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A jettisonable metallic shroud is utilized on the Titan/Centaur launch vehicle as a fairing to protect the payload and the Centaur stage from aerodynamic and thermal environments during launch and ascent. A series of tests were conducted to verify the structural capabilities of the shroud and to evaluate the structural interaction of the shroud with the Centaur stage. A flight configured shroud and the interfacing structural assemblies of the associated Centaur and Titan stages were subjected to a series of tests consisting of combinations of applied axial and shear loads to design ultimate values. One set of the tests included thermal conditions to verify localized strength capabilities of the shroud and of the forward structural ties to the Centaur. Two dynamic response tests were performed to verify the analytical stiffness model. The test series demonstrated the strength capabilities of the shroud and the interfacing Centaur and Titan flight configured assemblies at ultimate (125 percent of design limit) loads. The shroud design for ultimate load without forward structural ties to the Centaur was also verified. It was further verified that the spring rate of the flight configured shroud-to-Centaur forward structural deflections of the specimen became nonlinear, as expected, above limit load values. The data provided additional verification that the stiffness properties of the shroud and associated structures were adequately defined by the previous limit load test series. This test series qualification program verified that the Titan/Centaur shroud and the Centaur and Titan interface components are qualified structurally at design ultimate loads.

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SUMMARY

by C. W. Eastwood

A jettisonable metallic shroud is utilized on the Titan/Centaur launch vehicle as a fairing to protect the payload and the Centaur stage from aerodynamic and thermal environments during launch and ascent. A series of tests were conducted to verify the structural capabilities of the shroud and to evaluate the structural interaction of the shroud with the Centaur stage. A flight configured shroud and the interfacing structural assemblies of the associated Centaur and Titan stages were subjected to a series of tests consisting of combinations of applied axial and shear loads to design ultimate values. One set of the tests included thermal conditions to verify localized strength capabilities of the shroud and of the forward structural ties to the Centaur. Two dynamic response tests were performed to verify the analytical stiffness model.

The test series demonstrated the strength capabilities of the shroud and the interfacing Centaur and Titan flight configured assemblies at ulitmate (125 percent of design limit) loads. The shroud design for ultimate load without forward structural ties to the Centaur was also verified. It was further verified that the spring rate of the flight configured shroud-to-Centaur forward structural tie system was linear to ultimate load values. Structural deflections of the specimen became nonlinear, as expected, above limit load values. The data provided additional verification that the stiffness properties of the shroud and associated structures were adequately defined by the previous limit load test series.

This test series of the shroud qualification program verified that the Titan/Centaur shroud and the Centaur and Titan interface components are qualified structurally at design ultimate loads.

INTRODUCTION

by C. W. Eastwood

All spacecraft require some form of protection from weather and a thermally controlled environment during prelaunch operations. In addition, protection is required from aerodynamic and thermal environments during launch and ascent. These requirements are usually satisfied by a shroud or fairing attached to the forward end of the launch vehicle and enclosing the spacecraft. The shroud is jettisoned after the most adverse conditions are passed in the launch and ascent phase of flight.

In addition to spacecraft protection, launch vehicle upper stages utilizing cryogenic propellants require thermal insulation during prelaunch operations to prevent excessive propellant boiloff. Insulation is also required during ascent for protection from aerodynamic heating.

The Centaur upper stage vehicle, mated with the Titan IIIE booster (modified Titan IIID) was chosen to be the launch vehicle for the Viking spacecraft which is to orbit and soft land on the planet Mars in 1976. This Centaur vehicle is called the Centaur D-1T (reference 1).

The Centaur was the United States' first upper stage vehicle to use liquid hydrogen and liquid oxygen as propellants. As the upper stage for the Atlas booster, this combination has been the launch vehicle for Surveyor, Mariner, Pioneer, OAO, and a series of communication satellites.

The D-1A Centaur upper stage vehicle, using the Atlas as the booster stage, utilizes several shroud designs for spacecraft protection dictated by spacecraft size and mission requirements. Thermal protection for the Centaur vehicle during prelaunch and ascent is provided by jettisonable insulation panels.

The Viking spacecraft includes a bioshield that is larger than the inside diameter of the D-1A shroud designs. This meant that an increased diameter shroud would be required for spacecraft enclosure. A larger diameter shroud would also be heavier than existing shrouds. This increased diameter and weight attached to the forward end of the Centaur stage would tax its strength from aerodynamic loading during ascent. One possibility to enhance structural capability would be to make the Centaur tank heavier and redesign the present insulation panels to be capable of carrying structural loading. This, however, meant increased complexities and many modifications to existing designs.

Instead, a large shroud that would cover both the spacecraft and Centaur, and act as a structural member as well as incorporating insulation for Centaur's cryogenic propellant tanks, was conceived and studied. This was the design concept chosen and Lockheed Missiles and Space Company, Inc. (LMSC) was awarded the contract to design and build the shroud. This shroud for Titan/Centaur launch vehicles has been designated the Centaur Standard Shroud (CSS).

A test program consisting of the following three major series of tests was conducted at the Lewis Research Center's Plum Brook Station to qualify the CSS for flight:

1. Cryogenic unlatch tests to qualify the CSS insulation, gas purges, and jettison systems under cryogenic conditions (references 2 and 3).

2. Static structural tests to qualify the structural capabilities of the CSS, the interstage adapter (ISA), the forward bearing reactor (FBR) system, and the flight configured assembly with the Titan forward skirt.

3. Heated jettison tests at altitude conditions to qualify the CSS jettison system operation after experiencing simulated aerodynamic heating during ascent (references 4 and 5).

This report presents the results of the ultimate load phase of the static structural test series; the limit load phase was completed in July 1973 (reference 6). The ultimate load tests were conducted in May 1974, subsequent to the heated jettison test series. They were the final tests performed in the extensive qualification program. Axial and shear loads, to ultimate load values, were applied to the CSS with and without the FBR struts installed to demonstrate the ability of the CSS, ISA, and Titan forward skirt to withstand 125 percent of design limit loads. The limit load values are shown in Figure 1. The Centaur was tanked with liquid nitrogen (LN_2) for one of the static ultimate load tests to verify the structural integrity of the FBR system at low temperature.

The tests were performed with the active participation of General Dynamics Convair Division (GDC), the Centaur contractor; Lockheed Missiles and Space Company, Inc. (LMSC), the CSS contractor; and Martin Marietta Corporation (MMC), the Titan contractor. A test report has been prepared by each of the three contractors (references 7, 8, and 9) pertaining to the performance of the test specimen hardware furnished by them.

In addition, two dynamic response tests were performed on the CSS/Centaur structural system; one with and one without the FBR struts installed. The test specimen was deflected from the vertical by application of a shear load at the forward end and abruptly released to permit it to respond freely. The resulting data were used to verify the structural stiffness of the CSS/Centaur system as determined by the static limit load tests (reference 6).

TEST OBJECTIVES

The static ultimate load structural tests were performed last in the CSS Qualification Test Program because of the greater risk of premature failure. The specific objectives were as follows:

1. Demonstrate the structural integrity of the CSS, the D-1T interstage adapter, the FBR system, and the Titan forward skirt at 125 percent of design limit load (ultimate load).

2. Verify the spring rate of the FBR system, which includes the effects of the adjacent structures, when subjected to ultimate load.

3. Verify the CSS ultimate load design by demonstrating the ability of the CSS without the FBR struts installed to withstand 125 percent of the design limit loads.

4. Verify the CSS/Centaur stiffness properties, as determined in the static load testing, by dynamic response on the structure.

FACILITY AND TEST EQUIPMENT

by E. J. Cieslewicz, C. W. Eastwood, R. H. Fabik,
L. C. Gentile, J. L. Harrold, F. L. Manning

B-3 Facility

The CSS static ultimate load tests were conducted in the B-3 Test Facility located at NASA/Lewis Research Center's Plum Brook Station. The B-3 Facility is a tower structure 50 feet square and 200 feet high as shown in Figure 2. It contains a test area at level 3 which is 74 feet above the ground floor. The test area is approximately 24 feet by 36 feet with a working height of 100 feet. An overall view of the test configuration is shown in Figure 3. Moveable work platforms were installed in the test area for access to the test specimen. A 65 ton bridge crane serviced the test area and the ground level rail siding adjacent to the tower. The major components of the test specimen were subassembled and prepared for the test in a building remote from B-3 tower, but serviced by a Plum Brook Station rail line.

Test Fixtures

A base and a lower distribution fixture were used to support the test specimen and to react the applied test loads. At the forward end of the test CSS another distribution fixture was mounted, together with a load application fixture, to transmit the axial loads into the CSS. A strap and whiffletree assembly was used on the CSS conic section to apply the shear loads. For the Centaur branch of the specimen, shear loads were applied through a loading fixture attached to the forward structures. This fixture, by virtue of its 14,000 pound weight, also acted as a single value axial load on the Centaur branch.

In the dynamic response phase of the test series the forward load application fixture, the axial load cables, the shear load strap, and the Centur loading fixture were not installed. A cable and attachment fitting was connected directly to the load distribution fixture at the forward end of the CSS as a means to apply the displacement load.

Load Application System

The structural load application systems allowed each test load to be applied independently to build up a combined total load in any desired order. Axial loads are defined as loads acting aft to produce compression on the test specimen structures. Shear loads are defined as loads acting laterally to produce both shear and bending moments on the test specimen structures such that maximum compression is produced at a specified azimuth and maximum tension occurs diametrically opposite. Displacement loads are those required to deflect the test specimen prior to abrupt release of the load application force in the dynamic response tests.

The CSS axial load system was used to apply and maintain a compressive load on the CSS. The basic components were the load distribution and load application fixtures, whiffletree beams, and connecting cables to the four axial hydraulic load actuators. The whiffletree beams distributed the load more uniformly into the CSS load distribution fixture. The four axial loading actuators could simultaneously apply loads at either of two manually selected load application rates. The system provided loading and unloading only while the appropriate control was activated manually. An event marker for data reduction purposes was issued to the data system each time the load or unload controls were activated. The system included feedback control. A counterforce system was used to alleviate the tare weight of the CSS axial loading system prior to load application.

The CSS shear load system was used to develop bending moments on the CSS. The system included a linkage from the load application strap and whiffletree beam to the hydraulic actuator attached to the tower. The system was oriented for application of shear loads at the 150 degree azimuth. The assembly was counterbalanced so that the loading system exerted an insignificant tare force on the CSS prior to load application. The system control was similar to the one for the axial loading except that the position of the deflected test specimen assembly was the controlling parameter instead of the load application rate. Data markers also were issued in the same manner as for the axial system.

The displacement load for the dynamic response test was applied through the CSS load distribution fixture by the attached load cable and a hydraulic actuator which was mounted on the tower structure.

The tare weight of the Centaur loading fixture, as was previously mentioned, was the only axial load applied to the Centaur tank and payload support structures. A Centaur stretch assembly, which is described later, could be used to counterbalance this axial load for a no-load condition. The shear load system consisted of a cable assembly from the Centaur loading fixture to a hydraulic actuator attached to the tower structure. The cable passed through a non-flight type hole in the CSS at 330 degrees azimuth. Except for load magnitudes and rates, this system operated in the same manner as the CSS axial loading system.

Liquid Nitrogen and Inert Gas Systems

A cryogenic system supplied liquid nitrogen (LN_2) to the test vehicle. The LN_2 was pumped via insulated lines from ground level dewars to the Centaur fuel and oxidizer sump ports for the test performed with a cryogenic environment.

Inert gas systems supplied gaseous nitrogen and helium to the test specimen. Both gases were piped from storage cylinders adjacent to the B-3 tower. The gases were used for Centaur tank pressurization, test specimen compartment purging, and facility systems operation.

Centaur Tank Protection Systems

A system of servo-operated valves and pressure relief valves was connected to each of the Centaur tanks. These systems maintained the tank pressures at the desired levels throughout the tests. A facility vent system was used instead of the flight system for the oxidizer (LO_2) tank. The LO_2 vent line and the fill line had sufficient flexibility to permit the Centaur aft bulkhead to move 2.0 inches laterally during testing. There were two vent systems on the fuel (LH_2) tank. The flight LH_2 vent system was connected to a 6-inch vent line in the facility. This vent was used during the initial tank fill operation. An 8-inch facility vent system was connected to a flange on the forward door of the LH_2 tank and was sized to accommodate a large boiloff should the CSS insulation system be damaged. The facility vent line was flexible enough to allow the Centaur forward bulkhead to move 4.0 inches laterally and 1.5 inches axially. The top of the CSS could move 20.0 inches laterally without interfering with the vent line. A facility system based on Centaur tank differential pressure was used to protect the intermediate bulkhead between the oxidizer and fuel tanks. By use of pressure transducers and an automatic control system, the necessary tank pressure differential was maintained.

