Coflore® ACR Agitated Cell Reactor



Laboratory-Scale Flow Reactor



Company Overview

Founded in 2000, AM Technology is a chemical engineering company based in Cheshire, England that designs and manufactures the Coflore® range of actively-mixed continuous flow reactors for the chemical manufacturing industry.

Whether for laboratory, pilot or industrial scale chemical production, our range of flow reactors offer a unique scope of capabilities suited towards a wide range of processes, with wide-ranging reaction times and reaction mixture types. We also offer development services in our well-equipped laboratories to carry out feasibility and scale-up studies on client-specific chemical processes.

The Coflore® flow reactor range: the **Realistic Alternative** to Batch Chemical Manufacturing

Versatile. Productive. Efficient.







Certificate No: 12073 ISO 9001: 2015





Introduction

Coflore® flow reactors are designed for flexibility & scalability, for processes with reaction times ranging from seconds to many hours. The unique method of active mixing enables the processing of a wide and versatile range of reaction mixtures, including liquids, gases and slurries.



The **Coflore**® **ACR** is an actively-mixed ten-stage system for efficient mixing and a high degree of orderly flow, irrespective of residence time. The **Coflore**® **ACR** is a low volume reactor which delivers comparable performance to the larger **Coflore**® **ATR** and **RTR** reactors.



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Coflore® ACR System

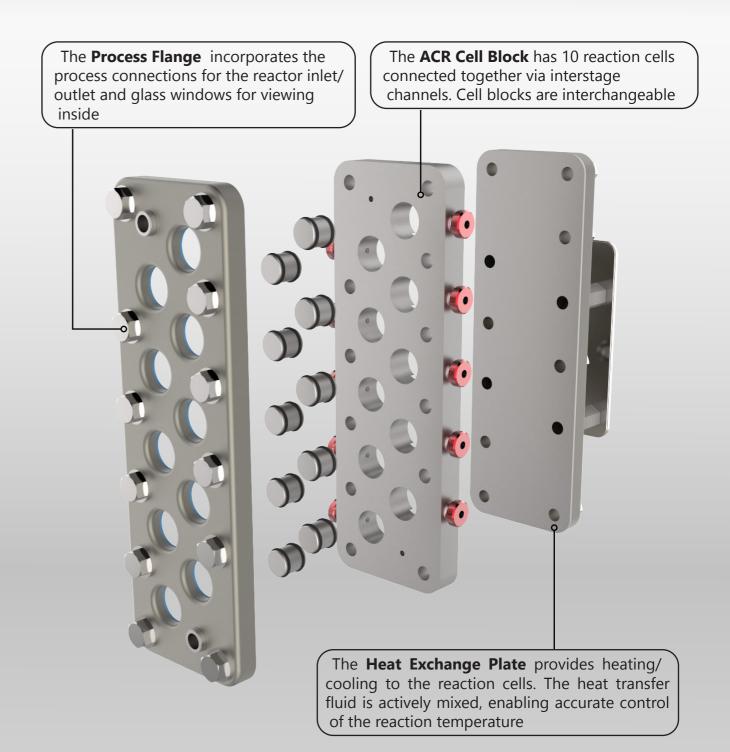
The Coflore® ACR system consists of an **Agitating Platform** and **Reactor Block Assembly**.



The **ACR Reactor Block Assembly** contains 10 reaction cells providing excellent plug flow. It can be fully dismantled for reconfiguration or cleaning. Sample points, addition points and temperature measurement can be added to any of the 10 reaction cells.

Coflore® ACR Reactor Block Assembly

The reactor block assembly consists of a **Process Flange, ACR Cell Block** and **Heat Exchange Plate**.



