EDGES MEMO #401

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Subject: MRO air circulation and insulation assembly

Introduction

This document describes the materials and plan for installing the EDGES-3 air circulation system and antenna insulation assembly at the MRO.

Air circulation materials & notes

Figure 1 displays a diagram of the EDGES-3 air circulation system. Table 1 includes an ID list of installation materials as referenced in the following listed notes.

1. All male NPT fittings shall be wrapped with greater than 1 and less than 4 layers of PTFE tape (ID #1.1) prior to threading into a mating fitting. BSPP fittings (also known as "G" fittings) seal with a bonded washer and do not require PTFE tape. Parts with NPT threads include the following:
    - 1/2" NPT – 3D-printed PVC pipe adapter fittings in case use of chord grip is necessary to bring cabling into the air flow path. This should not be necessary and ½" NPT plugs can be used in place of the chord grips.
    - 1/4" NPT – Pressure gauges, temperature gauge, receiving fittings from dehydrator
    - 1/8" NPT – Dehydrator outlet and steam exhaust
2. The 90mm OD large PVC pipes that run from the hut to the antenna shall be adapted to 1.5" blue duct hosing via 3D printed adapters.
    - **The blue duct hosing shall be threaded on to the 3D-printed adapter fittings prior to installing and sealing the 3D-printed adapter fittings to the PVC pipe.**
    - **Ensure that the ID of the 3D-printed adapter fittings is larger than the OD of the PVC pipe and can be slid over the top of the pipe, otherwise sanding the 3D printed fittings ID or PVC pipe OD will be necessary.**
    - Inside the hut – clean the OD of the PVC pipe with cleaner (ID #1.2). Apply a bead of elastomeric silicone RTV (ID #1.3) on the interior cylindrical face of the 3D-printed adapter fitting and slide the fitting over the PVC pipe.
    - At the antenna pit – A decision will need to be made on-site at the MRO regarding adding 90° PVC elbows to the existing PVC pipe. These elbows will be shipped to the MRO from Haystack but will need to be test fit prior to potential installation, as they are sourced from a U.S. manufacturer. If the elbows are added, an additional length of the 90mm OD PVC tubing will need to be mated to the other side of the elbow fitting to allow the 3D-printed adapter fittings to be installed. Clean the OD of the PVC pipe with cleaner (ID #1.2). If the PVC elbows are to be used, glue the PVC fittings together via

PVC cement (ID #1.4). Apply a bead of elastomeric silicone RTV (ID #1.3) on the interior cylindrical face of the 3D-printed adapter fitting and slide the fitting over the PVC pipe.

3. A combination of sealing tape and elastomeric RTV shall be used as seen fit to air seal interfaces between parts of the antenna and the air circulation system where a compressed gasket is not used. Several sealing options for this purpose are being sent to the MRO including the following:
    - ID #1.3 – general purpose elastomeric silicone sealant, requires use of caulk gun. This silicone is relatively easy to peal off after being installed.
    - ID #1.5 – large width general purpose weather-proofing tape, may be used for redundant sealing at interface between PVC pipe and 3D-printed adapter fittings. This tape is difficult to remove after being installed.
    - ID #1.6 – heavy duty, moldable sealing tape meant for filling gaps between interfaces. Similar potential use case to ID #1.5, but alternative option. This tape is likely difficult to remove after being installed, but this has not been tested.
    - ID #1.7 – Miscellaneous thin sealing tape for general use. This tape is easy to remove after being installed.
    - ID #1.8 – General purpose silicone, purchased primarily to have as an alternative option in a smaller and easier to dispense package than ID #1.3. If there is concern of water leaking into the foam insulation at the barbed pins (Insulation assembly ID #2.3) a dab of this silicone at the insulation contact face of the pin may be added prior to pushing the pins into the foam. This silicone is relatively easy to peal off after being installed.
4. The fiber connection between the antenna and the electronics in the hut shall pass through a 0.5” OD chord grip as shown in Figure 1. To protect and seal the fiber at this feedthrough, a ~3” section of neoprene tubing (ID #1.9) shall be cut and folded around the fiber. A dab of silicone RTV (ID #1.3) shall be added at the inner diameter of the neoprene tubing so that when the chord grip is tightened, the neoprene is squeezed and the RTV fills any remaining air gaps between the neoprene and the fiber for an air-tight seal.
5. Hose clamps shall be used on the 1.5” duct hose (ID #1.10) and the PVC tubing (ID #1.11) used for plumbing connections to the ADH Netcom dehydrator.

