

Laboratory Pumps

Syringe and Peristaltic pumps get your fluids flowing!

Home ☐ **Laboratory Pumps – About Programmable Pumps**

Laboratory Pumps – Learn About Programmable Syringe and Peristaltic Pumps

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Laboratory Pumps

The term laboratory pumps is a general term referring to pumps used in laboratories. Whilst the term covers all the pumps talked about on this website, it also might include vacuum pumps, pressure pumps, other kinds of fluid dispensing systems.

This site is primarily concerned with a subset of these pumps **programmable laboratory pumps** which can be used to generate a controlled or wave shaped fluidic flow. If you need to control your fluid flow – your looking in the right place!



NE-500 with Harvard Metal Syringe Loaded

Syringe Pump

You will find as you look around that a syringe pump is referred to by several names:

- Syringe Pump
- Syringe Infusion Pump – so named because they infuse fluids. Some of them withdraw fluids too.
- Syringe Driver – because it's a machine that 'drives' the **syringe plunger**. Can become confusing if you are familiar with computers where a driver is a piece of software that is associated with a hardware device.
- **LabVIEW** and Matlab users sometimes use the term Syringe Driver for a special module that Interfaces with syringe pumps from those environments. In their case It is a software driver of sorts for their pumps.
- Generically as a laboratory pump.



Syringe pumps are named because they generally operate with a syringe mounted in a **computer controlled** mechanism that drives the syringe to deliver fluid.

Peristaltic Pump

A very popular and commonly found laboratory pump is the Peristaltic Pump. Peristaltic pumps use an entirely different pumping action to syringe pumps which means there are some benefits and some disadvantages compared to the syringe pump.

Peristaltic pumps move fluids in a flexible hose kneaded by rollers turned by a **computer controlled** motor.



Some Peristaltic Pump Features

- Deliver consistent volumes and are easy to keep sanitary (no cleaning of the pump, Insert a new tube).
- Replacing tubing prevents sample contamination. Handy where pump is transferred from site to site. E.g. water sampling in different location. Replace tubing for each location – no sample contamination.
- Can safely pump flammable liquids – the fluid only comes into contact with the tubing and not the pump mechanism.
- The output pulses a little as the rollers squeeze and release the tubing. There is a small amount of suction (really small) when the rollers leave the tubing and the tubing expands after being squeezed.
- Constant repeatable volumes until the tubing wears out.
- Peristaltic action is ideal for work with blood cells as it won't shear them like conventional impeller pumps will.

Microfluidic Pump

Microfluidic pumps are usually syringe pumps but provide much finer fluid flows. These are used in microfluidic applications typically where precise control very small volumes of fluids are pump into very small physical devices. Typically these have dimensions below 1mm in size.

Microfluidic devices are used in everyday appliances such as the print head in your ink jet printer.



SP1070-m microfluidic syringe pump

More information about the Microfluidic pumps



Pressure Vessel

Pressure Vessels – an Alternative to a Microfluidic Pump

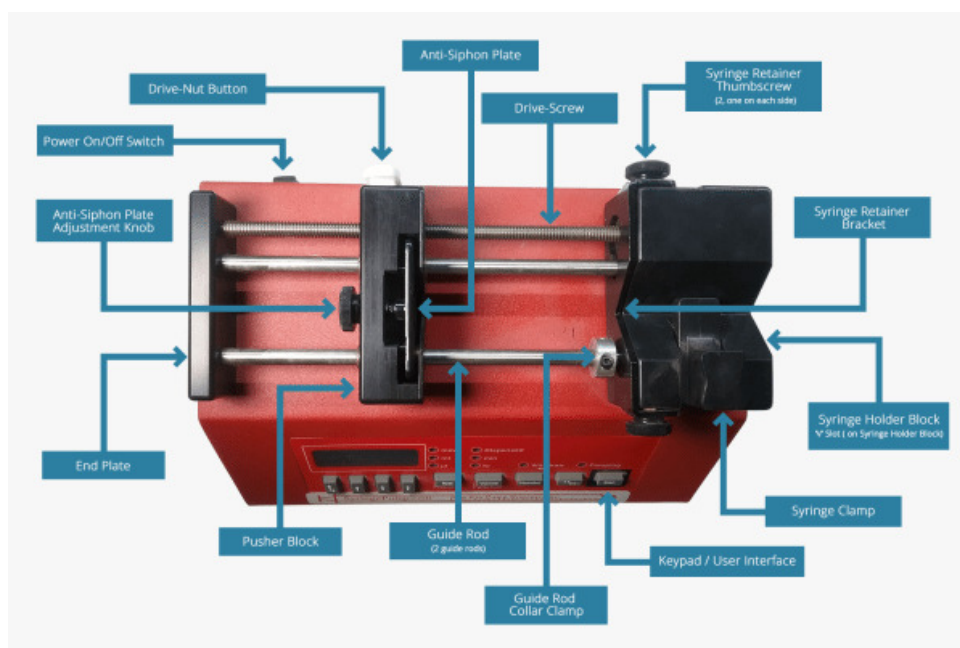
Pressure Vessels are an alternative way of providing microfluidic flows for some applications. In use the lid is removed and the fluid placed in the flask – typically 100ml in usable volume. The lid is then replaced and the flask then pumped up or vacated using a low pressure pump. Some applications just need a droplet formed and your pressure vessel might be a good alternative.

You might think – a pressure vessel has got to be much cheaper than a software controlled mechanical pump and you would be right! But! Pressure vessels cost about 1/2 the price of the microfluidic syringe pump, then you need to buy the low pressure lab pump to put pressure into the vessels. It's not unusual to discover that the cost of a low pressure pump will make a syringe pump look cheap!

Other major differences:

- No software control. So forget your **waveform flows, your controlled, timed and all other kinds of flows.**
- A syringe pump can produce both positive and negative pressures – where as you need two low pressure pumps to produce the positive and negative pressures.

Parts of a Syringe Pump



Parts of a syringe pump

Click the above diagram for a **more detailed explanation** of these parts and their function.

Parts of a Syringe



Parts of a Syringe

Click the above diagram for a [more detailed explanation](#) of these parts and their function.

[How to load a syringe on your pump.](#)

Parts of a Peristaltic Pump



Parts of a peristaltic pump

Click the above diagram for a [more detailed explanation](#) of these parts and their function.

Tubing



Tubing is used to connect syringes to apparatus – including other syringes. It's also used to provide the pumping action in peristaltic pumps. So there are several types of tubing. Your tubing selection will be affected by what you are passing through your tubing. You will need to consider the chemistry!

PVC Tubing – clear polyvinyl chloride and plasticizers that don't have extenders or fillers in them. These are see through, with flexibility and dimensional stability.

Silicon tubing – Not clear, very flexible, available as Peroxide-Cured silicon, Tygon silicon (I use this with petro chemicals), Platinum-Cured Silicon. It has an very smooth Inner surface which reduces particle entrapment and minimized bacterial growth. For use in high temperature applications.

There are many different tubing formulations, what you use will be basically decided by your application, Industrial grade, food grade, or chemical resistant.

OEM Pumps



An **OEM pump** is for use by Original Equipment Manufacturers. These pumps don't have a user interface – no buttons and screens or indicator lights. They are meant to be **buried inside a box** obviously with the syringes exposed to the operator – or maybe not.

These pumps will be computer controlled or have been pre-programmed to perform a sequence of pumping operations automatically.

OEM pump use example

One SyringePumpPro customer is working on a new exhibit for **The International Sherlock Holmes Exhibition**. It's an Interactive display involving blood spatters being made when you press a button. The blood is propelled using an OEM pump. The programming and development work has involved the use of my SyringePumpPro software.

Tip: Short on funds? OEM pumps can be purchased by anyone and they are a lot cheaper than laboratory pumps – but you need a piece of software to operate the pumps from your computer. That's one of the uses for SyringePumpPro. **Hey why not try it?**

Dual Pumps – Continuous flow



Dual reciprocating pumps

Dual Pump sets are for the provision of accurate and continuous flow. In these systems pumps and plumbing are configured such that when one syringe is infusing the other syringe is withdrawing to refill itself. As the infusing syringe approaches empty the pumps switch functionality. The specially configured plumbing provides a single output and a single connection for syringe refill or source fluid.

[Read more about Dual Pumps](#)

Pump Accuracy

Accuracy in pumping terms is an expression of how close the fluid flow rate delivered by the pump matches the numerical value of the fluid flow you entered into or requested via computer.

Pump manufacturers will offer **specification sheets** declaring their pump's accuracy. They are all pretty good.

