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APPLIED RESEARCH AND DEVELOPMENT

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Test Procedure

PHOEBUS II PRESSURE VESSEL/NOZZLE

INTERFACE TEST

ACF-411-282

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DISTRIBUTION:

W. W. Stagg, AEC-SAAO (2)

W. J. Jackel

J. W. Neudecker, LASL

J. E. Fisher

R. E. Pozega

J. M. Fowler

S. E. Logan

R. W. Randolph

H. L. Brammer

H. E. Hendricks (8)

R. E. Wandrey

H. T. Ried (2)

Alameda Accountability Center (2) ←

Prepared by:

H. T. Ried

H. T. Ried

Test Engineer

Approved by:

R. E. Wandrey

R. E. Wandrey

Supervisor, Test Operations

Approved by:

J. E. Fisher

J. E. Fisher, Manager

Mechanical Development &
Test Engineering

Concurrence:

H. L. Brammer

H. L. Brammer

Senior Project Engineer

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1. INTRODUCTION

This procedure establishes the methods and sequence for evaluation of the Phoebus II Pressure Vessel/Nozzle Interface region as requested by Work Order 5-1630, dated August 5, 1965, and a specification letter dated July 15, 1965, from Mr. J. W. Neudecker of the Los Alamos Scientific Laboratory.

2. TEST OBJECTIVES

The objectives of these tests are as follows:

- (a) To evaluate the load carrying capacity of the nozzle shear lip.
- (b) To verify the nozzle flange load carrying ability.
- (c) To investigate the effect of a nominal gap between pressure vessel flange and the nozzle shear lip.
- (d) To evaluate the load carrying ability of the attachment bolts and associated inserts.
- (e) To evaluate the shear-out loads on the pressure vessel flange.
- (f) To evaluate the torque versus axial load characteristics of the bolts and inserts.

3. TEST DESCRIPTION

3.1 In order to obtain all of the objectives listed above, the tests will be performed in two phases. Phase I will consist of the insert selection and the determination of the bolt torque versus axial load characteristics, and Phase II will consist of the two dimensional model tests.

3.2 Phase I Tests

- 3.2.1 The three types of inserts to be evaluated are Helicoil P/N 1191-10CN-1 .25, Keensert P/N KNH 1018-22, and Slimsert P/N SPL 628 SU-1. The test setup will include 7039-T61 Aluminum blocks internally threaded to accept the inserts.
- 3.2.2 The bolt head end of the test setup will be such that the surface mating with the bolt head simulates the hardness and surface finish of the Hastelloy-X used in the nozzle. The aluminum blocks and the bolt head fixtures will be fitted with adapters to make them compatible with the 400,000 pound capacity Riehle Testing Machine.

- 3.2.3 The test will consist of torquing the bolt head and recording the axial load from the Riehle Testing Machine. This test will be performed a minimum of four times for each insert.
- 3.2.4 After completing the tests described in Paragraph 3.2.3, an ultimate (or pullout) load test will be made on each insert to determine the failure mode and failure load.

3.3 Phase II Tests

- 3.3.1 Two dimensional models of the pressure vessel/nozzle interface, three bolts wide, will be fabricated. The ends of the model will be compatible (through the use of adapters) to the Riehle Testing Machine.
- 3.3.2 The interface models will be subjected to loads which duplicate the operational loads in magnitude and direction and interface moment values. This test will be performed a minimum of four times on each model.
- 3.3.3 Strain gages, displacement transducers, photostress, and Stresscoat will be used to determine the interface behavior.
- 3.3.4 After completing the tests of Paragraph 3.3.2, the interface models will be subjected to an ultimate load test in order to determine the failure mode.

