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SUBJECT: Master Order of HRP Grade 347 Stainless Steel

TO: HRP Steering Comm: e

FROM: W. R. Gall

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A meeting was held on June 4, to discuss the proposed master stock order of HRP grade 347 stainless steel; C. E. Winters presided. It was tentatively concluded that X-10 Stores should proceed to develop a pilot order for \$150,000 worth of this material (about 20 tons); Stores has approximately this amount of money available which has been tentatively reserved for this purpose. In the event it is decided to supplement the initial order to the original half million dollar figure, the additional funds will be drawn from the budgets of the HRP or Chem. Tech. groups concerned. It was also agreed that Stores should coordinate the purchase of HRP grade steel for stock, and to maintain supervision and control over its distribution. Control would be effected through the use of an "authorized signature list."

The recent revision of the preliminary list of HRP grade materials (memo from W. R. Gall, May 29) was discussed: several items, particularly certain flange and fitting sizes, were questioned, and it was suggested that most such items could be provided for through the maintenance of a stock of billets, bar, and/or plate to serve as a source of raw materials to be supplied to fabricators as specific fitting or flange sizes should be needed. E. G. Bohlmann noted that such a provision should not apply to commonly required shapes through 1-1/2" pipe size. Tube Turns, Inc. is preparing a list of the raw materials which would be required to fabricate the items on the list noted above.

General concurrence was expressed that \$400,000 to \$500,000 worth of steel, based on a two year usage period, is not excessive in view of the high cost of small, individual orders, the difficulty in obtaining materials of the required specifications, and the desirability of placing replacement orders in "mill run" lots. An order of such magnitude permits one to demand a specific chemical composition from the mill. However, Dr. Winters felt that it would be desirable to stock materials only for foreseeable needs for loops, replacement, and so on, and that the steel required for specific major projects should be ordered separately, as in the past. (In such an event, orders for the needs of either purpose should be combined where possible in order to gain the advantage of large scale ordering). W. B. Pike noted that he has ordered as much as \$150,000 worth of HRP grade steel, in small quantities, over the past year.

E. C. Miller presented a proposed materials specification to replace the earlier HRP specification. This is a single specification covering all shapes, and listing the exceptions to the corresponding ASTM specifications without repeating the content of those specifications. A question was raised as to the all-inclusive nature of the specification, the point being that individual specifications for each shape might restrict the mills to the desired requirements somewhat better than would an overall specification. (As it is desirable to have the steel for the entire order made at one time, negotiating with the rolling mills and fittings fabricators so as to permit them to purchase their requirements from the one lot of steel, it appears that at least one additional specification will be required to cover the initial melt of steel.) It was suggested that the 18.5% chromium requirement of the proposed specification should be applied to small diameter pipe and fittings only, but, since such a requirement would have to be applied also to the stock retained for future fabrication, further discussion developed that this might be a false economy. A further advantage of applying the 18.5% minimum chrome restriction to all HRP grade stock would be the prevention of statistical selection of steel from regular mill runs as a means, by the mill, of meeting HRP requirements.

A. J. Cook suggested that once a stock of HRP grade 347 stainless steel is developed, this material alone should be retained in X-10 Stores to meet the requirements for 347 stainless for any purpose for any X-10 requestor. In order to retain adequate supplies for the primary users (HRP and CT), withdrawal of the material would be based on an authorized signature basis. All current supplies of 347 stainless (which are being surveyed by Mr. Cook now) would be issued to depletion or excessed.

A second revision to the list of items suggested for purchase to HRP stock, based on retention of a stock of raw materials for future fabrication, will be issued following receipt of the data from Tube Turns.

Those present at the June 4 meeting were:

C. E. Winters (presiding)
E. G. Bohlmann
C. A. Burchsted
A. J. Cook
H. Falkenberry (for C. B. Graham)
W. R. Gall
H. E. Goeller
E. C. Miller
W. B. Pike

A copy of E. C. Miller's proposed specification, as presented, is attached for your review and comment.

