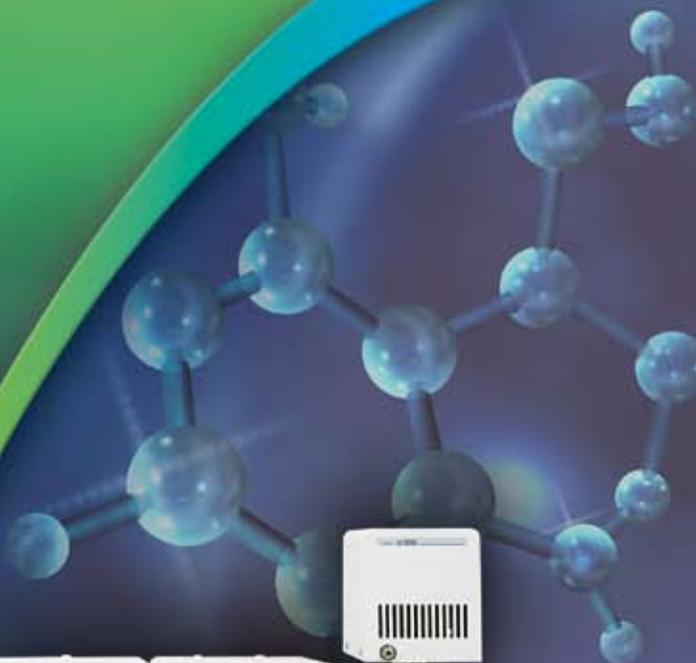


# Analytical & Preparative SFC/SFE Solutions

*Low-Cost, Fast, Green Technology*



**JASCO**



## Low-Cost, Fast, Green Technology

- 3 Supercritical Fluid Chromatography (SFC)
- 3 Analytical Systems
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*"Thank you for all your support in making this training experience a very positive one for me. I look forward to using the instrument more in the future."*

**Sarah Zhang**  
Organic Chemist

Over the years, JASCO has responded to the growing emphasis on reducing chemical waste by offering an alternative to traditional HPLC with a full line of "green" SFC/SFE products. The reduction in the use of organic solvents has cost, health and safety benefits as well as faster, cleaner sample recovery during experimental procedures. These advantages are a result of supercritical fluids liquid-like densities offering higher solubility and increased column loading. They have low viscosity and are highly diffusible enabling faster separation and extraction.

### THE JASCO ADVANTAGE

JASCO's modular SFC/SFE platforms have been optimized and refined over the last 20 years to provide reliable, worry-free performance for a wide variety of applications.

- The patented JASCO back-pressure regulator employs a high-speed switching valve to ensure that a constant back pressure is maintained at all times, regardless of the gas flow rate. Most other systems use a restriction device which is flow dependent and hence is unable to provide the essential constant pressure conditions. The JASCO design has the additional benefit of very low dead volume (below 10  $\mu$ L) which prevents fractions from re-mixing. It also presents a significant reduction in any precipitation buildup in the flow line.
- JASCO offers a wide range of detectors with high pressure cells – UV, Diode Array (real-time collection of 3-D spectra and chromatograms), and the only CD detector available for SFC.
- Our SFC/SFE versatile line can be easily converted to HPLC.
- JASCO's modifier delivery pumps guarantee stable delivery performance even at high flow rates.
- JASCO offers a truly modular system – from a simple extractor to a complex multi-instrument system that share the same basic components.
- JASCO SFC systems are compatible with most Mass Spectrometers and offer direct control in both Excalibur and Analyst software.
- JASCO provides professional, fast and courteous support on all our products. We have 28 different service centers around the United States to ensure the highest level of customer satisfaction. Our scheduled and our on-site training classes are available for advanced applications training.

### APPLICATIONS

SFC/SFE applications include analytical to preparative-scale chromatography and extraction systems used for chiral and achiral samples ranging from residual pesticide analysis to pharmaceutical drug development to petrochemical quality assurance. JASCO has also developed several dedicated platforms to help perform common analyses that are best-suited to a wide variety of technologies.

