Spe-ed SCF Product Line

Educational Systems

Prime

Laboratory Systems

***Spe-ed* SFE-2**
***Spe-ed* SFE-4**
***Spe-ed* SFE-15,000**
Helix

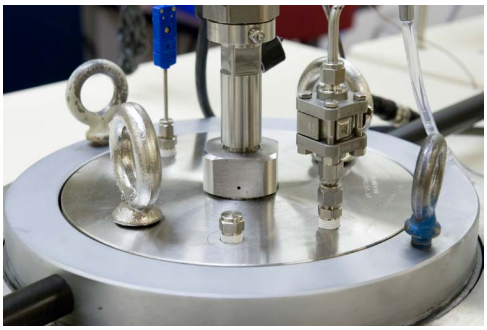
***Spe-ed* SFE-Basic**

Process Systems

Pilot Scale Systems

Production Systems

Large Scale SCF Systems



Applied Separations

Educational System

Spe-ed SFE-Prime

The *Spe-ed*™ SFE Prime is the newest SFE in our series of instruments for supercritical fluid processes. These systems meet the rigorous needs of day-to-day use in the classroom and are made for hands-on demonstrations. It is safe, simple to operate, fast and affordable, with features found in other, more expensive SFE systems.

The system features:

- temperatures to 150°C
- pressure up to 10,000 psi (690 BAR)
- pump flow rates up to 200mL/min
- control of flow rate to each vessel
- fully-adjustable, non-clogging micro-metering valve
- process vessels ranging in size from 5 to 100mL
- extract collected into SPE cartridges or standard glassware
- in-line trapping capabilities
- modifier addition capability
- liquid sample extraction capability
- multiple over-pressure safety devices

Heating Compartment

- Flip-up cover for easy access
- Heater goes to 150 degrees

Micro-metering valve

- Straightforward adjustable design
- Non-clogging
- Simplified cleaning / rinsing
- Maintenance free
- Flow control +/- 1.8%
- Heated to compensate for Joule Thompson cooling

Vessels

- 5 mL to 150 mL hand tightened
- Simplified shutoff valves
- Static and dynamic extractions

High Pressure CO_2 Pump

- Reliable air driven
- Pressure 690 BAR (10,000 psi)
- 200 mL/min flow rate
- Digital pressure setting maintains a desired set point throughout the system
- Integrated cooling requiring no external chiller

Safety

- Built-in automatic over pressure and over temperature safeguards
- Audible alarm
- Pressure relief valve
- Rupture disc

Temperature

- A PID temperature controller maintains the precise fluid temperature inside the high pressure vessel.
- Independent temperature sensor monitors precise temperature of the vessel

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Spe-ed SFE-2

2-Vessel Simultaneous Oven-based Extraction System

The *Spe-ed* SFE-2 is the original SFE in our series of instruments for supercritical fluid extraction. Built in conjunction with the USDA1, this system was designed to meet the rigorous needs of day-to-day use in the research lab. It is simple to operate, fast and affordable, with unique features not found in other SCF systems.

The system features:

- temperatures to 240°C
- pressure up to 10,000 psi (690 BAR)
- pump flow rates up to 400mL/min
- independent control of flow rates to each vessel
- fully-adjustable, non-clogging, variable restrictors
- parallel processing capabilities of 1 or 2 vessels from 5mL to 1.0L
- collection into SPE cartridges or standard glassware
- in-line trapping capabilities
- modifier addition capability
- multiple flow path capability
- extract directly from liquid samples

Applied Separations

Laboratory System

Spe-ed SFE-4

4-Vessel Simultaneous Oven-based Extraction System

Designed for every day use in the research lab, the *Spe-ed* SFE-4 is easy to use, cost-effective, and durable. The *Spe-ed* SFE-4 has all the advantages of the *Spe-ed* SFE-2 while expanding parallel processing capabilities up to four extractor vessels. This system doubles the processing capability of the *Spe-ed* SFE-2.