Of all the different types of pump available, syringe pumps are recognized as the most accurate and repeatable devices for low volumes and low rate fluid delivery.

What effects accuracy?

Your fluid. The **viscosity of your fluid** can really effect the pumping accuracy.

Your plumbing. The length of tubing, the dimensional stability of the tubing (does it inflate like a balloon or is it rigid), the fittings (number and type) and the destination device can all effect the ability of the pump to output fluids. This can all be rate dependent too.

Your pump's mechanics. A syringe pump with a non-rigid frame, and low quality components will have mechanical slack in it which will effect the rate at the start of pumping and at

direction of pumping reversals.

Other things: the number of rotational steps the pumps drive motor has, in combination with the torque of that drive motor, the control of the motor drive electronics, any gear chain or belt drive mechanism.

Pump Flow Rates



Accurate flow and the range of flow rates achievable by a pump are a result of precise motor speed control. Motor speed in combination with the mechanical driving mechanism determine the maximum and minimum flow rates a pump may deliver. This in turn affects the range of rates a pump may pump over in combination with the syringe selection made.

Syringe selection range is limited by physical sizes of the syringe holding mechanism both the length of the pump stroke and the diameter both small and large that the syringe holding mechanism can securely grasp.

To know what flow rates a pump can achieve you should read the manufacturers specification sheet for your pump. This site has some [specification sheets for download](#).

Pump Volumes

NE-1660-1860-1260-Rates-and-Specifications

The minimum volume that can be pumped is determined by the smallest diameter syringe that may be gripped by the pump's syringe holding mechanism. In combination with the small syringe diameter, the lowest speed that the syringe pump can drive the syringe plunger at will determine the lowest volume that can be delivered. Most syringe pumps use stepper motors which operate in discrete steps. At the slowest and lowest volumes, these step motor step movements deliver in fixed increments.

However if the step increment is becoming an issue in your fluid delivery, chances are you have the wrong pump model, and perhaps need to consider a [micro-fluidic specific pump](#).

Again the volumes your pump can deliver are specified by the pump manufacturer in their rates and specifications sheets.

What viscosity can be pumped?

A rough guide would be if you can pour it (even slowly) you can pump it.

Of course the amount of force the pump can deliver and the diameter of your syringe, tubing and all the equipment connected to the tubing are to be considered.



Syringe Heater and Controller

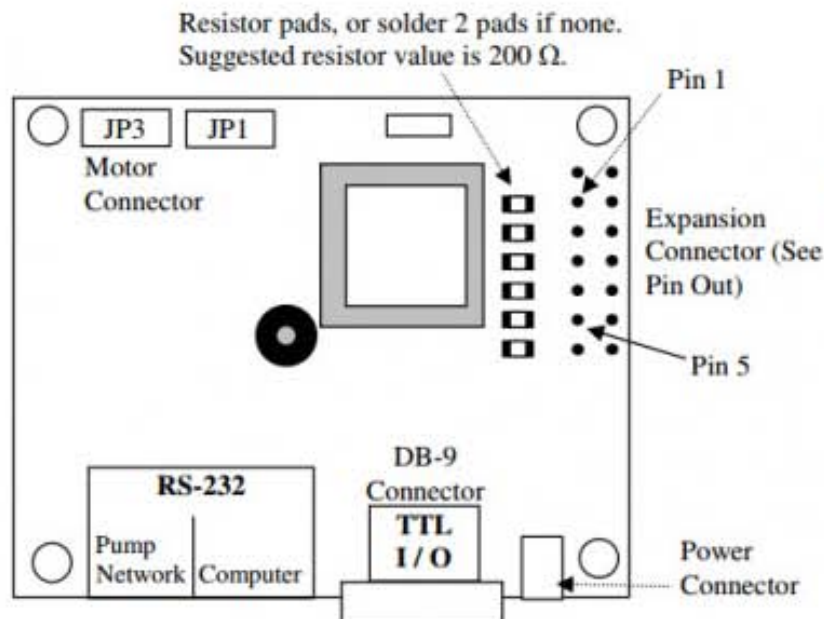
Some fluids won't pour at room temperature and need to be heated to decrease their viscosity. To achieve this you can heat the syringes on your pumps. You then need to be sure that the fluid doesn't cool in your apparatus and return to its higher viscosity.

This system will heat syringes and peristaltic tubing to help you pump those sticky gooey fluids.



Heater syringe and peristaltic installation

Pump Triggering



Expansion Connector Pin Out

Ground	Ground
Pin 1 (LSB)	Ground
Pin 2	Ground
Pin 3	Ground
Pin 4	Ground
Pin 5 (MSB)	Ground
VDD	n/c

Modern laboratory programmable pumps can have their pumping programs triggered by external electrical signals. A logical 0 or 1 electrical signal can be sent to the pump and cause it to jump to a certain pumping phase. Some lab equipment will emit a logical 0 or 1 signal to trigger external items. A great example of that is another pump!

You can see in the diagram here the availability of electrical signalling in the NE-500 pump.

Real Life Example

A fine example of pump triggering is connecting a foot switch to the pump.

A great example is the filling of ink cartridges by an operator. A **pump program** is written for a particular model printer cartridge. This is uploaded to the pump and set running with SyringePumpPro. When the operator presses on the foot switch the pump program dispenses the correct volume at a suitable pre-programmed rate to the ink cartridge thus guaranteeing the same fill for all cartridges.



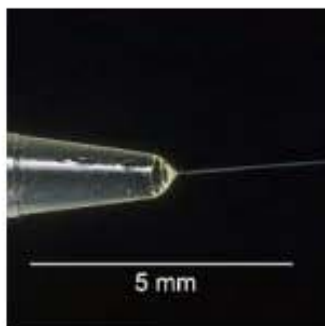
Foot Switch



Pump TTL Db9 Connector

The foot switch connects to the db-9 connector on the rear of the pump. In conjunction with a custom pump program (**which you can easily create**) allows an operator to trigger the pump to do some action – fill an ink cartridge. Simple to operate, precision dispensing, operator friendly!

Electrospinning



Taylor cone – Wikipedia

Electro spinning is a fascinating way of creating new materials by drawing very fine – extremely fine amounts of liquid at a high voltage probe. There is a fair bit about electrospinning on this site from the point of view of pumps and setting up. Many of my customers are working in this area.

To get started:

- See **Spraybase electrospinning and electro spraying machines** which use SyringePumpPro
- Read about the High voltage setup

Pump Manufacturers

Researching pump manufacturers? [There are several mentioned on this site.](#)

Computer Control




The pumps featured on this site are all capable of being connected to a computer. This can be for real time calculated flow changes or for pump monitoring and [uploading of pump programs](#), testing of pump programs, and stop/start operations. As pictured here you need a computer to run [SyringePumpPro](#), [some cables](#) and [your pumps](#). It's easy to setup, if you run into problems you can [contact me](#) and I will help you get started.

You can get an idea of some of the possibilities by watching the [SyringePumpPro Tour Video](#).



Take control of your pumps!

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Why Use SyringePumpPro?

Here's what SyringePumpPro can do to help you get faster and repeatable results when working with your pumps.

