

SFE Bio-Botanical Extraction System

The SFE Bio-Botanical Extraction System (BBES) is an automated supercritical fluid extraction (SFE) system from the Waters® line of pilot scale systems. The system consists of a CO₂ pump, a mass flow meter, two extraction vessels, an automated back pressure regulator, two heat exchangers, and three fraction collection vessels. Options include a co-solvent pump and mixer, and a CO₂ recycler.

SFE BBES SPECIFICATIONS

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|--------------------|--------------------------|
| Operating pressure | Up to 600 bar (8700 psi) |
|--------------------|--------------------------|

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|-----------------------|--------------|
| Operating temperature | Up to 120 °C |
|-----------------------|--------------|

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|---------------------------|-----------|
| CO ₂ flow rate | 200 g/min |
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VENTING

Carbon dioxide (CO₂) is a non-toxic gas. However, it will displace the air in the room and can lead to suffocation if not properly vented. The system provides for venting to a fume hood through a 1/4" compression fitting and line.

HIGH PRESSURE CO₂ PUMP

Ideal for high pressure, supercritical fluids, and pulseless flow applications.

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| Cooling | Circulating coolant |
|---------|---------------------|

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|----------------------------------------|------------------------------------------------|
| Liquid CO ₂ supply pressure | ~57 bar (825 psi) required (dip tube cylinder) |
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|------------------|-----------------------------------------------------|
| Wetted materials | High-strength stainless steel, sapphire, GFPM, PEEK |
|------------------|-----------------------------------------------------|

COOLING HEAT EXCHANGER

Cool and liquefy CO₂ before it enters the pump for maximum efficiency.

MASS FLOW METER

Located on the inlet of the CO₂ pump, the pump, for flow control, uses measured liquefied CO₂ mass output from the flow meter.

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|-----------|-----------------|
| Flow rate | Up to 200 g/min |
|-----------|-----------------|

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|------------------|--------------------|
| Maximum pressure | 100 bar (1450 psi) |
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ELECTRICAL HEAT EXCHANGERS

First is located upstream from vessel to ensure that the fluid is heated prior to entering the extraction vessel.

Second is placed between Collection Vessels 2 and 3, to help convert CO₂ to gas to aid collection.

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|--------------------|-------------------------------------------------|
| Process connection | Tubing: 1/8 inch stainless steel, high pressure |
|--------------------|-------------------------------------------------|

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|-------------|--------------|
| Temperature | Up to 100 °C |
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HIGH PRESSURE EXTRACTION VESSEL

Cap with spring-loaded seal enhances safety, and lends to automation for efficient loading and unloading of large vessels.

There are two in a system.

| | |
|-----------------|------------------------------------|
| Wetted material | 17-4 PH, nitronic 60 and polyamide |
|-----------------|------------------------------------|

| | |
|----------|-------------------------|
| Material | 17-4 PH stainless steel |
|----------|-------------------------|

| | |
|--------|-------------|
| Volume | 5 L or 10 L |
|--------|-------------|

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|-------|-------------------------------------------|
| Fluid | CO ₂ and most organic solvents |
|-------|-------------------------------------------|

HIGH PRESSURE VALVE

A high-pressure needle valve provides the user with the capability of isolating the vessel from high pressure.

AUTOMATED BACK PRESSURE REGULATOR (ABPR)

Motor-driven and temperature-controlled to compensate for cooling during depressurization.

A built-in pressure sensor provides closed loop feedback for control and pressure alarm monitoring.

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|-------------------|-------------------------------------------|
| Compatible fluids | CO ₂ and most organic solvents |
|-------------------|-------------------------------------------|

| | |
|------------------|----------------------------------------------|
| Wetted materials | High-strength stainless steel, 17-4 PH, PEEK |
|------------------|----------------------------------------------|

TEMPERATURE CONTROL MODULE

Monitors and controls up to six temperature zones independently. Two in system.

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| Inputs and outputs | Six |
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| Alarm setting | Six independent zones |
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| Maximum temperature | 120 °C |
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HIGH PRESSURE FRACTION COLLECTION VESSELS

The mixed fluid is introduced into the high pressure collection vessels, efficiently separated, and collected at the bottom of the vessels. There are two or three in a system, allowing for efficient collection of different extracts by varying pressure between collection vessels.

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|-----------------|-------------------------------------|
| Wetted material | 17-4 PH, nitronic 60, and polyamide |
|-----------------|-------------------------------------|

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|--------|-----|
| Volume | 2 L |
|--------|-----|

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|------------------|-------------------------------------------|
| Compatible fluid | CO ₂ and most organic solvents |
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MANUAL BACK PRESSURE REGULATORS

Maintains pressure on the high pressure fraction collection vessel in SFE mode for efficient collection and prevents freezing that occurs at depressurization.

| | |
|----------|-------------------------------|
| Material | High-strength stainless steel |
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| Pressure | Up to 6000 psi (1st vessel and 2nd vessel) Up to 2000 psi (last vessel) |
|----------|----------------------------------------------------------------------------|

VIEW CELL

Provides user capability to view flow from last collection vessel.

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| Vessel size | 10 mL |
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| Body material | 316 SS |
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| Pressure max | 6000 psi |
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| Temperature max | 150 °C |
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| Windows | Two 1.25" diameter, sapphire |
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CIRCULATING BATH

Circulates coolant through the CO₂ pump heads and heat exchanger.

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| Reservoir volume | 2.8 L |
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|---------|-------------------------------------|
| Coolant | Antifreeze/H ₂ O mixture |
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OPTIONS

HIGH PRESSURE CO-SOLVENT PUMP

Pumps a co-solvent as a percentage of the carbon dioxide flow rate up to its maximum flow rate and pressure rating.

| | |
|------------------|--------------------|
| Maximum pressure | 600 bar (8700 psi) |
| Flow rate | 50 g/min |

HIGH PRESSURE STATIC MIXER

Blends different liquids into one uniform concentration.

| | |
|--------------------|------------------------------------------------------------|
| Material | Stainless steel 316 or other high-strength stainless steel |
| Flow rate | Up to 200 g/min |
| Operating pressure | Up to 600 bar (8700 psi) |
| Fluid | CO ₂ and most hydrocarbon and organic solvents |

AUTOMATION MODULE

Allows automated switching between collection vessels, putting them in series or bypass.

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| Valves | Two 5 position valves, software controlled |
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RECYCLER

Reclaims vented CO₂ from extraction process. This system consists of storage vessel with level sensor for CO₂ storage, level sensor module to display level, condensing heat exchanger, condensing cooling bath, and valves. The system also features a pressure relief valve that can be piped to vent to relieve pressure in case of over-pressurization or overflow conditions.

| | |
|----------------------------|-----------------------------------------------------------------------------------------|
| Operating pressure range | 48–62 bar (700–900 psi) |
| Insulated storage capacity | 15 L |
| Level sensor | Low, Low-Low, High, High-High |
| Switching valve | Manual or automated Allows selection between CO ₂ source and recycle mode |

*For more details, please see Recycling System specification sheet.

Waters

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