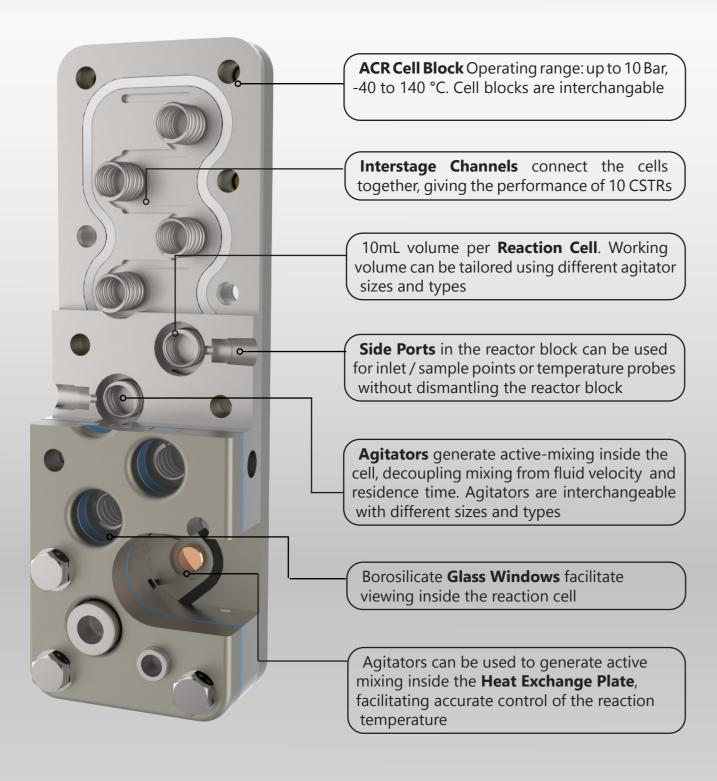


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Coflore® ACR Reactor Block Assembly

The reactor block assembly consists of ten **Reaction Cells** connected via an **Interstage Channel**.



Coflore® ACR Inlet/Outlet Connectors

Various **Inlet/Outlet Connectors** are used to introduce and remove material to/from the **Reactor Block**, and to measure temperature within a **Reaction Cell**.





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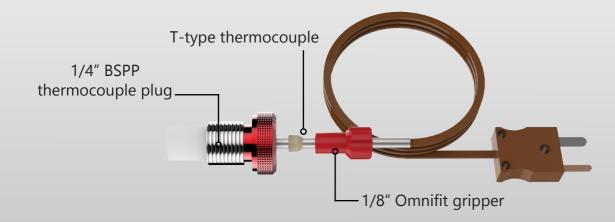
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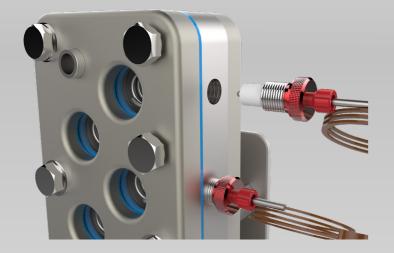
Coflore® ACR Temperature Measurement

Temperature in the ACR is measured with a **T-Type Thermocouple** through the **Reactor Block** side port.



The thermocouple is held in place with the thermocouple plug which seals on the bottom of the side port for zero dead space. The tip of the thermocouple is tangent with the wall of the cell, providing accurate temperature measurement without affecting agitator travel





Temperature can be measured in selected cells by using the thermocouple plugs where required. Temperature probes can be replaced with injection or blank plugs as required without dismantling the reactor block assembly

Coflore® ACR Agitators

Different agitators can be used to suit different types of chemistry; **Variable Volume, High Shear** and **Catalyst Basket. Agitator Sizes** determine overall reactor volume of between 30mL to 100mL.



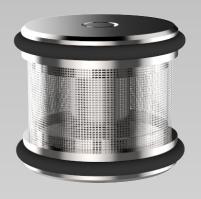
Variable Volume agitators are available in 3 sizes of 30%, 50%, and 70%. These are selected according to the working volume required in the reaction cell. Available in: **Hastelloy** and **Ceramic**





High Shear agitators are used for processes that require intense shear mixing. Applications include gas/liquid, solid/liquid, liquid/liquid, and gas/liquid/solid. Available in: **Hastelloy**