4. TEST PROCEDURE

4.1 Phase I Tests

- 4.1.1 Test four (4) inserts of each type with an unused 7039-T61 Aluminum block (Dwg. Nos. 3-763778-000, 3-763779-000 or 3-763780-000) for each insert.
- 4.1.2 Verify the dimensional integrity of the insert installation threads with a plug gage before installation in the aluminum blocks.
- 4.1.3 A sketch of the test setup is shown in Figure 1.
- 4.1.4 Lubricate all bolt threads with Lubribond Type A and all "K" seals with Dow Corning No. 11.
- 4.1.5 Mount the test fixture in the Riehle Testing Machine, as shown in Figure 1.
- 4.1.6 Insert the bolt and aluminum block into the test fixture.
- 4.1.7 Torque the bolt into the test assembly in 50 ft-lb increments to 150 ft-lbs and continue torquing in 20 ft-lb increments until an axial load of 23,000 lbs (approximately 240 ft-lbs) is reached. Record the axial load observed on the Riehle at each torque value on the data sheet in Table 1.

- 4.1.8 Record the break-away torque and remove the bolt. Check bolt and insert for galling. Relubricate the bolt if necessary.
- 4.1.9 Perform the tests described in Paragraphs 4.1.6 through 4.1.8 a total of four times with each bolt and insert combination.
- 4.1.10 After completing the tests specified in Paragraph 4.1.9, perform an ultimate load (pullout) test on each bolt and insert combination. Record the maximum load and the failure mode. Run the chart on the Riehle continuously during this test.
- 4.1.11 Take photographs of the test setup and test specimen failures.
- 4.1.12 Transmit all data from Phase I tests to H. Hendricks, Department 431, for selection of the type insert to be used in Phase II tests.

4.2 Phase II Tests

- 4.2.1 Perform Phase II tests on three interface models as shown in Figure 2, using the insert selected from the Phase I tests (only two models, Dwg. Nos. 3-516006-000, 3-516007-000 and 3-516015-000, 3-516016-000, are presently defined). One configuration is a LASL concept and the other is an ACF concept.
- 4.2.2 The ACF Quality Control and Inspection Department will perform a comprehensive dimensional inspection of the interface models.
- 4.2.3 Serialize the interface Models 1 through 3.
- 4.2.4 Apply strain and displacement gages before assembly, as shown in Figure 3.
- 4.2.5 Mount four (4) strain gages, axially oriented 90° apart, as shown in Figure 4, on the middle bolt (modified) of each model to measure the axial and bending loads. Lubricate threads and seals as in Paragraph 4.1.4.
- 4.2.6 Apply Stresscoat before assembly to the models, as shown in Figure 5, to determine whether additional gages are needed in subsequent tests.
- 4.2.7 Apply photostress coating before assembly to the models, as shown in Figure 5. Displacement gages are not mounted on model face which is photostress coated.
- 4.2.8 Setup the Gilmore Model 114 to record the outputs of the strain and displacement gages.
- 4.2.9 Setup photostress instruments to record the data from the photostress coating on one flat face of the model.

- 4.2.10 The effects of various torque values will be investigated; therefore, the torque values will be selected at test time by the cognizant test monitor.
- 4.2.11 Assemble the interface model in the Riehle, taking care that the instrumentation is monitored during assembly.
- 4.2.12 Load the interface model in 10% increments (6000 lbs) to the full power load of 60,000 lbs.
- 4.2.13 Record instrumentation data at each load increment on the data sheet.
- 4.2.14 Adjust torque according to Paragraph 4.2.10 and repeat Paragraph 4.2.12 under direction of monitor.
- 4.2.15 After the test data is evaluated, load the model until failure results. Record the failure load on the data sheet.
- 4.2.16 Take photographs of test setups and test specimen failures.

NOTE: A mechanical properties study shall be performed on the Hastelloy -X and the 7039-T61 Aluminum to determine that the materials used for these tests meet the proper specifications.

