# Doppler Flow Pump

Model 769

## USER GUIDE

CIRS

900 Asbury Ave • Norfolk, Virginia 23513 • USA • Tel: 757-855-2765 • **WWW.CIRSINC.COM**

# Table of Contents

**Overview** . . . . . 2
**Specifications** . . . . . 5
**Instructions for Use** . . . . . 7
**Program Pulsitile Flow** . . . . . 9
**Contrast Injection Setup** . . . . . 10
**Calibration and Resetting** . . . . . 10
**Care and Handling** . . . . . 11
**Appendix 1: Pump Calibration** . . . . . 12
**Warranty** . . . . . 13

# Overview

The Doppler Flow Pump is used to simulate blood flow when testing Doppler ultrasound devices. When used in conjunction with a tissue mimicking phantom (sold separately; a list of compatible CIRS phantoms is listed with the pump specifications on page 5), the flow pump supports routine Doppler quality assurance measurements of velocity accuracy, directional accuracy, sample volume accuracy and sensitivity. The configurable design also supports advanced research and engineering tests. For instance, test circuit may be modified to support either constant velocity flow or pulsatile flow. When in pulsatile flow mode, the peristaltic pump may be programmed to produce physiologic waveforms. In addition, the external tubing circuit ensures laminar flow rates over a wide range of flow rates, and it allows users to easily inject contrast agents for testing contrast enhanced ultrasound (CEUS).

The pump comes in a plastic ABS housing that conveniently stores all accessories needed for setting up a flow circuit, as described in the next section.

## Included with Model 769

The CIRS Doppler Flow Pump consists of the following parts:

1. Peristaltic Pump. The pump provides flow rates of 0.5 to 12.5 ml/s, which translates to an average flow velocity of 2-70 cm/s in a vessel with a 3/16" inside diameter. (Peak flow velocities will be 2-4 times greater than the average flow velocity because of laminar and pulsatile flow). For more information on flow rates and flow velocities, consult the Tables in Appendix 1.

| QTY | COMPONENT DESCRIPTION |
|---|---|
| 1 | Blue 3/16" cassette with white rotor |
| 2 | pump head tubing with quick disconnect fittings (two male each) |
| 1 | container of pump head lubricant |

2. CIRS Doppler fluid and User Guide. The fluid comes in a ½ gallon container that doubles as a fluid reservoir. More fluid may be purchased separately at www.CIRSinc.com (CIRS model 769DF). See Doppler fluid User Guide for more information

3. Graduated Cylinder. Located next to the Doppler fluid reservoir, the 500 ml graduated cylinder is used in pump calibration and provides a handy transfer reservoir when purging phantoms of Doppler fluid after each use.

4. Pulse dampener. The pulse dampener evens out the pressure pulse from the peristaltic pump to deliver constant velocity flow within the test circuit. Constant velocity flow is required for many quality assurance test procedures for doppler ultrasound systems. Please note pulse dampener will always have a small amount of Doppler fluid remaining after each use. This is normal. The pulse dampener will not leak in storage. Be sure to not get water in the dampener, as this will dilute the doppler fluid, ruining its ability to mimic blood under ultrasound.

5. Tubing Pack. The color-coded tubing comes with quick-disconnect fittings for easy setup.

| QTY | COMPONENT DESCRIPTION | QUICK DISCONNECT FITTINGS |
|---|---|---|
| 2 | red 3/8" outer diameter tubing | one male, one female |
| 1 | blue 3/8" outer diameter tubing | two male |
| 1 | reservoir cap with two fluid ports | two female |
| 2 | ATS phantom adapters | one male (each) |

6. Control Cables. Computer control of the peristaltic pump is possible through a pump-to-USB cable. See Program Pulsatile Flow for instructions on downloading the control software and programing the pump.

# Specifications

## GENERAL SAFETY NOTICE

The pump provided is pre-set to operate with 3/16” inner diameter tubing. To achieve flow rates lower than the minimum rates those listed below, the pump may be accommodated with 1/16” inner diameter tubing. Please contact CIRS to obtain a conversion kit to enable lower flow rates with this pump.

This product is designed for use with CIRS Doppler Fluid and water (for cleaning purposes) only. Use of other fluids (or non-liquids) may result in damage to the pump.

Turn the pump off when re-configuring the system setup. Failure to do so may result in accidental spillage.

Review the enclosed Doppler fluid User’s Guide for more information on the safe handling and disposal of Doppler fluid.

