

General Catalog 2024

Where
Innovative Technology
Begins

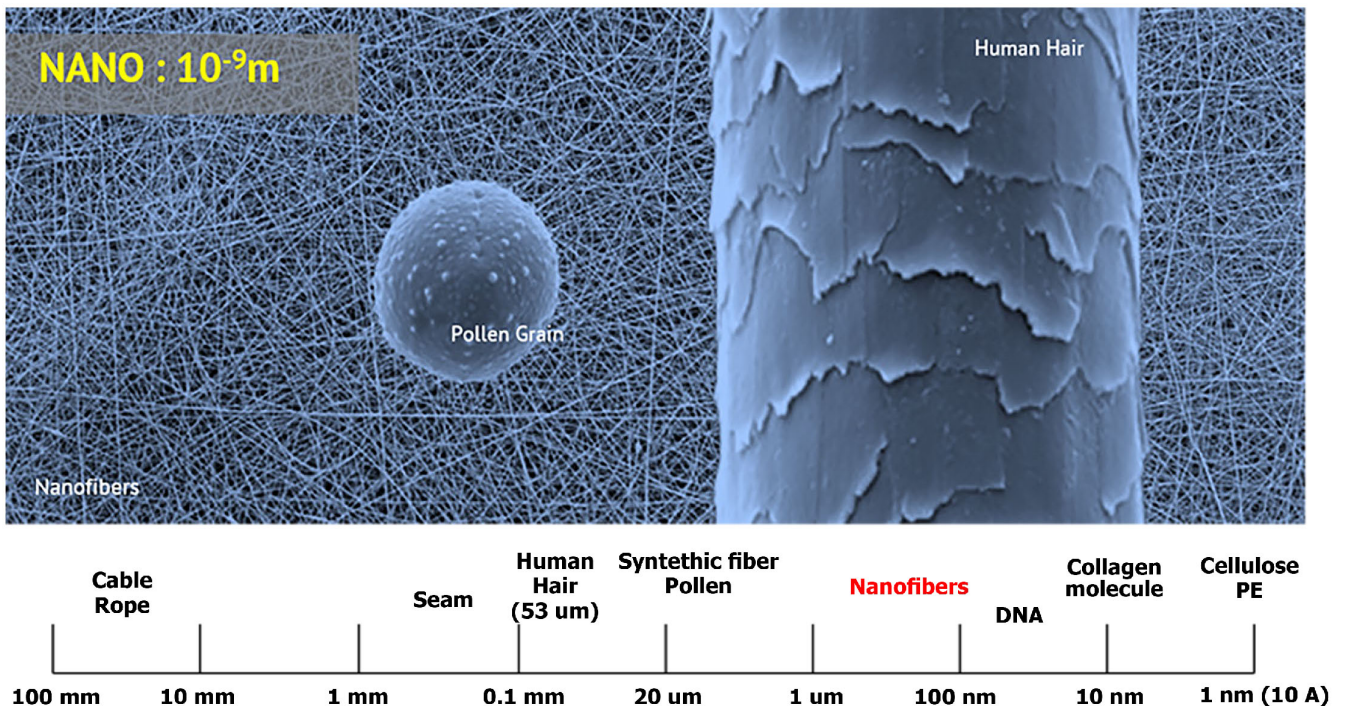


FNM co.
Electrospinning and
Nanofiber Company

Introduction to the Electrospinning Process

Electrospinning is a manufacturing technique involving electrostatic driven process used to create electrospun fibers. The diameter of these fibers typically ranges between tens of nanometers to a few micrometers. One of the main advantages of the electrospinning technique is its versatility of processing to create fibers with multiple arrangements and morphological structures. The popularity of the electrospinning technique has allowed multiple technologies such as new filters, tissue engineering, regenerative medicine,

and encapsulation of bioactive molecules, to emerge and evolve over the past decade. These days the electrospinning technique is not just for academic research, but one with real commercial applications. Currently, multiple industries around the world have adopted this technique in the development of new product innovations. Some of the applications where electrospinning is being currently used are tissue engineering, drug delivery, food encapsulation, insulating materials, energy conversion and storage, air and water filtration, among others.





- ISO 9001:2015; ISO 10002:2014; ISO 14001:2015; BS OHSAS 18001:2007
- CE mark for lab-scale electrospinning machine
- VTT, DMT approved air filtration tests
- Nano scale certificates from INIC
- Third laureate of 25th Khwarizmi International Award, 2012 Tehran, Iran
- Prize of academy of science in developing countries (TWAS); UNESCO, 2012
- Second rank in Technology at 6th National Nano-Awards Festival, October, 2011, Tehran, Iran
- First laureate nano products award at 11th National Nano-Awards Festival, October, 2016, Tehran, Iran
- Award for high tech export at 12th and 13th National Nano-Awards Festival, 2017 and 2018 Tehran, Iran
- Award of the inventions and technology in the 27th Razi Research Festival awards winners on Medical Sciences (2021)
- Selected Company in the 25th IRAN National Exports Day ceremony (2021)
- First prize of International Technology Transfer Award, of the D8 Group in Turkey, 2022.
- Selected as one of the top 6 five-star (highest rank) knowledge-based export companies in Iran, 2022.

FNM Co. (Fanavaran Nano-Meghyas) was established in 2004 as a knowledge-based company with a primary focus on the development of nanofiber technology and its various applications. FNM specializes in designing and manufacturing electrospinning machines in lab, pilot, and industrial scales, along with blown electrospinning systems. These systems come equipped with a range of accessories such as high-voltage power supplies, syringe pumps, and collectors. FNM's primary areas of expertise include the production of respiratory face masks, air and oil filters for power plants and automotive applications, window screens, vacuum cleaner bags, cosmetic face masks, wound dressings, and more, all based on electrospun nanofibers.

