FINAL TEST SPECIFICATION
BATH SHIELD MATERIAL TEST, 37/W411

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RADIATION EFFECTS TESTING

System:	NERVA
Component:	Shield Material
Test:	37/W411
Date:	July, 1968
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BATH Shield Material Test, 37/W411

I. EXPERIMENT IDENTIFICATION

A. EXPERIMENT DESIGN REFERENCE	37/W411, WANL-TME-1818
B. SPONSOR	WANL
C. TEST FACILITY	GD/FW (GTR-20)
D. TEST DATE	August, 1968

II. PURPOSE OF EXPERIMENT

Following are the objectives for 37/W411.

To determine:

1. 0.2% tensile yield strength
2. 0.2% compressive yield strength
3. hydrogen loss characteristics
4. the ultimate tensile and compression strengths
5. elongation
6. reduction of area

As a function of:

1. test temperature from 140 to 1140°R
2. fast neutron fluence from 0 to 1×10^{19} nvt
3. extrusion A or B
4. annealing temperatures between 540 and 740°R (at a fast neutron fluence of 5×10^{18} nvt)

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5. annealing times between 10 and 1000 minutes

6. notched vs. unnotched tensile specimens

Total length measurements will be made after irradiation for all specimens to be tested at room temperature and above.

III. DRAWINGS

WANL'S DRAWING NUMBERS

DESCRIPTION

801C377

Tensile Specimen, BATH Shield Material

650A584

Compression Specimen, BATH Shield Material

IV. EQUIPMENT LIST

A. TO BE PROVIDED BY WANL

<u>1. Test Specimens</u>	<u>Irradiation</u>	<u>Control</u>	<u>Total</u>
Tensile	66	26	92
Compression	12	12	24

2. Tensile Testing Cryostat

3. Fixture for Measuring Elongation

4. Grips and Pull Rods

5. Compression Test Apparatus Compatible with GD Instron Machine

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 10,000 Pounds

3. Storage Dewar for Maintaining LN₂ Temperature

4. Instrumentation for Recording all Data

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5. Transfer Devices to Transfer Specimens under LN_2
6. Annealing Furnace (1140°R)
7. Furnace for High Temperature Testing Compatible with Instron Machine (1140°R)

V. TEST ENVIRONMENT

A. TEMPERATURE

1. IRRADIATION TEMPERATURE LN_2 (-320°F)

B. PRESSURE Ambient

C. HUMIDITY Not Applicable

D. VIBRATION Not Applicable

E. 1. UNPERTURBED FAST NEUTRON FLUX 4.6×10^{13} and 2.3×10^{13} nv*
($E > 1.0 \text{ MeV}$)

2. UNPERTURBED THERMAL NEUTRON FLUX Not Applicable

F. UNPERTURBED INTEGRATED DOSE

1. Fast Neutron ($E > 1.0 \text{ MeV}$) 1×10^{19} and 5×10^{18} nvt*

2. Thermal Neutron Not Applicable

G. FLUID ENVIRONMENT (During Irradiation) LN_2

H. DURATION 600 Hours

VI. ANALYTICAL

A. PREDICTED PERTURBED FLUXES

1. Any perturbation of neutron flux by specimens, etc. on other

* See Appendix A of the Experiment Design for environment conditions on each specimen.

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specimens shall be estimated and taken into account, so that
specimens will receive the specified fluence within +5%.

B. ACTIVATION LEVELS

1. Not Applicable

VII. FACILITY REQUIREMENTS

A. ELECTRICAL	110 Volts - 60 Cycles
B. PNEUMATIC	Not Applicable
C. HYDRAULIC	Not Applicable
D. SPECIAL FLUIDS	LN ₂ for Irradiation - LN ₂ for
Testing + N ₂

VIII. DOSIMETRY - (To be supplied by GD)

Thermal and fast neutron dosimetry at the front and rear of each experiment.

IX. DATA REQUIREMENTS

The data requirements are indicated in detail in WANL-TME-1818.

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X. TEST DESCRIPTION

A total of 78 specimens will be irradiated in a LN_2 environment. A description of the post-irradiation test conditions is itemized in Appendix A of the Experiment Design (WANL-TME-1818) along with specimen numbers, which are the same as the testing order.

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 installed on racks in the test fixture by GD/FW. The location of specimens to be loaded into the dewars, designed by GD/FW and WANL, is given in the Experiment Design (WANL-TME-1818).

Detailed procedures including operating check lists shall be prepared by General Dynamics and approved by WANL.

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C. REACTOR INSTALLATION PROCEDURES

Upon initiation of LN_2 flow, all events affecting temperature of test specimens will be recorded.

D. IRRADIATION TEST PROCEDURE

The reactor shall be operated for 600 hours at 10 megawatts. There are no special requirements relating to reactor startup or shutdown procedures, except that the specimens irradiated must remain under LN_2 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 LN_2 temperature throughout the complete program through post-irradiation testing, except those specifically warmed up, and not allowed to warm up above the test temperature. 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 and materials.

1. Tensile Tests - Upon completion of tensile tests, the specimens will be fitted together and bench elongation data will be

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obtained with WANL fixture.* Area of reduction measurements using the photographic technique and/or micrometers will also be made. The tensile testing, alignment checks, and required metallography are described in the Experiment Design (WANL-TME-1818).

2. Compression Tests - Compression tests will be performed on the compression sub-press supplied by WANL as specified. Load-deflection curves will be used to determine the 0.2% offset compressive yield load.

XI. HAZARDS

A. PERSONNEL

No foreseeable hazard other than handling irradiated material for testing at high temperature.

B. FACILITY

No foreseeable hazards other than those connected with usual reactor operation.

XII. DATA REDUCTION

Data to be included in the report shall include ultimate and 0.2% offset yield tensile strength, 0.2% offset compressive yield strength

* Length between shoulders on each side of specimen shall be reported.

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the Instron chart elongation, compressive ultimate strength, the plastic elongation at maximum stress, the total plastic elongation obtained with bench measurement, and reduction of area using photography methods and/or micrometer measurements. 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.

XIII. 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.

XIV. SHIPPING AND RECEIVING INSTRUCTIONS

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

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