

Coflore[®] ATR Agitated Tube Reactor



Pilot Scale Flow Reactor



AM Technology
Engineering Chemistry

www.amt.uk

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

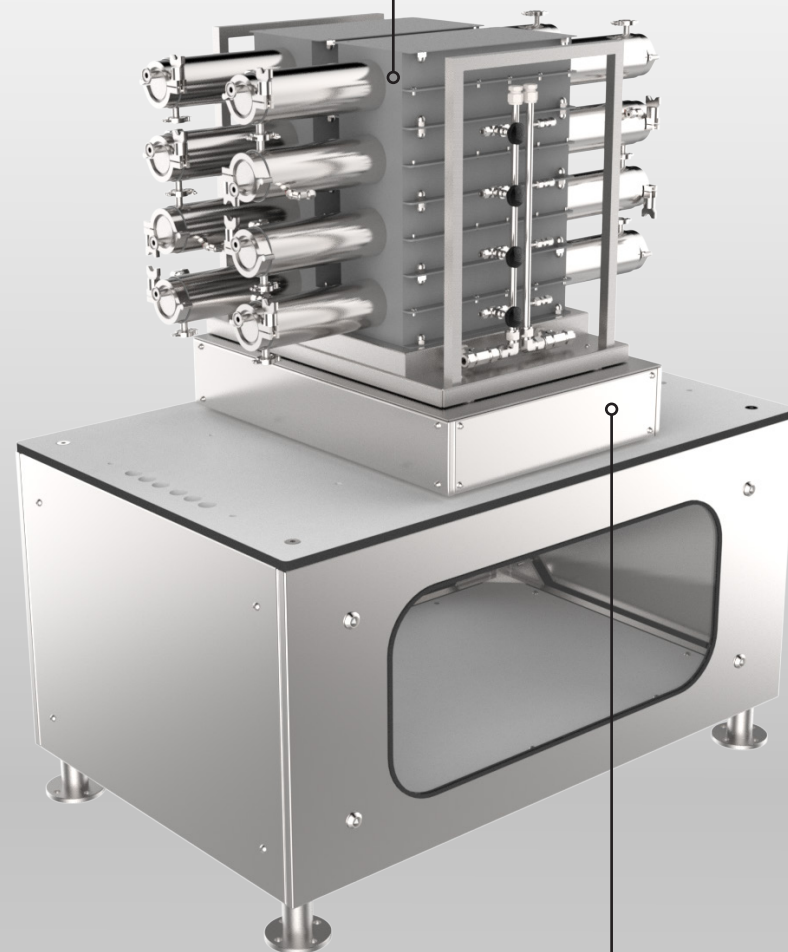


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Coflore® ATR System

The Coflore® ATR system consists of an **Agitating Platform**, **Reactor Tube Assembly** and **Acoustic Cabinet**.

ATR Reactor Tube Assembly can be configured in multiple arrangements which enables the volume of the reactor to be configured to suit the process requirements. Reactor tubes can be disassembled to allow access for cleaning and testing of all wetted surfaces



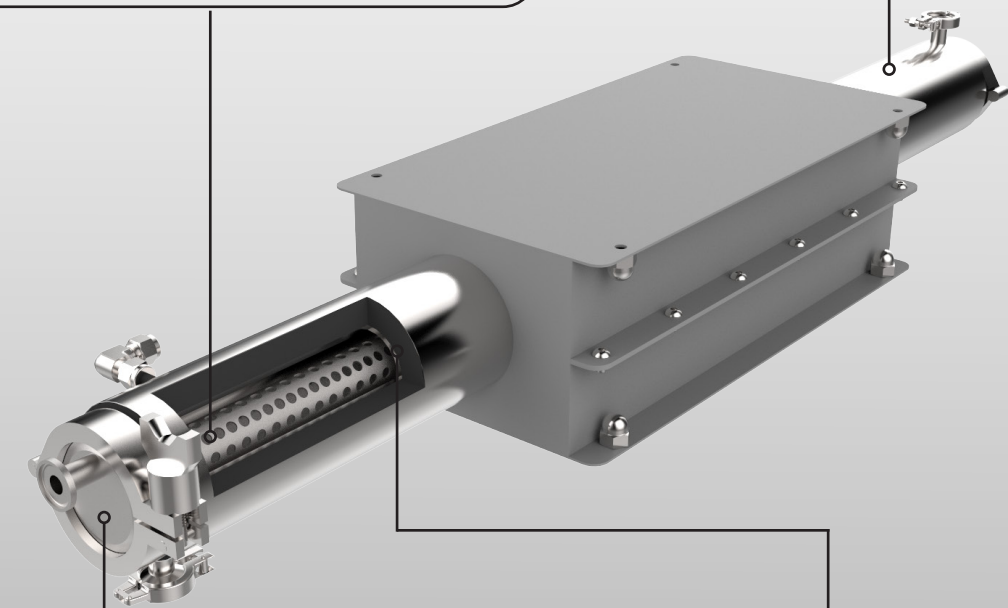
Agitating Platform provides horizontal agitation to the reactor tubes to generate mechanical mixing

Coflore® ATR Reactor Tube

The Coflore® ATR reactor tube consists of a **Reactor Tube** with **Heat Transfer Jacket**, **End Caps** and an **Agitator**.

ATR Reactor Tubes are available in two sizes 0.35L & 1.25L, these are interchangeable. Vertical reactor tube connections are used for process inlet/outlet or reactor tube interconnections

Agitators generate active mixing inside the reactor tube. Active mixing decouples mixing and plug flow from residence time. Agitators are interchangeable with different designs

