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the **Large Hadron Collider** project

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Engineering Specification

Acceptance Plan for LHC IR1/IR5 Neutral Beam Absorbers (TAN)

Abstract

This specification establishes the requirements and procedure for qualifying LBNL-produced LHC Neutral Beam Absorbers (TAN) for use in LHC IP1 and IP5.

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History of Changes

Rev. No.	*Date*	*Pages*	*Description of Changes*
0.1	2004-02-25	All	Initial Submission for approval
1.0	2004-03-10	All	Released version

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1. ACCEPTANCE PROCESS

1.1 TAN ACCEPTANCE BY LBNL

The neutral beam absorbers (TAN) are assembled at LBNL with parts and subassemblies primarily built by industry. The specifications provided to the various vendors are based on the TAN Functional [1] and Interface Specifications [2]. After assembly, acceptance by LBNL is based on in-process and final tests and measurements performed at LBNL. The criteria for acceptance by LNBL are described in [3].

LBNL will complete an acceptance report for each TAN unit. The document will summarize the results of final testing at LBNL and disposition of any deviations. The acceptance report will be reviewed as part of the TAN acceptance process. Acceptance will be documented by the completion of the acceptance report and the associated inspection travelers. The report will list all of the documentation that is being supplied with the TAN along with all other relevant documents listed below in Section 2.3. The acceptance report will be will be posted at

http://www-eng.lbl.gov/~wjelliot/LHC-IR_ABSORBERS/index.html

for evaluation and review by the US LHC Accelerator Project Management office (PMO), and CERN's LHC official contacts for the US Project [4].

During fabrication, assembly, inspection or testing, discrepancies between measured quantities and the acceptance criteria may be found. The LBNL-LHC Project Engineer will examine any deviations and make a recommendation for disposition to the LBNL-LHC Project Manager for approval. Disposition may include repair, rework or acceptance by LBNL with the noted deviation. In those cases where a deviation affects the Functional and Interface Specifications, concurrence on the waiver will be obtained from CERN and the PMO.

1.2 ACCEPTANCE TO SHIP

Acceptance to ship to CERN is predicated on successfully completing LBNL TAN Acceptance procedures referred to in Section 1.1 above.

1.3 DATA TRANSFER

In general, data will be transferred to CERN soon after the TAN units are accepted by LBNL. However, if the evaluation will benefit from prompt examination of the data by PMO and CERN staff, the relevant part of the complete data set will be transferred to them.

1.4 RECEIPT AT CERN

Upon arrival at CERN, a set of inspections and checks will be performed promptly, to verify the integrity of the TAN units following shipment. These inspections and checks, which are specified in Section 2.2 of this document, are chosen to look for indications of damage in transit. The disposition of the TAN units will be discussed among: the official CERN contacts for the US Project and for the Insertions, the US LHC-PMO, and LBNL personnel. Disposition may include repair done at CERN by LBNL or CERN personnel, or acceptance by CERN of the TAN units with the noted deviations. CERN will document its acceptance of the TAN units by memo (paper or e-mail) from the official CERN contact to the US LHC Project Manager and the LBNL LHC Project Manager. Once CERN has accepted the TAN units, responsibility for them will be formally transferred to CERN.

2. TAN ACCEPTANCE CRITERIA

2.1 ACCEPTANCE CRITERIA PRIOR TO SHIPPING.

The criteria for acceptance by LBNL during assembly and final checks before shipping to CERN are listed in LBNL Engineering Note No. M8134 "Acceptance Criteria and Traveler for TAN" [3]. The TAN specifications and completed travelers will be posted at

http://www-eng.lbl.gov/~wjelliot/LHC-IR_ABSORBERS/index.html

to facilitate access by The US LHC Accelerator Project Management office (PMO), and CERN's LHC official contacts for the TAN system.

The major components of the TAN Acceptance Criteria at LBNL include the following:

- Dimensional checks
- Continuity checks of heaters and thermocouples
- Bake-out and vacuum checks
- Fiducialization measurements
- Jack motion

2.2 ACCEPTANCE CRITERIA AFTER ARRIVAL AT CERN

The following is a list of the acceptance tests to be performed at CERN following shipment.

2.2.1 VISUAL INSPECTION

- Conduct internal and external inspections of the container and flat racks.
- Take pictures and compare to pictures of components prior to shipping.
- Prepare report on any damage or changes and notify LBNL and the shipper.

2.2.2 TRANSPORTATION SHOCKS

Report the state of each of the Shockwatch indicators on the crates.

- TAN BEAMTUBE CRATE – IP1-R
- TAN BEAMTUBE CRATE – IP1-L
- TAN BEAMTUBE CRATE – IP5-R
- TAN BEAMTUBE CRATE – IP5-L

Open the crates and report the condition of the internal Shockwatch indicators.

