

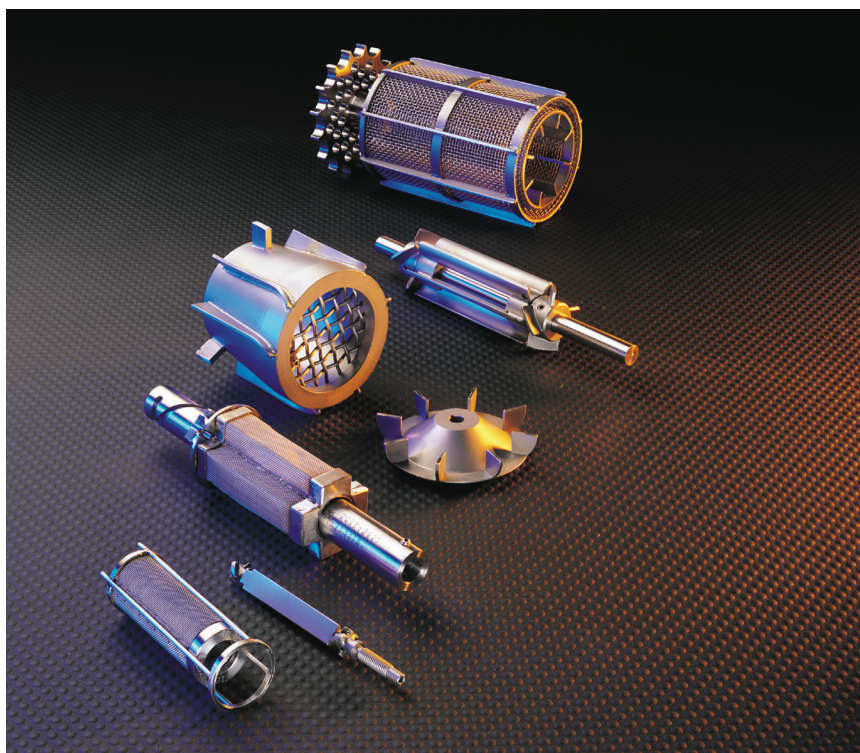
Catalytic Reactor

Selection Guide



Available from Micro to Pilot scale in stainless steel or assorted high-temperature, corrosion resistant alloys. Parker Autoclave Engineers offer a variety of reactors for use with liquids, gases or solids with stationary, spinning or falling catalyst baskets.

Corrosion resistant gradientless reactor is basic equipment for advancing the science of gas phase, solid phase, heterogeneous catalyst technology. This high pressure laboratory apparatus can be used for diverse supported and selective catalyst research, including catalyst screening, catalyst characterization, and surface chemistry studies. The leak-free metal gasket design provides bench-scale catalytic synthesis capability for scientific experimentation.



At a Glance:

- Fixed Bed (Tube) Reactors
- High Pressure Stirred Laboratory (Batch) Reactors
- Berty Stationary Catalyst Basket
- Berty “Micro” Stationary Catalyst Basket
- Robinson-Mahoney Stationary Catalyst Basket
- Robinson-Mahoney “Micro” Stationary Catalyst Basket
- Mahoney-Robinson Spinning Catalyst Basket
- Carberry Spinning Catalyst Basket
- Harshaw Stationary and Falling Catalyst Basket



ENGINEERING YOUR SUCCESS.

General Information:

Parker Autoclave Engineers offers a full range of catalyst research apparatus.

SIZES - Miniature to Pilot

PRESSURES - Vacuum to many thousand psi (several hundred bar)

TEMPERATURES - Sub-ambient to 650°F (343°C) is “standard” and higher and lower temperature designs are offered for specific applications. See the following pages for more information. Custom temperature and pressure ratings are available upon request.

MATERIALS - Stainless steel and assorted high temperature, corrosion resistant alloys.

DESIGNS - An assortment for both supported and unsupported catalyst research, continuous flow and several circulating flow designs for simulating diverse processes.

CONTROL SYSTEMS - Manual, through all levels of automation, including integrated systems with full computerized batch automation, data acquisition and fail-safe process controls.

SPECIAL DOCUMENTATION AND CERTIFICATION - ASME, CE (PED), and Canadian Registration (CRN) are available.

OPTIONS - As specified. (Special instrumentation, plated / polished catalyst supports, regulatory certifications, explosion-proof drive, special material handling and sampling etc.)

Parker Autoclave Engineers has developed an extensive library of proven, successful equipment designs for catalyst research. It is not practical to list them all. Feel free to contact Parker Autoclave Engineers with your requirements.

Application Selection Guide:

REACTORS	Page	Reactants			Typical Reactions						
		Liquid/Solids	Gas or Vapor/Liquids	Gas/Liquid/Solids	Hydrogenation	Liquefaction	Oxidation	Hydrotreating	Catalyst Testing	Hydrocarbon Petroleum Studies	Hydro Liquefaction
Fixed Bed Reactors	4	X	X	X	X		X	X	X		
CSTR-Continuous Stirred Tank Reactors	5	X		X	X	X	X	X	X		
Berty Stationary Catalyst Basket	6		X		X		X		X		
Berty Stationary Catalyst Basket - Top Driven	7		X		X		X		X		
Berty "Micro" Stationary Catalyst Basket	8		X		X		X				
Robinson-Mahoney Stationary Catalyst Basket	9	X		X		X		X	X		
Robinson-Mahoney "Micro" Stationary Catalyst Basket	10	X		X		X		X	X		
Mahoney-Robinson Spinning Catalyst Basket	11			X	X	X			X	X	X
Carberry Spinning Catalyst Basket	12	X	X	X	X	X	X	X	X		
Hawshaw Stationary and Falling Catalyst Basket	13			X	X		X		X		
Catalyst Baskets: Disperimax™-GLS and GGS	18		X	X	X				X		

Need Help Getting Started?

Selecting the right tool when faced with many choices can be overwhelming. The following series of questions may help in getting focused on the characteristics that differentiate the designs.

