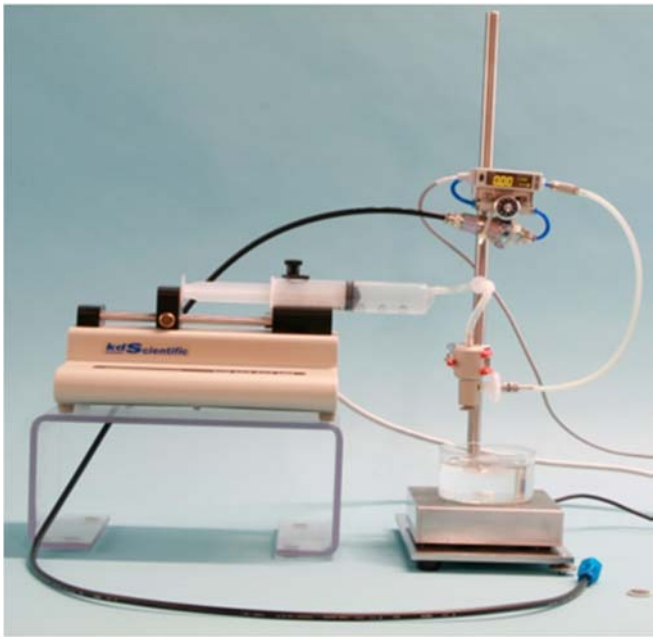
Technical Specification

OFF-LIN-1146 Rev.0

Encapsulation Unit Variation J1



Content

1. Introduction

The **VARJ1 Unit** is a simple device easy to handle. You can combine it with items already available in your lab. Thus, for example, you can use your own syringe pump.

An extensive stock allows us to deliver most spares right away. An efficient network of our qualified suppliers ensures that we can also deliver those parts in a relative short period of time, which we do not have on stock.

As an engineering-oriented company, we would like to discuss your specific problems and wishes. It is our challenge to design and offer you solutions, tailored to your particular problem. Should you need support in maintaining the unit or other type of consultation, our qualified employees like to assist you also at your site.

Based on the long-term contact with the customers, who actually work with our units, we can gain precious information to improve and further develop our products. It will allow us to meet your future requirements.

The described **VARJ1** system for producing microbeads works on the principle of „Coaxial airflow driven technology“. The unit can be sterilised and is delivered with a sterile air filter in case that sterility is required.

The fundamentals on which the encapsulation unit is based shall now be shortly described.

***Note:**

The VARJ1 unit has been developed by University Trondheim. The Technological Transfer to Nisco Engineering AG took place through FMC Biopolymer AS.

2. Fundamentals and Principle of the Encapsulation Unit

The encapsulation unit is best suited for the generation of microbeads using matrices, where gelling is based on interfacial coacervation (e.g. alginate, carrageenan and the like). Which of these, or any other matrix might suit your specific needs, depends on what you want to encapsulate (e.g. proteins or bacteria), what properties the beads should have (physical strength, permeability, edibility, and so on) and which regulations and guidelines you have to follow (Hygienic Guidelines for Food, FDA, etc.).

In most applications involving immobilisation of living cells or other biological materials the bead size is needed to be small (<1mm) and carefully controlled. The reason for this is mostly because of diffusion limitation of nutrients within the hydrogel beads. An easy way for production of small alginate beads in a controllable manner is the use of a coaxial bead generator.

The basic principle of the instrument is the use of a coaxial air stream to pull droplets from a needle tip into the gelling bath before they would fall due to gravity. The Nisco **VARJ1** Unit is designed for production of smaller quantities of spherical alginate beads ranging in size down to around 500µm.

The bead generator with coaxial airflow is basically made of Polyetheretherketone (PEEK) and can withstand most chemicals and high temperatures, which makes the unit very suitable for any disinfecting/cleaning method, typically autoclave cleaning.

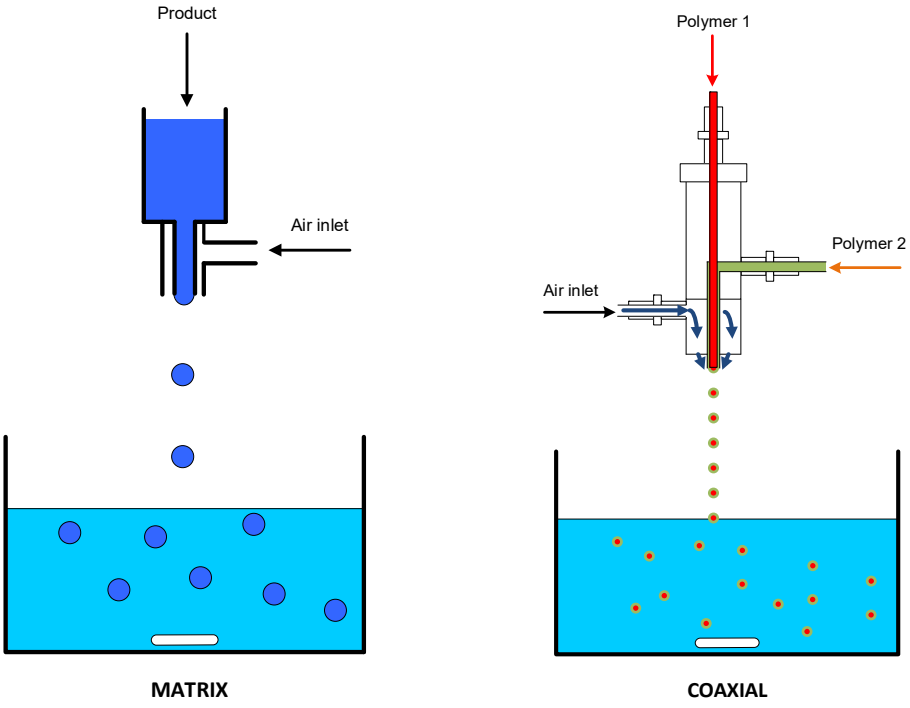


Fig. 2.1: Principle of coaxial airflow bead generator

The Unit is equipped with two connections:

