

ENGINEERING NOTE

Cat. Code

LH2004

Serial #

10032 B

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05/13/2004Project:**LHC IR FEEDBOX (DFBX)**Title:**LIQUID HELIUM VESSEL DIAGNOSTIC PROBE
FABRICATION TRAVELER****1. SCOPE**

This document specifies the assembly details of the diagnostic probe that will be installed in the LHC IR Region Feedboxes (DFBX). The probe contains 2 liquid helium level sensors (one is 400 mm long and the other is 100 mm long), 2 cartridge heaters (each provides about 50 W when operated at 240 Vac), and one Cernox temperature sensor. The probe will be used by CERN to monitor cooldown and maintain proper level of the liquid helium in the DFBX. The top level assembly is shown on LBNL drawing 27A412.

The probes will be installed into the DFBX by Meyer Tool & Mfg, the DFBX Fabrication Vendor.

2. SPECIAL CONCERNS**2.1 Heater Voltage**

The heaters are powered by 240 Vac through a small connector where the pin-pin and pin-ground spacing is about 1 mm. In order to prevent electrical flashover, we have to pot the helium side with epoxy.

2.2 Liquid Level Readings

We need to accurately position of the liquid level sensors with respect to the mating conflat flange so CERN can maintain proper control of the liquid helium level during LHC operation.

2.3 Cernox Temperature Sensors

The Cernox temperature sensors (supplied by CERN) are individually calibrated and assigned a serial number. CERN provided a traveler that must be filled out for each thermometer. The electrical feedthrough flanges (supplied by CERN) have a serial number etched on their outer surface, so we must make a record of the thermometer-feedthrough flange association.

3. CERNOX THERMOMETER CABLE CONNECTION

Refer to Appendix A, CERN Assembly Procedure LHC-QIT-AP-0002 rev1.0, pages 19-28, for overall guidance and documentation requirements for thermometer electrical hookup. The thermometer used in the DFBX helium bath is CERN type ST.

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The parts kit corresponding to each ST-Cernox thermometer installation are contained in a single plastic box. The kit consists of a thermometer (Cernox chip mounted in the ST configuration), a cover plate, thermometer cable, cable label, and Traveler.

In two of the boxes supplied by CERN, CX_LS_X18374 and CX_LS_X18375, the thermometer cable is attached to the sensor package and serves as examples of how we must connect the remaining 6 thermometers to their thermometer cables.

Extension wires are attached to the connector as shown on LBNL drawing 27A408A. Our extension wires are contained in a cable purchased from Habia and have the following differences from the CERN Traveler:

Wire: 26 AWG vs. 24 AWG
 Insulation: Kapton vs. Polyolefin
 Length: 24 inch vs 8 cm (3.15 inch)
 U+ (V+) Color: Blue vs. Black
 I+ Color: White vs Yellow .

These differences are not at all significant.

The connection of the thermometer cable to extension wires is covered in the Assembly Instructions on LBNL drawing 27A411A.

For measurements of 2 and 4 wire resistances we will use a HP multimeter, Model 3478A, which is equivalent to the Agilent 34401A mentioned in Appendix A from the standpoint of accuracy and excitation current.

Fill in the pertinent sections of the CERN Traveler for each thermometer and attach a copy of it to LBNL Traveler found in Appendix B.

4. LEVEL SENSOR HOOKUP

LBNL drawing 27A412A shows the proper position of the liquid level sensors. Document that correct positioning was done on the LBNL Traveler in Appendix B.

Hookup of the liquid helium level sensors (supplied by CERN) is covered by Assembly instructions on LBNL drawing 27A411A. The sensors were serialized at LBNL, and after installation are checked with 2-wire resistance measurements using the HP 3478A multimeter. Measure resistances between the Pins listed below on the 16-pin connector and record on the LBNL Traveler in Appendix B:

400-mm-long sensor: A to B, A to C, A to D, B to C, B to D, and C to D

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100-mm-long sensor: E to F, E to G, E to H, F to G, F to H, and G to H

level sensor - level sensor cross talk: A to E (should be very large)

level sensor - thermometer cross talk: A to J, and E to J (should be very large)

5. HEATER HOOKUP

Hookup of the electrical heaters is covered by Assembly instructions on LBNL drawing 27A411A. Make the following electrical measurements on the 4-pin connector and record results in the LBNL Traveler in Appendix B:

Heater resistance (2-wire method): A to B and C to D

In air, before the connector is epoxy potted:

Heater Hipot (1500 V ac): Pins A+B to C+D, Pins A+B to Ground, Pins C+D to Ground

Note: 1500 Vac is the connector rating. *some the heaters are limited to about 1000 V*

In helium, after the connector is epoxy potted:

Heater Hipot (720 V ac): Pins A+B to C+D, Pins A+B to Ground, Pins C+D to Ground

Note: 720 Vac is 3 x Operating Voltage. Ensure pure helium atmosphere by testing in leak test chamber. Evacuate and backfill with pure, dry helium. Repeat this 2 more times for a total of three purges. Hipot with the helium pressure at 14.7 psia (0 psig).

Hipot Procedure: Apply voltage for 1 hour; leakage current to be less than 50×10^{-6} A dc.

