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321 and 322 Pumps
User's Guide

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321 and 322 Pumps
User's Guide

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Safety

Read this section carefully before installing and operating the pump.

For safe and correct use of the pump, it is essential that both operating and service personnel follow generally accepted safety procedures as well as the safety instructions given in this document, the 321 and 322 Pump User's Guide.

The instruments described in this document are piston pumps, which should only be used in an indoor environment for pumping purposes by qualified personnel. If a 321 Pump, or a 322 Pump, is used in a manner not specified by Gilson, the protection provided by the pump may be impaired.

Voltages present inside the 321 and 322 Pumps are potentially dangerous. If there is a problem with any pump, the power cable should be removed until qualified service personnel have repaired it. This is to prevent anyone from inadvertently using the pump, thus causing possible harm to themselves, or damage to the pump itself.

The leakage current of a 321 Pump, and of a 322 Pump, is within the limits allowed by safety standards of laboratory equipment. An efficient ground connection is imperative for the physical protection of the user.

Power supply cord reference 500005 is for use in France and Germany. Power supply cord reference 500006 is for use in USA and Canada. For other countries contact your local Gilson distributor. You must only use the type of fuse described and specified in this User's Guide. The maximum voltage for any electrical device connected to each input or output contact of a 321 Pump is 48 V.

However, adequate protection including clothing and ventilation must be provided if dangerous liquids are used. In case of incidental spillage, carefully wipe with a dry cloth, taking into account the nature of the spilled liquid and the necessary safety precautions.

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Symbol	Explanation
~	Alternating current
	PROTECTIVE CONDUCTOR TERMINAL
I	On (Supply switch)
O	Off (Supply switch)
	Caution, risk of electric shock
	Caution (refer to User's Guide)

Cleaning, dismantling, maintenance, adjustment and repair should only be performed by personnel trained in such work, and who are aware of the possible dangers involved. Neither a 321 Pump, nor a 322 Pump, nor the pump heads, may be sterilized, using an autoclave, or any other device. When you need to clean a pump, use one of the three following methods:

1 - a clean dry cloth,
2 - a cloth dampened with water,
3 - a cloth dampened with soapy water.

If a cloth dampened with soapy water is used to clean the pump, only domestic soap may be used. No other form of detergent or chemical may be used.

The following electronic and hazard symbols appear on the pump:

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Declaration of Conformity

Application of Council Directives: **89/336/EEC and 73/23/EEC**

Standards to which Conformity is Declared:

Electromagnetic Compatibility:
EN 50081-1 (1992) for emission
EN 50082-1 (1992)for immunity

Safety:
EN61010-1, (1993, including AMD A2: 1995),
UL 3101-1 (1993) and CAN/CSA 1010-1 (1992, including MOD2: 1997)

Manufacturer: **Gilson S.A.**
19 rue des Entrepreneurs
BP45
95400 Villiers-le-Bel
France

Type of Equipment: **Laboratory Equipment**

Product: **321 and 322 Pumps**

Beginning with Serial Number: **186673 for 321 and 184862 for 322**

I, the undersigned, hereby declare that the equipment specified above, conforms to the above Directives and Standards.



Hervé Le Dorze
Quality Assurance Manager
Place: Sarcelles
Issue Date: 03/03/2000

The Gilson S.A. quality assurance system is registered as complying with ISO 9001 International Quality Standard, Registration Certificates No. 6621 and No. 18623 BVQI.

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Introduction 1

The multi-solvent pumps described in this User's Guide are Gilson 321-H1, 322-H1, 321-H2, and 322-H2, collectively referred to as 32X Pump(s).

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Notational Conventions and Units

Software Related Conventions (321 Pump)

The software displays messages and read only values on the control panel's screen as normal typeface inside a frame. This convention is followed in this User's Guide.

For software options where a key must be pressed, the related function is represented in bold (e.g. **Edit, HELP).**

When time is expressed in minutes it is to two decimal places. For example, 7.75 min is actually 7 minutes and 45 seconds.

Units and Conversion Factors

International System of Units (SI)

SI units are used in this document for specifications and reference data, although "Units in Use with the SI Unit" (e.g. bar and liter) are used in appropriate contexts.

The following information comes from the Handbook of Chemistry and Physics, 79th edition by D. R. Lide, CRC Press, 1998-1999, Section 1.19-23.

Name, Symbol, and Conversion factors

Pressure (Derived Unit)
Name of the SI Unit: pascal (symbol: Pa)
Unit in Use with the SI Unit: bar (symbol: bar)

Thermodynamic Temperature (Base Unit)
Name of the SI Unit: kelvin (symbol: K)
T(K) = T (°C) + 273
T (°C) = [T(°F) - 32] / 1.8
T (°F) = [1.8 x T(°C)] + 32

Length (Base Unit)
Name of the SI Unit: meter (symbol: m)
1 m = 3.28 feet = 39.4 inches
1 foot = 30.5 cm
1 inch = 25.4 mm

Conversion Factors

To Convert from: / Multiply by:	atm	bar	MPa	psi
atm	1	1.013	0.101	14.7
bar	0.987	1	0.1	14.5
MPa	9.87	10	1	145
psi	0.068	0.069	0.0069	1

1 atm = 760 mm Hg = 10^4 mm H_2O
1 hPa = 1 mbar = 10 mm H_2O
1 mm Hg = 1 Torr = 1.33 mbar = 133 Pa = 0.0193 psi

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Volume (Derived Unit)
Name of the SI Unit: cubic meter (symbol: m^3)
Unit in Use Together with the SI: liter (symbol: liter, l or L).
1 liter = 1 dm^3 = 1000 cm^3
1 gallon (UK, liquid) = 4.55 liter
1 gallon (USA, liquid) = 3.79 liter

Weight (Base Unit)
Name of the SI Unit: kilogram (symbol: kg)
1 kg = 2.20 pounds
1 pound = 0.454 kg

Prefixes

Prefix symbols should be printed in roman type (upright) with no space between the prefix and the unit symbol (e.g. km for kilometer). Prefixes are not to be used with temperature units.

Multiples			Submultiples		
Factor	Prefix	Symbol	Factor	Prefix	Symbol
10^{1}	deka	da	10^{-1}	deci	d
10^{2}	hecto	h	10^{-2}	centi	c
10^{3}	kilo	k	10^{-3}	milli	m
10^{6}	mega	M	10^{-6}	micro	µ
10^{9}	giga	G	10^{-9}	nano	n
10^{12}	tera	T	10^{-12}	pico	p
10^{15}	peta	P	10^{-15}	femto	f
10^{18}	exa	E	10^{-18}	atto	a
10^{21}	zetta	Z	10^{-21}	zepto	z
10^{24}	yotta	Y	10^{-24}	yocto	y

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Overview

User's Guide Description and Applicability

This guide is for user's of 321-H1, 321-H2, 322-H1, and 322-H2, Pumps. No distinction is made between the four models at the hydraulic level. However, because 322 Pumps have no control panel, the Sections relating to software are only relevant if control is from a 321 Pump. Where control is from a computer, the user can disregard Chapter 4 and parts of Chapter 3.

Information that relates only to one of the models is clearly identified at Chapter, Section or paragraph level. Otherwise, you can assume that the information relates to all.

Chapter 1 contains brief descriptions of the 32X Pumps, together with unpacking instructions, and warranty details.

Chapter 2 contains descriptions of a 32X Pump's major components.

Chapter 3 contains instructions for installing, and setting-up 32X Pumps.

Chapter 4 contains details of 321 Pump Software.

If you use external software to control 33X Pumps (up to three), you should refer to the manual for the controlling software (e.g. UniPoint). Some supplementary information has been included relating to UniPoint and GLP functions.

Chapter 5 relates to preventive maintenance and troubleshooting.

Chapter 6 contains reference information: specifications, technical data, hydraulic parameter information (solvent miscibility and compressibility corrections), and parts lists (items and references).

Chapter 7 contains information relating to GSIOC control and a list of available commands.

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Hardware Description

32X Pumps are reciprocating piston pumps for use in analytical and small-scale preparative chromatography (2mm to 20 mm bore columns). They are capable of multiple solvent delivery under high pressure (two solvents for the standard configuration).

321 Pumps are master pumps designed to pump from one to four solvents, they are equipped with two pump heads, which are used in such a way that each head acts as a separate pump. They also have a pressure module, a dynamic mixer, a purge valve, an outlet filter, and optionally a solvent valve block.

321 Pumps have a control panel (integral keypad and screen) for configuring, programming, and coordinating with other equipment (pumps, detectors, injectors, etc.). They my be controlled by their own software using control panel, or by PC base software and GSIOC (Gilson Serial Input-Output Channel) commands.

334 Pumps are designed as slave pumps; they are similarly equipped, but without the control panel. All references to software apply to the controlling device, be it a 321 Pump or a computer.

Software Description (321 Pump)

Although the pre-installed software is designed to be user-friendly, you are advised to read this guide carefully before using the pump. Programming consists of entering configuration details for your pump, and then a sequence of events (flow rate, composition, electrical contacts, etc.) as a Method Program.

By means of the pre-installed software (or PC based software), a 321 Pump may be used to control up to two other pumps, these are: a 322 Pump (the slave version of 321), Gilson 30X Series Pumps (with any head), or another 321 Pump; depending upn the configuration.

Alternatively, you may use Gilson UniPoint™ system software to control the 32X Pumps and associated Gilson equipment (via Gilson 506C interface and GSIOC slave bus).

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Coordination with any other instrument is carried out by electrical contacts.

One of the following Gilson detectors (UV-vis absorbance detection) may also be controlled from a 321 Pump: single-wavelength Model 151 or 152, dual-wavelength Model 155 or 156. You should refer to the user's guide of the relevant detector for full information, including soft-key functions that are accessible from the control panel of a 321 Pump.

Operating Principle

You have to go through three main steps before running your 321 Pump based Method Program:

1) Define the system configuration (enter descriptions of your pumping system's hardware).
2) Select the type of events and key in the related parameters (flow rate, composition, and coordination). The Method Program (configuration, list of events and associated parameters) is saved automatically by the software.
3) Initialize the system by priming the solvent channels; then run the Method Program.

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Unpacking

Hardware

You are advised to check your 32X Pump immediately, even if it is not to be used until later. Upon receipt of your instrument, unpack the unit carefully, inspect it for possible damage, and check the contents of each carton against the list of parts and accessories given in the Chapter 6. Your supplier should be notified immediately of any inconsistencies or any damage.

Your pump is delivered in a crate containing the main module and accessories. The original packing should be kept, especially for the period during which the instrument is under warranty, in case the equipment has to be returned to the factory.



Because of their weight (30 kg), you should take special care when handling the large cartons. Pump modules are heavy and should be lifted from the carton with care, by two persons. Instructions describing the unpacking procedures are to be found on and in the carton.

Software

The software is pre-installed and is accessible, using the control panel, immediately after switching on a 321 Pump.

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Warranty

If the pump does not appear to function correctly, first verify the electrical connections are correct and that the instrument is switched on. Contact your Gilson distributor for technical advice or possibly a service visit. Any service required will be given within the warranty conditions assured by your Gilson distributor.

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Customer Service

Gilson and its worldwide network of authorized distributors provide customers with four types of assistance: sales, technical, applications and service.

Customer Service personnel are able to serve you more efficiently if you provide the following information.

1) The serial number and model number of the equipment involved.

2) Type of computer (if used), available memory, microprocessor and software version(s) in operation.

3) The installation procedure you used.

4) A concise list of the symptoms.

5) A list of operating procedures and conditions you were using when the problem arose.

6) A list of other devices connected to the system and a system diagram showing the connections.

7) A list of other electrical connections in the room.

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Introduction 1

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Description 2

The 321 Pump is fitted with a control panel; it may be used to control other pumps, or work in the stand alone mode. The 322 Pump, which has no control panel, operates in the slave mode.

A single 321 Pump is capable of mixing two solvents in either isocratic or gradient modes. By adding a 322 Pump (or one or two 30X Pumps) up to four solvents may be pumped.

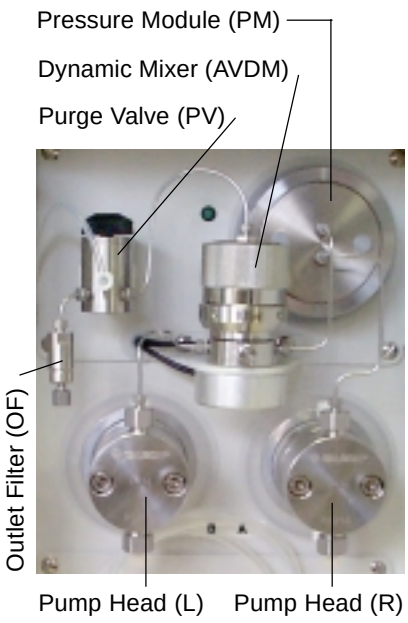
For both pumps, the hydraulics are revealed by opening the removable door - the pump's principal hydraulic components are pre-mounted. There is a drip tray at the bottom of both pumps. Solvent bottles can be placed in the tray at the top the pump.

A 321 Pump may also be used to control a sample injection pump. However, in total no more than two additional pumps of any type may be controlled from a 321 Pump, whether the controlled pumps be used for mobile phase, or for injection.





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Hydraulic Components

The principal hydraulic components of 32X Pumps are: pump heads, pressure module, dynamic mixer, purge valve, and the outlet filter. Construction characteristics are given in Chapter 6.

Two reciprocating pump motors are contained within the body of the pump. The tops of the pump motors protrude through the front panel. The maximum piston frequency is approximately 150 cycles / minute.

The right hand motor pumps a solvent (normally 'A') via the pressure module to the dynamic mixer and the left hand motor pumps another solvent (normally 'B') directly to the dynamic mixer.

Pump Heads



Two interchangeable pump-head types are available: H1 for analytical use (flow rates between 0.15 and 15 ml / minute, 60 MPa), H2 for analytical and small scale preparative use (flow rates between 0.30 and 30 ml / minute, 30 MPa).

The pump heads are pre-mounted directly onto the tops of the driving mechanisms, which have the same axis as the piston motors, so pump heads may be changed with relative ease. The pump heads must also be dismounted for routine servicing purposes (e.g. changing a piston seal).

Each head has a solvent inlet port, a solvent outlet port, an inlet port to the rinsing chamber, an outlet port from the rinsing chamber, and a reciprocating piston.

The piston seal and the bellows are inside the pump head. The solvent inlet port and the solvent outlet port are fitted with connectors containing the check valves. All of these items can be serviced by the user (see Maintenance, Chapter 5).

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Dynamic Mixer (AVDM)

The dynamic mixer performs high-pressure mixing of the solvents coming from channels A and B, and (optionally) solvent coming from another pump or pumps. The dynamic mixer volume is continuously adjustable between 0.20 ml and 2.20 ml. When the dynamic mixer is operating the indicator (green LED) lights-up.

Pressure Module

The pressure module minimizes the pulsations created by the reciprocating action of the pump motor. A built in transducer detects the pressure in this part of the hydraulic circuit.



Purge Valve

After mixing, the next component in the hydraulic circuit is the purge valve, which is used to manually switch the mobile phase between the outlet filter and the drain.

Outlet Filter

The outlet filter characteristics are: 2 µm threshold, 1.9 mm thickness, 4.8 mm diameter, and 16 µl total internal volume.



Solvent Valve Block (Optional)

Up to four solvent lines may be connected to a Solvent Valve Block (SVB) to test the effectiveness of different solvents (or to perform rinsing, cleaning, and conditioning). These solvents may be switched under software control, the selected solvent exits from the central connector and is routed to the left hand pump head.

Two types of Solvent Valve Block are available as additional accessories. For the 321 Pump, the SVB should be pre-installed into the front panel of the pump. For the 322 Pump, an external version of the SVB (including tubing and connector cable) can be obtained from your Gilson representative.

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Solvent Degasser (Optional)

The Gilson 864 Degasser is an on-line solvent degasser with four channels, operating under a vacuum of 70 hPa. It maximizes the stability of the chromatographic results by removing dissolved gasses from solvents, down to less than 0.4 ppm, for oxygen dissolved in water, at a flow rate of 1 ml/minute.

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Control Components (321 Pump)

The components for controlling from a 321 Pump are at the front of the instrument. All electrical connections are made at the rear.

Control Panel

Display Unit and Screens

The 40-character, 8-line unit is used to display sets of information: parameters, commands, messages (time related events, flow rates, solvent composition, in-run information, etc.), and soft-key functions.

A 'screen' comprises of a set of information, depending on the software and the choices that you make. Each screen has a unique number, accessible by pressing the **HELP** key.



Keypad and Function Keys

Soft-keys

The bottom line of the display unit is reserved for labeling six variable-function soft-keys (identified by the six evenly spaced circles just below the display unit). The functions of the soft-keys, which are determined by the software, may change from screen to screen. For any given screen, the current function is displayed above each active soft-key. Inactive keys have no function displayed.

Pressing a soft-key selects the function displayed directly above it, for example: **Edit**, **Create**, and **Run**. Descriptions of these and all other soft-key labels are given in Chapter 4.

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Fixed function keys

In addition to the variable-function soft-keys, there are fixed function keys as follows:

HELP: to display advice at any time, with no effect on the operation of the pump,

ESC: to change from a software level to a higher one or quit a HELP screen,

CLEAR: to cancel your last entry before it is stored in the memory,

ENTER: to confirm a selection or value and store it in the memory,

Arrow keys (4): to move from one variable field to another (screen dependent),

Numeric keys (**0** to **9**, and **.**): to enter values (for predefined parameters).

Stand-by Panel

The stand-by panel comprises an ON / OFF key and three Light Emitting Diodes (LEDs):



1) The 'POWER' LED (green) lights up when the main ON / OFF switch is set to ON.

2) The 'ON' LED (yellow) lights up when the main ON / OFF (I / O) switch is set to ON (I) and the ON / OFF key on the stand-by panel is set to ON (pressing the key toggles between ON and OFF).

3) The 'ERROR' LED (red) lights up under certain anomaly conditions (see Chapter 5).

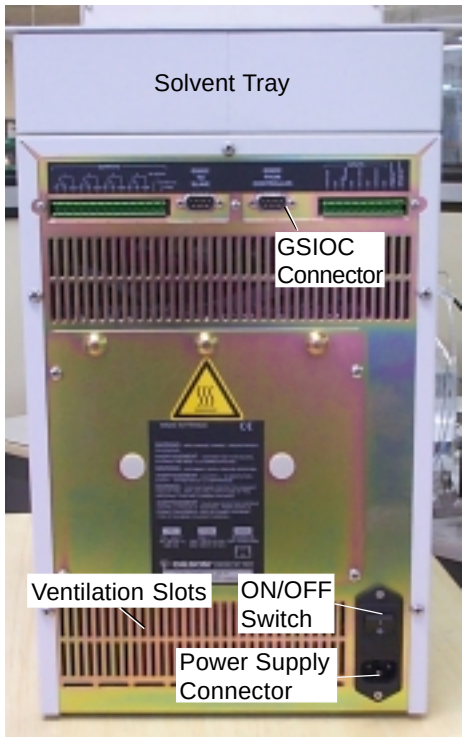
The ON / OFF key on the stand-by panel is for use when you want to turn off the power for a short period of time or to stop the 321 Pump instantaneously.

When you want to turn off the power for a longer period of time you should also switch off the power using the main ON / OFF switch on the back panel of the 321 Pump.

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Rear Panel - Electrical Connectors

All electrical connections are made to the rear panel. Also visible are the fan's ventilation slots, which must never be obstructed in any way.



For 321 Pumps, the function of each item is as follows:

1 Main power ON / OFF switch.

2 Power supply cable socket.

3 Fuses and voltage selector.

4 14-pin connector socket for output contact signals (relay type).

5 10-pin connector socket: 4 input signal channels and 2 output channels:
1 digital output converted to analog (pin-9, 0-1 V, configurable),
1 analog output (pin-10, 142-1000 mV, for pressure).

6 GSIOC from controller (321 Pump or computer).

7 GSIOC to slave pump (32X Pump and / or 30X Pump) or Gilson 15X UV Detector.

Only use standard GSIOC (Gilson Serial Input Output Channel) connectors.

For 322 Pumps, there is only one GSIOC connector (from controller) and a pair of rotary switches for setting the GSIOC ID number and bit rate; there is also a connector for the command-cable of the optional external SVB.

Power Connector

The standard 3-pin connector accepts the power supply cord supplied with your 32X Pump. Power supply cord reference 500005 is for use in France and Germany. Power supply cord reference 500006 is for use in USA and Canada. For other countries, your local Gilson distributor can advise you concerning the type of power connector to use.

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Input/Output Signal Connectors (321 Pump)

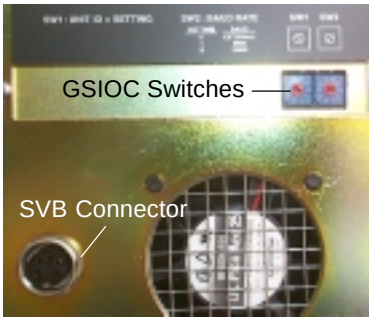
The two sockets use the 14-pin and 10-pin connectors supplied with your 321 Pump.



14-pin Connector GSIOC Connectors 10-pin Connector

GSIOC Connectors

The 9-pin socket(s) accept standard GSIOC connectors. The 321 Pump has two connectors (‘To Slave’ and ‘From Controller’); the 322 Pump has one connector (‘From Controller’) and two switches for setting GSIOC parameters.



External SVB Connector (322 Pump)

The 5-pin socket, which is present only on the 322 Pumps, accepts a standard connector. The cable is supplied with the external Solvent Valve Block.

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Accessories

The standard accessories, supplied with the pump, include plumbing items, tools, and electrical connectors. Additional accessories, to be ordered separately, include solvent valve blocks, solvent degasser, an injection valve holder, extra plumbing items, a column holder, electrical interfaces, and cable kits. A shelf is available on which the pump can be placed, allowing a 30X Pump to be placed underneath.

A diskette is supplied containing Gilson's Pump Data Transfer Software, which enables the user to download information from a 321 Pump to a Personal Computer (PC).

Chapter 6 contains lists of items supplied as standard accessories, additional accessories, and those available as replacement parts.

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Installation 3

Your 32X Pump is delivered with its principal hydraulic components already installed. Instructions are given for installing accessories, where appropriate. The software described in this Chapter is for users for whom a 321 Pump is the controlling device.

If you are not using a 321 Pump as the controlling device, you may disregard most of the information given in this user's guide relating to software. Instead you should refer to the user's guide for the controlling software.

The key steps, the minimum necessary to configure the pump(s) from a master 321, are given in this Chapter - for full details of the 321 software, refer to Chapter 4.

Here is a summary of the key steps:

1) Electrically connect the 32X Pump and any associated components (a detector, other pumps, etc.), connect them to a suitable power supply, and switch-on all components.
2) Check or enter the configuration details using the control panel on the 321 Pump.
3) Make the hydraulic connections between the pumps and their associated components, then prime the pumps; see Chapter 4.

You are then ready to enter or activate a Method Program using the control panel of the 321 Pump. For software information relating Gilson 15X detectors, you may refer to Chapter 4, 'Control of a 15X Detector'; however for full details, you are advised to refer to the appropriate detector user's guide.



When you install a pump, make sure that you do not obstruct any of the pump's ventilation slots.

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Electrical Connections

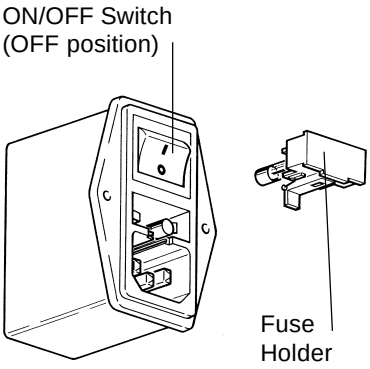
Power Supply

For safety reasons, 32X Pumps are shipped without the fuses having been installed. You just have to install two fuses (see below) and connect the power cord to a suitable AC power supply.

Voltage Selection

The pump can be connected to an AC power supply of 110 / 120 V or 220 / 240 V. Automatic selection of the operating voltage takes place on the power supply board. You only have to install the two supplied fuses.

Installing Fuses



The fuse-holder is located below the socket for the power cord. Two 3.15 A fuses (type 'T', slow blow) must be installed, as follows:

1) Disconnect the power lead from the 32X Pump.
2) Use a small flat-bladed screwdriver to pry open the fuse holder and pull the fuse-holder away from the power receptacle. The fuse holder just hinges down (you do not have to remove it completely).
3) Insert the fuses into their clips and then push the drawer back into the power receptacle.

Power Supply and Switching-on



Plug the power supply cord that you received with the pump into the socket on the power receptacle and to a suitable source of power.

A 32X Pump has two ON / OFF switches: one on the power receptacle and the other at the front (above the LEDs). To switch on a 32X pump:

1) Press the switch on the power receptacle to the 'I' position (see oppositeFigure); the 'Power' LED (green) on the front panel should light-up; if it does not, check the fuses and power connections.

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2) Press the soft-touch key on the stand-by panel; the 'ON' LED (yellow) should light-up. With a 321 Pump, the start up screen should be visible on the control panel's display unit.

The third indicator light on a 322 Pump is labelled 'Remote'; on a 321 Pump, it is labelled 'Error' - see opposite.

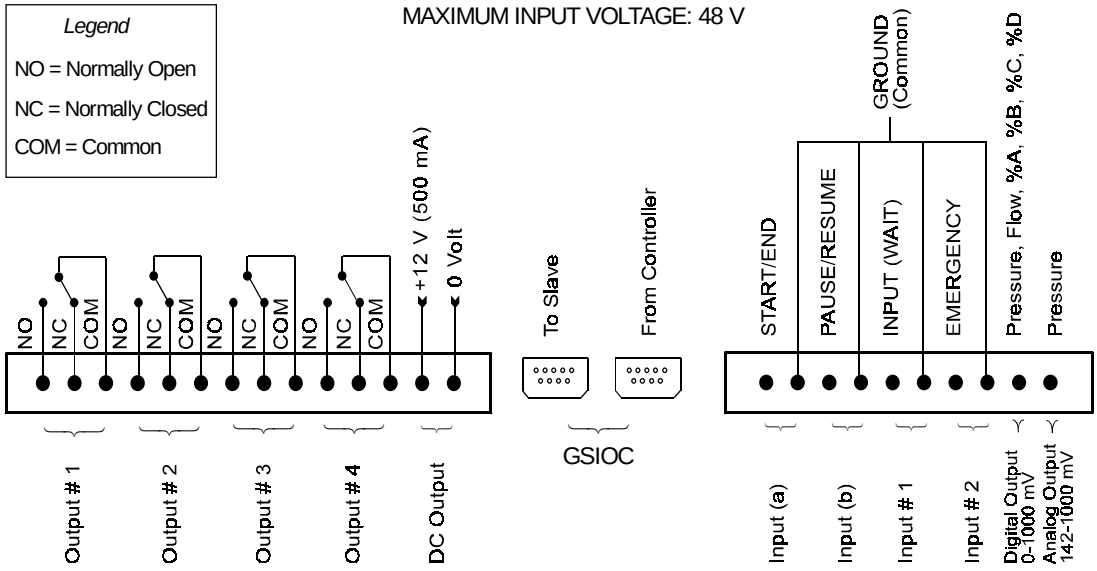


321 Pump 322 Pump

Communications

You need to connect GSIOC cables between the pumps, make connections to the detector, and make any single-wire contact connections (for input / output signals), which may be necessary for communicating with other equipment.

Contact Connections (Input & Output)

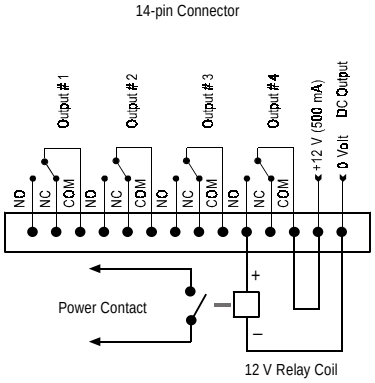


14-pin Connector **10-pin Connector**

The input and output contact functions are shared between two terminal blocks (14-pin and 10-pin) situated on the pump's back panel. **The maximum input voltage for any electrical device connected to each input or output contact is 48 V.**

In order to connect signal wires to the terminal blocks, you must first fit the appropriate connector (as supplied in the standard accessories package). The 14-pin connector fits the left-hand socket and the 10-pin connector fits the right-hand socket.

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After gently pushing each connectors into its socket, you can connect wires to the appropriate terminal.

To connect a wire to the terminal you should strip back the wire's protective covering by 5 mm, undo the terminal's fixing screw, push the bared wire into the corresponding hole in the terminal block, and then tighten the fixing screw using a small screwdriver.

Powering an External Relay

A 12 V (500 mA) DC supply is available at the right-most pair of pins of the left-hand terminal. This supply can be switched manually from the control panel or automatically from a Method Program by connecting it to one of its neighboring outputs.

Output Signals

a) Four two-way relay-type outputs are available via the left-hand socket. Each of these outputs is electrically isolated from the others and from ground. Switching from the 'normally closed' to the 'normally open' position takes place under software control (see Chapter 4) at pre-programmed times. You can program these contacts to 'Open', 'Close', or 'Pulse', for a specific duration.

   You connect one wire from the receiving device to the common terminal of Output # 1 (2, 3, or 4) and a second wire to either the corresponding 'normally open' or 'normally closed' terminal, depending on the requirements of the receiving device.

b) An output (pin # 9) is available on the right-hand socket for feeding a recorder or a PC (via a suitable interface). This output, which comes from the pump's microprocessor, can be configured to follow pressure, flow, or composition (%A, %B, %C, or %D). It is labelled 'Digital' but outputs a series of discrete signals (0 - 1 V) via the digital-to-analog converter.

c) An output (pin # 10) is available on the right-hand socket for feeding any suitable recorder or a PC (via a suitable interface). This analog output (0.142 - 1 V), which comes directly from the sensor, is for pressure only.

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Input Signals

Four pairs of terminals of the right hand socket are dedicated to specific software-related input functions:

START / END
PAUSE / RESUME
INPUT (WAIT) (Input # 1)
EMERGENCY (Input #2)

You connect a pair of wires from an output (e.g. relay-type) of the external device, to a pair of terminals, for each of the functions that you want controlled externally.

Except for WAIT, to activate one of these inputs, you must change the state (close or open) of an output on the external device.

START/END

An external relay contact, connected to this input, may be used to start (OPEN ➔ CLOSE) and stop (CLOSE ➔ OPEN) the program.

PAUSE/RESUME

An external relay contact, connected to this input, may be used to pause (OPEN ➔ CLOSE) and resume (OPEN ➔ CLOSE) the Method Program currently running. The pause may be configured (Chapter 4) with or without flow.

With flow means that pumping continues at the rate and composition that existed at the time the pause was initiated; when 'resume' is signaled the Method Program continues from the same point.

INPUT (WAIT) (Input # 1)

An external relay contact, connected to this input, may be used to signal to the Method Program currently running the 321 Pump that the external equipment (e.g. fraction collector, sampling injector) is ready.

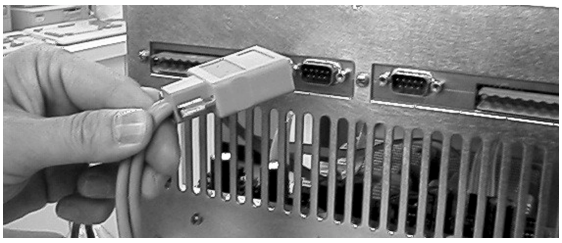
EMERGENCY (Input #2)

Closing an external relay contact, connected to this input, may be used to signal to the pump software to start a Safety Program file (file 24).

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GSIOC Connections

When connecting more than two pieces of equipment by GSIOC cable, the devices should be connected linearly (i.e. in series) using shielded Y-type Gilson cables (reference 500933). This type of cable has a pair of female and male 9-pin D-connectors at one end and a second female connector at the other.



You will need one less cable than the number of devices being connected. The first pair of devices in the chain are connected using the female sockets at either end of the cable. Then for the third and subsequent devices, you connect another cable between the male socket on the GSIOC cable and the appropriate socket on the next device.

A) A 32X is being controlled from a 321 Pump.
Plug one end of a GSIOC cable into the socket marked 'GSIOC FROM CONTROLLER' on the pump being controlled and plug the other end into the socket marked 'GSIOC TO SLAVE' on the controlling pump.

B) A 32X Pump is being controlled from a computer.
Plug one end of a GSIOC cable into the socket marked 'GSIOC FROM CONTROLLER' on the first pump being controlled, plug the other end into the GSIOC socket of a Gilson 506C System Interface Module, and connect an RS232 cable from the 506C to the computer. Alternatively you can use a Gilson 605 RS232C-GSIOC Adapter.

C) A 321 Pump is controlling other pump(s) and/or a Gilson 15X Detector
Plug one end of a GSIOC cable into the socket marked 'GSIOC TO SLAVE' on the controlling pump and plug the other end into the socket marked 'GSIOC FROM CONTROLLER' on the pump being controlled.

Chapter 7 contains a description of the GSIOC cable, connector pin-out information, a detailed description of the GSIOC protocol, and a list of commands.

GSIOC ID

You must use the default values for a system where a 321 Pump (Master) is controlling other devices (slaves). By default the master pump is assigned ID # 1, the slave elution pumps are assigned ID # 2, and #3. The slave injection pump is assigned ID #4.

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The GSIOC IDs may be changed where the pump(s) are being controlled from a computer. In which case, the configured IDs must correspond to those set using the controlling software.

For each level, the GSIOC identification number (ID) that you set must be unique for each item of Gilson equipment.

For a 321 Pump, the ID (0-63) is configured as follows:

1) Switch on the pump; wait until initialized.
2) Press in turn: **Edit**, **Config**, **Misc.**
3) Key in the desired ID for the 321 Pump, then press **ENTER.**

For a 322 Pump, the ID (0-9) is set mechanically using the left-hand of the two selectors on the rear panel (see opposite Figure).

GSIOC ID (0-9)



For a 305 Pump, the ID (0-63) is configured using the 305 Pump's keypad (see 305 Pump User's Guide).

For a 306 Pump, the ID (0-63) is set mechanically using switches on the rear panel (see 306 Pump User's Guide).

Bit Rate

You must use the default values for a system where a 321 Pump (Master) is controlling other devices (slaves).

When a 32X Pump is used as a slave to a 321 Pump, the bit rate of the slave must be set to 'External'. Or, when the bit rates of the sending and receiving devices need to be matched, you can set a specific bit rate.

Bit Rate



0 = External
1 = 9600 baud
2 = 19200 baud

For a 321 Pump, the bit rate is set as follows:

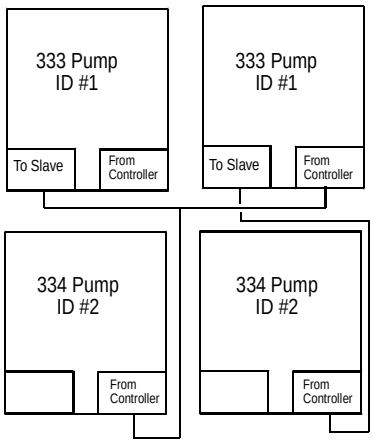
1) Switch on the pump; wait until initialized.
2) Press in turn: **Edit**, **Config**, **Misc.**
3) Press the down arrow key.
4) Press **Change** until you see the desired bit rate (1200 to 19200 or External).
5) Press **ENTER**.

