



Rules and procedures for the use of the HR 20 RHEOMETER acquired under the MUR Department of Excellence Project 2023- 2027

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Description of the instrument

The HR 20 rheometer is an instrument used to measure the flow and deformation properties of materials in liquid, semi-solid and soft-solid form and, with dedicated accessories, powders as well.

The main tests that can be performed with the HR 20 rheometer are:

- **Oscillatory tests:** these apply a deformation that varies periodically over time, usually sinusoidally, and are very useful for characterising the viscoelastic behaviour of a sample.

The main oscillatory tests available on the HR 20 rheometer are:

- **Amplitude:** the amplitude of the oscillatory deformation is varied to determine whether the sample responds linearly or whether non-linear effects occur.
- **Frequency:** an oscillatory deformation is applied at different frequencies to determine how the sample responds to slower or faster stresses.
- **Temperature Ramp/Sweep:** the sample is slowly heated or cooled while frequency and amplitude are kept constant, in order to observe how its viscoelastic properties change with temperature.
- **Time:** temperature, frequency and amplitude are kept constant, and the stability of the sample's viscoelastic properties is observed over time.

These tests provide information on the storage modulus (G') and loss modulus (G''), which indicate the elastic and viscous components of the sample, respectively; $\tan(\delta)$, which is the ratio of the viscous component to the elastic component; and the complex modulus (G^*), which represents the sample's overall response to oscillation.

- **Flow tests:** these assess the sample's resistance to flow and provide shear stress-shear rate curves for Newtonian and non-Newtonian fluids. The main flow tests available on the HR 20 rheometer are:
 - **Peak Hold:** a specified shear rate is rapidly applied and kept constant for a period of time while changes in the sample's viscosity are observed.
 - **Ramp:** a shear rate is applied and gradually increased (or decreased) while the sample's viscosity is measured (viscosity versus shear-rate curves).
 - **Ramp Loop:** similar to the Ramp test, but the shear rate is first increased and then decreased, creating a cycle or loop, while the sample's viscosity is measured (viscosity curves for increasing and decreasing shear rates).
 - **Temperature Ramp:** a constant shear rate is maintained while the temperature is gradually increased or decreased, and the sample's viscosity is measured (viscosity-versus-temperature curves).

Flow tests are used to study the sample's stability or structural behaviour under constant-stress conditions, identify Newtonian or non-Newtonian behaviour, and detect thixotropy or irreversible behaviour.

- **Powder analysis:** this characterises powder flowability and resistance (for example, cohesion and friction forces between particles) following the application of a force.

The main tests are:

- **Powder Flowability Test:** assesses a powder's ability to flow in response to an applied force.
- **Powder Shear Test:** determines the powder's shear resistance and internal cohesion properties under shear stress.

The following accessories are available for the HR 20 rheometer:

- **Peltier plate assembly: a flat plate that provides precise control of the sample temperature.**
Sample volumes range from ~0.1 to ~2 mL, depending on the geometry used and its diameter. It can be used with the following types of geometry:
 - **Set of steel plates of different diameters (8 mm, 20 mm or 40 mm)**
 - **60 mm steel cone plate:**
- **Concentric cylinder jacket assembly: consists of two concentric cylinders, one inner and one outer, with a temperature-controlled jacket to control the sample temperature.**
It is used with a DIN-standard conical rotor (sample volume ~20 mL).
- **Powder Flow Cell: for the analysis of powder samples (sample mass ~10-20 g)**

The system uses TRIOS software to set up tests, monitor the instrument during measurements, collect data and analyse it.

Authorised permanent staff and trainers

Surname	First name	Department/Centre	Contact
Padula	Cristina	Food and Drug Sciences	cristina.padula@unipr.it
Nicoli	Sara	Food and Drug Sciences	sara.nicoli@unipr.it
Demurtas	Anna	Food and Drug Sciences	anna.demurtas@unipr.it
Varacca	Giada	Food and Drug Sciences	giada.varacca@unipr.it
Bocchi	Elena	Food and Drug Sciences	elena.bocchi@unipr.it

The list of authorised personnel is kept up to date at all times and is provided in Annex 2 to these Rules.

Access to and use of the instrument

- 1) Research groups within the ALIFAR Department that have authorised users may access the instrument through their own personnel, subject to prior booking on the dedicated Teams platform managed by the Technical Contact. Those without a contact person may contact the designated staff. Access remains subject to booking on the Teams platform. Use of the instrument without a booking will result in a charge for a full working day, equivalent to eight hours. The instrument may be used only by personnel who have completed the initial training (authorised personnel and trainers) or who have subsequently been trained by a trainer.
- 2) Users from other University departments and external users may contact the Scientific Manager by completing the analysis request form (Annex 1).

Fee schedule

For the purposes of instrument usage fees, users are divided into three categories:

- 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 staff from universities, research bodies, and public and private institutions.

Type of analysis	ALIFAR USER €/hour	NON-ALIFAR INTERNAL USER €/hour	EXTERNAL USER €/sample tested in triplicate*
Viscosity analysis at constant shear rate	2	15	250
Flow curves	2	15	350
Viscoelastic analyses	2	15	450
Powder analysis to determine flowability, shear resistance and internal cohesion	2	15	500

ALIFAR users who contribute their own research funds towards preventive maintenance contracts and/or annual full-risk coverage, or towards repair costs, will not be charged until the amount contributed has been fully offset.



Annex 1. HR 20 RHEOMETER - ANALYSIS REQUEST FORM

to be sent by email to authorised personnel

Applicant details

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

EXTERNAL USER
Company name:
VAT No./Tax Code:
Address:
Applicant:
User:
E-mail:
Telephone:

Information on samples and type of analysis

No. of samples to be analysed (including blanks and replicates)	<i>e.g. "3 samples + 1 blank, all tested in triplicate = 12 samples"</i>
Sample type	<i>e.g. "Gels, creams, suspensions, solutions, powdered lactose, etc."</i>
Type of test requested	Constant-shear-rate viscosity analysis Flow curves Viscoelastic analyses Powder analysis
Geometry to be used	Parallel plate Cone Concentric cylinder Powder flow cell (mandatory for powder samples)
Temperature conditions	Single-temperature analysis Multiple-temperature analysis
Available volume or mass	<i>Specify the total volume or mass of each sample</i>
Risk factors	flammable irritant acute toxicity harmful corrosive oxidising carcinogenic/mutagenic hazardous to the environment

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

If the instrument is not used and the booking has not been cancelled within the specified time, the service fee will be charged.

Date

Applicant's signature (fund holder)

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Annex 2. List of personnel authorised to use the instrument

<i>Permanent staff and trainers</i>			
Surname	First name	Department/Centre	Contact
Padula	Cristina	Food and Drug Sciences	cristina.padula@unipr.it
Nicoli	Sara	Food and Drug Sciences	sara.nicoli@unipr.it
Demurtas	Anna	Food and Drug Sciences	anna.demurtas@unipr.it
Varacca	Giada	Food and Drug Sciences	giada.varacca@unipr.it
Bocchi	Elena	Food and Drug Sciences	elena.bocchi@unipr.it
<i>Authorised permanent staff</i>			
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Quarta	Eride	Food and Drug Sciences	eride.quarta@unir.it
<i>Authorised non-permanent staff</i>			
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