1. Are the kinetics of the reaction relatively fast or is the process you are trying to simulate a continuous flow process? If either are true, consider tube (fixed bed) reactor based systems like BTRS-Jr.[®], BTRS-Jr.[®] PC or BTRS 900 (See bulletin “BTRS-1” and Bulletin “RS-BTRS-Jr.[®]”).
2. Can a fluid be the dominant component of the mixture (perhaps a process solvent) and is unsupported catalyst a viable possibility? If yes, consider a High Pressure Laboratory (Batch) Reactor. (See the stirred reactor selection guide bulletin “SR-SG”).
3. Is fluid the dominant component and are you using supported catalysts? If yes, select the Robinson-Mahoney stationary catalyst basket design as the preferred tool for most applications. Some researchers suggest that centrifugal separation of components may limit the usefulness of the Mahoney-Robinson spinning basket design to reactions with miscible or soluble components.
4. Do you need sequential reactions where first the solid catalyst interacts with the gaseous reactants followed without interruption by a reaction where the solid catalyst is immersed in a liquid phase? If yes, consider the Harshaw “Falling Basket” design.
5. Is your reaction a Gas-Solid reaction where the reaction kinetics are relatively slow? There are two designs to consider, Berty or Carberry.
 - a. Consider the Berty if it is important to reproduce or closely correlate with the collected experimental work completed in Berty equipment. The Berty reactor is offered in various sizes. Select large diameter designs for applications with high pressure drop across the catalyst bed or very low gas density. The larger the diameter of the circulating blower the higher the pressure (head) for a given gas velocity and therefore the greater the circulation flow.
 - b. Consider the Carberry if you are interested in single tool that is versatile enough for nearly any gas and/or liquid reaction with a supported catalyst. The Carberry has been chosen to see a range of effects when there is a willingness to correlate Carberry based results with other equipment.
6. Are you using supported catalysts and the cost of catalyst is of concern? Then consider our small catalyst basket impellers, the Dispersimax[™]-GLS or the GGS.
7. Need help? Contact Parker Autoclave Engineers and ask for guidance.

Fixed Bed (Tube) Reactor:

Description:

The tubular reactor is packed with solid catalyst particles. The straight-through flow of gasses and/or liquids is suitable for chemical reactions with rapid kinetics. The reactor can be configured for both upward and downward flow as required by the process.

Reactants:

Liquid/Solids, Gas/Solids, Gas/Liquid/Solids, Vapor/Solids.

Typical Reactions:

Hydrogenation, oxidation, hydro-treating, catalyst testing.

Free Volume:

0.60 in.³ (10 cm³) and up.

Common Customizations:

Special materials, specific pressure and temperature rating, furnace assembly, "trickle feed" connection.

Standard Material:

316 Stainless Steel



Maximum Allowable Working Pressure/Temperature Combinations Examples for the Standard Material

Pressure Rating	Temperature for the Tabulated Pressure Rating
60,000 psig (4,137 Bar)	100°F (38°C)
48,450 psig (3,340 Bar)	800°F (427°C)

See BTRS[®] Bulletin for Bench Top Reaction Systems ordering information.

See Bulletin PV-CC for information on ordering a tube reactor as a stand alone part.

NOTES

Product information can be downloaded after registering your name on the Parker Autoclave Engineers web site: <http://www.autoclaveengineers.com> to reach the main page of Parker Autoclave Engineers reactor products. Request assembly drawings of the product(s) of interest to get more technical detail.

See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

High Pressure Stirred Laboratory (Batch) Reactor:

Description:

The stirred (batch) reactor is used to create a slurry using powdered catalyst in homogeneous catalyst research. Agitation creates isothermal conditions and allows the researcher to select the reaction time. Select the Dispersimax impeller for circulating the head space gas into the liquid phase. Other impeller shapes are offered to simulate other processes.

Reactants:

Liquid/Solids, Gas/Liquid/Solids, Vapor/Liquid/Solids

Typical Reactions:

Liquefaction, isomerization, polymerization, hydrogenation, oxidation, hydro-treating, catalyst testing.

Standard Material:

316 Stainless Steel and HASTELLOY® C-276

Standard Reactor Volume:

1.83 in.³ (30 cm³) to 244 in.³ (4,000 cm³)

Common Customizations:

Special materials, windows (video camera view ports and/or spectroscopic windows), non-standard capacity, non-standard vessel diameter and length, MagneDrive® with higher torque rating, welded heat transfer jacket for high pressure/temperature heat transfer fluid system, complete intrinsically safe barrier, control system, and special vessel lift mechanism. ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Agitator Speed:

1,000 to 3,300 RPM

Maximum Allowable Working Pressure/Temperature Combinations

Examples for the Standard Closure Design (Using Gasket With Highest Temperature Rating)

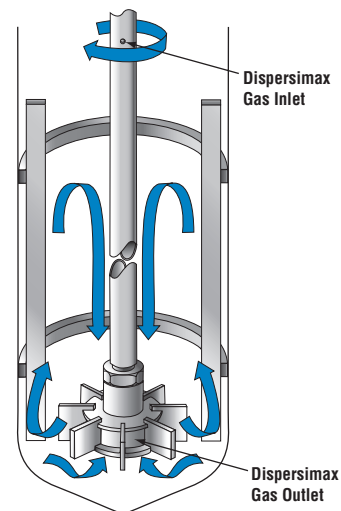
Name of Design	Pressure Rating	Temperature Rating
Mini-Reactor	2,900 psig (200 Bar)	600°F (315°C)
Micro-Reactor	5,000 psig (345 Bar)	650°F (343°C)
ZipperClave®	2,200 psig (151 Bar)	450°F (232°C)
EZE-Seal™	3,300 psig (227 Bar)	850°F (454°C)
Bolted Closure	5,500 psig (379 Bar)	650°F (343°C)
High Temp. Bolted Closure	5,000 psig (345 Bar)	950°F (510°C)

See the Stirred Reactor Selection Guide, ZipperClave, EZE-Seal™, Bolted Closure, High Temperature Vessel Bulletins and Ordering Guides.

NOTES

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See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.



Berty Stationary Basket Catalyst Testing Reactor:

Description:

This internal recycle reactor is designed with a fixed, circular, screened catalyst bed and a bottom mounted vane type blower. Fluid circulation is directed upward along the vessel wall and deflected downward through the catalyst bed. Large diameter designs are used in applications with high pressure drop across the catalyst bed or that have very low gas density. The predictable gas/vapor circulation of the Berty design has made it the most widely used gas phase catalyst research tool.

