Procedures for Working on the DECam Test Dewar at the 1-Meter Telescope to Address ESD Concerns

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Introduction:

To mitigate ESD hazards, specifically to the CCD inside the test dewar and to the electronics in general, an ESD work area and procedures were developed for while working on the DECam test dewar. These procedures pertain to three separate types of activities: dewar installation and removal, working on the installed electronics, and recharging the dewar with liquid nitrogen. These procedures use the improvised ESD safe work area installed on Thursday (11-5-09).

General Guidelines:

The basic principle to preventing damage due to ESD is to equalize the potential voltage differences between separate pieces of equipment, especially if that equipment is isolated electrically from each other, and the personnel. Thus the basic precaution in almost all situations is to choose where to connect up the grounding discharge lead to an earth ground, connect up the individual grounding straps (from the star ground connection point) and in what order for those connections to be made. The specific task(s) situation will determine this order of connection and where exactly to locate the ESD discharge path. When working with ESD sensitive devices, it is always strongly recommended that any metal **NOT** be floating (no dedicated connection to the ground discharge path). Also, any ESD grounding connections for personnel, equipment, and work surface must be through a resistance, usually this is 1 Mohm. Do **NOT** use low impedance (shorts) wires or clips for discharging equipment of for use by personnel since the discharge currents will not be limited to a safe level (5-10 mAmps).

The situation at present is to prevent ESD damage to the CCD inside the test dewar and to the associated electronics as these pieces of equipment are moved onto the work area conductive surface and installed or removed from the telescope metal. Without these procedures, the risk for ESD related damage is fairly high considering the observed ESD environment when an assessment was initially made.

At the 1-meter telescope, the discharge grounding path will be through telescope metal since this metal has a fairly low-impedance path to the AC power safety ground. The safety grounds are usually used for this primary path since they always should be connected to any metal that has AC power in or around it and it is also connected to an earth grounding mechanism.

The star ground point for this ESD work area is within the junction box located at the corner. This box is at the same potential (electrical connection) as the work surface so if the box is on the work surface or off of the work surface, it makes no difference. This box is shown in the picture below:

Picture 1: The ESD junction box that contains the ESD star ground point and the associated clip leads that are used.

Each red clip lead (3 of them), the personnel wrist strap, the work surface, and the black discharge grounding lead are connected together at a common point, each through a 1-Mohm resistor. The diagram is taped to the top of the box. The discharge grounding lead is black while the equipment and personnel leads are red in color.

While working on the equipment, or around the telescope, it is a good idea to frequently check the surfaces of the equipment and work areas with an ESD meter. With proper procedures, no meter reading should be above 10-20 volts. Any more than that and there exists a possible ESD problem. Make sure the box is connected to the work surface. The biggest problem here will be if the box has been kick or pulled from its connection. Another problem is tripping on the assorted leads being used and this is why there should be a limited number of people working on the ESD surface at any one time.

Procedure for Installation of the Dewar and Associated Electronics

1) **First**, connect up the BLACK grounding discharge lead to the telescope metal. A good point for this connection is located as shown. This is your discharge path to earth ground. Make sure that there are no low-impedance parallel connections to this point.

Picture 2: Connection of the grounding discharge lead to the telescope metal

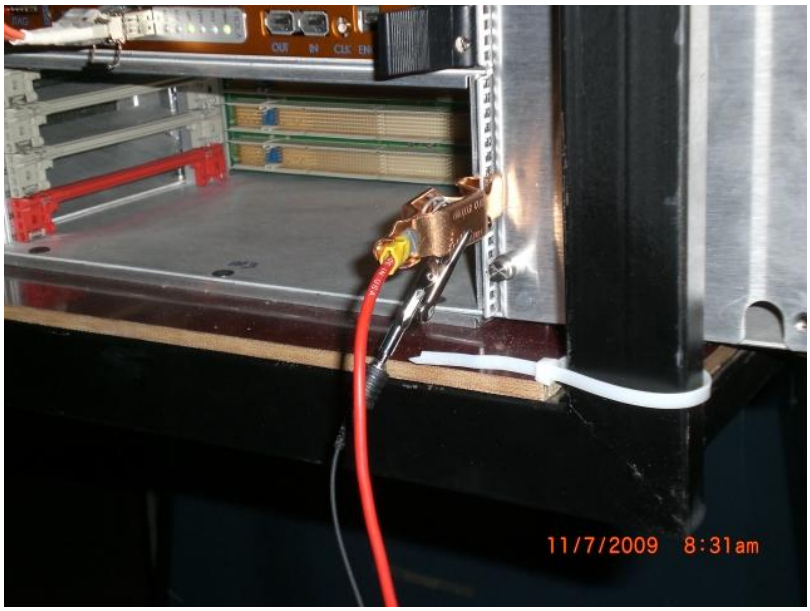
2) **Second**, the person working on the ESD work surface needs to put on the personnel wrist strap. Only people wearing the wrist strap should be working on the ESD work surface and touching the equipment being worked on. It is a good idea to limit the number of people on the work surface to two or three people at any one time.