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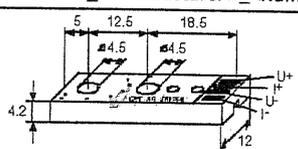
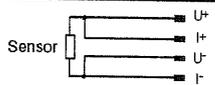
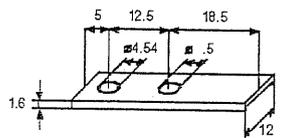
APPENDIX A: CERN THERMOMETER ASSEMBLY PROCEDURE

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5. SHORT THERMOMETER

5.1 SPECIFICATIONS

| | | | | | | |
|-------------------------------|---|--------------------|----------------------|-----------------------|-----------------------|----------------------|
| <i>Short Code</i> | ST | | | | | |
| <i>Application</i> | In liquid or gaseous cryogenic environment | | | | | |
| <i>Serial Number</i> | The serial number is marked on the short thermometer and is composed like follow: <Sensor>_<Manufacturer>_<Number> | | | | | |
| <i>Mechanical Design</i> | Top view:  | | | | | |
| <i>Electrical Scheme</i> |  | | | | | |
| <i>Electrical Data (typ.)</i> | | <i>Thermometer</i> | <i>Sensor Model</i> | <i>Temperature</i> | | |
| | | | | <i>Tamb</i> | 77 K | 4.2 K |
| | $R(U+, I+)/?2 W$ | n. a. | n. a. | 0.1 ... 0.5 | 0.1 ... 0.5 | 0.1 ... 0.5 |
| | $R(U-, I-)/?2 W$ | n. a. | n. a. | 0.1 ... 0.5 | 0.1 ... 0.5 | 0.1 ... 0.5 |
| | $R(U+, I+, U-, I-)/?4 W$ (Excitation current) | CRT_AB_... | 100 ?, 1/8W | 100 ± 3 (0.1 mA) | 120 ± 15 (0.1 mA) | 1000 ± 250 (1 µA) |
| | CRT_JINR_... | TVO | 900 ± 20 (0.1 mA) | 1300 ± 150 (10 µA) | 4500 ± 1.5k (1 µA) | |
| | CX_LS_... | XCX-1050 -SD-30 | 50 ± 20 (0.1 mA) | 180 ± 55 (10 µA) | 3600 ± 2k (1 µA) | |
| | PRT_... | PT100 | 108 ± 0.2 (1mA) | 20 ± 0.7 (1mA) | n. a. | |
| <i>Cover</i> | A mechanical protection cover shall be fixed on the thermometer. Top view:  | | | | | |



The electrical data refers to the short thermometer only (cable not included).

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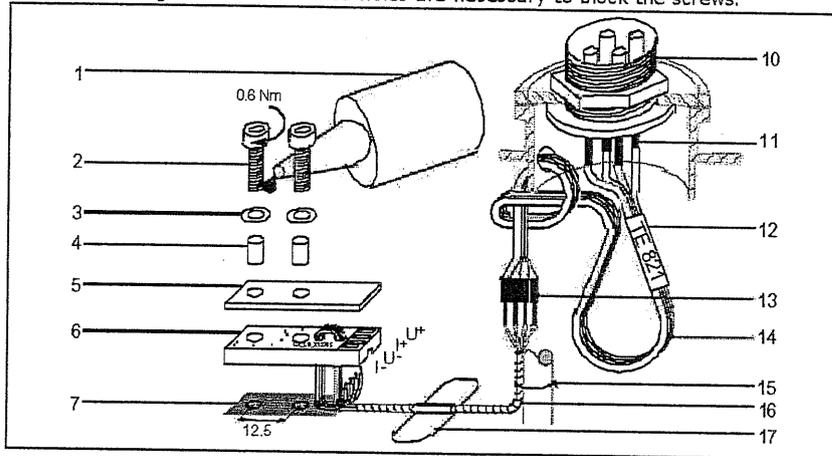
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5.2 FIXING

The short thermometer can be fixed in three different ways. A polyimide foil shall be sandwiched between thermometer and mounting surface to avoid electric damage of the sensor in case the surface is under high electric potential.

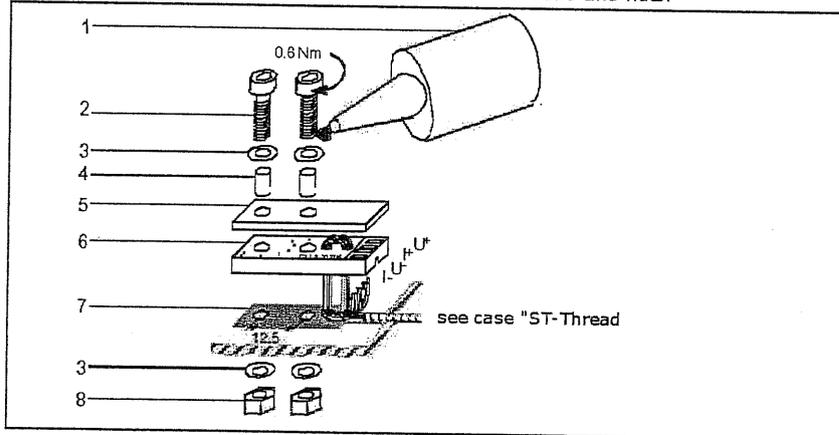
5.2.1 CASE "ST-THREAD"

On the mounting surface 2 threaded holes are necessary to block the screws.



5.2.2 CASE "ST-HOLE"

If the mounting surface is a thin sheet where no threading can be done, then simply two holes are needed, to fix the thermometer with 2 screws and nuts.



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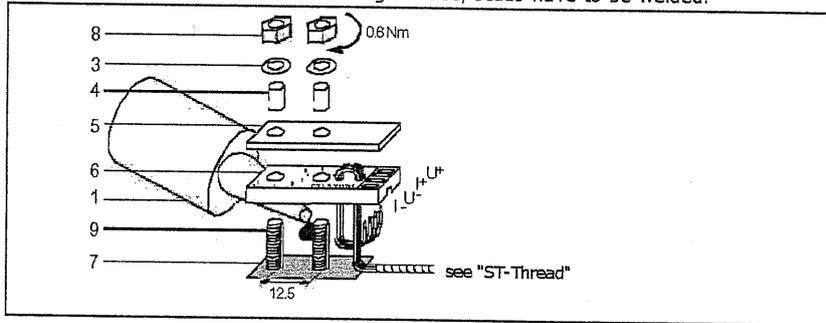
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5.2.3 CASE "ST-STUD"

If no hole can be drilled in the mounting surface, studs have to be welded.



