



Multiple Reactor System (MRS)

Series 5000



Parr Instrument Company

Parr Series 5000 Multiple Reactor System (MRS)



The Parr Series 5000 Multiple Reactor System has been designed to provide an integrated system for applying the principles of high throughput screening 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 systems for rapid turn around and to allow two different input gases.
- Reactor geometry and volumes designed for three phase reactions.
- Flexible Control Software.
- Data Logging 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 reactors have been designed with the ideal reactor length to diameter ratio of 1.5.

The vessel valves and accessories are designed for maximum operating pressures up to 3000 psi at operating temperatures up to 300°C.

Stirring System

All six vessels are stirred with a single magnetic stirrer assembly 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 used. The stirring speed of the stir bar is variable from 0-1700rpm. All vessels will have the same stirring speed during a single run of the apparatus. A digital tachometer to display stirring speeds is optional equipment in the MRS. An optional PC-controlled stirrer speed and display is also available.

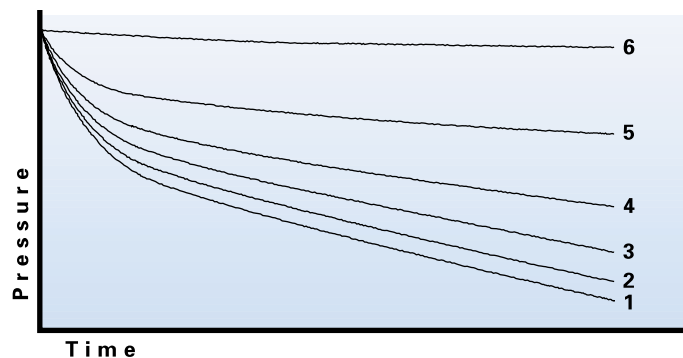
Heaters

Vessels are heated through the vessel walls and bottom of the vessel for rapid and uniform heating and temperature control. Each vessel is individually controlled. The 250-watt heaters used on each vessel produce heating rates of 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 loading while varying pressures at a common temperature to study the effect of pressure on reactor 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.



Example of Continuous Individual Pressure Monitoring

Reactor Options

As Parr customers have come to expect with our line of laboratory sealed 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:

1. O-ring or Teflon™ flat gasket seals. Vessels are closed by simply tightening the screw cap down hand tight when using o-rings. The maximum operating temperature will depend upon the material of construction of the o-ring. A fluoroelastomer such as Viton® is a widely used o-ring material which provides operating temperatures up to 225°C.

Temperatures up to 300°C are available with more expensive perfluoroelastomers such as Kalrez® material. In addition to the temperature limits, careful consideration of chemical capability must also be given when selecting o-ring materials.

PTFE gaskets can be used to 300°C and offers virtually universal chemical compatibility. Six cap screws are used to develop the sealing forces on the PTFE gaskets used in this design.

2. 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 head with a single 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.

3. 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 more corrosive chemistry, the head, cylinder, and wetted internal metal parts can be made of alloys: C-276, B-3, 400, 600 and 20Cb3, as well as titanium and zirconium.

4. Stirrer Configuration

Three choices are offered for the internal magnetic stir bar arrangement. The simplest is a loose stirring bar. The internal magnetic stirring bar can also be suspended from the cover of the vessel if there is a reason, such as the form of the catalyst, to avoid the bar spinning on the bottom of the vessel.

The third option incorporates a bladed impeller holder for the suspended bar magnet for enhanced gas entrainment in the liquid phase.

5. Thermocouple Configuration

Thermocouples are mounted inside the vessel for the best temperature monitoring and control. These thermocouples are protected by stainless steel sheaths which can be mounted in the head of the vessel with a compression fitting or installed in a protective thermowell. The direct mounted thermocouples are permanently attached to the vessel head and provide the best temperature response for kinetic studies. Thermowells (recommended for ease of handling) make it easy to install and remove thermocouples from the vessels, plus provide additional chemical and mechanical protection to the thermocouple and are the only option for vessels constructed of materials other than stainless steel.

6. Inlet Manifold

Two inlet valves allow one of two selected gasses to enter the manifold. The manifold has six reactor feed lines and a vent valve. Each feed line connects to an automatic check valve at the reactor (Head Mount) or gage block (Manifold Panel). Users with the head-mounted design can choose a manual shut off valve.

Series 4870 Process Controller

The Series 5000 multiple reaction system is controlled by a dedicated Parr 4870 process controller. This controller is set up to provide:

- Temperature monitoring of individual reaction vessels.
- PID Temperature control of each individual reactor.
- Pressure monitoring of individual 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/outputs for interlocks, alarms or other safety features, plus additional analog and digital inputs/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. All control actions are generated in the 4870 Process Controller. The PC is used strictly as the user interface and logging module. PC not included with the 5000 apparatus.