Catalyst Basket Agitators are designed specifically for solid catalysed reactions. Catalyst particle sizes of between 0.4mm and 2mm can be loaded into the enclosed basket and recovered at the end of the process. Available in: **Hastelloy**





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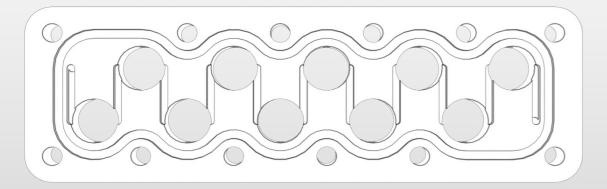


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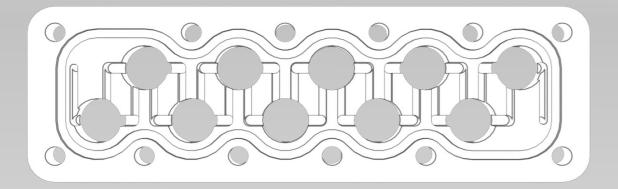
Coflore® ACR Cell Block

The Coflore® ACR **Cell Block** is available in two designs: **Reactor Cell Block** and **Extractor Cell Block**.

The **ACR Reactor Cell Block** is the standard cell block used in the ACR. It has a low pressure drop and can handle reaction times from seconds to many hours. It is suitable for use with a wide range of reaction mixtures, including slurries, gas/liquid mixtures and immiscible fluids. Available in **Hastelloy** and **PTFE**



The **ACX Extractor Cell Block** is used for developing counter-current extractions or reactions. It can handle multiphase materials flowing in opposite directions. The ACX extractor cell block can replace the ACR reactor cell block to provide added flexibility to the ACR. Continuous counter-current extractors give higher extraction efficiency with lower solvent usage. Available in **PTFE**



Coflore® ACR Agitating Platform

The ACR agitating platform is mounted on an anti-vibration table. The agitating platform is available with either **Analogue** or **Digital Control**.





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Coflore® Analogue ACR Control

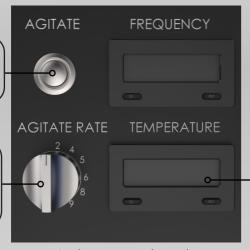
Analogue ACR Control incorporates the standard controls for operating the platform.



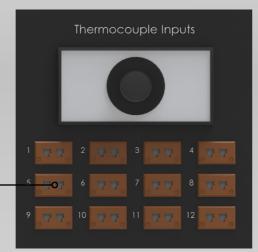
Temperature Display with up to 12 thermocouple inputs and one temperature display. Select display temperature with selector switch



Select **Agitatation Rate** from 6 agitation frequencies with dial (2,4,5,6,8,9 Hz)



Analogue control panel



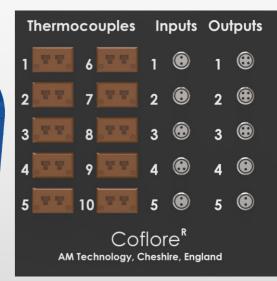
Analogue input/output panel

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Coflore® Digital ACR Control

Digital ACR Control has a 5.5" interactive touchscreen for controlling the platform and peripherals.





Digital input/output panel

Digital Control Features include:

- **Temperature Display** with up to 10 thermocouple inputs and 10 temperature displays
- **Programmable Alarm** for high and low temperature set points
- Ethernet Connection enabling remote control via PC
- **Start/Stop Agitation** with 8 agitation frequencies: 2,3,4,5,6,7,8,9 Hz
- Remote DCS/PLC Interface for remote agitation control with local and remote emergency stop
- **Pump Control** for up to 3 pumps via a 4 20 mA signal to include: start/stop, set point 0 100%, pump flow rate totaliser & automatic pump control
- **Actuated Valve Control** for up to 2 actuated valves to include: open / close time & flow rate totaliser
- 4 20 mA Input Monitoring for up to 4 input signals measuring 4 20 mA from 0 -100%
- Data Logging for process monitoring & data export to MS Excel
- ATEX certification and CFR21 compliance options available on request



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Coflore® ACR Catalogue

A Coflore® ACR system consists of an Agitating Platform, Reactor Block Assembly, Agitators and Accessories.





