HUNCH Crew Quarters Lint Catchers

Schools: Cypress Woods H.S., Conroe H.S., Lincoln County H.S., Breckenridge County Area Technology Center, Clear Creek H. S.
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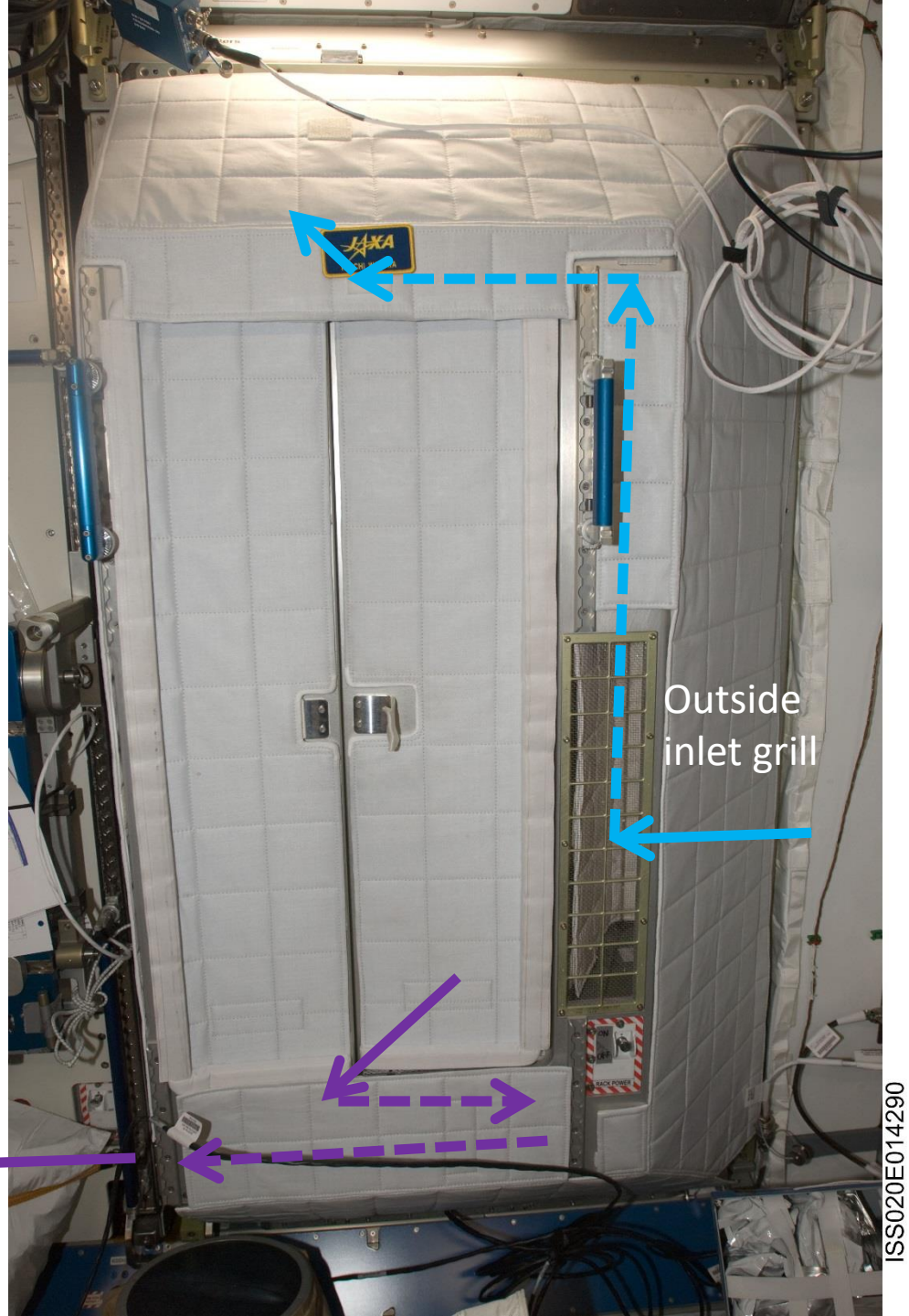
Teachers: Mike Bennett, Eric Canestorp, Randy Anderson, Dean Monarch, Bill Gibson, Tommy Gillis
Mentors: Glenn Johnson, Bob Zeek, Carlos Valencia, Roy Bellard, Alli Westover, George Kessler

Problem:
Lint from the module is pulled in to the Crew Quarters clogs up the ducting and air flow sensors giving false indications of low air flow. Mosquito netting from the Russian sleeping bags has been taped on the both inlets of the CQs and has decreased the lint in the ducting and air flow sensors. Engineering wanted a more permanent solution that didn't include spending crew time to cut up sleeping bag liners.

Solution:
HUNCH students designed and built grills to hold stainless steel mesh that is more durable than the mosquito netting, easy to clean and vacuum and also easy to remove and replace as needed.