List of parts:

| Pos | Part | Details | Supplier | Model | CERN-SCEM |
|-----|-------------|---|--------------|----------------------|----------------|
| 1 | Glue | Screw glue | LOCTITE | Loctite® 245 | 37.30.35.074.3 |
| 2 | Screw | M4 x 10, Stainless steel | - | - | 47.62.71.154.8 |
| 3 | Washer | Curved spring, phosphor bronze | - | - | 47.78.08.607.4 |
| 4 | Tube | Polyimide Tube | | | |
| 5 | Cover | Short thermometer cover | CERN | - | - |
| 6 | Thermometer | Short thermometer | CERN | - | - |
| 7 | Foil | Polyimide Foil 0.07 mm x 12 mm x 36 mm | | | 04.94.70.100.3 |
| 8 | Nut | M4, Stainless steel | - | - | 47.43.77.040.1 |
| 9 | Stud | M4 x 10, Steel | - | - | 47.62.97.154.4 |
| 10 | Connector | - | - | - | - |
| 11 | Sleeve* | Heat shrinkable, $\phi=16$ mm | RAYCHEM | RT-102 | - |
| 12 | Label* | Shrinkable, $\phi=3.4$ mm, yellow | | Halogen free | - |
| 13 | Sleeve* | Heat shrinkable, $\phi=16$ mm | RAYCHEM | RT-102 | - |
| 14 | Wire* | Extension wires, black | HUBER-SUHNER | 0.25 mm ² | 04.01.61.340.1 |
| | | Extension wires, red | HUBER-SUHNER | 0.25 mm ² | 04.01.61.370.5 |
| | | Extension wires, yellow | HUBER-SUHNER | 0.25 mm ² | 04.01.61.390.1 |
| | | Extension wires, green | HUBER-SUHNER | 0.25 mm ² | 04.01.61.310.7 |
| 15 | Lace | Linen | GRUSCHWITZ | 18/7 | 04.76.81.007.2 |
| 16 | Cable | Thermometer cable for type ST | AXON' | HT 3007 H4 | - |
| 17 | Tape | Aluminium, width=19 mm | TESA | 4500 | 04.95.20.219.8 |

* shall be in accordance with CERN Safety Instruction IS 23.

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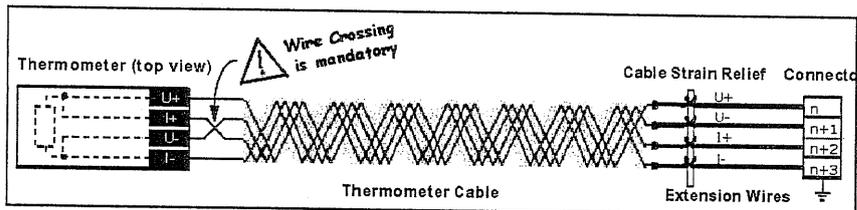
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5.3 CABLING

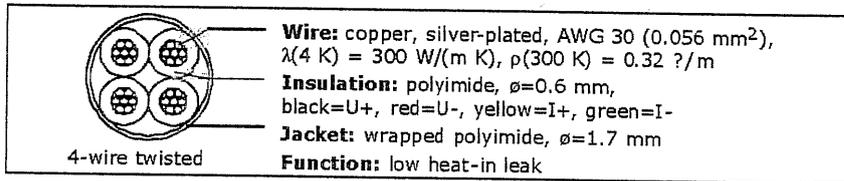
5.3.1 DIAGRAM

The resistance of the temperature sensor is measured in the Ω 4W-way. Therefore a 4-wire twisted "thermometer cable" is soldered to the thermometer. To minimize heat flow from ambient environment to the sensor by conduction of the electrical leads, thin wires are used. Stress on those thin wires is avoided by more robust extension wires, which are mechanically fixed (f.e. by a knot) close to the connector. The cabling looks like follows.

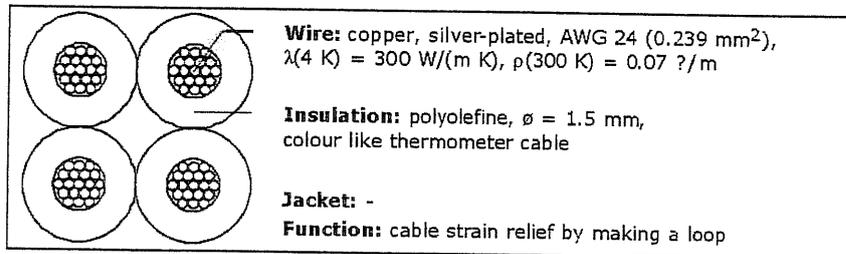


The electrical connections on the thermometer and connector do NOT follow the same order!

5.3.2 SHORT THERMOMETER CABLE



5.3.3 EXTENSION WIRES



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5.4 THERMOMETER TRAVELLER

Every thermometer has its specific "Thermometer Traveller"-sheet, like a curriculum vitae. This traveller traces the life of the thermometer.

Example:

Cabling

Thermometer Serial Number: CX-LS-X05648

Connector Tag Name: _____

Wire Crossing is mandatory.