Reactants:

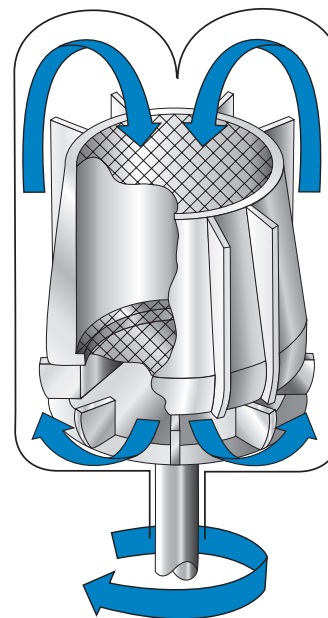
Gas/Solids, Gas/Liquid/Solids, Liquid/Solids, Vapors/Solids.

Typical Reactions:

Hydrocarbon oxidation, ethylene hydrogenation, catalyst testing.

Basket Screen:

4 x 4 mesh, 0.062" (1.5 mm) wire and a nominal opening size of 0.187" (4.75 mm)



	3" (76.2 mm) Inside Diameter (Standard)	3" (76.2 mm) Inside Diameter (Hi-Temp)	5" (127 mm) Inside Diameter
Basket Volume (5" design includes internal spacers for three volumes)	6.1 in. ³ (100 cm ³)	6.1 in. ³ (100 cm ³)	9.8 in. ³ (160 cm ³) 18.4 in. ³ (303 cm ³) 31.2 in. ³ (511 cm ³)
Free Volume	17 in. ³ (280 cm ³)	17 in. ³ (280 cm ³)	88.5 in. ³ (1,450 cm ³)
Maximum Allowable Working Pressure	5,800 psig (400 Bar)	2,450 psig (169 Bar)	3,700 psig (255 Bar)
Temperature	650° F (343°C)	1,200° F (649°C)	650°F (343°C)
Maximum Blower Speed	2,500 RPM	2,500 RPM	2,500 RPM (Gas Service) 1,500 RPM (Liquid service with special impeller for liquids) 500 RPM (Liquid service using stan- dard gas impeller)
Catalog Number Prefix	BC0010...	BM0010...	BC0043...

Common Customizations:

Special wire mesh size, special materials, special internal spacers for custom basket volumes, and specific pressure/ temperature rating. ASME code stamp, CE mark for Pressure Equipment Directive and CRN.

Standard Material:

316 Stainless Steel

NOTES

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See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Berty Stationary Catalyst Basket - Top Driven

Description:

This internal recycle reactor is designed with a fixed, circular, screened catalyst bed and a top mounted vane type blower. Fluid circulation is directed downward along the vessel wall and deflected upward through the catalyst bed. Large diameter designs are used in applications with high pressure drop across the catalyst bed or that have very low gas density.

Reactants:

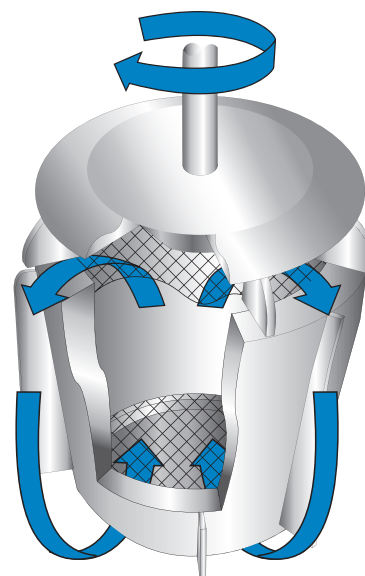
Gas/Solids, Gas/Liquid/Solids, Liquid/Solids, Vapors/Solids.

Typical Reactions:

Hydrocarbon oxidation, catalyst testing.

Basket Screen:

4 x 4 mesh, 0.062" (1.5 mm) wire and a nominal opening size of 0.187" (4.75 mm)



	3" (76.2 mm) Inside Diameter (Standard)	3" (76.2 mm) Inside Diameter (Hi-Temp)	5" (127 mm) Inside Diameter
Basket Volume (5" design includes internal spacers for three volumes)	6.1 in. ³ (100 cm ³)	6.1 in. ³ (100 cm ³)	9.8 in. ³ (160 cm ³) 18.4 in. ³ (303 cm ³) 31.2 in. ³ (511 cm ³)
Free Volume	17 in. ³ (280 cm ³)	17 in. ³ (280 cm ³)	88.5 in. ³ (1,450 cm ³)
Maximum Allowable Working Pressure	5,800 psig (400 Bar)	2,450 psig (169 Bar)	3,700 psig (255 Bar)
Temperature	650° F (343°C)	1,200° F (649°C)	650°F (343°C)
Maximum Blower Speed	2,500 RPM	2,500 RPM	2,500 RPM (Gas Service) 1,500 RPM (Liquid service with special impeller for liquids) 500 RPM (Liquid service using stan- dard gas impeller)
Catalog Number Prefix	-	-	-

Common Customizations:

Special wire mesh size, special materials, special internal spacers for custom basket volumes, and specific pressure/ temperature rating. ASME code stamp, CE mark for Pressure Equipment Directive and CRN.

Standard Material:

316 Stainless Steel

NOTES

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See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Berty “Micro” Stationary Basket Catalyst Testing Reactor:

Description:

This internal recycle reactor is designed with a fixed, circular, screened catalyst bed and a top mounted vane type blower. Fluid circulation is directed downward along the vessel wall and deflected upward through the catalyst bed.

Reactants:

Gas/Solids, Vapor/Solids.

Typical Reactions:

Oxidation, hydrogenation, catalyst testing.

Basket Screen:

50 x 50 mesh, 0.009" (0.23 mm) wire and a nominal opening size of 0.011" (0.28 mm).