The system features:

- temperatures to 240°C
- pressure up to 10,000 psi (690 BAR)
- pump flow rates up to 400mL/min
- independent control of flow rates to each vessel
- fully-adjustable, non-clogging, variable restrictors
- parallel processing capabilities of up to 4 vessels from 5mL to 1.0L
- collection into SPE cartridges or standard glassware
- in-line trapping capabilities
- modifier addition capability
- multiple flow path capability
- extract directly from liquid samples

Applied Separations

Spe-ed SFE-15,000

Higher Pressure Oven-based Extraction System

The *Spe-ed* SFE-15000 is designed for higher pressure SCF extraction. Researchers investigating higher pressure extraction will find the *Spe-ed* SFE-15000 simple to operate, fast and affordable. The system has been designed with special high pressure components to reliably provide rugged service, and increased solubility of many compounds. For example, at 15,000 psi, triglycerides are completely miscible in SC-CO_2.

The system features:

- temperatures to 240°C
- pressure up to 15,000 psi (1000 BAR)
- pump flow rates up to 400mL/min
- independent control of flow rates to each vessel
- fully-adjustable, non-clogging, variable restrictors
- parallel processing capabilities of up to 2 vessels from 5mL to 1.0L
- collection into SPE cartridges or standard glassware
- in-line trapping capabilities
- modifier addition capability
- multiple flow path capability
- low cost

Applied Separations

Spe-ed SFE-Basic

Get Started with Supercritical Fluids Technology

The *Spe-ed*™ SFE Basic is the base SFE in our series of instruments for supercritical fluid processes. This no-frills machine satisfies the rigorous needs of research in the lab with a price tag that allows everyone to take advantage of the benefits of Supercritical fluids. It is safe, simple to operate, fast and affordable, with features found in other, more expensive SFE systems.

Supercritical Fluids excel in emerging industries like foods, natural products and nanotechnology where solvents can't be used.

The system features:

- temperatures to 150°C
- pressure up to 10,000 psi (680 BAR)
- pump flow rates up to 200mL/min
- control of flow rates to each vessel
- fully-adjustable, non-clogging micro-metering valve
- process vessels ranging in size from 5 to 150mL
- extract collected into SPE cartridges or standard glassware
- in-line trapping capabilities
- modifier addition capability
- liquid sample extraction capability
- multiple over-pressure safety devices

Highlights of the *Spe-ed* SFE-Basic

Heating Compartment

- Flip-up cover for easy access
- Heater goes to 150 degrees

Micro-metering valve

- Straightforward adjustable design
- Non-clogging
- Simplified cleaning / rinsing
- Maintenance free
- Flow control +/- 1.8%
- Heated to compensate for Joule Thompson cooling

Vessels

- 5 mL to 150 mL hand tightened
- Simplified shutoff valves
- Static and dynamic extractions

High Pressure CO_2 Pump

- Reliable air driven
- Pressure 680 BAR (10,000 psi)
- 200 mL/min flow rate
- Digital pressure setting maintains a desired set point throughout the system
- Integrated cooling requiring no external chiller

Temperature

- A PID temperature controller maintains the precise fluid temperature inside the high pressure vessel.
- Independent temperature sensor monitors precise temperature of the vessel

Safety

- Built-in automatic over pressure and over temperature safeguards
- Audible alarm
- Pressure relief valve
- Rupture disc

Applied Separations

Helix

Basic Requirements for All Extractions

All extractions require at least these Applied Separations, Inc. components:

Base unit

CO_2 Pump
Pressure vessel assembly
Recirculating bath (chiller)
and these utilities:
A source of air delivered at 7 BAR
Electrical power: 240v or 120v
Source of liquid CO_2

The Helix is made up of several "base" components. The basic components are put together in a variety of standard or custom configurations to make a unit to perform a specific function.

With the base system you will be able to use the same components to do separations and extractions as well as make nanoparticles, but not at the same time. This means on one day you can do extractions and on another day you can make nanoparticles.

With this system you will be able to use the same components to do each of these operations, but not at the same time. This means on one day you can do extractions and on another day you can make nanoparticles.