Another protection system for the Centaur tank, which is not self-supporting when depressurized, was a Centaur stretch system. This system consisted of a cable sling assembly connected to an actuator that was attached to the tower structure. The sling was connected to the forward end of the Centaur loading fixture. Activation of the actuator exerted sufficient force to counterbalance the load application fixture and all hardware mounted on the forward end of the Centaur tank and, in addition, support the weight of the tank. This system was required if the tank should lose pressure or when it was purposely depressurized. Also, the system could be controlled to counterbalance the tare weight of the Centaur loading fixture only, when that load was not required in a test.

Camera Systems

A single frame camera was used to record the CSS and forward seal (Figure 3) deflections at discrete steps. This camera and its lighting system was activated manually for each frame. Three TV cameras were used to provide general views of the test hardware during the tests.

Instrumentation Transducers

Several types of instrumentation transducers were used to provide test data. A brief description of each type is given below. For more details of the test instrumentation, see Appendix A.

Strain Gages - Uniaxial, biaxial (Poisson), and three-element rosette types of strain gages were used in this test program. The uniaxial gages were used with temperature compensating tab mounted dummy gages, as were each of the rosette elements. Each biaxial gage was arranged in its electrical bridge circuit to be temperature compensated. Approximately 170 strain gages were used in the total test series. A maximum of 83 were used for any single test.

Deflectometers - Deflections of the test specimen were measured with rotary potentimetric transducers of various ranges. A total of 105 deflectometers were used in the test series with a maximum of 49 connected for any one test. The B-3 facility tower deflections were measured with a NASA developed system which tracked a laser light source with a two-axis photo detector.

Pressure Transducers - Most of the approximately 42 pressure measurements were made by standard eight-wire strain gage transducers. Both absolute and differential types were used. Special low temperature calibrations were employed where appropriate.

Temperature Transducers - Temperatures were measured with thermocouple and platinum resistance transducers. Platinum types were used where maximum accuracy was required. The chromal-constantan thermocouples provided low volume, low mass, and low heat transfer. Approximately seven temperature measurements were made for these tests.

Accelerometers - The vibration measurements for the dynamic response test were made with strain gage type accelerometers. A total of eight accelerometers were used.

Load Cells - Load measurements were made with standard strain gage type load cells. A total of seven measurement locations were required. However, a maximum of six locations were used for any one test configuration.

Liquid Level Probes - The three liquid level probes were capacitance type. The main LO_2 and LH_2 tank probes were standard coaxial types. The LH_2 tank ullage probe was a NASA designed double coaxial type. This design provided the additional accuracy and sensitivity required for heat transfer studies.

Signal Conditioning and Data Recording

The outputs from the various transducers were conditioned at the B-3 Facility and transmitted in digital form to the data building for further processing. All signal conditioner outputs were routed to a patchboard. This arrangement allowed interconnection flexibility from the signal conditioners to the digital data recorder, the FM recorder, the light beam oscillographs, the strip chart recorders and the panel meters. It provided also for input and output connection of amplifiers, where required. The data for these tests were recorded in digital form on magnetic tape using a 400 channel multiplexer at the B-3 tower and the central recording system at the data building. The data were recorded at a rate of 2,500 data points per second. This gave sample rates per channel of about six data points per second. High response data such as vibration were recorded on FM and light beam oscillographs. Ink type strip chart recorders were used to display certain critical parameters. Time was recorded on all recorders to provide precise time correlation.

Data Display and Reduction Systems

The data display system allowed immediate visual analysis of test data in engineering units. Data were displayed in real time in tabular and graphic forms on Cathode Ray Tube (CRT) displays. The display controller regulated three keyboard/CRT units and provided printouts on a remote digital plotter. Remote pushbutton print commands caused the program to print the associated CRT image on the remote plotter and generate, upon request, plots of selected parameters.

The magnetic tapes containing the primary data from each test were processed using a pre-programmed data retrieval program. This program was designed to retrieve preselected parameters and specific test events. The program outputs were zero-corrected (pretest zero offsets were removed from the data), averaged and smoothed. The data reduction and calibration program converted the stored signals into appropriate engineering units. These values were, in turn, printed as post-test digital data listings and data plots.

Test Control, Abort, and Alarm Systems

The test control, abort, and alarm systemsconsisted of a digital computer and its output relay system, an abort monitor system, a minicomputer alarm system, and a loading and positioning system which also included an analog computer ramp generating and error detection sub-system.

The digital computer allowed the test load application and positioning system to be operated manually as long as the abort limits were not violated. The minicomputer processed the multiplexed data and exhibited on television screens those channels which exceeded the alarm limits. Once an abort limit was exceeded, as determined by the abort monitor, the manual loading capability was deactivated by the digital computer and the abort sequence was performed. Essentially it activated all hydraulic load cylinder fail-safe systems. The fail-safe feature prevented the hydraulic cylinders from developing any force by closing the hydraulic pressure supply and venting the load cylinders to the hydraulic reservoir. Also, relief valves were on each cylinder and in the circuit at all times for use in case the other devices failed. Differential pressure relief valves were included in the load cylinder hydraulic circuits for redundant protection.

The ramp rate and direction command switches provided slow, medium (CSS shear only), and fast; increase and decrease; and hold. The ramp generator produced a signal which was linear with respect to time and was used as the load rate or position command. This command signal was prevented from exceeding a predetermined maximum level by the maximum command limiter, which also prevented the command signal from drifting with time. The zero command limiter prevented the command signal from going negative.

The primary purpose for the error abort system was to detect control loop failure before a maximum load abort was reached. The system was used for both the load rate controlled loops (axial load and payload shear) and the position controlled loop (CSS shear). The system used for the CSS shear also incorporated a maximum load limit detector.

The analog computer was also used to generate a marker pulse every two percent of applied load. This pulse was recorded by the digital recording system and used in the data plotting program to limit the reduced data to 100 points (50 on the increasing load ramp and 50 on the decreasing load ramp).

TEST SPECIMEN CONFIGURATION

By R. T. Barrett, C. W. Eastwood, R. C. Edwards,
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The test specimen for the CSS ultimate load structural tests consisted of the following major items and systems:

1. A CSS with all pertinent bolt-on hardware and the tank section insulation installed.

2. A Centaur tank with stub adapter, equipment module, truss adapter, FBR system, forward seal, aft seal, hydrogen vent disconnect system, and other hardware which interfaces with the CSS to configure the Centaur to a D-1T vehicle.

3. Centaur interstage adapter.

4. Titan forward skirt.

The overall test configuration and assembly of this specimen in the Plum Brook B-3 Facility is shown in Figure 3. Vehicle stations shown in the figure and referred to throughout this report are Centaur/CSS station designations. The interface of the Titan skirt and the ISA is Station 2127.43 and the forward terminus of the Centaur/CSS test assembly is Station 2882.25.

The test specimen was the same assembly which was previously used in the CSS cryogenic unlatch test (reference 2), limit load structural test (reference 6), and heated altitude jettison test (reference 4). As a result the specimen had been subjected to many functional operations and structural loadings prior to the ultimate load testing. Inspection of the specimen performed before the ultimate load tests did not indicate any distortion or degradation of the specimen from the earlier testing.

Structurally significant differences between the test specimen configuration and the flight hardware for the first Titan/Centaur flight (Proof Flight) are listed in Appendix B. A brief description of the CSS, Centaur structures, interstage adapter, and Titan skirt follows.

Centaur Standard Shroud (CSS)

The Centaur Standard Shroud (CSS) encloses both the Centaur and the spacecraft, and provides environmental protection for both while on the ground and in flight. The CSS general configuration is shown in Figure 4. The cylindrical portion of the CSS is 14 feet in diameter. Total CSS length is 58 feet.

The payload section (forward of Station 2514.00) is a biconic/cylindrical configuration approximately 31 feet long. The nose dome is made from stainless steel, but was not installed for the structural tests. The two conical sections forward of Station 2680.66 are of magnesium semimonocoque construction reinforced by internal rings. The cylindrical section between the Stations 2514.00 and 2680.66 is of aluminum semimonocoque construction with corrugated outer skin and smooth inner skin weld-bonded together and riveted to internal rings. Attached to the internal rings in the biconic and cylindrical sections are fiberglass insulation blankets (these fiberglass blankets were not installed for these tests).

The equipment section, from Station 2459.14 to Station 2514.00 allows access to hardware on the Centaur equipment module through doors in the CSS structure. This section is of the same construction as the cylindrical portion of the payload section.

The forward bearing reaction system between the CSS and the Centaur at Station 2459.14 reduces CSS/Centaur relative deflections through load sharing during launch and ascent. This reaction path is released in flight after maximum aerodynamic loading by a pyrotechnic system that severs the FBR struts which retract to stowed positions on the Centaur and the CSS.

The tank section of the CSS from Station 2241.78 to 2459.14 encloses the Centaur LH_2 tank. It is also of aluminum semimonocoque, corrugated construction with reinforcing internal rings. The annular space between the CSS and the Centaur is isolated from the other compartments of the CSS by the aft and forward seals at Stations 2241.78 and 2459.14. This annular volume is purged with gaseous helium during prelaunch operations to prevent the formation of frozen air. Fiberglass insulation attached to internal rings in this section of the CSS provides insulation for the Centaur LH_2 tank.

The boattail section of the CSS is from Station 2180.48 to 2241.78. It contains the aft circumferential separation joint, jettison hinges, and the interface to the Centaur interstage adapter. The section forward of Station 2209.00 is of the same construction as the tank section of the CSS. The section aft of Station 2209.00 is of riveted aluminum ring-skin-stringer construction.

The two halves of the CSS are joined along a longitudinal separation joint. Each half also is joined to the fixed aft part of the shroud along the circumferential separation joint at Station 2211.80.

At jettison, all separation joints are severed by a noncontaminating pyrotechnic system. Eight main springs (four per half) mounted longitudinally at the aft end of the cylindrical section of the CSS force the two halves to rotate about hinges and jettison. Four smaller springs (two at the nose dome and two at the equipment section) mounted laterally between the halves assist in the initial separation. Two hinges for each half are mounted at the aft circumferential separation plane. The conical section of the boattail is bolted to the Centaur interstage adapter which is jettisoned with the Titan Stage. The separation and jettison systems were not actuated during this test series.

Centaur Structures

The Centaur test specimen structures consisted of the basic propellant tank assembly, stub adapter, equipment module, and truss adapter. Other Centaur D-1T systems not necessary for the conduct of the tests, such as propulsion, pneumatic, and propellant feed systems, were not installed.

Centaur Tank - The Centaur tank assembly used was a flight-weight tank of the "D" series configuration. The basic tank configuration and dimensions are shown in Figure 5. The tank assembly is made of type -301 stainless steel and is a completely monocoque structure requiring internal pressure for structural strength. A double-walled bulkhead separates the forward liquid hydrogen tank from the aft liquid oxygen tank.

The Centaur tank assembly was not tested to ultimate conditions in this program. It was included in the specimen stack-up primarily as a support for the forward structures and as a container for the liquid nitrogen (LN_2) during the thermal phase of the test series.

Stub Adapter - The stub adapter shown in Figure 3 is a cylindrical structure 25 inches in height and 120 inches in diameter and is mounted on the forward end of the Centaur tank. The adapter as used on the Titan/Centaur vehicle consists of titanium skin and stringers reinforced by aluminum rings.

Equipment Module - The Centaur equipment module (Figure 3) is a truncated conical aluminum structure 30 inches in height. The diameter of the base, which is attached to the stub adapter, is 120 inches; the diameter of the forward end is 60 inches. The construction of the equipment module is skin/stringer with reinforcing rings.