Inside Diameter:

1 in. (25.4 mm)

Basket Volume:

0.22 in.³ (3.6 cm³)

Free Volume:

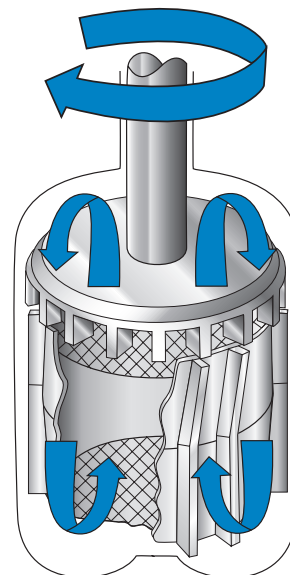
0.94 in.³ (15.4 cm³)

Maximum Allowable Working Pressure:

5,000 psig (345 Bar)

Maximum Blower Speed:

5,000 RPM



Version	Standard	High Temperature
Temperature	650°F (343°C)	1,000°F (538°C)
Catalog Number Prefix	CRB2HC...	CRBHT...

Common Customizations:

Special wire mesh size, special materials, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

Hastelloy[®] C-276

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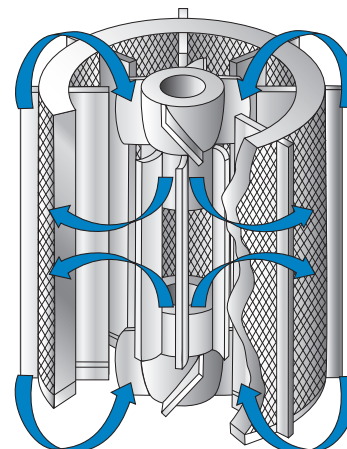
Product information can be downloaded after registering your name on the Parker Autoclave Engineers web site: <http://www.autoclaveengineers.com> to reach the main page of Parker Autoclave Engineers reactor products. Request assembly drawings of the product(s) of interest to get more technical detail.

See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Robinson-Mahoney Stationary Catalyst Basket Reactor:

Description:

The fixed annular catalyst basket has baffles inside and outside to control vortices. The rotating shaft is equipped with two impellers that draw fluid into the center of the annulus at the top and bottom and outward through the catalyst bed. The gradient-free design and long duration circulation capability for multiple phases has made the Robinson-Mahoney the most widely used design for supported, heterogeneous catalyst research with liquids.



Reactants:

Liquid/Solids, Gas/Liquid/Solids, Vapor/Liquid/Solids.

Typical Reactions:

Liquefaction, hydro-treating, catalyst testing.

Basket Screen:

14 x 14 mesh, 0.020" (0.51 mm) wire and a nominal opening size of 0.051" (1.3 mm)

	1.8" (45.7mm) Inside Diameter	3" (76.2 mm) Inside Diameter
Basket Volume	3.0 in. ³ (49 cm ³)	8 in. ³ (131 cm ³)
Free Volume	16 in. ³ (262 cm ³)	63.5 in. ³ (1,040 cm ³)
Maximum Allowable Working Pressure	5,400 psig (372 Bar)	5,800 psig (400 Bar)
Temperature	650° F (343°C)	650° F (343°C)
Maximum Agitator Speed	1,000 RPM	2,500 RPM
Catalog Number Prefix	BC0005...	BC0012...

Common Customizations:

Conversion kits to switch an EZE-Seal™ or Bolted closure batch reactor into a Robinson-Mahoney catalytic reactor, special wire mesh size, special materials, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

316 Stainless Steel

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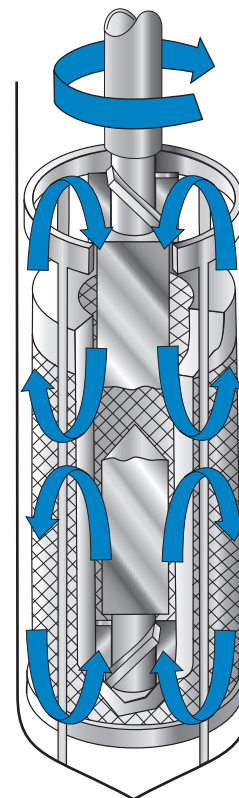
Product information can be downloaded after registering your name on the Parker Autoclave Engineers web site: <http://www.autoclaveengineers.com> to reach the main page of Parker Autoclave Engineers reactor products. Request assembly drawings of the product(s) of interest to get more technical detail.

See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Robinson-Mahoney “Micro” Stationary Catalyst Basket Reactor:

Description:

The fixed annular catalyst basket has baffles inside and outside to control vortices. The rotating shaft is equipped with two impellers that draw fluid into the center of the annulus at the top and bottom and outward through the catalyst bed. The gradient-free design and a long duration circulation capability for multiple phases has made the Robinson-Mahoney the most widely used design for supported catalyst research with liquids.



Reactants:

Liquid/Solids, Gas/Liquid/Solids, Vapor/Liquid/Solids

Typical Reactions:

Liquefaction, hydro-treating, catalyst testing

Basket Screen:

50 x 50 mesh, 0.009" (0.23 mm) wire and a nominal opening size of 0.011" (0.28 mm)

Inside Diameter:

1" (25.4 mm)

Basket Volume:

0.436 in.³ (7.15 cm³)

Free Volume:

3.05 in.³ (50 cm³)

Maximum Allowable Working Pressure:

5,000 psig (345 Bar)

Temperature

650°F (343°C)

Maximum Agitator Speed:

5,000 RPM

Version	Standard	High Temperature
Temperature	650°F (343°C)	1,000°F (538°C)
Catalog Number Prefix	CRA5HC...	CRAHT...

Common Customizations:

Special wire mesh size, special materials, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

HASTELLOY® C-276

NOTES

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See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Mahoney-Robinson Spinning Catalyst Basket Reactor:

Description:

The annular catalyst basket is rotated on a shaft to move the catalyst through the reactants. Baffles inside the basket and fixed baffles outside the basket direct reactant flow.

Reactants:

Gas/Liquid/Solids, Vapor/Liquid/Solids.

Typical Reactions:

Hydrocarbon petroleum studies, hydro-liquefaction, catalyst testing.