Coflore® ACR System Package ACR-131

Consists of an Analogue Agitating Platform, Reactor Block Assembly, Agitators and Accessories.



Analogue ACR Agitating Platform (ACR-P100)



Hastelloy Reactor Block Assembly (ACR-100-Ha)



10 x 50% Volume Agitators (ACR-50%-Ha)



10 x High Shear Agitators (ACR-HS-Ha)



10 x Blank Plug (ACR-PLUG-B)



3 x Injection Plug 1 (ACR-PLUG-INJ) A



10 x Temperature Probe 2 x 1/4-28 UNF Adaptor Assembly (ACR-TP-Ha) (ACR-1-4-28-P)



1 x Insulation Jacket (ACR-INS)



1 x Toolkit (ACR-Tool Kit)



Reactor Block Assembly Seal Kit, includes: 4 sets of gaskets & O-rings (ACR-Seal Kit)



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Coflore® ACR System Package ACR-231

Consists of a Digital Agitating Platform, Reactor Block Assembly, Agitators and Accessories.

Coflore® ACR Agitating Platforms

Available as **Analogue** or **Digital** versions. **ATEX** and **CFR21** compliance available on request.



Digital ACR Agitating Platform (ACR-P200)



Hastelloy Reactor Block Assembly (ACR-100-Ha)



10 x 50% Volume Agitators (ACR-50%-Ha)



10 x High Shear Agitators (ACR-HS-Ha)



10 x Blank Plug (ACR-PLUG-B)



3 x Injection Plug (ACR-PLUG-INJ)



Assembly (ACR-TP-Ha)



10 x Temperature Probe 2 x 1/4-28 UNF Adaptor (ACR-1-4-28-P)



1 x Insulation Jacket (ACR-INS)



1 x Toolkit (ACR-Tool Kit)



Reactor Block Assembly Seal Kit, includes: 4 sets of gaskets & O-rings (ACR-Seal Kit)



Analogue Agitating Platform (ACR-P100)

Controls:

Agitation: Start/stop

Agitate rate selection: 2,4,5,6,8,9

Inputs: 12 thermocouple inputs, one temperature

display

Power Requirements: 110-240 VAC 2A

Compressed air: 3 Bar (g), 3.2 CFM oil-free clean air **Connections:** Heat Transfer Fluid inlet/outlet: M16x1.0; Compressed Air: 6mm push-fit; Power: IEC Socket

connector

Components Include: ACR Agitating Platform with analogue control, anti-vibration table, power lead



Digital Agitating Platform (ACR-P200)

Controls:

Agitation: Start/stop

Agitate rate selection: 2,3,4,5,6,7,8,9

Inputs: 10 thermocouple inputs, 10 temperature displays **Input/output controls:** 3 x pump control output, 2 x actuated valve control output, 4 x 4-20 mA input 0-100%, 1 x digital input, programmable alarm, data logging to MS Excel, export data to MS Excel via USB, remote control via ethernet

Power Requirements: 110-240 VAC 2A

Compressed air: 3 Bar (g), 3.2 CFM oil-free clean air **Connections:** Heat Transfer Fluid inlet/outlet: M16x1.0; Compressed Air: 6mm push-fit; Power: IEC Socket connector

Components Include: ACR Agitating Platform with

digital control, anti-vibration table, power lead



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Coflore® ACR Reactor Blocks

Coflore® ACR Reactor & Cell Blocks



Reactor Block Assembly: Hastelloy (ACR-100-Ha)

Operating Range: Up to 10 Bar; -40 to 140 °C

Wetted Material: Cell block: Hastelloy C276; Gasket: PTFE; O-ring: FFKM; Glass window: borosilicate Glass; Heat exchange plate: Hastelloy C276

Dimensions: 300mm H x 100mm W x 55mm D;