Table 1 – Air circulation installation materials

ID	Part	Part Number/Link
1.1	½” PTFE tape	#6802K33
1.2	PVC pipe cleaner	#74605A25
1.3	Elastomeric silicone RTV sealant	#6937T8
1.4	PVC cement	#74605A14
1.5	3.75” ZIP tape	Amazon
1.6	2” moldable sealing tape	#7593A9
1.7	Sealing tape (found at Haystack, unsure of source)	n/a
1.8	3M super silicone sealant	#74955A53
1.9	0.5” OD, 0.25” ID neoprene tube	#2029N11
1.10	1.5” hose clamp	#7269N11
1.11	¼” hose clamp	#5011T141

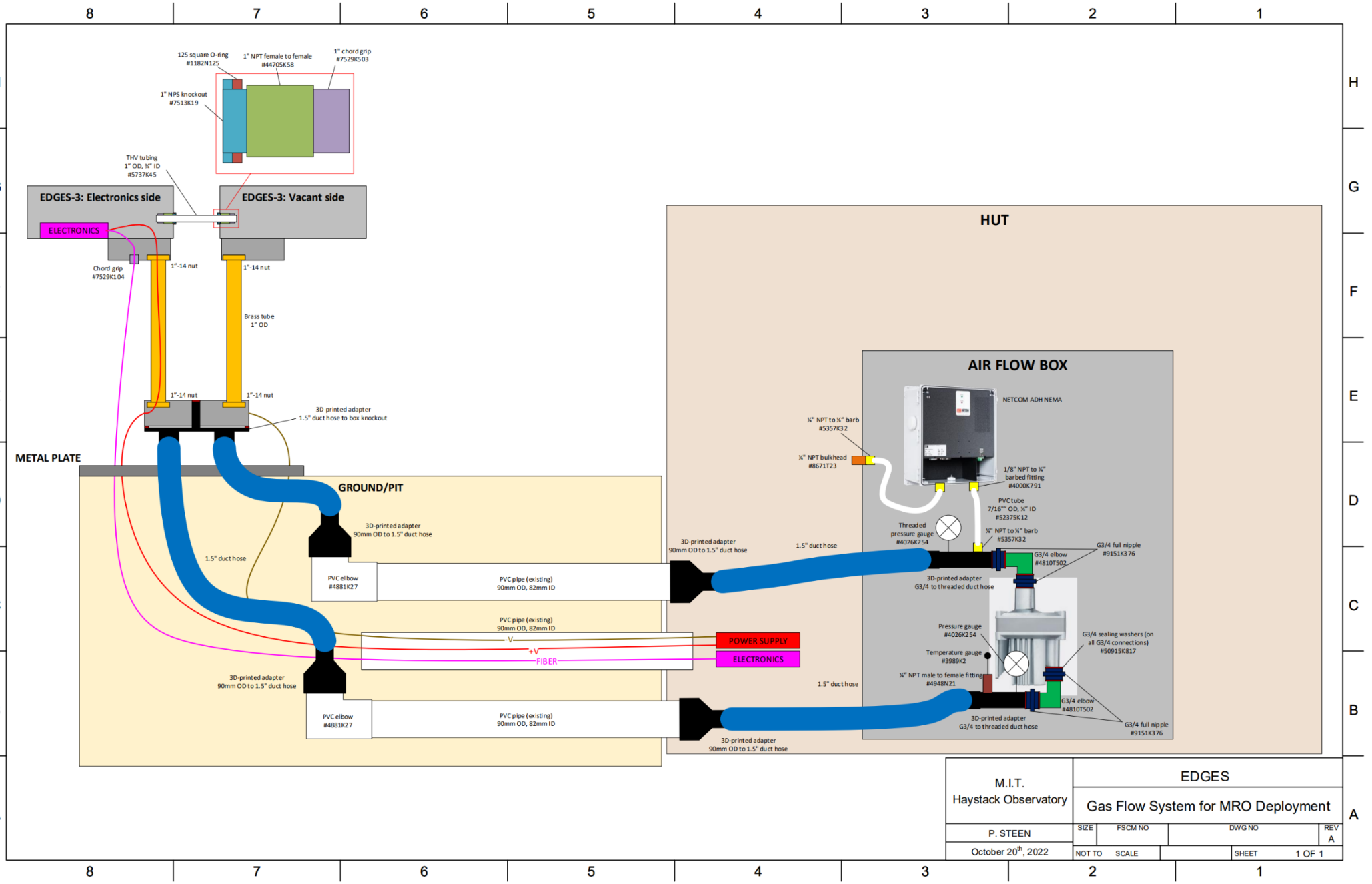


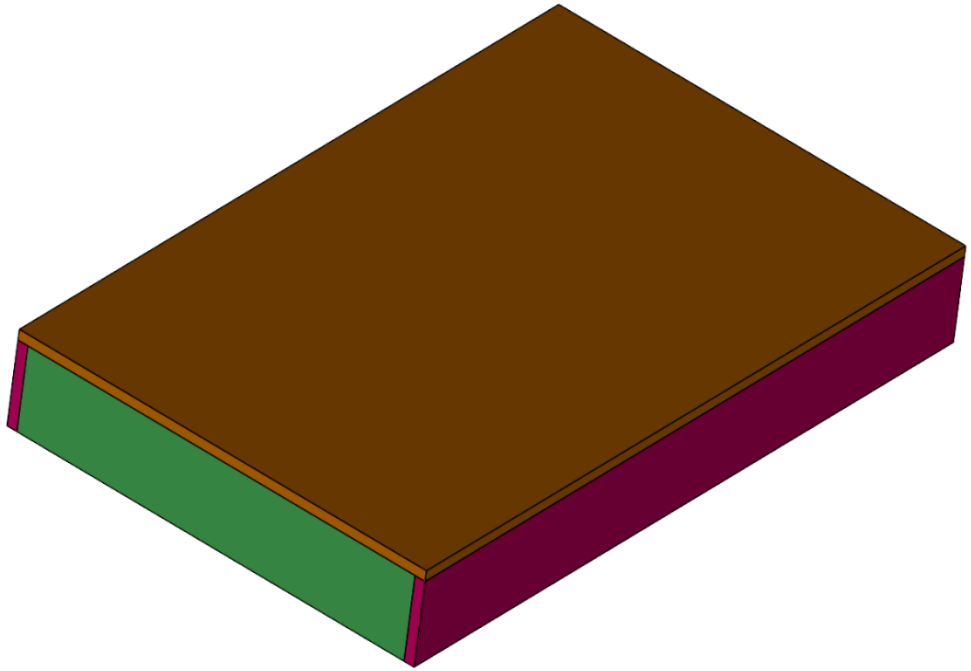
Figure 1: Diagram of EDGES-3 air circulation system

Insulation assembly

Table 2 below describes materials and installation notes to be used for the assembly of the EDGES-3 insulation at the MRO. Figure 2 shows dimensions of the insulation top cover assembly pieces.

