Laying Flexible (Lay-flat) Fuel Lines, South Pole Station

OP-S-340

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Approved by [redacted]

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Active Divisions/Departments:
South Pole Area Directorate

Raytheon Polar Services Company
South Pole Area Directorate
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Purpose

The intent of this procedure is to ensure consistency and safety when laying and connecting the flexible, lay-flat Angus Chemicoil fuel hose employed at the South Pole. Chemicoil hose is used to transfer product between the Fuel Pits and Fuel Storage Facility. Two-and-one-half-inch and four-inch Chemicoil hoses are stocked at the South Pole.

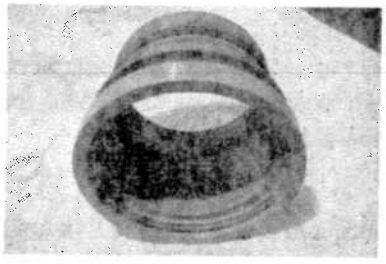
Scope/Applicability

This procedure applies to all Fuels personnel at the South Pole. This Standard Operating Procedure shall be presented to and discussed with the hose-laying crew in a detailed training session before any work begins on the project.

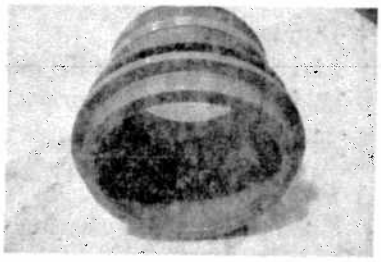
Terms and Definitions

Angus Chemicoil Hose
Four-inch lay-flat hose used for delivery of fuel to the Fuel Storage Facility (Fuel Arch) and for Pit 2 applications. Similar six-inch hose is used in McMurdo for all runway operations and tanker offloads. Two-and-one-half-inch hose is attached to nozzles and used for aircraft operations.

Barbed Nipple Gender Fitting
Metal cylinder over which a hose end can be fitted to make a Hydrasearch Segmental Gender Coupling. Barbed nipple gender fittings are either male or female:

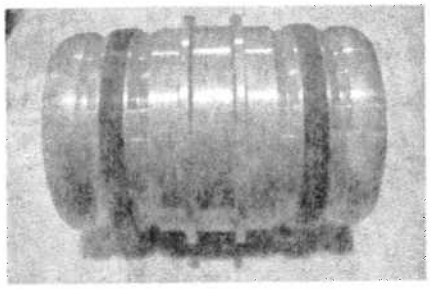


FEMALE FITTING

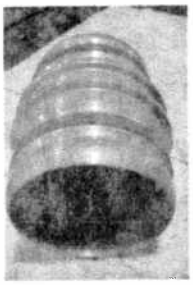


MALE FITTING

Barbed Nipple Mender Fitting
One-piece metal cylindrical fitting with barbed nipples on both ends. A Mender Fitting allows a connection to be made without the use of gender fittings or a wedding band.



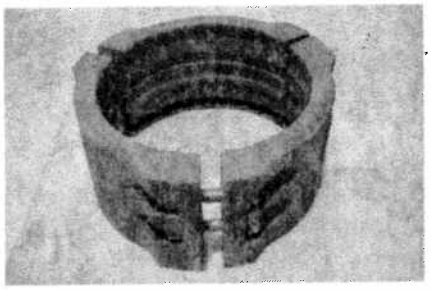
MENDER FITTING



MENDER FITTING

Cargo Strap
Polyester web tie-down straps with an integrated ratchet and hooks on both ends.

Collar
Segmented metal clamp that binds the hose to the barbed nipple of a gender or mender fitting. The collar presses on the floricilian gasket to create a seal. A collar is held together with dedicated bolts.



COLLAR

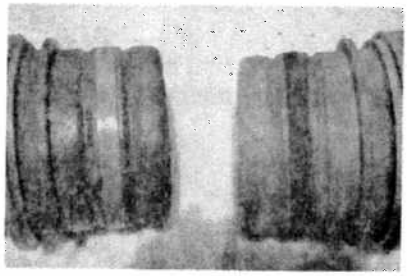
Drip Pan
A shallow pan used to catch small amounts of fuel.

Dunnage
Large (e.g., 8" x 8" x 8') pieces of wood used in holds and containers to protect shipped goods and their packaging from mechanical damage. Also used to elevate pallets and alongside hoses as protection at road crossings.

FEMC
The Facilities, Engineering, Maintenance and Construction Division of Raytheon Polar Services Company.