For a 322 Pump, the bit rate (9600, 19200, or External) is set mechanically using the right-hand of the two selectors on the rear panel.

When a 322 Pump is used as a slave to a 321 Pump, you must select 'External'.

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External clock control should also be selected for all pumps running under computer control. Internal is used when the connected device does not provide a clock source, in which case you have to select an appropriate bit rate.



For a 306 Pump, the bit rate is set mechanically using switches on the rear panel (see 306 Pump User's Guide). When the 306 Pump is used as a slave to a 321 Pump, you must select 'External'.

Twin Pump Systems

Two pumps may be connected in parallel thereby doubling the programmed flow rate. In theory there is no limit to the number of pumps that can be connected in parallel, but the twin system with two liquid streams is the most practical. The hydraulic outlet tubings are connected together using a Tee-piece to increase the overall flow rate.

To set-up 32X Pumps to operate in parallel, you must give each of the paralleled pumps the same GSIOC ID: the Master 321 Pump has an ID = 1 as does its twin; the Slave 32X Pump and its twin both have an ID = 2, and so on. The twinned pumps are connected together using GSIOC cables.

When operating a twinned system, the commands from the controlling device go to each pair of twins, so that they act in unison. The twinned pumps must have the same configuration as their master pumps.

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Hydraulic Connections

Pump Head Installation

Two sizes of pump head are available (H1 & H2). The pump heads are pre-installed. For routine servicing, or to fit a different pump head, refer to Chapter 5.

Inlet Lines

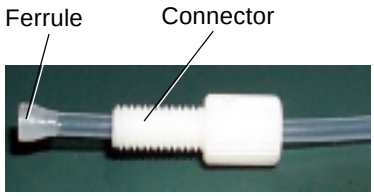
The standard accessory package contains inlet lines, marked A and B. Each line includes a 20 µm inlet filter and a manual stop valve (to prevent syphoning).



Air entering the hydraulic circuit would adversely affect the flow rate. Make sure that all connectors are correctly seated and properly tightened.

Proceed, with care, as follows:

1) Remove the plastic plug (ref: 410108) from the inlet of each head.
2) Check that the reverse ferrule is correctly seated at the end of the tubing.
3) Connect line-A to the right-head and line-B to the left-head. When screwing or unscrewing the white connector, simultaneously push the tubing so that the end of the tubing touches the bottom of the female port and so that the ferrule is not gripped by the connector, which would otherwise cause the tubing to twist.
4) Check that the connectors are tight enough to prevent air from entering the hydraulic circuit.
5) In normal use, the pump operates with the door closed, the solvent line must therefore be threaded through the port to the exterior, before placing the inlet filter in the appropriate solvent bottle.
6) Clip the solvent lines to the tray. First, each tubing is attached to a clip by pushing it gently into the fissure, then the clip is pushed into the appropriate slot on the tray.
7) Prime the solvent lines (refer to Chapter 4).

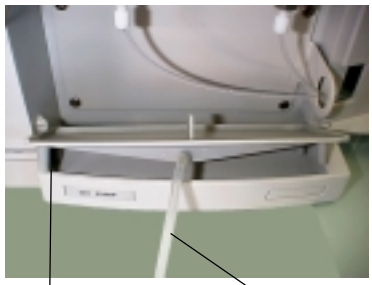




Because of the larger diameter tubing, a different clip is supplied for the rinsing line.

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Drip Tray

The removable drip-tray fitted to the pump is supplied as standard.

The drip tray slots into the well at the bottom of the pump. Installation consists of lifting up the tray, fitting one end with a length of tubing. The other end of the tubing goes to the drain (or a suitable receptacle) via the drain tubing exit port. Installation is completed by replacing the drip tray.

Piston Rinsing Chamber

If the solvent is an aqueous solution containing more than 0.1 M of solute, which is solid in ambient conditions, then the piston should be rinsed continuously with water. A plumbing kit must be installed for the piston rinsing chamber of either head: the kit for the right head is supplied as standard, the kit for the left head is available as an additional accessory.



1) Each plumbing kit consists of: a rinsing line, which connects to the rinsing-chamber inlet at the **bottom** of the head and a shaped purge line, which connects to the rinsing-chamber outlet at the **top** of the head.
2) Fill the glass bottle (reference E66386) with distilled water and push the open end of each rinsing line through the bottle's pierced cap, to between 1 to 2 cm of the bottom.
3) Clip the rinsing lines to the tray (the longer line connects to the left head). Each line is first attached to a clip by pushing it gently into the fissure, and then the clip is pushed into a slot on the tray.
4) Ensure that each purge line is closed (turn each connector fully counterclockwise until finger tight), then press **Manual**, **Prime**, **Start**. After about 20 seconds, water should have sufficiently filled the rinsing line, even though some air is also present.
5) Press **Stop**; then undo both purge-line connectors. Water will run from each purge line into the drip tray; the rinsing lines and rinsing chambers will fill with water. When you see bubble-free water in the rinsing lines, and that air is no longer exiting from the head via the purge lines, close both purge lines. In use, water from the small bottle rinses the piston - although it is a closed circuit you may need to change the water from time to time, and of course repeat this procedure.

For the 322 Pump, it is easier to make the hydraulic connections to the rinsing chamber when you first remove the drip tray. (Don't forget to put it back before starting the purge.)

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Connection to Injector

For flow rates lower than 10 ml/min, use the 0.25 x 1.6 x 550 mm tubing (reference 430060). For flow rates higher than 10 ml/min, use the 0.5 x 1.6 x 500 mm tubing (reference 430035).

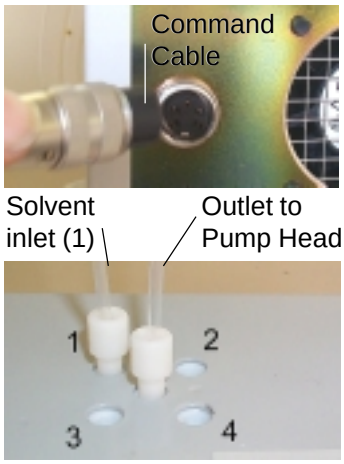
Solvent Valve Block (SVB)

Solvent Valve Blocks are available as additional extras (refer to Chapter 6): they are for switching between up to four solvents, under software control.



For 321 Pumps the SVB should be pre-installed by your Gilson representative. (The SVB would replace the plate that can be seen just above the drip tray.)

For 322 Pumps you must use an external SVB: it may be clipped to the side of the 322 Pump or placed next to the pump on the bench. Connect the command cable from the socket on the rear panel to the DIN socket on the SVB. The SVB for 322 Pumps is for use in systems where control is from computer based software (Gilson UniPoint, for example).

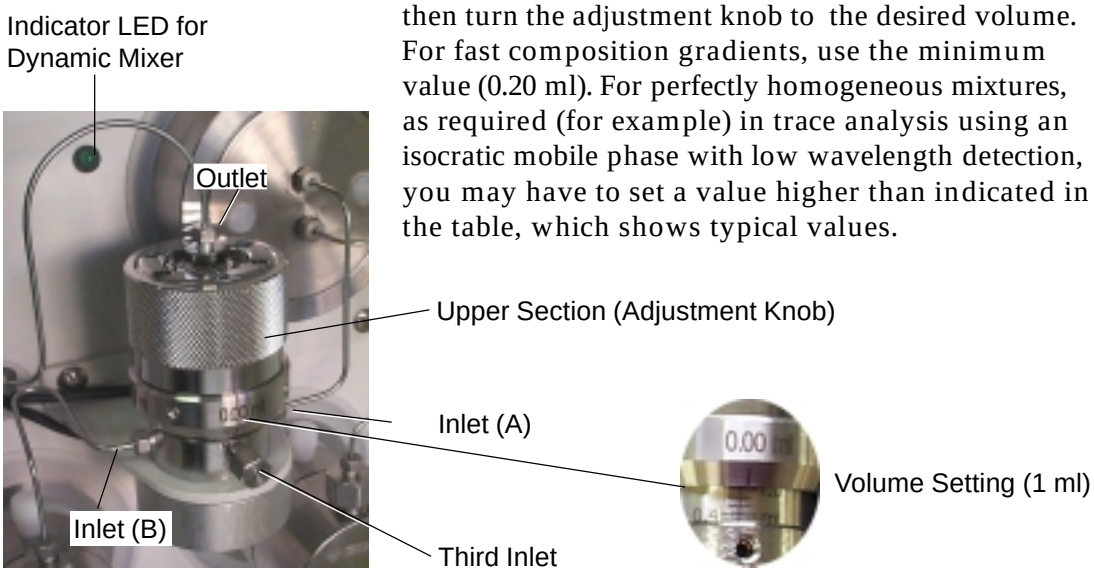


In either case up to four solvents are routed via suitable tubing to the SVB, which performs all of the required switching functions at low pressure. Connect inlet tubings (fitted with filters) from the solvent bottles to the inlets on the SVB's hydraulic connector, and the outlet from the SVB, which is at the center of the group of connectors, to the pump head using the supplied tubing.

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Adjusting the Mixer Volume

The AVDM is factory set at 0.40 ml (default value). You can set a value from 0.20 to 2.20 ml (refer to the table, below). To change the mixer volume, fully depressurize the pump by opening the purge valve, then turn the adjustment knob to the desired volume. For fast composition gradients, use the minimum value (0.20 ml). For perfectly homogeneous mixtures, as required (for example) in trace analysis using an isocratic mobile phase with low wavelength detection, you may have to set a value higher than indicated in the table, which shows typical values.



F (ml/min)	MV (ml)
0.15 - 0.6	0.2 - 0.3
0.7 - 2	0.4 - 1.0
2.1 - 5	1.1 - 2.2
> 5	2.2

Settings are realized (mechanically) by rotating the adjustment knob; graduated markings on the body indicate the volume setting. There are four vertical graduations on the upper section at 0.05 ml intervals, corresponding to 0.00, 0.05, 0.10 , and 0.15 ml. There are eleven horizontal graduations on the body at 0.20 ml intervals; one complete turn on the adjustment ring equals 0.20 ml.

When the dynamic mixer is operating the indicator (green LED) lights-up.The AVDM may only be adjusted when the pump is stopped and depressurized.

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Accessories

Additional accessories may be obtained from Gilson, these are: a degasser, a column holder, a holder for a manual injection valve, and a shelf to enable you to stack 32X Pumps and 15X Detectors.

Degasser

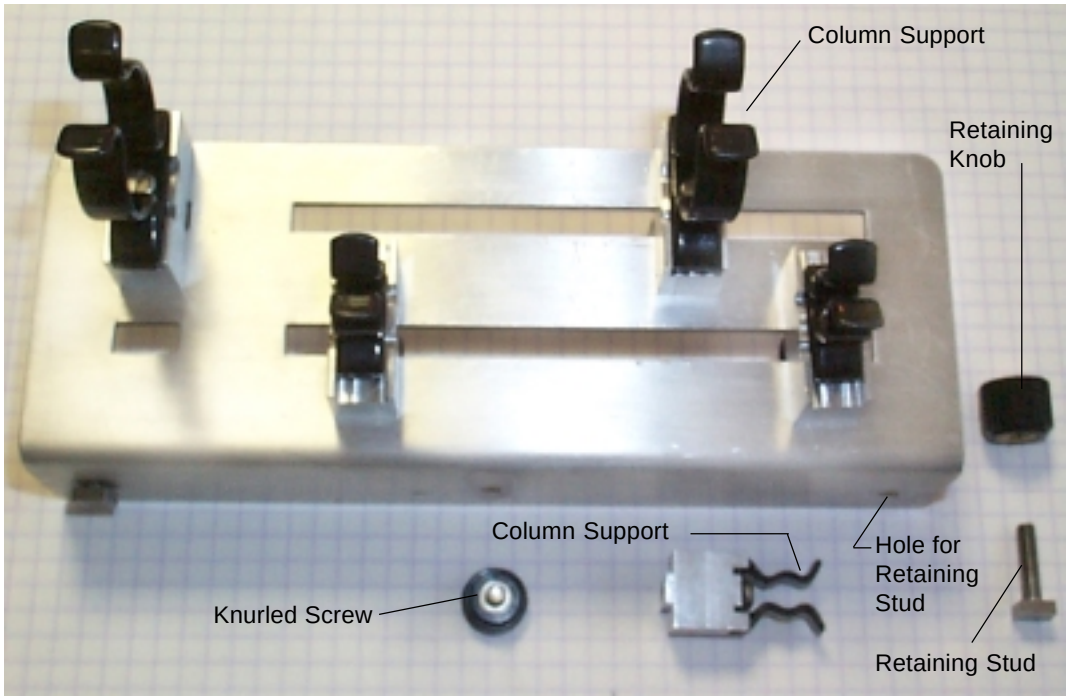
Please refer to the User's Guide of the Gilson 864 degasser.

Column Holder

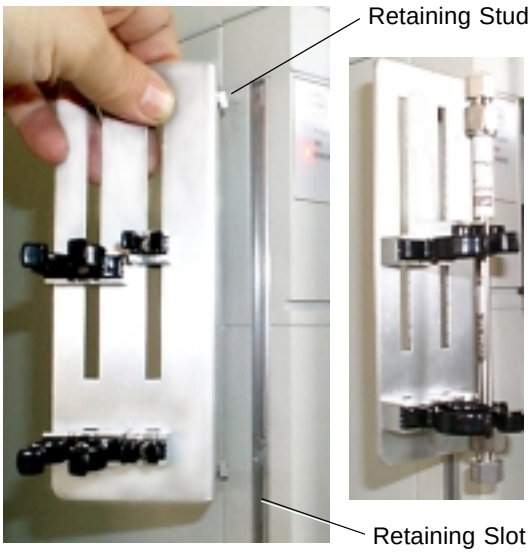
The column holder attaches to the left side of the pump. Three pairs of column support, fitted with clips for different diameter columns, are provided in the kit.

Holder Installation

1) Loosely fit the retaining stud.
2) Slide the studs into the tops of the retaining slots at the side of the pump.
3) When the holder is correctly positioned, fully tighten the retaining knobs.



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Support Installation

1) Push one of a pair of column supports into either of the slots.
2) Fix the column support in position using a knurled screw.
3) Repeat for the second column support but don't fully tighten the screw.
4) Slide the second column support along the long slot to match the length of the column.
5) Fully tighten the screws.

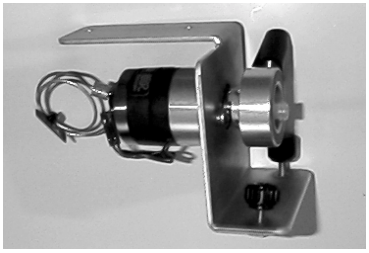
Injection Valve Holder

The injection valve holder has two pairs of holes, one pair is for mounting the valve in the vertical position and the other is for mounting the valve in the horizontal position.



Holder Installation

1) Loosely fit the retaining studs to either pair of holes.
2) Slide the feet into the top of the retaining slot at the side of the pump.
3) When the holder is securely positioned, fully tighten the retaining-feet knobs.



Valve Installation

1) Secure the valve body to the holder using two screws.
2) Fit the valve handle, as described in the documentation supplied by the valve manufacturer.

Shelf

This shelf is designed to support the weight of the pump and solvent bottles. Assembly consists of using the supplied screws to attach four legs to the mettalic tray. Space is available between the legs for a detector or a 30X Pump.

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Setting-up with Control from a 321 Pump

Three typical configurations are described in this Section. In its simplest configuration, a 321 Pump is capable of mixing two solvents (A and B). By adding up to two pumps you can mix up to four solvents, or inject a sample, or both.

Extended capabilities for solvent selection (B1 to B4) are offered by the addition of a Solvent Valve Block (SVB).

Configuration 1:
a) 321 Pump, alone;
b) 321 Pump with SVB;
c) 321 Pump with another 32X Pump.

Configuration 2:
321 Pump associated with two 30X Pumps.

Configuration 3:
321 Pump associated with an injection pump (30X Pump).

Take care when you are reconfiguring a 321 Pump, and have previously created Method Program files, you will probably need to modify these files, if they are to work correctly with the new configuration.



Configuration 1: 32X Pumps

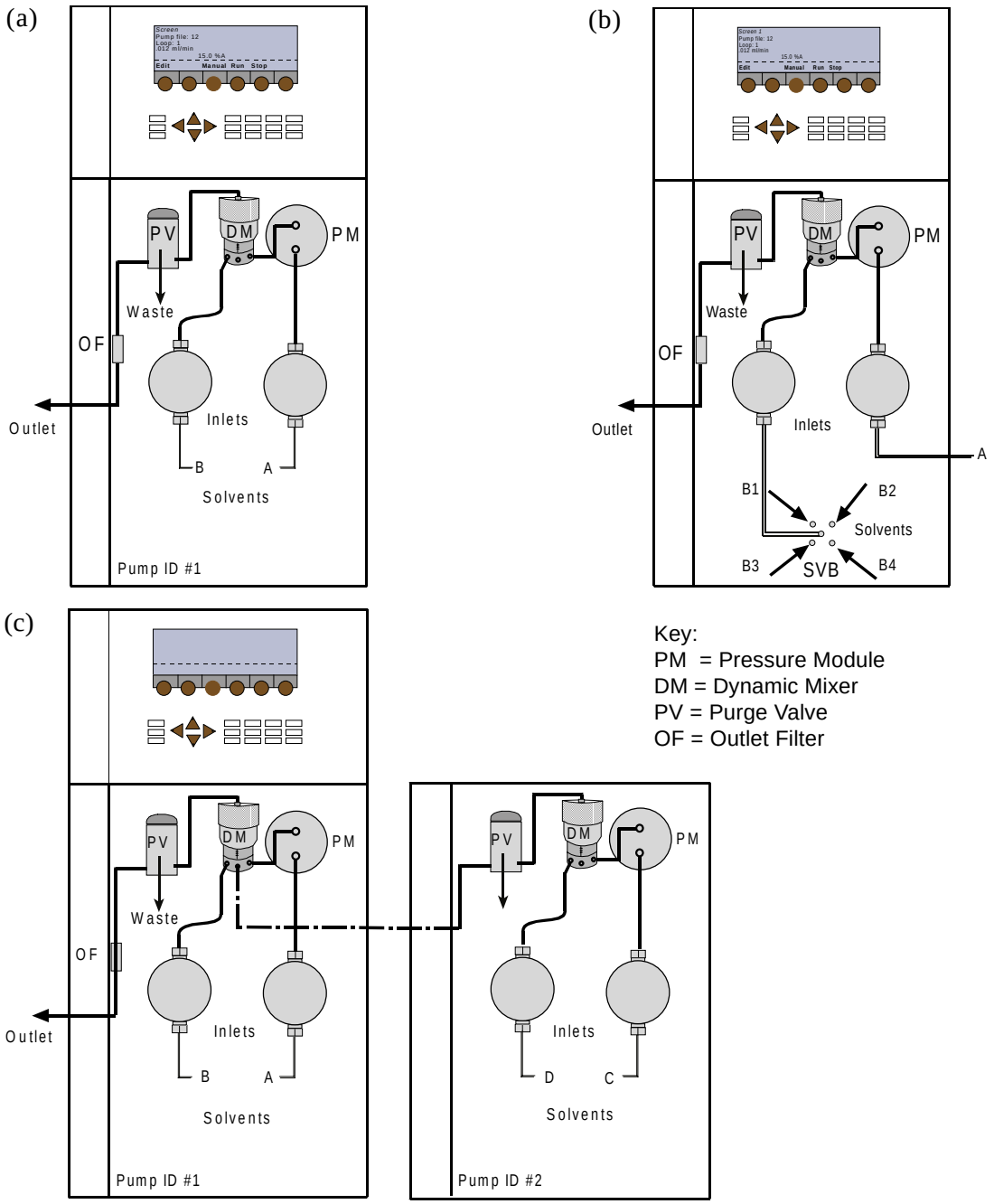
Solvent Mixing - What You Can Do

When associated with a second 32X Pump, a 321 Pump may be set-up to control the flow and composition using up to four solvents on a time variant or a time invariant basis. Thus, you can pump multi-solvent gradients using 2 to 4 solvents, or you can pump in isocratic mode, after mixing up to four solvents (A and B from one pump, C and D from the other).

In the following figures

(a) shows the simplest configuration. The two solvents are mixed at high pressure using the Dynamic Mixer (DM).

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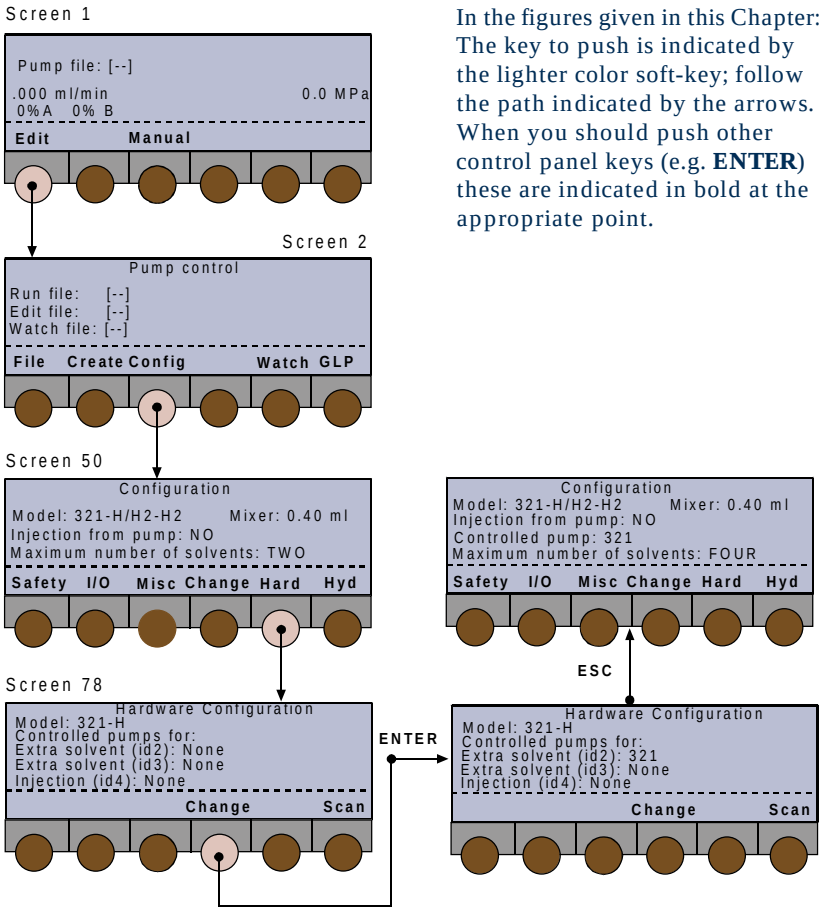
(b) shows how the addition of a Solvent Valve Block (SVB) to Inlet B may be used to test the effectiveness of different solvents, selected succesively. The solvents are routed via suitable tubing to the SVB, which performs all of the required switching functions, at low pressure (no mixing takes place between solvents B1, B2, B3, B4).

(c) shows a 321 Pump (Master) at the left and a 322 Pump (Slave) at the right; although the slave pump could be a second 321 Pump. In either case, the solvents C and D are routed via a Tee-piece to the third inlet on the Dynamic Mixer of the Master 321 Pump.

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Setting-up - What You Must Do

1) Switch on the pump(s) and set their GSIOC IDs. The start-up screen appears, briefly (Screen 0); then make the electrical connections between the instruments.
2) Check and if necessary change the software configuration:
   - at the Run Screen (1), press **Edit,** or **Pump** if linked to a Gilson detector (151, 152, 155, 156).
   - at the Pump Control Screen (2) press **Config**.
   - the Configuration Screen (50) should show 321 as the model and H1 or H2 as the head type.
   - for two pumps, press **Hard**, Screen (78) appears; at 'Extra solvent (2)' press **Change**, until you see '32X', press **ENTER**.
   - check that 'Extra solvent (3)' and 'Injection' = None.
   - then for each head (if a head type does not correspond to that fitted to a pump):
   - press **Hyd**, then at the next screen (90, 91, 92 or 93),
   - select the head by pressing the **Next** and **Prev** keys,



In the figures given in this Chapter: The key to push is indicated by the lighter color soft-key; follow the path indicated by the arrows. When you should push other control panel keys (e.g. **ENTER**) these are indicated in bold at the appropriate point.

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- press ▼ (twice) to select 'Head type',
- press **Change**, until you see the head type fitted (H1 or H2), press **ENTER**.
- press **ESC**, configuration Screen (50) should say 'Maximum number of solvents: Four'.

Alternatively, provided the first step (1) is completed correctly, you may press **Scan** to identify any connected pumps, which are then added to Screen 78 next to their currently configured IDs.

Optionally, you can now refer to Chapter 4, 'Configuring' to modify advanced configuration features.

You are now ready to create your Method Program file(s).

3) Make the following hydraulic connections:
   - from the Outlet Filter of the Master 321 Pump to the injector.
   - solvent lines to inlets A and B (2 solvents) on the 321 Pump,
   - solvent lines to inlets C and D on the Slave 32X Pump (4 solvents) ,
   - outlet lines from C and D on the Slave 32X Pump to a Tee-piece (ref: 410454),
   - from the Tee-piece to the third input of the Master Pump's Dynamic Mixer,
   - prime the system (Chapter 4, Hydraulic Priming).

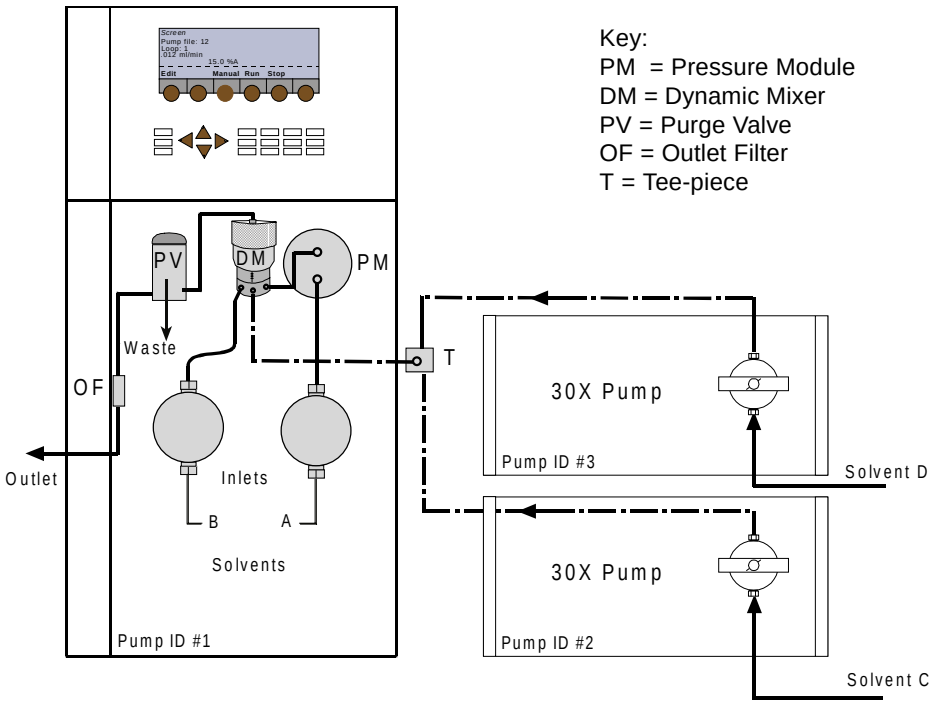
Configuration 2: 321 Pump and 30X Pumps

Solvent Mixing - What You Can Do

When associated with up to two 30X Pumps, a 321 Pump may be set-up to control the flow and composition using up to four solvents, in a time variant or a time invariant basis. Thus you can pump multi-solvent gradients using 2, 3, or 4 liquids, or you can pump in isocratic mode after mixing up to four solvents at high pressure (A and B from the master pump, C and D from the two slaves).

This figure shows a 321 Pump (Master) at the left and two 30X Pumps (Slaves) at the right.

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Setting-up – What You Must Do

1) Switch on the pump(s) and set their GSIOC IDs. The start-up screen appears, briefly (Screen 0); then make the electrical connections between the instruments.

2) Check and if necessary change the software configuration:
   - at the Run Screen (1), press **Edit,** or **Pump** if linked to a Gilson detector (151, 152, 155, 156).
   - at the Pump Control Screen (2) press **Config**.
   - the Configuration Screen (50) should show 321 as the model and H1 or H2 as the head type.
   - for one extra 30X pump (3 solvents), press **Hard**, Screen (78) appears; at 'Extra solvent (2)' press **Change**, until you see '30X', press **ENTER**.
   - for two extra pumps (4 solvents) press ▼, then at 'Extra solvent (3)' press **Change**, until you see '30X', press **ENTER**.
   - check that 'Injection' = None.
   - then for each head (if a head type does not correspond to that fitted to a pump):
   - press **Hyd**, then at the next screen (90, 91, 92 or 93),
   - select the head by pressing the **Next** and **Prev** keys,
   - press ▼(twice) to select 'Head type',
   - for the 32X Pump (H1 or H2), for a 30X (5, 10, 25, 50, 100, 200) press **ENTER**,

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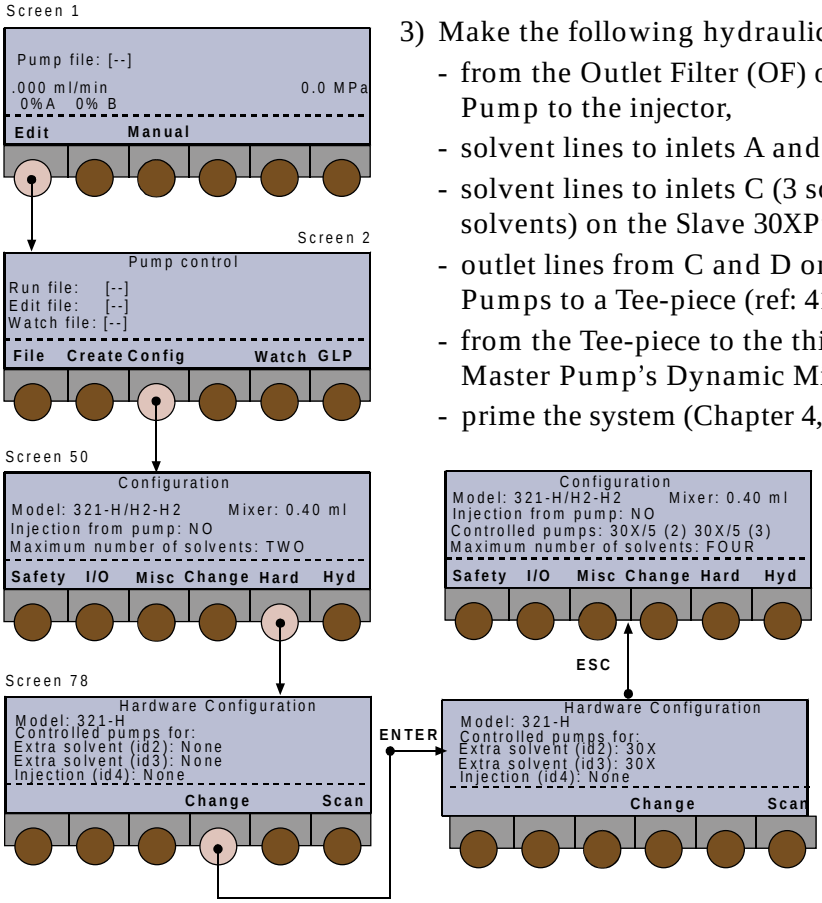
In the figures given in this Chapter: The key to push is indicated by the lighter color soft-key; follow the path indicated by the arrows. When you should push other control panel keys (e.g. **ENTER**) these are indicated in bold at the appropriate point.

- press **ESC**, configuration screen (50) should say 'Maximum number of solvents: Four' (with two extra 30X Pumps).

Alternatively, provided the first step (1) is completed correctly, you may press **Scan** to identify any connected pumps, which are then added to Screen 78 next to their currently configured IDs.

Optionally, you can now refer to Chapter 4, Configuring to modify advanced configuration features. You are now ready to create your Method Program file(s).

3) Make the following hydraulic connections:
   - from the Outlet Filter (OF) of the Master 321 Pump to the injector,
   - solvent lines to inlets A and B on the 321 Pump,
   - solvent lines to inlets C (3 solvents) and D (4 solvents) on the Slave 30XPump(s),
   - outlet lines from C and D on the Slave 32X Pumps to a Tee-piece (ref: 410454),
   - from the Tee-piece to the third input of the Master Pump's Dynamic Mixer,
   - prime the system (Chapter 4, Hydraulic Priming).



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Configuration 3: Injection Pump

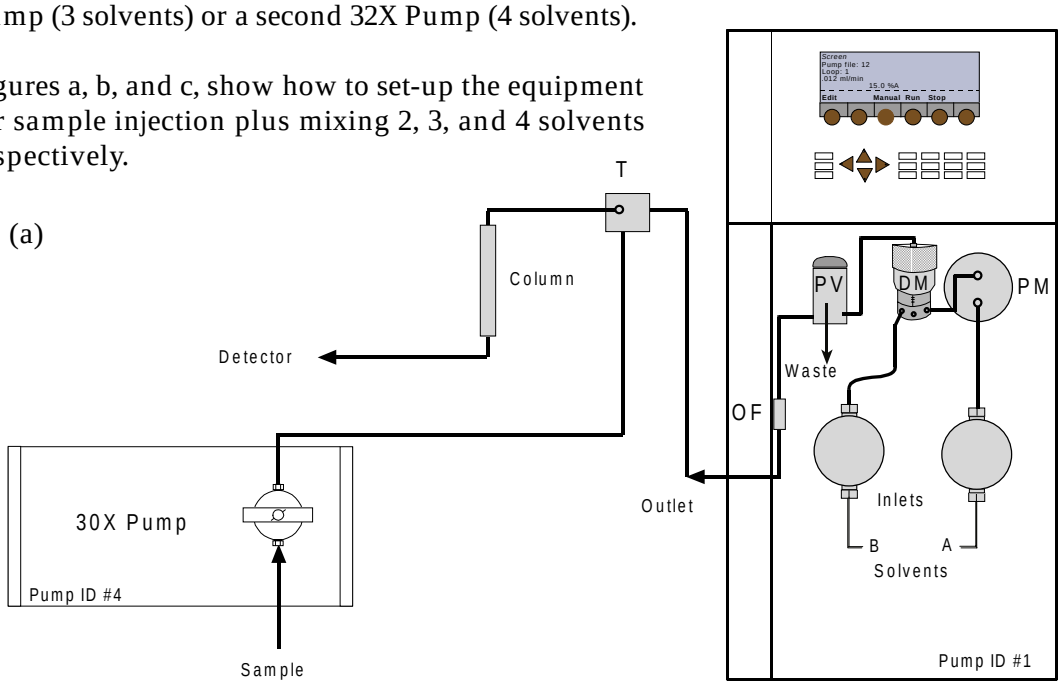
Solvent Mixing and Injection

A 30X Pump can be associated with a 321 Pump to carry out repeated sample injection. In this case, the 321 Pump controls the injection pump, and flow and composition using two solvents. Additional mixing capability may be provided by adding a second 30X Pump (3 solvents) or a second 32X Pump (4 solvents).

