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Westinghouse Astronuclear Laboratory

NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING

HELD WITH SNPO AT WANL ON SEPTEMBER 26, 1968

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NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING

HELD WITH SNPO AT WANL ON SEPTEMBER 26, 1968

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Westinghouse Electric Corporation

Astronuclear Laboratory

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W. J. Havener
W. J. Havener, Manager
Thermo-Flow Laboratory

Classification cancelled for change to
by authority of DOC

by H.A.C. TIC, date SEP 11 1973

INFORMATION CATEGORY

Confidential Restricted Data
W. J. Havener
Authorized Classifier Date

T. O. Harves 8XK 10/9/68
T. O. Harves, Manager
Engineering Mechanics

SPECIAL PREVIEW FINAL DETERMINATION	Reviewers	Class.	Date
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NOTES OF MONTHLY DEVELOPMENT TEST PROGRAM REVIEW MEETING

HELD WITH SNPO AT WANL ON SEPTEMBER 26, 1968

(U)

ATTENDEES:

Andra, J.	WANL	Gagne, R. W.	SNPO
Baker, W.	WANL	Harves, T. O.	WANL
Caum, D.	WANL	Havener, W. J.	WANL
Davidson, S. L.	WANL	Helms, I.	SNPO
DeZubay, E. A.	WANL	Kalvin, G. A.	SNPO
Downs, G. T.	WANL	Koetting, J. L.	WANL
Eichbauer, R. N.	WANL	Muth, R. J.	WANL
Ettenson, N. J.	WANL	Norman, N.	AGC
Fix, H. J.	WANL	Oelrich, R. L.	WANL

The Monthly Development Test Program Review Meeting was held on September 26, 1968.

This report is divided into two discrete sections. The first section covers the activities of the Thermo-Flow Laboratory and the second, those of the Engineering Mechanics Laboratory. Table I of each section lists the tests performed during the reporting period and those planned for the next period. Discussions of the individual tests follow.

(This Page is Unclassified)

SECTION A

MONTHLY REVIEW OF THERMO-FLOW LABORATORY TESTS

TABLE I

9-26-68

THERMO-FLOW LABORATORY TEST SCHEDULE

PERFORMED THIS PERIOD (August 28 - September 27)PLANNED NEXT PERIOD (Sept. 28-October

Tests for NRX-A6

TFL-3.f Reflector Thermal Transient Test - Testing Complete

No activity.

Tests for PW-1

TFL-1.a Single Cluster Tests

TFL-1.a.29f PW-1 Test (Pedestal III)

Complete 1 hour PW-1 composite Hot End Hardware

TFL-1.a.29g PW-1 Test (Pedestal III)

(Pedestal III) LASL Exit Gas Thermocouple

Tests for R-1

TFL-1.e Stem Orificing - Complete design

Fabrication

TFL-2.a Core Periphery Test

Wrapper assembly, total of layers of Z-liners installed
Ventilation system fabricated

Complete assembly of wrapper

TFL-4.b Support Plate Plug Leak Test - Complete design

Fabrication

TFL-4.d Pressure Vessel Instrumentation Port Transition - Fabrication

Initiate Testing

Pressure Vessel Transition Weld Study - Fabrication

Initiate Testing

General Development Tests

TFL-1.b Single Element Test - Total - 28 (1.2607 to 1.2634)

7 - Phase Y11-Ga, Y-12 high expansion graphite element tests

2 - Phase TS-3012 WNC0 "Q"-Coat Development

6 - Phase TS-3013, WEFF "Q"-Coat Development

7 - Phase QCD, Y12 "Q"-Coat Development element tests at
R1.07 conditions

4 - Verification tests as part of XE-2, Side-by-Side test Series

2 - Tests of high expansion elements at R1.07 conditions

TFL-5.b Interstitial Corrosion Tests on Pyrofoil

Continue testing

Facilities

WANL LH₂ Facility

FS-1 installation

WANHES

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TESTS FOR NRX-A6

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TFL-3.f Reflector Thermal Transient Test

The data from Test 4 was analyzed by Thermal Design engineers. On the basis of the analysis, testing under the present scope of test document supplemented by TRD-68-295 is complete. A report describing the tests will be prepared.