Air Flow Description

- Air is pulled in through the front grill goes through a fan and then blows out past the crew's face through a grill on the inside of the CQ.
- A second fan pulls air from the a grill by the crew's foot area and sends the air back into the rest of the module.
- There is no added cooling or heating of the CQ air but the crew members are able change the fan speed to their liking.
- Part of the problem is that the station gets more dusty than initially expected. Most of this dust comes from the people themselves. This dust gets into the ducting of the CQ and causes problems with the air flow sensors.
- The ground support has had crew install a mosquito net like material on both the outside inlet grill and the inside inlet grill and it has done a good job of cutting down on the dust in the ducting but it was only intended as a temporary fix. Now we would like to have something that is a more permanent fix of the problem.



Original Dust problem

Air flow sensors inside Crew Quarters ducting don’t read the correct air velocity when covered with dust.

ISS025E013417

Ducting collects more dust than expected.

This is the inside inlet grill with dust in the ducting before the mosquito net material was installed.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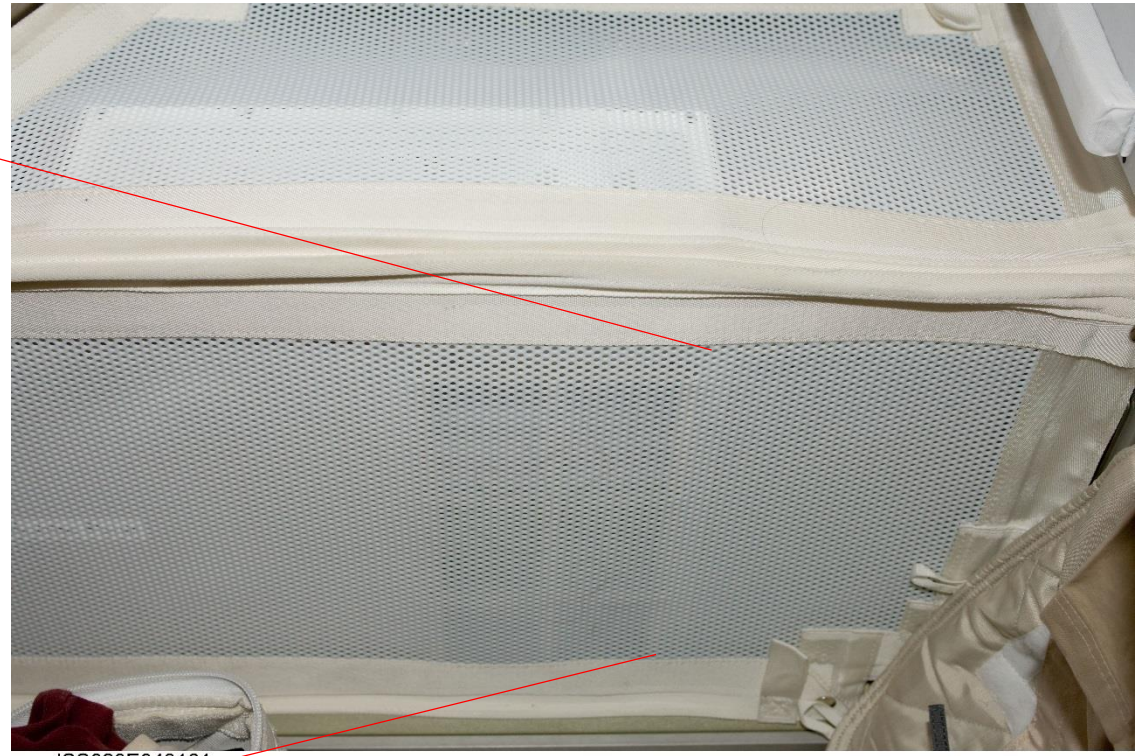
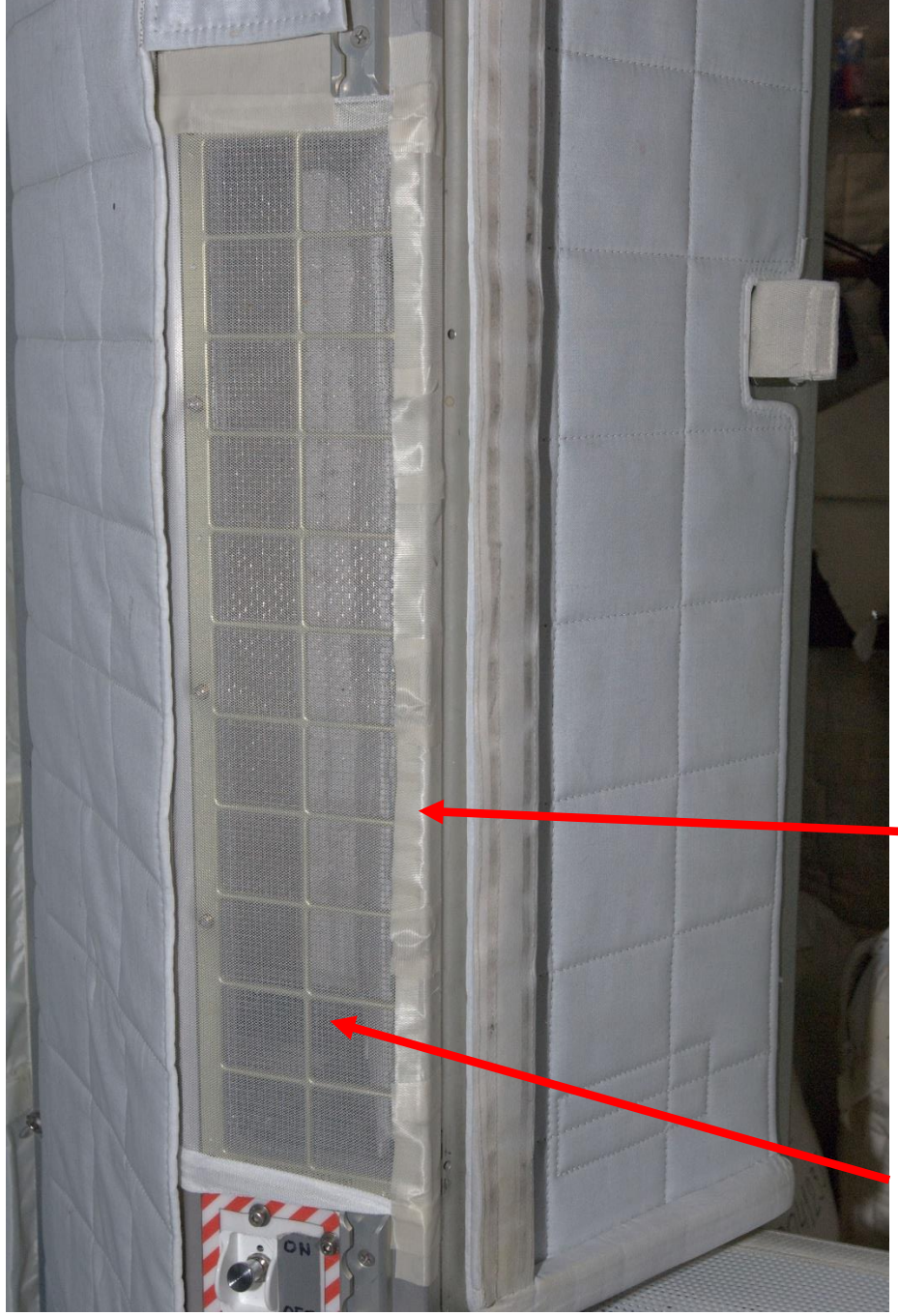
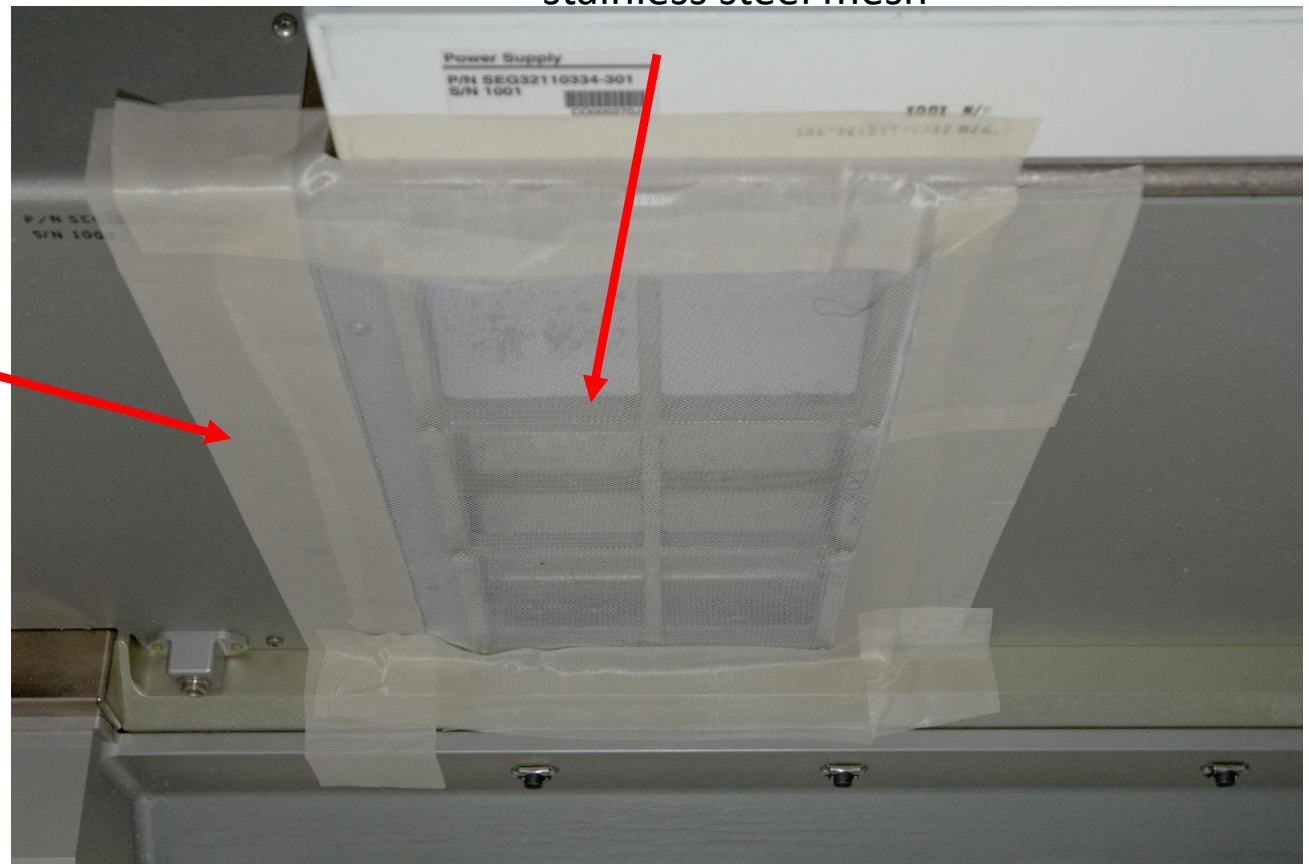