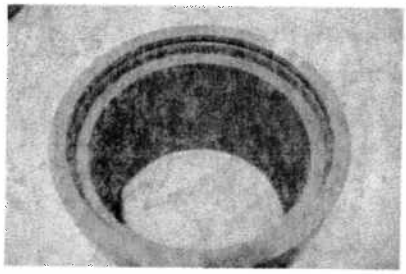
Flight Deck
The aircraft operations ramp at South Pole Station.

Floricilian Gasket
Specialized low temperature gasket that fits in a groove on a barbed nipple gender or mender fitting. Floricilian gaskets are blue in color.



FLORICILIAN GASKETS

Floricilian O-ring
Specialized low temperature O-ring used when making a connection between Hydrasearch Segmental Gender Couplings. The O-ring is inserted into the female gender fitting. Floricilian O-rings are blue in color.



O-RING INSIDE FEMALE GENDER FITTING

Four-inch Hose Kit
Small tool box consisting of a torque wrench, speed wrench, 9/16" socket, 9/16" deep well socket, flat head screw driver, dead blow hammer or rubber mallet, utility knife, oil, spare bolts, a file, a permanent marker, and four-inch gaskets and O-rings used to make four-inch hose connections.

Fuel Pit
A fuel transfer facility, normally containing equipment such as pumps, valves, meters and fuel manifolds.

Gender Connection
Two, Hydrasearch, Segmental Gender Couplings sealed with a wedding band.

Hebert Clamps
Specialized hose clamp used to collapse and isolate sections of lay-flat hose.

Hose Reels
Spools on which the four-inch lay-flat hose is stored. Reels are typically re-used wooden reels from electrical cable storage. They vary in size and are handled manually.

Hydrasearch Segmental Gender Coupling
One, barbed nipple gender fitting with the collar attached.

Hydrasearch Segmental Mender Coupling
A mender fitting with collars on both ends. Same as a Mender Connection.

Mender Connection
Same as a Hydrasearch Segmental Mender Coupling (no wedding band is necessary as the fitting is one piece).

Packing a hose
As a hose is initially filled, using the air trapped ahead of the liquid to leak-test hose connections before the liquid reaches them..

Pit 2
Secondary fueling station on the South Pole flight deck.

Polypack
A 20-gallon container used to catch excess fuel or air/fuel mixture that is bled from the hose.

Station-all
An e-mail message addressed to all personnel currently assigned to South Pole station.

Torque Wrench
A specialized wrench that measures the amount of torque applied to a bolt.

Wedding Band
Hinged ring that fits over the shoulder of joined male and female gender fittings. Also called a split-ring clamp by Hydrasearch.

Responsibilities

The Fuels Foreman is responsible for setting a timeline and coordinating the use of heavy equipment for hose laying projects. The Fuels Foreman should also coordinate

with the Fuels Supervisor in McMurdo to ensure that all torque wrenches used are properly calibrated. Fuels Operators are responsible for safely laying the hose.

Discussion

Planning the Hose Lay

Typically, the hose line to the Fuel Arch is set up as soon as safely possible after season opening.

Before any hose lay begins, the following must occur:

1. Decide what route that the hose will follow. The hose is laid in the same general area each year. While the positioning for the hose location does not need to be exact, some departments' needs must be considered. Contact Fleet Operations, Cargo, FEMC, and the Science community to avoid placing the hose where it will interfere with their operations.

2. Determine the appropriate locations for hose line vehicle crossing points, and arrange to have culverts delivered to those locations by heavy equipment. Coordinate the hose-laying across roads with Fleet Operations to bury the culvert soon after placement and minimize road closure time.

3. Send out a station-all e-mail message announcing the planned hose location and avoidance procedures.

4. Select the location and order of hoses and reels. Reels should be marked when hoses are picked up each season (hose length, fittings on ends, previous location, etc). Minimizing connections is desirable, so choose hoses accordingly. One reel, for example, should be marked and dedicated to Pit 2 operations. Forklift support is needed to carry the reels while Fuels Operators unwind and properly place the hoses.

5. Arrange the use of a snowmobile and portable heater ("Herman-Nelson") from the Garage. Try to avoid long-idling time of equipment in cold temperatures. Frequent warm-ups of equipment and personnel are advised.

6. Review the hose laying process with all who will be involved. Go over Fuel Transfers (see procedure OP-S-302), this SOP, and site-specific safety issues, including cold injury prevention. Emphasize safety in all tasks. Using four-inch hose couplings, instruct Fuels Operators on how to make a coupling, how to inspect the collars, and how to properly use the tools in a four-inch hose kit. Take special care to make sure that the torque wrench is set to its lowest setting after use.

