

SN-50 Series Syringe Pump

SN-50C6/SN-50C6T/SN-50C6A

SN-50C66/SN-50C66R/SN-50C66T/SN-50C66TR

SN-50F66/SN-50F66R/SN-50F6/SN-50F6A

User manual

Version: 1.0

Please read this user manual before using this product

Sino Medical Device Technology Co., Ltd.

Statement:

Information contained herein is based on experience and knowledge of this field of the discussed products of Sino Medical Device Technology Co., Ltd. (hereinafter referred to as Sino) prior to the issuance hereof.

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The contents of this manual are subject to changes due to the product upgrade or the design modification, and Sino will not give further notice.

The user should read this manual carefully before installing and using the SN-50 series syringe pump.

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1. Safety Information

1.1 Manual Conventions

This manual highlights patient- or equipment-related information or potential risks with the following symbols.

	Caution: This symbol serves as reminder and warning about possible equipment or environmental damages.
	Warning: This symbol is used to draw attention to matters that may lead to injury or death.
Note: This symbol is used to highlight important guide information, which affects how to use the manual and product, or it is used to provide additional information such as detailed explanation, hints or reminders.	

1.2 Safety Overview

Equipment classification:

Class I; internally powered; CF type applied part; IPX2, continuous operation equipment; not used in an oxygen-rich environment.

Equipment of IPX2 is protected against vertically falling water drops.

The use of syringes: Syringe applied

Users must use the syringes that conform to the national standards with medical admittance. The default specifications are Shandong Weigao Syringes 5 ml, 10 ml, 20 ml, 30 ml and 50 ml. Syringes of other brands can also be user-defined according to the syringe automatic calibration functions of this syringe pump (as for the calibration methods, please refer to Section 4.2 Calibration of Syringes).

Overview of safety prevention:

- Operators are not allowed to open the housing of the device shell of the equipment under any circumstance.
- Do not make the security functional parts of built-in device invalid or short-circuited.
- If the device is not working, do not repair it by yourself. Instead, the operator should immediately contact eligible personnel that are authorized to maintain the equipment. Authorized maintainers can ask for the corresponding materials from this company.
- There is no repair part inside the machine that you need.

- Observe all Warning and Caution tips no matter whether they are clearly defined or self-evident.
- Follow all requirements on the safety labels of the equipment.

1.3 Electrical / mechanical safety

Only the maintenance personnel who are qualified by training and authorized by Sino can open the shell of the equipment to replace electrical and mechanical components; otherwise, problems associated with equipment safety may occur.

The following is an overview of the warning information:

1.3.1 Electrical Safety

	Warning: Shock hazard -- in order to protect patients and medical personnel, it must be guaranteed that the device has good earthing and power-supply socket has intact protective earth. It is forbidden to connect the triaxial cable of this apparatus to biaxial plug.
	Warning: In case that the internal protective guide wire is compromised in terms of installation or wiring completeness, the apparatus must be run powered by this internal power supply.
	Warning: Shock hazard -- Do not open the shell of the apparatus during the operation or when the power is on; only authorized maintenance engineers are allowed to open it.
	Caution: Before use, the user must ensure the apparatus and cable are free from any obvious damage that may affect the patient's safety or apparatus performance. The recommended examination period is once a week or less. If you find obvious damages, it is recommended the defective parts be replaced before the use.
	Caution: Safety equipment should be periodically tested to ensure the safety of the device. Including leakage current measurement and insulation test. The recommended test cycle is once a year or the test is performed according to the regulatory requirements and testing procedures.
	Caution:

	The power cable must be removed before cleaning. During cleaning, use a soft brush or soft cloth to remove the dust on the device surface; use a brush to sweep the dust on the connector and dust panel edge; or use a soft cloth moistened with a neutral detergent / disinfectant or 70% alcohol and dimethyl carbinole. Make sure that the detergent or disinfectant does not permeate the interiors of the equipment. Special attention must be paid to the sites of connectors and panel board margins.
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1.3.2 Use safety

	Warning: This apparatus must not be operated on out of the operation environmental setting; otherwise, the apparatus fails to work normally.
	Warning: Inapplicable to the operation in the environment of flammable anesthetic gas mixed with oxygen and nitrogen oxides. Otherwise, explosion may be caused.
	Warning: The use of inappropriate or non-calibrated syringes may result in inaccuracy in rate or drug volume, bringing harm to patients.
	Warning: During use of this apparatus, pay attention to avoid the harm from air entering into human body.
	Caution: Keep the environment clean and avoid shock. Keep away from corrosive medicine, dust, high temperature and humid environment.
	Warning: Apart from the transducer and cable sold by the equipment manufacturer as backup units for internal components, the accessories, transducer and cable out of the specified range may cause increase in equipment emission or decrease in immunity to interference.
	Warning: The equipment must not be placed close to other equipment or overlapped with other equipment. If the equipment must be placed close to or be overlapped with other equipment, verify that operation is normal under normal configuration.
	Caution: It should be ensured that the device installation is not subject to the strong

	electromagnetic interference, such as interference of wireless transmitters or mobile phones.
	Note: In case that the RS232 port of the apparatus is not in use, cover the protective lid.
	Note: The used syringe is disposable and conforms to corresponding national hygiene and quality standards. Cross use is forbidden. After the use of disposable syringes, operators should treat them as medical wastes.
	Note: The power lines and batteries provided by Sino must be used; otherwise, the apparatus fails to work normally.

1.4 Symbols

1.4.1 Safety symbols

~	Alternating current
AC	Alternating current
==	Direct current
DC	Direct current
	Power on / off
	Refer to instruction manual/booklet
	CF type applied part
	Indicator light for alternating current supply
	Indicator light for battery power

	Date of manufacturing
	Serial number
	Company logo
IPX2	Protected against vertically falling water drops when enclosure tilted up to 15°
	Non-ionizing electromagnetic radiation

1.4.2 Transport Symbols

	Fragile: Handle With Care
	Keep dry
	Up
	Stacking tier limit
	Humidity limit
	Atmospheric pressure limit
	Temperature limit

2. About the Product

2.1. Overview

SN-50 series syringe pump is a channel-and-rate-controlled constant-volume infusion pump. It boasts high timely accuracy, stable flow rate and low drug consumption. It is particularly applicable to the infusion of sodium nitroprusside, dopamine, propofol and antibiotic drugs for acute and severe diseases. The 5 ml, 10 ml, 20 ml, 30 ml or 50 ml disposable sterile syringes (hereinafter referred to as syringe), which are calibrated on this machine, can be selected for the SN-50 series syringe pump. Once the syringe is clamped into the pump, the pump automatically recognizes the specification of the clamped syringe (5 ml, 10 ml, 20 ml, 30 ml or 50 ml). Multiple types of alarm functions are set on this pump to guarantee safe and reliable process of infusion. This product is used to clinically control the flow and rate of the fluids (drug fluid, nutrient fluid and blood) infused into the patient's body so that the use is safer.

2.2 Product Models

Model	L*W*H (mm)	Channel	Compatible Syringe (ml)	Drug Library	Wireless Function	Flow Rate	Body Weight	Time
SN-50F6	354*195*148	Dual	10/20/30/50			✓		
SN-50F6A	354*195*148		10/20/30/50			✓		
SN-50F66	354*195*148		5/10/20/30/50			✓		
SN-50F66R	354*195*148		5/10/20/30/50		✓	✓		
SN-50C6	306*140*146	Single	10/20/30/50			✓		
SN-50C6A	306*140*146		10/20/30/50			✓		
SN-50C6T	306*140*146		10/20/30/50			✓	✓	✓
SN-50C66	306*140*146		5/10/20/30/50			✓		
SN-50C66R	306*140*146		5/10/20/30/50		✓	✓		
SN-50C66T	306*140*146		5/10/20/30/50	✓		✓	✓	✓
SN-50C66TR	306*140*146		5/10/20/30/50	✓	✓	✓	✓	✓
SN-50C66TS	306*140*146		5/10/20/30/50			✓	✓	✓
SN-50C66TSR	306*140*146		5/10/20/30/50		✓	✓	✓	✓
SN-50C66TSR	306*140*146		5/10/20/30/50		✓	✓	✓	✓

2.3 Principles and application

2.3.1 Operating principles

As a constant-volume pump, the pump is different from constant-pressure pumps (such as peristaltic pump), and its output of drug amount within the specified time period is not subject to the influence of resistance in the infusion channels. When the pressure reaches a certain value, the occlusion alarm system set on the pump sends sound and light alarms and stops the injection. By means of this mechanism, the actual output of the pump is consistent with the pre-set output. This pump is equipped with a micropropulsion system, which can obtain the relatively large rate adjustment range through the control circuit. After any of the five specifications (5 ml, 10 ml, 20 ml, 30 ml or 50 ml) is installed on the pump, the pump recognition system automatically adjusts the corresponding upper limit for the limited rats. At this time, it is only necessary to set the injection rate and pressure the start button so that the pump starts to work.

2.3.2 Intended use

SN-50 series syringe pump is used to inject drug into human body under conditions where the dosage is very accurate, velocity is stable, and dosing speed is slow or constant within a long period of time.

2.3.3 Applicable population

Applicable to drug infusion and infusion therapies among patients such as adult, infant and newborn patients.

2.3.4 Intended users

Doctors and nurses in hospital environments, or the professional medical personnel qualified by training.