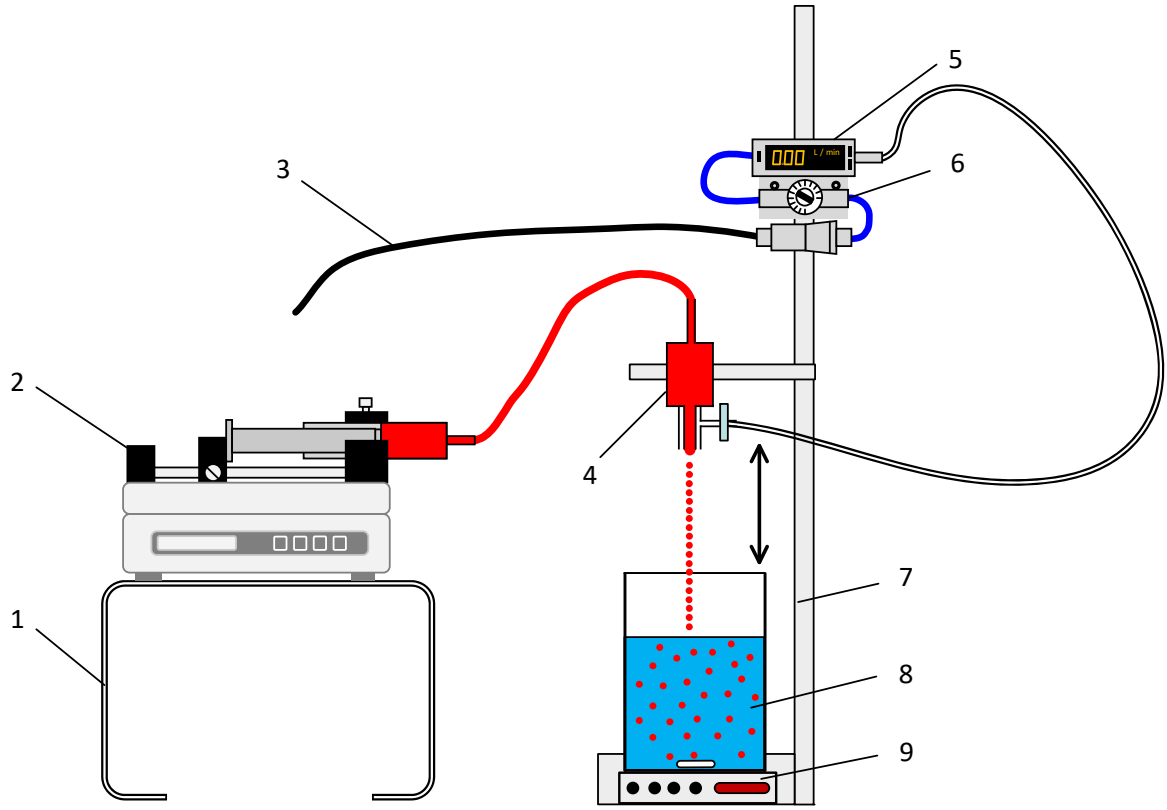
- one for the hose, which feeds the alginate (or other) solution, and
- the second connection which is meant for an air-hose with 4 mm OD.

The alginate (or other) solution may be fed into the unit with a syringe, using a syringe pump.

The magnetic stirrer is placed underneath the gelling bath to keep the beads separated during gelling.

3. Layout of the Unit

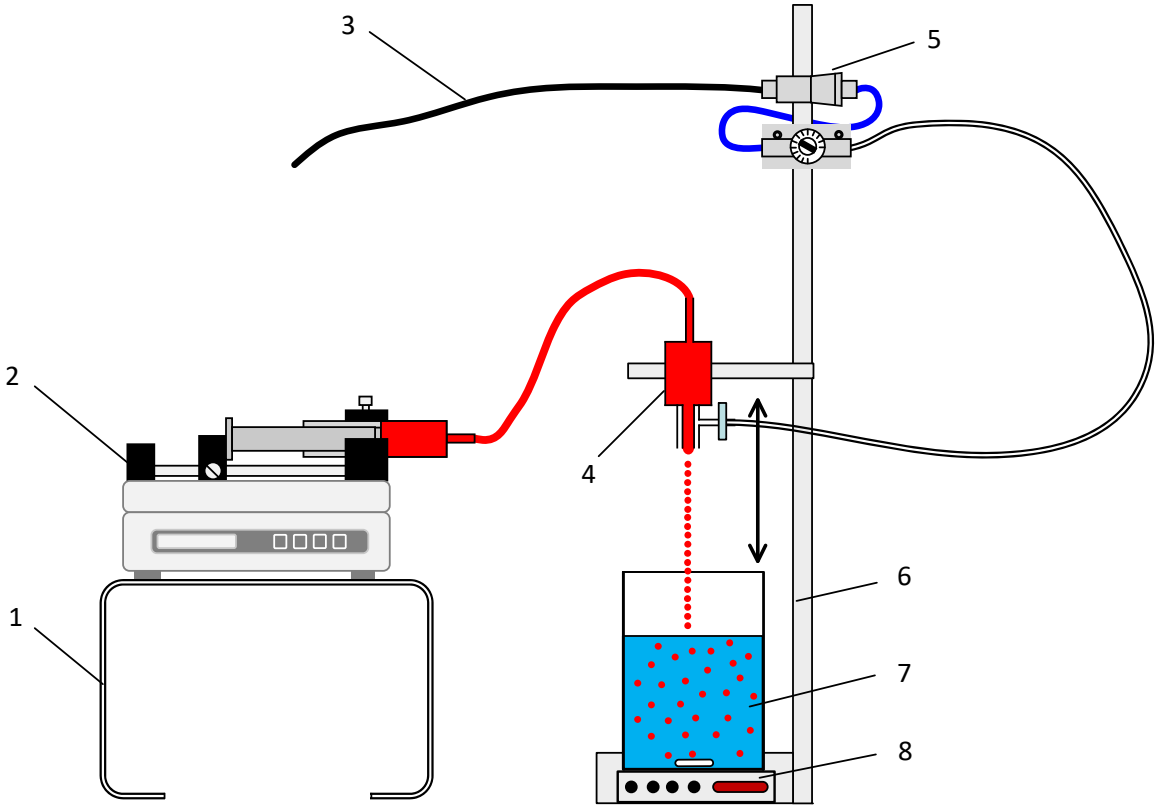
3.1 Unit with Syringe Pump and Thermal Mass Flow Meter (option)