7. Identify/gather the following materials:
   - Four-inch hose kit (see definition, above)
   - Plywood to cut hose on
   - 6-8 Hebert hose clamps
   - 2-3 drip pans
   - 2 20-gallon polypaks
   - 2 male gender fittings
   - 2 female gender fittings
   - 1 mender connection, if available
   - 4 hose collars
   - 2 split-ring clamps (wedding bands)
   - 2 cargo straps
   - 100 blue flags on 8' bamboo poles
   - Absorbents
   - Shovels
   - Banana or cargo sled for hauling materials
   - Dunnage and plywood to extend road crossings. Dunnage should be at least 8"x 8" and of sufficient length to put next to culverts to ensure road crossings are at least 22' wide
   - Hose to be laid

Laying Fuel Hose

Because the South Pole Fuels Team is small (typically 2-4 individuals), all members are needed for laying the hose to the Fuel Arch. Pull the hoses off the reels and lay

them approximately where they should go. Mark the road crossings and have the culverts placed and buried. Feed the hoses through the culverts and make the hose connections according to procedure (see below).

Note Some of the hoses on reels are already connected to each other. All of these fittings will need to be examined and tested.

At each connection, prior to being filled with fuel, the torque of each collar is checked, the hose is "packed" with the air moving ahead of the fuel, and then the air is bled from the line. To do this, clamp two Hebert clamps on the upstream side of the connection and one on the downstream side, with a drip pan under the connection. Leave at least three feet of hose between the Hebert clamps and the connection to allow the connection to be cut out and re-made if necessary. As a safety precaution, a fourth Hebert clamp should be closed on the line further downstream, prior to the next connection. The purpose of this last clamp is to stop air or fuel from reaching a connection that has not yet been tested.

Making and Testing 4-inch Hose-end Fittings

Adding New Fittings

When assembling a new fitting on an open hose end, follow these procedures:

1. Cut hose squarely to length using a sharp knife
2. Be sure the nipple fitting has an intact, blue floricilian gasket. If a new gasket is needed, remove one from the hose kit and warm it before installing. Do not use a black (buna-N) gasket as they do not work well at the extreme temperatures of the South Pole.
3. Insert coupling nipple into hose until the hose meets the shoulder on the nipple. Keep a close eye on the gasket to ensure that it does not pinch or slide out of its groove. A heat source (e.g., Herman-Nelson) will make this process easier.
4. Find a segmented collar and inspect the collar carefully, looking for any signs of cracking, distortion, or other damage prior to use. Place segments around the hose so that the lip on the segments captures the shoulder on the nipple. Take

care to ensure that none of the gaps of the collar are lined up with a crease in the hose.

5. Insert bolts with flat washers through the holes in the segment marked "hex". Place the square nut in the pocket marked "sq", and hand-start the bolt into the nut. This design allows the bolts to be tightened with one wrench for easier installation.

6. Using a socket wrench, tighten the bolts in random order, taking care to maintain an even spacing between the segments. Never tighten one set of bolts completely without tightening the other bolts--doing so will cause an uneven gripping of the hose and could lead to coupling failure.

7. Continue tightening bolts alternately to maintain even spacing between segments. Do not work continuously on one bolt or one section; rotate around the collar, slowly tightening each bolt until they have been evenly torqued.

8. For 4-inch fittings (and 6-inch fittings), initially tighten bolts to 25 foot-pounds of torque, then 30 foot-pounds, and finally 32 foot-pounds. This progression allows for even pressure across the collar.

9. Using a permanent marker, draw a line on the hose against the edge of each collar. Write the date and gender of the connection next to the line.

Testing Existing Fittings

Do the following for each existing collar on a fuel line:

1. Back off all bolts ¼ - ½ turn.

2. Once all bolts have been loosened, torque all bolts to 25 foot-pounds.

3. Starting with the bolt on the hose-side of the collar, tighten all bolts, alternating the order in which they are tightened. Do not work continuously on one bolt or one section; rotate around the collar, slowly tightening each bolt until they have been evenly torqued. Torque all bolts to 30 foot-pounds.

4. Continue alternating bolts and tightening to the specification of 32 foot-pounds.

5. After the collars on both sides of a coupling have been torqued, visually inspect the coupling. Ensure that the gaps between the collar sections are even. (The sections of the collar should be parallel to each other. Each gap should be consistent, and the three gaps should all be consistent in width with each other.) In addition, make sure the hose is not being pinched in the gaps between collar sections. Look for any cracks in the collars or for any other signs of damage or wear.