### DOPPLER FLOW PUMP

| | |
|---|---|
| MOTOR TYPE | Step motor |
| MOTOR STEPS PER REVOLUTION | 200 |
| MICROSTEPPING | 1/8 to 1/1 depending on motor speed |
| DC CONNECTOR | 2.1mm, center positive |
| VOLTAGE AT DC CONNECTOR | 24V DC at full load |
| AMPERAGE | 900mA at full load |
| POWER SUPPLY TYPE | Unregulated linear external wall adapter, country and power source specific |
| POWER SUPPLY OUTPUT RATING | 24V DC @ 1A |
| DIMENSIONS | 9” x 4” x 8” High<br>(23 cm x 10cm x 20 cm) |
| WEIGHT | 4.51 lbs. (2.05 kg) |
| MAXIMUM SPEED | 372 rpm |
| MINIMUM SPEED | 0.0168 rpm |
| MAXIMUM PUMPING RATE | 775.2 mL/min with 3/16 ID tubing |
| MINIMUM PUMPING RATE | 0.04 mL/min with 3/16 ID tubing |

### DOPPLER FLUID (MODEL 769DF)

| PROPERTY | HUMAN BLOOD (37°C) | DOPPLER FLUID (22°C) |
|---|---|---|
| Viscosity (mPa) | 3 | 4 ± 0.5 |
| Velocity (m/s) | 1583 | 1570 ± 30 |
| Attenuation (dB/cm/MHz) | 0.15 | < 0.1 |
| Backscatter ($f^4$ $m^{-1}$ $sr^{-1}$) | $4x10^{-31}$ | Not Measured |
| Fluid Properties | Non Newtonian | Newtonian |
| "Validation of a New Blood-Mimicking Fluid for Use in Doppler Flow Test Objects", K. Rammnarine, et. al., Ultrasound in Medicine & Biology, Vol. 24. No. 3, pp.454. | | |

### MODEL 769 INCLUDES

| QTY | COMPONENT DESCRIPTION |
|---|---|
| 1 | Doppler Flow Pump |
| 1 | Peristaltic Pump |
| 1 | Half Gallon of CIRS Doppler fluid (769DF) |
| 1 | Pulse dampener |
| 1 | Tubing Pack |
| 1 | Graduated Cylinder |
| 1 | Set of two Control Cables |
| - | 24-Month Warranty |
| - | User Guide |
| - | Certificate of Compliance |

### COMPATIBLE PHANTOMS*

| MODEL | DESCRIPTION |
|---|---|
| ATS 524 & 525 | Peripheral Vascular Doppler Flow Phantom |
| ATS 527 | Doppler Flow Directional Discrimination Phantom |
| ATS 523 & 523A | Cardiac Doppler Flow Phantom |
| 069A | Doppler Flow Phantom |

*Must be purchased separately

Custom phantoms are available upon request. Contact customer service at admin@cirsinc.com for more information.

## PUMP SAFETY INFORMATION

**WARNING: THE LIST BELOW PROVIDES INFORMATION THAT, IF IGNORED OR APPLIED INCORRECTLY, CREATES THE POSSIBILITY OF DEATH OR SERIOUS INJURY. IE. FIRE, EXPLOSION.**

- Read the user’s manual.
- This product is designed for liquid only.
- User is responsible to determine the suitability of the pump to its desired function.
- Verify that tubing is appropriate for liquid being pumped.
- Disconnect power from the pump when replacing tubing or connecting or disconnecting cables.

- Never leave any dangerous liquid inside of tubing when replacing tubing and disposing pump. Use of liquids other than CIRS Doppler Fluid or water is not recommended.
- Never use in atmosphere with flammable gas.
- Never use in any location where there is a possibility of high humidity, high temperature, or extreme dust.
- Use only with the supplied power supply connected to a power source as specified on the power supply label.
- Never use a voltage that is different from voltage specified in this manual, unless authorized by CIRS.
- Do not operate with any foreign matter (water, dirt, metal or other materials) inside the Pump-head.
- Do not push objects of any kind into the chassis openings, except for appropriate cables and connectors.
- Never try to take the unit apart or modify it except as described in this manual or authorized by CIRS. **No user serviceable parts inside.**
- Do not immerse the pump in liquid. If spilling occurs unplug pump immediately.
- Install on a stable surface.
- The pump can automatically start when the Pumping Program is operating or when attached to an external control device.
- Prevent liquids from entering openings in the rear of the pump.
- If the pump becomes damaged, do not use unless certified safe by a qualified technician. Damage includes, but is not excluded to ,frayed cords and deterioration in performance.