- TAN BEAMTUBE CRATE – IP1-R
- TAN BEAMTUBE CRATE – IP1-L
- TAN BEAMTUBE CRATE – IP5-R
- TAN BEAMTUBE CRATE – IP5-L
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2.2.3 PRESSURE INTEGRITY

The intent of this check is to ensure that the beam tube physical integrity. The beam tube is shipped from LBNL at 0.11Mpa internal pressure (dry Argon). Since the pressure will not be the same at CERN due to altitude and temperature, the following procedure will be followed:

- Check beam tube pressure –
  - Using the supplied manifold with pressure gauge, loosely attach the ½" VCT connector on the manifold to the ½" VCR connector on the valve protruding from the IP blank off flange of the TAN.
  - Connect a bottle of dry Argon to the remaining connector on the manifold.
  - Flow dry Argon for 1 minute through the manifold and out through the loose VCR fitting to sweep out any trapped air.
  - Tighten the VCR connectors and shut off Argon flow.
  - Report the gauge pressure
  - Open the valve attached to the IP flange
  - Report the gauge pressure
    - If pressure is below .11 Mpa, re-pressurise to .11 Mpa with dry Argon.
    - Wait 24 hours
  - Report the gauge pressure

2.2.4 VACUUM LEAK CHECK

The CERN AT-Vacuum Group will perform a leak check of each beam tube to verify that the vacuum can still be maintained at room temperature, post bake-out leak rate of less than 7.5×10^{-11} Torr-l/s (9.87×10^{-11} atm cc/s) Helium. The TAN beam tubes are shipped with all flanges set up for vacuum leak test. The single bore end with the 304 mm flange will have the required Helicoflex seal and chain clamp installed and readied for the vacuum leak test. If the beam tube does not pass the initial vacuum leak test, the technician should check the torque on the chain clamp to make sure that it did not come lose during shipping. The torque recommended by the manufacturer is 180N-M

2.2.5 HEATER CHECK-OUT

The CERN AT-Vacuum Groups will perform an electrical check-out of the heaters and thermocouples. Individual heater resistance will be measured and accepted if it is within ±10% of the values measured and recorded in the travelers at LBNL prior to shipping. Ground isolation resistance measurements will also be performed to verify open circuit to ground. However, full powering of the heaters is not required.

Individual thermocouple resistance will be measured and accepted if it is within ±10% of the values measured and recorded in the travelers at LBNL prior to shipping.

2.3 DOCUMENTATION

Documentation for the TAN will be shipped to CERN separately in paper and transmitted in electronic form. The following is a list of the documentation to be provided:

2.3.1 ENGINEERING NOTES

Engineering Note Description	***Serial No.***	***Author***
LHC Category Code Index	M 7740A	Hoyer
Engineering Note Index	M 7927	Hoyer
TAN Vacuum Chamber Tolerances	M 7741B	Hoyer
TAN In-Situ Bakeout Calculations	M 7742A	Hoyer
TAN Component Weights and Seismic Stablility	M 7743A	Hoyer
TAN Ambient Cooling Calculations	M 7744B	Hoyer
TAN Assembly Procedure	M 7906	Bercovitz
TAN Stresses and Deflections	M 7907A	Bercovitz
TAN Installation Sequence	M 7908	Bercovitz
TAN Safety Note	M 7909	Bercovitz
TAN Vacuum Chamber Handling Stresses	M 7935A	Lundgren
TAN Abs Vacuum Chamber Lifting and Handling Instruct.	M 8187A	Lundgren
TAN Shipping Specifications	M 8135A	Elliott

2.3.2 DRAWING PACKAGES

TAN: LBNL Category Code LH1002
TAN DWG LIST:

LBNL DRW	DESCRIPTION
24C4043	VAC CH ROT CONFL FLANGE
24C4053	VAC CH BM TUBE LG
24C4103	VAC CH TUBE-DISCON END
24C4114	VAC CH QUICK DISCON COL
24C4142	DET POS PULLEY
24C4153	DET POS PULLEY BRKT
24C4163	DET POS COPPER BAR
24C4173	DET POS CASKET FRONT PL
24C4184	DET POS CASKET SIDE PL
24C4194	DET POS CASKET BACK PL
24C4204	DET POS SLIDE GATE
24C4212	DET POS GATE LATCH BAR
24C4223	DET POS LATCH BAR RETNR
24C4236	TAN CONCPT DESIGN 140M
24C4246	CROSS SECTION REG 5
24C4256	CROSS SECTION REG 1
24C4266	TAN ABSORBER BOX
24C4276	TAN ELEVATION REG 5
24C4286	TAN ELEVATION REG 1
24C4294	TAN ABS BASE PL LOWER
24C4302	TAN ABS BASE PL ALIGN KEY
24C4314	TAN ABS BASE PL UPPER
24C4322	TAN ABS INSULATION PAD
24C4333	TAN ABS HOIST RING RESTR
24C4344	TAN ABS SHIELD AISLE SIDE
24C4354	TAN ABS SHIELD CRYO SIDE
24C4366	TAN ABS SHIELD UPPER
24C4374	TAN ABS FLR PL LARGE
24C4384	TAN ABS FLR PL SMALL
24C4393	TAN ABS JACK HST CLT R5
24C4404	TAN ABS JACK HST CLT R1
24C4412	TAN ABS MARBLE RET ROD
24C4424	TAN ABS MARBLE FRONT
24C4436	TAN ABS BOX UPPER PLATE
24C4446	TAN ABS BOX LOWER PLATE
24C4456	TAN ABS BOX SIDE PLATE
24C4464	TAN ABS BOX HEATR CVR
24C4474	TAN ABS BOX SD HTR CVR
24C4484	TAN ABS BOX CLM SH UPR
24C4494	TAN ABS BOX CLM SH LWR
24C4501	DET POS GUIDE PIN
24C4514	JUNCTION BOX SUP STAND
24C4521	JUNCTION BOX SPACER
24C4536	JUNCTION BOX
24C4543	JUNCTION BOX COVER PL

24C4554	JACK HOIST SCHEME REG 5
24C4564	JACK HOIST SCHEME REG 1
24C4574	VAC CHAMBER SUPRT BRKT
24C4582	TAN ABS CORT TIE ROD
24C4594	TAN ABS CORE PIN SUB ASM
24C4643	TAN ABS MARBLE LIFT ROD
24C4652	TAN ABS MARBLE ROD NUT
24C4664	TAN ABS MARBLE SUB-ASM
24C4674	TAN ABS TRANSP CVR IR SIDE
24C4683	TAN ABS TRANSP CVR D2 END
24C4692	CU CASKET STOR BASE PL
25I9002	CU CASKET STOR SIDE PL
25I9011	CU CASKET ALIGNMENT PIN
25I9024	CU BAR TRANSPORT HOUSING
25I9033	T. HOPSON SPHERE STAND
25I9044	T. HOPSON SPHERE BRKT
25I9056	TAN ABS BOX SUB-ASM
25I9064	JACK HOIST SHIM
25I9076	BOX HEATER WIRE SCHEM
25I9082	DETECTOR WINCH BRACKET
25I9094	JUNCTION BOX LAYOUT
25I9106	TAN VACUUM CHAMBER ASM
25I9116	TAN ABSORBER GEN ASM
25I9123	T. HOPSON SPHERE STAND
25I9523	RADIATION SHIELD, TOP
25I9533	RADIATION SHIELD, BOTTOM
25I9543	RADIATION SHIELD, SIDE
25I9556	VAC CH TRANS SEG 1
25I9564	VAC CH TRANS SEG 2
25A1452	VACUUM BEAMTUBE STUB
25A1462	PAIR OF PANTS PLUG

2.3.3 FABRICATION / PROCUREMENT REPORT

2.3.4 ASSEMBLY PLAN, PROCEDURE, AND TRAVELERS

a. TRAVELER for the TAN ABSORBER GENERAL ASSY – M8129

2.3.5 LBNL ACCEPTANCE TEST PLAN

a. ACCEPTANCE CRITERIA AND COMPLETED TRAVELER FOR TAN – M8134

2.3.6 LBNL QUALITY ASSURANCE PLAN

a. LBNL/PUB-5478-Rev. B

2.3.7 INTERFACE SPECIFICATION

LHC-TAN-ES-0200 REV 1.2, LHC IP1/IP5 Neutral Beam Absorbers (TAN)

2.3.8 FUNCTIONAL SPECIFICATION

LHC-TAN-ES-0100 REV 2.2, LHC IP1/IP5 Neutral Beam Absorbers (TAN)

3. REFERENCES

[1] "LHC IP1/IP5 Neutral Beam Absorbers (TAN),"LHC Functional Specification, LHC-TAN-ES-0100.

[2] "LHC IP1/IP5 Neutral Beam Absorbers (TAN)," LHC Interface Specification, LHC-TAN-ES-0200.

[3] "Acceptance Criteria and Traveler for TAN," LBNL Engineering Note, M8134.

[4] Implementing Arrangement to the Accelerator Protocol Between CERN and the U.S. DOE Concerning Scientific and Technical Co-operation on the LHC, http://www-td.fnal.gov/LHC/Uslhc_accel_docs/Implementing_Arrangement.pdf.