Truss Adapter - The Centaur truss adapter (Figure 3) is 120 inches in diameter and 49 inches in height. It consists of 24 aluminum tubular struts equally spaced around the circumference. The struts were attached to 12 fittings located on the aft end of the Centaur loading fixture and to 12 fittings located on the forward end of the stub adapter. The wall thickness of the struts used in the test assembly were slightly below the design minimum value. However, the assembly was not a qualification item in the test program and was not subjected to full load. It was primarily acting as a spacer to support the Centaur loading fixture.

CSS/Centaur Bolt-ons

Forward Bearing Reaction System - The CSS/Centaur FBR system provides load sharing and limits the relative deflection between the CSS and the Centaur vehicle during flight until the vehicle has passed through the period of significant aerodynamic loading (approximately 100 seconds after lift-off). The system is located at Station 2459.14 and consists of six spring loaded double action struts. The major structural components of the struts are aluminum. Figures 6 and 7 illustrate the FBR system and details of the strut installation. The spring rate of the system (19,000 lbs/in) is compatible with the relative stiffnesses of the CSS and the Centaur in order to prevent overloading the Centaur and yet maintain payload-to-CSS clearances at acceptable levels. Conical steel washers are utilized to produce the required spring rate in tension and compression (Figure 8).

Separation of the FBR struts is accomplished by redundant explosive bolts. Following bolt separation, the strut halves are retracted against the CSS by a spring loaded retractor and against the Centaur stub adapter by a tension spring. Non-explosive bolts were used in this test series since the separation system was not actuated.

Forward Seal and Release System - The forward seal, illustrated in Figure 9, is located at Station 2454 between the CSS and Centaur stub adapter. The seal consists of a silicone rubberized dacron fabric attached to the stub adapter by bolts and retained on the CSS forward bulkhead by a cable and retaining mechanism. A 5/16-inch diameter segmented teflon bead on the outboard edge of the seal holds the seal under the cable. A bolt with redundant explosive cartridges is employed to release the seal. This is the same bolt design used for the FBR separation. Two bolts, one at each split line, are attached to the seal retaining cable. When the bolts separate, the cable tension is relaxed and the seal releases. For this test series the release system was not activated and non-explosive bolts were employed.

LH_2 Vent Fin Disconnect - The LH_2 vent disconnect is an extendable duct connection between the fixed vent nozzle on the Centaur tank vent duct and the vent fin duct on the CSS. The function of the vent disconnect is to accommodate the differential motion between the tank and the CSS during prelaunch and boost flight phase. It also provides a release mechanism to disconnect the vent fin duct from the fixed vent nozzles at CSS jettison. The LH_2 vent system configuration is illustrated in Figure 10. The design is a telescoping tube section with the inboard end attached to the vent nozzle and the outboard end attached to the CSS mounted vent fin duct fitting by means of spherical ball joints. The disconnect mechanism is engaged by extension of the telescoping tubes to the full free length of travel as limited by internal stops. Release of the disconnect can be accomplished in one of two modes during CSS jettison. In the primary mode a continued pull on the disconnect in the bottomed-out condition shears two pins in the assembly. Shearing the pins permits release of the latching lugs and disconnection of the assembly from the vent nozzle. The secondary mode is used if the pins fail to shear. In this mode the continued outward pull on the vent disconnect forceably pulls the telescoping duct assembly off the vent nozzle by bending the latching lugs. The latching lugs are designed to bend in this manner at a load slightly above that required to shear the pins. The vent disconnect detailed design is shown in Figure 11.

Interstage Adapter

The Centaur interstage adapter is the structure that provides the interface between the Centaur tank, CSS, and Titan forward skirt. The D-1T ISA is a 113-inch long structural spacer between the forward end of the Titan skirt and the aft end of the Centaur vehicle. It also supports the CSS through an external ring flange at Station 2180.48. It is an all-aluminum sheet and stringer structure with 10 circular rings. At the aft end there are 72 external hat section stringers. Thirty-six internal fittings are included in the aft bay of the ISA to match up with the Titan skirt 36 internal longerons. Each longeron has two bolts, for a total of 72 interface bolts. A bearing pad fits between the rings at each longeron connection to ensure controlled load distribution on the Titan skirt ring.

Titan Forward Skirt

The Titan forward skirt (Figure 3) is the most forward section of the Titan booster vehicle. It is a 10-foot diameter, 76-inch long aluminum structure of ring reinforced skin and stringer construction. The face of the forward ring flange (Station 2127.43) is the interface plane between the Titan booster vehicle and the face of the aft flange of the ISA section of the Centaur upper stage vehicle. A Titan guidance equipment truss is mounted in the forward end of the Titan forward skirt.

TESTS PERFORMED

by C. W. Eastwood

Because of the nature of the tests (ultimate loading) and the danger of structural failure of the test specimen under such conditions, only a select few tests were planned. All were conducted satisfactorily and consisted of three groups, not including preliminary runs at low level loads to exercise and settle the test hardware assemblies. The numerical designations (except those of the dynamic response series) were based on the similarity of the test conditions to those of the limit load tests in reference 6. The chronological order of the tests was not associated with the numerical designation but was arranged for structural strength considerations and priority of objectives. A summary of the tests as performed is presented in Table I.

TEST RESULTS

by R. T. Barrett, C. W. Eastwood, R. C. Edwards, R. P. Miller,
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CSS Structural Strength

The stresses developed in the CSS structure were determined by strain gage instrumentation. These measurements were concentrated in regions of low margins of safety and in areas where analytical stress predictions are less certain because of the redundant nature of the load paths in the highly complex structure. The strain gage locations are illustrated in Figure 12. Most of the gages were installed in back-to-back pair configuration to measure local bending effects as well as axial stresses. Others were mounted to measure the circumferential stresses in the biaxial stress field that exists in the aft cone/cylinder boattail of the CSS. Typical strain gage installations are shown in Figure 13. More detailed instrumentation information is given in Appendix A. The stress data from the two tests (3E and 7E-2A) which loaded the CSS most highly are summarized in Appendix C.

Tests 7E-2A and 7E-2B - The 7E series of tests were performed to demonstrate the structural integrity of the CSS, FBR system, ISA, and Titan skirt at design ultimate loads. These tests also provided data to evaluate the load distribution (sharing) between the Centaur vehicle and the CSS structure. Two methods were used in evaluating the load distribution: (1) an analytical calculation based on the measured FBR load resultants, and (2) direct stress measurements in the aft cone/cylinder ~~boattail~~ region of the CSS. The analytical method indicated,— for equally applied CSS transverse shear loads, the calculated loads in the CSS boattail region were 77 percent of the values obtained without the FBR system. A direct comparison of the boattail region limit load stress measurements for Tests 3L (reference 6) and 3E with 7E shows that the 7E test stresses varied from 63 to 82 percent of those obtained from Tests 3L and 3E (without FBR). A review of the 7E test data and an examination of the test hardware did not reveal any yielding or permanent set in the structure from the application of ultimate transverse shear loads. The maximum measured stress was 53,000 psi compression at Station 2213 and 161 degree azimuth. This value is below the material allowable compressive yield stress of 56,000 psi.

Test 3E - An analysis of the data from the gages located on the corrugations and longerons forward of Station 2264 indicated excellent correlation with predicted values for applied load distribution in the CSS structure. A comparison of the actual stress measurements with the predicted values shows a range of 0.99 to 1.11. Also, the test results for this region show a linear relationship for the stresses from zero load to the ultimate load level. This can be attributed to the relatively low level resultant stresses. The maximum values did not exceed 18,000 psi, which is well below the yield allowable of 56,000 psi.

An evaluation of the circumferential separation joint stresses in the maximum load azimuth region was primarily directed towards the resolution of the structural response for this complex structure. The forward and aft ring flange structures, adjacent to the Super-Zip frangible doublers, were designed as "plastic hinges" to relieve excessive local bending moment rotation in the doublers. Consequently, the high indicated stress levels from Test 3E are not correct above the material yield point of 56,000 psi, because of plastic bending effects.

The tensile load azimuth (330 degree) of the structure responded in a very predictable manner. The stress magnitudes were generally linear with application of the transverse shear load. The maximum level observed during the test occurred on the inner surface of the Station 2209 ring flange at the 341 degree azimuth. The maximum indicated tensile value of 55,000 psi is below the allowable tensile yield of 58,000 psi.

The ring flange structure stress measurements observed on the compressive azimuth (150 degree) shows both an erratic behavior and a non-linear response to the applied shear load. This phenomenon can be attributed to the load path shift to stable regions as the ring flanges yield. The lateral displacements of the rings are sensitive to the manner and location of the permanent set distribution with a consequential non-linear load-displacement response. The combination of the two effects resulted in complicated plots of stresses versus applied loads.

The detonator block opening regions (Station 2211, 0 and 180 degree azimuth) are considered the most likely "weak link" in the CSS structure due to the high bending deformations of the ring flanges which support the circumferential separation joint frangible doublers. An examination of the hardware after the final test revealed that the outer frangible doubler was deformed outboard approximately 0.015 inches at the edge of the detonator block opening (180 degree). Approximately six inches from the opening there was no deformation in the doubler (Figure 14). The strain gage data confirmed this situation by the substantial residual stresses remaining in this region after the test. The character of the permanent deformation response observed was not unexpected but was fully anticipated.

Strain gage instrumentation, which simulated the type used on the CSS for the Titan/Centaur Proof Flight (TC-1) and was planned for the Helios A flight (TC-2), was mounted on the test specimen. The purpose of the flight simulated structural instruments was to verify the correlation developed in the limit load test series (reference 6) and between the test specimen and flight data. Other strain gages, that were installed on the ISA, also simulated flight instruments but at different locations. The data from these ISA instruments were for verification of the extrapolation method used to determine bending moments at other stations on the structures. The strain gage locations are shown in Figure 15.

The bending moment calculated from the CSS strain gage data was 18.8 x 10^6 inch-pounds at Station 2294. This differed from the applied bending moment of 17.6 x 10^6 inch-pounds by 7 percent which was within the ± 10 percent accuracy of the system. Thus, the correction factor to be used with the measured moments to obtain values equal to the applied moments is 0.94 which compares with 0.99 in the limit load tests (reference 6).

Axial loads calculated from the CSS strain gage data exceeded the actual applied loads by 57 percent. In the limit load tests (reference 6) the loads calculated from the measured data were less than the applied loads by 59 percent. The explanation of these large discrepancies is the small portion of the total strain that the axial loading created. The percent-full-scale instrument error was a large part of the instrument reading in the axial portion of the strains developed.

The bending moments calculated from the ISA strain data were used to plot a moment diagram for the CSS/Centaur/ISA structures. Moments from this diagram for other stations were within ±10 percent of the applied moment values. This was within the accuracy of the method developed in the limit load test and established a greater degree of confidence in using the method with flight data.

CSS Stiffness Properties

The assembled test specimen was instrumented to provide flexibility data for each structural system independent of the others, such as the CSS, ISA, Titan skirt, Centaur and the FBR system. This was accomplished by defining the lateral translation and cross sectional plane rotation at the interface between the various systems. The instrumentation plan for measuring the deflections to determine these parameters is shown in Figure 16. Detailed instrumentation information is given in Appendix A.

The primary deflection data were obtained from Test 7E-2A and Test 3E that generated the largest deflections for the configurations with and without the FBR struts installed respectively. All deflection data presented have been corrected for plane rotation and translation effects aft of the base of the Titan skirt. This data correction eliminates deflection effects contributed by the aft test fixture and base and is equivalent to a fixed-end test condition at Station 2050.

The lateral deflection of the test assembly under ultimate design load with the FBR system active is shown in Figure 17. This data is compared with 125 percent of the deflection obtained in the static limit load test series (reference 6). The data indicates non-linear deflection above the limit load value, as expected. Figure 18 presents similar data for the configuration with the FBR system not installed. The relative motion or clearance loss between the CSS and the simulated payload at Station 2626 is 4.7 inches without the FBR struts. With the FBR system installed, the clearance loss is 2.3 inches.

Shear load versus lateral deflection of assembly at Station 2680 with FBR struts is shown in Figure 19. The data indicates reasonable linearity. However, a change in slope is apparent at approximately 20,000 pounds of shear load. Corresponding data for the test without the FBR struts is shown in Figure 20. This data indicates a significant deviation from linear response at the higher load values.

