

Collider Accelerator Department / SNS Ring Systems
BROOKHAVEN NATIONAL LABORATORY
Brookhaven Science Associates
Upton, New York 11973



SPEC. SNS-008
Revision A
Date: October 1, 1999

Specification for Ring Dipole Chamber Assembly

Approvals:



Michael Mapes, Engineer



H.-C. Hseuh, Vacuum System



Joseph Tuozzolo, Chief M/E



David Passarello, Quality Assurance

This Specification consists of 7 pages, including this cover sheet.

SNS Ring System
BROOKHAVEN NATIONAL LABORATORY
Brookhaven Science Associates, Inc.
Upton, New York 11973

SPEC. SNS Ring Systems-008
Rev. A
Date: October 1, 1999

SPECIFICATION
FOR
RING DIPOLE CHAMBER ASSEMBLY

1.0 SCOPE

This specification, in conjunction with the associated Statement of Work (SOW, hereafter) and the following Specification Control Drawings (SCD hereafter), defines the design requirements, configuration, materials, fabrication, applicable Brookhaven National Laboratory (BNL, hereafter) Quality Assurance clauses, workmanship, cleaning, fabrication and packaging for the Spallation Neutron Source (SNS) Ring Dipole Vacuum Chamber Assemblies (chambers, hereafter).

#5501010D	Ring Half Cell Chamber Assembly - Dipole Chamber Assembly - Type I
#5501011D	Ring Half Cell Chamber Assembly - Dipole Chamber Assembly - Type II
#5501003D	Ring Half Cell Chamber Assembly - Dipole Vacuum Chamber
#5501006D	Ring Half Cell Chamber Assembly - Vacuum Chamber 8" Transition
#5501008D	Ring Half Cell Chamber Assembly - Vacuum Chamber 10" Transition

2.0 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issue date or revision level shall be that in effect on the date of the Request for Quote (RFQ). Exceptions shall be approved in writing by BNL.

BNL-QA-101	BNL Seller Quality Assurance Requirements
ASTM A240-89b	Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A249/A249M-88b	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat Exchanger, and Condenser Tubes
ASTM A380-88	Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems
ASTM A480/A480M	Specification for General Requirements for Flat-rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

ASTM E498-90	Standard Test Methods for Leaks Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Tracer Probe Mode - Method A
ASTM A700-81	Standard Practices for Packaging, Marking and Loading Methods for Steel Products for Domestic Shipment

2.1 Current Revisions

It is the responsibility of the seller to determine that the applicable documents used in the preparation of a quotation by the seller and possible execution of the Purchase Order (PO, hereafter) are the most current revisions. This is emphasized here, in the interest of the seller.

2.2 Order of Precedence

Requirements specifically stated herein, including SOW and the associated SCDs, shall take precedence over requirements in the remaining Applicable Documents invoked by this technical specification in the event of conflicts between requirements.

3.0 REQUIREMENTS

3.1 Design, Material, Fabrication and Processes

The chambers shall be compatible for use as ultra high vacuum (UHV) hardware. The chambers shall be free of oils, particulate, organic matter and chlorides. All surfaces of each chamber shall be smooth and free of scale, stains and residues of any kind upon delivery to the buyer.

3.1.1 Design

The chambers shall comply with the dimensions specified on the SCDs. Permissible variations in dimensions shall be in accordance with the applicable requirements of ASTM A249/A249M-88b for stainless steel unless otherwise specified on the SCDs.

3.1.2 Material

The chamber shall be fabricated entirely from AISI 316L or 316LN vacuum arc remelt or electro slag remelt stainless steel material, in accordance with the chemical composition requirements of ASTM 240-89b and ASTM A480/A480M. Material must be in the condition required to produce a smooth, wrinkle-free chamber. Chemical analysis & certification are required, with documentation submitted to BNL.

3.1.3 Mechanical Properties

The material mechanical properties shall be in accordance with the tensile and hardness requirements specified in ASTM A249/A249M-88b.