# Analytical SFC



## High throughput analysis supercritical fluid chromatography

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The physical characteristics exhibited by supercritical fluid include a diffusion coefficient that is a hundred times greater than liquid and a viscosity that is at least one figure smaller. A supercritical fluid chromatography system, such as a mobile phase medium, can rapidly perform separations without any drop in separation efficiency, even at fast flow rates, due to a rapid mass transfer inside the column when compared with high-speed liquid chromatography. In addition, when carbon dioxide is used as the medium, gasification will occur keeping the separated and fractionated sample at a constant temperature, making this technique capable of highly efficient refining with few post-processing hassles, such as the elimination of solvents after preparative isolation. This offers a host of advantages, including cost cuts related to the expense of purchasing and discarding organic solvents, high throughput analysis, and rapid preparative isolation over a short period of time.

As a gradient elution technique, SFC is capable of varying the three parameters of pressure, temperature, and modifier solvent volume when separating oligomers and constituents with differing characteristics.

# Preparative SFC/SFE



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## Preparative supercritical fluid chromatography

Figure 1 shows an example of using a 10 X 250mm column to separate 250mg of a warfarin sample using a circular dichroic (CD) detector. Outputting UV and CD at the same time as g-factor enables monitoring the position of the optimum state of optical purity while isolating with high efficiency. Figure 2 shows the chromatograms obtained through continuous measurement while stacking the collected fractions.

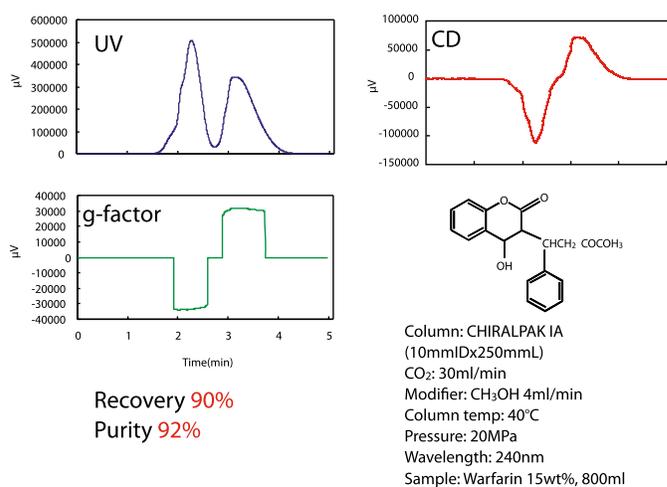


Figure 1

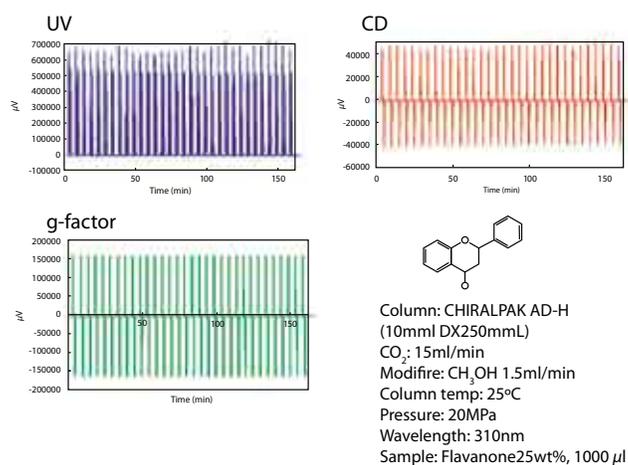


Figure 2

# Supercritical Fluid Extraction (SFE)

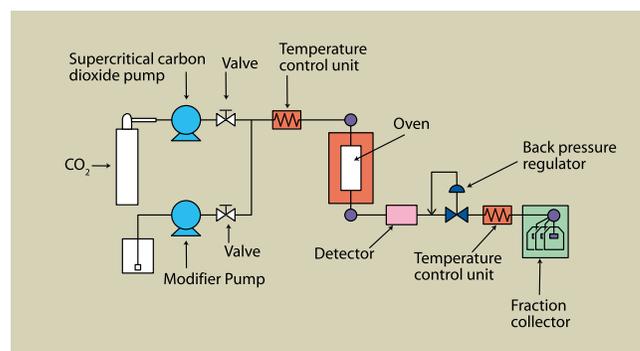


## Supercritical fluid extraction (SFE) system

Supercritical fluid extraction (SFE) is a technique that uses supercritical fluid as an extraction medium. Methods employing supercritical carbon dioxide as an extraction medium have many advantages and are used in a variety of fields. Extraction by means of supercritical carbon dioxide can improve efficiency, including shorter extraction times and simplified procedures, when compared with extraction techniques that employ organic solvents. At the same time, it offers easier solvent elimination and concentration procedures.