Legend:

1.	Support for height adjustment of syringe pump (PET) (option)
2.	Addition System with Syringe Pump
3.	Air Supply to Unit VARJ1 (max. 4 to 10barg)
4.	Encapsulation Unit VARJ1
5.	Thermal mass flow meter
6.	Pressure reducing unit with needle valve
7.	Stainless steel support for the VARJ1 Unit, flow meter and pressure reducing station
8.	Hardening Solution with Beads (information only)
9.	Laboratory Stirrer (option)

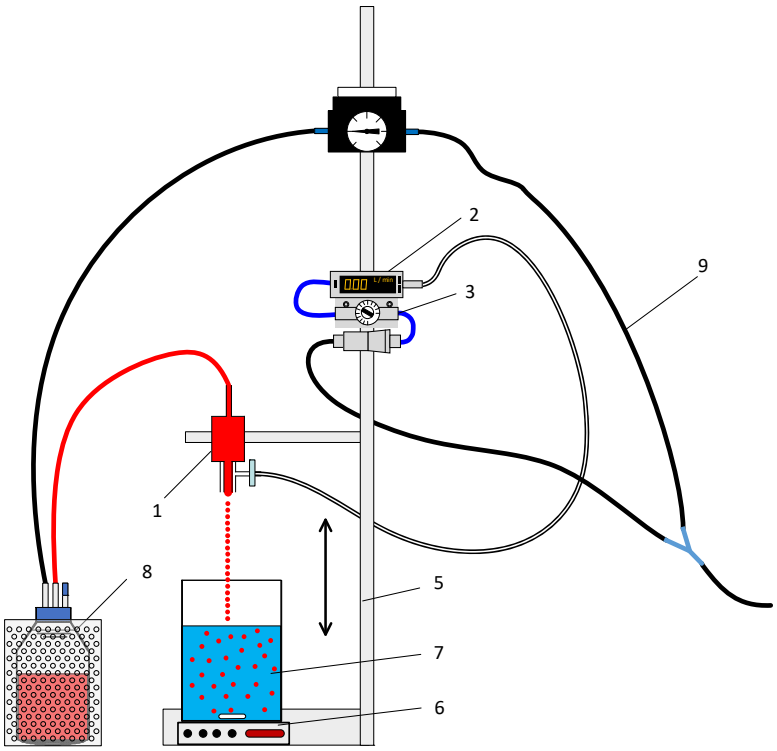
3.2 Unit with Syringe Pump and Needle Valve (option)



Legend:

1.	Support for height adjustment of syringe pump (PET) (option)
2.	Addition System with Syringe Pump
3.	Air Supply to Unit VARJ1 (max. 4 to 10barg)
4.	Encapsulation Unit VARJ1
5.	Pressure reducing unit with needle valve
6.	Stainless steel support for the VARJ1 Unit, flow meter and pressure reducing station
7.	Hardening Solution with Beads (information only)
8.	Laboratory Stirrer (option)

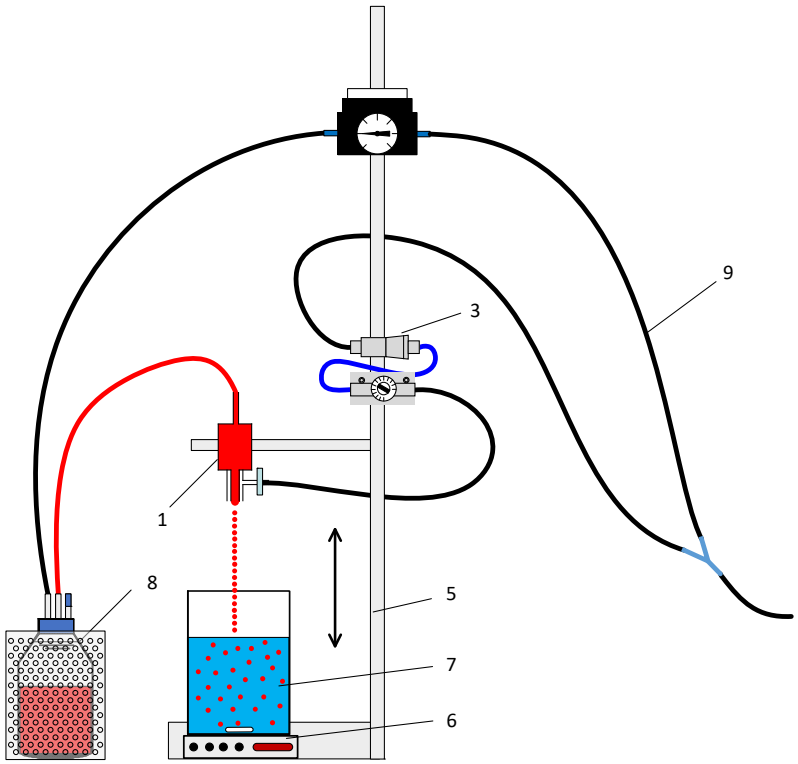
3.3 Unit with Pressurised Flask and Thermal Mass Flow Meter