Series 5000 Specifications

Multiple Reactor System Model Number	5000			
Sizes, mL	75			
Number of Reaction Vessels	6			
Maximum Pressure, psi (bar)	3000 (200)			
Maximum Temperature °C				
with FKM O-Ring	225			
with FFKM O-Ring	300			
with PTFE Flat Gasket	300			
Closure				
with O-ring	Screw Cap			
with Flat Gasket	Screw Cap with 6 Cap Screws			
Material of Construction	T316SS*			
Process Controller Model Number	4870			
Analog Inputs	6 Temperature			
	6 Pressure			
	1 Motor Speed			
Analog Output	1 Stirrer Speed			
Digital Outputs	6 PID Temperature Control			
Temperature Measurement	Type J Thermocouple			
Heater Style	Aluminum Block			
Heater Power Watts	250W per station, 1500W total			
Stirrer Motor	Manual or Computer Controlled			
Stirrer Style	Magnetic Stirrer Bar			
Electrical Supply	115V/15 amp or 230V/7.5 amp			
Vessel Dimensions				
Inside Diameter, inches	1.5			
Inside Depth, inches	2.75			
Weight of Vessel, pounds	3			
Dimensions	Width, inches	Depth, inches	Height, inches	Weight, pounds
Heater	25.75	9.25	2.88	23
Stirrer	28	9.5	7.62	32
Controller	15	13	22	31

* Alternative Materials of Construction are Available

Series 5000 Ordering Guide

A composite identification number to be used when ordering a Multiple Reactor System can be developed by combining individual symbols from the separate sections.

Example

A Six Station MRS, reactor with PTFE flat gasket, T316SS, 115V electrical, fixed thermocouple, on-head valve, with automatic check valve, a transducer range of 200, a magnetic bar stirrer, computer controlled stirrer, without tach display and ASME certification would be listed as:

No. 5000-T-SS-115-TC-H-AC-200-MB-CC-ASME

Model	Gasket	Material of Construction	Voltage	Temperature Measurement	Valve Mounting	Inlet Valve	Transducer Range	Stirrer Type	Stirrer Control	Certification	
No .	5 0 0 0	- T -	S S -	1 1 5 -	T C -	H -	A C -	2 0 0 -	M B -	C C -	A S M E
	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.	I.

A. BASE

Model No.	Size	Stations
5000	75 mL	6

B. GASKET/MAXIMUM TEMP.

- JV	FKM O-Ring	225°C
- JK	FFKM O-Ring	300°C
- T	PTFE Flat Gasket	300°C

C. MATERIALS OF CONSTRUCTION

- SS	T316 Stainless Steel
- HB	Alloy B-3
- HC	Alloy C-276

D. ELECTRICAL SUPPLY

- 115	115 Volt, 50/60 Hz
- 230	230 Volt, 50/60 Hz

E. TEMPERATURE MEASUREMENT

- TC	Fixed Thermocouple
- TW	Thermocouple in thermowell

F. VALVE MOUNTING

- H	On Head
- P	On Manifold Panel

G. INLET VALVE

- AC	Automatic Check Valve
- MV	Manual Needle Valve

H. TRANSDUCER RANGE

- 200	0-200 psi
- 1000	0-1000 psi
- 2500	0-2500 psi
- 5000	0-5000 psi

Note: Rupture Disc Same

I. STIRRER TYPE

- MB	Magnetic Bar Stirrer
- SB	Suspended Bar Stirrer
- SP	Suspended Impeller Stirrer

J. STIRRING CONTROL

- M	Manual
- CC	Computer Controlled

L. CERTIFICATION

No Symbol	No Certification
- ASME	ASME Certification
- TUV	TUV Certification

- CE (PED) European Community Certification

- P Parr Certification

The **PARR** Warranty

Parr Instrument Company (Parr) pressure reactors and associated products are designed and manufactured only for use by or under the direct supervision of trained professionals in accordance with specifications and instructions for use supplied with the products. For that reason, Parr sells only to professional users or distributors to such users. Parr produces precision equipment and associated products which are not intended for general commercial use.

Exclusive Warranty

To the extent allowed by law, the express and limited warranties herein are the sole warranties. Any implied warranties are expressly excluded, including but not limited to implied warranties of merchantability or fitness for a particular purpose.

Express Warranties

Subject to the above Conditions, Parr expressly warrants that its products:

Are as described in the applicable Parr sales literature, or as specified in Parr shipping documents.

Will function as described in corresponding Parr sales bulletins, or for specifically engineered assemblies, as stated in the sales proposal and purchase agreement.

Will remain free from defects in materials and workmanship for one year from date of delivery of the product to the original purchaser/user. Note that there is no guarantee of a service life of one year after delivery.

Limitations On The Parr Warranty

As to the original purchaser/user and to the distributors to such users, Parr limits its liability for claims other than personal injury as follows:

Replacement or repair. With respect to express warranties herein, Parr's only obligation is to replace or repair any parts, assemblies or products not conforming to the warranties provided herein.

Disclaimer of consequential damages. In no event shall Parr be liable for consequential commercial damages, including but not limited to: damages for loss of use, damages for lost profits, and damages for resulting harm to property other than the Parr product and its component parts.

Due to their fragile nature, glass parts are not warranted beyond incoming inspection.



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