Fixing Case:
 Thread
 Hex
 Blue

Thermometer Cable for Type ST:
 n (200 K) n n 30 Cm
 Copper AWG 30
 Length = 5.2 m

Extension:
 n (200 K) n n 0.07 Dm
 Copper AWG 34
 Length = 0.07 m

| Interval | Date | Check | R(U) (U=1-11) | R(U) (U=12-14) | R(U) (U=15-17) | R(U) (U=18-20) | Temperature | Final Laboratory | Checked by |
|-------------------|---------------|-------------------------------------|---------------|----------------|----------------|----------------|-------------|------------------|------------|
| Production | 15 April 2000 | <input checked="" type="checkbox"/> | 50.2 | - | - | - | ambient | Lake shore | Johanson |
| Integration | 22 June 2000 | <input checked="" type="checkbox"/> | 50.0 | 0.2 | 0.2 | 0.2 | ambient | NMS | Moser |
| Calibration | 23 June 2000 | <input checked="" type="checkbox"/> | 50.4 | 0.2 | 0.2 | 0.2 | ambient | JEN, Cragg | Dupond |
| Workshop, Cabling | 28 June 2000 | <input checked="" type="checkbox"/> | 50.6 | 0.2 | 0.2 | 0.2 | ambient | Aktion | Bauer |
| Workshop, Cabling | 28 June 2000 | <input checked="" type="checkbox"/> | 50.6 | 0.4 | 0.4 | 0.4 | ambient | Aktion | Bauer |

Short Thermometer (ST) Traveller

Thermometer Serial Number: CX-LS-X05648

Thermometer's CERN Pan ID: HCQITE5CXI-CR01481

Name of ST on Top Assembly: HCWBE-A001-D10000012/TEB21

Functional Equipment ID: MB-C23L1/TEB21



After every mechanical or electrical intervention the checks indicated on the traveller shall be done and filled in.

5.5 INSTALLATION PROCEDURE

The installation procedure of a short thermometer is divided in 4 consecutive phases:

| Order | Phase | Main Activity |
|-------|------------------|--------------------------------|
| 1 | Office | Allocation of the thermometer |
| 2 | Workshop | Wire attachment to thermometer |
| 3 | On Site, Fixing | Fixing of the thermometer |
| 4 | On Site, Cabling | Cabling |

During all the phases the thermometer traveller is an important tool to check the well functioning of the thermometer.

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5.5.1 OFFICE

5.5.1.1 PROCEDURE

| Step | Description |
|----------|---|
| Check | 1. Make sure that the serial number indicated on the "Short Thermometer Traveller" is in accordance with the serial number of the thermometer. |
| Planning | 2. Fill in the "Cabling"-frame of the "Short Thermometer Traveller"-form, completely. 3. Write down the interventions after which a check must be done to the column "Intervention" of the frame "Checks". |

5.5.2 WORKSHOP

5.5.2.1 EQUIPMENT

See also 5.2 Fixing

| Tool | Details | Supplier | Model | CERN-SCEM |
|----------------|------------------------------------|-----------|----------------|----------------|
| Pliers | Side cutting, ϕ 0.2...1.25 mm | LINDSTROM | SANDVIK 8140 | 34.95.64.151.8 |
| Flat pliers | Nose width=7 mm | FACOM | 188-16 CPY | 34.76.15.160.6 |
| Cable stripper | For wrapped polyimide | ABIKO | ABMK-1F | 34.95.62.140.9 |
| Scalpel | - | - | - | 54.41.14.110.3 |
| Cable stripper | ϕ 0.3 mm | JOKARI | SWS | - |
| Cable stripper | for extension wires | STRIPAX | - | 34.95.62.154.4 |
| Tweezers | - | BELZER | - | 34.76.10.170.4 |
| Scissors | - | BOSSARD | 12.57200.200 | 34.94.22.130.7 |
| Alcohol | Isopropyl-alcohol | - | - | 58.04.45.300.8 |
| Duster | Clean and fuzz-free | - | - | 55.60.82.100.2 |
| Ohmmeter | 2-and 4 wires, $R_i=1$ M? | AGILENT | 34401A | - |
| Soldering iron | Power = 50 W | WELLER | MIN FH | 34.94.57.C |
| Labeling tool | Thermal labeling system | BRADY | TLS 2200 | - |
| Solder | Sn62Pb36Ag2, $\phi=1$ mm | MULTICORE | LMP Ersin 362 | 29.20.01.349.6 |
| Magnifier | Illuminated | WALDMANN | SNLE 319 | - |
| Connector | Temporary female connector | WAGO | 734-104 | - |
| Needle | For temporary connector | WAGO | 233-332 | - |
| Ruler | Push-pull ruler | STANLEY | Instamatic 116 | 34.20.16.210.0 |
| Cleaner | Ultrasonic cleaner | ELMA | - | - |
| Soap water | For ultrasonic cleaner | ZESTRON | Vigon US | - |
| Extractor | For solder | - | - | 34.94.04.A. |
| Vices | For delicate works | TIRO-CLAS | - | 34.95.92.100 |
| Hot air blower | For heat-shrinkable sleeves | LEISTER | Triac | 34.95.35.100.0 |

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5.5.2.2 PROCEDURE

| Step | Description |
|---|--|
| Start checks | 4. Make sure that the serial number indicated on the "Short Thermometer Traveller" is in accordance with the serial number of the thermometer. 5. Measure R(U+, U-, I+, I-), R(U+, I+), R(U-, I-) and R(U+, GND) at the thermometer "Check Point T". 6. Write the measured values to the "Short Thermometer Traveller". 7. Check if measured values are in accordance with the values in the first line ± 3 ? . |
| Preparation extension wires | 8. Cut four extension wires by a length of approx. 800 mm with side cutting pliers. 9. cutting pliers. 10. Strip the extension wires with the appropriate tool. Tin the wires on the thermometer cable side, only. |
| | |
| Preparation thermometer cable for type ST | 11. Cut the thermometer cable for type ST by the length indicated on the "Short Thermometer Traveller" with side cutting pliers. 12. Strip the thermometer cable. 13. Tin the wires of the thermometer cable on both ends. |
| | |
| Soldering cable | 14. Fix the short thermometer cable carefully with vices. 15. Solder the 4 extension wires to the short thermometer cable colour by colour with solder Sn62Pb36Ag2. Don't exceed a temperature of 250 °C. |
| Fixing temp. connector | 16. Write the name of the thermometer TE... (see "Short Thermometer Traveller") on the heat shrinkable label \varnothing 3.4 mm. 17. Shrink label over the 4 extension wires with hot air blower. 18. Clip temporary connector to the extension wires with needle tool. |

