HEXAMEM 80

HIGH-PERFORMANCE STIRRED-CELL LABORATORY MEMBRANE SYSTEM

Document	HEXAMEM 80 Datasheet
Revision	March 30, 2026
Manufacturer	Messinger Engineering

Key Benefits

Controlled Hydrodynamics
Independent control of pressure and stirring speed enables precise investigation of transport phenomena.

Broad Membrane Compatibility
Supports microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO) membranes.

Reproducible Results
Defined geometry and microprocessor-controlled drive ensure consistent experimental conditions.

Low Sample Volume
Efficient testing with minimal feed volume (50 mL internal volume).

Overview

The HEXAMEM 80 stirred membrane cell is a laboratory-scale system designed for membrane characterization and filtration studies under controlled operating conditions.

It enables systematic investigation of membrane performance by independently adjusting key parameters such as pressure and hydrodynamic conditions.

The compact stainless steel design ensures operational safety, chemical compatibility, and ease of handling.

Operating Principle

The feed solution is positioned above the membrane. A rotating turbulence promoter generates shear flow across the membrane surface, reducing concentration polarization.

Filtration is driven by transmembrane pressure (TMP), which can be generated using either a pump or an inert gas supply (typically nitrogen).

The independent control of hydrodynamic and hydraulic parameters allows precise analysis of mass transfer limitations and fouling behavior.

Key Features

- Stainless steel laboratory cell (AISI 304)
- Hexagonal internal geometry to prevent co-rotation
- 3D-printed rotor with magnetic coupling
- Stepper motor with programmable speed profiles
- Reproducible pressure and flow conditions
- Easy membrane replacement and cleaning
- Customizable connection ports
- Compatible with ceramic and polymer membranes
- Maximum operating pressure: 40 bar
- Sensor integration capability

Assembly

There are several options available for operating the assembled HEXAMEM. The simplest configuration involves placing it on a standard magnetic stirrer.

The standard package also includes a mounting bracket equipped with an integrated stepper motor and a magnetic disc for mechanical power transmission. This replaces the magnetic stirrer.

