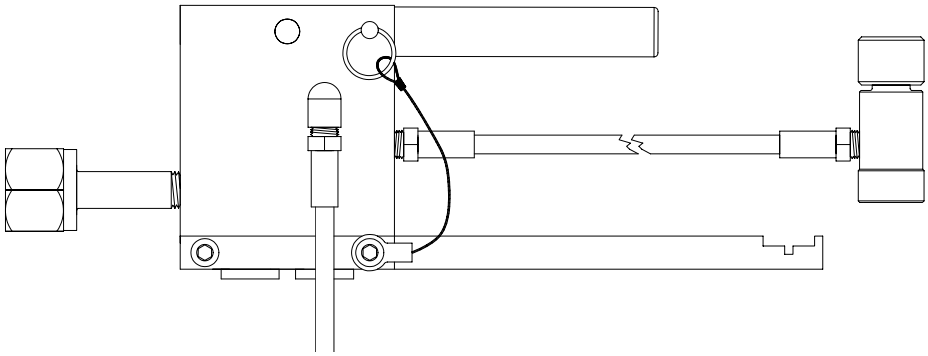
CO2 FILL OPERATIONS

SAFETY CONSIDERATIONS

ALWAYS WEAR EYE PROTECTION WHEN WORKING WITH COMPRESSED GAS! VENTING GAS CAN AND DOES ACCELERATE PARTICLES OF DIRT AND DEBRIS TO HIGH VELOCITY. KEEP ALL PERSONS WITHOUT EYE PROTECTION OUT OF THE IMMEDIATE AREA!

ALWAYS WEAR GLOVES TO PROTECT YOUR HANDS FROM EXTREME COLD. THE ACTION OF VENTING DOWN A CO2 BOTTLE CAN PRODUCE TEMPERATURES AS LOW AS –130 F. IMMEDIATE AND DESTRUCTIVE FREEZING OF EXPOSED FLESH IS POSSIBLE.

ALWAYS LOCK THE CONTROL LEVER IN THE "DUMP" POSITION WITH THE LOCKING PIN, WHEN THE FILL STATION IS NOT BEING USED!!!



SETTING UP THE FILL STATION

PLEASE NOTE: THIS FILL STATION IS FOR USE WITH CO2 ONLY!

Before you even remove the safety cap on the bulk cylinder, the bulk cylinder ***MUST*** be solidly secured to a post or wall bracket. If the cylinder were to be knocked over, the valve could be broken off, and the cylinder "Launched".

To perform fills, the fill station must be attached to the CO2 supply tank, and the discharge vent hose must be connected. Both of these operations are simple, and require little time.

The fill station is equipped with a standard "CGA 320" fitting on it's input side (the side labeled "BULK TANK"). This fitting will connect to any standard CO2 bulk tank in the United States. Please note that the threads are right –handed, and that a sealing washer is required.

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The bulk supply tank you connect to must always be equipped with an internal "dip tube" because we wish to dispense the liquid CO2 from the bottom of the bulk supply tank.

On the side of the fill station you will notice a port labeled "VENT". For safety reasons, a VENT hose should be run from this port to a safe discharge point. Depending on your circumstances, there are several ways of routing your VENT line.
If you are operating outdoors, you really only need enough vent line to direct the exhausting gas away from the operator and bystanders. Care should be taken to secure the end of this line solidly, because a loose hose can "whip" dangerously when high pressure gas is discharged from it.
If you are operating indoors, where the discharge noise is objectionable, you have two options. The first and most desirable option is to run the VENT hose to a point where it can exhaust outside. The second is to use the accessory muffler unit . The muffler unit sits on the floor, and is connected to the vent port with a five foot hose.

NOTE: *UNDER NO CIRCUMSTANCES SHOULD ANY OF THE SMALL, LOW PRESSURE INDUSTRIAL AIR MUFFLERS BE SUBSTITUTED FOR THE PROPER MUFFLER!! THESE UNITS ARE NOT PRESSURE RATED FOR THIS SERVICE, AND CANNOT TOLERATE THE POSSIBLE ACCUMILATION OF DRY ICE.*

An important point to consider when setting up your fill station is that high concentrations of CO2 can pose a serious inhalation hazard. If you are operating and venting indoors, your fill station must be located in an area where there is adequate ventilation.

UNDER NO CIRCUMSTANCES SHOULD THE FILL STATION BE LOCATED IN AN ENCLOSED SPACE LIKE A SMALL UTILITY ROOM OR STORAGE AREA!!!!