Basket Screen:

14 x 14 mesh, 0.020" (0.51 mm) wire and a nominal opening size of 0.051" (1.3 mm)

Basket Volume:

2.2 in.³ (35 cm³)

Free Volume:

30 in.³ (500 cm³)

Maximum Allowable Working Pressure:

5,500 psig (379 Bar)

Temperature:

650°F (343°C)

Maximum Rotation Speed:

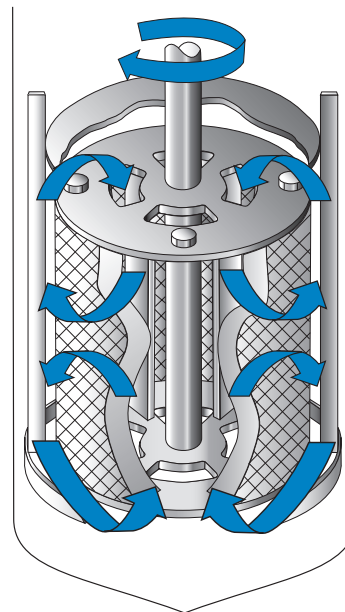
1,500 RPM. The catalyst and fluid loads may unbalance or overstress the bearings. A typical rotation speed range is 100 to 1,500 RPM.

Common Customizations:

Special wire mesh size, special materials, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

316 Stainless Steel



NOTES

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See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Carberry Spinning Catalyst Basket Reactor:

Description:

The catalyst basket has a “cruciform” cross-section. The test catalyst is placed in the cruciform basket and rotated on a shaft. Each arm of the cruciform acts as a differential reactor sweeping through the fluid reactants at high speed. Propellers are mounted above and below the cruciform to direct fluid flow.

Reactants:

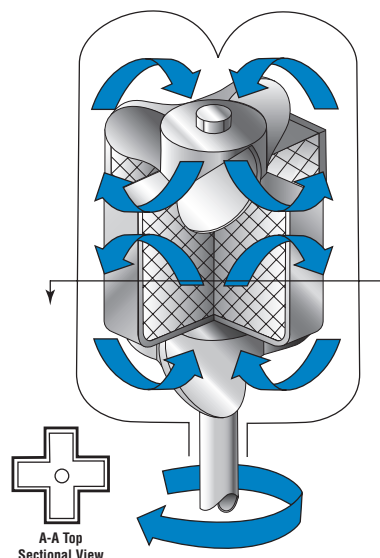
Liquid/Solids, Gas/Solids, Vapor/Solids, Gas/Liquid/Solids, Vapor/Liquid/Solids.

Typical Reactions:

Liquefaction, hydrogenation, hydro-treating, oxidation, catalyst testing.

Basket Screen:

14 x 14 mesh, 0.020” (0.51 mm) wire and a nominal opening size of 0.051” (1.3 mm).



	3" (76.2 mm) Inside Diameter (Standard)	3" (76.2 mm) Inside Diameter (Hi-Temp)	5" (127 mm) Inside Diameter
Basket Volume	2.5 in. ³ (41 cm ³)	2.5 in. ³ (41 cm ³)	6.3 in. ³ (103 cm ³)
Free Volume	18 in. ³ (295 cm ³)	18 in. ³ (295 cm ³)	88 in. ³ (1,442 cm ³)
Maximum Allowable Working Pressure	5,800 psig (400 Bar)	2,450 psig (169 Bar)	3,700 psig (255 Bar)
Temperature	650° F (343°C)	1,200° F (649°C)	650°F (343°C)
Maximum Impeller/Basket Speed	2,500 RPM (gas) 1,000 RPM (liquid)	2,500 RPM (gas) 1,000 RPM (liquid)	2,500 RPM (gas) 1,000 RPM (liquid)
Catalog Number Prefix	BC0006...	BM0006...	BC0012...

Common Customizations:

Conversion kit to switch from a Berty catalytic reactor to a Carberry reactor, special wire mesh size, special material, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

316 Stainless Steel

NOTES

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Harshaw Stationary and Falling Catalyst Basket Reactor:

Description:

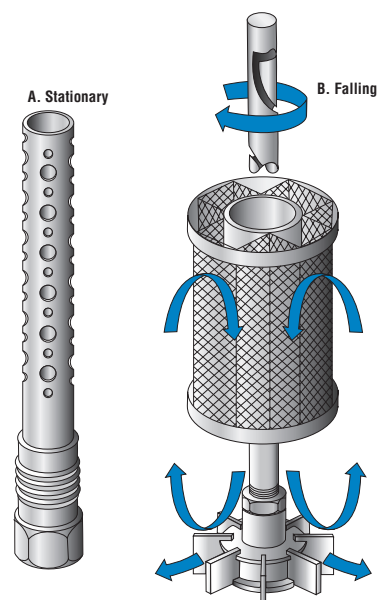
- A.** The catalyst basket is a perforated tube that is installed in the bottom of a reactor. The basket can be easily filled with supported (formed) catalysts and changed between batch runs.
- B.** The catalyst basket has a cruciform shape (similar to the Carberry). The catalyst basket is held in a catch near the top of the grooved agitator shaft in the gas/vapor phase during the initial part of the experiment. The basket releases when the shaft is stopped and momentarily reversed. This allows the catalyst basket to travel down the groove to the bottom position for the liquid phase of the experiment.

Reactants:

Gas/Vapor/Liquid/Solids.

Typical Reactions:

Hydrogenation, oxidation, catalyst testing.



	A. Stationary	B. Falling
Basket Screen	Perforated with 0.062" (1.5 mm) and 0.120" (3.0 mm) diameter holes	50x50 mesh, 0.009" (0.23 mm)
Screen Opening	-	0.011" (0.28 mm)
Basket Volume	0.7" in. ³ (17 cm ³)	2.6" in. ³ (42.6 cm ³)
Free Volume	60.4" in. ³ (990 cm ³)	60.4" in. ³ (990 cm ³)

Maximum Allowable Working Pressure:

5,500 psig (379 Bar)

Temperature:

650°F (343°C)

Maximum Rotation Speed:

Variable with the stage of the process and other considerations. 2,500 RPM is the maximum recommended if a) the basket is in the top position (in the gas phase) and b) the catalyst weight distribution is uniform. 1,000 RPM is the maximum recommended if a) the basket is in the lower position (in the liquid phase) and b) the catalyst weight distribution is uniform. Actual rotational speeds may need to be reduced further if catalyst weight distribution is not uniform.