Mass: 9 Kg; Cell diameter: 25mm; Interstage channel: 4mm x 4mm x

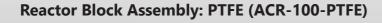
30mm

Capacity: 100mL Nominal

Connections: Inlet/outlet: 1/8" BSPP female; Side port: 1/4" BSPP

female

Components Include: 1 x process flange, 1 x reactor cell block: Hastelloy, 1 x HTF flange, 1 x mounting plate, 10 x glass window, 10 x window gasket, 1 x process gasket, 2 x process connection gasket, 2 x process connection, 10 x 1/4" BSP blank plug, 1 x process O-ring, 1 x HTF O-ring, 10 x HTF agitator



Operating Range: Up to 4 Bar; -40 to 140 °C

Wetted Material: Cell block: PTFE 25% GF; Gasket: PTFE; O-ring: FFKM; Glass window: borosilicate Glass; Heat exchange plate: Hastelloy C276

Dimensions: 300mm H x 100mm W x 55mm D;

Mass: 4 Kg; Cell diameter: 25mm; Interstage channel: 4mm x 4mm x

30mm

Capacity: 100mL Nominal

Connections: Inlet/outlet: 1/8" BSPP female; Side port: 1/4" BSPP

female

Components Include: 1 x process flange, 1 x reactor cell block: PTFE, 1 x HTF flange, 1 x mounting plate, 10 x glass window, 10 x window gasket, 1 x process gasket, 2 x process connection gasket, 2 x process connection, $10 \times \frac{1}{4}$ " BSP blank plug, 1 x process O-ring, 1 x HTF

O-ring, 10 x HTF agitator



Reactor Block Assembly: Extractor (ACR-100-ACX)

Operating Range: Up to 4 Bar; -40 to 140 °C

Wetted Material: Cell block: PTFE 25% GF; Gasket: PTFE; O-ring: FFKM; Glass window: borosilicate Glass; Heat exchange plate:

Hastelloy C276

Dimensions: 300mm H x 100mm W x 55mm D;

Mass: 4 Kg; Cell diameter: 25mm; Interstage channel: 4mm x 4mm x

30mm; 6mm x 15mm x 30mm **Capacity:** 100mL Nominal

Connections: Inlet/outlet: 1/8" BSPP female; Side port: 1/4" BSPP

female

Components Include: 1 x process flange, 1 x reactor cell block: ACX, 1 x HTF flange, 1 x mounting plate, 10 x glass window, 10 x window gasket, 1 x process gasket, 2 x process connection gasket, 2 x process connection, 10 x 1/4" BSP blank plug, 1 x process O-ring, 1 x HTF

O-ring, 10 x HTF agitator



Reactor Cell Block: Hastelloy (ACR-RB-Ha)

Material: Hastelloy C276

Dimensions: 300mm H x 100mm W x 20mm D; Cell diameter:

25mm; Interstage channel: 4mm x 4mm x 30mm **Connections:** Side port: 1/4" BSPP female



Reactor Cell Block: PTFE (ACR-RB-PTFE)

Material: PTFE 25% GF

Dimensions: 300mm H x 100mm W x 20mm D; Cell diameter:

25mm; Interstage channel: 4mm x 4mm x 30mm **Connections:** Side port: 1/4" BSPP female



Extractor Cell Block: PTFE (ACR-RB-ACX)

Material: PTFE 25% GF

Dimensions: 300mm H x 100mm W x 20mm D; Cell diameter: 25mm; Interstage channel: 4mm x 4mm x 30mm; 6mm x 15mm

x 30mm

Connections: Side port: 1/4" BSPP female



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Coflore® ACR Agitators

Different agitators can be used to suit different types of chemistry; **Variable Volume, High Shear** and **Catalyst Basket. Agitator Sizes** determine overall reactor volume of between 30mL to 100mL.