ISS020E048161

Adding the mosquito net material to the Exterior inlet grill and to the Interior inlet grill made a significant difference to the dust problem on the ducting. Netting is vacuumed clean on a regular basis and cuts down on the interior dust. Unfortunately the netting gets worn over time and the tape stops sticking over time. It takes a significant amount of time for crew to make new screens on orbit. It would be a time saver for crew if permanent screens could be made on the ground to help with the problem.



Grill is bolted to the front of CQ with 10 bolts

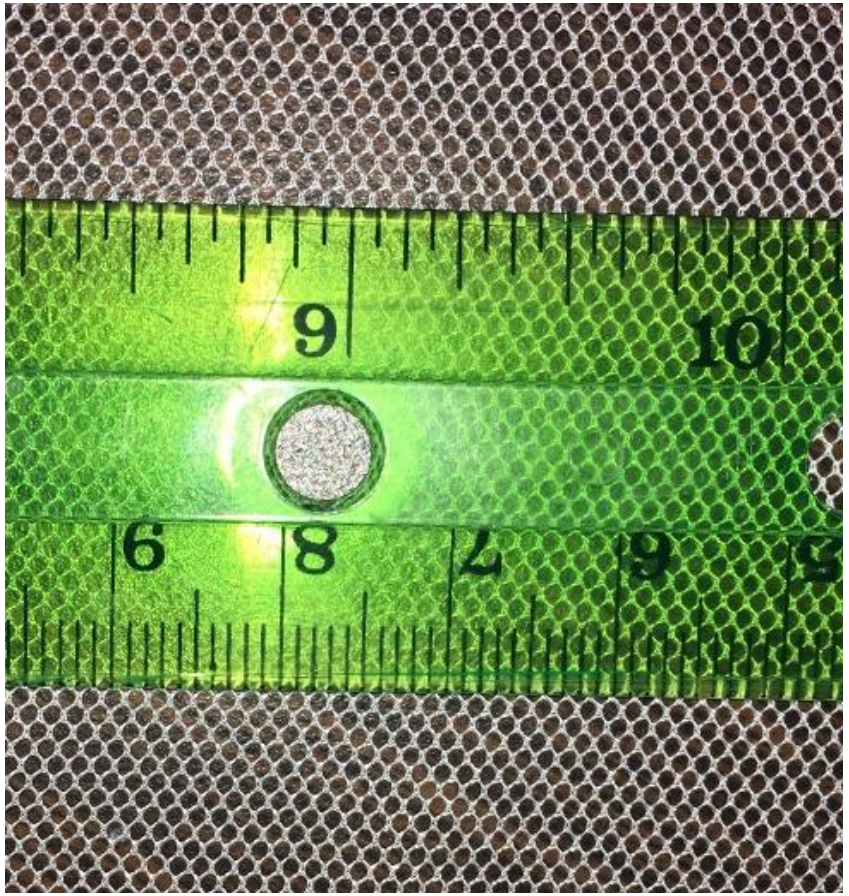
Netting and grill but no stainless steel mesh



Grill is riveted onto the close out panel.