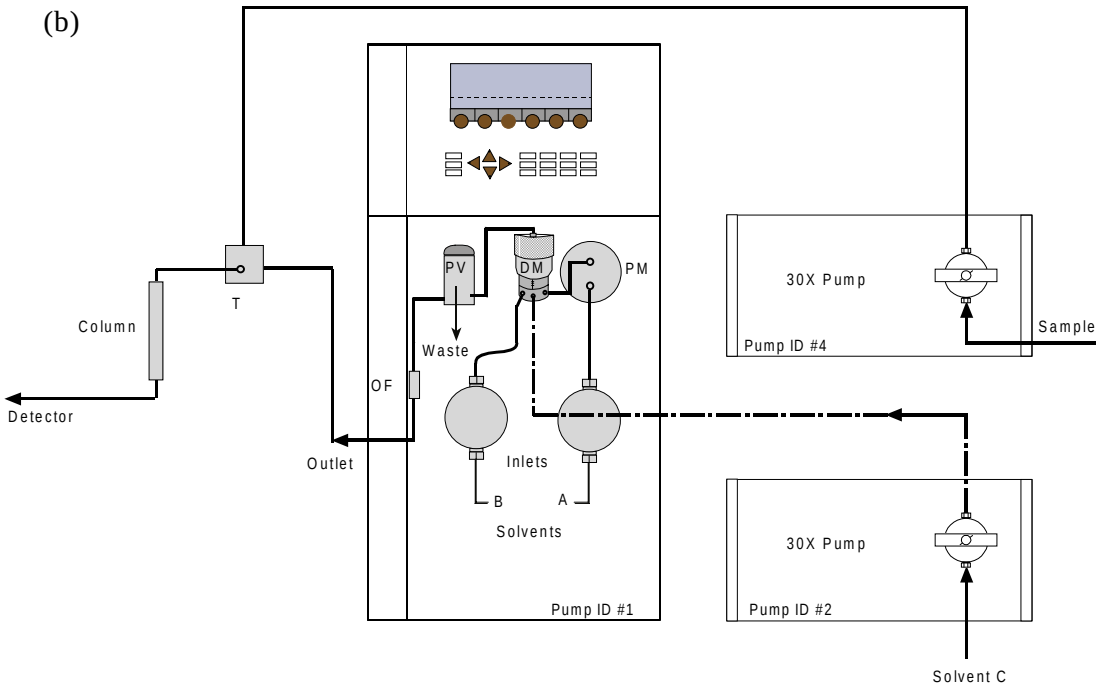
Key:
PM = Pressure Module
DM = Dynamic Mixer
PV = Purge Valve
OF = Outlet Filter
T = Tee-piece

Figures a, b, and c, show how to set-up the equipment for sample injection plus mixing 2, 3, and 4 solvents respectively.

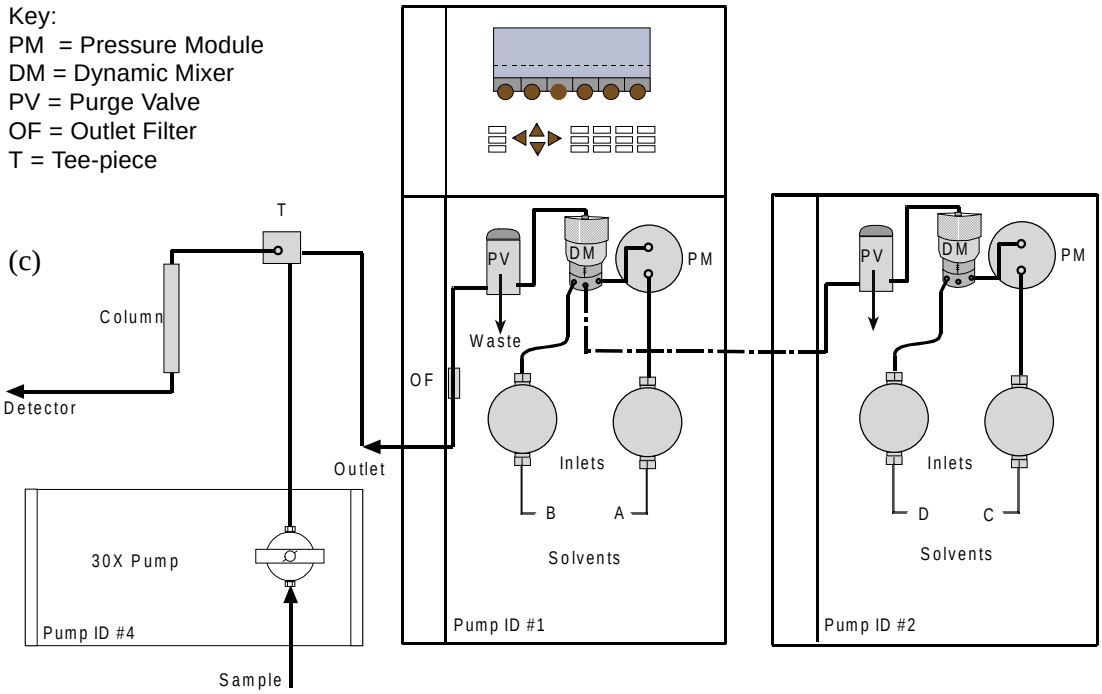
(a)



(b)



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Setting-up – What You Must Do

1) Switch on the pump(s) and set their GSIOC IDs. The start-up screen appears, briefly (Screen 0); then make the electrical connections between the instruments.

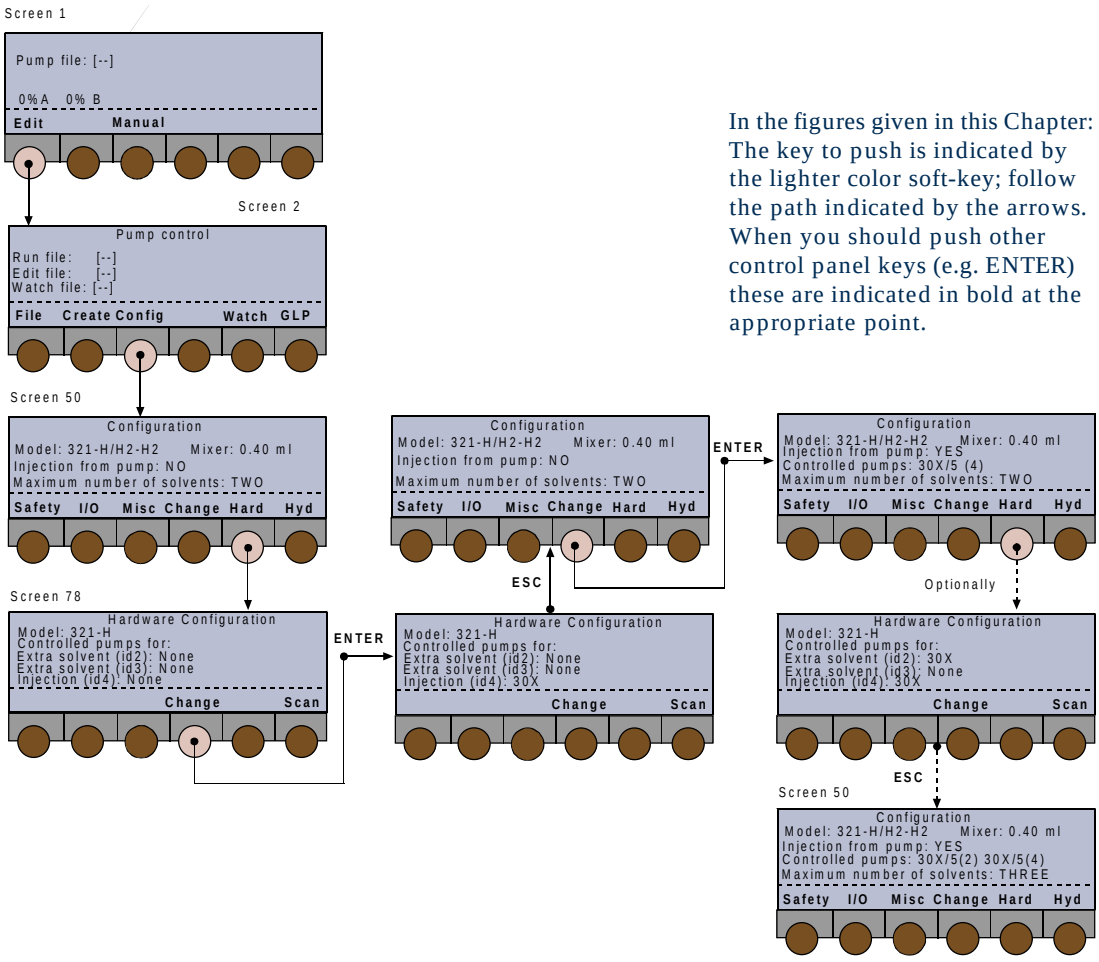
2) Check and if necessary change the software configuration:
   - at the Run Screen (1), press **Edit,** or **Pump** if linked to a Gilson detector (151, 152, 155, 156).
   - at the Pump Control Screen (2) press **Config**.
   - the Configuration Screen (50) should show 321 as the model and H1 or H2 as the head type.
   - to add the injection pump, press **Hard**, Screen (78) appears; press ▼(twice), at 'Injection',
   - press **Change**, to select 30X, then press **ENTER**.
   - press **ESC**, at configuration screen (50) press ▼, at 'Injection from Pump',
   - press **Change**, until you see 'YES', press **ENTER**.
   - to add one or two solvents press **Hard**, at the next screen (78) press ▼; at 'Extra solvent (2)'
   - press **Change** until you see '30X', for 1 extra solvent, press **ENTER**, or
   - press **Change** until you see '321', for 2 extra solvents, press **ENTER**.
   - check that 'Extra solvent (3)' = None (you can't use ID #3 if injection is selected).

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- then for each head (if a head type does not correspond to that fitted to a pump):
- press **Hyd**, then at the next screen (90, 91, 92 or 93),
- select the head by pressing the **Next** and **Prev** keys,
- press ▼(twice) to select 'Head type',
- for the 32X Pump (H1 or H2), for a 30X (5, 10, 25, 50, 100, 200) press **ENTER**,

Alternatively, provided the first step (1) is completed correctly, you may press **Scan** to identify any connected pumps, which are then added to Screen 78 next to their currently configured IDs.

Optionally, you can now refer to Chapter 4, Configuring, to modify advanced configuration features. You are now ready to create your Method Program file(s).



In the figures given in this Chapter: The key to push is indicated by the lighter color soft-key; follow the path indicated by the arrows. When you should push other control panel keys (e.g. ENTER) these are indicated in bold at the appropriate point.

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3) Make the following hydraulic connections:
   - from the Master Pump's Outlet Filter (OF) to the column via a Tee-piece (ref: 410454),
   - from the injection pump (30X) outlet to the Tee-piece,
   - solvent lines to inlets A and B (2 solvents) on the 321 Pump,
   - for 3 solvents, connect a solvent line to inlet C on the Slave 30X Pump, and connect its output to the third input of the Dynamic Mixer on the Master 321 Pump,
   - for 4 solvents, connect solvent lines to inlets C and D on the Slave 32X Pump,
   - connect outlet lines C and D to a Tee-piece (ref: 410454),
   - connect fron the Tee-piece to the third input of the Dynamic Mixer on the Master 321 Pump,
   - prime the system (Chapter 4, Hydraulic Priming).

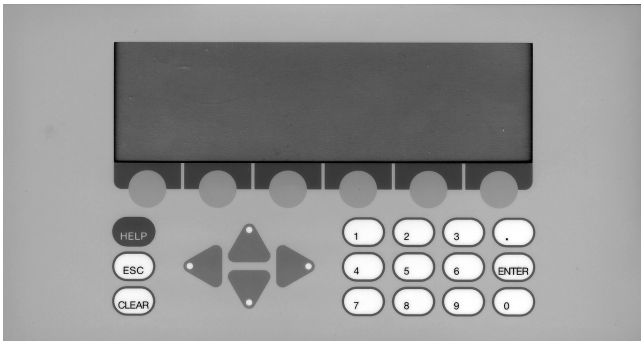
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Software 4

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Using the Control Panel

The control panel consists of a display unit and a keypad.



Display Unit

The 40-character, 8-line display unit is used to show time related events, flow rate, solvent composition, in-run information, and so on. The bottom line of the display unit is for labeling six variable-function soft-keys.

Keypad

The soft-keys are identified by the six evenly spaced circles just below the display unit.

Pressing a soft-key selects the function displayed directly above it, for example: **Edit**, **Manual**, and **Run**. Descriptions of these and all other soft-key labels are given later in this Chapter. Where a soft-key may take an alternative label, the alternative is shown in between parenthesis; for example, **Edit** (**Pump**).

In addition to the variable-function soft-keys, there are fixed function keys as follows:

Four arrow keys:
to navigate around the screen,

Eleven numeric keys (**0** to **9**, and **.**):
to enter values (for predefined parameters),

ENTER to enter a value or option into memory,

HELP for detailed help messages (including the screen number).

CLEAR to cancel a value before it is entered into the memory,

ESC to change from a software level to a higher one.

For the screens that illustrate this Chapter, the soft-key to press is indicated by the lighter color soft-key; follow the path indicated by the arrows. When you should press other control panel keys (e.g. **ENTER**) these are indicated in bold at the appropriate point.

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Overview

The following steps must be completed before operating the pump, under the control of the pump's software, by a computer based program, or manually from the pump's control panel.

1) Make the electrical and hydraulic connections to the pump(s).
2) Connect the power and switch on the pump(s).
3) Prime the hydraulics, initialize and run-in the piston seals (if new).

Hydraulic Priming

This is an essential step, which must be carried out before operating a 321 Pump in other ways.

1) If one or more pumps will be controlled from a Master 321 Pump, the additional pump(s) must be declared in the configuration (see 'Configuring').
2) Fill the solvent bottles with (degassed) HPLC-grade solvents and immerse the filters of the pumps' inlet tubings in these bottles.
3) Switch the valve to the purge position.
4) Press **Manual**, **Prime**, then **Start** for the pump head that is to be primed (see 'Manual Operations'). If after two minutes, solvent does not flow from the purge valve's outlet, check that the valve is in the open position, then remove the tubing and attach the supplied syringe to the purge valve's outlet, using the adapter provided.
5) Draw solvent into the syringe while continuing to pump. When solvent appears in the syringe, press **Stop**, to cease pumping.
6) Reconnect the tubing and continue priming for as long as is necessary. No bubbles should be present in the solvent flowing through the tubing. Press **Stop**, to cease pumping.
7) Repeat the procedure for the other pumps in the system.

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1) Running a pump head dry, for more than a short time, will damage the piston seal.

2) Ensure that the purge valve is fitted with a drain tube, before priming the pump.

3) During priming the low pressure limit is inactive, the high pressure limit is automatically set to 3 MPa, to protect the column if you forget to open the purge valve, in which case the screen displays the following message, 'Open Purge Valve'.

After Priming

1) Use the GLP function **Seal** to initialize the piston seals.

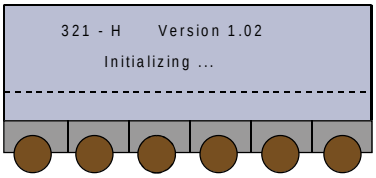
2) After completing the installation and configuration processes, you can create and run Method Programs.

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Switching On the Pump

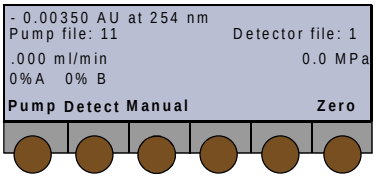
1) The power supply switch, located on the rear panel, must be set to the ON position (I); the POWER LED comes on. Next, press the ON / OFF switch on the stand-by panel at the front of the pump; the ON LED illuminates.

2) After switching on a 321 Pump, the display shows *Screen 0* for one second whilst initialization takes place. During which time a message indicating the software version is displayed, then you see the ready-to-run screen (*Screen 1*). This dynamic screen varies according to the associated equipment, whether a Method Program exists, and according to in-run information.

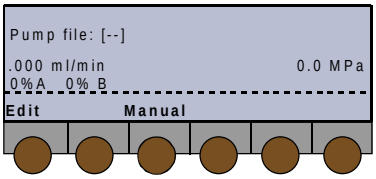


Wait for 1 second ...

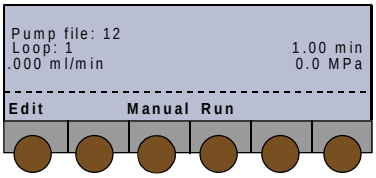
Screen 1 looks like this, the first time you switch on, when a Gilson Model 15X Detector is associated with the pump. In this case the top line is dedicated to showing the output signal and wavelength of that detector. Dual wavelength detectors (155 & 156) have both output signals displayed. The **Detect** key accesses the detector functions.



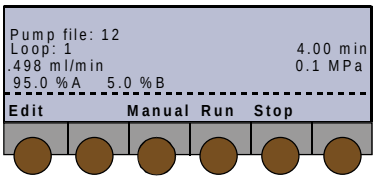
Screen 1 looks like this, the first time you switch on, when no Method Program file has yet been run and when there is no associated 15X Detector.



Screen 1 looks like this, when you switch on, and a Method Program file has been run previously.



Screen 1 may look like this where, at the end of the Method Program, the flow rate is > zero.



Convention for pump file numbers:
Pump file: [- -] = no file selected.
Pump file: [xx] = file xx is selected but is empty.
Pump file: xx = file contains at least one event
(Method Program or Safety File)

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Configuring

Introduction

To configure, you enter descriptions of your pumping system's hardware. You verify, and where necessary, change the configuration.

As a minimum, you must correctly describe and identify (GSIOC) all pumps: the controlling pump and those being controlled from the controlling pump.

Additionally, you may configure the input/output signal parameters, safety functions, and fine tune the hydraulic parameters (refill time, inlet pressure, compressibility, etc.).

Procedure

Switch on the 321 Pump, then (after initialization) you see the ready-to-run screen (*Screen 1*). You will see the following soft-keys at one time or another:

Pump (Edit) to access pump operations,

Detect to access an associated detector,

Manual to prime and operate manually,

Run to run the current Method Program file,

Pause to interrupt the Method Program,

Resume to restart a paused Method Program,

End to stop a Method Program,

Stop to stop pumping and Method Program (if running),

Zero to zero the detector signal (if associated).

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1) Press: **Pump (Edit)**, you see the 'Pump Control' screen (*Screen 2*) you will see the following soft-keys at one time or another:

   File to access the file management operations,

   Edit (**Create or View**) to modify an existing Method Program file,

   Create (**Edit or View**) to enter a new Method Program file,

   View (**Edit or Create**) to read (only) an existing Method Program file,

   Config to enter configuration parameters,

   GLP to access audit, maintenance, run-in and test functions for a 321 pump,

   Watch to obtain post-run information.

2) Press: **Config**, you see the 'Configuration' screen (*Screen 50*), which shows the pump model, mixer volume, and any associated pumps. Inside this descriptive screen, you can only change the mixer volume. The available soft-keys are:

   Safety to access high and low pressure limits, restart and malfunction options,

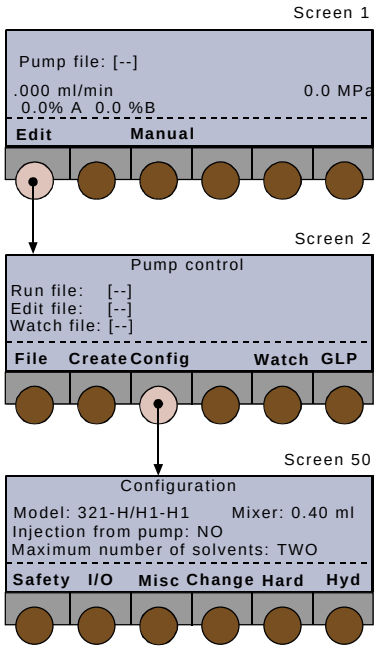
   I/O to access specific Input/Output functions (pulse length, output signal type, etc.),

   Misc to access GSIOC id, bit rate, units, and display contrast,

   Hard to change the pump model and identify any controlled pumps,

   Hyd to access hydraulic parameters, such as Inlet Pressure and Compressibility.

When setting-up a new system you should proceed by reviewing, and changing where necessary, these items in the following order: Hard, Hyd, Safety, I/O, and Misc.



(1) The top-line of the in-run screen is reserved for a Model 15X detector, if associated with a 321 Pump (not shown in most of the figures given in this Chapter).

(2) For the functions accessible from the 'Detect' soft-key, you should refer to the user's guide for the relevant detector.

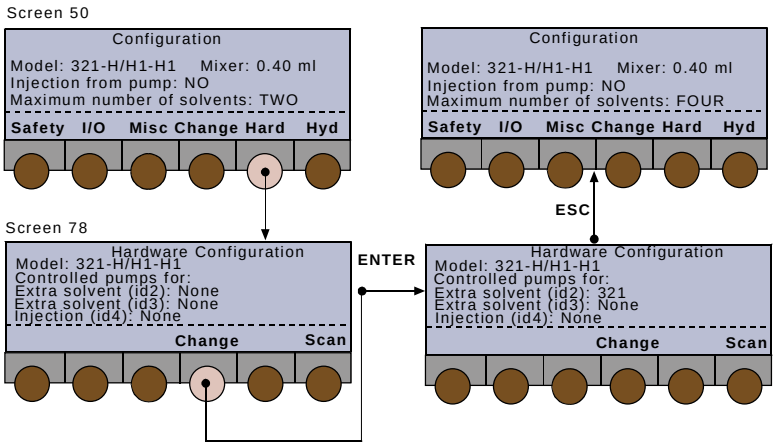
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Hardware Configuration

Press **Hard,** you see the 'Hardware Configuration' screen (*Screen 78*), which shows the pump(s) currently configured: 32X (for 321 and 322), 30X (for 305, 306, 307, and 308), or NONE. The available soft-keys are:

Change to change the current selection,

Scan to check the GSIOC bus for suitably connected and viable pumps.



Although three controlled pumps are listed (*Screen 78*), the controlling 321 Pump (Master) can only control one or two additional pumps (Slaves). The controlled pumps must be assigned as follows:

'Extra solvent (id 2)' can be a 32X Pump or a 30X Pump,

'Extra solvent (id 3)' can be a 30X Pump only if id 2 is also a 30X Pump, and id 4 = None.

'Injection (id 4)' must be a 30X Pump, if a sample pump is present, in which case only one other extra solvent pump is permitted, id 3 = None.

Adding a Pump

1) Use the arrow keys (▼ and ▲) to move the cursor to 'Extra solvent (id 2)', if you want to add an extra pump for solvent C.
2) Press **Change** until you find the required option (32X or 30X) then press **ENTER**, or press **Scan** to scan the GSIOC bus for devices connected to the pump.

'Scan' checks the ids of the controlled pumps, which must be connected via GSIOC, and switched on. Scan does not validate the pump's configuration - you must ensure that you describe the pump correctly to the software.

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3) With the cursor at the appropriate line, repeat step 2 for 'Extra solvent (id 3)' only if you are assigning a second 30X Pump for solvent D **or** for 'Injection (id 4)' if you are assigning a second 30X Pump for injecting samples.

4) Press **ESC** to return to *Screen 50*; check that the one or two controlled pumps are listed correctly; the format for a 30X Pump is '30X/yy(z)', where 'yy' is the configured pump-head size (see Hyd) and 'z' is the id of the controlled pump.

If you have assigned an injection pump in step 3, you must confirm the assignment as follows: with the cursor at 'Injection from pump: NO' press **Change** until you see 'YES', then press **ENTER**.

Removing a Pump

1) Use the arrow keys (▼ and ▲) to move the cursor to 'Extra solvent (id 2)', if you want to remove the extra pump for solvent C.

2) Press **Change** until you find the required option (NONE) then press **ENTER**.

3) With the cursor at the appropriate line, repeat step 2 for 'Extra solvent (id 3)' **or** repeat for 'Injection (id 4)'.

4) Press **ESC** to return to *Screen 50*.

Mixer Volume

You can modify the Mixer Volume value shown on *Screen 50*; this value is descriptive only, for reporting purposes, without any effect on the software's control of the pump.

For calibration purposes, the 'Mixer' parameter is factory set at 0.20 ml (default value). If you change this value (refer to Chapter 3), you should change the value shown on *Screen 50* to that physically set on the AVDM (0.20-2.20 ml).

1) At *Screen 50*, use the arrow keys to move the cursor to 'Mixer:',

2) Key in the volume, then press **ENTER**.

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Hydraulic Configuration

Press **Hyd** to access the 'Hydraulics Configuration' screens for each solvent. The first one deals with solvent A (channel 1R), pumped by the right-hand head of pump 1; it shows the parameters for the solvent (and sample) channels currently configured.

The available soft-keys are:

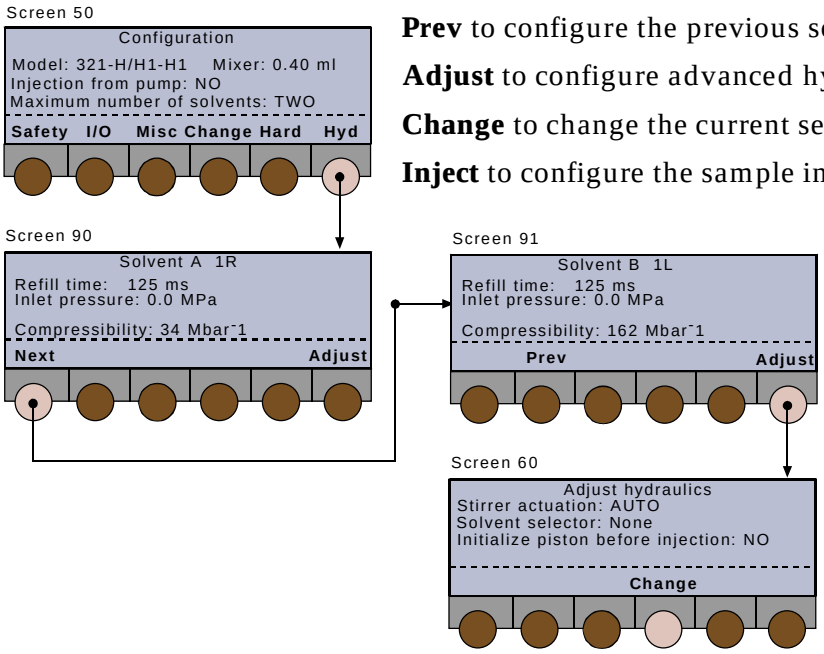
Next to configure the next solvent channel,

Prev to configure the previous solvent channel,

Adjust to configure advanced hydraulic functions,

Change to change the current selection

Inject to configure the sample injection pump.



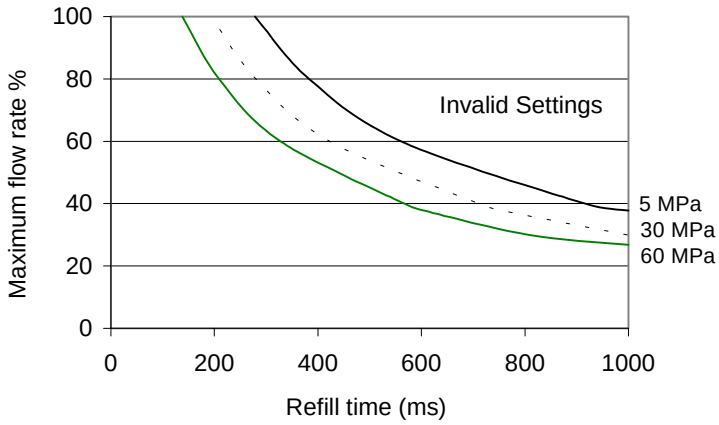
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Configuring a Channel

For each of up to four solvent channels (A, B, C, D), key in appropriate values for the hydraulic parameters: Refill Time, Inlet Pressure, Compressibility, and Head Type.

Refill Time (125-1000 ms) is the duration of the piston return stroke. If cavitation occurs use a higher value. With reference to the figure:

1) Normally, you can use the default value of 125 ms.
2) For volatile and non-degassed solvents, better performance may be achieved by entering a higher value, up to the limits shown.
3) If you enter a value that exceeds the limits, the software displays 'Invalid settings', in which case you must enter a lower value for Refill Time.



Inlet Pressure (0-50 MPa) is the pressure at the inlet to the pump head.

Compressibility (0-2000 Mbar-1) is a compensation parameter for solvent compressibility, usually 34 for water, 162 for methanol, 180 for acetonitrile (see Chapter 6).

Head Type to select the type fitted.
For a 30X Pump: 5, 10, 25, 50, 100, 200;
For a 321 or 322 Pump: H1 or H2.

1) Starting with solvent A (*Screen 90*), use the arrow keys (▲ and ▼) to move the cursor to a parameter **if** you wish to change its value.
2) Key in the desired value, then after keying in the value press **ENTER**. After pressing **ENTER** the cursor jumps automatically to the next parameter.
3) Press **Next**, then repeat the procedure for the Solvent B (*Screen 91*).
4) Press **Next**, then repeat the procedure for the Solvent C, if present (*Screen 92*).
5) Press **Next**, then repeat the procedure for the Solvent D, if present (*Screen 93*).

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6) Press **Inject**, then repeat the procedure for the injection pump, if present (*Screen 94*).

7) Press **Adjust** to access 'Adjust Hydraulics' screen (*Screen 60*).

Adjusting the Hydraulics

You use this screen (*Screen 60*) to configure the following hydraulic components: Stirrer Actuation, Solvent Selector, Initialize Piston (before injection).

Stirrer Actuation (AUTO, OFF), which concerns the Dynamic Mixer, should normally be set to 'AUTO'.

Solvent Selector, concerns the Valve Block, which is an optional hydraulic component, enabling you to switch solvents in line B (B1, B2, B3, B4). When the Solvent Valve Block is not in use you select the default, 'NONE', otherwise select either B1, B2, B3, or B4.

Initialize Piston Before Injection (NO / YES): initializing the piston of the injection pump 30X can improve injection precision at low flow rates (set to YES).

1) At the 'Adjust hydraulics' (*Screen 60*), use the arrow keys (▲ and ▼) to move the cursor to a parameter **if** you wish to change its value or state.

2) For example, to configure the Valve Block, move the cursor to 'Solvent selector: None' then press **Change** until you see 'Solvent selector: in use, Bx selected' (where x = 1, 2, 3 or 4). Then press **ENTER** to confirm.

3) 'Initialize piston before injection' only appears if 'Injection from pump'= YES.

4) Press **ESC** twice to return to *Screen 50*.

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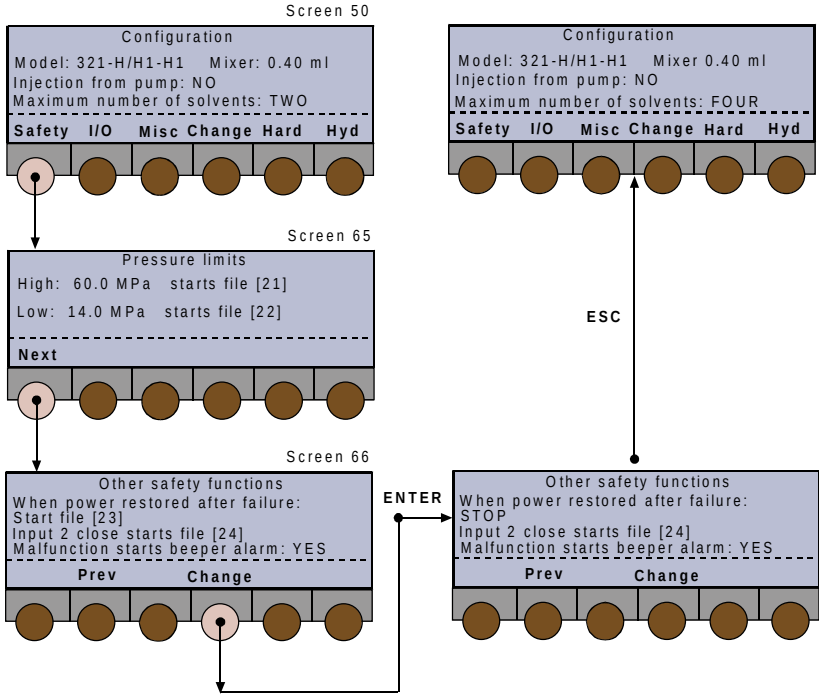
Safety Functions

Press **Safety,** you see the 'Pressure Limits' screen, which shows the high and low pressure limits and the associated safety files. The available soft-keys are:

Next to configure the 'Other safety functions' (*Screen 65*).

Prev to return to the 'Pressure Limits' screen (*Screen 66*).

Change to change the current selection.



Pressure Limits are model and configuration dependent and subject to automated validation. You need to ensure that the pressure limits defined here are suitable for the safe and correct operation of your system.

Other safety functions allow you to decide on the course of action after a power failure and to turn on or off the beeper.

Take care to ensure that safety files started as a result of choices made here perform the desired actions (e.g. stop pumping).

File numbers 21 to 24 are reserved for safety files, therefore they should not be assigned to Method Programs. You should create Safety Programs for files 21-24 in the same way that you create Method Programs. In each case, if you do not create the file, an error message will be displayed on the screen and the pump will stop.

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If file #21 is being executed, the pressure limit is automatically raised by 10%; then, if the new pressure limit is passed, the pump stops.

When the low pressure limit is crossed by decreasing values, the effect is delayed by 0.3 of a minute, whatever be the effect: stop pumping if file 22 is empty, or start file 22 if you have defined it. The delay is to allow the Method Program to continue, if a fugitive air bubble creates a brief and abrupt pressure decrease.

Changing the Pressure Limits

The maximum values for these limits are configuration dependent. **High limit > Low limit.**

1) Key in the new value for 'High:' (0 to 60 MPa) - starts file [21], press **ENTER**.
2) Key in the new value for 'Low:' (0 to 60 MPa) - starts file [22], press **ENTER**.
3) Press **Next** to configure the 'Other safety functions'.

Other Safety Functions

One function is predetermined - you cannot change 'Input 2 close starts file [24]'.

After a power failure you may choose to stop the pump, continue with the file (Method Program) that was running at the time of the failure, or start safety file [23]. To select the required option:

1) With the cursor at 'When power restored after failure:' - starts file [23], press **Change**.
2) At the required option (STOP, CONTINUE SAME FILE, START FILE [23]), press **ENTER**.
3) With the cursor at 'Malfunction sounds beeper alarm:', press **Change**.
4) At the required option (YES, NO), press **ENTER**.
5) Press **ESC** to return to *Screen 5*0.