Home ☐ **Pump Control Software?**

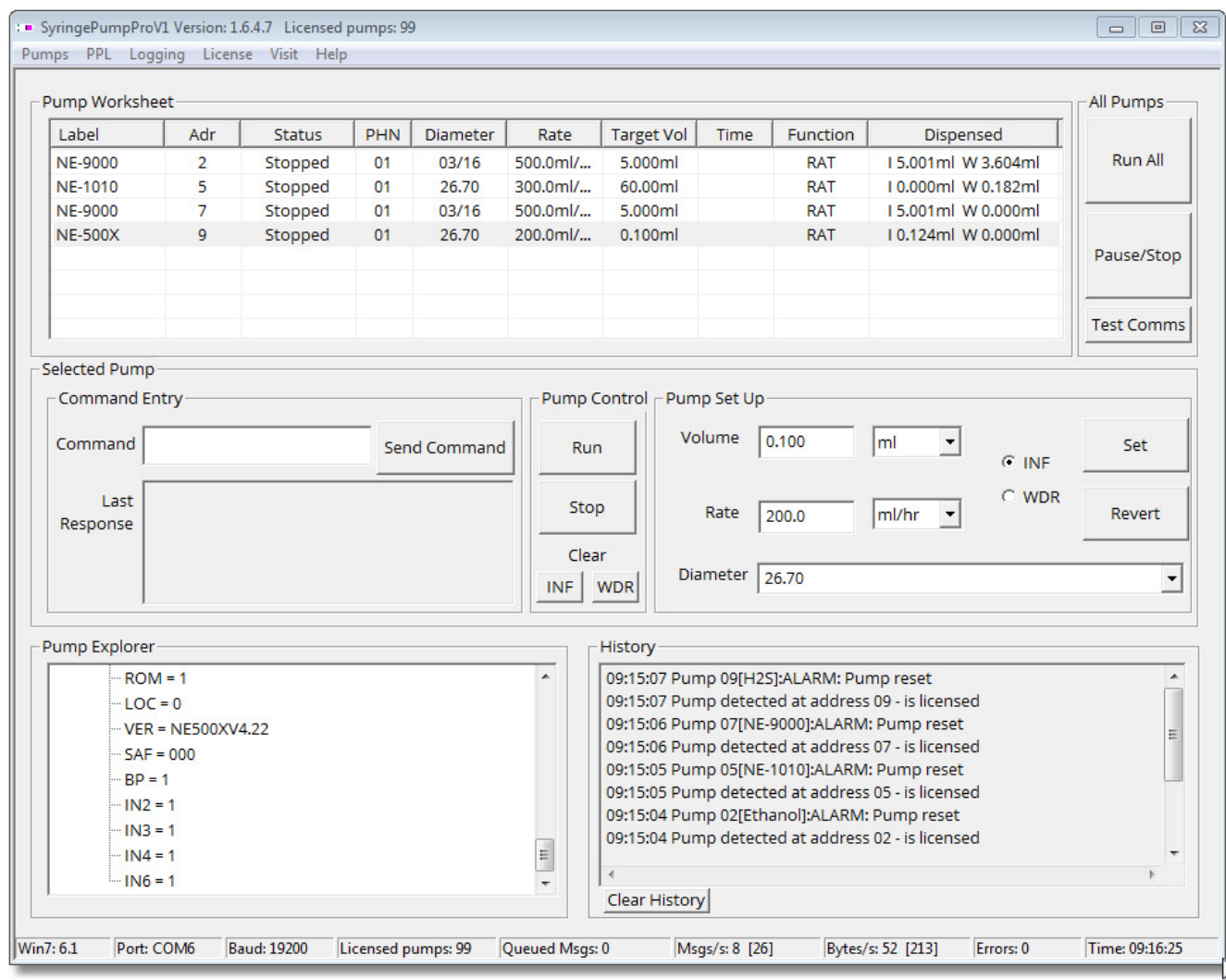
How Can Pump Control Software Help?

SyringePumpPro does this and more!

- + Connect Any Model And/Or Brand At The Same Time
- + Enter Pump Commands
- + Pump Explorer
- + Monitor Pumping Rate And Pumped Volume
- + See Pump Responses And Alarms
- + Start And Stop Pumping. Single Or Multiple Pumps. And Synchronised Multiple Pump Start Pause Stop.
- + Remote Pump Operation
- + Pump Monitoring Tool
- + Upload Pump Programs
- + Pump Programming Examples
- + Configure Syringes
- + OEM Pumps – No Buttons – You Need A Software Tool Like SyringePumpPro
- + Massive Time Saving – Entering Pump Programs
- + Connect Up To 100 Pumps
- + Load Multi-Pump Recipes – With A Single Upload To Any Pump – Great For Production Processes
- + Labview/Matlab Users
- + Display Pump Communication Log Files
- + Display/Edit PPL Files
- + Installs Easy To Use Pump Programming Spreadsheet
- + Alternative To SyringePumpPro
- + Solid Support



Connect any model and/or brand at the same time



SyringePumpPro connects to many pump manufacturer's models. You can mix infusion and peristaltic pumps, microfluidic pumps – what ever your application needs.

Enter pump commands



SyringePumpPro provides a command box where pump commands can be typed in and then sent to a pump. The pumps response is then displayed underneath your command.

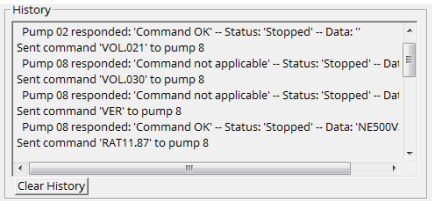
More about [pump commands](#) and where to find documentation for them.

Monitor pumping rate and pumped volume

Pump Worksheet									
Label	Adr	Status	PHN	Diameter	Rate	Target Vol	Time	Function	Dispensed
Ethanol	2	Stopped	01	03/16	500.0ml/...	5.000ml		RAT	I 10.00ml W 26.89ml
NE-1010	5	Withdrawing	01	26.70	300.0ml/...	60.00ml		RAT	I 0.000ml W 0.895ml
NE-9000	7	Stopped	01	03/16	500.0ml/...	5.000ml		RAT	I 15.00ml W 0.000ml
H2S	9	Infusing	01	26.70	75.00ml/...	0.500ml		RAT	I 0.188ml W 0.000ml

In the pump worksheet, SyringePumpPro displays each pumps current pumping rate and the volume dispensed, as well as the volume withdrawn. As the pumps run these values are updated continuously so that you know what fluid flows you are getting.

See pump responses and alarms



A history window logs all communications with the pumps, so you can revise previous commands and check out any unexpected pump alarms and error messages.

Start and Stop Pumping. One or multiple pumps. And Synchronised multiple pump start pause stop.

Often your pump is over there just out of reach, when you notice that something is going wrong with your apparatus. Your computer will naturally be close at hand, and so will the SyringePumpPro Start and Stop buttons. Just handy and possibly safer.

If you want a group of pumps to start pause or stop at the same SyringePumpPro will do this by clicking on the Run All and All buttons.

Remote pump operation

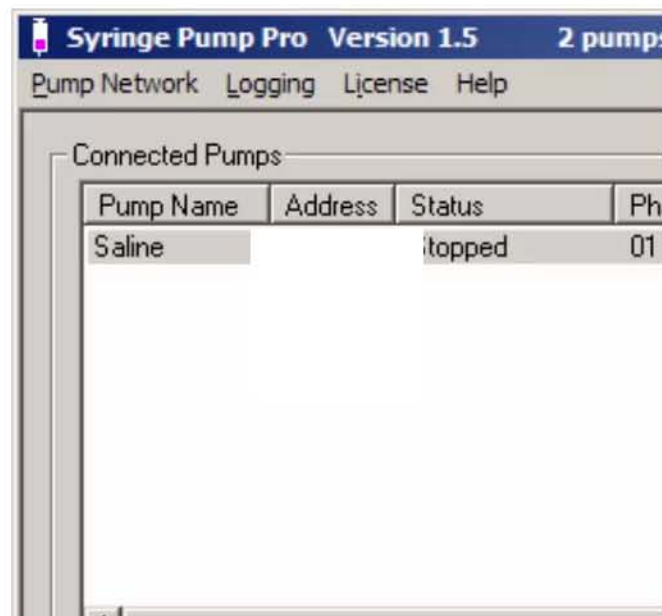
For some setups the pumps are located away from the operator. I have customers with pumps in the next room mounted over the top of all sorts of amazing things – some of them dangerous. Being able to remotely operate your pumps is a very handy feature of these clever pumps.

How far away can pumps be?

Pump monitoring tool

Download and install **SyringePumpPro** and you will have a pump monitoring tool free forever. After the trial times out SyringePumpPro will detect and monitor any number of connected pumps forever.

Upload pump programs



Programming your pump from the buttons on the front panel is slow, tedious and repetitive work, which is error prone and can lead to accidental results. The video on the left shows a pump program being uploaded. The last seconds zoom in on the pump accepting the program statements – it's quick!

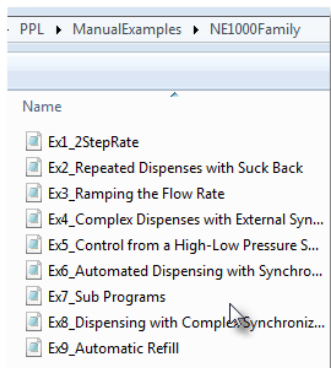
Uploading programs to your pump gets the job done quickly and reliably. Even better it saves you so much time! **See the video showing** 10 minutes of manual operation vs 10 seconds upload with SyringePumpPro.

Select the target pump on the pump worksheet in SyringePumpPro then right click to access the pump content menu, and select upload pump program. You will be asked for the file name of your pump program using standard Windows Explorer interface.

