GE Healtcare

Peristaltic Pump P-1

User Manual

Pump P-1

Important user information

All users must read this entire manual to fully understand the safe use of Pump P-905.

WARNING!

The WARNING! sign highlights instructions that must be followed to avoid personal injury. It is important not to proceed until all stated conditions are met and clearly understood.

CAUTION!

The Caution! sign highlights instructions that must be followed to avoid damage to the product or other equipment. It is important not to proceed until all stated conditions are met and clearly understood.

Note

The Note sign is used to indicate information important for trouble-free and optimal use of the product.

CE Certifying

This product meets the requirements of applicable CE-directives. A copy of the corresponding Declaration of Conformity is available on request.

The **CE** symbol and corresponding declaration of conformity, is valid for the instrument when it is:

– used as a stand-alone unit, or

– connected to other CE-marked GE Healthcare instruments, or

– connected to other products recommended or described in this manual, and

– used in the same state as it was delivered from GE Healthcare except for alterations described in this manual.

WARNING!

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Recykling

This symobl indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment.

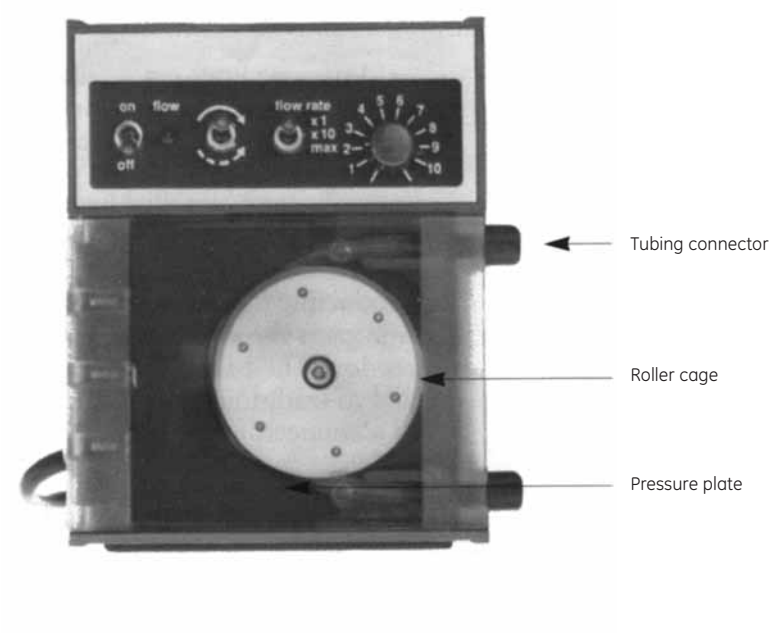
Contents

1. Introduction

The Peristaltic Pump P-1, (Code No. 18-1110-91), is a single channel laboratory pump for use in liquid chromatography and other applications where accurately controlled liquid flows are required. Pumping action is provided by a roller cage driven by a stepper motor controlled by a range selector and a continuously variable potentiometer. The motor speed is almost independent of temperature (0–40 °C) and load thus giving an accurate and reproducible flow rate under all conditions.
An asymmetric shape gives the pump a very low pulsation in the forward direction. The reverse direction has a pulsation which is more similar to traditional peristaltic pumps. Maximum flow function and a connector for remote control and pulse counting are provided.

2. General Description

2.1 Main panel



ON/OFF Switch

Starts and stops the pump. Can be overridden by the remote control.

Flow lamp

Indicates that the pump is turned on. The pump will now run if not overridden by the remote control.

Switch

A switch to reverse the flow.

Note: Because of the asymmetric design of the pressure plate, the forward direction (unbroken arrow on the switch) shows less pulsation than the reverse direction (broken arrow).

Flow rate switch

A range selector for the flow rate. The switch gives a ten-fold variation of the flow rate. Pressing the switch to the spring loaded bottom position gives maximum flow rate independent of the potentiometer setting.

Flow rate potentiometer

A continuously variable potentiometer for the control of the flow rate. Gives a linear response in the range from 1 to 10.

