER, RESET, SELECT, UP or DOWN key to return to the feedback control setting sub-menu or the MENU key to return to the main menu.

■ Electropneumatic regulator setting

Set the starting pressure, minimum/maximum allowable supply air pressure to the LPC-1 controller.

- 1** Select "2. E-P REGURATOR" (electropneumatic regulator setting) in the sub menu and push the ENTER key.

```
QUANT. CONST. CTRL
 1. FLOW QUANTITY
>2. E-P REGURATOR
 3. 1shot d CAPA
```

- 2** Select each setting option and push the ENTER key.

```
E-P REGURATOR
>1. START PRESSURE
 2. MIN PRESSURE
 3. MAX PRESSURE
```

- 3** Set a starting, the min/max supply air pressure separately and push the ENTER keys.

The default setting for the regulator is as follows. Move between digits with the SELECT key and change numerical values with the UP and DOWN keys.

*Note a starting supply air pressure must be at or higher than the min supply air pressure and lower than the max.

*Observe the possible maximum supply air pressure of 0.5MPa.

*The starting supply air pressure means the set pressure of the regulators.

The LPC-1 default setting for the electropneumatic regulator

Starting supply air pressure	0.2MPa
Minimum allowable supply air pressure	0.2MPa
Maximum allowable supply air pressure	0.5MPa

```
E-P REGURATOR
START PRESSURE
```

Sp=0. ** Mpa



```
FLOW QUANTITY
SET OK!
```

- 4** Push the ENTER, RESET, SELECT, UP or DOWN key to return to the feedback control setting sub-menu or the MENU key to return to the main menu.

■ Liquid volume per shot setting

Set the liquid volume per shot to the LPC-1 controller. The flow rate on the operation display is calculated by multiplying the liquid volume by the number of pump shots.

- 1 Select "3. 1 shot d CAPA" in the sub menu and push the ENTER key.

```
QUANT. CONST. CTRL
 1. FLOW QUANTITY
 2. E-P REGURATOR
>3. 1shot d CAPA
```

- 2 Set liquid volume per shot and push the ENTER keys.

Move between digits with the SELECT key and change numerical values with the UP and DOWN keys.

*The default setting is 205.0cc/shot.

```
1shot d CAPA
dc= 205. _ cc/shot
```



```
1shot d CAPA
      SET OK!
```

- 3 Push the ENTER, RESET, SELECT, UP or DOWN key to return to the feedback control setting sub menu or the MENU key to return to the main menu.

Alarm output (4. SETTING: ALARM)

Program alarm output behaviours of Time-up, Fast and Life alarms.

■ Time up alarm setting (Default: 20sec)

The LPC-1 controller outputs the time-up alarm to the user PLC and the TIME UP LED lights when either right or left proximity switch does not detect the connecting plate within the set time. The signal output and LED lightening continues unless the detection is made in time.

■ Fast alarm setting (Default: 140spm)

The LPC-1 controller outputs the fast alarm signal to user PLC and the FAST LED lights when the pump speed exceeds the maximum stroke rate at each supply air pressure during feedback control. The signal output and LED lightening continues unless the pump speed falls to the maximum stroke rate or below.

*The LPC-1 controller stops feedback control if the pump speed continues rising and exceeds the fast alarm speed (the max stroke rate at each supply air pressure plus 20spm). Eight more shots later, the controller performs teaching and speed compensation (see page 50) to reduce spm to the compensation speed (the max stroke rate above plus 10spm).

■ Life alarm setting (Default: 99,999,999 counts)

The LPC-1 controller outputs the life alarm signal to the user PLC and the LIFE LED lights when reciprocation times (TOTAL COUNT1) exceeds the set number of times (max 999,999,999).

*Alarm output cancellation (see page 61) just turns off the LIFE LED temporarily. Reset the accumulated data in the TOTAL COUNT1 before restarting operation, or the LED turns on again in operation. See "Total number of pump shots confirmation/cancellation" on page 59 for detail.

- 1 Select "4. SETTING" and push the ENTER key.
Sub-menu options will appear.

- 2 Select "2. ALARM" and push the ENTER key.
Further options will appear.

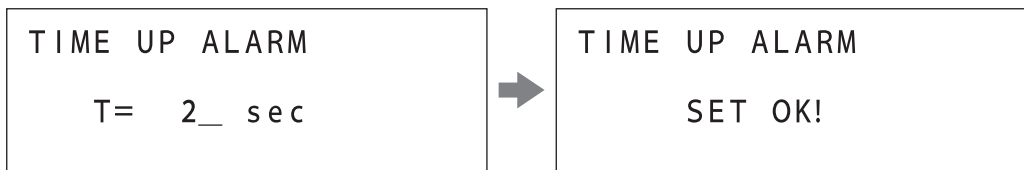
```
SETTING
 1. QUANT. CONST. CTRL
>2. ALARM
 3. SET VALUE CONFIRM
```

- 3 Select one of the options according to programming to be made and push the ENTER key.

```
ALARM
>1. TIME UP ALARM
 2. FAST ALARM
 3. LIFE ALARM
```

4 Set alarm behaviour and push the ENTER keys.

Move between digits with the SELECT key and change numerical values with the UP and DOWN keys.



5 Push the ENTER, RESET, SELECT, UP or DOWN key to return to the alarm setting sub-menu or the MENU key to return to the main menu.

Setting confirmation (4. SETTING: SET VALUE CONFIRMATION)

Setting details can be checked through "3. Set value confirmation".

Stroke length confirmation

The LPC-1 controller shows stroke length measured through teaching.

LEFT: Stroke length measured with the left displacement sensor.

RIGHT: Stroke length measured with the right displacement sensor.