3.1.4 Fabrication

The top and bottom halves of the chambers, with the exception of transitions, shall be formed from a single sheet of flat rolled stainless steel. The preferred method of forming is through the

use of curved dies. The formed two halves shall be cleaned and descaled in accordance with the requirements of ASTM A380-88. The two halves shall be welded by an automatic welding process without the addition of filler material and in accordance with the manufacturing requirements of ASTM A249/A249M-88b. Weld seams shall be continuous and have 100% penetration.

The end transitions shall be formed from a sheet, cleaned and welded to the ends of the chamber

Only aqueous based lubricants such as Blassocut 4000 and Missile Lube No. 5 may be used when performing any operation on the chamber. Other types of aqueous based lubricants may only be used with BNL written approval.

The completed chambers shall be annealed at a uniform temperature between 950 and 1000° C in vacuum or in clean inert atmosphere, then water quenched or rapid cooled in a uniformed manner by other means as specified in ASTM A249/A249-88b. Prior to annealing operations all traces of lubricants shall be removed from the chamber in accordance with the standard practices specified in ASTM A380-88.

All chambers shall be deburred by the seller prior to the final cleaning process specified herein. However there shall be no grinding allowed.

3.1.5 Final Cleaning

Delivered chambers shall be free of oils, particulate, organic matter and chlorides. All surfaces of each tube shall be smooth and free of scale, stains and residues of any kind upon delivery to the buyer. Upon completion of all forming operations each tube shall receive a final cleaning of all surfaces by using the cleaning procedure listed herein or BNL approved alternatives. No acid pickling shall be performed on the completed chambers.

Cleaning Procedure

- A. Degrease using only non-chlorinated solvents for a minimum of five(5) minutes. The duration shall be sufficient to remove all remaining lubricants.
- B. Rinse thoroughly in cold running tap water for >1 minute.
- C. Soak in non-etch alkaline solution (e.g., Oakite 166, ENBOND Q567, etc.) for five (5) minutes at > 65C with air agitation.
- D. Rinse vigorously in cold running tap water for > 2 minutes. If water beading appears, repeat step C. The use of 300 series stainless steel brushes or high pressure water jets to thoroughly neutralize the interior and exterior surfaces of the chamber is permitted.
- E. Immerse and rinse in a heated (to > 65C) deionized water bath for > 2 minutes.
- F. Dry using oil free dry air or nitrogen.

G. Wrap the chamber ends with lint free paper. Over wrap tightly with vacuum grade aluminum foil and secure in place with protective covers. The protective cover shall be sufficiently secure to ensure protection during subsequent shipping and handling. The protective cover shall not require tools for application and removal and shall not leave a residue on the chamber or adjacent chambers.

H. After final cleaning, the ends of each tube shall remain covered as specified above during storage, handling and inspection in all cases unless the tube ends or interior are being inspected.

3.2 Performance

The buyer reserves the right to test the performance of any chamber to the requirements specified herein. The seller is not required to qualify the chambers to these performance requirements, but is required to perform factory tests (see Section 4.). However, chambers that do not meet these requirements shall be in non-conformance.

3.2.1 Leak Rate

The chamber shall be leak-tight when checked with a helium mass spectrometer leak detector with a minimum sensitivity of 10^{-11} Atm.cc He/sec. Leak tight is hereby defined as an allowable leak of $<1 \times 10^{-10}$ atm.cc/sec helium measured during tests at BNL.

3.2.2 Operating Life

The chamber shall remain leak tight after 10 thermal cycles between 10 and 300C.

3.2.3 Outgassing

The outgassing rate of the interior surface of the chambers shall not exceed 1×10^{-10} Torr liter/sec cm^2 after maintaining the chamber interior under vacuum for 48 hours. Conventional all-metal ultra-high vacuum practices shall be used to make these measurements.

The chambers shall exhibit no traces of oils or other contaminants with atomic masses greater than 40 amu when tested using a residual gas analyzer with a minimum detectable partial pressure of 1×10^{-11} Torr N_2 .