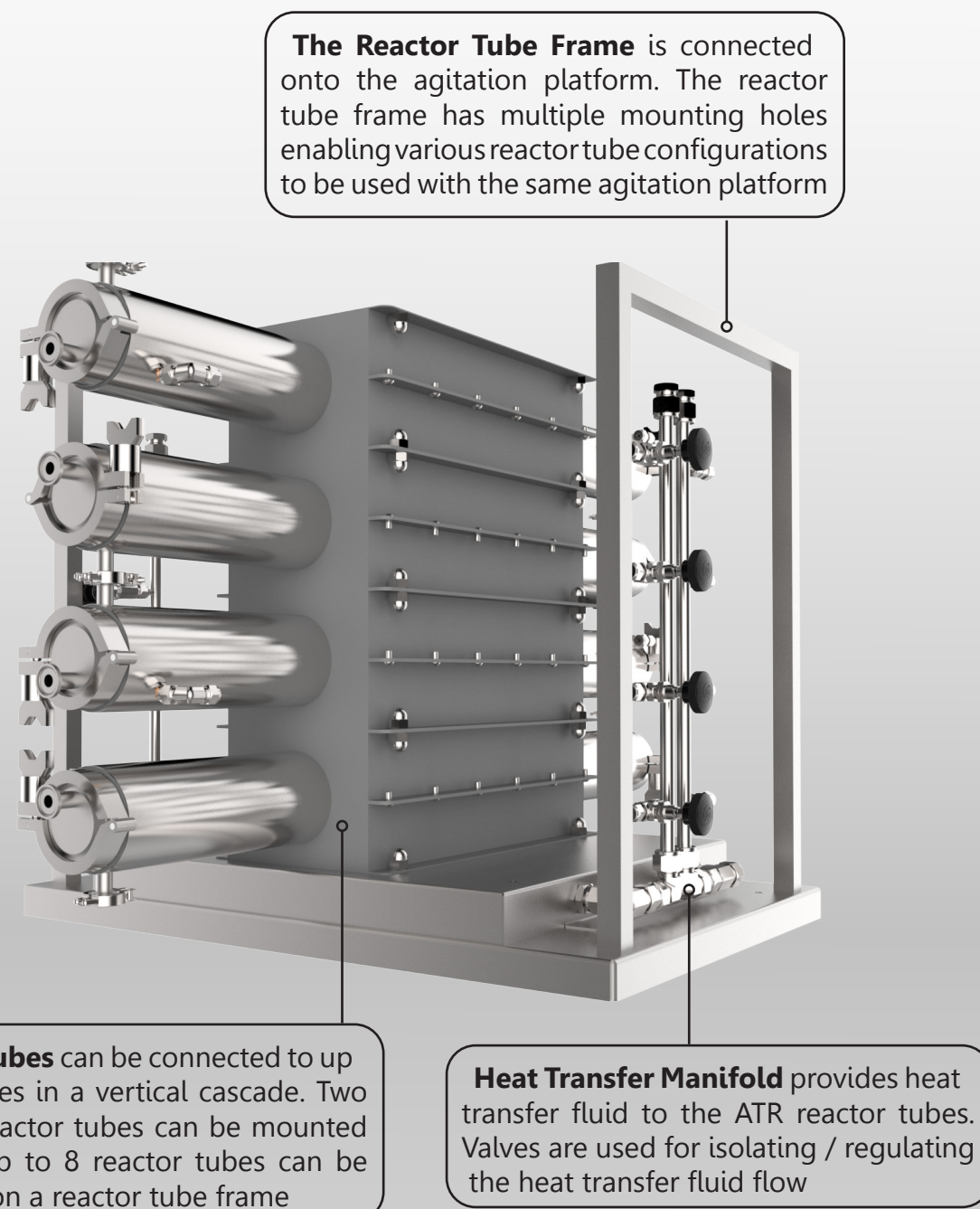


End Caps are used for connecting additional process inlets or temperature probes. They can be removed to gain access for cleaning and testing of all wetted surfaces

Heat Transfer Jacket consists of a spiral wound coil which transfers heating/cooling through the reactor tube wall. The heat transfer jackets are connected to the heat transfer manifold in either counter current or co-current configurations