Legend:

1.	Encapsulation Unit VARJ1
2.	Thermal mass flow meter
3.	Pressure reducing unit with needle valve
4.	Not applicable
5.	Stainless steel support for the VARJ1 Unit, flow meter, pressure reducing station and needle valve
6.	Laboratory stirrer (option)
7.	Hardening solution with beads (information only)
8.	Addition system with pressurised flask
9.	Air supply to Unit VARJ1 (4 – 5barg)

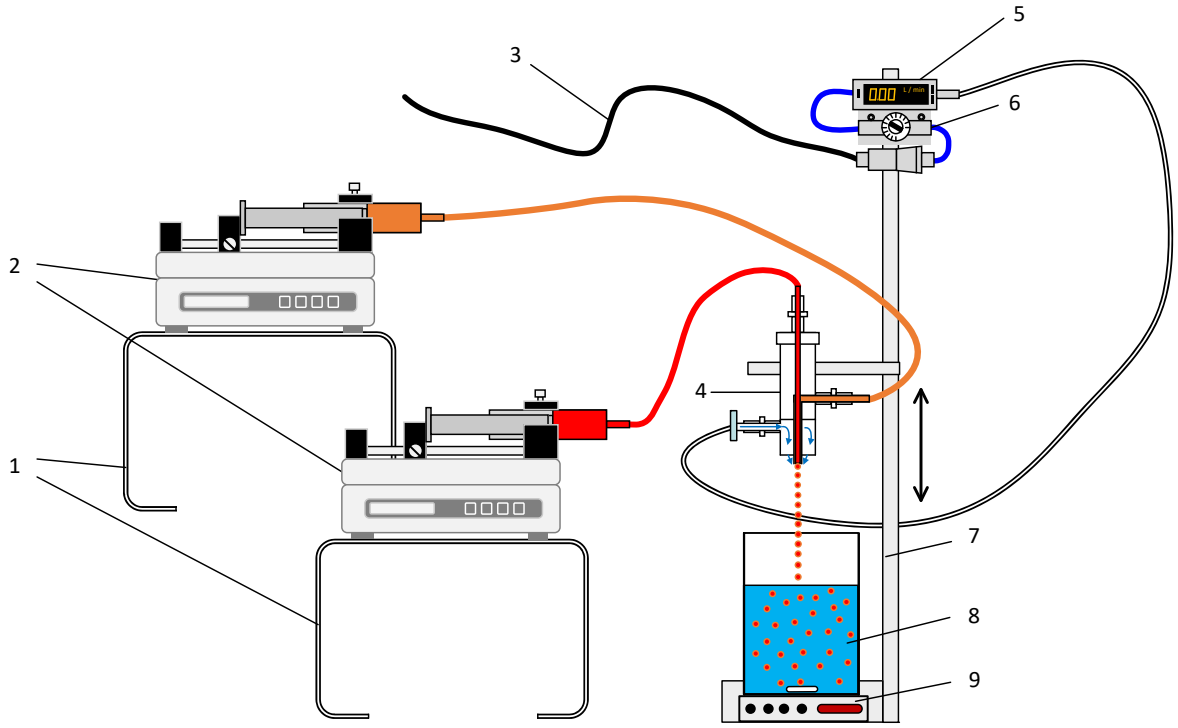
3.4 Unit with Pressurised Flask and Needle Valve (option)



Legend:

1.	Encapsulation unit VARJ1
2.	Not applicable
3.	Pressure reducing unit with needle valve
4.	Not applicable
5.	Stainless steel support for the VARJ1 Unit, pressure reducing station and needle valve
6.	Laboratory stirrer (option)
7.	Hardening solution with beads (information only)
8.	Addition system with pressurised flask
9.	Air supply to Unit VARJ1 (4 – 5barg)

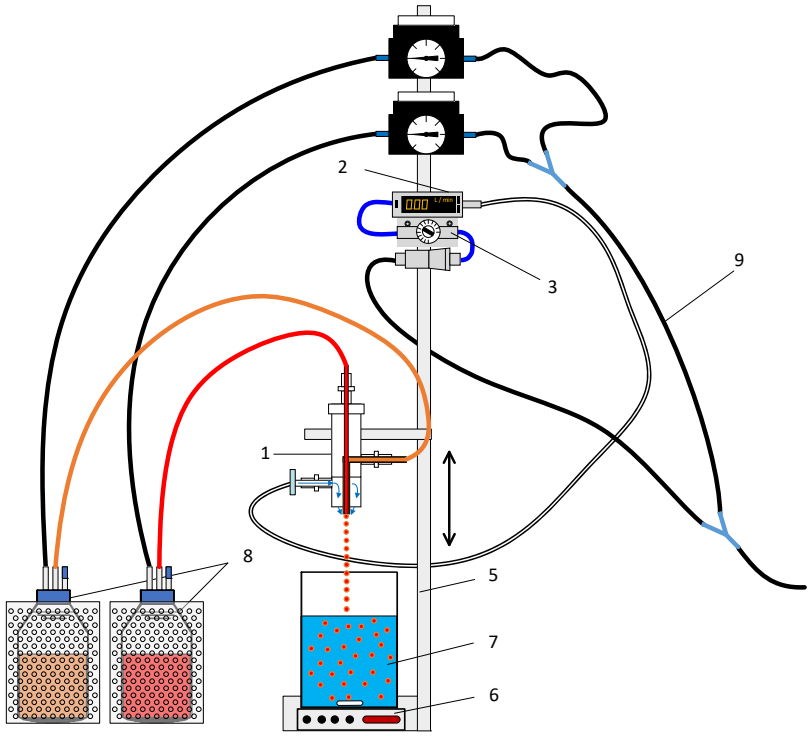
3.5 Unit with Coaxial Nozzle and two Syringe Pumps