AVE: Average stroke length measured by the right and left displacement sensors.

Pump model

The LPC-1 controller shows the selected pump model code.

MANU or AUTO

The LPC-1 controller shows the current operation mode of MANU or AUTO.

Drive mode

The LPC-1 controller shows whether operation is with feedback control or not. "QUANT.CONST.CTL" represents operation with feedback control and "LOW PULSE MODE" represents no feedback control.

1 Select "3. SET VALUE CONFIRM" in the sub menu and push the ENTER key.

```
SETTING
 1. QUANT. CONST. CTRL
 2. ALARM
>3. SET VALUE CONFIRM
```


- 2** Select one of the options according to programming to be made and push the ENTER key.

```
SET VALUE CONFIRM
>1. STROKE LENGTH
  2. PUMP MODEL
  3. MANU or AUTO
```



```
STROKE LENGTH
LEFT : 0. 0 mm
RIGHT: 0. 0 mm
AVE  : 0. 0 mm
```

- 3** Push the ENTER, RESET, SELECT, UP or DOWN key to return to the confirmation sub-menu or the MENU key to return to the main menu.

Default setting (4. SETTING: RESET ALL DATA)

Default the LPC-1 controller through the following procedure below.

- 1** Select "4. RESET ALL DATA" in the sub menu and push the ENTER key.

```
SETTING
>4. RESET ALL DATA
```

- 2** Select "YES" and push the ENTER key.

```
RESET ALL DATA?

[YES] NO
```

- 3** Push the ENTER, RESET, MENU, SELECT, UP or DOWN key to return to the main menu.

Keypad lock (5. KEY PROTECT)

Keypad lock can be active for the prevention of erroneous key operation.

NOTE

Any key operation is not acceptable when the keypad lock is active. In an emergency, press and hold the start/stop key for 2 seconds. The pump enters a wait state and stops running.

■ Keypad lock activation

- 1 Select "5. KEY PROTECT" and push the ENTER key.
Sub-menu options will appear.

```
>5. KEY PROTECT
6. TOTAL COUNT
7. MANU or AUTO
8. PRESSURE SENSOR
```

- 2 Select "1. PROTECT" and push the ENTER key.
Any key operation is disabled.

```
KEY PROTECT
>1. PROTECT
2. PROTECT CANCEL
```



```
KEY PROTECT
PROTECT OK!
```

- 3 Push the ENTER, RESET, SELECT, UP or DOWN key to return to keypad lock sub-menu or the MENU key to return to the main menu.

■ Keypad lock deactivation

- 1 Select "5. KEY PROTECT" and push the ENTER key.
Sub-menu options will appear.

- 2 Select "2. PROTECT CANCEL" and push the ENTER key.
All key operation is enabled.

```
KEY PROTECT
PROTECT CANCEL OK!
```

- 3 Push the ENTER, RESET, SELECT, UP or DOWN key to return to keypad lock sub-menu or the MENU key to return to the main menu.

Total number of pump shots confirmation/cancellation (6. TOTAL COUNT)

Default the accumulated reciprocation times in the TOTAL COUNT1 and 2 through the following procedure as necessary (one reciprocation time means two pump shots.). TOTAL COUNT3 can not be defaulted.

*TOTAL COUNT 2 and 3 are not linked to the alarm output. The alarm output works based on the accumulation in TOTAL COUNT1. The LPC-1 controller outputs the life alarm signal to the user PLC and the LIFE LED lights when reciprocation times (TOTAL COUNT1) exceeds the set number of times (max 999,999,999).

■ Confirmation

- 1 Select "6. TOTAL COUNT" and push the ENTER key.
Sub-menu options will appear.

```
5. KEY PROTECT
>6. TOTAL COUNT
7. MANU or AUTO
8. PRESSURE SENSOR
```

- 2 Select one of TOTAL COUNT1, 2, or 3 and push the ENTER key.

```
>1. TOTAL COUNT1
2. TOTAL COUNT2
3. COUNT1 RESET
4. COUNT2 RESET
5. TOTAL COUNT3
```

```
TOTAL COUNT■
117100 count
```

- 3 Push the ENTER, RESET, SELECT, UP or DOWN key to return to the confirmation/cancellation sub-menu or the MENU key to return to the main menu.

■ Cancellation

- 1 Select "COUNT1 RESET" or "COUNT2 RESET" in the sub menu and push the ENTER key.

```
1. TOTAL COUNT1
2. TOTAL COUNT2
>3. COUNT1 RESET
4. COUNT2 RESET
```

- 2 Select "YES" and push the ENTER key.

```
TOTAL COUNT
COUNT ■ RESET
[YES] NO
```

```
COUNT■ RESET
RESET OK!
```

- 3 Push the ENTER, RESET, SELECT, UP or DOWN key to return to the confirmation/cancellation sub-menu or the MENU key to return to the main menu.

Regulator set pressure confirmation (8. PRESSURE SENSOR)

The greater difference between the right and left regulator set pressure, the more pulsation it becomes. Be sure to keep the same set pressure to the right and left regulators (max allowable deviation is $\pm 0.001\text{MPa}$).

1 Select "8. PRESSURE SENSOR" and push the ENTER key.

When a pressure sensor or a regulator is provided and the pump is running...

5. KEY PROTECT
6. TOTAL COUNT
7. MANU or AUTO
>8. PRESSURE SENSOR



PRESSURE SENSOR
LEFT : 0. ■■ MPa
RIGHT : 0. ■■ MPa

When a pressure sensor or a regulator is not provided...

PRESSURE SENSOR
LEFT : ERROR
RIGHT : ERROR

When an electropneumatic regulator is provided and the pump stops...