Once you have selected your pump program

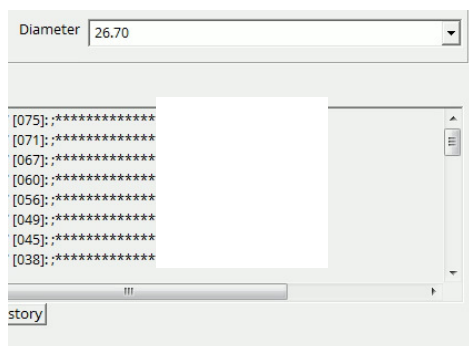
file, it will be uploaded to your target pump. If you file is a **master file or recipe file**, other pumps may also receive pump programs automatically. Eliminate multi-pump operations with the wrong pump program loaded into one or more pumps.

Pump programming examples



SyringePumpPro comes with some example pump programs. Study these examples, upload them to your pump, edit and alter them and learn how to write your pump programs. Cut the examples up and recombine them to make your pumping application.

Configure Syringes



00:00

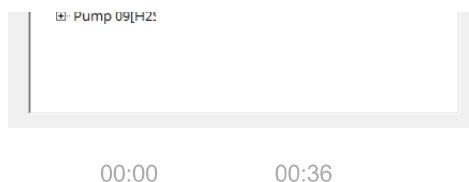
00:21

SyringePumpPro comes with a large list of commonly used syringes. If you are using a syringe not on the list – you can add it, using the Syringe Editing feature. Use the syringe drop-down box to tell the pump which syringe is currently installed. Having the correctly set syringe diameter is critical so that your pump can produce accurate flows and volumes.

Pump Explorer



SyringePumpPro has a pump Explorer feature. For every connected pump and expanding tree can be manipulated to inspect pump parameters. This is especially handy when entering commands and wanting to see the effect on the



pump.

To see the pump explorer in action – click the play button at the bottom of the picture.

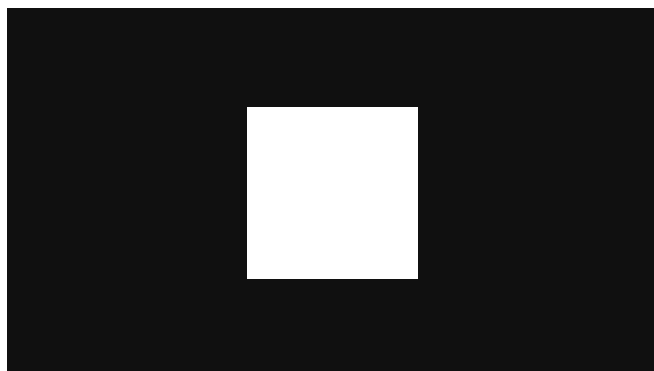
OEM pumps – no buttons – you need SyringePumpPro



As you can see from the OEM syringe pump pictured here – there's no buttons and no display. You can't manually operate the pumps at all.

[Learn more about these OEM pumps.](#)

Massive Time Saving Uploading Pump Programs



00:00

02:03

[Click To Watch Larger Version](#) ☐

If you have some lines of pump program to enter – you can press the front panel buttons to enter it. When you start with pumps, this is error prone and time consuming. Are you trying to get to a result or have fun with buttons?

That's for one pump. For those using more than one pump the time saving, elimination of errors is multiplied by the number of pumps you are using.

This video shows a *portion* of a ppl program being manually entered on a button pump and then demonstrates how long it takes SyringePumpPro to upload the entire ppl program to the pump. Manual entry about 10 minutes – SyringePumpPro upload – 10 seconds.

After watching the video – you can probably see how well used pumps wind up with missing buttons like the one in this photo.

Broken Program and
Phase Button

Connect up to 100 pumps

SyringePumpPro will communicate with 100 pumps connected on a single serial port.

SyringePumpPro will also communicate with a mix of pump models at the same time.

More about the [number of connected pumps](#) and the development and testing of SyringePumpPro.

Multi pump Recipes

You can create a single master pump program which will send any number of pump programs to the pumps you specify. Very useful for ensuring that all pumps used in a protocol are loaded with the correct program for that protocol.

Learn more about [multi pump recipes](#) – they are great for repeatable results in complex pumping applications.

Labview/Matlab users

These are two proprietary environments which are commonly used in labs. Very powerful software indeed. Usually these are used to control a pump or pumps in response to complicated calculation or control inputs. These environments have considerable build process with lots of testing and apparatus resets. In these contexts SyringePumpPro is used for initial communications configuration and test, pump testing, programming tests, and for all those pump operations where it's quicker to issue the pump commands from SyringePumpPro than it is to create code in LabVIEW/Matlab.

- Use SyringePumpPro to design and test your **pump commands** before integrating them into your LabVIEW/Matlab design.
- SyringePumpPro is used as a pump tool box.

Display pump communication log files

Every transaction with every pump can be logged. This is very handy for program development. See how SyringePumpPro commands a pump and copy that into your program. See command syntax and timing.

Display/edit PPL files

A simple internal text editor is provided to inspect and edit ppl files.

Installs easy to use Pump Programming spreadsheet

The **pump programming spreadsheet** is a great way to get started programming your pump.

- **Plan your flow** first.
- Now that you understand your flow load the **pump programming spreadsheet**. It's automatically installed and accessible from **SyringePumpPro**.
- Select the commands you want your pump to do, then export a pump program file which can be uploaded to your pump with SyringePumpPro.

Getting started programming your pump is easy!

Alternative to SyringePumpPro

Yes there is a free alternative to SyringePumpPro called PumpTerm. PumpTerm was created over 10 years ago to run under DOS. Today you can download it for free and it runs using the DOSBOX open source software.

It's free. It works. Many people use it. Try It!

Solid Support

*SyringePumpPro is supported by **the guy who writes the software** and earns his living selling it.*

Imagine! Software support that doesn't fade away.

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So if you need support for your installation of SyringePumpPro, or help getting your pumps connected get in touch – you will be amazed. Too good to be true? Try it!


- [Ask me a question.](#)
- [Say hi!](#) What would you use SyringePumpPro for? – I often help people and can tell you what things you need and help you get started.
- I answer all email quickly – typically in hours, generally within 24 hours and always in under 72 hours

Don't take my word for it! [Read what people have said about my customer support.](#)

Get your free trial of SyringePumpPro

Try SyringePumpPro ☐

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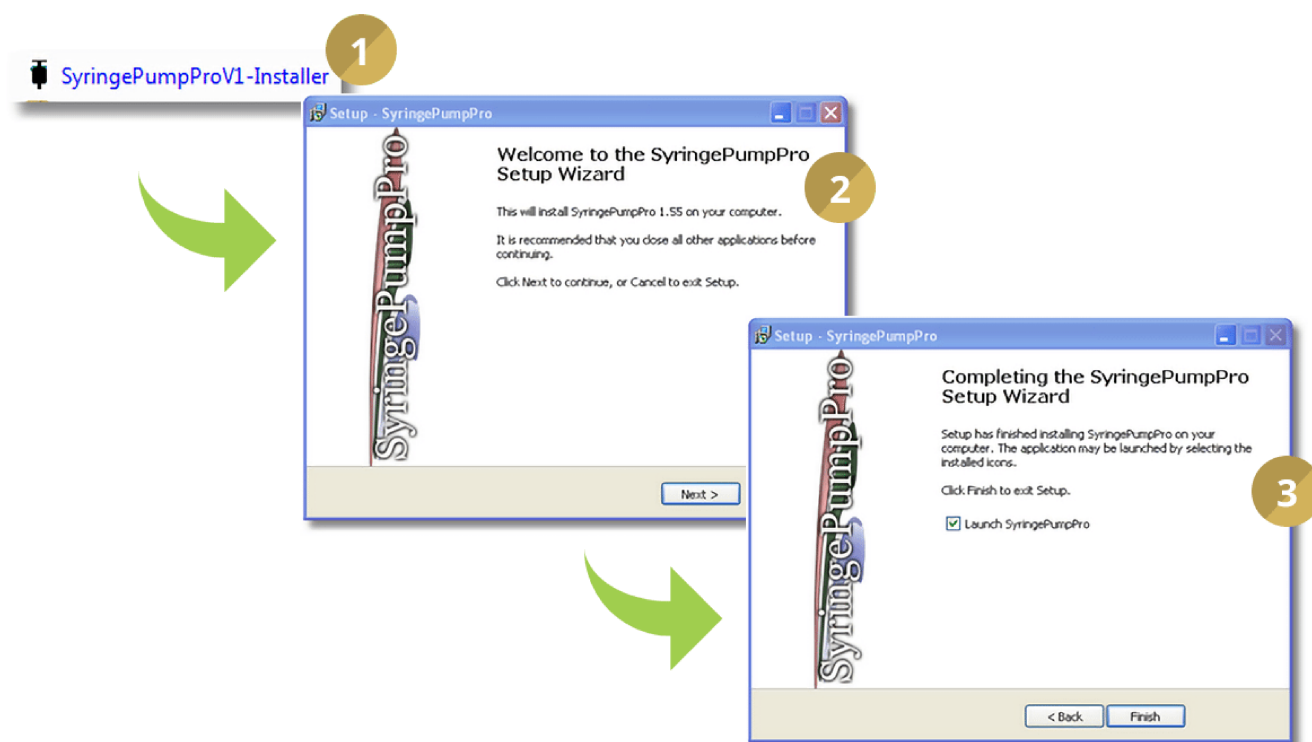
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Installation Guide

Thank you for choosing SyringePumpPro!