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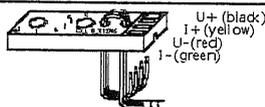
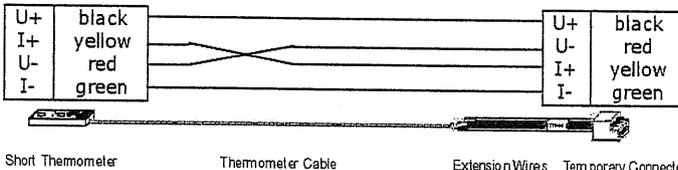
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|-----------------------|--|
| Soldering thermometer | <p>19. Create a strain relief by passing the thermometer cable through the two, small holes of the thermometer.</p>  |
| | <p>20. Solder wires of the thermometer cable to the short thermometer with low melting point solder Sn62Pb36Ag2. Don't exceed a temperature of 250 °C.</p>  |
| Cleaning | <p>21. Put the thermometer and the soldered cable in an ultrasonic cleaner with soap water of 20 °C for 3 minutes, and then rinse with deionised water for 3 minutes.</p> |
| Shrinking sleeves | <p>22. Protect the soldering by shrinking 4 sleeves $\varnothing 1.6$ mm x 10 mm with hot air blower.</p> |
| End checks | <p>23. Measure R(U+, U-, I+, I-), R(U+, I+), R(U-, I-) and R(U+, GND) at the temporary connector "Check Point W".</p> <p>24. Write the measured values to the "Short Thermometer Traveller".</p> <p>25. Check if measured values are in accordance with the values in the first line ± 3 ?.</p> <p>26. Put the short thermometer with the attached cable, the cover and the "Short Thermometer Traveller" -Sheet in the transport case.</p> |

5.5.3 ON SITE, FIXING

5.5.3.1 EQUIPMENT

See also 5.2 Fixing

| Tool | Details | Supplier | Model | CERN-SCEM |
|-------------|---------------------------|-----------------|--------------|----------------|
| Duster | Clean and fuzz-free | - | - | 55.60.82.100.2 |
| Alcohol | Isopropyl-alcohol | - | - | 58.04.45.300.8 |
| Lamp | Safety wander-lamp, 220 V | - | - | 03.52.10.620.2 |
| Scissors | - | BOSSARD | 12.57200.200 | 34.94.22.130.7 |
| Screwdriver | Torque-limiting 0.6 Nm | MHH Engineering | Torqueleader | - |
| Ohmmeter | 2-and 4 wires, Ri = 1 M? | HP | - | - |
| Connector | Temporary male connector | WAGO | 733-204 | - |
| Cable | Extension cable, 220 V | - | - | 04.66.11.230.9 |

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5.5.3.2 PROCEDURE

| Step | Description |
|--------------------|---|
| Start checks | 27. Make sure that the serial number indicated on the "Short Thermometer Traveller" is in accordance with the serial number of the thermometer. 28. Make also sure that the fixing case indicated on the "Short Thermometer Traveller" is in accordance with the fixing case on site. 29. Measure R(U+, U-, I+, I-), R(U+, I+) R(U-, I-) and R(U+, GND) at the temporary connector "Check Point W". 30. Write the measured values to the "Short Thermometer Traveller". 31. Check if measured values are in accordance with the values in the first line ± 3 ?. |
| Fixing thermometer | 32. Clean the mounting surface. 33. Place the thermometer on its final position. Don't squeeze the cable! 34. Place the cover on top of the thermometer. 35. Put a drop of screw glue on the screws or studs. 36. Put the curved spring washers. 37. Screw the thermometer with a torque of 0.6 Nm. |
| Fixing cable | 38. Fix the cable at every change of direction, at least every 50 cm with easy tighten slopes of lace. Leave the cable lose between the fixings! Where fixing with lace is not possible, use edge-rounded aluminium-tape after cleaning the surfaces with isopropyl alcohol. |
| End checks | 39. Measure R(U+, U-, I+, I-), R(U+, I+) R(U-, I-) and R(U+, GND) at the temporary connector "Check Point W". 40. Write the measured values to the "Short Thermometer Traveller". 41. Check if measured values are in accordance with the values in the first line ± 3 ?. |

5.5.4 ON SITE, CABLING

5.5.4.1 EQUIPMENT

See also 5.2 Fixing

| Tool | Details | Supplier | Model | CERN-SCEM |
|----------------|-----------------------------|----------|---------|----------------|
| Lamp | Safety wander-lamp, 220 V | - | - | 03.52.10.620.2 |
| Soldering iron | Power = 50 W | WELLER | - | 34.94.57.350.2 |
| Solder | SN96.3AG3.7, rosin-free | KESTER | - | - |
| Hot air blower | For heat-shrinkable sleeves | RAYCHEM | CV1981 | 34.95.35.100.0 |
| Ohmmeter | 2-and 4 wires, Ri = 1 M? | HP | - | - |
| Connector | Temporary male connector | WAGO | 733-204 | - |
| Needle | For temporary connector | WAGO | 233-332 | - |
| Test box | With connector for test | - | - | - |
| Cable | Extension cable, 220 V | - | - | 04.66.11.230.9 |