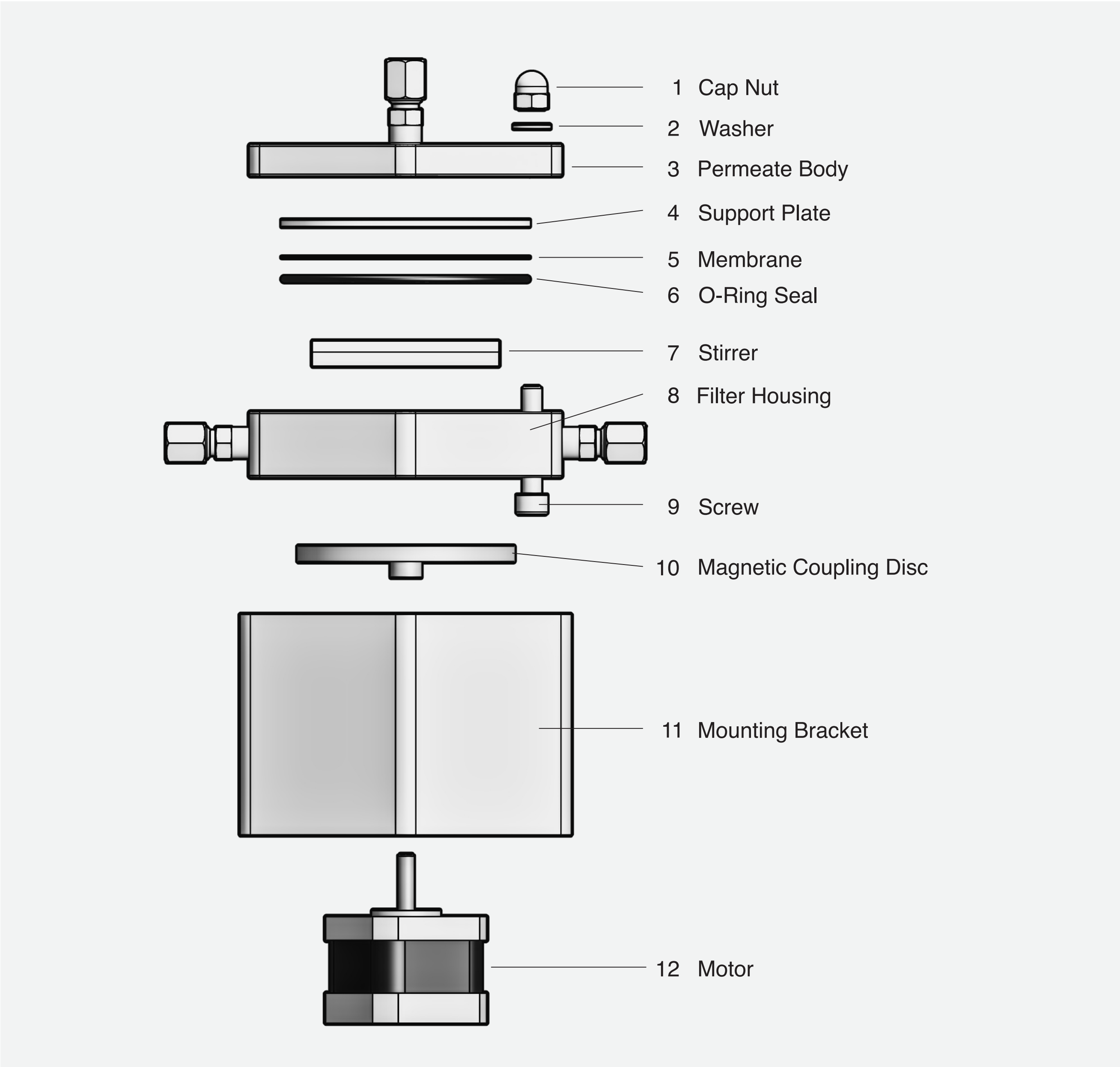


Figure 1: HEXAMEM assembly, including mounting bracket with motor

Stepper Motor Control Using Arduino, Raspberry Pi, and M5Stack

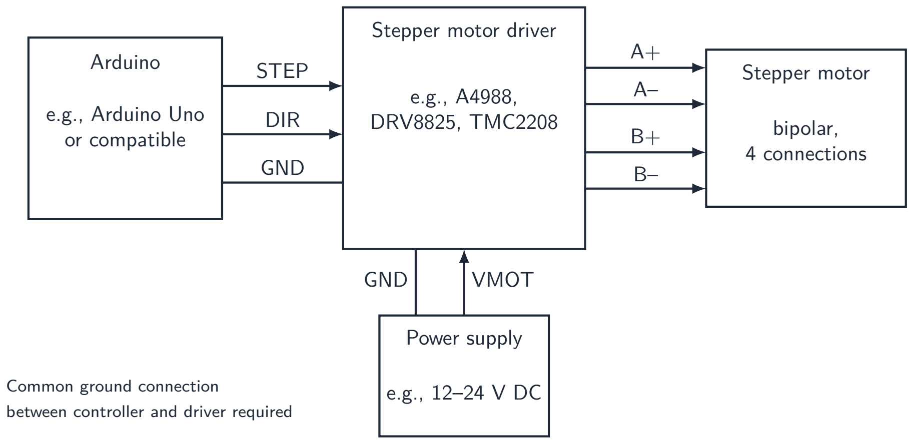
The stepper motor used in this system can be operated with common microcontroller and embedded platforms such as Arduino, Raspberry Pi, or M5Stack. These platforms enable flexible and application-oriented implementation of motor control.

Control is typically achieved using standardized step and direction (STEP/DIR) signals. The microcontroller generates pulse signals that define the discrete step movement of the motor. A suitable motor driver is required to provide the necessary power. The driver regulates current and protects the control electronics.