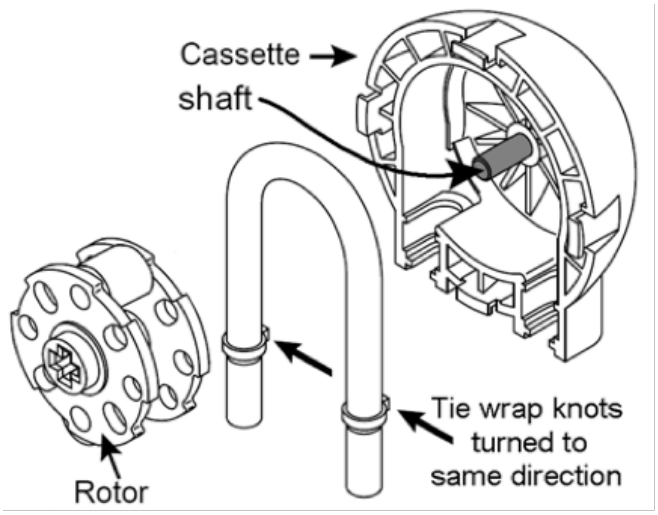
**CAUTION: THE LIST BELOW PROVIDES INFORMATION THAT, IF IGNORED OR APPLIED INCORRECTLY, CREATES THE POSSIBILITY OF MINOR OR MODERATE PERSONAL INJURY OR PROPERTY DAMAGE**

- Do not transport and store this product where the temperature and the humidity are high or fluctuate greatly, or the product is subjected to direct sunlight.
- Remove tubing from pump when not in use. Tubing will become deformed changing dispensed volume per rotation.
- Tubing wall may become permanently damaged if the roller compresses the same part of the tubing for a long time.
- During installation and use, be careful not to cut yourself on the edge of the Pump parts.
- Tubing life depends upon chemical and operating environment.
- Tubing Chemical compatibility list mentioned is only a guide. The user is responsible to determine the tubing compatibility to the chemical to be used.
- Keep delivery and suction lines as short as possible, use a minimum number of bends.
- Pump operates best at medium speeds. At very slow speeds pump will get hot. At high speeds pump and tubing life will decrease, pump will lose force/ pressure and may stall.
- Run at slow speed and use larger diameter tubing when pumping viscous liquid.
- User is responsible to determine the maximum speed the pump can operate.
- Discharge static from control cables before connecting by touching the cable to ground.
- Before touching the pump, discharge static by touching ground.

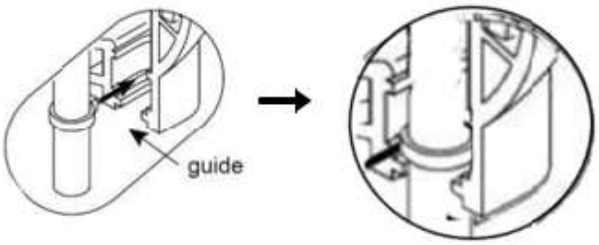
# Instructions for Use

**1. Assemble the pump head assembly**

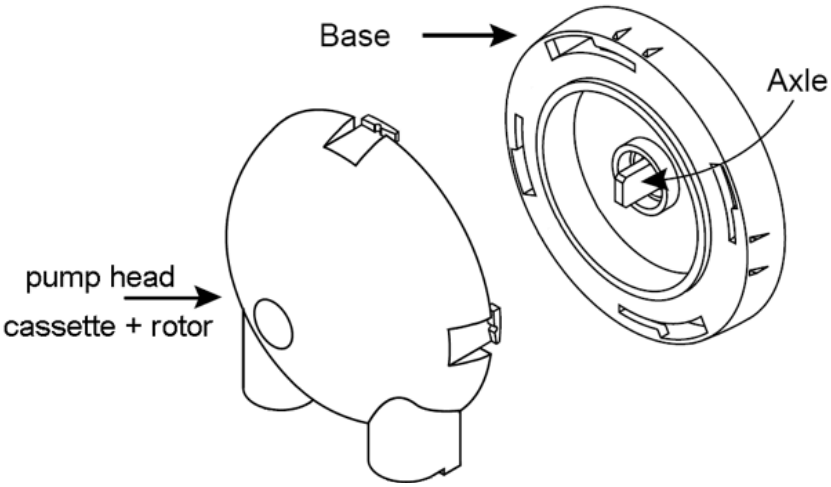
– Remove rotor from cassette (see figure below). Add grease to pump Shaft and pump Tubing. (Tubing comes pre-cut with Quick-Disconnect fittings and tie-wraps spaced 5 3/8" apart.)




