Graseby Instruction Manuals

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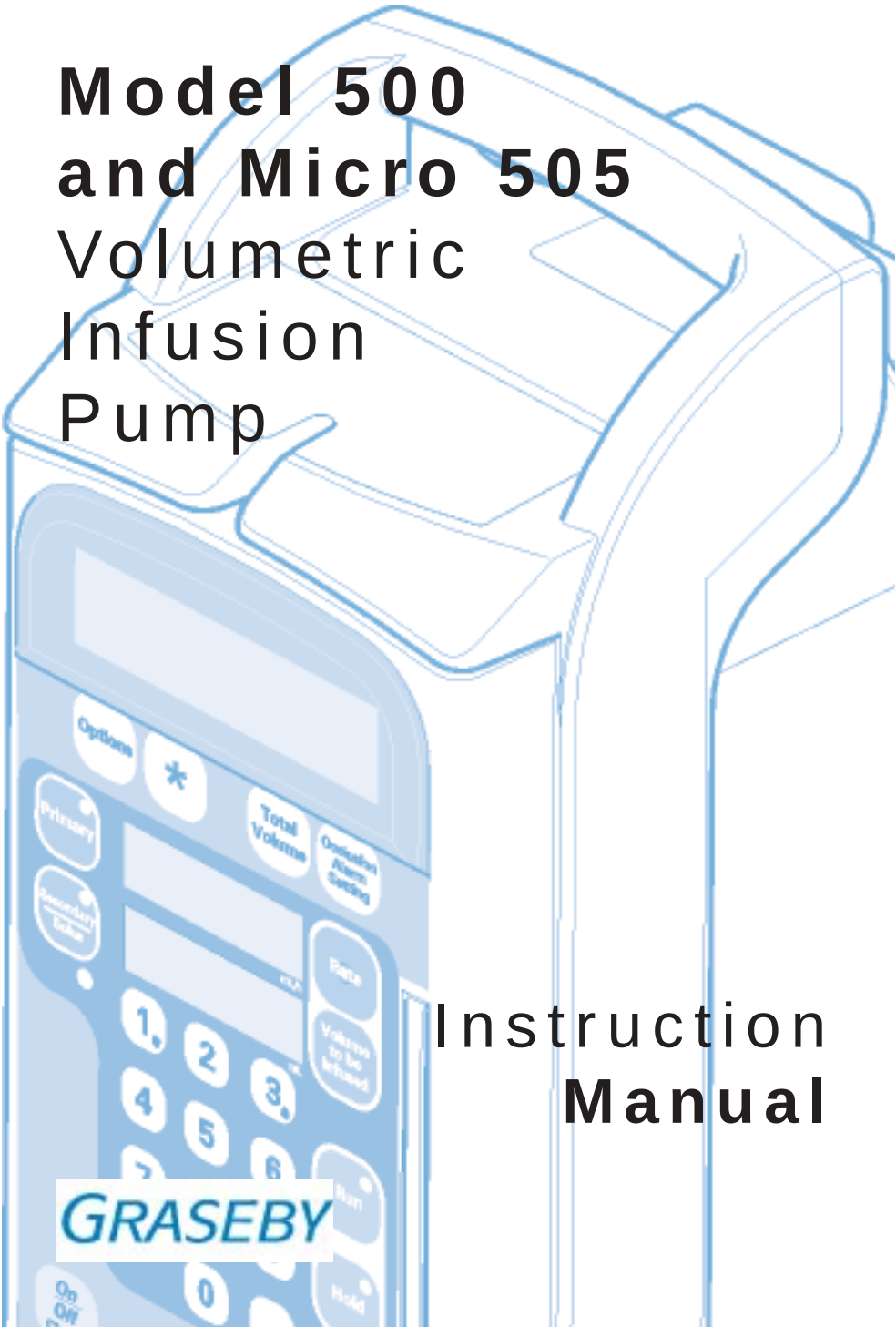
Model 500 and Micro 505 Volumetric Infusion Pump



Instruction **Manual**

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Warnings

Warnings tell you about dangerous conditions, that could lead to death or serious injury to the user or patient, that can occur if you do not obey all of the instructions in this manual.

1. **WARNING: You should ensure that the performance offered by the pump is fit for the intended purpose. Failure to do so may result in compromised function of the product, patient injury or user injury.**
2. **WARNING: Do not use a faulty pump. If the pump detects a fault when it is first turned on, or if it develops a fault during operation then a continuous system alarm sounds. The pump must be referred to a suitably qualified technician or returned to Graseby Medical in order to have the fault rectified.**
3. **WARNING: Before using the pump, it should be inspected for physical damage. The pump should not be used if damage is evident, and should be returned to service personnel for repair before being returned to use. Failure to do so may result in compromised function of the product, patient injury or user injury.**
4. **WARNING: Do not use the pump if you detect any cracks, chips and loose or bent parts, or if the buttons do not move in and out freely when they are pressed. Failure to do so could cause inadvertent disconnection of the pumps.**
5. **WARNING: Do not push or pull on the pumps, or the IV pole may tip over or the pumps fall to the floor. Do not try to remove modular connected pumps from the IV pole whilst they are joined together. Either of these could cause the administration set to separate from the fluid container thus spilling the medication, or the pumps themselves could be damaged.**
6. **WARNING: Correct entry of data is essential in order to ensure that the intended infusion is performed. Before confirming any displayed data when setting up an infusion, you should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.**
7. **WARNING: Dose-rate calculation requires care in entering data. Refer to specific product drug labelling for information on appropriate administration techniques and dosages. Entering incorrect data may result in patient injury or death.**
8. **WARNING: When delivering drugs in the epidural space, use only those medications specifically indicated for epidural use. Epidural administration of other drugs could result in serious patient injury or death.**
9. **WARNING: The use of administration sets incorporating injection sites could lead to an improper or inappropriate infusion resulting in serious patient injury or death.**
10. **WARNING: Failure to clearly identify the pump and administration sets could lead to an improper or inappropriate infusion resulting in serious patient injury or death.**
11. **WARNING: Remove any air to prevent air embolism. The presence of air within the infusion can result in complications resulting in patient injury or death.**
12. **WARNING: To avoid over infusion, do not prime the infusion line when the administration set is connected to the patient. Over infusion can result in patient injury or death.**
13. **WARNING: The Occlusion alarm level must be checked before starting an infusion to ensure that it is appropriate for the infusion. Failure to do so may result in an unacceptably slow time to Occlusion alarm, resulting in patient injury or death.**
14. **WARNING: Prior to starting an infusion, inspect the fluid path for kinks, a closed clamp or other obstructions. Failure to do so may result in the infusion not being delivered correctly, resulting in patient injury or death.**
15. **WARNING: If using a blood pressure cuff above the patient's venipuncture site take extra care in setting the Occlusion alarm pressures. Failure to do so may result in unnecessary Occlusion alarms, resulting in patient injury or death.**
16. **WARNING: The Occlusion detection system measures downline pressure in the administration set, but does not detect infiltration. In accordance with local protocol, you must periodically inspect the patient's infusion site for signs of infiltration. Failure to do so may result in an unacceptably slow time to Occlusion resulting in patient injury or death.**
17. **WARNING: If an Occlusion alarm occurs, immediately clamp the line to the patient. Then inspect the fluid pathway to determine what has caused the obstruction. An unintentional bolus of medication can result in patient injury or death.**

18. **WARNING: Do not run parallel infusion lines below the pump. Delivering a Secondary infusion means running a second line *above* the pump. Failure to do so may result in an inaccurate delivery of medication, resulting in patient injury or death.**
19. **WARNING: Check the Secondary set carefully, since an occlusion above the pump on the Secondary line could cause the Primary fluid to be delivered instead of the Secondary infusion. Administering the wrong medication may cause serious patient injury or death.**
20. **WARNING: The Secondary volume to be infused must match the amount of fluid in the secondary container. Primary flow resumes when the secondary container is empty. If the volumes do not correspond, the wrong infusion may be delivered which could cause serious patient injury or death.**
21. **WARNING: Correct management of battery charging, as described in this documentation is essential to ensure that the pump can operate on battery for the time specified. Failure to do so may result in compromised function of the product or patient injury.**
22. **WARNING: If a backup alarm sounds, the pump should be immediately removed from the patient and sent to be repaired by a Graseby Medical qualified technician. Failure to do so may cause patient injury or death.**
23. **WARNING: Failure to use the power cord retainer means that the pump may be accidentally or erroneously disconnected from the mains. Although there is a battery backup in case this happens, the battery may not be charged sufficiently. Consequently, there is a risk of the pump not functioning which could lead to patient injury or death.**
24. **WARNING: Do not open the pump housing. Refer all service faults only to qualified technical personnel. Opening the pump housing may cause electric shock leading to patient or user injury or death.**
25. **WARNING: When the pump is carrying out an infusion, to ensure that electrical safety is maintained, only items of equipment that conform to EN60950 are to be connected to the RS232 connector situated at the back of the pump, otherwise patient safety may be compromised.**
26. **WARNING: While Graseby Medical Limited have taken all reasonable steps to ensure that the pump operates correctly while under remote control, it is the responsibility of the person who designs and implements the controlling device to ensure that the resulting system (pump and controlling device) is fit for its intended purpose. Failure to do so may result in compromised function of the product, patient injury or user injury.**
27. **WARNING: Use only Graseby Medical administration sets with this product. Failure to do so may result in compromised system accuracy leading to complications resulting in patient injury or death.**

Cautions

Cautions tell you about dangerous conditions that can occur and cause damage to the pump if you do not obey all of the instructions in this manual.

1. **CAUTION: Refer all service, repair and calibrations only to qualified technical personnel. Unauthorised modifications to the pump must not be carried out.**
2. **CAUTION: Do not autoclave, steam sterilize, ETO sterilise or subject the pump to temperatures in excess of 55° C (131° F). Excessive temperatures may cause damage to the pump.**
3. **CAUTION: To prevent serious damage to the pump it must not be immersed in any liquids or exposed to strong organic solvents. Wipe off spills immediately. Do not allow fluid or residues to remain on the pump. Additionally, the pump is not designed to allow it to be sterilised. Failure to observe these cautions may cause internal damage to the pump.**
4. **CAUTION: Carry out periodic cleaning following the detailed instructions in the *Volumetric Infusion Pumps Service Manual*. Do not use unapproved cleaning agents.**
5. **CAUTION: When turning the pump on, if screens similar to those illustrated are not displayed, do not use the pump, and send the pump to authorised service personnel.**
6. **CAUTION: Only carry the pump by the handle. Failure to do so may result in damage to the pump, or the pump may be dropped which could cause internal damage to the pump.**
7 **CAUTION: The backlight has a limited life and may, if used constantly, cause the light to dim. Eventually the message display may then need to be replaced. To preserve the life of the message display, you should only turn on the Message Display Light as described here if it is specifically required. Misuse of this feature could lead to both battery and LCD depletion.**

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New features of version 0.71 software

The information in this section is intended for technicians and clinicians already familiar with earlier versions of the Graseby 500/505 volumetric pump. It summarises the changes to the pump that appear with version 0.71 of the pump software:

- new menu,
- new options,
- new features that the menu and options provide.

To find out the software version of a particular pump, check the instructions label on the right side of the pump. If there are more than eight options listed, then the software version is 0.71 or later.

For full details on how to use the pump see the *Volumetric Instruction Manual*. For information on configuring the pump, see the *Technical User Manual*, and for more detailed technical information, obtain a copy of the *Volumetric Service Manual*.

New Menu

A Technician Menu has been introduced, to simplify the configuration of each pump. Some of the items on the Technician Menu affect how the pump behaves; others control the options that appear to the pump user when they press the Options button to show the Options menu. The configurable items on the new Technician Menu are shown on page 12 of the *Technical User Manual*.

If the Technician Menu settings are left at their factory defaults, the pump behaves as the previous version of the pump.

New Options

The new options (and some of the previous options) can be enabled on the Technician Menu. This means that they can appear when appropriate, but can be disabled if not required. On the instruction label on the pump, Options numbered 1 to 8 are the ones that appeared in previous versions of the pump software. The additional new options shown on the label are:

- Primary infusion Minimum
- Primary infusion Maximum
- Primary Max Volume to be infused
- Secondary/Bolus Minimum
- Secondary/Bolus Maximum
- Secondary/Bolus Max Volume to be infused
- KVO Rate
- Drug Library to allow selection and display of a drug label.

New features

The new menu and new options in version 0.71 software provide a number of new features. These fall into the following broad areas:

- Infusion mode features
- Safety features
- Display features
- Servicing features.

Infusion mode features

Using the Technician Menu, the pump can be configured:

- to stop at the end of a Secondary infusion, or to continue infusing and automatically switch to the programmed Primary rate;

- to allow a Bolus infusion to be programmed where the volume infused is deducted from the primary infusion volume to be infused; to highlight this feature, the key previously called "Secondary" is now called "Secondary/Bolus"
- to allow the user to set a KVO rate for an infusion, or remain at the default rate configured for the particular pump;
- to use the Occlusion Alarm level specified for an infusion, or remain at the configured default alarm level;
- to allow access to a previously programmed Dose-Rate Calculation infusion when the pump is switched on (Dose-Rate Calculation recovery), or display the standard messages.

Safety features

- a timeout safety feature has been added. This means that when messages are not actioned within the timeout period, for example setting a value, the pump reverts to the previous display.
- safety keypad lockout, this feature is only activated when operating the pump on AC power. It allows the user to lockout the keypad after setting the pump up for use, so that it can be ready for infusion at a later time.

Configurable safety features that can be controlled on the Technician Menu are:

- automatic keypad lock after one minute, to prevent malicious tampering, and increase patient safety;
- preset rate and VTBI limits, so that Infusion Rate and Volume to be Infused are limited to a suitable range; this prevents values being programmed accidentally which are inappropriate for infusions in particular environments (such as epidural infusions, or paediatric applications).

Display features

- configured parameters are shown on the Message Display when the pump is switched on.

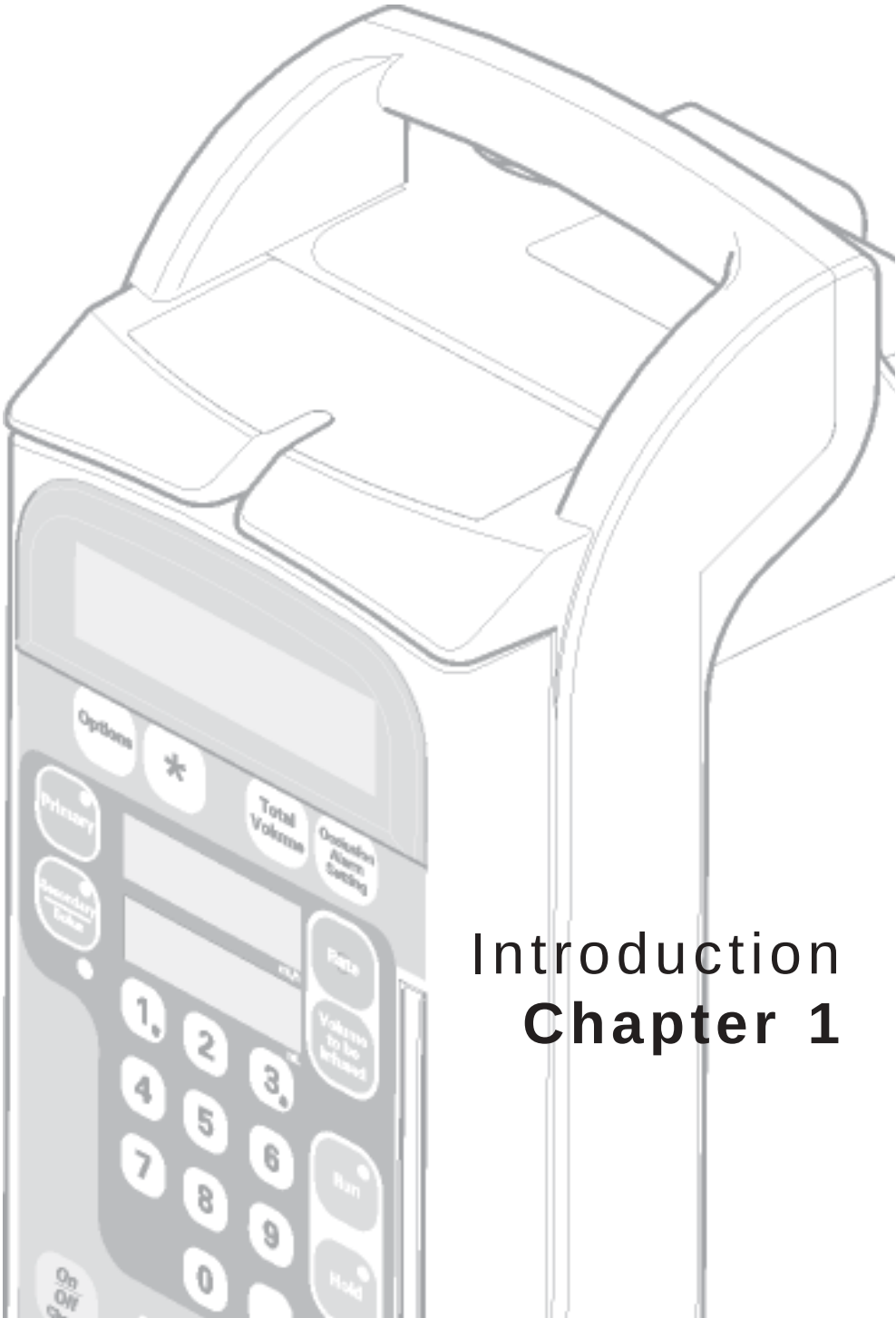
Configurable display features that can be controlled on the Technician Menu are:

- the backlight may be activated when the keypad is touched, or kept on permanently;
- one of 30 preset drug labels may be selected and viewed as required during an infusion;
- the display of micrograms (when programming an infusion using dose-rate calculation) can be shown as 'µg' or 'mcg';
- the time display may include the suffix GMT, or the suffix can be suppressed if it is not appropriate.

Servicing features

On the Technician Menu, the pump can be programmed with a pump ID to suit the hospital protocol, and a service due date:

- the ID, for example the serial number of the pump, or an alphanumeric pump name, is displayed each time the pump is turned on;
- when a Service Date is set, the date is displayed each time the pump is switched on. An alarm sounds when the date is reached.



Introduction
Chapter 1

Introduction to the 500/505 pumps

The Graseby Medical 500 and 505 Volumetric pumps are designed for use in infusion therapy in both venous and arterial infusions. They offer both standard and optional features bringing accurate fluid delivery to the patient.

This makes them ideal for use in general care, home care, and intensive/ critical care areas.

The **Model 500** and **Micro 505** pumps are very similar in design. The differences are in colour, graphics and in the maximum rate and volume to be infused that can be programmed for an infusion.

The main features of the pumps are described starting on page 1-3. For full details on the differences between the 500 and 505, see the Specification section at the end of this manual.

Read the entire contents of this manual carefully before using the pump.

Model 500 Volumetric pump

The Model 500 is designed for use in all areas, as it can be programmed with an infusion rate of up to 999 millilitres per hour, and a maximum volume to be infused of 9999 millilitres.

Micro 505 Volumetric pump

The **Micro 505** is designed for use in paediatric/neonatal environments and for fluid restricted patients. It can only be programmed with an infusion rate below 100 millilitres per hour, and the maximum volume to be infused is 999.9 millilitres.

Epidural administration

Both the **Model 500** and the **Micro 505** pumps may be used for epidural administration.

Anaesthetics

Epidural administration of anaesthetics is limited to short-term (not to exceed 96 hours) infusion, with indwelling catheters specifically indicated for short-term delivery of anaesthetic drugs.

Analgesics

Epidural administration of analgesics is limited to use with indwelling catheters that are specifically indicated for short or long term delivery of analgesic drugs.

To prevent infusion of drugs not indicated for epidural use and to avoid inappropriate delivery rates when using the pump for epidural applications:

- use the pump's Maximum Rate option, to set a maximum infusion rate of 20 mL/h on a pump to be used for epidural administration. This feature is described fully in *Chapter 3, Options*;
- do not use IV administration sets which contain injection sites;
- differentiate the pump and IV set being used for epidural delivery from those being used for other routes of administration. A yellow Epidural Label Set for the Volumetric Infusion Pump (part number TPF-00306) is available from Graseby Medical. The labels should be stuck on the front, top and sides of the pump to help staff to identify a pump that is dedicated to epidural application.

WARNING: When delivering drugs in the epidural space, use only those medications specifically indicated for epidural use. Epidural administration of other drugs could result in serious patient injury or death.

WARNING: The use of administration sets incorporating injection sites could lead to an improper or inappropriate infusion resulting in serious patient injury or death.

WARNING: Failure to clearly identify the pump and administration sets could lead to an improper or inappropriate infusion resulting in serious patient injury or death.

Pump features

The main features of the **500** and **505** pumps are listed below:

Easy to use features

The pumps have been designed to be easy to use:

- they are easy to set up and operate, yet with all the advanced features typically associated with the more complicated infusion systems;
- they have a straightforward keypad and an easy-to-read message display;
- the unique air-in-line removal system allows clearing of bubbles in the line by simply opening and closing the door: air is prevented from going beyond the cassette; this increases patient safety, minimises the risk of infection and saves operator time;
- they can be used at the bedside or as transportable equipment; using the internal battery which also switches in automatically if the pump is being used on mains power and this is interrupted.

Use of administration sets

The pumps can only be used with Graseby Medical administration sets. These administration sets have the following features:

- all Graseby Medical administration sets incorporate a safety clip to prevent accidental free flow when the administration set is removed from the pump;
- when used with Graseby Medical blood administration sets the pumps deliver blood and blood products without significant haemolysis of red blood cells.

Infusion mode features

- accurate (± 2%) fluid delivery;
- the pumps can be configured to stop at the end of a Secondary infusion, or automatically switch to infuse at the programmed Primary rate;
- a Bolus infusion may be programmed so that the volume infused is deducted from the primary infusion volume to be infused;
- KVO rate may be specified for an infusion, or remain at the default rate for a particular pump;
- the pumps offer a quick rate change feature for complete titration capability;
- automatic delivery of a secondary medication (if a secondary infusion has been set up).

Safety features

The pumps have been designed with a high emphasis on safety:

- there is an optional automatic keypad lock which prevents inadvertent operation and increases patient safety;
- the keypad can also be locked manually at any time;
- a pump may be configured so that its Infusion Rate and Volume to be Infused are limited to a suitable range; this prevents values being entered accidentally which are inappropriate for infusions in particular environments (such as epidural infusions).
- the pumps have indicators that are lit to show if they are running on battery or mains;

- when using the battery, a test is performed on power-up and the level is shown on the display; manual testing is also available;
- the pumps have an RS232 interface allowing connection to a computer for external monitoring.