DOING THE FILL

OPERATION 1: KNOW THE BOTTLE YOU'RE FILLING!

In order to properly fill a CO2 bottle, you need some basic information, and virtually all of this information comes right off the label and the stamped markings on the bottle. Because there are Federal Standards involved, this information is found in the form of a standard data line. An example taken from an aluminum bottle is shown below.

DOT – 3AL 1800 H50HD ACME 04^94 – 2.5# CO2

While this may look confusing at first, it is really quite simple. This line of data breaks down like this:

DOT	Department of Transportation (a Federal Agency).
3AL	The specification standard the bottle conforms to.
1800	The working pressure rating of the bottle.
H50HD ACME	The model and manufacturer of the bottle.
04^94	The production date of the bottle.
2.5# CO2	The amount of CO2 the bottle is rated to hold.

The first bit of information you need is the production date on the bottle. In the United States, it is Federal Law that any gas storage vessel over two inches in diameter must be periodically re-tested. If the bottle is steel or aluminum, it must be re-tested every five years. If it is one of the new fiberglass composite bottles, it must be re-tested every three years. As a fill operator, the very first thing you should check is the date on the bottle. As you can see in our example, our aluminum bottle was born in April of 1994. It would be illegal to refill this bottle after April of 1999. (At least until it had been re-tested and re-marked.)

UNDER NO CIRCUMSTANCES SHOULD YOU FILL AN OUT-OF-DATE BOTTLE.

The next piece of information you want is the Working Pressure Rating. According to Federal Law, bottles for CO2 use must have a working pressure rating of at least 1800 PSI.

If the bottle you are being asked to fill is not rated for at least 1800 PSI, DO NOT FILL IT!!

The last piece of information you want off the label is the quantity of CO2 the bottle may be safely filled with. Depending on the size of the bottle and the manufacturer, this may be expressed either in ounces or pounds. In the case of our example bottle, we see that this bottle is rated for 2.5 pounds of CO2.

NEVER PUT MORE THAN THE RATED AMOUNT OF CO2 INTO A BOTTLE!!

To understand the relevance and importance of the last statement, it is necessary to give you a little bit of chemistry and physics. We will try to keep it painless.

> The CO2 you are dispensing into the customer's bottle is stored in a liquid state, under high pressure. At 70 degrees, the internal bottle pressure is about 850 PSI. This is OK., because 850 PSI is a good pressure for most airguns. Unfortunately for us, at 89 degrees, CO2 suddenly refuses to behave like a liquid. All the liquid in that bottle "jumps phase" and becomes a very dense, high pressure gas. Since it is still occupying the same space, the bottle pressure can instantly jump into the 1800 PSI range..
>
> To allow for this, the Department of Transportation created a standard where CO2 vessels are never filled more than 67% full of liquid. This leaves 33% of the bottle as a buffer space. If these percentages are properly observed, the CO2 can do it's 89 degree thing without really serious problems. (BTW, this is why CO2 bottles are rated for 1800 PSI, even though normal bottle pressure is in the 800 PSI range.)
>
> If a fill operator exceeds the 67% limit, he is intruding on that buffer space. If that bottle is then warmed up past 89 degrees, the resulting pressures can easily exceed 3000 PSI. Serious damage to the gun, bottle, and user are all possible.

If you find that there is no marking on the bottle or label that indicates the proper amount of CO2, DO NOT GUESS! If you are not sure what the rated fill is, do not fill the bottle

The general condition of the bottle is also important. Always take a moment to examine the bottle for dents, gouges or other significant damage. Do not fill a bottle that has been abused or damaged. Reference CGA pamphlet CGA C-6 and CGA C-6.1

The last piece of information you need about the bottle to be filled is it's true empty weight. Many bottles are stamped with their Tare Weight (abbreviated T.W.) that will give you the empty weight of the bottle and valve assembly. From that information, it is simple addition to determine what a properly filled full bottle should weigh.
If that information is not on the bottle, DO NOT GUESS. Just because you have seen this style bottle before is no guarantee that you know how much this one weighs empty. Bottle weight can vary from production run to production run. Valve assemblies vary considerably in weight from manufacturer to manufacturer. If the Tare Weight is not on the bottle, the only safe way to fill it is

to make sure the bottle is completely empty, and weigh it.