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TESTS FOR PW-1

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TFL-1.a Single Cluster Development Tests

- (U) Two tests were completed during this period on the PW-1 composite hot end hardware.
- (U) Test number TFL-1.a.0029f was completed on August 30, 1968. The test was aborted after 5.7 minutes at 133 volts. High void XE-2 elements were used in the model but caused no problems as in the past tests. Post-test examination of the furnace showed a defective electrode was causing poor electrical contact in the cold end chuck assembly.
- (U) Disassembly of the center element section and block was not possible. The whole assembly was then incorporated in the next build without replacing the tube liner thermocouple.
- (C-RD) Test number TFL-1.a.0029g was conducted on September 17, 1968. Steady-state test time was 17.1 minutes leaving 6.9 minutes required to complete the PW-1 series. The test was aborted due to sudden changes in test parameters. Post-test examination revealed 11 breaks in the elements and a defective furnace electrode. The block was also cracked due to thermal cycling.
- (U) The cold end furnace electrodes have been in use for as long as 4 years and have suffered dimensional changes over the years that now require resleeving the electrodes for satisfactory service.
- (U) An investigation was conducted to determine if increased helium atmosphere pressure would cause excessive helium leakages. A study of helium flow rates in the furnace indicate no appreciable increase in

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flow rate. The total helium leakage flow is approximately 0.004 lb/sec compared to a total hydrogen flow rate of 0.11 lb/sec. A review of the element surface temperatures, diffuser exit gas temperature and block temperatures, as measured using the transition sight port, indicate no reduction in temperature.

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TESTS FOR R-1

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TFL-1.e Stem Orificing Test

The purpose of the Stem Orificing Test is to determine the steady-state performance of the present stem orificing and turn-around arrangement and to establish flow impedance characteristics of various orifice sizes.

Design of the test fixture is complete. Drafting of the detail and assembly drawings is complete. Fabrication of the fixture will begin during the next report period.

Stem Assembly Manufacturing Process and Development Tests

The purpose of this test is to obtain flow impedance characteristics of manufactured stem assemblies, and to verify analytical methods of predicting flow impedances in a stem assembly. Five stem assemblies will be tested.

Drafting of the detail and assembly drawings is complete. The test fixture is being fabricated in the Machine Shop. Completion of the fabrication is expected during the next report period.

TFL-2.a Core Periphery Test

Installation of the Z-liners for the wrapper continued until work was stopped because of a safety requirement. Currently, twenty-seven complete layers of Z-liners have been installed. The sub-total to date includes bonding 324 acceptable Z-liners while utilizing 503 man-hours or an average of approximately 1.6 man-hours per bonded strip accepted.

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A complete wrapper sub-assembly consists of about 33 layers or 396 pieces, if the average Z-liner thickness dimension is nominal (5.5 mils).

Work necessary to complete the wrapper subassembly was discontinued at the direction of safety until approval is obtained on the use and handling of the Petrolatum-Benzene solution in the new assembly area. Benzene vapors are toxic when inhaled in air at or above certain concentration levels; therefore, mechanical ventilation must be installed before continuation of assembly work.

A design of a down-draft ventilation plenum was devised to provide a method for exhausting Benzene vapors to a ventilation system while installing Z-liners. Detail and assembly drawings were prepared and parts fabricated.

Analysis work completed this month includes: (1) resizing of seal segment holes, (2) recalculating model test temperature profiles, and (3) comparing wrapper strain conditions in the model design with current R-1 reactor conditions.

To meet the latest changes in seal schedule requirements, existing holes in the seal segments had to be enlarged.

Temperature levels in the model were recalculated utilizing the latest thermal conductivity values released on flat pyrofoil samples. These test samples were specially designed to represent an R-1 lay-up and were tested at SRI under the direction of material personnel.