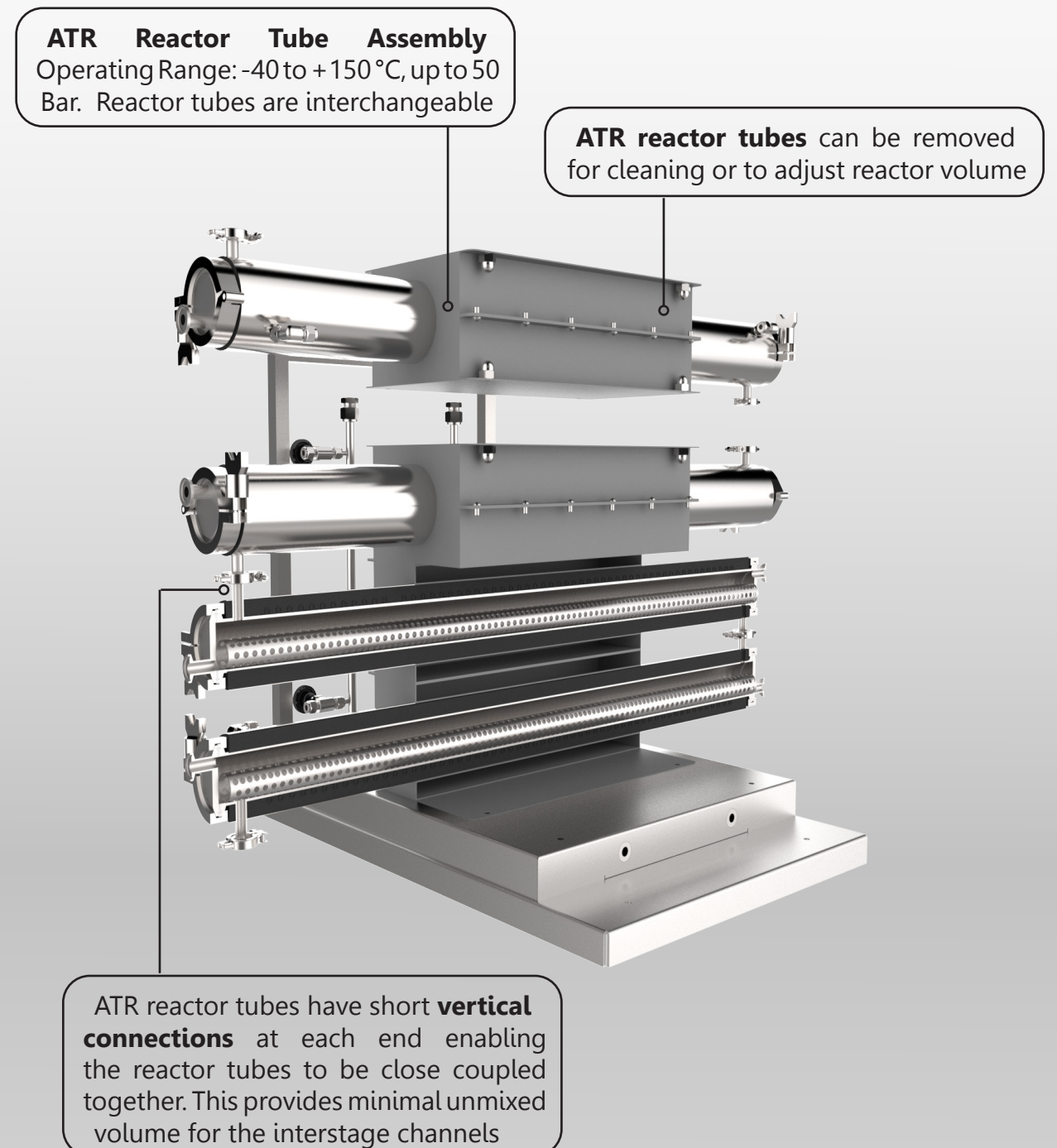
Coflore® ATR Reactor Tube Assembly

The Coflore® ATR Reactor Tube Assembly consists of a **Reactor Tube Bank** with **Heat Transfer Jacket Manifold** mounted on a reactor tube frame.



Coflore® ATR Reactor Tube Assembly

The Coflore® ATR Reactor Tube Assembly consists of a **Reactor Tube Bank** with **Heat Transfer Jacket Manifold** mounted on a reactor tube frame.



Coflore® ATR Inlet / Outlet Connectors

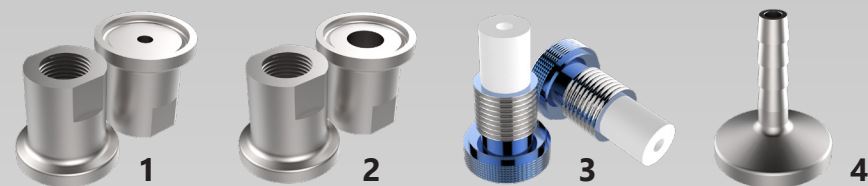
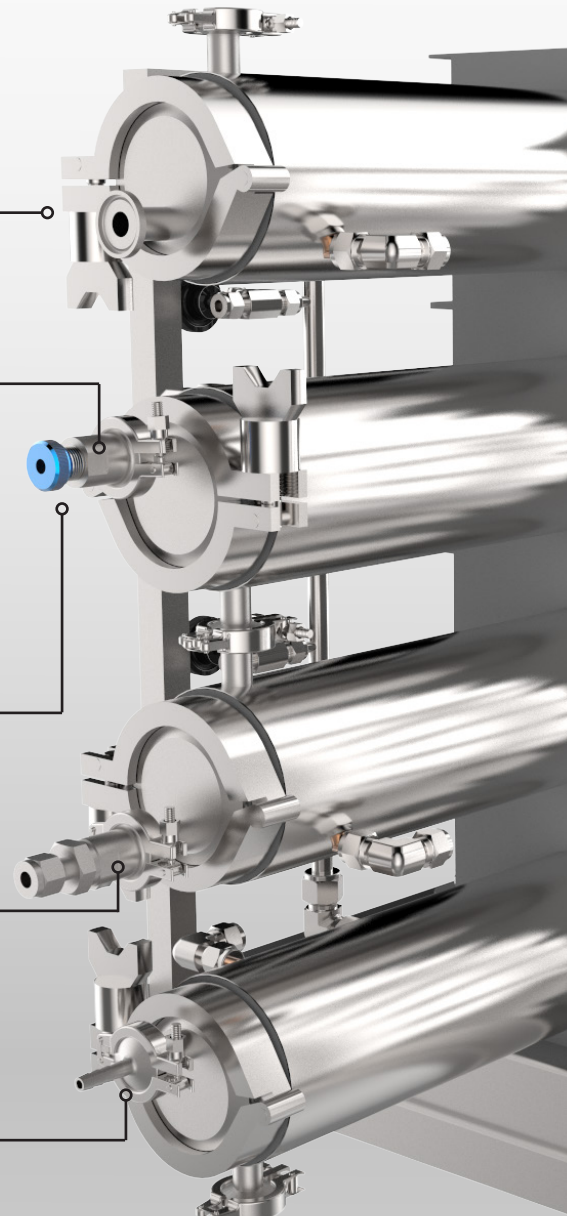
Reactor Tube End Caps have 1/2" triclover connections with a 9.5mm ID inlet. Custom design end caps with multiple connections are available on request

4mm Triclover Adaptors¹ adapt to a 1/4" BSPP with a 4mm diameter through-hole. Can be used with 1/4" BSP injection plug to maintain deadspace and adapt to a 1/4-28 UNF thread

Injection Plugs³ can be used to adapt from a 1/4" BSPP to 1/4 - 28 UNF thread

9.5mm Triclover Adaptors² adapt from a 1/2" triclover to a 1/4" BSPP with a 9.5mm through-hole

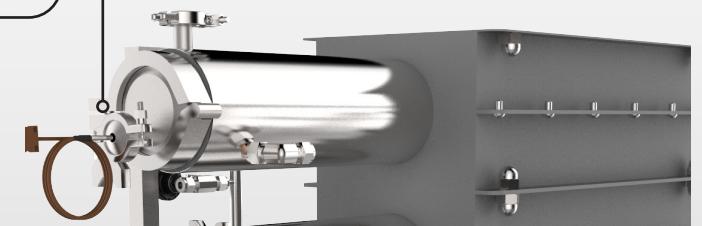
Hose Barb Adaptors⁴ adapt from a 1/2" triclover to a hose barb to suit 4.8mm ID tubing