Display features

Apart from the standard display, pumps can be configured to show extra information, either as a standard message display or by pressing a key to toggle the display.

Standard displays are:

- the volume infused in the current infusion;
- the infusion rate;
- the Volume to be Infused in the remainder of the infusion.

Additionally:

- the rate and volume to be infused displays are automatically adjusted to make them easy to read in any light;
- the time remaining in the present infusion may be viewed;
- the total volume of fluid delivered to your patient since the totaliser was last cleared to be viewed; also displayed with the total volume is the total time (hours and minutes) that the pump has been in use since the totaliser was last cleared;

Using configurable displays:

- the backlight may be activated when the keypad is touched, or kept on permanently;
- optionally, one of 30 preset drug labels may be selected and viewed as required during an infusion.

Occlusion Pressure features

These features increase safety in infusing fluid, particularly in critical care areas such as neonatal and paediatric care:

- when setting occlusion alarms, three standard occlusion alarm settings between 100 and 500 mmHg can be made; see the Specification section at the end of this manual for full details of the occlusion alarm values;
- the occlusion pressure alarm setting when the pump switches on is configurable; you can change the setting for a particular infusion using the ***Occlusion Alarm Setting*** key;
- when an occlusion alarm sounds, the pumping mechanism backs off to reduce downline back pressure and bolus potential (bolus potential is approximately 0.3 mL regardless of the rate and the administration set used);
- when an occlusion is detected, the pump does not give an occlusion alarm immediately, but only alarms if the occlusion pressure continues to exceed the occlusion threshold for up to 10 seconds; however, if such temporary occlusions persist, then the occlusion alarm is generated; this helps to avoid nuisance occlusions.

Special infusion features

The pumps have a number of special infusion options:

- a Volume over time option allows the user to set the volume to be infused and total time for the infusion, the pump automatically calculating the infusion rate;
- a Dose-rate calculation option which allows automatic calculation of the infusion rate by entering infusion dose; patient weight (kg or lbs); drug amount in fluid container (in MG, Gm or mcg units), and volume of fluid in the container, in mL;
- a Rate Tapering option allows automatic tapering of the infusion rate (either up or down) for administration of IV nutrition.

Multiple use features

When multiple infusion lines are required, two or three pumps can be fitted together:

- modular side rails and hooks mean that one, two, or three pumps may be connected to a single IV pole; this provides space saving;
- the modular connection system has a safety feature which ensures that the first pump must be correctly attached to an IV pole before the second and third pumps can be connected.

Servicing features

The pumps have been designed with a number of features for Biomedical engineers:

- a Service Due Indicator, allows a service date to be set, which is displayed on power-up with an alarm;
- special menus are provided to aid in testing, troubleshooting and service;
- the last 200 events are recorded and available on these menus;
- downloading of the pump history is possible using the RS232 port with a special optional kit (Part no 0150-0673).

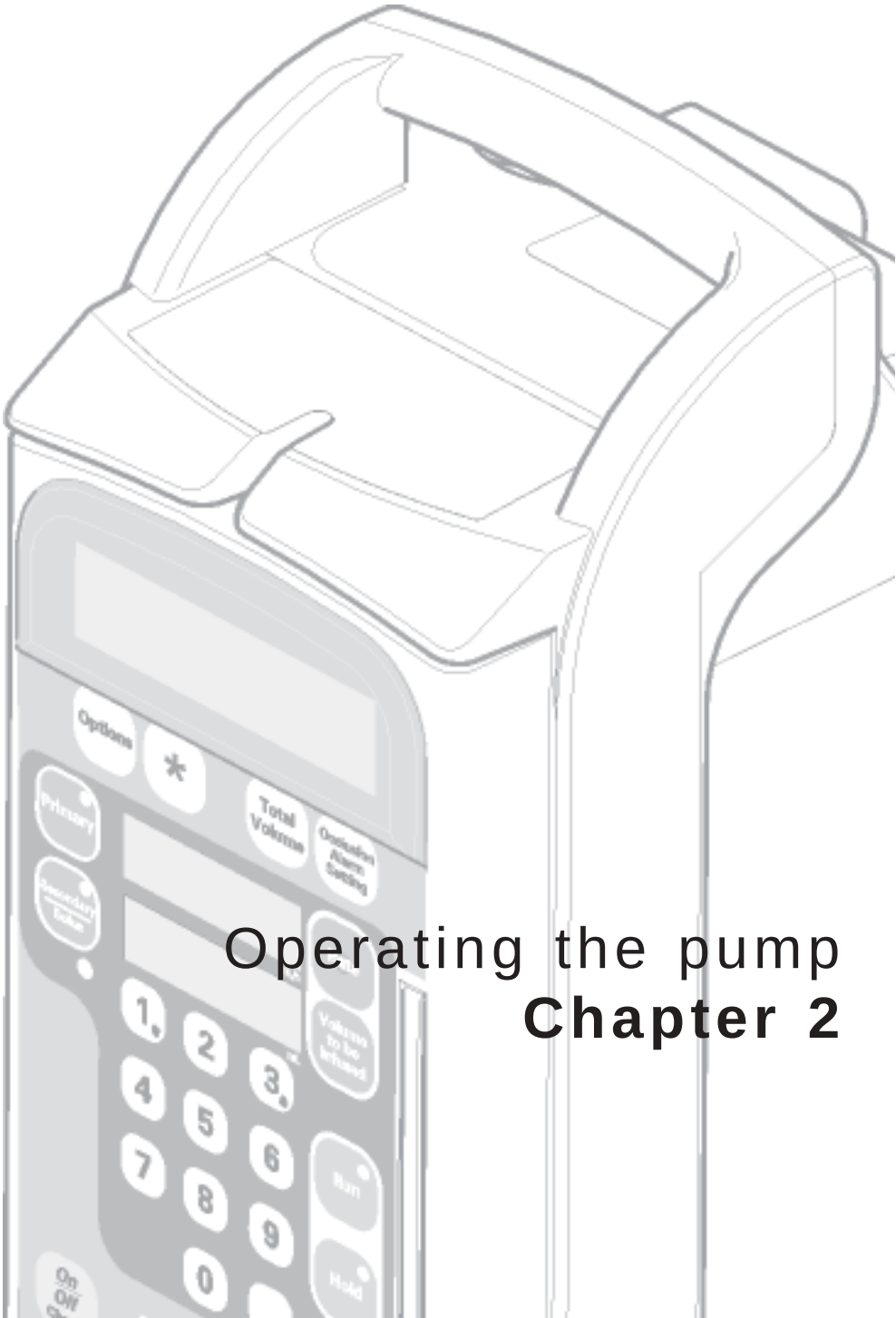
Together with the ability to configure the pump using the Technician Menu, these features offers greater management flexibility.

Instructions for using these functions appear in the Technical User Guide and the Volumetric Service Manual.

Optional features

Some pumps are optionally fitted with a Nurse-Call Feature which allows a pump to be connected to a hospital nurse call system and signal alarms occurring in the pump.

Note: This feature is not available in all countries.



Operating the pump
Chapter 2

Introduction

This chapter introduces the Volumetric pump. It explains all the terminology that you should understand, and the techniques that you use to operate the pump.

Who should read this chapter

This chapter is aimed at all users who have been trained in how to use the Volumetric pump.

It is not designed to be used as a self-teach manual, but should be used to reinforce the best-practice techniques demonstrated during training sessions.

What this chapter covers

These sections describe physical aspects of the Volumetric:

- front of the pump - indicators and displays
- front of the pump - programming keys
- rear of the pump
- attaching the pump to an IV pole
- switching the pump on and off
- using the pump on battery
- sounds on the pump.

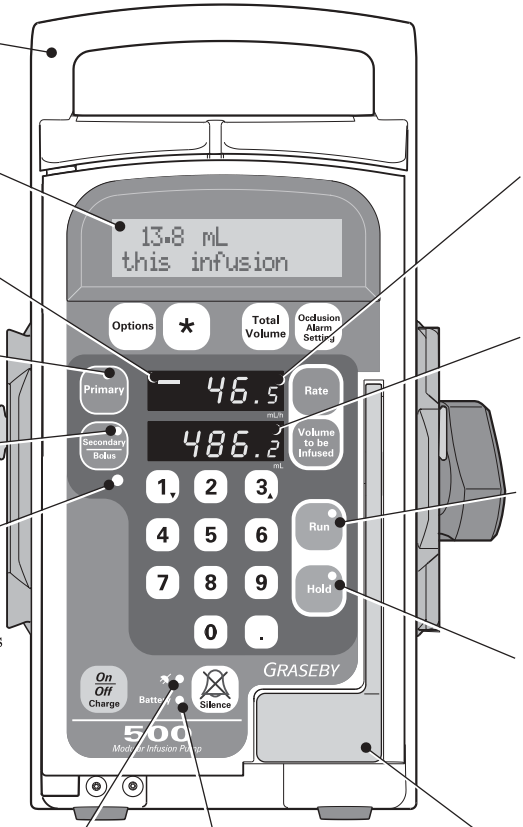
These sections explain how to program an infusion:

- types of infusion
- setting up a Primary infusion
- about Secondary infusions
- running a Bolus infusion.

This chapter does not cover the types of infusion that may be run if the pump has optional features enabled. These are described in *Chapter 3, Options.*

Front of a 500 series pump

Indicators and displays



Carry handle

Message display

Pumping indicator
moves to show the solution is being infused

Primary infusion indicator

Secondary/ Bolus indicator

Ambient light sensor
automatically adjusts brightness of message display.

Rate display
for Primary, Secondary or Bolus infusion, depending on indicator.

Volume display
for Primary, Secondary or Bolus infusion, depending on indicator.

Run
indicator ON when pump is infusing. Flashing when infusing at KVO rate.

Hold
indicator ON when pump is not infusing. Flashing when alarm sounds.

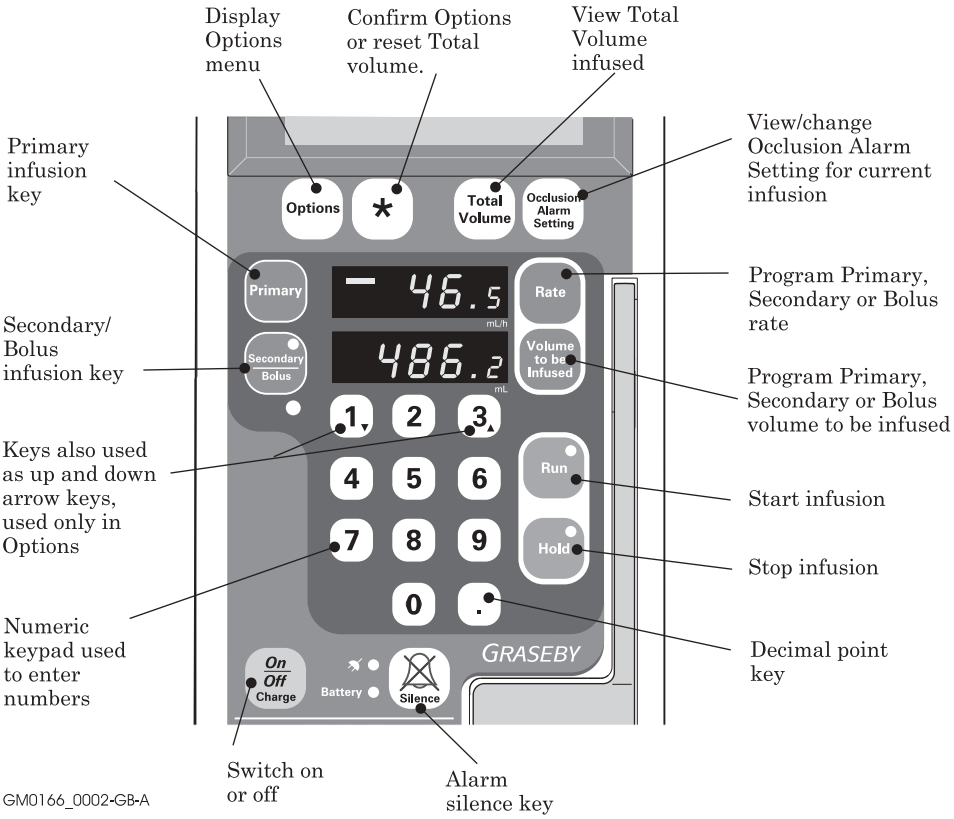
Mains indicator (green)
lit when pump is connected to AC mains supply.

Battery indicator (yellow)
lit when pump is switched on, but not connected to AC mains supply. Flashes when battery is low.

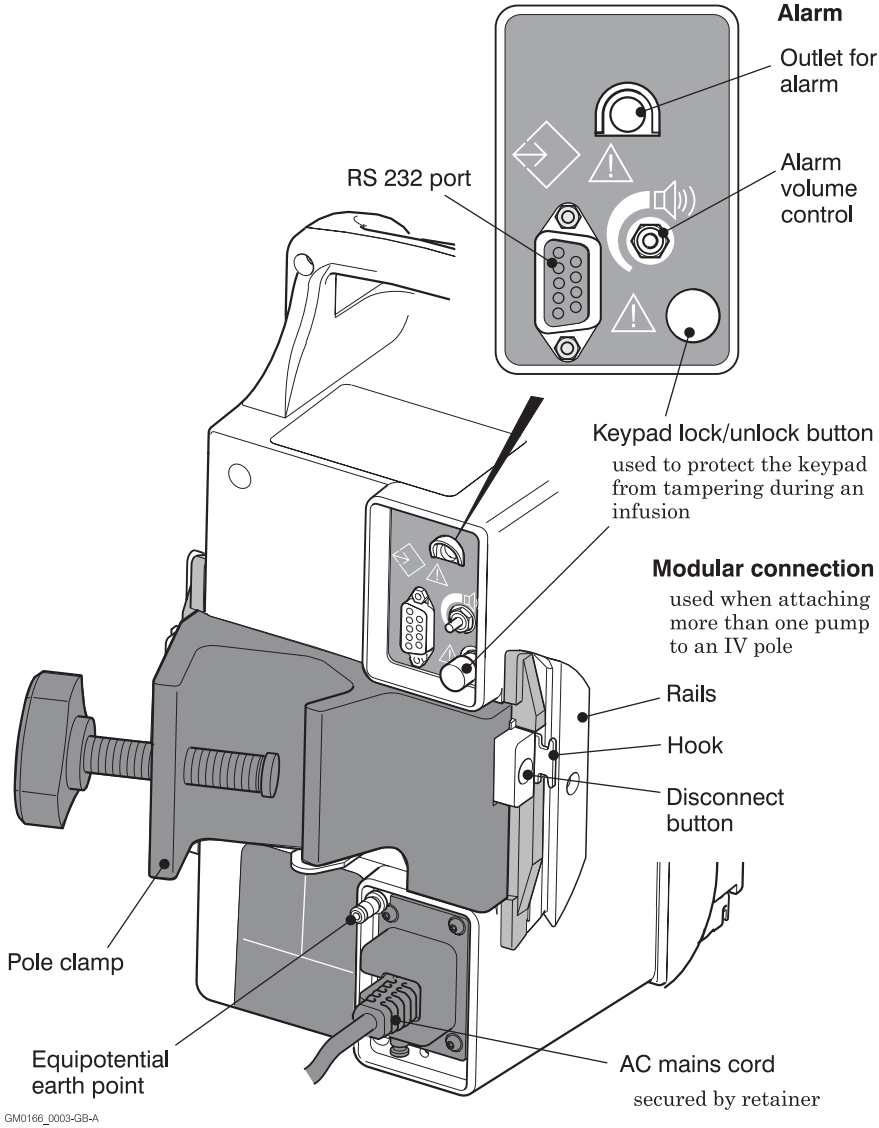
Door latch
pull the latch up and out to switch pump on and open door for loading.
Swing door closed and push the latch in to secure the door.

GM0166_0001-GB-A

Programming keys



Rear of the pump



Connecting the pumps to an IV pole

In use, Graseby Medical recommend that the pump should be connected to a suitably balanced IV pole using the pole clamp as illustrated in the diagram on the opposite page.

The diameter of the pole must be between 1.2 cm and 3.8 cm (0.5 and 1.5 inches).

To provide maximum stability when using the modular connection system, ideally, the IV pole should have 6 wheels and a low centre of gravity. The base diameter should be 56 cm (22 inches).

Attaching a single pump to an IV pole

To attach the pump to a suitably balanced IV pole:

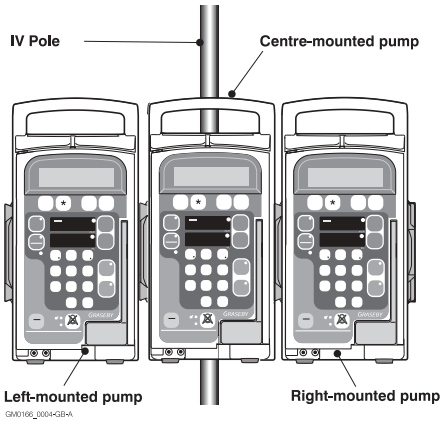
1. Loosen the screw on the pole clamp.
2. Hold the pump by the handle and slip the arms of the pole clamp onto the pole.
3. Tighten the screw on the pole clamp to firmly attach the pump to the pole.

Attaching more than one pump to an IV pole

When multiple infusion lines are required, you can connect up to three pumps to a single pole using the hooks and rails that make up the modular connection system.

As all pumps have connectors on both sides, you can use any one as the centre, left, or right pump.

This diagram shows how three pumps may be connected together using the Volumetric's modular connection system:



Inspecting the modular connections

Before connecting the pumps, you must check that the modular connection parts are all in good condition:

1. Carefully inspect the modular connection system for damage, including cracks, chips, loose or bent parts.
2. Press the disconnect buttons several times to make certain that the buttons move in and out freely.

WARNING: Do not use the pump if you detect any cracks, chips and loose or bent parts, or if the buttons do not move in and out freely when they are pressed. Failure to do so could cause inadvertent disconnection of the pumps.

How to connect pumps together

Once you have inspected the modular connection system as described in the previous section, connect the pumps as follows:

1. Clamp the first pump to the IV pole. This is now the "centre" pump.

Note: As you tighten the screw on the pole clamp, you automatically adjust the modular connection hook and disconnect button. Once the pump is securely attached to the pole, the hook is in the correct position to allow you to connect further pumps.

2. Take the second pump, grasping it by the handle and hold it so that the modular connector rails are directly above or below the connector rails of the centre pump.
3. Engage the edges of the modular connector rails and slide the second pump up or down until it is connected to the centre pump. When the connection is secure, you hear a distinct click.
4. Before releasing the handle of the second pump, double-check that the connection is secure by moving the pump up and down and exerting pressure on the top of the pump.

To attach a third pump to the other side of the first pump, repeat steps 2, 3 and 4.

Note: If the connection is loose, or the pumps seem to wobble, disconnect then carefully reconnect them, making sure both edges of the modular connectors engage. Do not use pumps where the connection is loose, but return them to a suitably qualified technician for repair.

Moving an IV pole with pumps connected

If you need to move the IV pole once the pumps are attached, always ensure that you grasp the IV pole with one hand and steady the pumps with the other hand if necessary.

Disconnecting modular connected pumps

You must always disconnect modular connected pumps one by one before removing the centre mounted pump from the IV pole.

Disconnect the left and right hand pumps from the centre mounted pump as follows:

1. Grasp handle of pump to be removed.
2. Lift the pump slightly.
3. Press the disconnect button and slide the pump up or down to disconnect from the centre pump.
4. Place the pump in a location where it will not be damaged.

WARNING: Do not push or pull on the pumps, or the IV pole may tip over or the pumps fall to the floor.
Do not try to remove modular connected pumps from the IV pole whilst they are joined together.
Either of these could cause the administration set to separate from the fluid container thus spilling the medication, or the pumps themselves could be damaged.

Switching the pump on and off

Before switching the pump on, visually check for any cracks on the case, or damage to any part of the pump or its connectors. Plug the AC mains cord into an AC mains supply if possible. If necessary, the pump can be run on its internal batteries, see *Using the pump on batteries*, later in this chapter.

Switching on

To switch on the pump you can do either of the following:

- press the ***On/Off*** key
- open the front door by lifting the latch.

Note: If the pump is switched off and connnected to AC power and the saftey keypad lockout feature is active, the pump cannot be switched on via the keypad, see *Safety keypad lockout*, page 2-22.

Switch on in Quiet Pump mode

If you want to use the pump without any key clicks and also suppress the non-insistent alarms, you can switch on in "quiet pump" mode:

1. Press the ***Silence*** key and keep it pressed down.
2. Press the ***On/Off*** key.

Note: Quiet Pump operation is cancelled when you turn off the pump.

Self test

When you switch it on, the pump carries out a series of tests to ensure that all components are functioning correctly. If any electrical or mechanical problems are detected, or if any potential problems are detected, then a message is displayed and the alarm sounds. See *Chapter 4, Troubleshooting* for more details on handling alarms.

Message Display at Switch on

The messages displayed when you switch on the pump depend on which features have been enabled on the pump and whether or not it is connected to the AC mains supply.

If all the pump options have been enabled, the pump displays messages to provide you with the following information about itself:

- Pump Identifier
- Drug Label
- Primary Min Rate and Max Rate
- Primary Max VTBI
- Battery gauge (displayed only if the pump is disconnected from the AC mains supply)
- Service due date.

After switching on

When the pump has completed its self tests, it is ready for you to program, load a cassette (see page 2-18), or start an infusion. You see a screen something like this:

Switching off

For safety reasons, the front door must be properly closed and any infusion must be on Hold before you switch off the pump.

- If the pump is running an infusion, press the ***Hold*** key;
- if the front door of the pump is open, close it with the latch;
- then press the ***On/Off*** key.

Using the pump on battery

The pump contains an internal rechargeable battery. However, in everyday use, the pump should be connected by its cord to a suitable AC mains supply, if one is available. The battery is then kept fully charged, and will continue to be charged whilst the pump is infusing.

The pump automatically uses the battery:

- if you switch on whilst the power cord is unplugged, or
- if the AC power fails whilst the pump is operating.

Switching on using the battery

When you switch on the pump, if it is being powered by internal battery:

- you need to hold down the ***On/Off*** key to turn the pump on. If the pump is operating on the AC mains supply, it switches on instantaneously when you touch the ***On/Off*** key;
- there is a short pause whilst the pump carries out the Battery Test and displays the Battery Gauge screen to indicate the current battery capacity:

Note: The battery is always tested when the pump is switched on, even though the Battery Gauge is not displayed during Dose-Rate Calculation, DRC Recovery or Rate Taper infusion start up.