4.0 QUALITY ASSURANCE

Quality Assurance clauses applicable to this contract are listed in Appendix A. The seller is responsible for providing chambers to the buyer, which are in total compliance with this specification. The buyer reserves the right to carry out inspection and to witness tests before delivery. The seller shall inform BNL at least three (3) weeks prior to commencement of final testing such that BNL representatives may attend the final testing.

4.1 Factory Tests

Acceptance tests, including magnetic permeability measurements, dimensional inspection and leak rate tests, shall be performed on all articles supplied under this contract. All articles shall pass these tests prior to delivery. Upon delivery, the seller shall supply to BNL with each

chamber, the seller test data in accordance with this section and a Certificate of Conformance. Furthermore, all articles shall pass all BNL tests. Evidence of noncompliance with the above shall constitute cause for rejection.

4.1.1 Magnetic Permeability Measurement

The magnetic permeability of the chambers shall be measured at 20-cm intervals along the length of the chamber at each weld and at every 2 cm around the chamber transition welds. Instrument such as Feritscope from Fischer Technology, Inc. or equivalent shall be used to measure the permeability. Chambers with localized permeability higher than 1.1 shall be annealed again following steps described in step 3.1.4. The methods of measurement and the data shall be provided to BNL for approval.

4.1.2 Dimensional Inspection

Dimensions of the chambers shall be as defined in the SCDs when in a relaxed and unrestrained state. Dimensional measurements include the chamber cross section, the curvature and the twist. The cross section of the chamber shall be checked every 20 cm with a cross section template. The exact methods of measuring curvature and twist shall be agreed upon between the seller and BNL. The inspection shall include the location and size of the welds, any dents or damage, and the cleanliness of the chamber. The seller shall provide detailed information concerning inspection procedures, equipment and data to BNL for approval.

4.1.3 Leak rate test

The seller shall leak check the chamber to a leak rate $\leq 1 \times 10^{-10}$ Atm cc He/sec with a differential external pressure of 1 bar. Leak testing shall be performed with a helium mass spectrometer leak detector with a minimum sensitivity of $\leq 5 \times 10^{-11}$ Atm cc He/sec in accordance with ASTM E498-90.

Special care shall be taken not to contaminate the chambers with backstreaming rough pump oil. Viton 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.

4.2 BNL Tests

BNL reserves the right to perform any test on the chambers, at BNL's expense, and at BNL facilities, for the purpose of verifying full compliance with any aspect of this specification. Failure of a chamber to meet any requirement specified herein shall be cause for rejection.

4.3 Warranty and Certificate of Conformance

All chambers shall be covered by a warranty against material and manufacturing defects. The warranty period shall be for a period of at least two (2) year from the date of receipt at BNL. The seller shall specify in detail the warranty provisions.

5.0 PREPARATION FOR DELIVERY

The seller is responsible for the safe and clean packaging, transport and delivery of the chambers to BNL site. The chamber ends shall be capped in accordance with Step G in procedure 3.1.5.

bags. Provisions shall be made to maintain a separation between chambers. Loose packaging materials such as plastic "peanuts" shall not be used. Any such loose packing material shall be returned to the seller at seller expense.

Chambers shall be shipped in self-supporting containers designed such that chambers do not bear externally applied loads to the container. Only one type of container shall be used for all chambers. Each container shall not exceed a height of thirty-two (32) inches and a width of thirty-six (36) inches. The container shall include features to protect and prevent the chambers from damage during shipping, handling and subsequent storage at BNL. The container shall be clearly marked with PO number and necessary information to allow a safe delivery

6.0 NOTES

6.1 Performance Objectives

The seller is encouraged to bring to the attention of buyer any improvement in performance and reliability, which would result from the use of material, parts and processes other than those specified. A request for approval of any such improvement shall be submitted to BNL for consideration. Each request shall be accompanied by complete supporting information at least fourteen (14) days prior to bid submittal date. Changes may be made only with the written approval of a representative of BNL Purchasing.

