

# Accessories for Pressure Reactor & Systems

Optional accessories are offered to increase the versatility of the equipment, to add value & feature to the standard product & to provide complete range of instrument/ equipment required for a particular application.

Complete mounting of all the accessories shall be done on autoclave stand/ trolley.

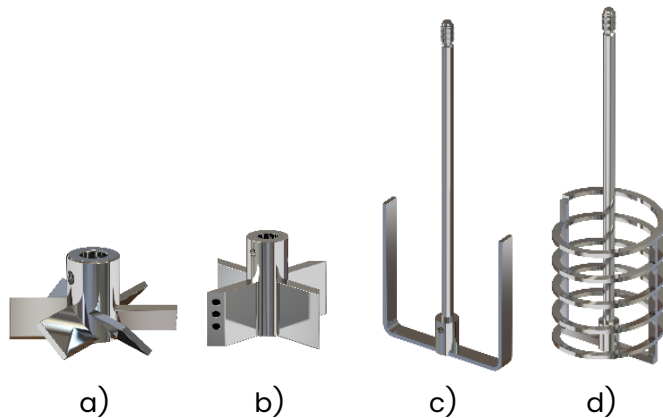
All the indicators/ controllers are mounted on a common SS panel.

## 1. Interchangeable Impellers

Different types of impellers can be supplied or selected based on the reaction. Below are the various types of impellers:

- a) Pitch Blade turbine impeller for liquid-liquid reactions
- b) Hollow Shaft with Gas-induction impeller for gas-liquid reactions
- c) Anchor Impeller for viscous material
- d) Spiral Impeller for viscous material

Note: The above impellers can be supplied individually or can be interchanged with another impeller.



## 2. Forward Pressure Regulator

These are used to manually charge a gas at desired pressures up to 140 bar / 2000 psi or higher into the reactor from the gas cylinder. The regulator is made from SS316 & comes with inlet -outlet pressure gauges & flexible SS braided PTFE high pressure hose pipe (4m long) with non return valve.



## 3. Flush Bottom Valve

For 5 ltr volume and above autoclaves this valve is provided as a standard fittings. For volumes below 5 ltr it is optional as the vessel can be easily lifted and drained manually. This valve can be provided in SS316, Hastelloy C or Inconel material of construction for temperatures up to 300°C & 500°C



## 4. Digital Pressure indicator

The pressure sensor has a temperature limitation up to 100°C The sensor can be either non-flameproof or an intrinsically safe pressure sensor with ex-proof IIC certification. Pressure sensors in Hastelloy C or Inconel material of construction can be offered on request



## 5. Pressure Relief Valve

A pressure relief valve is set to open at a predetermined set pressure to protect the autoclave. This valve can be provided in SS316 or Hastelloy C material of construction. The set pressure can be varied within a certain range



## 6. Chain Pulley / Head Lifting System

For Autoclave volumes from 10 ltr to 250 ltr & removable head design, the head & vessel are too heavy to fit manually.

### Optional:

- Electric chain pulley lift
- Hydraulic Lift lifting arrangement can be offered

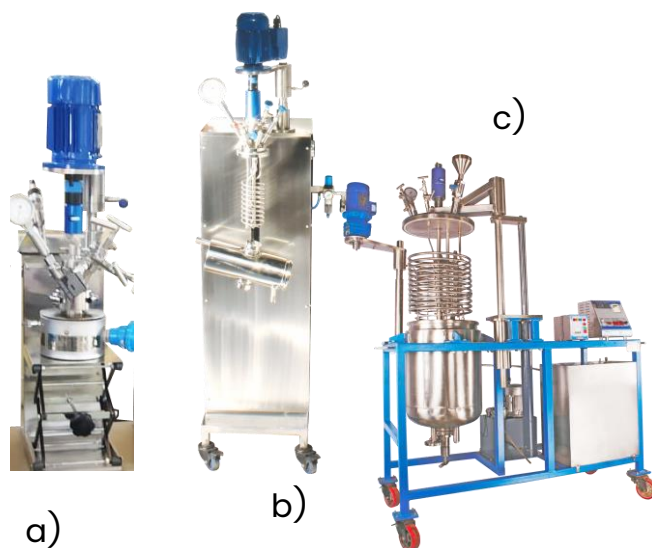


## 7. Fixed Head Design With Raising & Lowering:

In this system the head of the autoclave is fixed with motor stand & the vessel & heater are raised & lowered manually by