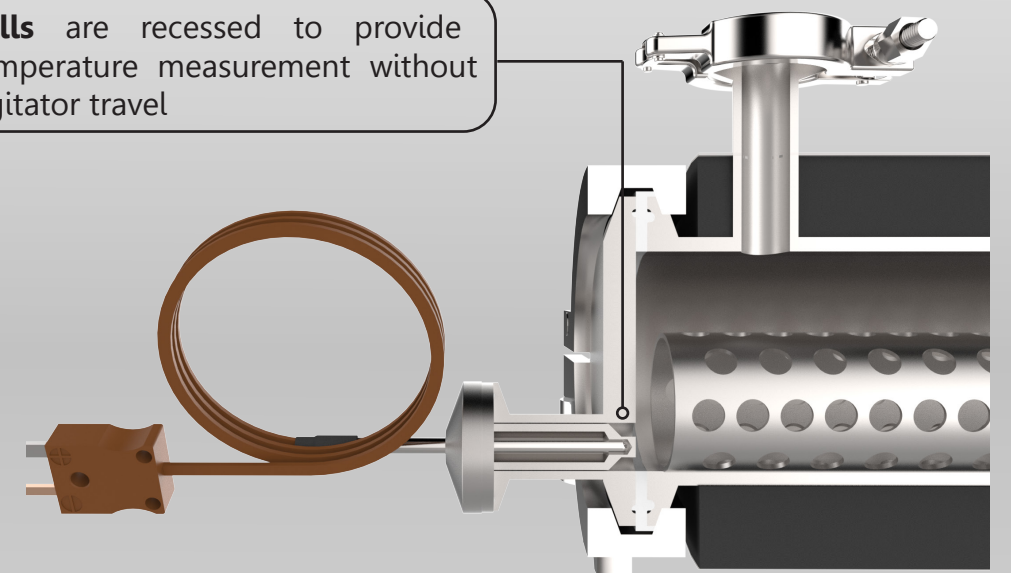
Coflore® ATR Temperature Measurement

A **Thermowell** sensor is used for temperature measurement within the ATR reactor tube. Thermowells incorporate a T-type thermocouple with miniature plug.

A **Thermowell** can be fitted to the ATR through the ATR reactor tube end cap

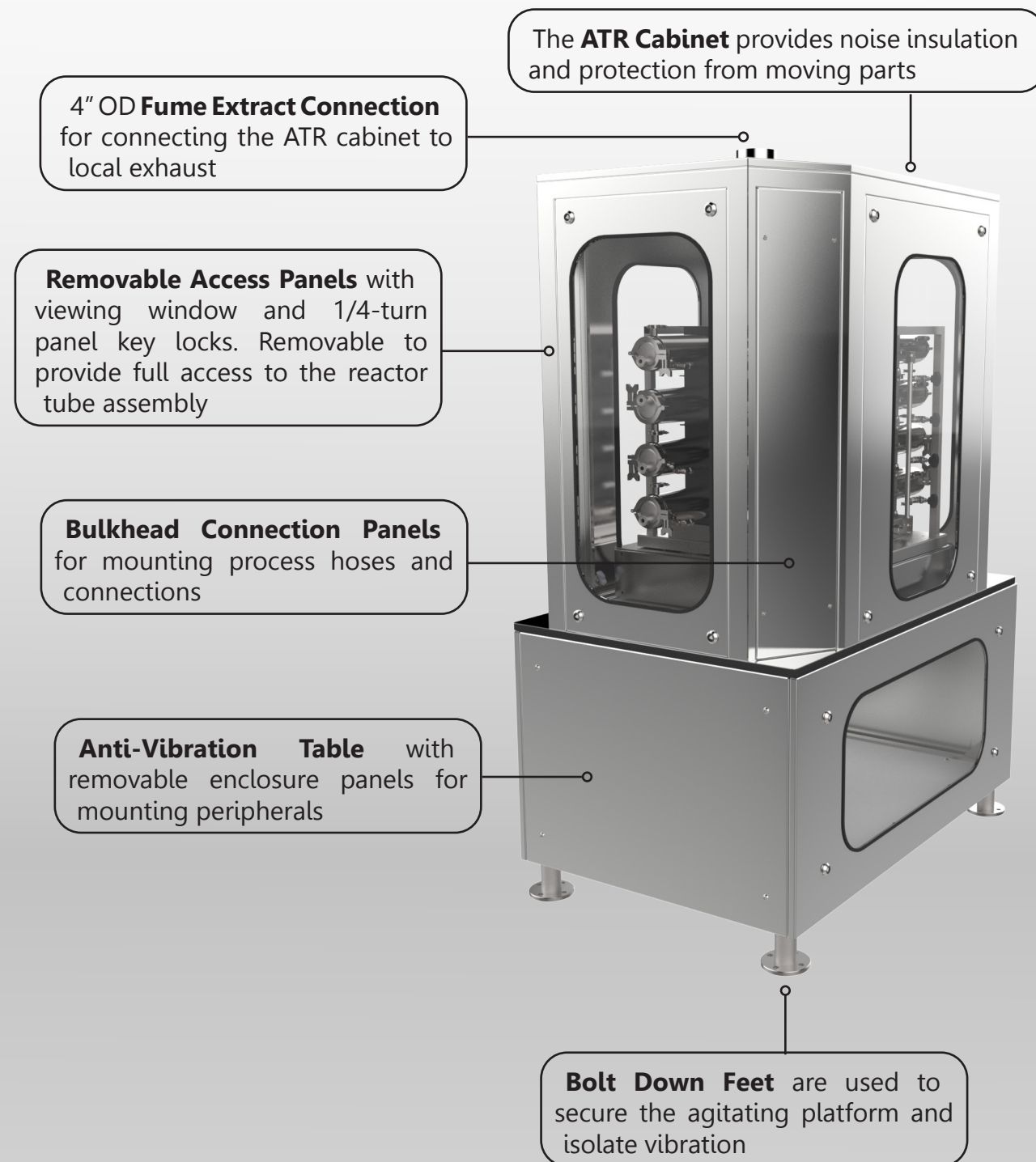


Thermowells are recessed to provide accurate temperature measurement without affecting agitator travel