File numbers 21 to 24 are reserved for the safety features described here. However, these files do not exist until you create the Safety Programs. You must ensure that any Safety Programs that you create and save as files 21 to 24 function correctly and provide the desired level of protection.

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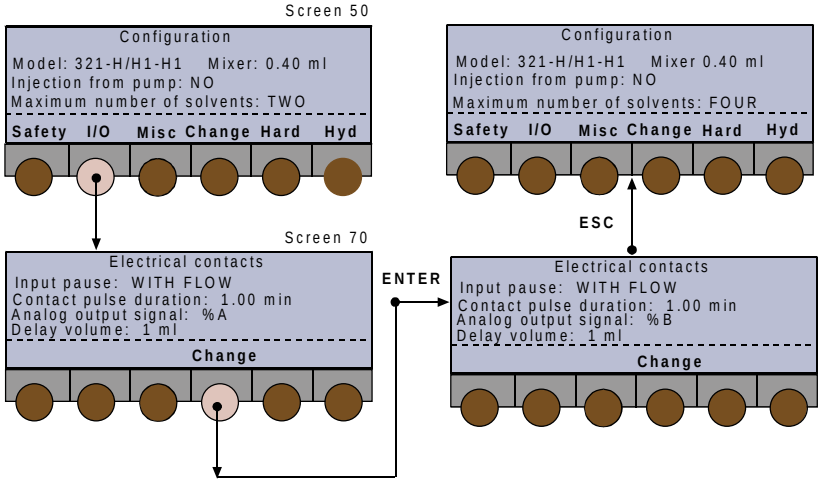
Electrical Contacts

Press **I/O,** you see the 'Electrical Contacts' screen (*Screen 70*), which allows you to modify certain options related to electrical signals (see Chapter 3 'Electrical Connections-Communication').

a) You may either continue with or stop the flow when an input pause signal is received.

b) You may set the length of an output pulse to between 0.01 and 1 minute (0.6 to 60 seconds).

c) You may set the output signal to follow pressure, flow rate, composition (%A, %B, %C, %D). If you choose one of the composition parameters, you should also enter a value for Delay Volume (0 to 90 ml) to get the best synchronization between the programmed profile and the detected profile.



Changing a Function

1) With the cursor at 'Input pause:', press **Change**.
2) At the required option (WITH FLOW, WITHOUT FLOW), press **ENTER**.
3) With the cursor at 'Contact pulse duration:', key in a value (0.01 to 1), press **ENTER**.
4) With the cursor at 'Analog output signal:', press **Change**.
5) At the required option (FLOW, PRESSURE, %A, %B, %C, %D), press **ENTER**.
6) If either %A, %B, %C or %D is selected 'Delay Volume:' appears (next line). With the cursor at 'Delay Volume:', key in a value (0 and 90), press **ENTER**.
7) Press **ESC** to return to *Screen 50*.

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GSIOC ID and Miscellaneous

Press **Misc,** you see the 'Miscellaneous' screen (*Screen 75*), which allows you to modify the following items:

a) GSIOC id (0-63). This must be done if one 321 Pump is to be used as a slave to another (each must have a unique id) or if the default id (#1) conflicts with other equipment.

b) Bit rate of the 321 Pump (External, 1200, 2400, 4800, 9600, 19200).

c) Turn off the display after 'x' minutes (press any key to reactivate the display).

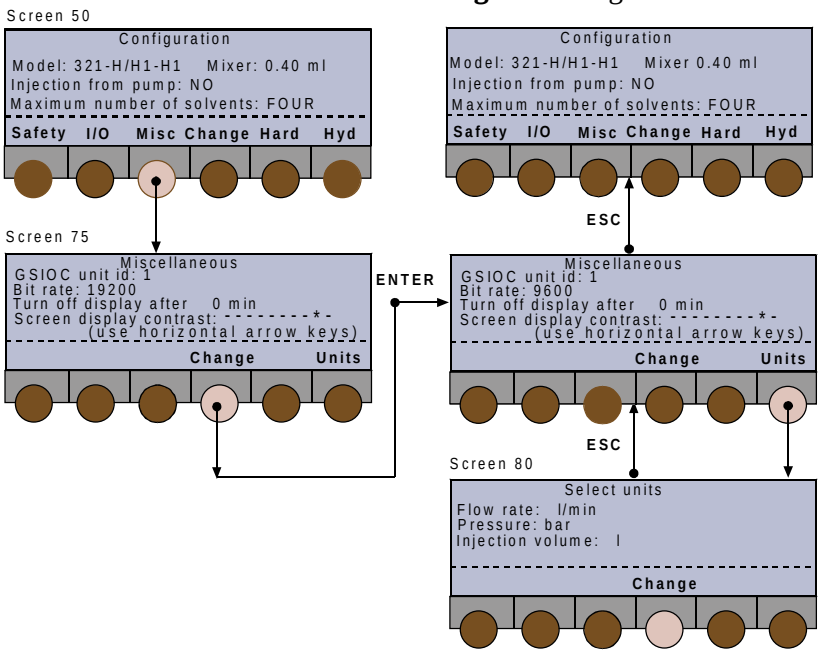
d) Screen contrast.

e) Units of displayed values for flow rate, pressure, and injection volume.

The available soft-keys are:

Units to modify the units displayed (*Screen 80*).

Change to change the current selection.



Changing the GSIOC ID

Key in a number between 0 and 63, then press **ENTER**.

Changing the Bit Rate

1) With the cursor at 'Bit rate:', press **Change**.

2) At the required option (EXTERNAL, 1200, 2400, 4800, 9600, 19200), press **ENTER**. EXTERNAL is the recommended setting.

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3) Press **ESC** once to return to *Screen 50*.

Changing the Screen Saver

1) Place the cursor at 'Turn off display after: ... min:'.
2) Key in a number between 0 and 999 minutes, then press **ENTER**.

The display is turned off at the end of the specified period of time, counting from the moment when you last pressed a key.

Otherwise, 0 disables the screen saver.

Changing the Screen Contrast

Press either of the horizontal arrow keys (◄ ►) until you arrive at a suitable level. This is shown as follows: 'Screen display contrast: ----------* ' where the * marks the current setting.

Changing the Units

1) Starting at *Screen 75*, press **Units,** you see the 'Select Units' screen (*Screen 80*).
2) With the cursor at 'Flow rate: ml/min', press **Change** to select 'µl' or 'ml', then press **ENTER**.
3) With the cursor at 'Pressure: MPa', press **Change** to select 'MPa' or 'psi' or 'bar', then press **ENTER**.
4) With the cursor at 'Injection volume:', press **Change** to select 'µl' or 'ml' or 'l', then press **ENTER**.
   You may also use the vertical arrow keys (▲ and ▼) to move the cursor from one parameter field to another, but you must first confirm the previous selection by pressing **ENTER**.
5) Press **ESC** once to return to *Screen 75*, twice to return to *Screen 5*0.

Beeper Status

1) Starting at *Screen 75*, press **Other,** you see *Screen 76*.
2) Use **Change** to set the keypad beeper to either ON or OFF.
3) Confirm your selection by pressing **ENTER**.
4) Press **ESC** to return to *Screen 5*0.

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Manual Operations

Introduction

The following manual functions are available:

a) Prime the channels (must be done for a new pump or pump head).

b) Pump solvents at a specific flow rate and composition (to condition the column).

c) Operate the four contact outputs.

Procedure

Switch on the Model 321 Pump, after initialization you see the ready-to-run screen (*Screen 1*). You will see the following soft-keys at one time or another:

Pump (Edit) to access pump operations,

Detect to access an associated detector,

Manual to prime and operate manually,

Run to run the current Method Program file,

Pause to interrupt the Method Program,

Resume to restart a paused Method Program,

End to stop a Method Program,

Stop to stop pumping,

Zero to zero the detector signal (if associated).

Press: **Manual**, at the 'Manual Control' screen (*Screen 8*) you will see following soft-keys:

Flow to pump solvents at a specific flow rate.

Prime to prime specific channels.

Output to operate the four contact outputs.

Hydraulic Priming

Hydraulic priming is an essential precursor to operating the pump. Refer to page 4-3 for essential information. You can prime any actively associated pump (32X or 30X) from the 321 Master Pump.

Press **Prime,** you see the 'Prime' screen (*Screen 25*); for each channel the available soft-keys are:

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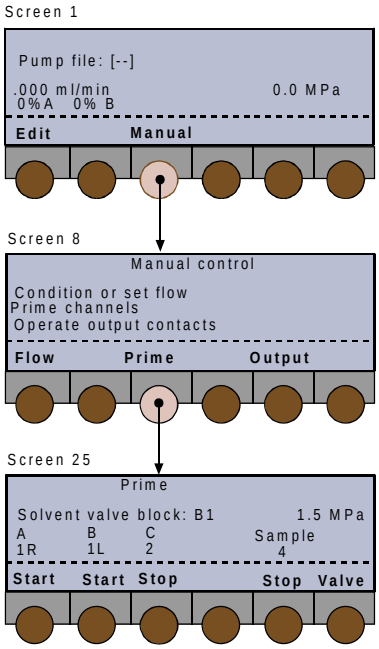
Start to start pumping.

Stop to stop pumping.

Valve to select solvent valve block channel (if fitted).

Priming Channels

Screen 25 shows all of the currently configured channels (up to 5) A, B, C, D, Sample: below each channel name is an identifier (e.g. B = 2L) showing the corresponding pump number (nominal GSIOC ID) and head (32X Pumps only, L = left, R = right).



1) Open the purge valve to the drain vessel.
2) Press the **Start** soft-key corresponding to the channel(s) you wish to prime. Self-priming is generally obtained after 2 minutes. If not, press **Stop**. Disconnect the drain tubing from the purge valve, and replace it with the supplied syringe (ref: 460058) equipped with its fitting adapter (ref: H44249). Press **Start**, then draw on the syringe piston, while the pump is active.
3) When the line is filled with liquid, press the **Stop** soft-key corresponding to the channel(s) you wish to stop priming.
4) Press **ESC** to return to *Screen 8*. You must stop **all** channels before pressing ESC, in order to leave this screen.



Running a pump-head dry, for more than a short time, will damage the piston seal. Therefore, be prepared to intervene manually in the priming process.

Manual Flow Control

Press **Flow,** you see the 'Manual Flow Control' screen (*Screen 20*); after entering the parameters the available soft-keys are:

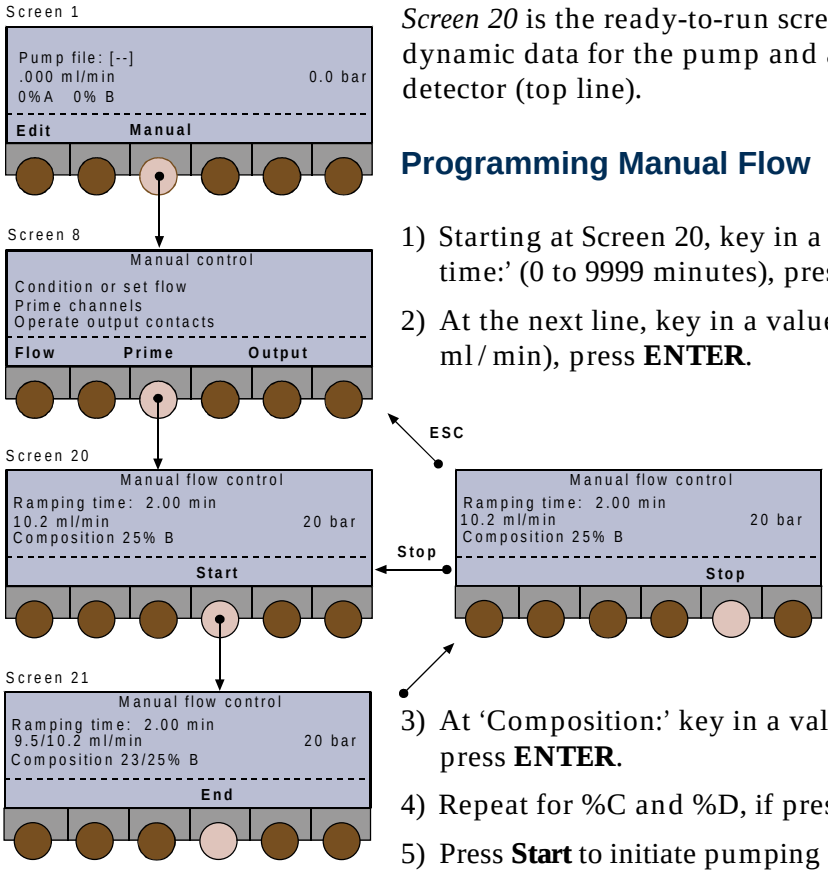
Start to start pumping after ramping on to the desired flow rate and composition. Present if the values demanded are different from the actual values.

Stop to stop pumping (immediately).
Present only if flow is not equal to zero.

End to interrupt the ramp-on (*Screen 21*), pumping continues.

Zero to zero the detector signal (if associated).

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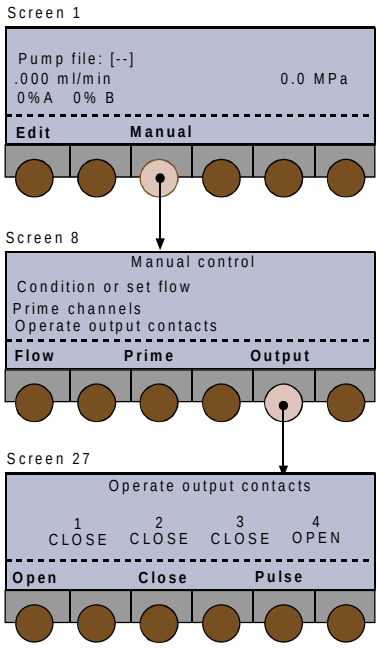
Back to *Screen 20*, at end of specified 'Ramping Time', or after pressing **End** (pump continues at flow rate and composition of *Screen 21*).

Screen 20 is the ready-to-run screen, which displays dynamic data for the pump and an associated detector (top line).

Programming Manual Flow

1) Starting at Screen 20, key in a value for 'Ramping time:' (0 to 9999 minutes), press **ENTER**.
2) At the next line, key in a value for flow (0 to 15 ml / min), press **ENTER**.
3) At 'Composition:' key in a value (0 to 100) for %B, press **ENTER**.
4) Repeat for %C and %D, if present.
5) Press **Start** to initiate pumping or **ESC** to abort and return to *Screen 8*.

Output



The pulse length (0.01 to 1 minute) is configurable (**Config, I/O**, Contact Pulse Duration).

Refer to Chapter 3 for a physical description of the output connectors, which may be programmed to send a signal to other equipment during a run.

Press **Output,** you see the 'Operate Output Contacts' screen (*Screen 27*); for contact (1 to 4) the available soft-keys are:

Open to set the contact to normally open.

Close to set the contact to normally closed.

Pulse to change the state (open or closed) of the contact.

1) Press either of the horizontal arrow keys (◄ ►) to select a contact.
2) Use the appropriate soft-key to change the selected contacts state.
3) Press **ESC** to return to *Screen 8*.

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Entering Method Programs

Creating and editing Method Program files is detailed in the following Sections. You are advised to check and correct the configuration parameters before using the edit functions to create a list of events and the related parameters (flow rates, volumes, composition, and so on).

Creating a Method Program consists of two simple steps: assigning a file number and entering a list of events that you want to occur at the times that you specify. However, it is recommended that you list the events required by your Method Program, on paper, before attempting to create the file.

Method Program files (1 to 20) can be looped and linked to other files.

Safety Program files (21 to 24) are created in exactly the same way as Method Program files.

Getting Started

Switch on the Model 321 Pump, then (after initialization) you see the in-run screen (*Screen 1*). You will see the following soft-keys at one time or another:

Pump (Edit) to access pump operations,

Detect to access an associated detector,

Manual to prime and operate manually,

Run to run the current Method Program file,

Pause to interrupt the Method Program,

Resume to restart a paused Method Program,

End to stop a Method Program,

Stop to stop pumping,

Zero to zero the detector signal (if associated).

1) Press **Pump (Edit)**, you see the 'Pump Control' screen (*Screen 2*); you may be presented with the following soft-keys at one time or another:
   File to access file operations,
   Edit (**Create**) to review or modify a Method Program, or ...

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View to review a file that can't be modified,

Create (Edit) to begin editing a Method Program,

Config to enter a configuration parameters for the currently selected Edit File,

GLP to access audit, maintenance, run-in and test functions for a 321 Pump,

Watch to obtain post-run information.

2) With the cursor on 'Edit file: #', key in the number of the file that you wish to edit (or create). For a new file the number is contained by square brackets [#].

3) Press **Create or Edit** (for an existing file), you see the 'Edit Method' screen (*Screen 30*); the possible soft-keys are:

Events to access or enter a list of events,

Link to link the file currently selected to another file,

No Link to undo a link with another file,

Consump to see the predicted fluid consumption for the file currently selected.

Creating and Editing Method Programs

Entering Events

With reference to the following figures, starting at *Screen 30*, press **Events** (or **Select**), you see the 'Edit Method File' screen (*Screen 39*); you will be presented with soft-keys for the following event types:

FLOW to schedule the flow rates,

COMP to schedule a change in the composition of the mobile phase,

WAIT to wait for a signal (e.g. injection) on input #2,

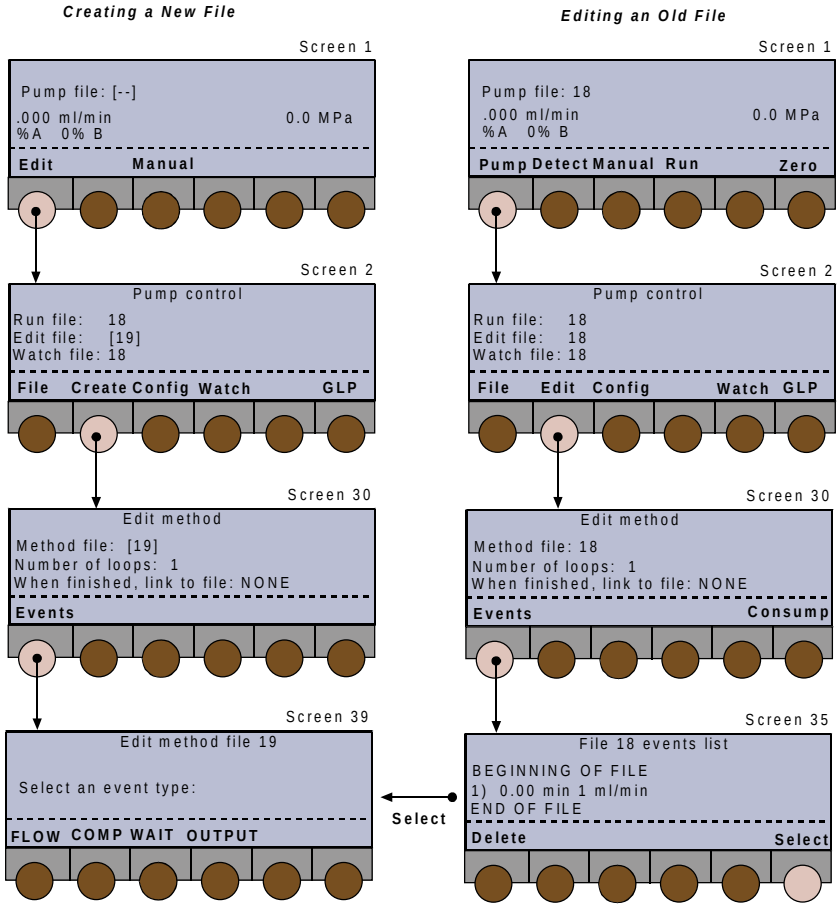
OUTPUT to schedule output signals,

INJ to schedule an injection from the pump (if configured).

You can enter all or any of these event types according to the requirements of your Method Program (see Method Program Work Sheet). Whichever event types you enter, the procedure is the same.

1) Press an event type key (**FLOW**, **WAIT**, **COMP**, etc.); you see the first 'File # xxxx events' screen (*Screen* 36), the possible soft-keys are:

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Delete to remove an event from a file, Present provided at least one event is present.

Create (Add) to create the first event in a new file ([#]), or the first event of this type in an existing file (#),

Time (Flow) to toggle between injection flow rate and duration,

Add (**Create**) to add an event to a file,

List to review the events currently present in a file,

Select to choose an event type to add to the file (*Screen 39)*,

Confirm to affirm the value entered (at *Screen 36a*)

2) Press **Create** or **Add**, you see the second 'File # xxxx events' screen (*Screen 36a*); key in the time of the event, followed by parameters, which vary according to the event type (see below).

3) Press **Confirm**, then **Add** to add an event of the same type (returns to *Screen 36*) or **Select** to choose a different event type (returns to *Screen 39*).

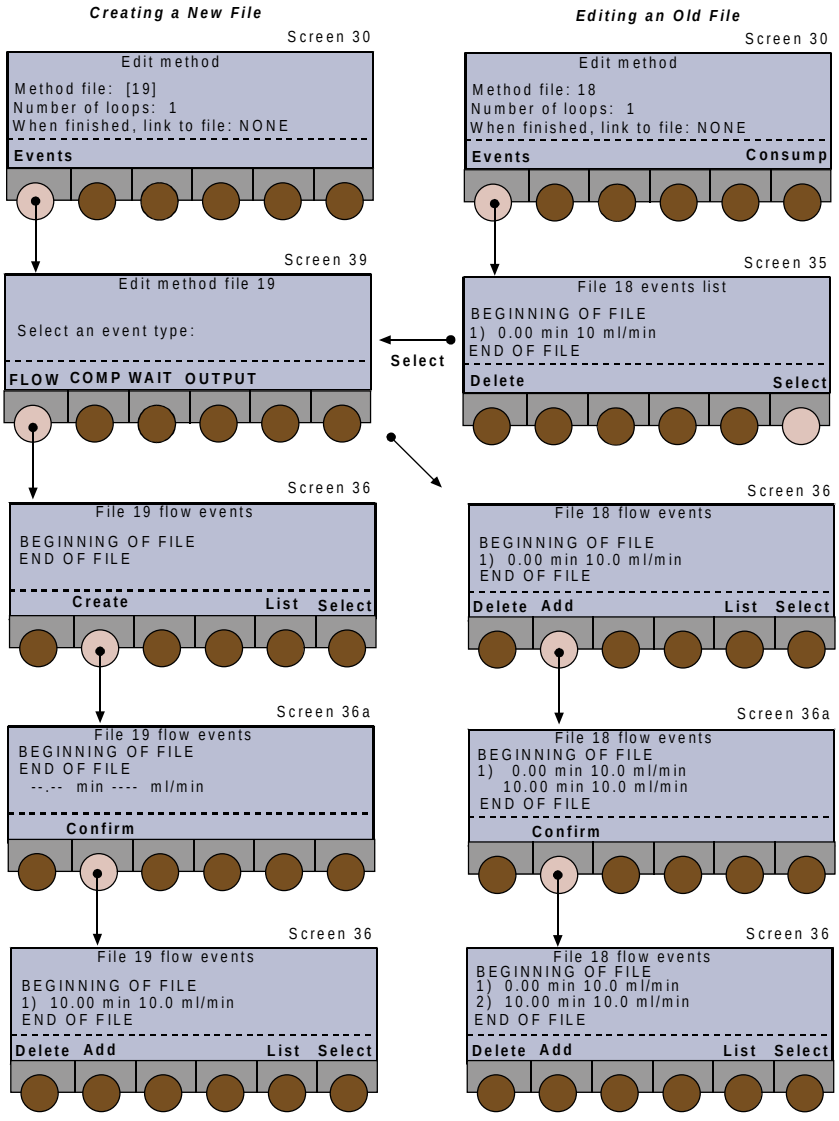
4) Continue to cycle between *Screens 36* and *36a* (**Add**) or *Screens 36*, *36a*, and *39* (**Select**) until you have

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completed the schedule of events. Normally, you would enter the complete profile for events of one type before using **Select** to access the next parameter type (e.g. **FLOW**, then **COMP**, followed by **INJ**, **WAIT**, and **OUTPUT**). If the events are not entered sequentially, the software automatically sorts them into the correct time-order.

After keying in one of a series of parameter values, pressing **ENTER** automatically moves the cursor on to the next parameter. However, you may use the horizontal arrow keys (◄ ►) to move the cursor to the parameter that you wish to modify.

5) When done, press **ESC** to return to *Screen 30*. Here, by pressing **Consump,** you may access solvent consumption (per loop) for the currently configured channels (*Screen 32*) ; press **ESC** to return to *Screen 30*.



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FLOW

1) Key in a time (0.00 to 9999 minutes), then press **ENTER**,
2) Key in a flow rate (0 to 15 ml/min for H1, 0 to 30 ml/min for H2), then press **ENTER**,
3) For a new event (after **Add**), press **Confirm** to affirm the values entered,
4) Press **ESC** to go back to *Screen 30*.

COMP

1) Key in a time (0.00 to 9999 minutes), then press **ENTER**,
2) Key in a percentage (0 to 100), for solvent channel 'B', then press **ENTER**,
3) Key in a percentage (0 to 100), for solvent channel 'C', and 'D' (if configured),
4) For a new event (after **Add**), press **Confirm** to affirm the values entered,
5) Press **ESC** to go back to *Screen 30*.

WAIT

1) Key in a time (0.00 to 9999 minutes), then press **ENTER**,
2) Press **Change** to select either CLOSE or OPEN,
3) Press **Confirm** to affirm the value entered, or **CLEAR** to abort the value.
4) Press **ESC** to go back to *Screen 30*.

OUTPUT

1) Key in a time (0.00 to 9999 minutes), then press **ENTER**,
2) Key in an output contact number (1 to 4), then press **ENTER**,
3) Press **Change** to select either CLOSE, OPEN, or PULSE,
4) For a new event (after **Add**), press **Confirm** to affirm the values entered,
5) Press **ESC** to go back to *Screen 30*.

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INJ

You enter one injection event (per loop), specifying the time at which the injection starts and the volume to be injected. The third parameter can be either the required flow rate or the length of the injection (duration).

If you enter the required flow rate, the duration is calculated according to the volume of sample you specify, and vice versa. Flow rate and volume depend on the size of head fitted to the 30X Pump. There are two extra soft keys (*Screens 35 and 36*) for an injection event:

Time (Flow) to select time as the third parameter,

Flow (Time) to select flow rate as the third parameter.

1) Key in the time at which the injection starts (0.00 to 9999 minutes), then press **ENTER**,
2) Key in the volume of sample to be injected (0 to 500 ml), then press **ENTER**,
3) Key in an injection flow rate (0.001 to 5 ml/ minute*), then press **ENTER**, or ...
4) Key in an injection duration (.001 to 9999 minutes*), then press **ENTER**,
5) Press **Confirm** to affirm the values entered,
6) Press **ESC** to go back to *Screen 30*.

* Depends on the injection volume entered previously.

Creating Loops

You create loops to repeat the Method Program 'n' times, which means the number of times the Method Program will be executed before it ends. With reference to *Screen 30*:

- if necessary, move the cursor using the vertical arrow keys (▲ and ▼) to the 'Number of loops:' line, key in a number between 1 and 999, then press **ENTER.**

Linking Files

You link files so that they will be executed as a chain, that is they will be run one after the other, starting with the file currently selected. With reference to *Screen 30*:

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- if necessary, move the cursor using the vertical arrow keys (▲ and ▼) to the '... link to file:' line, press the **Link to**, key in the number of the file (1-24) to which the current file is to be linked, and then press **ENTER**. To undo a link you must press the **No Link** key.

Listing Events

At *Screens 36 or 36a*, press **List** to list all of the events entered in the currently selected file, the possible soft-keys are:

Delete to remove an event from a file,

Time (Flow) to toggle between injection flow rate and duration,

Change to change the state of an output,

Select to select an event type from *Screen 39*.

As well as reviewing a Method Program file, you may change the parameters. In either case, you use the vertical arrow keys (▲ and ▼) to scroll through the list of events and to move the cursor from one parameter field to another.

After keying in each new value, you must press **ENTER** to confirm the value and move the cursor on to the next parameter.

Deleting Events

1) At *Screens 35 or 36*, use the vertical arrow keys (▲ and ▼) to scroll through the list of events.
2) With the cursor at the line corresponding to the event that you want to delete, press **Delete**.
3) At *Screen 37*, press **Yes** to confirm the deletion (returns to *Screen 35*) or **No** to return to *Screen 36*.
4) Repeat for other events, if required, and press **List** to review the revised Method Program file.
5) When done, press **ESC** to return to *Screen 30*.

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Method Program Work Sheet

File Number:	Method Name

SETUP PARAMETERS

Pressure: High limit = Low limit =						
Number of pumps = Loops = Link file =						
Pump Line	Model	Solvent	I.D	Refill	Comp	Head Size
A						
B						
C						
D or Inj						

I/O OPERATIONS

Time	Contact	State	Function

PROGRAM STEPS

Step No	Time	Event	Operation
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			

Step No	Time	Event	Operation
14			
15			
16			
17			
18			
19			
20			
...			
30			

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File Management

The file management facility enables you to see a list of currently assigned files, to copy, lock, delete, and edit files.

Procedure

Switch on the 321 Pump, then (after initialization) you see the ready-to-run screen (*Screen 1*). You will see the following soft-keys at one time or another:

Pump (Edit) to access pump operations,

Detect to access an associated detector,

Manual to prime and operate manually,

Run to run the current Method Program file,

Pause to interrupt the Method Program,

Resume to restart a paused Method Program,

End to stop a Method Program,

Stop to stop pumping,

Zero to zero the detector signal (if associated).

1) Press: **Pump (Edit)**, you see the 'Pump Control' screen (*Screen 2*) you may be presented with the following soft-keys at one time or another:

   File to access the file management operations,

   Edit (**Create or View**) to modify an existing Method Program file,

   Create (**Edit or View**) to enter a new Method Program file,

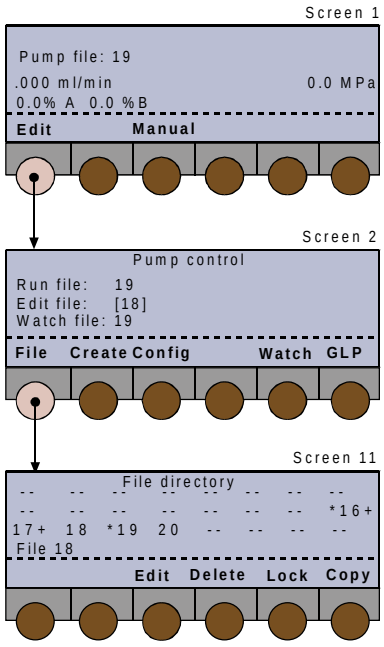
   View (**Edit or Create**) to review an existing Method Program file,

   Config to enter a configuration parameters for the currently selected file,

   GLP to access audit, maintenance, run-in and test functions for a 321 Pump,

   Watch to obtain post-run information.

2) Press: **File**, to access the file management screen, you see the 'File Directory' screen (*Screen 11*), which shows all currently assigned files. Use any of the arrow keys to move around the screen.



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Which of the possible soft-keys you see depends on the state of the file (#) you select:

[#] = file unedited (empty)
*# = file locked
#+ = file linked

Create (**Edit or View**) to enter a new Method Program file,

Edit (**Create or View**) to modify an existing Method Program file,

View (**Edit or Create**) to review an existing Method Program file,

Delete to delete the currently selected file,

Lock (Unlock) to lock (or unlock) the currently selected file,

Copy to copy the currently selected file.

Links shows which files are linked to the currently selected file.

Create or Edit

These keys allow you to create a Method Program in a previously empty file, or to edit an existing file.

View

View enables you to view a locked file, using the same screens as **Edit,** but without the possibility to use the **Delete** key to remove events from the file currently selected, or to delete the file itself. However, you may copy a locked file and then edit the copied file.

Delete

To delete a file press **Delete** (*Screen 18*), then press **Yes**. If in doubt, press **No**, because a deleted file cannot be recovered (unless a copy exists).

Pressing either key returns you to *Screen 11*.

Lock

To lock a file press **Lock** (*Screen 19*), then press **Yes**. If in doubt, press **No**, a locked file cannot be edited or deleted. However, you may copy a locked file, in which case the copy is automatically unlocked by the software. A locked file is indicated by an asterisk before the file number (*#).

Pressing either key returns you to *Screen 11*.

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UnLock

To unlock a file press **Unlock** (*Screen 19*), then press **Yes**. A locked file is indicated by an asterisk before the file number (*#).

Pressing either key returns you to *Screen 11*.

Copy

To copy a file press **Copy** (*Screen 14*); key in the number to which the currently selected file will be copied. A message appears asking you to confirm your actions; normally press **Yes**. Or, if in the destination file already exists, press **No**, unless you want to over-write the existing file. Care! overwritten files cannot be recovered.

Pressing either key returns you to *Screen 11*.

Links

To see how the existing files are linked, press **Links,** the following screen (*Screen 12*) shows the order in which the linked files will be run.

'Chain circular' means that you have cross linked files resulting in more than one occurrence of one or more file numbers, in the series.

Take care, when linking files. Bad links can lead to unforeseen consequences. Linking to a file that does not yet exist is not allowed.

You should consider carefully your linking strategy, create, and check the files before linking them (see "Linking Files").

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Good Laboratory Practice (GLP) Functions

The following functions are selectable by pressing the appropriate key:

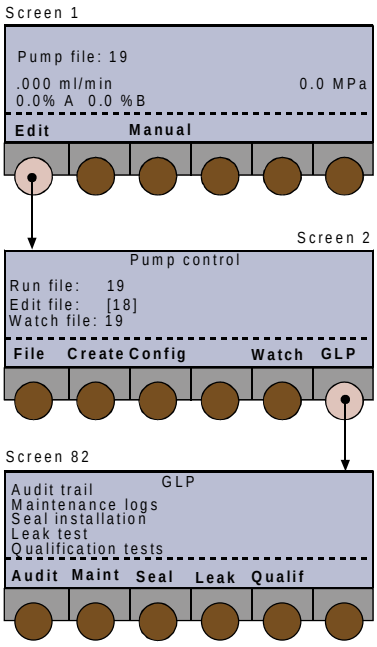
a) Audit trail records the sequence of events that take place during a run when you execute one or more Method Program files. Audit trails are recoverable by the PC based Pump Data Transfer software supplied with each 321 Pump. From the Control Panel of a 321 Pump you can only activate or deactivate the audit trail function and adjust the date and time.

b) You can access the pump's maintenance logs for the Master 321 Pump and its Slave 32X Pump (if connected via GSIOC) and activate the dismount function. When replacing any 32X Pump head, you are obliged to use the dismount function in order to be able to physically remove the head from the front of the pump.

c) New piston-seals should be run-in after installation. The seal installation procedure prepares the piston seals in advance of a full run-in (10 to 12 ml/min using methanol or isopropanol).

d) 'Leak' is used to check the 'watertightness' of the hydraulic circuit.

e) A pre-programmed qualification test is available to test the mixing functions of the Master 321 Pump.