FNM's lab-scale electrospinning machines are ideal for conducting research and development in the fields of ceramic, polymer, and composite nanofibers. These machines offer a combination of competitive pricing and high quality and have been successfully exported to various countries.

In the realm of large-scale electrospinning machines, FNM's technology is particularly valuable for coating filter papers with a layer of polymeric nanofibers. This thin layer enhances filtration efficiency, extends filter life time, and increases dust-holding capacity without raising pressure drop. The resulting nanofilters find applications in various sectors, including automobile filters, power plant filters, and respiratory face masks. FNM's nanofilters meet stringent quality standards and have obtained certifications from reputable institutions such as VTT (Finland) and DMT (Germany). Furthermore, FNM is committed to advancing a wide range of nanofiber-related technologies, including ceramic nanofibers, composite nanofibers, scaffold nanofibers, and core-shell nanofibers.

FNM's research and development department is well-equipped with state-of-the-art tools, including a Scanning Electron Microscope (SEM), a diverse array of electrospinning machines in lab and pilot scales, ultrasonic homogenizer, and various filter testing equipment.



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High Voltage Power Supply

High voltage power supplies (HVPs), manufactured by Fanavaran Nano-Meghyas Co. Ltd. (FNM Co.) offer small and lightweight packages, making them suitable for demanding laboratory and OEM applications such as capacitor testing, free-electron laser, ion implantation, physical vapor deposition, capillary electrophoresis, electrospinning, ion-beam assisted deposition, and ion sources. These supplies also feature a 1000:1 voltage monitor, scaled to match most common handheld voltmeters. The capacitors are fully embedded in solid resin for protection.

FNM HVPs series

D-RC Series	OC Series	OV Series
HV35P D-RC	HV35P OC	HV35P OV
HV50P D-RC	HV50P OC	HV50P OV
HV35N D-RC	HV35N OC	HV35N OV
HV50N D-RC	HV50N OC	HV50N OV

HV35P OC: High Voltage 35kV, Positive, OC series

OV Series only have output voltage indicator (Accuracy = 0.1 kV).

OC series have output voltage indicator (Accuracy = 0.1 kV) and output current display (Accuracy = 1 micro-amp).

D-RC Series have a standard USB connector for digital remote control via windows Operating System with 10 bit resolution which means that 50kV (max) would be divided into 1024 segments. In this case, 50,000/1024 which is approximately 50V per bit.

Typical Applications

- Electrospinning
- Capillary electrophoresis
- Capacitor testing
- CRT display testing
- Free-electron lasers
- Photomultipliers
- Ion sources
- Biasing
- Dielectric Testing
- Piezoelectric Drivers
- Electrostatic Chucks
- Sealing Applications
- Inkjet Printers
- Photo Detectors

Features:

High Frequency Switch-Mode Circuit Design: HVPs design topologies are based upon switch mode

power conversion technology, while operating at high frequencies. The “switcher” is the design of choice for many industrial and medical applications because of its desirable combination of high efficiency, small size, and low weight as well as increased safety for high voltages supplies.

Arc Sensing Circuitry (Optional): Proprietary arc sensing circuitry will suppress arcing conditions that can occur regularly in high voltage applications and provide maximum safety and protection for both the power supply and user.

Software: The DRC Series High Voltage Power Supply includes, control software and accessories, providing all the connectivity needed right out of the box. After the control software has been installed on a Windows compatible computer, the DRC HV unit is “plug and play”. The user enters the desired output voltage and clicks the Start button. The power supply is activated and continuous read-back of the high voltage is displayed. The USB interface is accessed by a Windows USB driver through a standard communications port.

Specifications:

Weight: about 5 kg (35 and 50 kV) and 7 kg (more than 50 kV)

Output: Continuous, stable adjustment, from 0 to the desirable voltage by panel-mounted 10-turn potentiometer (OC and OV series) or by a digital volume (DRC Series).

Dimensions: OC and OV: 34×38×12 cm, D-RC: 34×43×12 cm

Input: 100-240 V AC, single-phase

Power: 35 Watt

Working Temperature: -5 to +45 °C

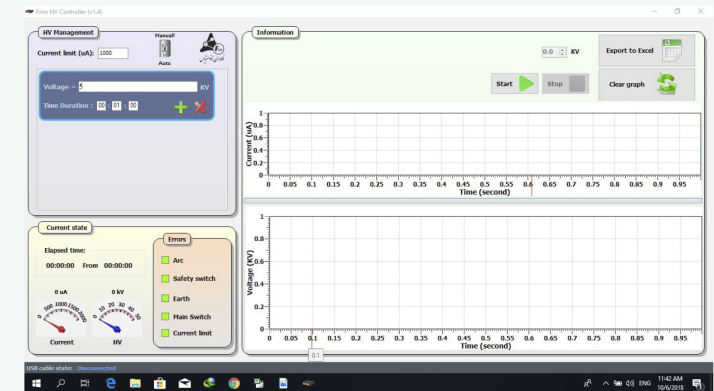
Voltage Monitoring: Accuracy: 0.1 kV

Current Monitoring (OC and DRC series): Accuracy: 1 µA

Arc detector: in DRC series

Polarity: Available either positive or negative

Warranty: 1 year for manufacturing defects



DRC Series



OV Series



OC Series

Syringe Pump

FNM syringe pumps are designed as a low-cost unit, capable of holding 2 or 10 syringes of any make from 10µl to 60ml. These syringe pumps are ideal for delivering accurate and precise amounts of fluids for

a multitude of syringe pump applications including electrospraying, infusing calibration into a mass spectrometer or reaction chamber, long term drug infusion to animals and general infusion applications.