Flow rate guide

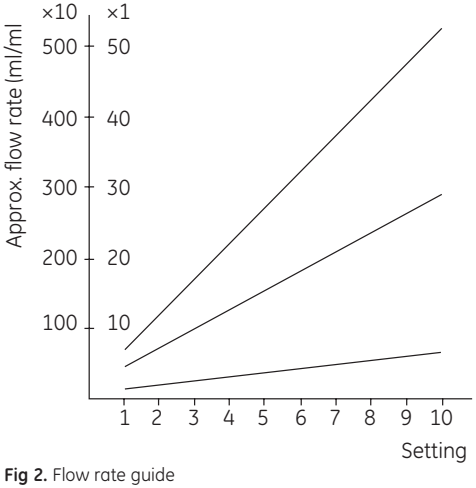


Fig 2. Flow rate guide

2.2 Side panel

A guide showing the relationship between the flow rate and the setting for different tube diameters. The flow rate guide is adhesive and should be stuck to the outside of the clear plastic lid.

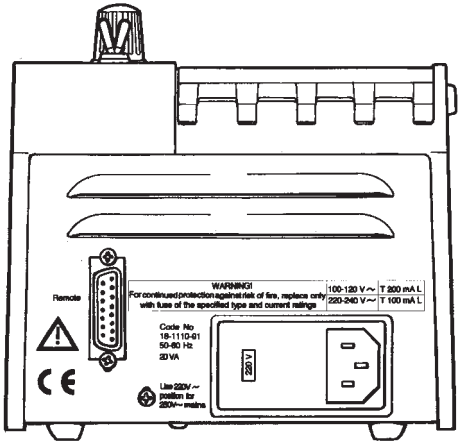


Fig 3. The side panel

Mains voltage selector

The socket for mains inlet contains a rotary switch for selection of appropriate voltage range. The voltage ranges is 100, 120, 220 and 240 V.

Note: Use 220 V setting for 230 V~ mains.

Fuse

Protects the electronics from damage in case of short circuiting.

Remote control

15 pin connector of D-type. The numbers referred to are imprinted on the connector.

Outputs (TTL open collector, 5 V)
Actual speed (pin 13). 0–200 Hz.
Rotation direction sensing (pin 4).

1=forwards, 0=backwards.
Earth (pin 15).
ON/OFF (pin 10).

0=pump on, 1 =pump off.

Inputs (TTL activation)
Internal/external speed control (pin 12).

1=internal, 0=external
External speed control (pin 14).

0–200 Hz, pin 12 must be 0 (see above).
Internal/external rotation control (pin 3).

1= internal, 0= external.
External rotation control (pin 2).

1= forwards, 0= backwards.

Pin 3 must be 0 (see above).

2.3 The pump mechanism

The roller cage

Contains six polytetrafluoroethylene (PTFE) pumping rollers mounted between two aluminium plates, which hold the roller bearings. As the cage rotates, the rollers rotate in the opposite direction, driven by drive wheels which engage the chassis cog ring. The roller diameter and the gear ratio have been chosen so that the points of the rollers in contact with the pump tubing are stationary with respect to the tubing. Waves of compression thus pass along the tubing without dragging the tubing in the direction of movement of the roller cage.

The pressure plate

An asymmetric semi-circular formed plate which presses the tube against the rollers. The correct pressure is automatically set by a ball and spring construction when the lid is closed. The pump accepts all three standard dimensions of tubing without adjustment.

The tubing

The pump accepts three standard dimensions of tubing: i.d. 1.0, 2.1 and 3.1 mm. The supplied connectors function as stop collars when mounted on the tubing.

Three qualities of tubings are available for the P-1 pump: silicone, PVC and fluoro-rubber. The silicone tubing is preferred for most aqueous applications because of its excellent mechanical properties while PVC and fluoro-rubber tubing extend the range of applications to include most organic solvents (see Part II; Solvent resistance of the pump tubing).

3. Installation

3.1 Unpacking

Carefully unpack the Peristaltic Pump P-1. Check the contents against the packing list supplied. Inspect for any damage that may have occurred during transit. Report any damage immediately to your local Amersham Biosciences representative and to the transport company concerned. Save the packing material if future transport can be foreseen.