2.3.5 Contraindications

N/A

2.4 Product features and description

2.4.1 Delivery rate

5ml	0.10 ml/h~150.00 ml/h, stepping is 0.01ml/h
10ml	0.10 ml/h~400.00 ml/h, stepping is 0.01ml/h
20ml	0.10 ml/h~600.00 ml/h, stepping is 0.01ml/h
30ml	0.10ml/h~900.00 ml/h, stepping is 0.01ml/h
50ml/60ml	0.10ml/h~1500.00 ml/h, stepping is 0.01ml/h

2.4.2 Accuracy

Delivery accuracy: Within $\pm 2\%$ (Dimensional precision of syringe should be within $\pm 1\%$ and Mechanical precision should be within $\pm 1\%$)

2.4.3 Bolus (Purge) rate range

Manual mode:

50 ml syringe: 5.0ml/h~1500ml/h

30ml syringe: 5.0ml/h~900.0ml/h

20ml syringe: 5.0ml/h~600.0ml/h

10ml syringe: 5.0ml/h~400.0ml/h

5ml syringe: 5.0ml/h~150.0ml/h

Auto mode:

50 ml syringe: 0.1ml/h~1500ml/h

30ml syringe: 0.1ml/h~900.0ml/h

20ml syringe: 0.1ml/h~600.0ml/h

10ml syringe: 0.1ml/h~400.0ml/h

5ml syringe: 0.1ml/h~150.0ml/h

2.4.4 Query of total amount

0.1ml~999.9ml, stepping is 0.1 ml;

1000ml - 9999 ml, stepping is 1 ml

2.4.5 Limiting quantity

0.1ml~999.9ml, stepping is 0.1 ml;

1000ml - 9999 ml, stepping is 1 ml

2.4.6 Occlusion alarm threshold

High (H): 800 mmHg $\pm$ 200 mmHg (106.7 kPa $\pm$ 26.7 kPa)

Central (C): 500 mmHg $\pm$ 100 mmHg (66.7 kPa $\pm$ 13.3 kPa)

Low (L): 300 mmHg $\pm$ 100 mmHg (40.7 kPa $\pm$ 13.3 kPa)

Calibration unit: kPa

2.4.7 KVO rate

50ml syringe: 0.1 ml/h~5.0 ml/h, default value: 0.5 ml/h

30ml syringe: 0.1 ml/h~5.0 ml/h, default value: 0.5 ml/h

20ml syringe: 0.1 ml/h~5.0 ml/h, default value: 0.5 ml/h

10ml syringe: 0.1 ml/h~1.0ml/h, default value: 0.5 ml/h

5ml syringe: 0.1 ml/h~1.0ml/h, default value: 0.5 ml/h

2.4.8 Residual amount

Length mode: 1mm – 18mm, stepping 1mm;

Volume mode: 1mm – 5mm, stepping 1ml;

Time mode: 1min – 10min, stepping 1min

2.4.9 Historical records

This series of products can store no less than 2,000 historical records, which include the following information: injection mode, injection rate, alarm information, total injected volume, **threshold value of pipeline obstruction pressure limit**, limiting quantity, syringe number, and operation information.

2.4.10 Alarms

This series of products are equipped with the following alarm functions:

Prompt alarm about residue, alarm about injection completion, alarm about pipeline obstruction, alarm about wrong syringe specification, alarm about wrong injection head, alarm about excessive rate, alarm about injected volume being equal to limit, alarm about grid electricity power down, alarm about low battery power, alarm about battery power depletion; alarm about missed operation, and alarm about system error.

2.4.11 Power

AC input: 100-240V~, 50/60Hz

DC input: 12V ---

Battery voltage: 12V

Battery working time: under the condition of full charging, the battery can support 6-hour single-channel operation at the rate of 5 ml/h, and 4-hour dual-channel operation.

Rated power: 40 VA

Mains fuse: T2L,250V — Time lag, low breaking capacity.

2.4.12 Environment conditions

Operational conditions

Temperature: +5~+40℃

Humidity: 15%~95% (non-condensing)

Atmospheric pressure: 57kPa~106kPa

Transportation and storage conditions:

Temperature: -40~+70℃

Humidity: 10%~98% (non-condensing)

Atmospheric pressure: 50kPa~106kPa

2.4.13 Net weight

Single channel pump: 2.25kg (including the holder)

Dual channel pump: 3.45kg (including the holder)

2.4.14 Syringe brands

It can store syringes manufactured by 33 different manufacturers, including Weigao and other 32 customized brand syringes. “Customized” syringes must pass the syringe calibration function test of the

pump, and the user-selected 5 ml, 10 ml, 20 ml, 30 ml and 50 ml syringe parameters are recorded in the “Custom” column. Only after that can the syringes of this brand and specification be used.

	Warning: The syringes used by users should have certificates of effective registration. The syringes to be used must be calibrated. If there is no calibration, the infusion may be inaccurate.
---	--

2.5 Diagram of the exterior

The graphic presentation of external composition of SN-50 series syringe products is as follows:

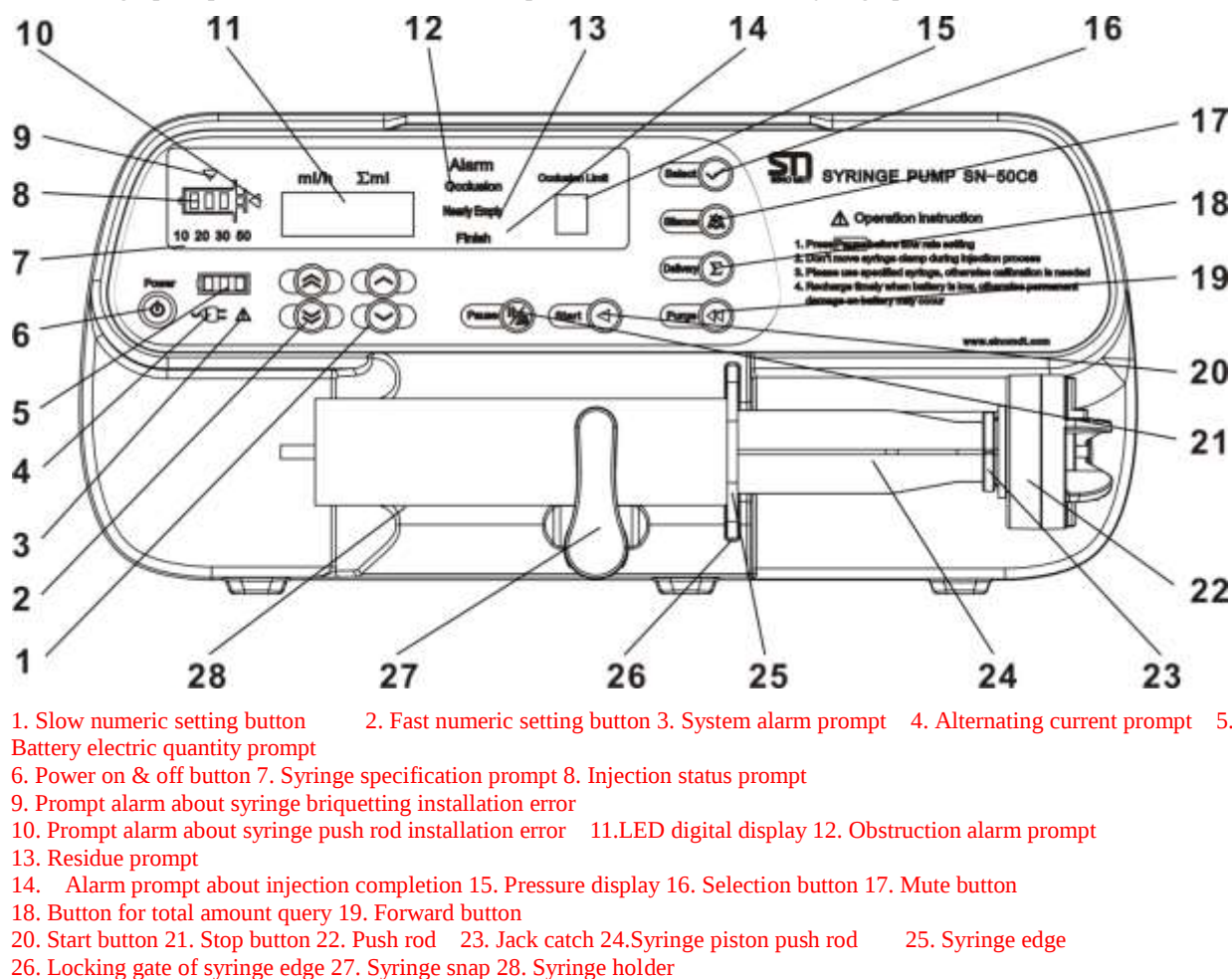
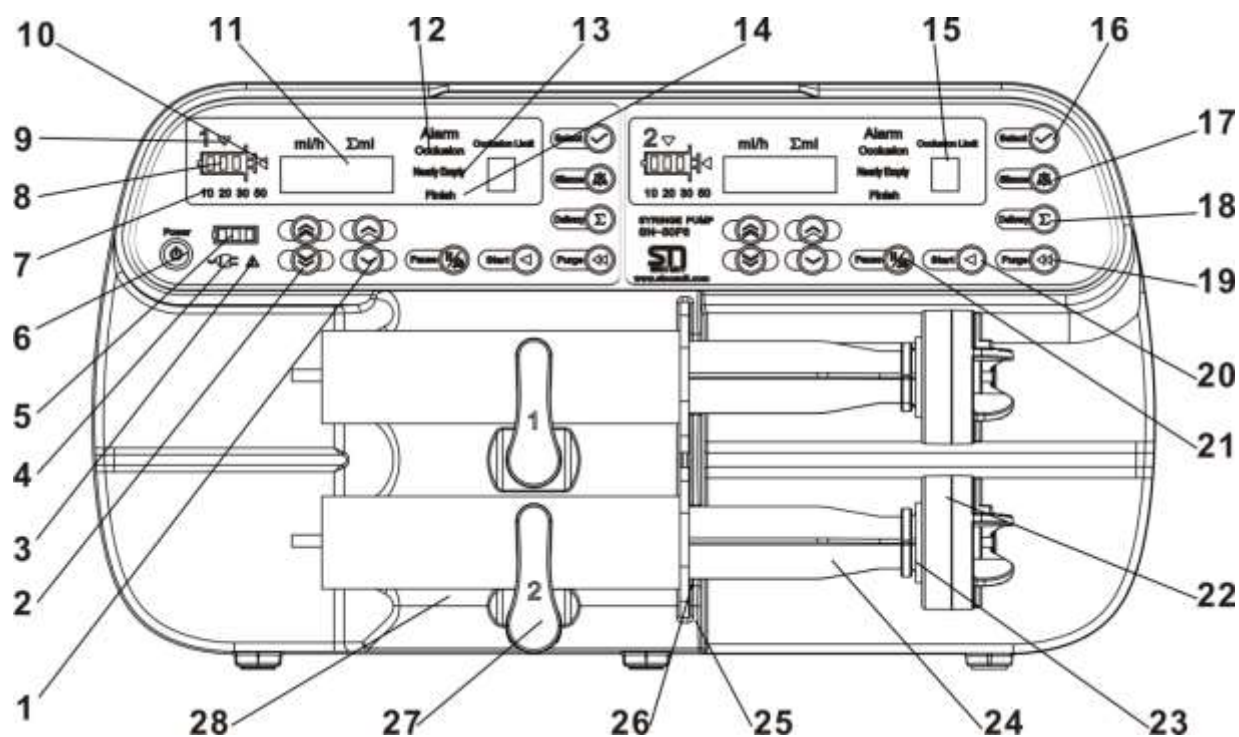
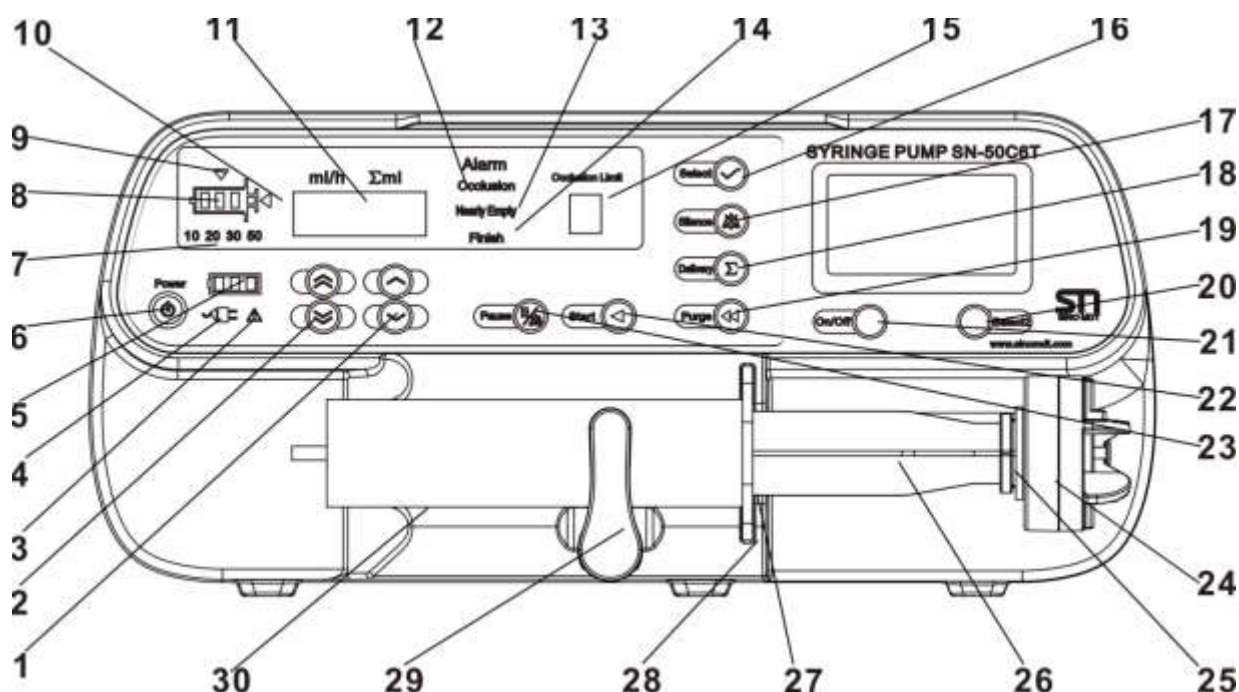