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5.5.4.2 PROCEDURE

| Step | Description |
|--------------|--|
| Start checks | 42. Make sure that the serial number indicated on the "Short Thermometer Traveller" is in accordance with the serial number of the thermometer. 43. Measure R(U+, U-, I+, I-), R(U+, I+), R(U-, I-) and R(U+, GND) at the temporary connector "Check Point W". 44. Write the measured values to the "Short Thermometer Traveller". 45. Check if measured values are in accordance with the values in the first line ± 3 ? . |
| Connector | 46. Disconnect the temporary connector with needle tool. 47. Make a strain relief with the extension wires by fixing them close to the connector. 48. Push sleeve $\varnothing 1.6$ mm x 10 mm over each of the extension wires. 49. Solder wires in accordance to the "Short Thermometer Traveller" to the connector. Use rosin-free solder SN96.3AG3.7. 50. Protect the soldering by shrinking the 4 sleeves. |
| End checks | 51. Measure R(U+, U-, I+, I-); R(U+, I+), R(U-, I-) and R(U+, GND) at the connector "Check Point C". 52. Write the measured values to the "Short Thermometer Traveller". 53. Check if measured values are in accordance with the values in the first line ± 3 ? . |



If during the installation phase of a cryogenic thermometer problems are encountered or questions raised up, the thermometry team at CERN shall be contacted (see '9. CERN Contact Persons').

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LIQUID HELIUM VESSEL DIAGNOSTIC PROBE TRAVELER

| | | |
|---|---------------------|--|
| VIBROMETER FLANGE SER | | AA_26409 |
| LEAK RATE: <u>1.4</u> X10 ⁻² STD CC/SEC (HELIUM) BY <u>ANDERSON</u> | | DATE <u>8/18/04</u> |
| USED IN | | DFBX IT |
| CERNOX SERIAL NUMBER | | CS-LS-X <u>18379</u> |
| (ATTACH COPY OF COMPLETED CERN TRAVELER) | | |
| LEVEL SENSOR SERIAL NUMBERS | | HD100- <u>7</u> , HD400- <u>7</u> |
| LEVEL SENSORS POSITIONED PER 27A412A | | <u>DAVE ANDERSON</u> (SIGNED) <u>6/21/04</u> (DATE) |
| LEVEL SENSOR RESISTANCE CHECKS (2-WIRE HP 3478A) (16-PIN CONNECTOR) | | |
| A TO B: <u>76.31</u> | A TO C: <u>2.59</u> | A TO D: <u>75.61</u> |
| B TO C: <u>78.47</u> | B TO D: <u>1.53</u> | C TO D: <u>77.72</u> |
| E TO F: <u>19.56</u> | E TO G: <u>3.13</u> | E TO H: <u>19.34</u> |
| F TO G: <u>22.30</u> | F TO H: <u>6.50</u> | G TO H: <u>22.09</u> |
| A TO J: <u>0VL</u> MOHMS | | E TO J: <u>0VL</u> MOHMS |
| HEATER ELECTRICAL CHECKS (4-PIN CONNECTOR) | | |
| A TO B: <u>524</u> | | C TO D: <u>571</u> KOHM |
| 750 BEFORE POTTING, IN AIR, 1500 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 4500 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> (SIGNED) <u>8/23/04</u> (DATE) |
| AFTER POTTING, IN HELIUM, 720 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | |
| REVIEWED <u>Jon Zbasnik</u> | | DATE <u>8/31/04</u> |
| APPROVED <u>Joseph Rason</u> | | DATE <u>9/11/04</u> |
| | | JOSEPH RASSON |

ENGINEERING NOTE

Author

Jon Zbasnik

Department

Mechanical Engineering

Date

05/13/2004

LIQUID HELIUM VESSEL DIAGNOSTIC PROBE TRAVELER

| | | |
|--|---------------------|--|
| VIBROMETER FLANGE SER | | AA 76408 |
| LEAK RATE <u>4.8</u> X10 ⁹ STD CC/SEC (HELIUM) BY <u>D. ANDERSON</u> | | DATE <u>8/2/04</u> |
| USED IN | | DFBX <u>6</u> |
| CERNOX SERIAL NUMBER | | CS-LS-X <u>18377</u> |
| (ATTACH COPY OF COMPLETED CERN TRAVELER) | | |
| LEVEL SENSOR SERIAL NUMBERS | | HD100- <u>4</u> , HD400- <u>5</u> |
| LEVEL SENSORS POSITIONED PER 27A412A | | <u>DAVE ANDERSON</u> (SIGNED) <u>8/21/04</u> (DATE) |
| LEVEL SENSOR RESISTANCE CHECKS (2-WIRE HP 3478A) (16-PIN CONNECTOR) | | |
| A TO B: <u>76.03</u> | A TO C: <u>2.96</u> | A TO D: <u>75.31</u> |
| B TO C: <u>78.51</u> | B TO D: <u>1.54</u> | C TO D: <u>77.77</u> |
| E TO F: <u>18.77</u> | E TO G: <u>3.60</u> | E TO H: <u>18.77</u> |
| F TO G: <u>22.10</u> | F TO H: <u>.661</u> | G TO H: <u>21.87</u> |
| A TO J: <u>0VL</u> MOHMS | | E TO J: <u>0VL</u> MOHMS |
| HEATER ELECTRICAL CHECKS (4-PIN CONNECTOR) | | |
| A TO B: <u>.565</u> | C TO D: <u>.533</u> | KOHMS |
| BEFORE POTTING, IN AIR, 1500 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>DAVE ANDERSON</u> (SIGNED) <u>7/29/04</u> (DATE) |
| AFTER POTTING, IN HELIUM, 720 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>DAVE ANDERSON</u> <u>8/3/04</u> |
| REVIEWED <u>Jon Zbasnik</u> | DATE <u>8/31/04</u> | |
| APPROVED <u>Joseph Rason</u> | DATE <u>9/1/04</u> | |