Features:

- Bright Display and Easy-To-Use Interface
- Continuous flow of stream
- Injection capability in microliter (µl) scale
- Nonvolatile Memory
- Programmable (HPM and HSM series)
- Windows based Software (HSM series)
- Appropriate for high viscous substances (more than 5 bars: HSH series)
- Alarm as soon as the desired injection is completed (in HPM and HSM series)
- Dual pump is available (200 series)
- Autofill capability (HPM and HSM series); electric valve is optional
- Infuse/refuse capability (HPM and HSM series)

Software Description (windows platform)

The programming functions of HSM series provide powerful capabilities for advanced experiments. While in program mode, the pump could perform the following tasks at a predetermined time or when prompted by a signal from an external device:

- Start or stop pumping (injection)
- Change pumping (injection) direction (infuse-withdraw)
- Change flow rates
- Pump (Inject) a precise volume and stop
- Ramp up or down flow rates
- Inject in a desired formula

In the "Program" mode, the above-mentioned tasks could be linked together into powerful programs to simplify your automation projects. (commands are available)

SP Series	HOM	HPM	HSM	HSH
Internal Programming	-	✓	✓	✓
Computer Control	-	-	✓	✓
Autofill	-	✓	✓	✓
High Pressure	-	-	-	✓

Model	SP102	SP110	SP204	SP301
No. of Mechanical mechanism	1	1	2	1
Max. Syringe No.	2	10	2 + 2	1
Big Cylinder	-	-	-	✓

FNM Syringe Pump nomenclature:

SPXY ABC

X: 1: one Mechanical system, **2:** Two Mechanical system, **3:** one big mechanical system

YY: Max. Syringe lines. **(1, 2, 4 or 10)**

A: M: Medium precision **H:** High precision

B: O: not programmable; **P:** Internal programmable; **S:** Software and Internal programmable

C: M: Medium pressure **H:** High pressure

Example:

SP204 HSH → Syringe Pump, 2 motors, maximum 4 syringes, High precision, Software, High pressure

SP110 HPM → Syringe Pump, 1 motor, maximum 10 syringes, High precision, Programmable, Medium pressure

SP301 HSM → Syringe Pump, 1 motor, maximum 1 big syringe, High precision, Software, Medium pressure

Specifications:

Input Power: 100-240V AC, 50-60 Hz.

Number of Syringe: Up to 2 (SP102 series) / Up to 10 (SP110 series)

Display: 4 lines, 20 character LCD display

Nonvolatile Memory: Stores syringe inner diameter, rate, target volume, programs and settings

Syringe Type: Plastic, metal or glass

Minimum Flow Rate: 1 µl/hr using a 10µl syringe (barrel diameter: 1 mm)

Maximum Flow Rate: 5968 ml/hr using a 60 ml syringe (barrel diameter: 29 mm)

Pedal resolution per step: 10 nm

Linear Force (Max): 17 kg (in M series); 25 kg (in H series); measured at the 120 ml/hr injection rate

Drive Motor: 1.8° Stepper Motor

Motor Drive Control: Microprocessor with 1/128 micro stepping

Number of Micro steps per one rev. of Lead Screw: 25600

Step Resolution: 0.049 µm/µstep

Pusher Travel Rate: Minimum: 0.25 µm/min; Maximum: 152 mm/min

Connectors: USB (S Series)

Operating Temperature: 0 – 45 °C

Storage Temperature: 0 – 45 °C

Method of Operation: Continuous

Dimension: SP102: 24 × 26 × 20 cm, SP110: 24 × 34 × 20 cm, SP204: 30 × 30 × 22 cm

Weight: SP102: 4 kg, SP110: 5.8 kg, SP204: 9.2 kg

Warranty: 1 year

Typical Applications:

- Cell injection
- Controlled drug injection
- Electrospraying
- Controlled reactive injection into the reactor
- Lab on a chip



Electrospinning Accessories



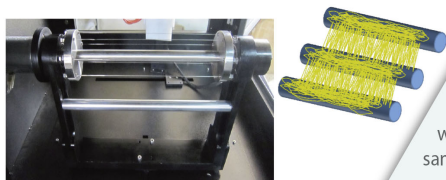
Rotating Drum Collector

In electrospinning, rotating collector is used to produce a uniform nanofibrous mat. This collection module consists of the rotating drum with a rotation speed control and display unit. Using this type of collector, randomly/oriented nanofibers are deposited onto the surface of the drum.



Disk Collector

Using this collector, nanofibrous threads or highly aligned nanofibers could be formed. Furthermore, the effect of linear speed on the fiber formation could be studied.



Rotating Wire Collector

The rotating wire collector is used to produce highly aligned nanofibers. It is composed of thin stainless-steel wires arranged at the same distance from the axis of the rotation. When the collector is rotating at very low speeds, fibers are also deposited between the conductive wires. The principle for the formation of aligned fibers is the same as in the case of the static patterned collector. At higher speeds, electrostatic and mechanical forces are combined, increasing the degree of alignment of the individual fibers. To achieve very good fiber alignment, the collector speeds could be much lower than those of the rotating drum collector.