Legend:

1.	Support for height adjustment of syringe pump (PET) (option)
2.	Addition System with two Syringe Pumps
3.	Air Supply to Unit VARJ1 (max. 4 to 10barg)
4.	Encapsulation Unit VARJ1 Coaxial
5.	Thermal mass flow meter
6.	Pressure reducing unit with needle valve
7.	Stainless steel support for the VARJ1 Unit, flow meter and pressure reducing station
8.	Hardening Solution with Beads (information only)
9.	Laboratory Stirrer (option)

3.6 Unit with Coaxial Nozzle and two Pressurised Flasks (option)



Legend:

1.	Encapsulation Unit VARJ1
2.	Thermal mass flow meter
3.	Pressure reducing unit with needle valve
4.	Not applicable
5.	Stainless steel support for the VARJ1 Unit, flow meter, pressure reducing station and needle valve
6.	Laboratory stirrer (option)
7.	Hardening solution with beads (information only)
8.	Addition system with pressurised flask
9.	Air supply to Unit VARJ1 (4 – 5barg)

4. Mechanical Design of the Unit

4.1 Feeding System

4.1.1 Single-Syringe Infusion Pump (up to 60 ml - Cole-Parmer) (option)

Part No. 74900-00

The Cole-Parmer Single-Syringe Infusion Pump is a simple, accurate cost effective syringe pump designed to hold glass or plastic syringes, of any make, from 10 microliter to 60 millilitre.

Setup and operation of this pump is extremely simple. A menu, displayed on an alphanumeric LCD "prompts" the operator to make the necessary selections using the keypad for choice of features and numerical entries.

Fig. 4.1.1: Cole-Parmer Single-Syringe Infusion Pump

Suitable applications

The pump is suitable for producing a steady flow with most fluids at ambient temperature. It is designed for a batch size up to 60 ml. The unit is suitable to run sterile batches, for example, for living cells, when using sterile syringes and tubing.

The pump is not recommended for fluids containing fast sedimentary particles.

Advantage

The pump is designed for applications with low flow rate, has a robust construction and long period of use.

Nisco applications

The pump is used for **VARJ1**, **VARJ30** and **VARV1** units.

Pump specifications

Flow rate range:	0.1µl/hr (10µl syringe) to 426 ml/hr (60 ml syringe)
Syringe size:	10 microliter to 60 millilitre
Accuracy:	+/-0.5%
Linear force average:	9kg (20lbs)
Voltage operating range:	
	US model 100-120V~, 50/60Hz
	CE model 200-240V~,50/60Hz
Weight:	2kg (4.5lb)
Dimensions:	9x6x5 inch (23x15.25x13 cm)

Environmental conditions

Operating temperature range:	4°C to 40°C (40°F to 104°F)
Humidity:	20% to 80% RH, non-condensing

4.1.2 Pressurised Feeding System with Flask

The pressure feeding system consists of:

a. Pressure reducing station;
b. Flask (100ml, 250ml) with three nozzles on the head: one for vent, one for transfer with a dip tube and one for filling;
c. Stainless steel safety basket for protection if flask bursts

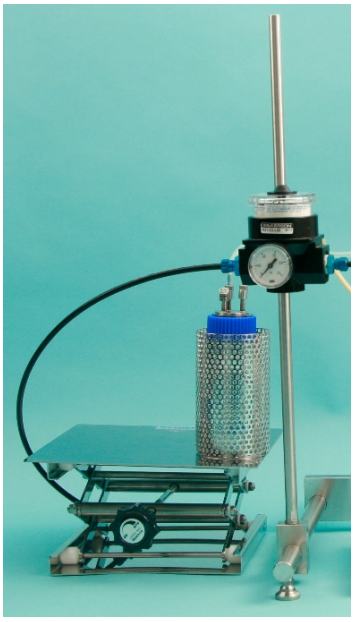


Fig. 4.1.2.1: Pressurised feeding system with flask

a. Pressure reducing station with manometer

In most laboratories, the gas supply is conducted through a central distribution system (line, taps) or through gas steel cylinders on a pressure level of 10barg or higher.

The supplied pressure reducing station with manometer is limited to 1.5barg for security reasons (flask).

The pressure reducing station (Article N° PE-01327) consists of:

Pos.	Description	Note
1	Pressure reducing station with manometer	Part N° PE-01327
2	Connectors	Part N° PE 00758
3	Adaptation piece	Part N° D 01235
4	Laboratory support (Option)	
5	Holding clamp	Part N° PE-00253