Base Unit

The compact Base Unit, measuring 10"w X 16"d X 34"h is the starting platform for operations. Pressure vessel assemblies up to 1 liter are placed on the base unit's shelf. Input, output and vent lines are controlled by shutoff valves located on the front of the unit. Digital temperature and pressure indicators also on the front of the unit show pressure and temperature.

Pressure vessels are heated by specially designed band heaters which are plugged into the front of the base unit making for easy access. An additional CO_2 preheater is employed to ensure that the CO_2 is at the designed temperature before entering the pressure vessel. A back pressure regulator controls the flow of gaseous CO_2 if exiting to ambient collection or regulating the pressure in a downstream pressure vessel (e.g. cyclone separator).

A base unit with its vessel assembly can be linked to other base units for additional processing capabilities: cyclone separators, precipitation vessel, expansion vessel, etc.

Applied Separations

Helix

Helix Configuration Options

Basic Configuration	#7409
Helix SCF Base Unit 240v	#7305
Touchpad Controller and Standard CO_2 Pump Module 240v	#7401
1 Liter Vessel Assembly with basket	#7322
500mL Vessel Assembly	#7323
300mL Vessel Assembly	#7324
100mL Vessel Assembly	#7329
50mL Vessel Assembly	#6414
32mL Vessel Assembly	#6413
24mL Vessel Assembly	#6412
Standard Flow Meter	#7927
Standard Collector Vessel	#7735

Basic Configuration Options

Modifier/Liquid Pump, Helix 240v	#7172
Recirculating Bath, Helix 240v	#7027
800mL CO_2 Pump Module 240v	#7316
Stirring Assembly - stirrer, controller	#7320

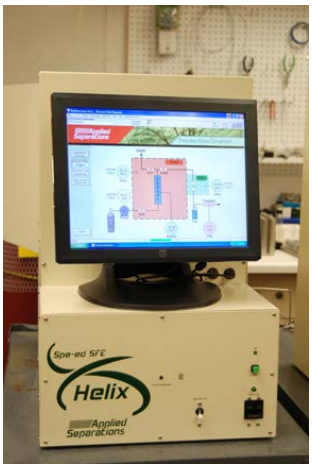
Variety of Flow Meters

CO_2 Recycle Module Chiller, Level Indicator, etc.	#7399
	#7027

Vessel with Stirrer Assembly

Collection

Pressure Relief Device



Touchpad System Control

RESS collector

Basic Helix system with the separator module.

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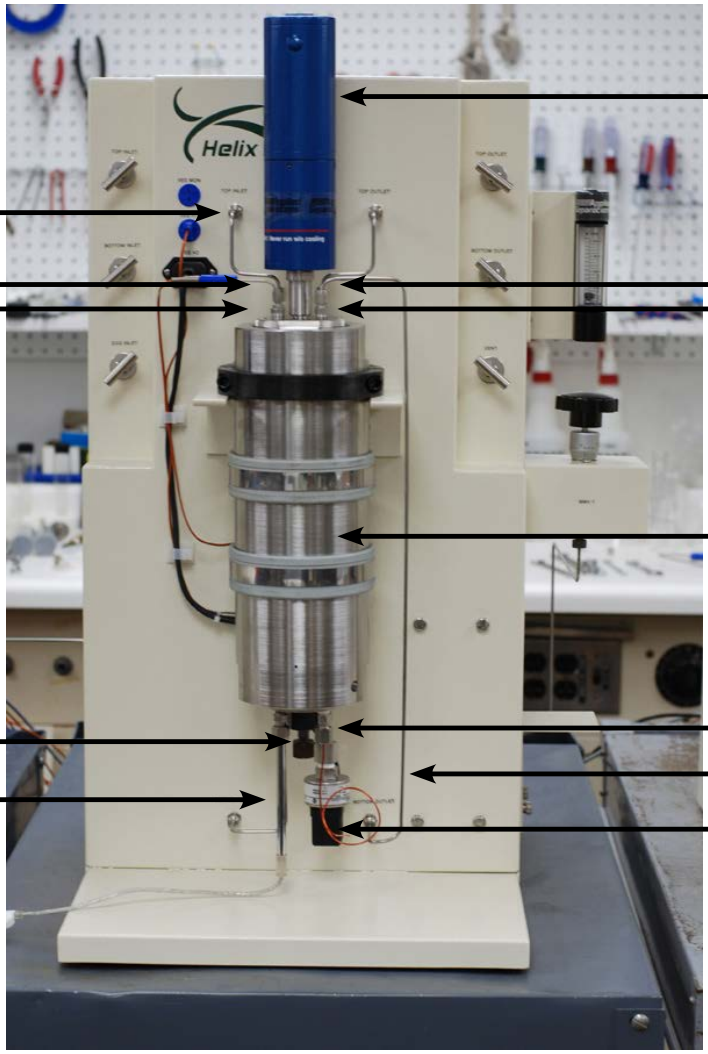
Helix