Emptying a CO2 bottle is not quite as simple as opening the valve. You will notice that as you "blow down" a bottle it gets quite cold (dangerously cold, in fact). This is because as you release the pressure in the bottle, the liquid CO2 is changing to a gas. This change of phase absorbs heat from the bottle and it's surroundings. During this operation, the inside of the bottle can get cold enough to form solid CO2 (dry ice). This dry ice will stick to the inside of the bottle even after you have vented off all the pressure. If you now weigh the bottle, you will be weighing not only the bottle, but also the dry ice trapped inside. This can cause a filling error of several ounces.

The best way to vent down a bottle for weighing is to use the "Inverted Dump Procedure". Before the valve is pushed to the "DUMP" position, the operator inverts the bottle. In this attitude, the gas pressure in the bottle forces any liquid CO2 out first, and this liquid makes it's change of phase somewhere other than in the bottle. This minimizes the chilling of the bottle, and the resulting dry ice formation.

THE ONLY WAY YOU CAN BE SURE A CO2 BOTTLE IS COMPLETELY EMPTY IS IF IT IS WARM TO THE TOUCH, ***AND*** SHOWS NO INTERAL PRESSURE.

OPERATION 2: HOOKING UP!

Once you have all your information, the physical procedure is quite simple. The procedure is illustrated graphically on the following page.

Step one: Attachment. Screw the bottle into the adapter on the end of the fill hose. Once the bottle is attached, turning the knob on the adapter clockwise will depress the pin in the bottle to open the bottle valve.

Step two: Purging. Purge off the residual CO2 in the customer's bottle. It is necessary to do this because you must decrease the pressure in the customer's bottle for the transfer from the bulk tank to take place. You do this by inverting the bottle so that the valve is at the bottom, and pushing the control handle all the way to the "DUMP" side and holding it there until gas ceases to be exhausted. The "Inverted Dump" is used because it minimizes the chilling of the bottle, and the subsequent dry ice formation.

Step three: Weighing. When you are satisfied that there is no residual CO2 in the bottle, hang or place the bottle on the scale and zero out the scale.

Step four: Filling. Push the control lever to the "FILL" side to allow the CO2 to flow from the bulk tank to the bottle you're filling. Watch the scale to make sure you don't over fill the bottle.

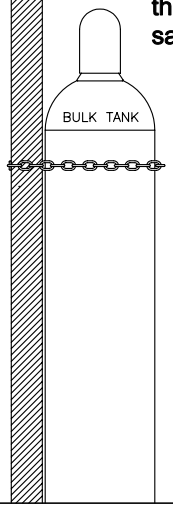
Step five: Disconnecting. Turn the knob on the fill hose adapter counterclockwise to allow the pin valve in the bottle to close. Push the control lever all the way over to "DUMP" to vent any CO2 that may be trapped in the hose. Unscrew the bottle from the fill adapter.

Step six: Double Check. Re-weigh the bottle to make sure the weight is correct. Remember, the fill hose and adapter may have affected your first reading slightly, and a second weighing is essential. ***THIS IS THE MOST IMPORTANT STEP IN THE WHOLE OPERATION! DO NOT OMIT IT!!!***

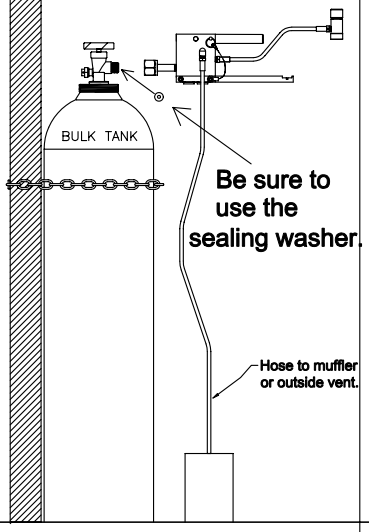
You have now filled a CO2 bottle safely, and in conformity with Federal Law. That is the only way it should be done. Remember: follow the procedures, take no shortcuts, and assume nothing. Your safety and that of your customer depend on it.

THE REFILL PROCEDURE

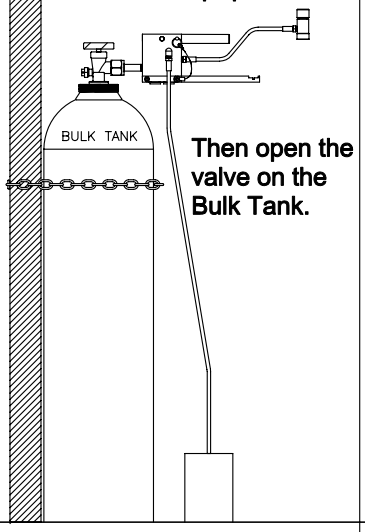
1. Secure the Bulk CO2 cylinder to a pillar or wall before removing the protective safety cap!!!