Table 2 – Insulation assembly installation materials and notes

ID	Part	Part Number/Link	Quantity	Installation notes
2.1	1.7-pound density, closed cell, 1", polyethylene foam	FoamFactory	See Figure 2	Foam insulation pieces shown in Figure 2 will arrive pre-cut at the MRO. The bottom insulation pieces to be used for deployment are not shown in Figure 2, but will also arrive pre-cut at the MRO.
2.2	Goldstone paint #7	Triangle Coatings	2 coats	**Prior to assembly, all foam insulation pieces shown in Figure 2 as well as the bottom insulation pieces shall be painted with two coats of Goldstone #7 paint.** It is acceptable to paint around the pre-installed hook and loop on the bottom insulation pieces.
2.3	9/32" barbed pins (McMaster #92410A415)	#92410A415	~50	Fasten the insulation pieces together by pressing the barbed pins into the insulation every ~3", or as necessary.
2.4	1-1/2" 3M Dual Lock hook and loop	#94935K14	~25 ft	1. The bottom insulation pieces have hook and loop pre-installed, matching hook and loop will need to be added to the antenna side. 2. Hook and loop may not be necessary for the top cover of the insulation shown in Figure 2. It is up to the MRO deployment team to decide if adding the hook and loop for the top foam cover is necessary. 3. The black and clear hook and loop are the exact same and can be used together, McMaster ran out of the black supply. 4. **To adhere the hook and loop to the foam (ID #2.1):** first rough the surface of the foam via a steel brush. Then with the hook and loop protective cover peeled, use ID #2.5 to add additional acrylic adhesive to the hook and loop prior to sticking it to the foam. 5. **To adhere the hook and loop to the antenna:** No additional adhesive is necessary, peel the protective cover off the hook and loop and stick it to the antenna.
2.5	Loctite 454 acrylic adhesive	#74765A35	0.7 fl. oz.	Acrylic adhesive to be used with existing hook and loop adhesive to ensure appropriate adhesion to the foam insulation.



NAME	COLOR	LENGTH	WIDTH	QUANTITY
TOP	ORANGE	62.5"	40.6"	1
SHORT SIDE	GREEN	38.6"	8"	2
LONG SIDE	PINK	62.5"	8"	2

Figure 2: Dimensions of EDGES-3 insulation top cover.

Dehydrator testing at Haystack prior to MRO deployment

The Micronel blower is outfitted with an upstream & downstream pressure gauge and a downstream temperature gauge. Relative to atmospheric pressure, the blower will provide slightly higher pressure at the outlet and a slight vacuum at the inlet with an average pressure equal to atmospheric pressure.

The Netcom ADH NEMA dehydrator has two main intended uses:

1. Supply a higher rate of air flow into the cooling loop than the rate at which air leaks out of the cooling loop to increase the average pressure of the air flow loop. This would increase the inlet pressure (return line) of the Micronel blower so that the pressure in the cooling loop is always greater than atmospheric pressure, thus preventing ambient air/water from entering the cooling loop. This operation is only possible if the maximum flow rate of the dehydrator exceeds the leak flow rate of the system in operation.
2. Reduce the dew point of air in the cooling loop by providing a constant flow of dry air that dilutes any moisture added from atmospheric air.

In a temporary configuration at Haystack prior to deployment to the MRO, it was determined that the dehydrator could not provide a flow rate greater than the leak flow rate of the system. This was shown by no pressure increase at the Micronel blower inlet as read by both the dehydrator user interface and the inlet pressure gauge, indicating the total average pressure of the system was not greater than atmospheric pressure. This observation comes with the caveat that this test was done with a temporary configuration, where much of the parts in the air circulation assembly require permanent silicone seals to be added at the MRO. Therefore, installation at the MRO should attempt to fully, permanently air seal the flow path in effort to yield an average pressure in the flow path that is greater than atmospheric pressure. This may not be possible, but the dehydrator will still perform it's second intended use mentioned above by supplying a constant flow of dry air to the cooling loop. This use cannot be quantified without a humidity sensor installed in the flow path.