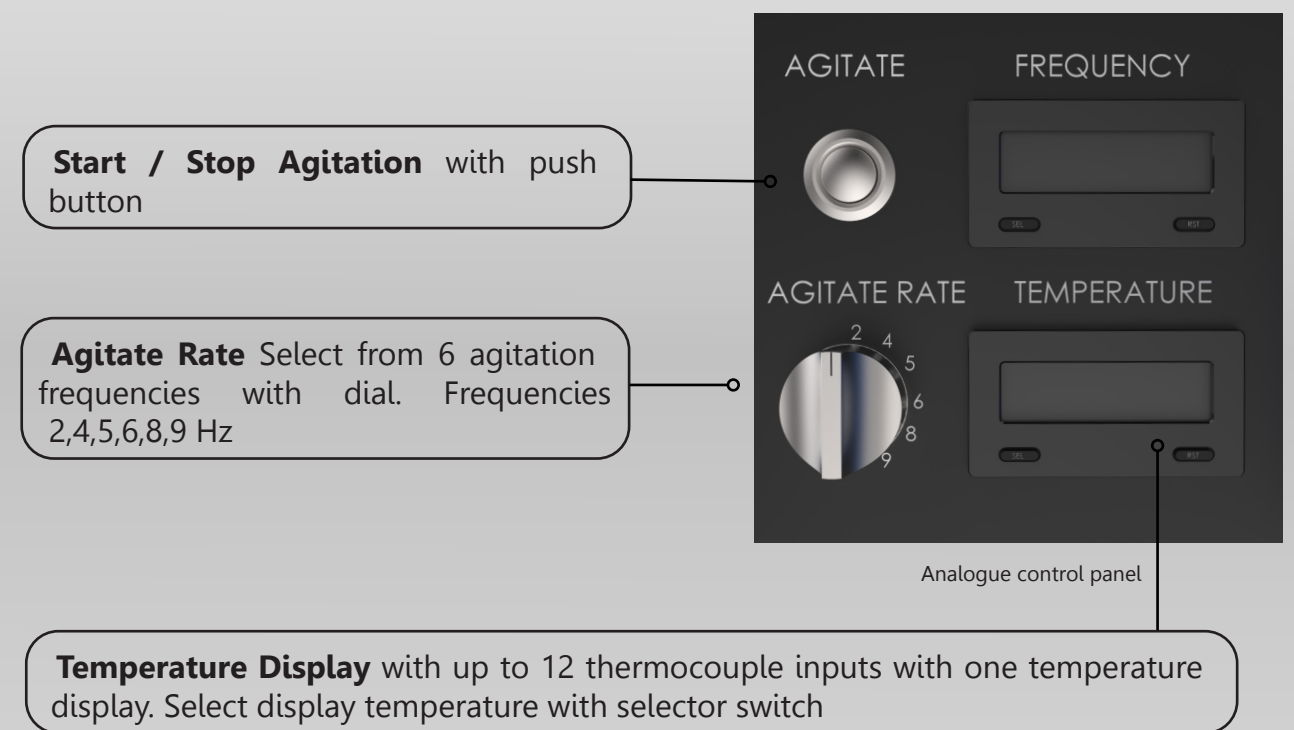
Coflore® ATR Agitating Platform

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



Coflore® Analogue ATR Control

Analogue ATR control incorporates the basic controls for operating the platform. Control of the ATR is performed via a **Local Control Panel** on the anti-vibration table.



Coflore® ATR Digital Control

Digital ATR control has a 5.5" interactive touchscreen enabling the user to control the platform and peripherals. Digital ATR control is performed via a **Remote Control Panel**.

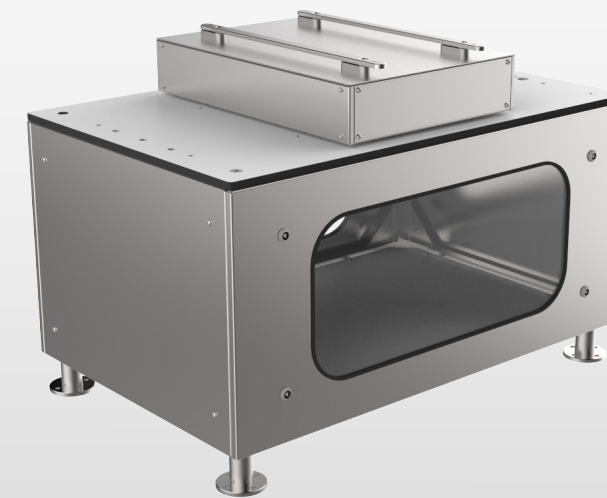


Digital Control Features include:

- **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

Coflore® ATR Catalogue

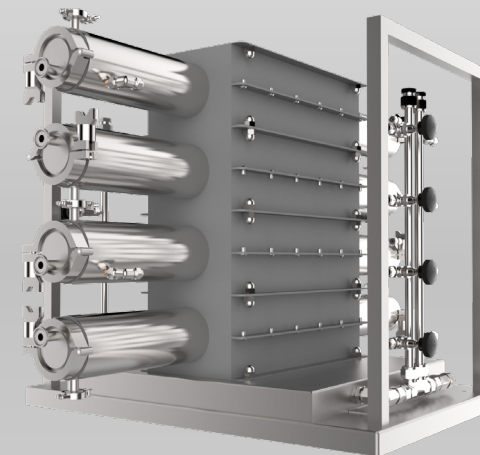
The Coflore® ATR is a modular and easily customisable platform consisting of an **Agitating Platform**, **Control System**, **Reactor Tube Assembly** and **Accessories**.



Agitating Platform



Control System



Reactor Tube Assembly



Accessories

Coflore® ATR Agitating Platforms

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



Analogue Agitating Platform (ATR-P100)

Controls:

Agitation: Start/stop

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

Temperature: 12 thermocouple input, one display

Size: 1200mm W, 780mm D, 1800mm H (with cabinet)

Material: 316 Stainless Steel

Reactor mass: 270 Kg (total assembly)

Temp. range: - 40 to 150 °C

Power: 1ph + N+E 100-240 VAC 50/60 Hz 2A
(2P + E + 16A 3 pin plug)

Compressed air: 10mm push fit connection

Air consumption: 13 CFM at 7 Bar (g), oil free clean air

Heat transfer: 1/2" swagelok tube connection.

Single zone heat transfer manifold



Digital Agitating Platform (ATR-P200 / ATR-P200-Ex)

Controls:

Agitation: Start/stop

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

Input/output controls:

10 x thermocouple input, 10 x temperature display, E-stop circuit, 3 x pump control output, 2 x actuated valve control output, 4 x 4-20 mA input 0-100%, 1 x digital input, remote DCS/PLC interface, programmable alarm, data logging, export data to MS Excel, remote control via ethernet, supplied with 5 metre cable for connecting to ATR agitation platform

Size: 1200mm W, 780mm D, 1800mm H (with cabinet)

Material: 316 Stainless Steel

Reactor mass: 270 Kg (total assembly)

Temp. range: - 40 to 150 °C

Power: 1ph + N+E 100-240 VAC 50/60 Hz 2A
(2P + E + 16A 3 pin plug)

Compressed air: 10mm push-fit connection

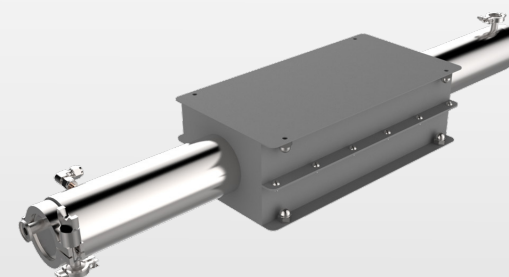
Air consumption: 13 CFM at 7 Bar (g), oil-free clean air

Heat transfer: 1/2" swagelok tube connection.