CO_2 In

Light Port

Liquid Reactant In

Emergency Pressure Relief Device*

Endoscope
UV/IR
Particle Sizing
Turbidity

Stirrer

Pressure Probe

Gas Reactant In
- H_2
- O_2
- CO_2
- NH_3, etc.

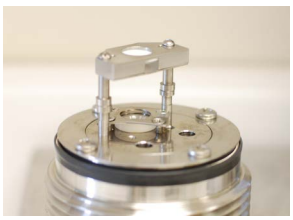
Reactor Vessel with Agitator

Electric In/Out
e.g. Ultrasound

Out

Temperature Probe

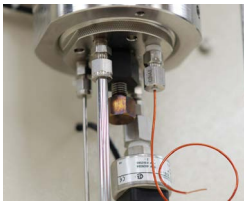
Endoscope



UV/IR

Monitor
Meters
- Spectrophotometer

Stirrer Shaft/Impeller
- Variable length
- Interchangable impellers



Close-up of the top and bottom vessel ports.

*Patent Pending

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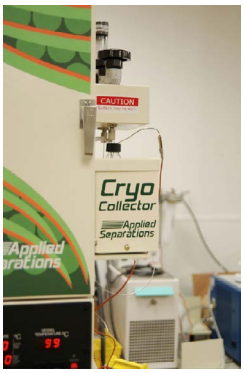
Helix

Cryo Cooler



Low pressure/ambient aluminum containers are available to collect a variety of extracts. Should the extract be highly viscous heat can be applied, or if volatile, chilling can be applied.

Pump Module

There are two standard CO_2 pumps (#7321 and #7316). These are air-driven, liquid pumps capable of delivering CO_2 from a cylinder (nominally 60 BAR at room temperature) to a pressure of 690 BAR. Because they are pneumatic, they are inherently more compact, safer, cleaner, quieter and requiring less maintenance than either electric or hydraulic pumps. In both pumps, the pressure is set and shown by a digital readout. There is another gauge to show the air pressure.

Recirculating Bath

The *Spe-ed* RCB for Helix (#7029) (820 BTU/hr, 15LPM, -10 C to +40C) is a specifically designed recirculating cooling bath that chills the CO_2 to liquidity. It is microprocessor controlled, with a small footprint and nearly noise free.

Stirrer

Applied Separations now offers new stirrers to go into their extraction/ reaction vessels via the 5-Port cap that allows access to the inside of the vessel during your process.

The stirrers are rated to 10,000 PSI, 650°F, and go up to 3,000 rpm. The instrument control panel includes a digital display to monitor rpm. Stirrers are available with different shaft lengths, with a wide variety of impellers available to attach to the bottom of the stirrer.

Modifier/Liquid Pump

Liquid pumps may be necessary in several operations when using the Helix: adding polar modifiers, introducing solvents during PCA and for the operation of the countercurrent column.

Spe-ed MAX (#7298) is a microprocessor controlled pump delivering 690 BAR at adjustable flow rates up to 24 ml/min.