3.2 Mains installation

Before connecting Pump P-1 to the mains supply, read the following instructions carefully:

1. Two Mains Kits are supplied with Peristaltic Pump P-1, one for 100–120 V and one for 220–240 V. Choose the kit appropriate to your mains supply voltage, and discard the other kit.

WARNING Installing the wrong mains kit can endanger personal safety and cause irreparable damage to the pump. Always connect Pump P-1 to a properly grounded mains supply.

WARNING Only use mains cables delivered or approved by GE Healthcare.

WARNING Do not block the rear panel of the system. The mains power switch must always be easy to access.

2. Remove the yellow warning label covering the fuse/voltage selector the real panel (Fig. 3).

3. Open the fuse/voltage selector with the key provided or with a thin screwdriver (Fig. 4a).

4. Place the fuse appropriate to your mains supply voltage in the fuse holder and insert it into the right-hand position (Fig. 4b). The left hand position is a holder for a spare fuse (included in the Mains Kit).

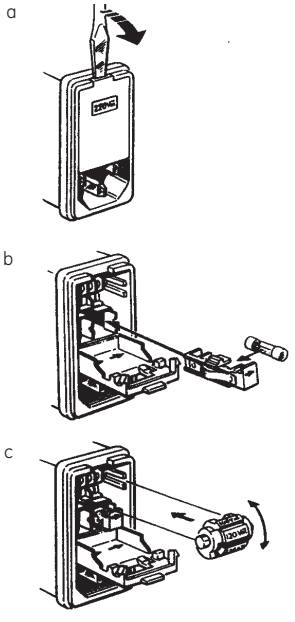


Fig 4. Setting the correct mains voltage

5. Remove the voltage selector switch, select the correct voltage, and replace the switch with the correct voltage showing (Fig. 4c).

Note: Use 220 V for 230 V ~ mains outlet.

6. Close the fuse/voltage selector cover and make sure the chosen voltage is shown in the window.

7. Connect the pump to a grounded mains outlet using the cable included in the Mains Kit.

3.3 Assembling the pump tubing

Assemble the pump tubing by inserting one connector in each end of the tubing. The distance between the nuts of the two connectors must be 140 mm (Fig. 5). This length ensures firm positioning of the tubing.

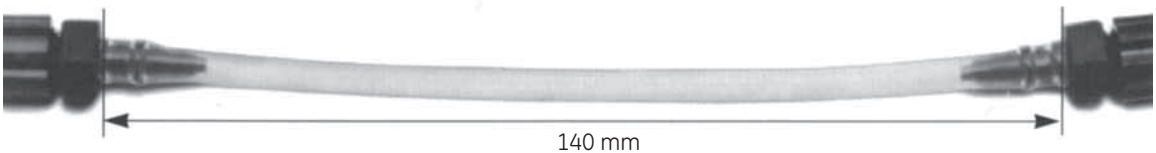


Fig. 5. The pump tubing

3.4 Inserting the tubing

1. Open the lid.

2. Push back the pressure plate.

3. Insert the tubing (Fig. 6). Make sure the nuts of the connectors fit correctly into their housings.

4. Close the lid. The correct tubing pressure is set automatically.

3.5 Setting the flow rate

The Peristaltic Pump P-1 has two flow rate ranges for each tubing diameter. The appropriate range is chosen by setting the flow rate switch for ×1 or ×10 giving a ten-fold variation of the flow rate. The desired flow rate is then set with the potentiometer. An estimation of the appropriate setting can be read from the "Flow rate guide" (Fig. 2).

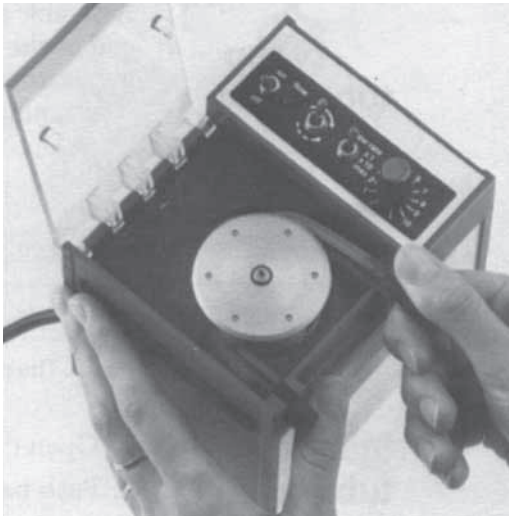


Fig 6. Inserting the pump tubing.