Single zone heat transfer manifold

Coflore® ATR Reactor Tubes

Available in sizes **0.35L** or **1.25L** and materials **Hastelloy C276** or **316 Stainless Steel**. Up to 8 reactor tubes per agitating platform.



0.35L Reactor Tube (ATR 0.35L-Ha / ATR 0.35L-SS)

Size: 22.2mm ID x 870mm L

Volume: 0.35L

Wetted material: Hastelloy C276 & PTFE (**ATR 0.35L-Ha**) or 316 Stainless Steel & PTFE (**ATR 0.35L-SS**)

Temp. range: - 40 to 150 °C

Pressure: Up to 50 Bar

Connections:

2 off 1/2" triclover connection per reactor tube end

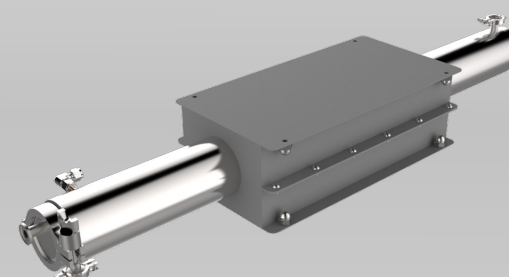
1 off connection on end cap

1 off vertical connection per end

Additional components include:

1 off perforated tube agitator Ø16mm x 865mm L

Available in Hastelloy C276 or 316 Stainless Steel



1.25L Reactor Tube (ATR 1.25L-Ha / ATR 1.25L-SS)

Size: 42.7mm ID x 870mm L

Volume: 1.25L

Wetted material: Hastelloy C276 & PTFE (**ATR 1.25L-Ha**) or 316 Stainless Steel & PTFE (**ATR 1.25L-SS**)

Temp. range: - 40 to 150 °C

Pressure: Up to 50 Bar

Connections:

2 off 1/2" triclover connection per reactor tube end

1 off connection on end cap

1 off vertical connection per end

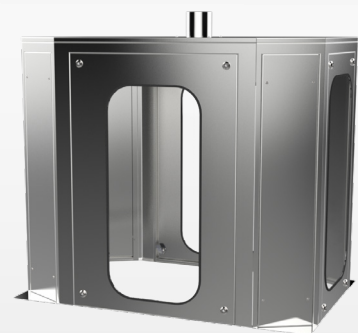
Additional components include:

1 off perforated tube agitator Ø27mm x 865 mm L

Available in Hastelloy C276 or 316 Stainless Steel

Coflore® ATR Accessories

Accessories are available to meet your process requirements.

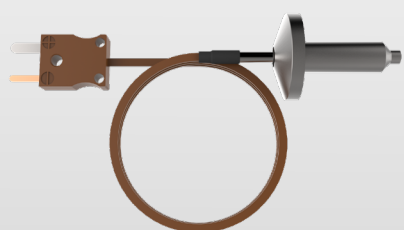


Acoustic Cabinet (ATR-Cabinet)

Provides noise insulation and protection from moving parts. With fume extract connection and removable window panels for viewing and accessing the reactor tube assembly

Size: 1200mm W, 780mm D, 1800mm H

Material: 304 Stainless Steel



Thermowell (ATR-TP-Ha / ATR-TP-SS)

T-type thermocouple calibrated from -40 to 200 °C

Connections: 1/2" triclover

Wetted material: Hastelloy C276 (ATR-TP-Ha) or 316 Stainless Steel (ATR-TP-SS)

Thermowells incorporate a T-type Thermocouple with miniature plug



Inlet / Outlet Hose (ATR-H-2000)

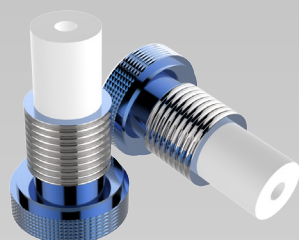
Size: 9.5mm ID x 2000mm PTFE braided hose

Operating pressure Range: up to 50 Bar

Material: 316 Stainless Steel (non-wetted) & PTFE

Connections: 1/2" triclover

Custom sizes available on request



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

1/4" BSP injection plug

For use with 4mm triclover adaptor

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

Coflore® ATR Accessories

Accessories are available to meet your process requirements.



Hose Barb Adaptor (ATR-HB-Ha / ATR-HB-SS)

Adapts from 1/2" triclover to hose barb

Material: Hastelloy C276 (ATR-HB-Ha) or 316 Stainless Steel (ATR-HB-SS)

Connections: 1/2" triclover, 4.8mm ID hose barb

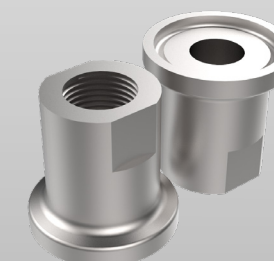


4mm Triclover Adaptor (ATR-BSP4-Ha / ATR-BSP4-SS)

Adapts 1/2" triclover to 1/4" BSP thread 4mm through hole. Can be used with 1/4" BSP injection plug

Material: Hastelloy C276 (ATR-BSP4-Ha) or 316 Stainless Steel (ATR-BSP4-SS)

Connections: 1/2" triclover, 1/4" BSP female, 4mm through hole



9.5mm Triclover Adaptor (ATR-BSP9.5-Ha / ATR-BSP9.5-SS)

Adapts 1/2" triclover to 1/4" BSP thread 9.5mm through hole

Material: Hastelloy C276 (ATR-BSP9.5-Ha) or 316 Stainless Steel (ATR-BSP9.5-SS)

Connections: 1/2" triclover, 1/4" BSP female, 9.5mm through hole

Coflore® ATR Tool Kits & Service Kits

AM Technology recommends periodic maintenance using **Tool kits and Service Kits** to maintain optimum performance of the **Coflore® ATR**.