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Wrapper strain calculations were made on the present model configuration and values compared with R-1 strain conditions. In addition, SX-5 high expansion graphite was substituted for existing model components, i.e., core, simulated elements, and core-simulated element combination to determine how high the wrapper could be strained if the higher expansion material were used. Results of this evaluation is presently being reviewed by Advanced Reactor Design personnel.

TFL-4.b Support Plate Plug Leak Test

The purpose of this test is to evaluate candidate seal plug configurations that can be used to seal the radially drilled holes in the combined core support/plena plate. Data from this test will help in the selection of a suitable seal plug design. Three types of plugs will be tested.

The test fixture detail and assembly drawings were completed. The work order for fixture fabrication is in the Machine Shop.

TFL-4.d Pressure Vessel Instrumentation Port Transition

The purpose of this test is to determine whether the anticipated reactor temperature and pressure ramps will have any effect on the co-extruded transition and/or its associated hardware. Particular attention will be paid to weldments.

The test will consist of hydrostatic pressure check to failure, pressure/thermal gradients test for leakage and pressure/thermal cycling effects for leakage.

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All hardware has been completed with the exception of the co-extruded transition hardware. Start of leak tests and weld evaluation tests is dependent on the date of reception of the transition hardware. The test fixture assembly is shown in Figure 1.

Pressure Vessel Transition Weld Study

The purpose of the Pressure Vessel Transition Weld Study Test is to determine if the temperature created by welding will have any effect on the instrumentation lead braze or co-extruded transition.

The transition and seal block will be thermally monitored during the welding operation to ascertain that heat generated during welding will not exceed the transition or braze limitations. Thermocouples will be oriented in an axial and transverse pattern so that a temperature profile may be plotted.

All hardware is available with the exception of the vendor produced co-extruded transition hardware. Testing can begin with the availability of the missing hardware. This hardware is expected during the next report period.

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Figure 1
Test Fixture
Instrumentation Port Transition

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GENERAL DEVELOPMENT TESTS

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TFL-1.b Single Element Process Development and Evaluation Tests

Twenty-eight single element corrosion tests were conducted during this period.

Seven Phase YII-GA, Y-12 high expansion graphite elements were corrosion tested. Six elements were tested at R1.07 conditions and one element was tested at D1.01 conditions.

Two Phase TS-3012 WNCO "Q"-Coat Development elements were tested. One element was tested at R1.07 conditions and one element was tested at D1.01 conditions.

Six Phase TS-3013 WEFF "Q"-Coat Development elements were tested. Two elements were tested at R1.07 conditions and four elements were tested at D1.01 conditions.

Seven Phase QCD, Y12 "Q"-Coat Development elements were corrosion tested at R1.07 conditions.

Four Verification Tests were conducted as part of the XE-2, Side-by-Side Test Series. Two elements were tested at XE-2 QC test conditions and two elements were tested at A6.04 conditions.

Two tests were conducted on high expansion elements at R1.07 conditions as part of hot end chuck development.

Planned for the next period are LASL Exchange Tests and tests of Phase YII-GA, Y12 high expansion, "Q"-Coat Development Tests, XE-2 Side-by-Side Tests, and Hot End Chuck Development for High Expansion Elements.

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TFL-5.b Interstitial Corrosion Tests

One specimen simulating a 0.0055-inch "Grafoil" wrapper opposite a 0.005-inch thick filler strip gap was tested. Data reduction on this test has not been completed. Results will be presented at the next meeting.

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FACILITIES

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The operating procedures for the WANL Liquid Hydrogen Facility were completed and submitted to SNPO. The 5000 gallon dewar was filled on September 5 and no difficulties were encountered during this operation. Subsequent fills were accomplished on September 12 and 19. The rebuilt Paul Vaporizer was also tested and found to operate satisfactorily. This operation was accomplished by starting with the Paul Vaporizer and then switching over to the Hex unit. Checkout tests on the Cryosonics Vaporizer remain to be accomplished. This represents completion of the WANL Liquid Hydrogen Facility.