PRESSURE SENSOR
LEFT : 0. 00 MPa
RIGHT : 0. 00 MPa

2 Push the ENTER, MENU, RESET or SELECT key to return to the main menu.

Alarm output cancellation (9. ALARM RESET)

Stop the alarm output and turn off the time-up, fast or life LED through the following procedure.

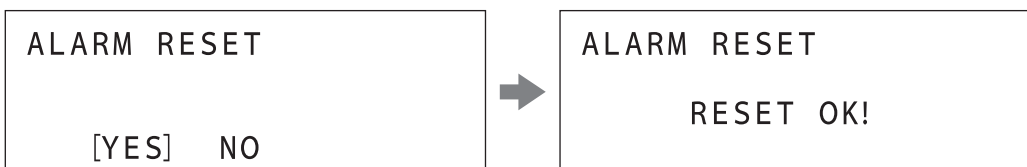
- 1 Select "9. ALARM RESET" and push the ENTER key in the main manu.

>9. ALARM RESET

- 2 Select "YES" and push the ENTER key.

The LPC-1 controller stops outputting the alarm signal and turn off the time-up, fast or life alarm LED.

*The LPC-1 controller outputs the life alarm signal to the user PLC and the LIFE lights when reciprocation times accumulated in TOTAL COUNT1 exceeds the set number of times (max 999,999,999). Default the accumulation in TOTAL COUNT1 to cancel the life alarm.



- 3 Push the ENTER, MENU, RESET or SELECT key to return to the main menu.

NOTE

The LPC-1 controller resumes alarm output and turns on an appropriate LED two minutes after the cancellation when an error condition is not solved.

Maintenance

This section describes troubleshooting, inspection, specification and dimensions.

! Points to be observed

Observe the following points during maintenance work.

- Observe instructions in this manual for maintenance, inspection, dismantlement and assembly. Do not dismantle the pump beyond the extent of the instructions.
- Always wear protective clothing such as an eye protection, chemical resistant gloves, a mask and a face shield during disassembly, assembly or maintenance work. The specific solution will dictate the degree of protection. Refer to MSDS precautions from the solution supplier.
- Solution in the discharge line may be under pressure. Release the pressure from the discharge line before disconnecting plumbing or disassembly of the pump to avoid solution spray.
- Risk of electrical shock. Be sure to turn off power to stop the pump and related devices before service is performed.
- If you notice any abnormal or dangerous conditions, suspend operation immediately and inspect/solve problems.
- Before stopping the pump, release the pressure from the discharge line. Otherwise, the bellows may deform.
- Do not close a discharge valve as stopping the pump. An impact pressure may deform the bellows or a connecting plate.

Troubleshooting

First check the following points. If the following measures do not help remove problems, contact your distributor.

States	Possible causes	Points to be checked	Solutions
The pump does not run.	Switch-over failure of the solenoid valve (SV)	-	<ul style="list-style-type: none"> • Inspect, repair or replace as necessary. • Use a QEV if corrosive gas affects the SV.
	Improper wiring or the disconnection of the SV, displacement sensors or proximity switches.	<ul style="list-style-type: none"> ○ If wiring is done according to each device manual. ○ Air lines and electrical wiring 	<ul style="list-style-type: none"> • Inspect/correct wiring. • Replace as necessary.*
	Supply air pressure is too low to operate the SV.	<ul style="list-style-type: none"> ○ Set pressure of the regulator (LPC-1 controller) ○ Minimum operating pressure of the SV 	<ul style="list-style-type: none"> • Observe the minimum operating pressure of the SV. • Adjust the minimum operating pressure of the SV as necessary.

*Solutions marked with * are conducted by us.

