NCSX

Product Specification
Station 1 Field Period Assemblies (S1-FPA)

NCSX-CSPEC-185-01-03

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Controlled Document

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Record of Revisions

Revision	Date	ECP	Description of Change
Rev. 0	9/18/2006		Initial Issue
Rev 1	7/31/2007		Incorporated NCR3715 in to Sections 4.2.2.1.2 and 4.2.5.1. Requirement changed to agree with vendor's specification of > 1.5 MOhms at a minimum of 500V.
Rev 2	10/29/2007	058	• Revised Section 4.2.1.1 (Pressure Range). • Revised Section 4.2.1.2 (Pressure-flow characteristics).
Rev 3	2/25/2008	059	Revised Section 4.2.1.1 to clarify testing requirements as a percentage of the operating pressure.

Table of Contents

1 Scope

This document defines the Station 1 Field Period Assemblies (S1-FPA), their requirements, and the associated verifications.

2 Applicable Documents

2.1 Drawings

SE120-002 Vacuum Vessel Sub Assembly (VVSA)

SE121-004 VVSA Phase I Assembly

SE121-008 VVSA Phase 2 Assembly

SE123-049 VVSA Phase 3 Station 1 Assembly

SE310-030 Magnetic Loop Arrangement Drawing

2.2 ICDs

ICD-123-64 VV Cooling/Heating Requirements

2.3 Procecures

D-NCSX-FPA-001 (Field Period Assembly Station One)

2.4 Other Documents

NCSX-CSPEC-310-00 (Diagnostic Specification – External Saddle Loops

3 Requirements

3.1 System Definition

At the completion of assembly at Station 1 there shall be three complete S1-FPA units including all the components as described in SE121-004, SE121-008, and SE123-049. These components include the VVSAs delivered from Major Tool, heating/cooling hose assemblies and mounting saddles, the heating/cooling manifolds, the Port 12 diagnostic flanges, the flux loop assemblies, heater tapes on Port 12, and thermocouples as described in SE121-004.

The completed units will not include any insulation or provisions for leak checking, that is, the vessel ends, Port 4, and the Neutral Beam Port will not be blanked off.

3.2 Characteristics

3.2.1 Gaseous heating/cooling system

3.2.1.1 Pressure range

The cooling/heating system shall be capable of being operated with pressurized helium gas from atmospheric pressure up to 20 atmospheres absolute.

3.2.1.2 Temperature range

During normal operation the heating/cooling system shall be capable of being operated between 20 C and 390 C.

Following a loss of flow condition, the heating/cooling system components attached to the vacuum vessel shall remain operable following a temperature drop to 80 K.

3.2.1.3 Pressure-flow characteristics

3.2.1.3.1 Pressure-flow characteristics during vacuum vessel heating

The heating/cooling system shall be capable of operating with a helium gas supply temperature of 390C at a pressure of 20 atmospheres. With a flow rate of 81 cfm (per field period), the pressure drop between the supply and return lines shall not exceed 0.1 atmospheres. [Ref. ICD-123-64]

3.2.1.3.2 Pressure-flow characteristics during vacuum vessel cooling

The heating/cooling system shall be capable of operating with a helium gas supply temperature of 20C at a pressure of 20 atmospheres. With a flow rate of 133 cfm (per field period), the pressure drop between the supply and return lines shall not exceed 0.3 atmospheres. [Ref. ICD-123-64] The flow requirements will be qualified using room temperature nitrogen testing per 4.2.1.2.

3.2.1.4 Installation

3.2.1.4.1 Clamp spacing

The installation and approximate locations for the mounting studs and clamps are located in SE121-008. The spacing may be varied along the length of the theoretical hose location $\pm$ 1 inch and lateral $\pm$ 1/2 inch if necessary to avoid interference with the flux loop installation.

3.2.1.4.2 Coolant tube supports

The installation of the supports for the coolant tube assemblies on Port 12 is shown in SE121-008.

3.2.1.4.3 Header installation

The header mounting onto Port 12 and the diagnostic flange bellows to header welding shall be per SE123-049.

3.2.1.4.4 Header connection

Final connection of the coolant tube ends to the header Yor-Lok ® compression fittings shall be per SE123-049 and the Manufacturer's installation instructions.

3.2.1.4.5 Clamp bolt torquing

After final inspection and testing of the S1-FPA is complete, the coolant tube clamps will be required to be re-tightened an additional amount which will be specified in **D-NCSX-FPA-001** (2.3) after tests are performed on prototypic assemblies to determine the proper torque for the bolts.

3.2.1.4.6 Magnetic permeability

The permeability of all mounting hardware, i.e., brackets, nuts, fasteners, and washers, and also field welds performed during assembly of the components, shall not exceed 1.02.

3.2.2 Electrical heating system

There are a total of 16 heater tapes. They are located on each of the S1-FPA assemblies, 8 on the vertical Port 12A and 8 on Vertical Port 12B. Half the tapes will be connected for initial operation half will be for backup and will not be connected. The heaters are each rated at 520 watts maximum and operate on 120 VAC, but will nominally only be operated at 120 watts.