6.2 Seller Subcontracting

The seller may subcontract all or part of the work defined by this specification and the contract. However, the seller is responsible for fulfilling all of the conditions given in this specification and the requirements of the terms and conditions outlined in the contract.

BROOKHAVEN NATIONAL LABORATORY
SELLERS QUALITY ASSURANCE REQUIREMENTS
(BNL Personnel should refer to form BNL F 3022 for guidance)

1.0 SCOPE

- This document, when invoked by purchase order or contract, establishes quality assurance requirements to which sellers to Brookhaven National Laboratory (BNL) shall conform during the performance of work required by the purchase order, or contract.
- 1.2 This document contains two main sections. Section 3.0 covers the general requirements that are applicable to all sellers. Section 4.0 contains special quality assurance requirements that are applicable only when specifically invoked by the purchase order.

Note: In order to use this form properly, one 3.1 subparagraph must be check marked. In doing so, paragraphs 3.2 through 3.8 will automatically apply to the seller. Review and check mark special requirements in Section 4.0, as needed.

2.0 DEFINITIONS

- 2.1 The term *Purchase Order* means the purchase order, contract, subcontract or other written agreement with the Seller (supplier) in which the requirements of this document are incorporated by reference.
- 2.2 The term *Buyer* means Brookhaven Science Associates (BSA) operating Brookhaven National Laboratory, acting by and through its Division of Contracts & Procurement issuing the purchase order.
- 2.3 The term *Seller* means the legal entity which is the contracting party with the Buyer with respect to the purchase order.
- 2.4 The term *article or item* means a product and/or a service.

3.0 GENERAL REQUIREMENTS

Unless otherwise specified in the purchase order, the following General Requirements apply:

3.1 Seller Quality Assurance Program/Inspection System

The Seller shall have and maintain an effective quality assurance program or inspection system that will, as a minimum, comply with all of the requirements of the specification indicated by check mark below:

- 3.1.1 ISO 9001 "Quality Systems- Model for Quality Assurance in Design, Development, Production, Installation, and Servicing" (Latest revision as of the date of issuing the purchase order).
- 3.1.2 ISO 9002 "Quality Systems- Model for Quality Assurance in Production, Installation and Servicing" (Latest revision as of the date of issuing the purchase order).
- 3.1.3 Conformance to Manufacturer's Specifications.
- 3.1.4 Other: Refer to requirements stated in Specification/P.O. documentation.

Note: In the event that Requirement 3.1.1 or 3.1.2 is specified, and the Seller's quality assurance program or inspection system does not comply with the specified requirement, the Seller shall submit with their quotation a description of their existing quality assurance program or inspection system that will apply to this order. The description will be evaluated by the Buyer prior to award.

3.2 Assessment by Buyer

The Seller's Quality Assurance Program or inspection system may be subject to assessments by the Buyer's Representative(s) for conformance with the requirements of the purchase order.

3.3 Conformance to Requirements

All items furnished to the Buyer shall conform with all requirements of the purchase order. No change(s) shall be made to any Buyer requirements without the prior written approval of the Buyer. The Buyer reserves the right to request failure analysis and corrective action for non-conforming articles or items submitted or supplied to the Buyer.

3.4 Responsibility for Subcontractors

It is the responsibility of the Seller to impose applicable quality assurance requirements upon their subcontractors. Additionally, the Buyer reserves the right to approve, in writing, any subcontractor.

3.5 Responsibility for Conformance

Neither assessments, surveillance, inspection and/or tests made by the Buyer or its representatives at either the Seller's or Buyer's facility, nor the Seller's compliance with all applicable Quality Assurance Requirements shall relieve the Seller of the responsibility to furnish items which conform to the requirements of the purchase order. The Buyer reserves the right to request failure analysis and corrective action for nonconforming articles or items submitted or supplied to the Buyer.

