5000 Series 5000 Multiple Reactor System (MRS)

Series Number:
5000

Type:
Bench Top Multiple Vessel

Vessel:
Moveable

Sizes:
45 & 75 mL

Maximum Operating Pressure:
3000 psi (200) bar

Maximum Operating Temperature:
225 °C
w/ FKM O-ring
275 °C
w/ FFKM O-ring
300 °C
w/ PTFE Flat Gasket

Model 5000 Multiple Reactor System with 4870 Process Controller

The Parr Series 5000 Multiple Reactor System has been designed to provide an integrated system for running multiple reactions simultaneously and applying the principles of high throughput experimentation to reactions conducted at elevated temperatures and pressures.

The principle features of the new instrument include:

- Six reactors with internal stirring.
- Operating pressures to 3000 psi.
- Operating temperatures to 300 °C.
- Individual temperature control.
- Continuous individual pressure monitoring.
- Computer control and data logging
- Manifold system for rapid turn around and to allow two different input gases.
- Volumes and reactor geometry designed for three phase reactions.
- Flexible Control Software.
- Data Reduction Software.

Stirred Batch Reaction Vessel

This multiple reaction system has been designed around a vessel with 75mL total volume. This will accommodate between 15 and 40mL of liquid reactants which is close to the minimum volume appropriate for heterogeneous catalytic reactions.

The vessel valves and accessories are designed for maximum operating pressures up to 3000 psi at operating temperatures up to 300 °C. A system with 45 mL vessels is also available.

Stirring System

All six vessels are stirred with a single magnetic stirrer system specifically designed and built for this application. The magnetic drives and fields are focused on the stirrer bars within each vessel. High strength compact magnets are used to provide coupling forces which will operate through the heaters and vessels. The stirring speed of the stir bar is variable from 0-1200 rpm. All vessels will have the same stirring speed during a single run of the apparatus. For manual controlled stirring, a digital tachometer is included. An optional computer controlled stirrer speed and display is also available.

Heaters

The external heaters surround the vessel walls and bottom for rapid and uniform heating and temperature control. Each vessel is individually temperature controlled. The 250-watt heaters used on each vessel produce heating rates up to 15 °C per minute.

Operating Modes

The Series 5000 Multiple Reaction System provides an apparatus for running up to six reactions in parallel to build a database for comparing and optimizing operating conditions. The user can design experiments to:

- Run all reactions at the same temperature and pressure while varying catalyst loading or reactant concentrations to optimize these parameters.
- Run all reactors with identical loads varying pressures and a common temperature to study the effect of pressure on reaction rates.
- Run individual reactors with individual loading and temperature and pressure to screen multiple options for activity.
- We expect a comparison of the plots of pressure drop versus time within the reactors running under parallel conditions to be the most useful means of measuring reaction rates and comparing operating conditions. The internal thermocouple also provides a means of detecting parameters of exothermic reactions.

Reactor Options

As Parr customers have come to expect with our line of laboratory pressure reactor equipment, these reactors are offered with a number of options which permit the user to configure the system to their reactions and intended operating conditions, these options include:

O-ring or Flat Gasket Seals. Vessels with O-ring seals are closed by simply tightening the screw cap down hand tight. The maximum operating temperature will depend upon the O-ring material. When equipped with FKM (Viton®) O-rings operating temperatures up to 225 °C are permitted. By substituting FFKM (Kalrez®) O-rings this limit can be raised to 275 °C. Careful consideration of chemical compatibility must also be given when selecting O-ring materials. PTFE gaskets can be used to temperatures in the 300 °C range and offers virtually universal chemical compatibility. Three cap screws are used to develop the sealing forces on the PTFE gaskets in this design.

Head Configuration. Each reaction vessel is equipped with an inlet valve, exhaust valve, safety rupture disc, and pressure transducer in addition to an internal thermocouple. The user can choose to have the valves, transducer and rupture disc mounted on a gage block connected directly to the vessel head, or remotely mounted on the back panel and connected to the valve with a quick coupling flexible high pressure hose. The head mounted design makes it possible to remove pressurized vessels from the heater/stirrer assembly or to prefill the vessels in a remote location. The remote panel mounted arrangement connects all of the pressure inlets/outlets to each vessel with a single flexible connection for the greatest ease of handling.

Materials of Construction. Type 316 stainless steel is the standard material of construction for both the vessel with its wetted parts and the gage block assemblies exposed to vapors. For investigators working with systems containing strong mineral acids or other more corrosive systems these vessels can be made of any of the Parr standard materials of construction.

Stirrer Configuration. Our testing has shown that the best stirring option is a loose stirring bar. PTFE coated or glass stirrer bars are available.

Thermocouple Configuration. Thermocouples are mounted inside the vessel for the best temperature monitoring and control. These thermocouples are protected by stainless steel sheaths which are inserted into a protective thermowell. These thermowells make it easy to install and remove thermocouples from the vessels, plus provide additional chemical and mechanical protection for the thermocouple.

Inlet Valve Type. Two gas inlet valves are provided and are connected to a manifold. The third valve is for venting the lines. The manifold allows for adding a purge gas, usually nitrogen, and a reactant gas, usually hydrogen, to these reactors. The valves for the gas inlet to each vessel can be either an automatic check valve or manually controlled. The automatic check valves permit the operator to fill all six vessels simultaneously to the same operating pressure. Manual needle valves permit the operator to fill each vessel to a unique starting pressure.