States	Possible causes	Points to be checked	Solutions
The pump does not run.	Bellows rupture (Leak alarm output)	<ul style="list-style-type: none"> ○ Supply air pressure ○ Stroke rate ○ Liquid temperature ○ If discharge line pressure is released as soon as the pump stops. ○ Air line I.D and length ○ Closed suction line 	<ul style="list-style-type: none"> ● Replace the bellows if damaged.* ● Observe pump spec and composite effective cross sectional area.
	Rising discharge pressure	<ul style="list-style-type: none"> ○ Filter for clogging ○ If a filter is wet. 	<ul style="list-style-type: none"> ● Check or replace the filter as necessary. ● Wet the filter.
		○ Closed discharge line	<ul style="list-style-type: none"> ● Open the discharge line.
	Supply air pressure or air flow is too low.	<ul style="list-style-type: none"> ○ Minimum operating pressure of the SV ○ If proper air line I.D. is selected if two or more pumps are installed. 	<ul style="list-style-type: none"> ● Observe the minimum operating pressure. ● Adjust the regulator set pressure as necessary.
	Leak sensor malfunction	<ul style="list-style-type: none"> ○ Wet pump 	<ul style="list-style-type: none"> ● Keep the pump dry.
		<ul style="list-style-type: none"> ○ If supply air is dry. 	<ul style="list-style-type: none"> ● Keep the supply air dry.
	Incorrect air line piping	<ul style="list-style-type: none"> ○ Both right and left air lines 	<ul style="list-style-type: none"> ● Correct as necessary.
	Incorrect electrical wiring	<ul style="list-style-type: none"> ○ If teaching is performed. 	<ul style="list-style-type: none"> ● Correct as necessary.
	Keypads are locked.	<ul style="list-style-type: none"> ○ If keypad lock is active. 	<ul style="list-style-type: none"> ● Deactivate keypad lock.
	MANU/AUTO mode selection is wrongly done.	<ul style="list-style-type: none"> ○ Operation mode setting (LPC-1 controller) 	<ul style="list-style-type: none"> ● Correct as necessary.
Solenoid valve failure	<ul style="list-style-type: none"> ○ If the SV switches correctly. 	<ul style="list-style-type: none"> ● Replace as necessary. 	
Liquid can not be pumped up.	A check valve is clogged with foreign matters.	<ul style="list-style-type: none"> ○ A check valve for clogging 	<ul style="list-style-type: none"> ● Install a guard filter in a suction line. Clean or replace the pump.*
		<ul style="list-style-type: none"> ○ Closed suction line. 	<ul style="list-style-type: none"> ● Open the suction line.
	Pump check valve is worn.	<ul style="list-style-type: none"> ○ A valve on the suction line 	<ul style="list-style-type: none"> ● Install a guard filter in a suction line. Clean or replace the pump.*
Pulsation is not dampened.	A different pump model is set to the LPC-1 controller.	<ul style="list-style-type: none"> ○ Pump model selection (LPC-1 controller) 	<ul style="list-style-type: none"> ● Set a correct pump model to the controller.
	Teaching is not performed.	<ul style="list-style-type: none"> ○ If teaching is done. 	<ul style="list-style-type: none"> ● Perform teaching.
	Different set pressure between right and left regulators.	<ul style="list-style-type: none"> ○ Regulator set pressure 	<ul style="list-style-type: none"> ● Set the same pressure to both the regulators.
	Air ingress into the pump	<ul style="list-style-type: none"> ○ Air in liquid 	<ul style="list-style-type: none"> ● Install a baffle in supply tank.
	Trapped air in the bellows	<ul style="list-style-type: none"> ○ Evidence of calibration 	<ul style="list-style-type: none"> ● Run the pump at the max speed to expel air.
	Calibration	<ul style="list-style-type: none"> ○ If the pump speed stays at a target rate. 	<ul style="list-style-type: none"> ● Wait until calibration ends.
	Calibration with discharge pressure fluctuation	<ul style="list-style-type: none"> ○ If discharge pressure fluctuates. 	<ul style="list-style-type: none"> ● Wait until calibration ends.
	Supply air pressure/air flow is too low.	<ul style="list-style-type: none"> ○ Supply air pressure/air flow 	<ul style="list-style-type: none"> ● Observe the max air consumption/air flow.
	Composite effective cross sectional area is too small.	<ul style="list-style-type: none"> ○ Effective cross sectional area of each pneumatic device 	<ul style="list-style-type: none"> ● Meet the minimum composite effective cross-sectional area required.

*Solutions marked with * are conducted by us.

States	Possible causes	Points to be checked	Solutions
Flow rate is reduced.	Supply air pressure or air flow is too low.	<ul style="list-style-type: none"> ○ If proper air line I.D. is selected if two or more pumps are installed. 	<ul style="list-style-type: none"> ● Reset the system. ● Adjust the regulator set pressure as necessary.
	Discharge pressure increment	<ul style="list-style-type: none"> ○ Filter for clogging. ○ If a filter is wet. ○ If discharge line is open. 	<ul style="list-style-type: none"> ● Review discharge conditions.
	Pump a check valve is clogged with foreign matters.	<ul style="list-style-type: none"> ○ A check valve for clogging. 	<ul style="list-style-type: none"> ● Install a guard filter in a suction line. Clean or replace pump head*
	Insufficient NPSHa (Net positive suction head available)	<ul style="list-style-type: none"> ○ Air line I.D. and length 	<ul style="list-style-type: none"> ● Review suction conditions.
Liquid leaks.	Bellows rupture	<ul style="list-style-type: none"> ○ Supply air pressure ○ Stroke rate ○ Liquid temperature ○ If discharge line pressure is released as soon as the pump stops. ○ Air line I.D and length ○ Closed suction line 	<ul style="list-style-type: none"> ● Replace the bellows if damaged.* ● Observe pump spec and composite effective cross sectional area.
Excessive air consumption.	Worn lip seal	<ul style="list-style-type: none"> ○ Air leak from the air chamber 	<ul style="list-style-type: none"> ● Replace as necessary.*
	Stud bolt is loose.	<ul style="list-style-type: none"> ○ Air leak from the air chamber 	<ul style="list-style-type: none"> ● Tighten stud bolts with rated torque. See next page.
Unbalanced pump operation	Worn valve or valve seat	-	<ul style="list-style-type: none"> ● Check, clean or replace the pump*.
	Switch-over failure of the SV	<ul style="list-style-type: none"> ○ Solenoid valve set pressure 	<ul style="list-style-type: none"> ● Inspect, repair or replace the solenoid valve.
Excessive vibration or noise	Loose pump fixation	-	<ul style="list-style-type: none"> ● Tighten anchor bolts.
	Stroke rate is too high.	<ul style="list-style-type: none"> ○ The rated stroke rate 	<ul style="list-style-type: none"> ● Observe the maximum stroke rate.
Foreign matters from the pump outlet	Chemical crystal, Wafer or check valve fragments (through long time operation)	-	<ul style="list-style-type: none"> ● Do not send a liquid that crystallizes by nature. ● Install a guard filter in a suction/discharge line. Clean or replace pump head.*

*Solutions marked with * are conducted by us.

Inspection

Perform daily and periodic inspection to keep pump performance and safety.

Daily inspection

Check for a leak or any other abnormality during operation. Upon sensing abnormality, stop operation immediately and remove problems according to "Troubleshooting". Replacement of wear parts is necessary at periodic intervals. Contact us or your nearest distributor.

No.	Points to be checked	Remarks
1	Stroke rate	Observe the maximum stroke rate at each supply air pressure range.
2	Regulator set pressure	Observe the supply air pressure range at each liquid temperature.
3	Air flow rate	Use a flow meter. Observe the maximum air consumption.
4	A leak from an air or liquid line	Check line connections

*The maximum stroke rate changes with supply air pressure. See page 67 for detail.