Pressure Vessel Assemblies

316 Stainless steel pressure vessels for the Helix are hand-tightened and range in size from 24ml to 1,000ml. The assembly is comprised of the pressure vessel, heating elements, electrical input cable, and insulation. Standard sizes are

7972	5mL Vessel	1” O.D. x 5.125” O.L. .390” I.D. x 2.24” I.L.
7972	10mL Vessel	1” O.D. x 5.125” O.L. .560” I.D. x 2.24” I.L.
7973	24mL Vessel	1” O.D. x 8.875” O.L. .560” I.D. x 5.9” I.L.
7974	32mL Vessel	1” O.D. x 10.5” O.L. .560” I.D. x 8” I.L.
7975	50mL Vessel	1” O.D. x 15.25” O.L. .560” I.D. x 12.72” I.L.
7329	100mL Vessel	2.25” O.D. x 9.57” O.L. 1.25 “ I.D. x 4.97” I.L.
7324	300mL Vessel	3.5” O.D. x 11.42” O.L. 2” I.D. x 5.87” I.L.
7323	500mL Vessel	4.75” O.D. x 9.49” O.L. 3” I.D. x 4.49” I.L.
7322	1000mL Vessel	4.75” O.D. x 13.63” O.L. 3” I.D. x 8.62” I.L.

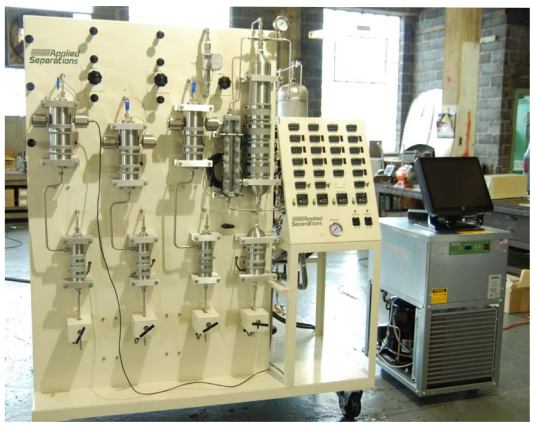
Applied Separations

Pilot Systems

Multipurpose, Expandable SFE Pilot System

Applied Separations, Inc. offers SCF systems in any size and configuration. Although the size of a pilot system versus a production system is arbitrary, customarily, Applied Separations designates pilot systems as having extraction/reaction vessels from 5 liters to 80 liters. Greater than 80 liters, we consider production scale.

Applied Separations, Inc. will work with you one-on-one to design your custom, multipurpose, movable pilot plant/small production system. The system may be as straight forward as a manual system having one extractor vessel and venting to atmosphere to an automated system having multiple extraction/reaction vessels with multiple separators, recycling the CO_2.



Manufacturing
Supercritical Systems
for 30 years

Numerous System Options
...too many to list, but here are a few...

- Temperatures ambient to 650° C
- Pressures from low to very high, more than 2000 BAR
- Single or multiple separators
- Particle formation… organic/inorganic
- Counter-current Columns
- Automated control, Automated closures
- View cells, video interface
- Manual or sophisticated automated software
- Crossover networks
- Supercritical water
- Supercritical propane and other gases and liquids
- Beaming Microwave through SCF pressure vessels
- Ultrasonic interfaces
- In-vessel UV/Vis measurements
- Cleanroom environments… medical or IC
- Specialty basket designs

Applied Separations

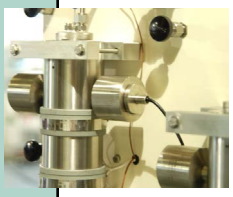
Process System

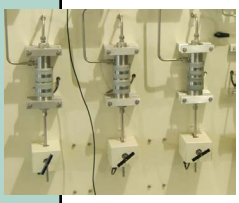
Pilot Systems

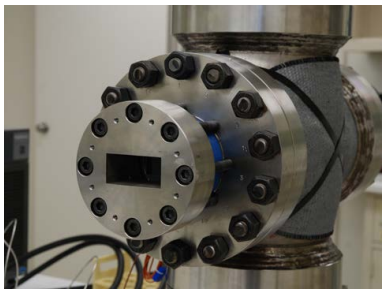
Multipurpose, Expandable SFE Pilot System

