Transportation and Lifting of Liquefied Gas Dewars

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Fermilab uses liquefied gasses or cryogenics in various forms around the lab. These liquefied gasses are sometimes transported in large dewars weighing up to 600 lbs. Transportation of these dewars using a standard cart can be dangerous as apparent by several injury-producing incidents that have occurred within the DOE labs. Several of these incidents are highlighted below. This handout will provide instructions on safely using different methods of transportation of these dewars. Once you have been given time to review this handout with your supervisor, your supervisor will walk you through the proper procedures for moving dewars and then evaluate you in a hands-on scenario to complete your training.

Things to remember when handling dewars:

1. Dewars are very heavy and must be handled properly to prevent serious accidents and injury. Transporting dewars on inclines can be particularly hazardous.
2. Dewars come in different sizes and the lifting points change from dewar to dewar, which requires that the dewar cart be adjusted accordingly.
3. Always inspect the transport cart, and take it out of service if it looks to be in need of repair.
4. Always check the welds on the dewar ring posts (where the dewar lifting points are located) for cracks.
5. Use proper body position and body weight when tipping the dewar backwards towards you to avoid straining the body.
6. NEVER place a hand on the ring when tipping the cart backwards. ALWAYS place both hands on the dewar cart handle.
7. If you do not feel comfortable operating a certain cart, STOP. Ask your supervisor or knowledgeable employee for assistance.
8. **NOTE: Do not panic if the dewar should slip and fall to the floor.** A dewar is specifically designed for transporting cryogens and is protected with safety devices.

Dewar Incidents

Incident #1

An employee was attempting to move a 160 L liquid nitrogen dewar using a dewar cart. The employee stood the cart up next to the dewar and inserted the cart lifting pin into the slot provided for this purpose. The lifting slot is located in the handling ring support post near the top of the dewar. He then placed his left hand on the handling ring and his right hand on the cart handle and began to tilt the cart back and down onto its wheels. As he pulled back on the cart and dewar, the lifting pin disengaged from the post slot and the dewar rapidly slid down the cart. The employee's middle finger of his left hand, which was curled underneath the handling ring, was caught between the handling ring and a horizontal steel support member of the cart. The dewar continued sliding down the cart and came to rest on the floor. The employee sustained an avulsion of the fingertip. The employee was transported by ambulance to a hospital ER for treatment, where the fingertip was reattached. The employee remained off work for five days following the incident and then returned to work with job-limiting restrictions.

Incident #2

As an experienced worker attempted to stabilize a 160 L Argon dewar that began to dislodge from a commercial transport cart, his right hand got caught between the dewar and the cart, severing the ends of his right ring and little fingers. The dewar fell onto the dock and the transport cart fell to the parking lot below the dock. The worker had intended to move the recently filled dewar a few feet to connect it to the building's gas manifold for laboratory use. Indications are that as the worker pulled back on the cart, the lifting stem became dislodged from the dewar. The worker was immediately transported to a local medical center for treatment and evaluation. Medical personnel indicated that the worker lost two centimeters from the end of his right ring finger and one centimeter from the end of his right little finger.

Incident #3

An employee was preparing to move an argon dewar weighing approximately 300 pounds using a "notch-type" dewar-wheel cart with a four way adjustable post. The post must be adjusted for the height of the dewar that is being moved. In this instance, the employee did not select the correct adaptor position, and therefore the dewar did not fully rest on the post of the dewar cart. The employee had selected an adapter position that required the adapter to be in a somewhat raised position rather than in the fully down position in which it was being used. When the employee tipped the cart and dewar back to rest on all four wheels, the dewar rolled on the cart trapping the employee's middle finger on the right hand between it and the cart. The finger was crushed and partially pinched off, and later had to have 4 mm of the tip of the bone amputated.

The Harper "Post-Type" Cart

The Harper post type cart has a slightly upward curved hook that is adjustable using a pin and slot system.

Adjustment of the hook is critical. The post type cart must be adjusted to fit the height of the dewar before the post is inserted in the lifting hole. The correct adjustment is to raise the post so that the top of the lifting post is about one inch higher than the lifting hole.

After the post is properly adjusted, lean the tip of the cart in towards the dewar on an angle that will allow insertion of the post into the lifting hole. Some carts are equipped with a handle to assist with the positioning of the cart.