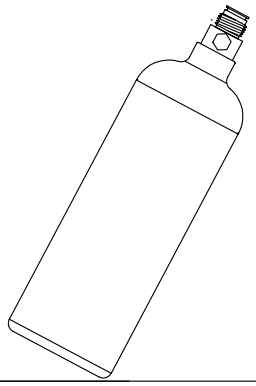
2. Attach the Fill Station to the Bulk cylinder.



3. Make sure the control lever is still locked in the "Dump" position.....,

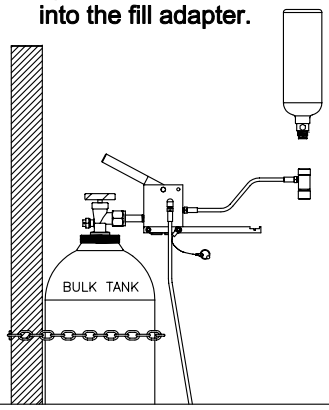


4. Inspect the bottle to be filled for visible damage, and check the bottle date!

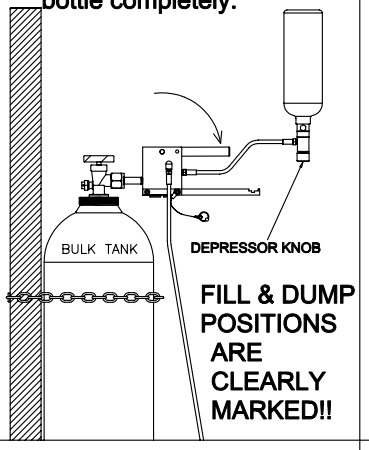


5. Remove the Control Lever Locking Pin, and allow the Control Lever to move into it's neutral position.

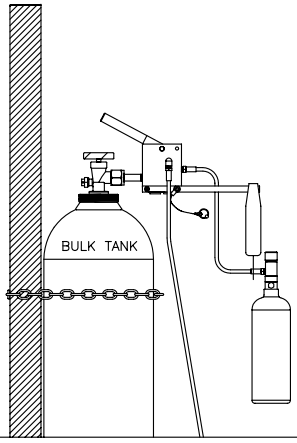
Turn the bottle to be filled upside down, and screw it into the fill adapter.



6. Turn the depressor knob on the fill adapter clockwise until it stops.
Push the control lever to the DUMP position to drain the bottle completely.

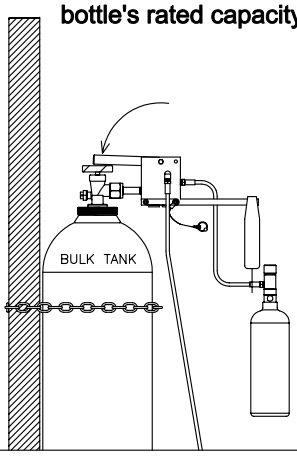


7. Hang the empty bottle from the Digital Scale, and then reset the scale to zero.

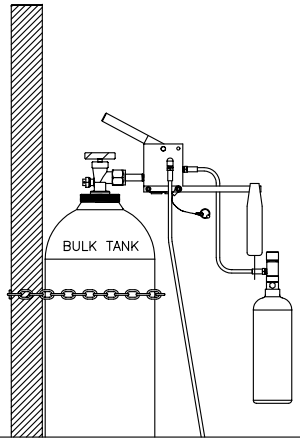


8. Move the control lever to the FILL position and watch the scale.

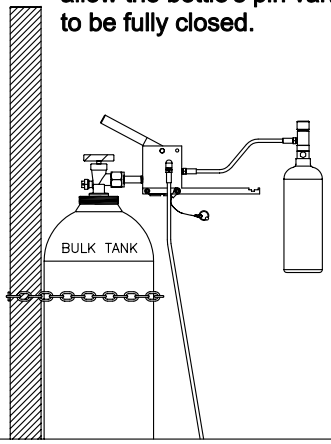
Do not fill beyond the bottle's rated capacity!!!