The connection between the controller and the driver is established via digital input and output signals. Depending on the platform, various interfaces and software libraries are available.

Programming can be implemented in Arduino (C/C++), Python, or MicroPython. This allows precise control of rotational speed, direction of rotation, and acceleration profiles. Complex motion sequences can also be implemented in software.

Integration into existing measurement or automation systems is straightforward. The Raspberry Pi is particularly well suited for integration into network-based applications. Arduino-based systems provide robust and simple real-time control. M5Stack systems combine compact hardware with integrated interfaces and display functionality. System parameters can therefore be configured locally or remotely.



In most cases, an external power supply is required to operate the motor. The supply voltage depends on the specifications of the selected driver and motor. The modular system design allows different power requirements to be accommodated.

Overall, this approach enables precise, reproducible, and flexibly configurable control of the stepper motor.

- arduino.cc
- raspberrypi.com
- m5stack.com

Performance

Permeate Flow

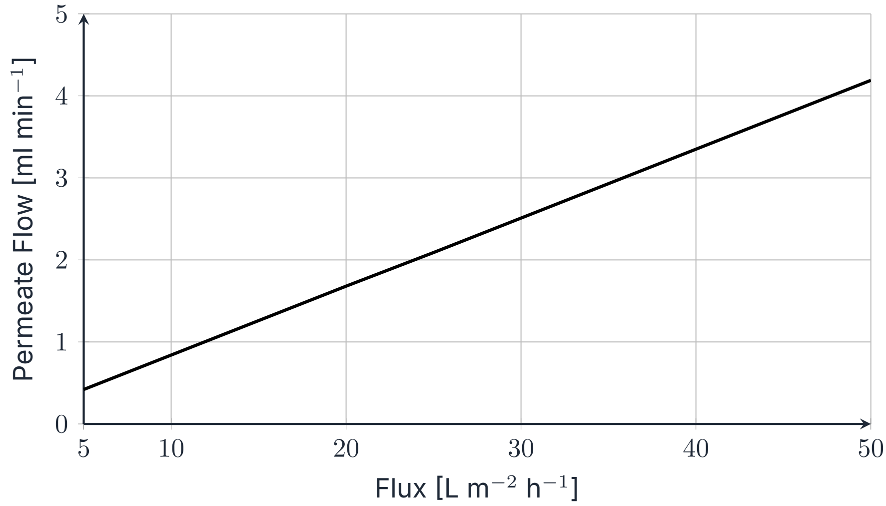


Figure 2: Permeate flow as a function of flux for a membrane disc with a diameter of 80 mm.

Rotational Speed

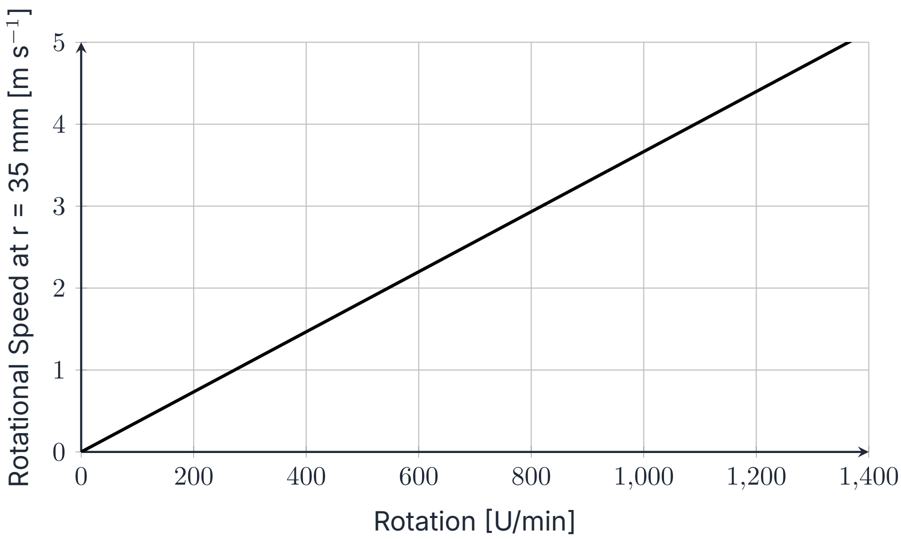


Figure 3: Rotational speed at a radius of 35 mm as a function of rotational speed (up to 5 m/s).

