

# CO<sub>2</sub> Applications & Technical Notes

## For Teledyne ISCO Syringe Pumps

## Overview

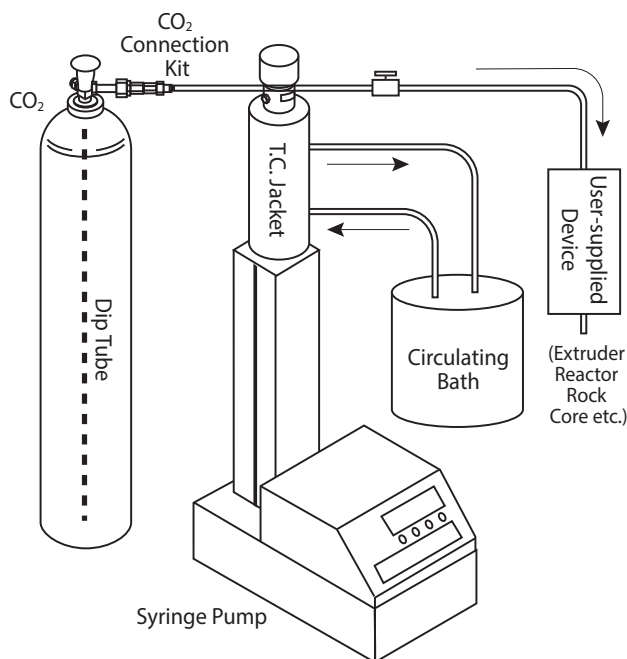
Supercritical CO<sub>2</sub> and its associated technologies are being used in many applications to replace hazardous solvents, lower costs, and improve efficiencies. Some of the applications requiring a supercritical fluid pump include:

- Carbon Sequestration Studies
- Supercritical Fluid Extraction (SFE)
- Supercritical Fluid Chromatography (SFC)
- Catalysis/Reaction Feed
- Injection molding and Extrusion
- Particle Formation
- Cleaning
- Electronic Chip Manufacturing
- Plastics Production

Teledyne ISCO Syringe Pumps are used in R&D and production in many of these applications. Syringe pumps are well-suited for use with CO<sub>2</sub> and can operate at high pressures with great accuracy and reliability.

## CO<sub>2</sub> Cylinder Connection

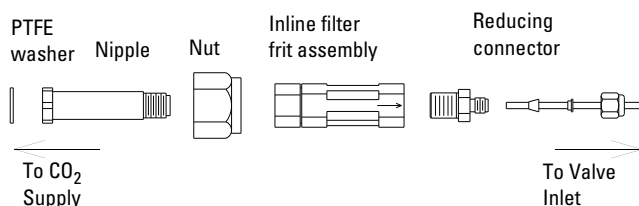
For North American gas tank connections, customers are instructed to purchase connecting parts from other suppliers, such as Matheson. CO<sub>2</sub> cylinder connection parts can be found at: <http://store.mathesongas.com>



**Figure 1: ISCO Pump and CO<sub>2</sub> dip tube tank with ISCO temperature control jacket and circulating bath**

**Table 1: CO<sub>2</sub> Cylinder Connection Assembly**

Part Number	Description
CGA-330	Fitting - short (Brass)
CGA-320	Washer - Teflon



**Figure 2: CO<sub>2</sub> cylinder connection assembly**

## Tips and Additional Equipment:

### 1. Dip Tube

An upright CO<sub>2</sub> cylinder must be equipped with a dip tube in order to pump a steady supply of liquid and not gas. The dip tube is a piece of copper tubing plumbed from the valve at the top of the tank to the bottom.

### 2. Temperature Control

To ensure a good fill, maintain the temperature in the cylinder with the ISCO temperature control jacket. The temperature control jacket is useful in SFC applications where cylinder cooling facilitates pump filling with supercritical liquid CO<sub>2</sub>. The jacket is used with a circulating temperature-controlled bath (user supplied) to keep the fluid inside the pump at a constant temperature. This can be critical when operating at very low flow rates (below 100 µl/min), where temperature fluctuation can cause flow variations.

Pump systems are available from Teledyne ISCO with the temperature control jacket already installed. For existing systems, order the appropriate package for your pump model. Refer to Technical Bulletin TB07 *Temperature Control Jacket* for additional information about installation and operation.

Contact your local sales representative for part numbers as required.

### 3. Valve Packages for Dual Pump Systems

A continuous flow system consists of two syringe pumps and a valve package regulated by one controller. This allows you to continuously deliver liquefied gas in constant flow or constant pressure mode.



Teledyne ISCO has three different types of valve packages:

- Electric valves
- Air valves
- Manual valves

Electric valves, which provide the best positive valve closure, are the most commonly used valves in liquefied gas applications. Electric valves require the pump controller to be equipped with the valve driver board.

Air valves generally open and close faster and are less prone to error and component wear, making them suitable for industrial use and other applications where the system will be constantly running; however they require a user-supplied pressurized air source and special upgrade kit in order to operate with CO<sub>2</sub>. All other wetted materials are CO<sub>2</sub> compatible.

Manual valves are used in lower-cost CO<sub>2</sub> applications where automation is not required.

For detailed installation and operation instructions, refer to Technical Bulletin #1 *Dual Pump Systems*.




**Table 2: Valve Packages for Dual Systems**

Manual	
1000D Refill	68-1247-117
1000D Outlet	68-1247-118
500D Refill	68-1247-083
500D Outlet	68-1247-082
260D/100DM/DX Refill	68-1247-077
260D/100DM/DX Outlet	68-1247-078

### 4. Low Tank Level Alarm

In constant pressure mode, the Poor Fill feature allows you to set a fill point as a percentage of pump volume. If this volume percentage is not reached after a refill and re-pressurization, the system sounds an alarm and stops the pump.