The data presented in Figure 21 compares the deflection versus shear load of CSS without the FBR struts to data obtained in the CSS limit load testing. Also compared are the expected values based upon analytical models. The data indicate good correlation with the limit test data and with predictions based upon the analytical model for dynamic analysis. The analytical model for static load is based upon the most extreme displacement obtained at higher loads in the limit load tests on a totally unexercised structure. It is utilized for conservative assessment of the quasi-static portion of the flight air loads.

Figure 22 shows the lateral displacement of the Centaur structures at Station 2464 (with displacements aft of Station 2177 zeroed out) versus FBR system load. The data agree with the results of the limit load tests indicating non-linear response for FBR system loads to approximately the 6,000 pound value. The upper load region is relatively linear providing a slope about 15 percent less than the analytical model.

From the data presented in Figures 17 and 18 it can be seen that the flexibility of the test assembly is influenced to a large extent by the rotation of the boattail section. Figure 23 shows the bending rotation of the boattail at Station 2209 versus shear load values and compares it to predicted response. The predicted values are in good agreement with test values except at loads above limit values where the test results become non-linear. A residual rotation of about 7 percent of the maximum value indicates some yielding or permanent set.

The limit load testing conducted on the CSS and associated structures revealed varying stiffness properties as shear load was applied to limit values alternately in diametrically opposite directions. It was evident that the structure undergoes hardening as repeated loads are applied in the same direction, resulting in increased stiffness. When loading is reversed, the opposite phenomenon occurs. For the first loading in the opposite direction, the system exhibits significantly lower stiffness. Therefore, to insure that the analytical stiffness model of the CSS/ISA/Centaur structure would allow realistic analysis of transient responses expected from flight events, the CSS dynamic response tests were conducted. The test setup and instrumentation is shown in Figure 24.

The lateral displacement and acceleration responses for the system with and without the FBR system are compared with predicted values in Figures 25, 26, 27, and 28. The predicted values were determined with standard modal analysis techniques utilizing the mass and stiffness properties of the CSS, Centaur, ISA, and Titan skirt as they are currently represented in the flight type mathematical models. Damping of 4 percent was used in the first mode and 1 percent in higher modes. The data in the figures present the response of the structure at various stations and indicate good agreement with predictions. In some instances the higher frequency content of the predicted values exceeds the test values. This is attributed to the relatively low damping used for the analytical higher modes.

The first two natural frequencies of oscillation, predicted and test values, are as follows:

	With FBR Frequency (Hz)		Without FBR Frequency (Hz)	
Mode	Test	Predicted	Test	Predicted
1	2.28	2.18	2.16	2.07
2	11.25	10.79	9.60	9.23

The frequency data shows good correlation between the predicted and test values.

Deflection data from the real time monitoring system are included in Appendix D.

Centaur Structures

Truss Adapter - The Centaur truss adapter structure was not a component to be qualified in this test series. The maximum load applied to an individual strut was less than 90 percent of the strut allowable compressive load. In test 7E-1, maximum loads of 13,500 pounds axial and 13,000 pounds lateral shear with the associated bending moment were applied. At the completion of testing, no structural damage or yielding of the truss structure was noted. Very small values of strut bending were indicated by the test data. Compressive forces were measured in the two struts that were instrumented; one strut at 240 degrees azimuth was at a point of high shear load and small axial load and the second strut at 330 degrees azimuth was at a point of low shear and large axial load.

Since the loading into the truss adapter was applied through a very stiff loading fixture, the loading that the individual struts sustained would only be indicative for missions with this type of payload support. A summary of loads sustained by the forward end of the truss adapter is as follows:

Shear load, lbs.	Bending moment, in-lbs.	Bending equivalent axial load, lbs.	Compressive axial load lbs.	Total equivalent compressive axial load, lbs.
13,000	1.52×10^6	±50,700	13,500	64,200

Stub Adapter - The stub adapter was not a component to be qualified in this test series. It was subjected to shear, axial, and bending loads applied through the Centaur truss adapter and forward bearing reaction system. Neither crush nor burst pressure was imposed on the stub adapter. However, in test 7E-2B the FBR system supports on the stub adapter were subjected to ultimate loading.

A summary of the loads sustained by the forward end of the stub adapter is as follows:

Truss adapter shear load, lbs.	Forward bearing shear load, lbs.	Bending moment in-lbs.	Bending equivalent axial load, lbs.	Compressive axial load, lbs.	Total equivalent compressive axial load, lbs.
+13,000	- 5,800	2,160,000	±72,000	13,500	85,500
0	-23,200	0	0	13,500	13,500
+ 6,000	-25,000	990,000	±33,000	13,500	46,500

The magnitude of stress recorded in an instrumented stringer indicated the stub adapter satisfactorily distributed the concentrated load of the truss adapter struts.

Strain gage rosettes located on the skin in the forward bay of the stub adapter did not exhibit consistent behavior. This was probably due to their proximity to the concentrated loadings from the truss adapter struts and the struts of the forward bearing reaction system.

The stub adapter satisfactorily distributed the axial and shear loading with no permanent deformation or structural degradation.

Equipment Module - The equipment module structure was not instrumented for this series of testing. No loads were directly applied to this component.

Centaur Bolt-ons

Forward Bearing Reaction System - During test 7E-2B the FBR system was subjected to a 25,000 pound ultimate system design load. The spring rate of the system as shown by Figure 29 was 18,700 lbs/in and remained constant during load application. The system provided the proper stiffness between the CSS and the Centaur vehicle.

The FBR system loads and the individual strut loads were determined by strain gages mounted inside the struts as shown in Figure 8. The FBR struts were individually calibrated to determine the load versus strain relationship and to verify the strut spring rate of 6,500 lbs/in. A typical spring rate calibration is shown in Figure 30.

The individual struts were designed to 10,000 pounds ultimate load. Maximum individual strut loads during testing were 10,207 pounds compression and 11,535 pounds tension. Post-test inspection verified that no damage or yielding occurred in any strut or attaching hardware during testing.

Forward Seal and Release System - The forward seal retention cable loads were monitored throughout the 7E test series to determine whether loads vary significantly over extended periods of time and during the various phases of testing. Load cells mounted at the ends of each cable were used for this evaluation. Table II lists the cable loads during the 7E tests and indicates the variation in load was less than 10 percent.

LH_2 Vent Disconnect - For the 7E test series, with the forward bearing reaction, the LH_2 vent disconnects were installed. The maximum excursion between the CSS and Centaur at the disconnect was 1.30 inches when the FBR load was 25,000 pounds. Post-test inspection verified that the disconnect telescoping mechanism functioned properly and that the disconnect had not disengaged. The telescoping stroke in the nominally installed position is approximately ±2.0 inches and is adequate.

Interstage Adapter

Test 7E-2A and 7E-2B - The ISA stresses during the 7E test series were very comparable in values. The highest stress indicated was 24,000 psi compression on gage 4838S and was less than 50 percent of either the stringer yield allowable or buckling allowable.

Strain gages were installed on the diagonal of the ISA shroud boattail support ring as indicated in Figure 31. The gages indicate bending stresses primarily, but the levels reached only 28 percent of material yield.

Test 3E - In test 3E, without the FBR struts installed and, therefore, without load sharing, the bending stresses in the diagonal of the CSS boattail support ring exceeded the yield allowable but not the ultimate of the 2219-T852 material. However, post-test inspection of this ring did not detect any visible yielding. All other gage readings were below yield levels.

Titan Skirt

These tests resulted in application of the ultimate equivalent compressive axial load to the Titan skirt/ISA interface at Station 2127.43, as shown in Table II. Loads not demonstrated in these tests were (1) ultimate collapse pressure and (2) ultimate thermal barrier loads. However, analysis has shown that the structure is capable of withstanding a combination of these loads coupled with ultimate equivalent axial load. The stresses recorded during the tests were always less than those predicted by analysis.

Figures 32 through 41 present digital stress data versus percent limit equivalent axial load for each strain gage location on the Titan skirt. Plots of predicted stresses along with plots of limit load stresses previously reported from test 3L in reference 6 are shown for comparison purposes. The predicted stresses were determined by extrapolating limit load test data from test 3L in reference 6. The test results presented in this section verify that the Titan skirt in combination with the ISA met the test objectives.

CONCLUSION

The static ultimate load tests verified the CSS design by demonstrating the ability of the structure to withstand ultimate (125 percent limit) loads without the FBR struts installed. The CSS, ISA, Titan skirt, and FBR system, in flight configuration (with the FBR struts installed), will sustain design ultimate aerodynamic loads with the Centaur at cryogenic temperature.

The FBR spring rate was shown to be constant for loads on the flight configured structure to design ultimate values.

Regions around the detonator block openings at Station 2211, at 0 and 180 degree azimuths, were confirmed to be potentially the weakest areas in the CSS structure.

The deflection data from the ultimate load tests verify that the limit load test data adequately define the stiffness properties of the CSS and associated structures.

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6. Eastwood, C. W.: Centaur Standard Shroud (CSS) Static Limit Load Structural Tests. NASA TM X-71727, 1975.

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8. Simson, S. C.: Static Structural Test Evaluation, Centaur Standard Shroud Engineering Evaluation Tests. LMSC-D422774, Lockheed Missiles and Space Co. (NAS3-13503), 1974.

9. Zishka, W.: Ultimate Load Structural Test of the Titan III E Stage II Forward Oxidizer Skirt. MCR-73-266, Martin Marietta Co., 1973.

TABLE I SUMMARY OF TESTS PERFORMED

Test No.	Test date	FBR struts installed	FBR developed load, lbs	LN_2 in Centaur, lbs	CSS axial load, lbs	Centaur axial load, lbs	Total axial load at stn 2127, lbs	CSS shear load, lbs	Centaur shear load, lbs	Total equivalent axial load at station 2127.43, lbs.
(a) DR 1	4-8-74	No	-	0	No fixture	0	(b) N/A	10,550 at 150° azim.	0 0	276,000
DR 2	4-9-74	Yes	N/A	0	No fixture	0	N/A	10,480 at 150° azim.	0	274,000
7E-1	5-9-74	Yes	5,298	59,500	19,500	13,500	103,400	1,575 at 150° azim.	12,980 at 330° azim.	286,400
7E-2A (c)	5-10-74	Yes	23,430	59,500	41,500	13,500	125,400	46,275 at 150° azim.	0	1,084,700
7E-2B	5-10-74	Yes	24,954	59,500	41,500	13,500	125,400	45,675 at 150° azim. (d)	5,960 at 330° azim.	980,200
3E	5-15-74	No	-	0	101,000	13,500	125,400	45,924 at 150° azim. (d)	0	1,079,000

(a) DR = Dynamic Response Test E = Ultimate Load Test

(b) Includes specimen weight of 10,900 lbs.

(c) Aborted immediately subsequent to CSS maximum shear load application and prior to Centaur shear load application.

(d) 46,000+ observed on real time data monitor screen.