ATR Tool Kit (ATR-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



ATR Service Kits (ATR-Service Kit (non-ATEX), ATR-Service Kit-EX (ATEX Zone IICT4))

Service and maintenance kit for the ATR

Components include:
1 x Solenoid Valve Assembly
4 x Pneumatic Actuator
4 x Agitation Springs

Some of the agitating platform components have a limited life cycle. The solenoid valve assembly, pneumatic actuator and agitation springs should be replaced according to the following schedule:

Infrequent use (less than 1 day per week):
Replace at user's discretion
Frequent use (2-3 days per week):
Replace every 12 months
Continuous use (5 days per week):
Replace every 6 months
Continuous use (7 days per week):
Replace every 4 months

In the event of the need to replace solenoids, actuators or agitation springs, **please contact AM Technology**

Coflore® ATR Gaskets & Tube Fittings

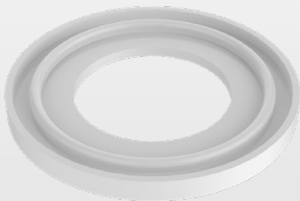
Gaskets are used to ensure a tight liquid and gas seal within the end-cap flange of the ATR tube. Available as **Kits** on request. **Tube fittings** are used as process connections.



1/2" Triclover Gasket (Gk.BS0050.PE)

PTFE envelope gasket
Material: PTFE, Viton (non-wetted)

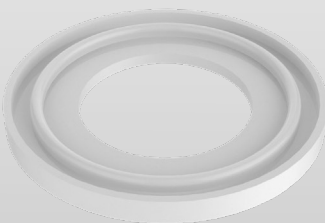
For use with: ATR end caps, ATR interconnections, ATR PTFE hoses



1" Triclover Gasket (Gk.BS0100.PE)

PTFE envelope gasket
Material: PTFE, Viton (non-wetted)

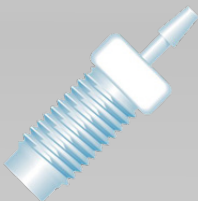
For use with: 0.35L ATR reactor tube



1 1/2" Triclover Gasket (Gk.BS10.0150.PE)

PTFE envelope gasket
Material: PTFE, Viton (non-wetted)

For use with: 1.25L ATR reactor tube



Soft Tubing Connector

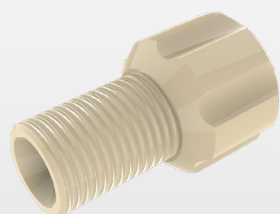
Soft tubing connectors for use with peristaltic pump tubing and 1/4" BSP injection plug (ATR-PLUG-INJ)

Material: ETFE
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

Coflore® ATR Tube Fittings

Tube fittings are used as process connections.



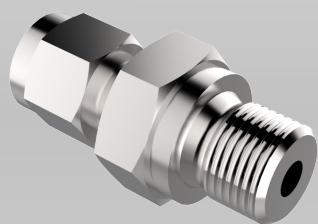
Omnifit Tube Connectors

Omnifit tube connectors for use with PTFE tubing and 1/4" 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)

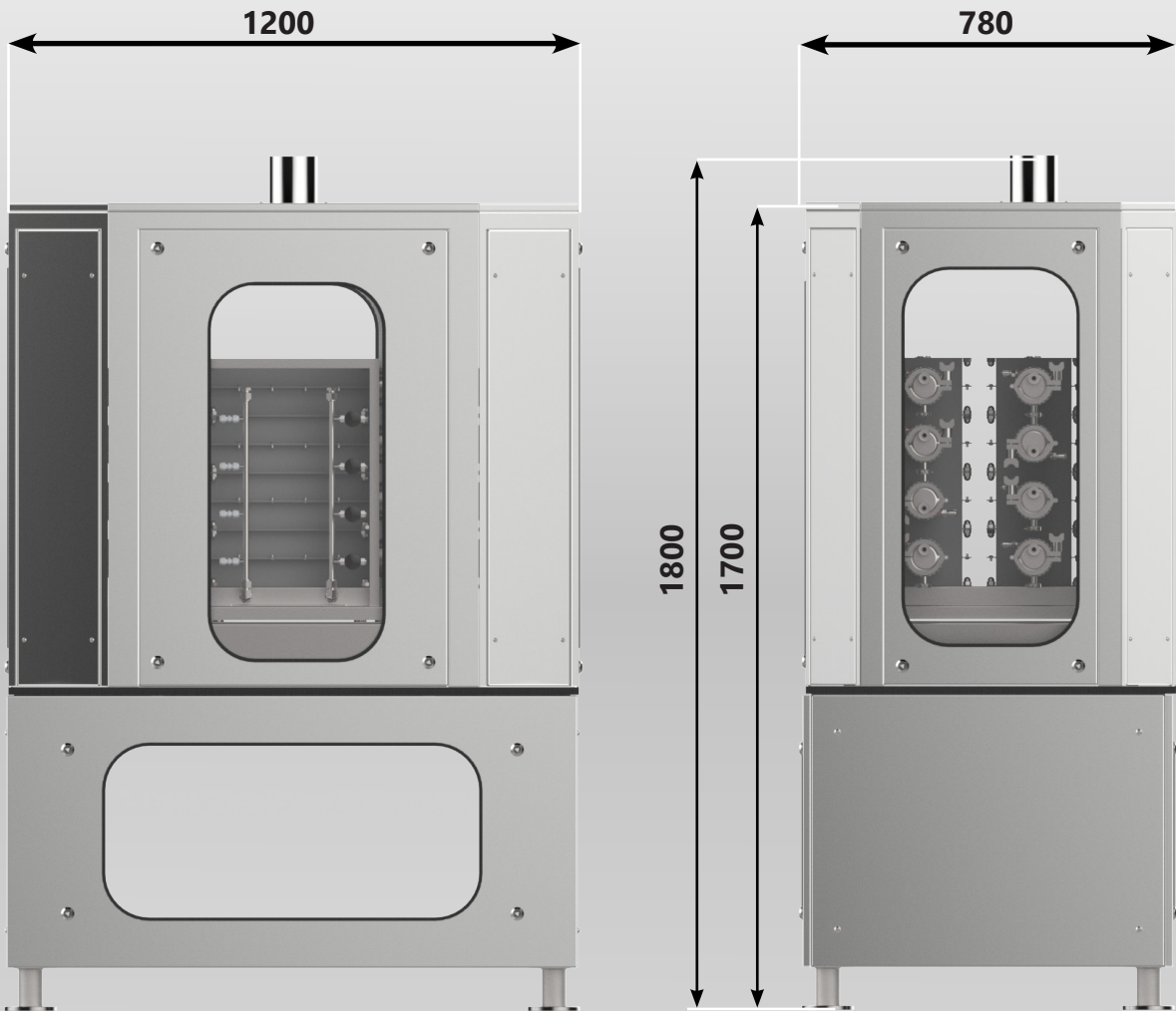
Material: Fitting: 316 Stainless Steel. Washer: Stainless Steel, viton