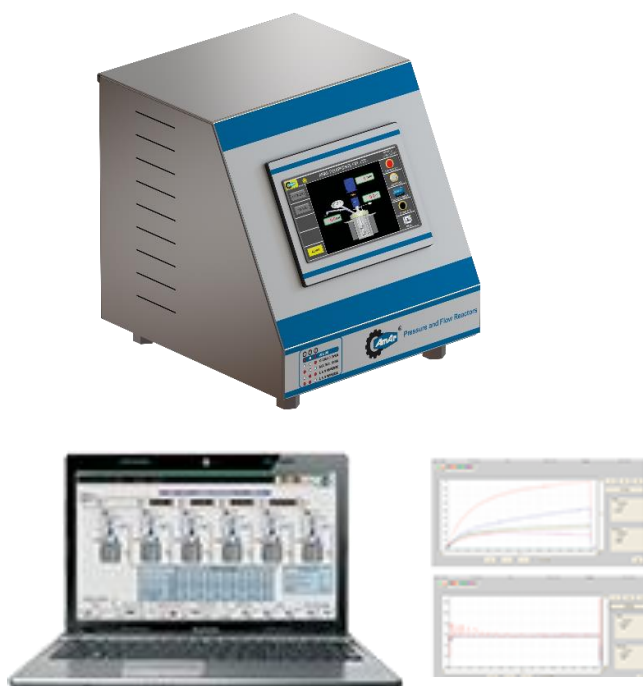
- scissor lift for 50 ml – 250 ml
- pneumatically (50 ml to 25 ltr)
- hydraulically (50 ltr & above).

This system is useful when head of the autoclave has lot of fittings & accessories, making it difficult to lift the head & detach all the fittings after every batch. Further, removing the heater for faster cooling & ease of lifting or lowering the vessel is advantageous.



## 8. Touch Panel & SCADA software

SCADA is a supervisory control & data acquisition software with all controllers or indicators having RS 485 Modbus communication port or PLC & HMI or touch panel, for online display, setpoint changes & data logging of various parameters like pressure, temperature, motor RPM, motor current or torque, liquid or gas flow rate with totaliser, heater temperature level, pH, ORP, turbidity, IR etc. remotely from PC as well as locally from panel. It gives continuous online datalogging at predefined (variable) time interval, online graphical representation as well as historical data & graphs on PC for single or multiple autoclaves. RS 485-232 convertor & cable up to 5 m or higher is also supplied. Wireless data communication from PC to panel or mobile alerts can be supplied on request.



## 9. High Pressure Charging Pot

It consists of high-pressure SS-316 pot designed for working pressure 100 bar or higher. These pots can also be used for storage of gases when gas cylinders are located at a faraway place. Forward pressure regulators can be provided at the outlet of pot if they are used as gas charging.



## 10. Powder Inlet

For 10L volume and above autoclaves this valve is provided as a standard fitting. For volumes below 10L it is optional as the head can be easily opened. The ball valve can be provided in SS316 or Hastelloy C material of construction.



## 11. Reflux Condenser

It is a jacketed single tube SS-316 heat exchanger with packing material. It is available in 0.01, 0.02 or 0.05 m<sup>2</sup> area. Higher surface area and different materials can be offered on request.



## 12. Shell & Tube Condenser

It is a SS-316 shell & tube reverse flow heat exchanger for distillation or condensing up to 10 bar pressure. It is offered in different surface areas such as 0.1, 0.2, 0.5, 1 & 2 m<sup>2</sup>. Higher area, pressure and different materials can be supplied on request.