TABLE II. FORWARD SEAL CABLE LOADS

TIME & EVENT	CABLE LOADS-POUNDS Azimuth 1°	Azimuth 179°	Azimuth 359°	Azimuth 181°
5/9/74, After Installation	870	930	750	1130
5/10/74, 8:55 AM Prior to Tanking	870	930	750	1130
5/10/74, 9:55 AM LN_2 Tanking	870	930	750	1130
5/10/74, 11:30 AM LH_2 Tanking	915	870	780	1080
5/10/74, 11:55 AM LH_2 Tanking	915	870	780	1080
5/10/74, 1:15 PM Tanking Complete	915	855	765	1080
5/10/74, 7E-2 Max P/L Shear	942	855	780	1080
5/10/74, 7E-2 Max CSS Shear	900	840	750	1040
5/10/74, 7E-2 Max FBR Shear	930	840	750	1010
5/13/74, 11:00 AM Post-test	840	860	700	1030
MAX VARIATION	4%	8%	7%	10%

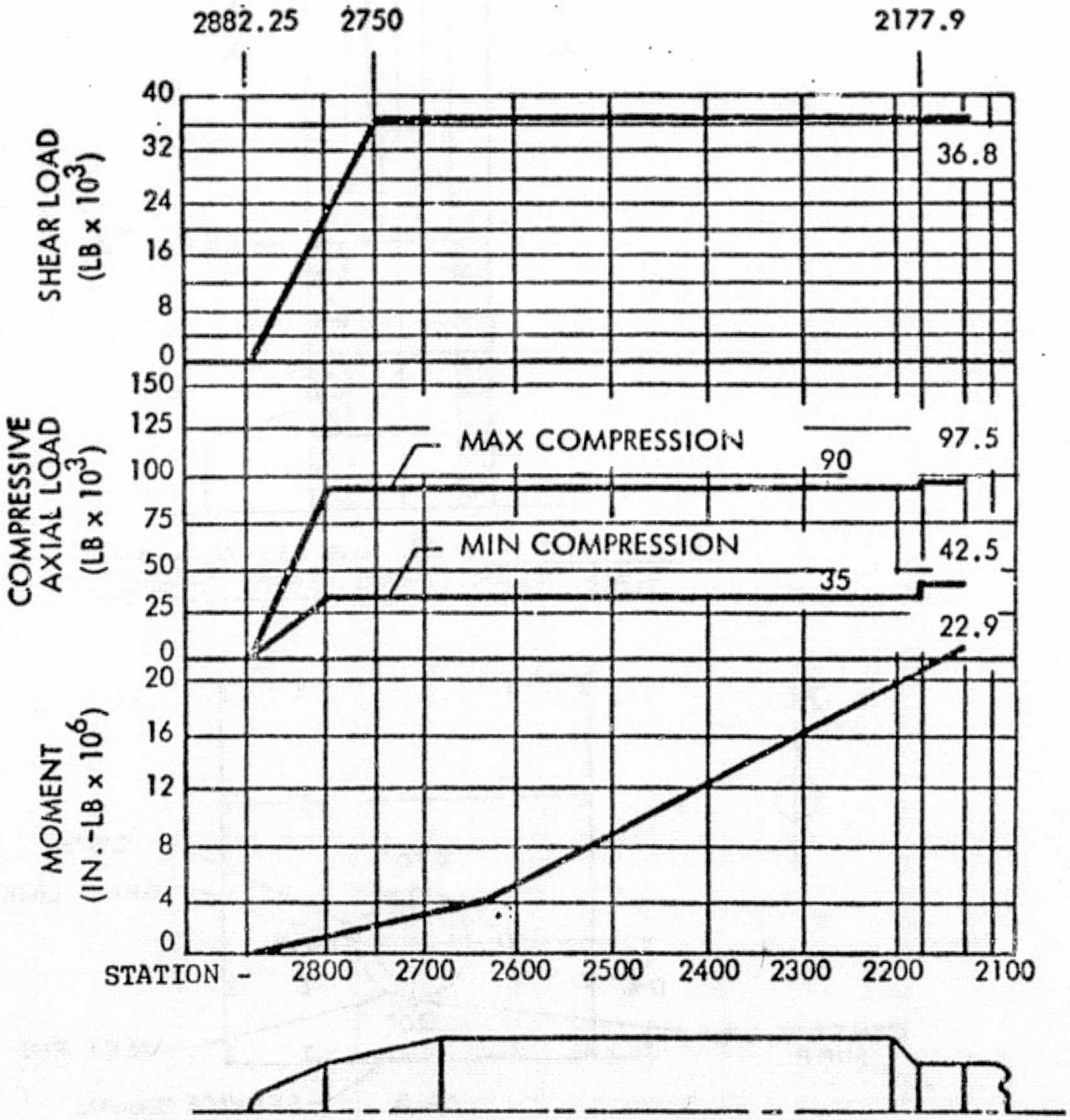
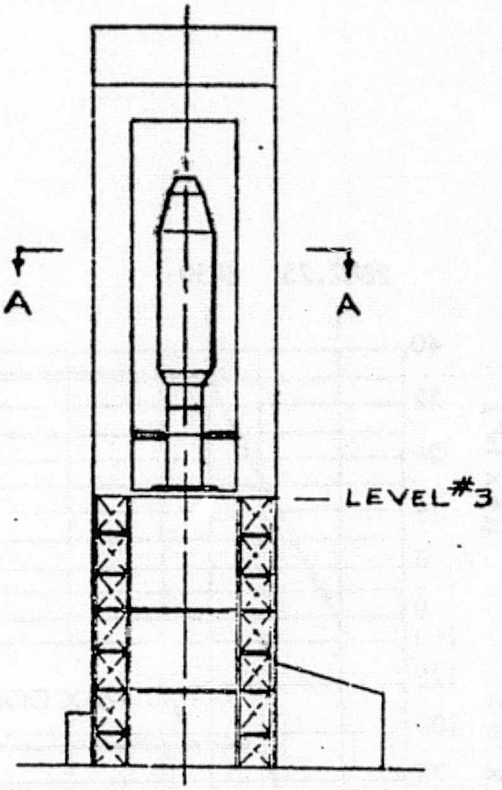
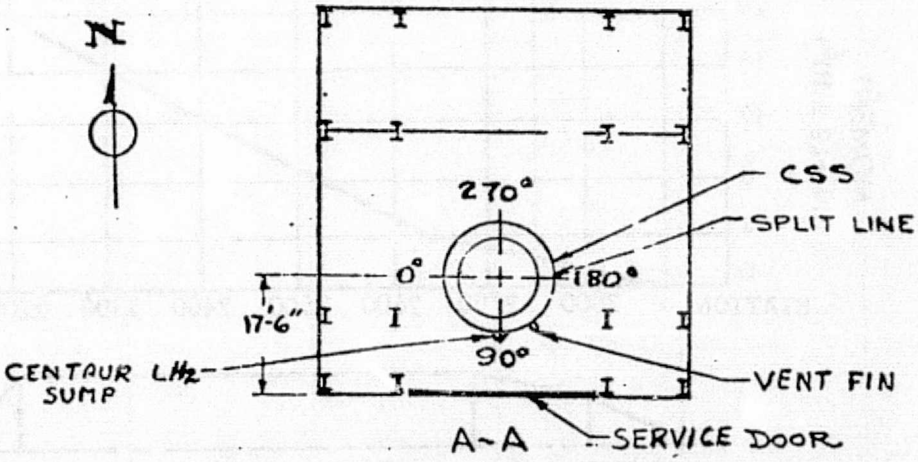


FIGURE 1. CSS DESIGN LIMIT AXIAL, SHEAR, AND MOMENT LOADS



ELEVATION VIEW OF B-3 WITH CSS SEEN THRU OPEN DOOR



PLAN VIEW OF B-3 (ENLARGED)

FIGURE 2. B-3 FACILITY TOWER STRUCTURE.

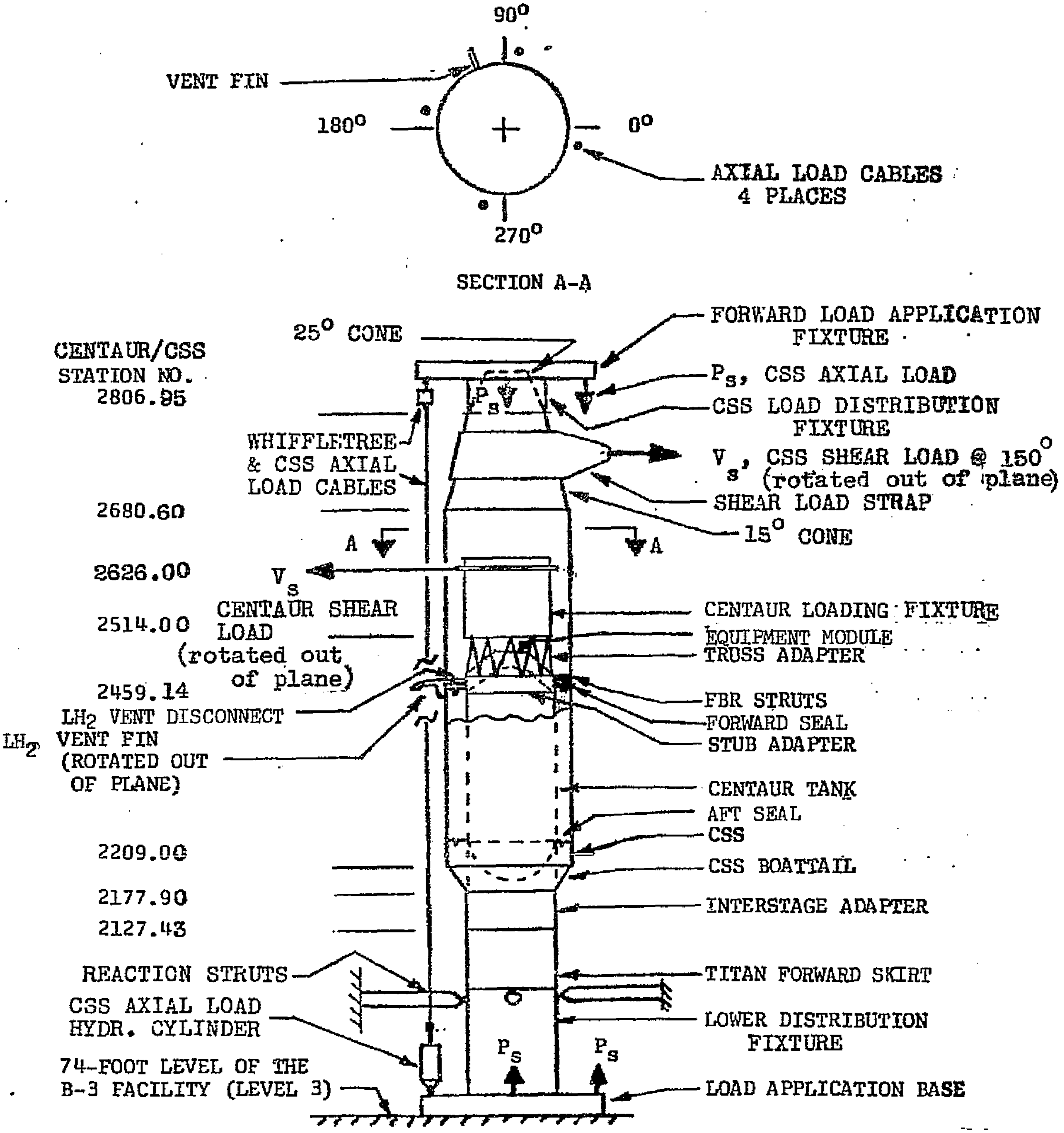


FIGURE 3. TYPICAL TEST CONFIGURATION FOR CSS ULTIMATE LOAD TESTS.

