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Westinghouse Astronuclear Laboratory

FINAL TEST SPECIFICATION

WASPALOY MATERIALS TEST

37/W412

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37/W412

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INFORMATION CATEGORY

Authorized Classifier / 20/69 Date

FINAL TEST SPECIFICATION
WASPALOY MATERIALS TEST
37/W412

I. EXPERIMENT IDENTIFICATION

A. EXPERIMENT DESIGN REFERENCE	37/W412
B. SPONSOR	WANL
C. TEST FACILITY	GD/FW (GTR-20)
D. TEST DATE	as available

II. PURPOSE OF EXPERIMENT

Following are objectives for 37/W412:

To Determine for Group I*

1. 0.2% offset tensile yield strength
2. ultimate tensile strength
3. % elongation

As a Function of:

1. test temperatures 140, 340, 540, 740°R
2. fast neutron fluences 0, 2.5, 5, 10×10^{18} N/cm², $E > 1$ Mev

To Determine for Group II

1. 0.2% offset tensile yield strength
2. ultimate tensile strength
3. % elongation

As a Function of:

1. test temperatures 1250, 1500, 1750, 2000°R
2. thermal neutron fluences 0, 1, 50, 500×10^{17}

* Refer to attached matrix.

III. DRAWINGS

WANL DRAWING NO. 799C877

THICKNESS = 0.015", Ends modified to 0.100" thickness with Inconel 718

IV. EQUIPMENT LIST

A. TO BE PROVIDED BY WANL

1. Test Specimens

	Irradiation	Control	Total
Waspaloy*Group 1	15	5	20
Waspaloy*Group 2	15	5	20

2. Grips and Pull Rods

3. Cryogenic Temperature Control Coil

B. TO BE PROVIDED BY TESTING AGENCY (GENERAL DYNAMICS/FORT WORTH)

1. Test Racks and Dewar for Holding Specimens During Irradiation

2. Instron Floor Model, Minimum Capacity 20,000 Pounds

3. Storage Dewar for Maintaining LN₂ Temperature

4. Instrumentation for Recording all Data

5. Transfer Devices to Transfer Specimens Under LN₂

6. Furnace for High Temperature Testing Compatible with Instron Machine (2000°R)

7. Tensile Testing Cryostat

8. Thermocouple Recorders

* The Waspaloy was purchased from Hamilton Precision Metals as heat VD 115

WANL Purchase Order 59-NY-BO 4316 rolled to size 0.0150" x 2 5/8" with the following chemical certification received: (%)

Al 1.51	Mn 0.10 ⁺
B 0.003 added	Ni Balance
Cr 20.35	Si 0.20 ⁺
C 0.06	S 0.010 ⁺
Co 14.00	Ti 2.95

Cu 0.05 ⁺		Mo 4.00
Fe 0.50 ⁺	+ means less than	Zr 0.05

V. TEST ENVIRONMENT

A. TEMPERATURE

1. Irradiation Temperature

Group 1	LN ₂ (140°R)
Group 2	Room temperature

B. NEUTRON FLUX, FLUENCE AND DURATION THAT IS NECESSARY TO OBTAIN FLUENCES INDICATED ON ATTACHED MATRICES.

VI. DATA REQUIREMENTS

A. ACCURACY REQUIREMENTS

The neutron fluence for specimens with the same fluence requirement in any given group shall be within $\pm 5\%$. The ratio of high to low fluence shall be within $\pm 10\%$. Variation in fluence between groups shall be $\pm 30\%$.

The gamma dose of all specimens shall be reported to within $\pm 50\%$ to comply with the NERVA Trend Data Retrieval Program. The Instron machine load shall be recorded within $\pm 0.5\%$.

Room temperature shall be recorded to the nearest °R. The Instron machine grip temperatures shall be monitored with thermocouples, and they should be recorded to within $\pm 1^\circ\text{R}$. The specimen temperature shall be accurate to $\pm 5^\circ\text{R}$.

VII. TEST DESCRIPTION

A. RECEIVING INSPECTION PROCEDURE

Upon receipt of specimens from WANL, all specimens will be visually inspected by GD/FW for possible damage due to handling and the results of this inspection recorded.