Just follow these easy steps to get started:



On your computer double click the installer executable file.

NOTE: SyringePumpPro does not support installation on network shares, or running multiple copies of SyringePumpPro from a single network folder.

You will see the installer program running. Just follow the steps of the setup wizard to complete the installation.

Click finish to launch SyringePumpPro!

Need help with **connecting your pumps**

License Agreement Screen.

Read the contents of the license and if you do not agree to the terms, cancel the installation.

If you do agree to the license terms, indicate your acceptance by clicking on “I accept the agreement”.

File Permission Issue

A few installations in corporate and some academic environments run into file permission problems. You will know you have this problem when SyringePumpPro will run and perform quite normally but it will pop up a couple of error messages each time you start the application. I have prepared some instructions for your IT people to work around this problem for you.

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March 6th, 2017 | [FAQs, Software Support](#)



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Home ☐ **Have You Got Cables? – Start Here**

Have You Got Cables? – Start Here

If you have got a pump and a PC you will need cables to connect them. Have you got cables?

A lot of folks either expect the cables to come with a new pump or they have come to a place where the cables have been lost – I mean put in a special place for safety :-}

This page will take you to other pages which will help you get cables through purchasing information or DIY cables information.

PS If you are trialing SyringePumpPro, dont worry! Relax the trial period starts after your first pump is detected.

Where to buy cables?

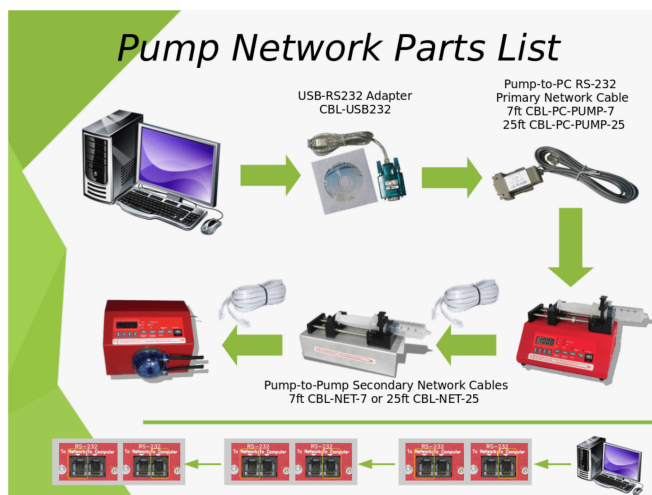
The quick answer is from your pump distributor. [Find your pump distributor.](#)

Hey tell 'em SyringePumpPro sent you.

Don't know what to order?

The part numbers are on [this diagram](#).

The [CBL-PC](#) pictured here should definitely be on your shopping list along with a USB-RS232 adapter. [Here is the manual for that cable.](#)



Thinking of simply buying some generic RS-232 cables? ---

Don't. Take care I regularly see folks struggling with bought cables and then purchasing the pump manufacturer cables in the end. I have photos of a the handy-work of one frustrated general serial cable purchaser – it reveals hacksaw cutting on a cable end – ugly!

DIY cables? ---



tools

Bought cables are inexpensive and will save you time, simply because they will work properly and leave you in no doubt that the cables are the correct ones.

However a lot of people like to build their own. [Here's how...](#)

What are all the different cables/ what are they used for? ---

There's a [table showing each cable and describing it's use](#) here.

Do you need a power supply for your pump? ---

[Here's how.](#)

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Cables

There are several cables that go with your pumps. The following table is a list of all the cables, their part numbers and their description and usage.



- Are you looking to **make your own pump cables**?
- Are you trying to figure out what cables you need to **connect your pumps to your PC**?
- Are you an electro spinner or electro sprayer. See my post on **High Voltage setups**.

Part Number	Description	Photo
CBL-TTL-1	<p>This is a pump synchronization cable. For use with two pumps only.</p> <p>It is used with pump programs to create continuous infusion systems and dual infusion systems.</p> <p>You can use with your own custom pump programs to start and stop another pump</p> <div>Download Cable Instruction Sheet</div>	<p>TTL Cable</p>

CBL-PC-PUMP-7 (7 ft. cable)

CBL-PC-PUMP-25 (25 ft. cable)

Used to connect from a USB-RS232 adapter to the first pump in your pump network.

[Download Cable Instruction Sheet](#)



primary cable PC-Pump

CBL-DUAL-3

- Used for creating a continuous infusion system, dual infusion system, or one of the other 2 pump automation modes.
- Replaces cable CBL-TTL-1, unless the use of the TTL ports for synchronization is preferred. Can result in more responsive pump reactions – no RS232 transmission delays.

[Download Cable Instruction Sheet](#)

Pump-to-Pump Secondary

Used to connect second pump and subsequent pumps in a pump network.

Network Cable CBL-NET-7 CBL-NET-25	<p>See how to connect this cable</p> <div>Download Cable Instruction Sheet</div> <p>25ft (7.6m) Cables not long enough?</p>	
RS-232 to USB Converter CBL-USB232	<p>Connects to your PC via USB and provides modern reliable 9 pin RS232 port with buffering.</p>	

Need your pumps and PC separated by more than 25ft (7.6m)? Thinking of MRI users in particular.

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Home ☐ **Make your own pump cables CBL-PC and CBL-NET**

Make your own pump cables CBL-PC and CBL-NET

Can you make your own pump cables? _____

YES! – you can and this page contains the instructions on how to do it. To most people reading this page I'd like to say – don't make your own cables. Read the section below Why not just buy them.

This page contains instructions and diagrams to show you how to make:

- CBL-PC connects your computer to your first pump and
- CBL-NET which connects between pumps. You will need 1 less than the number of pumps you plan to connect.

Why not just buy them? _____



The total cost of a set of cables for one pump is approximately \$US25 for one pump and for multiple pumps it's \$US25 plus \$US2 for each extra pump. If you order them today – you will have them in a few days as a general rule. **They will work. You will be finished in minutes. So why not just buy them?**

How hard is it to make your own pump cables? _____



I find it rather easy – I have all the parts and an electronics background and all the tools. I used to solder for a living. I have seen photos of cables people make. A lot of them are nice and very serviceable, but some of them – enough said.

- It will take you time, you will need to purchase parts – the correct parts, and the correct cable. You will probably do this for about \$10US There is a list of parts on this page.

- You need to be able to solder and have a soldering iron and general electronics skills, wire stripping, reading diagrams.
- You need a special crimp tool for the RJ11 connectors and possibly some instruction on how to use it. A crimping tools will cost say \$US20.
- If you make a mistake and it doesn't work – then you have to diagnose your issue and rework your cable.

I help a lot of folks making their own cables – possibly half of them give up after a week or two of emails and frustration and just buy the cables.

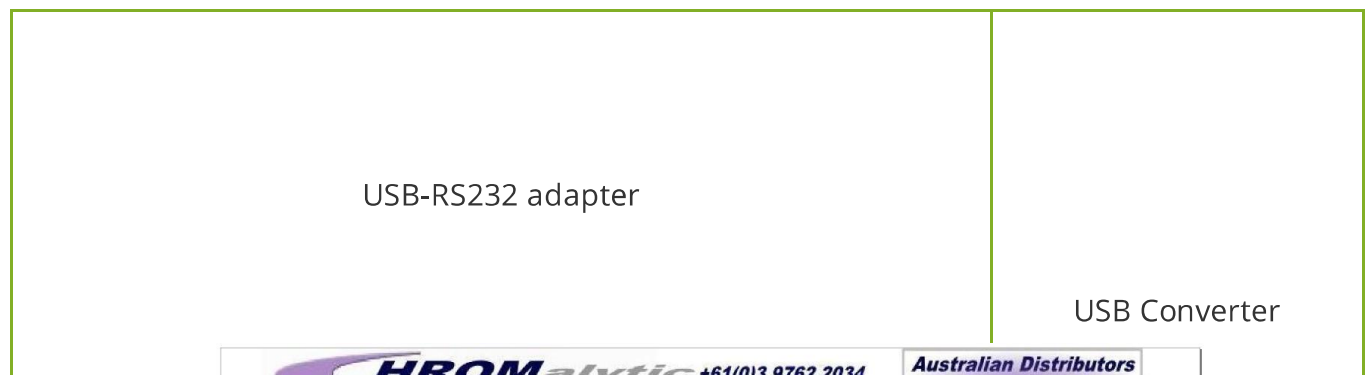
What cables do you need? One CBL-PC and how many CBL-NET?