Mandrel Collectors

Mandrel collector is a device to make tubular nanofibrous samples. The mandrel collector contains a stage, controller and a set of changeable mandrel collectors. The rotating mandrel collector could be used either as a stand-alone collector or could be integrated into lab-scale electrospinning machine. Six mandrels with the diameters of 2, 4, 6, 8 and 10 mm are included in this product.



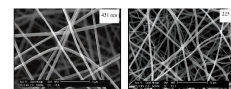
Wet Collector

Wet collector is designed for electrospinning of polymers which could not be dissolved in normal solvents. A typical example of these types of collectors is cellulose. Common solvent for cellulose is liquid crystals which do not evaporate during jet traveling. So instead of evaporation, coagulation mechanism is used to produce nanofibers from the electrospinning jet. For this purpose, a solution bath is used with the rotating drum to solidify the jet and get the final fibers.

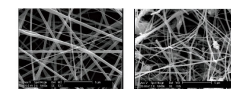
Specifications*

Collector type	Drum Collector	Disk Collector	Wet Collector	Wire Collector	Mandrel Collector
Application	Producing uniform nanofibrous mat	Producing parallel (aligned) fibers/fibrous threads	Wet electrospinning of polymers such as cellulose	Producing parallel (aligned) fibers	Producing nanofibrous tubular structures (artificial vessel, etc.)
Input power	100-240 VAC; 50-60 Hz				
Rotation speed	Up to 3000 rpm	Up to 3000 rpm	Up to 50 rpm	Up to 2500 rpm	Up to 2500 rpm
Length of collector	30 cm	N/A	16 cm	25 cm	20 cm
Collector diameter	8 cm	19.8 cm	10 cm	8 cm	2, 4, 6, 8 and 10 mm
Speed control	10-turn potentiometer				
Display	2 × 16 character LCD				

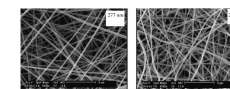
Inorganic and Organic Nanofibers



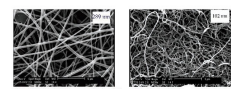
AL₂O₃ Nanofibers



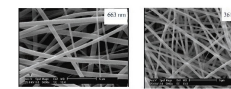
TiO₂ Nanofibers



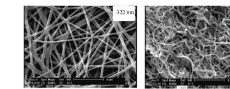
SiO₂ Nanofibers



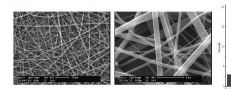
Fe₂O₃ Nanofibers



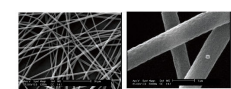
ZrO₂ Nanofibers



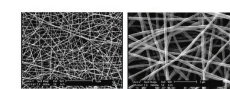
CeO₂ Nanofibers



Polyvinylpyrrolidone (PVP) Nanofibers



Poly (lactic acid) (PLA) Nanofibers



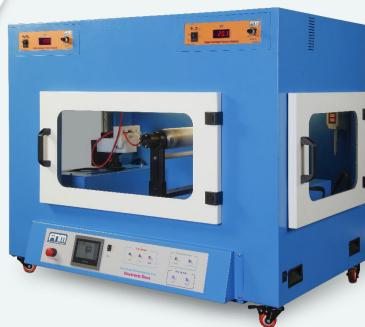
Poly (ε-caprolactone) (PCL) Nanofibers

Lab-Scale Electrospinning Machine (Electroris)

Electroris® is a lab-scale electrospinning machine to prepare polymeric/carbon/ceramic nanofibers with diameter range of 50 nm to a few microns. The machine mainly consists of metallic body, syringe pump, spinneret system, collector system and high voltage power supply.

Two different types of Electroris are available: Standard and dual pump model (Side by Side Electroris).

In side by side Electrospinning system, there are two syringe pumps on both sides of the rotating collector drum, making the system to consist of 2 syringe pumps, 2 scan systems, 2 distance adjusters and 2 high voltage power supplies. In these systems two different materials could be electrospun simultaneously. Furthermore, the system makes it possible to electrospin polymeric material from one side and additive materials, such as medications, from the opposite side, producing composite nanofibers containing desired components. Therefore, it is suitable for pharmaceutical, medicinal and biological applications. This machine employs a touch screen panel for controlling electrospinning parameters. Electroris® provides excellent safety schemes for the users with respect to the handling of high voltage power supply and chemical solvents.



Main Features

- Advanced safety features
- Reliable performance
- Modular design
- 4.3" touch screen HMI panel for controlling process parameters
- Emergency button to stop machine in any unexpected situation
- Easy use and maintenance
- Dual syringe pump model is available
- Core-Shell nanofibers can be produced by coaxial nozzle.

General

Chassis: Metallic body with 3 doors for easy access

Input power: 100-240 V AC/50-60 Hz

Ventilation: A programmable fan adjustable by HMI panel

Heating system: Adjustable from room temperature up to 45°C via HMI panel

Heater: 1000W, 4A

Safety: Voltage cut-off in case of door opening, grounding problem, or process disruption

Dimensions (L×W×H): Standard: 88 × 76 × 87 cm;

Dual pump: 131 × 80 × 96 cm

Weight: Standard: 100 kg; Dual pump: 140 kg

Spinneret

Number of syringes: Standard: 1 or 2; Dual pump: Up to 4 syringes

Configuration: Horizontal (No need for hose)

Scanning rate: 0-30 mm/s

Scanning range: 0-30 cm

Syringe pump injection rate: 10 µl/h to 500 ml/h

Usable syringe size: 1-25 mm (Inner Diameter)

Accessories (Optional): Co-axial nozzle with tube

Dual pump series:

- 2 syringe pumps (Up to 4 syringes can be used)
- 2 scan systems
- 2 distance adjuster

Collector

Type: Rotating drum (wire, cylinder, mandrel and disk collectors are optional)

Material: Stainless steel

Rotation speed: 300-3000 RPM

Spinning distance: 5-20 cm

Size:

Drum: 8(ø) cm × 30(L) cm

Plate: 25(L) cm × 20(W) cm

Wire (Optional): 8(ø) cm × 25(L) cm

Disk (Optional): Diameter: 19.8 cm

Mandrel (Optional): Length: 25 cm; Diameter: 2, 4, 6, 8 and 10 mm

Attachable to negative high voltage power supply up to -20 kV (Optional)

High voltage power supply

Model: HV35P OV

Max. output voltage: 35 kV

Power: 35 watt

Voltage monitoring: Digital, Accuracy: 0.1 kV

Body: Durable metal casing

Two high voltage power supplies are installed for dual pump series

Control

Type: PLC

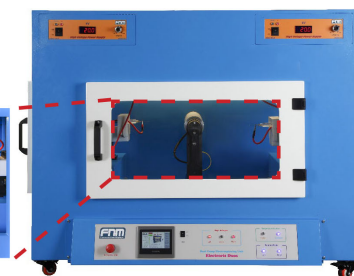
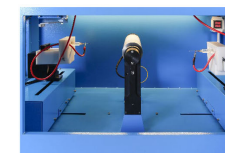
HMI: 4.3" touch screen

Control:

- Start and end position of the nozzle(s)
- Injection rate of syringe pump(s)
- Electrospinning distance(s)
- Electrospinning time
- ON/OFF timer for exhaust fan
- Drum ON/OFF switch (RPM controller) in standard series, and RPM control from HMI in dual pump series
- Temperature control
- Humidity indicator (dual pump series)
- Alarm after desirable volume of injection and after finishing the solution in syringe (after the operation of syringe pump switch)



Single pump electrospinning machine



Dual pump electrospinning machine

Industrial NanoFiber production Line

Industrial Electrospinning Machine



Pilot-scale Electrospinning Machine (Electroris-Pilot)

Pilot-scale Electrospinning Unit (Electroris-Pilot)

FNM Pilot-Electroris machine (NFL60R), which has 1 electrospinning unit, is a polymeric/ceramic nanofibers producer machine in pilot (semi-industrial) scale for various applications. In pilot-electroris, the electrospinning parameters and conditions such as spinneret and collector parameters, working distance, linear movement speed of the used substrate, working temperature, operation time, and the value of applied high voltages (positive and negative) could be controlled using an HMI control panel. The machine offers excellent safety for users with respect to the handling of high voltage power supplies and chemical solvents. The pilot electrospinning machine has been designed and built to coat various substrates. Applying high voltage to the solution forms hundreds of polymer jets to the collector that is located on top of the spinneret. Finally, a layer of nanofibers forms on the collector. Using this machine, nanofibers could be deposited on different substrates in pilot scale. Nanofiber coating rate on different substrates is about 1 - 100 m/h using this machine.



Pilot-Electroris with a winder roll (NFL60R)

Specification

Flexibility

- Various polymers and composites have the potential to be electrospun.
- Different product specifications such as porosity, morphology, diameter, and ability to load beads can be obtained.
- The process is easy and economical.
- Different polymer types such as synthetic, biodegradable and natural polymers and/or polymer/composite may be processed.

Easy operations and convenient functions:

- Electrospinning parameters could be fully controlled through a user-friendly HMI control panel.

Nanofiber diameters:

- 60 to 500 nm

Systems, control systems and panels:

- PLC system for controlling operating conditions

- Touch Screen interface (HMI)
- Using both positive and negative high voltage power supplies to obtain optimum electrospinning conditions
- Blown system:
 - Control the air pressure
- Scan system:
 - Control the scan speed
 - Control the start and end position of the spinnerets
- Control the temperature of the electrospinning Chamber
- Indicating the humidity of the chamber (control is optional)
- Advanced high voltage control systems
- Emergency stop button
- easy-to-use

Input power

- 220 volts, single phase, 50-60 Hz

Power consumption:

- Heater System: maximum 3 kW
- Control and HVPS: maximum 0.7 kW

High voltage:

- Totally 80 kV DC
 - 0-40 kV DC, positive polarity, precisely adjustable
 - 0-40 kV DC, negative polarity, precisely adjustable
- Digital voltage monitoring and control (accuracy: 0.1 kV)
- HMI control system
- HV current limit to minimize the risks

Collector:

- Stainless steel plate (static collection of fibers) or rotating drum (coating a desired substrate)
- Working distance: 5 - 17 cm
- Rotating speed: 0 - 50 RPM (Synced by substrate speed)
- Diameter: 17 cm

Ventilation and heating

- Removing solvent from the chamber by a ventilation fan with a scheduled operation time
- Room temperature up to 45 °C

Substrate winder

- Servo motor control system
- Substrate speed: 1 to 100 m/h
- Maximum substrate width: 60 cm
- Analogue Tension control (Digital control is optional)

Case

- 7 doors for easy access to all parts of the system

Dimensions

- Length: 342 cm
- Width: 174 cm
- Height: 234 cm

Weight

- About 1000 kg



Pilot-Electroris with a winder roll (NFL60R)

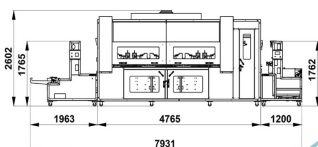
Industrial Nanofiber Production Line (INFL)

FNM Industrial Nanofiber Production Line (INFL) is a polymeric/ceramic nanofibers producer machine in industrial scale for various applications. INFL uses 1 to 8 electrospinning units, based on the customer requirement.