In addition, the storage tubes and the liquid hydrogen dewar were repainted.

Design work on the thermocouple system was initiated and detailed sketches are in the process of being prepared.

A review of the operation of FS-1 flow system including a simulated functional checkout of console operation was held. A preliminary draft of the test operating procedure was completed and submitted for typing.

Construction work on the facility continues as people are available. Cluster program presently dictates the work assignments. Work on plumbing of the high pressure gas system was completed. This work included the installation of valve trims in addition to completing the piping requirements. Spare parts and additional required equipment for the facility were ordered.

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Remaining parts for the furnace electrode terminals were received and mock-up assembly was made. Interference of auxiliary piping requires rework of some parts.

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SECTION B
MONTHLY REVIEW OF ENGINEERING MECHANICS TESTS

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TABLE I

ENGINEERING MECHANICS LABORATORY

PERFORMED THIS PERIOD

August 27, 1968 - September 26, 1968)

PLANNED NEXT PERIOD

(September 27, 1968 - October 31, 1968)

TESTS IN SUPPORT OF R-1

REFLECTOR SYSTEM TESTS

Ganged Drum Drive System Tests

FUEL ELEMENT TESTS

Fuel Element Compression Testing

AXIAL SUPPORT SYSTEM TESTS

Interface Friction Tests

CORE PERIPHERY TESTING

Axial Differential Pressure Tests

Periphery Radial Impedance Test

Periphery Wrapper Axial Test

Graphite Foil Material Ductility Test

SUPPORT STEM TESTS

Stem Assembly Tensile and Thread Strength Test

Stem Manufacturing Process and Axial Load Test

REFLECTOR SYSTEM TESTS

Continue Ganged Drum Drive Band Tensile Tests

Ganged Drive Band Fatigue Tests

Ganged Drive 3 Drum System Titanium Band Test

FUEL ELEMENT TESTS

AXIAL SUPPORT SYSTEM TESTS

CORE PERIPHERY TESTING

Continue Axial Differential Pressure Tests

SUPPORT STEM TESTS

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ENGINEERING MECHANICS LABORATORY

PERFORMED THIS PERIOD

(August 27, 1968 - September 26, 1968)

PLANNED NEXT PERIOD

(September 27, 1968 - October 31, 1968)

TESTS IN SUPPORT OF NRX & XE

XE-2 Neutron Detector Test

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TESTS IN SUPPORT OF R-1

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REFLECTOR SYSTEM TESTS

Ganged Drum Drive System

- (U) Seven band tensile specimens were tested to failure at ambient temperature to determine the actual material tensile properties of the cross sectional configuration. Specimens were made of titanium per PDS 30067-1 (5% Al, 2-1/2% Sn). Figure 1.
- (U) Each specimen was bolted to a knurled clamping fixture. The fixture ends were connected to a universal joint to assure alignment of the specimen. Figure 2 and 3.
- (U) A typical specimen which failed at ambient temperature is shown in the photograph. Figure 4. Results of the tests are summarized in Table II.
- (U) Additional specimens will be tested at both ambient and cryogenic temperatures in order to obtain statistical data.

FUEL ELEMENT TESTS

Fuel Element Compression Testing

- (U) During this period, compression/creep testing of PEWEE II central elements was continued with the testing of five additional specimens. In these tests, three inch specimens were subjected to axial compressive loads of 900 lbs for 75 minutes at temperatures of 4300°R, 4600°R, and 4900°R. As in previous tests of this type, the specimens were brought to temperature under minimum load, then at temperature the test load was rapidly applied (minimum to test load in about five seconds) and held for the test period. During the

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FIGURE 1
BAND TENSILE SPECIMENS
ROOM TEMPERATURE TEST

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FIGURE 2
BAND TENSILE SPECIMEN IN TINIUS OLSEN
ROOM TEMPERATURE TEST