Testing the battery

At any time when operating on battery, you can check the battery capacity by carrying out the Battery Test described in *Chapter 3, Options*.

Operating using the battery

During operation of the pump on battery:

- the yellow Battery indicator is lit
- the Message Display light turns off if the pump is left on Hold, unless you have set the 'Backlight on' option, described in *Chapter 3, Options*.

Low battery

When you switch on the pump, and during operation, the pump warns you when the battery capacity is low. If you see the yellow Battery indicator flashing whilst the pump is infusing, you should plug the power cord into the AC mains supply as soon as possible.

Low battery alarms

When approximately one hour of operation remains, the pump sounds an alarm and displays this message:

If you see this message, plug the power cord into the AC mains supply as soon as possible.

If you decide that you must continue to use the pump on battery, another alarm sounds approximately half an hour before it is fully discharged.

This message is displayed:

It is essential that the pump is plugged into the AC mains supply at this point.

WARNING: Correct management of battery charging, as described in this documentation is essential to ensure that the pump can operate on battery for the time specified. Failure to do so may result in compromised function of the product or patient injury.

Recharging the battery

To charge the battery, plug the power cord into the AC mains supply.

It takes approximately 10 hours to recharge a completely depleted battery.

Capacity

A new, fully charged battery will operate the pump for approximately 6 hours at 100 mL/h (99.9 mL/h on Micro 505).

The battery may discharge more quickly if the battery has aged and is in a poor condition even though it was recently charged.

Pump in storage

You should connect the pump to the AC mains supply to charge the battery every three months, even when the pump is not in service. This helps to maintain the life of the battery.

Sounds on the Volumetric

The Volumetric pump makes a 'click' sound as you press each key. It also sounds an audio alarm to alert you to a condition that requires attention on the pump: either an insistent (three-tone) or non-insistent (two-tone) alarm. The click and non-insistent alarm do not sound if the pump is switched on in Quiet Pump mode. See next page. As a further safety feature, the Volumetric emits a high-pitched system alarm to indicate a problem requiring the attention of a Graseby Medical qualified technician.

Audio alarm

When the Volumetric pump requires attention, it uses an audio alarm to indicate that there is a problem.

Whilst sounding the alarm, it also displays a message to explain the problem. A full list of all the alarm messages, their possible causes and how to solve the problem is explained in *Chapter 4, Troubleshooting.*

This section explains the different types of alarm sounds made by the pump.

You may hear three types of alarm from the Volumetric:

- insistent
- non-insistent
- continuous (backup alarm).

Insistent alarm

This type of alarm indicates that fluid delivery has stopped, or cannot be started. It alerts you to a condition that must be corrected before the infusion can be started, or continued, for example if an occlusion is detected.

The insistent audio alarm consists of three tones: two high-pitched and one low-pitched, repeated at two-second intervals.

To silence an insistent alarm, press the ***Silence*** or ***Hold*** key. The alarm will recur unless you correct the problem as described in *Chapter 4, Troubleshooting.* This chapter describes each alarm, its cause and action to take.

Non-insistent alarm

This type of alarm alerts you to a condition that needs attention, but has not caused the infusion to stop. For example, you hear a non-insistent alarm if the pump is running on batteries and the batteries are low, or if the infusion has switched to a KVO rate.

The non-insistent audio alarm consists of two tones, one high-pitched and one low-pitched, repeated at two-second intervals. To silence this type of alarm:

- press the ***Silence*** or ***Run*** key to silence the alarm without stopping fluid delivery;
- press the ***Hold*** key to silence the alarm and stop fluid delivery.

Note: In Quiet Pump mode, there is no audio alert for certain non-insistent alarms. See the next page for more details.

Continuous - backup alarm

In addition to the insistent and non-insistent operational alarms, the Volumetric pump has a fail-safe backup alarm system. This has a distinctive high-pitched tone:

- should the audio alarm system fail, then the pump sounds the backup alarm, with a 1.5 second pause between alarm tones;
- should an electromechanical system failure occur, the pump sounds the backup alarm continuously.

If you hear the backup alarm sounding, you should immediately remove the pump from the patient and have it repaired by a Graseby Medical qualified technician.

Quiet Pump mode

In some circumstances, it may be desirable to operate the Volumetric without the associated sounds.

For safety reasons, you cannot turn off the insistent or continuous alarms, but if necessary you can operate the pump without the key-press 'click' sound and certain non-insistent alarms. This is called a 'Quiet Pump' infusion.

To run a 'Quiet Pump' infusion:

1. Ensure that the pump is turned off.
2. Press ***Silence*** and keep it held down.
3. Turn on the pump with ***On/Off.***

The keypad click and non-insistent alarm sound is now off. The pump remains in Quiet Pump mode until you switch off and then on again.

Silent alarms in Quiet Pump mode

When running the pump in Quiet Pump mode, certain alarms associated with a Secondary infusion are silent. The alarm is silent in the following circumstances:

- when the pump automatically switches from Secondary to Primary when the Secondary infusion is complete;
- when you program the Secondary infusion, but press the ***Primary*** key then the ***Run*** key without running the Secondary infusion;
- when you press ***Run*** to start the Secondary infusion with the Volume to be Infused set to zero.

Alarms and computer control

If a pump is being run under computer control, you can silence it from the computer. However, you must resolve the problem causing the alarm on the pump.

WARNING: If a backup alarm sounds, the pump should be immediately removed from the patient and sent to be repaired by a Graseby Medical qualified technician. Failure to do so may cause patient injury or death.

Types of infusion

Hospital protocols dictate how the Primary, Secondary and / or Bolus features are used, and the pump should be configured to conform with these protocols.

This section summarises the typical use of these features of the pump.

Using the pump, you may carry out:

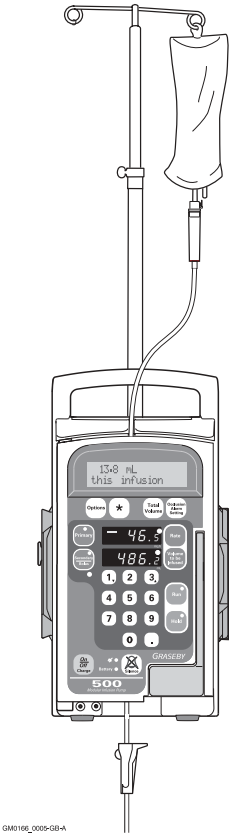
- a Primary infusion
- a Primary and a Secondary infusion
- a Primary and a Bolus infusion.

Primary

For a Primary infusion, you set up the pump to deliver solution from a single container. This diagram shows an example of how a pump looks when set up for a Primary infusion using a Standard administration set (8C-820)

The pump's Volume to be Infused Display shows the remaining Volume to be Infused and on its Message Display the pump shows the total infused so far.

For full details on how to set up a Primary infusion: see *Setting up a Primary Infusion*, page 2-16.



Primary and Secondary

For a Primary and a Secondary infusion, two containers are used:

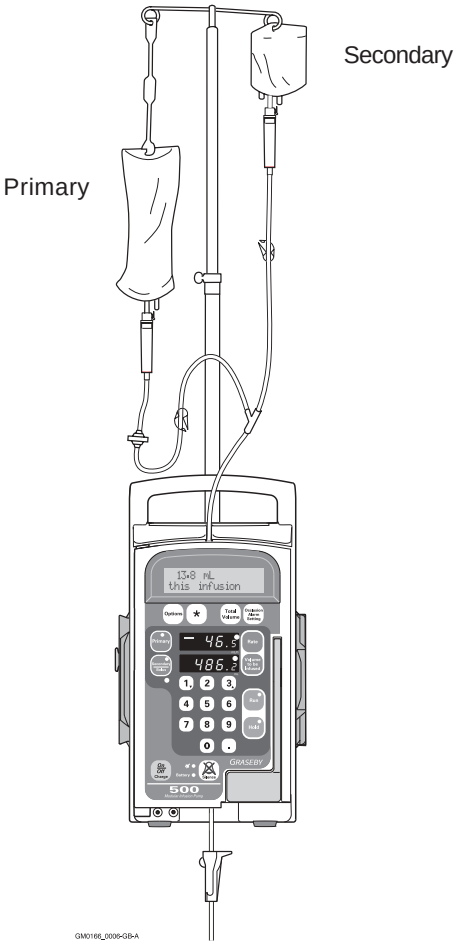
- one to deliver the Primary infusion, for example, a hydration solution;
- a second to deliver an additional infusion, for example an antibiotic dose; this is sometimes called a "piggyback" infusion.

The pump keeps separate totals for the Primary and Secondary infusions: the total infused in the Secondary infusion is not deducted from the Primary Volume to be Infused.

The pump can be configured to work in one of two ways at the end of the Secondary infusion: see *Ending a Secondary infusion*, over the page.

For full details on how to set up a Secondary infusion:

- first follow the steps in *Setting up a Primary Infusion*, page 2-19;
- then see *About Secondary Infusions*, page 2-26.



Secondary infusion with Bolus enabled

The pump can be configured, using the Technician Menu, to offer a Bolus infusion as an alternative to the Secondary infusion. If the Bolus feature is enabled, you can:

- run a Secondary infusion, where the volume infused is not deducted from the Primary Volume to be Infused

or

- run a Bolus infusion, where the volume infused is deducted from the Primary Volume to be Infused.

Primary and Bolus

With the pump configured to offer the Bolus feature, you can carry out a Bolus infusion as an alternative to the Secondary infusion.

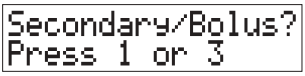
A Bolus infusion may be administered at a different rate, with the volume to be infused entered separately to the Primary volume, just as for a Secondary infusion.

However, for a Bolus infusion, the Volume infused is **deducted** from the **Primary** Volume to be Infused.

At the end of the Bolus, the pump reverts to the Primary infusion at the previously programmed Primary rate.

The Secondary Stop feature, if enabled has no effect at the end of a Bolus.

When the Bolus feature is configured, each time you press the ***Secondary/ Bolus*** key, the Message Display shows:



At this point, you would press 3 to enter Rate and Volume to be Infused for the Bolus, or to view the totals for the Bolus infusion.

For full details on how to administer a bolus infusion, see *Running a Bolus Infusion* on page 2-31.

Ending a Secondary infusion

The Secondary Stop feature in the Technician Menu controls how the pump works when the Secondary infusion is complete.

- With Secondary Stop *disabled*, the pump automatically reverts to the Primary infusion at the previously programmed rate, so that there is a continuous flow. When the Primary infusion starts a non-insistent alarm sounds.
- With Secondary Stop *enabled*, the pump stops and sounds an alarm until you manually silence it and start the Primary infusion.

The effect of Options settings on infusions

Some of the Options settings can affect the way you program the infusion, what you can do during the infusion, or the way the pump behaves. For example, if the pump has the appropriate Options enabled on the Technician menu, you may choose to:

- turn on the Message Display backlight
- set the KVO rate
- select a Drug Label
- program a Dose-Rate Calculation, Volume Over Time or Rate Taper infusion.

However, the settings which may most affect the way you program an infusion are Rate and VTBI limits. Such limits restrict the values you can use during an infusion and their use is described below.

If you need to make any changes to these Options settings, you must do so before programming the infusion. See *Chapter 3, Options* for full details.

Infusing with Rate and VTBI limits enabled

If the features for setting limits are enabled on the Technician Menu, the limit values can be set or examined using the ***Options*** key. They can be set independently for Primary and Secondary infusions and may not all be enabled. If Primary Rate or VTBI limits are enabled, you can also see the settings displayed after the pump is switched on.

When limits are enabled, you cannot run an infusion with a Rate or Volume to be infused set outside the limits. Also, you cannot change the rate while running to go outside the limits. If you try to do this, or if you program a value outside the limits and then press the ***Run*** key, you see the message:

```
Preset Limits
 Exceeded
```

Wherever possible check or set the limits before you program the infusion, especially if you might have to give a Secondary infusion or a Bolus. The easiest way to check Primary infusion settings is to look at the message display when you switch the pump on. To check Secondary infusion settings, you must use the ***Options*** key. Setting limits is described in *Setting Rate and VTBI limits* on page 3-29 in Chapter 3, *Options.*

Limits are enabled and set for a safety purpose (for example, where the pump is used for Epidural administration). If you are likely to be in a situation where you have to give an infusion in an emergency, ensure that when a pump is switched off, the limits are left with safe value settings.

Setting up a Primary Infusion

To set up and run a Primary infusion the main steps are:

- attach the pump to the IV pole, described on page 2-5;
- set the Options for the infusion if appropriate, particularly Rate or VTBI Limits if they are enabled as described on page 2-15;
- prepare the solution;
- prime the administration set;
- load the administration set into the pump;
- program the infusion;
- start the infusion.

Prepare the solution

Using an aseptic technique, prepare the solution container and prime the administration set following the instructions provided with the set. As a guide:

1. Remove the solution container from its packaging and remove the cap from the fluid outlet.
2. Remove the administration set from its packaging and close the roller clamp.
3. Remove the cap from the spike on the administration set and insert the spike into the fluid outlet on the solution container.
4. Hang the container with the administration set on the IV pole and ensure that the container is the correct height above the pump.

WARNING: Correct entry of data is essential in order to ensure that the intended infusion is performed. Before confirming any displayed data when setting up an infusion, you should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.

Height of solution container above the pump

If necessary, adjust the height of the pole so that the bottom of the solution container is between 15 cm and 30 cm (between 6 inches and 12 inches) above the top of the pump

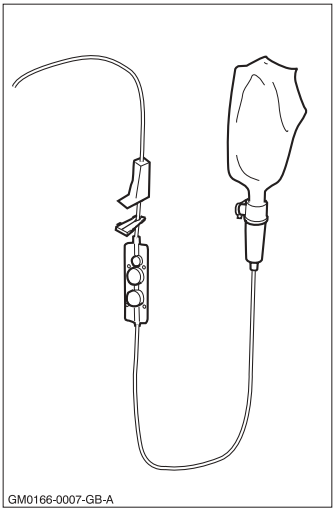
On Model 500, 30 cm (12 inches) may be required for rates over 500 mL/h.

On both Model 500 and Micro 505, 30 cm (12 inches) may be required when using thick solutions and/or 60 drops/mL sets.

Note: A thick solution in this case may be certain cytotoxic agents, lipid-based fluids and other viscous solutions, for example Total Parenteral Nutrition.

Prime the administration set - Example

You must always follow the *Instructions for Use* that accompany the administration set to be primed. This section shows an example to explain the basic priming steps to be carried out on an administration set without a bi-directional check valve, filter, injection site or c-clamp.



With the solution container hanging on the IV pole and the administration set spike inserted into the container, prime the administration set as follows:

WARNING: Remove any air to prevent air embolism. The presence of air within the infusion can result in complications resulting in patient injury or death.

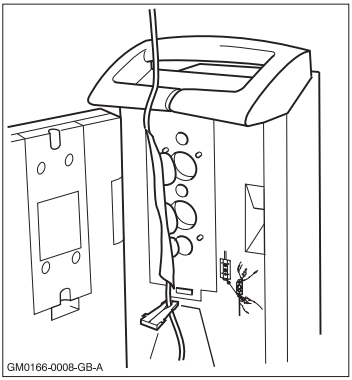
WARNING: Use only Graseby Medical administration sets with this product. Failure to do so may result in compromised system accuracy leading to complications resulting in patient injury or death.

1. Squeeze the drip chamber and fill until it is at least one third full. The drip chamber may fill completely during loading and/or an infusion. This will not adversely affect the fluid delivery or the operation of the pump.
2. Hold the cassette inverted, so that the roller clamp is above the cassette, as shown here.
3. Slowly open the roller clamp to allow the solution to flow through and prime the cassette and the line. You can control the flow by moving the roller clamp as necessary.
4. When the entire set is primed, close the roller clamp.

WARNING: To avoid over infusion, do not prime the infusion line when the administration set is connected to the patient. Over infusion can result in patient injury or death.

Load the cassette into the pump

With the administration set primed and the solution container hanging on the IV pole, you can load the cassette into the pump as follows:



1. Open the door of the pump by raising the latch.
2. With the flat side of the cassette towards you, and the roller clamp below the cassette, match the four holes in the corners of the cassette with the four metal pins inside the pump.
3. Press the cassette into place and run your finger down the cassette to ensure that it is flat and correctly fitted.
4. Slide the safety clip up to the base of the cassette and push it fully inward, into its slot.
5. Close the door, pushing the latch into place.

The safety clip on the administration set is marked with arrows to indicate the correct direction for insertion.

The pump is marked with a diagram showing the position of the safety clip slot.

Setting the Occlusion Alarm

When you switch the pump on, the Occlusion Alarm setting is always the same, and is defined by the Technician Menu configuration setting.

Before an infusion, always check, and if necessary, change the setting to suit the infusion by pressing the ***Occlusion Alarm Setting*** key. Continue pressing the key until you see the setting you want. Never use a *Low* setting with high infusion rates.

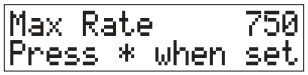
For full details, see *Change the Occlusion Alarm setting*, on page 2-24.

See the *Specification* section at the end of this manual for details on the pressure values for High, Medium and Low settings.

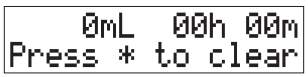
WARNING: The Occlusion alarm level must be checked before starting an infusion to ensure that it is appropriate for the infusion. Failure to do so may result in an unacceptably slow time to Occlusion alarm, resulting in patient injury or death.

Primary infusion setup

Once the solution is ready and the cassette is loaded into place in the pump, check that the Primary indicator is lit. If not, press the ***Primary*** key.



1. If Min and Max Rates and Max VTBI are enabled on the pump, ensure they are appropriate for the infusion by pressing the ***Options*** key. To find out more see page 2-15.



2. If the infusion is for a new patient, or if you need to clear the totals for this patient, press ***Total Volume*** then press *******.

3. Press the ***Occlusion Alarm Setting*** key to display the current setting and continue pressing if necessary to set an appropriate level.

4. Press the ***Rate*** key then use the keypad to enter the infusion rate in mL/h.

5. Press the ***Volume to be Infused*** key then use the keypad to enter the volume in mL.

   Ensure that the Rate and Volume to be infused are correct for this Primary infusion then open the roller clamp. Inspect the fluid path for kinks, a closed clamp, or any other upstream obstructions.

6. Press the ***Run*** key to start the infusion.

WARNING: The Occlusion alarm level must be checked before starting an infusion to ensure that it is appropriate for the infusion. Failure to do so may result in an unacceptably slow time to Occlusion alarm, resulting in patient injury or death.

WARNING: Prior to starting an infusion, inspect the fluid path for kinks, a closed clamp or other obstructions. Failure to do so may result in the infusion not being delivered correctly, resulting in patient injury or death.

During the infusion

This section explains the main activities you may want to carry out once you have started the infusion.

When the infusion is running, you can:

- see the progress of the infusion from the information shown on the different displays on the pump;
- change the infusion rate;
- lock the keypad to provide security on the pump;
- display the drug label (if this feature is enabled);
- stop the infusion.

If you press ***Hold*** to stop the infusion, you can:

- change the occlusion alarm setting (see page 2-24);
- set up and start a Secondary infusion (see page 2-26).

If the infusion will not start running

This will only occur if you have one or more of the following features enabled on the Technician menu:

- Min and Max Rate;
- Max VTBI.

If you have entered a rate which is outside the set limits, or a VTBI which is greater than the maximum, when you press ***Run*** you see the message:

and an alarm sounds. The Rate or VTBI display also changes to the one used before you programmed the infusion.

If this happens, you should:

1. Silence the alarm.
2. Check the Rate or VTBI display to see which has changed to find out which limit has been exceeded.
3. Check the prescription.
4. Check the Min and Max Rate and Max VTBI settings by pressing the Options key until each is displayed.
5. Make corrections as necessary.
6. Press ***Run*** to start the infusion.

Infusion information displays

Message Display

The Message Display starts at zero and counts up in mL to show the volume infused so far, for example:

Rate display and Pumping indicator

The Rate display shows the infusion rate. The Pumping indicator is a horizontal line located at left of the Rate display.

The indicator moves to show that the solution is being infused. The speed of the Pumping indicator is approximately proportional to the infusion rate.

Volume to be Infused display

The Volume to be Infused display initially shows the programmed volume. During the infusion, it counts down to show the volume remaining for this infusion.

Original volume to be infused

To find out the original programmed Volume to be Infused, add the amount in the Volume to be Infused display to the amount in the Message Display.

Running Rate Change (Rate titration)

Whilst the pump is running, you can change the infusion rate. For example, you may need to adjust the initial rate once the infusion is established.

You can also stop the infusion and then change the rate, but the ability to change without stopping the delivery of the solution is especially important with some drugs, for example, vasoactive drugs.

You can carry out a running rate change on Primary or Secondary infusions.

Once the infusion has started, to enter a running rate change:

1. Press ***Rate.***
2. Enter the new rate using the numeric keypad.
3. Press ***Run*** within 10 seconds.

If you do not complete the rate change within 10 seconds, an alarm sounds and the rate reverts to the previous running rate, followed by a message to tell you the change has not been completed.

If rate limits are enabled, and you enter a rate that is outside those set, an alarm sounds and you see:

The pump continues at the previous rate. Silence the alarm and check the current settings using the ***Options*** key. If you need to change the rate limit, you must first put the pump on hold.

Security on the pump

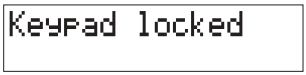
To prevent any tampering with the keypad during the infusion, there are two ways to secure the keypad:

- manual locking
- automatic locking.

Manual keypad locking

This safety feature is always available on the pump, whether or not the automatic keypad locking feature is enabled.

To lock the keypad during an infusion, press the grey Keypad lock button on the rear of the pump. The Message Display confirms that the keypad is locked:



If you touch any of the keys on the keypad once it is locked, the pump re-displays the message.

Safety keypad lockout

The saftey keypad lockout is only active when operating the pump on AC power. It allows the user to 'lockout' the keypad, so that after setting up the pump for use, it is ready for infusion at a later time.

To set the saftey keypad lockout, switch the pump off and connect to an AC power supply. Then press the keypad lock button once. If you now attempt to switch the pump on, the keypad is locked out and the pump inactive. The pump can only be switched on by:

- pressing the keypad lock once and then switching the pump on using the On/Off key
- or by opening the door.

If the AC power supply is removed during the 'lockout', the feature is abandoned, pressing the On/Off key switches the pump on. If the AC power is removed and reconnected without any user interface with the pump, the lockout remains active. When the pump is used on battery power this feature is inactive.