*The supply air pressure range changes with liquid temperature. See page 67 for detail.

Periodic inspection

Check the following items every month.

1. Stroke rate reduction

Stroke rate reduces as air leaks. The wear of lip seal is a cause of air leak. Replace the lip seal as necessary.

*Lip seal replacement should be conducted by Iwaki.

2. Air and liquid leak

If air or liquid leak is detected from the pump, release the discharge pressure and the supply air pressure, and leave the pump until it cools down to ambient. Then retighten the stud bolts by 8.3N•m.

3. Valve assembly and bellows

Valve assembly and bellows are wear parts and need to be replaced at the end of their estimated life or when their performance deteriorates.

*Life span at each wear part differs with a liquid handled and operating condition.

*Valve assembly and bellows replacement should be conducted by Iwaki.

4. Pump operation after a long period of suspension

Supply the air to the pump (approx. 0.2MPa) and confirm there is no air leakage from the outlet before operation.

Wear part list

To run the pump for a long period, wear parts need to be replaced periodically or when pump performance has reduced. Contact your distributor with the following information for wear part replacement.

1. Part names and part number (See "**Part names**" on page 70.)
2. Pump model identification code and manufacturing number (See pump nameplate.)
3. Drawing number if you have our approval drawing

Parts No.	Parts names	Q'ty ^{*1}	Estimated life ^{*2}
1,2,3,4,5,6	Pump head bellows UNIT	1	1 year
17,18	Connecting shaft R UNIT	2	
20	Main retainer	4	
21	Auxiliary retainer	4	
23	Linear bush	2	
24	Main spring	2	
25	Auxiliary spring	2	
34	Lip seal	2	
40	Laser type displacement sensor	2	

*1 Q'ty shows the number of parts per pump.

*2 The estimated life span varies with operating conditions and is not warranted.

Specification/Outer dimension

Specification

Information in this section is subject to change without notice.

■ Pump

	Items	Spec		
Operating conditions	Ambient temperature/humidity	0-40°C/30-60%RH (non-condensing)		
	Storage temperature/humidity	-10-60°C/20-70%RH (non-condensing)		
	Installation location	Indoor (No dusty environment)		
	Operation rating	Intermittent/continuous		
	Driving method	Pneumatic drive		
	Pump connection	PFA tube (O.D. 25 × I.D. 22 mm)		
	Supply air port bore	Rc3/8"		
Performance	Max. flow rate*1	50L/min		
	Liquid temperature range	5-100°C	101-150°C	151-180°C
	Supply air pressure range	0.1-0.5MPa	0.1-0.4MPa	0.1-0.3MPa
	Suction lift*2	1m		
	Max. allowable liquid viscosity	50mPa·s		

*1 The maximum flow rate is based on pumping clean water at an ambient temperature and the supply air pressure of 0.2MPa.

*2 The suction lift is based on pumping clean water at an ambient temperature and the maximum spm.

Stroke rate/Air consumption at each supply air pressure

Items	Spec				
Supply air pressure	0.41-0.5MPa	0.31-0.4MPa	0.21-0.3MPa	0.11-0.2MPa	0.10MPa
Max stroke rate	120spm	140spm	155spm	160spm	160spm
Max air consumption	464NL/min	419NL/min	388NL/min	252NL/min	116NL/min

■ LPC-1 controller

Item	Items	Spec	
Operating conditions	Power voltage	24VDC (-5% - 10%)	
	Max. power consumption	LPC-1	0.11A
		24VDC signal	1.8A
	Ambient temperature	0-50°C	
	Ambient humidity	5-90%RH (non-condensing)	
	Storage temperature	-10 - 60°C	
	Outer dimensions	W185×D152×H112mm	
	Weight	1.3kg	
Analogue input	Number of input channels	6 (single-end input)	
	Input voltage	Displacement sensor	0-10V
		Regulator (Pressure sensor)	1-5V
		Leak sensor (Resistance range)	0Ω to infinity
			Detectable at 15kΩ or below (Initial resistance: 10MΩ or more)

Digital input	Number of input channels		6
	Input voltage		24V
	Input current		5mA(min)/10mA(max)
	Insulation		Photocoupler insulation
	Withstand voltage		500VAC/min (breaking current 0.5mA or below)
	Insulation resistance		50MΩ or more
Analogue output	Number of channels to regulator		2
	Output voltage range to the regulator		0-10V
	Output isolation		None
	Max output current		5mA
	Min load resistance		2kΩ
	Min load capacity		200pF
	DA conversion		Trigger source signal, Software trigger
Digital output	Number of output channels		7
	Output type		Open collector
	Max output current	SV ch1/ch2	300mA
	Insulation		Photocoupler insulation
	Withstand voltage		500VAC/min (breaking current 0.5mA or below)
	Insulation resistance		50MΩ or more (500VDC)

■ Proximity switch

Items	Spec
Manufacturer	KOYO ELECTRONICS INDUSTRIES CO.,LTD
Model	APS4-12U-E-2242
Output type	Open collector
Power voltage	10-30VDC

■ Displacement sensor

Items	Spec
Manufacturer	OPTEX FA CO.,LTD.
Model	CD33-120NV
Analogue output	0-10V
Power voltage	18-24VDC