W. R. Gall
W. R. Gall

C. A. Burchsted/jsw

June 4, 1956

PROPOSED ORNL SPECIFICATION FOR TYPE 347 WROUGHT AUSTENITIC STAINLESS STEEL

1. SCOPE. This specification covers wrought type 347 austenitic stainless steel sheet, plate, bar, pipe, tubing, flanges, bolts, nuts, forgings, and fittings for use in high temperature, high pressure, corrosive radioactive chemical environments.
2. REFERENCE SPECIFICATIONS. The material shall conform to all the requirements of the ASTM specification for the specific product as listed below and as stated in the purchase order, together with optional provisions, exceptions and additions included herein and in the purchase order.

Plate and Sheet	A240-54, A167-54,	Grade C, Grade C,	No. 1 finish, or No. 1 finish (SA167 modification)
Welded pipe	A358-55T*	Grade C(plus S3 option) (8 in. and larger)	
Seamless Pipe	A376-55T*	TP 347	Welded Tubing A249-55T* TP 347
Seamless Tubing	A213-55T*	TP 347	Bolting(L.T.) A320-55T* B8C
Bars	A276-55T	Type 347	Bolting(H.T.) A193-55T* B8C
Forged flanges, fittings and valves	A182-55T*	F 347	Nuts A194-55T* 8C
Welded Fittings	A234-52aT, insofar as applicable, with added appropriate provisions of A312-TP347 (This is to be replaced by the pending ASTM specification, when and if adopted, WP-347) Specifications marked (*) will probably have 1956 revisions shortly.		

3. COMPOSITION. Chemical composition shall conform to the requirements for type 347 stainless steel in the applicable ASTM specification, with the further provisions that:

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(a) the chromium content shall be not less than 18.5%, (b) the carbon content shall not exceed 0.06%, based on a check analysis of the finished product, (c) the composition shall be balanced to produce a substantially austenitic structure in the wrought annealed form, (d) no selenium shall be present, except as the total of selenium plus sulphur does not exceed the stated permissible sulphur content, (e) check analyses on wrought finished products, permitted as options in the specifications shall be required and subject to permissible standard check analysis deviations, except that the check carbon shall not exceed 0.06%, (f) the total of columbium plus tantalum shall be not less than 10 X C and shall not exceed 1.0%.

4. **HEAT TREATMENT.** All forms of these materials shall be supplied in the quench annealed condition. An added stabilizing anneal is permissible provided it is performed above 1600°F. Conventional straightening operations are permissible, and cold finishing may be used if specifically stated and required by the finish requirement for the product.
5. **SURFACE FINISH.** All material shall be furnished free from scale, accomplished by sand blasting, salt bath cleaning, or pickling. All cleaning agents shall be completely removed by rinsing. The surface shall not be pitted or intergranularly corroded to an excessive degree as a result of any pickling or cleaning operation. Weld repairs on finished products shall not be permitted unless authorized by the specification or agreed to by the purchaser. Bright annealing of small diameter pipe and tubing may be employed if specifically approved by the purchaser in advance.
6. **CORROSION TESTS.** Corrosion test specimens representative of each heat and each furnace charge shall be sensitized at 1250°F for one hour, air cooled, and subjected to the corrosion test of ASTM A262-55T. The mean corrosion rate for 5 periods shall not exceed 0.0020 in. penetration per month. In each case specimens are to be selected in quadruplicate, with 2 specimens run and certified by the vendor and 2 submitted to the purchaser for retention or check corrosion tests at the purchaser's option.
7. **MACROETCH TESTS.** Macroetch test specimens representative of each lot and heat shall be performed in accordance with applicable methods of ASTM A317-52T. The steel shall be sound, have a reasonably uniform, and homogeneous structure, and shall be free from injurious laminations, cracks, and similar defects. The macroetched specimens shall be submitted to the purchaser for approval and retention.

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8. **SAMPLES.** Samples for mechanical, chemical, macroetch and corrosion testing shall be selected in accordance with the procedures established in the applicable ASTM specification. In the event the selection of such specimens may involve the destruction of a forging, fabricated fitting, or machined part, the vendor shall propose a method of sampling representing the extent of working and heat treatment to which the material has been subjected, without requiring the destruction of a finished part. The use of such method shall be subject to the approval of the purchaser.
9. **HYDROSTATIC TESTS.** Hydrostatic tests required by the specifications shall be carried out, with the further provision that the maximum test pressure resulting from the formula shall be increased to 4000 psi and the time of test shall be not less than 3 minutes.
10. **SPECIAL PRODUCT REQUIREMENTS APPLICABLE TO INDIVIDUAL SPECIFICATIONS.**
- (a) **Tube Dimensions:** Tube sizes, wall thicknesses and weights, shall conform to the applicable ASTM specification with the following additions in the case of A213-53T.