Automatic keypad locking

Before starting the infusion, you can enable the Autolock Keypad feature in the Technician Menu.

With Autolock Keypad enabled, the keypad locks automatically if you leave the pump untouched for one minute.

If you touch a key, the Message Display reminds you that the keypad has been locked:

Unlocking the keypad

To unlock the keypad once it is locked, press the grey Keypad lock button on the rear of the pump:

- for a manually locked keypad, press the button once;
- for an automatically locked keypad, press the button twice.

To silence alarm with keypad locked

If the pump is sounding an alarm whilst the keypad is locked, you must:

- first unlock the keypad with the button on the rear of the pump,
- then press the ***Silence*** key.

Display the Drug Label

The pump may be configured, in the Technician Menu, to display the Drug List.

If the Drug List is enabled, you can display the Drug Label that was last selected using the ***Options*** key.

To display the Drug label on the Message Display for two seconds:

- press the ***** key.

For more information on Drug Labels, see *Chapter 3, Options*.

Stop the infusion

To stop the infusion at any time:

- press the ***Hold*** key.

If an occlusion is detected

If an occlusion is detected, the ***Run*** light remains lit, but the Pumping indicator stops. The pump does not give an occlusion alarm immediately, but only alarms if the occlusion pressure continues to exceed the occlusion threshold for 10 seconds. This helps to avoid nuisance occlusions.

However, the pump monitors any temporary occlusions, and if such occlusions persist, then the occlusion alarm is generated.

If an occlusion is detected when the occlusion alarm is set to Low, the pump alarms immediately.

If an occlusion alarm occurs

If an occlusion alarm occurs, immediately clamp the line to the patient. Then inspect the fluid pathway to determine what has caused the obstruction.

Change the Occlusion alarm setting

You can check the current occlusion alarm setting when an infusion is running if you press the ***Occlusion Alarm Setting*** key. You can change the setting if you first put the infusion on ***Hold***, see steps in opposite column.

When you switch the pump on, the Occlusion Alarm setting is always the same, and is defined by the Technician Menu configuration setting. You should set the alarm to be appropriate for the infusion before pressing ***Run***.

The occlusion alarm setting determines the amount of back pressure allowed before the pump alarms. There are three possible settings: Low, Medium or High.

When an occlusion alarm occurs, the pumping mechanism backs off to reduce down-line pressure and bolus potential (bolus potential is approximately 0.3 mL regardless of the rate and the administration set used).

Whilst the pump is infusing, particularly at higher infusion rates, or with thick solutions (see Note opposite), or with small diameter cannulas, you may see the following alarm message:

WARNING: If using a blood pressure cuff above the patient's venipuncture site take extra care in setting the Occlusion alarm pressures. Failure to do so may result in unnecessary Occlusion alarms, resulting in patient injury or death.

If there is no obvious reason for the alarm, the message may occur because you have not selected an appropriate Occlusion Alarm Setting for the infusion. If this is the case, you may want to change the Occlusion Alarm Setting.

To change the Occlusion Alarm Setting during an infusion, whether or not an alarm has occurred:

1. Press ***Hold*** to silence the alarm if necessary, and stop the infusion.
2. Press the ***Occlusion Alarm Setting*** key once to display the current setting.
3. Press the ***Occlusion Alarm Setting*** key repeatedly to display the available settings.
4. When the correct setting is displayed, press ***Run***.

Note: A thick solution may be certain cytotoxic agents, lipid-based fluids and other viscous solutions, for example Total Parenteral Nutrition.

Approximate Occlusion alarm settings

Low	2 psi, 103 mmHg, 13.5 kPa
Medium	5 psi, 259 mmHg, 34.5 kPa
High	10 psi, 517 mmHg, 68.9 kPa

WARNING: The Occlusion detection system measures downline back pressure in the administration set, but does not detect infiltration. In accordance with local protocol, you must periodically inspect the patient's infusion site for signs of infiltration. Failure to do so may result in an unacceptably slow time to Occlusion resulting in patient injury or death.

Ending the Primary infusion

The pump warns you that the infusion is complete when the Primary Volume to be Infused reaches zero.

At this moment, the pump sounds a two-tone alarm. You can decide to:

- silence the alarm and stop the infusion - press the ***Hold*** key
- silence the alarm and continue to infuse at the KVO Rate - press the ***Silence*** key (see details below).

KVO infusion

If you press ***Silence*** to stop the alarm, the pump continues to infuse at the KVO (Keep Vein Open) rate. The KVO rate is shown on the Rate display.

Depending on how the pump is configured, the KVO rate may be:

- the default KVO rate of 3.0 mL/h,
- the programmed infusion rate if that was less than 3.0 mL/h;
- the KVO rate specified for this pump, see *Specifying a different KVO Rate*, below.

The Message Display shows "KVO", as well as the combined Primary and KVO volume infused, for example:

The pump continues to infuse at the KVO rate. After six minutes, the two tone alarm sounds again, as a reminder that the KVO infusion is still running. You can decide to:

- silence the alarm and stop the infusion - press the ***Hold*** key
- silence the alarm and continue to infuse at the KVO Rate - press the ***Silence*** key.

Specifying a different KVO rate

If the 'KVO Rate Entry' option has been enabled in the Technician Menu, you can use the ***Options*** key to specify a KVO rate, before you start the infusion.

When you set the KVO rate you can go to a maximum of 10 mL/h (on a 500 pump) or 3mL/h (on a 505 pump) or the Max Primary Rate if one is also enabled and set below these limits.

If the programmed infusion rate is less than the set KVO rate, when the pump goes into KVO, it will continue pumping at the programmed lower rate.

For full details on how to set the KVO rate, see *Chapter 3, Options*.

About Secondary infusions

The pump has the facility for you to set up and run a Secondary infusion, for example, to:

- administer a dose of antibiotics to a patient who is already receiving a Primary infusion;
- administer a loading dose of a drug, of a different concentration of the same drug as in the Primary container.

You use the ***Secondary/Bolus*** key to program a Secondary infusion. The Secondary volume infused is kept as a separate total. It is not deducted from the Primary Volume to be Infused.

Once you have started an infusion from the Secondary set, the solution from the Secondary container takes precedence over the Primary infusion. For details on what happens if the Volume to be Infused is less than the contents of the Secondary container, see page 2-27.

Secondary Rate and VTBI limits may be set if enabled in the Technician menu. See page 2-15 for more details.

Bolus feature enabled

If the Bolus feature has been enabled in the Technician Menu, you can use the ***Secondary/Bolus*** key to:

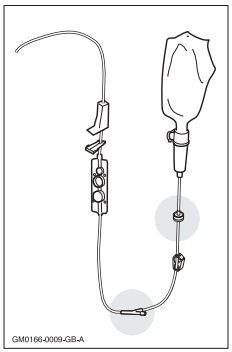
- run a **Secondary** infusion, where the volume infused **is not deducted** from the Primary Volume to be Infused;

or alternatively,

- run a **Bolus** infusion, where the volume infused **is deducted** from the Primary Volume to be Infused.

Setting up a Secondary infusion

To set up a Secondary infusion, you need a means of combining a Primary and Secondary infusion. This may be the combined Primary/Secondary (8C-6200) IV Administration set from Graseby Medical, product code 591.096.



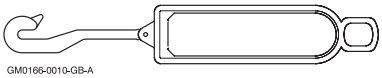
Alternatively, use an administration set with an injection site or Y-site (as shown here) plus a Secondary Administration set (not shown).

The basic steps for setting up a Secondary infusion are described in the following sections:

- lower the Primary solution container;
- prime the Secondary administration set;
- connect the Secondary to the Primary administration set;
- program the Secondary infusion (with or without the Bolus feature enabled);
- start the infusion.

Lower the Primary solution container

Open the packaging around the Secondary administration set and find the hanger that looks something like this:



Take the Primary container from the IV pole and use the hanger to suspend it from the IV pole.

This should lower the Primary container by approximately 20 cm (eight inches). Make sure that the drip chamber on the Primary container is still at least 15 cm (six inches) above the pump.

Prime the Secondary administration set

You must always follow the *Instructions for Use* that accompany the particular administration set to be primed. Each set contains specific priming instructions, and also gives details of any warnings concerning the use of the administration set.

WARNING: Do not run parallel infusion lines below the pump. Delivering a Secondary infusion means running a second line *above* the pump. Failure to do so may result in an inaccurate delivery of medication, resulting in patient injury or death.

Connect the Secondary to the Primary administration set

If you are using the combined Primary/ Secondary (8C-6200) IV Administration set from Graseby Medical, product code 591.096, follow its accompanying *Instructions for Use.*

If you are using a separate Primary and Secondary set, then go through the following steps.

1. Insert the needle from the Secondary set into the injection site on the Primary set.
2. Keep the Secondary clamps closed until you are ready to start the Secondary infusion.
3. Check that the roller clamp below the pump is closed, and go on to program the Secondary infusion.

The position of the two solution containers and administration sets is shown on the diagram on page 2-13.

About the Secondary Volume to be Infused

Because the Secondary container hangs on the IV pole at a higher level than the Primary, the entire contents of the Secondary container may be infused at the end of the Secondary infusion. This can happen even though the Secondary Volume to be Infused is zero.

On a pump where Secondary Stop is not enabled in the Technician Menu, you must ensure that the amount that you enter as the Secondary Volume to be Infused is equal to the volume of fluid in the Secondary container.

If the Secondary Stop feature is enabled, the pump stops infusing and sounds an alarm when the Secondary infusion is complete and the Secondary Volume to be Infused has been delivered. You can then clamp the Secondary set to prevent any more fluid from being infused from the Secondary container.

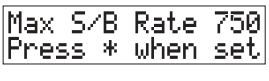
WARNING: Check the Secondary set carefully, since an occlusion above the pump on the Secondary line could cause the Primary fluid to be delivered instead of the Secondary infusion. Administering the wrong medication may cause serious patient injury or death.

WARNING: The Secondary volume to be infused must match the amount of fluid in the Secondary container. Primary flow resumes when the Secondary container is empty. If the volumes do not correspond, the wrong infusion may be delivered which could cause serious patient injury or death.

Program the Secondary infusion

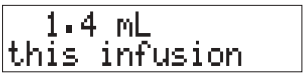
This section describes how to program the Secondary infusion on a pump where the **Bolus feature is disabled** on the Technician Menu.

1. Press the ***Hold*** key if the pump is running.



2. If Secondary Min and Max Rates and Max Secondary VTBI are enabled on the pump, ensure that they are appropriate for the infusion by pressing the ***Options*** key. To find out more see page 2-15.

3. Press the ***Secondary/Bolus*** key. The yellow Secondary indicator is lit.



4. The Message Display shows the volume from the previous Secondary infusion.

5. The Rate Display shows the last rate used for a Secondary infusion. Press the ***Rate*** key and enter the rate for the Secondary infusion, in mL/h.

6. Press the ***Volume to be Infused*** key and enter the Secondary volume in mL. This should normally match the volume in the Secondary container.

7. Verify that the rate and volume to be infused settings are correctly displayed. Open the roller clamp on the Secondary administration set

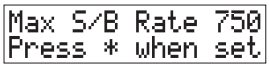
8. Press the ***Run*** key to start the Secondary infusion. The Message Display shows the volume infused.

When the infusion is complete, see *Ending a Secondary infusion* on page 2-32.

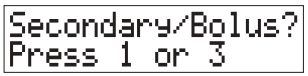
Secondary infusion - Bolus enabled

This section shows the different screens and the additional step for a Secondary infusion with the **Bolus feature enabled** on the Technician Menu.

1. Press the ***Hold*** key if the pump is running.



2. If Secondary Min and Max Rates and Max Secondary VTBI are enabled on the pump, ensure that they are appropriate for the infusion by pressing the ***Options*** key. To find out more see page 2-15.



3. Press the ***Secondary/Bolus*** key. With the Bolus feature is enabled, the Message Display tells you to press 1 for Secondary or 3 for Bolus.

4. To enter the Secondary rate, press ***1***. The Message Display shows the volume of the previous Secondary or Bolus infusion. The yellow Secondary indicator is lit.

5. Press the ***Rate*** key and enter the Secondary infusion rate in mL/h.

6. Press the ***Volume to be Infused*** key to clear the display, and enter the Secondary volume in mL. This should normally match the volume in the Secondary container.

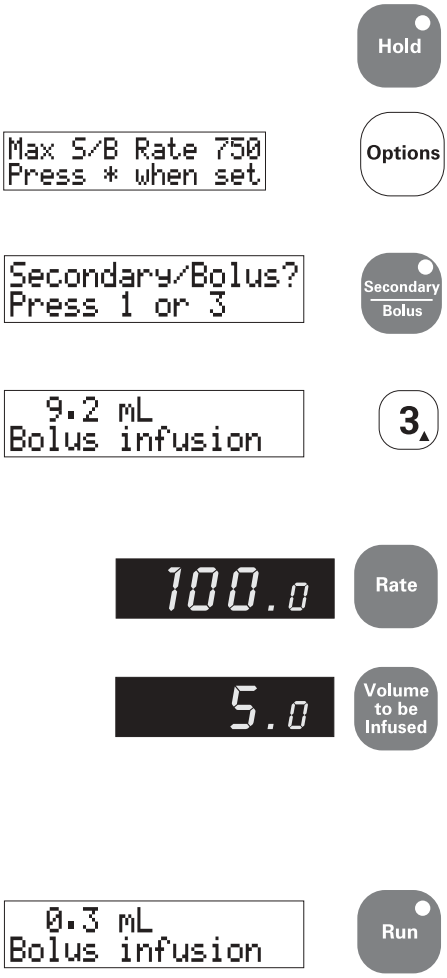
7. Verify that the rate and volume to be infused settings are correctly displayed. Open the roller clamp on the Secondary administration set.

8. Press the ***Run*** key to start the Secondary infusion. The Message Display shows the volume infused.

When the infusion is complete, see *Ending a Secondary infusion* on page 2-32.

Running a Bolus infusion

This section shows how to administer a Bolus with the **Bolus feature enabled** on the pump on the Technician Menu.



1. Press the ***Hold*** key if the pump is running.
2. If Secondary Min and Max Rates and Max Secondary VTBI are enabled on the pump, ensure that they are appropriate for the infusion by pressing the ***Options*** key. To find out more see page 2-15.
3. Press the ***Secondary/Bolus*** key. When the Bolus feature is enabled, the Message Display tells you to press 1 for Secondary or 3 for Bolus.
4. To enter the Bolus rate, press ***3***. The Message Display shows the volume of the previous Secondary or Bolus infusion. The yellow Secondary indicator is lit.
5. Press the ***Rate*** key and enter the Bolus rate in mL/h.
6. Press the ***Volume to be Infused*** key to clear the display, and enter the Bolus volume in mL.
7. Verify that the rate and volume to be infused settings are correctly displayed for the Bolus.
8. Press the ***Run*** key to start the Bolus infusion. The Message Display shows the Bolus volume infused so far. The volume infused is deducted from the Primary Volume to be Infused.

When the infusion is complete, see *Ending a Secondary or Bolus infusion* on the next page.

Ending a Secondary infusion

The pump is configured to work in one of two ways when the Secondary infusion is complete, depending on the Secondary Stop setting in the Technician Menu.

With Secondary Stop ***disabled*** on the Technician Menu, the pump:

- sounds a non-insistent alarm twice, and then reverts to the Primary infusion, running at the previously programmed Primary rate.

Alternatively, if Secondary Stop is ***enabled*** on the Technician Menu, the pump:

- stops the at the end of the Secondary infusion (is put on Hold) and sounds an insistent alarm,
- displays the message:

```
Secondary
Complete
```

Restarting Primary infusion

If Secondary Stop is enabled on the pump, you restart the Primary infusion as follows:

1. Press the ***Silence*** key.
2. Press the ***Primary*** key.
3. Press ***Run.***

Ending a Bolus infusion

At the end of a Bolus infusion, the pump sounds a non-insistent alarm twice. It then reverts to the Primary infusion, running at the previously programmed Primary rate.

The Secondary Stop feature does not have any effect on a Bolus infusion.

Checking infusion totals

Before, during or after an infusion, you can check the fluid volumes that have been infused, and the volumes remaining to be infused.

The pump can display the following totals:

- Total volume infused
- Primary totals
- Secondary totals
- Bolus totals

Total Volume infused

To view the combined total volume of all fluid infused by the pump since the total was last cleared, for example to check the fluid balance for a patient:

- press the ***Total Volume*** key.

If the pump is running an infusion, the total volume is displayed on the Message Display as follows:

The total volume includes the volumes from any of the following types of infusion:

- Primary
- Secondary
- Bolus
- KVO
- Rate Taper
- Dose-Rate Calculation.

The Message Display also shows the total hours and minutes that the pump has been in use since the display was last cleared (higher than 99 hours reads 100+hrs).

Clearing the Total Volume

To clear the Total Volume on the pump, for example to reset the pump before programming an infusion for a new patient:

- press ***Hold*** to stop the infusion, if the pump is infusing,
- press ***Total Volume.***

The Message Display shows the total volume as in this example:

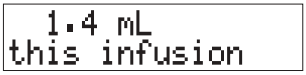
- press * to reset the Total Volume and Time to zero.

Primary totals

Whilst a Primary infusion is running, the Message and Volume to be Infused Displays show the volumes for the Primary infusion.

Volume infused so far

During an infusion, the Message Display counts up to show the volume infused so far, for example:



Volume to be Infused

The Volume to be Infused display counts down to show the remaining volume to be infused for this infusion, for example:

At the end of an infusion, the Volume to be Infused is zero.

Secondary totals

Whilst a Secondary infusion is running, the Message and Volume to be Infused Displays show the volumes for the Secondary infusion.

To view Secondary volumes after completing a Secondary infusion:

1. Press the ***Secondary/Bolus*** key.
2. If the Bolus feature is enabled, press 1 to choose the Secondary volume.
3. The Message Display shows the infused volume for the Secondary infusion as shown in this example:

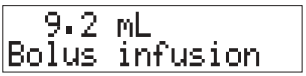
The Volume to be Infused display shows the volume remaining for the Secondary infusion.

The Secondary volumes are kept separate from the Primary totals. To view the combined infusion volume press ***Total Volume***.

Bolus totals

If you have carried out a Bolus infusion, you can view the volumes as follows:

1. Press the ***Secondary/Bolus*** key.
2. Press 3 to choose the Bolus volume.
3. The Message Display shows the infused volume for the Bolus infusion as shown in this example:



The Bolus volumes affect the Primary infusion volumes. The volume that was infused as a Bolus is added to the Primary infusion volume infused figure and deducted from the Primary infusion Volume to be Infused figure.

Re-running infusions at the same rate

When an infusion is complete, you may want to repeat it with the same Rate and VTBI values. The Rate is still displayed but you need to bring back the previous VTBI.

You can either bring back the VTBI and start the infusion immediately, or bring back the VTBI to check it before you start the infusion.

To bring back the VTBI and start the infusion immediately:

1. Press the ***Volume to be Infused*** key TWO TIMES.
   The VTBI is not displayed at this point.
2. Press the ***Run*** key.

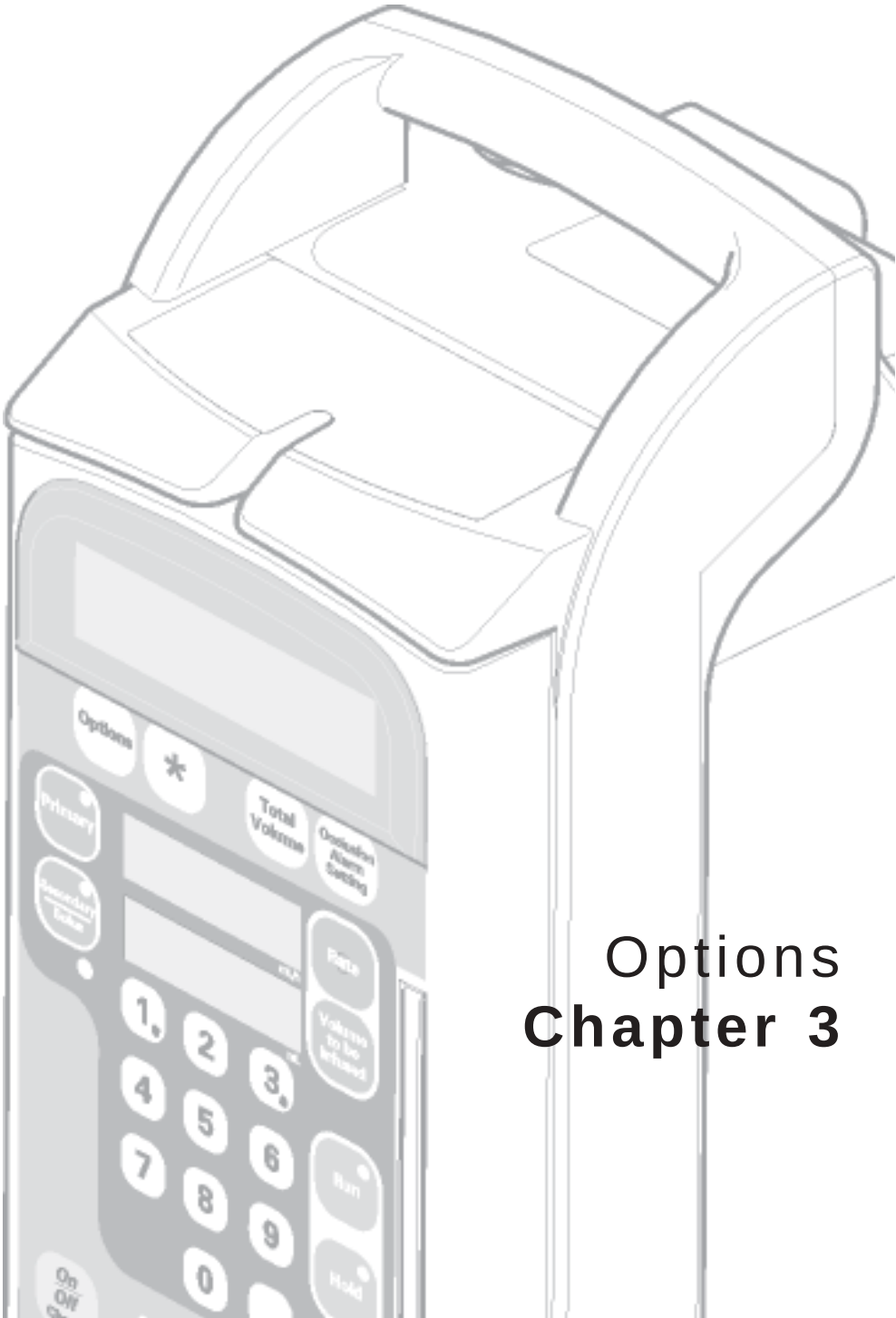
   When you press ***Run***, the VTBI value for the previous infusion is displayed and the infusion starts immediately.