First stop is to learn about wiring your pumps up. Take a look at this page on to [build a pump network](#), work out what cables you will need.

There are two kinds of cables

1. Pump-to-PC Primary Network Cable – you need exactly one of these. It's part number is CBL-PC. It connects your computer to your first pump.
2. Pump-to-Pump Secondary Network Cable – you need one to go between each pair of pumps you have. (One less than the number of pumps to be connected). It's part number is CBL-NET.

The official cables look like this:



<p>Cable to connect from the COM port or USB-RS232 adapter to the first pump.</p> <p>This assembly consists of a RJ11 female (socket)-Db9 adapter and an RJ11 to RJ11 cable. CBL-PC.</p>	
<p>Cable to connect from pump to pump. CBL-NET.</p>	

Pump-to-PC Primary Network Cable and RJ11-Db9 Adapter – CBL-PC

To make one set of these – an adapter and a cable, you will need

- 2 off RJ11 crimp connectors – 4 connector, they come in 4 and 6 connector styles. You need the 6 position style but with only 4 connectors fitted. A 6P4C. Look closely at the pump connector picture and you can see 6 position but only the middle 4 have gold connectors.
- You will need the special crimping tool- they are cheap. There is a photo on this page of this tool in action crimping a connector. The connector is not particularly visible as it is inside the tool.
- a length of 4 conductor telephone cable.
- A DB9 female to RJ11 female adapter kit – they are a few dollars. I get mine from ebay. This device is a rectangular plastic shell with a mounting for the DB9 plug, a few wires and the RJ11 socket. You have to insert the wires into the shell. There's a picture below showing the correct colors and holes being used. You don't have to have the adapter kit – you can solder to straight to a female solder type DB9F if you wish.

db9 to rj11 adapter kit

NOTE Think about buying a spare or two of each component – by the time you purchase this gear and wait for it to arrive Please consider the cost of a cable and adapter from your **pump distributor** – then it's just plug and play – your not saving any? money really by making your own.

Here's the wiring diagram for the adapter.

PC to Pump Cable Wiring Diagram

There are Two Styles of DB9F

Note the adapter kit may come with wires and pins. The pins are inserted into the plastic block. Or it may come with a solder type of DB9F where the pins are already inserted into the plastic block and you need to solder the wires yourself. They both work the same.

solder db9f front and back

Wiring it – CBL-PC

We have two components to make:

1. The adapter shell assembly– which includes wiring the DB9F to the shell's RJ11 socket
2. The “telephone cable” Which connects the adapter to your first pumps To Computer socket

pump network connectors To Computer highlighted

Assembling the Adapter Shell

The DB9F connector on the left is a female, and is illustrated from the Socket side – the side that receives the USB-RS232 connector. This photo shows the rear of that female Db9 plug with the wires inserted. These wires are the internal cables for the shell. The end you can't see is wired into the RJ11 socket in the shell. These wires come from the factory connected to the RJ11 and with the female pins already soldered on. They are from the left 2(black), 3(green) and 5(red).

If you look closely you can see the pin numbers are on the black plastic which holds the pins – the writing is very small and very hard to see. Use the photograph to guide you.

RS232toRJ11 Adaptor Showing Connections

Your 4 connector cable will have black, red, green and yellow wires.

On the RJ11 end use – these are most likely already connected in the shell for you.

- black for pin 1
- red for pin 2
- green for pin 3
- Yellow is not used. Crimp it in the RJ11

On the DB9 female (pictured)

- black to pin 2
- green to pin 3
- red to pin 5
- yellow cut off. Yellow should be cut short it's not used. Cut it off at the db9 end.

Simply push the pins into the rear of the socket as shown in the photograph. Assemble the plastic shell.

Making the "Telephone" Cable

- You will need:
- 2 off RJ11 crimp connectors

A length of "telephone cable" – this can safely be up to 25ft long (7 metres)

[Learn more about maximum cable length and issues with electrical noise.](#)

Crimp both connectors to the cable – make sure the order of the wires is the same in both connectors

CBL-PC pin connections

Pump-to-Pump Secondary Network Cable CBL-NET

This is the cable that connects the first pump to the second, and then the second pump to the third etc. You will need

- 2 off RJ11 4 contact 6 position connectors
- a length of 4 conductor telephone cable

secondary cable

Let’s make the cable

CBL-NET pin connections

This cable has what's known as a twist. This is where the wires in the cable connect to opposite pins. Don't be confused by this diagram – you don't do anything other than reverse (twist the cable) when you crimp your second connector.

There are 4 wires in the cable coloured Black, Red, Green Yellow – they lay in that order.

1. Crimp the first RJ11 connector on one end of the cable – black wire to pin 2 just like in the diagram left hand connector.
2. Reverse the wire orientation in the second connector. i.e. make the green wire pin 2 instead of the black wire.
3. Reverse the wire orientation in the second connector. i.e. make the black wire pin 4, Red pin 3, green, pin 2."

Test Your New Pump Cable(s)

What you need next is a piece of software you know will work, and is free. Your in luck! The trial version of **SyringePumpPro can be downloaded** from this website for free. Once installed it will ALWAYS detect any correctly connected pumps, even after the trial period times out. So go ahead, download SyringePumpPro and test your cable. If you have problems getting a connection to your pump, I have a heap of information on trouble-shooting in my FAQ-Connections section, and by all means please **contact me** and I will help you get your pumps up and running with SyringePumpPro.

Continuous Infusion Cable

CBL-DUAL-3

I have included a photo of the continuous infusion cable. If you look closely at the image above, you will see the wire colors in each plug – this will let you make your own cable. If you compare the CBL-DUAL-3 Continuous infusion cable to a CBL-NET Pump-to-Pump Secondary Network Cable – you can see that they are wired the same. Really study that photo first! Then build yourself and CBL-NET!

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Home ☐ **Pump Network Parts List**

Pump Network Parts List

What cables and things do you need to connect your pumps to your computer? Here's the items you need.

When one or more pumps are connected to your computer, we refer to the interconnecting cabling and USB-RS232 adapter as a pump network.