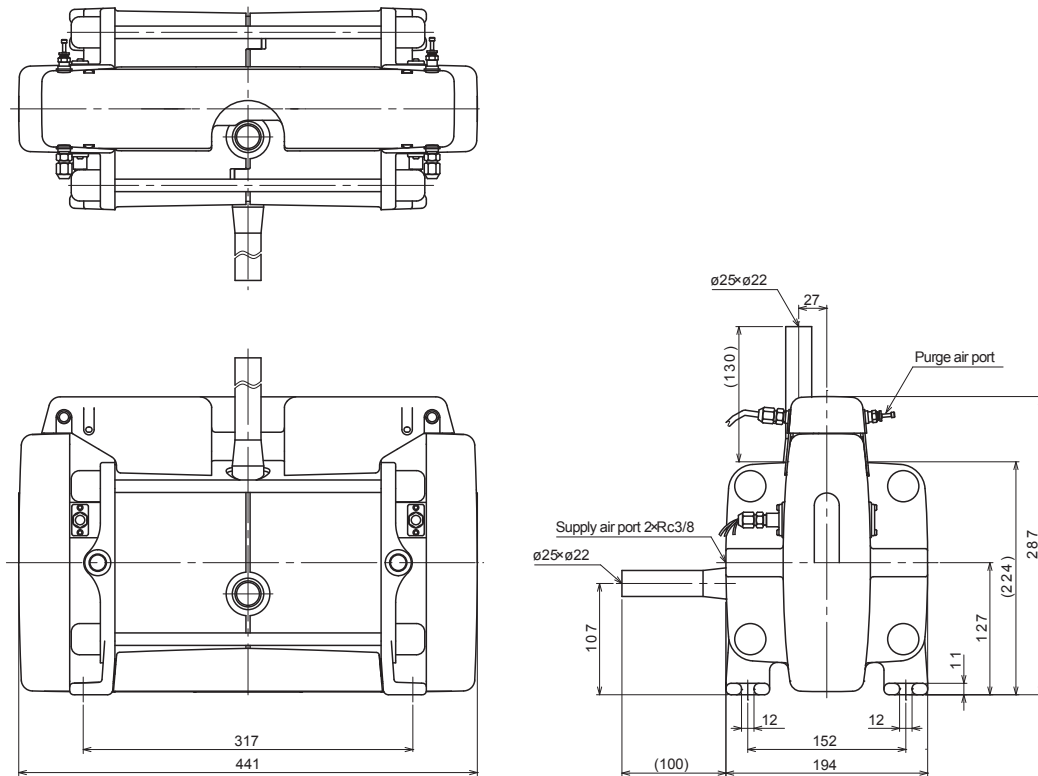
■ Leak sensor

Items	Spec
Probe material	Stainless

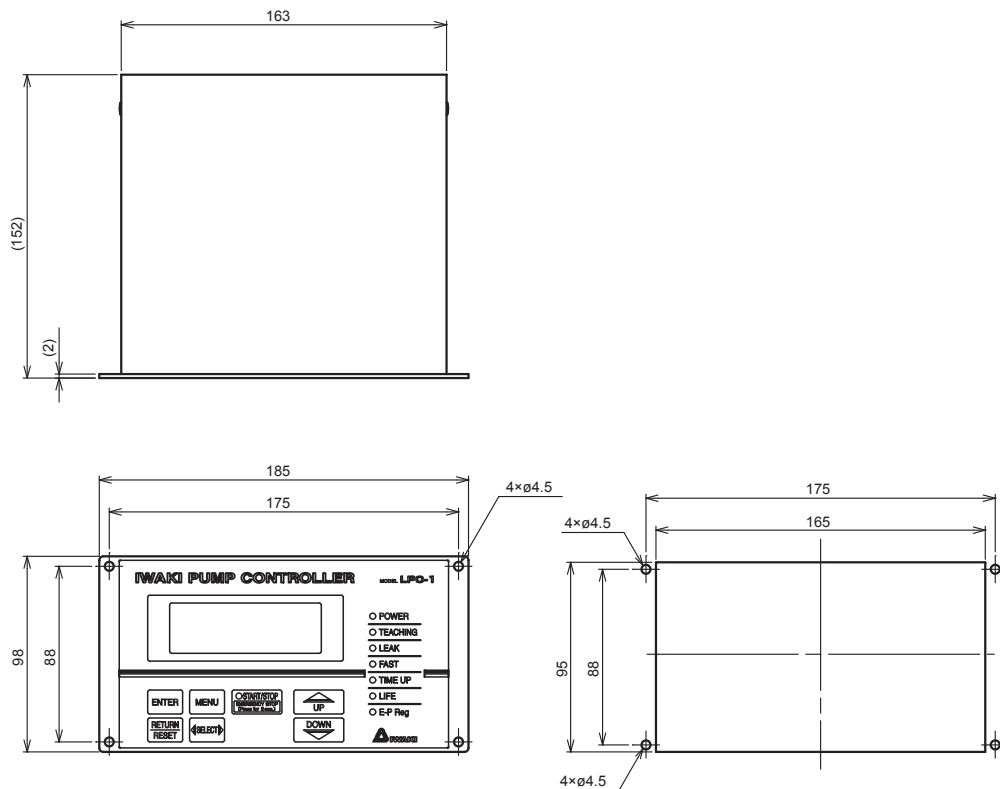
Outer dimension

■ FLP-60W

Weight: 22kg

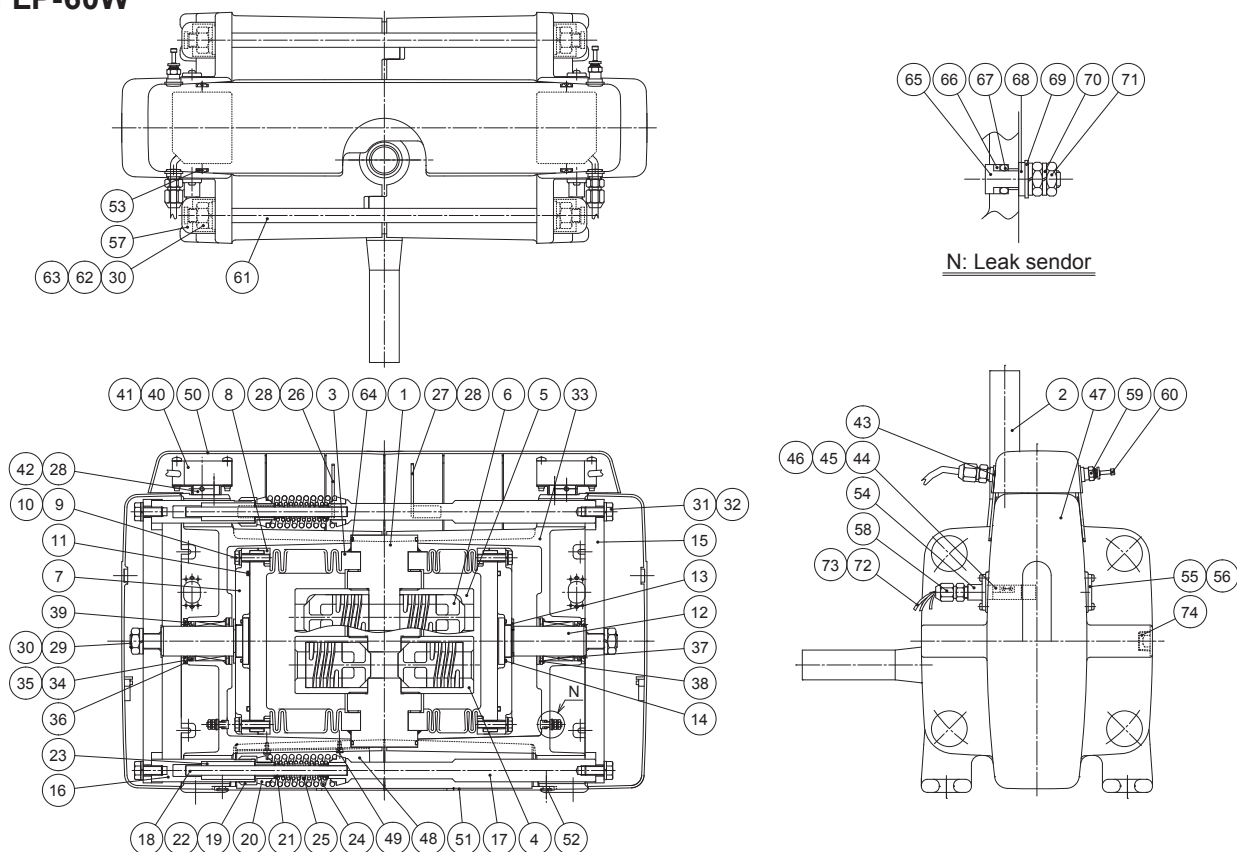


■ LPC-1 controller



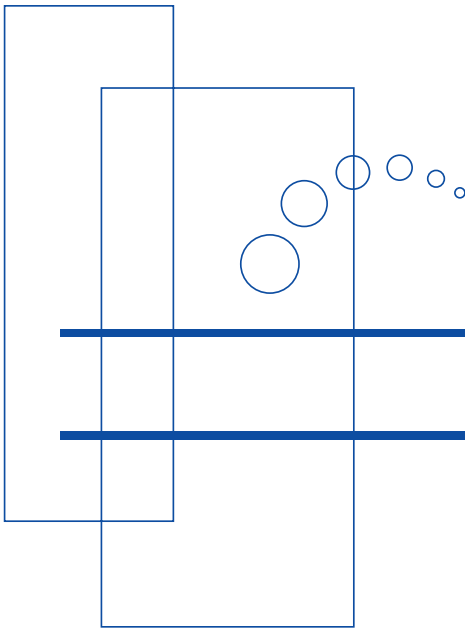
Part names

■ FLP-60W



No.	Name	Q'ty	Material	Remarks	No.	Name	Q'ty	Material	Remarks
1	Pump head	1	PTFE		38	Stop ring	2	STNLS STL	Nominal 37
2	Tube	2	PFA		39	Screw	8	STNLS STL	M3×8
3	Bellows	2	PTFE		40	Displacement sensor	2	-	
4	Suction valve case	2	PTFE		41	Screw	4	STNLS STL	M4×25
5	Discharge valve case	2	PTFE		42	Sensor fixed plate	2	STNLS STL	
6	Valve	4	PTFE		43	Cover bush	4	PPE	
7	Bellows plate	2	ADC12	4F coating	44	Proximity detector	2	-	
8	Bellows flange	4	STNLS STL		45	Screw	4	STNLS STL	M3×10
9	Hexagon bolt	16	STNLS STL	M6×25	46	Mounting base	2	STNLS STL	
10	Spring washer	16	STNLS STL	M6	47	Cylinder head cover	2	PPE	
11	O ring	2	FKM	G-110	48	Spring cover	2	STNLS STL	
12	Pump shaft	2	STNLS STL	HCP	49	Hex soch head bolt	4	STNLS STL	M3×4
13	Stop ring	2	STNLS STL	E-19	50	Top cover	1	PPE	
14	O ring	2	FKM	S-32	51	Under cover	1	PPE	
15	Connecting plate	2	STNLS STL		52	Low head bolt	4	STNLS STL	M4×8 4F coating
16	Connecting shaft L	2	STNLS STL		53	Screw	4	STNLS STL	M4×8 4F coating
17	Connecting shaft R	2	STNLS STL		54	Switch holder A	2	PPE	
18	Slide shaft	2	STNLS STL		55	Switch holder B	2	PPE	
19	Retainer L	2	STNLS STL		56	Screw	8	STNLS STL	M3×6 4F coating
20	Main retainer	4	PPS		57	Cap	8	PP	
21	Auxiliary retainer	4	PPS		58	Connector	4	PP	CP-C8-R1/8