Procedure

Switch on the 321 Pump, then (after initialization) you see the ready-to-run screen (*Screen 1*).

1) **Edit (Pump)** to access pump operations, you see the 'Pump Control' screen (*Screen 2*).

2) Press **GLP**, you see the 'GLP' screen (*Screen 82*); the possible soft-keys are:

Audit to access the audit trail functions,

Maint to verify maintenance logs or dismount a pump head,

Seal to install the piston seals,

Leak to test the hydraulic circuit,

Qualif to perform the qualification test.

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Audit Trail

Starting from the 'GLP' (*Screen 82*), press **Audit** (*Screen 83*), then use the arrow keys to move the cursor to the field you wish to change. To switch on or off the audit trail: select the 'Audit trail used:' field, press **Change** to select ON or OFF, then press **ENTER**.

Date and Time

1) Select the 'Date:' field, key in the date as a 6-digit number (ddmmyy, for example 140299), then press **ENTER**.
2) Select the 'Time:' field, key in the time as 4 digits separated by a point (hours.minutes, for example 22.35), then press **ENTER**.
   The date and time are retained when you switch off the 321 Pump (or in the event of a power failure).
3) Press **ESC**, to return to *Screen 82*.

Dismounting Pump Heads and Accessing Maintenance Logs

This series of screens enables you to review, and if required (after changing a pump head), reset the maintenance logs for each of the currently configured 321 and 322 pump heads.

This dismount procedure is required to change a pump head, piston seal or a piston assembly. UniPoint users should refer to "UniPoint Commands for 321 and 322 Maintenance". An alternative manual procedure is described in Chapter 5 for users not having access to either 321 Pump or UniPoint software.

Dismount Procedure



The dismount procedure should only be carried out by suitable qualified people.

The pistons must go to the dismount position before you can physically remove the head(s) from the pump. Starting from the 'GLP' (*Screen 82*), press **Maint** to access 'Maintenance logs' (*Screen 84*); you will see these soft-keys at one time or another:

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Change to select the pump-head,

Dismount to move the pump head pistons to the dismount position,

End to finish the dismount procedure,

1) Close the stop valves attached to the inlet tubings of the heads.
2) Disconnect the inlet tubings and open the purge valve.
3) Prime the head(s) for about 10 seconds: press **Manual/Prime/Start/Stop**.
4) Press **GLP/Maint/Dismount** to unlock the piston assemblies from their driving mechanisms. (Check that it is safe to set the pistons in motion before pressing **Yes**.)
5) Wait while the pistons move to their dismount positions, until the screen displays 'Change heads'.
6) For each head disconnect the outlet tubing. To remove a pump head, undo with one hand the two screws that attach the head to the motor, while supporting the head with the other.
7) Refit the pump head, then press **End**; wait while the pistons move back into their locked positions and screen displays 'Go to the dismount heads position'. When you have finished press **No** to return to *Screen 84* and **ESC** to return to *Screen 82*.

Maintenance Logs

You use this function to view the log of wear parts for any configured 32X or 30X Pump. The log contains the usage of the part to date (hours), the user set upper limit (hours), or the number of operational piston cycles that the part has completed (megacycle = one million cycles). The parts logged are the piston, piston seal, inlet check valve ('In CV'), outlet check valve ('Out CV').

After the specified usage, you would normally service or replace the part in question (see Chapter 5). You specify limit values that are suitable for your applications and in line with GLP procedures applicable to your working environment.

1) Starting from the 'GLP' *(Screen 82)*, press **Maint** *(Screen 84)*.
2) Press **Change**, to select a pump head (1L, 1R, 2L, 2R), press **ENTER**, to see the log *(Screen 86)*.

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3) To reset a logged value, use the vertical arrow keys (▲ and ▼) to select the part, press **Reset**.
4) To change an upper limit, use the arrow keys to select the required field, key in the new value, then press **ENTER**. The flashing cursor indicates the currently selected field.
5) Press (two times) **ESC**, to return to *Screen 82*.

Seal Installation

This procedure is designed for installing new piston-seals, using isopropanol. For a different solvent, you should adapt the flow rate in proportion to the viscosity of the solvent used.

The procedure is in two parts:

- first priming for two minutes at a fixed flow rate to the drain (see table, below),
- second pumping at a pre-programmed gradient (ascending then descending flow rate) against the back pressure provided by the supplied capillary tubing, for 14 minutes. If the pressure indicated in the table is reached before 2 minutes, then the software interrupts the positive flow rate gradient, and maintains, during 10 minutes, the flow rate at the value that generated this pressure, otherwise it goes to the flow rate indicated in the table and maintains it during 10 minutes. At the end of this time, the flow rate linearly decreases to zero in 2 minutes.

Flow Rates and Pressure Values (F and P) Implemented by the Pre-stored Procedures available under Soft-keys GLP/Seal and GLP/Leak.

Pump-Head	Prime	GLP/Seal			GLP/Leak
	F Fixed ml/min	Purge F Fixed ml/min	Procedure F Default ml/min	Procedure P Default MPa	Procedure P Default MPa
32X-H1	13.8	11.25	12	45	45
32X-H2	27.7	22.5	12	28	22.5
30X-5	5	3.75	5	45	45
30X-10	10	7.5	10	45	45
30X-25	25	18.75	12	28	21
30X-50	50	22.5	12	14	10.5
30X-100	100	22.5	12	7	5.2
30X-200	200	22.5	12	3.5	2.6

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GLP/Seal implements a procedure for the supplied capillary (E66257, 0.13 x 1.6 x 400 mm), which is to be connected at the outlet filter. Isopropanol is the recommended solvent. In these conditions, the pressure should be 38-45 MPa for 12 ml / min.

GLP/Leak uses the supplied plug (ref: 410432), to be connected at the outlet filter.

You can select any head, from the 321 Pump, or any controlled pump. The parameters are adjusted automatically by the software.

Starting from the 'GLP' (*Screen 82*), press **Seal** (*Screen 265*); you will see these soft-keys at one time or another:

Change to select the pump-head to run-in,

Start to start the pumping,

Continue to start pumping at the programmed rate,

End to stop the pump.

1) Connect the supplied capillary tubing (ref: E66257) to the outlet of the outlet filter; then switch the purge valve to the drain position.
2) Press **Change** followed by **ENTER**, to select the pump to run-in.
3) Optionally, if you are not using isopropanol as the solvent, you may change the flow rate. ***Normally, you should keep the default value given in the table.***
4) Press **Start** to start the pump (*Screen 266*) or **End** to stop the pump (in an emergency).
5) After two minutes the pump stops (*Screen 267*); switch the purge valve to the use position, then press **Continue**.
6) The pump then runs the pre-programmed sequence (*Screen 268*).
7) After the program has finished (*Screen 265*), press **ESC** (*Screen 82*), then run the leak test or press **Seal** to repeat the procedure for another pump.

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Leak Test

This test consists of pressurizing the pump at a user selectable pressure, in a closed hydraulic circuit. Built-in default values for this pressure are given in the Table, page 4-35. When this pressure is reached the pump stops. If during the next 5 minutes the pressure decay is less than 10 % the test is successful. For a successful test 'OK' is displayed on the screen, otherwise, 'FAILED' is displayed. Check for leaks before repeating the test. Starting from the 'GLP' (*Screen 82*), press **Leak** (*Screen 260*); you will see these soft-keys at one time or another:

Start to start the test (pump starts),

End to end the test (pump stops).

1) The outlet from the pump (filter) should be sealed with plug supplied (ref: 410432), before running the test.
2) The test pressure is automatically set at the following recommended default values: 45 MPa for 32X-H1, 22.5 MPa for 32X-H2. The test flow-rate is displayed as 1 ml/min by default. To save time, and pressurize the circuit in approximately one minute, it is recommended to change this value, using 4 ml/min for 32X-H1 and 2 ml/min for 32X-H2.
3) Press **Start** to start the pump or **End** to stop the pump (in an emergency).
4) Press **ESC**, to return to *Screen 82*.

The selected test pressure must be within the configured pressure limits.

Qualification Test

This test is based on an ASTM method for determining the linearity, accuracy, and repeatability of a binary composition gradient. The test automatically implements a program consisting of three 80-minute loops.

Starting from the 'GLP' (*Screen 82*), press **Qualif** (*Screen 270*) to perform the binary mixing test. For details, refer to the document entitled 'Operational Qualification Procedure', reference 804033.

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Running a Method Program

Preparing for a Run

In addition to creating your Method Program file, the following steps must be completed before running a Method Program.

1) Make the electrical and hydraulic connections between the pump(s) and other equipment in the system, as described in Chapter 3.
2) Connect the power and switch on all of equipment.
3) Configure the Master 321 Pump.
4) Prime the hydraulics, initialize and run-in the piston seals (if new).

Starting and Stopping a Run

Switch on the 321 Pump, then (after initialization) you see the ready-to-run screen (*Screen 1*). Before starting the run, you may see the following soft-keys:

Pump (Edit) to access pump operations,

Detect to access an associated detector,

Manual to prime and operate manually,

Run to run the current Method Program file,

Zero to zero the detector signal (if associated).

1) The cursor indicates the currently selected file number; to select a different file key in its number, then press **ENTER**.
2) Press **Run**, you will see the following soft-keys at one time or another:

   Edit to view or modify any file during a run (it may be another file),

   Pause interrupt the Method Program (pumping continues),

   Resume to continue a paused Method Program,

   End to stop the Method Program file (pumping continues),

   Stop to stop pumping (the Method Program may continue).

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After pressing **Run**, the ready-to-run screen dynamically displays the flow rate and composition of the mobile phase, and displays the pressure detected by the pressure sensor. The top line of the screen is reserved for information from a 15X detector (if connected).

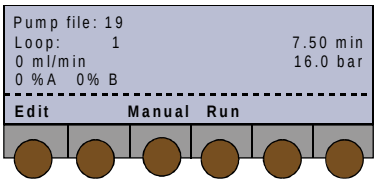
If you press **Pause,** the Method Program is interrupted, but pumping continues at the rate and composition that existed when that soft-key was pressed. A pause time counter replaces the run time counter until you press **End** or **Resume**. Pressing **Resume**, restarts the Method Program, from the point at which it interrupted. Pressing **Stop** during a pause stops pumping until you press **Resume**.

Whenever you press **End,** the Method Program is terminated, but pumping continues at the rate and composition that existed when that soft-key was pressed. After pressing **Stop**, you may need to press **End** to terminate the Method Program.

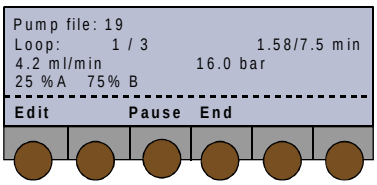
When a Method Program comes to an end, the pump continues to pump at the flow rate and composition that were applicable at the last programmed event (or at the end of 'n' loops); unless you program a flow rate of zero at the end of the program, or link the run file to a stop program, otherwise you must press **Stop** to stop pumping.

You can press the **Edit** key, to access and change the Method Program parameters, even when the Method Program to be edited is running. When you see the word 'running' after the file number (on selected screens), it means that the ***Method Program*** is either running or paused; it does not refer to the pistons, which may be pumping or stopped. Likewise, the absence of the word 'running' does not imply that the pistons are not in motion.

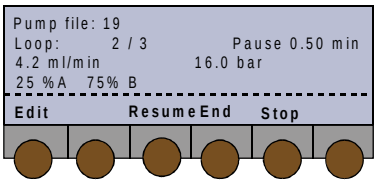
Before a run of after pressing **Stop** (no flow).



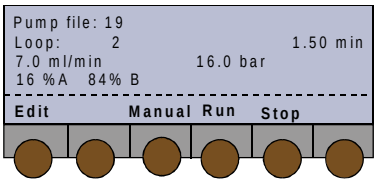
During a run (flow and composition changing).



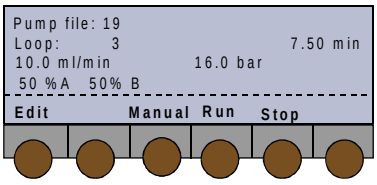
During a run, after pressing **Pause** (flow and composition constant at rates when program was paused).



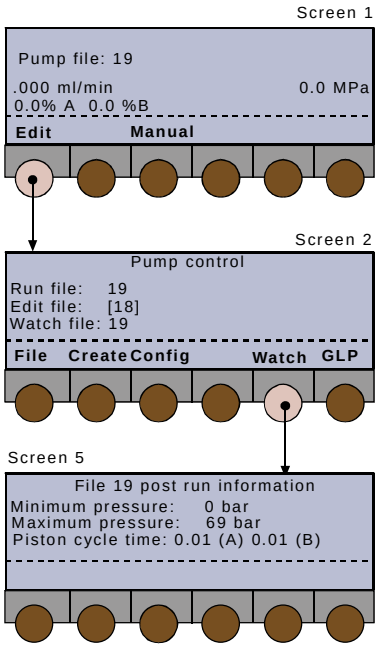
During a run, after pressing **End** (flow and composition constant at rates when program was ended).



After a run, before pressing **Stop** (flow and composition constant at rates when program ended).



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Post Run Information

At the 'Pump control' screen (*Screen 2*), press **Watch** to obtain the following post-run information:

- the minimum and the maximum pressures attained during the latest run of the file selected by the watch file number.
- the time taken per cycle for each piston (provided the flow and composition remained constant during the run). This may be useful information when analyzing baseline pulsations (for example).

In the case of linked files, the first one is selected automatically, but you can select another one.

For a complete log of events you should use the Audit trail function. Audit trail records the unprogrammed events that take place during a run when you execute one or more Method Program files. Audit trails are recoverable by PC based software.

Information Transfer

Gilson software is supplied with each 321 Pump to transfer information between a 321 Pump and a computer. This diskette-based Pump Data Transfer (PDT) software is for use on a Personal Computer (PC) or similar.

Data transferred from the pump may be printed out from the PC or saved as files. In addition previously saved Configuration and Method Files may be transferred from a PC to a pump.

Connections

1) **Using a Gilson 605 Adapter**

For simpler systems, or where control is normally from the 321 Pump's keyboard, a 605 Adapter is normally sufficient. Your computer must have at least one serial communications socket.

When connecting a Model 605 to an IBM PC (or equivalent) having a 9-pin RS-232 output, a 9-pin D (female) to 25 pin D (male) converter is required.

i) Connect the 9-pin (female) end of the converter to the 9-pin (male) RS 232 socket on the PC.

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ii) Connect the 25-pin (female) end of the Model 605 to the 25-pin (male) connector on the converter.

iii) Connect the 9-pin (female) connector of the Model 605 to the 9-pin (male) GSIOC socket on the right-hand 9-pin (male) GSIOC socket (From Controller) on the Master 321 Pump.

iv) When connecting to a two-pump system, a GSIOC Cable is also required from the 'To Slave' socket on the Master 321 Pump to the 'From Controller' socket on the slave pump.

2) **Using a Gilson 506C Interface**

For more complex systems, you need:
- a Model 506C Interface,
- a 9-pin D (female) to 25-pin D (male) converter,
- a 25-pin male-female connection cable.

i) Connect the 9-pin (female) end of the converter to a 9-pin (male) RS 232 socket on the IBM PC.

ii) Connect the female connector of the 25-pin cable to the 25-pin (male) connector on the converter.

iii) Connect the male connector of the 25-pin cable to the RS-232 socket of the 506C Interface.

iv) Connect a GSIOC cable from the GSIOC socket of the 506C Interface to the 32X Pump.

Installation

1) The PDT Software runs under Windows 95, 98 or Windows NT 4.0.
2) Place the diskette supplied by Gilson, in drive A.
3) Run the Setup.exe file.
4) Follow the instructions given on the screen.

Functionality

Four data types can be transferred from the pump: Audit Trail, Method, Configuration, and Counters. After transfer, data can be printed or stored as files on the computer. All files stored on the computer can be recovered and printed. Two types can be transferred back to the pump: Method and Configuration. The table shows the functions that are possible for each data type.

You can add comments or supplementary information to each file saved.

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Transferable Data Types

	Import	Export	Open	Close	Save	Print
Audit	x		x	x	x	x
Method	x	x	x	x	x	x
Config	x	x	x	x	x	x
Counters	x		x	x	x	x

Drop down menus allow you to access the following data types:

Audit Trail
Displays the Audit Trail File including the following tabulated headings: Config, Method and Log. Config contains the information detailed below (Main, etc.).

Method
Displays graphical and numeric data of the transferred or opened method.

Config
Displays parameters and data for the transferred or opened configuration. The information is grouped under the following tabulated headings: Main, Safety, Others, I/O, Solvent A, Solvent B, etc.

Counters
Displays the counters for the transferred or opened data set.

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Control of a Model 15X Detector

The following is a summary of information relating to Gilson Model 15X Detectors. For complete information, refer to the relevant detector user's guide.

Introduction

Any one of the following Models can be controlled from a 321 Pump:

- Model 151 Single Wavelength Detector (with Control Panel),
- Model 152 Single Wavelength Detector (no Control Panel),
- Model 155 Dual Wavelength Detector (with Control Panel),
- Model 156 Dual Wavelength Detector (no Control Panel).

Procedure

1) Make sure the Detector ID is set to 16 (top switch) and that the Baud rate is set to External (bottom switch, at position = 0).
2) Connect a GSIOC cable from the 'To Slave' socket on your 321 Pump to the appropriate socket on the detector.
3) Switch on both the pump and the detector, at their rear panels.
4) Switch on the pump and the detector lamp, at their front panels (Power and Lamp On).
5) Wait (~ 1 minute) while the detector completes its validation process; the top line of the pump's screen shows the status, and after validation of the output from the active channel(s).
6) Press the **Detect** soft-key on the pump.

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Software Functions

After pressing the **Detect** soft-key on the pump a series of screens showing the pump parameters are available. In addition you have access to the same soft-key functions that are normally accessible from the control panels of the Model 151 and Model 155 detectors.

The soft-keys are:

Next to access the following screen,

Previous to access the previous screen,

Mode to access mode and other soft-keys,

Event to output an event marker,

Zero to zero the baseline.

The following parameters can be viewed:

- sensitivity for each channel,
- peak width,
- ratio multiplier (dual wavelength mode)
- ratio threshold (dual wavelength mode)

After pressing **Mode** the following soft-keys become available:

Single to select single-wavelength mode,

Dual to select dual-wavelength mode,

Scan to store a reference scan, (or to compare with previous reference),

File to access the file functions,

Setup to configure the detector,

Status to view (and reset) lamp usage, etc.

For more information, refer to the 151 or 155 Detector User's guide.

For all 15X detectors, the remote indicator lights-up after pressing the 'Detect' key on the pump's control panel plus pressing a detector command (e.g. Zero); after which, for the 151 and 155 Detectors, selections made from the pump's control panel are shown on its screen and are mimicked on the detector's screen. Under remote control, the 151 and 155 keyboards no longer function.

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UniPoint Commands for 321 and 322 Pump Maintenance

This information is for users Gilson's UniPoint software (from System Version 1.90) who want to control or communicate with 321 or 322 Pumps. Additional information can be found in the 'Dismount Procedure' and Chapter 5, and in the Addendum to the UniPoint User's Guide for System Version 1.90.

Dismounting and Remounting a Pump Head

To **dismount** pump heads from UniPoint, use the following sequence:

Manual / Generic / Custom / 321 or 322 / **aD** / Buffered.

To **mount**, replace **aD** by **aN** in the above sequence.

Maintenance Counters

To read, modify or reset the maintenance counters,

1) Use the GSIOC Utility Software (installed with UniPoint) including the following dialog boxes: Identification Number, Command (Immediate or Buffered), and Response.
2) Enter GSIOC commands and parameters corresponding to the desired information, in the appropriate dialog boxes. A full list of GSIOC commands is given in the Chapter 7.

Example 1: read the counters for the piston-seal of the right pump head.

Unit ID: 1	Defines pump identified as GSIOC number 1.
Command: C0,0	Buffered; defines index as right-head piston-seal counter.
Command: C	Immediate; reads maintenance counter.
Response: 0,0 = 3,0,2500	Meaning: 3 h of work, less than 5000-cycles*, limit at 2500 h.

* Because the figures are rounded, the pump software generates 0 for 0-5000 cycles and 1 for 5001-15000 cycles.

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Example 2: change the limit of the above counters.

Command: C0,0 = 3000	Buffered; sets right-head piston-seal with limit at 3000 h.

Example 3: reset the above counters.

Command: C0,0 = R	Buffered; resets counters for piston-seal or right-head.

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Maintenance and Troubleshooting 5

For 32X Pumps, user maintenance is generally limited to the following:

1) cleaning check valves and filters (clean outlet filter after changing piston seal),
2) replacing parts subject to wear and tear in each pump head: piston seal, check valves, and piston assembly.

General guidelines for the periodic replacement of the 'wear parts' are indicated below, according to the amount of use: intensive, regular, or occasional. This schedule should be regarded as a guide; changes in performance, or visible leaks, give an indication that a part should be changed.

Typical Replacement Schedule for Wear Parts

Component	Intensive (168 h/week)	Regular (40 h/week)	Occasional (10 h/week)
Piston seals	4.5 months (3000 h)	1-1.5 years (2500 h)	2 years (1000 h)
Check valves	7 months (4500 h)	1.5 years (3000 h)	3 years (1500 h)
Piston assembly	9 months (6000 h)	2-3 years (5000 h)	4 years (2000 h)

The figures are based on the assumption that the pump is working at half its maximum flow rate and pressure.

The nature of the liquid pumped is a major factor affecting longevity of the piston seal:

- standard UHMWPE seals (translucent for H1, yellow for H2) are best suited for water, aqueous solutions, alcohols, acetonitrile, and (in general) polar solvents,
- black PTFE piston seals, offered as additional accessories, are best suited for tetrahydrofuran, hexane, methylene chloride, carbon dioxide, and (in general) low-polarity solvents.

You can check and reset your pump's Maintenance Logs (press **Edit**, **GLP**, **Maint** ...). If your type of use is intensive with relatively constant solvents and operating conditions, then set the limiting values (numbers of hours) to reflect your experience as well as GLP requirements.

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Pump Head Maintenance

Before a head can be physically removed from a 321 or a 322 Pump, you must disengage the pump-head from the pump-motor, by using the software dismount procedure. Normally, this procedure is accessed from the control panel of the controlling 321 Pump. There is an alternative manual procedure in case of loss of power, or for a 322 Pump not controlled by a 321 Pump or by UniPoint software (see below).



Normal Dismounting Procedure

1) Switch on the pump(s).
2) Dismount the pump heads using the procedure described in Chapter 4 “GLP Functions”.
3) Refit the head(s) and reconnect the solvent lines to the pump heads.
4) Prime the hydraulics.

Alternative Dismounting Procedure

1) Open the purge valve.
2) Switch off the 32X Pump and disconnect it from the mains.
3) Insert the supplied 3-mm Allen wrench (9-cm long) through the access holes on the back-panel, so that it engages the mounting screw. You should be able to freely turn the mounting screw in either direction.
4) Insert the 3-mm Allen wrench to turn the mounting screw in the clockwise direction, until you reach a stop (you will hear a ‘thump’ as you hit the stop). At this point, the piston engaging mechanism will be withdrawn to a maximum distance into the interior of the pump motor. Then turn the wrench two turns counterclockwise.
5) Disconnect all solvent lines from the pump head(s) in question.
6) Progressively remove each of the two screws securing the pump head to the pump motor, using the supplied 5-mm Allen wrench. Support the pump head with your other hand, after loosening the two screws (moderate force is required).

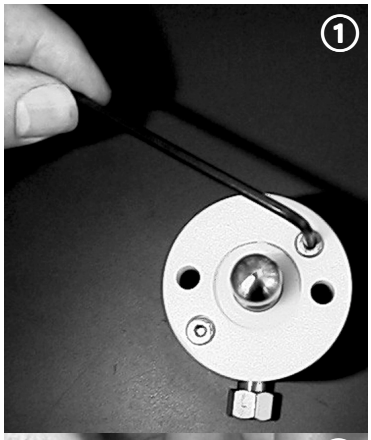
When remounting the pump head you can leave the mechanism at the fully withdrawn position - in fact, if you turn the retaining screw fully counterclockwise, you reach another stop, and risk unscrewing the mechanism (at the fully out position), if excessive force is used.

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Disassembling a Pump Head

The following steps should be carried out on a clean, dry surface. No special tools are required.

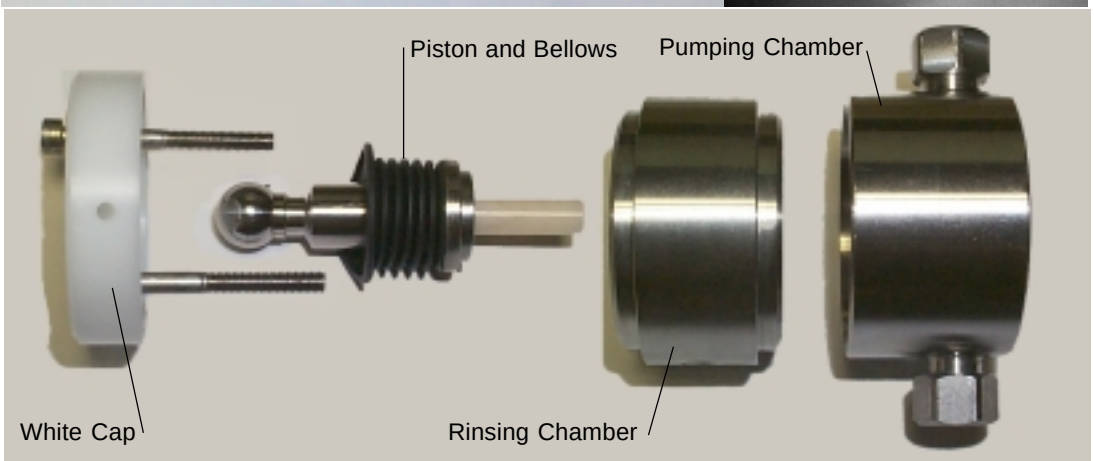
1) Undo the two retaining screws using a 3 mm Allen wrench, as supplied.
2) Remove the white cap and retaining screws.
3) Pull the piston and bellows out of the body of the pump head.
4) Pull apart the two halves of the pump head (with a slight twisting motion).
5) Inspect the bellows for damage; if this component needs to be replaced, use your thumbs to push it firmly away from the retaining collar.





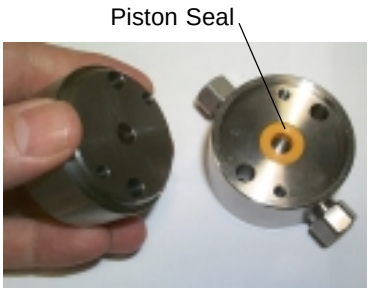






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Replacing a Piston Seal

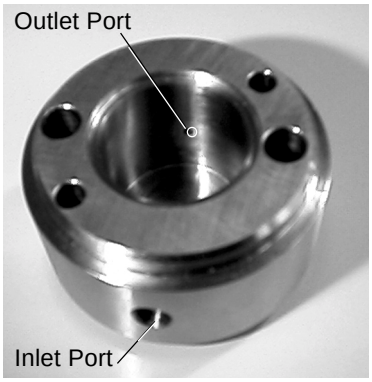




The following steps should be carried out on a clean, dry surface. No special tools are required.

1) Pull apart the two halves of the pump head (with a slight twisting motion).
2) Remove the piston seal either by:
   a) carefully levering out the seal using the end of the Allen wrench, in which case the seal must be discarded, or ...
   b) blocking the outlet and using an air line, inserted into the center of the seal, to blow the seal out of the recess in the pump head.
3) Clean out any debris from the old seal remaining in the recess using a soft cloth or an air line.
4) Push a new seal carefully into the recess. Only use the type of seal specified in Chapter 6.
5) Initialize and run in the new seal(s).

Piston Rinsing Chamber



When a pump is delivered, the inlet and outlet ports to the rinsing chamber are fitted with plugs, which prevent airborne particles from entering the ports. If you do not need to use piston rinsing, you should leave these plugs in place.

If you pump a liquid containing more than 0.1 M of solute, being solid in normal ambient conditions, you must rinse the piston(s) when pumping, using the same liquid, but without the solute.

To facilitate the required connections (refer to Chapter 3) for the rinsing liquid(s) two plumbing kit are available:
- one for the right-hand head (supplied as standard),
- the other for the left-hand head (offered as an additional accessory).

You should change the rinsing liquid at least once a week.

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Piston and Bellows

To inspect and if necessary replace the bellows, follow the steps shown in the figure (a, b, c).

Use your thumbs to remove the bellows; moderate force is required. When removing the bellows, support the piston by the head, not by the shaft.

a) H1 Piston Assembly



b) Removing the Bellows



c) Individual Components (Piston & Bellows)



d) Inserting the Tool



e) Opening the Orifice



Mounting The Bellows

1) Insert the tool (ref: E66231), which ensures that the orifice at the end of the bellows remains open, into the open end of the bellows (d).
2) Place the tool on a firm, flat, surface.
3) Push down on the metallic ring using four digits (e), until the orifice grips the end of the tool on its own.

Refitting The Bellows

1) The tool, which keeps the end of the bellows open, enables the bellows to be slid back into position (f).
2) Pull on the metallic ring at the end of the bellows until it can go no further (g).
3) Remove the tool and check that end of the bellows (with the metallic ring) is correctly seated against the piston collar (h).

Pull on the metallic ring to refit the bellows; moderate force is required. When refitting the bellows, support the piston by the head, not by the shaft.

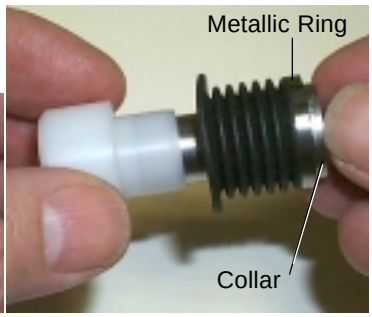
f) Refitting - Step 1



g) Refitting - Step 2



h) Refitting - Step 3



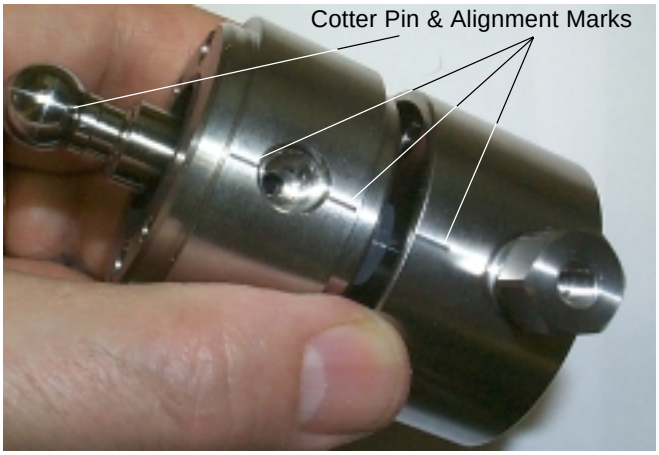
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Reassembling a Pump Head

1) Push together the two halves (rinsing and pumping chambers) of the pump head (with a slight twisting motion).
2) Turn the rinsing chamber relative to the pumping chamber, until holes for the pump head retaining screws are aligned (because of the asymmetry of the holes there is only one correct position).
3) Check that the marks on the rinsing and pumping chambers are aligned (a).
4) Refit the bellows (new if necessary) to a clean piston and insert the assembly fully into the rinsing chamber (b).
5) Turn the piston until the small cotter-pin at the rounded end of the piston is in line (approximately) with the alignment marks on the pump head.
6) Refit the white cap (c), reinsert the screws, and progressively tighten them (d), making sure that the alignment marks are still correctly aligned (do not overtighten the screws).

Do not turn the piston after the head is reassembled, because it is possible to damage the bellows.

a) Correct Alignment of Chambers and Pistons



b) Correctly Seated Piston Assembly



c) Refitting the White Cap



d) Tightening the Screws



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Check Valves

The two check valves, inlet and outlet, should be cleaned periodically, to ensure reliable flow rates. If they become partially blocked the flow rate will drop, in which case they must be cleaned or replaced.

For 32X Pumps, Gilson check valves are supplied in the form of cartridges: one for the inlet connector and one for the outlet connector.

Because the dimensions of the threaded parts of the connectors are different, they cannot be interchanged. This also applies to the check-valve cartridges, which have different forms.

Cleaning a Check Valve

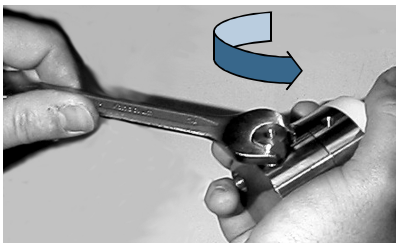
This procedure is carried out with the check valves in situ:

1) Open the purge valve to the drain position.
2) Pump isopropanol (provided the current solvent and isopropanol are miscible).
3) When the pump head is full of isopropanol, stop the flow for at least 15 minutes, to dissolve any sticky deposits.
4) Reconnect the current solvent and pump to the drain to clear the isopropanol.
5) Check that the flow rate has returned to normal, if not remove the check valve.
6) Clean the check valve by blowing compressed air though it, or replace it with a new one.

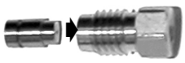
Replacing a Check Valve

You can, if necessary, replace a check valve without dismounting the head. However, in this case you must first turn off the pump and disconnect the hydraulic tubing(s) from the connector(s).

1) Loosen the connector using the supplied 14 mm wrench.
2) Fully unscrew the connector from the pump head, by hand.
3) Remove the check valve from the connector.
4) Make sure that the connector and pump-head housing are clean.
5) Slide a new check valve, with the orientation shown in the figure, into the connector.
6) Screw the connector into the pump-head housing.



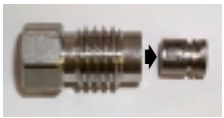
Inlet Check Valve (H1)



Outlet Check Valve (H1 & H2)



Inlet Check Valve (H2)



Arrow on the H2 inlet cartridge must point in direction of solvent flow.

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7) Carefully tighten the connector using a torque wrench set to 7 Nm. Or, turn the connector using the 14-mm wrench until there is contact, then tighten the connector by turning it a further 30° in the clockwise direction. If leakage is observed, tighten the connector progressively until the leakage stops.

8) Run the pump and perform the leak test (Chapter 4).

Filters

Inlet Filters



To protect the check valves, an inlet filter must be used with all solvents. Inlet filters must be in good condition for the pump to operate efficiently.

Change the inlet filter if you suspect that it has become plugged.

Outlet Filter

The outlet filter protects the injection valve and the column. A plugged outlet filter may cause pressure build-up and leaks.

You should routinely check and clean the interior of the outlet filter, and when necessary replace the filter cartridge.

For the outlet filter of 32X pumps, the normal pressure drop is 1 MPa maximum with 30 ml/min of methanol.

When the pump is new, and also when a piston seal is changed, progressive pressure build-up normally appears during the first hundreds of hours of operation, because run-in particles are produced by new piston seals and deposited on the internal filter.