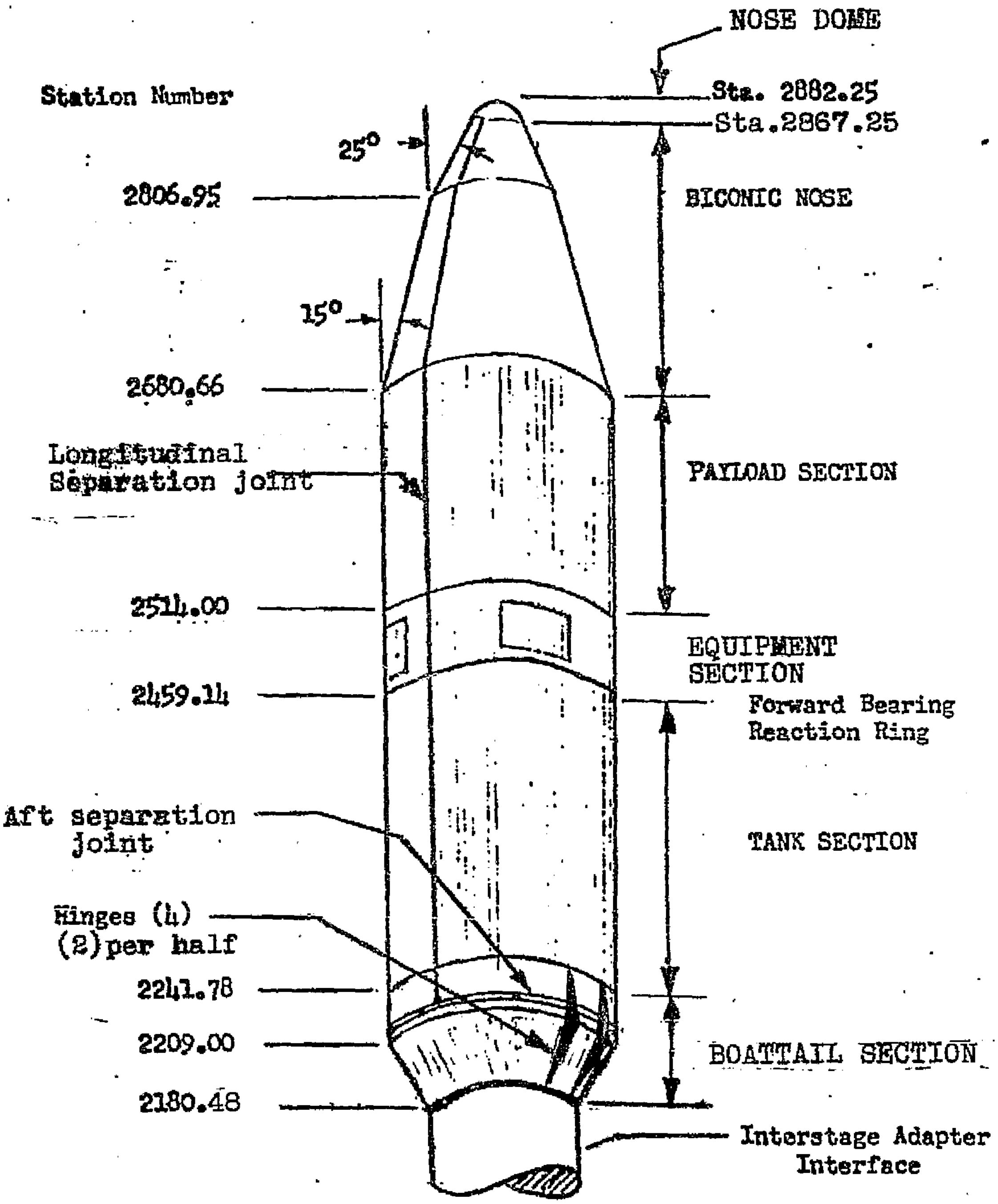


FIGURE 4. CENTAUR STANDARD SHROUD (CSS) GENERAL CONFIGURATION

STAINLESS STEEL WELDED CONSTRUCTION; SKIN THICKNESS, 0.013 TO 0.026; PRESSURE STABILIZED STRUCTURE; MODIFIED FORWARD BULKHEAD

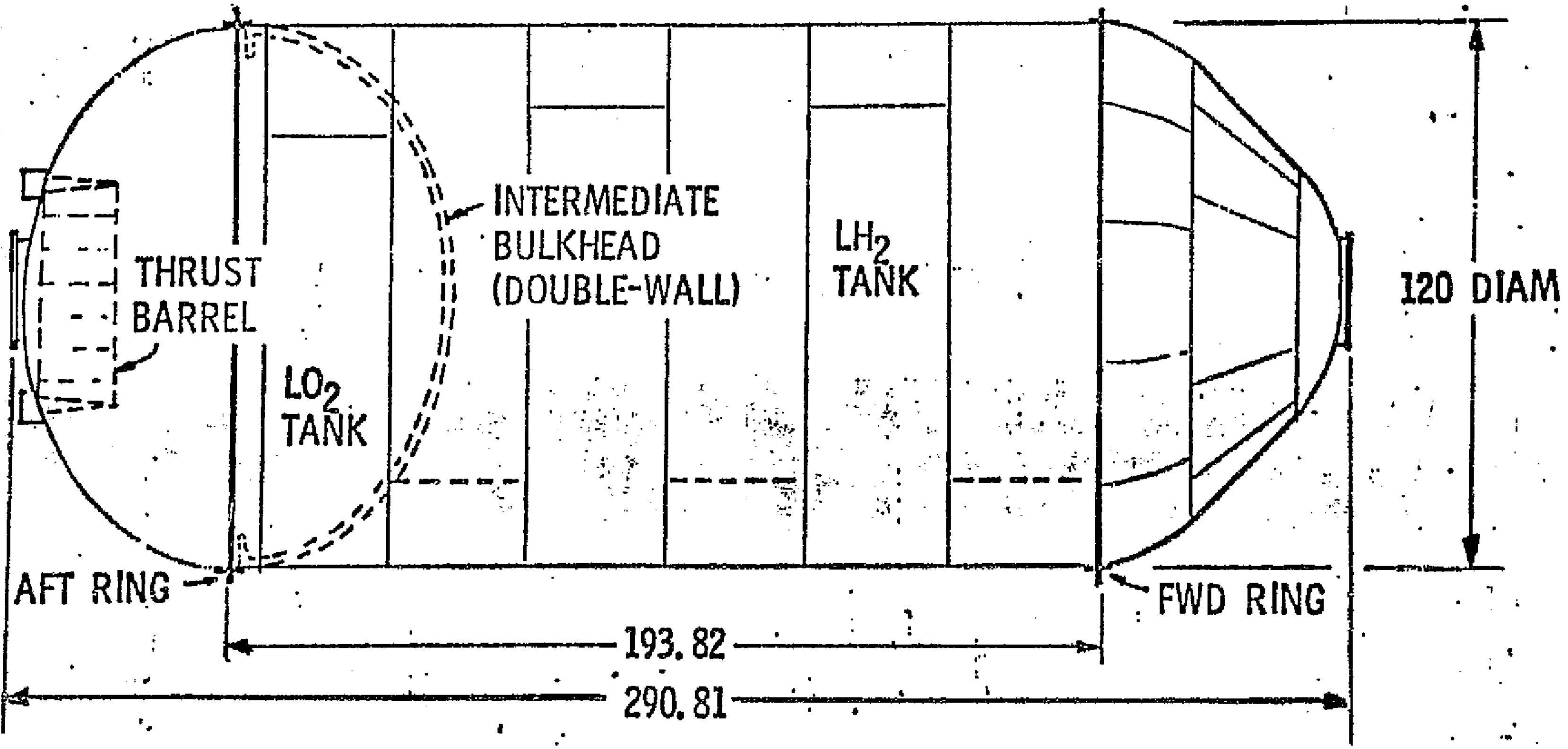


FIGURE 5. CENTAUR PROPELLANT TANK CONFIGURATION

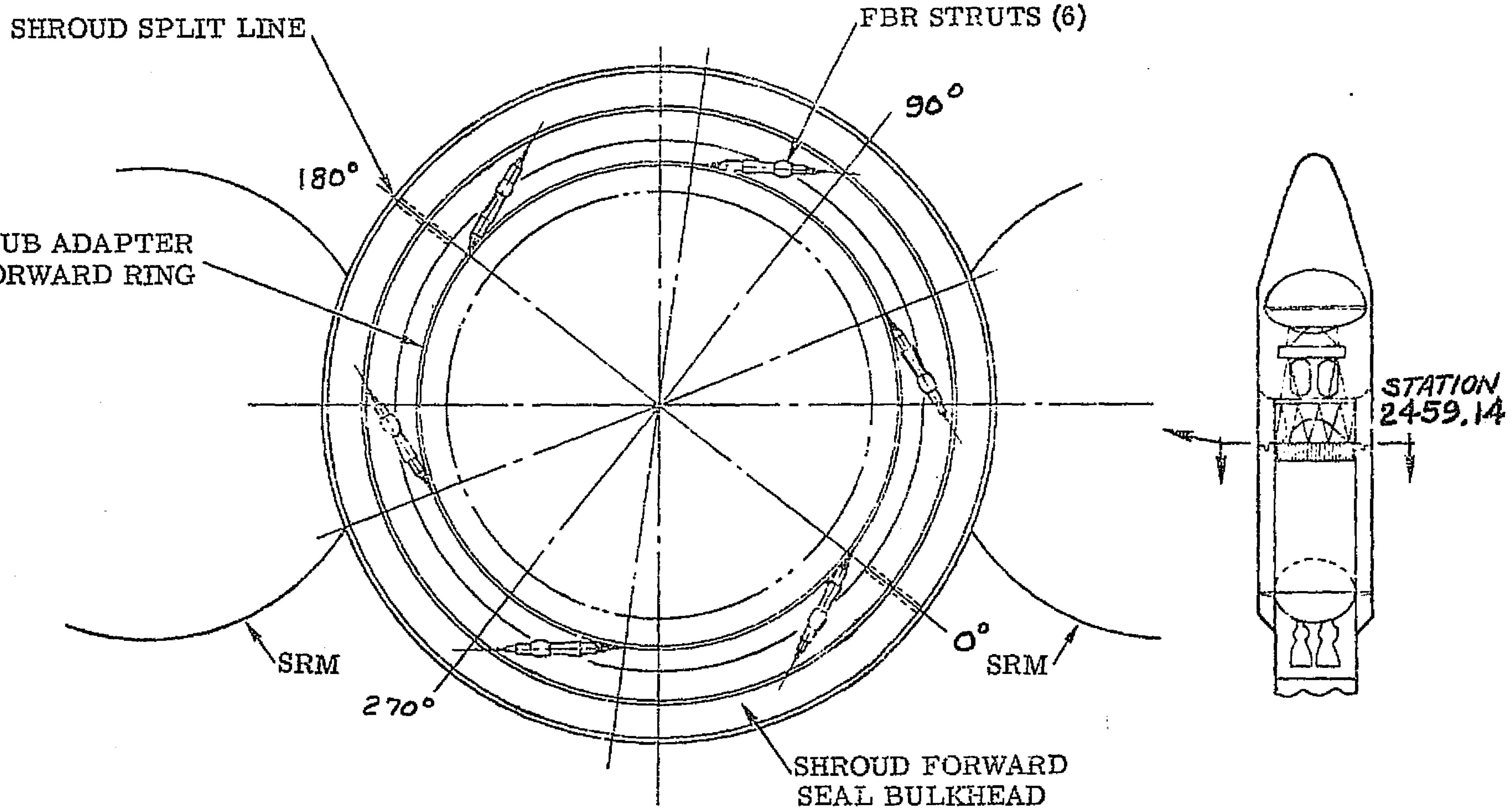


FIGURE 6. FORWARD BEARING REACTOR SYSTEM.

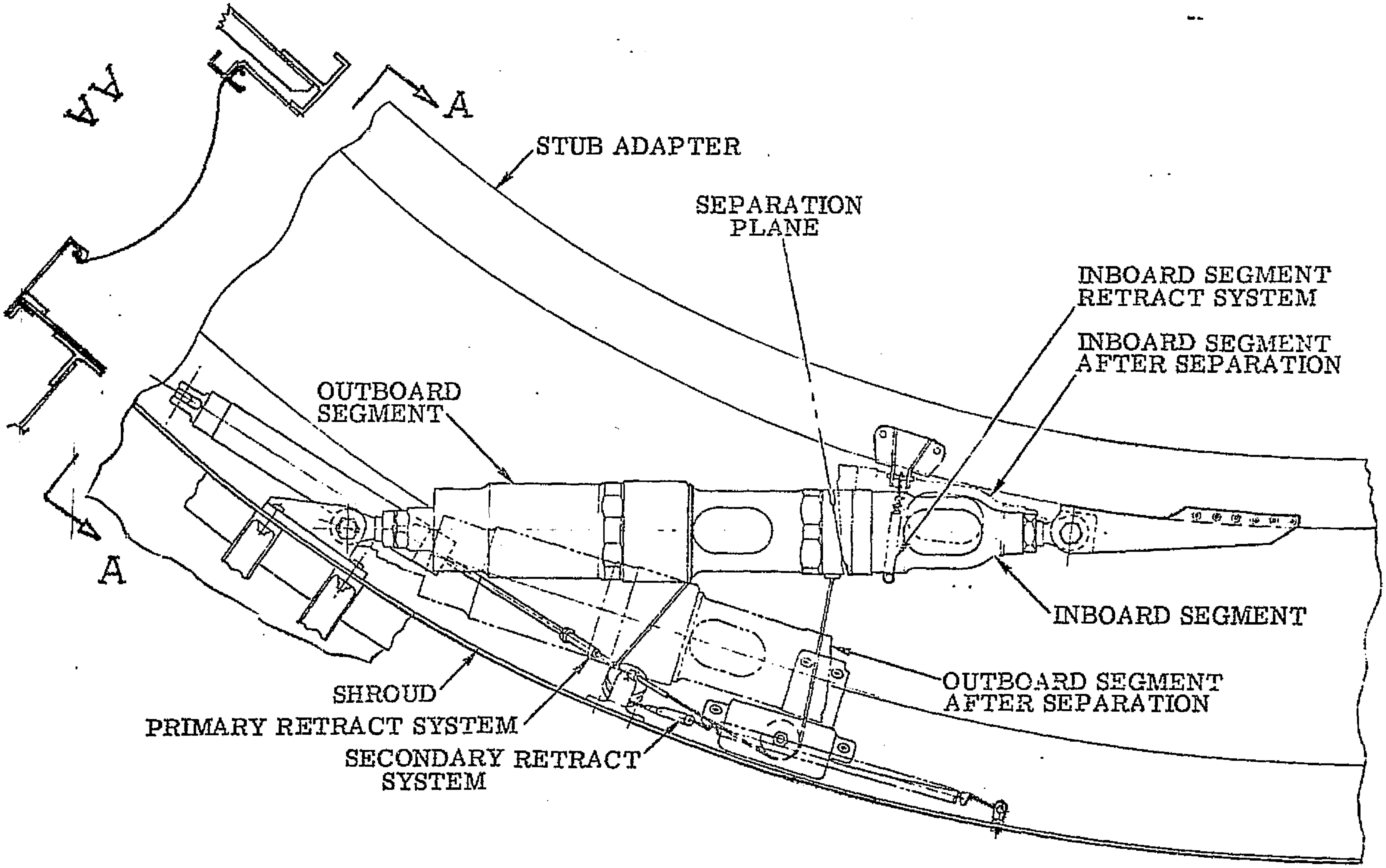


FIGURE 7. FORWARD BEARING REACTOR STRUT INSTALLATION.