3.6 Protection of Material and Equipment

The Seller shall employ procedures which assure adequate protection of material and equipment during shipment and while in storage. Such protection shall include special environmental packaging, as necessary. All items shipped (originally packaged or repackaged) to BNL or other locations cited in the purchase order or contract, shall comply with the requirements set forth in the National Motor Freight Traffic Associations' National Motor Freight definitions, specifications and basic requirements (e.g., size, strength and materials) for commonly used packages. The Supplier shall include in their procedures a process for notifying the Buyer of any precautions that must be taken in the storage and/or handling of the item or article (ie., age, control, environmental conditions, etc.

3.7 Certification of Conformance

By making shipment under this purchase order, the Seller automatically certifies that the articles shipped, the materials (except when the materials are furnished by the Buyer) used in the articles shipped, and the processes applied to such articles comply with the applicable drawings, specifications and requirements of the purchase order. The Seller agrees to retain objective evidence, including records, of the inspections and tests performed in the course of manufacturing, testing, inspecting, preserving, packaging, and preparation for shipment of said articles. These records shall be made available to the Buyer's representative for review upon request. These records shall be maintained for a minimum of 3 years, up to lifetime, as appropriate, after the completion of the Purchase Order.

3.8 Measuring and Test Equipment Calibration

The Seller shall establish and maintain a documented system for the calibration of measuring and test equipment used in the fulfillment of the purchase order requirements. As a minimum, the Seller shall calibrate measuring and test equipment against certified standards which have known valid relationships to national standards. The calibrations shall be performed at established periods to assure measuring and test equipment accuracy at the time of use. The Seller shall notify the Buyer of any condition found during the calibration, servicing or repair of measuring and test equipment that may affect the quality or reliability of material supplied to the Buyer.

4.0

SPECIAL REQUIREMENTS

The following Special Requirements are applicable only when specifically invoked by purchase order, or as indicated by check mark hereon.