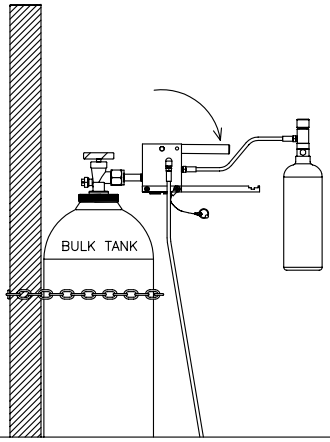
9. Allow the control lever to return to it's neutral position.



10. Unhook the bottle & hose from the scale and turn the Depressor Knob counterclockwise at least 2 full turns. This should allow the bottle's pin valve to be fully closed.



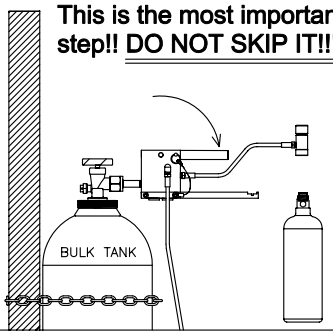
11. Move the control lever to the DUMP position to drain any residual CO2 from the hose.



12. Unscrew the bottle from the fill adapter.
Move Control Lever to the "Dump" position, and replace locking pin.

RE-WEIGH THE BOTTLE TO MAKE SURE YOU HAVE NOT OVER-FILLED!

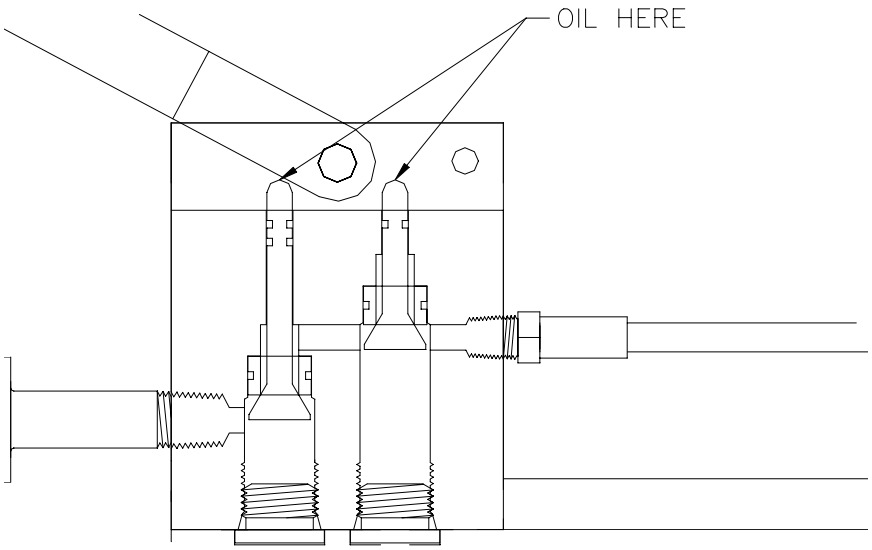
This is the most important step!! DO NOT SKIP IT!!!



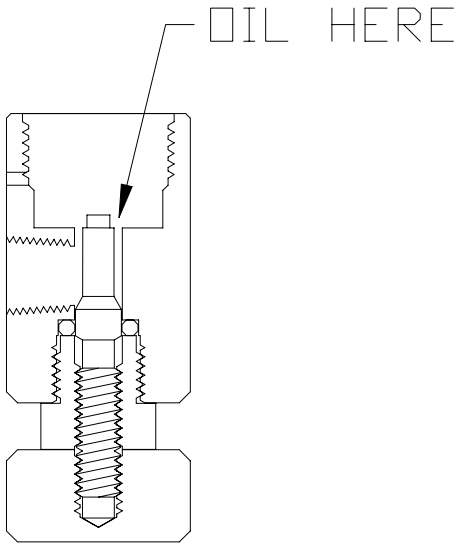
A LITTLE CARE (AND OIL) GO A LONG WAY!

Your M10 CO2 Fill Station has been designed for years of reliable service, and it will require only the simplest routine maintenance.

On a daily basis, you should apply a couple of drops of air tool or airgun oil to the tops of the valves, right where the Control Lever presses on them. Oil applied here will not only lube the lever contact point, but it will run down the valve stem, and keep your valve seals happy.



The other Item that wants occasional lubing is the “O” ring in the Universal Fill Adapter. On at least a daily basis, apply a couple of drops of oil to the depressor pin in the UFA, in order to keep this “O” ring lubricated.



Liquid CO2 behaves like a solvent, and tends to wash away oils, so if you fill a large number of bottles per day, you may want to perform this operation two or three times daily.