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ENGINEERING NOTE

Author

Jon Zbasnik

Department

Mechanical Engineering

Date

05/13/2004

LIQUID HELIUM VESSEL DIAGNOSTIC PROBE TRAVELER

| | | |
|--|---------------------------|--|
| VIBROMETER FLANGE SER | | AA 76403 |
| LEAK RATE: 2.6×10^{-5} STD CC/SEC (HELIUM) BY <u>ANDERSON</u> DATE <u>8/17/04</u> | | |
| USED IN | | DFBX F |
| CERNOX SERIAL NUMBER | | CS-LS-X12380 |
| (ATTACH COPY OF COMPLETED CERN TRAVELER) | | |
| LEVEL SENSOR SERIAL NUMBERS | | HD100-2, HD400-1 |
| LEVEL SENSORS POSITIONED PER 27A412A | | <u>D. ANDERSON</u> (SIGNED) <u>6/21/04</u> (DATE) |
| LEVEL SENSOR RESISTANCE CHECKS (2-WIRE HP 3478A) (16-PIN CONNECTOR) | | |
| A TO B: <u>76.13</u> | A TO C: <u>2.67</u> | A TO D: <u>75.95</u> |
| B TO C: <u>78.57</u> | B TO D: <u>1.54</u> | C TO D: <u>77.58</u> |
| E TO F: <u>19.42</u> | E TO G: <u>2.92</u> | E TO H: <u>19.17</u> |
| F TO G: <u>21.37</u> | F TO H: <u>6.69</u> | G TO H: <u>21.22</u> |
| A TO J: <u>OVVL</u> MOHMS | E TO J: <u>OVVL</u> MOHMS | <u>D. ANDERSON</u> (SIGNED) <u>7/26/04</u> (DATE) |
| HEATER ELECTRICAL CHECKS (4-PIN CONNECTOR) | | |
| A TO B: <u>.518</u> | C TO D: <u>.523</u> | |
| BEFORE POTTING, IN AIR, 1500 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> (SIGNED) <u>8/24/04</u> (DATE) |
| AFTER POTTING, IN HELIUM, 720 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | |
| REVIEWED <u>Jon Zbasnik</u> | DATE <u>8/31/04</u> | |
| APPROVED <u>Joseph Rasson</u> | DATE <u>9/1/04</u> | |
| | | JOSEPH RASSON |

ENGINEERING NOTE

Author

Jon Zbasnik

Department

Mechanical Engineering

Date

05/13/2004

LIQUID HELIUM VESSEL DIAGNOSTIC PROBE TRAVELER

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| VIBROMETER FLANGE SER | | AA 76394 |
| LEAK RATE: 3.4×10^{-5} STD CC/SEC (HELIUM) BY <u>ANDERSON</u> , DATE <u>8-17-04</u> | | |
| USED IN | | DFBX <u>E</u> |
| CERNOX SERIAL NUMBER | | CS-LS-X <u>8375</u> |
| (ATTACH COPY OF COMPLETED CERN TRAVELER) | | |
| LEVEL SENSOR SERIAL NUMBERS | | HD100- <u>5</u> , HD400- <u>4</u> |
| LEVEL SENSORS POSITIONED PER 27A412A | | <u>D. ANDERSON</u> (SIGNED) <u>6/21/04</u> (DATE) |
| LEVEL SENSOR RESISTANCE CHECKS (2-WIRE HP 3478A) (16-PIN CONNECTOR) | | |
| A TO B: <u>75.97</u> | A TO C: <u>3.02</u> | A TO D: <u>75.20</u> |
| B TO C: <u>28.51</u> | B TO D: <u>1.45</u> | C TO D: <u>77.92</u> |
| E TO F: <u>19.35</u> | E TO G: <u>3.49</u> | E TO H: <u>19.10</u> |
| F TO G: <u>22.40</u> | F TO H: <u>.67</u> | G TO H: <u>22.22</u> |
| A TO J: <u>OV</u> MOHMS | E TO J: <u>OV</u> MOHMS | <u>D. ANDERSON</u> (SIGNED) <u>8/13/04</u> (DATE) |
| HEATER ELECTRICAL CHECKS (4-PIN CONNECTOR) | | |
| A TO B: <u>.553</u> | C TO D: <u>.555</u> | |
| 720 BEFORE POTTING, IN AIR, 720 4500 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 1500 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> (SIGNED) <u>8/17/04</u> (DATE) |
| AFTER POTTING, IN HELIUM, 720 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> <u>8/26/04</u> |
| REVIEWED <u>Jon Zbasnik</u> | DATE <u>8/31/04</u> | |
| APPROVED <u>Joseph Rasson</u> | DATE <u>9/1/04</u> | |
| | | JOSEPH RASSON |