FIGURE 3
BAND TENSILE CLAMPING FIXTURE

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FIGURE 4
BAND TENSILE SPECIMEN AFTER
ROOM TEMPERATURE FAILURE

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(U) TABLE II
SUMMARY OF TEST RESULTS AT ROOM TEMPERATURE
BAND TENSILE TEST

Specimen Number	Dimensions in Gage Length Area			Ultimate Load (lbs)	Tensile Stress (psi)	Yield Stress (psi)	Percent Elongation	Modulus of Elasticity (10^6 psi)
	Gage Length	Width	Thickness (in.)					
1	3.958 - 3.964	.7510	.0142 - .0145	1270	117,500	91,666	14.5 (1)	14.8
2	3.966 - 3.957	.7510	.0140 - .0138	1280	122,500	107,307	6.2 (2)	16.6
3	3.968 - 3.968	.7510	.0128 - .0130	1164	120,000	102,500	7.2 (2)	15.4
4	3.960 - 3.958	.7507	.0130 - .0135	1140	114,600	103,434	12.0	15.4
5	3.971 - 3.963	.7510	.0138 - .0140	1256	120,500	99,230	8.5	15.6
6	3.962 - 3.956	.7505	.0130 - .0132	1194	121,800	105,918	10.5	16.1
7	3.959 - 3.951	.7508	.0132 - .0135	1210	121,000	98,400	10.5	16.0

NOTES: (1) Specimen Number (1) experienced excessive bending before test run

(2) Percent elongation measured over nonuniform cross sections 4.00 inch gage length, instead of uniform cross sectional 2.00 inch length.

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test, specimen deflections were monitored by the Optron Optical Extensometer.

(U) All samples were of Y-12 manufacture, representative of PEWEE II development status. A summary of the test results performed this period is shown in Table III. Since testing of this group of specimens completes a test scope, a discussion of all work performed under this test scope (including the results of seven tests performed previously) follows:

(CRD) There were no specimen failures, nor were there any unusual or unexpected occurrences. The specimens tested at 4300°R, and 4600°R, shortened under load. Those tested at 4900°R, showed some distortion; that is, in addition to the decrease in length, there was also some lateral displacement. This latter displacement was expected as graphite, at 4900°R, is somewhat plastic. In turn, this plastic behavior probably explains some of the large apparent creep strains recorded at this temperature.

(CRD) In general, there was indication that the specimens continued to creep for the entire duration of the test at all temperatures. The rate at which creep occurred was relatively high initially and then became more or less constant for the duration of the test. At 4300°R, the initial portion lasted about six minutes, after which the indicated creep rate was approximately 0.00005 inch/inch/minute. At 4600°R, the initial portion lasted about 15 minutes, after which the indicated creep rate was approximately 0.00009 inch/inch/minute. At 4900°R, the initial portion lasted about 15 to 20 minutes, after which the indicated rate was approximately 0.00028 inch/inch/minute. For two of the 4900°R tests, the indicated creep rate suddenly accelerated after approximately 40 to 50 minutes of run time. Post-test examinations of

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TABLE III
SUMMARY OF TEST RESULTS ON COMPRESSION/CREEP
OF PEWEE II CENTRAL ELEMENTS

	<u>Specimen 1</u>	<u>Specimen 2</u>	<u>Specimen 3</u>	<u>Specimen 4</u>	<u>Specimen 5</u>
1. Test Temperature (°R)	4300	4600	4900	4600	4900
2. Specimen Location (Station)	8	11 1/4	14 1/2	11 1/4	17 3/4
3. Indicated Strain Due to Initial Loading (in/in)	.0021	.0023	.0034	.0021	.0032
4. Indicated Additional Creep Strain Under Load (inch/inch)	.0032	.0092	.0316	(1)	.0230
5. Measured Change in Overall Lgth. (inch) (3)	-.0094	-.0274	-.1019	-.0192	-.0663
6. Measured Change in Across Flats (inch) (4)	+.0009	+.0028	+.0072	+.0017	+.0053
7. Measured Change in Bore Diameter (inch) (4)	-.0041	-.0035	+.0005	-.0036	-.0008