Some Uses for SCF Technologies

Aerogel Drying
Medical Implant Cleaning
Metal Injection Molding/Powder Injection Molding
Extractions of Natural Products
Critical Cleaning
Textile Dyeing
Essential Oils - Flavors and Fragrances
Nanoparticles
Coatings
Electronic Cleaning
Enzymatic Reactions
Reactions
Foods
Hydrogenation
Impregnations
Pharmaceuticals
Subcritical Water
Polyolefin Fractionation
Critical Point Drying
Archeological Artifact Drying







Applied Separations

Custom Large Scale Systems

Not all laboratories are the same, and neither are all projects. We can help you customize our systems to meet your needs. Production scale systems from Applied Separations offer all the same options and advantages of the Pilot Scale systems.

Computer control/Automation
Applied Separations offers you a completely computer controlled/automated system for use in your laboratory. Ask us how our automated technology can help you.

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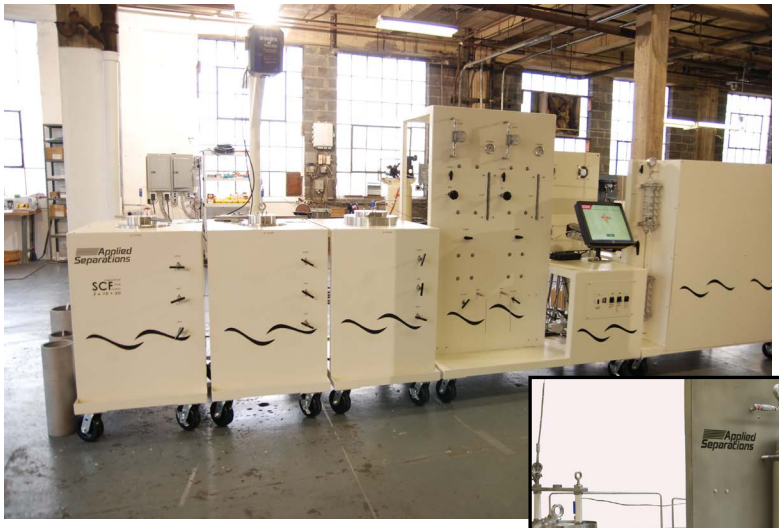
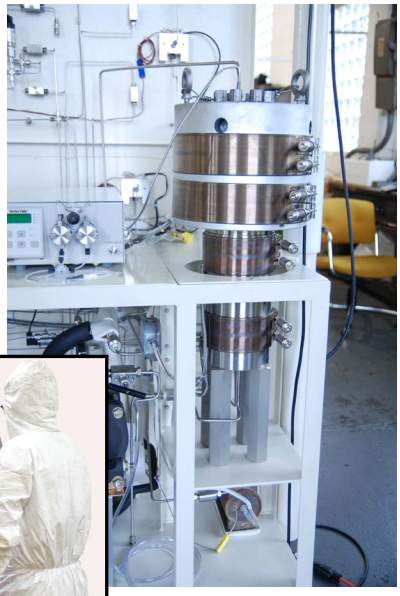
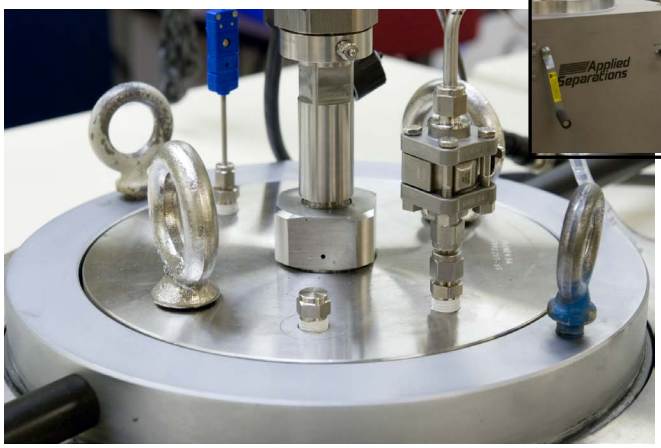
Custom Large Scale Systems







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