ThermoSafe®
DryIceMachine-Ultra

Operating Instructions for ThermoSafe® Dry Ice Machine-Ultra, Model 560

The ThermoSafe® Dry Ice Machine-Ultra, Model 560, is the state-of-the-art bench-top dry ice machine. Making dry ice with the Model 560 is easier, faster and safer than ever before, and will provide better value from liquid CO_2 cylinders.

Before you use the machine, please read these operating instructions completely.

To make solid blocks of dry ice, you will need the following:

- The ThermoSafe® Dry Ice Machine-Ultra (Model 560)
- A cylinder of liquid CO_2 with siphon
- Wrench (included) to connect supply line and CO_2 cylinder
- Insulating gloves and protective goggles

Expected results (at room temperature):

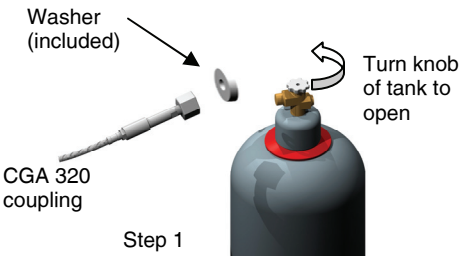
- Weight: 1-pound dry ice block
- Dimensions of final dry ice block: 6 x 4 x 1-1/2 inches
- Density: a function of the temperature and pressures inherent in the process, density typically is 50% of commercial grade.

Cautionary Notes:

1) This machine should be used only in an open and well-ventilated room. CO_2 vapor – whether from the cylinder, from the machine during operation, or from blocks of sublimating dry ice – is heavier than air; and may displace air in a closed space leading to **possible asphyxiation**.

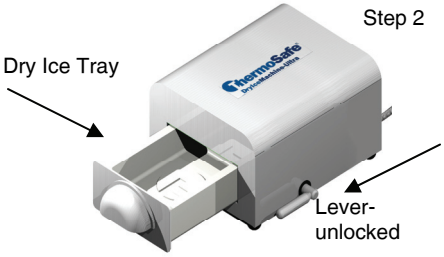
2) Cylinders of liquid CO_2 at room temperature (20-24°C) operate at pressures near 850 pounds per square inch (psi). Users should be familiar with using such equipment.

3) While using the Model 560, incidental contact with dry ice (-78.5°C /-109.3°F) is likely. ***Please wear insulated gloves and protective goggles.***



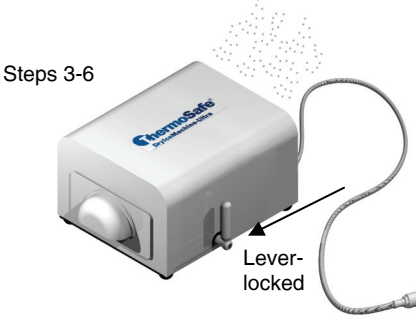
Operation:

1) Place unit on a table or counter, near CO_2 cylinder. To make dry ice, attach supply line to valve of liquid CO_2 cylinder, making sure to insert washer (included) between the CGA 320 coupling and cylinder. Tighten nut with wrench (included).



2) Slide dry ice tray into machine so that foam gasket of tray is in contact with front plate of the machine.

3) Rotate lever clock-wise until it moves just past the vertical position and stops. The dry ice tray is now "locked" in place. ***Never make dry ice unless the tray is locked.***



4) Open valve of liquid CO_2 cylinder, allowing liquid to flow through the supply line and enter tray of Model 560.

5) While tray is filling with dry ice, CO_2 vapor will vent into heat exchange chamber (cooling incoming liquid), and then will exit through bottom of the machine.

6) After about 50 to 60 seconds, the pressure relief feature will operate, making a noticeable sputtering sound, releasing vapor and small bits of dry ice. When the sputtering is sustained for 2 seconds, close the valve on the CO_2 cylinder to stop the flow of liquid.