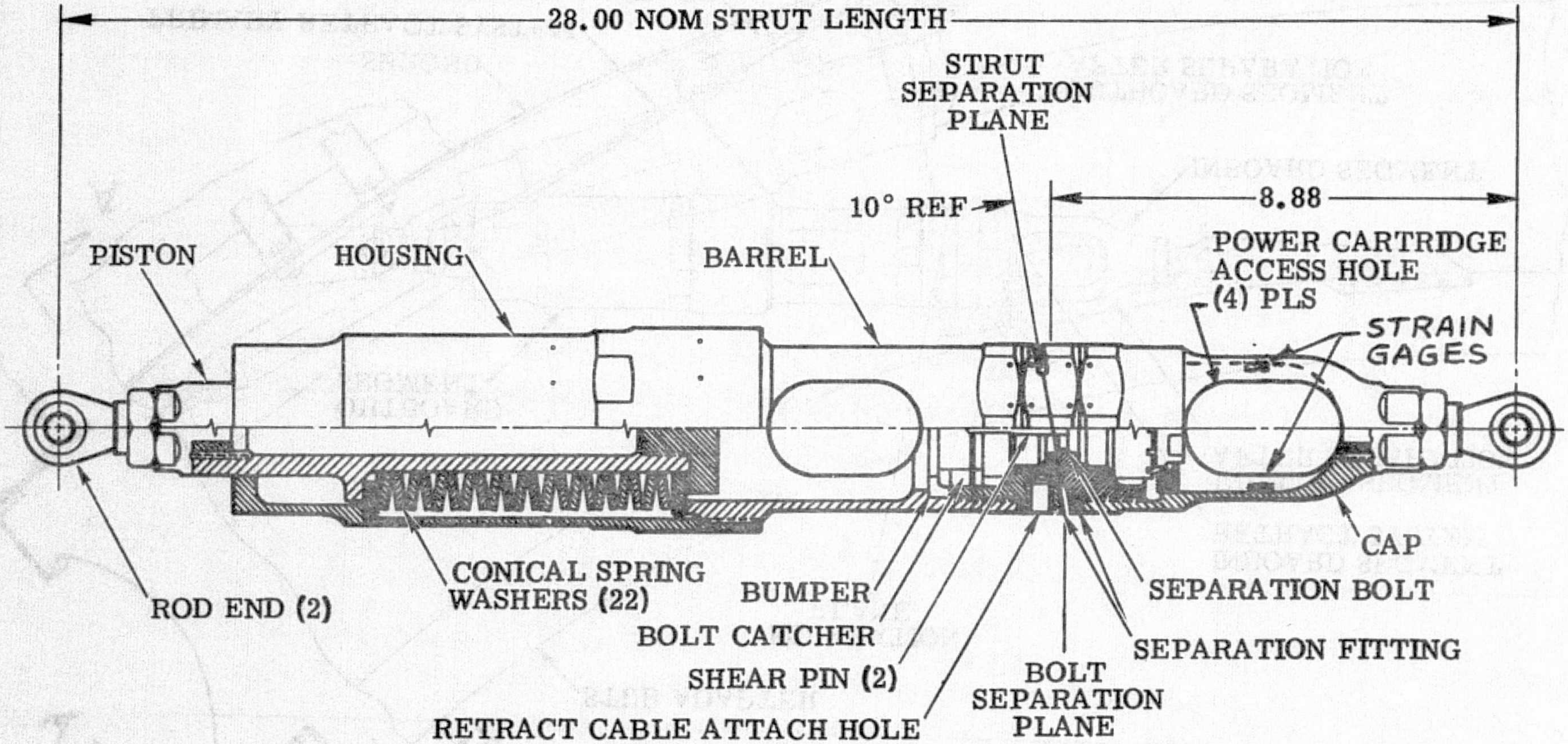


FIGURE 8. FORWARD BEARING REACTOR STRUT.

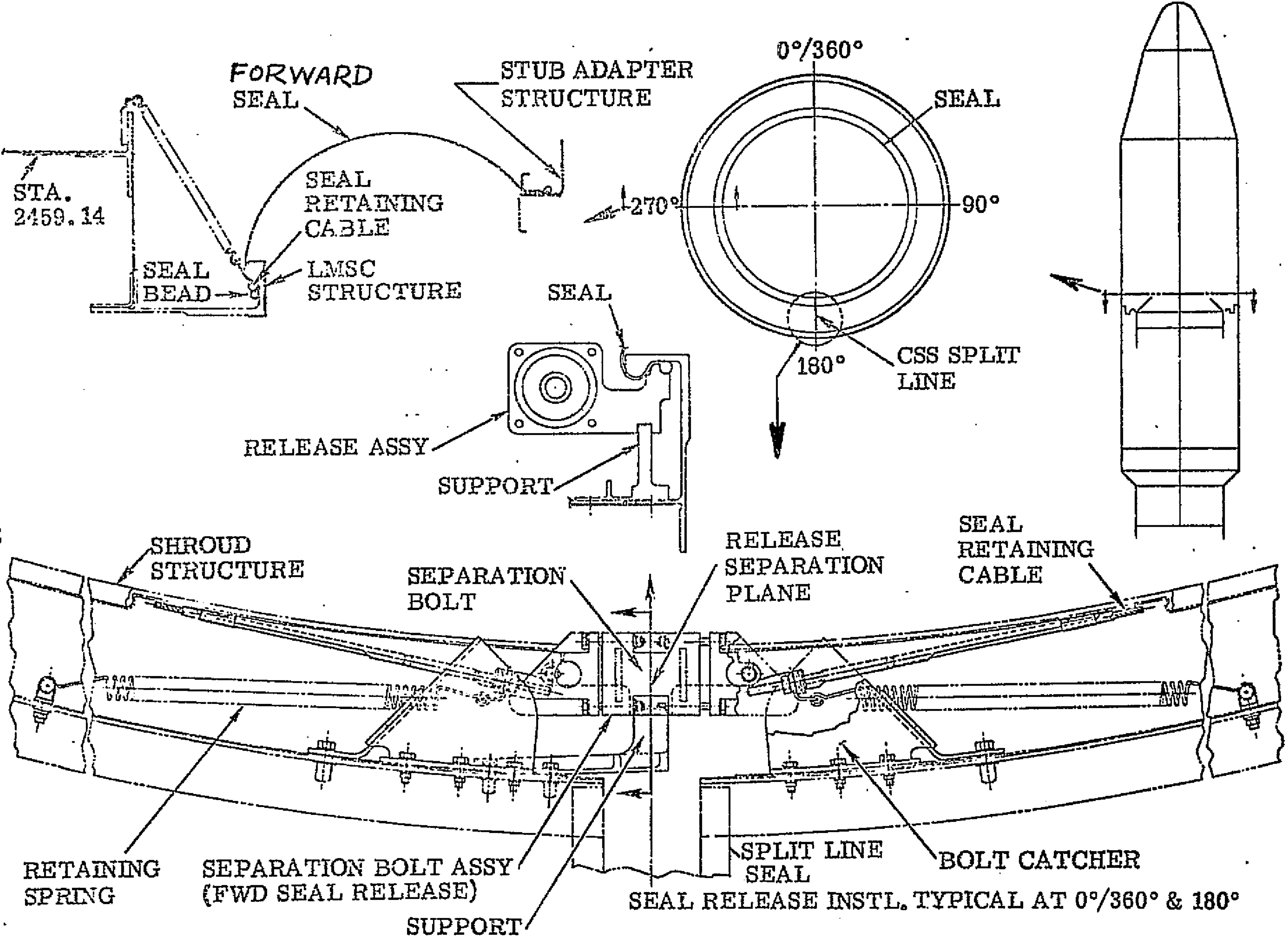


FIGURE 9. FORWARD SEAL INSTALLATION.

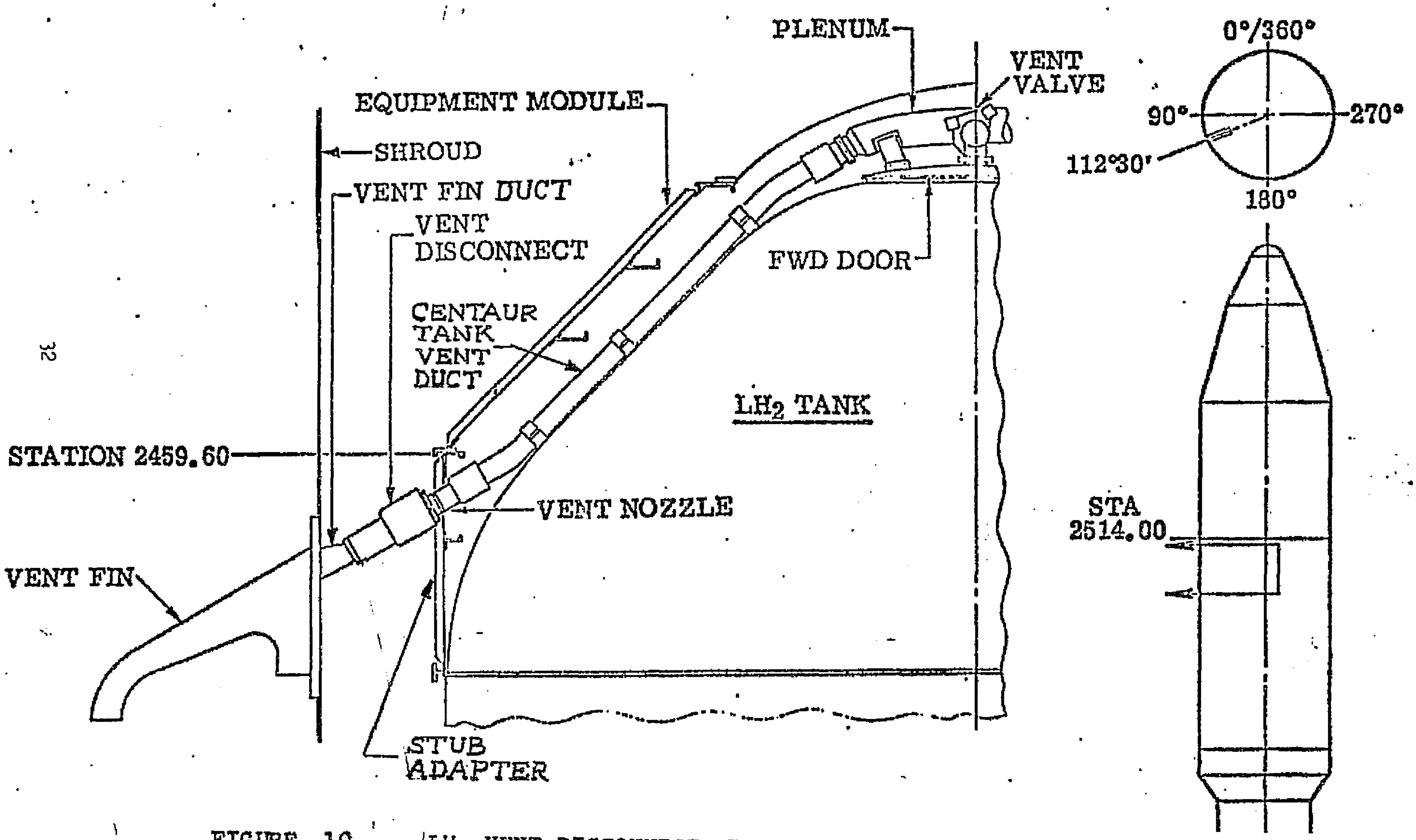


FIGURE 10. LH$_2$ VENT DISCONNECT SYSTEM.