22	Set screw	2	STNLS STL	M4×4	59	Straight fitting	2	-	PPC4-01C
23	Linear bush	2	STNLS STL	SMS8W KGL	60	Plug	2	-	PPP4C
24	Main spring	2	STNLS STL	CRYO-S	61	Stud bolt	4	STNLS STL	4F coating
25	Auxiliary spring	2	STNLS STL	CRYO-S	62	Hexagon nut	8	STNLS STL	M12
26	Target L	1	STNLS STL		63	Plate washer	8	STNLS STL	M12
27	Target R	1	STNLS STL		64	O ring	2	FKM	AS568-166
28	Screw	8	STNLS STL	M4×6	65	Leak sensor	4	STNLS STL	
29	Hexagon nut	2	STNLS STL	M12	66	Gasket	4	PTFE	
30	Spring washer	10	STNLS STL	M12	67	O ring	4	FKM	P-4
31	Hexagon bolt	4	STNLS STL	M8×18	68	Gasket C	4	PTFE	
32	Spring washer	4	STNLS STL	M8	69	Plate washer	4	STNLS STL	M4
33	Cylinder head	2	ADC12	4F coating	70	Spring washer	8	STNLS STL	M4
34	Lip seal	2	Filled PTFE		71	Hexagon nut	8	STNLS STL	M4
35	O ring	2	FKM	S-30	72	Black cord	2	-	
36	Packing stopper	2	STNLS STL		73	White cord	2	-	
37	Bearing	2	Filled PTFE		74	Cap plug	2	STNLS STL	3/8" 4F coating

*4F coating is not pin-hole less.



<http://www.iwakipumps.jp>

()Country codes

IWAKI CO.,LTD. 6-6 Kanda-Sudacho 2-chome Chiyoda-ku Tokyo 101-8558 Japan
TEL:(81)3 3254 2935 FAX:3 3252 8892

Australia	IWAKI Pumps Australia Pty. Ltd.	TEL: (61)2 9899 2411	FAX: 2 9899 2421	Italy	IWAKI Europe GmbH, Italy Branch	TEL: (39)0444371115	FAX: 0444 336350
Austria	IWAKI EUROPE GmbH	TEL: (49)2154 92540	FAX: 2154 9254 48	Korea	IWAKI Korea Co.,Ltd.	TEL: (82)2 2630 4800	FAX: 2 2630 4801
Belgium	IWAKI Belgium n.v.	TEL: (32)1367 0200	FAX: 1367 2030	Malaysia	IWAKIm Sdn. Bhd.	TEL: (60)3 7803 8807	FAX: 3 7803 4800