Alternatively, to bring back the VTBI, to check it before you start the infusion:

1. Press the ***Volume to be Infused*** key TWO TIMES.
2. Press the ***Hold*** key.

   When you press ***Hold***, the VTBI value for the previous infusion is displayed but the infusion does not start.
3. To start the infusion, press the ***Run*** key.

Note: You can also bring back the previous VTBI if you press the ***Volume to be Infused*** key TWO TIMES and then wait for 10 seconds.



Options
Chapter 3

Introduction

This chapter describes the Options that are available for the Volumetric pump. Some of the optional features allow the pump to meet the requirements of special clinical situations.

The Options available for the Volumetric pump are listed on the "Start-up" instruction label on the side of the pump. If your pump does not display the Option you require, return the pump to your Biomedical department to have the feature enabled by a suitably trained person.

Options 1, 2 and 4 are always available on the pump, and cannot be disabled. The other Options listed below can be enabled or disabled by a suitably trained person, using the Technician Menu (see the *Technical User Manual*).

Do not use any of the Options without correct training.

Options available

The first options are:

1. Standard Message
2. Time Remaining
3. Message Display Light (Backlight)
4. Battery Test

The Backlight and all options after Battery Test only appear in the Option menu if they have been enabled in the Technician Menu.

5. Quick Rate Change
6. Rate Taper
7. Volume Over Time
8. Dose-Rate Calculation

The pump can be programmed with Minimum and Maximum infusion rates and Maximum VTBI to limit the Primary and Secondary/Bolus Rate and Volume to be Infused values. These are provided by the following options:

- Min Rate
- Max Rate
- Max VTBI
- Min S/B Rate
- Max S/B Rate
- Max S/B VTBI

The final two options appear if they have been enabled in the Technician Menu:

- KVO Rate
- Drug List

You can go directly to options with numbers against them using the Fast access method described on the next page.

WARNING: Before confirming any displayed data, the user should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.

WARNING: Correct entry of data is essential in order to ensure that the intended infusion is performed. Before confirming any displayed data when setting up an infusion, you should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.

Using options

There are two ways to select an Option:

- sequential access to view all available options;
- fast access to take you to directly to an option.

You use fast access, as described below, using a number from 1 to 8 for the numbered options in the list on the previous page. The numbers are also shown in the Options list on the 'Start up' label on the right hand side of the pump.

Viewing sequentially

To view each available Option, press the ***Options*** key. Each time you press, it will take you to the next available option. After the final option, the next screen is the Standard Message Display. If you press the ***Option*** key again at the Standard Message, you re-display the Options.

Options without a number in the list on the previous page can only be viewed by using this method.

Fast Access

To go directly to one of the numbered items, first press the ***Options*** key and then its number on the numeric keypad, using the one shown in the list on the previous page or on the side of the pump. For example, if you press the ***Options*** key and then numeric key 4 you are taken directly to the option to test the battery.

If a numbered option has been disabled, nothing will happen. Press the ***Options*** key again to see the next available option.

Values in the Message Display

When you see a Message Display where you need to change, enter or confirm a numerical value, the previous setting will flash (even if no value previously been entered). You can either enter a new value, or accept the existing value by pressing the ***** key or by pressing the ***Options*** key again to move onto the next option.

To enter a new value use the numeric keypad when the value is flashing and then press the ***** key. If you make a mistake, do not press the ***Options*** key, wait a few seconds and the value will flash again. You can enter a value whenever the value is flashing. It will flash again even though you have pressed the * key. If you press the ***Options*** key without first pressing *, any changes you make are discarded.

Using Options while infusing

If you press the ***Options*** key while running a standard infusion, then the options where you enter values (such as rate limits) display the current values, but will not allow you to change them. Backlight and Quick Rate change options can be activated. Options for programming other special types of infusions (Dose-Rate calculation, Rate Taper and Volume over Time) will tell you to place the pump on Hold.

To leave Options

When you have entered a value or set an option, use the ***Options*** key to move to the next Option, or start programming the pump by pressing an active key, for example, ***Rate***, ***Occlusion Alarm Setting*** or ***Volume to be Infused***.

1. Standard Message

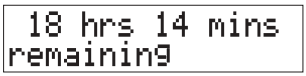
The Standard Message refers to the pump's normally displayed message when an alternative option is **not** selected.

The Standard Message display is similar to the screen below:

2. Time Remaining

This option displays the time remaining until completion of the current infusion.

To use the time remaining display press the ***Options*** key and then press numeric key ***2***, or press the ***Option*s** key until the Message Display shows:



If the pump is on hold, the time remaining is displayed until another active key is pressed. If the pump is running, time remaining is displayed for 5 seconds.

The time remaining is displayed and relates to the operating mode the pump is running in: Primary, Secondary, Bolus, Rate Taper or Dose-Rate Calculation (if enabled).

3. Message Display Light

The Message Display has a backlight that normally turns **off** one minute after the pump begins running, or if the pump is left on Hold while using battery power. It turns on automatically with any keypress, or if the alarm sounds.

This option, if enabled on the Technician Menu, allows you to keep the Message Display's backlight **on** constantly whilst the pump is in use.

Battery operation and backlight use

When using the pump on battery power, the backlight normally turns off after one minute. If you turn the light on as described here, the backlight remains on constantly, until you turn the option (or the pump) off.

You may need to monitor the battery capacity if you keep the light on, as the light uses the battery power.

Turning the light on and off

To turn the light on

Press the ***Options*** key then press numeric key ***3,*** or repeatedly press the ***Options*** key until the Message Display shows the following:

```
To keep light
on press *
```

Press the ***** key to keep the light on. The light will remain on until the pump is turned off, or until it is returned to normal operation.

CAUTION: The backlight has a limited life and may, if used constantly, cause the light to dim. Eventually the message display may then need to be replaced. To preserve the life of the message display, you should only turn on the Message Display Light as described here if it is specifically required. Misuse of this feature could lead to both battery and LCD depletion.

To turn the light off

Press the ***Options*** key, then press key ***3***, or press the ***Options*** key until the Message Display shows the following:

```
To turn light
off press *
```

Press the ***** key to turn the backlight display off.

4. Battery Test

The battery is automatically tested as part of the power on sequence, if the pump is disconnected from the AC mains supply when it is switched on. The Battery Gauge is displayed to indicate the approximate battery capacity, unless the pump is in Dose-Rate Calculation Recovery or Rate Taper mode.

Using the Battery Test option

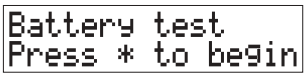
The Battery Test option can only be used if the AC cord is disconnected from the AC mains supply and the pump is on Hold.

If the pump is disconnected from the AC mains supply whilst it is infusing, it continues to infuse and automatically switches to use the internal battery.

In this case, you may use the Battery Test Option described here to test the battery. This way, you can find out the approximate battery capacity, without switching off the pump.

1. Press ***Hold*** and ensure that the pump is disconnected from the AC mains supply.

2. Press the ***Options*** key and then press numeric key ***4***, or press the ***Options*** key until the Message Display shows the Battery Test screen.



3. Press the ***** key to start the Battery Test.

   The pump measures the battery voltage. After 5 seconds it displays a Battery Gauge showing the approximate battery capacity.

This would indicate a battery approximately half charged.

WARNING: Correct management of battery charging, as described in the documentation, is essential to ensure that the pump can operate on batteries for the time specified. Failure to do so may result in compromised function of the product or patient injury.

This indicates a fully charged battery.

A fully charged battery in good condition will power the pump for approximately 6 hours at 100 mL/h (99.9 mL/h on Micro 505).

4. When the test is complete, you can press ***Run*** to restart the infusion.

   If the battery capacity is low, you must connect the pump to the AC mains supply to recharge the battery.

   For further information on batteries see *Chapter 2, Operating the pump*, or *Specifications*.

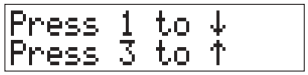
5. Quick Rate Change

The Quick Rate Change option, if enabled, allows you to change the infusion rate with single presses of the keypad while the pump is running. The option applies while the pump is running or when on hold, but changes cannot be made when the pump is in Rate Taper, Volume Over Time or Dose-Rate Calculation.

The Quick Rate Change is automatically discontinued when the pump is turned off. The next time the pump is turned on it will display the Standard Message display.

Any rate limits which are set will apply. The pump will alarm if you try to set a rate outside the limits

Performing Quick Rate Changes



1. Press the ***Options*** key and then press numeric key ***5***, or press the ***Options*** key until the Rate Change message appears.
2. Press the ******* key to begin changing the rate. The Message Display shows this screen for 10 seconds.
3. Change the rate:

- press the ***1*** key to decrease the infusion rate by 1 mL/h, or to decrease by 0.1 mL/h if the original rate was set in 10ths mL/h, or

- press the ***3*** key to increase the infusion rate by 1 mL/h, or to increase by 0.1 mL/h if the original rate was set in 10ths mL/h.

4. After 10 seconds the Message Display changes to show the volume infused so far. The arrows are displayed as a reminder that the Quick Rate Change option is still selected. You can repeat step 3 as required.

5. When you have finished with Quick Rate Change, to exit and redisplay the Standard Message:
   - press the ***Options*** key to display this screen, then
   - press ******* .

6. Rate Taper

This option, if enabled, allows automatic tapering of the infusion rate, either up or down for the administration of Total Parenteral Nutrition (TPN).

Rate taper is programmed by setting four infusion variables.

1. Volume
2. Total time or Maximum rate
3. Taper up time
4. Taper down time

The pump then makes the necessary calculations and performs the rate changes at the required times.

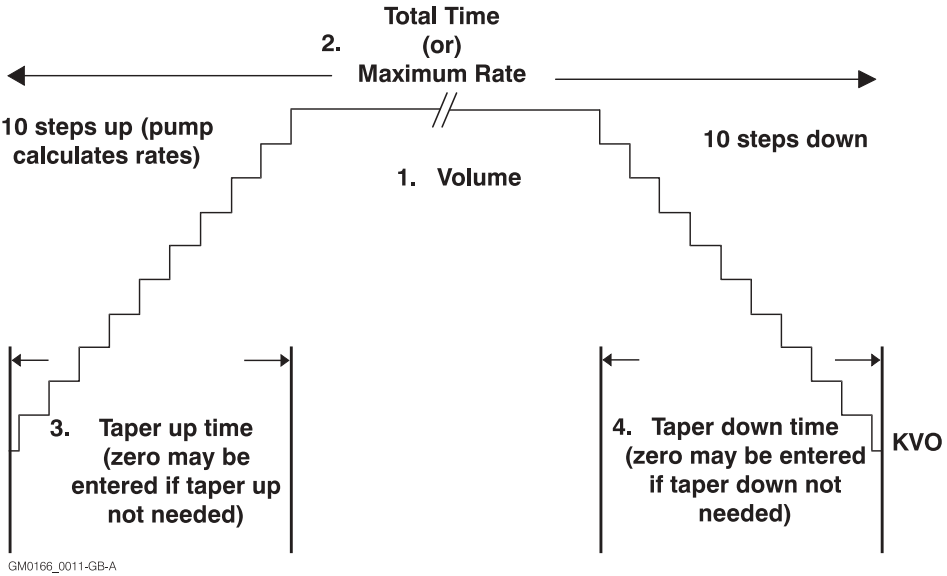
A Rate Taper infusion can be repeated exactly as the previous infusion, or changes can be made if the volume or time requirements vary from one infusion to another.

This option cannot be used while the Quick Rate Change, Volume Over Time setup, or Dose-Rate Calculation is in use.

If the pump is switched off whilst in Rate taper mode, and not connected to the AC mains supply when it is switched on again, the automatic battery test is carried out, but the Battery Gauge is not displayed. If the battery is low, the alarm sounds and a warning message is displayed.

Neither the primary or secondary indicator lights are lit when in Rate Taper.

The diagram below shows a typical Rate Taper infusion and the four programming variables that must be set.



Rate and volume limits

The highest allowable infusion rate in Rate Taper is 400 mL/h (99.9 mL/h on **Micro 505**).

The highest allowable volume to be infused in Rate Taper is 4400 mL (999.9 mL on **Micro 505**).

Any limits set with options (such as Rate or VTBI limits) will apply. You will be able to program Rate Taper as normally, but you will be prevented from running the infusion. For more details, see page 3-16.

Rounding in rate steps

If a rate step calculates to less than 1 mL/h it always appears in the display as 10ths. At 1 mL/h and higher the pump may calculate a rate step and deliver in 10ths, however the display will show a rate which is rounded to the nearest whole number.

Entering hours and minutes

When programming by total time, for a total time of less than 10 hours, enter '0' before the hours digit (for example 09h, 00min). The highest allowed number of minutes is 59. For 60 minutes or higher, enter the time as hours, or hours and minutes.

To enter Rate Taper

To program an infusion using the Rate Taper option, the pump must be on hold.

```
Rate Taper
Press * to set
```

1. Press the ***Options*** key, then press numeric key ***6***, or press the ***Options*** key until you see this screen.
2. Press the ***** key then follow the steps given to program by 'total time' on page 3-10, or 'maximum rate' on page 3-12.

To exit Rate Taper

To end a Rate Taper infusion, you must use the Option key to exit the Rate Taper and return to the standard operation:

```
Exit Rate Taper?
Press * to exit
```

1. Press the ***Hold*** key and then press the ***Options*** key repeatedly until you see this screen.

```
  0.0 mL
this infusion
```

2. Press the ***** key to return to the Standard Message Display.

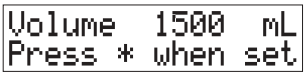
To program a Rate Taper by 'Total Time'

If you need to select the exact total time for the Rate Taper delivery, you should choose the Total Time Rate Taper method.

In this example for 'Total Time' we have chosen the following values to program:

- a volume of 1500 mL to be infused over a time period of 9 hours and 30 minutes;
- taper **up** for 1 hour;
- taper **down** for 45 minutes.

1. Press the ***Options*** key and numeric key ***6*** or press the ***Options*** key repeatedly until the Message Display shows the Rate Taper option, then press the ***** key to begin.

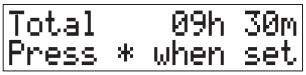


2. Enter the volume to be infused.

   If an error is made while entering the new volume, press the ***Volume to be Infused*** key and re-enter the correct setting (or alternatively press the ***Volume to be Infused*** key twice to return to previous setting).

   When the correct volume is displayed press the ***** key.

3. Press numeric key ***1*** to select 'total time'.



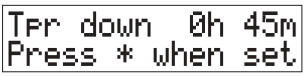
4. Enter the hours and minutes required to complete the infusion. Enter the leading zero as shown in this example for numbers less than 10.

   If you make an error while entering the time, press any number key repeatedly until the first number in the hour value is flashing, then enter the correct time.

When the infusion time is correct press the ***** key.

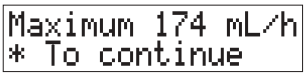
5. Enter the hours and minutes for the taper **up** period (enter zero hours and minutes if you do not want to taper up).

   When the correct 'Taper up' time period is entered press the ***** key.



6. Enter the hours and minutes for the taper **down** period (enter zero hours and minutes if you do not want to taper down).

   When the correct 'Taper down' time period is entered press the ***** key.

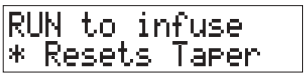


7. The pump calculates the maximum rate that is required to complete the Rate Taper infusion within the specified time period.

   If the maximum rate is correct for the patient press the ***** key.

   If you need to change the maximum rate, press the ***** key twice to take you back to step 2 and adjust the program (a longer total time may be required).

   If ***** was pressed and this display appears, then you need to review the program you have set. You will have to adjust to the volume, time and/or maximum rate value. Press the ***** key. This takes you back to step 2 to review the program values.



8. If ready to start the Rate Taper infusion, press the ***Run*** key or press the ***** key to review your settings. If you pressed the ***** key to review the settings the display will take you through steps 2 to 8 again.

9. If you pressed the ***Run*** key the Rate Taper infusion will start. The display will count up the volume infused from zero.

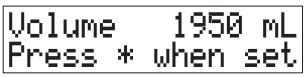
To program a Rate Taper by 'Maximum Rate'

If you want to set the maximum rate at which the pump delivers the Rate Taper infusion, choose the Maximum Rate taper method.

In this example for maximum rate we have chosen the following values to program:

- a volume of 1950 mL to be infused at a maximum rate of 225 mL/h,
- taper **up** time for 1 hour and 30 minutes,
- taper **down** time for 30 minutes.

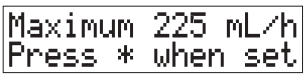
1. Press the ***Option***s key and numeric key ***6*** or press the ***Options*** key repeatedly until the Message Display shows the Rate Taper option, then press the ***** key to program your settings.



2. Enter the volume to be infused. If an error is made while entering the new volume, press the ***Volume to be Infused*** key and re-enter the correct setting (or alternatively press the ***Volume to be Infused*** key twice to return to previous setting).

   When the correct volume is entered press the ***** key.

3. Press numeric key ***2*** to select 'maximum rate'.

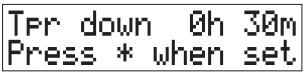


4. Enter the maximum rate at which the infusion should be run. If an error is made while entering the maximum rate, press the ***Rate*** key and re-enter the correct value (or alternatively press the ***Rate*** key twice to recall the previous setting).

   When the correct maximum rate is entered, press the ***** key.

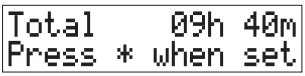
5. Enter the hours and minutes for the taper **up** period (enter zero hours and minutes if you do not want to taper up).

   When the correct 'Taper up' time period is entered press the ***** key.



6. Enter the hours and minutes for the taper **down** period (enter zero hours and minutes if you do not want to taper down).

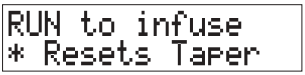
   When the correct 'Taper down' time period is entered press the ***** key.



7. The pump calculates the length of time in hours and minutes required to complete the infusion with the maximum rate entered. If the total time is correct press the ***** key.

   If you need to change the total time, press the ***** key twice to take you back to step 2, and adjust the program (a higher or lower maximum rate may be required).

   If ***** was pressed and this display appears, then you need to review the program you have set. You will have to adjust to the volume, time and/or maximum rate value. Press the ***** key. This takes you back to step 2 again to review the program values.



8. If ready to start the Rate Taper infusion press the ***Run*** key or press the ***** key to review your settings. If you pressed the ***** key to review the settings the display will take you through steps 2 to 8 again.

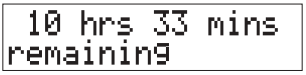
9. If you pressed the ***Run*** key the Rate Taper infusion will start. The display will count up the volume infused from 0.

Using the 'End Early' feature

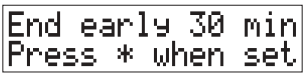
If it is necessary for a patient's Rate Taper infusion to end earlier than planned, this feature provides an alternative to stopping the pump abruptly when it is infusing at a high flow rate.

If the infusion ends early, the patient does not receive the full infusion as initially programmed.

1. With the Rate Taper infusion running press the ***Hold*** key.



2. Press the ***Options*** key twice to view the time remaining for the Rate Taper.



3. Press the ***Options*** key again to access the "end early" display. This shows the actual time remaining or 30 minutes, whichever is less.

   If the displayed time is acceptable for the infusion rate to taper down, press the ***** key. If you need to change the time displayed any number of minutes from 01 to 99 can be entered. Press the ***** key when the correct time is displayed.

4. Press the ***Run*** key to start tapering down immediately.

   If the early feature is not required then press the ***** key to continue the Rate Taper program as originally programmed. If the pump is on hold press the ***Run*** key to continue the infusion.

5. When the rate has tapered down over the set length of time, the pump alarms then continues to infuse at the KVO rate.

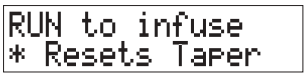
Resuming, restarting or reprogramming the Rate Taper

If the pump is turned off when Rate Taper is selected, the current Rate Taper program is stored in memory. You can use this feature of the pump to set up a program ready for later use.

When the pump is turned on again, the Message Display depends on whether or not the Rate Taper has been run.

Rate Taper programmed but not run

When the pump is turned on again, if the Rate Taper was programmed but not run , the Message Display shows:



Either:

- press ***Run*** to start the infusion using the pre-programmed settings, or
- press * to review or reprogram the settings.

Rate Taper run but not completed

When the pump is turned on again, if the Rate Taper was programmed and Run, but not completed, the Message Display shows:

- Press the ***Run*** key to resume the infusion, or
- press the ***Options*** key then press * to review or reprogram the Rate Taper settings.

Repeat a completed Rate Taper

After completing a Rate Taper program you can repeat the program (from its beginning):

1. Press the ***Volume to be Infused*** key twice. The previous volume to be infused appears in the display.
2. Press the ***Run*** key to start the infusion using the previous values.

Modify previous Rate Taper volume

If you need to repeat a Rate Taper program but need to change the Volume:

1. Press the ***Volume to be Infused*** key and enter the new volume. The total time and/or the maximum rate changes automatically.
2. Check that the correct volume is displayed then press the ***Run*** key to start the infusion.

Modify other Rate Taper values

If you need to change any other programmed Rate Taper values: total time, maximum rate, taper up time, or taper down time, you must press the ***Options*** key and follow the steps for either programming Total time or Maximum rate in this chapter.

Any limits set with options (such as Rate or VTBI limits) will apply. You will be able to program Rate Taper as normal, but you will be prevented from running the infusion. For more details, see page 3-16.

Programming or reprogramming the Rate Taper with Limits set

If any limits are set for the Primary Rate or Max VTBI, then these will apply when you program the Rate Taper or if you modify a program. Setting limits is described on page 3-29.

Before you enter Rate Taper

It is worthwhile checking what values are set for Min and Max Primary Rate limits and for Max VTBI *before* you enter Rate Taper. If they are inappropriate for the prescription, you can then adjust them and not have the Rate Taper infusion halt as described below.

If you program outside the limits

The pump tests whether the entered or calculated values are within the limits when you press ***Run***. This also applies if you change values as described on the previous page.

If the pump detects that the calculated rate is outside the limits, or the VTBI is too high, then the alarm sounds and the Message Display shows this warning:

```
Preset Limits
 Exceeded
```

Note: This happens when the calculated rate is valid, but not acceptable because of the VTBI or infusion rate limits set on the pump. It is not the same as the “cannot infuse” message displayed because the rate calculation is invalid.