– Place tubing into the guide of the cassette, tie wrap knots facing cassette. This will be a tight fit and will NOT snap into place.




– Tuck the edge of the rotor under the center of tubbing, so the tubbing is resting between the yel low wheels of the rotor.
– Push the rotor onto the shaft. Note that the rotor has two sides: one with a circle and one with a cross. Only the circle side will fit onto the shaft.
– Install the pump head onto base by first lining up rotor and driving axle, then applying forward pressure and rotating cassette clockwise until it enters its groove. Continue turning until it stops.



**2. Prepare pump for operation**

– Plug in the pump. Use appropriate power supply. (220V power supply is available. Please contact CIRS.)

– Press the power switch on the back of the pump to turn on power.

– Press any key to stop the display from blinking.

**3. Setup Pump for Continuous Flow:**

– Display the pumping rate by momentarily pressing the 'Rate' key.

– Momentarily press the 'Rate' key again. The display will show: Unt 5

– Press any up arrow key to select the rate units until the "mL" and "min" indicators are lit.

– Press 'rate' key, or wait for the time out to set the rate units.

– Set the pumping rate using the arrow keys. If the pumping rate is out of range, the display will show: or:01

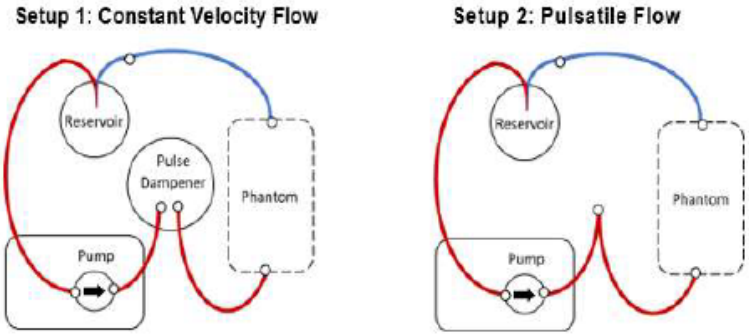
– Display the volume by momentarily pressing the 'Volume' key. 'Dispensed' LED should be off. Press the up arrow keys to change the display to 0; once entered the display will show OFF which means the pump is set for continuous pumping.

**4. Construct the flow circuit**

– Use the tubing pack and pulse dampener to construct a flow circuit with a Doppler phantom.

– For constant velocity flow, direct flow through the pulse dampener. (Setup 1)

– For pulsatile flow, remove the pulse dampener. (Setup 2)




**5. Start the pump**

– Momentarily press the 'start/stop' key to start the pump.
– The pumping rate can be changed by pressing the up-arrow keys, even while the pump is running. Note the pump can make a loud noise at some flow settings. A small change in pump speed will eliminate this noise.

**6. Stop the pump**

– Momentarily press the 'start/stop' key to stop the pump.

# Program Pulsitile Flow

To program pulsatile flow, you must first download and install the PumpTerm program.

1. Go to http://www.syringepump.com
2. Under “Accessories”, click on “Pump Software.”
3. Scroll down to PumpTerm. Download for free.
4. Follow the installation instructions included in the download

The pump has a dispense mode that is useful for filling up bottles. But before programming the pump, the dispense mode must be disabled.