Components include: Compression fitting, bonded washer

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

Coflore® ATR Technical Details

Maximum reactor mass	120 Kg
Agitating platform mass	150 Kg
Noise	< 70 dBA
Requirements;	
Compressed air	3-7 Bar (g), 13 CFM oil free clean air
Maximum air pressure	7 Bar (g)
Power supply	1ph + N+E 100-240 VAC 50/60 Hz 2A
Compressed air connection	10mm push fit
Heat transfer fluid connections	1/2" Swagelok



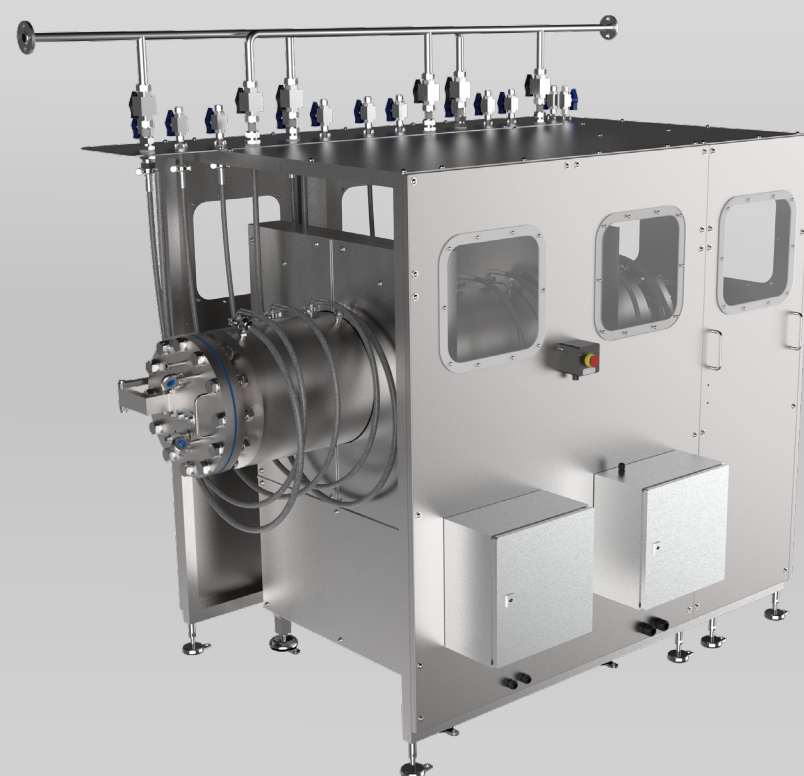
The Coflore® Flow Reactor Range

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.

Address

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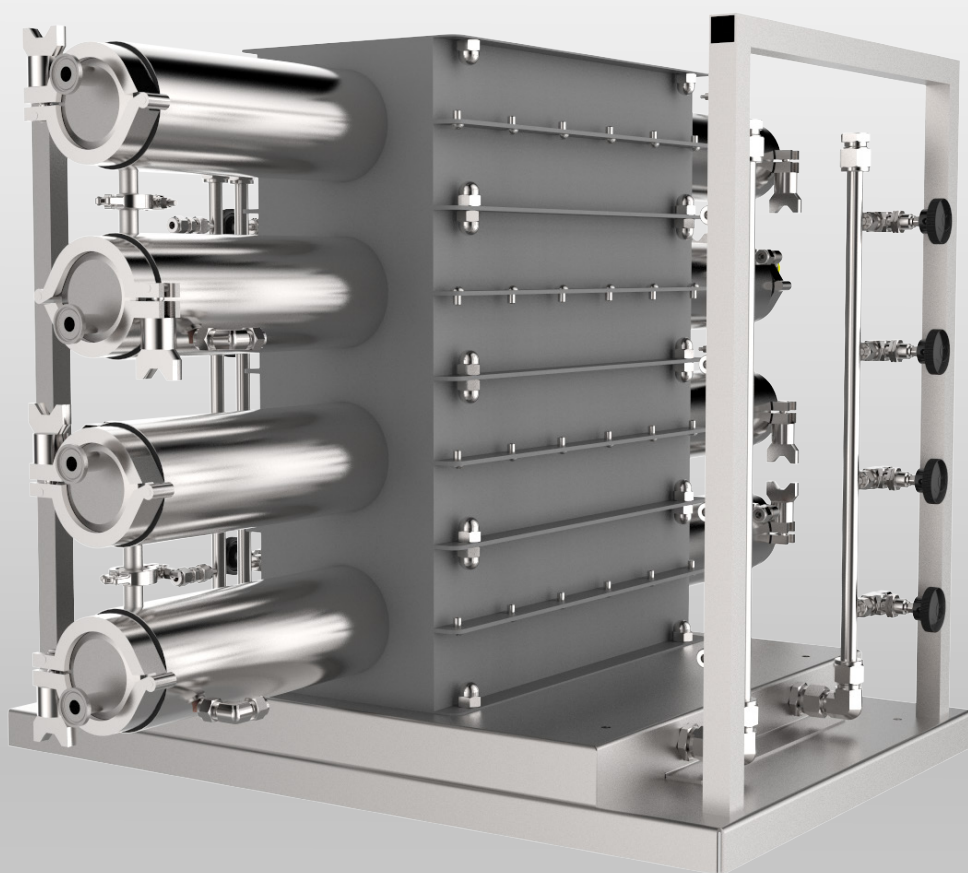
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