



## 1.0 SCOPE:

1.1 This specification defines the equipment, methods and procedures to be used when leak checking RHIC superconducting magnets, magnet cryostats and associated equipment.

## 2.0 APPLICABLE DOCUMENTS:

2.1 ASTM Specification E 425-90, "Standard Definition of Terms, RELATING TO LEAK TESTING", Vol. 03.03 Nondestructive Testing.

2.2 ASTM Specification E 498-73 (Reapproved 1990), "Standard Methods of Testing for LEAKS USING THE MASS SPECTROMETER LEAK DETECTOR OR RESIDUAL GAS ANALYZER IN THE TRACER PROBE MODE", Method A.

## 3.0 DEFINITIONS:

3.1 Three leak check sensitivities are applicable:

3.1.1 VERY HIGH SENSITIVITY, corresponding to a leak rate of  $\leq 10^{-11}$  Atm. cc He/s,  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ .

3.1.2 HIGH SENSITIVITY, corresponding to a leak rate of  $\leq 2 \times 10^{-10}$  Atm. cc He/s,  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ .

3.1.3 MODERATE SENSITIVITY, corresponding to a leak rate of  $\leq 10^{-9}$  Atm. cc He/s,  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ .

3.2 To BAG a part or assembly when leak checking corresponds to surrounding the part or assembly being leak checked in some form of envelope and filling the envelope with helium while at the same time pumping on the part with the helium leak detector.

3.3 Any part or assembly determined to have a He leak rate greater than specified will be in NONCOMPLIANCE with this specification and be subject to return to the vendor.

3.4 Referring to Fig. 1, the CRYOSTAT VACUUM ENVELOPE is the vessel and associated parts constituting the vacuum container within which magnets and other components are housed. The CRYOSTAT HELIUM CONDUITS are all those pipes and associated parts, including bellows, detached from the magnet cold mass, yet contained within the cryostat vacuum envelope. The MAGNET COLD MASS and COLD MASS BUS & HELIUM CONDUITS herein constitute the vacuum barriers separating the magnet volume and associated parts from the cryostat vacuum envelope. The UHV COLD-BORE TUBE is a vacuum barrier between UHV cold-bore tube volume and both the magnet cold mass and cryostat vacuum envelope volumes.

#### 4.0 LEAK CHECKING EQUIPMENT

4.1 The leak checking equipment used to accomplish the Very High Sensitivity leak checking will have a sensitivity of  $\leq 5 \times 10^{-12}$  Atm. cc He/s,  $23^\circ\text{C} \pm 3^\circ\text{C}$ .

4.2 The leak checking equipment used to accomplish the High Sensitivity leak checking will have a sensitivity of  $\leq 1 \times 10^{-10}$  Atm. cc He/s,  $23^\circ\text{C} \pm 3^\circ\text{C}$ .

4.3 The leak checking equipment used to accomplish the Moderate Sensitivity leak checking will have a sensitivity of  $5 \times 10^{-10}$  Atm. cc He/s,  $23^\circ\text{C} \pm 3^\circ\text{C}$ .

4.4 Leak checking equipment will be calibrated a minimum of twice a day, each day of use, at the start and conclusion of each shift. These data and the calibrated leak serial number will be logged in a record book accompanying each leak detector.

4.5 After leak checking, assemblies are to be vented to atmospheric pressure with dry, high purity (99.99%), water pumped nitrogen bottled gas or nitrogen from an evaporated liquid source. The vacuum venting valve is to be separate from the pumping system to prevent pump oil from being blown into the chamber assembly when the assembly is being vented.

4.6 BNL reserves the right to perform at BNL acceptance tests which include, but are not limited to, those described in this specification. Any assembly which at that time is found to not meet the requirements of this specification may be returned to the vendor for repair or replacement.

#### 5.0 LEAK TIGHTNESS REQUIREMENTS AND TESTING PROCEDURES

**CAUTION:** Consideration must be given to properly supporting assemblies during evacuation. Damage to assemblies (e.g., collapsed bellows), or injury to personnel may occur without proper consideration in the design of leak checking fixtures.

5.1 The cryostat vacuum envelope will be leak tight as defined in Section 3.1.3. It need not be bagged. The probe through which the leak check helium flows will be moved across the joint being leak checked at a velocity of  $\leq 1.5$  inch/s. The helium flow rate through the probe will be  $\geq 10$  CFH.