The post should be engaged as in the photo before tipping the dewar back towards you. When the post is fully engaged into the lifting hole, the top of the lifting post is touching the top of the lifting hole. There should be no free play. If the hook does not fit snug, readjust.

Place both hands on the upper handle, and place one foot against the lower bar for leverage, to tilt the cart back). Never grab the dewar ring with one of your hands. Pull back gently using your body weight until the cart comes to rest on all four wheels.

The dewar is now fully tipped and stable on all four wheels. The dewar and cart can now be rolled to the desired location. Check for, and remove, any obstacles that may hinder transport. Be mindful of elevation changes or sloped surfaces.

The Harper "Notch-Type" Cart

This is a Harper model notch-type cart. It has a four-way adjustable post that has notches to receive the dewar lifting point. The post is spring loaded.

The post must be adjusted for the height of the dewar that is being moved. This mechanism must be lifted up out of the post, rotated, and re-inserted into the post.

The bottom of the properly chosen notch will align with the top or slightly above the lifting point opening.

Tip the top of the cart towards the dewar and insert the notch mechanism. Some carts are equipped with a handle to assist with the positioning of the cart.

This is a close-up of the desired position of the notched bar. Note that the bottom of the notch is touching the top of the lifting hole on the dewar ring support.

Place both hands on the upper handle, and place one foot against the lower bar for leverage, to tilt the cart back. Never grab the dewar ring with one of your hands. Pull back gently using your body weight until the cart comes to rest on all four wheels.

The dewar is now fully tipped and stable on all four wheels. The dewar and cart can now be rolled to the desired location. Check for, and remove, any obstacles that may hinder transport. Be mindful of elevation changes or sloped surfaces.

The Anthony Cart

The Anthony cart is very similar to the Harper “post- type” cart with an upturned hook, but uses a gear rack to adjust the height of the post. It also has a built-in ratchet strap to secure the dewar if necessary.

The adjustment of the post is marked on the post. This line on the post (note the white line in the photo) should be even with the top of the hole in the dewar post. The adjustment should be made prior to inserting the post into the dewar lifting hole. The frame of the cart is leaned towards the dewar to insert the post into the lifting hole.

To adjust the height of the post, you must remove the “L”- shaped bracket. Adjust the post and replace the “L” bracket.

Lean the cart towards the dewar and insert the upward turned hook into the lifting point. Once the hook is fully inserted and snug, the strap can be placed around the dewar and tightened.

When tilting the cart back, ensure that <u>both hands</u> are on the cart handle(s). <u>Never</u> grab the dewar ring with one of your hands. Place one foot against the lower bar for leverage, and pull back gently using your weight.

The Barrel Hawk

The Barrel Hawk lifts dewars vertically. No tilting of the cart is needed.

Place the barrel hawk near the dewar. Position the cart's lifting post in line with the lifting hole on the dewar. The lift mechanism is hydraulically actuated.

One must close the valve and pump the handle to raise the lifting post.

The lifting mechanism is different than the Harper or Anthony carts. The post must be raised as the Barrel Hawk is moved closer to the dewar to fully engage the lifting mechanism with the lifting hole on the dewar. The dewar can now be lifted off the ground by pumping up the hydraulics.

The dewar should be lifted no more than an inch or two off of the floor. Watch for obstacles and uneven surfaces when moving the cart, as the cart may tip forward.
Once lifted, the support straps can be connected and tightened prior to moving.

MOVING DEWARS WITH A CRANE

Lifting Dewars with a Basket Sling

In some cases, when an overhead lift of a dewar is required, a basket sling can be used. The Barrel Hawk is an ideal tool to raise the dewar to install the basket sling. Use the Barrel Hawk to lift the dewar as usual, but do not connect the support straps. Position the basket sling under the dewar and place the webbing and lifting eye on the dewar.

Connect and snug the ratchet straps. Pull upwards on the basket strap to remove slack from the bottom up. Raise the lifting eye to connect to overhead crane hook. When connected, lower the Barrel Hawk and move it out of the way. Proceed with the dewar lift using the crane following the usual safe crane practices.

Lifting Dewars with J-Hooks

When using J-hooks to lift dewars, ensure that the hooks are not grabbing anything but the lifting hole. Make sure the welds on the ring posts are not cracked. **Per the manufacturer's requirements, never lift a dewar by its ring.**