Operating Modes

Operation with Pump

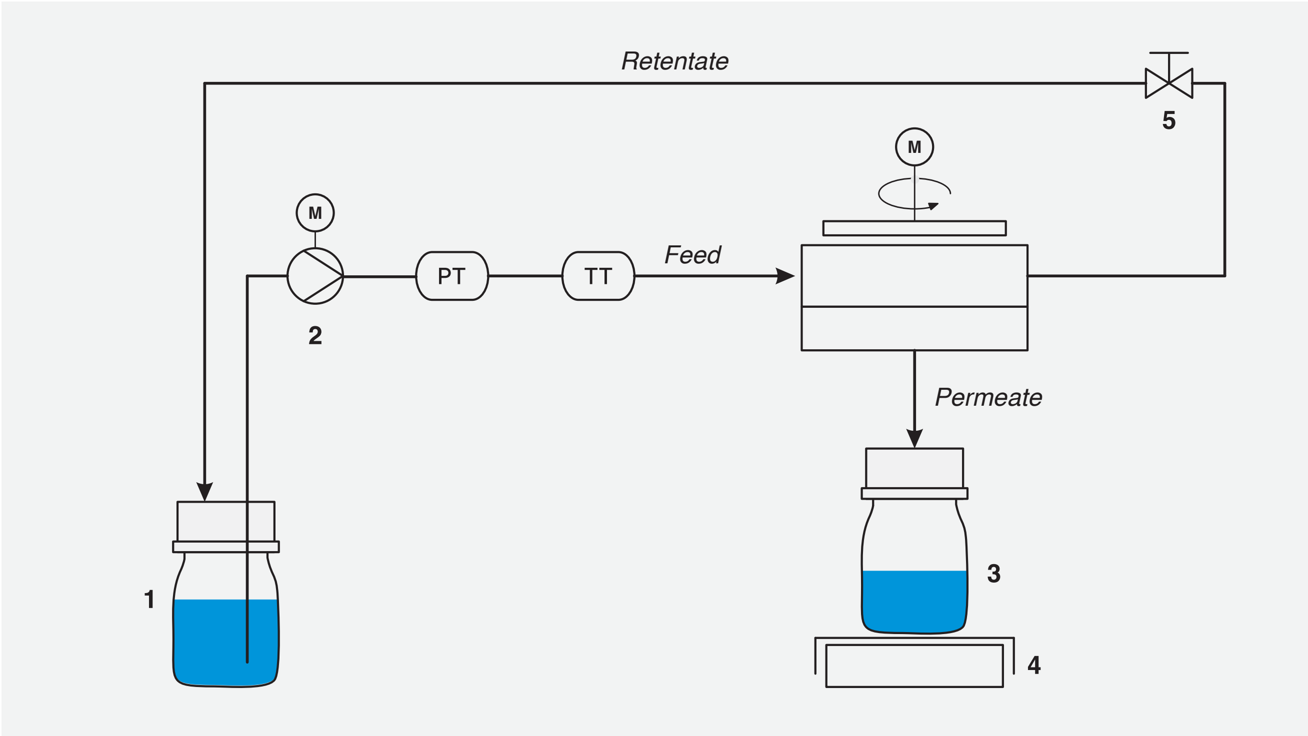


Figure 4: Operation with pump

The feed solution is drawn from a reservoir vessel [1] (e.g., SCHOTT DURAN) by a pump [2] and delivered to the test cell under controlled pressure.