Common Customization:

Conversion kits to convert an EZE-Seal™ or Bolted closure batch reactor into a Harshaw Falling Basket Reactor, special wire mesh size, special materials, specific pressure/temperature ratings, ASME code stamp, CE mark for Pressure Equipment Directive, and CRN.

Standard Material:

316 Stainless Steel

NOTES

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Performance Comparison Chart

Parker Autoclave Engineers Catalytic Reactors - Sizes and Capabilities

Designation	Maximum Allowable Working Pressure/Temperature (see note 1)	Maximum Agitation Speed	Free Volume	Maximum Basket Volume	Screen Size	Screen Operating	Catalog Page
Fixed Bed Reactor	60,000 psig (4,137 bar) @ 100°F (38°C) 48,450 psig (3,340 bar) @ 800°F (427°C)	N/A	10-300 cm ³	N/A	N/A	N/A	4
High Pressure Laboratory (Batch) Reactor	5,500 psig (379 bar) @ 650°F (343°C) 3,300 psig (227 bar) @ 850°F (454°C)	1,000-3,000 RPM	50-4,000 cm ³	N/A	N/A	N/A	5
Berty 3" I.D. Standard	5,800 psig (400 bar) @ 650°F (343°C)	2,500 RPM	280 cm ³	100 cm ³	4x4 mesh 0.062" (1.5 mm) wire	0.187" (4.75 mm)	6
Berty 3" I.D. Hi-Temp	2,450 psig (169 bar) @ 1,200°F (649°C)	2,500 RPM	280 cm ³	100 cm ³	4x4 mesh 0.062" (1.5 mm) wire	0.187" (4.75 mm)	6
Berty 5" I.D. Standard	3,700 psig (255 bar) @ 650°F (343°C)	500-2,500 RPM (see note 2)	1,450 cm ³	511 cm ³	4x4 mesh 0.062" (1.5 mm) wire	0.187" (4.75 mm)	6
Berty 3" Top-Driven	5,800 psig (400 bar) @ 650°F (343°C)	2,500 RPM	280 cm ³	100 cm ³	4x4 mesh 0.062" (1.5 mm) wire	0.187" (4.75 mm)	7
Berty "Micro" 1" I.D. Standard	5,000 psig (345 bar) @ 650°F (343°C)	5,000 RPM	15.4 cm ³	3.6 cm ³	50x50 mesh 0.009" (0.23 mm) wire	0.011" (0.28 mm)	8
Berty "Micro" 1" I.D. Hi-Temp	5,000 psig (345 bar) @ 1,000°F (538°C)	5,000 RPM	15.4 cm ³	3.6 cm ³	50x50 mesh 0.009" (0.23 mm) wire	0.011" (0.28 mm)	8
Robinson-Mahoney 300 cm ³	5,400 psig (372 bar) @ 650°F (343°C)	1,000 RPM	262 cm ³	49 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	9
Robinson-Mahoney 1 Liter	5,400 psig (372 bar) @ 650°F (343°C)	1,000 RPM	1,000 cm ³	131 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	9
Robinson-Mahoney "Micro" 50 cm ³	5,000 psig (345 bar) @ 650°F (343°C)	5,000 RPM	50 cm ³	7-15 cm ³	50x50 mesh 0.009" (0.23 mm) wire	0.011" (0.28 mm)	10
Mahoney-Robinson Spinning	5,500 psig (379 bar) @ 650°F (343°C)	1,500 RPM (see note 3)	500 cm ³	35 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	11
Carberry 3" I.D. Standard	5,800 psig (400 bar) @ 650°F (343°C)	2,500 RPM (see note 4)	295 cm ³	41 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	12
Carberry 3" I.D. Hi-Temp	2,450 psig (169 bar) @ 1,200°F (649°C)	2,500 RPM (see note 4)	295 cm ³	41 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	12
Carberry 5" I.D.	3,700 psig (255 bar) @ 650°F (343°C)	2,500 RPM (see note 4)	1,442 cm ³	103 cm ³	14x14 mesh 0.020" (0.51 mm) wire	0.051" (1.3 mm)	12
Harshaw Stationary 1 Liter	5,500 psig (379 bar) @ 650°F (343°C)	N/A	990 cm ³	17 cm ³	N/A	0.062" & 0.12" (1.5 & 30 mm)	13
Harshaw Falling 1 Liter	5,500 psig (379 bar) @ 650°F (343°C)	1,000-2,500 RPM (see note 5)	990 cm ³	42.6 cm ³	50x50 mesh 0.009" (0.23 mm) wire	0.011" (0.28 mm)	13

Notes:

- The pressure and pressure ratings tabulated above are the standard listing. Parker Autoclave Engineers will provide pressure ratings for unlisted temperatures upon request. Parker Autoclave Engineers will quote custom pressure and temperature ratings upon request if the standard designs are unsuitable.
- The recommended maximum varies with a) impellers used, b) whether the reactants are gas/vapor or liquid and c) the catalyst weight distribution. See the assembly drawing for detailed information.
- The tabulated rotation speed is the "ideal" maximum. The catalyst and fluid loads may unbalance or overstress the bearings. A typical rotation speed range is 100 to 1,500 RPM.
- The tabulated rotation speed is the "ideal" maximum for gas service. The maximum for liquid service is 1,000 RPM. The catalyst and fluid loads may unbalance or overstress the bearings. A typical rotation speed range is between 100 RPM and the maximum.
- The maximum rotational speed varies with the stage of the process and other considerations. 2,500 RPM is the maximum recommended if:
 - the basket is in the top position (in the gas phase) and
 - the catalyst weight distribution is uniform.
 1,000 RPM is the maximum recommended if:
 - the basket is in the lower position (in the liquid phase) and
 - the catalyst weight distribution is uniform.

Actual rotational speeds may need to be reduced further if catalyst weight distribution is not uniform.