Making and Testing 2-½" Gender Fittings

Preparing and making connections on the 2-½" Chemicoil hose is similar to the procedure for larger hoses. The primary difference is in the torquing of the bolts. Collars for the 2-½" hose have 2 segments. The cast fittings are prone to cracks and defects, thus they must be inspected prior to every use. Torquing of the bolts for 2-½" collars should be initially at 15 foot-pounds, then 18 foot-pounds; then test the connection. If leakage occurs, torque can be increased to a maximum of 21 foot-pounds, but experience in the cold temperatures of the South Pole has proven that many collars break at this level.

Making Gender Connections

Remove the floricilian o-ring from the female gender coupling and inspect it for nicks, cuts or defects. Warm the o-ring and replace it in the female gender coupling. Apply a few drops of oil to the o-ring to help facilitate the coupling without damaging the o-ring. Inspect the male gender coupling for any damage or defects that might nick the o-ring or prevent a good seal once the connection has been made. Connect the male and female gender couplings. Clean any ice or dirt from the inside of the wedding band and place the wedding band around the joined gender couplings. Secure the connection by tightening the screw on the wedding band.

Testing Existing Gender Connections

Check each connection with pressurized air and then fuel. Close the Hebert clamps on both sides of the connection to be tested and let fuel flow into the line (either by gravity or pump). When the upstream side of the Hebert clamps has become packed with air, slowly open each upstream clamp to bleed air into the connection. Be

careful to maintain control of the clamp because they can, when being opened, slip along the line from pressure behind them. Listen for air escaping from the fitting. When the connection is packed with air, open the downstream clamp and listen closely for the flutter of fuel running through the clamps. Wait until all air pockets have passed through the Hebert clamps and only fuel remains in the hose near your connection. Clamp off the downstream side and pack the hose with fuel. Maintain close communication with all team members during this operation so that the hose is not over-pressurized and fuel flow can be quickly stopped if need be. Carefully examine the connection, looking for leaks or cracks. Check the lines that were drawn on the hose against the collars to ensure the hose is not stretching or pulling away from the fittings. Once it has been determined that the connection is secure, clamp the next connection to be tested, then release all three Hebert clamps on the completed connection and remove the drip pan.

Upon Completion of the Hose Line

Ensure that the torque wrenches are set to their lowest torque setting at the end of each day.

Mark the hose line with bamboo poles and blue flags.

- Place one flag every 30-75' along the line.
- Mark connections with crossed poles so that they can be easily identified.
- Mark road crossings to direct traffic over the safe culvert crossings.

In the Fuels Log Book, record the date of hose set up and fuel line testing. Also record the amount of fuel transferred into fuel lines and subsequent tanks for testing.

Wait at least 72 hours and re-torque each coupling to compensate for the natural cold flow of the hose and fittings. Exercise caution when re-torquing bolts—be sure to clamp the hose on each side of the coupling and place a drip pan under the coupling.

Thoroughly inspect the fittings after this re-torquing and each day of hose employment. Any cracks, damage, or wear on the fittings or hoses must be reported and mitigated as soon as possible.

References

RPSC Procedure OP-S-302 *Fuel Storage, Transfer, Testing, and Filling; South Pole Station*

Hydrasearch Company Inc., Vendor Number 94067, 100 Log Canoe Circle, Stevensville, MD, 21666, ph 410-643-8900, *Catalog 406*. segmental '81 couplings, pp. 26, 31, 37, 70. http://www.hydrasearch.com

Angus Chemicoil: http://www.kidde-fire.com/anguschemicoil.shtml

Records

Fuels Log Book – Record date of hose set up and fuel line testing. Also record amount of fuel transferred into fuel lines.

Record Identification, Format, & Owner	**Active Location Storage, Protection, & Retrieval**	**Facility Storage, Protection & Retrieval**	**Retention Time**	**Ultimate Disposition**
Fuel Database (Access database) South Pole Operations	South Pole Station and DHQ Network Drives, available from Fuels Foreman or Operations Manager.	Maintained by South Pole Operations Manager	Active: One Year. Storage: Length of contract	Destroy/recycle at the end of contract
Fuels Log Book Hard copy. Fuels Operators enter all flight and transfer data in the hand-written log book. Fuels Foreman is responsible ensuring that data is entered into Fuels Database.	The Active Fuels Log Book is stored in the Flight Deck Pump-house or Fuels Office and is available from Fuels Foreman.	Old logbooks are maintained by the stored in the South Pole Operations Manager's Office.	Fuels Log Books are to be retained until contract completion.	Books are disposed of in white paper and burnables recycling bins.

Attachments, Appendices

None.