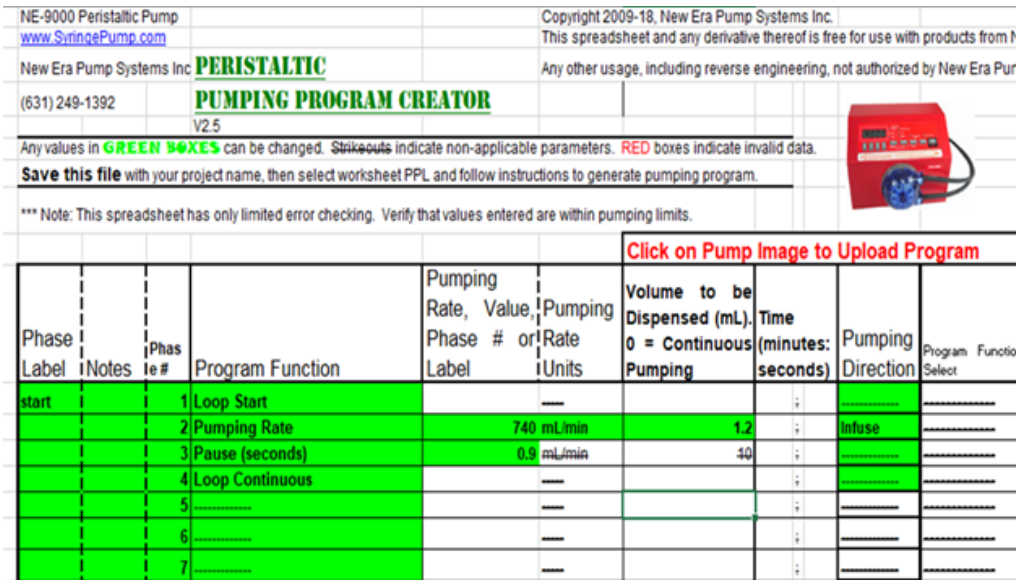
1. Press the ‘diameter’/’setup’ key while turning on power to the pump. The display shows diA
2. Use the up-arrow keys to scroll through to disP
3. Press ‘rate’ or ‘volume’ or wait for the time out to select.
4. The display shows: dis:n where ‘n’ is the setting: ‘0’ = disabled, ‘1’ = enabled.
5. Use the up arrow to disable dispense mode. The display shows dis:0
6. Press ‘rate’ or ‘volume’ or wait for the time out to select.

The pump is ready for programing.

For a 60 beats-per-minute pulse, open the PPL Creator excel spreadsheet. Using the drop-down menu in each cell, set

– Phase 1 to Loop Start
– Phase 2 to Pumping Rate 740 ml/min for 1.2ml
– Phase 3 to Pause (seconds) 0.9
– Phase 4 to loop continuously.
– Leave other phases blank

The excel page will look like this:



NE-9000 Peristaltic Pump
www.SyringePump.com
New Era Pump Systems Inc
(631) 249-1392

PERISTALTIC
PUMPING PROGRAM CREATOR
V2.5

Copyright 2009-18, New Era Pump Systems Inc.
This spreadsheet and any derivative thereof is free for use with products from N
Any other usage, including reverse engineering, not authorized by New Era Pur

Any values in GREEN BOXES can be changed. Strikeouts indicate non-applicable parameters. RED boxes indicate invalid data.
**Save this file** with your project name, then select worksheet PPL and follow instructions to generate pumping program.
*** Note: This spreadsheet has only limited error checking. Verify that values entered are within pumping limits.

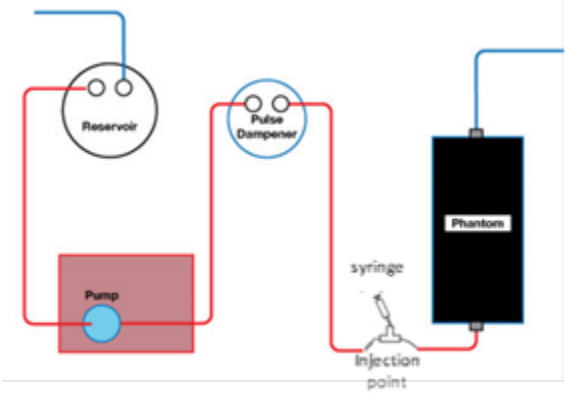
Click on Pump Image to Upload Program

| Phase Label | Notes | Phase # | Program Function | Pumping Rate, Value, Phase # or Label | Pumping Rate Units | Volume to be Dispensed (mL). 0 = Continuous Pumping | Time (minutes: seconds) | Pumping Direction | Program Functio Select |
|---|---|---|---|---|---|---|---|---|---|
| start | | 1 | Loop Start | | --- | | : | ---------- | ---------- |
| | | 2 | Pumping Rate | 740 | mL/min | 1.2 | : | Infuse | ---------- |
| | | 3 | Pause (seconds) | 0.9 | ~~mL/min~~ | ~~10~~ | : | ---------- | ---------- |
| | | 4 | Loop Continuous | | --- | | : | ---------- | ---------- |
| | | 5 | ---------- | | --- | | : | ---------- | ---------- |
| | | 6 | ---------- | | --- | | : | ---------- | ---------- |
| | | 7 | ---------- | | --- | | : | ---------- | ---------- |

Upload the program to the pump by clicking on the pump picture in the Excel file. The pump will beep twice to indicate successful program upload.

# Contrast Injection Setup

The model 769 can be used for contrast injection studies. See Setup 3 below. The outlet from the phantom is collected in a separate container. The injection (not included with 769) is put between the pulse dampener and phantom.