Fig. 2.5.1 Composition of SN-50 series single channel pump (without a display) system



1. Slow numeric setting button 2. Fast numeric setting button 3. System alarm prompt 4. Alternating current prompt 5. Battery electric quantity prompt
 6. Power on & off button 7. Syringe specification prompt 8. Injection status prompt
 9. Prompt alarm about syringe briquetting installation error
 10. Prompt alarm about syringe push rod installation error 11.LED digital display 12. Obstruction alarm prompt
 13. Residue prompt
 14. Alarm prompt about injection completion 15. Pressure display 16. Selection button 17. Mute button
 18.Button for total amount query 19. Forward button
 20. Start button 21. Stop button 22. Push rod 23. Jack catch 24.Syringe piston push rod 25. Syringe edge
 26. Locking gate of syringe edge 27. Syringe snap 28. Syringe holder

Fig. 2.5.2 Composition of SN-50 series dual channel pump system



1. Slow numeric setting button 2. Fast numeric setting button 3. System alarm prompt 4. Alternating current prompt 5. Battery electric quantity prompt
6. Power on & off button 7. Syringe specification prompt 8. Injection status prompt
9. Prompt alarm about syringe briquetting installation error
10. Prompt alarm about syringe push rod installation error 11.LED digital display 12. Obstruction alarm prompt
13. Residue prompt
14. Alarm prompt for injection completion 15. Pressure display 16. Selection button 17. Mute button
18. Button for total amount query 19. Forward button
20. Select button 21. On & off button of LCD screen 22. Start button 23. Stop button 24. Push rod 25. Jack catch
26. Syringe piston push rod 27. Syringe edge 28. Locking gate of syringe edge 29. Syringe snap 30. Syringe holder

Fig. 2.5.3 Composition of SN-50 series single channel pump (with a display) system

2.6 External interface

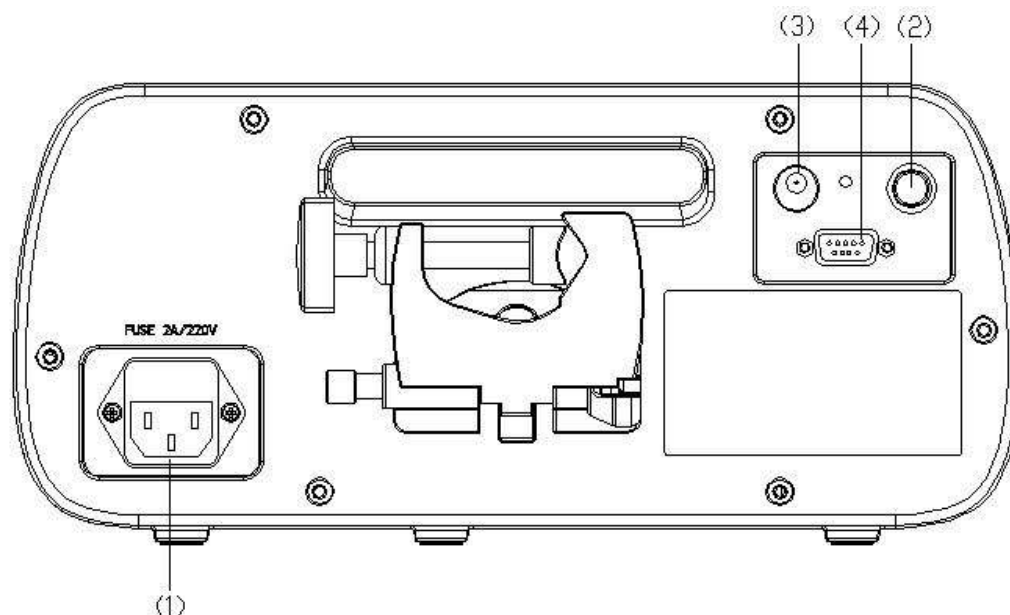


Fig. 2.6.1 External interface of SN-50 series single channel pump system

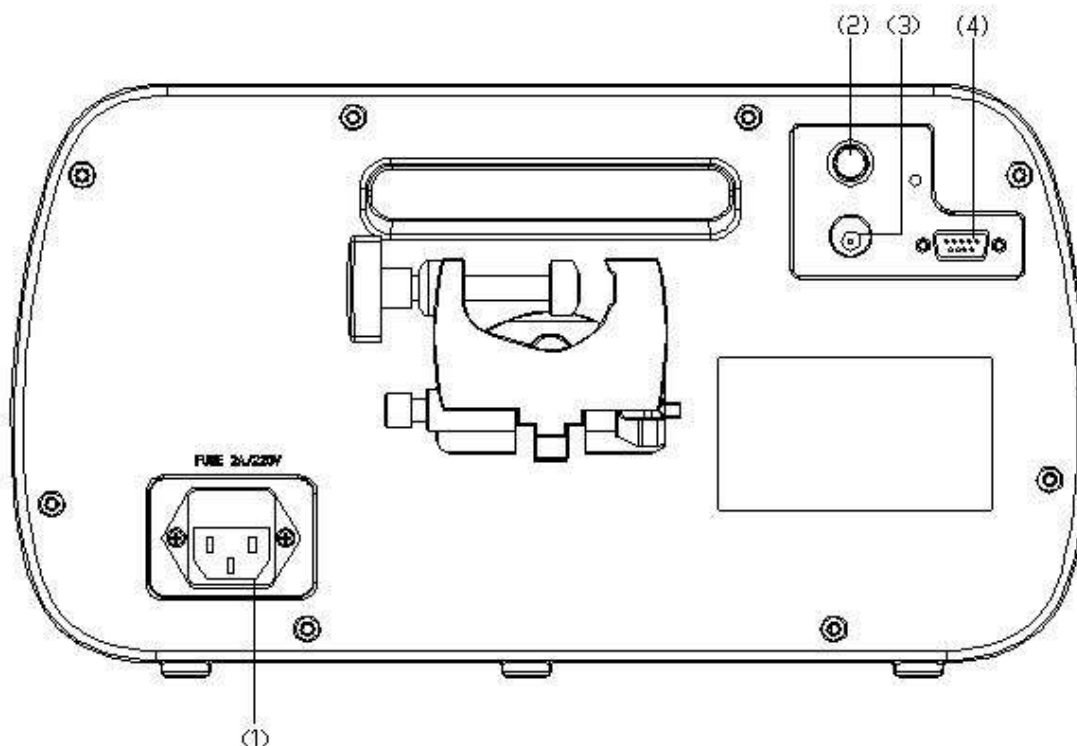


Fig. 2.6.2 External interface of SN-50 series dual channel pump system

(1) AC power supply port: connecting to AC power supply.

(2) Nurse call port: connecting to nurse call system.

(3) External DC power supply port: connecting to 12V external DC power supply.

(4) RS232 port: used to communicate with external devices.

RS232 Interface: Communication with the exteriors is carried out through this interface. It is required that shielded lines be used for the RS232 communication lines, and the equipment connected with the communication line should conform to IEC60950-1. Nurse call interface: used to connect to the nurse call system.

External direct current power supply interface: used to connect 12 V external direct current power supply. The direct current must meet IEC60601-1 standards.

Alternating current power supply: used to connect the alternating current.

3 Operation procedure

3.1 Syringe mounting and clamping

- Pinch the toggle, open the jaw lock, push the push rod leftwards until the push rod reaches the press hand of the syringe, unclamp the toggle, and release the jaw lock.
- Fill in the syringe with drug liquid and load the airless syringe into the syringe seat.

	Warning: Before the installation of syringe, the air inside must be emptied to avoid aeroembolism.
	Caution: The syringe edges must be inserted into the edge locking gate of the injection pump.

- Rotate the snap of syringe back to the original position and release it.
- Clench the push head to let the jack catch open, move the push head to the tail of the syringe push rod, unclamp the toggle and release the jaw lock, so that the syringe smears are stuck between the push head and jack catch.
- Press the forward button, and release it after the scalp acupuncture is above the drug liquid.
- After all parameters are set, insert syringe needle into the patient's vein (artery), press the “Start” button, and then the pump starts the infusion.

	Warning: Before injection, empty the air in the infusion connection tubes to avoid harm caused by aeroembolism to the patient.
---	--

3.2 Pump fixation

The fixation clamp at the dorsal side of the apparatus can be used to fix the apparatus on the fulcrum bar of injection pump.