In the industrial production line, the electrospinning parameters and conditions such as spinneret and collector parameters, working distance, linear movement speed of the used substrate, working temperature and operation time could be controlled

using an integrated advanced control system. The machine offers excellent safety for users with respect to the handling of high voltage power supplies and chemical solvents.

Using this production line, nanofibers could be deposited on different substrates in industrial scale. INFL is widely used for producing nano-filters and nano-respiratory facemasks. Depending on the number of electrospinning units, nanofiber coating rate will be about 50-800 square meters per hour.



INFL6100B

- Two 10" Human Machine Interfaces (HMI)
- Independent control of electrospinning parameters for each spinning unit
- Using both positive and negative high voltage power supplies to obtain optimum electrospinning condition
- Blown system:
 - Control the air pressure
- Scan system:
 - Control the scan speed
 - Control the start and end position of the spinnerets
- Control the temperature of the electrospinning chamber
- Indicating the humidity of the chamber (control is optional)
- Advanced digital high voltage control systems
- Emergency stop button
- easy-to-use

Input power

- 380 volts, three phases, 50-60 Hz

Power consumption:

- Heater System: maximum 2.25 kW
- Dryer: maximum 2.25 kW
- Control and HVPS: maximum 3 kW

High voltage:

- 0-40 kV DC, positive polarity, precisely adjustable
- 0-40 kV DC, negative polarity, precisely adjustable
- Digital voltage monitoring and control (accuracy: 0.1 kV)

- Independent positive and negative voltage control of each unit
- HMI control system
- HV current limit to minimize the risks

Electrospinning Units

- 1 (INFL160), 4 (INFL 4100), 6 (INFL 6100) and 8 units (INFL 8100)

Collector:

- Stainless steel plate (static collection of fibers) or rotating drum (coating a desired substrate)
- Working distance: 5-17 cm
- Rotating speed: 0-50 RPM (Synced by substrate speed)
- Diameter: 17 cm

Heating system

- Room temperature up to 45 °C

Ventilation

- Removing solvent from the chamber by a ventilation fan with a scheduled operation time

Dryer system:

- Substrate dryer chamber with temperature control

Substrate winder

- Servo motor control system
- Substrate speed: 10 to 800 m/h
- Maximum substrate width: 60, 100 or 160 cm (depending on the model)
- Edge control system
- Tension control system
- Substrate cutting section (Optional)

Case

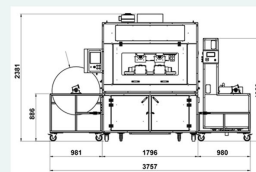
- 6 doors for easy access to all parts of the system

Dimension

- Length: 300 - 800 cm
- Height: 220 - 250 cm
- Width: 210 - 230 cm

Weight

- Depends on the model and the number of electrospinning units (a machine with 6 electrospinning units: about 4500 kg)



INFL260B



FNM INFL nomenclature:

INFLXXX

X: Number of electrospinning units (1, 2, 4, 6)

YYY: Maximum electrospinning width (60 cm, 100 cm or 160 cm)

INFL4100: Industrial Nanofiber Production Line, 4 units, width: 100 cm

INFL6160: Industrial Nanofiber Production Line, 6 units, width: 160 cm

INFL160: Industrial Nanofiber Production Line, 1 unit, width: 60 cm

Model	Units	Width (cm)	Nozzels	Autofill	Dryer section	Coating Speed for F8 Filter (m/h)	Coating Speed for F9 Filter (m/h)	Coating Speed for PFE80% (m/h)	Coating Speed for PFE95% (m/h)	media for 80% mask Per an hour (pcs)	media for 95% mask Per an hour (pcs)
INFL260B	2	60	8	*	*	220	150	150	100	2250	1500
INFL2100B	2	100	16	✓	✓	210	140	140	95	3500	2375
INFL4100B	4	100	32	✓	✓	400	290	290	190	7250	4750
INFL4160B	4	160	48	✓	✓	380	270	270	180	10800	7200
INFL6100B	6	100	48	✓	✓	620	420	420	280	10500	7000
INFL6160B	6	160	72	✓	✓	580	400	400	260	16000	10400

* PFE: filtration efficiency for 0.3 µm NaCl particles

* F9: Initial filtration efficiency for 0.4 µm NaCl particles is more than 80%

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High level technical consulting



Values



Collaboration



Values



Collaboration

Figure 1 is a line graph showing Initial efficiency (%) on the y-axis (ranging from 0 to 90) versus Particle size (micron) on the x-axis (ranging from 0.1 to 3). Two data series are plotted: 'nano fiber coated filter' (represented by a solid black line with open circles) and 'Uncoated filter' (represented by a solid blue line with open circles). The nano fiber coated filter shows a much higher initial efficiency, starting around 65% at 0.1 micron and reaching nearly 90% at 3 microns. The uncoated filter starts around 25% at 0.1 micron and reaches about 85% at 3 microns. Both filters show a sharp increase in efficiency between 0.1 and 0.5 microns, followed by a more gradual increase.