Variable Volume Agitators: Hastelloy (ACR-70%-Ha; ACR-50%-Ha; ACR-30%-Ha)

Material: Body: Hastelloy C276; O-ring: FFKM

70% Volume agitator: Occupies 70% cell volume (7mL approx.), diameter: 22mm; **50% Volume agitator:** Occupies 50% cell volume (5mL approx.), diameter: 18.6mm; **30% Volume agitator:** Occupies 30% cell volume (3mL approx.), diameter: 14.5mm



Variable Volume Agitators: Ceramic (ACR-70%-C; ACR-50%-C; ACR-30%-C)

Material: Body: Technox 2000; O-ring: FFKM

70% Volume agitator: Occupies 70% cell volume (7mL approx.), diameter: 22mm; **50% Volume agitator:** Occupies 50% cell volume (5mL approx.), diameter: 18.6mm; **30% Volume agitator:** Occupies 30% cell volume (3mL approx.),

diameter: 14.5mm



Catalyst Basket Agitator: Hastelloy (ACR-CB-Ha)

Material: Body: Hastelloy C276; O-ring: FFKM

Diameter: 18mm



High Shear Agitator: Hastelloy (ACR-HS-Ha)

Material: Body: Hastelloy C276; End sleeve: PTFE

Diameter: 19mm, occupies 10% cell volume (1mL approx.)



Accessories are available to meet your process requirements.



1/4" BSP Injection Plug (ACR-PLUG-INJ)

For use with 4mm triclover adaptor. Adapts from $\frac{1}{4}$ " BSP to $\frac{1}{4}$ -28 UNF

Operating pressure range: up to 10 Bar Material: PTFE, 316 Stainless Steel (non-wetted) Connections: 1/4" BSPP male, 1/4-28 UNF female



1/4" BSP Thermocouple Plug (ACR-PLUG-TC)

For holding thermocouple in ACR side port. Adapts from 1/4" BSP to 1/4-28 UNF

Operating pressure range: up to 10 Bar Material: PTFE, 316 Stainless Steel (non-wetted) Connections: 1/4" BSPP male, 1/4-28 UNF female

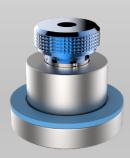


1/4" BSP Blank Plug (ACR-PLUG-B)

For blanking ACR side ports

Operating range: up to 10 Bar; -40 to 140 °C **Material:** PTFE, 316 Stainless Steel (non-wetted)

Connections: ½" BSPP male



Injection Nozzle Assembly (ACR-WIN-Ha)

Replaces glass window for extra addition point

Operating pressure range: up to 10 Bar

Wetted Material: Body: Hastelloy C276; ¼" BSP injection plug seal: PTFE; Window gasket: PTFE Connections: Injection nozzle body: ¼" BSP female; ¼" BSP injection plug: 1/4" BSPP male, ¼-28 UNF

female

Components Include: 1 x injection nozzle body, 1 x ½" BSP injection plug, 1 x window gasket



Glass Window (ACR-GW)

Window assembly for ACR Reactor Block Assembly

Material: Borosilicate Glass **Dimensions:** 34mm OD x 6.5mm



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Coflore® ACR Accessories

Accessories are available to meet your process requirements.



Temperature Probe Assembly: Hastelloy (ACR-TP-Ha)

T-Type thermocouple, measures process temperature at cell

wall

Probe Diameter: 1/8" OD.

Operating Range: up to 10 Bar; -40 to 140 °C

Wetted Material: Thermocouple: Hastelloy C276; Seal:

PTFE; Thermocouple gripper olive: PTFE

Connections: Thermocouple plug: 1/4" BSPP male; Thermocouple gripper: ½-28 UNF; Thermocouple: IEC miniature

C plug

Components Include: 1 x T-Type thermocouple, 1 x 1/4" BSP thermocouple plug, 1 x 1/8" omnifit gripper



1/4-28 UNF Adaptor (ACR-1/4-28-P)

For adapting ACR inlet/outlet to 1/4-28 UNF

Material: Body: PEEK; Gasket: PTFE

Connections: 1/8" BSPP male, ½-28 UNF female

Components Include: 1 x 1/4-28 UNF adaptor, 1 x 1/8" BSP

PTFE gasket, 1 x 5 mm OD PTFE gasket



Channel Restrictor (ACR-CR)