- 4.1 **Q.A. Program or Manual:** The Seller shall submit a copy of their Quality Assurance Program or Manual with their proposal for review and evaluation.
- 4.2 **Configuration Control System:** The Seller shall establish and maintain a system to assure that all end items (including spares) are of the proper configuration, and that all approved configuration changes are incorporated at the specified effectivity points. Records shall be maintained verifying the configuration of each item.
- 4.3 **Process Sheets, Travelers, etc.:** The Seller shall maintain a system of process sheets, shop travelers, or equivalent means to define the sequence of manufacturing, inspection, installation and test activities to be performed. Flow sheets, or equivalent, shall provide for sign-off by designated inspection personnel at specified inspection and test points, including re-inspection and re-test points, to assure completion as well as proper sequencing of required operations.
- 4.4 **Manufacturing/Inspection/Test Plan:** ³⁰ Sixty (60) days prior to fabrication the Seller shall prepare and submit for the Buyer's review and approval a manufacturing/inspection/test plan for the item(s) to be produced, which satisfies the following:
 - 4.4.1 Identification of parts and subassemblies showing integrated flow into end item(s).
 - 4.4.2 Identification of critical manufacturing operations as well as inspection and test checkpoints.
 - 4.4.3 The Plan may be a single document, or may make use of existing "travelers", or other suitable planning and control documents.
 - 4.4.4 Revisions or changes to the Buyer approved Plan must be submitted for the Buyer's review and approval prior to implementation.
- 4.5 **"Witness" Points:** The Buyer reserves the right to designate selected manufacturing, inspection, and/or test operations as "witness" points. The Seller shall provide the Buyer with five (5) working days notice in advance of reaching such witness points during the manufacturing and test cycle of each item.
- 4.6 **Test and Inspection Procedures:** Test and inspection procedures required to demonstrate satisfactory completion of purchase order requirements shall be prepared by the Seller and submitted to the Buyer for review and approval sixty (60) days prior to use of such procedures.
- 4.7 **Special Process Procedures:** ³⁰ Special processes (e.g. welding, brazing, bonding, plating, chemical machining, chemical coating, chemical cleaning, precision cleaning, heat treating, radiographic inspection, ultrasonic testing, pressure leak testing or waste processing) shall be performed in accordance with detailed written procedures. These procedures shall specifically describe the exact manner in which the processes are to be performed.
 - 4.7.1 Copies of special process procedures shall be available for review by the Buyer's representative upon request.
 - 4.7.2 At least sixty (60) days prior to use on items deliverable to the Buyer, the Seller shall submit to the Buyer copies of all applicable process procedures for review and approval. Revisions or changes to Buyer approved special process procedures must be submitted to the Buyer for review and approval prior to implementation.
- 4.8 **Qualification of Special Process Procedures, Facilities, and Equipment:** The Seller shall, prior to use, qualify the procedures/specifications, facilities and equipment that will be used for the performance of special processes. Records of such qualification shall be available to the Buyer's representative upon request.
- 4.9 **Qualification of Special Process Personnel:** The Seller shall provide for the qualification of personnel, prior to their use, to ensure competence in the use of the special process procedures or specifications. Records of such qualification shall be available to the Buyer's representative upon request. Only those personnel who have been qualified to perform a specific special process shall be used to perform that process.
- 4.10 **End Item Documentation Package:** The Seller shall provide a documentation package for each shipment of the item(s) supplied, which consists of objective evidence of compliance with purchase order requirements. This documentation package shall be complete, legible, indexed, and traceable to the item supplied, and shall contain the following, as applicable:
 - 4.10.1 Copies of reports of all required or necessary inspections, examinations and tests, properly validated by the Seller's authorized personnel.
 - 4.10.2 A listing of the as-built configuration of each delivered item; this may be defined by the use of drawing numbers and revisions, unique parts lists or other such means of positive identification.
 - 4.10.3 Copies of nonconformance reports dispositioned as "repair" or "use-as-is".
 - 4.10.4 Copies of material test reports for specified materials, showing physical and chemical properties.
 - 4.10.5 A Certification of Conformance (See 4.16).
- 4.11 **Release for Shipment:** The Seller shall provide the documentation package required in 4.10, for review by the Buyer's representative prior to release of the item for shipment.
- 4.12 **Shipment of Documentation Package to Buyer:** Three (3) copies of the documentation package shall be shipped to the Buyer with or prior to each shipment of the purchased items.
- 4.13 **Failure Reporting, Analysis and Corrective Action:** The Seller shall maintain a failure reporting, analysis and corrective action program to determine and report what reliability or safety problems may exist in the equipment, define their nature and cause, and recommend and implement the necessary corrective actions.

The Seller's failure reporting, analysis, and corrective action program shall, as a minimum, evaluate and analyze failures occurring during qualification, first article and end-item acceptance testing and inspection.

To determine the true cause of failure, the analysis should include, as appropriate, the disassembly or dissection of the failed item(s). The results of all failure evaluations and analyses shall be documented and available for review by the Buyer.