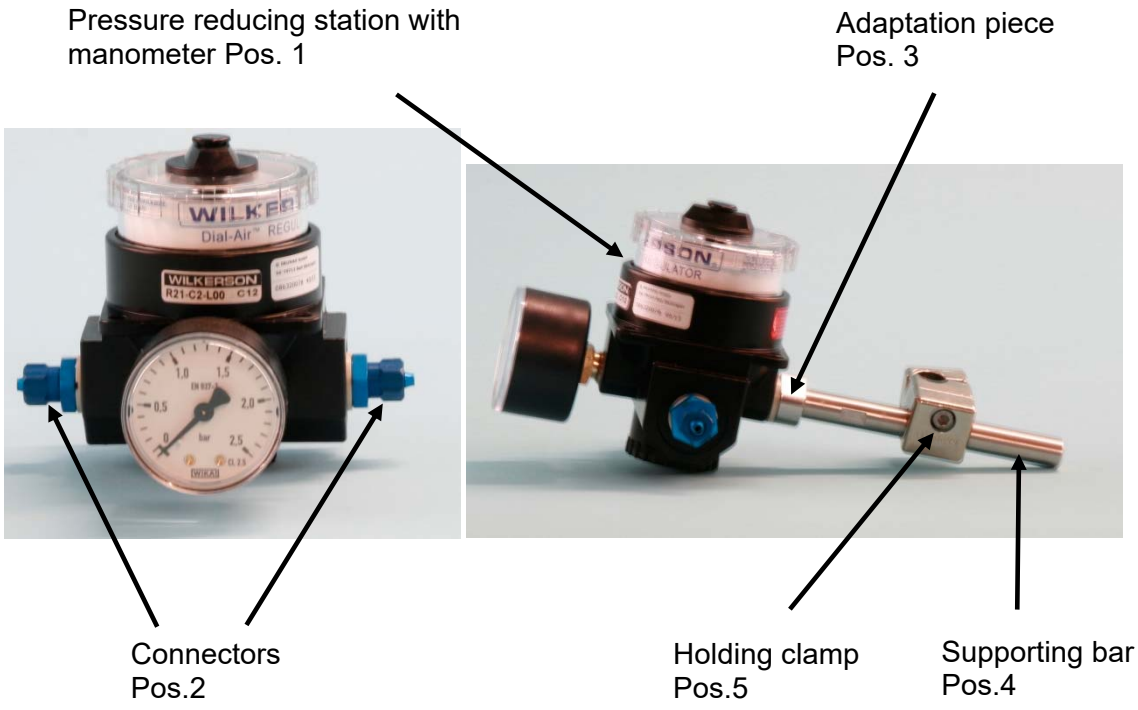


Fig. 4.1.2.2: Pressure reducing station

Specification:

Flow capacity:	117SCFM (55dm³/s)
Adjusting range pressure:	0 to 40PSIG (0 to 2.8bar)
Maximum supply pressure:	300PSIG (20.7bar)
Operating temperature:	32° to 150°F (0° to 65.5°C)

Material of construction:

Body:	Zinc
Bonnet:	Zinc / Brass
Piston:	Acetal
Seals:	Nitrile
Springs:	Steel
Valve assembly	Brass / Nitrile / Acetal

b. Flask

Working pressure range:	-1 to 1.5barg
Max. working temperature:	140°C
Material:	Duran borosilicate glass 3.3

Certificate for pressure resistance:

Acc. DIN ISO 1595, confirmed with GS-Sign (TUEV ID: 0000020716)

Flask connections:

Three female Luer-Locks, one with dip hose connection inside for dip tube.

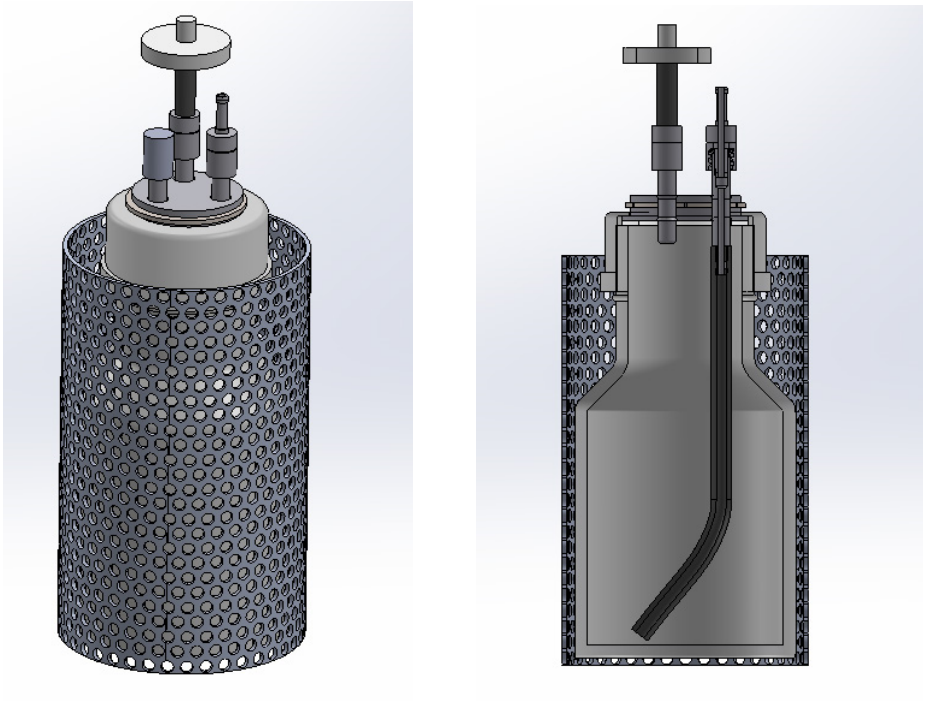


Fig. 4.1.2.3: Standard flask connections

c. Safety basket

When working with pressure a safety basket made of stainless steel 1.4301 is of advantage. If the glass has a crevice or if the pressure is too high (for example, it can happen, if it is connected to the wrong pressure or if the pressure reducing station is defective), the glass can burst.

In order to protect the operator and the other staff in the lab always put the flask into the basket when working under pressure.

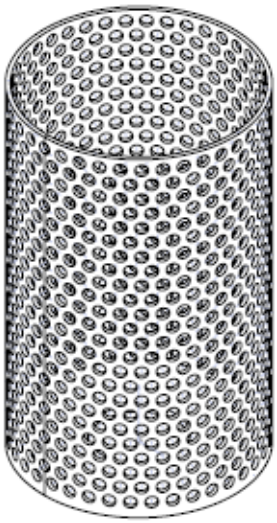


Fig. 4.1.2.4: Safety basket

4.2 Nozzles

4.2.1 VARJ1 Nozzle for Matrix Encapsulation

Fig 4.2.1: Coaxial nozzle for the matrix encapsulation

4.2.2 VARJ1 Nozzle for Coaxial Encapsulation

The coaxial encapsulation with use of two different media with VARJ1 is possible.