## 13. Receiver Pot

It is connected at the outlet of the shell & tube or reflux condenser to collect the condensate separately. It is also provided with a port to apply vacuum & offered in volume up to 5L and SS316 or Hastelloy C material of construction. Higher volumes & other materials can be offered on request. It can be optionally provided with level indication.



## 14. Internal Catalyst Filter

These are small 7 microns SS 316 sintered cup filters which are threaded to bottom of the sampling dip tube so that the catalyst does not come out while sampling liquid. These catalyst Filters are available for 500 ml - 100 ltr volume autoclaves. Different material and micron size filter can be provided based on the availability and design conformity.



## 15. External Catalyst Filtration & Recycling system

It consists of vertical SS sintered filter cartridges in a SS housing. This system is suitable & available for 2 ltr to 10000 ltr reactor volume. These filters are available with zero hold-up volume as well.



## 16. Back Pressure Regulator

It is a device that helps to maintain a defined pressure inside the autoclave. The pressure can be set initially either manually, pneumatically, or electronically. Once the set pressure is exceeded, the excess pressure is released till the autoclave pressure becomes equal to or below the set pressure.

Optional

- a) Electronically actuated digital pneumatic back pressure regulator
- b) Pneumatically actuated pilot operated back pressure regulator
- c) Manual Back Pressure Regulator



## 17. Catch Pot

It is used to collect the vent vapours / gases from the autoclave vent, rupture disc, safety valve port when the vapour or gas is highly hazardous and cannot be released directly into the atmosphere. It is provided with inlet, outlet, vent, dip tubes, pressure gauge, safety valve & optionally a flame or flash back arrester. It is suitable & available for any autoclave volume



## 18. Ethylene Oxide / Propylene Oxide Pot

This pot is used during the ethoxylation or propoxylation reactions. It consists of a horizontal pot with inlet, outlet valves, gas inlet with dip tube, thermowell, pressure gauge & high-pressure hose pipe for 10 bar working pressure. This pot can be also offered with a weighing balance on request to measure the quantity of Ethylene Oxide or Propylene Oxide charged in the reaction.



## 19. Light & Sight Glass view windows

These are quartz or sapphire view glass windows / light & sight glass of small diameter or along the length of the vessel with special cameras & software for continuous online viewing / recording in vessels to see the reaction. Suitable for high pressures up to 200 bar & any autoclave / reactor volume.



Multiple view windows



Round view window



Sight glass along the vessel length

## 20. Gas Booster

They are pneumatically operated. Special gas booster pumps are available for liquid CO<sub>2</sub> used in supercritical fluid extraction system. The booster systems are supplied with air filter regulator, pressure relief valves, inlet-outlet pressure gauges, valves & flexible hose pipe. Gas booster are reaction specific and can be supplied as per the client's requirement.



Gas Booster



SS mounting with all fittings & valves

## 21. Vacuum Pump

Suitable rotary vane or diaphragm oil free vacuum pumps can be supplied for vacuum from 100 mbar up to 0.001 mbar in the reactor. It is used either before starting the batch or for high vacuum distillation. Suitable analogue or digital vacuum indicator with controller can be offered on request. The reactor fittings would change for very high vacuum & this may limit its pressure rating.



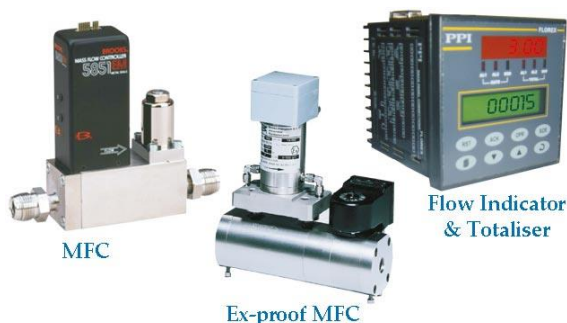
## 22. Heating Cooling Circulators

- Single Fluid closed loop system from -90°C to 250°C.
- Heating Cooling bath circulators from 70°C to 175°C.
- High temperature circulators from ambient to 350°C.
- Chillers up to -15°C.
- Suitable for reactor volume from 10 ml to 3000 ltr.