The backpressure is adjusted using a fine control valve [5]. The internal circulation within the test cell is controlled independently of the pump pressure by the rotational speed of the rotor.

The permeate is collected in a receiving vessel [3] (e.g., SCHOTT DURAN), which is placed on a balance [4]. The measured weight is continuously recorded via an interface and logged using software.

Based on these data, permeate flux and concentration factor are calculated in real time, along with additional parameters depending on the specific application.

Messinger Engineering provides support for the setup of such measurement systems using commercially available sensors and actuators.

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Operation with Inert Gas and Pressure Vessel

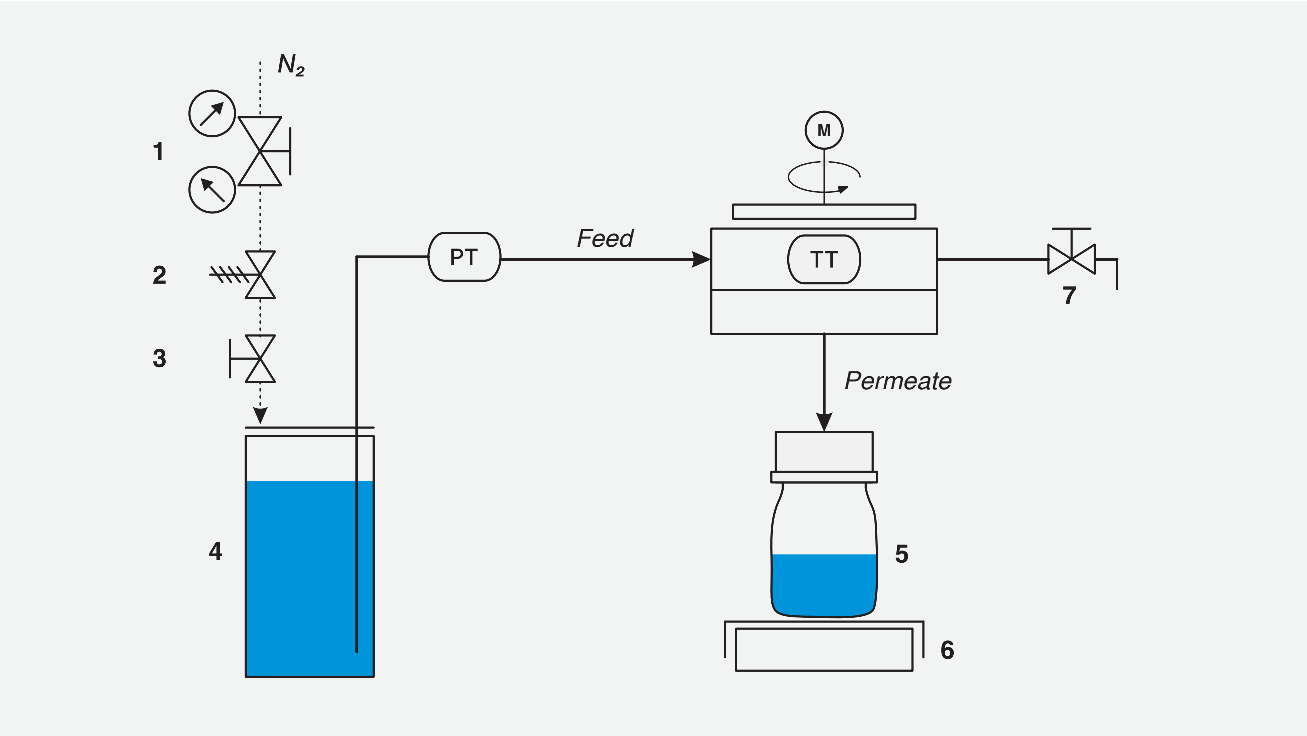

Figure 5: Operation with inert gas and pressure vessel

As an alternative to pump-driven operation, an inert gas can be used to generate pressure. The required operating pressure is set using a pressure regulator [1] (typically two regulators connected in series), which is mounted directly on the gas cylinder. Suitable purely mechanical pressure regulators [2] are available from gas suppliers as turnkey solutions.