To silence alarm and leave Rate Taper

If you see the Preset Limits message when you are programming or reprogramming a Rate Taper infusion,

- Press the ***Silence*** key to silence the alarm. The pump automatically leaves Rate Taper and displays the Standard Message:

```
  0.0 mL
this infusion
```

This is so that you can use the ***Options*** key to check and if appropriate, adjust the preset limits, which you cannot do when you are in Rate Taper.

Troubleshooting Preset Limits error in Rate Taper program

To find out why the Rate Taper program exceeds the limits, check the following:

1. Check the prescription volume against the Maximum VTBI limit and adjust the limit if it is incompatible with the prescription.
2. If the prescription requires that you enter a Maximum Rate, check this against the Max Rate limit setting.
3. If the VTBI or Rate limits are acceptable, note all limits that are set by using the ***Options*** key. Re-enter Rate Taper and check if you have made a mistake in programming the prescription.
4. Step through the program, look at the calculated values and compare them to the limits.

7. Volume Over Time (VOT)

This option, if enabled in the Technician Menu, allows you to set up an infusion using the volume to be infused and the total time (with the pump automatically calculating the infusion rate). It can be used with either Primary, Secondary or Bolus infusions.

Note: If rate limits are enabled and set, you may be restricted in the values you enter. Always use the ***Options*** key to check any limits before you enter the mode. See page 3-30 for more details.

Rounding up calculated rates

If the calculated rate is 99.9 mL/h or less the rate will be rounded to the nearest 0.1 of a mL/h. On the Model 500 pump, if the calculated rate is greater than 100 mL/h, the rate will be rounded to the nearest 1 mL/h.

Volume and time value rates

If the selected volume and time values calculate a rate which must be rounded, the pump calculates a revised time appropriate to the rounded rate. For example, if the volume entered is 14 mL and the time entered is 8 hours, the actual rate calculated will be 1.75, and then rounded to 1.8. The time then automatically changes to 7 hours, 47 minutes and the following display appears:

```
 14 mL in  7h47m
* To accept time
```

Press the ***** key to accept time.

To enter Volume Over Time

With the pump on hold press the ***Options*** key then press numeric key ***7***, or press the ***Options*** key until the Volume Over Time option appears.

```
Volume over Time
Press * to set
```

To exit Volume Over Time

To exit Volume Over Time when programming the volume or time, press the ***Options*** key. The following Message Display appears:

```
OPTIONS to exit
* To review
```

Press the ***Options*** key to exit or press * to continue setting Volume Over Time.

When the pump is switched off, Volume Over Time is cancelled. When next switched on, the pump resumes normal operation.

Minimum and maximum infusion time

Infusion time is entered as hours and minutes.

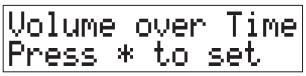
Minimum infusion time: 00 hrs 01 min

Maximum infusion time: 48 hrs 00 min

For time less than 10 hours, enter '0' before the hours digit (for example 09 h 00 m).

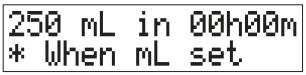
The highest number of minutes that you can enter is 59. Times of 60 minutes or higher must be entered as hours, or hours and minutes.

To use Volume Over Time



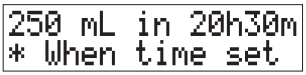
1. With the pump on hold, press the ***Options*** key then press numeric key ***7***, or press the ***Options*** key until the Volume Over Time option appears.

   Press the ***** key to set the program.



2. Enter the volume to be infused.

   When the correct volume is displayed press the ***** key. If an incorrect value has been entered press the ***Volume to be Infused*** key and re-enter the volume.



3. Enter the total infusion time in hours and minutes. If you make an error while entering a time value, press any numeric key until the first hour digit is flashing, then enter the correct time value. To start entering values again from step 2, press the ***Volume to be Infused*** key.

   When the correct time is displayed press the * key.

4. Press the ***Run*** key to start the infusion, or press the ***** key to review the settings.

5. When you press ***Run*** the Message Display shows the Standard Message. When the infusion is completed, the pump sounds an alarm, and continues to infuse at the KVO rate until you press ***Hold***.

Cannot infuse

If you see this message when you press ***Run***, then you have entered a time/ volume combination that resulted in an invalid rate.

1. Press the ***** key to return to step 2 and enter the correct volume and time values.
2. Press the ***** key, then press ***Run***.

8. Dose-Rate Calculation

This option, if enabled in the Technician Menu, allows the automatic calculation of the infusion rate when the following parameters are set:

- dosing rate (for example mcg/min or mcg/kg/min),
- patient weight in kg or lbs (if required in dose mode selected),
- drug amount in fluid container (MG = milligrams, Gm = grams, mcg = micrograms, or units),
- volume of fluid in container (mL).

Dose-Rate Calculation can be used with the pump on hold or while running. It is only available for a Primary infusion.

When in Dose-Rate Calculation mode, all values for the current infusion are stored when the pump is switched off.

During a Dose-Rate Calculation infusion, if the Drug List feature is enabled, you can press * twice to view the selected Drug Label.

Minimum/Maximum Rate or VTBI limits set in Options apply to a Dose-Rate Calculation program. For more details, see page 3-28.

µg may be displayed instead of mcg in Dose-Rate Calculation displays, see the *Technical User Manual*.

Dose-Rate Calculation Recovery

Dose-Rate Calculation Recovery is an additional feature which can only be enabled in the Technician Menu. It enables you to set up a Dose-Rate Calculation program for later use.

To use Dose-Rate Calculation Recovery:

1. Program the Dose-Rate Calculation infusion, see page 3-20.
2. Press ***Run*** then ***Hold***.
3. Switch off the pump. When it is next switched on, the pump displays:

```
RUN to infuse
* Reviews Dosing
```

WARNING: Correct entry of data is essential in order to ensure that the intended infusion is performed. Before confirming any displayed data when setting up an infusion, you should ensure that it is correct. Failure to do so may result in compromised function of the product, patient injury or user injury.

You can:

- press ***Run*** to restart the previous Dose-Rate Calculation infusion, or
- press ***** to review the dose-rate prescription, or enter new values for an infusion, or
- press ***Options*** then ***** to leave Dose-Rate Calculation and return to the Standard Message display.

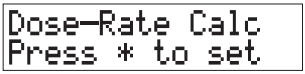
Note: When you switch on the pump with DRC Recovery enabled, no information screens are displayed in the self test. However, if there is a problem, such as low battery, a warning message is displayed with an alarm sounding.

WARNING: Dose-rate calculation requires care in entering data. Refer to specific product drug labelling for information on appropriate administration techniques and dosages. Entering incorrect data may result in patient injury or death.

To enter or exit Dose-Rate Calculation

To enter Dose-Rate Calculation

To enter the Dose-Rate Calculation display press ***Options*** and numeric key ***8***, or press the ***Options*** key until you see the following screen.



Press the ***** key to program the infusion.

To exit Dose-Rate Calculation

To exit Dose-Rate Calculation, press the ***Options*** key until you see the following screen:

Press the ***** key to return to the Standard Message display.

Dose-Rate Calculation steps

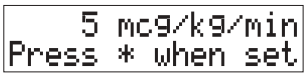
This section looks at each Dose-Rate Calculation step in programming order.

- Programming the dosing rate
- Programming the body weight
- Programming the drug amount
- Programming the volume.

A complete programming example is described on page 3-22.

Programming the dosing rate

When you enter the Dose-Rate Calculation option, you see a display similar to the following asking you to confirm the current dosing rate:



You can confirm the current rate by pressing *****, or:

- change the dosing rate mode, or
- enter a new value for the dosing rate.

Changing the dosing rate mode

The pump can be configured in the Technician Menu to display either µg or mcg (micrograms).

To change the dosing rate mode (that is the rate units),

1. Press ***Options*** to display this screen:

2. Press * until the screen shows the dosing rate mode you want to use for the infusion.

Dosing rate modes available

The following dosing rate modes are available:

- mcg/kg/min (micrograms/kilogram/minute),
- mcg/min (micrograms/minute),
- MG/min (milligrams/minute),
- MG/hour (milligrams/hour),
- units/hr (units/hour),
- MG/kg/hr (milligrams/kilogram/hour),
- mcg/kg/hr (micrograms/kilogram/hour),
- MG/kg/min (milligrams/kilogram/minute),
- units/kg/hr (units/kilogram/hour).

Enter new value for the dosing rate

When you have the mode you want to use on the screen, enter the value for the dosing rate from the keypad. The screen changes to show that you are entering a value and not selecting the mode, as if you had just entered Dose-Rate Calculation. Press * when you have done so.

When you enter values, the precision with which you can enter them depends on the range:

- 0.01 to 99.99 in increments of 0.01,
- 0.1 to 999.9 in increments of 0.1,
- 1 to 9999 in increments of 1.

If you have chosen one of the following modes using patient weight (mcg/kg/min, MG/kg/hr, mcg/kg/hr, MG/kg/min or units/kg/hr), you are next asked to enter it as described in *Programming the patient weight* below.

For dosing rate modes without the patient weight, you are next asked to enter it as described in *Programming the drug amount*, opposite.

Programming the patient weight

The Patient's body weight follows the dosing rate entry for the following dosing rate modes:

- mcg/kg/min,
- MG/kg/hr,
- mcg/kg/hr,
- MG/kg/min,
- units/kg/hr.

You need to enter the patient weight when you see a display similar to the following:

```
Pt wt        73 kg
Press * when set
```

Press the ***Options*** key to change the weight measurement from kg to lbs or lbs to kg. The pump recalculates any value entered into the new weight units.

If you press the ***Options*** key a second time by mistake, you are taken back to the beginning of programming. Just press * to get back to entering and confirming the patient weight.

Enter the patient weight from the keypad. When entering the weight, the precision depends on the units you are using. See the *Specification* at the end of the manual for the increments for each weight unit.

Press * to set the weight and move on to the drug amount.

Programming the drug amount

The drug amount entry follows the dosing rate entry or the patient weight (if a dosing rate involving weight is selected).

When you are asked to enter the drug amount display, you will see a display similar to the following:

```
 400 MG drug/bag
Press * when set
```

If you need to change from MG drug/bag (in this example), press the ***Options*** key to enter the change screen:

```
   _ g drug/bag
* For new mode
```

Press the * key repeatedly to display *g*, *MG* and *mcg*.

When the display is correct, enter the drug amount value from the keypad.

When entering the amount, the precision depends on the units you are using. See the *Specification* at the end of the manual for the increments for each range.

When the dosing rate mode selected requires 'units' input, only "units/bag" appears in the Message Display.

Once you have entered the drug amount, you are next asked to enter the volume of the bag. This is used with the drug amount to calculate the drug concentration.

Programming the volume

When you enter the volume display, you see a display similar to the following:

```
  250 mL in bag
Press * when set
```

For the range of volumes that can be entered, see the section on *Primary and Secondary infusion* in the *Specifications* at the end of this manual.

Enter the number of millilitres in the fluid container. **This must be the volume when the bag is full**. It is used to calculate the concentration.

When the setup is complete

When the programming steps for the Dose-Rate Calculation infusion are completed, the display shows that the infusion is ready to run or be reviewed:

```
RUN to infuse
* Reviews Dosing
```

You will need to review if an invalid rate is calculated and the Message Display shows:

```
Cannot infuse
* Reviews Dosing
```

As well as the Message Display which shows the volume infused and the dosing rate, the programmed volume to be infused appears in the Volume display and the calculated infusion rate appears in the Rate display.

Calculated infusion rates may be rounded up as follows:

- below 100 mL/h, rounded to the nearest 0.1 mL/h,
- above 100 mL/h, rounded to the nearest 1 mL/h.

The pump also back-calculates and displays the actual dosing rate being delivered if rounding has occurred.

Changing the volume to be infused

If you do not want the whole bag to be infused, you can change the volume to be infused if the pump is on ***Hold*** and the Message Display shows:

```
RUN to infuse
* Reviews Dosing
```

or when the infusion has been started and then stopped:

```
Infused   3.1 mL
10.00 mcg/kg/min
```

To alter the volume:

- press the ***Volume to be Infused*** key
- enter the new volume to be infused
- press ***Run***.

Note: Changing the Volume to be infused does not affect the programmed dosing rate or the calculated infusion rate.

If you do not enter any values when programming, but accept each previous value by pressing * at every option, the VTBI may not be correct for the infusion. Set it to an appropriate value before running the infusion. Changing it will not affect the calculated rate.

Programming the pump using a fixed infusion rate

Once you have completed the programming steps for the Dose-Rate Calculation infusion, you can change the infusion rate instead of accepting the calculated infusion rate. When the Message Display shows:

```
RUN to infuse
* Reviews Dosing
```

- press the ***Rate*** key and enter the desired rate, then
- press the ***Run*** key.

The pump will then back-calculate the dosing rate based on the new infusion rate that you have entered.

Dose-Rate Calculation programming example

In this example we have chosen the following values to program:

- dosing rate - 5 mcg/kg/min
- patient weight 73 kg
- drug amount in fluid container - 400 mg
- volume of fluid in container - 250 mL

This example includes patient weight. Step 5 is not necessary if you program without it.

```
Dose-Rate Calc
Press * to set
```

```
    5 mcg/kg/min
Press * when set
```

```
_____ mcg/kg/min
* For new mode
```

```
    5 mcg/kg/min
Press * when set
```

1. To enter Dose-Rate Calculation press ***Options*** then numeric key ***8***, or press ***Options*** until you see this screen.

   Press the ***** key to enter the dosing rate display.

2. You can either accept the dosing rate or enter a new dosing rate .

3. If you need to change the dosing rate mode press the ***Options*** key.

   Press the ***** key until the required mode is displayed, as described in *Programming the dosing rate* on page 3-20.

4. Enter the dosing rate value, then press the ***** key.

```
Pt wt      73 kg
Press * when set
```

5. In this example, because the dosing rate mode chosen is mcg/kg/min, the patient weight screen is displayed, as described in *Programming the patient weight* on page 3-21.

   The weight is displayed in either kgs or lbs. Changing the weight measurement is described in *Programming the patient weight* on page 3-21.

   Either accept the patient weight that is currently shown by pressing *, or enter the new weight of 73 then press the ***** key.

```
 400 MG drug/bag
Press * when set
```

6. The next message asks for the drug amount in the bag.

   If you need to change the entry type, see *Programming the drug amount* on page 3-21.

```
   _MG drug/bag
* For new mode
```

```
 500 MG drug/bag
Press * when set
```

   Enter the correct drug amount in the bag and press the ***** key.

```
  250 mL in bag
Press * when set
```

7. Next enter the fluid volume of the bag and press the ***** key.

```
RUN to infuse
* Reviews Dosing
```

8. Before you start the infusion it is good practice to review your settings. Press the ***** key to review the program and make any necessary changes.

Note: You may also need to review if the pump finds that the values you have entered are incompatible.

```
Infused   0.0 mL
5.00  mcg/kg/min
```

9. When your program is correct press ***Run***. As well as the Message Display, which shows the volume infused and the dosing rate, the programmed Volume to be Infused appears in the Volume display and the calculated infusion rate appears in the Rate display.

Changing the dosing rate without stopping the infusion

The pump allows you to change the dosing rate (thus altering the infusion rate) without stopping the infusion.

1. To change the dosing rate without stopping the infusion, press the ***** key.

   The current dosing rate displayed in the Message Display starts flashing, and the infusion Rate display goes blank. However, the pump continues to infuse at the original rate.

2. Enter the new dosing rate value using the keypad.

3. Within 10 seconds of entering the new dose, press the ***Run*** key.

   If a warning appears in the Message Display and the pump alarms, refer to *Dose or rate change alarms* on page 3-27.

4. The pump calculates the new dosing rate and new infusion rate. The new dosing rate is now displayed in the Message Display and the new infusion rate in the rate display. The pump is now infusing at the new rate.

   If a warning appears in the Message Display and alarms, refer to *Dose or Rate change alarms* on page 3-27.

   If the calculated rate is rounded up the pump will back-calculate and display the actual dosing rate being infused.

Changing the infusion rate without stopping the infusion

The pump allows the infusion rate to be changed (thus altering the dosing rate) without stopping the infusion.

1. To change the infusion rate without stopping an infusion, press the ***Rate*** key.

   The current dosing rate displayed in the Message Display and the infusion Rate display goes blank. However the pump continues to infuse at the original rate.
2. Enter the new infusion rate using the keypad.
3. Within 10 seconds of entering the new rate, press the ***Run*** key.

   If a warning appears in the Message Display and the pump alarms, refer to *Dose or rate change alarms* on page 3-27.

4. The pump calculates the new dosing rate. The new dosing rate is now displayed in the Message Display and the new infusion rate in the rate display. The pump is now infusing at the new rate.

   If a warning appears in the Message Display and alarms, refer to the next page *Dose or rate change alarms*.

Dose or rate change alarms

Dose or rate change not completed within 10 seconds

If the new dosing rate or infusion rate is entered, but the ***Run*** key is not pressed within 10 seconds, or if another function key is pressed, the new rate is discarded and the Message Display reverts to the previous values, a ***non-insistent*** alarm sounds and one of the following displays appear:

Press the ***Silence*** key to silence the alarm.

The pump now continues infusing at the old rate. If you still need to change the dosing rate press the ***** key to take you back to step 1 of *Changing the dosing rate without stopping the infusion* on page 3-25 or *Changing the infusion rate without stopping the infusion* on page 3-26.

Dose or Rate change not accepted

If the dosing rate or infusion rate is changed, but the resultant calculated rate is incorrect, the displays revert to their previous values, the ***non-insistent*** alarm sounds, and one of the following displays appear:

Press the ***Silence*** key to silence the alarm.

The pump now continues infusing at the old rate. If you still need to make a change, press the ***** key to take you back to step 1 of *Changing the dosing rate without stopping the infusion* on page 3-25 or *Changing the infusion rate without stopping the infusion* on page 3-26.

Check values you want to change before entering them to ensure that they will result in a valid calculated rate/dose.

Programming or reprogramming Dose-Rate Calculation with Limits set

If any Limits are set for the Primary Rate or Max VTBI, then these will apply when you program the Dose-Rate Calculation or if you modify a program. Setting limits is described on page 3-29.

Before you enter Dose-Rate Calculation

It is worthwhile checking what values are set for Min and Max Primary Rate limits and for Max VTBI *before* you enter Dose-Rate Calculation. If they are inappropriate for the prescription, you can adjust them and not have the infusion halt as described below.

If you program outside the limits

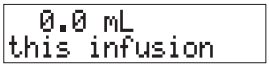
The pump tests whether the entered or calculated values are within the limits when you press ***Run***.

If the pump detects that the calculated rate is outside the limits, or the VTBI is too high, then the alarm sounds and the Message Display shows:

Note: This happens when the calculated rate is valid, but is outside the VTBI or infusion rate limits set on the pump. It is not the same as the "cannot infuse" message displayed if the calculation is invalid.

To silence alarm and leave DRC

If you see the Preset Limits message when you are programming or reprogramming a Dose-Rate Calculation infusion, Press the ***Silence*** key to silence the alarm. The pump automatically leaves Dose-Rate Calculation and displays the Standard Message:



This is so that you can use the ***Options*** key to check and if appropriate, adjust the preset limits, which you cannot do when you are in Dose-Rate Calculation.

Troubleshooting Limits in a DRC program

To find out why the Dose-Rate Calculation program exceeds the limits, check the following:

1. Check the prescription volume (the volume in the bag) against the VTBI limit and adjust the limit if it is incompatible with the prescription.
2. The rate calculated will remain in the LED display when you are taken out of Dose-Rate Calculation. Check this against the Rate limit setting.
3. Check the value for the VTBI since you may have accepted all values for a previous Dose-Rate calculation program and this will not have updated the VTBI from the bag volume.
4. If the VTBI or Rate limits are acceptable, note all limits that are set by using the ***Options*** key. Re-enter Dose-Rate Calculation and check if you have made a mistake in programming the prescription.

If you change the rate while running

If you change the rate (either the dosing rate or the pump infusion rate) while running, and exceed the limits, then press ***Run,*** the pump alarms but continues at the programmed rate.

Setting Rate and VTBI limits

You can limit the infusion Rates and VTBI (volume to be infused) values for each pump. When you set up an infusion, the pump rejects a Rate or VTBI value that is not within the Minimum/Maximum rate limits, or is greater than the maximum VTBI.

For example, you should set a maximum rate on a pump that is intended for use in an Epidural application, or set a maximum VTBI on a pump to be used in a neonatal environment. Setting rate limits is also called **Rate Capping**.

Rate Taper, Volume Over Time and Dose-Rate Calculation are also affected by limit settings.

The following Options are used to limit the infusion rates and volumes to be infused on the pump:

For Primary infusions:

- Min Rate, Max Rate, Max VTBI.

For Secondary or Bolus infusions:

- Min S/B Rate, Max S/B Rate, Max S/B VTBI.

To define the ranges, the items must be enabled on the Technician Menu, and then set using the ***Options*** key.

See page 3-32 for more details on how limits affect programming an infusion.

The instructions on the following pages explain how to set values for the (Primary) Minimum and Maximum Rate and Maximum VTBI. Once you have understood how to change these values, you will find that you can set the Secondary/Bolus minimum and maximum rates in the same way.

Minimum and Maximum Infusion Rates

If the Primary 'Min Rate' and 'Max Rate' are enabled in the Technician Menu, their current settings are displayed when you switch on the pump. If the defaults have not been changed (on a Model 500), the screen looks like this:

The Secondary/Bolus Maximum and Minimum rates are not displayed when you switch on the pump, even if they are enabled and set.

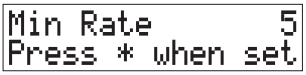
Entering rates

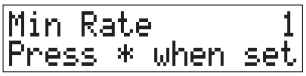
Rates must be entered as whole numbers: they cannot include a decimal point. If the Min Rate is set to zero, there is no lower limit. The Max Rate may be set to 999 (on a Model 500) or 99 (on a Micro 505).

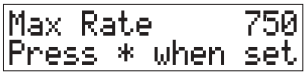
Unless the display includes S/B, the rate being changed is always the Primary.

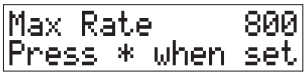
To set the minimum and maximum infusion rate

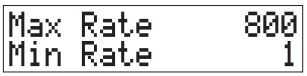
If the Options are enabled, you can change either or both values. This section explains how to change both values.











1. Press the ***Options*** key repeatedly until you see the Minimum Rate display. The current minimum infusion rate flashes, showing that you can change this value.
2. Enter a new rate, using the numeric keypad, then press the ***** key to confirm.