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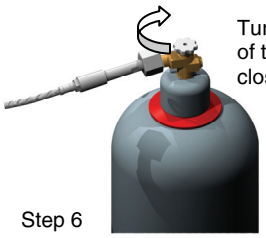
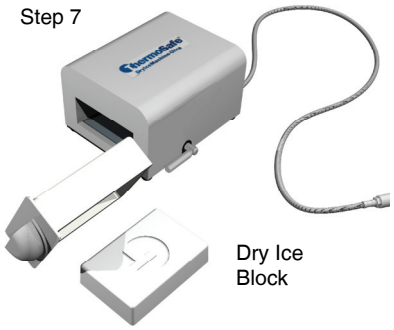


Step 6

7) Rotate lever counter clock-wise to unlock dry ice tray. Pull tray from machine. Turn tray upside down. A 6 x 4 x 1-1/2 inch block of dry ice, weighing about one pound, will slip out of the tray. **Don't forget to use insulating gloves.**
Note: Under some conditions, you may have to shake or tap bottom of tray to release dry ice block.

Step 7



8) Repeat steps 2 through 7 to make additional blocks of dry ice. Subsequent blocks may take slightly less time to make, since the dry ice tray and assembly already are cold. Blocks of dry ice may be stored in rigid ThermoSafe® Insulated Shipper-PUR or ThermoSafe® Insulated Shipper, expanded polystyrene (EPS). **Never store dry ice in air-tight containers. CO_2 vapor will sublimate off the surface of the dry ice, building up pressure and eventually bursting the container.**

9) When you have completed making dry ice, allow the machine to reach room temperature before returning it to storage.

Making Dry Ice from Liquid Carbon Dioxide (CO_2)
Making dry ice takes advantage of the principle of adiabatic expansion, also known as the Joule-Thomson effect. Liquid CO_2 in a cylinder at room temperature and at approximately 850 psi is ejected through a small orifice into the dry ice tray of the Model 560, which is at normal atmospheric pressure (about 14 psi). However, at normal atmospheric pressure, the liquid CO_2 expands, cooling rapidly. Within the confines of the Model 560 dry ice machine, the cooling is so severe that the temperature drops to -78.5°C /-109.3°F, at which point some of the CO_2 converts to dry ice snow (solid), packing inside the dry ice tray.

The efficiency of the process (ratio of solid-to-liquid) varies based on temperature and pressure, so that lowering the temperature of the liquid improves the yield of solid (dry ice.) For example, at room temperature and approximately 800 psi, the yield is near 26%; but at 0°F and 290 psi, the yield improves to 39%. With this in mind, cold vapor generated by the process is directed within the Model 560 to pre-cool incoming liquid through a heat exchanger, which improves the yield of the Model 560 over previous units. Under typical conditions of use, dry ice yield can be 25% to 30% better than in previous dry ice machines. Storing cylinders of liquid CO_2 in refrigerators or even freezers can increase yields still further.

Note: Lowering the liquid CO_2 temperature will lower the pressure in the cylinder, which will likely lower the density of dry ice produced by the Model 560.

Cold storage of liquid CO_2 has another benefit: it increases the proportion of CO_2 liquid to vapor in the cylinder. For example, at 70°F a cylinder with 50 lbs. of CO_2 actually contains about 70% liquid and 30% vapor. Lowering the temperature to 60°F increases the proportion to 77% liquid and 23% vapor, while raising the temperature to 80°F decreases the proportion to 58% liquid and 42% vapor. Above 87.8°F (the critical temperature), all liquid CO_2 converts to vapor and dry ice can not be produced. Below 87.8°F, the colder the CO_2 cylinder, the more liquid CO_2 is available for production of dry ice.

WARRANTY

Tegrant. warrants that the Model 560 Dry Ice Machine – Ultra ("Product") conforms, on the date of purchase, to Tegrant's specifications for the Product and, as of such date, is free from defects in material, workmanship, and design. Any claim under this warranty must be made within twelve (12) months from the date of purchase of the Product (the "Warranty Period"). Customer must promptly notify Tegrant in writing of any defect discovered during the Warranty Period. In no event shall such notice be given more than thirty (30) days following Customer's discovery of the defect. Tegrant shall promptly repair or replace, at its option and without cost to Customer, any defective Product. Except as specifically set forth above, Tegrant MAKES NO OTHER WARRANTY, EXPRESS, OR IMPLIED, CONCERNING THE PRODUCT, AND SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The liability of Tegrant with respect to any and all claims in connection with the sale of the Product whether based in contract, warranty, tort, strict liability or otherwise shall in the aggregate not exceed an amount equal to the purchase price for the Product. Notwithstanding anything provided herein or otherwise to the contrary, in no event shall Tegrant be liable for any consequential, special, or indirect losses, including, but not limited to, damages arising from loss of use, business interruption or loss of profits.

Serial # _____ Inspected by: _____

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