The pressure line is connected via an on/off valve [3] to a pressure-resistant vessel [4] (stainless steel, volume approx. 1 L, equipped with a safety valve) containing the feed solution.

The outlet valve [7] at the test cell remains closed during the filtration process (batch operation). The permeate [5] is collected in a receiving vessel positioned on a balance [6].

Messinger Engineering also provides support for the setup of measurement systems for this configuration.

Applications

Membrane Screening	The stirred cell is used for the reproducible investigation and comparison of different membranes under defined operating conditions. The targeted mixing of the feed solution reduces concentration polarization and promotes a steady-state filtration condition. The hexagonal geometry of the cell prevents co-rotation of the liquid and results in improved flow to the membrane surface. The stirred cell is suitable for the systematic investigation of membrane properties as well as process-relevant influencing factors.
Samples	The stirred cell enables the processing of small liquid volumes under controlled filtration conditions. Even with small sample volumes, defined operating parameters ensure reproducible and comparable results. To achieve high concentration factors, the outlet can be closed so that the fed volume is concentrated in the measuring cell (batch operation). The volume concentration factor VKF is calculated as the ratio of the fed volume to the remaining retentate volume. With a maximum working volume of 50 ml, a total inflow of 500 ml is required to achieve a concentration factor of VKF = 10.
Cleaning Tests (CIP)	After the cleaning process is complete, the membrane can be removed, analyzed, and then reinserted into the measuring cell. This allows for repeated testing of the same membrane under defined conditions. Changes in membrane performance, as well as deposits and structural changes, can thus be systematically recorded.
Microfiltration	By using ceramic microfiltration in combination with a backflush system (Messinger Engineering), experiments on enzyme application and protein purification can be conducted using ceramic MF and UF membranes.

Technical Specifications

Housing dimensions	100 × 100 × 30 mm
Weight	1600 g
Internal volume	50 mL
Membrane diameter	80 mm
Active membrane area	50 cm^2
Max. operating pressure	40 bar at 25°C
Temperature range	0–100°C
Material (wetted parts)	AISI 304 stainless steel
Seal	O-ring (EPDM, Viton, silicone)
Orientation	Any orientation
Fasteners	M6 stainless steel (DIN 912 / ISO 4762)
Stepper motor	NEMA 17
Mounting	3D-printed ABS bracket

Ordering and Accessories

Ordering Information

HEXAMEM 80-304	Membrane diameter 80 mm, AISI 304 stainless steel
Connections	Please specify: F = Feed, R = Retentate, P = Permeate

Accessories (sold separately)

Seals	Replacement seals and O-rings (Viton, EPDM, silicone)
Permeate support	Sintered discs (polymer or stainless steel)
Connections	Adapters and connection kits (e.g., Swagelok, Tri-Clamp)
Instrumentation	Sensors, transducers, balances, sample collectors, and pumps
Rotors	3D-printed rotors with integrated magnets
Cleaning agents	Cleaning solutions

Experimental Setups

Messinger Engineering offers a wide range of actuators (pumps, valves) and sensors (e.g., flow, mass, temperature). Suitable third-party components can also be recommended and sourced directly by the customer.

A key component is the Tinkerforge system, which enables flexible integration of sensors and actuators into modular experimental setups.

Documentation

The HEXAMEM documentation includes an operating manual, a safety data sheet, and a hazard analysis. These documents are currently under preparation (as of March 2026).

Safety Instructions

- Do not exceed the maximum operating pressure
- Verify chemical compatibility before use
- Operate only with trained personnel
- Depressurize the system before opening
- Replace damaged components immediately

Manufacturer / Contact

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Manufactured in Europe using modern CNC machining technology, with a strong focus on a European supply chain.