Table 1

PHASE I TESTS - INSERT EVALUATION DATA SHEET

Date		
Insert Type		
Torque Value (ft-lbs)	Load	Remarks
50		
100		
150		
170		
190		
210		
230		

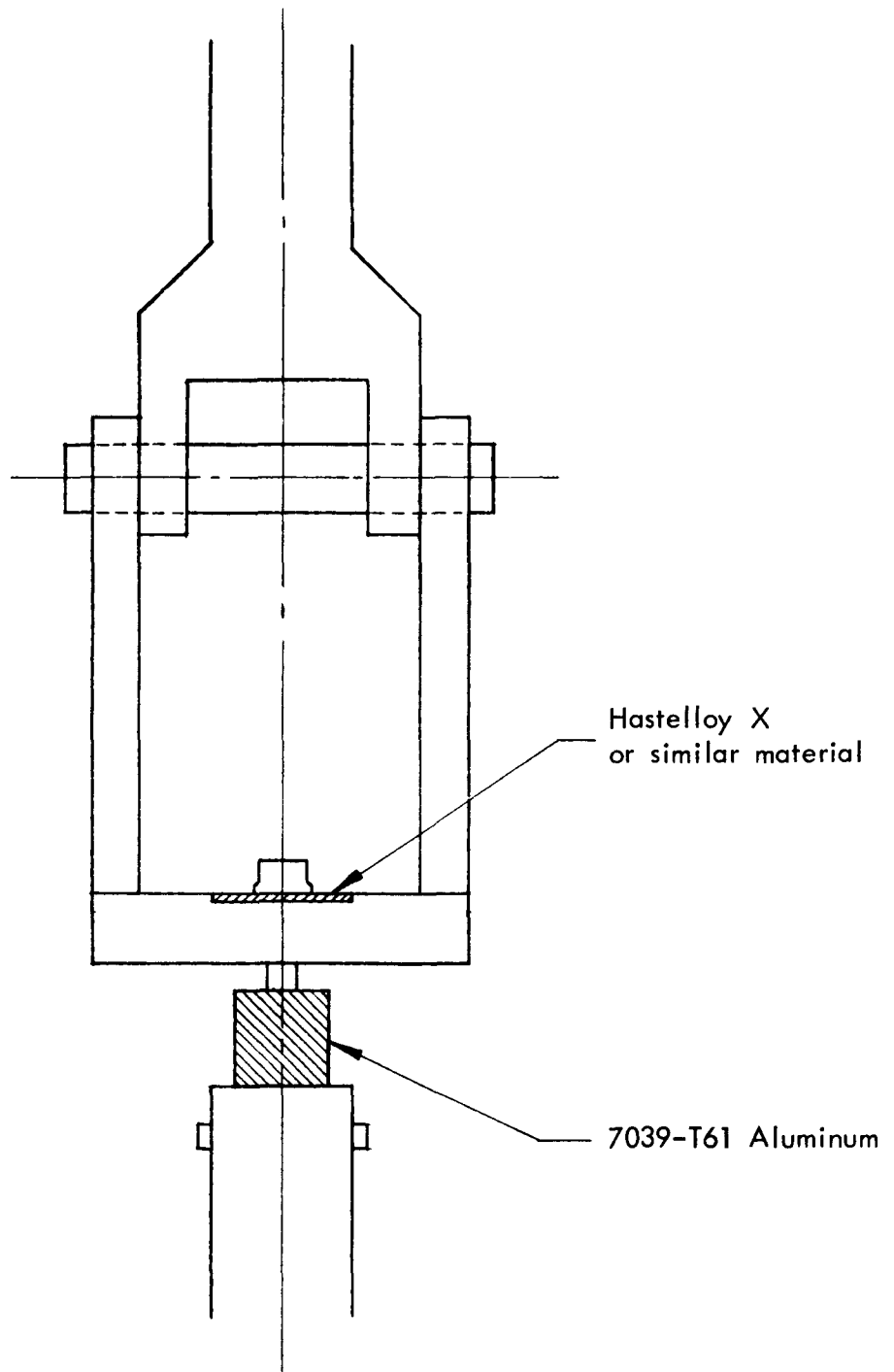


Figure 1. TEST