Screen Material and size

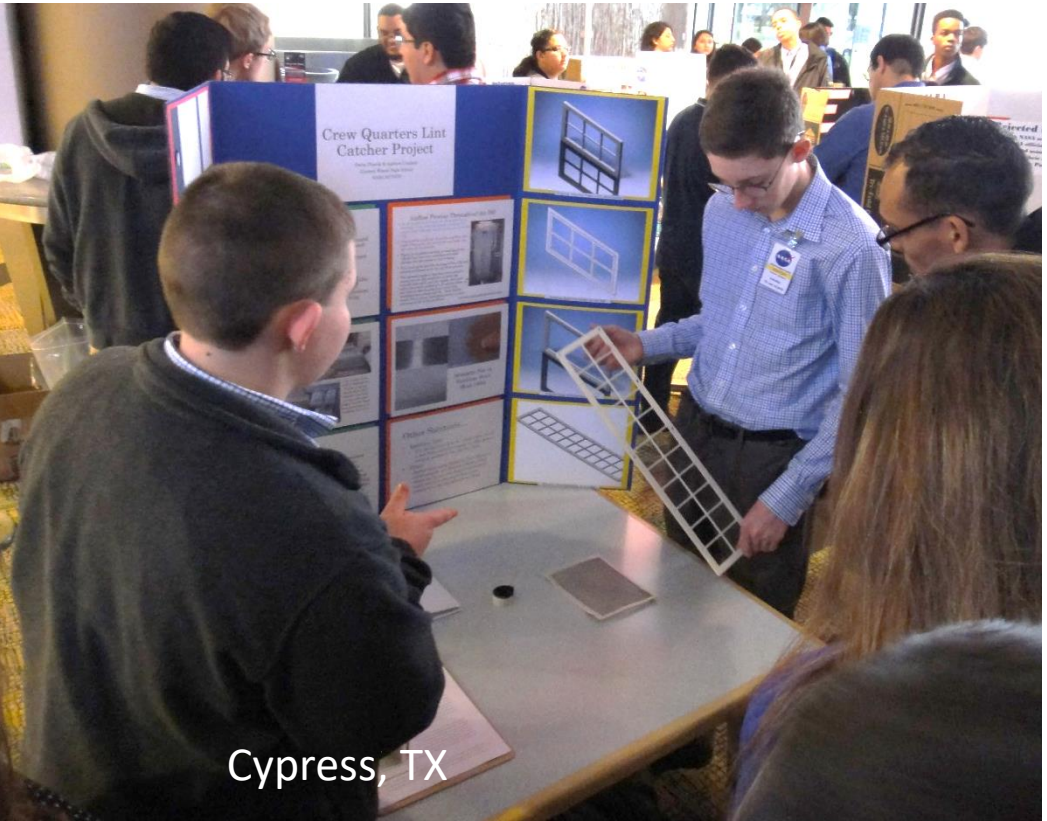
- Current mosquito netting filter is described as 24 holes per linear inch.
- Because the current filter is cloth, the dust is more likely to be captured by the threads. Using stainless steel wire, the particles may be less likely to stick to the metal.



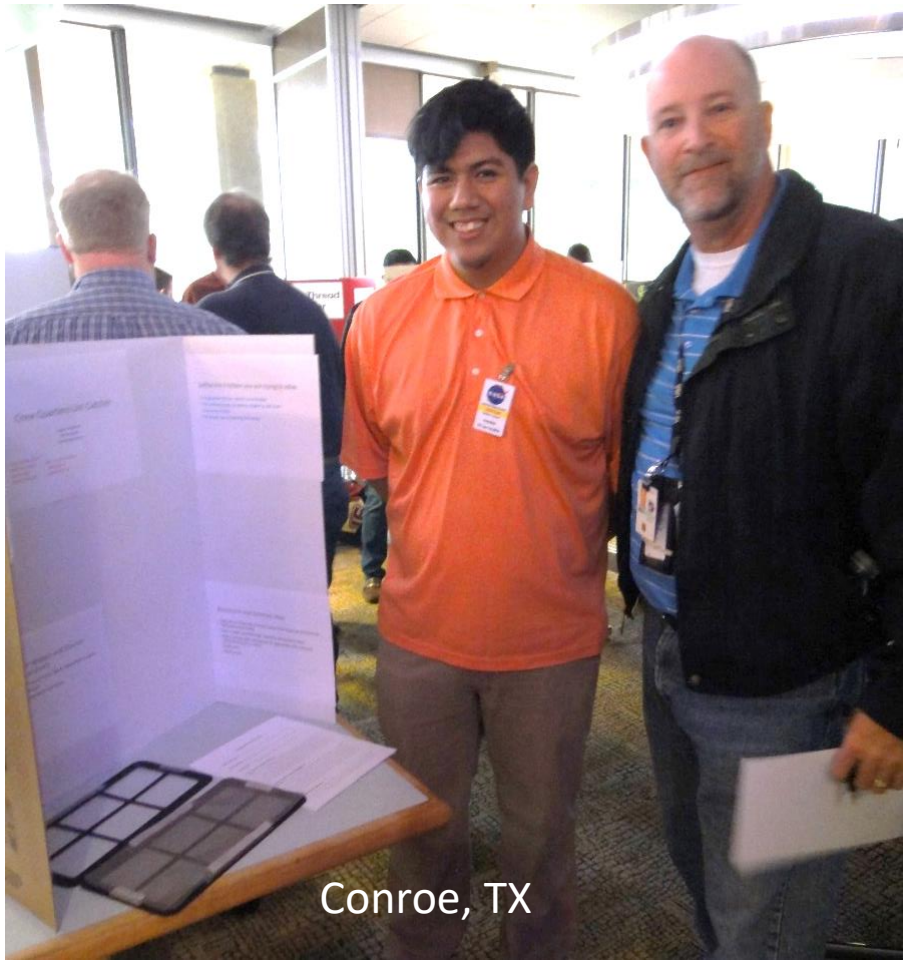
This is the netting on the current sleeping bag liner that Crew Systems has access to.

