Rules and procedures for the use of the equipment SUNSHINE MICROFLUIDICS SYSTEM acquired under the MUR Department of Excellence Project 2023–2027

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Approved by the Council of the Department of Food and Drug on 9 September 2026

Description of the technique

The Sunshine system is a microfluidic platform designed for the controlled production of nanoparticles, including liposomes, lipid nanoparticles (LNPs) and polymeric nanoparticles.

This technology allows small quantities of liquids to flow through microchannels. In the system, the different liquid solutions are delivered by high-precision pumps into a microfluidic chip with specific geometries designed to bring the streams together.

This enables extremely uniform particle growth, with high process reproducibility and very narrow particle size distributions.

The fluid dynamic conditions governing nanoparticle formation are:

- fluid flow rate ratios;
- dilution ratios;
- flow rates;
- microfluidic module geometry.

The system is controlled using “Sunny Suite” software, which allows the operator to set and modify process parameters, start experiments and monitor their progress in real time.

Description of the equipment

The system hardware configuration comprises:

- Pressurized Fluid Store, a compartment dedicated to fluid management and delivery;
- Quad Pump (×2), syringe pumps providing precise flow rate control;
- Automated Sample Valve, a system dedicated to sample injection;
- Automated Collector, for automated collection of the products obtained.

All components are connected by calibrated fluidic tubing and “Sunnies” microfluidic chips, which enable controlled mixing of the solutions and nanoparticle formation.

The following “Sunnies” chip geometries are available:

- Sunny 490 Trident T
- Sunny 50 Micromixer
- Sunny 190 T
- Sunny 100 X

The following sample collection rack types are available:

- Type 2 mL, 35 vials, 5x7
- Type 8 mL, 20 vials, 4x5

Description of the production modes

The Sunshine system has two main operating modes, protocol mode and continuous production mode, which serve different purposes.

Protocol mode enables sequential screening of multiple experimental settings to identify the optimal conditions for nanoparticle formation.

In this mode, small reagent volumes are loaded through the Automated Sample Valve, and the key fluid dynamic parameters can be varied flexibly.

Continuous production mode is used for larger-scale production of an already optimised formulation. In this case, large reagent volumes are loaded directly into the Pressurized Fluid Stores, and the system generates

a continuous stream of nanoparticles. The process parameters remain unchanged from those established during development, ensuring product reproducibility.
The material produced is collected continuously by the collector.
In this mode, the ASV is bypassed, as the process no longer requires individual sample handling.

Authorised permanent staff and trainers

Surname	First name	Dept./Centre	Contact
Sonvico	Fabio	Food and Drug	fabio.sonvico@unipr.it
Demurtas	Anna	Food and Drug	anna.demurtas@unipr.it
Varacca	Giada	Food and Drug	giada.varacca@unipr.it

The list of authorised personnel is kept up to date and is available in Annex 2 to these Rules.

Access to and use of the equipment

1) Research groups in the ALIFAR Department with authorised users may access the equipment through their own staff, subject to prior booking on the dedicated Teams platform managed by the Technical Contact. Groups without a designated contact may contact the staff listed above. Access remains subject to booking on the Teams platform. Use of the equipment without a booking will result in a charge for a full working day, equivalent to eight hours. Only personnel who have completed the initial training (authorised personnel and trainers), or who have subsequently been trained by the trainers, may use the equipment.
2) Users from other University departments and external users may contact the Scientific Coordinator by completing the analysis request form (Annex 1).

Fees

Three user categories apply for the purpose of equipment usage fees:

1) ALIFAR Users: teaching and research staff of the University of Parma affiliated with the ALIFAR Department;
2) Internal Users: teaching and research staff of the University of Parma;
3) External Users: researchers and other staff from universities, research bodies and public and private institutions.