# Calibration and Resetting

**Pump calibration**

The flow rate generated in a peristaltic pump depends on the inside diameter of the tubing used, the amount of occlusive force generated by the pump head rollers and the pump head speed (revolutions per minute, or RPM). The control indicator for the pump is calibrated to the pump RPM setting speed and converted to flow rate for a given tube diameter. However, the actual flow rate may vary from the value indicated if the tubing stretches or deforms over time, causing the amount of occlusive force to change over time. Differing viscosities will also affect pumping speed.

The pump has a built-in calibration setting, in which the pump operates in the dispense mode to deliver 250 mL of fluid at a flow rate of 500 mL/min. To calibrate the pump, you will need a graduated cylinder or similar calibrated measuring cup to verify the actual dispense volume.

NOTE: The graduated cylinder provided with the Model 769 is not calibrated & is provided for convenience. Users needing to perform calibration measurement as part of a quality process may want to obtain a calibrated cylinder.

1. Turn off power to the pump.
2. Press the 'rate' key while turning on power to the pump. The display will show: cAlr
3. Press the 'start' key to begin the dispense.
4. When the pump has dispensed 250 ml of fluid it will stop, and the dispensed volume will be displayed with the volume units LED blinking.
5. Use the up-arrow keys to enter the actual volume measured by the graduated cylinder.
6. Press the 'rate' key.

The pump uses the entered volume to recalibrate the pumping rate and dispense volume. Calibration may need to be repeated multiple times for the best results.

Changing the tubing diameter or resetting the pump will cancel the entered calibration. The pump will use the tube diameter as the calibration value.

# Calibration and Resetting (Cont)

**Resetting the pump**

This pump is programable, so it can behave in unexpected ways if programmed incorrectly. If your pump is acting strange, resetting the pump will clear the programs memory and return the pump to a continuous flow mode.

The pump has a built-in calibration setting, in which the pump operates in the dispense mode to deliver 250 mL of fluid at a flow rate of 500 mL/min. To calibrate the pump, you will need a graduated cylinder or similar calibrated measuring cup to verify the actual dispense volume.

1. Press the right-most up arrow key while turning on power to the pump.
2. The display will show rEST

Pressing any key will clear the display.

# Care and Handling

**After each use**

When the pump is not in use, remove the black tubing from the pump head. If the tubing is left in the pump head while the rotor is stationary, the tubing will become stretched out. **Failure to remove the tubing from the pump head will result in premature wear of the tubing, which could affect pump calibration.**

1. Remove the pump head from the pump by turning the cassette counterclockwise
2. Remove the black tubing from between the cassette and rotor.

**Preparing for storage**

Doppler fluid will not affect the tubes in the pumping system. However, particle agglomeration can occur if the Doppler fluid remains stationary in a tight space for too long. Particle agglomeration may cause the tubes to become clogged if the pump is not run for an extended period of time.

Purging the circuit of Doppler fluid with water will ensure the tubes do not become clogged. To purge the circuit, follow the steps below:

1. Disconnect the reservoir outlet from the pump and leave the tube in air.
2. Run the pump until all remaining fluid is returned to the reservoir. Some fluid will remain in the pulse dampener. This is by design. The pulse dampener can be stored with fluid inside. The fluid will not leak out of the pulse dampener.
3. Turn off the pump. Remove the reservoir adaptor tubing from the Doppler fluid. Replace the standard cap on the Doppler fluid
4. Fill graduated cylinder with water and place the reservoir adapter in the cylinder. **Remove the pulse dampener.**
5. Re-attach reservoir outlet to the pump and circulate water through the phantom to clean any remaining Doppler fluid from the circuit. When complete, turn off the pump, disconnect the tubing from the phantom and return accessories to the pump storage drawer. Storage conditions vary for each phantom. In general, urethane-based phantoms can be stored empty, while Zerdine-based phantoms should remain filled with water to prevent the tube from collapsing. For more information, see the User Guide for the phantom.
4. Remove the black tubing from the circuit as described above. Place the pump head and black tubing in the pump storage drawer.

# Appendix 1: Conversion of Flow Rate to Flow Velocity

The conversion from flow rate to average flow velocity is made by dividing the flow rate by the cross-sectional area of the tubing.

For laminar flow, the flow velocity at the center of the tube is double the average flow velocity. In constant velocity mode, the maximum flow velocity is double the average flow velocity. In pulsatile mode, the maximum flow velocity depends on the shape of the pulse profile. Assuming a simple sine wave, the peak flow velocity will be double the maximum flow velocity in constant velocity mode.

