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Fabrication of Signal Cables for the CLAS Drift Chamber

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Abstract: The fabrication process of the signal cables for the CLAS drift chamber is presented in this paper.

CLAS drift chambers determine the track of charged particles. The CLAS drift chamber is strung with three types of wires; the sense or anode wires, the field and the guard wires. Each positively charged anode wire is surrounded by field wires in a regular pattern. An interior cell consists of a sense wire and its surrounding field wires. The chamber is filled with an ionizing gas. As a charged particle passes through the chamber it ionizes the gas. Electrons released during ionization, drift to the nearest positively charged anode wire (sense wire). When the electrons reach the anode, a signal is initiated.

Signals from the drift chambers are data logged to a computer using signal cables. There are about 144 signal cables per chamber that connect to the front-end electronics. Cables are divided into bundles, each bundle consists of six cables. There are seventeen twisted wire pairs that are arranged according to a color code.

Cable construction is performed in the following order:

1) Preparing cables
2) Laminating the wires using a color code
3) Soldering ground wire
4) Attaching connectors, strain relief with pull tabs
5) Mounting heat shrink for insulation
6) Attaching lugs to ground wire
7) Labeling cables
8) Testing cables for errors

1. **Preparing Cables:** Cable lengths are measured using a cable counter/spooler. Cables are cut to different lengths (65 feet - 90 feet), which depends upon where the front-end electronics are located. Four inches are measured from the end of the cable and stripped using a CYCLOPS Cable-Jacket Stripper. The braided shielding is pulled back from the cable. The mylar is cut and removed from the cable. A 2.5" and a 3" heat shrink, of0.5" diameter, are guided onto the cable for insulation.

2. **Laminating the Wires using a Color Code:** The twisted pairs are combed in a color code and is placed on the laminator. The color code is:

(red-black)-(white-black)-(green-black)-(blue-black)-(yellow-black)-(brown-black)-(orange-black)-(white-red)-(green-red)-(blue-red)-(yellow-red)-(brown-red)-(orange-red)-(white-green)-(blue-green)-(yellow-green)-(brown-green)

After the wires are combed, the lamination tape is placed on wires. The laminator heats the lamination tape for about 20 seconds and the laminated cable is cooled for about another 20 seconds. Any excess lamination tape is discarded.

3. **Soldering Ground Wire:** The braided shielding is cut to have ample length for soldering of the ground wire. The 18 AWG ground wire is 10 inches long. Solder of 18 AWG is used with a soldering iron.

4. **Attaching Connectors and Strain Relief with Pull Tabs:** A ribbon cutter is used for straightening the edge of the laminated cable. An adhesive connector is attached to the edge of the cable and the top connector is pressed on top of the cable using a ribbon connector press. The cable is folded back and the pull tabs, attached to a strain relief, are clipped on the connector for easy removal of cables.

5. **Mounting Heat Shrink for Insulation:** The joint of the ground wire with the braided shield is insulated with the application of a 0.25 inch long, 0.5 inch in diameter, heat shrink. The ground wire is pulled back along the cable and the 2.5" heat shrink is shrunk using a heat gun. Next, the ground wire is pulled up to the end of the cable and the 3" heat shrink is applied on top of the ground wire.

6. **Attaching Lugs to Ground Wire:** The ground wire is stripped using a wire stripper for about the length of the base of the lug. The wire is inserted in the lug and placed flat on the crimper and crimped. Ground wires reduce noise in the signal.

7. **Labeling Cables:** Since there are six cables in a bundle, the respective ends of each cable is identified using a multimeter. The ends of the cables are labeled with an unique alpha-numeric number. This allows for easier identification of the end of one cable in a bundle if one of the cable malfunctions.

8. **Testing Cables for Errors:** The cables are tested for continuity using two types of testers. One tester allows for a broad check, while the other tester is more detailed and specifically states what is wrong with the cable. The two testers are:

1. CTS-64; Cable-Continuity Test Set; Beta Automation, Inc.
2. Signature 2000; Cable Analyzer; CIRRIS.

If an error is found, the cable undergoes repair and all necessary steps are repeated. Computed cables are stored in a transportainer.