4. Operation

4.1 Using the Peristaltic Pump P-1 in chromatography

WARNING When using hazardous chemicals, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the chemicals used. Follow local regulations and instructions for safe operation and maintenance of the system.

The wide flow rate range, reproducibility and almost complete freedom from pulsation make the Peristaltic Pump P-1 particularly suitable for gel filtration, affinity chromatography, hydrophobic interaction chromatography and ion exchange chromatography. For the best results please consider the following points. The flow rate through a column packed with most types of gel-based chromatography media e.g. Sephadex™ Sepharose™ and their derivatives, is limited by the rigidity of the media. The flow rate vs pressure curve for such a medium bed shows a distinct maximum i.e. there is a maximum flow rate at which the column can be run. It is not possible to exceed this flow rate by setting the pump to give a higher flow rate. Attempts to do so will merely compress the bed and give a lower flow rate than would otherwise have been obtained.

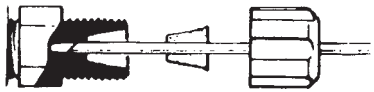
To avoid these problems, always determine the flow rate which the column will give under gravity elution alone. For long term use, a flow rate of 50–75% of the maximum flow rate attainable under gravity elution will be suitable. Flow rate recommendations are to be found in the “Gel filtration – theory and practice” and “Ion exchange chromatography – principles and methods” handbooks which are available from Amersham Biosciences.

4.2 Connecting the pump

The Peristaltic Pump P-1 may be connected into the system either before or after the chromatography column. Air bubbles may appear in the bed if the pump is connected after the column and the eluent has not been degassed. However, this set-up does have the advantage that the flow can be controlled by the pump during sample application as well as during elution.

The P-1 pump is connected to the system with the two connectors on the pump tubing following the instructions below. To minimize the pulsation, use the pump in the forward direction.

1. Cut the tubing cleanly at a 45¡ angle.
2. Remove the connector nut (1) and slip it over the tubing.



3. Remove the sealing plug (2).
4. Push the tubing through the sealing plug until it projects about 1 cm.
5. Seat the tubing in the nipple (3). Slide the sealing plug along the tubing into the nipple.
6. Finger-tighten the connector nut.

The pump can be used in a vertical or horizontal position and can be connected to laboratory scaffolding by fitting the support rod to the rear panel (Fig. 7).

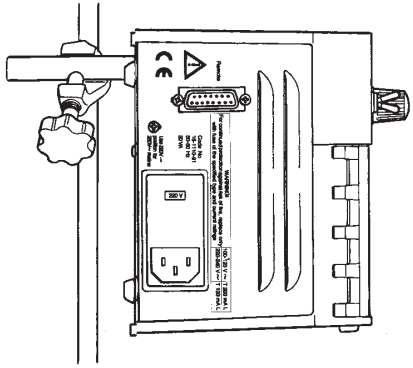


Fig 7. The P-1 pump attached to a lab rod.

4.3 Connections to the remote control socket

Information such as motor speed and direction of rotation can be received from, and sent to, other instruments. This feature can be used in a variety of situations, two of which are described below.

1. Volume information to a fraction collector

The stepper motor in the pump gives a pulse for every 0.4¡ of rotation. This angle corresponds to a certain volume and the information can be used to determine fraction size in a fraction collector. One pulse corresponds to approximately 1 ml when using tubing with i.d. 3.1 mm in the P-1 pump.

For further details, see Section 4.4.

2. Connection to a controller

For use in completely automated systems, the P-1 pump can be controlled from a controller like the Gradient Programmer GP-250 or GP-250 Plus or the Liquid Chromatography Controller LCC-500, LCC-501 Plus or LCC-500 CI.

For further information refer to the relevant controller's Instruction Manual.