CIRS doppler phantoms often have multiple flow tubing of different diameters by design. The following table have flow rates calculated using the most common tubing diameters found in CIRS doppler phantoms.

**Conversion Chart for Flow Velocities**

| Flow rate (ml/s) | Flow rate (ml/min) | Average flow velocity (cm/s) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Ø1mm | Ø2mm | Ø3mm | Ø4mm | Ø3/16in | Ø6mm | Ø8mm |
| 1 | 60 | 127.3 | 31.8 | 14.1 | 8.0 | 5.6 | 3.5 | 2.0 |
| 2 | 120 | 254.6 | 63.7 | 28.3 | 15.9 | 11.2 | 7.1 | 4.0 |
| 3 | 180 | 382.0 | 95.5 | 42.4 | 23.9 | 16.8 | 10.6 | 6.0 |
| 4 | 240 | 509.3 | 127.3 | 56.6 | 31.8 | 22.5 | 14.1 | 8.0 |
| 5 | 300 | 636.6 | 159.2 | 70.7 | 39.8 | 28.1 | 17.7 | 9.9 |
| 6 | 360 | 763.9 | 191.0 | 84.9 | 47.7 | 33.7 | 21.2 | 11.9 |
| 7 | 420 | 891.3 | 222.8 | 99.0 | 55.7 | 39.3 | 24.8 | 13.9 |
| 8 | 480 | 1018.6 | 254.6 | 113.2 | 63.7 | 44.9 | 28.3 | 15.9 |
| 9 | 540 | 1145.9 | 286.5 | 127.3 | 71.6 | 50.5 | 31.8 | 17.9 |
| 10 | 600 | 1273.2 | 318.3 | 141.5 | 79.6 | 56.1 | 35.4 | 19.9 |
| 11 | 660 | 1400.6 | 350.1 | 155.6 | 87.5 | 61.7 | 38.9 | 21.9 |
| 12 | 720 | 1527.9 | 382.0 | 169.8 | 95.5 | 67.4 | 42.4 | 23.9 |

| Flow Rate (ml/s) | Flow Rate (ml/min) | Maximum Flow Velocity: Constant Velocity Mode (cm/s)[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Ø1mm | Ø2mm | Ø3mm | Ø4mm | Ø3/16in | Ø6mm | Ø8mm |
| 1 | 60 | 254.6 | 63.7 | 28.3 | 15.9 | 11.2 | 7.1 | 4.0 |
| 2 | 120 | 509.3 | 127.3 | 56.6 | 31.8 | 22.5 | 14.1 | 8.0 |
| 3 | 180 | 763.9 | 191.0 | 84.9 | 47.7 | 33.7 | 21.2 | 11.9 |
| 4 | 240 | 1018.6 | 254.6 | 113.2 | 63.7 | 44.9 | 28.3 | 15.9 |
| 5 | 300 | 1273.2 | 318.3 | 141.5 | 79.6 | 56.1 | 35.4 | 19.9 |
| 6 | 360 | 1527.9 | 382.0 | 169.8 | 95.5 | 67.4 | 42.4 | 23.9 |
| 7 | 420 | 1782.5 | 445.6 | 198.1 | 111.4 | 78.6 | 49.5 | 27.9 |
| 8 | 480 | 2037.2 | 509.3 | 226.4 | 127.3 | 89.8 | 56.6 | 31.8 |
| 9 | 540 | 2291.8 | 573.0 | 254.6 | 143.2 | 101 | 63.7 | 35.8 |
| 10 | 600 | 2546.5 | 636.6 | 282.9 | 159.2 | 112.3 | 70.7 | 39.8 |
| 11 | 660 | 2801.1 | 700.3 | 311.2 | 175.1 | 123.5 | 77.8 | 43.8 |
| 12 | 720 | 3055.8 | 763.9 | 339.5 | 191.0 | 134.7 | 84.9 | 47.7 |

[1]maximum flow velocity is given for laminar flow, in which the flow velocity at the center of the tube is twice the average flow velocity.