## 23. Thermal Gas Mass Flow Meter (MFM)/ Controller (MFC)

MFM can be used to measure accurate mass flow rate of gas (in gm/hr or LPH) & totalized quantity of mass/volume (in gm/ltr) charged in the reactor at any point. Mass flow controller (MFC) is used to charge the set flow rate of gas into the reactor at high pressures up to 100bar. The same MFM/MFC comes with high pressure flexible hose, inlet filter with digital gas flow indicator.



## 24. Coriolis Gas-liquid Mass Flow Meter / Controller

These are used for higher & accurate gas or liquid flow rate indication or control in cases where thermal mass flow meters are not suitable. A common meter can be used for different gases & liquids for a particular range of flow.



## 25. Control Panel

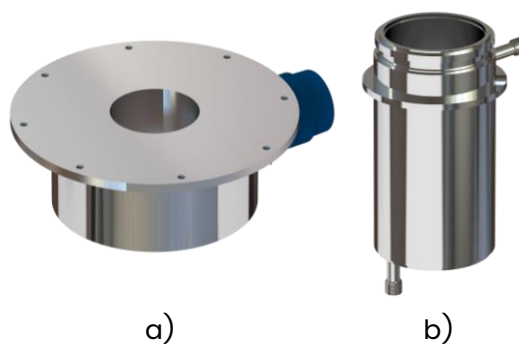
- Complete ex-proof-flame proof (FLP) group IIC, ATEX zone 1, class 1 div. 2 certified control panels mounted on trolley.

Note: FLP panels should be opted only if the heater & motors are FLP & the area is totally ex-proof as panels are too bulky & inconvenient for operation & maintenance.



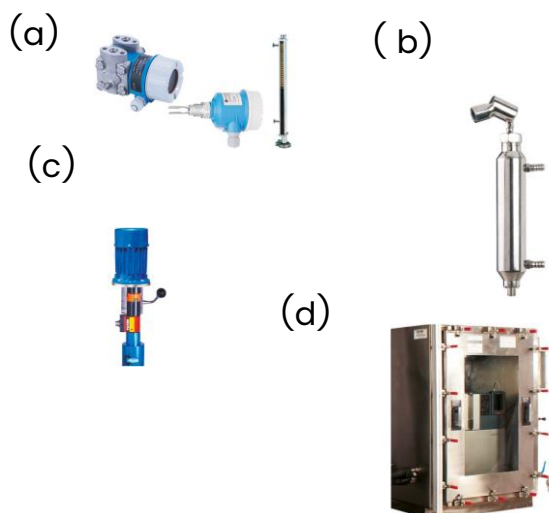
## 26. Heater

- Flameproof / explosion proof IIB + H<sub>2</sub> certified, aluminum cast heater for H<sub>2</sub> gas with totally enclosed heating element inside metal tube. These are suitable when the maximum temperature inside the autoclave is less than 300°C. Heating rates are lower in comparison to ceramic band heaters.
- SS-304 jacket for oil / system heating with insulation & cladding.



## 27. Other Accessories

- Level Transmitter (LT)/ switch (LS) with indicator to measure or maintain level inside the reactor under high pressure. Used mainly in CSTR.
- Sampling pot with condenser for cooling/condensing & collecting the sample taken at high pressure & temperature.
- Torque sensor for accurate measurement of the motor torque, where change in torque indicates change in viscosity of the reaction.
- Ex-proof certified gas purge panels for electrical accessories/utilities like heating cooling circulators, etc.



## 28. Liquid Metering Pump System

This system is used to charge liquid at a desired rate from as low as 1 ml/ hr to 100 ltr / hr, when the autoclave is under pressurized condition. The system comes with:

- Diaphragm metering pumps
- High pressure more accurate HPLC type lw flow metering pumps

Inline flow meters can be connected to measure & control the flow of liquids.