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ENGINEERING NOTE

Author

Jon Zbasnik

Department

Mechanical Engineering

Date

05/13/2004

LIQUID HELIUM VESSEL DIAGNOSTIC PROBE TRAVELER

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|--|--------------------------|--|
| VIBROMETER FLANGE SER | | AA76389 |
| LEAK RATE: 1.0×10^{-2} STD CC/SEC (HELIUM) BY <u>D. ANDERSON</u> , DATE <u>8/17/04</u> | | |
| USED IN | | DFBX A |
| CERNOX SERIAL NUMBER | | CS-LS-X 18378 |
| (ATTACH COPY OF COMPLETED CERN TRAVELER) | | |
| LEVEL SENSOR SERIAL NUMBERS | | HD100-3, HD400-8 |
| LEVEL SENSORS POSITIONED PER 27A412A | | <u>D. ANDERSON</u> (SIGNED) <u>6/21/04</u> (DATE) |
| LEVEL SENSOR RESISTANCE CHECKS (2-WIRE HP 3478A) (16-PIN CONNECTOR) | | |
| A TO B: <u>76.39</u> | A TO C: <u>3.10</u> | A TO D: <u>75.67</u> |
| B TO C: <u>79.06</u> | B TO D: <u>1.57</u> | C TO D: <u>78.24</u> |
| E TO F: <u>18.97</u> | E TO G: <u>3.26</u> | E TO H: <u>18.76</u> |
| F TO G: <u>21.77</u> | F TO H: <u>7.03</u> | G TO H: <u>21.53</u> |
| A TO J: <u>0V4</u> MOHMS | E TO J: <u>0V4</u> MOHMS | |
| <u>D. ANDERSON</u> (SIGNED) <u>8/13/04</u> (DATE) | | |
| HEATER ELECTRICAL CHECKS (4-PIN CONNECTOR) | | |
| A TO B: <u>.554</u> | C TO D: <u>.565</u> | |
| BEFORE POTTING, IN AIR, 1500 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 1500 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> (SIGNED) <u>8/17/04</u> (DATE) |
| AFTER POTTING, IN HELIUM, 720 VAC A+B TO C+D FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC A+B TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N 720 VAC C+D TO GROUND FOR 1 HR OK? <input checked="" type="checkbox"/> Y <input type="checkbox"/> N | | <u>D. ANDERSON</u> <u>8/24/04</u> |
| REVIEWED <u>Jon Zbasnik</u> | DATE <u>8/24/04</u> | |
| APPROVED <u>Joseph Rasson</u> | DATE <u>9/1/04</u> | |

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Cryogenic Thermometer Traveller

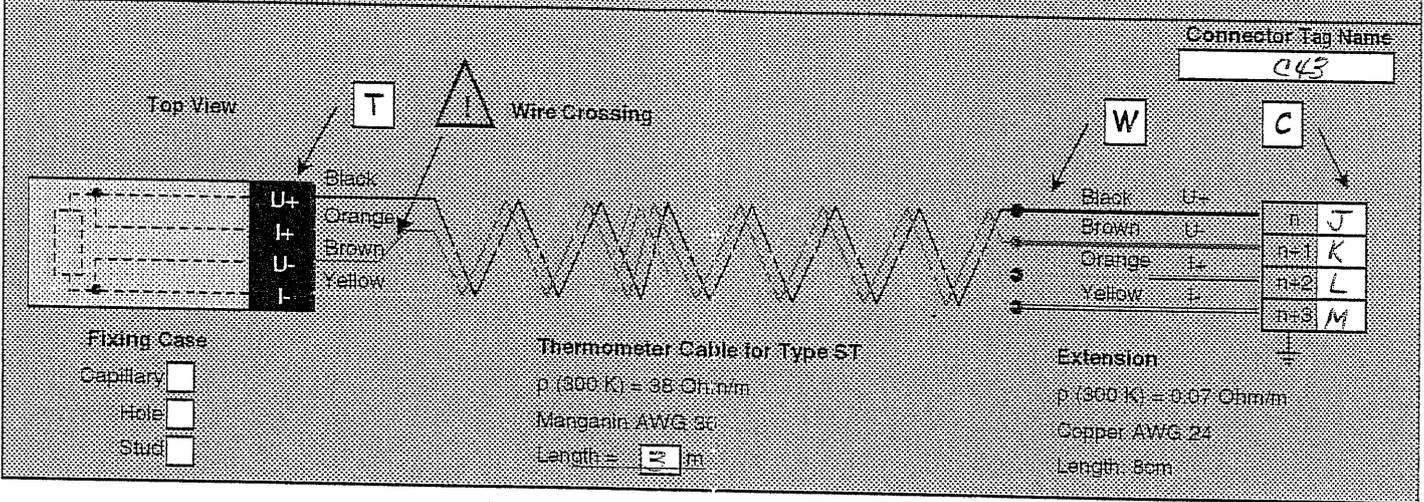


DESCRIPTION*

| | | | |
|-----------------------|-----------------------|----------------------------------|-------------|
| Part Description: | Cryogenic thermometer | Instrument Name: | VIBRO-METER |
| CERN Part Identifier: | HCQITESCXT-CR016170 | Top Assembly: | AA76 392 |
| Other Identification: | CX_LS_X18376 | Functional Equipment Identifier: | DFBKD |

* In accordance with LHC-QIT-QA-0002

CABLING



CHECKS

| Intervention | Date DD-MM-YYYY | Check Point | R(U-U _{ref}) [Ohm] 4W | R(U-I ₁) [Ohm] 2W | R(U-I ₂) [Ohm] 2W | R(U-GND) [Ohm] 2W | Resistance [K] | From Laboratory | Checked by |
|--------------|--------------------|----------------|------------------------------------|----------------------------------|----------------------------------|----------------------|-------------------|-----------------|------------|
| Reference | 11-Feb-2002 | T | 60.65 | 0.65 | 0.50 | OVL | 300.00 | IPN | Joly |
| Expedition | 2-Sep-2003 | T | 59.35 | 0.65 | 0.50 | OVL | 293.00 | CERN | Vauthier |
| Reception | | W | | | | | | | |
| CABLE | 27-JUNE 2004 | W | 60.20 | 253.18 | 249.55 | OVL | 22° C | LBNL | ANDERSON |
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