- 4.14 **Source Inspection/Surveillance:** Items to delivered under this purchase order require inspection, tests or surveillance by the Buyer's representative at the Seller's facility. Five (5) work days notice of acceptance inspections and tests shall be given by the Seller to the Buyer to permit scheduling of source inspection.
- 4.15 **Chemical and Physical Test Report:** One copy of actual chemical and physical test report(s) for each heat, batch or lot shall accompany each shipment. Test reports shall list the actual parameters tested, the acceptable limits for each parameter, and shall contain the actual readings taken during test.
- 4.16 **Certificate of Conformance:** With each shipment of items covered by this purchase order, the Seller shall submit a certificate of conformance. In case of drop shipment, a copy of the certificate shall be submitted to the Buyer at the time of shipment. The certificate shall be signed by an authorized representative of the company, and shall constitute a representation by the Seller that:
 - A. Materials used are those which have been specified by the Buyer, and that the items delivered were produced from materials for which the Seller has on file reports of chemical or physical analysis, or any other equivalent evidence of conformance of such items to applicable specifications;
 - B. Processes used in the fabrication of items delivered were in compliance with applicable specifications forming a part of the purchase order, or Buyer approved procedures or specifications;
 - C. The items as delivered comply with all specifications and other requirements of the purchase order.
- 4.17 **Report with Each Shipment:** Superseded by paragraph 4.10.
- 4.18 **First Article Acceptance:** Buyer acceptance of first article(s) is required prior to the production run. The first article(s) shall be identified as such, including the purchase order number, part number and part name. The Seller is required to:
 - 4.18.1 Submit the first article(s) to the Buyer's representative for test/inspection to be conducted at the Seller's facility by the Buyer's representative;
 - 4.18.2 Submit the first article(s) to the Buyer for test/inspection by the Buyer at the Buyer's facility;
 - 4.18.3 Submit the first article(s) to the Buyer together with documents showing data representing results of the Seller's first article(s) test/inspection, including the actual dimension or value for each specified characteristic;
 - 4.18.4 After Buyer acceptance of first article(s), all of the remaining units required by the purchase order shall be produced by the Seller and the Seller's suppliers using the same design, materials, processes, methods and tooling that were used to manufacture the approved first article(s). Any changes must have prior approval from the Buyer.

- 4.19 **Notification of Change to Design, Methods, or Processes:** The Seller shall immediately notify the Buyer of any significant changes (those that may effect form, fit, function, reliability, safety or interchangeability) in product design, fabrication methods, material or processing from those used by the Seller at time of Seller's quotation or offer to the Buyer, which resulted in the purchase order.

- 4.20 **Age/Shelf Life and Storage Control:** The Seller shall have an effective storage and age control system for items whose acceptability is limited by the age or manner of storage of the item. The system must include a method of identifying the age of such items, and provisions for the rotation and purging of stock.

The Seller shall show on each container of materials having a limited or specified shelf life (both Seller's in-plant containers and containers in which material is delivered to the Buyer) the cure or manufacture date, expiration date, lot or batch number, and special storage and handling conditions applicable to the contents. This information shall be in addition to the normal identification requirements of name, part or code number, specification number, type, size, quantity, etc. If cure or manufacture date is coded, Seller shall provide decoding information. Special handling conditions shall be recorded on certifications and shipping documents covering the material delivered to the Buyer.

At the time of receipt, the material shall not have less than three-quarters of its shelf life remaining, without prior written approval from the Buyer for each shipment.

- 4.21 **Serial Numbers:** The Seller shall assign a separate and distinct serial number to each end item furnished under this purchase order. Where impractical to stamp individual items due to size or shape, the serial number shall be stamped on identifying tags or the smallest unit package. No two items having the same part number are to be identified with the same serial number. Records of serial numbers for each part number must be maintained by the Seller.

- 4.22 **Lot or Batch Numbers:** For items furnished under this purchase order, the packing list, certifications and other applicable documents must be identified by manufacturing lot or batch number. Where impractical to stamp individual parts due to size or shape, the lot or batch number shall be stamped on identifying tags or the smallest unit package.

- 4.23 **Material Traceability:** Materials used must be identified by material type, applicable specification and revision number, and be traceable to their lot number(s) and heat number(s). Traceability records shall be available for review by the Buyer's representative.

- 4.24 **Shipment Destination Other than BNL:** The material ordered against this purchase order is to be shipped to other than the Buyer's facilities. Copies of the Quality Assurance data required by this order shall accompany the shipment; in addition, one copy of such data shall be mailed to the Buyer on the same day that shipment is made.

- 4.25 **Heat Treat Bars:** Superseded by paragraph 4.7.