Press the cover at the end of the revolution axis, turn the fixation clamp open by 90 degrees, rotate the handle, and clamp the fulcrum bar.

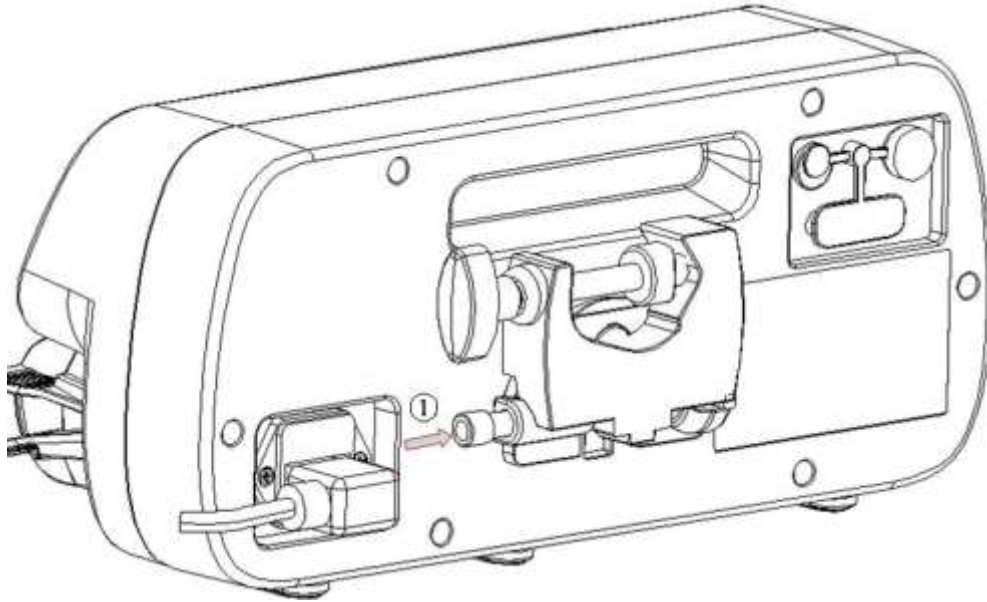


Fig. 3.2.2 Open the fixation clamp

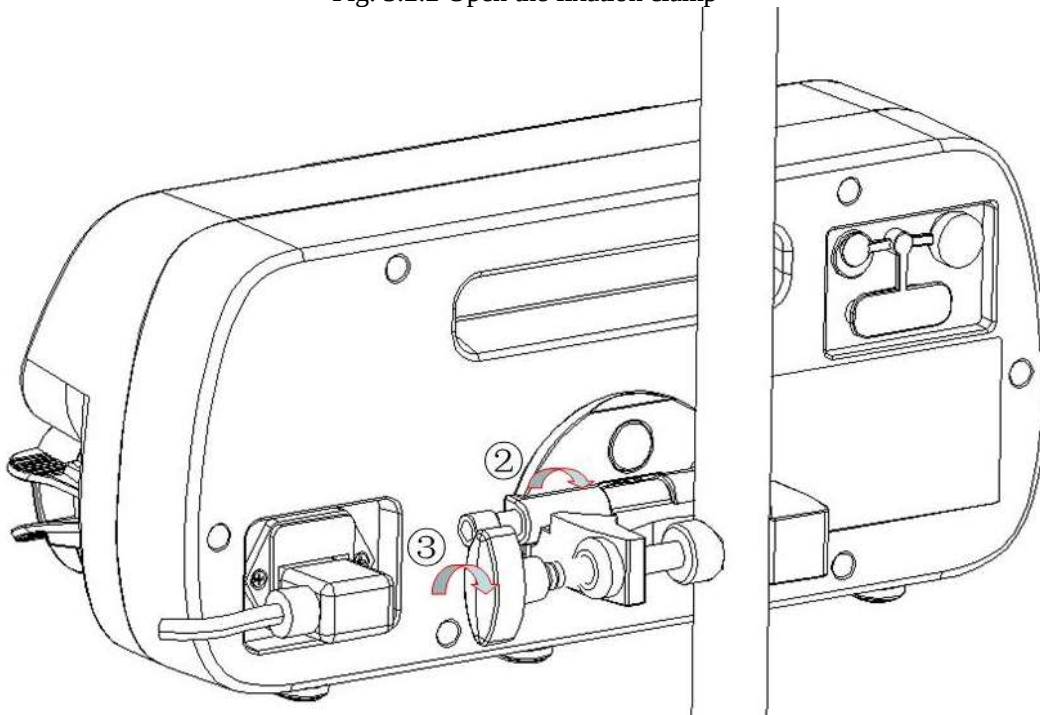


Fig. 3.2.3 Clamp the fulcrum bar

- The method of fixing the horizontal fulcrum bar is as follows: Rotate the entire fixation clamp anticlockwise by 90 degrees, press the cover at the end of the revolution axis, turn the fixation clamp open by 90 degrees, rotate the handle, and clamp the fulcrum bar.

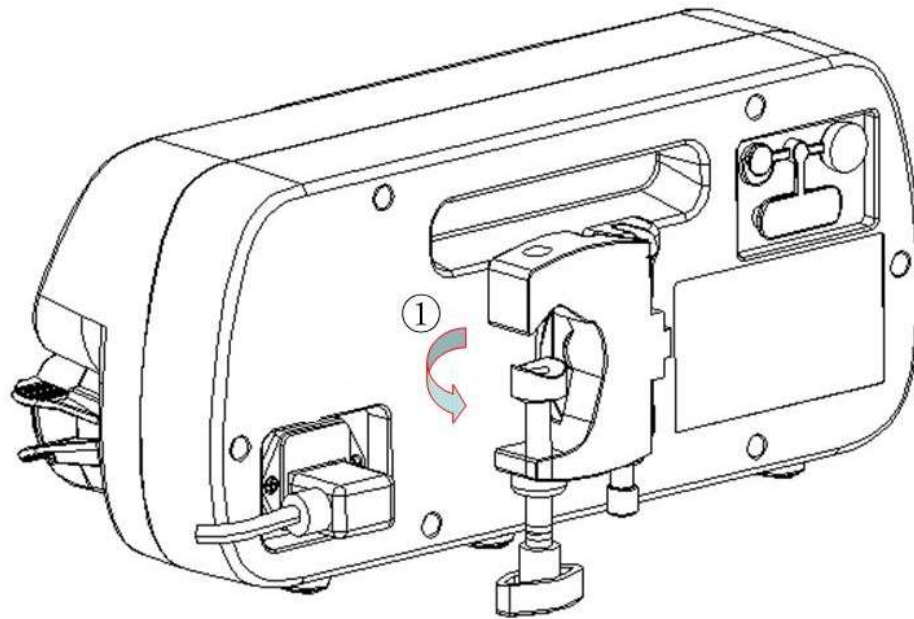


Fig. 3.2.4 Rotate it by 90 degrees anticlockwise

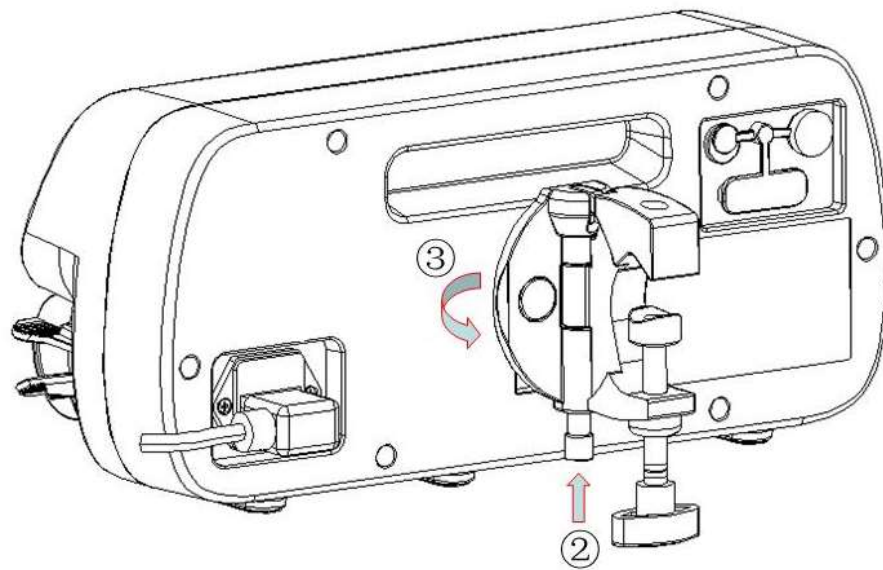


Fig. 3.2.5 Open the fixation clamp

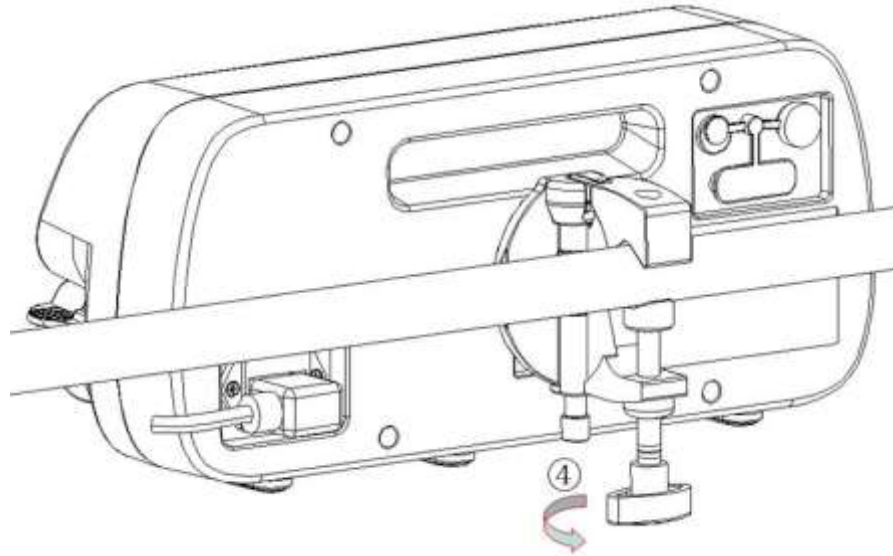


Fig. 3.2.6 Clamp the fulcrum bar

Note:

	Warning: After the long-term use of the pump, in case of the appearance of inferior fovea of the buttons of the operation surface film, the manufacturer should be notified in good time to have it replaced; otherwise, this will induce the wrong trigger.
	Warning: As the film at the button may become sunken and subsequently press the button, resulting in the wrong trigger, due to the long-term of plastic surface film, the relevant personnel should pay attention to observe whether the rate returns to the originally set rate after the forward button is pressed. In case of the same with the forward rate, the apparatus still needs be shut down; otherwise, the pump will keep pushing at the rate of rapid injection, bringing risks to the patients. At this time, it is necessary to notify the authorized maintainers to have the surface film replaced before another use.
	Warning: After the jack catch on the push head becomes ruptured, it should be replaced in good time; otherwise, the siphon will arise to make the residual solution in the syringe flow into the patient's body and overdosing will occur, bring harms to the patients.
	Warning: The syringe edges must be inserted into the locking gate of syringe edges of the injection pump; otherwise, there is no drug fluid output or there will be output at a large dose due to siphon, bringing harms to the patients.
	Warning: The syringes at the accurately-calibrated specifications and models must be used; otherwise, there will be inaccurate injection rate and non-stop of injection.