- NOTES:
- (1) Optical Extensometer lock-on lost after 57 min. run time. Indicated creep strain at that time .0067 inch/inch. Test continued for full 75 minutes.
 - (2) Specimen Numbers 1, 2, and 3 are Serial Number 001-75173. Specimen Numbers 4 and 5 are Serial Number 001-75150.
 - (3) Average of three (3) readings along alternate edges.
 - (4) Average of three (3) readings taken at the mid-length of the specimen.

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the specimens indicated that the probable cause was rotation of the targets as the specimens deformed.

(CRD)

It would be premature to form a definite conclusion from the few tests that were run. However, from these tests, element number 001-75150 (Y-12, M-3 Flour, PEWEE II Development) showed the least deformation under load at all temperatures. One pattern which does appear from the data obtained is that the specimen deformation increases by a factor of three with each temperature increment. At 4300°R, the total deformation was about .010, at 4600°R, about .030; and at 4900°R, about .090.

AXIAL SUPPORT SYSTEM TESTS

Interface Friction Tests

- (U) Tests on material smoothness were performed on coated unfueled graphite against coated unfueled graphite in the High Temperature Friction Furnace. Figures 5 & 6.
- (U) The specimens had a 20 microinch finish. Three 5 cycle runs indicated a coefficient of friction of 0.85 to 1.00 before the ten (10) minute temperature soak and 2.15 to 2.38 after the soak. Figure 7.
- (U) With a surface finish of six (6) microinches, the welding of samples caused breakage of the furnace heater elements on the first half cycle before the ten minute soak. The heater elements will be replaced and additional testing performed on coated unfueled graphite.

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FIGURE 5
WESTINGHOUSE HIGH TEMPERATURE
FRICTION FURNACE

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FIGURE 6
INTERFACE FRICTION TEST ASSEMBLY

SPECIMEN WITH
25-30 MICROINCH FINISH
BEFORE POLISHING

SPECIMEN WITH
6 MICROINCH FINISH
AFTER POLISHING

FIGURE 7
INTERFACE FRICTION TEST SPECIMEN FINISHES

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CORE PERIPHERY TESTING

Axial Differential Pressure Tests

- (U) During the past month, approximately fourteen test runs were made on various samples of peripheral designs to determine the axial flow impedance to helium gas at several variations of gas pressure difference and mechanical bundling pressures. Types of specimens tested included sharp saw-tooth and truncated saw-tooth shapes, which were further divided into continuous sheaths of pyrofoil layers and those with butt joints of known gap widths.
- (U) Since considerable learning processes has been involved in folding and shaping the specimens, the quantities of gas flow involved are somewhat more qualitative than quantitative to date, and no final conclusions should be drawn from the results until several confirming runs on each type have been conducted. In addition, the mass of data involved has necessitated the development of a computer program to convert rotometer readings into the mathematical forms desired by the Analysis Department. This program has had several trial runs and is expected to be operational by the end of the month.
- (CRD) It has been possible to draw some preliminary conclusions based on physical observations and relative magnitudes of flow under the varying test conditions involved. One conclusion is that the saw-tooth configuration is difficult to fill with pyrofoil particularly at the bottom of the "Vee"-shaped areas. Individual pyrofoil layers can be folded to closely contour shape of the saw-tooth configuration. However, when 26 layers of pyrofoil are stacked, the resultant 0.155 inch thickness is too great to follow the shape precisely, and

a gap is produced at the bottom of the "Vee". This is not quite so much of a problem with the truncated "Vee" shapes since a mismatch of dimensions between the flat surfaces permits the pyrofoil to flow into any available space during heating, thus giving a slightly better seal.

(U) A second conclusion is that when comparing the specimens with the 0.040 inch butt joints with those having 0.010 inch butt joints, there was slightly less axial flow through the 0.040 inch butt joint specimen. This is in part accounted for by the tendency of underlying pyrofoil sheets to bulge into the larger gap, while the smaller gap was too small for the material to deform into under the pressures involved.