   If it is correct, to leave the rate unchanged, just press *.
   If the pump finds that the rate is invalid, the number continues to flash, so you should repeat this step.
3. With the value for Min Rate static, press the ***Options*** key to display the flashing Maximum Primary rate.
4. Enter a new rate then press ***** to set the value. Just press * if you want to leave the maximum rate unchanged.

You can now do one of the following:

- press the ***Options*** key once to move on to the next Option;
- press the ***Options*** key repeatedly to move through all the Options that have been enabled on the pump. You can stop when the Standard Message is displayed on the screen, indicating that the pump is ready to be programmed, or carry on until you reach the Min Rate screen again, where you can make further changes;
- turn the pump off then on again, to see the new primary minimum and maximum values in the messages displayed in the power up sequence.

Maximum VTBI

This Option is to limit the volume that may be programmed for a single infusion. The Max VTBI is 9999 (on a Model 500) or 999 (on a Micro 505), There is no lower limit for the VTBI.

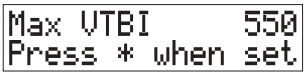
If the Primary Maximum VTBI is enabled, the current setting is displayed when you switch on the pump.

If the default has not been changed, (on a Model 500) the screen looks like this:

The Max Secondary/Bolus VTBI is not displayed, even if it is enabled.

The example here shows how to set the Maximum VTBI for the Primary infusion. The process is the same for setting the Maximum VTBI for the Secondary/Bolus infusion.

To set the maximum infusion volume



1. Press the ***Options*** key repeatedly until you see the Max VTBI display. The current maximum VTBI flashes, showing that you can change this value.

2. Enter a new VTBI, using the numeric keypad, then press the ***** key to confirm.

   If it is correct, to leave the VTBI unchanged, just press *.
   If the pump finds that the rate is invalid, the number continues to flash, so you should repeat this step.

3. Press the ***Options*** key to take you to the next option.

Programming and running infusions with limits

If limits are set and you try to run an infusion, the pump will prevent you from running with a rate or VTBI value entered outside the limits. This includes special infusion modes such as Volume over Time, Rate Taper and Dose-Rate calculation. In the latter two infusion modes, the pump behaves in a slightly different way.

For **Rate Taper**, instructions on programming with limits set are described on page 3-16.

For **Dose-Rate Calculation**, instructions on programming with limits set are described on page 3-28.

If you change rates while running or put the pump on hold and change the volume, the limits are checked when you press ***Run***. The pump continues to infuse at the previous rate when an error is detected during a rate change while running.

Rate limit settings also affect Quick Rate changes.

When the pump detects a value which is outside the set limits it sounds an alarm and the Message Display shows:

Silence the alarm and enter a value which is valid for the limits. The previous value is restored to the LED display.

If are using Quick Rate change, and try to move outside the rate limits, the pump will alarm with the limits exceeded message, and the rate LED will show the limit setting. If you are changing the rate while the pump is running, the infusion will continue at the limit rate.

KVO rate

The pump automatically switches to a KVO infusion when the programmed infusion ends. The default rate for KVO is 3.0 mL/h, or the programmed infusion rate if that was less than 3.0 mL/h.

The KVO option, if enabled in the Technician Menu, allows you to set a different KVO rate.

The pump remembers the value entered as described here, and uses it as the KVO rate. You cannot set the KVO rate to zero.

The range for the KVO rate must be within the following limits:

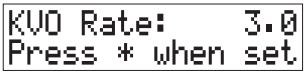
500	0.1 to 10.0 mL/h
Micro 505	0.1 to 3.0 mL/h.

When you set the KVO rate, if the Max Primary Rate is also enabled and set below these limits, then that will define the maximum KVO value you can enter.

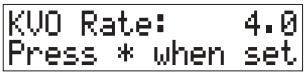
If the programmed infusion rate is less than the set KVO rate, when the pump goes into KVO, it will continue pumping at the programmed lower rate.

KVO rates cannot be changed when an infusion is running, but if you press the ***Options*** key, the current setting is displayed.

Setting a KVO rate



1. Press the ***Options*** key until you see the KVO rate display. The current value flashes, showing that you can enter a new value.



2. Enter the new KVO Rate using the numeric keypad, then press * to confirm.

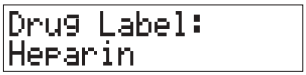
   If the rate is correct, press ***Options*** to move on to the next Option.

In the unusual situation that the rate you enter is not accepted, then the Max Primary Rate limits are set below the value you wish to enter. The Min Primary Rate does not affect the KVO entry.

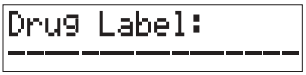
Drug Label

The Drug List feature, if enabled in the Technician Menu, allows you to use the ***Options*** key to select a drug label from a predefined list that is stored in the pump.

When the Drug List is enabled, the selected drug label is displayed for two seconds when you switch on the pump, for example:



If no drug label has been selected, the screen is shown like this:



The selected Drug Label is displayed for two seconds if you press * when the pump is on hold, or infusing.

If you press the ***Options*** key when an infusion is running, you will also see the current label, but will not be able to change it.

Drug Library

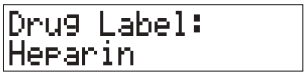
This is a complete alphabetical list of the drug labels retained in the pump's memory. Due to the number of characters that the pump can display some of the drug names have been shortened or abbreviated.

The drug label provides a visual reminder of the name of the drug, but it does not control any pump features.

It is your responsibility to ensure that the correct drug name is selected.

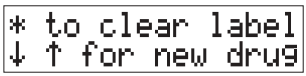
Acetylcysteine
Alfentanil
Aminophylline
Carboplatin
Cisplatin
Cyclophosphamide
Dextrose
Dextrose/Saline
Dobutamine
Dopamine
Doxapram
Doxorubicin
Droperidol
Epidural
Fentanyl/Bupiv
Fluorouracil
Hartmanns
Heparin
Morphine
Nitroglycerine
Nitroprusside
Oxytocin
Propofol
Prostaglandin
Remifentanil
Ritodrine
Ropivacaine
Saline
Syntocinon
TPN

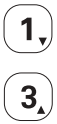
Checking the current drug label

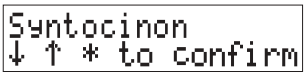


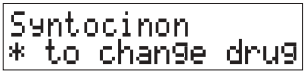
- Switch the pump off and then on, or
- Press * when the pump is on hold, or infusing.

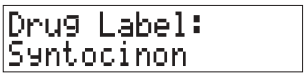
Selecting a new drug label





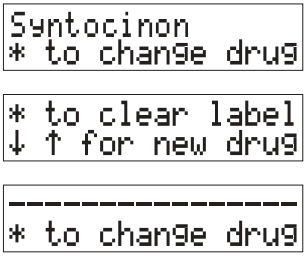




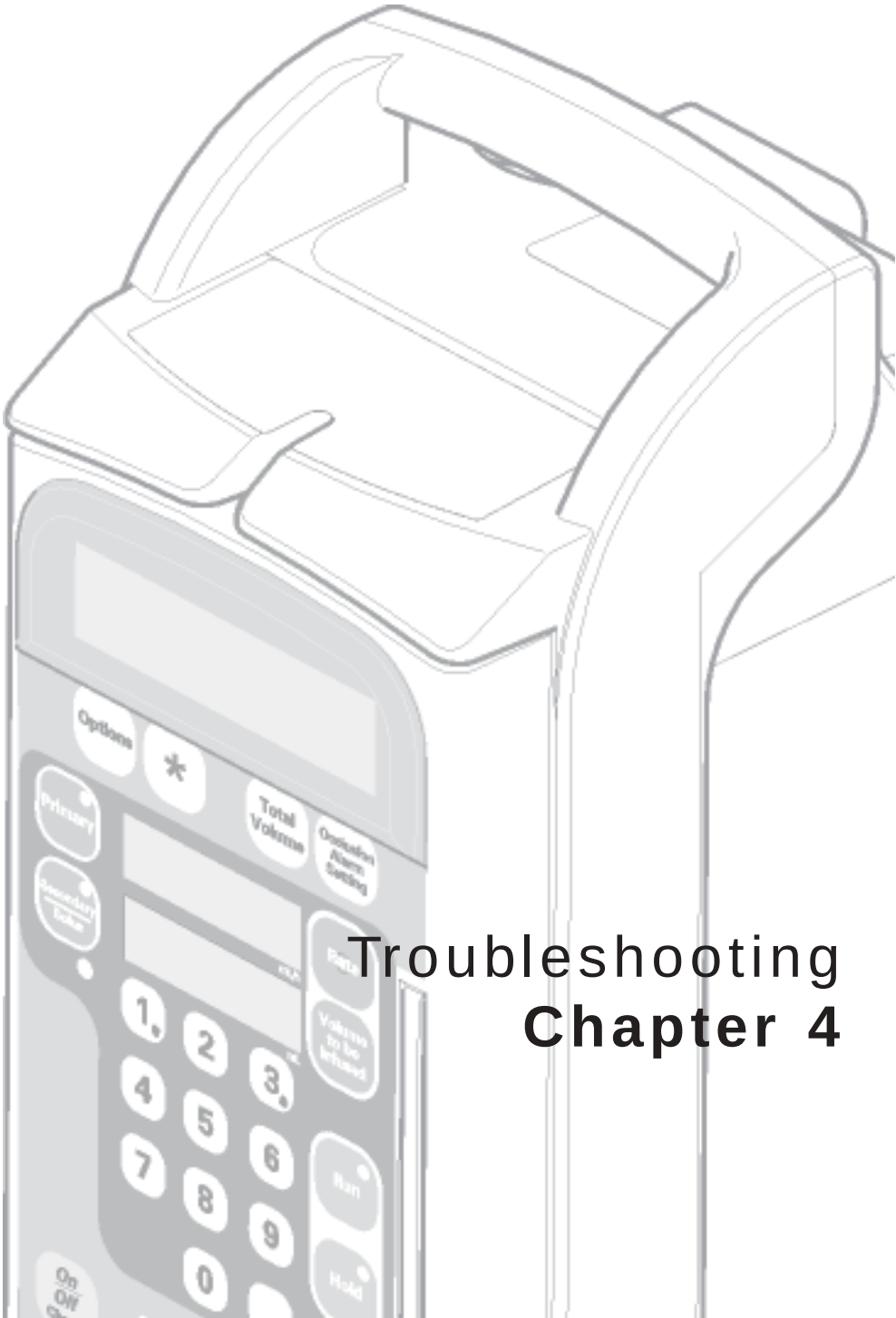


1. Press ***Hold*** if the pump is infusing.
2. Press the ***Options*** key until you see the Drug Label display. It shows the name of the drug that is currently stored in the pump.
3. Press * to change the drug.
4. To select the drug label, press
   - the 1 key to scroll down through the list, or
   - the 3 key to scroll up through the list.
5. When the required drug label is displayed, press the ***** key to confirm the name.
6. This display shows that the selected drug is now stored in the pump as the Drug Label. Press the ***Options*** key to take you to the next option.
7. When you see the Standard Message Display, press * to show the Drug Label for two seconds.

Clearing the drug label



1. Press ***Hold*** if the pump is infusing.
2. Press the ***Options*** key until you see the Drug Label display.
3. Press * to display this screen.
4. Press * to clear the label and display this screen.
5. Press the ***Options*** key repeatedly to return to the Standard Message Display.



Troubleshooting
Chapter 4

Introduction

This chapter covers all the error messages and alarms, displayed by the Volumetric, that notify you of any operating problem.

If you cannot solve the problem after reading this chapter, the pump should be inspected and repaired by a suitably qualified technician, or returned to Graseby Medical at the address on the back cover of this Instruction Manual, in order to have the fault rectified.

What's in this chapter

The chapter contains two sections:

- warning messages with alarms, divided into Continuous (backup) alarm, Insistent alarms and Non-insistent alarms;
- warning messages with no alarms.

The chapter lists the possible causes and recommended action to take for each of the warning messages.

The chapter does not contain details of the Volumetric pump System errors or warnings that indicate a problem that can only be solved by the Biomedical engineering department, or by returning to the distributor/factory. These are described in the *Volumetric Service Manual*.

Who should read this chapter

You should read this chapter to find out how to solve any problems that arise whilst you are using the Volumetric pump.

You are likely to be in one of the following groups:

- Biomedical engineering department, needing to find out what alarms may arise during the normal operation of the pump
- People being trained, who have access to the Instruction Manual as additional training material
- People who have been trained, who need a concise summary to remind them of the Volumetric pump's alarms and a description of what to do if the pump sounds an alarm.

Handling problems with the pump

Most problems in using the pump are signalled by alarms whose accompanying messages are described in the rest of this manual.

You should also use your experience in using the pump to take action if the pump behaves as if it is faulty. Follow the warnings and cautions on this page to take appropriate action to send the pump to a suitably qualified technician for checking.

Pump will not switch on

If the pump does not switch on when the On/Off key is pressed when connected to an AC power supply. Check that the keypad lockout feature is not active, see *Safety keypad lockout*, page 2-22.

CAUTION: Refer all service repair and calibrations only to qualified technical personnel. Unauthorised modifications to the pump must not be carried out.

WARNING: You should ensure that the performance offered by the pump is fit for the intended purpose. Failure to do so may result in compromised function of the product, patient injury or user injury.

WARNING: Do not use a faulty pump. If the pump detects a fault when it is first turned on, or if it develops a fault during operation then a continuous system alarm sounds. The pump must be referred to a suitably qualified technician or returned to Graseby Medical in order to have the fault rectified.

WARNING: Before using the pump, it should be inspected for physical damage. The pump should not be used if damage is evident, and should be returned to service personnel for repair before being returned to use. Failure to do so may result in compromised function of the product, patient injury or user injury.

WARNING: Do not open the pump housing. Refer all service faults only to qualified technical personnel. Opening the pump housing may cause electric shock leading to patient or user injury or death.

Pump Messages

Messages are divided into those where an alarm sounds and those which just display a message.

Programming Messages with alarms

Message display	Possible causes	Action
Preset Limits Exceeded	Rate or VTBI limits have been set and you are trying to program a value outside these limits.	Correct the value or change the limits if appropriate.
	or	
	You have entered a Bolus VTBI greater than the Primary VTBI.	Correct the value.

Warning Messages with alarms

Continuous (back up) alarms

When a continuous alarm occurs, the pump automatically stops the fluid delivery.

Message display	Possible causes	Action
Pump needs service	Electrical or mechanical problem.	Do not use. Pump needs to be repaired by a qualified technician or returned to Graseby Medical.
System check Turn off then on	Potential pump problem detected.	Turn pump off, then on. If alarm persists, remove pump from use. Pump needs to be repaired by a suitably qualified technician or returned to Graseby Medical.

Insistent alarms (pump stops infusing)

Message display	Possible causes	Action
Air in cassette	Air detected in the cassette.	To remove air: 1. Close the lower roller clamp. 2. Open the door latch. 3. Wait briefly for the cassette to fill. 4. Slowly close the door latch. 5. Repeat if necessary.
	or	
	Cassette loaded backwards.	Make sure cassette is properly loaded (flat side out, pillow side in).
Battery too low Plug in cord	Battery is depleted.	AC power cord must be plugged in to continue infusion.
Close clamp! Load Safety Clip	Tubing safety clip is not correctly loaded.	To load the safety clip: 1. Close lower roller clamp. 2. Open the door. 3. Place safety clip in the slot. 4. Close the door. 5. Open the lower roller clamp.
Door open	Door was opened while the pump was running.	Always press the ***Hold*** key and close the roller clamp before opening the door. To restart the infusion: 1. Press ***Silence.*** 2. Close the door. 3. Press ***Run***.
Loading problem Check tubing set	Problem detected above the pump as the door was being closed.	1. Open the door. 2. Check clamps and tubing for any restrictions 3. Reload cassette if necessary. 4. Close the door.

Insistent alarms (continued)

Message display	Possible causes	Action
No flow above pump	Insufficient flow from the container to the pump.	1. If the fluid container is empty, replace it. 2. Raise the height of the fluid container so that the bottom of the drip chamber is 15-30 cm (6 to 12 inches) above the top of the pump. 3. Open the upper clamp if closed, remove any restriction to the upper tubing. 4. Replace the admin set if there is damage to the spike or other admin set problem.
Occlusion below pump	Pressure below pump exceeds the Occlusion Alarm Setting.	Open the lower roller clamp, remove any restriction to the lower tubing. Change the Occlusion Alarm Setting if not appropriate for infusion. Verify patient catheter is patent.
On Hold	Pump is on hold for 2 minutes with the door closed, or 6 minutes with the door open.	Press the ***Silence*** or ***Hold*** key to silence the alarm. Press the ***Run*** key to start the infusion, or turn the pump off if not in use.
Secondary Complete	Secondary/Bolus infusion ended and Secondary Stop has been enabled on the Technician Menu.	Press the ***Silence*** or ***Hold*** key to silence the alarm. Press the ***Primary*** key Press Run to start the Primary infusion.

Note: In Medium or High occlusion alarm settings, when downline pressure exceeds the alarm threshold, the motor pauses, the ***Run*** key remains lit and the Pumping indicator stops. If within 10 seconds the pressure drops back below the threshold, pumping resumes and the alarm does not sound (if pressure remains high, the alarm sounds). If repeated pressure spikes occur, causing the pump to enter this filtering mode for a total of 30 seconds, measured over the last 4 minutes that the pump was infusing, the alarm sounds. Occlusions detected in the Low occlusion alarm setting cause an immediate alarm.

Non-insistent alarms (pump continues to infuse)

Message display	Possible causes	Action
Dose setup not completed	Dose-rate calculation program setup started with the pump running; dosing parameters not completed.	Press the ***Silence*** or ***Run*** to silence the alarm, if necessary re-enter the Dose-rate calculation program setup.
Dose change not completed	Running dosing rate change was attempted, but not properly completed.	Press the ***Silence*** or ***Run*** key to silence the alarm. Re-enter the running dose change, see *Chapter 3 Options.*
Dose change not accepted	The entered dose or calculated rate is incorrect.	Press the ***Silence*** or ***Run*** key to silence the alarm. Re-enter the parameters.
KVO xxxxx mL this infusion	The infusion is complete and the pump has switched to KVO rate.	Press the ***Silence*** or ***Run*** key to silence the alarm and continue the KVO delivery. The pump re-alarms every 6 mins. *or* press the ***Hold*** key to silence the alarm and stop infusing.
Low battery Plug in cord	Battery nearly depleted (1/2 hour or less remains).	Plug in the AC power cord, if possible, *or* Press the ***Silence*** or ***Run*** key to silence the alarm for 6 minutes and continue running the infusion.
Rate change not completed	Infusion rate change was attempted, while running but not completed.	Press the ***Silence*** or ***Run*** key to silence the alarm. Re-enter the running rate change, see *Chapter 2 Operating the pump.*
Secondary was set	Secondary infusion was programmed but the Primary was run.	Press ***Hold*** then ***Secondary*** key, Re enter the VTBI and Rate. Press the ***Run*** key.

Warning Messages with no alarms

Message display	Possible causes	Action
Keypad locked	Keypad Lock/unlock button on rear of the pump has been pressed.	Press the Keypad Lock/unlock button on the rear of the pump to unlock the keypad.
Keypad locked automatically	Keypad Auto lock button has been enabled.	Press the Keypad Lock/unlock button on the rear of the pump, *twice* to unlock the keypad. **Note:** The keypad will automatically lock 1 minute after the last key is pressed.
↓ ↑ xxxxx mL this infusion	Quick rate change option has been selected	See *Chapter 3 Options*
Taper xxxxx mL this infusion	The Rate taper option has been selected.	See *Chapter 3 Options*
Cannot infuse * To review	The rate taper program or volume over time program cannot be infused as entered.	Infusion values must be changed, see *Chapter 3 Options, Programming a rate taper* or *Programming volume over time.*
Cannot infuse * Reviews Dosing	Dose-rate calculation program cannot be infused as entered.	The infusion values must be changed, see *Chapter 3 Options, Programming dose rate calculation*).

Instrument Care

Periodic cleaning of the pump housing and inside surface of the door is recommended. Unplug the power cord and use a sponge or cloth lightly dampened with a solution of warm water and a mild, non-staining disinfectant/cleaner. Do not use cleaning agents which could damage the outer pump housing.

The Service Manual contains information on which cleaning agents may or may not be used, and how to perform cleaning.

CAUTION: Carry out periodic cleaning following the detailed instructions in the *Volumetric Infusion Pumps Service Manual*. Do not use unapproved cleaning agents.

Specifications/ Standards

Specifications

General

Weight	5 kg (11 pounds).	
Dimensions	including pole clamp Height Width Depth	 28 cm (11 inches). 21.5 cm (8.6 inches). 23.5 cm (9.45 inches).
Temperature	Operating Storage	18° to 40° C (64° to 104° F) -25° to +55° C (-13° to 131° F).
Relative humidity	Operating Storage	30% to 75% (non-condensing). 30% to 75% (non-condensing).
Pressure range	Operating Storage	50 kPa to 106 kPa 19 kPa to 106 kPa
Immunity levels	Immunity levels are the full levels specified in EN60601-1-2 (radiated immunity is 3 V/m and ESD immunity is 3 kV contact and 8 kV air).	
Free flow protection	The pump mechanism operates the safety clip on the administration set.	
Head-height	*From bottom of drip chamber to top of pump*	
Model 500	15 cm (6 ins) minimum for flow rates <500 mL/h 30 cm (12 ins) minimum for flow rates >500 mL/h 30 cm (12 ins) when using 60 drops/mL sets 30 cm (12 ins) when using thick solutions*	
Micro 505	15 cm (6 ins) minimum 30 cm (12 ins) when using 60 drops/mL sets 30 cm (12 ins) when using thick solutions*	
	* certain cytotoxic agents, lipid-based fluids and other viscous solutions, for example Total Parenteral Nutrition.	
Self test	Dual microprocessors independently test each other.	

Maximum over infusion	Under a single-fault condition, the maximum over infusion which may occur is 12.5% over the selected flow rate. Larger inaccuracies are detected by the pump, and cause the pump to stop infusing and to alarm.
Air detect system	Air bubbles are detected by electronic opto-encoder detection device (with self-checking sensors) located on cassette housing.
Accuracy	± 2% of displayed rate and volume to be infused. The quoted accuracy is ±2% for a long-term infusion. Below rates of 1 mL/h this accuracy may not be achieved for a short-term infusion. During the total infusion time the accuracy averages out (see trumpet curves in this chapter).
Accuracy measurement equipment	50 mL glass measurement burette graduated in 0.1 mL increments and traceable to National Institute of Standards and Technology or appropriate international standards bureau.
Test solution	Sterile water or normal saline at room temperature (70°F ±5°/21°C ±3°). Graseby standard (primary), 20 drops/mL, non-checkvalve administration set (8C820).
Testing conditions	
Model 500	Fluid level in the solution container 46 cm (18 inches) above top of the pump, rate set at 999 mL/h and volume to be infused of 49 mL.
Micro 505	Fluid level in the solution container 46 cm (18 inches) above top of the pump, rate set at 99.9 mL/h and volume to be infused of 25.0 mL.