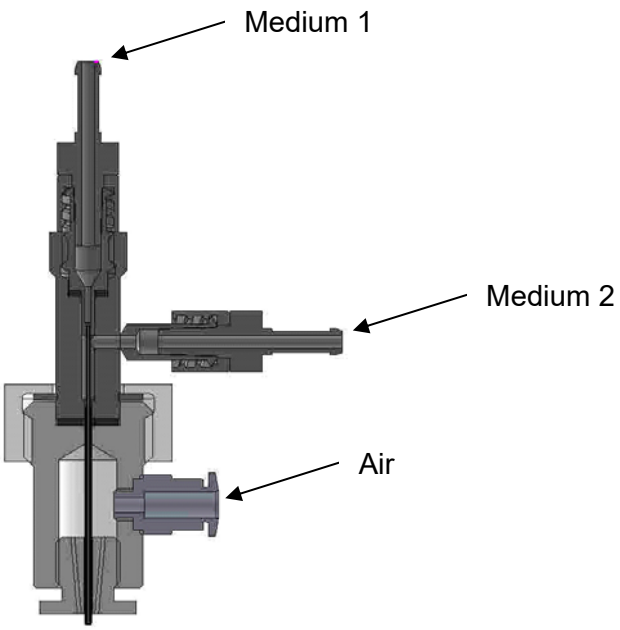
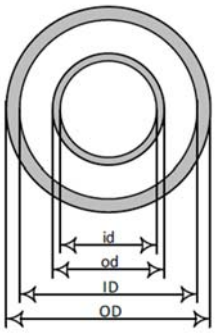


Fig 4.2.2: VARJ1 Coaxial nozzle

The following nozzles sizes are available:



id 0.09 / ID 0.4

id 0.15 / ID 0.5

id 0.25 / ID 0.5

id 0.35 / ID 0.8

*)

id – inner diameter of inner nozzle

ID- inner diameter of outer nozzle

4.3 Support

4.3.1 PET Support for Feeding (option)

The PET Support is used to place the syringe pump or flasks on it.

Dimensions: 150 x 123 x 250mm

Fig 4.3.1: PET support (A – 00723)

4.3.2 Support with Height Adjustment for Feeding (option)

Fig 4.3.2: Support with height adjustment (PE – 01162)

Support Construction:

- Improved scissor technology with reduced tolerances
- Ergonomic knob, rounded and user friendly
- Scissor-construction made of 18/10-stainless steel

Properties:

- All models are manufactured according to DIN 12897.
- The operating load differs between the maximal dynamic operating load (Kg max. dyn.) and the maximal static operating load (Kg max. stat.) of the lab jack. These norms are also according to DIN 12897.
- Smaller models up to 240x240mm have a simple adjusting wheel, which can be operated easily by hand.

Dimensions:

- Length: 240mm
- Width: 250mm
- Max. Height: 275mm
- Min. Height: 60mm
- Max. Weight: 7kg.

4.3.3 Stainless Steel Support for VARJ1

Material: Stainless Steel

Fig 4.3.3: Support for VARJ1 Unit

4.4 Flow Control

4.4.1 Flow Control Unit with Thermal mass flow meter (for VARJ1 Unit)

Nisco article No. A 01061

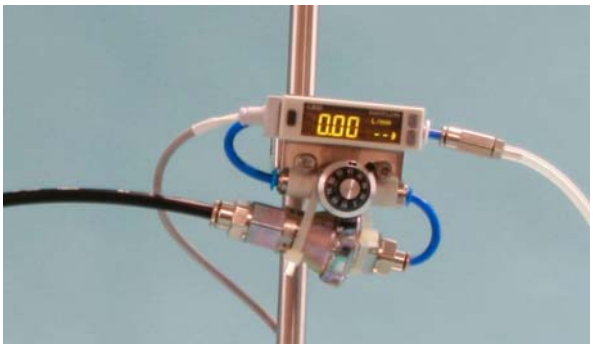


Fig 4.4.1: Flow control unit with thermal mass flow meter

Complete flow unit mounted on a holder with 12mm bar and double socket to fix it on a lab support with 12mm bar. The flow control unit consists of:

Pressure limiter

Inlet:	pressurized oil free air 5-18barg
Outlet:	1.5barg
Needle valve range:	0…10L/min with potentiometer type manual drive

Thermal mass flow meter:

Type:	FSM2-PAF050-H041K
Measuring range:	1-5NL/min
Repeatability:	+/-1% of FS or less
Display resolution:	0.01 l/min
Medium:	Air
Temperature:	0..50°C
Primary pressure:	3.0bar a
Post pressure:	1.5bar a
Connection:	G1/4“ female thread
Power supply:	24VDC

Power Supply unit:

Type:	FPPS 5-7.5WP//FPPS 24-12WP
Input:	110-240V/AC. 50/60Hz
Output:	24VDC, max. 500mA, max. 12W
Cable length:	1.8 meter
4 Plugs:	UK, EU, US, AU

Inlet Air hose

Inner diameter 4mm outer diameter 6mm (outside calibrated)

On the picture a black PE hose has been used.

Outgoing hose

Inner diameter 2mm.

On the picture a silicone hose has been used.