B. PRE-IRRADIATION CHECKOUT

Pre-irradiation checks will include (1) the measurement and recording of pre-test

dimensions on all specimens by WANL and (2) identification of all specimens to be used in either the control or irradiation tests by WANL. The identification symbols assigned to each specimen, which are scribed on each end, together with a description of the material, will be entered in a permanent log book, along with the recorded location of specimens and dosimetry as in the test fixture by GD/FW. Detailed procedures including operating check lists shall be prepared by General Dynamics and approved by WANL.

C. REACTOR INSTALLATION PROCEDURES

Upon initiation of LN₂ flow, all events affecting temperature of test specimens will be recorded.

D. IRRADIATION TEST PROCEDURE

There are no special requirements relating to reactor startup or shutdown procedures, except that the specimens irradiated cryogenically, must remain under LN₂ from the start of irradiation through the post-irradiation testing unless otherwise specified.

E. POST-IRRADIATION

The control specimens will be exposed to the same temperature environment including thermal cycling as the irradiated specimens. The specimens shall be maintained at LN₂ temperature throughout the complete program through post-irradiation testing and not allowed to warm up above the test temperature, except those specifically warmed up. Procedures similar to those employed in GTR-16 will be required for the transfer of test specimens from the test dewar to the cryostat used in conjunction with the tests. GD/FW will concur with WANL on the use of load ranges for specific tests.

F. TENSILE TESTING (INSTRON MACHINE)

Each specimen shall be held at its planned test temperature for 15 minutes before starting the crosshead. This time is approximate and may be changed by the WANL monitor at the time of testing. The Instron machine crosshead speed shall be

0.05 inches/min. for specimens tested at temperatures between 140 and 740°R
and 0.002 inches/min. for specimens tested at temperatures between 1250 and
2000°R.

G. DISPOSITION OF SPARE SPECIMENS

Spare specimens will be used to replace damaged specimens if there are any.

If spares are not used to replace damaged specimens, they will be used for additional replication at the most stringent test temperature (140°R, or as determined by the WANL monitor).

VIII. DATA REDUCTION

Data to be included in the report shall include ultimate and 0.2% offset yield tensile strength, the Instron chart elongation, and the plastic elongation at maximum stress. Data shall be based on actual WANL reported gage length. Original or legible reproduced copies of all load-deflection curves, temperature recording curves, and raw data tabulations are to be made available to WANL as soon after testing as possible.

IX. DISPOSITION OF SPECIMENS AND HARDWARE

Disposition of irradiated test specimens and/or equipment will be handled in accordance with current AEC regulations. The test specimens will be returned to WANL if specified. Obtain approval from WANL prior to disposition of any material or equipment.

X. SHIPPING AND RECEIVING INSTRUCTIONS

Specimens to be shipped to Mr. J. W. Allen at General Dynamics, Fort Worth, Texas.

GTR-20 WASPALOY TEST MATRIX

GROUP I

<u>Test Order</u>	<u>Specimen Number</u>	<u>Fluence ($E > 1 \text{ Mev}$)(N/cm^2)</u>	<u>Test Temperature °R</u>
461	740	0	140
463	741	0	340
470	742	0	540
472	743	0	740
459	744	2.5×10^{18}	140
466	745	2.5×10^{18}	340
467	746	2.5×10^{18}	540
471	747	2.5×10^{18}	740
462	748	5×10^{18}	140
465	749	5×10^{18}	340
469	750	5×10^{18}	540
474	751	5×10^{18}	740
460	752	1×10^{19}	140
464	753	1×10^{19}	340
468	754	1×10^{19}	540
473	755	1×10^{19}	740
Spares:	756	0	
	757	2.5×10^{18}	
	758	5×10^{18}	
	759	1×10^{19}	

GTR-20 WASPALOY TEST MATRIX

GROUP II

<u>Test Order</u>	<u>Specimen Number</u>	<u>Fluence ($E \leq 0.48\text{ev}$)(N/cm^2)</u>	<u>Test Temperature °R</u>
475	760	0	1250
491	761	0	1500
496	762	0	1750
489	763	0	2000
483	764	10^{17}	1250
494	765	10^{17}	1500
476	766	10^{17}	1750
490	767	10^{17}	2000
480	768	5×10^{18}	1250
478	769	5×10^{18}	1500
482	770	5×10^{18}	1750
495	771	5×10^{18}	2000
477	772	5×10^{19}	1250
493	773	5×10^{19}	1500
492	774	5×10^{19}	1750
481	775	5×10^{19}	2000
Spares:	776	0	
	777	10^{17}	
	778	5×10^{18}	
	779	5×10^{19}	