Catalytic Reactor Ordering Guide

The following reactor assemblies INCLUDE motor, thermocouples and electrically heated 1,300°F (704°C) maximum furnace (for the voltage specified in the table). Be advised, speed controls, tachometer, motor controls, tachometer display, furnace controls and the display for the thermocouple are purchased as separate items. See the "Instrumentation" section of the Parker Autoclave Engineers Catalog for process instruments and controls.

Catalog Number	Description SS = ANSI 316 Stainless Steel HC = Hastelloy® C-276	Motor	Power Source	Temp. Rating	Furnace Watts	Furnace Current Draw (ampere)	Typical Furnace Power Supply Rating (ampere) See Note 1	Note	Weight lb.
BC0006SS06AM16D	Carberry Reactor 3" SS	DC	120V	650°F (343°C)	3,000	25	31.3		175
BC0010SS06AM16D	Berty Reactor 3" SS	DC	120V	650°F (343°C)	3,000	25	31.3		175
BC0006SS06AM26D	Carberry Reactor 3" SS	DC	220V	650°F (343°C)	3,000	13.6	17		175
BC0010SS06AM26D	Berty Reactor 3" SS	DC	220V	650°F (343°C)	3,000	13.6	17		175
BC0012SS04AK16D	Carberry Reactor 5" SS	DC	120V	650°F (343°C)	3,000	25	31.3		300
BC0043SS04AK16D	Berty Reactor 5" SS	DC	120V	650°F (343°C)	3,000	25	31.3		300
BC0012SS04AK26D	Carberry Reactor 5" SS	DC	220V	650°F (343°C)	3,000	13.6	17		300
BC0043SS04AK26D	Berty Reactor 5" SS	DC	220V	650°F (343°C)	3,000	13.6	17		300
BM0006SS04AM16D	Carberry Reactor 3" SS	DC	120V	1,200°F (649°C)	3,000	25	31.3	2	175
BM0010SS04AM16D	Berty Reactor 3" SS	DC	120V	1,200°F (649°C)	3,000	25	31.3	2	175
BM0006SS04AM26D	Carberry Reactor 3" SS	DC	220V	1,200°F (649°C)	3,000	13.6	17	2	175
BM0010SS04AM26D	Berty Reactor 3" SS	DC	220V	1,200°F (649°C)	3,000	13.6	17	2	175

NOTES

- 1) Power supply rating is calculated based on NEC (National Electrical Code) requirements for branch circuit overload protection of 125% of load. Verify that your power supply circuit is in conformance with local codes.
- 2) Reactor is equipped with bolts suitable for pressurized use when operating temperatures exceed 1,000°F/538°C.
- 3) See "Conversion Kit" section for kits to convert stirred reactors into Robinson-Mahoney catalytic reactors. Product information can be downloaded after registering your name on the Parker Autoclave Engineers web site: <http://www.autoclaveengineers.com> to reach the main page of Parker Autoclave Engineers reactor products. Request assembly drawings of the product(s) of interest to get more technical detail.

See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Micro-Catalytic Reactor Ordering Guide

The following reactor assemblies INCLUDE motor, thermocouples and electrically heated furnace (for the voltage specified in the table). Be advised, motor controls, tachometer display, furnace controls and the display for the thermocouple are purchased as separate items. See the "Instrumentation" section of the Parker Autoclave Engineers Catalog for process instruments and controls.

Catalog Number	Description SS = ANSI 316 Stainless Steel HC = Hastelloy® C-276	Motor	Power Source	Temp. Rating	Weight lb.
CR0005HC05ZH16A	Micro Reactor 50cc HC	Air	120V	650°F (343°C)	47
CR0005HC05ZH16D	Micro Reactor 50cc HC	DC	120V	650°F (343°C)	62
CRHT05HC05ZH16D	Micro Reactor 50cc HC	DC	120V	1000°F (536°C)	62
CR0005HC05ZH26A	Micro Reactor 50cc HC	Air	240V	650°F (343°C)	47
CR0005HC05ZH26D	Micro Reactor 50cc HC	DC	240V	650°F (343°C)	62
CRHT05HC05ZH26D	Micro Reactor 50cc HC	DC	240V	1000°F (536°C)	62
CRA5HC05ZH16A	Micro Robinson 50cc HC	Air	120V	650°F (343°C)	47
CRA5HC05ZH16D	Micro Robinson 50cc HC	DC	120V	650°F (343°C)	62
CRAHT5HC05ZH16D	Micro Robinson 50cc HC	DC	120V	1000°F (536°C)	62
CRA5HC05ZH26A	Micro Robinson 50cc HC	Air	240V	650°F (343°C)	47
CRA5HC05ZH26D	Micro Robinson 50cc HC	DC	240V	650°F (343°C)	62
CRAHT5HC05ZH26D	Micro Robinson 50cc HC	DC	240V	1000°F (536°C)	62
CRB2HC05ZH16A	Micro Berty Reactor 12cc HC	Air	120V	650°F (343°C)	47
CRB2HC05ZH16D	Micro Berty Reactor 12cc HC	DC	120V	650°F (343°C)	62
CRBHT2HC05ZH16D	Micro Berty Reactor 12cc HC	DC	120V	1000°F (536°C)	62
CRB2HC05ZH26A	Micro Berty Reactor 12cc HC	Air	240V	650°F (343°C)	47
CRB2HC05ZH26D	Micro Berty Reactor 12cc HC	DC	240V	650°F (343°C)	62
CRBHT2HC05ZH26D	Micro Berty Reactor 12cc HC	DC	240V	1000°F (536°C)	62

NOTES

The circulating pressure generated by the impellers in the "Micro Series" reactors is low. Parker Autoclave Engineers makes no claims about the ability to scale-up or correlate "Micro Series" catalytic reactors with any other process equipment. Product information can be downloaded after registering your name on the Parker Autoclave Engineers web site: <http://www.autoclaveengineers.com> to reach the main page of Parker Autoclave Engineers reactor products. Request assembly drawings of the product(s) of interest to get more technical detail.

See the "Ordering Guide" of this bulletin to find drawing numbers and contact your local Sales Representative or Parker Autoclave Engineers directly to obtain assembly drawings.