Particle size (micron)	Initial efficiency (%) - nano fiber coated filter	Initial efficiency (%) - Uncoated filter
0.1	65	25
0.2	75	35
0.3	80	45
0.4	82	55
0.5	83	65
0.6	84	70
0.8	85	75
1.0	86	78
1.5	87	82
2.0	88	84
3.0	89	85

Figure 10 is a line graph showing Efficiency (%) on the Y-axis (ranging from 0 to 100) versus Particle Size (micron) on the X-axis (logarithmic scale from 0.4 to 10). Three data series are plotted: nano-coated filter (red line), nano-coated filter (blue line), and uncoated filter media (green line). The nano-coated filter media shows the highest efficiency, followed by the nano-coated filter, and then the uncoated filter media.

Particle Size (micron)	nano-coated filter (red)	nano-coated filter (blue)	uncoated filter media (green)
0.4	75%	60%	10%
0.6	78%	62%	12%
0.8	80%	65%	15%
1.0	82%	68%	18%
1.5	85%	72%	22%
2.0	88%	75%	25%
3.0	90%	78%	35%
4.0	92%	82%	45%
5.0	94%	85%	60%
6.0	96%	88%	75%
8.0	98%	92%	85%
10.0	99%	95%	90%

[illegible]

Sample Name	Particle size 0.4 μm	Particle size 1 μm	Particle size 2.5 μm	Pressure drop (Pa)
Common filter (Non-coated)	~18%	~32%	~92%	~70 Pa
Fnm Filter (coated)	~52%	~68%	~98%	~82 Pa

Figure 1: Window screen

(a) Photographs of three window screens: Common Screen (Non-coated), Benchmark (coated), and Firm Screen (coated). The Common Screen is a standard white mesh. The Benchmark screen is a white mesh with a black frame. The Firm Screen is a white mesh with a black frame and a black coating on the mesh.

(b) Bar chart showing Efficiency (%) for each screen type across three particle sizes: 0.4 μm , 1 μm , and 2.5 μm . The chart shows that the Firm Screen (coated) has the highest efficiency, especially for 2.5 μm particles, while the Common Screen (Non-coated) has the lowest efficiency across all sizes.

Screen Type	0.4 μm	1 μm	2.5 μm
Common Screen (Non-coated)	~1%	~1%	~2%
Benchmark (coated)	~10%	~10%	~25%
Firm Screen (coated)	~25%	~40%	~65%



Applications



Solutions

Figure 1: Vacuum cleaner bag efficiency. The figure consists of three parts: a photograph of a hand inserting a blue 0.3 µm bag into a vacuum cleaner, a photograph of several tan-colored 1 µm bags, and a bar chart titled "Vacuum cleaner bag". The bar chart shows the efficiency (%) of these bags for different particle sizes (0.3 µm, 1 µm, and 2 µm) across eight samples: Fem (cowan), Benchmark 1, Benchmark 2, Benchmark 3, Benchmark 4, Benchmark 5, Benchmark 6, and Benchmark 7. The legend indicates that blue bars represent 0.3 µm, red bars represent 1 µm, and green bars represent 2 µm.

Sample Name	0.3 µm (%)	1 µm (%)	2 µm (%)
Fem (cowan)	65	95	95
Benchmark 1	5	65	90
Benchmark 2	35	60	85
Benchmark 3	10	65	85
Benchmark 4	15	60	80
Benchmark 5	5	65	85
Benchmark 6	8	60	80
Benchmark 7	8	70	90

Industrial air filter

Filter Type	Coating	Particle size (μm)	Pressure drop (Pa)	Efficiency (%)
Common Filter	Non-coated	0.4	~65	~15
	Non-coated	1.0	~35	~35
Fine Filter	Coated	1.0	~85	~60
	Coated	2.5	~100	~100

Filter Test Machine/Air Permeability Tester

FNM's filter test machines (FT150PA, FT200PO and FT200PS) can determine the efficiency, pressure drop and air permeability of different flat sheet filter media using oil / salt aerosols or atmospheric dust. Our filter test machines can be employed for testing different flat sheet media which are used to produce respiratory face masks and air filters.



Filter test machines are equipped with a high precision particle counter (four-channel particle sizes: 0.3, 0.5, 1.0 and 3.0 μm) for counting the particles generated by oil / salt particle generator or atmospheric dust in order to calculate filtration efficiency. The software calculates the aerosols penetration (P (%)) and media filtration efficiency (E (%)). Additionally, this machine can calculate air permeability and pressure drop of flat sheet media automatically.

Filter test machine uses a particle counter that counts upstream and downstream particles. Data can be saved automatically and also test reports can be printed by an installed printer on the machine.

FNM's filter test machines can measure the efficiency and pressure drop of flat sheet media according to BS EN 143, BS EN 149, BS EN 779, US 42 CFR 84, ISO 16890, ISO 16900-3, ISO 11155-1 and ISO 5011 standards.