Since its critical temperature is a low 31°C, SFE enables extraction at or near room temperatures or in a carbon dioxide atmosphere devoid of oxygen. This makes it a technique that can be used for materials that exhibit temperature instability or constituents that are susceptible to oxidation. In addition, it has received a great deal of attention as an environmentally friendly extraction technique that does not use hazardous organic solvents, as has been advocated by the green chemistry movement in recent years.

Applications for SFE include the extraction of active constituents, including various flavors and medicinal constituents from natural products, docosahexaenoic acid (DHA), advanced unsaturated fatty acids and fatty esters such as eicosapentaenoic acid (EPA), fat-soluble vitamins, and pharmaceuticals, as well as the elimination of unwanted constituents, such as decaffeination and desolvation within tablets. It also can be applied to the preprocessing of analysis samples, including HPLC and GC.



*Basic configuration and flow path of a supercritical carbon dioxide extraction system.*

# System Components

## SFC/SFE

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### SFC/SFE Basic System Components

#### PUMPS

##### Supercritical Carbon Dioxide Pump

- PU-2080-CO<sub>2</sub> Analytical
- PU-2086-CO<sub>2</sub> Semi-Preparative
- PU-2088-CO<sub>2</sub> Preparative

#### SUPERCritical MODIFIER DELIVERY PUMPS

- PU-2085/2080 Semi-Micro/Analytical HPLC Pump
- PU-2086 Preparative Pump
- PU-2088 High Flow Rate Pump

#### DETECTORS

- UV-2070/2075 UV-Vis Detector
- MD-2010/2015 Diode Array Detector
- CD-2095 Circular Dichroism Detector

#### OTHER COMPONENTS

##### Back-Pressure Regulator

- BP-2080/2080-M Back-Pressure Regulator (patented)

##### SFC AUTOSAMPLER

- AS-2059-SF Autosampler

##### COLUMN OVENS

- CO-2060/2065 Column Oven



PU-2080-CO<sub>2</sub>  
Supercritical Carbon Dioxide  
Analytical Pump



PU-2088  
Supercritical Modifier Delivery  
High Flow Rate Pump



AS-2059-SF  
SFC Autosampler



CO-2060  
Column Oven



UV-2075  
UV-Vis Detector



BP-2080  
Back-Pressure Regulator

For a detailed list of additional components, please request our full-color catalog at [www.jascoinc.com/sfc](http://www.jascoinc.com/sfc)

# SFC Chiral

## CD-2095 – Exclusive to JASCO

The CD-2095 measures optical isomers with circular dichromatic absorption between 220 and 420 nm with high sensitivity and excellent selectivity. Compared to an optical rotation detector, it is generally 10 to 100 times more sensitive. It can measure both CD and UV chromatograms as well as g-factor (CD/UV) chromatograms. Since g-factor in particular has a proportional relationship with the compositional ratio of optical isomer samples, the CD-2095 can perform compositional measurements and high purity fractionation for non-separated peaks by, for example, measuring the chromatogram of the g-factor. In addition, spectral measurement for CD and UV is possible by stopped-flow spectrometry.