	However, as for the syringes, we only guarantee that the appearance, structure, dimension, and biochemistry, physical and metrological indicators are recognized by the detection of relevant supervisory departments.
	Warning: During the transfer of injection pump, relevant personnel should pay attention to connection of syringe, extension tubes and syringe needles; and prevent the harms caused by connector detachment to patients.
	Warning: The pump is mounted and clamped according to the requirements indicated in the graph, or fixed reliably per se; and it cannot be placed on the fenceless plates at the bedside to avoid the pump slide due to pipeline traction; otherwise, risks are caused to the patients.
	Warning: This pump cannot be operated on by the patient's family members to avoid the risk caused by incorrect operation to the patients.
	Warning: During the test of pump rate, it should be noted that the selected syringes must be used.
	Warning: Precision errors of syringes affect the precision of pump output. During detection of pump precision, the syringes for the use of pumps with relatively high precision must be selected.
	Warning: The intra-pump charging battery should be examined on the charging and discharging time every three months to avoid the failure in normal use due to the consumption of battery electric quantity when the battery is working. The rated discharging time of the battery is 6 hours (in case of single channel injection at the rate of 5 ml/h), but the battery will be damaged or the charging is incomplete, and there will be no guarantee on the time for the battery to support the pump work.
	Note: The apparatus should be charged continuously for 4 hours in the shutdown mode. If the pump is not used for a period of time, it should be charged once every three months to avoid worthlessness due to the automatic discharge of the in-built battery. In case of alarms for consumption of battery electric quantity, the pump must be connected with alternating current power supply in good time; otherwise, the consumption of electric quantity in the battery may damage the batteries.
	Note: Ineffective batteries must be handled over to the places designated by competent environmental authorities, and sent to this company for central treatment to prevent environmental contamination. In case of expiration of useful life, the apparatus and removed accessories after maintenance must be properly taken care of to prevent environmental contamination.

3.3 Power-on

After the connection with supply mains (alternating current), the alternating current indicator lamp is on, indicating that the pump is in electrified status. In case that the apparatus is off and battery electric quantity is not full, the pump is charged automatically

3.4 Power on / off and main interface

After the connection with grid electricity (alternating current), the alternating current indicator lamp is on, indicating that the pump is in electrified status.

Power on: After the power on/off  button is long pressed for 1.2 second, the system will perform a self-inspection; at this time, the  button should be released, and no button is pressed during the self-inspection process to prevent the triggering of system errors by mistake. In case that the LED digital display does not display Err, it means the pump is normal. At this time, the apparatus is in standby status.

Dormancy: In standby status, long press the  button, and the apparatus enters the dormant energy-saving status. The four-digit LED digital display sequentially displays the symbol of “-”. In case of pressing any button except  button in this channel, this channel can be aroused.

Shut down: After the power on/off  button is long pressed for 1.2 second, the apparatus is shut down.

In injection status, the  button must be pressed first to stop the injection and then the power on/off  button is long pressed so that the apparatus can be shut down. After the shutdown, the data stored on the memory chip will not be missing due to shutdown.

3.5 Flow rate mode

The  button can be used to switch among the four parameters [Speed] [Limiting Quantity] [Pressure Limit Level] [Syringe Number].

3.5.1 Setting of parameters at the velocity mode

A) Setting of speed parameters:

In standby status, the  button is used to enter the velocity setting status; at this time, the “ml/h” lamp will be on, and the four-digit LED digital tube displays the value of the current infusion rate. The four-digit setting button can be used to adjust the value of total injection velocity, and the

four-digit LED digital tube displays the corresponding values.

 are rapid digit setting buttons.  are slow digit setting buttons. Keep pressing  or  in pause status, and the velocity can be rapidly up-regulated. Keep pressing  or  to rapidly low-regulate the velocity.

Under the condition that the injection is not paused, the   or   buttons can be pressed to adjust the infusion speed. After proper adjustment, press the start button, and the system will run at the adjusted speed. In case of no operation for 10 seconds or the pressing of the pause button during the adjustment, the pump returns to the status of normal injection.

B) Setting of parameters of limiting quantity

Limiting quantity: limit value of injected drug dose. When the injected drug dose reaches the limiting quantity, the machine sends out the corresponding prompts: the default of 0 means no limit.

In standby status, the  button is used to enter the limiting quantity setting status; at this time, the “ Σml ” lamp is on, and the four-digit LED digital tube displays the value of the current limiting quantity. The four-digit setting button can be used to adjust the limit value of total injected drug dose, and the four-digit LED digital tube displays the corresponding values. The data will be locked at the initiation status. Press the  button, and you can check the set limiting quantity.

In standby or pause status, the simultaneous pressing of  button and  button will make the set limiting quantity return to zero.

C) Setting of threshold value of obstruction alarm

Threshold value of obstruction alarm: the pressure is detected in real time during the injection; in case that the threshold value of obstruction alarm is exceeded, the alarm “pipeline obstruction” arises. There are three levels in the threshold value of obstruction alarm: high (H), central (C) and low (L); and the default value is central (C).

In standby status, use the  button to enter the status of setting threshold value of obstruction alarm. The four-digit LED digital tube displays OCCL; and the unit LED digital tube displays L or C or H (threshold value level). The pressing of   or   can shift among the three statuses: high (H), central (C) and low (L).

D) Setting of syringe numbers:

In standby status, use the  button to enter the status of setting the syringe numbers. The four-digit LED digital tube displays “-XX-”. “XX” means the syringe number; the pressing of   or   can select the corresponding syringe numbers. In case that no number is set, the number of the apparatus is automatically set to the number when the syringe was lastly used after the  button is pressed, and then the injection is started.

3.5.2 Air elimination

In standby status, press the  button for two consecutive times and keep pressing the button during the second time, and the apparatus will start gas discharge. The four-digit LED digital tube displays the rapid injection speed. Release the  button and the apparatus will stop gas discharge. The four-digit LED digital tube displays the pre-set rate.

3.5.3 Injection start

After the parameters of [Speed] [Limiting Quantity] [Pressure Limit Level] [Syringe Number] are set, directly press the  button. About one second after the four-digit LED digital tube blinkingly displays the “-XX-”, the speed value is displayed; in the meantime, the injection status indicator lamp blinks sequentially, meaning that the apparatus is in injection status.

3.5.4 Query

In any status, press the  button, and the relevant personnel can check the total dose of the drug liquid that has been injected into the patient's body.

In standby status, the simultaneous pressing of  button and  button can make the total injected dose to return to zero.

3.6 Time mode

On the main interface, select button 2 to shift the cursor to the time mode, and press the

 button to enter the time mode setting interface.

In this mode, the user can set the injection time, the total volume of fluid to be injected, and the speed. Set either of the two parameters (except the combination of time and rate), and the system will calculate the corresponding speed / time.

Note: The set injection time 00:00:00 means hour, minute and second from the left to the right.

3.6.1 Setting of parameters in the time mode

After the  button is pressed to make the modified parameters in highlighted status, set the corresponding parameters according to the parameter adjustment button , and the  key cannot make other parameters except total amount return to zero.

Note: Pressing the total amount button and + mute button can make the injected amount return to zero, and it cannot be changed through the speed adjusting button!

3.6.2 Air elimination

On the interface of setting at the time mode, press the  button for two consecutive times and keep pressing the button during the second time to shift to the air discharge interface. The apparatus starts to discharge gas. After the air in the pipeline is emptied, release the  button, and the apparatus stops gas discharge, and returns to the interface of setting in the time mode.

3.6.3 Injection start

On the interface of setting at the time mode, press  to initiate injection after the setting of relevant parameters. The LED display dynamically displays the accumulative amount.

In case of the need to stop injection, press the  button, and the apparatus stops the injection at.

3.7 Body weight mode

After the machine is started, keep pressing the [on/off] for 2 seconds to start the display screen and select the weight mode.

3.7.1 Introduction to weight mode

Weight mode: it is a type of injection mode of apparatus conversion into the rate according to the dose specified for the unit weight and in combination with the relevant parameters.

Formula:

1. The dose unit is $\mu\text{g/kg/min}$

$$\text{Velocity (ml/h)} = \frac{\text{dose } (\mu\text{g/kg/min}) \times \text{weight (kg)} \times \text{solution amount (ml)} \times 60}{\text{Drug amount (mg)} \times 1000}$$

2. The dose unit is mg/kg/h

$$\text{Velocity (ml/h)} = \frac{\text{dose (mg/kg/h)} \times \text{weight (kg)} \times \text{solution amount (ml)} \times 60}{\text{Drug amount (mg)}}$$

At this mode, the user can set four parameters **dose**, **drug amount**, **weight** and **solution amount**, and the speed will be automatically produced through calculation.

Dose: the effective content of injected drug per kilogram weight within the unit time in the medical order (unit: mg/kg/h or $\mu\text{g/kg/min}$)

Drug amount: drug content in the injected drug fluid. (Unit: mg)

Weight: patient's weight. (Unit: kg)

Solution amount: total volume of drug fluid that will be injected into the patient's body. (Unit: ml)

3.7.2 Setting of parameters in the weight mode

Through pressing the [Select 2], the user can select different parameters: dose, weight, solution amount, and drug amount: through pressing the numeric setting button, the user can input the needed parameters. After the setting of the four parameters is completed, the apparatus automatically calculates the injection speed, which will be displayed in the four-digit LED digital tube.

The default dose unit is $\mu\text{g/kg/min}$. Through pressing [Select 2], the user can switch between $\mu\text{g/kg/min}$ and mg/kg/h .

The user can press the initiation button to start the operation. In 5 seconds, the back light of the weight mode display window puts out; in order to turn on the light, press the weight mode.

Simply press the on/off button.

After starting the weight mode, the user cannot directly modify the velocity, and it can be automatically changed through doses.