Suggested Solution from Students

- Build a permanent screen holder for each inlet that will hold a fine mesh stainless steel screen that is easy to clean and easy to install and remove.



Cypress, TX

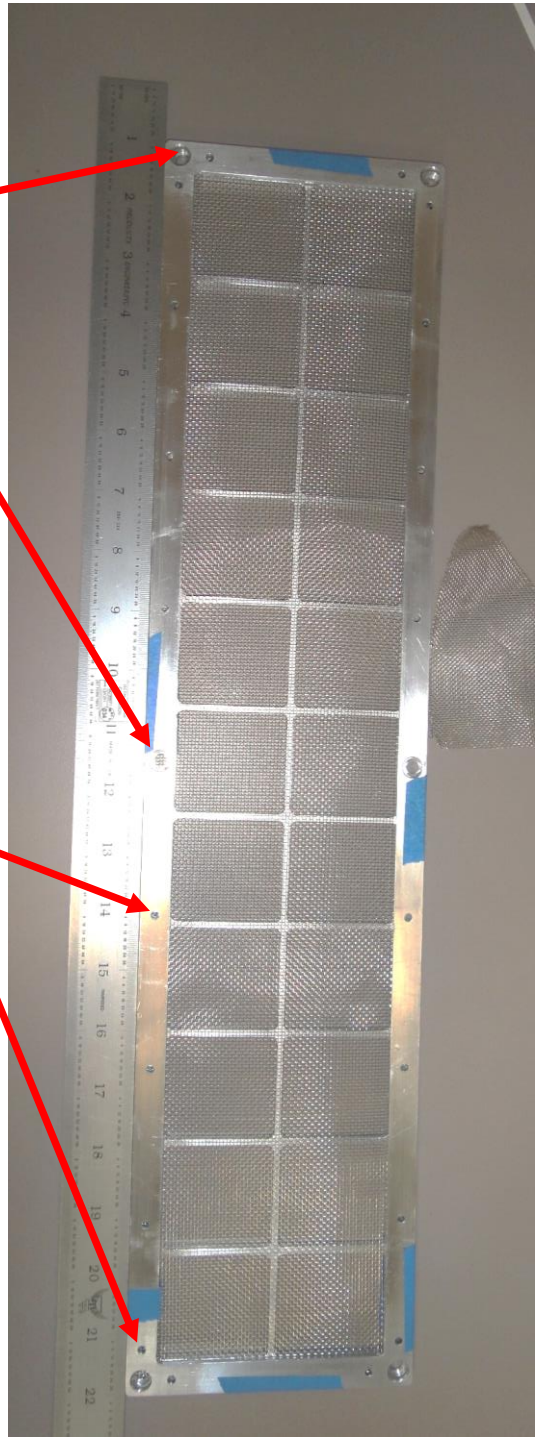

Conroe, TX

CQ Intake Inlet Screen

- The existing exterior inlet can be replaced since it is bolted in place.
  - Grill has 10 bolts to protect for launch loads—excessive for on orbit loads.
  - Reduce the number of bolts to six
  - Screen in front of grill for easy cleaning

Install Plan

- Remove the existing grill from the CQ and discard.
- Install HUNCH Exterior inlet grill with six captive screws.
- Captive screws allow for removal of the grill so the interior of the screen and the cavity can be cleaned.