To activate the alarm, press MENU (  ) > MORE

(  ) > MORE (  ), and select POOR FILL (  ).

### CO<sub>2</sub> with Modifier

**Note**  
See the *Modifier Addition* section of your user manual for detailed information about two-pump (CO<sub>2</sub> & modifier) systems.

A dual pump system in constant pressure mode pumping supercritical CO<sub>2</sub> combined with a third pump delivering a modifier (usually a solvent) can dispense a mixture with a programmable v/v ratio, with the Modifier Addition Kit (part #68-1247-079) installed. Both fluids pass through one-way check valves before they meet and are blended in a mixing tee (see Figure 3 on the following page).

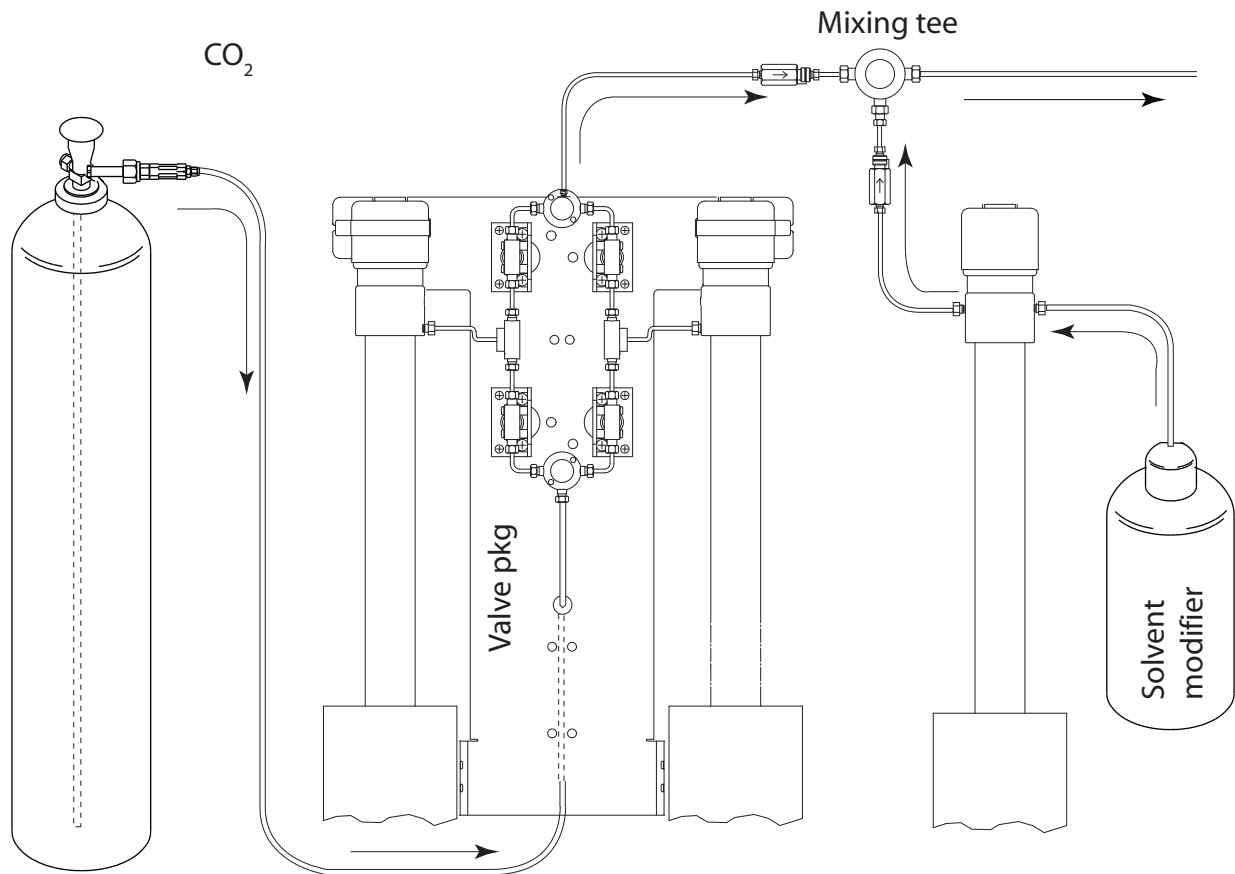
Note that the CO<sub>2</sub> input tubing runs behind the valve package mounting bracket before emerging at the valve inlet.

**Table 2: Valve Packages for Dual Systems**

Valve Package	Part #
Electric	
1000D	68-1247-109
500D	68-1247-091
260D/100DM/DX	68-1247-090
Controller for electric valves	68-1240-062
Air	
1000D	60-1247-104
500D	60-1247-061
260D/100DM/DX	60-1247-058

**Note**  
Air valves require a special upgrade kit in order to operate with CO<sub>2</sub>.

Air Valve Upgrade Kits:	
1/8"	60-5364-234
1/4"	60-5364-259



**Figure 3: Modifier addition setup** Shown with electric valve package

Before operation in modifier mode, zero and fill the pumps under independent control/constant pressure mode (*Modifier Addition* in Section 6 of your D Series user manual).

**Modifier Mode**

Once the pumps are ready, place them in modifier mode:

Press MENU ( **MENU** ) > MORE ( **A** ) > MULTI-PUMP ( **4** ), and select MODIFIER ( **3** ). Press PREVIOUS ( **D** ) three times to return to the main menu. The screen will display the words MODIFIER ON.

**Modifier Concentration**

To set the modifier concentration, press % PUMP ( **C** ). Use the numeric keys to enter the desired percentage of modifier and press ENTER to save the value.

**Note**

For additional important information about setup and operation of the modifier addition system, consult Section 9 of your D Series user manual.

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