Type of analysis	ALIFAR USER €/hour	INTERNAL USER €/hour	EXTERNAL USER €/measurement
Protocol mode analysis (one protocol comprises screening of 3 experimental conditions), 1 to 5 protocols, per protocol	3.0	10	150
Protocol mode analysis (one protocol comprises screening of 3 experimental conditions), more than 5 experimental protocols, per protocol	3.0	10	100
Scaled-up production of nanoparticle formulations in continuous mode (up to 250 mL)	3.0	10	300
Scaled-up production of nanoparticle formulations in continuous mode (surcharge for each additional 250 mL or part thereof)	3.0	10	200

ALIFAR users who contribute their own research funds towards annual preventive maintenance contracts and/or comprehensive insurance, or towards repair costs, will not be charged usage fees until the amount contributed has been offset.

Annex 1. SUNSHINE MICROFLUIDICS SYSTEM – ANALYSIS REQUEST FORM

To be emailed to the authorised personnel

Applicant details

UNIVERSITY OF PARMA INTERNAL USER
Dept./Centre:
Applicant:
User:
E-mail:
Telephone:

EXTERNAL USER
Organisation name:
VAT no./Tax code
Address:
Applicant:
User:
E-mail:
Telephone:

Sample information and type of analysis

Sample type	☐ Lipid nanoparticles (LNPs) _____ ☐ Liposomes _____ ☐ Polymeric nanoparticles _____ ☐ Other: _____ *E.g. "RNA-containing LNPs", "PEGylated liposomes in PBS", "PLGA nanoparticles in an organic/aqueous solvent…"*
Solvent system and phases used	☐ Aqueous phase/aqueous phase Describe: _____ ☐ Organic phase/aqueous phase Describe: _____ ☐ Organic phase/aqueous phase with surfactants Describe: _____ ☐ Other Describe: _____ *E.g. "PBS/ultrapure water", "Ethanol with phospholipids/aqueous buffer", "Organic solvent + polymers (PLGA, PCL)/aqueous phase with surfactants (Tween, PVA)"*
Production mode	☐ Protocol mode for screening experimental conditions ☐ Small-scale production of individual optimised formulations in protocol mode (up to 250 mL of product) ☐ Scaled-up production in continuous mode (over 250 mL of product)
Number of protocols (for protocol mode only)	Specify: Number of experimental protocols (sets of conditions to be tested): _____ (e.g. variations in flow rate, phase ratios and solvent composition) Number of replicates per protocol: _____ (e.g. number of repetitions of the same formulation/condition)
Initial reagent volumes and final formulation volume	Specify: Initial volume of each reagent: _____ mL and _____ mL Final volume per protocol/formulation: _____ mL
Hazards	**☐ flammable ☐ irritant ☐ acute toxicity ☐ harmful ☐ corrosive** **☐ oxidising ☐ carcinogenic/mutagenic** **☐ hazardous to the environment**

Bookings may be cancelled up to the third working day before the requested date.

If the equipment is not used and the booking has not been cancelled in time, payment for the service is still required.

Date …….

Applicant's signature (research fund holder)

……

Annex 2. SUNSHINE MICROFLUIDICS SYSTEM – ANALYSIS REQUEST FORM

List of personnel authorised to use the equipment

Permanent staff authorised as trainers			
Surname	**First name**	**Dept./Centre**	**Contact**
Sonvico	Fabio	Food and Drug	fabio.sonvico@unipr.it
Demurtas	Anna	Food and Drug	anna.demurtas@unipr.it
Varacca	Giada	Food and Drug	giada.varacca@unipr.it
Authorised permanent staff			
Bianchera	Annalisa	Food and Drug	annalisa.bianchera@unipr.it
Quarta	Eride	Food and Drug	eride.quarta@unipr.it
Authorised non-permanent staff			
Bazzoli	Gianluca	Food and Drug	gianluca.bazzoli@unipr.it
Bucella	Arianna	Food and Drug	arianna.bucella@unipr.it
Caraua	Georgeta	Food and Drug	georgeta.caraua@unipr.it
Cipollone	Giorgia	Food and Drug	giorgia.cipollone@studenti.unipr.it
Filice	Mariachiara	Food and Drug	mariachiara.filice@studenti.unipr.it