5.2 All other parts and assemblies defined in Fig. 1 and Section 3.4 excluding the UHV cold-bore tube, will be leak tight as defined in Section 3.1.2. The UHV cold-bore tube will be leak tight with respect to both the cryostat vacuum envelope and magnet cold mass volumes as defined in Section 3.1.1. All of these parts and assemblies shall be bagged for  $\geq 15$  minutes while pumping on the assembly exclusively with the leak detector. All gas from the part or assembly must pass through the leak detector during this test and the leak

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test in Section 5.1.

5.3 Precautions shall be taken to prevent any oil backstreaming into assemblies during roughing and leak checking operations.

5.4 All parts must be cleaned prior to welding. No parts may be cleaned, wiped down, exposed to solvents or water, painted or exposed to any other possible leak plugging operation after welding and prior to leak checking.

5.5 Elastomers o-rings may be used as temporary seals for leak detection. No lubricants or greases of any kind are to be used on the o-ring seals, parts or assemblies which are leak checked in accordance with Section 3.1.1. After leak checking, the ends of the tubes shall be wiped with lint free paper and methy alcohol, and thereafter the ends wrapped with aluminum foil.

5.6 The UHV cold-bore beam tube must be kept free of all particulate matter, metal shavings, dust and organics.

5.7 The leak checking of each of the items described in Section 4 and Fig. 1 must be recorded on hardware-specific, manufacturing travelers accompanying the item. Data to be recorded will include: 1) the serial number of the leak detector used; 2) date; 3) the name or initials of the person(s) conducting the leak check; and, 4) the initials of the witnessing resident GSI, in all cases except when leak checking the cryostat vacuum envelope.

## 6.0 QUALITY ASSURANCE REQUIREMENTS

The following sections of the BNL SELLER QUALITY ASSURANCE REQUIREMENTS, #BNL-QA-101, dated September, 1993, apply:

6.1. Section 3.1.2, MIL-I-45208A, "Inspection System Requirements" (or an equivalent system):

6.2. Sections of MIL-I-45208A which will be invoked in this specification include: 3.2.2, 3.2.4, 3.11 (on a noninterference basis), and 3.13.

6.3. All additional GENERAL REQUIREMENTS of #BNL-QA-101.

6.4. Sections 4.16, and 4.23 of BNL-QA-101.

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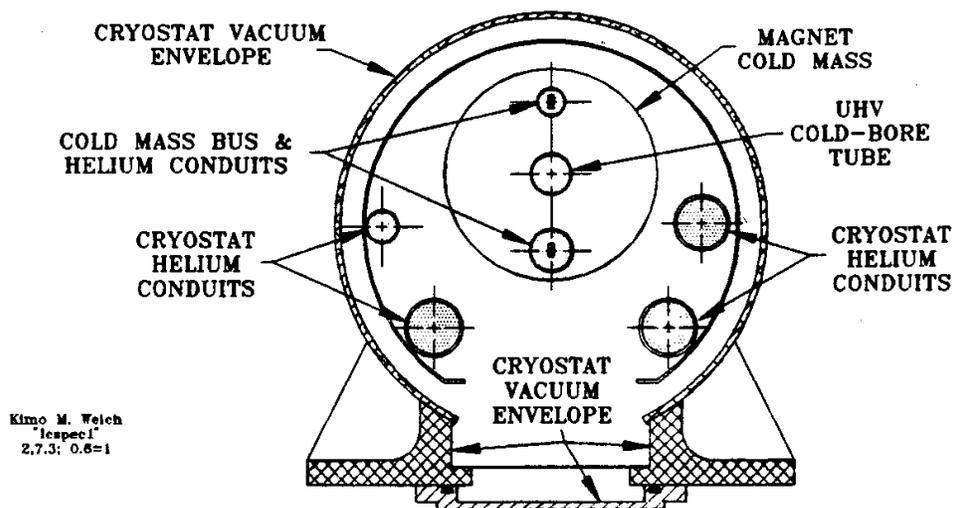


Figure 1. Schematic representation of magnet cold mass, cryostat conduits and associated equipment which must be leak checked.