3) Bring in the equipment and place it next to but not on the work surface. A person with a wrist strap now connects up an equipment (red) grounding lead to the metal surface of the equipment.

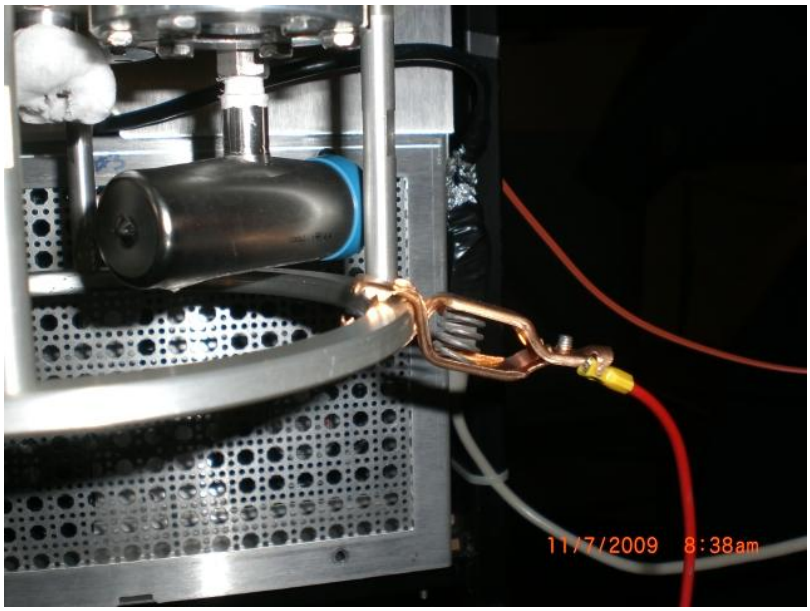
4) Once connected, the equipment can be moved onto the ESD work surface. At this moment, all people, equipment, and mounting surfaces should be at the same potential. It would be a good idea to check things with an ESD meter.

5) If the crate and dewar are to be installed one at a time (preferably), the crate should be installed first and then the dewar. Once the crate is installed, **DO NOT** disconnect the red ESD grounding lead. Leave it connected since the crate is not electrically connected, when installed, to the telescope metal.

6) The dewar should now be installed. Again, leave the grounding lead clipped on the dewar metal. Note: the dewar handling ring is anodized so you need to dig the teeth of the clip into the metal to make a good electrical contact. Below are pictures showing good areas to clip onto the crate and dewar. Note that the crate clip shows a second personnel wrist strap clip. Since only one personnel wrist strap is wired to the junction box, a good place to clip on another personnel wrist strap is on the clip metal that is already clipped on the crate.



Picture 3: Crate ESD grounding clip position



Picture 4: Crate ESD grounding clip position

7) Now, check all surfaces with the meter. Everything should be at the same potential.

8) The last thing to do is connect up the signal cables. The signal cables should be connected to the electronic crate **FIRST.** Once that is done, the protective caps can be removed from the dewar connectors and the cables connected. Make sure to hold the metal shell while making first contact. With the ESD grounding leads still connected, the power to the crate can be turned on or plugged in.

9) OK. With that done the removal of the grounding clips can be done. First, remove the dewar clip lead, then remove the crate clip lead. Next, personnel can remove their wrist straps and exit the ESD work surface. From this point forward, nobody should be on the ESD work surface or touching any dewar or related equipment.

10) Lastly, the black discharge grounding lead can be removed from the telescope.

Procedure for Removal of the Dewar and Associated Electronics

1) Attach the black discharge grounding lead to the telescope.

2) Put on the personnel wrist strap.

3) Attach the red grounding leads onto the equipment to be removed.

4) If the dewar is to be removed, remove this one before removing the crate. Disconnect the signal cables and immediately put on the protective shorting caps on the dewer connectors.

5) Remove the dewar. Once it is removed it can be placed off of the ESD work surface. **At this point the red equipment grounding lead should still be on**. Now, remove the red ESD grounding lead.

6) Remove the crate and likewise, make sure the grounding lead is removed, once it is off of the ESD work surface, by a person who is still grounded.

7) If work is completed the personnel can remove their wrist straps.

8) Again, the last thing to do is remove the black discharge grounding clip from the telescope metal.

Procedure for Performing Tasks on the Dewar and Associated Electronics

1) Attach the black discharge grounding lead to the telescope.

2) Put on the personnel wrist strap.

3) Attach the red grounding leads onto the equipment to be worked on.

4) If the dewar is to be removed, remove this one first. Disconnect the signal cables and immediately put on the protective shorting caps on the dewer connectors.

5) Perform the tasks. Keep in mind that the only people who should be touching tools or equipment on the ESD work surface should be properly protected using wrist straps. Note: the wrist straps need to be on skin. Do not put them over gloves or clothes. Also, any equipment or tools should be touched be people wearing wrist straps and the equipment should be continuously connected to the ESD grounding leads. If necessary, a spare lead can be used that has the 1-Mohm resistor inserted into the lead (shown below).

Picture 5: Spare equipment and personnel ESD grounding leads

6) When work is completed, the red equipment ESD grounding leads can be removed.