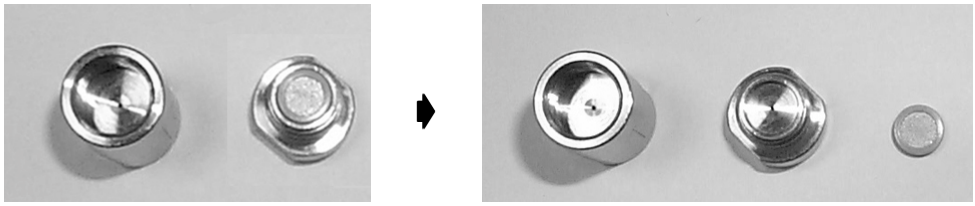
Therefore, after 100 or 200 h operation, you should clean, then reinstall, the outlet filter. This filter can be cleaned several times before having to be changed.

1) Remove the filter from the pump.

2) Separate the two halves of the filter casing using two 11 mm wrenches.

3) Gently tap the top half to remove the filter cartridge (or use an air line).

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4) Rinse the interior of both halves of the casing using a suitable solvent, using an air line to complete the cleaning process.

5) Clean the upstream face of the filter cartridge, using a jet of solvent, or fit a new filter cartridge.

6) Reinstall the filter cartridge, then reassemble the filter casing, using moderate force.

7) Refit the filter to the pump and re-prime the system, checking for leaks.

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Troubleshooting

When troubleshooting, try to check each part of the system independently; try one solution at a time and proceed in a systematic way.

If for example, the delivered flow rate is not correct, check each pump head independently. Check the solvent bottles, the connections between the bottles and pump heads, inlet filters, outlet filters, and so on. Systematically check each component in the circuit, even if it's new.

Refer to the following tables for diagnostic information relating respectively to electrical and to hydraulic problems.

Error situations are signalled by a 321 Pump by means of an error message appearing on the screen and the error LED on the front panel lighting up. On the 322 Pump the error LED is replaced by 'remote'; this LED simply indicates when the slave is being controlled from the master.

Error LED (321 Pump)

The error LED could light-up (steady red) for any of the following reasons:

1) A pump motor has ceased to function or has been asked to function in a way that is not possible.
2) Communication has failed with a slave pump.
3) Pressure limits have been exceeded (high - file #21 or low - file #22). Any attempt to run a file that does not exist will activate the error LED.
4) Restart after a power failure has attempted to start file #23. However, the file does not exist; the software stopped the pump and activated the error LED.
5) Input #2 was closed, attempting to start file #23. However, the file does not exist; the software stopped the pump and activated the error LED.
6) A maintenance counter limit has been reached (see Chapter 4).
7) The audit trail is saturated.
8) Invalid setting.

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Error Messages (321 Pump)

Many types of messages are displayed on the screen, for example 'errors' during the entry of Method Program or configuration parameters. For this type of error the software displays messages that explain the required corrective action. However, there are some critical error situations that can occur during or after a run.

Message	Corrective Action
"Pressure lower than 'X' "	Check for leaks, check configuration parameters, check and possibly rerun Method Program file.
"Pressure higher than 'Y' "	Check hydraulics, check configuration parameters, check and possibly rerun Method Program file.
"Input 2 was activated"	Check hydraulics, check configuration parameters, check and possibly rerun Method Program file.
"Power restored after failure"	The latest run could be invalid. Check the system before a possible rerun of this file.
"Channel 'Z' failing"	Failure may be caused by a blockage (tubing, check valve, etc.). Check the hydraulics, especially Channel 'Z', check configuration parameters, check and possibly rerun Method Program file.
"Communication fails with 'N ' "	Check that pump 'N' is switched on. Check GSIOC ID and connections.
"File does not exist"	Check that you are trying to run a valid file. Check that any linked files are valid.
"Maintenance limit is passed for 'M' "	Service item 'M' and reset the counter (see Chapter 4, **Config**, **GLP**).
"Audit trail is saturated"	Archive the audit trail (PC), then reset the audit trail.
"Validation process has restored default parameter(s)"	Check all Method Program and configuration parameters.
"RAM error contact your Gilson representative"	Contact your distributor.

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Electrical & Program Problems

Problem	Possible Causes	Solutions
Pump does not operate - no POWER indicator LED.	No power or fuse blown.	Check fuses, plug-in power cord, switch on at rear.
Pump does not operate - no ON indicator LED.	Pump is not operational.	Press the ON/OFF key on the indicator panel.
Pump does not stop at the end of a run.	Not programmed.	Program a flow rate of zero and a composition of zero at the desired end time for all solvents.
Error LED lights up.	Various.	See text.
Slave pump does not operate.	No GSIOC communication.	Check GSIOC cable(s) are connected correctly between pumps and that GSIOC ID #s are correctly set.
Pump ‘X’ is missing message appears on the screen.	No GSIOC communication or the Slave Pump (‘X’) is not switched on.	Switch on the Slave Pump, check GSIOC connectors, the baud rate and ID of the slave.

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Hydraulic Problems

Problem	Possible Causes	Solutions
Air bubbles in both the inlet and the outlet tubings.	Inlet tubing is loose. Nut and/or ferrule damaged.	Tighten the connectors. Replace the nut and/or ferrule
	Inlet filter is plugged.	Clean or replace the inlet filter(s).
	Refill time is too short.	Increase the refill time (see Chapter 4, **Config**, **Hyd**).
Air bubbles in the outlet tubing, only.	Loose connection of outlet.	Tighten connectors.
Leaks from a pump head.	Defective piston seal.	Replace the defective seal.
Abnormally low flow rate.	Leaks.	Check the hydraulic circuit for leaks.
	Air entering upstream from the head.	Check the upstream connections.
	Plugged inlet filter.	Replace inlet filter.
	Defective check valve.	Replace check valve.
	Incorrectly mounted pump head.	Remount the pump head.
Abnormally high pressure.	Plugged outlet filter.	Clean or replace outlet filter.
	Column particle size too small or plugged column.	Replace check valve. Change or flush column.
	Mobile-phase viscosity too high.	Use lower viscosity solvents or increase temperature.
Baseline noise , periodic pulses (see Chapter 4, piston cycle time).	Mixer volume too small.	Increase mixer volume.
	Air in the hydraulics.	Prime the pump, degas the solvent.
	Faulty pressure module	Contact your Gilson representative.

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Reference Information 6

This Chapter contains Technical Data, Lists of Parts and after Reference Information.

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Technical Data

The following information presents construction and operational characteristics for Gilson 321 and 322 Pumps. The operational characteristics include:

- Performance data, quantifying separately the accuracy (bias [1]) and the associated repeatability (Standard Deviation, SD) for pressure, flow rate, two-solvent composition [2], and repeated sample injection from an extra pump. These performance data were estimated for common solvents (water, methanol, acetonitrile, tetrahydrofuran, isopropanol, hexane, and dichloromethane), 20-23 °C (988-1038 hPa, 45-75 % humidity), over the whole nominal range for flow rate and pressure, using the recommended values for adjustment parameters (inlet pressure, compressibility correction), and excluding the uncertainty in measurement attributable to the measuring procedure.
- Limits of acceptance for the results specified in the individual Quality Control Report supplied with each pump and in the Operational Qualification Procedure (to be implemented by qualified personnel).

[1] The bias of a measuring instrument is the systematic error of the indication of a measuring instrument. The bias is normally estimated by averaging the error of indication over an appropriate number of repeated measurements (source: Characteristics of Measuring Instruments, in *International Vocabulary of Basic and General Terms in Metrology*, 2nd Edition, ISO, 1993, Section 5).

[2] Gilson Operational Qualification procedure for 321 and 322 Pumps, based on P. A. Hartman, *Proposed Standard Practice for the Evaluation of Gradient HPLC Pumps*, ASTM E-19.09.07, May 1990.

Gilson 321 and 322 (32X) Pumps

Type of Pump

Multi-solvent, high-pressure mixing, reciprocating piston pumps, with interchangeable heads (H1 and H2).

Gilson 321-H1: master pump (with control panel), 15 ml/min, and 60 MPa.

Gilson 322-H1: remote controlled pump (without control panel), 15 ml/min, and 60 MPa.

Gilson 321-H2: master pump (with control panel), 30 ml/min, and 30 MPa.

Gilson 322-H2: remote controlled pump (without control panel), 30 ml/min, and 30 MPa.

Use of Pumps

Delivery of two solvents (up to four using extra pumps, and five using an additional valve block) under high pressure, with variable-volume, dynamic

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high-pressure blending, flow rate, composition and event programming, for analytical and small-scale preparative chromatography using columns from 2 to 20 mm bore (2-12 mm for H1, 3-20 mm for H2).

Working Range and Performance Data

Solvents

Nature: common solvents, buffers and any liquids chemically compatible with the flow-path materials (see below).

Viscosity: 0.3-20 mPa.s (cP).

Temperature: 2-40 °C.

Compressibility: up to 2000 $Mbar^{-1}$.

Solute concentration: typically up to 1 M of solutes being solid in ambient conditions (piston rinsing chamber is a standard feature).

pH: 1-13 (if less than 0.1 M chloride ions).

Flow-path Materials

Metals: stainless steel (AISI 316L), and titanium (ASTM grade 2).

Thermoplastics: FEP, PTFE, PCTFE, ETFE, PEEK and UHMWPE.

Refractories: sapphire, ruby and ceramics.

Pressure

Nominal range: from 0.5 MPa (5 bar, 70 psi) up to 60 MPa (600 bar, 8700 psi) for H1, up to 30 MPa for H2.

Selectable units: MPa, bar and psi (default: MPa), three significant digits.

Readout increment: 0.1 MPa (1 bar, 10 psi).

Digital output acquisition period: 500-1000 ms (pin 9).

Analog output: 142-1000 mV for 0-60 MPa (pin 10).

Safety limits: low and high, both adjustable from 0 to 60 MPa for H1, and to 30 MPa for H2 (default: 0 and 60 MPa respectively for H1, and 30 MPa for H2).

Accuracy (bias): < ± 2 % or 0.1 MPa whichever is greater.

Repeatability (SD): < 1 % or 0.1 MPa whichever is greater.

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Residual pulsation amplitude: < 1 % or 0.1 MPa whichever is greater, above 2 MPa at 1 ml / min, and above 15 MPa at 10 ml / min; < 5 % above 10 MPa at 30 ml / min.

Flow Rate

Selectable units: µl / min and ml / min (default: ml / min), three significant digits.

Adjustment increment: 1 µl / min.

Minimum adjustable value: 2 µl / min for H1, 5 µl / min for H2.

Single Solvent

Nominal range: 0.015-15 ml / min for H1, 0.03 ml / min for H2.

Accuracy (bias): < ± 1 % or 0.4 µl / min for H1 and 0.8 µl / min for H2 whichever is greater.

Repeatability (SD): < 0.5 % or 0.2 µl / min for H1 and 0.4 µl / min for H2whichever is greater.

< 0.2 % specified for H1 and H2 at from 1 to 5 ml / min (after a run of more than 30 minutes with a new piston seal).

Two Solvents Mixed Under Pressure

Nominal range: 0.15-15 ml / min for H1, 0.30-30 ml / min for H2.

Accuracy (bias): < ± 2 % or 4 µl / min for H1 and 8 µl / min for H2 whichever is greater.

Repeatability (SD): < 0.7 % or 2 µl / min for H1 and 4 µl / min for H2 whichever is greater.

Composition and Mixing

Number of solvents: two (A and B), one of them (B) selectable out of four (B1-B4) using a solvent valve block supplied as an additional accessory. Up to four solvents available using additional pumps.

Composition increment: 0.1 %.

Dwell volume (total system volume from mixing point to filter outlet [2]): 260-2260 µl / min, pressure-independent (60 µl excluding mixer volume).

Effective mixing vol. (indicative of the mixer volume [2]): 220 µl at 1 ml / min.

Composition time constant: < 0.5 minutes to reach the injection valve with 63 % of the nominal composition value, for 1 ml / min and higher, with 0.2 ml mixer volume adjustment.

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Gradient linearity range [2]: 1-98 %B for 1 ml / min and higher, with 0.2 ml mixer volume adjustment.

Accuracy (bias): < ± 0.7 %B from 10 % composition steps, for 1 ml / min and higher.

Repeatability (SD): < 0.5 % from 2 % composition steps, for 1 ml / min and higher.

Residual UV-absorbance pulsation amplitude: < 0.1 mAU for binary mixtures of solvents with UV-absorbance contrast below 100 mAU, using appropriate mixer volume adjustment.

Sample Injection from Extra Pump

Requirement: extra Gilson 30X Pump (305 / 306 / 307 / 308 with any head), tee fitting and extra tubing at column inlet.

Volume range: from 2 x 10^{-3} to 10^{2} multiplied by head size in ml (10 µl to 20 liters).

Flow-rate: from 2 x 10^{-3} to 1 multiplied by head size in ml / min (10 µl / min to 200 ml / min).

Minimum adjustments: 10^{-4} multiplied by head size for volume (ml) and flow rate (ml / min).

Time: from 0.01 to 9999 min.

Injection volume accuracy (bias): < ± 1 % or 5 x 10^{-5} multiplied by head size in ml, whichever is greater, for the whole volume range.

Injection volume repeatability (SD): < 0.5 % or 2 x 10^{-5} multiplied by head size in ml, whichever is greater, for the whole volume range.

Control Characteristics

Control from a 333 Pump

Control Panel

Keypad: 25 functional keys including six soft-keys.

Display: eight lines of 40 characters each, adjustable contrast (10-position), turning off after 0-999 min (default: 10 min).

Keystroke beeper: on or off (default: on).

Alarm beeper: on or off (default: on).

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Controlled Gilson Instruments

Gilson 321 (GSIOC master) can control a Gilson detector and two other Gilson pumps:

- For UV-vis absorbance detection: a single-wavelength model 151 / 152, or a dual-wavelength model 155 / 156.
- For repeated sample injection into preparative systems: a 30X Pump (305 / 306 / 307 / 308 with any head).
- For up to four solvents: two 30X or one 32X (321 / 322).
- For up to four solvents and repeated sample injection: one 32X plus one 30X.

Coordination with any other instrument: carried out by electrical contacts.

Electrical Contacts

Maximum accepted voltage for each input and output contact (48 V).

Inputs (TTL type): wait for injection (configurable and programmable), emergency signal, run / end, and pause / resume.

Outputs: four configurable and programmable outputs (relay type, 30 V, 2 A); one DC power supply (12 V, 0.5 A, to be associated with a programmable output); one digital output converted into analog signal (1 V, pin 9) and configurable for pressure, flow rate or composition; one analog output (142-1000 mV, pin 10) for pressure.

Manual Control

Operations: prime, flow rate, and electrical output contacts.

Prime: carried out at 13.8 ml / min for H1, 27.7 ml / min for H2 (using 125 ms refill time) successive or simultaneous for each channel.

Operating Programs

Application methods: mobile phase flow rate and composition (constant or multi-segment linear gradient), sample injection, coordination with other instruments, safety, maintenance, and mixing test (see below); 20 files of 30 steps, with indication of solvent consumption.

Mixing test: pre-stored binary gradient profile, according to the ASTM method E-19.09.07 [2], for the evaluation of the range of composition linearity, and of the composition accuracy and repeatability, using 20 % steps and selectable flow rate.

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Safety methods: four files of 30 steps (pressure limits, emergency and power failure); anomaly processing procedures with related outcomes including red light indicator, beeper alarm, pumping stop, end of program, display of specific message defining the anomaly, and edition of this message in an audit trail that can be printed out from a PC (data transfer software supplied, 605 or 506 C interface required).

Watchdog function: post-run information displaying minimum and maximum pressures, plus piston cycle times for isocratic work.

GLP functions: audit trail of unexpected events, anomalies, conditional operations, loops and links; maintenance logs for all wear parts (use and limits, hours and number of cycles); automatic procedures for piston seal installation, leak test and mixing test.

Data transfer: a PC software supplied on diskette permits to view and print with headlines all method files (application, safety and mixing test), plus configuration and audit trail (605 interface required).

Time range: from 0.01 to 9999 min (0.6 s to 166 h) by steps of 0.01 to 1 min according to the range used.

Loops: 1-999 (default: 1).

Link: one for each file (default: none).

Adjustment Parameters

Ramping time for manual flow control: 0-9999 min (default: 0 min).

Head size: H1 or H2 (factory set according to the ordered configuration).

Refill time (R): 125-1000 ms (default: 125 ms).

Compressibility correction (K_0): 0-2000 $Mbar^{-1}$ (default: 34 $Mbar^{-1}$ for water).

Inlet pressure (P_0): 0-50 MPa (default: 0 MPa).

Stirrer actuation: automated or off (default: automated).

Initialize piston before injection from pump: yes or no (default: no).

After power failure: continue, stop, or start a specific file (default: continue).

Pause input contact: with or without flow (default: without flow).

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Wait for injection input contact: close or open (no default, compulsory answer depending on associated injector).

Output contact state: close, open or pulse (no default, compulsory answer depending on associated instrument).

Pulse output contact: 0.01-1 min (default: 0.03 min).

Analog output profile (pin 9): pressure, %B, %C, %D, or flow rate (default: pressure).

Delay volume (associated with analog output for composition profile): 0-90 ml (default: 0).

GSIOC unit identification: 0-63 for 321 Pump (default: 1), 0-9 for 322 Pump (default: 1).

GSIOC bit rate, 321 Pump: external, 19200, 9600, 4800, 2400 or 1200 bauds (default: external).

GSIOC bit rate, 322 Pump: external, 19200 or 9600 bauds (default: external).

Parameters for Associated 30X Injection Pump

Head size: 5, 10, 25, 50, 100 or 200 (default: 5 for injection pump, 10 for solvent pump).

Refill time, compressibility correction, and inlet pressure: as above.

Maintenance Counters

Time: up to 9999 h for wear parts (piston seal, check valves, and piston assembly).

Cycles: up to 10^8 for wear parts.

Computer Control of 321 and 322 Pumps

From Gilson UniPoint system software: using Gilson 506C interface and GSIOC slave bus.

From other system software: using Gilson 506C or 605 interface, GSIOC slave bus.

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Hydraulic Components

Standard Components

Low-pressure Plumbing

Filter: 316 steel, 20 µm, for 3.2 mm (1/8") tubing.

Tubing: FEP, 2 x 3 mm (1/8").

Nut: POM, white, 1/4"-28 TPI, for 3.2 mm (1/8") tubing.

Ferrule: ETFE, natural, for 3.2 mm (1/8") tubing.

Piston Pump Heads

Identification: Gilson 866026 plus serial number for H1, Gilson 866027 plus serial number for H2.

Flow-path materials: 316 steel (body), Sapphire (H1 piston) ceramic (H2 piston), UHMWPE or PTFE (piston seal), ruby (check-valve ball), sapphire (check-valve seat), and titanium (body).

Maximum pressure: 60 MPa for H1, 30 MPa for H2.

Mean flow rate during head refill time (125 ms): 62.1 ml/min for H1, 124 ml/min for H2.

Stroke volume: 108.6 µl for H1, 217.5 µl for H2.

Dead volume: 124.5 µl for H1, 222.0 µl for H2.

Piston rinsing chamber volumes: 2.54 ml total and 1.40 ml stroke for H1 (670 ml/min for 125 ms refill time), 2.34 ml total and 1.29 ml stroke for H2 (618 ml/min for 125 ms refill time).

Pressure Module

Identification: Gilson 866036 plus serial number.

Flow-path materials: titanium (cover), PCTFE (seal), and glass fiber reinforced PTFE (membrane).

Damping liquid: 88 ml of methanol (blue-colored with 2.4 % Fluka 27816 acid dye).
Internal volume: 3.4 ml (± 0.5 ml) at atmospheric pressure, 9.9 ml at 60 MPa (1.4 mm diameter external through-holes).

Maximum pressure: 60 MPa.

Variable-volume Dynamic Mixer

Identification: Gilson 866037 plus serial number.

Flow-path materials: 316 steel (chamber), PTFE (fixed seal) and EP (mobile seal).

Number of inlet ports: three (1.2 mm diameter through-holes).

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Mixing volume nominal range: 0.20-2.20 ml (excluding 0.02 ml total for the three inlet channels).

Mixing volume adjustment: manual at atmospheric pressure, continuous over the whole nominal range, four 0.05 ml horizontal graduations, ten 0.20 ml vertical graduations, 0.20 ml per revolution.

Mixing volume accuracy (bias): < ± 0.05 ml over the whole adjustment range.

Stirrer speed: 875 ± 10 rpm.

Maximum pressure: 60 MPa.

Purge Valve

Identification: Gilson 866064.

Flow-path materials: 316 steel (body), black PEEK (mobile rod), and PTFE (mobile seal).

Number of ports: three (1 mm diameter external through-holes).

Internal volume: 8 µl.

Maximum pressure: 60 MPa.

Outlet Filter Assembly

Identification: Gilson 410452 (Upchurch A315).

Flow-path materials: 316 steel (body and frit filter), PEEK (frit ring).

Internal volume: 16 µl (1.3 mm diameter through-holes).

Filter: 2 µm, 1.9 mm thickness, 4.8 mm diameter (Gilson 410453, Upchurch C402).

High-pressure Plumbing

Filter: 316 steel, 2 µm, 4.8 mm diameter, 1.9 mm thickness, 16 µl, for 1.6 mm (1/16") tubing.

Tubing upstream from the filter: 316 steel, 0.5 x 1.6 mm (1/16").

Tubing downstream from the filter: 0.25 x 1.6 mm (1/16") for flow rate lower than 10 ml/min, 0.5 x 1.6 mm (1/16") for flow rate from 10 to 30 ml/min.

Nut: 316 steel, 10-32 TPI, for 1.6 mm (1/16") tubing.

Ferrule: 316 steel, for 1.6 mm (1/16") tubing.

Total Pressurized Volume

< 95 ml (including 13 ml maximum for the pumped liquid).

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Additional Components

Solvent Selection Valve Block

Identification: For 321 Pumps Gilson E66038 (with holder, four tubings and filters), for 322 Pumps Gilson E66803 (external, four tubings and filters), plus serial number.

Flow-path materials: PTFE.

Number of ports: one outlet and four inlets to select one solvent out of four.

Internal volume: 53 µl total per channel (1.6 mm diameter through-holes).

On-line Vacuum Solvent Degasser

Identification: Gilson 864 Degasser (Gilson E66250, SAS 154-864G) plus serial number.

Flow-path materials: PTFE and PPS.

Number of channels: four.

Internal volume: 9.2 ml per channel.

Vacuum: 69-72 hPa.

Residual concentration of dissolved oxygen (oxygen-saturated water, 1 ml / min, 25°C):
< 0.4 ppm for a single channel,
< 0.2 ppm for two channels in series.

Power consumption: 32 W.

Size: 80 (width) x 150 (height) x 260 (depth) mm.
Weight: 3 kg.

Wear Parts

Outlet filter, piston seals, inlet check-valves, outlet check-valves, piston assemblies.

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Quality References

Individual Quality Control Report

Flow Rate Accuracy and Repeatability

Conditions
Automated gravimetry, water 20-23 °C (988-1038 hPa, 45-75 % humidity), 0.9968 g / ml, 5 ml / min, 10 ± 2 MPa, default values for all adjustment parameters. Six measurements of 1 minute each, after a less than 30-minute run with a new piston seal.

Limits of Acceptance
Accuracy (bias): < ± 1 %
Repeatability (SD): < 0.20 % (< 0.15 % after a more than 30-minute run with a new piston seal).

Composition Accuracy

Conditions
UV absorbance measurement, 254 nm, 500 mAUFS. Solvent A is water, Solvent B is water plus 0.3 % acetone, 3 ml / min, 10 ± 2 MPa, 0.40 ml mixer volume adjustment.
Six 5-minute steps at 100 %B, 80 %B, 60 %B, 40 %B, 20 %B, 0 %B, one measurement per step. Other conditions as above.

Limits of Acceptance
Deviation: < ± 0.7 %B for each step.

Operational Qualification Procedure

Leak Test

Duration approximately 15 minutes.

Conditions
Pressure: 45 MPa for H1, 22.5 MPa for H2.

Limits of Acceptance
Pressure decay: < 10 % in 5 minutes.

Composition Linearity, Flow Rate and Composition Accuracy and Repeatability

This test is for both composition and flow rate. Duration less than 2 hours, in total.

Conditions
Solvent A is methanol, Solvent B is methanol plus 0.3 % acetone, 2 ml / min, 5-10 MPa, 0.40 ml mixer volume adjustment. Three cycles of 27.5 min each including composition ramp and steps.

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UV absorbance measurement, 265 nm, 500 mAUFS. One measurement per step. Digital flowmeter, typically 1 µl / min resolution, 0.2-0.3 ml priming volume, ± A % accuracy bias, R % repeatability RSD. Six measurements.

Limits of Acceptance
Flow Rate accuracy (bias): < ± (A + 2) %
Flow Rate repeatability (RSD): < $(R^2 + 0.7^2)^{0.5}$
Composition Linearity Range: 2-97 %B.
Composition Accuracy: < 1 %
Composition Repeatability: < 1 %.

Flow Rate Accuracy and Repeatability

This is a simple quick test that can be performed for each head, for example, after repairing.

General Conditions

Water or methanol, 1 ml / min and / or 10 ml / min (according to type of work), approximately 10 MPa, default values for all adjustment parameters. Three measurements using one of the following procedures, which cannot be implemented simultaneously and have specific limits of acceptance.

General Limits of Acceptance
Accuracy (bias): < ± 1 %
Repeatability (SD): < 0.3 %.

Procedure 1

Duration for two heads and one flow rate, approximately 10 minutes.

Digital flowmeter, typically 1 µl / min resolution, 0.2-0.3 ml priming volume,

± A % accuracy bias, R % repeatability (RSD).

1 ml / min or 10 ml / min: accuracy (bias) < ± (A + 2) %, repeatability (RSD) < $(R^2 + 0.7^2)^{0.5}$.

Procedure 2

Duration for two heads and one flow rate, approximately 1.5 hours.

Manual volumetry, class A volumetric flasks, 20-23 °C:
1 ml / min, 10 ± 0.025 ml flask: 10 min ± 8.5 s (± 1.42 %), < 0.5 % SD.
10 ml / min, 100 ± 0.1 ml flask: 10 min ± 7.6 s (± 1.27 %), < 0.5 % SD.measurements.

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Environmental Conditions

Operation

Voltage: 90-260 V, 50 or 60 Hz.

Power: 150 W.

Electrical installation: category II.

Temperature: 4-40 °C for 322 Pump, 10-40 °C for 321 Pump.

Humidity: 15-80 %.

Altitude: < 2000 m.

Pollution: degree 2.

Storage

Temperature: -15 °C to 40 °C.

Humidity: as for operation.

Altitude: < 4600 m.

Size and Weight

321 Pump, Width: 260 mm. Height: 507 mm. Depth: 410 mm.

322 Pump, Width: 260 mm. Height: 303 mm. Depth: 457 mm.

321 and 322 Pumps, Weight: about 30 kg (39 kg packed).

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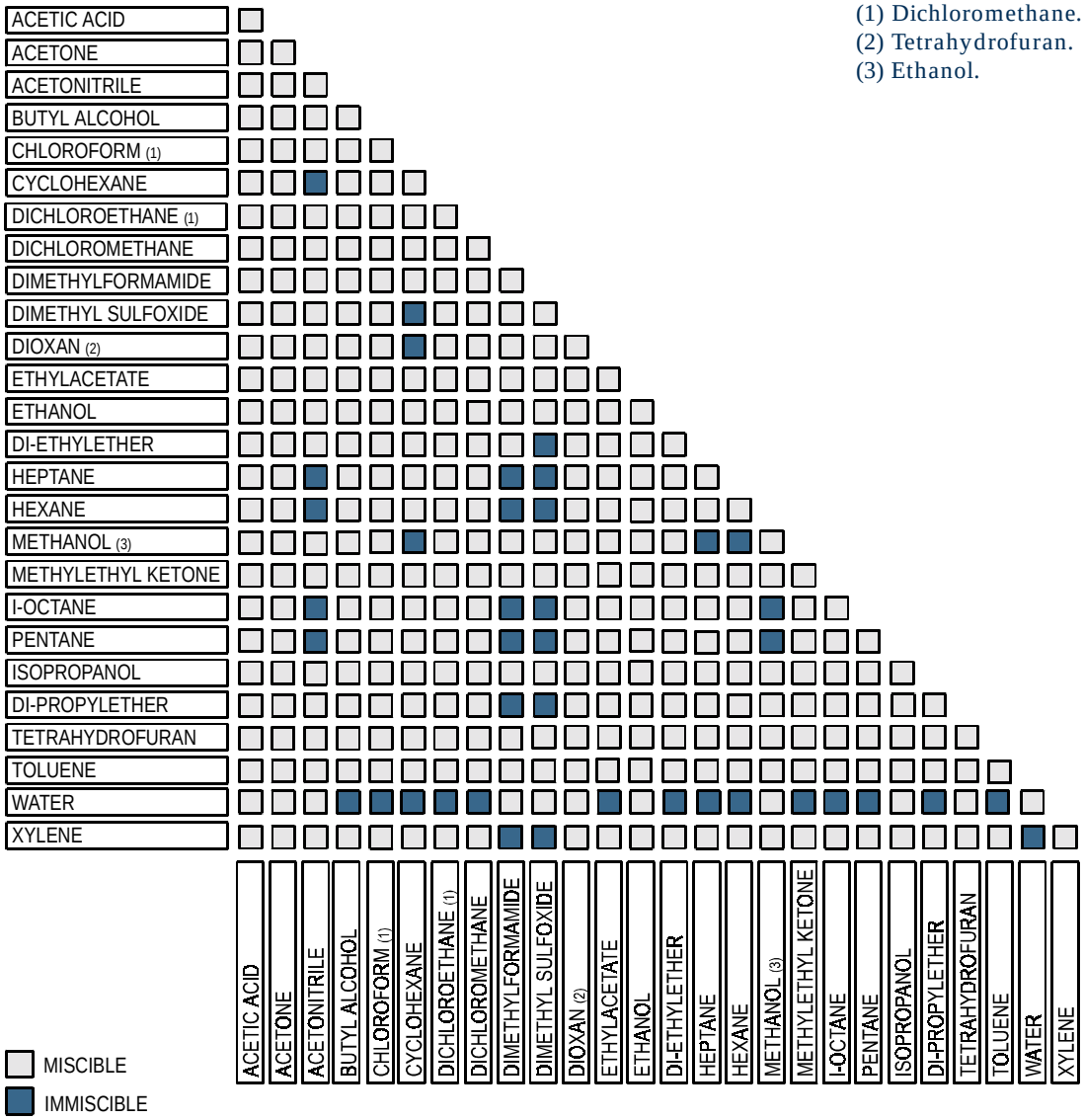
Solvent Parameters

Solvent Miscibility

Miscibility means that solvents should mix with each other in all proportions. That solvents should be miscible is important both during elution and when switching from one solvent to another.

You are advised to refer to the table, below, when selecting solvents. For some solvents, lower toxicity alternatives are indicated [(1), (2), (3)], as follows:

(1) Dichloromethane.
(2) Tetrahydrofuran.
(3) Ethanol.



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Flow Rate Accuracy

Principle

1) To generate the selected flow rate with the specified accuracy, maintained under high pressure and for a variety of liquids, the software adds two complementary corrections to the basic 'piston flow rate'. Defined from the piston stroke volume only, the piston flow rate is theoretically accurate only at atmospheric pressure.

   The objective flow rate (F) is considered as the sum of three components, $F = F_0 + F_1 + F_2$

   F_0, the piston flow rate decreases when pressure increases,

   F_1, the compensation flow rate for the liquid compressibility, increases with pressure,

   F_2, the compensation flow rate for all other factors, also increases with pressure.

   The piston flow rate (F_0) is defined by $F_0 = N_0 \ V_S$ where:

   N_0 = number of piston cycles per unit time and
   V_S = piston stroke volume.

2) The compensation flow rate (F_1) is calculated as a function of five variables:

   $F_1 = f_1 (F_0, V_S, V_D, P, X)$, where:
   V_D is the volume of the dead space inside the compression chamber,

   P is the operating pressure,

   X is the compressibility of the liquid under the pressure P.

   In the software, X is calculated using the simplified Tait equation: $X = c/(P+ d)$

   Coefficient 'c' varies only slightly with the nature of the liquid. It is a constant included in the software. Coefficient 'd' is calculated (first estimate), from liquid compressibility at atmospheric pressure, X_0 (for P = 0). Values of X_0 for some common solvents are given in the following tables.

   The operating pressure 'P' is continuously transmitted by the Pressure Transducer to the firmware in the pump.

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3) The complementary compensation flow rate (F_2) is defined as the difference:

$F_2 = F - (F_0 + F_1)$

When F_2 was measured, experimental results yielded a simple function: $F_2 = f_2 (a, b, P)$.

Coefficients 'a' and 'b' were determined for each pump head; they are manufacturing constants related to the pump head size.

Adjustments

Experimental results showed that it was possible to define an optimum empirical value K_0 for X_0. This value K_0, called ***empirical compressibility correction for use with Gilson 32X Pumps*** is given below. Your attention is drawn to the fact that K_0 is not a physical constant.

The empirical values (generated at 20-23 °C) were obtained from experiments to maximize the flow rate accuracy, i.e. minimize the bias, minimize its pressure dependence, center it on zero, and obtain closely related values for common solvents having very different physical properties. Extensive measurements of the bias versus X_0 were carried out over the whole pressure range.

For Gilson 321 and 322 Pumps, the empirical compressibility correction K_0 maximizes the accuracy of flow rate and two-solvent composition over the whole of their nominal ranges for flow rate and pressure.

Solvent	K_0 (Mbar^{-1})
Water	34
Methanol	162
Acetonitrile	180
Isopropanol	162
Ethanol	148
Tetrahydrofuran	150
Hexane	290
Heptane	270
Dichloromethane	200
Chloroform	204

Empirical Compressibility Correction (K_0)

Mixture	K_0 (Mbar^{-1})
Water-methanol, 10-90	130
Water-methanol, 20-80	110
Water-methanol, 30-70	92
Water-methanol, 40-60	73
Water-methanol, 50-50	55
Water-methanol, 60-40	46
Water-methanol, 70-30	43
Water-methanol, 80-20	40
Water-methanol, 90-10	37

Mixture	K_0 (Mbar^{-1})
Water-acetonitrile, 10-90	146
Water-acetonitrile, 20-80	123
Water-acetonitrile, 30-70	103
Water-acetonitrile, 40-60	82
Water-acetonitrile, 50-50	62
Water-acetonitrile, 60-40	52
Water-acetonitrile, 70-30	48
Water-acetonitrile, 80-20	42
Water-acetonitrile, 90-10	36

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General Properties of Common Solvents

With reference to the table, lines 1 to 8 are physical properties compiled from the *Handbook of Chemistry and Physics*, 79th edition, D. R. Lide, CRC Press, 1998-1999.

F_c and $\Delta P / L$ are examples of basic hydrodynamic calculations.