| Flow rate (ml/s) | Flow rate (ml/min) | Peak Flow Velocity: Pulsatile Mode (cm/s)[2] | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Ø1mm | Ø2mm | Ø3mm | Ø4mm | Ø3/16in | Ø6mm | Ø8mm |
| 1 | 60 | 509.3 | 127.3 | 56.6 | 31.8 | 22.5 | 14.1 | 8.0 |
| 2 | 120 | 1018.6 | 254.6 | 113.2 | 63.7 | 44.9 | 28.3 | 15.9 |
| 3 | 180 | 1527.9 | 382.0 | 169.8 | 95.5 | 67.4 | 42.4 | 23.9 |
| 4 | 240 | 2037.2 | 509.3 | 226.4 | 127.3 | 89.8 | 56.6 | 31.8 |
| 5 | 300 | 2546.5 | 636.6 | 282.9 | 159.2 | 112.3 | 70.7 | 39.8 |
| 6 | 360 | 3055.8 | 763.9 | 339.5 | 191.0 | 134.7 | 84.9 | 47.7 |
| 7 | 420 | 3565.1 | 891.3 | 396.1 | 222.8 | 157.2 | 99.0 | 55.7 |
| 8 | 480 | 4074.4 | 1018.6 | 452.7 | 254.6 | 179.6 | 113.2 | 63.7 |
| 9 | 540 | 4583.7 | 1145.9 | 509.3 | 286.5 | 202.1 | 127.3 | 71.6 |
| 10 | 600 | 5093.0 | 1273.2 | 565.9 | 318.3 | 224.5 | 141.5 | 79.6 |
| 11 | 660 | 5602.3 | 1400.6 | 622.5 | 350.1 | 247 | 155.6 | 87.5 |
| 12 | 720 | 6111.5 | 1527.9 | 679.1 | 382.0 | 269.5 | 169.8 | 95.5 |

[2]assumes simple sine wave pulse.

# Warranty

All standard CIRS products and accessories are warranted by CIRS against defects in material and workmanship for a period as specified below. During the warranty period, the manufacturer will repair or, at its option, replace, at no charge, a product containing such defect provided it is returned, transportation prepaid, to the manufacturer. Products repaired in warranty will be returned transportation prepaid.

| PRODUCT | WARRANTY PERIOD |
|---|---|
| Model 769- Doppler Flow Pump | 24 Months |

There are no warranties, expressed or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description on the face hereof. This expressed warranty excludes coverage of, and does not provide relief for, incidental or consequential damages of any kind or nature, including but not limited to loss of use, loss of sales or inconvenience. The exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the product at manufacturer's option.

This warranty does not apply if the product, as determined by the manufacturer, is defective because of normal wear, accident, misuse, or modification.

## NON-WARRANTY SERVICE

If repairs or replacement not covered by this warranty are required, a repair estimate will be submitted for approval before proceeding with said repair or replacement.

## RETURNS

If you are not satisfied with your purchase for any reason, please contact Customer Service or your local distributor prior to returning the product. Visit https://www.cirsinc.com/distributors/ to find your local distributor. Call 800-617-1177, email rma@cirsinc.com, or fax an RMA request form to 757-857-0523. CIRS staff will attempt to remedy the issue via phone or email as soon as possible. If unable to correct the problem, a return material authorization (RMA) number will be issued. Non-standard or "customized" products may not be returned for refund or exchange unless such product is deemed by CIRS not to comply with documented order specifications. You must return the product to CIRS within 30 calendar days of the issuance of the RMA. All returns should be packed in the original cases and or packaging and must include any accessories, manuals and documentation that shipped with the product. The RMA number must be clearly indicated on the outside of each returned package. CIRS recommends that you use a carrier that offers shipment tracking for all returns and insure the full value of your package so that you are completely protected if the shipment is lost or damaged in transit. If you choose not to use a carrier that offers tracking or insure the product, you will be responsible for any loss or damage to the product during shipping. CIRS will not be responsible for lost or damaged return shipments. Return freight and insurance is to be pre-paid.

With RMA number, items may be returned to:

**CIRS**
**Receiving**
**900 Asbury Ave,**
**Norfolk, Virginia, 23513 USA**

**COMPUTERIZED IMAGING REFERENCE SYSTEMS, INC.**
900 Asbury Ave
Norfolk, Virginia 23513 USA

**Toll Free:** 800.617.1177
**Tel:** 757.855.2765
**Fax:** 757.857.0523
**Email** admin@cirsinc.com

**www.cirsinc.com**

**Technical Assistance**
1.800.617.1177

Computerized Imaging Reference Systems, Inc. has been certified by UL DQS Inc. to **(ISO) 13485:2016**. Certificate Registration No.10000905-MP2016.

©2016 Computerized Imaging Reference Systems, Inc. All rights reserved. All brand names, product names or trademarks belong to their respective holders.

Specifications subject to change without notice.
Publication: Doppler 769 UG 010521