3.2.2.1 Temperature control

The electrical heating system shall be capable of maintaining the temperature of the vertical ports at 150C +5C/-25C during bake out. (Requirements for the controllers are TBR)

3.2.2.2 Installation

Heater tapes shall be installed on ports 12A and 12B per drawing SE121-004. The heaters shall be electrically isolated from the vacuum vessel.

3.2.3 Magnetic diagnostics

Flux loops shall be installed per drawing SE310-030 and installation requirements NCSX-CSPEC-31-001 (2.4).

3.2.4 Diagnostic feed through flange

3.2.4.1 Flange installation

The Diagnostic interface flange and its mounting hardware will be welded to the Port 12 extensions per SE123-049.

3.2.5.2 Flange sealing

The flanges are sealed to the cryostat for the purpose of limiting nitrogen gas loss from the cryostat to the test cell. The interface seams shall be caulked with RTV as specified in the Bill of Materials (BOM) shown on SE121-004

3.2.5 Instrumentation and control

3.2.5.1 Temperature sensing

Temperature sensing shall be done with Type E thermocouples. They shall be armored types covered with Inconel braiding and the junctions shall be isolated from ground. The leads shall be attached by clips spot welded to the VV shell per SE121-004. Signal conditioners for the thermocouples shall also be isolated from ground. (TBR)

4 Quality Assurance Provisions

4.1 Responsibility for Verification

The responsibility for performing all verifications rests with the Field Period Assembly Manager. Quality Control will periodically monitor procedure compliance and performance of verifications.

4.2 Quality Conformance Verifications

The following verifications shall be performed to determine that the item conforms to the requirements in Section 3.2 of this specification.

4.2.1 Gaseous heating/cooling system

4.2.1.1 Pressure range

- The heating/cooling system shall be leaked checked with helium gas at 120% of the operating pressure of 300 psig in accordance with ENG-014.
- The region around the compression fittings shall be checked with a helium leak detector tuned to 1×10^{-5} torr-l/s. Acceptance criteria shall be no detectable leaks.

4.2.1.2 Pressure-flow characteristics

A supply of room temperature, dry, clean, oil-free nitrogen gas or instrument air shall be connected to the S1-FPA to verify that the pressure-flow characteristics are acceptable. A flow test to check for blocked passages shall be performed by connecting a blower to the hose manifold and passing warm air (approximately 120°F) through the hoses at sufficient velocity to heat the hose assemblies. Flow shall be determined by manually feeling the hoses near the exit or by using infrared temperature detectors.

Installation:

- The installation of the heating/cooling system shall be checked for compliance with assembly drawings identified in Section 3.2.1.4.
- A check of all mounting hardware, i.e., brackets, nuts, fasteners, and washers, and also field welds performed during assembly of the components, shall be checked with a calibrated Severn Gauge.

4.2.2 Electrical Heating System

Background. All heater elements will be checked for electrical continuity and isolation from ground. These two checks provide confidence that the heater elements will work when powered.

4.2.2.1 Temperature control

4.2.2.1.1 Electrical Continuity

The electrical continuity of each heater element shall be measured using a calibrated Volt Ohm Meter (VOM) after installation onto Port 12.

4.2.2.1.2 Electrical Isolation

The resistance between the vacuum vessel and each of the heater elements shall be checked using a calibrated VOM to assure that it is greater than 1.5 Mohms at a minimum of 500V.

Note: Revised NCR 3719 dispositioned nonconformances to "use as is" and installation procedure (D-NCSX-FPA-001 revised to permit readings of >0.4 MOhms at a minimum of 500V).

4.2.2.1.3 Controllability

Active and inactive heaters shall be connected to the electrical heating system controllers to demonstrate that the components operate and the system meets temperature control requirements. System performance would need to be checked only on the first article if the electrical isolation and continuity checks truly suffice to determine the operability of the heater elements after insulation. Inactive heater elements shall be properly terminated outside the cryostat interface flange following verification. (TBR)

4.2.2.2 Installation

4.2.3 Magnetic diagnostics

The flux loop installation shall be checked to be in accordance with drawing SE310-030 and the installation specification NCSX-CSPEC-310-01 . Testing shall be performed per the installation specification NCSX-CSPEC-310-01 .

4.2.4 Diagnostic Feed Through Flange

4.2.4.1 Flange installation

The diagnostic interface flange and its mounting hardware shall be inspected for compliance with SE123-049.

4.2.4.2 Flange sealing

The RTV caulking seams shall be visually inspected to assure a continuous bead has been applied and that there are no visible gaps or other defects which might impair the seal.

4.2.5 Instrumentation and control

4.2.5.1 Temperature sensing

- The resistance between the vacuum vessel and each of the thermocouple elements shall be checked to assure that it is greater than 1.5 Mohms at a minimum of 500V.

  Note: Revised NCR 3719 dispositioned nonconformances to "use as is" and installation procedure (D-NCSX-FPA-001 revised to permit readings of >0.4 MOhms at a minimum of 500V).

- Each thermocouple shall be checked for proper operation after installation onto the vacuum vessel. The temperature indicated by each thermocouple must be within 2 C of expected temperature.