Technical Specifications of Air Permeability Tester Machine

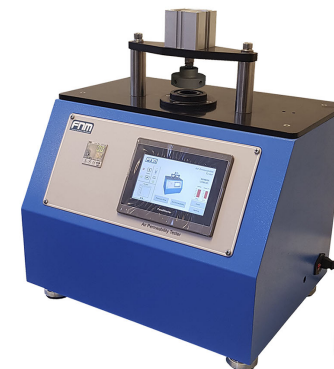
Specification	Acceptance Criteria
Tests	1. Pressure drop (respiratory resistance) 2. Air permeability Flat sheet with maximum area of 5 cm^2
Aeration measurement range	1..... 1666 $\text{l/m}^2/\text{s}$ @ 2 cm^2
Displayable units	l/min , CFM , $\text{l/m}^2/\text{s}$, cm/s , $\text{ft}^3/\text{ft}^2/\text{s}$
Calibration method	Manual
Aerosol generator flow	Adjustable from 1 – 20 l/min through the panel
Design	Minimum leakage, ergonomic
Sensors	Temperature, relative humidity, pressure
Sample fixture (cm^2)	Flat sample (circular holder with area of 1, 4 and 5 cm^2)
Differential pressure sensor range (Pa)	0 – 1000 Pa
Control	PLC
User interface	HMI (7" touch screen)
Data report	Display on the HMI screen, the machine is able to print the reports (printer is optional)
Presentable information	Flow rate, temperature, relative humidity, pressure drop, air permeability
Chassis	Steel profile with electrostatic paint
Body	Steel sheet with electrostatic paint
Time of the first test	Less than 1 minute
Continuous test operation cycle (hours)	24 hours / 7 days
Compressed air source requirements	Air compressor (tank capacity: 50 l)
Input power	110-240 V, single phase, 50 – 60 Hz

Filter/Mask Test Specifications

	FT150EA	FT200PO	FT200PS
Test Modes	Pressure drop test	✓	✓
	Air permeability test	✓	✓
	Filtration efficiency test	Atmospheric	Atmospheric and oil aerosols
	Bubble point	Optional	Optional
Control	PLC	✓	✓
	HMI (Touch Screen)	7"	7"
Air flow	Mass Flow	1 - 150 l/min	1 - 200 l/min
	Digital control	✓	✓
Media Holder	Test area	4.9, 20, 25, 38, 50 and 100 cm^2	4.9, 20, 25, 38, 50 and 100 cm^2
Sensors (Transmitters)	Temperature	✓	✓
	Relative humidity	✓	✓
	Digital tank pressure control	×	✓
Air Compressor	Tank pressure	1 – 8 bar	1 – 8 bar
Pressure Drop	Pressure drop	0 – 1000 Pa	0 – 1000 Pa
	Digital control	✓	✓
Air Dryer	Airline trap	✓	✓
	Dryer system	Optional	Optional
Particle Counter	Laser particle counter	1	1
	Channels	four-channels	four-channels
	Channel sizes	0.3, 0.5, 1.0, 3.0 μm	0.3, 0.5, 1.0, 3.0 μm
	Flow rate	2.8 L/min	2.8 L/min
Aerosol Generator (Oil)	Generator	×	✓
	Particle dilution	×	100:1
Aerosol Dilutor	Type of aerosol challenge	×	Paraffin, PAO, DOP
Aerosol Generator (Salt)	Generator	×	✓
	Neutralizer	×	✓
Printer	Optional	Optional	✓
Respiratory Face Mask Holder (3D masks)	Optional	Optional	✓
Input Power	Single phase, 220 V, AC	Single phase, 220 V, AC	Single phase, 220 V, AC
Weight	About 170 kg	About 180 kg	About 180 kg
Size (cm) (Length × Width × Height)	94×92×163	94×92×163	94×92×163

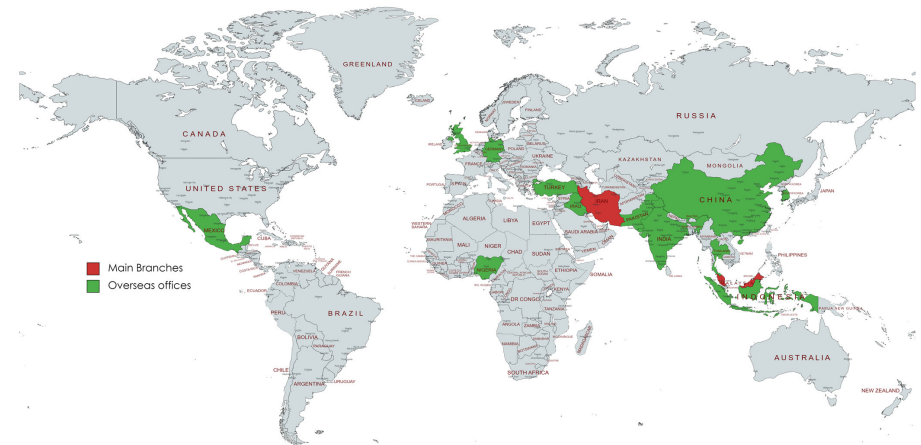
Standards

BS EN 149
BS EN 779
US 42 CFR 84
ISO 16890
ISO 16900-3
ISO 11155-1
ISO 5011



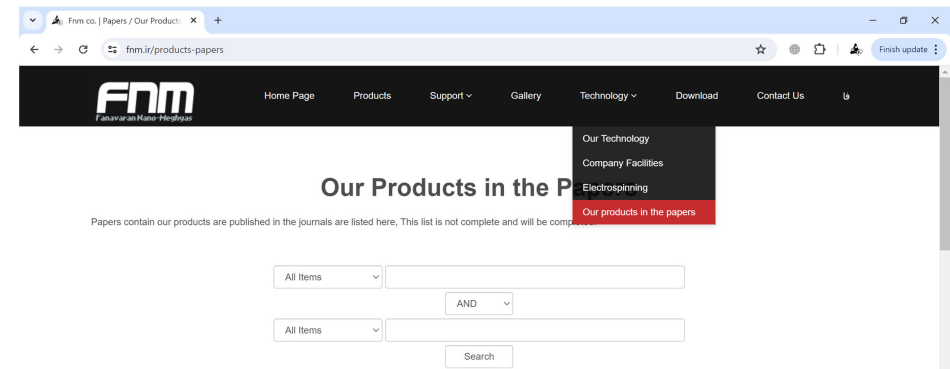


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