3.7.3 Air elimination

In standby status, press the  button for two consecutive times and keep pressing the button during the second time, and the apparatus starts gas discharge. The four-digit LED digital tube displays the

rapid injection speed. Release the  button and the apparatus stops gas discharge. The four-digit LED digital tube displays the pre-set rate.

3.7.4 Injection start

After the parameters of [Speed] [Limiting Quantity] [Pressure Limit Level] [Syringe Number] are set,

directly press the  button. About one second after the four-digit LED digital tube blinkingly displays the “-XX-”, the speed value is displayed; in the meantime, the injection status indicator lamp blinks sequentially, meaning that the apparatus is at the injection status.

3.7.5 Query

In any status, press the  button, and the relevant personnel can check the total dose of the drug liquid that has been injected into the patient’s body.

In standby status, the simultaneous pressing of  button and  button can make the total injected dose to return to zero.

3.8 Drug library

After the machine is started, keep pressing the [on/off] for 2 seconds to start the display screen and select the drug library mode.

3.8.1 Drug library

On the drug library selection interface, press [Select button 2] or  to select the corresponding drugs.

After selecting the corresponding drugs, press  button so that the user can enter the drug parameter check interface.

LHL: lower hard limit; in case of pressing the adjustment speed or dose, the value cannot be adjusted to the one lower than this value.

LSL: lower soft limit; in case of pressing the adjustment speed or dose, when the actual value is less than this value, the interface will give the corresponding alarm signs.

USL: upper soft limit; in case of pressing the adjustment speed or dose, when the actual value is greater than this value, the interface will give the corresponding alarm signs.

UHL: upper hard limit; in case of pressing the adjustment speed or dose, the value cannot be adjusted to the one higher than this value.

Through pressing the  button, the user can enter the interface of speed mode parameter under the mode drug library or weight mode parameter under the drug library.

3.8.2 Drug library

In pause status, the user can select different parameters through pressing the **[Select 2]** button, and if the user

keeps pressing  , he/she can set the corresponding parameters.

3.8.3 Air elimination

In standby status, press the  button for two consecutive times and keep pressing the button during the second time, and the apparatus starts gas discharge. The four-digit LED digital tube displays the

rapid injection speed; release the  button and the apparatus stops gas discharge. The four-digit LED digital tube displays the pre-set rate.

3.8.4 Injection start

After the parameters are set, directly press the  button. In the meantime, the injection status indicator lamp blinks sequentially, indicating that the apparatus is in injection status.

3.8.5 Query

In any status, press the  button, and the relevant personnel can check the total dose of the drug liquid that has been injected into the patient's body.

In standby status, the simultaneous pressing of  button and  button can make the total injected dose to return to zero.

3.9 Bolus (purge)

Manual rapid discharge functions:

On the injection interface, press the  button for two consecutive times, and keep pressing it during the second time to carry out the rapid injection, and then the apparatus enters the rapid injection interface;

Release the  button, the apparatus automatically stops the rapid injection and injects the drug according to the originally-set parameters.

Automatic rapid discharge functions:

On the injection interface, press the  button and the machine enters the automatic bolus setting interface, and the ml/h LED light blinks; by pressing the parameter adjustment button , the user can set the automatic rapid discharge rate; by pressing the  button, the user can shift to the pre-set volume; when the pre-set volume LED indicator lamp blinks, the user can adjust the automatic rapid discharge pre-set volume by pressing the parameter adjustment button .

After the setting ends, press the  button to enter the automatic bolus interface, and the digital tube will dynamically display the automatic rapid discharge accumulative volume; If the user wants to abandon the automatic rapid discharge at the automatic bolus setting interface, the user can press the  button / carry out no operation for 10 seconds to automatically withdraw from the rapid discharge setting interface to carry out the injection according to the originally set parameters.

3.10 Standby mode

In standby status, long press the  button, the apparatus enters the standby status, and four-digit LED digital display sequentially displays the symbol of “-”. In case of pressing any button except  button in this channel, this channel can be aroused.

3.11 Battery charging management

3.11.1 Battery

The model of adopted battery: B1

Appearance of Ni-H battery there should be no defects such as deformation and fluid leakage.

The intra-pump charging battery should be examined on the charging and discharging time every three months to avoid the failure in normal use due to the consumption of battery electric quantity when the battery is working. The rated discharging time of the battery is 6 hours for the single channel and 4 hours after the dual channel, but the battery will be damaged or the charging is incomplete, and there will be no guarantee on the time for the battery to support the pump work; it should be charged for 4 hours

consecutively in shutdown status before the first use. If the pump is not used for a period of time, it should be charged once every three months to avoid the worthlessness due to the automatic discharge of the in-built battery. In case of the alarms for the consumption of battery electric quantity, the pump should be connected with the alternating current power supply in good time; otherwise, the consumption of electric quantity in the battery may damage the batteries. The ineffective batteries should be handled over to the places designated by the environmental departments, and also sent to this company for the uniform treatment to prevent the environmental contamination.

3.11.2 Charging

This product should be charged at the shutdown status for at least four hours, and the charging automatically stops after the electric quantity is full. When the battery is charged, first use the constant current; when it is close to the saturation, shift to the trickle charging; after it is full, stop the charging.

4. Syringe Selection and calibration

4.1. Syringe Selection

Syringe numbers: The syringe parameters of the manufacturers should be stored, and the same number can simultaneously contain 4 to 5 kinds of specifications of syringes; the default is 0.1, Shandong Weigao Syringe.

In standby status, use the  button to enter the status of setting the syringe numbers; at this time, the four-digit LED digital tube displays “-XX-”. “XX” means the syringe number; the pressing of   or   can select the corresponding syringe numbers.

4.2 Syringe calibration

In standby status, it is necessary to pull the rated syringe piston to the position about 5 mm beyond the rated graduation line (the apparatus should be fill with water, the extension tube and the graduation line should be connected, the water output of the syringe needle is not lower than the pump body to guarantee a better calibration precision), and the syringe is correctly mounted and clamped on the apparatus.

Press the  button for two consecutive times and keep pressing the button during the second time so that the piston is pushed to syringe rated volume graduation line (5 ml, 10 ml, 20 ml, 30 ml or 50 ml), and then release the  button.

Long press the  button, the apparatus enters the syringe calibration status, and the injection status lamps  blinks simultaneously. Release the  button. At this time, the four-digit LED digital tube displays the “-XX-” syringe number, indicating: the brand of syringe to be calibrated currently and the XX number at this apparatus preparation to be saved. The user can use   or   to set the calibrated numbers.

After the  button is pressed, the syringe starts the automatic calibration. During this period, do not carry out any operation on the apparatus to avoid the failure in calibration

When the piston is pushed to the top of the syringe, the apparatus intermittently sends out buzz and automatically shifts to the pause status, and then the calibration is completed.

5. Advanced setting

5.1 Bed number setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display in highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.

- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Bed No. Setting]**, and press the  button to enter the bed number setting interface.

- Press the  button to set the bed number. Press the  button to save the parameters and return to the senior setting interface.

The value adjustment range of bed setting is 0 to 255.

Dual channel and single channel pump (without display):

- In power-on status, press the  button to set the speed at 123.3ml/h, and long press the  button to enter the bed number setting interface in the senior setting interface;

- Press the  button to set the bed number. Press the  button to save the parameters and return to the injection mode interface.

The value adjustment range of bed setting is 0 to 255.

5.2 Nurse port setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display at the highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.

- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Nurse Port Setting]**, and press the  button to enter the nurse interface setting interface.

- Press the  button to set the nurse interface ON/OFF, press the



button, save the parameters and return to the senior setting interface.

Dual channel and single channel pump (without display):

- 

In power-on status, press the button to set the speed at 123.3ml/h, and long press the  button to enter the senior setting interface; press the  button for twice, and the digital tube display place can shift to the **[Nurse Port Setting]** Place.
- 

Press the button to set the nurse interface ON/OFF. Press the  button to save the parameters and return to the injection mode interface.
- On the nurse call setting interface, in case that “n” is displayed at the pressure grade digital tube place, it means that the function of nurse call is started; in case that “o” is displayed at the pressure grade digital tube place, it means that the function of nurse call is disabled.

5.3 Bolus(purge) setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display at the highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.
- 

Press the button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Purge Rate Setting]**, and press the  button to enter the forward speed setting interface.
- 

After pressing button, press the  button to change the specifications of the syringe; after the specifications of the syringe are selected, press the  button to set the forward speed after pressing the  button. Press the  button to save the parameters and return to the senior setting interface.

Dual channel and single channel pump (without display):

- 

In power-on status, press the button to set the speed at 123.3ml/h, and long press the  button to enter the senior setting interface; press the

 button for three times, and the digital tube display place can shift to the **[Purge**

Rate Setting] Place; press the  button, and the user can enter the forward speed setting interface.

- Press the  button to change the specifications of the syringe; after the specifications of the syringe are selected, press the     button to set the forward speed after pressing the  button. Press the  button to save the parameters and return to the senior setting interface.

5.4 Residual Limit Setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display at the highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.

- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Residual Limit]**, and press the  button to enter the residue volume setting interface.

- First press the  button and then press the  button; shift among the three residue modes: “volume, time, distance”; after the completion of the setting of residue mode, press  to select the residue mode parameters, and press the     button to set the needed values.

Set the trigger mode of “residual alarm”:

- Distance 2 mm ----- the alarm is triggered in case of still a distance of 2 mm from the syringe piston to the end; range: 1 to 18 mm, the step length is adjusted to 1 mm.
- Volume 1 ml ----- the alarm is triggered in case of still a volume of 1 ml from the syringe piston to the end; range: 1 to 5 ml, the step length is adjusted to 1 ml.
- Time 1 min ----- the alarm is triggered in case of still time of 1 min from the syringe piston to the end; range: 1 to 10 min, the step length is adjusted to 1 min.

Dual channel and single channel pump (without display):

- In power-on status, press the     button to set the speed at 123.3ml/h, and

long press the  button to enter the senior setting interface; press the  button for four times, and the digital tube display place can shift to the **[Residual**

Limit] Place; press the  button, and the user can enter the residue mode setting interface.

- Press the  button; shift among the three residue modes: “volume (2), time (3), distance (1)”; after the completion of the setting of residue mode, press  to select the residue mode parameters, and press the  button to set the needed values.

Set the trigger mode of “residual alarm”:

- Distance 2 mm ----- the alarm is triggered in case of still a distance of 2 mm from the syringe piston to the end; range: 1 to 18 mm, the step length is adjusted to 1 mm.
- Volume 1 ml ----- the alarm is triggered in case of still a volume of 1 ml from the syringe piston to the end; range: 1 to 5 ml, the step length is adjusted to 1 ml.
- Time 1 min ----- the alarm is triggered in case of still time of 1 min from the syringe piston to the end; range: 1 to 10 min, the step length is adjusted to 1 min.