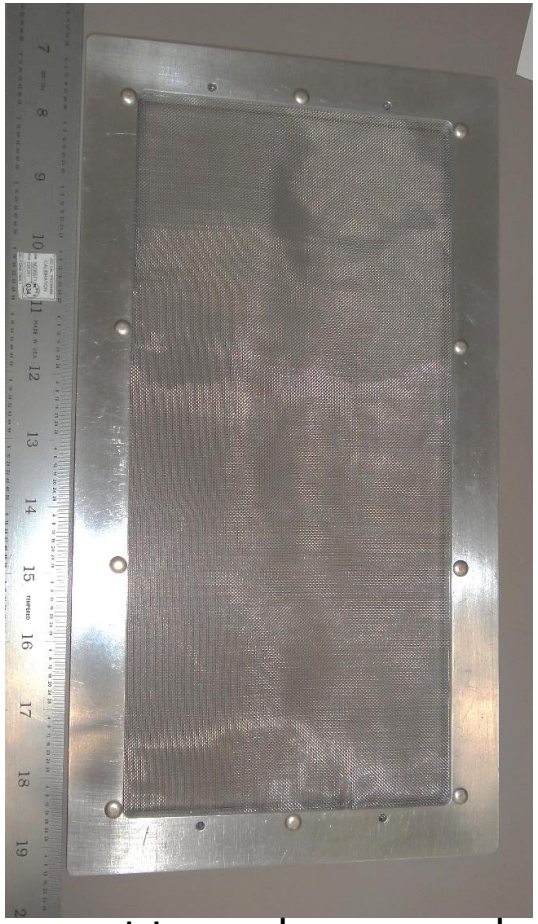


CQ Interior Inlet Screen

- The grill on the interior inlet panel is riveted onto the panel so it is impossible for crew to remove the grill. Students suggested attach the screen over the existing grill and to use either Dual Lock (similar to Velcro but more rigid) or a weak magnetic tape. After discussing cleanability, NASA engineers determined magnets would be easier to clean.
- Reasoning for magnets over Dual Lock or velcro
  - Both magnets and Dual Lock were tested to hold the grill—both held the grill on. Both were great ideas to so solve a problem.
  - Magnets were easier to install onto the grill and remove. Dual Lock took a lot of force for both installation and removal.
  - Magnets are easier to clean. Hair and lint could be caught in the mushroom shaped pins of the Dual Lock—similar for velcro.

Install Plan

- The magnetic tape on the screen bracket can be installed on the ground while the magnets on the CQ interior close out panel will need to be flown in place on the screen bracket or in a separate baggie and installed by the crew onto the CQ interior close out panel.
- Leave spaces for the rivet heads on the existing grill
- This use of magnetic tape is similar to that used to hold the air filter in the WHC.

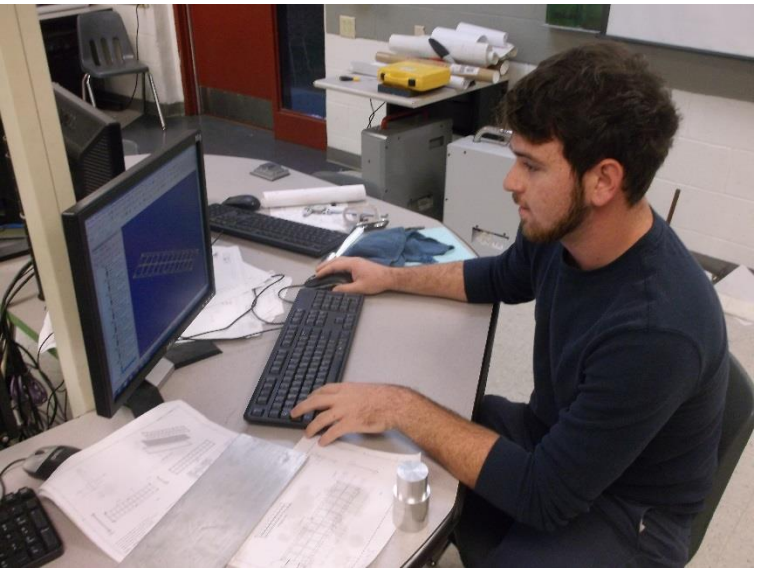


Faces out toward crewmember

Spacing between magnetic tape for rivets on existing grill.

Faces in toward fan ducting

Students machining grills



Feyettville, TN

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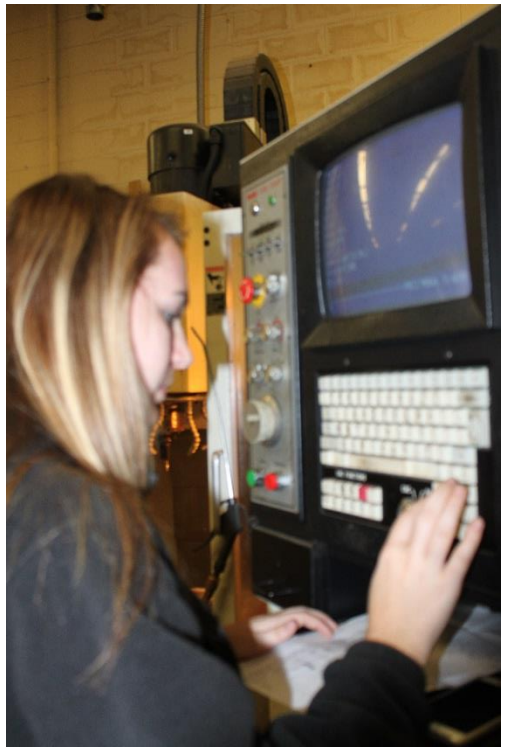
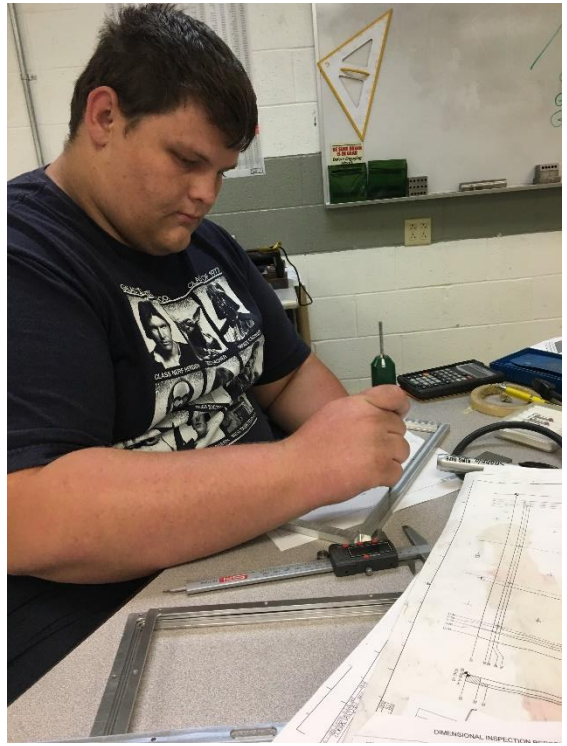