SETUP FOR PHASE I TESTS

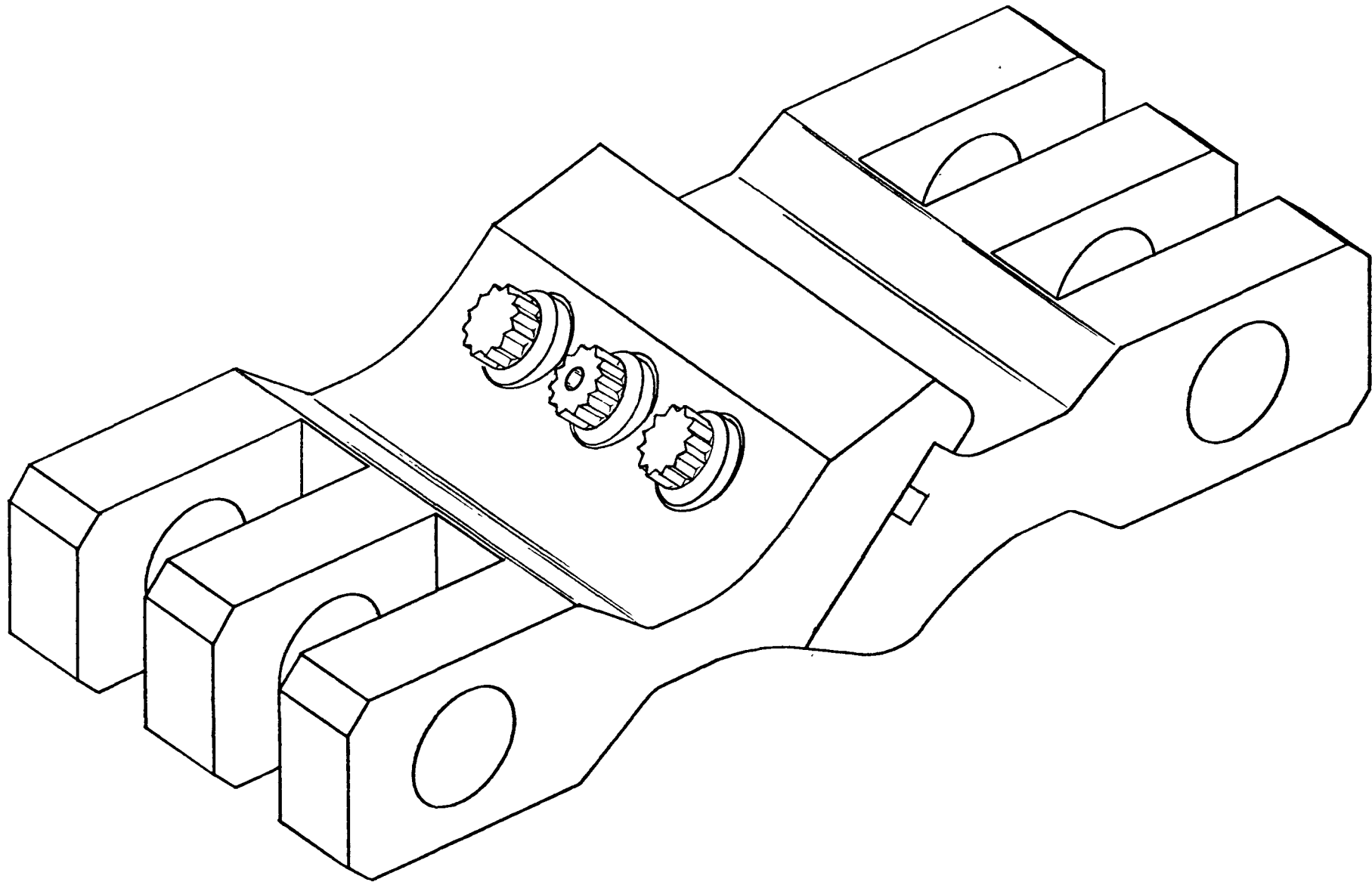
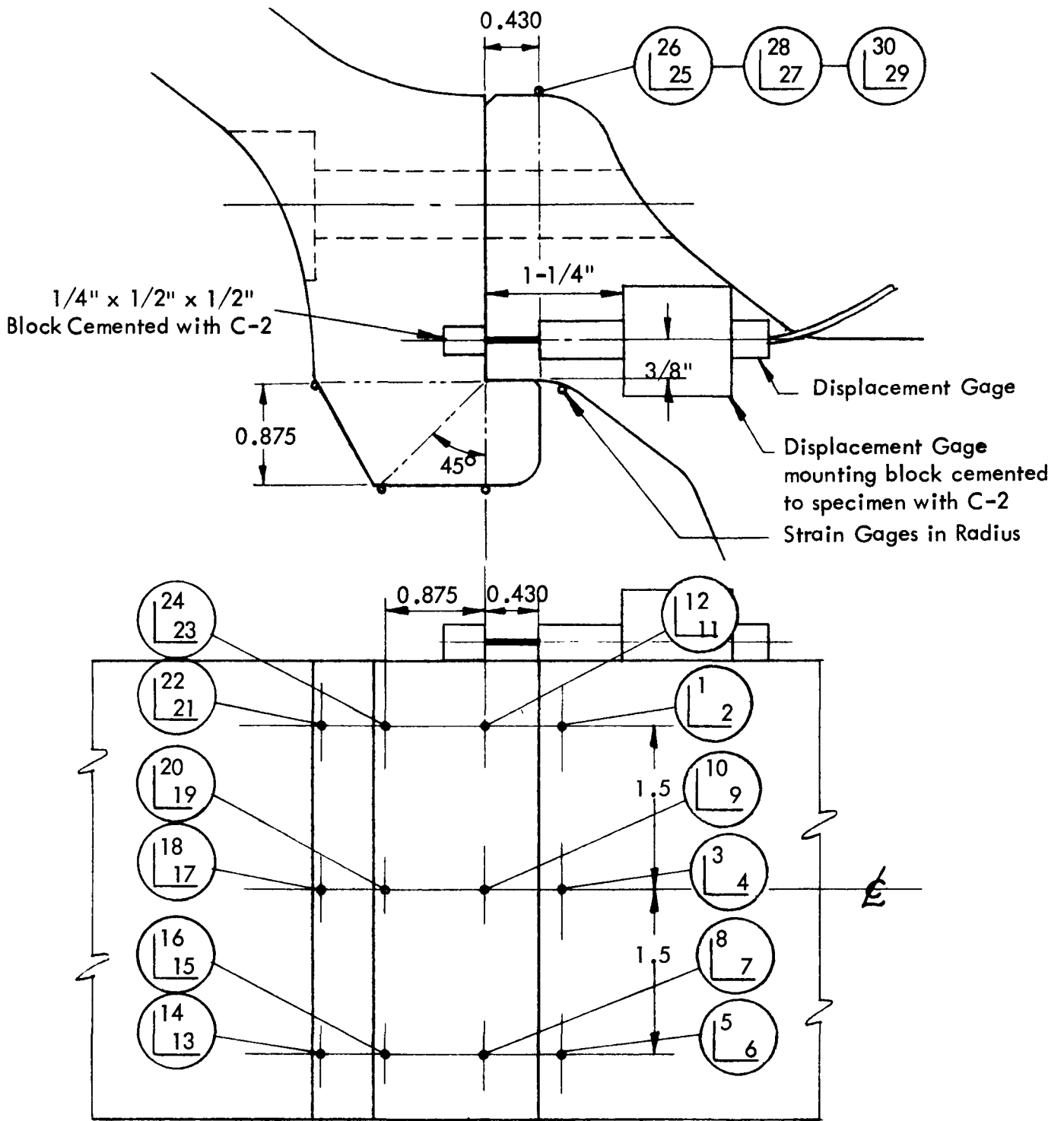