CD-2095  
Circular Dichroism Detector

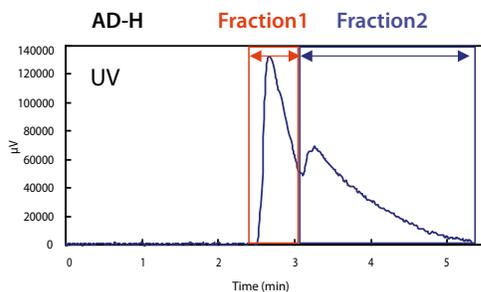
<b>Model name</b>	CD-2095
<b>Light source</b>	Hg-Xe lamp
<b>Wavelength range</b>	220 - 420 nm (Both of UV and CD)
<b>Photometric method</b>	PEM modulation method (single beam)
<b>Noise level</b>	$\pm 2.5 \times 10^{-5}$ deg at 291 nm
<b>Drift</b>	$\pm 5 \times 10^{-5}$ deg/h at 291 nm
<b>Programming</b>	Wavelength, Range, Auto Zero, Response, spectral measurement
<b>Spectral scanning</b>	220 - 420 nm fixed (Both of UV and CD)

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### HIGH-PURITY FRACTIONATION

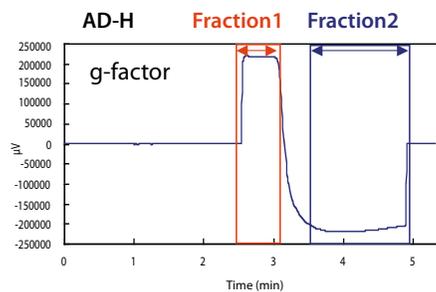
A circular dichroism (CD) detector can effectively be used for determination of purity of chiral chromatographic peaks. The g-factor, which is defined as CD/UV or AU/AU, has a value independent of the chromatographic peak concentration. Its value stays at a constant level if the optical purity is constant during peak elution.

When monitoring by a UV detector



**OPTICAL PURITY**  
Fraction 1: 100%, Fraction 2: 80%

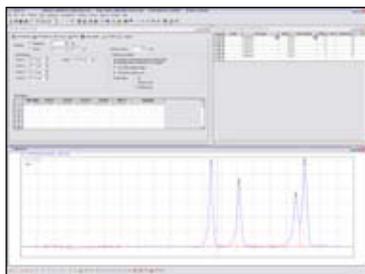
When monitoring g-factor by CD-2095



**OPTICAL PURITY**  
Fraction 1: 100%, Fraction 2: 96%

## EZChrom *Elite*™ Chromatography Data System for Analytical and Semi-Preparative Systems

### COMPREHENSIVE DATA ANALYSIS



EZChrom *Elite* is a comprehensive software package that can flexibly handle all types of chromatography data requirements and demands. These capabilities range from single-channel to diode-array and spectral data collection modes. Integrated GPC/SEC and system suitability functions are also available. Chromatographers can use EZChrom *Elite* with the confidence that they are using a powerful software package that will meet all of their current and future laboratory data processing needs.

- GLP/GMP features
- Sensible photodiode array data handling
- Fully integrated to control JASCO's SFC/SFE, X-LC®, LC-2000Plus Series

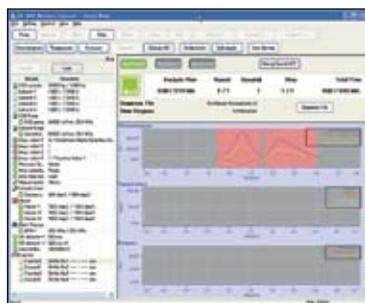
## SF-Nav for Preparative SFC

SF-NAV is software for the control and process management of SFE systems and preparative SFC systems. In addition to pumps, autosamplers, and detectors, it can also control automatic back-pressure valves and fractionation. SF-NAV can monitor and save information such as temperature, pressure, and CO<sub>2</sub> flow within the system during preparative isolation and the extraction process, making it useful when investigating fractionation and extraction conditions. It can also set fractionation and extraction conditions in line with the slope and threshold values of signals obtained from detectors and other devices, enabling full process automation for preparative isolation and extraction.

The program can display the operation state of units, icons that invoke processes by sample, and a monitor screen for chromatograms. This makes work related to SFE and preparative SFC easy to understand. Furthermore, it can batch save parameters including chromatograms, temperature, pressure, and CO<sub>2</sub> flow and export them in ASCII format.

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For system control of preparative SFC/SFE system



System control program allows for control and management of all important parameters for preparative SFC such as temperature, pressure, flow rate, etc.



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