Series 5000 Ordering Guide

A composite identification number to be used when ordering a 5000 Series reactor can be developed by combining individual symbols from the separate sections.

A Six Station MRS, reactor with PTFE flat gasket, T316SS, 115V electrical, fixed thermowell, on-head valve, with automatic check valve, a transducer range of 1000, a PTFE magnetic bar stirrer, computer controlled stirrer, and ASME certification would be listed as:

Example: No. 5000-T-SS-115-TW-H-AC-1000-MB-CC-ASME

A. Model	B. Gasket	C. Material	D. Voltage	E. Temp. Meas.	F. Valve Mount.	Etc.
No.5000	-T	-SS	-115	-TW	-H	

A. Base Model		
Model No.	**Size**	**Vessel Style**
5000	45 or 75 mL	6 Stations

B. Gasket / Maximum Temperature	
-JV	FKM O-ring, 225 °C
-JK	FFKM O-ring, 300 °C
-T	PTFE Flat Gasket, 275 °C

C. Materials of Construction	
-SS	T316 Stainless Steel
-MO	Alloy 400
-IN	Alloy 600
-HB	Alloy B-3
-HC	Alloy C-276
-HC2	Hastalloy C-2000
-CS	Alloy 20Cb3
-TI2	Titanium Grade 2
-TI4	Titanium Grade 4
-NI	Nickel 200
-ZI	Zirconium 702 or 705

D. Electrical Supply	
-115	115 Volt, 50/60Hz
-230	230 Volt, 50/60Hz

E. Temperature Measurement	
-TW	Thermocouple in Thermowell

F. Valve Mounting	
-H	On Head
-P	On Manifold Panel

G. Inlet Valve	
-AC	Automatic Check Valve
-MV	Manual Check Valve

H. Transducer Range	
-1000	0-1000 psi
-2500	0-2500 psi
-5000	0-5000 psi

I. Stirrer Type	
-MB	Magnetic Bar Stirrer, PTFE
-GB	Magnetic Bar Stirrer, Glass

J. Stirring Control	
-M	Manual
-CC	Computer Controlled

Rear Panels of the 4870 Process Controller, Heater, Stirrer, and Manifold Panel of the Series 5000 Multiple Reactor System

K. Certifications	
-No Symbol	No Certification
-ASME	ASME Certification
-CE/PED	European Community Certification
-P	Parr Certification

Other Options
Glass Liner
PTFE Liner
Dip Tube with Sampling Valve
Cold Finger
Input Pressure Gage
Type K or RTD

Parr also designs and builds a wide range of multiple reactor systems with overhead magnetic drive stirrers. These have been based upon our Series 4590 Micro Reactors, Series 4560 Mini Reactors, and our Series 5500 High Pressure Compact Reactors. Please contact our Customer Service Department for details and proposals for custom systems.

5000 Series 5000 Specifications

Series 4870 Process Controller

The Series 5000 Multiple Reaction System is controlled by a dedicated Parr 4870 Process Controller. A detailed description of this controller is found on page 110 of this catalog. For this application this controller is set up to provide:

- Temperature monitoring of all six reaction vessels.
- PID Temperature control of each individual reactor.
- Pressure monitoring of each of the six reaction vessels.
- Data logging of temperature and pressure in each vessel.
- Digital stirrer speed readout and manual control.
- Optional computer control-stirrer speed and digital display.

In addition to its standard configuration, the controller can provide Ramp & Soak programming for individual reaction vessels, digital inputs and outputs for interlocks, alarms or other safety features, and additional analog and digital inputs and outputs to control flow meters or other accessories which might be added at some future date.

The users control station is a PC running any current Windows operating system. A simplified graphical user interface has been designed for the control and monitoring of the Series 5000 Multiple Reaction System. The PC is used strictly as the user interface and data logging module. All control actions are generated in the 4870 Process Controller (not the PC).

Series 5000 Reactor Specifications

Shaded bar indicates specifications that change within series.

Model Number	5000			
Sizes, mL	75			
No. of Reaction Vessels	6			
Maximum Pressure	3000 psi (200 bar)			
Maximum Temperature				
with FKM O-ring	225 °C			
with FFKM O-ring	275 °C			
with PTFE Flat Gasket	300 °C			
Closure				
with O-ring	Screw Cap			
with Flat Gasket	Screw Cap with 6 Cap Screws			
Material of Construction	T316SS*			
Process Controller	Model 4870			
Analog Inputs	6 Temperature			
	6 Pressure			
	1 Motor Speed			
Analog Outputs	1 Stirrer Speed			
Digital Outputs	6 PID Temperature Control			
Temperature Measurement	6 Type J Thermocouple			
Heater Style	Aluminum Block			
Heater Power Watts	250W Per Station 1500W Total			
Stirrer Motor Type	VS or Computer Controlled			
Stirrer Style	Magnetic Stirrer Bar			
Electrical Supply				
Volts	115 or 230			
Maximum Load, amps	15 / 7.5			
Vessel Dimensions				
Inside Diameter, inches	1.5			
Inside Depth, inches	2.69 Flat Gasket, 2.50 O-ring			
Weight of Vessel, pounds	3			
Dimensions	Width, in.	Depth, in.	Height, in.	Weight, lb.
Heater	25.75	9.25	2.875	31
Stirrer	28	9.5	7.625	12
Controller	15	13	22	25
Manifold, Remote	26.5	9.0	15	36
Manifold, Head Mount	26.5	9.0	15	18

* Other options available. See Ordering Guide