4.4 Calibration of volume information

Below is a step by step procedure for the calibration of the volume information transmitted from the P-1 pump to the fraction collector when connected to the remote control.

1. Set up the chromatography system as desired.
2. Connect the P-1 pump to the fraction collector with a communication cable.
3. Set a flow rate approximately equal to that desired (see "Flow rate guide", Fig. 2).
4. For further information refer to the instruction manuals for Frac-100, Frac-200, SuperFrac™ or GradiFrac™.

Note: The calibration remains valid whenever the P-1 pump and the same fraction collector are connected via the remote outlet. If a different i.d. tubing is used, the volume information should be recalibrated. Calibrate the P-1 pump once every day.

5. Maintenance

5.1 Cleaning procedure

The Peristaltic Pump P-1 does not need any regular servicing or maintenance other than the replacement of worn out tubing. It is advisable to replace the tubing after 200 hours to minimize the risk of tubing breakage during operation. If a breakage should occur please follow the cleaning procedure given below. It is advisable to replace the O-ring on the roller cage if it has come into contact with the solvent.

1. Open the lid and remove the tubing.
2. Dismantle the roller cage by undoing the Allen screw and lifting the cage straight up. Take care not to lose the two metal washers.
3. Slide the pressure plate forwards and take it out of the pump.
4. Clean the roller cage and the roller cage housing with soapy water.
5. Fit a new O-ring on the roller cage.
6. Reassemble the pump by reversing the procedure described above.

6. Technical Specifications

Flow rate range	0.6–500 ml/h depending on tubing diameter and range selector (×1 or ×10) See Fig. 2 "Flow rate guide"
Standard tubing	Silicone rubber of internal diameters 1.0 mm, 2.1 mm and 3.1 mm
Power supply voltage	100/120/220–230/240 V~
Frequency	50–60 Hz
Max power	20 VA
Environment	Ambient temperature 0–40 ¡C Relative humidity 20–95% Atmospheric pressure 84–106 kPa
Dimensions	112×115×145 mm (W×D×H)
Weight	1.7 kg
Motor	Stepper motor
Remote control	The following operations can be obtained via the remote control socket: Outputs: Actual speed (0–200 Hz) Forward/backward direction ON/OFF Inputs: Forward/backward direction Speed control (0–200 Hz)
Compliance with standards	The declaration of conformity is valid for the instrument only if it is: • used in laboratory locations • used in the same state as it was delivered from GE Healthcare except for alterations described in the User Manual • connected to other CE labelled GE Healthcare modules or other products as recommended.

Safety standards	This product meets the requirement of the Low Voltage Directive (LVD) 73/23/EEC through the following harmonized standards: • EN61010-1 • IEC 61010-1 • CAN/CSA-C22.2 No. 61010-1 • UL61010-1
EMC standards	This device meets the requirements of the EMC Directive 89/336/EEC through the following harmonized standards: • EN 61326 (emission and immunity) • EN 55011, GR 2, Class A (emission) • This device complies with part 15 of the FCC rules (emission). Operation is subject to the following two conditions: 1 This device may not cause harmful interference. 2 This device must accept any interference received, including interference that may cause undesired operation.

7. Accessories and Spare Parts

Designation	No./pack	Code No.
Communication cable (Remote control)	1	19-6005-02
Lid	1	19-4626-01
Roller cage complete	1	19-4616-01
Support rod/P-1	1	19-4619-01
Silicone tubing/P-1 i.d. 1.0 mm	2	19-4692-01
Silicone tubing/P-1 i.d. 2.1 mm	2	19-4691-01
Silicone tubing/P-1 i.d. 3.1 mm	2	19-4690-01
Fluoro-rubber tubing/P-1 i.d. 1.0 mm	2	19-7626-01
Fluoro-rubber tubing/P-1 i.d. 2.1 mm	2	19-7627-01
Fluoro-rubber tubing/P-1 i.d. 3.1 mm	2	19-7628-01
PVC tubing/P-1 i.d. 1.0 mm	2	19-7629-01
PVC tubing/P-1 i.d. 2.1 mm	2	19-7630-01
PVC tubing/P-1 i.d. 3.1 mm	2	19-7631-01
Flow rate guide	1	19-4651-01
O-ring	5	19-4653-01
Tubing connector	6	19-2150-01

7 Accessories and Spare Parts

1. Solvent resistance of the pump tubing

Below is a list stating the resistance of the tubing available for the P-1 pump against different solutions.