(CRD) A third conclusion is that the results seem to be strongly affected by variations in the material itself. It has been observed to vary in thickness from 0.0020 to 0.0025 inch on the same roll, which is a substantial percentage of the nominal 0.0055 inch thickness. Likewise, some of the foil expands enough under heat and pressure to add up to 0.030 inch to the 0.155 inch assembled thickness. Other material from the same roll has expanded enough to add 0.0040 inch to the final thickness. In general, it is felt that not enough foil has been tested to isolate the effect of every possible variable.

(U) One other effect has been observed which involves the use of liquid Petrolatum for pasteing the various layers together at room temperature. Axial flow is greatly impeded while the Petrolatum is in place; but as it melts and vaporizes, the gas flow increases. No ash or residue appears to be left in the test specimens themselves.

(U) By the middle of October, it is hoped to have a fixture available to fold the various layers more consistently. This fixture should help

to reduce test variables introduced by the manual folding operations of different laboratory personnel. In addition, flow coefficients will have been developed to help determine the significance of any isolated data points.

Periphery Radial Impedance Test

- (U) A "D-Spec" was issued to Drafting to:
- a) Re-design the graphite heating element to allow for thermal growth.
 - b) Re-design the electrode connections from the DC collector bus cables. Flexible rather than rigid connections will be used.

A blanket purchase order release was issued to procure small hardware (cam followers, set screws, etc.) for the electrode guide assembly on the aft end of the EML-E.1 Rig.

Periphery Wrapper Axial Test

- (U) Stainless Steel (AISI Type 446) test cylinder halves for both the "sawtooth" (across-flats) and "on-flats" (across-corners) have been placed on order .
- (U) Stainless Steel is being used to attempt to eliminate the graphite-wear factor from the leak sealing capability of the wrapper and its surrounding core components and to aid in wrapper forming.

Graphite Foil Material Ductility Test

- (U) A "D-Spec" was issued to Drafting to design an induction-heated tensile testing rig which will be based on an INSTRON Table

Model Universal Testing Machine. The unit will permit tensile testing of "Grafoil" at temperatures up to above 5000°R and at load ranges (full-scale) from 0 - 1.0 to 0 - 500.0 pounds at loading rates of 0.002 to 50.0 inches/minute. Inert atmosphere capability is included.

SUPPORT STEM TESTS

Stem Assembly Tensile and Thread Strength Test

- (U) Static tests were performed to determine the structural adequacy and relative strength of simulated support stem ends. Two groups of stems were made from inconel 718 material. The forward and aft ends were ground for one case and rolled for the second.
- (U) Each specimen was placed in the universal testing machine and axial tension loads were applied. Before pulling the stems to failure, the loading was cycled 100 times from zero to 800 lbs. The test arrangement is shown in Figure 8. A typical condition of the specimens after failure is seen in Figure 9.
- (U) The results of the tests are listed in Table IV. The aft end with ground and rolled threads were consistent as seen from the maximum loads attained (3260 to 3480 lbs). The forward end showed some variance as the ground threads failed at 2535 to 2850 lbs and the rolled threads from 3700 to 3720 lbs.
- (U) The addition of RTV-891 silastic sealant had little affect on the mode of failure. All specimens were unaffected by the cycling condition.