Checking dimensions



Wire Mesh

We need a mesh that will remove as much lint as possible without decreasing the air flow.

After discussions with FCS and Boeing Engineering, 24 holes per linear inch was determined to be the desired mesh for both the interior and exterior screen. This is similar spacing to what is on the CQ now but the wire uses less space than the threads in the mosquito netting.

Upgrades for flight units from the display units

Ethan Reid, Lloyd Irwin, Jim Shelby confirmed that HUNCH will be using stainless steel mesh with 24 holes/linear inch is the material desired for the screen material.

Exterior:

- Use 6-32 screws on the exterior screen
- Use epoxy to hold the screen into frame

Interior:

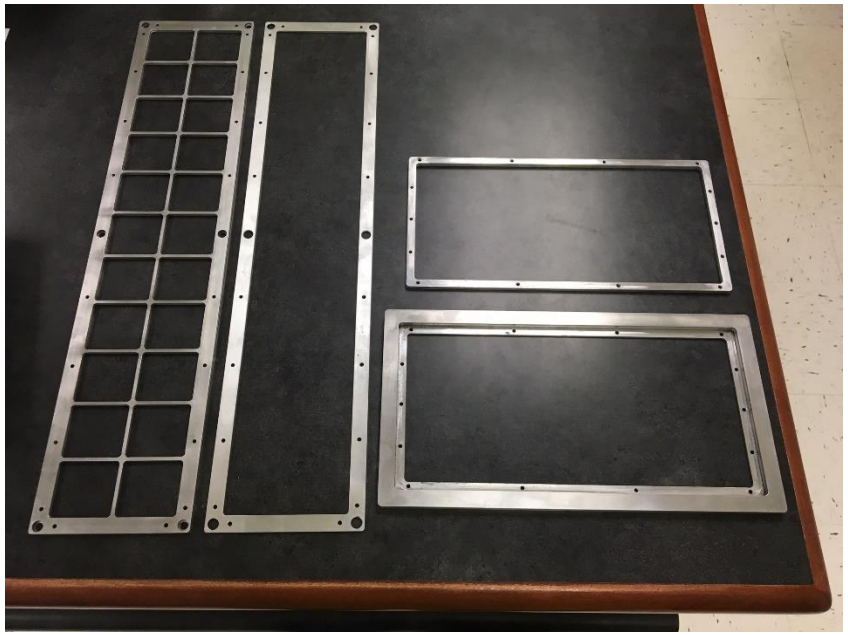
- Use epoxy to hold the screen into frame
- Use rivets for the interior screen
- Remove the 4 additional rivet holes from the interior inlet screen
- Add a finger notch for the interior inlet screen’s bracket corner to make it easier to grab and remove from the magnets

Fit check verification?

- There is not a ground unit that is high enough fidelity to perform a fit check on.
- The Crew Quarters trainer in B9 was built long before the flight units were built and is much lower fidelity. There is no confidence in the CQ specialists in the trainer being similar enough for this activity.

Lloyd Irwin of Boeing verified by way of the drawings that our grills will match the units on board.

Assembly



Delivery Plan

- Approved Op/nom is
  - CQ Intake Inlet Screen SEG39138901-301
    - Screws are captive and ready for installation.
  - CQ Exhaust Inlet Screen SEG39138902-301
    - Magnetic tape attachment
- 4 Magnetic tape strips will be installed on the screen. There will be another 4 magnetic strips that need to be installed by the crew on the Crew Quarters interior panel. 4 magnets will be flown in a separate bag for each CQ Exhaust Inlet Screen
- Crew will need to remove tape cover and stick them to the CQ interior panel using the screen as the template.
- 4 sets of screens for on orbit use
- 1 set of screens for training
- The final build and delivery was Sept. 4, 2018.
- Launch will be Nov. 15, 2018 on NG10 from Kennedy Space Center.

Completed screens before delivery.

Trainer delivered.