7) Once the equipment is disconnected, the personnel can remove their wrist straps and exit the ESD work surface. Do not touch any installed equipment at this point.

8) Again, the last thing to do is remove the black discharge grounding clip from the telescope metal.

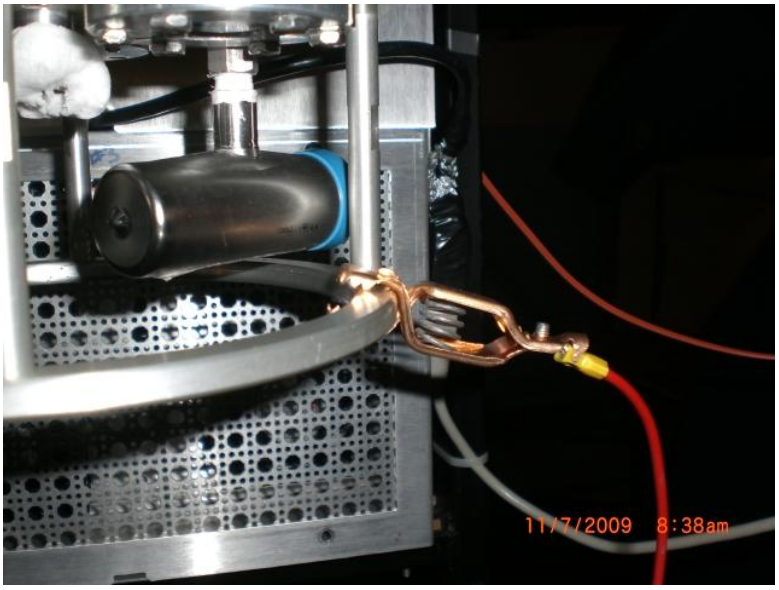
Procedure for Recharging the Dewar (Installed) with Liquid N2

1) Attach the black discharge grounding lead to the telescope.

Picture 6: Connecting the ESD grounding discharge lead to the telescope

2) Put on the personnel wrist strap.

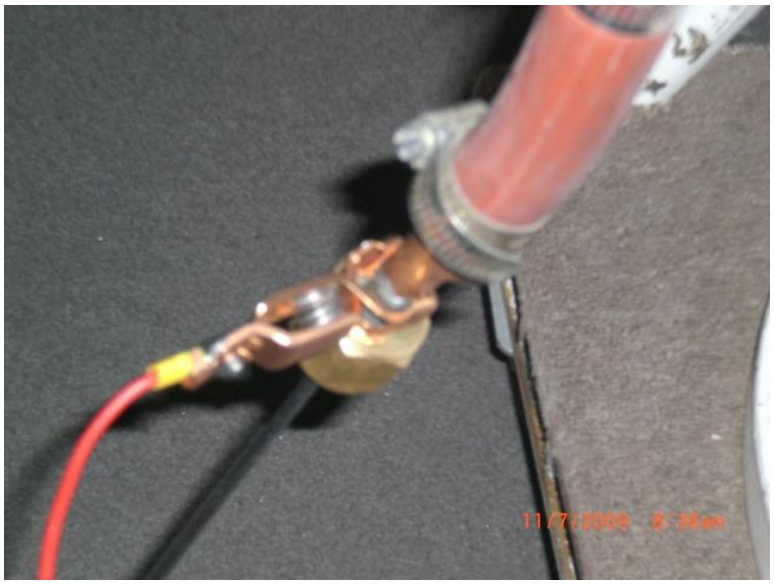
3) Attach the red grounding leads onto the dewar.



Picture 7: Connecting the ESD equipment grounding lead to the dewar

4) Move the N2 tank next to, but not on the ESD work surface. Attach an equipment ESD grounding lead to the tank metal. Then roll the tank on the work surface and next to the dewar.

5) Take the nozzle and clip on the third ESD grounding lead as shown.



Picture 8: Connecting the ESD equipment grounding lead to the probe's nozzle

6) Now, insert the probe and recharge the dewar.

7) When completed, roll the tank a bit away from the dewar and remove the nozzle's ESD grounding lead.

8) Roll the tank off of the ESD work surface and disconnect the ESD grounding lead.

9) Remove the personnel wrist strap.

10) Lastly, remove the black discharge grounding lead from the telescope metal.

Some Helpful ESD references:

During my searches for ESD reference material, I have come across some pretty good websites with some articles and fundamental information about ESD protection and safeguards.

1) This first one describes the basic fundamentals behind ESD: http://www.esda.org/esd_fundamentals.html

2) The second website, http://www.esdjournal.com/eosesd/safety.htm contains a list of articles on ESD. One titled "A Thoughtful Approach to Field-Service Grounding" has quite a lot of useful information on grounding procedures when working in the field. Another one titled "Auditing for Static Safety" contains an example of a metal shelving unit which is mounted on nylon rollers (very similar to our situation with the cart for the MCCDTV).

3) The third one, http://www.esdjournal.com/index.htm , is where I found most of the above links. If you don't mind the advertisements and advocacy, there is some useful information contained in the articles and technical papers archive.