- 4.26 **Burn-in:** Burn-in shall be performed on each completed item per the procurement specification. Records of the burn-in testing, repairs and test results shall be maintained, and shall be available to the Buyer's representative upon request.
- 4.27 **Welding Procedures:** Superseded by paragraph 4.7.
- 4.28 **Weld/Braze Inspection Report:** A report(s) shall be submitted that indicates the complete inspection of welds or brazes from the initial fitup stage through the final inspection. Inspection reports shall be accompanied by all radiographic films, filler metal reports, etc. The reports shall contain the signature or stamp, and title of an authorized Seller representative.
- 4.29 **Radiographic Quality Requirements:** Items requiring radiographic inspection shall be radiographed and processed in accordance with Seller special process procedures that satisfy design specifications, standards or other purchase order requirements. Personnel reading and interpreting film shall have been subjected to examination and certification. Responsibility for this certification shall rest with the Seller, whether the Seller does the work or subcontracts to a specialized laboratory. Findings shall be reported on an appropriate form, including the name of the reader and the signature of a responsible representative. The radiographic film and a reproducible copy of the report shall accompany each shipment. An adequate method of identifying and cross referencing each film exposure, report, and item shall be provided. When parts are serialized, serial numbers shall appear on the report and the film.
- 4.30 **Nondestructive Test Reports:** All nondestructive testing shall be conducted in compliance with Seller special process procedures that satisfy the applicable provisions of the design specifications, or other purchase order requirements. Personnel and equipment utilized in performance of such tests shall have been evaluated and certified for the type of test performed.
- Seller shall furnish with, or prior to, each shipment reports of such nondestructive examination of material or items furnished. These reports shall be identifiable to the respective item or material including the specific section, joints or views of the item furnished. These reports shall contain the signature and title of an authorized Seller representative. When items are serialized, the serial numbers shall appear on the reports.
- 4.31 **Pressure or Leak Test Reports:** Test reports shall be prepared for all pressure and leak tests. Such reports shall state the requirement, the Seller's test procedure number, and the observed result for each item, joint or connection tested. When items are serialized, the serial numbers shall appear on the report. The reports shall contain the signature and title of an authorized Seller representative, and shall accompany each shipment.
- 4.32 **Cleaning Certification:** Each shipment shall be accompanied by a certification which states that all Buyer requirements relative to cleaning and cleanliness have been completely satisfied. The certification shall reference the Seller's applicable cleaning procedure(s) identification number(s), and shall also contain the signature and title of an authorized Seller representative.
- 4.33 **Calibration Certification:** The Seller shall submit with each instrument/system a certification that the instrument/system has been calibrated and is ready for use. The certification shall contain, as a minimum, the identity of the instrument/system, the identification of the calibration procedure used, identification of the standards and/or equipment utilized for the calibration, and a statement that the calibration of the standards and/or equipment used is traceable to the National Institute of Standards and Technology (NIST) or some other recognized national standard. Detailed support data shall remain on file with the Seller and shall be available for review by the Buyer. The certification shall also contain the signature and title of an authorized Seller representative.
- 4.34 **Operating-Maintenance Manual:** Documentation containing operating procedures, maintenance instructions, spare parts lists, and handling procedures shall be submitted with the shipment of the first item.
- 4.35 **Computer Software Configuration Management:** The Seller shall develop and implement a software configuration management system that ensures an orderly development of software. The system shall establish requirements for placing software under configuration control, provide for the positive identification of software, and the control of all software baseline changes.
- 4.35.1 The Seller shall submit a copy of their software configuration management procedure(s) with their proposal for review and evaluation.
- 4.36 **Computer Software Design Control:** The Seller shall develop written procedures describing the controls applied to the design of software, and the verification of the design through independent technical review. The procedures shall provide for documentation of review activities, including requirements for documenting comments and resolutions of comments. Seller software designs and review documentation shall be subject to review and approval by the Buyer.
- 4.37 **Computer Software Verification Testing:** The Seller shall test and verify computer software developed or modified to fulfill the requirements of the purchase order. The verification testing shall be accomplished by a comparison of test results with those from other verified software, or by a comparison with results from analytical solutions or Buyer approved alternatives.
- 4.38 **Electrostatic Discharge Control:** Items that are susceptible to electrostatic discharge shall be handled and packaged to protect them from damage. Items and/or packages shall be labeled to indicate the susceptibility to electrostatic discharge.