Figure 2. SKETCH OF PHOEBUS - II INTERFACE MODEL



NOTES:

1. Mount gages using C-2 Cement.
2. Gages 1-6 and 25-30 to be C-12-111.
Gages 7-24 to be C-9-111. .062" lgth.
3. Displacement gages to be 0-.050 inches range, sensitivity of 1×10^{-4} inch, such as Sanborn Model 581-25-1.

Figure 3. STRAIN AND DISPLACEMENT GAGE LOCATIONS

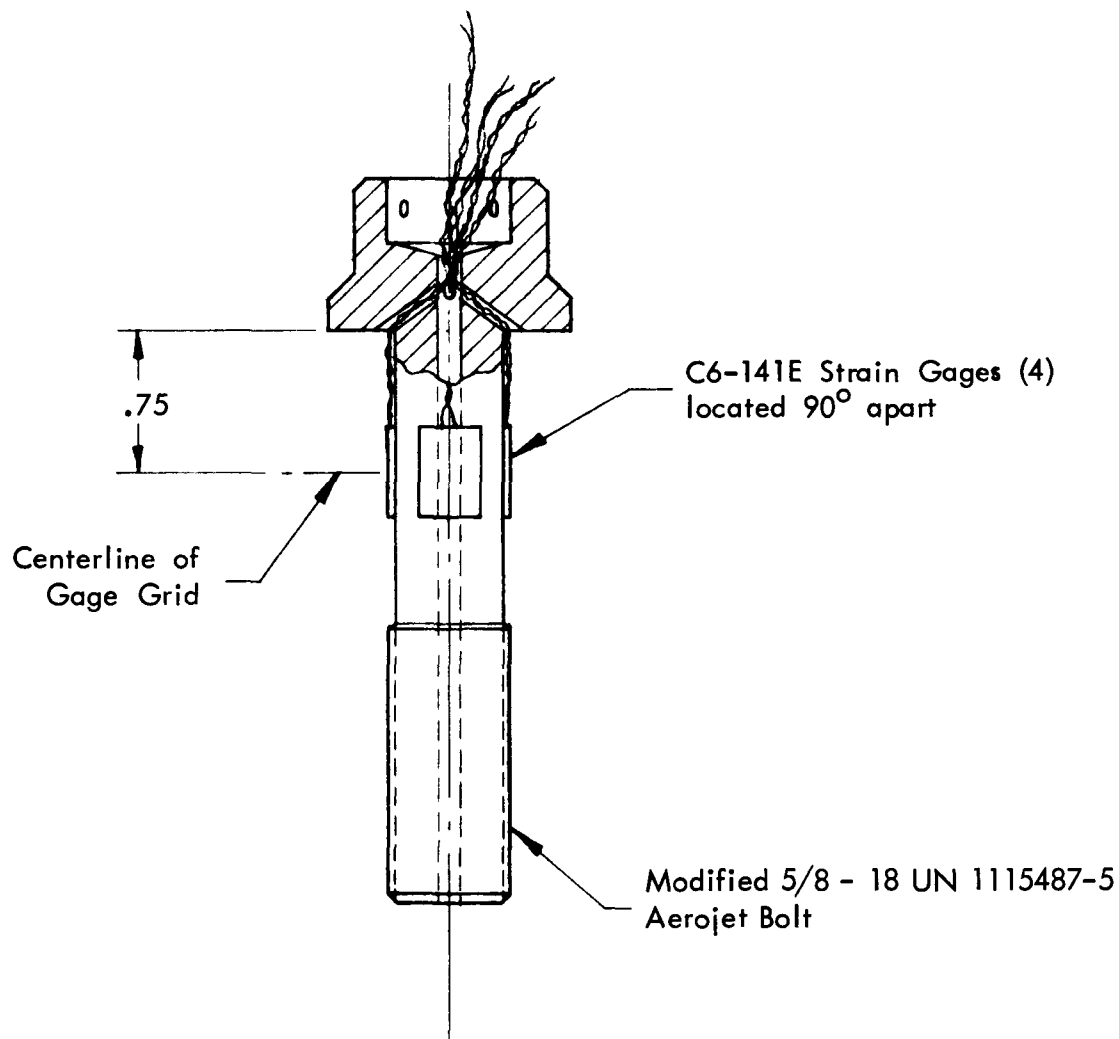


Figure 4. STRAIN GAGE INSTRUMENTATION ON MODIFIED NOZZLE BOLTS

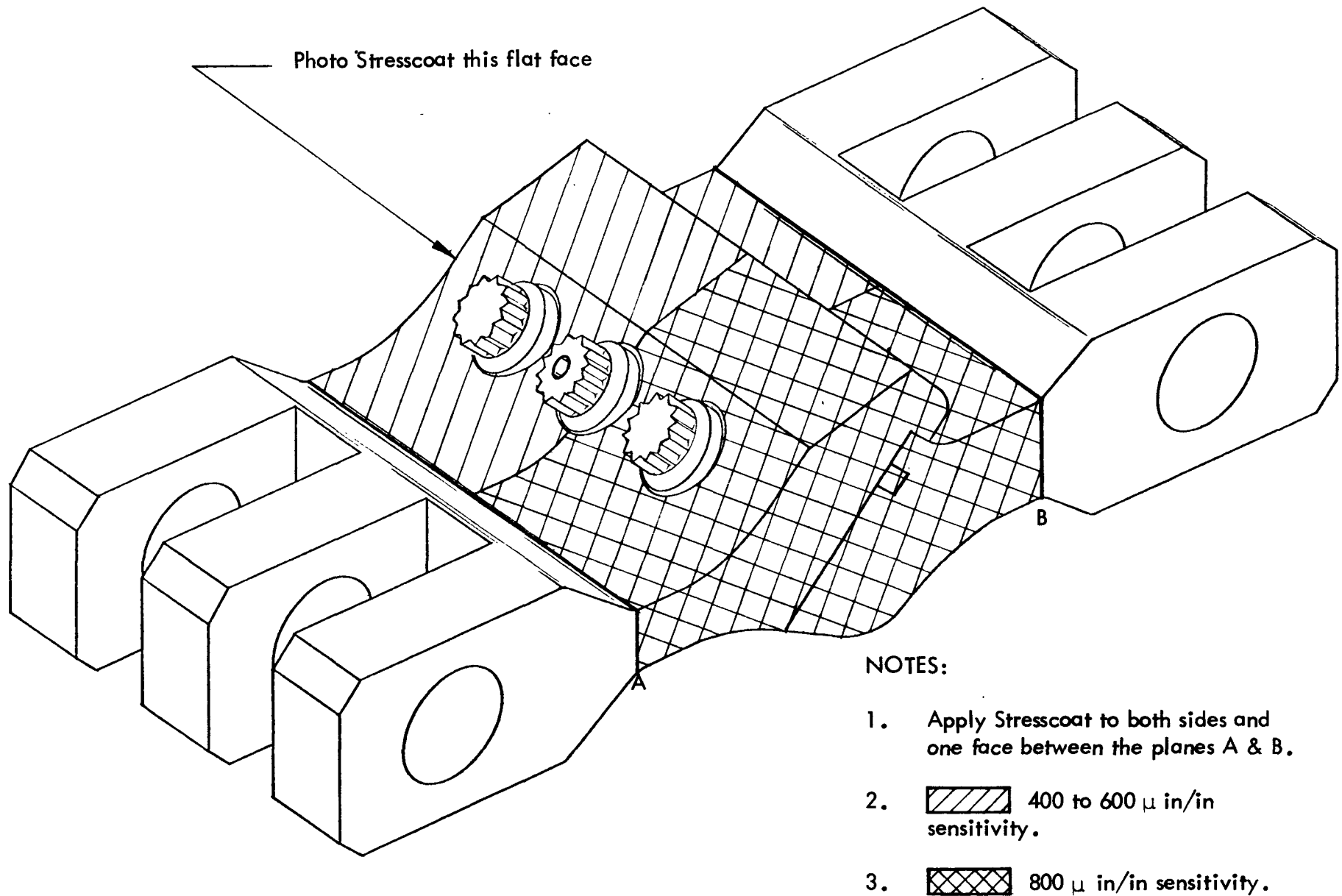


Figure 5. SKETCH OF AREA TO BE STRESSCOATED