China	IWAKI Pumps (Shanghai) Co., Ltd.	TEL: (86)21 6272 7502	FAX: 21 6272 6929	Norway	IWAKI Norge AS	TEL: (47)23 38 49 00	FAX: 23 38 49 01
China	IWAKI Pumps (Guangdong) Co., Ltd.	TEL: (86)750 3866228	FAX: 750 3866278	Singapore	IWAKI Singapore Pte. Ltd.	TEL: (65)6316 2028	FAX: 6316 3221
China	GFTZIWAKI Engineering & Trading (Guangzhou)	TEL: (86)20 8435 0603	FAX: 20 8435 9181	Spain	IWAKI Europe GmbH, Spain Branch	TEL: (34)93 37 70 198	FAX: 93 47 40 991
China	GFTZIWAKI Engineering & Trading (Beijing)	TEL: (86)10 6442 7713	FAX: 10 6442 7712	Sweden	IWAKI Sverige AB	TEL: (46)8 511 72900	FAX: 8 511 72922
Denmark	IWAKI Nordic A/S	TEL: (45)48 24 2345	FAX: 48 24 2346	Switzerland	IWAKI (Schweiz) AG	TEL: (41)26 674 9300	FAX: 26 674 9302
Finland	IWAKI Suomi Oy	TEL: (358)9 2745810	FAX: 9 2742715	Taiwan	IWAKI Pumps Taiwan Co., Ltd.	TEL: (886)3 573 5797	FAX: 2 8227 6818
France	IWAKI France S.A.	TEL: (33)1 69 63 33 70	FAX: 1 64 49 92 73	Taiwan	IWAKI Pumps Taiwan (Hsin-chu) Co., Ltd.	TEL: (886)3 573 5797	FAX: (886)3 573 5798
Germany	IWAKI EUROPE GmbH	TEL: (49)2154 92540	FAX: 2154 9254 48	Thailand	IWAKI (Thailand) Co., Ltd.	TEL: (66)2 322 2471	FAX: 2 322 2477
Holland	IWAKI Europe GmbH, Netherlands Branch	TEL: (31)547 293 160	FAX: 547 292 332	U.K.	IWAKI Pumps (UK) LTD.	TEL: (44)1743 231363	FAX: 1743 366507
Hong Kong	IWAKI Pumps Co., Ltd.	TEL: (852)2 607 1168	FAX: 2 607 1000	U.S.A.	IWAKI AMERICA Inc.	TEL: (1)508 429 1440	FAX: 508 429 1386
Indonesia	IWAKI Singapore (Indonesia Branch)	TEL: (62)21 690 6606	FAX: 21 690 6612	Vietnam	IWAKI pumps Vietnam Co.,Ltd.	TEL: (84)613 933456	FAX: 613 933399