Wall Thick-									
ness in.	0.028	0.035	0.049	0.058	0.065	0.072	0.083	0.095	

Size, Out-									
side Dia.									
in.									
1/4	0.0664	0.0804	0.1052	0.1189	0.1284	0.1369	0.1480	0.1573	
3/8	0.1038	0.1271	0.1706	0.1964	0.2152	0.2330	0.2588	0.2841	

- (b) **Pipe and Tubing (A213, A376, A358, A249)**
Ends of pipe and tubing shall be furnished squared and deburred, and after cleaning shall be covered with metal or plastic caps and taped to insure a dust-free interior when delivered. Internal surface of all finished pipe and tubing shall be free from injurious defects such as ball scratches, mandrel scratches, breaks or seams.
- (c) **Fittings. (A182, A234)**
Internal contours of all fittings shall be smooth, and all sharp edges on the inside surface shall be broken to a minimum radius equal to the nominal wall thickness of the fittings. All machined surfaces on fittings shall have at least an ASA 250 finish.

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(d) Weld Fabricated Pipe (A358)

Pipe shall be subject to the following modifications. All welding shall be performed using procedures and operators qualified in accordance with provisions of Section IX of the latest edition of the ASME Boiler Code. Except where the pipe diameter is large enough to permit double welding, the first 1/4 in. of the root shall be made using the inert gas shielded arc welding process, with either tungsten or consumable electrodes, and with all passes including the first, involving the deposition of filler metal and the use of an inert gas backup. Filler metal shall conform to the requirements of ASTM A371-53T, ER 347. Passes subsequent to the first 1/4 in. of weld deposit may be made by either the inert gas shielded process or by metallic arc welding using lime-coated electrodes (A298-55T, E347-15 with a chromium-nickel ratio of not less than 1.9 in the weld deposit). The welded pipe shall be furnished fully annealed. All welded joints shall be inspected visually following the first pass, for evidence of cracks or lack of fusion, and defects shall be repaired before subsequent passes are made. Liquid penetrant and radiographic examination shall be employed for the full length of the pipe on completion of the inert gas shielded arc portion of the weld. After completion of the entire weld, liquid penetrant and radiography shall again be performed. Radiographic techniques and standards shall be those of Section UW-51 of the Unfired Pressure Vessel Code, except that no inclusions, cracks, lack of fusion, porosity, incomplete penetration or tungsten contamination shall be permitted in the inert gas shielded portion of the welds; the completed weld shall be free from radiographic indication of cracks, lack of fusion, or incomplete penetration; and there shall be no slag inclusions or porosity in the completed weld in excess of the quantity permitted in the applicable chart in Appendix A (or IV).

11. MARKING. All material shall be legibly stenciled by ink marking in accordance with the requirements of MIL-STD-183, the marking shall contain all the information required for marking by the applicable ASTM specification together with the number of this specification.

12. INSPECTION AND CERTIFICATION.

(a) The purchaser's representative shall have all of the privileges permitted by the applicable specification for source inspection. The purchaser shall be notified at least one week in advance of the date on which significant operations, such as welding, forging, and hydrostatic testing, are to be performed, as well as the date when the material is to be inspected prior to shipment. The manufacturer shall furnish further certification,

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in accordance with the required or optional provisions of the specifications, the certification to include results of chemical analyses, mechanical and corrosion tests, and names of manufacturers and intermediate fabricators, and all applicable heat, lot, and order numbers, to permit subsequent reference and identification.

- (b) The purchaser may, at his option, further inspect the material after receipt, including such non-destructive tests as he chooses. These non-destructive tests shall not be a basis for rejection unless required in the specification or order, or unless conventional tests confirm that the indicated defects are in excess of the permissible limitations of the specifications.

C. A. Burchette for
E. C. Miller

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