Power

AC power supply	Internally configured for either 100-120 V AC, 200 mA, 50/60 Hz. or, 220-240 V AC, 80 mA, 50/60 Hz.
Battery type	Rechargeable, sealed lead-acid, 12 Volt, 1.3 Ah.
Battery operating time	6 hours at 100 mL/h (99.9 mL/h on **Micro 505**), with approximately 1/2 hour warning of discharged battery.
Battery recharge time	Approximately 10 hours, depending on the operating conditions. The batteries will be charging during an infusion.
Leakage current	100 to 120 V less than 20 microamps ungrounded or, 220 to 240 V less than 50 microamps ungrounded This is measured between the ground stud and the earth protective prong of the AC mains connector.

Over-current protection

Voltage	AC line fuse	Thermal fuse	Battery fuse
100 to 120 V	200 mA	130°	1.0 amp
220 to 240 V	2 x 80 mA	130°	1.0 amp
Note: All fuses are time delay fuses			

Primary and Secondary Infusions:

Rate range

Model 500	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h
	1 to 999 mL/h	1 mL/h

Micro 505	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h

Volume to be infused

Model 500	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL
	1 to 9999 mL	1 mL

Micro 505	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL

Rate Taper Infusions:

Rate range

Model 500	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h
	1 to 400 mL/h	1 mL/h

Micro 505	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h

Volume to be infused

Model 500	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL
	1 to 4400 mL	1 mL

Micro 505	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL

Time range

Model 500 & Micro 505	*Range*	*Increment*
	0 to 59 minutes	1 minute
	0 to 48 hours	1 hour

Volume Over Time Infusions:

Rate range

Model 500	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h
	1 to 999 mL/h	1 mL/h

Micro 505	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h

Volume to be infused range

Model 500	*Range*	*Increment*
	0.1 to 99.9 mL	0.1 mL
	1 to 9999 mL	1 mL

Micro 505	*Range*	*Increment*
	0.1 to 99.9 mL	0.1 mL
	1 to 999 mL	1 mL

Time range

Model 500 & Micro 505	*Range*	*Increment*
	0 to 59 minutes	1 minute
	0 to 48 hours	1 hour

Dose-Rate Calculation Infusions:

Dose range

	Range	*Increment*
	0.01 to 99.99	0.01
	0.1 to 999.9	0.1
	1 to 9999	1

Body weight range

Units	*Range*	*Increment*
Kilograms (kg)	0.10 to 99.99 kg	0.01 kg
	0.1 to 453 kg	0.1 kg
Pounds (lbs)	0.22 to 99.99 lbs	0.01 lbs
	0.2 to 999 lbs	0.1 lb.

Drug amount modes/range

Mode	*Range*	*Increment*
MG drug/bag	0.01 to 99.99	0.01
	0.1 to 999.9	0.1
	1 to 99999	1
Gm drug/bag	0.01 to 99.99	0.01
	0.1 to 99.9	0.1
	1 to 999	1
mcg drug/bag	0.01 to 9.99	0.01
	0.1 to 99.9	0.1
	1 to 9999	1
units/bag	0.01 to 99.99	0.01
	0.1 to 999.9	0.1
	1 to 99999	1

Rate range

Model 500	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h
	1 to 999 mL/h	1 mL/h
Micro 505	*Range*	*Increment*
	0.1 to 99.9 mL/h	0.1 mL/h

Volume to be infused range

Model 500	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL
	1 to 9999 mL	1 mL
Micro 505	*Range*	*Increment*
	0.1 to 999.9 mL	0.1 mL

Occlusion sensing

Alarm levels *(approximate values)*

Pressure units	Low	Medium	High
mmHg	103 mmHg	259 mmHg	517 mmHg
psi	2 psi	5 psi	10 psi
kPa	13.5 kPa	34.5 kPa	68.9 kPa

Time to occlusion

Maximum (measured +25%) delay times for activation of the "**Occlusion below pump**" alarm:

Rate	Low setting maximum time to alarm	High setting maximum time to alarm
1 mL/h	11 min, 5 sec.	1 hour, 10 min.
25 mL/h	15 sec.	2 min, 35 sec.

KVO rate

Default KVO rate

3.0 mL/h, or at the programmed rate if set at less than these values.

Configurable KVO rates

Model 500	0.1 to 10.0 mL/h
Micro 505	0.1 to 3.0 mL/h

Accessories

For a complete list of Administration Sets, please contact Graseby Medical or your local distributor.

Symbols used on the pump

Front panel symbols

Battery is charging/mains power applied.

Audio alarm silence button.

Side panel symbols

Use pump only in upright position.

Rear panel symbols

Attention: consult accompanying documents.

Data input/output.

CF Application (cardiac floating)

Audio alarm volume control.

Alternating current.

Nurse call option (only if option is fitted)

Inside battery door symbols

Attention: dangerous voltages, risk of electric shock if the housing is opened.

Equipotential point.

Internal battery.

Dispose of in an environmentally safe manner.

Battery symbols

Recycle battery

Dispose of in an environmentally safe manner.

Standards

Electrical Safety

Classified as Internally Powered Equipment
Class 1, Type CF (Cardiac Floating) insulation on all inputs.

Design Standards

EN 60601-1, EN 60601-1-2, IEC 601-2-24 (Draft).

Fluid Ingress Protection

IPX 1 Drip proof

CE Marking

CE 0473

The CE mark demonstrates that the pump conforms to the requirements in the European Council Directive 93/42/EEC concerning medical devices.

The number 0473 identifies the Notified Body under which the Quality Systems operated within Graseby Medical Ltd are assessed.

Disposal

When the time comes to dispose of the pump, its batteries, or any of its accessories, do so in the best way to minimise any negative impact on the environment.

You may be able to use special recycling or disposal schemes. To find out about these contact your local waste disposal service. Separate any other parts of the equipment where arrangements can be made for their recovery, either by recycling or energy recovery.

Important: Existing national or local regulations concerning waste disposal must take precedence over the above advice.

Patents

USA	5401256	*GB*	2247765
	5103214	*France*	2715073
	5429485		
	5017192		

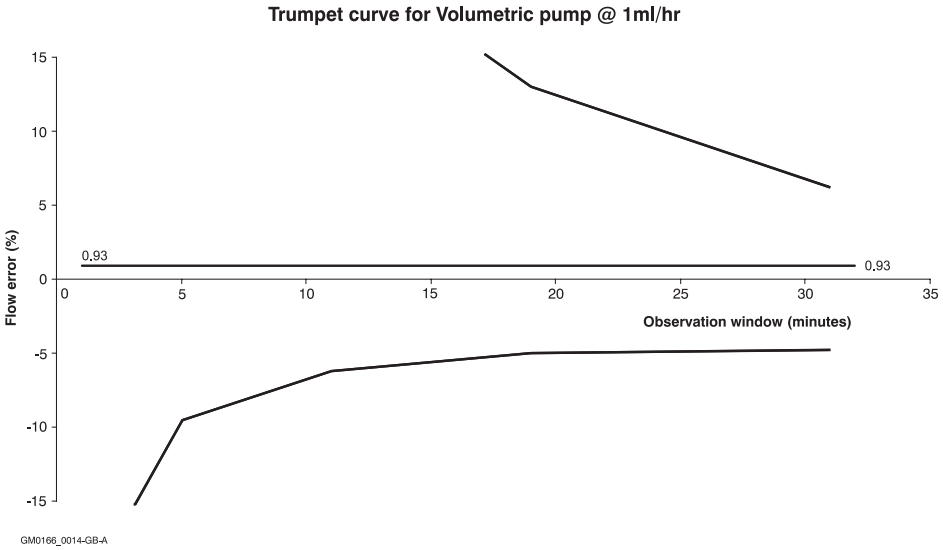
Trumpet curves

The curves were developed while testing the **Model 500** using a *Graseby Medical Standard Adult Set, 8C-820* administration set.

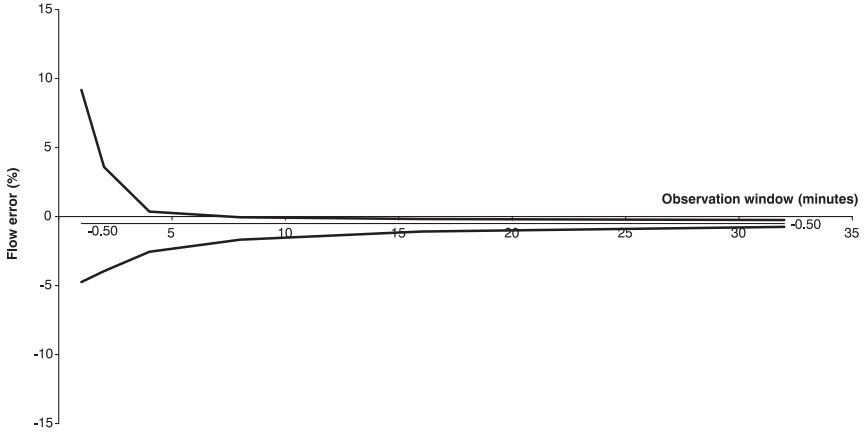
The curves for the **Micro 505** are identical since both pumps have the same pumping mechanism.

The trumpet curve represents the worst case rate error in any given observation window over the whole infusion period.

These trumpet curves were prepared according to the requirements of IEC 601-2-24.

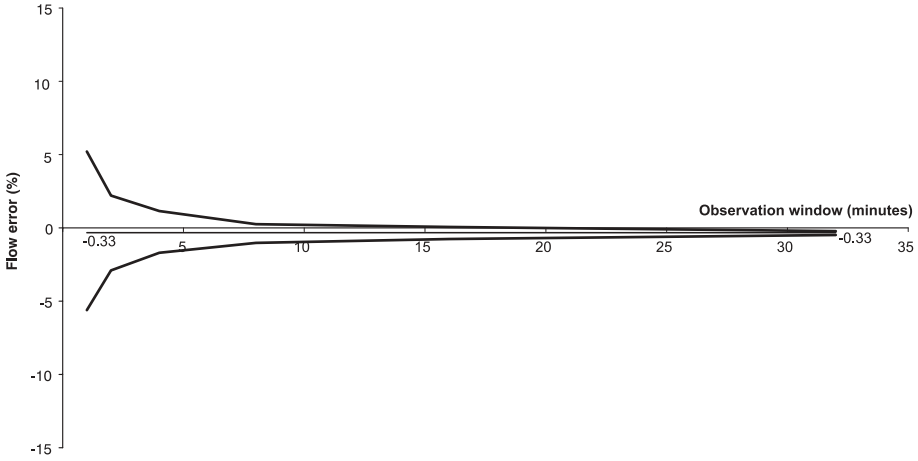


Trumpet curve for Volumetric pump @ 25 ml/hr



GM0166_0015-GB-A

Trumpet curve for Volumetric pump @ 100 ml/hr



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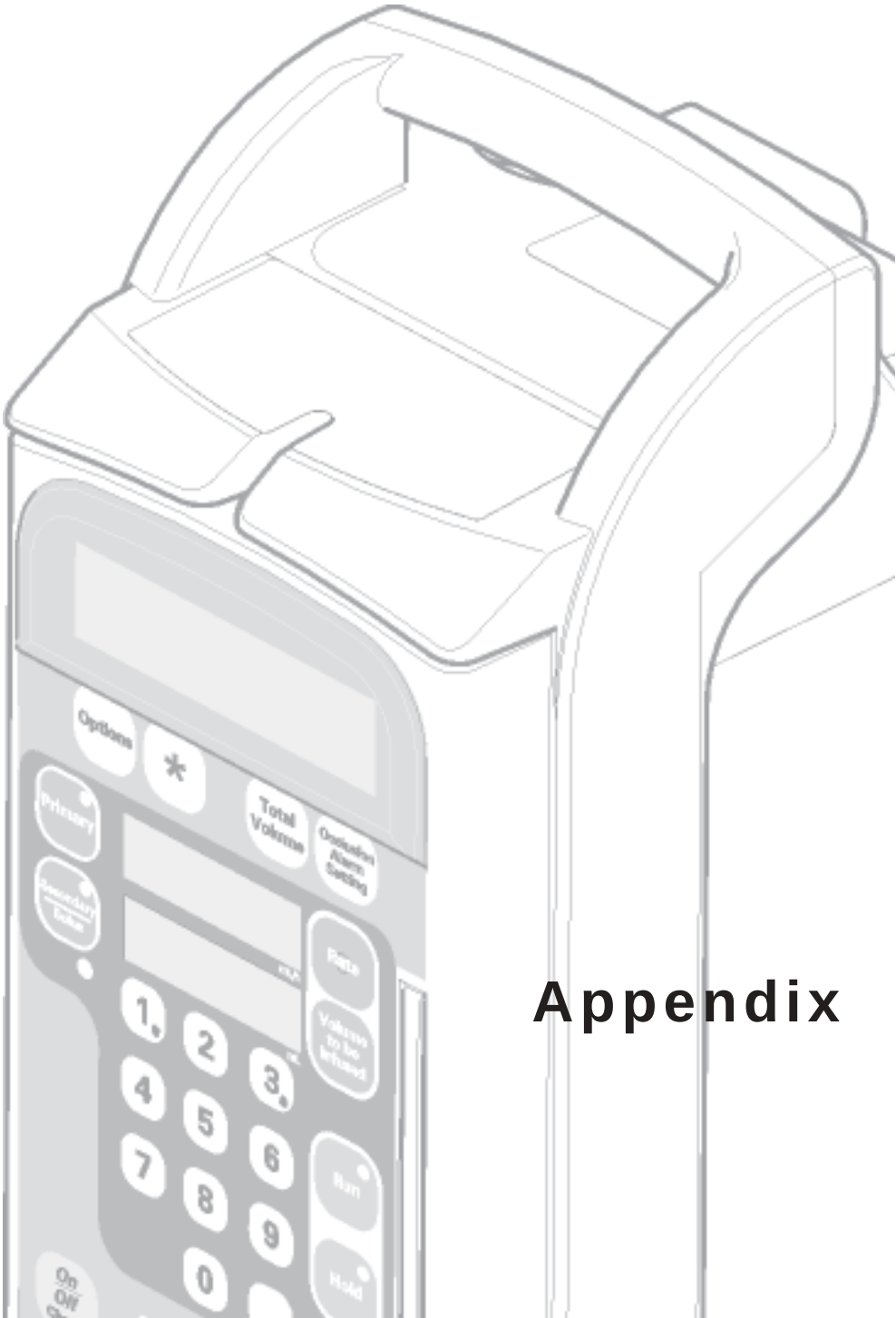


Appendix

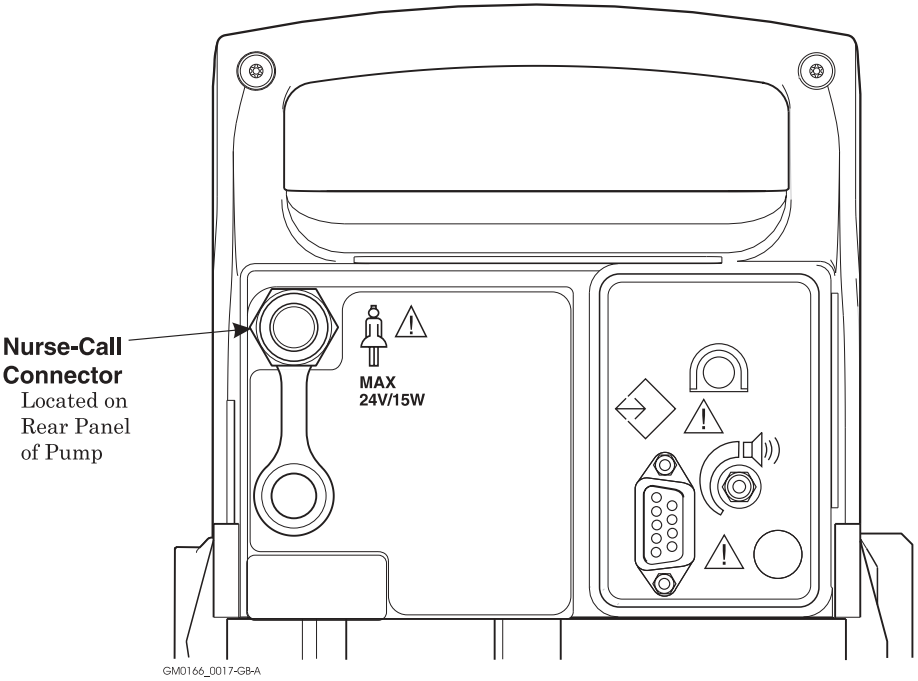
Nurse-Call Feature

Some pumps are fitted with a Nurse-Call feature which makes these pumps compatible with most existing hospital nurse-call systems.

A Graseby Medical pump equipped with the nurse-call feature may be connected to the hospital's system by inserting a 0.25 inch system plug into the Nurse-Call Connector (see illustration, below) on the pump's rear panel.

Once connected, any activation of the pump's various audio alarms also activates the hospital nurse-call system.

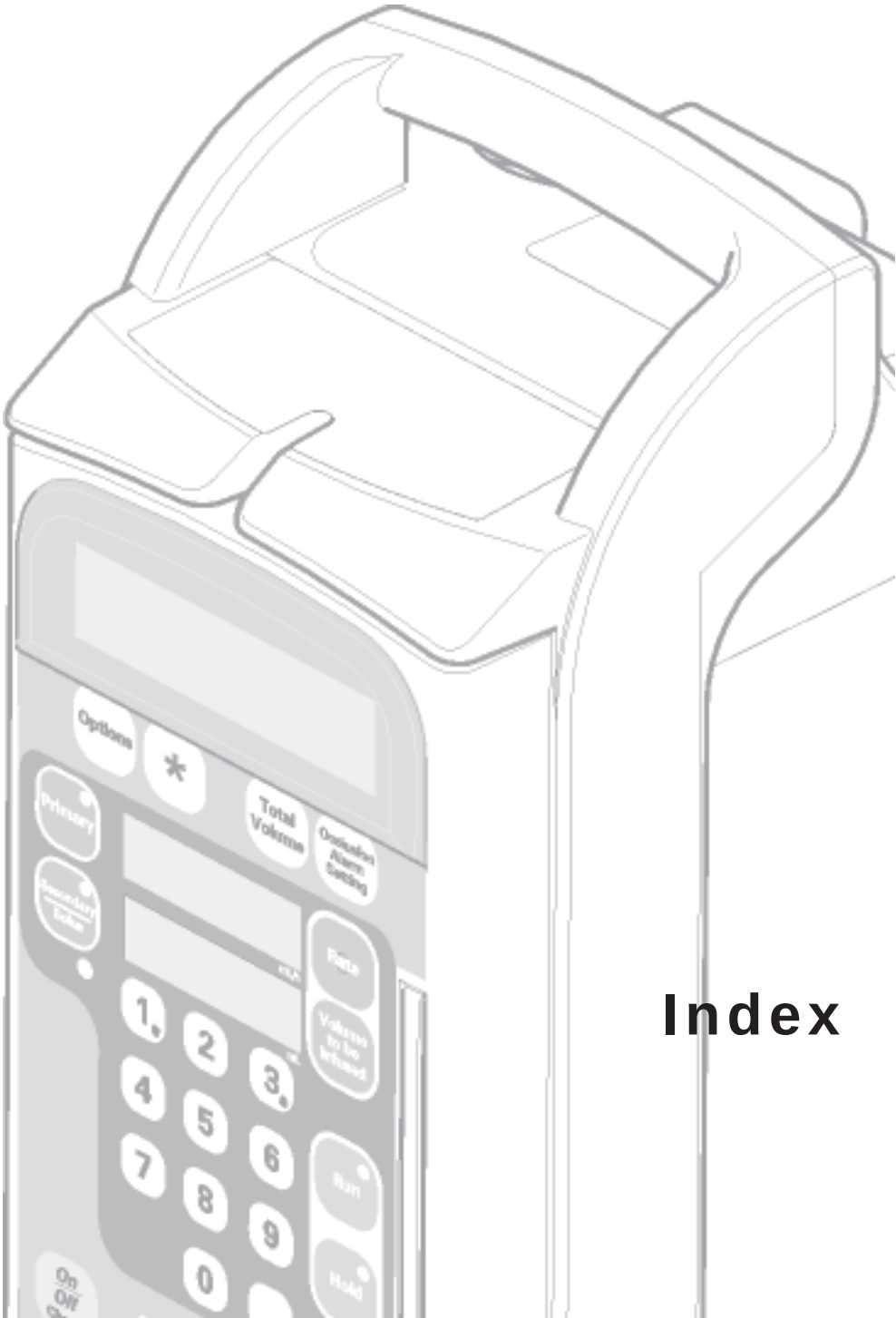
Note: This feature is not available in all countries.



Symbol Definitions:

Nurse-Call

Attention -
consult accompanying documents



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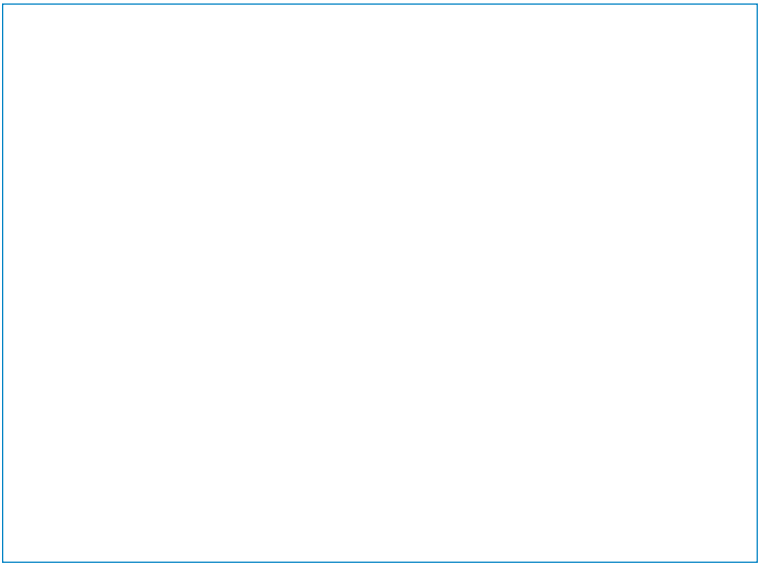
For further information, please contact your local distributor or
Graseby Medical direct on +44 (0)1923 246434



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