P' is the polarity calculated by L.R. Snyder (*Journal of Chromatographic Sciences*, 16, 223, 1978) from experimental measurements by L. Rohrschneider (*Analytical Chemistry*, 45, 1241, 1973).

	Water	Methanol	Acetonitrile	Tetrahydrofuran	Isopropanol	Hexane	Dichloromethane
UVC (nm)	180	205	190	212	205	195	233
RI	1.333	1.329	1.344	1.406	1.378	1.376	1.424
BP (°C)	100	65	82	66	82	69	40
VP (hPa)	32	169	118	216	60	202	582
η (cP = mPa.s)	1.00	0.60	0.37	0.55	2.3	0.33	0.44
ρ (g/ml)	0.997	0.79	0.78	0.88	0.78	0.66	1.32
η/ρ (cP/g.ml^{-1})	1.00	0.76	0.47	0.62	2.9	0.50	0.33
X_0 (Mbar^{-1})	46	123	99	93	100	160	97
F_c (ml/min)	28	21	13	18	83	14	9.4
ΔP/L (MPa/m)	0.17	0.10	0.06	0.10	0.40	0.06	0.08
P'	10.2	5.1	5.8	4.0	3.9	0.1	3.1

UVC: UV cutoff

RI: refractive index at 20 °C

BP: boiling point at 1013 hPa

VP: vapor pressure at 25 °C

η: kinematic viscosity at 20 °C

ρ: density at 20-23 °C

F_c: critical flow rate for a 0.25 mm ID tubing

F_c (ml/min) = 113 x 0.25 mm x η (cP) / ρ (g/ml)

$\Delta P / L$: linear pressure drop for 1 ml/min and 0.25 mm ID tubing

$\Delta P / L$ (MPa/m) = 6.8 x 10^{-6} x 1 ml/min x 100 cm x η (cP) / (0.25 mm)^4

X_0: compressibility at 20 °C

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Safety Data for Flammable Solvents

For flammable solvants, the following table gives safety data according to the following definitions and references:

Definitions

1. The **flash point** (FP) is the lowest temperature at which a substance or mixture in an open vessel gives off enough combustible vapors to produce a momentary flash of fire when a small flame is passed near its surface [1].
2. A substance is classified as **flammable** if its FP is lower than 38 °C [2].
3. The **auto-ignition temperature** (AIT) is the lowest temperature at which a substance can self-ignite at atmospheric pressure, without an external ignition source. The determination of AIT is rather imprecise and apparatus-dependent. Nevertheless, the AIT indicates the maximum allowable surface temperature of equipment and apparatus when exposed to air-vapor mixtures of these substances [2].
4. An **explosive atmosphere** consists of a mixture of the vapor of a flammable substance being at a temperature higher than its FP with air at a concentration within **the limits of flammability** (LOF) [3].

Volatile does not imply flammable; for example dichloromethane is volatile, but is non-flammable.

	Ethanol	Methanol	Acetonitrile	Tetrahydrofuran	Isopropanol	Hexane	Heptane	Ethyl acetate	Diethyl ether
BP (°C)	78	65	82	66	82	69	98	77	35
VP (hPa)	93	169	118	216	60	202	55	121	735
FP (°C)	12	11	6	-14	12	-22	-4	-4	-45
AIT (°C)	490	510	520	320	540	260	230	490	190
LOF (%)	3-19	7-36	3-16	2-12	2-12	1-8	1-7	2-11	2-36

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Abbreviations for Thermoplastic Materials

EP	Ethylenepropylene
ETFE	Ethylenetetrafluoroethylene (e.g. Tefzel™ from Du Pont de Ne mours)
FEP	Fluoride ethylenepropylene
PCTFE	Polychlorotrifluoroethylene (e.g. Kel-F™ from 3M)
PE	Polyethylene
PEEK	Polyetheretherketone
POM	Polyoxymethylene (e.g. Delrin™ from Du Pont de Nemours)
PP	Polypropylene
PPS	Polyphenylene sulfide (e.g. Ryton™ from Phillips Petroleum)
PTFE	Polytetrafluoroethylene (e.g. Teflon™ from Du Pont de Nemours)
UHMWPE	Ultra-high molecular-weight polyethylene

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Part Numbers

Pump, Standard Accessories, and Documents are supplied as standard. Additional Accessories, Wear Parts, and Replacement Parts, are available from your Gilson distributor.

Gilson 321 Pump

Either one of the following items:

Reference	Description
E66002 E66020	321-H1 Pump (110 and 220 V), 2-solvent, 15 ml/min, 60 MPa 321-H2 Pump (110 and 220 V), 2-solvent, 30 ml/min, 30 MPa

Each is supplied with two power cords, part number 500006 for 110 V and 500005 for 220 V.

Standard accessories

Reference	Description	Quantity
Hydraulic		
866149	Bottle tray for 32X Pumps	1
E66159	Inlet tubing, solvent A, for H1/H2 pump head	1
E66180	Inlet tubing, solvent B, for H1/H2 pump head	1
430060	Tubing, 316 steel, 0.25 x 1.6 x 550 mm, 27 µl (to injector, < 10 ml/min)	1
430035	Tubing, 316 steel, 0.5 x 1.6 x 500 mm, 98 µl (to injector, > 10 ml/min)	1
460058	Syringe, glass, 10 ml, male luer (to prime pump head)	1
H44249	Fitting adapter, 1/4”-28 TPI to female luer	1
E66257	Capillary, 316 steel, 0.13 x 1.6 X 400 mm, 5 µl, one fitting (seal replacement)	1
E66804	Plumbing kit, piston rinsing chamber of right pump head **(H1 or H2, Version 2)**	1
410426	Nut, 316 steel, 10-32 TPI, for 1.6 mm, 1/16” tubing (Upchurch U400)	4
410425	Ferrule, 316 steel, 10-32 TPI, for 1.6 mm, 1/16” tubing (Upchurch U401)	4
E66230	Bottle, glass, 180 ml, pierced PE cap, screwed cap, for piston rinsing chamber	1

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Reference	Description	Quantity
Mechanical		
610101	Spanner for tubing nuts, 6.3 - 7.9 mm (¼" - 5/16")	1
610112	Spanner for check valve holder, 14 mm	1
610117	Spanner for outlet filter, double-ended 11 and 13 mm	2
610043	Allen wrench, 3 mm (rear-end, to release pump head)	1
610045	Allen wrench, 5 mm (front-end, to remove pump head)	1
E66157	Tubing clip, PP, for 3.2 mm, 1/8" for 32X Pump bottle-tray	2
E66158	Tubing clip, PP, for 4.8 mm, 3/16" for 32X Pump bottle-tray	1
E66231	Bellows mounting tool, POM, white, piston assembly, for pump heads	1
Electrical		
506341	Barrier strip connector, 14-pin (for output contacts)	1
506367	Barrier strip connector, 10-pin (for input contacts and two outputs)	1
502132	Fuse, 3.15 A	5
500006	Power cord, 110 V	1
500005	Power cord, 220 V	1

Documents and Data Transfer Software

Reference	Description	Quantity
804035	Quality control certificate, 32X Pumps	1
None	Quality control report, 32X Pumps	1
801384	User's guide, 321 and 322 Pumps	1
804030	Installation Qualification procedure, 32X Pumps	1
804033	Operational Qualification procedure, 32X Pumps	1
801397	Unpacking notice	1
E66050	PC software for 321 Pump data-transfer	1

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Gilson 322 Pump

Either one of the following items:

Reference	Description
E66801 E66802	322-H1 Pump (110 and 220 V), 2-solvent, 15 ml/min, 60 MPa 322-H2 Pump (110 and 220 V), 2-solvent, 30 ml/min, 30 MPa

Each is supplied with two power cords, part number 500006 for 110 V and 500005 for 220 V.

Standard accessories

Reference	Description	Quantity
Hydraulic		
866149	Bottle tray for 32X Pumps	1
E66159	Inlet tubing, solvent A, for H1/H2 pump head	1
E66180	Inlet tubing, solvent B, for H1/H2 pump head	1
430060	Tubing, 316 steel, 0.25 x 1.6 x 550 mm, 27 µl (to injector, < 10 ml/min)	1
430035	Tubing, 316 steel, 0.5 x 1.6 x 500 mm, 98 µl (to injector, > 10 ml/min)	1
460058	Syringe, glass, 10 ml, male luer (to prime pump head)	1
H44249	Fitting adapter, ¼" - 28 TPI to female luer	1
E66257	Capillary, 316 steel, 0.13 x 1.6 x 400 mm, 5 µl, one fitting (seal replacement)	1
E66806	Plumbing kit, piston rinsing chamber of right pump-head (**H1 or H2, Version 2**)	1
410426	Nut, 316 steel, 10-32 TPI, for 1.6 mm (1/16") tubing (Upchurch U400)	4
410425	Ferrule, 316 steel, for 1.6 mm (1/16") tubing (Upchurch U401)	4
E66230	Bottle, glass, 180 ml, pierced PE cap, screwed cap, for piston rinsing chamber	1
Mechanical		
610101	Spanner for tubing nuts, 6.3 - 7.9 mm (¼" - 5/16")	1
610112	Spanner for check valve holder, 14 mm	1
610117	Spanner for outlet filter, double-ended 11 and 13 mm	2
610043	Allen wrench, 3 mm (rear-end, to release pump head)	1
610045	Allen wrench, 5 mm (front-end, to remove pump head)	1
E66157	Tubing clip, PP, for 3.2 mm, 1/8" for 333 and 334 Pump bottle-tray	2
E66158	Tubing clip, PP, for 4.8 mm, 3/16" for 333 and 334 Pump bottle-tray	1
E66231	Bellows mounting tool, POM, white, piston assembly, for pump heads	1

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Reference	Description	Quantity
Electrical		
500933	Cable, GSIOC connection	1
502132	Fuse, 3.15 A	5
500006	Power cord, 110 V	1
500005	Power cord, 220 V	1

Documents

Reference	Description	Quantity
804035	Quality control certificate, 32X Pumps	1
None	Quality control report, 32X Pumps	1
801384	User's Guide, 321 and 322 Pumps	1
804030	Installation Qualification procedure, 32X Pumps	1
804033	Operational Qualification procedure, 32X Pumps	1
801397	Unpacking notice	1

Additional Accessories for 321 and 322 Pumps

Reference	Description
Hydraulic	
E66250	Gilson 864 degasser, 4-channel, PTFE and PPS, 9.2 ml, 70 hPa
866031	H1 (Version 2) pump head, for 32X Pumps; includes: - 1 x 804035:Quality Control Certificate, H1/H2 pump head - 1 x Quality control report
866032	H2 (Version 2) pump head, for 32X Pumps; includes: - 1 x 804035: Quality Control Certificate, H1/H2 pump head - 1 x Quality control report
400134	Piston seal, PTFE, black, flange-type, Hastelloy C276 spring, for H1 pump head
400136	Piston seal, PTFE, black, flange-type, Hastelloy C276 spring, for H2 pump head
E66038	Valve block, PTFE, solvents 1 to 4, for 321 Pumps; includes: - 1 x 866053: Valve block, 4-solvent, without holder and tubing, for 32X Pumps - 1 x E66124: Holder, valve block, for 32X Pumps - 1 x E66232: Tubing, FEP, 2 x 3.1 x 1250 mm, with filter, four units marked B1 to B4 - 1 x E66233: Tubing, FEP, 2 x 3 x 150 mm, with fittings (from valve to head B) - 1 x E66157: Tubing clip, for 3 mm (1/8") tubing and 32X Pump bottle-tray - 1 x 801405: Instruction leaflet, solvent valve block
E66803	Valve block, external, solvents 1 to 4, for 322 Pumps
410054	Tee fitting, 316 steel, 10-32 TPI, 0.5 mm through, 0.6 µl (Upchurch U428)
410456	Union fitting, 316 steel, 10-32 TPI, 0.25 mm, 0.025 µl (Upchurch U435)
410457	Adapter, 316 steel, 10-32 TPI female and 1/4" - 28 TPI female, 1 mm through, 0.6 µl (Upchurch U1583)

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Reference	Description
E66805	Plumbing kit for 321 Pump, piston rinsing compartment of left pump-head (**H1 or H2, Version2**)
E66807	Plumbing kit for 322 Pump, piston rinsing compartment of left pump-head (**H1 or H2, Version 2**)
E66184	Capillary kit, PEEK, 0.064 x 1.6 x 200 mm, 0.6 µl, two fittings (< 30 MPa); includes: - 1 x 410448: Tubing, PEEk, 0.064 x 1.6 x 200 mm - 2 x 410435: Nut, C-loaded, PEEK, 10-32 TPI, for 1/16” tubing - 2 x 410447: Ferrule, C-loaded PEEK, 10-32 TPI, for 1/16” tubing
E66238	OQ Plumbing kit, 321 and 322 Pumps; includes: - 1 x E66184: Capillary kit, 0.064 x 1.6 x 230 mm, 0.6 µl, two fittings (< 30 MPa) - 1 x 410456: Union fitting, 316 steel, 10-32 TPI, 0.025 µl (Upchurch U435)
Mechanical and Electrical	
E66209	Valve holder with manual Rheodyne 7725i injection valve, for 32X Pumps
E66195	Valve holder without valve
E66197	Column holder, equipped for 2 to 20 mm i.d. column, for 32X Pumps
E66201	Shelf, 180 x 240 x 425 mm (external), for stacking pump or injector over detector
500944	Cable kit, 4-wire, 1.7 m, for electrical input/output contacts

Wear Parts

Wear parts are those items that will have to be changed from time-to-time according to the usage of the pump (refer to Chapter 5).

Reference	Description
410453	Filter, 316 steel, 2 µm, 1.9 x 4.8 mm, for 32X Pumps (Upchurch C402)
400133	Piston seal, UHMWPE, translucent, flange-type, Ti spring, for H1 pump head
400134	Piston seal, PTFE, black, flange-type, Hastelloy C276 spring, for H1 pump head
400135	Piston seal, UHMWPE, yellow, flange-type, Ti spring, for H2 pump head
400136	Piston seal, PTFE, black, flange-type, Hastelloy C276 spring, for H2 pump head
850170	Check valve cartridge, inlet, for 5/10/25/H1 pump head
850180	Check valve cartridge, outlet, for 5/10/25/H1/H2 pump head
866206	Check valve cartridge, inlet, for H2 pump head
866078	Piston assembly with bellows, for H1 pump head
866204	Piston assembly with bellows, for H2 pump head

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Replacement Parts

Reference	Description
Hydraulic	
866053	Valve block, 4-solvent, without holder and tubing, **for 321 Pump**
866149	Bottle tray, for 32X Pumps
410431	Inlet filter, 316 steel, 20 µm, (Upchurch A225A)
8420581	Tubing, FEP, 2 x 3 mm, 1/8”, 10 meters (H1/H2 inlet)
410455	Stop Valve, ETFE and PCTFE, 1/4” - 28 TPI, for inlet tubing (Upchurch P721 without nuts and ferrules)
E66159	Inlet tubing, Solvent A, for H1/H2 pump head
E66180	Inlet tubing, solvent B, for H1/H2 pump head
E66183	Drain nut, PCTFE, natural, 5/16” - 24 TPI, for 3/16” tubing
866067	Bellows, fluoroelastomer, piston rinsing compartment, for H1/H2 pump head
866160	Drip pan, PP, with drain tubing (silicone, 4 x 6 mm, 1000 mm), for 32X Pumps
J17976	Tubing, silicone, 4 x 6 mm, 3 meters (drip pan tray)
866036	Pressure module, 316 steel and PTFE, 60 MPa, 1.8 - 8.5 ml, for 32X Pumps
866400	Dynamic mixer, 316 steel, 60 MPa, 0.2 - 2.2 ml, for 32X Pumps
866064	Purge valve, 316 steel and PCTFE, 8 µl, for 32X Pumps
460058	Syringe, glass, 10 ml, male luer (to prime pump head)
H44249	Fitting adapter, 1/4” - 28 TPI to female luer
410452	Filter assembly, 316 steel, 0.5 mm through, 2µm, 4.8 mm (Upchurch A315)
410453	Filter, 316 steel, 2µm, 1.9 x 4.8 mm, for 32X Pumps (Upchurch C402)
430060	Tubing, 316 steel, 0.25 x 1.6 x 550 mm, 27 µl (injector connection, <10 ml/min)
430035	Tubing, 316 steel, 0.5 x 1.6 x 500 mm, 98 µl (injector connection, > 10 ml/min)
E66257	Capillary, 316 steel, 0.13 x 1.6 x 400 mm, 5 µl, seal replacement; includes: - 1 x 430078: Tubing, 316 steel, 0.13 x 1.6 x 400 mm - 1 x 410426: Nut, 316 steel, 10-32 TPI, for 1/16” tubing (Upchurch U400) - 1 x 410425: Ferrule, 316 steel, 10-32 TPI, for 1/16” tubing (Upchurch U401)
Mechanical and Electrical	
E66211	Column holder clips, 1/4”, two units
E66212	Column holder clips, 1/2”, two units
E66215	Column holder clips, 1”, two units
E66157	Tubing clip, PP, for 3.2 mm, 1/8” tubing and 32X bottle tray, two units
E66158	Tubing clip, PP, for 4.8 mm, 3/16” tubing and 32X bottle tray
500933	GSIOC Cable
506341	Barrier strip connector, 14-pin (output contacts)
506367	Barrier strip connector, 10-pin (input contacts and two outputs)
807533	Fuse, 3.15 A, five units
Documents and Data Transfer Software	
801384	User’s guide, 321 and 322 Pumps
804030	Installation Qualification procedure, 32X Pumps
804033	Operational Qualification procedure, 32X Pumps
E66050	PC software for 321 Pump data-transfer

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GSIOC 7

GSIOC stands for Gilson Serial Input Output Channel. GSIOC is a bidirectional communications channel that can link a controlling device with up to 63 other devices. The system controller (or master module) controls all of the connected devices (or slaves) in the system by sending GSIOC commands. The master communicates with one slave at a time. When the master identifies a slave, it connects to the channel as the previous slave disconnects.

Each device connected to the GSIOC channel is distinguished by a unique GSIOC identity number (ID). For the 321 Pump the ID may be set to any number between 0 and 63; for the 322 Pump the ID may be set from 0 to 9.

32X Pumps can receive GSIOC commands (as can most other Gilson modules). 321 Pumps are also capable of sending commands as the controlling device. Alternatively, the controlling device may be a computer (via a suitable interface) on which a GSIOC driver and the controlling software is installed. The controlling software must be able to receive and transmit GSIOC commands, character-by-character, according to the protocol specified in this document.

There are two command types that the controlling device sends to a slave device: buffered and immediate. The slave executes buffered commands as background processes. Immediate commands have a higher priority; the slave device interrupts the execution of a buffered command to execute an immediate command. Immediate commands, unlike buffered commands, allow the slaves to send data to the master. Therefore, status requests from the master must be immediate commands.

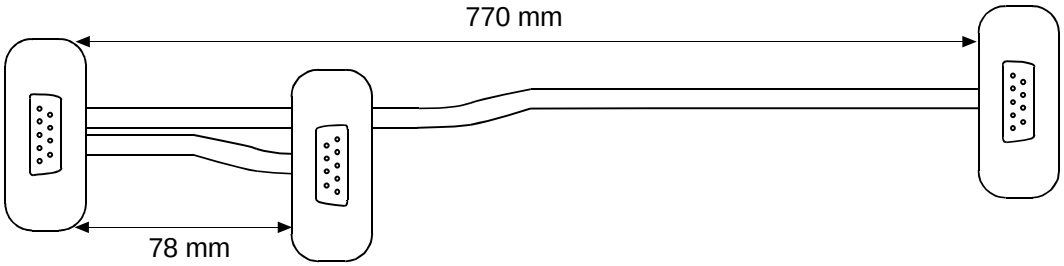
Connections between devices are made with specific Gilson GSIOC cables (9-pin D connectors). The multi-drop protocol allows the addition of more slaves into the system by permitting the cabling to be connected as a daisy-chain.

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Physical Level

GSIOC Control Cable

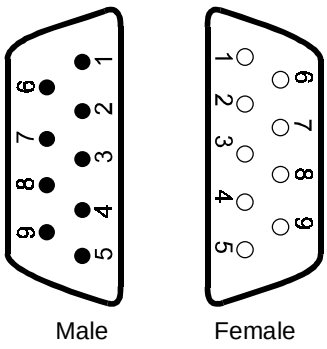
The control cable contains one male and one female connector at the master end, and one female connector at the slave end.



GSIOC Connector Pin Functions

The GSIOC cable has nine wires connecting corresponding pins. GSIOC consists of three differential signal pairs: the master data pair, the slave data pair, and the clock pair. To improve immunity to electrical noise, differential signals are used to eliminate ground loops in the system.

The pin-out and pin functions are as follows.



Pin	Function	Source
1	Reserved	
6	Reserved	
2	- slave data	slave
7	+ slave data	slave
3	- master data	master
8	+ master data	master
4	- clock	master
9	+ clock	master
5	ground	

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Electrical Level

The signals on the GSIOC are differential and are compatible with RS-422 and RS-485 specifications. The master device drives both the master data pair and the clock pair.

Each slave drives the slave pair only when it is selected. All slaves must be capable of deselecting from the channel on command. Both the controller and slaves should look for parity, framing, and overrun errors.

Although GSIOC is differential, the common mode voltage between slaves and masters should be less than +/- 7V to ground. The ground connection is not implemented in every GSIOC device, so they must be grounded locally by connecting the machine to a good earth circuit. This ensures compliance with the common mode specification.

The GSIOC clock is either transmitted by the channel link (external clock) or its local (internal) clock; in which case Master and Slave must have the same bit rate. The clock runs at sixteen times the desired bit rate, normally set at 19200. For a 321 Pump the bit rate may be set (using the control panel) to 1200, 2400, 4800, 9600, 19200, or External; for a 322 Pump three switch setting are available: 9600, 19200, or External.

Bit Rates

When a 321 Pump is used as a slave to another 321 Pump, or is controlled from a computer, the bit rate of the slave must be set to 'External'. Or, when the bit rates of the sending and receiving devices need to be matched, you can set a specific bit rate for both.

For a 321 Pump, the bit rate is set as follows:

1) Switch on the pump; wait until initialized.
2) Press in turn: **Edit**, **Config**, **Misc.**
3) Press the ▼ key.
4) Press **Change** until you see the desired bit rate (1200 to 19200 or External).
5) Press **ENTER**.

For a 322 Pump the bit rate (9600, 19200, or External) is set mechanically using the right-hand of the two selectors on the rear panel.

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GSIOC IDs

The GSIOC IDs may be changed where the pump(s) are being controlled from a computer. In which case, the configured IDs must correspond to those set using the controlling software. For each level (i.e. from one Master), the GSIOC identification number (ID) that you set must be unique for each item of Gilson equipment.

For a 321 Pump, the ID (0-63) is configured as follows:

1) Switch on the pump; wait until initialized.
2) Press in turn: **Edit**, **Config**, **Misc.**
3) Key in the desired ID for the 321 Pump, then press **ENTER.**

For a 322 Pump the ID (0-9) is set mechanically using the left-hand of the two selectors on the rear panel.

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Character Level and Format

Because the GSIOC is a multi-drop channel, with the ability to have several slave units connected at the same time, GSIOC reserves some of the possible characters for channel control.

The data format is asynchronous serial, with one start bit, eight data bits, one even parity bit, and one stop bit. Any parity error can be corrected by reconnecting and restarting the message.

Bit	Function
s	start bit
0	value 1
1	value 2
2	value 4
3	value 8
4	value 16
5	value 32
6	value 64
7	address flag if high*
p	parity (even)
s	stop (optional)

* Or the last character for an immediate command response.

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Disconnect and Connect Sequences

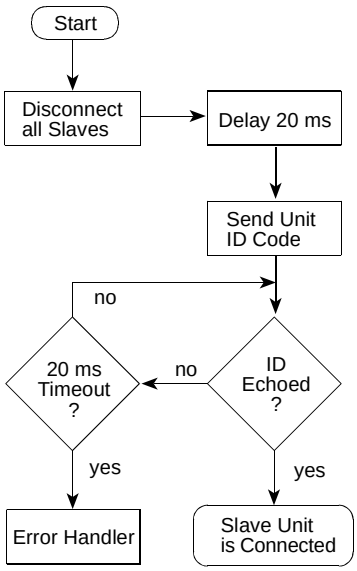
The following sequence is used to select a slave device:

1) The master sends a 255 ASCII character (FF hexadecimal) to disconnect all slaves from the GSIOC.

2) The master device uses one of the following terminations to ensure that no slaves are active:
   - passive (no break) termination; the master waits for 20 milliseconds to allow all slaves to disconnect,
   - break active; the master receives a 'break' character as soon as a selected slave disconnects.

3) The master announces the binary name of the desired slave device. The value of the binary name is equal to the unit ID plus 128 (10000000 binary). For example, if a unit's ID is 16 (10000 binary) its binary name is 10010000.

   Binary names are used to identify devices because GSIOC interprets unit IDs (ASCII 0 to 63) as commands.



4) The slave device that recognizes the binary name as its own connects its transmitter to the slave data channel and echoes its binary name to the master. The selected slave device must respond within 20 milliseconds, otherwise the master assumes that the desired slave is not available. Any slave device that does not recognize its own name remains disconnected.

5) After the slave device is connected, the master device may send a command (immediate or buffered) as described in the following Sections.

The selected device remains active until it receives the disconnect code (FF hexadecimal) or the binary name of a different slave device.

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Immediate Command Protocol

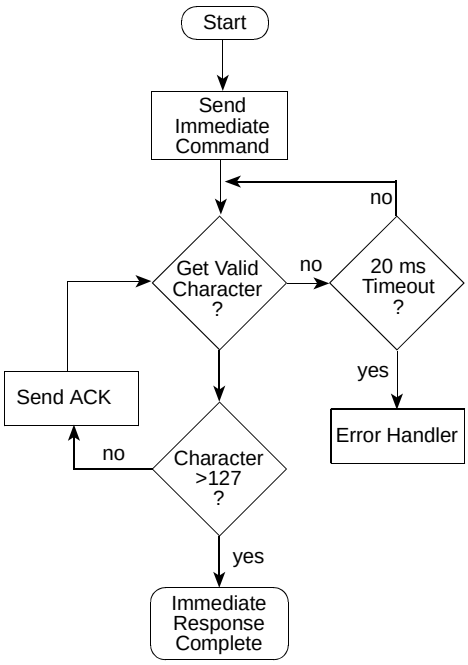
Immediate commands, which are always in the form of a single character, request status reports from a slave device, for example:

- what kind of device are you?
- what is your current operating mode?
- what are you doing now?

When a master device issues an immediate command to a designated slave, the slave interrupts its current job to respond to the immediate (high priority) command.

After a slave device receives an immediate command, it answers the request with the first character of its response. The master checks the value of the ASCII character. If the character's value is less than 128, it responds to the slave with an ACK character (06 hexa-decimal). This exchange continues until the slave sends the last character of the response. To indicate that the last character is being sent, the slave adds 128 (10000000 binary) to the characters value.

In response to an unrecognized immediate command, a slave responds with the pound sign (#).



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Buffered Command Protocol

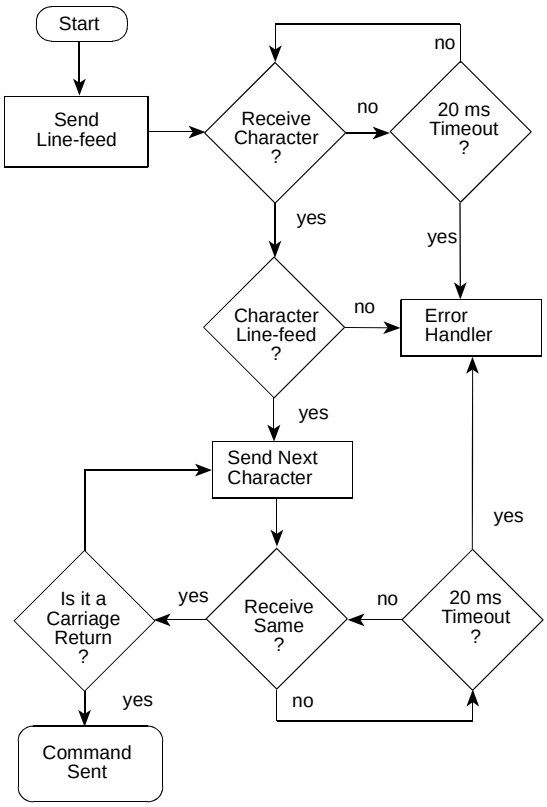
Buffered commands send instructions to a slave device, for example:

- close a contact,
- change the mode,
- write to the display.

A buffered command is defined as an ASCII string, preceded by a line feed (0A hexadecimal), and followed by a carriage return (0D hexadecimal).

After the master device selects a slave, it begins the buffered command protocol with a line feed character.

If the salve is ready to accept a buffered command, it ecoes the line feed to the master. The master then sends each susequent character in the ASCII command string.



As each character is recived by the slave, it is echoed to the master for confirmation. When the master sends a carriage return character, the slave knows that the entire command has been sent.

If a slave is busy performing a buffered command, it responds with the pound sign (# = 23 hexadecimal). The master continues to send the line feed character until the slave responds with a line feed character. Then, the rest of the command string is sent.

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GSIOC Driver and Interface

A GSIOC driver is required when the controlling device is a computer. Normally, this file is supplied and installed with the controlling Gilson software. An interface is also required between the computer and the controlled devices.

Contact your Gilson representative for details of the latest interface and driver.

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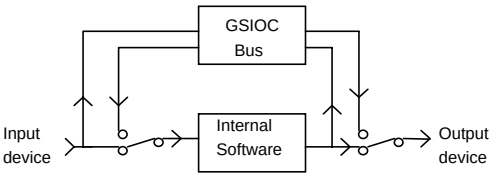
Introduction to GSIOC Commands

This document includes commands for pumps that may not be commercially available.

GSIOC commands for 32X Pumps are detailed in the following tables, with their type (buffered or immediate) and function. The response format is described for immediate commands (type 'I'). For buffered commands (type 'B') the parameters are documented.

There are two devices types: input devices and output devices. For a 321 Pump input devices are: the keypad, the contact inputs, and the pressure transducer. The 321 Pump output devices are: the mixer motor, the contact outputs, the display unit (screen), and the 4-way valve block (optional).

The pump peripheral devices can be either driven by the internal software or by the GSIOC bus. A type of software switch (actually a dedicated GSIOC command) is used to disconnect and reconnect each device from the internal software, as illustrated below.





1) **When using any command, take care to use the correct, command specific, syntax. A syntax error could have unforeseen consequences.**

2) **The commands and parameters described in this document are case specific. You must take care to use the specified case (upper or lower).**

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Commands for 321 and 322 Pumps

Operational Functions

Command	Type	Description
%	I	Request module identification
%	B	Define Module identification
$	I	Master reset
?	I	Pump status
?	B	Application control
C	B	Reset maintenance counters
C	I	Read maintenance counters
D	B	Dims or brightens front panel display (not available on slave pumps)
D	I	Read file directory
E	B	Assigns a value to a parameter
E	I	Read the value of a parameter
F	B	Set pumping parameters
F	I	Returns pumping parameters
G	B	Write application event into Edit file
G	I	Read application event from Edit file
H	I	Reset Application event index
H	B	Delete application event from Edit file
I	B	Write contact inputs (not available on slave pumps)
I	I	Read contact inputs (not available on slave pumps)
i	I	Read contact input buffer (not available on slave pumps)
J	B	Write contact outputs (not available on slave pumps)
J	I	Read contact outputs (not available on slave pumps)
j	I	Read contact output buffers (not available on slave pumps)
K	B	Input remote keystrokes
K	I	Read key entry
M	B	Mixer control
M	I	Mixer status
n	I	Reset Audit trail configuration parameters index (not available on slave pumps)
N	I	Read Audit trail configuration parameters (not available on slave pumps)
O	B	Set Audit trail files index (not available on slave pumps)
O	I	Read audit trail files (not available on slave pumps)
o	I	Read audit trail files events (not available on slave pumps)
Q	B	Enter pressure value
Q	I	Read pressure value
S	I	Buffer status
T	I	Read Audit trail line (not available on slave pumps)
t	I	Reset audit trail file line index (not available on slave pumps)
U	B	Delete Audit trail file (not available on slave pumps)
V	B	4-valve module control (solvent selection)
V	I	4-valve module status
v	I	4-valve module buffer status
W	B	Write display (not available on slave pumps)
W	I	Read display (not available on slave pumps)
w	I	Read display buffer (not available on slave pumps)
z	I	Read compression stroke

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Maintenance Functions

Command	Type	Description
a	B	Dismount/Mount head
b	B	Start maintenance sequence
c	B	Calibrate pressure transducer
c	I	Pressure transducer calibration status
d	I	Leakage maintenance sequence status
e	I	Run in maintenance sequence status
g	B	This command is for Gilson use only
i	B	This command is for Gilson use only
h	B	This command is for Gilson use only
h	I	Motor status

Description of Commands

Command	Type	Description
%	**I**	**Request module identification** Response format: xxxxx Va.bc where Va.bc is the software version and xxxxx is the pump identification string. xxxxx = '321-H' for 321-H master unit xxxxx = '321-L' for 321-L master unit xxxxx = '321-Bio' for 321-Bio master unit xxxxx = '322-H' for 322-H remote unit xxxxx = '322-L' for 322-L remote unit xxxxx = '322-Bio' for 322-Bio remote unit xxxxx = '331-L' for 331-L unit xxxxx = '331-Bio' for 331-Bio unit
%	**B**	**Define module identification** syntax is %string where: string = '321-H' for 321-H master unit string = '321-L' for 321-L master unit string = '321-Bio' for 321-Bio master unit string = '322-H' for 322-H remote unit string = '322-L' for 322-L remote unit string = '322-Bio' for 322-Bio remote unit string = '331-L' for 331-L unit string = '331-Bio' for 331-Bio unit Comment: This command sets all parameters to the default value, erases all applications, erases all counter values.
$	**I**	**Master reset** returns $ and reset the machine in its power-up state.

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Command	Type	Description
?	**I**	**Pump status** returns abcde where: a is the application status: 'S' for Stop. 'R' for Running. 'P' for Pause. 'C' for Conditioning. ******* only for maintenance ******* '0' for <To run in new piston seal> sequence running. 1' for < Leakage checking> sequence running. b is the pump status '-' for normal operation. 'L' for low pressure limit (the reading resets the low pressure limit state). 'H' for high pressure limit. c is the invalid condition flag '-' for normal operation. 'I' for invalid settings. The invalid conditions flag is reset by: Start a file or send a flow=0 using the buffered 'F' command. d is the status of the right head actuator in single piston mode or the status of both head actuators in Dual piston mode. '-' for no errors. 'E' if there is an error. e is the status of the left head actuator in single piston mode. '-' for no errors or if the pump works in dual piston mode. 'E' if there is an error.
?	**B**	**Application control** syntax is ?ab where a is: 'S' for Stop. 'R' for running application; b is the running file number. 'P' for Pause. 'Q' for Resume application. This command will be ignored if it is inconsistent (e.g. run an application which does not exist).
C	**B**	**Write maintenance counters** Syntax is Cn,m=x where: n is the Head identification. n=0 means right head. n=1 means left head. n=5 means another counter. m is the counter identification. m=0 means piston seal counter (Head = 0 or 1). m=1 means piston counter (Head = 0 or 1). m=2 means outlet check valve counter (Head = 0 or 1). m=3 means inlet check valve counter (Head = 0 or 1). m=4 Actuator counter (Head = 0 or 1). m=5 Solvent selector valve A counter (Head = 5) m=6 Solvent selector valve B counter (Head = 5) m=7 Solvent selector valve C counter (Head = 5) m=8 Solvent selector valve D counter (Head = 5) x = R means RESET counter; x = 0 to 65534 means set counter limit.