5.5 Time setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display in highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.
- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Time Setting]**, and press the  button to enter the time setting interface.
- Press the  button and then press the  button to shift the years, months, days, hours and minutes, and press the  button to set the parameters of the years, months, days, hours and minutes. Press the  button to save the parameters and return to the senior setting interface.

Dual channel and single channel pump (without display):

- In power-on status, press the  button to set the speed at 123.3ml/h, and long press the  button to enter the senior setting interface; press the  button for five times, and the digital tube display place can shift to the **[Time Setting]** position; press the  button, and the user can enter the time setting interface.

Press the  button to shift the years, months, days, hours and minutes, and press the  button to set the parameters of the years, months, days, hours and minutes. Press the  button to save the parameters and return to the senior setting interface.

5.6 Auto save setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display in highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.

Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Auto Save on/off]**, and press the  button to enter the start to display zero clearing setting interface.

Press the  button to set the On/Off of Display Zero Clearing Setting button. Press the  button to save the parameters and return to the senior setting interface.

Dual channel pump (without display):

- In power-on status, press the  button to set the speed at 123.3ml/h, and long press the  button to enter the senior setting interface; press the  button for six times, and the digital tube display place can shift to the **[Auto Save on/off]** Place.

- Press the  button to set the On/Off of Display Zero Clearing Setting button. Press the  button to save the parameters and return to the senior setting interface.
- At the start to display zero clearing setting interface, in case that “n” is displayed at the pressure grade digital tube place, it means that the function of starting to display zero clearing is started; in case that “o” is displayed at the pressure grade digital tube place, it means that the function of starting to display zero clearing is disabled.

5.7 KVO setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display in highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.
- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[KVO Rate]**, and press the  button to enter the KVO speed setting interface.
- After pressing  button, press the  button to change the specifications of the syringe; after the specifications of the syringe are selected, press the  button to set the KVO speed after pressing the  button. Press the  button to save the parameters and return to the senior setting interface.

Dual channel and single channel pump (without display):

- In power-on status, press the  button to set the speed at 123.3ml/h, and long press the  button to enter the senior setting interface; press the  button for seven times, and the digital tube display place can shift to the **[KVO Rate]** Place; press the  button, and the user can enter the KVO speed setting interface.
- Press the  button to change the specifications of the syringe; after the specifications of the syringe are selected, press the  button to set the KVO speed after

pressing the  button. Press the  button to save the parameters and return to the senior setting interface.

5.8 Language setting

Single channel pump (with display):

- In power-on status, long press the LED display [ON/OFF] button to make the LED display in highlighted status, and by pressing the [Select 2] button, the user can shift the cursor to the **[Settings]**.

- Press the  button to enter the senior setting interface, press the [Select 2] button to shift the cursor to the **[Language]**, and press the  button to enter the language selection setting interface.

- Press the [Select 2] button or     button to switch the language ; after selecting the corresponding language, press the  button, save the parameters, and return to the senior setting interface.

5.8 History record

Single channel pump (with display):

Press [Select2] to highlight [History Record], then press  to enter history record, and check records by pressing     .

6. Alarms

6.1 Incorrect location of syringe alarm

During the normal injection of the apparatus, in case of the elevation of the syringe briquetting, the pump will send out intermittent alarms, the  lamp blinks and the operation will stop. This alarm is also called “the alarm arises as the syringe is not clamped or wrong clamped”.

6.2 Prior end of injection alarm

When the fluid in the container satisfies the residue alarm in Section 5.3, the  lamp on the panel board blinks and in the meantime sends out the intermittent alarm sound.

6.3 Injection end alarm

When the injection of the drug fluid in the syringe is about to end, the  lamp blinks and sends out the intermittent alarm sound, the four-digit LED digital tube displays the KVO rate, and at this time the pump carries out the injection at the speed of KVO.

6.4 Occlusion alarm

In case of infusion obstruction due to the reasons such as syringe needle obstruction or infusion pipeline bending, when the pressure of the pipeline system reaches the preset threshold value, the  lamp on the panel board blinks and sends out the intermittent alarm sound, and at this time, the user can press the



button to mute this alarm.

Note: All the pump pressure obstruction alarms of all brands both at home and abroad have to go through a process from complete obstruction to the alarm; with the increase in the pump output, the system pressure gradually increases; when the system pressure reaches the pre-set pressure value, the obstruction alarm is initiated.

6.5 No action alarm

In standby status, in case of no operation on the apparatus within 2 minutes, the pump will send out the intermittent alarm sound, and in the meantime the four-digit LED digital tube blinks to display the “NOOP”; the user can long press the “Pause” button to enter the dormancy status, or press the mute button to eliminate this alarm.

6.6 Injection completion alarm

In case that the injection volume is equal to the pre-set limiting quantity, the pump will send out the intermittent prompt sound; at this time, the pump will stop injection, the four-digit LED digital tube alternately display the speed value and limiting quantity value, and also display the alarm prompt sound in case of limiting quantity.

6.7 Over-limit alarm

When the set rate exceeds the maximal velocity of 5 ml, 10 ml, 20 ml and 30 ml syringe, if the user presses

the  button, the pump will not be initiated, the four-digit LED digital tube will alternately display the speed value and the printed words of 05CC, 10CC, 20CC and 30CC, and in the meantime send out the intermittent alarm sound.

6.8 Push head error alarm

In case that the syringe push head is not inserted between the push head and the jack catch, the pump will

send out the intermittent alarm sound after the injection is initiated, the  lamp blinks, and the apparatus will not enter the injection status.

During the normal injection of the apparatus, in case that the jack catch is opened after the push head is

pushed downwards, the pump will send out intermittent alarms, the  lamp blinks and the operation will stop.

This alarm is also called “alarm for the wrong installation of syringe push rod”.

Note: Regarding all the above alarms, the user can press to eliminate the alarm sound, but cannot rule out the alarm.



6.9 Mains failure alarm

In case that the power switch is on, if the alternating current power supply is not connected or the power cord becomes detached in the middle of the use, the  lamp blinks (all the grids blink), and the pump will send out the intermittent alarm sounds.

6.10 Battery alarm

At this time, the pump can work for 30 minutes at the rate of 5 ml/h.

In case of battery undervoltage, the  lamp blinks (only one grid blinks), and the pump will send out the intermittent alarm sound.

6.11 Battery depletion alarm

At this time, the pump stops injection, set the alarm for continuous three minutes and is shut down automatically.

In case that battery electric quantity runs out, the pump stops the injection.  The lamp blinks (all the three grids blink), and the apparatus will send out continuous alarm sound.

6.12 Equipment error alarm

Due to machine failure, the apparatus will send out alarm sound, and the four-digit LED digital tube displays the error codes (the error codes are as follows); at this time, the machine needs to be restarted; in case the system still sends out the error alarms, please contact the after-sales service department of the distributor or manufacturer.

Error codes:

ERR1: the button is out of order.

ERR2: motor rotation speed is abnormal.

ERR3: communication is abnormal.

ERR4: pressure sensor is abnormal.

ERR5: memory errors

6.13. Alarm Priority

Alarms that occur during injection, such as alarm about injection completion, alarm consecutive pipeline obstruction, alarm about wrong syringe specification, alarm about wrong injection head, alarm about excessive rate, alarm about injected volume being equal to limit, alarm about battery power depletion, and alarm about system error, which are alarms of high priorities.

Prompt alarm about residue, alarm about grid electricity failure, alarm about low battery power, and alarm about missed operation are alarms of low priorities.

6.14. Alarm volume

The sound pressure range of sound signals is 45dB to 85dB.

7. Failure analysis and corrective action

Fault	Cause	Troubleshooting
Inaccurate rate	The syringe margins are not inserted into the groove of syringe seat.	Mount and clamp it correctly again.
	The syringe is not matched.	Select a calibrated syringe.
The alarm for battery undervoltage arises after the power is on, and the machine cannot be started.	The battery is not charged after the previous use of the pump, or it stands too long after the charging.	Shut it down for charging.
	The in-built battery is not used correctly, and the battery has been damaged.	Have the battery replaced.
Blood return is observed after the infusion is started.	Before syringe needle is inserted into the veins, the gap between the syringe press hand and the machine jack catch is excessively large.	Correctly mount the syringe again.
	The syringe margins are not inserted into the locking gate of syringe margins.	Correctly mount the syringe again.
The movement of the push head is not smooth.	There is drug fluid on the pump push rod.	Wrap it with alcohol.

In case of product failure under general conditions, the product should be sent to our company for maintenance within one year of maintenance period. Our company can provide the documents listed in 6.8.3C in IEC60601-1 to the designated qualified technicians. The service life of this product is 8 years, and the product date can be found on the product nameplate. After the service life is exceeded, there is risk involving the use of the apparatus, and you are recommended not to use it.

8. Maintenance

- Clean wet cloth with a proper amount of cleaning agent is used to wipe the external appearance of the pump on a regular basis, then clean wet cloth is used again to wipe the surface, finally clean cloth is wipe it clean, and it is placed on the dry shelves.
- In case of undervoltage, the pump sends out intermittent sound-light alarms. Please charge it in good time or connect the pump with the alternating current power supply. In case of battery consumption, the pump sends out continuous sound-light alarms and the pump immediately stops working. The user should immediately shut the pump down, and re-connect it with the alternating current power supply before another use. Charging method: at the power-off status, connect the injection pump with the alternating current power supply; at this time, the alternating current indicator lamp is on, and the pump is at the charging status. Note: The apparatus should be charged x for 4 hours consecutively in power-off status.
- If the pump is not used for a period of time, it should be charged once every three months to avoid the worthlessness due to the automatic discharge of the in-built battery.
- In case that the pump is not used for long, the corresponding charging and discharging examinations should carried out before the use to avoid that the in-built battery cannot be used in case of power failure. In case that the battery cannot be charged and discharged as normal, please contact us for the new charging combination batteries for the replacement. The battery should be replaced by the authorized personnel. The replacement methods: take off the screws at the posterior lip, open the posterior lid, take off the lead plug, take off the screws of the battery box, take out the old battery, replace it with the new battery, insert the battery lead into the seat, and finally put on the screws.
- When the pump is working normally, in case that the power cord fails to work properly, it can be replaced by a new one, which is provided by our company. The power cord replacing method: pull off the power cord plug from the grid electricity source, pull off the power cord socket from the pump, replace it with the new power cord, connect the socket to the power supply interface, and insert the power cord socket to the grid electricity source.
- In case of the need to replace the blown fuse, take off the fuse holder of the power supply socket at the rear of the pump so that the blown fuse can be replaced. Before the replacement, the apparatus should not be connected to grid electricity, and should be placed in power-off status.