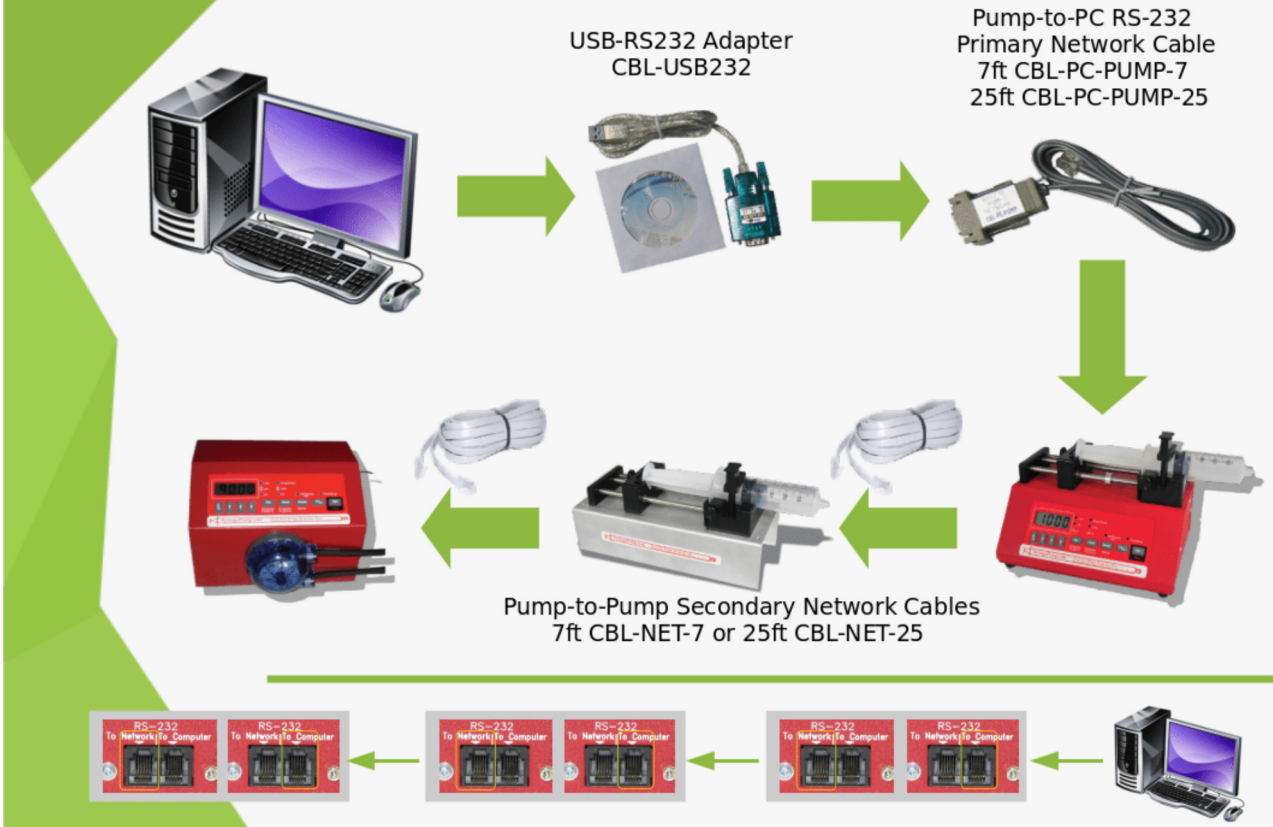
- *Are you trying to figure out what cables you need to **connect your pumps to your PC?***
- Are you looking to **make your own pump cables?**
- Are you an electro spinner or electro sprayer? See my post on **High Voltage setups.**
- Want to buy cables but don't know where?

What parts do you need to build your pump network?

One or More Pumps? **Different manufacturers?** **Different Models?**

Study this diagram:

Pump Network Parts List






- If you have a single pump, you only need the parts from the computer to the first pump. **CBL-USB232** and a CBL-PC-PUMP-7
- If you have multiple pumps, you need to buy all the parts up to the first pump and then a CBL-NET-7 Pump-to-Pump Secondary Network Cable for the number of pumps you have minus 1. You already have connected the first pump with the CBL-NET-7.
- Remember you can **mix models and brands** of compatible pumps.

Print this diagram for reference whilst you order cables and leave it with your pumps as documentation on how to make your pump network.

[Download Pump Network Parts List Diagram](#)

Table of Cables

Part Number	Description	Photo
	<ul style="list-style-type: none">• Adds RS-232 serial port to	

RS-232 to USB Converter CBL-USB232	<p>your computer. Connect to a USB port on your computer.</p> <ul style="list-style-type: none"> Attaches to cable CBL-PC-PUMP-7 	
Pump-to-PC RS-232 Primary Network Cable CBL-PC-PUMP-7 (7 ft. cable) CBL-PC-PUMP-25 (25 ft. cable)	<ul style="list-style-type: none"> DB-9 adapter connects to 9-pin serial port provided by CBL-USB232 RJ11 connector connects to first pump – “To Computer” socket 	
Pump-to-Pump Secondary Network Cable CBL-NET-7 (7 ft. cable) CBL-NET-25 (25 ft. cable)	<ul style="list-style-type: none"> Allows networking of two or more pumps or other device to a single computer First pump to be connected with primary network cable 	

[See our Cables Page for a list of all cables and their application](#)

Where to Buy Cables?

These parts are available from your [pump distributor](#). If you don't know who your distributor is you can search our distributors by country they serve here. Or you can go to the manufacturer [New Era Pump Systems cables page](#) and then on to [their order form](#).

Do you have a CBL-DUAL-3?

That is for connecting [dual pumps](#) on their own without computer control. Don't use this cable to make a pump network – it won't work. Read more about [Dual Pump Sets](#).

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CBL-DUAL-3

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Pump Programming

Program your pumps to get the fluid flows you need!

Home ☐ **Pump Programming**

Pump Programming – A Quick Primer

- | | |
|-------------------------------|--------------------------------|
| + Play With Your Pump First | + Program Documentation |
| + Plan Your Fluid Flow | + More Than One Pump – Recipes |
| + Plan Your Pump Triggers | + Build Incrementally |
| + Are There Program Limits? | + Time Delays |
| + Where To Find Pump Commands | + Testing Time |
| + Your First Program | + Multi Syringe Pumps |
| + Uploading Programs | + Pump Inputs And Outputs |



Play with your pump first

These programmable pumps are incredibly capable and have a mass of computer controlled functionality. They also aren't just a simple pump – they are complex devices. Don't let this put you off using or purchasing a pump.

You need to budget some time to sit with the pump and the [pump user guide](#) and play with it. This will help get your head around how the pump works and familiarize you with it's capabilities.



Pressure Wave Setup

Once you can get some [simple commands](#) working then it's time to sit and read about all the different commands at least once – so that you can see what functions you might use in your application.

Start by writing very short and very basic programs – this will get you used to using the [Pump Programming Spreadsheet](#) and the Pump Programming language.

If you get stuck, by all means [contact me](#) and tell me what problems you are having – I will help you.

Plan your fluid flow



Writing a pump program to create a fluid flow is not a lot different to ordinary computer programming. If you have done a course in computer programming revisit the techniques you were taught to plan and design programs.

If you haven't programmed before – don't let that stop you. Whilst your learning and playing with your pump, manually enter a few of the flows and try them. This is a simple and basic step but it really helps.

At this point of time sit and write a detailed description of your fluid flow. How does it start? What starts it? What flow do you need and when. Draw a graph of the desired flow. Label it with flow rates and volumes to be pumped.

I have more detailed steps in the post [How To Specify Your Flow](#)

Hate the thought of programming? There are some who just can't program and others whose time constraints require them to eliminate the learning curve. If your one of these people, [perhaps I can help](#).

Waveform Flow

I often have customers who wish to pump a wave form – ramped flows, sinusoidal flow and

mimic a measured flow – a common example is a blood flow. Actually that's pretty common! It can be done. **We need to talk.**

Plan your pump triggers



Triggers? A trigger is an external electronic signal that can trigger your pump to start pumping, stop pumping or change it's pumping.

For example people working with different lab scanners might need a sample irrigated or washed in a fluid whilst on the slide or what ever actually contains the sample they are scanning.

These scanners will output a digital signal – a logical 0 or 1 that indicates that they are finished or about to start a scanning operation or pausing operation. This signal can be connected to your pump and through

the use of event triggers in the pump programming language you can have the pump start or stop pumping or change to a different rate.

This is very handy. Very popular with microscope users.

You can use a pump to generate a trigger signal to start or stop another pump or group of pumps. I did a job for a prestigious German research institute in which the pumps were connected in a 'circle'. Pump 1 triggered pump 2 which triggered pump 3 which in turn triggered pump 1. This application required repeated rinsing and washing with a reagent. I then provided three **Muli-Pump recipies** which implemented different treatments and rinses for many hours at a time.

Are there program limits?

Yes the pumps are computer controlled mechanisms. Both the computer part and the mechanical parts of the pumps have performance limitations.

Rates Volumes and the Range of Rates and Volumes

Rates and volumes that you can program are limited by the size of your syringe, your pump's pumping force. The range of rates available within a pump program are limited by the syringe size and your pumps mechanical parameters. You can learn more about these by reading your pumps **Rates and Specification Sheet**. So you cant expect to pump ml/minute and then nl per hour. It's not mechanically possible with a single syringe and depending on

your range not possible with a single pump. However this rarely seems to be a real life issue.

Your pump will only accept a range of syringe sizes which again appears in the **Rates and Specification Sheet**.

The Pump Program

There are only a certain number of steps available in the pump for you to program. This can be determined by reading your pump manual. Typically 40 or 340 steps are available to you. Whilst 40 steps doesn't sound like much – it's amazing just what flow complexities can be achieved with a little optimization.

If you need really complex flows – use more than one pump

Using your plumbing you can combine more than one pump to produce complicated flows but assigning different pumps to produce different parts of the flow. Now read the topics **Multi-Pump flows** and Triggers.

Where to find Pump Commands

Operational Commands

g: PROGRAM

no-]

into-]]

Pumping Program operation:

When the Pumping Program was paused, then the Pumping Program resumes at the g: Observe, the Pumping Program starts from Phase 1.