For adding restriction in ACR interstage channel

Material: PTFE

Dimensions: 3.8mm x 3.8mm x 15mm; through hole: 0.2mm, 1mm, 2mm. To be specified on order



Insulation Jacket (ACR-INS)

For insulating the reactor block assembly

Material: Insulation jacket: silicone sponge insulation;

O-rings: silicone

Dimensions: 420mm x 220mm x 5mm

Components Include: 1 x insulation jacket front, 1 x insulation jacket back, 1 x insulation jacket wrap, 1 x large

O-ring, 3 x small O-ring



ACR tool kit (ACR-Tools)

Components include: 1 x tool bag, 1 x allen key set, 1 x 17mm ratchet spanner, 2 x 13mm spanners, 2 x adjustable

spanners, 1 x pliers



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Coflore® ACR Tube Fittings

Tube fittings are used as process connections.



Soft Tubing Connector

Soft tubing connectors for use with peristaltic pump tubing and 1/4" BSP injection plug (ATR-PLUG-INJ)

Material: PTFE

Connection: 1/4 -28 UNF male

Master flex tubing size	Tubing ID (mm)	Barb size (mm)	Part number
L/S 13	0.8	1.6	P-646
L/S 14	1.6	1.6	P-646
L/S 16	3.1	3.2	P-647
L/S 25	4.8	4.8	P-648



Omnifit Tube Connectors

Omnifit tube connectors for use with PTFE tubing and ¼" BSP injection plug (ATR-PLUG-INJ)

Material: Gripper body: PEEK. Ferrule: PTFE

Connections: 1/4-28 UNF male

Tubing size (OD)	Part number
1/16"	XP-283
1/8"	XP-335



Swagelok Tube Connectors

Swagelok tube connectors for use with PTFE/Stainless Steel tubing. For use with 9.5mm triclover adaptor (ATR-BSP9.5) **Material:** Fitting: 316 Stainless Steel. Washer: Stainless Steel,

viton

Components include: Compression fitting, bonded washer

Tubing size (OD)	Part number
1/8"	SS-200-1-4RP
1/4"	SS-400-1-4RP



Coflore® ACR Gaskets & Seals

AM Technology recommends Gaskets be replaced after each use; O-rings should be inspected after each use, and replaced intermittently.

Seal Kit for ACR Reactor Block Assembly (ACR-SEAL KIT)

4 sets of gaskets & O-ring set for ACR Reactor **Block Assembly**

Material: Gaskets: PTFE; Process O-ring (ACR-OR-

FFKM): FFKM; HTF O-ring: viton

Components Include: 4 x process gasket ACR-PG, 4 x window gasket set ACR-WG, 1 x process O-ring ACR-OR-FFKM, 1 x HTF O-ring ACR-OR-



Process Gasket (ACR-PG)

Gasket for ACR Reactor Block Assembly

Material: PTFE

Dimensions: 300mm x 100mm x 1.5mm



Window Gasket Set for ACR Reactor Block Assembly

Material: PTFE

Components Include: 10 x window gasket, 2 x

process connection gasket

HTF O-Ring (ACR-OR-HTF)

O-ring for ACR Reactor Block Assembly

Material: Viton

Process O-Ring (ACR-OR-FFKM)

O-ring for ACR Reactor Block Assembly **Temperature Range:** 0 °C to 140 °C **Material**: FFKM (FDA approved)

Low Temp Process O-Ring (ACR-OR-FFKMLT)

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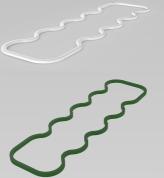
O-ring for ACR Reactor Block Assembly **Temperature Range:** -40 °C to 140 °C **Material**: FFKM (non-FDA approved)