Stem Manufacturing Process and Axial Load Test

- (CRD) The third and final series of tensile tests on full support stems

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FIGURE 8
SETUP FOR STATIC AXIAL TENSILE TEST OF STEM ENDS

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FIGURE 9
TYPICAL FAILURES TO STEM ENDS

(U)

TABLE IV
SUMMARY OF TEST RESULTS

Description	Used Silastic RTV-891	Ultimate Load (lbs)	Yield Strength .2% Offset (140 ksi) (ksi)	Ultimate Strength (170 ksi) (ksi)	Area at Failure (in ²)	Failure Location
Ground Threads Aft End Stems	No	3,350	109	154	.0217	In the neck
	No	3,275	106	150	.0217	In the neck
	Yes	3,315	94	130	.0255	In the 1st thread
	Yes	3,290	106	151	.0217	In the neck
Ground Threads Forward End Stems	No	2,535	125	147	.0172	In the thread
	Yes	2,600	131	151	.0172	In the thread
	Yes	2,550	---	148	.0172	In the thread
	Yes	2,850	128	164	.0172	In the thread
Rolled Threads Aft End Stems	No	3,310	135	153	.0217	In the neck
	Yes	3,480	130	160	.0217	In the neck
	Yes	3,260	131	150	.0217	In the neck
Rolled Threads Forward End Stems	No	3,700	205	215	.0172	In the thread
	Yes	3,700	215	215	.0172	In the thread
	Yes	3,720	205	216	.0172	In the thread

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(CRD) (388D267) was completed. The previous two test series, reported last month, TME-1856, were performed on stems made from: 1) a conventional tube process (PDS 30043-2) and 2) centerless ground bar stock PDS 30043-1). The third group was manufactured according to Aerospace Material Specification (AMS 5590) which describes a nickel base seamless alloy tubing. The stems had a wall thickness of 10 mils and an outside diameter of 0.320 inches.

(CRD) One specimen was loaded to 880 lbs. A second specimen was cycles 50 times to 653 lbs before loading to failure at 1885 lbs. The third and fourth specimens failed at loads of 1935 lbs and 1905 lbs. Figure 10 shows a typical failure. The results of this and the previous two series of tests are summarized in Table V. In all cases, failures occurred, as designed, in the tubing and not in the threads.

(U) 1) The stems returned to their original length after being loaded to 1.35 times the expected stress level, 2) none of the three stem designs were damaged by applying loads to produce the static operational stresses, and 3) failures occurred at levels in excess of three times the expected stress level.

(U) Other factors are being considered before selecting an optimum design.

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Specimen: Group and k lb/in	Load to 1.35 times the Expected R1 Stress Level (lbs)	50 Cycles at Expected R1 Stress Level in Material (lbs)	Load to Failure (lbs)	Failure Location
H01-B				
4450	880	-	-	No cracks or deformation
4400	-	653	-	No cracks or deformation
4940	-	-	2300	7.25 from fwd end
4400	-	653	-	No cracks or deformation
5170	-	-	2280	45" from fwd end
4400	-	653	-	No cracks or deformation
4940	-	-	2290	2.312" from fwd end
4500	-	-	2250	2.3" from fwd end
4500	-	653	-	No cracks or deformation
4500	-	-	2250	Test discontinued after 7.185 in elongation
5170	-	653		No cracks or deformation
5170	-	-	2310	16.14" from fwd end
5250	-	-	2290	47.59" from fwd end
5170	-	-	2140	6.73" from fwd end
H02				
4000	800	-	-	No cracks or deformation
4000	-	593	-	No cracks or deformation
4270	-	-	1840	2.2" from fwd end
H04				
3800	880	-	-	No cracks or deformation
4000	-	653	-	No cracks or deformation
4270	-	-	1885	1.75" from aft end
4050	-	-	1935	8.125" from aft end
4270	-	-	1905	Failed in two locations 1.8" from aft end and 17.75" from fwd end

(CRD)

TABLE V
RESULTS OF SUPPORT STEM TESTS

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FIGURE 10
TYPICAL STEM TUBE FAILURE

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TESTS IN SUPPORT OF NRX & XE

XE-2 Neutron Detector Test

- (U) The 60°R temperature as well as the required temperatures for testing to (T711-906) were attained. Test utilized a refrigeration system fabricated by Engineering Mechanics Laboratory. The neutron generator malfunctioned, consequently three neutron sources were substituted for the generator.
- (U) All test data presently being collected by the Instrumentation Group. Tests were expected to be completed September 21, 1968.