NOTE: If a Phase number is specified (replace data), then the Pumping Program will start from the specified phase number. By programming sub-programs in different custom memory, this command can be used to individually execute different sub-programs without the need to restart the Pumping Program.

re data-]

Pumping Program Event while the Pumping Program is active:

A pre-defined event defined with the Pumping Program's Event function will cause a jump to the Pumping Program Phase defined by the event function.

data is specified, the program will immediately jump to the Pumping Program Phase specified, and cancel any other event set by the Pumping Program.

g: Pump releases or withdraws at the top speed, depending on the pump

Pump Run Command

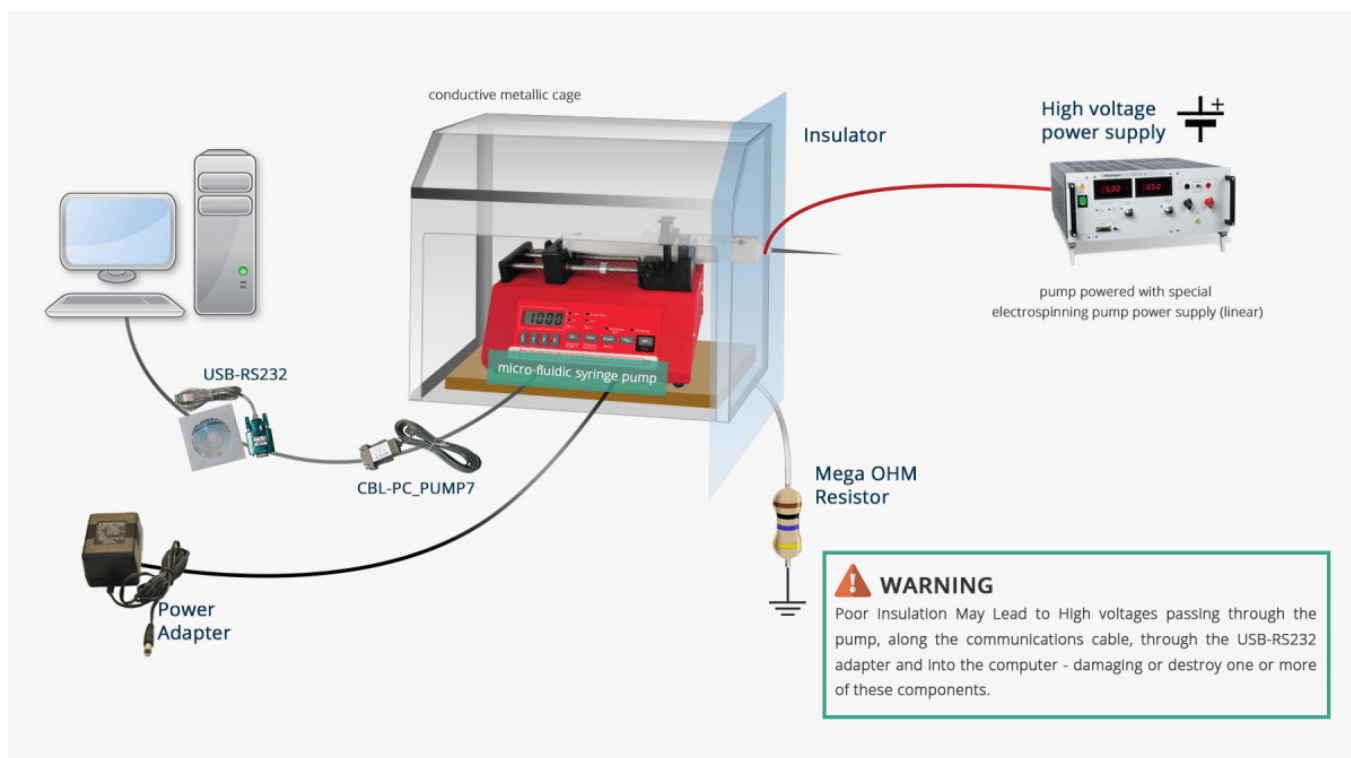
The best place to find all the pump commands listed and their syntax details is in the pump manual. I have **many pump manuals** available for download.

It might take you a little while to understand the way a command works but the example shown here is very typical. These technical descriptions at first glance might appear to be hard to follow but after studying and using a few commands you will soon get the hang of it.

Your first Program

Home ☐ **Electro-spinning – High Voltage Protection**

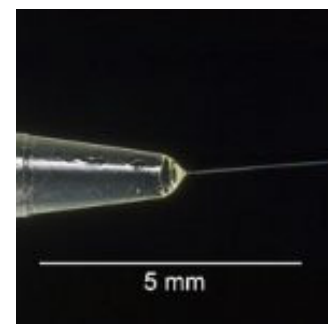
Electro-spinning – High Voltage Protection



The above diagram shows a layout for electro-spinning or electro-spraying. More details about the [pump to PC interface cables](#).

Whilst I talk about electro-spinning in this post, my comments apply to electro-spraying too.

Electro-spinners use a very high voltage up to 50kV (at a low current) to attract a very fine threads from the needle of a syringe pump. The pump's ability to provide very low flow rates combined with the high voltage allows the creation of new materials. Some of the applications are nano-fibres for protective clothing, ultra fine or specialist filters, medical drug applications, or to make materials for replacement body parts to name a few. It's an exciting field indeed.



Taylor cone – Wikipedia

If you want to see state of the art electro-spinning equipment that uses SyringePumpPro, take a look at [Spraybase equipment](#).

Best Electro Spinning Shielding Practices

- Place the pump in a wire cage that is grounded
- Make sure there is a mesh shield – larger than the pump – as large as the physical apparatus plus any reasonable airborne path back to the pump or other equipment.
- Shield all cables, with their shield outer core connected to earth.
- Distance is your friend – get the PC as far away from the high voltage as practical.
- Don't allow long data cables to roam the bench top and travel any where near the pump or spinning apparatus. Take all extra length to the PC end of your setup.
- Make sure it is easy to shut off the High Voltage source in a safe and quick manner – don't bury that power supply behind a bench full of other stuff.
- Have a safety switch system to shut off the high voltage should an operator attempt to open the shielded enclosure containing the pump.

Electro-Spinners Can Destroy Equipment

Cable positioning and insulation are vital points in your apparatus construction. I have seen several customers destroy laptops, and pumps following an high voltage leak.

A poorly setup electro-spinning setup can leak high voltage into cables passing by – or from the syringe needle back through the pump.

Once the high voltage is in the pump or the cables it seeks an earth connection and the only way to get to one is

- Via the operator – if they are attached
- the high voltage travels along the data cable connected to the pump, heads into the USB-RS232 adapter, up the data cable and into the PC and then along the to the pc power supply if it's a laptop.
- The high voltage may enter any cable that is not shielded.

The pumps fare better than the PC equipment

The pumps don't seem to completely die instead they **start doing weird stuff**. They will work and then stop. They will communicate with SyringePumpPro and then stop. It can be hard to diagnose.

Laptops and PC do seem to die outright – they don't take this kind of treatment lightly.

Operator Complacency Might be a Factor

One curious thing I have noted is that every time I am helping diagnose a situation where the

high voltage has escaped I note:

The customer story usually sounds like this:

We have been electro-spinning for a few sessions now – after just getting going – they are past the initial get it going phase.

Our pump started miss-behaving a few sessions ago, and then it seemed all right for a couple of sessions and now it wont work at all – your software isn't communicating with our pump.

We have tried re-installing your software but it didn't help – re installation hasn't ever fixed my software!

Now nothing is working.

I cant prove this – but I think we are seeing leaky high voltage escaping into the pump every now and then. I also suspect that as the operators get more comfortable, stuff moves around on the bench and perhaps a cable strays into the danger zone.

The pump chips do have limited electrostatic voltage protection – this is not a feature of the pump but a feature of all modern integrated circuits. So rather than the traditional zap – it's dead, I think we are seeing a series of small zaps which wind up killing the chips protection circuits – then one more small? zap is all it takes.

Only once was I approached and a customer told me – I killed my laptop.

What I am trying to say here – is I think operators get an early subtle warning that the high voltage is escaping, and rather than one zap killing something, we have gear exposed to marginal conditions and being damaged.

Look for signs of problems and audit your electro-spinning setup regularly.

I am concerned about the high voltage safety side of things – I was given a shock whilst working on an aircraft radar transmitter. It was 30kV – not easily forgotten, I was quite lucky and didn't suffer at all – but years later I still approach the high voltage stuff carefully – it JUMPS!

Download HV Protection Diagram

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