4.4.2 Flow Control Unit with Needle Valve (for VARJ1 Unit)

Nisco article No. A 01063

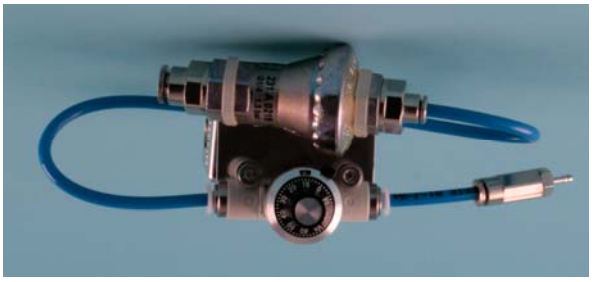


Fig 4.4.2: Flow control unit with needle valve

Complete flow unit mounted on a holder with 12mm bar and double socket to fix it on a lab support with 12mm bar. The flow control unit consists of:

Pressure limiter

Inlet:	pressurized oil free air 5-10barg
Outlet:	1.5barg
Needle valve range:	0…10L/min with potentiometer type manual drive

Inlet Air hose

Inner diameter 4mm outer diameter 6mm (outside calibrated)

Outgoing hose

Inner diameter 2mm.

4.5 Hardening for Hardening Solution

4.5.1 Magnetic Stirrer Lab Disc

(Nisco Article N° A-01798)

The inductive drives of magnetic stirrers operate without any moving parts such as motors, belts, or mechanical bearings, making magnetic stirrer Compact 100% wear and maintenance-free.

Fig. 4.5.1: Magnetic Stirrer Lab Disc

Magnetic stirrer specifications:

Plug-in power supply unit:		
Rated voltage:	V AC	100 – 240
Rated frequency:	Hz	50 - 60
Output voltage:	VDC	12
Absorbed power:	W	5
Output power:	W	min. 3
Magnetic stirrer:		coil drive 4-pole
Speed range:	1/min	15 - 1500
Stirred quantity (max.):	ml	500 (at 1500 rpm with 25mm stirring bar)
Operating time:	%	100
Protection class:		II
Pollution degree:		2
Overvoltage category:		II
EN 60529 protection class:		IP 65
Ambient humidity (relative)	%	80
Ambient temperature:	°C	5 to 40 (in the operation)
Transport temperature:	°C	-25 to +70
Storage temperature:	°C	-10 to +70
Material:		Housing PA GF TPU
Front membrane sheet		Polyester
Weight:	kg	0,3
Installed weight (max.):	kg	2,0

Set-up surface:	mm	ø 90
Dimensions: (W x D x H)	mm	114 x 161 x 12
Explosion hazard class:		II 3G EEx nC IIB T6
International Plugs:		EU/CH/UK/USA

Accessories:

1 piece of 150ml beaker Ø 80 x 45 mm, Article N° PE-00537

1 piece of agitation element Ø 5 x 15 mm Article N° PE-00957

Benefits of magnetic stirrer:

Hermetically sealed in a resistant stainless steel housing, thus suitable for use under conditions of high ambient humidity or in aggressive media; impermeable to microorganisms.

4.6 Heated Version (thermal option)

4.6.1 Heating System for VARJ1 (option)

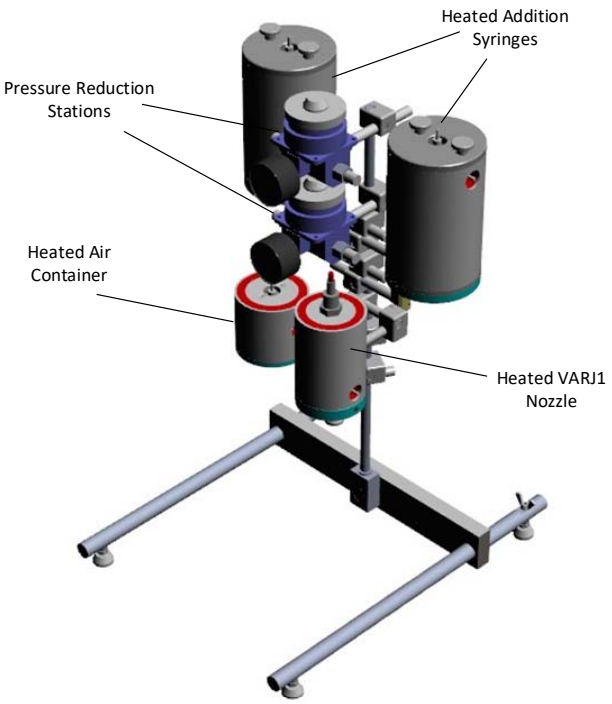


Fig. 4.6.1: Heating system for VARJ1

4.6.2 Control Cabinet for Heating - Thermal Box (option)

All electric parts and components related to the thermal option are built in the thermal box. It is located beside the VARJ1 Unit.

The box with thermal function is operated independently via the front panel.

Fig. 4.6.2.1: Front panel of the box with the thermal function

Fig. 4.6.2.2: Rear panel of the box with the thermal function

The control cabinet for the auxiliary heating consists of the following components:

- On/off switch
- Digital temperature controllers
- Power supply 240 V or 110 V (switch to adjust)
- Solid state relay for the electrical heating system
- Power supply 24V for the heatable hose through interconnection
- 4 fuses
- Plugs for the external heating cylinders and the heating coils for the hoses heating.
- The set-points are set through the front panel

5 Spare Parts and Available Needles

	Description	Piece	Material	Code
1.	Needle - od 0.5; id 0.25xL45	1	stainless steel AISI 304	D 4 00383
2.	Needle - od 0.3; id 0.17xL45	1	stainless steel AISI 304	D 4 00382
3.	Needle - od 0.7; id 0.40xL45	1	stainless steel AISI 304	D 4 00394
4.	Gasket (cylindrical with cone)	1	MVQ (Silicone)	D 4 00493
5.	Flat Gasket	1	MVQ (Silicone)	D 4 00492