9. Infusion characteristics

9.1 Infusion accuracy

The velocity accuracy $\pm 2\%$ includes the pump mechanical accuracy $\pm 1\%$ and syringe manufacturing accuracy $\pm 1\%$. In case of supervisory examinations and the user carries out the test according to the requirements of IEC60601-2-24, the following requirements are set for the syringe accuracy: the error in the dimension of all transverse sections of all syringes is less than $\pm 1\%$; there should be no slight leakage in all connections (including the plugs and the regions between the syringe walls) under the system pressure of positive and negative 13.33kPa (liquid leakage under the positive pressure and air input infusion system under the negative pressure). Applicable to the syringes in the precision test, it is Weigao 50 ml syringe.

9.2 Infusion accuracy characteristics

Syringes for test: Weigao 50 ml disposable syringe

Test method: the methods specified by IEC60601-2-24 are used.

Test results are as follows:

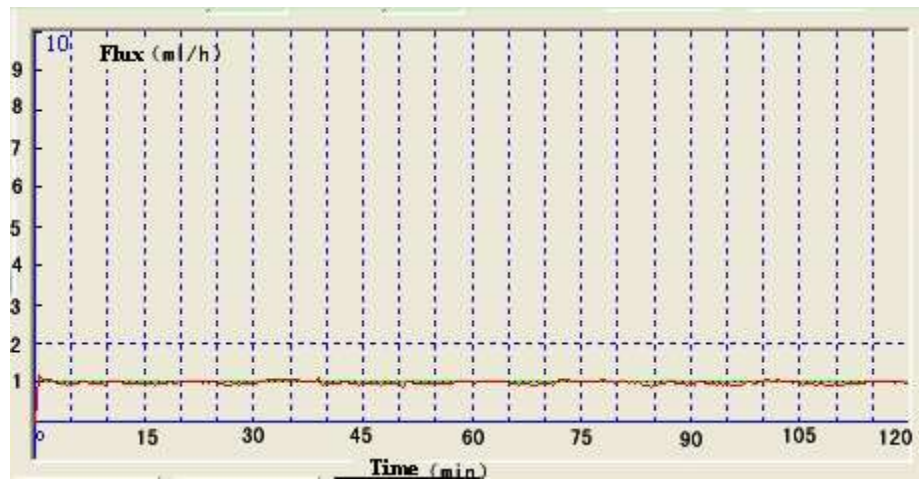


Fig. 9.2.1 velocity buildup curve when the rate is 1 ml/h



Fig. 9.2.2 trumpet curve when the rate is 1 ml/h

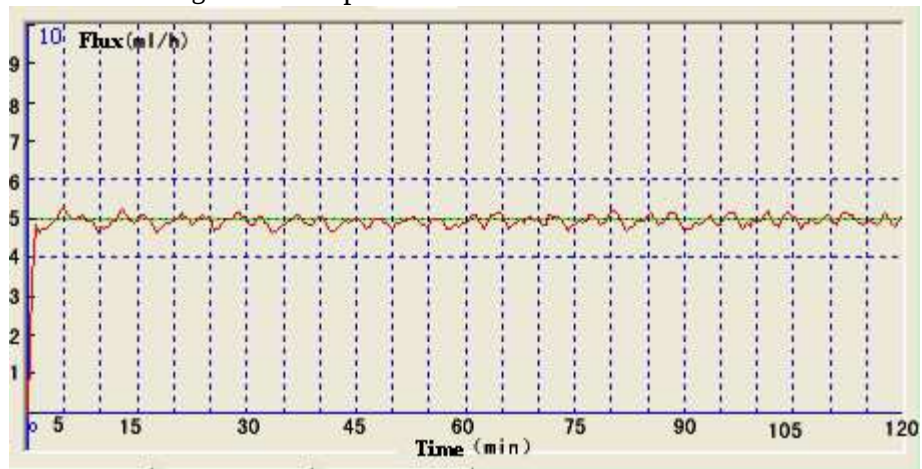


Fig. 9.2.3 velocity buildup curve when the rate is 5ml/h

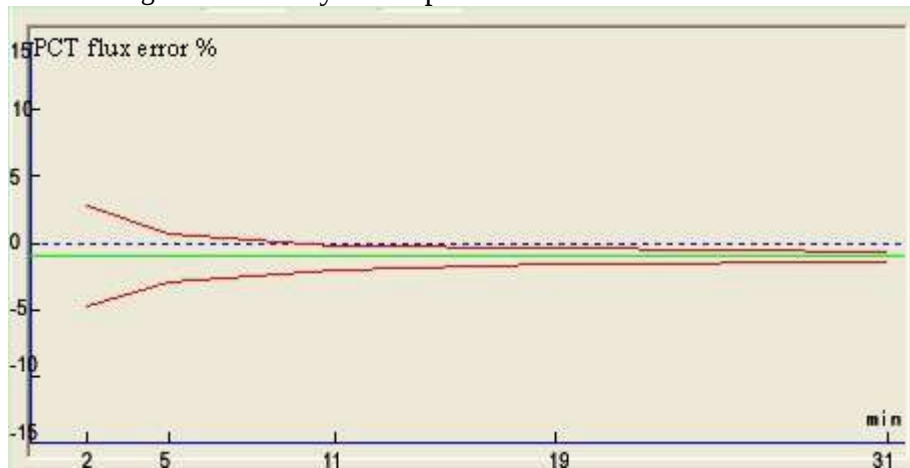


Fig. 9.2.4 trumpet curve when the rate is 5ml/h



Note:

	The above obtained test results are the results obtained from the tests on the manufacturer-recommended “Weigao” brain syringes. In case of use of the syringes of other brands, there may be deviation between the test results and the above results.
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9.3 Occlusion alarm feature

- Obstruction alarm time is the primary index for obstruction response characteristics. 50 mL Weigao Jierui syringes were used in this experiment, and the following data only represented the conclusion obtained from the syringes uses in this experiment. Note: the obstruction alarm time is subject to the influence of multiple factors such as injection rate, syringe manufacturing process, syringe specifications and sucked solution volume, and the length and pressure of patient pipeline.

Series No.	Flow rate(ml/h)	Occlusion setting	Obstruction pressure (mmHg)	Obstruction alarm time
1	120	Low	300	25 s
2	120	Central	500	33 s
3	120	High	800	58 s
4	5	Low	300	10 min 12 s
5	5	Central	500	15 min 38 s
6	5	High	800	20 min 22 s
7	1	Low	300	50 min 20 s
8	1	Central	500	1 h 14 min 36 s
9	1	High	800	1 h 30 min 10 s

- The bolus dose produced by obstruction alarm: 50 ml Weiago Jierui syringes were used in this experiment, the injection was carried out at the speed of 5 ml/h, the alarm threshold value was set as a low level, and the produced bolus dose was 0.06 ml; the alarm threshold value was set as a high level, and the produced bolus dose was 0.2 ml;

10. Electromagnetic compatibility

Guidance and manufacturer's declaration-electromagnetic emission for SN-50 Series Syringe Pump

Guidance and manufacturer's declaration – electromagnetic emissions		
The SN-50 Series Syringe Pump is intended for use in the electromagnetic environment specified below. The customer or the user of the SN-50 Series Syringe Pump should be assured that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - Guidance
RF emissions CISPR11	Group 1	The SN-50 Series Syringe Pump uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. The SN-50 Series Syringe Pump is suitable for use in all establishments, including domestic establishments and those directly connected to the public low voltage power supply network that supplies buildings used for domestic purposes.
RF emissions CISPR11	Class B	
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-2	Complies	

Guidance and manufacturer's declaration – electromagnetic immunity			
The SN-50 Series Syringe Pump is intended for use in the electromagnetic environment specified below. the customer or the user of the SN-50 Series Syringe Pump should assure that it is used in such an environment			
IMMUNITY test	IEC 60601 test level	Compliance level	Electromagnetic environment guidance
Electrostatic Discharge(ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) For 5 cycles 40% U_T (60% dip in U_T) For 5 cycles <5% U_T (>95% dip in U_T) For 5 sec	<5% U_T (>95% dip in U_T) for 0,5 cycle 40% U_T (60% dip in U_T) For 5 cycles 40% U_T (60% dip in U_T) For 5 cycles <5% U_T (>95% dip in U_T) For 5 sec	Mains power quality should be that of a typical commercial or hospital Environment .If the user of the SN-50 Series Syringe Pump requires continued operation during power mains interruptions, it is recommended that the SN-50 Series Syringe Pump be power from an uninterruptible power supply or a battery
Power frequency (50/60 Hz) Magnetic field IEC 61000-4-8	3A/m	3A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level $U_T = 230V/50Hz$			

Guidance and manufacturer’s declaration – electromagnetic immunity			
The SN-50 Series Syringe Pump is intended for use in the electromagnetic environment specified below. The customer or user of the *** should assure that it is used in used in such an environment.			
IMMUNITY test	IEC 60601 TEST LEVEL	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150kHz to 80 MHz	3 Vrms 150 kHz to 80 MHz	Portable and mobile RF communications equipment Should be used no to any part of the SN-50 Series Syringe Pump, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter Recommended separation distance $d=1.2 \sqrt{P}$ $d=1.2 \sqrt{P} \quad 80 \text{ MHz to } 800 \text{ MHz}$ $d=2.3 \sqrt{P} \quad 800 \text{ MHz to } 2,5\text{MHz}$ Where P is the maximum output power rating of the transmitter in watts(w) according to the transmitter manufacturer and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should Be less than the compliance level in each frequency range. ^b Interference may occur in the vicinity of equipment marked with the following symbol: 
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m 80 MHz to 2,5 GHz	
NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies. NOTE 2 These guidelines may not apply to all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
a) Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the SN-50 Series Syringe Pump is used exceeds the applicable RF compliance level above, the SN-50 Series Syringe Pump should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the SN-50 Series Syringe Pump . b) Over the frequency range 150 kHz to 80 MHz, field strengths should be less than [3] V/m.			

Recommended separation distances between
portable and mobile RF communications equipment and SN-50 Series Syringe Pump

The SN-50 Series Syringe Pump is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the SN-50 Series Syringe Pump can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the High-pressure Injector as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d=1.2 \sqrt{P}$	80 MHz to 800 MHz $d=1.2 \sqrt{P}$	800 MHz to 2,5 GHz $d=2.3 \sqrt{P}$
0.01	0.12	0.23	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

11. Product configuration

• Syringe Pump	1
• Power cord	1
• User's manual	1
• Packaging list	1
• Certificate of compliance	1
• Warranty card	1

12. Manufacturer information

Manufacturer: Sino Medical-Device Technology Co., Ltd.

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