For ordering information see Section 7.

Abbreviations:

P = PVC
S = Silicone
F = Fluoro-rubber
X = Satisfactory
C = Use only after testing
N = Not satisfactory
– = No data available

	Tubing		
Fluid to be pumped	**P**	**S**	**F**
Acetaldehyde	N	X	X
Acetates (low mol wt)	N	C	N
Acetic acid (less than 5%)	X	X	C
Acetic acid (more than 5%)	C	X	N
Acetic anhydride	N	C	N
Acetonitrile	–	X	–
Acetone	N	X	N
Acetyl bromide	N	–	–
Acetyl chloride	N	–	–
Air	X	X	X
Alcohols	C	X	X
Aliphatic hydrocarbons	C	C	C
Aluminium chloride	X	C	X
Aluminium sulphate	X	C	X
Alums	X	–	X
Ammonia (gas, liquid)	X	X	N
Ammonium acetate	X	–	–

Fluid to be pumped	Tubing P	S	F
Ammonium carbonate	X	–	X
Ammonium chloride	X	–	X
Ammonium hydroxide	C	X	X
Ammonium nitrate	X	–	X
Ammonium phosphate	X	–	X
Ammonium sulphate	X	–	X
Amyl acetate	N	C	N
Amyl alcohol	C	–	X
Amyl chloride	C	–	C
Aniline	N	C	X
Aniline hydrochloride	N	–	–
Antimony salts	X	–	C
Aqua regia (75% hydro-chloric, 25% nitric acid)	N	–	C
Aromatic hydrocarbons	N	C	X
Arsenic salts	X	–	–
Barium salts	X	X	X
Benzaldehyde	N	X	C
Benzene	C	C	X
Benzene sulphonic acid	C	–	–
Benzoic acid	X	–	–
Benzyl alcohol	X	–	X
Bleaching liquors	C	–	–
Boric acid	X	C	X
Bromine	X	N	X
Butane	C	N	X
Butyl acetate	N	C	N
Butyl alcohol (Butanol)	C	X	X
Butyric acid	C	–	C
Calcium oxide (dil)	–	X	X
Calcium salts	X	C	X
Carbon bisulfide	N	–	X
Carbon dioxide	X	C	X
Carbon tetrachloride	C	C	X
Chloracetic acid	N	X	X
Chlorine (wet)	C	C	X
Chlorine (dry)	X	–	X

Fluid to be pumped	Tubing P	S	F
Chlorobenzene	N	–	C
Chlorobromomethane	–	C	X
Chloroform	C	C	X
Chlorosulphonic acid	C	–	N
Chromic acid	X	C	X
Chromium salts	X	–	–
Copper salts	X	C	X
Cresol	N	X	X
Cyclohexane	–	N	X
Cyclohexanone	N	C	X
Diacetone alcohol	–	X	X
Dimethyl formamide	–	X	N
Essential oils	X	–	–
Ethers	C	N	N
Ethyl acetate	N	C	N
Ethyl alcohol (Ethanol)	C	X	X
Ethyl bromide	N	C	–
Ethyl chloride	N	C	X
Ethylamine	N	–	–
Ethylene chlorohydrin	N	–	–
Ethylene dichloride	N	C	X
Ethylene glycol	C	X	X
Ethylene oxide	–	C	N
Fatty acids	X	C	X
Ferric chloride	X	C	X
Ferric sulphate	X	C	X
Ferrous chloride	X	C	X
Ferrous sulphate	X	C	X
Fluoborate salts	X	–	–
Fluoboric acid	X	–	–
Fluo-silicaid	X	–	C
Formaldehyde	C	X	X
Formic acid	C	C	C
Freon	N	C	X
Gasoline (non-aromatic)	N	N	X
Gasoline (high aromaticity)	N	N	X