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>The limit value is in hours, except for solvent selector valve where the limit is in 10000 cycles unit.
Command ‘Cn,m’ only sets the counter index used by the C immediate command.
If the counter does not exist (ex: slave pump counters without slave pump), this command has no effect.</td></tr>
<tr><td>C</td><td>I</td><td>Read maintenance counters
Response format is n,m=xxx,yyy,zzz
n is the Head identification. See buffered C command.
m is the counter identification. See buffered C command.
xxx is the lifetime counter value in hours. (Does not exist for solvent selector valve counter.)
yyy is the cycles counter value in unit = 10000 cycles.
zzz is the counter limit value. (In hours for all counters except for solvent selector valve counter; for the solvent selector valve, the limit is in 10000 cycles unit.)
The pump returns the counter with the index sets by the last buffered C command.</td></tr>
<tr><td>D</td><td>B</td><td>Dims or brightens front panel display
Syntax: Dn where:
n= 0 dims display
n= 1 brightens display.</td></tr>
<tr><td>D</td><td>I</td><td>Read file directory
Response format: returns all existing file number separated by a comma.
If there is no existing file, return ‘N’ (example: 1,5,21,24)</td></tr>
<tr><td>E</td><td>B</td><td>Assigns a value to a parameter
Syntax: Ennn=mmmmmmm where nnn is the parameter code (see below)
mmmmmm is the value assigned to the parameter.
The following list identifies the code assigned to each parameter; it also gives the range of values that can be entered.
For ‘type’ R/W = Read/Write, R = Read only, L= available for N command.
<table>
<tr><th>Code</th><th>Type</th><th>Parameter</th><th>Units</th><th>Range</th></tr>
<tr><td>0</td><td>R/W</td><td>Application number selected to run (RFile)</td><td>1 to 24</td><td></td></tr>
<tr><td>1</td><td>R/W</td><td>Application number selected for edition (EFile)</td><td>1 to 24</td><td></td></tr>
<tr><td>2</td><td>R</td><td>Currently running application number (CFile)</td><td>1 to 24</td><td></td></tr>
<tr><td>3</td><td>R</td><td>Application state</td><td></td><td>returns: 0 if STOP,
1 if RUNNING,
2 if PAUSE,
3 if WAITING CONTACT
4 if WAITING CONTACT and PAUSE,
5 if INJECTING,
6 if INJECTING and PAUSE.</td></tr>
<tr><td>4</td><td>R</td><td>Running Elapsed time</td><td>1/100 min</td><td>1 to 999999</td></tr>
<tr><td>5</td><td>R</td><td>Total flow rate of the pumping system</td><td>1/10 µl/min</td><td>0 to 25000 for H1
0 to 50000 for H2</td></tr>
</table>
</td></tr>
</table>

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Command	Type	Description				
		Code	Type	Parameter	Units	Range
		6	R	Percentage of Solvent A	1/10 %	0 to 1000
		7	R	Percentage of Solvent B	1/10 %	0 to 1000
		8	R	Percentage of Solvent C	1/10 %	0 to 1000
		9	R	Percentage of Solvent D	1/10 %	0 to 1000
		10	R	Pressure P2 target (reserved for the SF pump)	1/10 MPa	0 to 600
		11	R/W	Pressure unit		0 for MPa, 1 for bar, 2 for psi
		12	R/W	Alarm		0 if beeper on alarm is OFF, 1 if beeper on alarm is ON.
		13	R/W L	Head A size code (can't be changed if pumping)		25 for H1, 50 for H2
		14	R/W L	Head B size code (can't be changed if pumping)		25 for H1, 50 for H2,
		15	R/W L	Piston mode (can't be changed if pumping)		1 if SINGLE piston mode 2 if DUAL piston mode
		16	R/W L	Head A Inlet pressure	1/10 MPa	0 to 500 (used in SINGLE piston mode only)
		17	R/W L	Head B Inlet pressure	1/10 MPa	0 to 500 (used in SINGLE piston mode only)
		18	R/W L	Head A Refill time	ms	125 to 1000 (used in SINGLE piston mode only)
		19	R/W L	Head B Refill time	ms	125 to 1000 (used in SINGLE piston mode only)
		20	R/W L	Head A Liquid compressibility	$Mbar^{-1}$	0 to 2000 (used in HPM mode only)
		21	R/W L	Head B Liquid compressibility	$Mbar^{-1}$	0 to 2000 (used in HPM mode only)
		22	RL	Nb of solvents (can't be changed if pumping)	1 to 4	
		23	R/W L	Mixing mode (can't be changed if pumping)		0 if HPM, 1 if LPM
		24	R/W L	Injection mode (can't be changed if pumping)		0 for no injection, 1 for HPI, 2 for LPI
		25	R/W L	Signal output profile		0 for PRESSURE, 1 for FLOW, 2 for % of pump A, 3 for % of pump B, 4 for % of pump C, 5 for % of pump D
		26	R/W L	Delay volume for signal output % profile.	1/10 µl	0 to 900000
		27	R/W L	Contact output pulse duration	1/100 min	1 to 100
		28	R/W L	Audit trail option		0 if ON, 1 if OFF
		29	R/W L	Contact input PAUSE with/without flow		0 if Pause without FLOW, 1 if Pause with FLOW
		30	R/W L	Elution pump synchronization before injection.		0 if synchro. OFF, 1 if synchro ON
		31	R/W L	% of piston stroke (can't be changed if pumping)	%	5 to 100
		32	R	Pause time	1/100 min	0 to 999999
		33	R	Wait contact time	1/100 min	0 to 999999
		34	R/W	Date (time)	min	0 to 23 x 60+59

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Command	Type	Description				
		Code	Type	Parameter	Units	Range
		35	R/W	Date (day)		1 to 31
		36	R/W	Date (month)		1 to 12
		37	R/W	Date (Year)		0 to 99
		38	R L	Pump model		0 for 32X-H, 1 for 32X-L, 2 for 32X-Bio, 3 for 332-L, 4 for 331-Bio
		39	R L	Remote pump		0 master pump, 1 slave pump
		40	R/W	Link application		1 to 24
		41	R/W	Number of loops		1 to 999
		42	R/W L	Restart after power failed option		0 means Stop, 1 means Continue current application, 2 means Start power failed application
		43	R/W	Application locked		0 if application unlocked, not equal 0 if application locked
		44	R/W L	Head C size code (can't be changed if pumping)		32X: 25 for H1, 50 for H2 33X: 50 for H2, 200 for H3 30X: see # 52
		45	R/W L	Head D size code (can't be changed if pumping)		32X: 25 for H1, 50 for H2 33X: 50 for H2, 200 for H3 30X: see # 52
		46	R/W L	Head C inlet pressure	1/10 MPa	0 to 500 (used in SINGLE piston mode only)
		47	R/W L	Head D ilet pressure	1/10 MPa	0 to 500 (used in SINGLE piston mode only)
		48	R/W L	Head C Refill time	ms	125 to 1000 (used in SINGLE piston mode only)
		49	R/W L	Head D Refill time	ms	125 to 1000 (used in SINGLE piston mode only)
		50	R/W L	Head C Liquid compressibility	$Mbar^{-1}$	0 to 2000 (used in HPM mode only)
		51	R/W L	Head D Liquid compressibility	$Mbar^{-1}$	0 to 2000 (used in SINGLE piston mode only)
		52	R/W L	Head Inj size code (can't be changed if pumping)		30X: 5, 10, 25, 50, 100, or 200
		53	R/W L	Head Inj Inlet pressure	1/10 MPa	0 to 500
		54	R/W L	Head Inj Refill time	ms	125 to 1000
		55	R/W L	Inj pump Liquid compressibility	$Mbar^{-1}$	0 to 2000 (used in HPI mode only)
		56	R/W L	High pressure limit - must be higher than low pressure limit!	1/10 MPa	0 to 600 for 32X-H, 32X-L 0 to 300 for 32X-Bio
		57	R/W L	Low pressure limit - must be lower than high pressure limit!	1/10 MPa	0 to 600 for 32X-H, 32X-L 0 to 300 for 32X-Bio
		58	R/W L	Solvent selector in HPM mode (0 for no solvent selector)		1 for solvent A, 2 for solvent B, 3 for solvent C, 4 for solvent D

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Code</th><th>Type</th><th>Parameter</th><th>Units</th><th>Range</th></tr>
<tr><td>59</td><td>R/W L</td><td>Stirrer activation</td><td></td><td>0 for automatic activation,
1 for STOP</td></tr>
<tr><td>60</td><td>R L</td><td>Type of pump A</td><td></td><td>0=NO_PUMP,
1=SINGLE,
2=DUAL, 3=P30X</td></tr>
<tr><td>61</td><td>R L</td><td>Type of pump B</td><td></td><td>0=NO_PUMP,
1=SINGLE,
2=DUAL</td></tr>
<tr><td>62</td><td>R L</td><td>Type of pump C</td><td></td><td>0=NO_PUMP,
1=SINGLE,
2=DUAL, 3=P30X</td></tr>
<tr><td>63</td><td>R L</td><td>Type of pump D</td><td></td><td>0=NO PUMP,
1=SINGLE,
2=DUAL, 3=P30X</td></tr>
<tr><td>64</td><td>R L</td><td>Type of injection pump</td><td></td><td>0=NO_PUMP,
3=P30X</td></tr>
<tr><td>65</td><td>R/W L</td><td>Mixer volume
(if pump has dynamic mixer)</td><td>1/100 ml</td><td>0 to 9999</td></tr>
<tr><td>67</td><td>R</td><td>Control of pump channels
(see F Command)</td><td></td><td>0 if controlled by the pump;
1 if controlled via GSIOC</td></tr>
<tr><td>68</td><td>R</td><td>Right head flow rate
(SINGLE mode); both in DUAL</td><td>1/10 µl</td><td>Same whether control is from pump or not.</td></tr>
<tr><td>69</td><td>R</td><td>Left head flow rate
(SINGLE mode only)</td><td>1/10 µl</td><td>Same whether control is from pump or not.</td></tr>
</table>
Parameter codes 40, 41, and 43 refer to “Edit” application. This application is defined by Edit Application number (code 1).
Comment: if the value mmmmmm and the ‘=’ sign are omitted, the value is unchanged, but the command sets the parameter index to the specified parameter (see above).
To define an application, first send the editing application number, add events (see G and H commands) and then send all parameters defining this application; the parameters have to be consistent.
</td></tr>
<tr><td>E</td><td>I</td><td>
Read value of parameter
Response format: nnn=mmmm, where
nnn identifies the parameter (see above)
mmmm is the value.
If the pump data base is busy, the response is ‘!’. In this case, send the command again later.
Comment: Use the buffered ‘Ennn’ command first to specify the parameter to be reviewed.
To read an application, first send the editing file number and then read all parameters (see also read application events command).
In case of error (ex: EFile not defined): The response is ‘????’.
</td></tr>
</table>

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Command	Type	Description
F	**B**	**Set pumping parameters** Syntax: Fabcccccc, ppp, dddd, eeee, ffff Where: a is the pump head identification: L for left pump head working in single piston mode, R for the right pump head working in single piston mode, B for the 2 pumps head working in dual piston mode. b is the mode: F for flow mode. cccccc is the flow value in tenth of µl/min. Range: 321-H/H1 0 to 150000, 321-H/H2 0 to 300000, 321-L/H2 0 to 250000, 321-L/H2 0 to 500000, 331-L 0 to 2000000. If cccccc=0, the pump head(s) stop(s) and goes to its rest position. ppp is the working pressure in tenth of MPa. dddd is the percentage in tenth of percent of liquid B aspirated through the 4-valve module during the refill of the head(s). eeee is the percentage in tenth of percent of liquid C aspirated through the 4-valve module during the refill of the head(s). ffff is the percentage in tenth of percent of liquid D aspirated through the 4-valve module during the refill of the head(s). Other pumping parameters such as head size, liquid compressibility, and inlet pressure for the single piston mode must be defined, using the buffered 'E' command, before to use the 'F' command. In LPM mode, the percentage of liquid A aspirated through the 4-valve module is equal to 100 % - (% B + % C, + %D). The 4 valves are used in proportional mode. In HPM mode, with the 4-valves modules installed, the software opens the valve with the percentage not equal to 0 and closes the other valves. If dddd=eeee=ffff=0, the valve A is opened.
F	**I**	**Returns pumping parameters** Response format: 'abc' where: a is the piston mode: S for single piston mode, D for Dual piston mode b is the right head status F if the right head (single piston mode) or the 2 heads (dual piston mode) are running in flow mode. S if the right head (single piston mode) or the 2 heads (dual piston mode) are stopped. E if the right head motor is jammed (single piston mode) or one of the two head motors is jammed (dual piston mode). c is the left head status (does not exist in DUAL piston mode). F if the left head is running in flow mode. S if the left head motor is stopped. E if the left head motor is jammed.
G	**B**	**Add application event in Edit file** Syntax: G type, time, p1, p2, p3 where 'type' is the event code 'time' is the event time in hundredth of min. ranging from 0 to 999999. p1 to p3 are additional parameters depending on event type. The meaning and number of parameters depends one event type (see below). When an event is added, it is sorted by increasing time order and event type. If the application is full, the new event is ignored.

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Parameter</th><th>Minimum</th><th>Maximum</th></tr>
<tr><td colspan="3">Event type = 0: FLOW EVENT</td></tr>
<tr><td>p1 Flow 1/10 µl/min</td><td>5 for 32X
40 for 331</td><td>See F command</td></tr>
<tr><td colspan="3">Event type = 1: MIXTURE EVENT</td></tr>
<tr><td>p1 Percentage of pump B in %</td><td>0</td><td>1000 and p1+p2+p3 inferior or equal to 1000</td></tr>
<tr><td>p2 Percentage of pump C in %</td><td>0</td><td>1000 and p1+p2+p3 inferior or equal to 1000</td></tr>
<tr><td>p3 Percentage of pump D in %</td><td>0</td><td>1000 and p1+p2+p3 inferior or equal to 1000</td></tr>
<tr><td colspan="3">Event type = 2: OUTPUT EVENT</td></tr>
<tr><td>p1 Output number</td><td>1</td><td>4</td></tr>
<tr><td>p2 Output state</td><td colspan="2">0 = CLOSE, 1 = OPEN, 2 = PULSE</td></tr>
<tr><td colspan="3">Event type = 3: INJECTION EVENT</td></tr>
<tr><td>p1 Injection flow, 1/10 µl/min</td><td colspan="2">HPI: See min and max flow for the injection pump</td></tr>
<tr><td></td><td>LPI: 5 for 32X,
40 for 331</td><td>25000 for 32X-L or Bio,
2000000 for 33X-L or Bio</td></tr>
<tr><td>p2 Injection volume, 1/10 µl</td><td colspan="2">HPI: See min and max volume for the injection pump</td></tr>
<tr><td></td><td>LPI: -------</td><td>25000000 for 32X-L or Bio,
200000000 for 33X-L or Bio</td></tr>
<tr><td colspan="3">Event type = 5: WAIT EVENT</td></tr>
<tr><td>p1 Input state</td><td>0 (wait input close)</td><td>1 (wait input opened)</td></tr>
</table>
</td></tr>
<tr><td>G</td><td>I</td><td>Read application event from Edit file
Returns event, selected by application event index, as previously set by a buffered G command.
Response format: EventNb, Type, Time, p1, p2, p3 where
EventNb range from 0 to 29.
Other parameters, separated by a comma, are defined in buffered G command.
Note: Type = 255 means empty event (End of file).
This command increments automatically the application event index.
p1 to p3 are additional parameters depending of the event type.
The meaning and number of parameters depends on the event type.
Pump will return only parameters corresponding to event type.</td></tr>
<tr><td>H</td><td>B</td><td>Delete application event from Edit file
Syntax: Hn where
n is the event index. range from 0 to 29.</td></tr>
<tr><td>H</td><td>I</td><td>Reset Application event index
Response format: ‘H’ if there is at least one event.
‘N’ if there is no event or if application does not exists.
Application contains up to 30 events.
The application can be read back event by event.
This command sets the index to the first event if any.</td></tr>
</table>

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Command	Type	Description
I	**B**	**Write contact inputs** Syntax: Iabcd where: ‘a’ is the input #1 (Start/End). ‘b’ is the input #2 (Pause/Resume). ‘c’ is the input #3 (Wait). ‘d’ is the input #4 (Emergency). Parameters: ‘C’ for closed. ‘D’ for open. ‘X’ for state unchanged. ‘-’ for reconnect to internal software. Comment: This command disconnects the input from the internal software if the corresponding parameter is ‘C’ or ‘D’. The value is stored in the contact input buffer(s).
I	**I**	**Read contact inputs** Response format: ‘abcd’ as above; for each input: ‘C’ if closed and connect to internal software. ‘c’ if closed and disconnect from internal software. ‘D’ if open and connect to internal software. ‘d’ if open and disconnect from internal software. This command reads the state of the physical input.
i	**I**	**Read contact input buffer** Response format: same as I immediate command. Comment: this command reads the input buffer of the internal software instead of the physical input.
J	**B**	**Write contact outputs** Syntax: Jabcd where: ‘a’ is the Out1 relay. ‘b’ is the Out2 relay. ‘c’ is the Out3 relay. ‘d’ is the Out4 relay. Parameters: ‘C’ for Close. ‘D’ for Open. ‘P’ for Pulse. ‘X’ for state unchanged. ‘-’ for reconnect to internal software. Comment: This command disconnects the output from the internal software if the corresponding parameter is ‘C’, ‘D’ or ‘P’. The default pulse duration is 0.03 min unless set otherwise by the buffered command E.
J	**I**	**Read contact outputs** Response format: ‘abcd’ as buffered J command for each output: ‘C’ if closed and connects to internal software. ‘c’ if closed and disconnects from internal software. ‘D’ if open and connects to internal software. ‘d’ if open and disconnects from internal software. The returned state(s) refers to the physical output(s).

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td>j</td><td>I</td><td>Read contact output buffers
Response format and parameters: same as immediate J command.</td></tr>
<tr><td>K</td><td>B</td><td>Input remote keystrokes
Syntax: ‘K‘ + ‘=‘ + key codes+’|’, up to 32 key codes per command.
Parameters are ASCII codes, as follows:
Comment: when this command has been sent, the keyboard is locked but it can memorized up to 8 key strokes (beep can be heard).
The key codes are stored in a buffer. At the time the keyboard is reconnect to the software, the buffer is cleared.
Command ‘K’ without any codes reconnects the keypad to the internal software.
Command ‘K=’ merely locks the keypad.
<table>
<tr><th>Code</th><th>Key name</th><th>Code</th><th>Key name</th></tr>
<tr><td>‘a’</td><td>Softkey F1</td><td>‘0’</td><td>Zero</td></tr>
<tr><td>‘b’</td><td>Softkey F2</td><td>‘1’</td><td>One</td></tr>
<tr><td>‘c’</td><td>Softkey F3</td><td>‘2’</td><td>Two</td></tr>
<tr><td>‘d’</td><td>Softkey F4</td><td>‘3’</td><td>Three</td></tr>
<tr><td>‘e’</td><td>Softkey F5</td><td>‘4’</td><td>Four</td></tr>
<tr><td>‘f’</td><td>Softkey F6</td><td>‘5’</td><td>Five</td></tr>
<tr><td>‘C’</td><td>Clear</td><td>‘6’</td><td>Six</td></tr>
<tr><td>‘E’</td><td>Enter</td><td>‘7’</td><td>Seven</td></tr>
<tr><td>‘.’</td><td>Dec. point</td><td>‘8’</td><td>Eight</td></tr>
<tr><td>‘X’</td><td>Escape</td><td>‘9’</td><td>Nine</td></tr>
<tr><td>‘H’</td><td>Help</td><td></td><td></td></tr>
<tr><td>‘U’</td><td>Up arrow</td><td>‘L’</td><td>Left arrow</td></tr>
<tr><td>‘D’</td><td>Down arrow</td><td>‘R’</td><td>Right arrow</td></tr>
</table>
Comment: The message ‘Keypad locked’ is shown on the lower line of the display instead label of soft-key.
For the remote pumps, the remote led is turned on when the keypad lock command (‘K=’ `) is received. It is turned off with the unlock command (‘K’).</td></tr>
<tr><td>K</td><td>I</td><td>Read key entry
Response format: ‘x..xx’, where
‘x..xx’ is an ASCII string, up to 8 characters long, encoding the last keys pressed.
This command clears the buffer.
Comment: If no key pressed, the ‘|’ ASCII characters is returned.
If the keyboard has not been disconnected by a buffered command ‘K’, the ‘@’ ASCII characters is returned.</td></tr>
<tr><td>M</td><td>B</td><td>Mixer control
Syntax: ‘Mn’ with
n = ‘S’ to turn off mixer,
n = ‘R’ to turn on mixer.
Comment: This command disconnects the mixer from the internal software.
‘M’ reconnects the mixer to the internal software.</td></tr>
<tr><td>M</td><td>I</td><td>Mixer status
Returns n with:
n = ‘S’ if mixer is off and connects to the internal software.
n = ‘s’ if mixer is off and disconnects from internal software.
n = ‘R’ if mixer is on and connects to the internal software.
n = ‘r’ if mixer is on and disconnects from internal software.</td></tr>
</table>

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Command	Type	Description
n	**I**	**Reset Audit Trail configuration parameters index** Response format: 'n' if log file exist. 'N' if log file does not exists.
N	**I**	**Read Audit Trail configuration parameters** Response format: nnn=mmmm where nnn identifies the parameter (see E command), mmmm is the value. This command is similar to the immediate 'E' command, but returns information from the configuration recorded in the log file at the starting time. Only the designated parameters (L type) are available. If the pump data base is busy, the response is '!'. In this case, send the command again, later. Comment: Use the immediate 'n' command first to set the index to the first parameter in the table. The index is set to the next available parameters after each reading.
O	**B**	**Set Audit Trail files index** Syntax: 'On' where n sets the stored file index ranging from 0 to 9. At the starting file time, the running file and its linked files (10 files maximum) are stored with the log file. This command sets the file index used by the 'O' immediate command and resets the Audit Trail file event index used in the 'o' immediate command.
O	**I**	**Read Audit Trail files** Response: n, m, p, q where: n = File number ranging from 1 to 24, any other value means the file does not exist. m = 0 if file is not locked, m=1 if it is locked. p = Nb of loop. q = Linked file. (255 if there is no linked file) Command reads the audit trail file selected by the index sets with the buffered O command, which must be used before.
o	**I**	**Read Audit Trail files' events** See G Command for response format. Returns event, selected by Audit Trail file event index. This command increments automatically the Audit Trail file event index. This index is reset by the O buffered command which must be used before.
Q	**B**	**Enter pressure value** Syntax: 'Qbxxx' in bar, Qpxx.xin MPa or Qkx.xx in kpsi If the parameter xxx is omitted, only the GSIOC pressure unit (used in immediate 'Q' command) is changed. This command does not affect the pressure unit for the user interface. Comment: This command disconnects the pressure value from the internal pressure transducer. 'Q-' reconnects pressure to the internal pressure transducer.

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td>Q</td><td>I</td><td>Read pressure value
Response format: as above, in the pressure unit used by the last buffered ‘Q’ command.
The default unit is the bar.</td></tr>
<tr><td>S</td><td>I</td><td>Buffer status
Response format: ab where:
a = 0 if the GSIOC buffered command buffer is empty.
a = 1 otherwise.
b = 0 if all buffered commands have been accepted since the last immediate ‘S’ command.
b = 1 if one or more buffered command has been rejected since the last immediate ‘S’ command.
b is reset to 0 after it has been transmitted.
If the pump received several commands at the same time, or in the mean time, it is not possible to know where the error is.</td></tr>
<tr><td>T</td><td>I</td><td>Read Audit Trail file line
Returns event pointed by Audit Trail line pointer.
Response format: Event code,YY,MM,DD,HH,mm,par1,par2. where:
Event code is the event code (see below).
YY is the year (0 to 99).
MM is the month (1 to 12).
DD is the day (1 to 31).
HH is the hour (0 to 23).
mm is the minute (0 to 59).
Par1 is the first additional value (0 to 255).
Par2 is the second additional value (0 to 65535).
Some parameters are not required for all events. In this case, the parameter exists in the response but has no meaning.
When the pump data base is busy, the response is ‘!’, so try again. If there are no available events or if the audit trail line pointer reaches the last line, the response is ‘|’.
This command increments automatically the Audit Trail line pointer. Use immediate T command to set pointer at the beginning of the file.
<table>
<tr><th>Event Code</th><th>Event Designation</th><th>Par1</th><th>Par2</th></tr>
<tr><td>‘a’</td><td>Start of application</td><td></td><td>Application number</td></tr>
<tr><td>‘b’</td><td>End of application</td><td></td><td></td></tr>
<tr><td>‘c’</td><td>Stop application</td><td></td><td></td></tr>
<tr><td>‘d’</td><td>Pause application</td><td></td><td></td></tr>
<tr><td>‘e’</td><td>Resume application</td><td></td><td></td></tr>
<tr><td>‘f’</td><td>Application modification</td><td>Application number.</td><td></td></tr>
<tr><td>‘g’</td><td>Configuration modification</td><td></td><td></td></tr>
<tr><td>‘h’</td><td>Pressure limit reached</td><td>0 for high pressure limit</td><td>Pressure limit in tenths of MPa</td></tr>
</table></td></tr>
</table>

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<table>
<tr><th>Command</th><th>Type</th><th>Description</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Event Code</th><th>Event Designation</th><th>Par1</th><th>Par2</th></tr>
<tr><td>‘i’</td><td>Counter change</td><td>Head identification:
0 for head A
1 for head B
2 for head C
3 for head D
4 for inj head
5 for other counter</td><td>Counter code:
0 for piston seal
1 for piston
2 for out check valve
3 for out check valve

5 for valve A
6 for valve B
7 for valve C
8 for valve D
9 for mixer magnet</td></tr>
<tr><td>‘j’</td><td>Counter limit</td><td>as for event code ‘i’</td><td>as for event code ‘i’</td></tr>
<tr><td>‘k’</td><td>Power failure</td><td>0 for STOP option
1 for Continue option
2 for start safety file</td><td></td></tr>
<tr><td>‘l’</td><td>Audit Trail is full</td><td></td><td></td></tr>
<tr><td>‘m’</td><td>Injection event</td><td></td><td></td></tr>
<tr><td>‘n’</td><td>Loop file begin</td><td></td><td>Loop number</td></tr>
<tr><td>‘o’</td><td>Link to next file</td><td>Link file</td><td></td></tr>
<tr><td>‘A’</td><td>Pressure limit reached (safety file absent)</td><td>0 for high pressure limit

1 for low pressure limit</td><td>Pressure limit in tenths of MPa
Pressure limit in tenths of MPa</td></tr>
<tr><td>‘B’</td><td colspan="3">Power failure (safety file absent)</td></tr>
<tr><td>‘C’</td><td colspan="3">Emergency input activated (emergency file absent)</td></tr>
<tr><td>‘D’</td><td>Invalid conditions</td><td colspan="2">Flag reset by start a file or flow using the buffered ‘F’ command</td></tr>
<tr><td>‘E’</td><td>Hydraulic failed</td><td>Pump Number
0 for pump A
1 for pump B
2 for pump C
3 for pump D
4 for inj pump</td><td></td></tr>
<tr><td>‘F’</td><td>Slave module absent</td><td>Unit ID</td><td></td></tr>
<tr><td>‘G’</td><td>Running file does not exist</td><td></td><td></td></tr>
<tr><td>‘H’</td><td colspan="3">Validation process has restored parameters to the default values</td></tr>
<tr><td>‘K’</td><td>Pressure limit reached (safety file already running)</td><td>0 for high pressure limit

1 for low pressure limit</td><td>Pressure limit in tenths of MPa
Pressure limit in tenths of MPa</td></tr>
</table>
</td></tr>
<tr><td>t</td><td>I</td><td>Reset Audit Trail line index
Response format: ‘T’ if file exists. ‘N’ if file does not exists.
The Audit trail file is an event file. Each line store one event. This file is read via GSIOC, event by event. See immediate ‘S’ command.
This command sets the index to the first line.</td></tr>
<tr><td>U</td><td>B</td><td>Delete Audit Trail file
Syntax ‘U’.</td></tr>
</table>

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Command	Type	Description
V	**B**	**4-valve module control (Solvent selection)** Syntax ‘n’ where ‘n’ is the solvent selection: n = ‘A’ for solvent A n = ‘B’ for solvent B n = ‘C’ for solvent C n = ‘D’ for solvent D n = ‘N’ for no valve opened. n = ‘-’ for reconnect to internal software. This command is ignored if the mixing mode is LPM. Comment: this command disconnects the valves from the internal software if the corresponding parameter is ‘A’, ‘B’, ‘C’ or ‘D’.
V	**I**	**4-valve module status** Response format: n. If the mixing mode is LPM, n is: ‘P’ if the mixing mode is LPM and valves connect to the internal software. ‘p’ if the mixing mode is LPM and valves disconnect from the internal software. If the mixing mode is HPM, n is: ‘A’ if the solvent A valve opened and valves connect to the internal software, ‘a’ if the solvent A valve opened and valves disconnect from the internal software. ‘B’ if the solvent B valve opened and valves connect to the internal software, ‘b’ if the solvent B valve opened and valves disconnect from the internal software. ‘C’ if the solvent C valve opened and valves connect to the internal software, ‘c’ if the solvent C valve opened and valves disconnect from the internal software. ‘D’ if the solvent D valve opened and valves connect to the internal software, ‘d’ if the solvent D valve opened and valves disconnect from the internal software. ‘N’ if no valve opened. This command refers to the physical valves.
v	**I**	**Read valve control buffer** Response format: as for immediate V command. Comment: The response is the image of the valves state if it were connected to the internal software. This is also the state which will be restored to the valves after a reconnect command.
W	**B**	**Write display** Syntax: Wm=xx..xx|. Where: m = line number = 0 to n-1, n being the number of the line. xx..xx is an alphanumeric string up to 40 characters long. Note that characters shown on the display unit may differ from characters sent by a computer. The string is made of: letters A-Z, a-z, numbers 0-9, special characters ! »#$%&’()*+,-./{|}~ and space. If the string is less than 43 characters (3+40), the remaining right-most characters of the display are blanked. If it is longer, extra characters are ignored. The vertical bar (|) is not required if this command is the last one in the buffer. This command disconnects the corresponding line from the internal software. The syntax has several variants: W0=xx..x disconnects and writes xx..x on line 1.

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Command	Type	Description
		Wn= xx..x disconnects and writes xx..x on line n+1. W= disconnects the whole display (but lines are not blanked). W0= disconnects line 1 (but lines are not blanked). Wn= disconnects line n+1 (but lines are not blanked). W reconnects all lines. W0 reconnects line 1. Wn reconnects line n+1.
W	**I**	**Read display** Response format: Wn=xx..xx. Where: n is the line number (0 to 7). xx..xx is a 40-character alphanumeric string. This command returns the contents of the selected display line. The selection of the line is done using the buffered W command. The characters returned are the real contents of the physical display, not the message produced by the internal software. Comment: The first line to be returned is the last entered by the buffer 'W' write command. If the write command has not been used, the upper line is read at the first occurrence of the read command, the second line is read at the second, and so on.
w	**I**	**Read display buffer** Response format: as for immediate W command. Comment: reading mechanism same as immediate W command. The response is the image of the display line if it were connected to the internal software. This is also the message which will be restored to the display after a reconnect command.
z	**I**	**Read compression stroke** Response format: aaaa, bbbb. Where: aaaa is the Head A compressibility stroke (if flow > zero) in one thousandth of the actual* piston stroke (0 to 1000). bbbb is the Head B compressibility stroke (if flow > zero) in one thousandth of the actual* piston stroke (0 to 1000). * Actual Stroke = Complete Stroke multiplied by % of stroke.
a	**B**	**Dismount/Mount heads** Syntax: an. Where: n = D means send the two pump heads to the dismount position (both heads simultaneously). n = N means to initiate the head mounting sequence (both heads simultaneously).

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Command	Type	Description
b	**B**	**Start maintenance sequence** Syntax: bnm,p,q. Where: n = '0' -> Start <To run in new piston seal> sequence. m = 'S' to start sequence. p = the run in head: 0 for right head of master pump 1 for left head of master pump 2 for right head of the 32X elution slave pump or for the head of the first 30X elution slave pump. 3 for left head of the 32X elution slave pump or for the head of the second 30X elution slave pump. 4 for the head of the inj pump q = the flow rate used to reach the run in pressure in tenth of µl. m = 'C' to continue sequence after priming. (see immediate 'e' command). n = '1' -> Start < Leakage test> sequence. m = test pressure value in tenth of Mpa ranging from up to system maximum pressure. p = the flow rate used to reach the test pressure in tenth of µl. n = 'S' -> Stop running maintenance sequence. If m,p,q are not useful, they do not exist.
c	**B**	**Calibrate pressure transducer** Syntax: cammm. Where: a = 'L' for low point calibration a = 'H' for high point calibration mmm is the calibration pressure in tenths of MPa (0 to 600) for the high point calibration. It does not exist for low point calibration.
c	**I**	**Pressure transducer calibration status** Response format: a. Where: a = '|' if there is no calibration before. a = 'Y' if the previous calibration command was successful. a = 'N' if the previous calibration command was unsuccessful.
d	**I**	**Leakage maintenance sequence status** Response format: a. Where a = 'R' for sequence running. a = 'K' if last sequence was successful. a = 'F' if last sequence failed. a = '|' if no leakage sequence.
e	**I**	**Run in maintenance sequence status** Response format: a. Where a = 'P' during priming phase of the sequence. a = 'E' when the pump is waiting before to begin the pressurization phase (see buffered 'b' command). a = 'R' during pressurization phase. a = '|' if no Run In sequence.
g	**B**	**Direct setting of motor frame control** This command is for Gilson use only.

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Command	Type	Description
i	**B**	**Update current frame** This command is for Gilson use only.
h	**B**	**Control the motor rotation** This command is for Gilson use only.
h	**I**	**Motor status** Response format: abcd. Where: a = R if right motor is running, else = S. b = E if right motor error, else = N. c = R if left motor is running, else = S. d= E if left motor error, else = N.

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