Catalytic Reactor Accessories:

Berty/Carberry Reactor

- Conversion Kit 3" Berty to 3" Carberry P/N US1075
- Conversion Kit 3" Carberry to 3" Berty P/N US2004
- Conversion Kit 5" Berty to 5" Carberry P/N 3100-6959

Catalytic Conversion Kits for Stirred Reactors (post 1999, see Notes)

Closure	Material	Volume	From	To	Part Number
EZE-Seal™	SS Note 1	300 cm ³	E030...	Robinson-Mahoney Stationary Basket	401A-8808
EZE-Seal™	SS Note 1	1,000 cm ³	E100...	Robinson-Mahoney Stationary Basket	401A-9100
EZE-Seal™	HC Note 1	300 cm ³	E030...	Robinson-Mahoney Stationary Basket	402A-8808
EZE-Seal™	HC Note 2	1,000 cm ³	E100...	Robinson-Mahoney Stationary Basket	402A-9100

Common Customizations:

Conversion kits to convert Bolted Closure Reactors to Robinson-Mahoney Catalytic Reactors

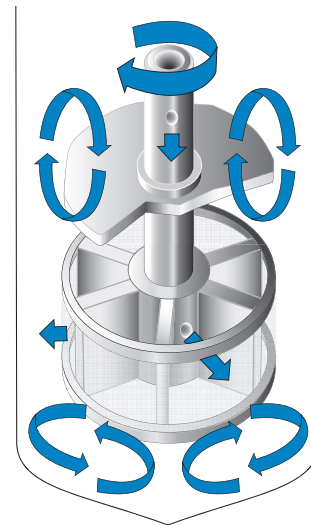
- NOTES:
- 1) Stainless Steel alloy ANSI 316
 - 2) Nickel alloy HASTELLOY® C-276
 - 3) Contact the factory for other conversion kits
 - 4) Contact the factory for OLD (Pre-1999) conversion kits

Dispersimax™ GLS and GGS Catalyst Basket Impellers

Parker Autoclave Engineers has two catalyst baskets available for their Mini-Reactors, the Dispersimax™-GLS and GGS.

The spinning Dispersimax™ catalyst basket impeller is designed for gas/liquid/solid (GLS) phases where the catalyst cannot be suspended or the researcher wants the catalyst in a basket. If the process is gas/gas/solid (GGS) work, then use the GGS basket impeller attached to a solid shaft with no Dispersimax™ features.

The Dispersimax™-GLS spinning catalyst basket impeller, apart from being a catalyst basket, works exactly as a standard Dispersimax™, allowing gas to be drawn down the hollow shaft and to promote a positive flow through the hole in the impeller for dispersion. This will allow the catalyst contained to have a positive flow of gas over it, or entrained. It also offers the effect of re-circulating the gas again down the shaft. This spinning basket developed for the Mini-reactor, has a mesh size as small as 8 micron and a volume between 1-1.5 ml. However, Parker Autoclave Engineers can custom design this to make it available for any reactor that uses a Dispersimax™ impeller. This feature allows the researcher to screw a new basket into the MagneDrive® shaft to replace the existing impeller, very easy and attractive option for any research where a catalyst cannot be suspended or is too fine.

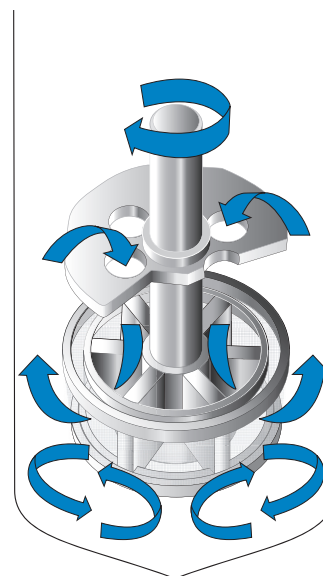


Dispersimax™
Gas/Liquid/Solid (GLS)

The Gas/Gas/Solid (GGS) spinning catalyst basket impeller is designed only for single phase applications or gases, is to be used with a solid shaft, and screws directly onto the MagneDrive® shank. The profile of the basket has a small annulus or space between the mesh of 1-2 mm from either 8 micron up to 20 micron or larger mesh sizes. The cover has holes which allow the gases to be drawn into the basket area and force a positive flow over the catalyst area suspended within the annulus. This effective motion realizes activation of the gases by the catalyst and any gas is re-drawn and entrained due to the flow path and features of the basket impeller.

Parker Autoclave Engineers has been at the forefront of development of reactors and products to support the development of new catalyst and processes through tried and tested systems, catalyst baskets and other associated equipment and approaches to support the researcher's needs.

For more information, please contact Parker Autoclave Engineers on the web at www.AutoclaveEngineers.com or by phone at 814 860-5700.



Gas/Gas/Solid (GGS)

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- **Dr. J.J. Carberry**
- **Dr. J.A. Mahoney**
- **Dr. K.K. Robinson**

Parker Autoclave Engineers makes Customized tools for research.

Automated Reactor Systems: Automating inputs and controls is a proven method to eliminate experimental process variation. Automatic data logging can reduce man-hours needed for long-duration experiments.

In Situ Analytical Instrumentation: Parker Autoclave Engineers will install any commercially available sensor probe in the reactor vessel (that is rated for the appropriate pressure and temperature) to provide data under actual reaction conditions.

High Throughput Catalyst Screening (Combinatorial Methodology Applied to Catalysts): Multiple, automated reactor systems, operating in parallel, can accelerate experimental material development by concurrent sample preparation/evaluation of multiple candidates.

Sample Handling/Evacuation/Separation/Condensation/Filtering/Purification/Scrubbers/Incinerators/Special Cleaning/Purging Features: Select commercially available process control elements you need to control chemical interference in the experiment. Parker Autoclave Engineers will integrate the process equipment into complete system to eliminate the source of the interference by process control.

Safety Systems: Sensors, controls and interlocks can be designed to minimize the risks of equipment damage and personal injury as well as permit unattended operation.

Other: Parker Autoclave Engineers has solved many high pressure/high temperature process problems since 1945. It is likely that a variation of your problem has been solved at least once in those years. Parker Autoclave Engineers invites direct inquiries about special equipment needs.

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