Fluid to be pumped	Tubing P	S	F
Glucose	X	X	X
Glue	C	–	X
Glycerine	X	X	X
Hydroiodic acid	X	–	X
Hydrobromic acid	X	–	X
Hydrochloric acid (dil)	X	X	X
Hydrochloric acid (med conc)	X	X	X
Hydrochloric acid (conc)	C	C	C
Hydrocyanic acid	X	–	X
Hydrofluoric acid	C	N	X
Hydrogen peroxide (dil)	X	X	X
Hydrogen peroxide (conc)	N	X	X
Hydrogen sulphide	X	–	X
Hypochlorous acid	X	–	X
Iodine and solutions	X	–	X
Kerosene	N	N	X
Ketones	N	C	N
Lacquer solvents	N	N	N
Lactic acid	X	–	X
Lead acetate	X	–	X
Linseed oil	X	N	X
Lithium hydroxide (5%)	–	X	X
Magnesium chloride	X	–	X
Magnesium sulphate	X	–	X
Malic acid	X	–	X
Manganese salts	X	–	X
Mercury salts	X	–	X
Methyl chloride	–	C	X
Mixed acid (40% sulphuric, 15% nitric)	C	–	X
Molybdenum disulphide	–	X	–
Monoethanolamine	–	X	–
Naphtha	C	C	X
Natural gas	X	C	X
Nickel salts	X	–	X
Nitric acid (dil)	X	X	X

Fluid to be pumped	Tubing P	S	F
Nitric acid (med conc)	X	X	X
Nitric acid (conc)	C	C	C
Nitrobenzene	N	–	X
Nitrogen oxides	X	C	C
Nitrous acid	X	–	–
Oils, animal	C	C	X
Oils, mineral	X	C	X
Oils, vegetable	C	X	X
Oleic acid	C	–	C
Oxalic acid	X	–	X
Oxygen (gas)	X	X	–
Perchloric acid	N	N	X
Phenol	C	–	X
Phosphoric acid (ortho)	X	–	X
Phthalic acid	X	–	–
Plating solutions	X	–	X
Polyglycol		–	X
Potassium carbonate	X	–	X
Potassium chlorate	X	–	X
Potassium hydroxide (med conc)	X	X	X
Potassium hydroxide (conc)	X	C	X
Potassium iodide	X	–	X
Pyridine	N	–	N
Silicone fluids	–	C	C
Silicone oil	X	C	X
Silver nitrate	X	–	X
Soap solutions	X	X	X
Sodium bicarbonate	X	–	X
Sodium bisulphate	X	–	X
Sodium bisulphite	X	–	X
Sodium borate	X	–	X
Sodium carbonate	X	X	X
Sodium chlorate	X	–	X
Sodium chloride	X	X	X
Sodium ferrocyanide	X	–	X
Sodium hydrosulphite	X	–	X

Fluid to be pumped	Tubing P	S	F
Sodium hydroxide (dil)	X	X	X
Sodium hydroxide (med conc)	X	X	X
Sodium hydroxide (conc)	C	C	C
Sodium hypochlorite (below 5%)	X	–	X
Sodium hypochlorite (above 5%)	C	–	X
Sodium nitrate	X	–	X
Sodium silicate	X	–	X
Sodium sulphide	X	–	X
Sodium sulphite	X	–	X
Steam (up to 40 psi)	C	X	C
Stearic acid	X	C	X
Styrene	–	–	X
Sulphur chloride	C	–	X
Sulphur dioxide	C	X	X
Sulphur hexafluoride	–	X	–
Sulphur trioxide	X	–	X
Sulphuric acid (dil)	X	X	X
Sulphuric acid (med conc)	X	C	X
Sulphurous acid (conc)	X	C	X
Tannic acid	X	C	X
Tanning extracts	X	–	X
Tartaric acid	X	–	X
Tin salts	X	–	–
Titanium salts	X	–	–
Toluene (Toluol)	N	N	X
Trichloracetic acid	C	–	–
Tri-sodium phosphate	X	–	X
Turpentine	C	N	X
Urea	X	X	X
Uric acid	X	–	–
Vinyl plastisol	–	X	–
Water	X	X	X
Water (brine)	X	X	X
Xylene (Xylol)	N	N	X
Zinc chloride	X	–	X

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