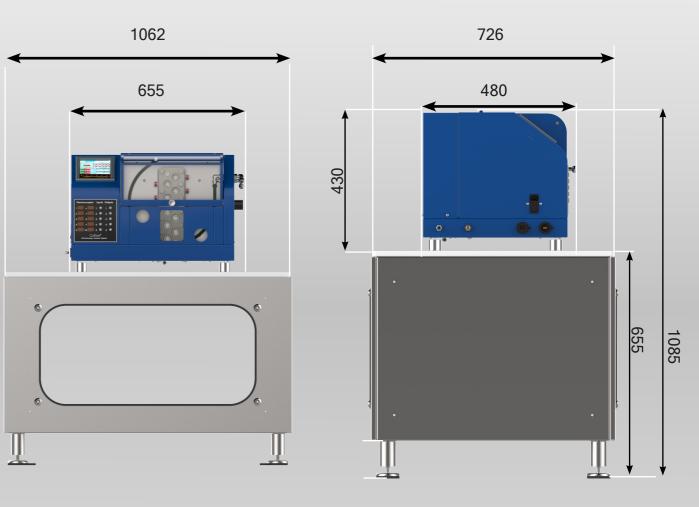


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M Technology Engineering Chemistry

Technical Details

Maximum reactor mass	9 Kg	
Agitating platform mass	130 Kg	
Noise	< 70 dBA	
Requirements;		
Compressed air	3 Bar (g), 3.2 CFM oil-free clean air	
Maximum air pressure	6 Bar (g)	
Power supply	100-240 VAC, 50/60 Hz, 2 A max	
Compressed air connection	6mm push fit	
Heat transfer fluid connections	M16 x 1.0 Huber	



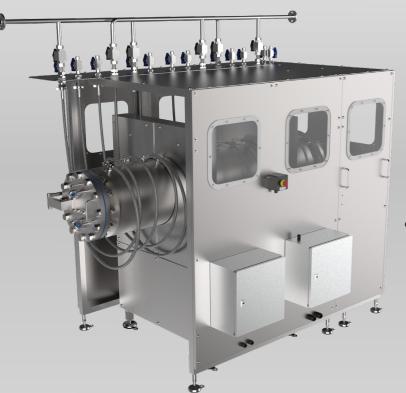
The Coflore® Flow Reactor Range

The range of Coflore® Flow Reactors consists of the Agitated Cell Reactor (ACR), Agitated Tube Reactor (ATR) and the Rotating Tube Reactor (RTR). Facilitates laboratory-scale to full industrial-scale chemical production.



The **Coflore**® **ACR** is an actively-mixed ten-stage system for efficient mixing and a high degree of orderly flow, irrespective of residence time. The **Coflore® ACR** is a low volume reactor (30mL to 100mL), which delivers comparable performance to the larger **Coflore® ATR/RTR** reactors

The **Coflore® ATR** is an actively-mixed, multi-stage, tubular reactor (0.35L to 10L reactor volume), achieving efficient mixing with a high degree of orderly flow, irrespective of residence time





The Coflore® RTR operates as a ten stage, actively-mixed continuous flow reactor with a 100L capacity that is capable of processing theoretically limitless reactor volumes without interruption

Contact AM Technology

We welcome enquiries from across the globe. If you require more information about our reactors, or to find out whether our reactors are suitable for any applications you have in mind, we would be very interested in hearing from you.

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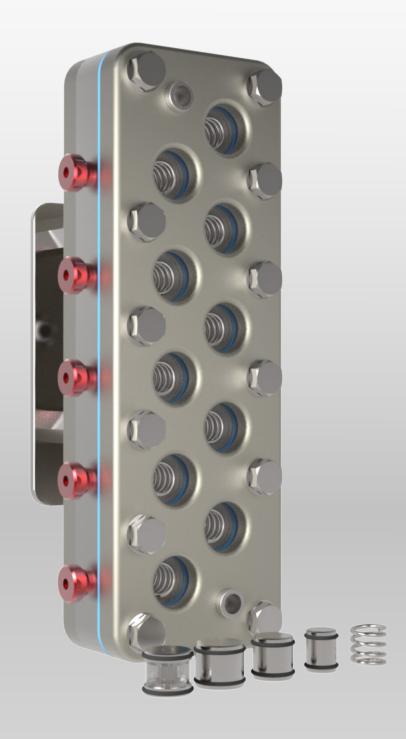
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