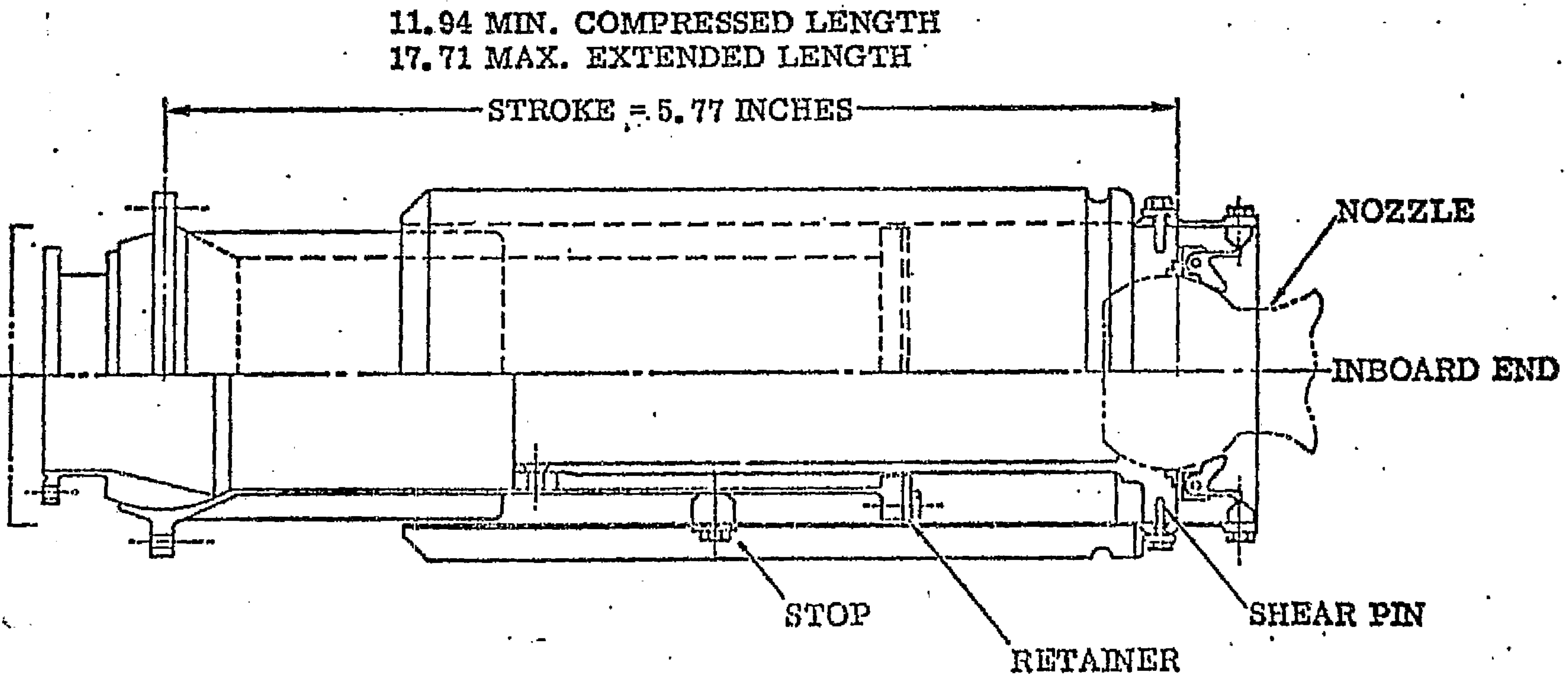


FIGURE 11. LH$_2$ VENT DISCONNECT DETAILS.

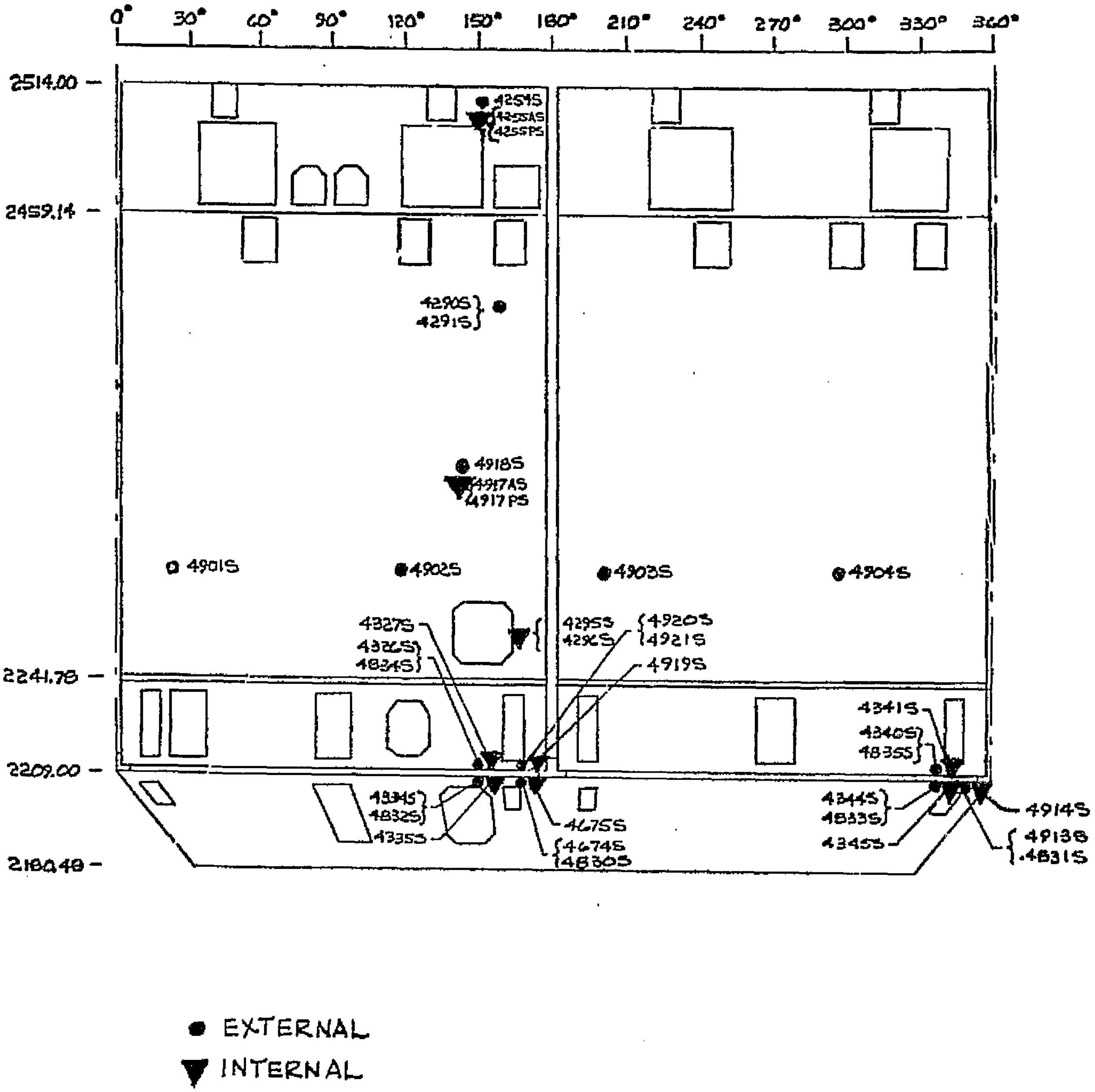
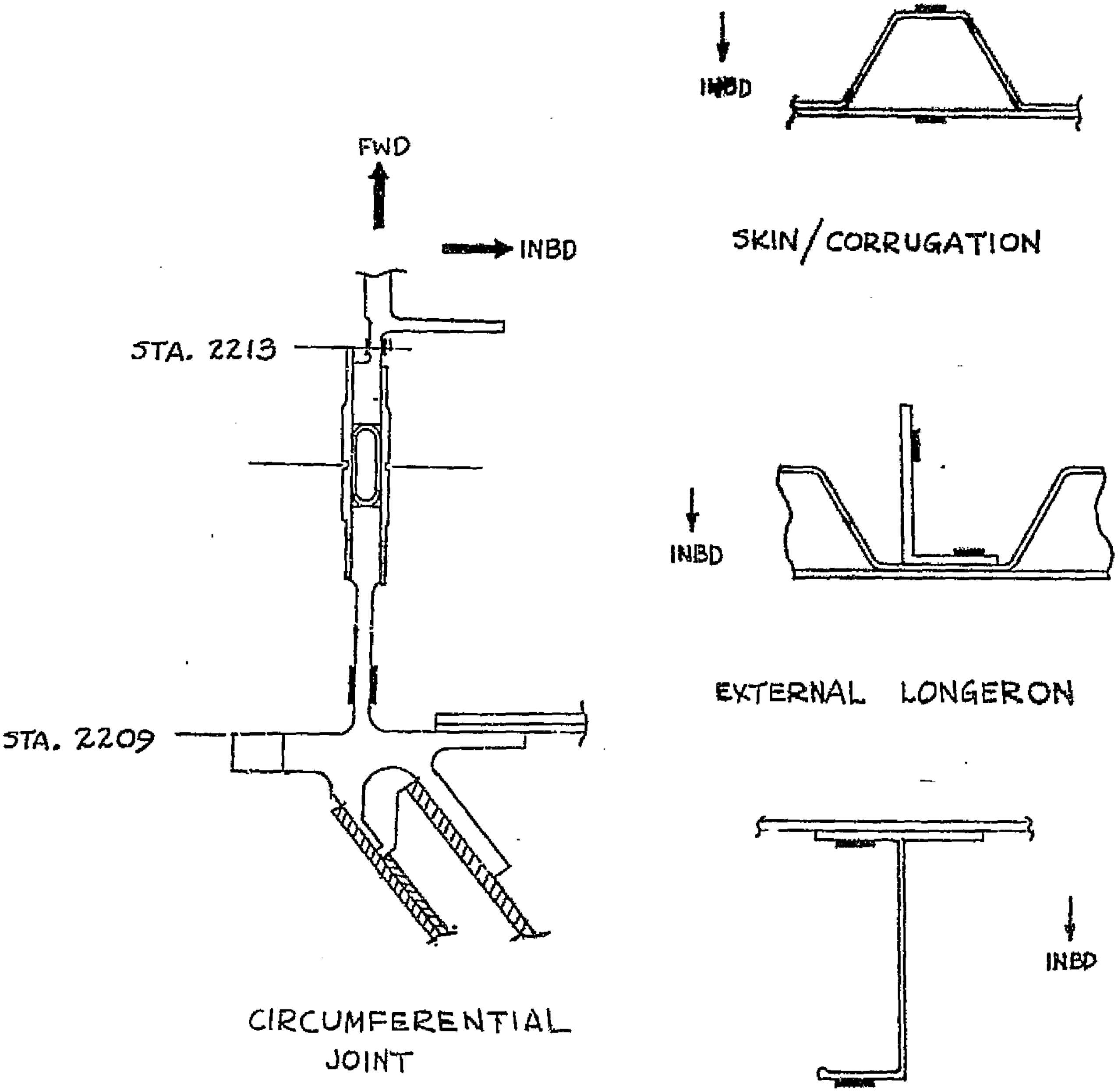


FIGURE 12. CSS STRAIN GAGE LOCATIONS.



SKIN/CORRUGATION

EXTERNAL LONGERON

CIRCUMFERENTIAL JOINT

INTERNAL LONGERON

FIGURE 13. TYPICAL STRAIN GAGE INSTALLATIONS ON CSS.

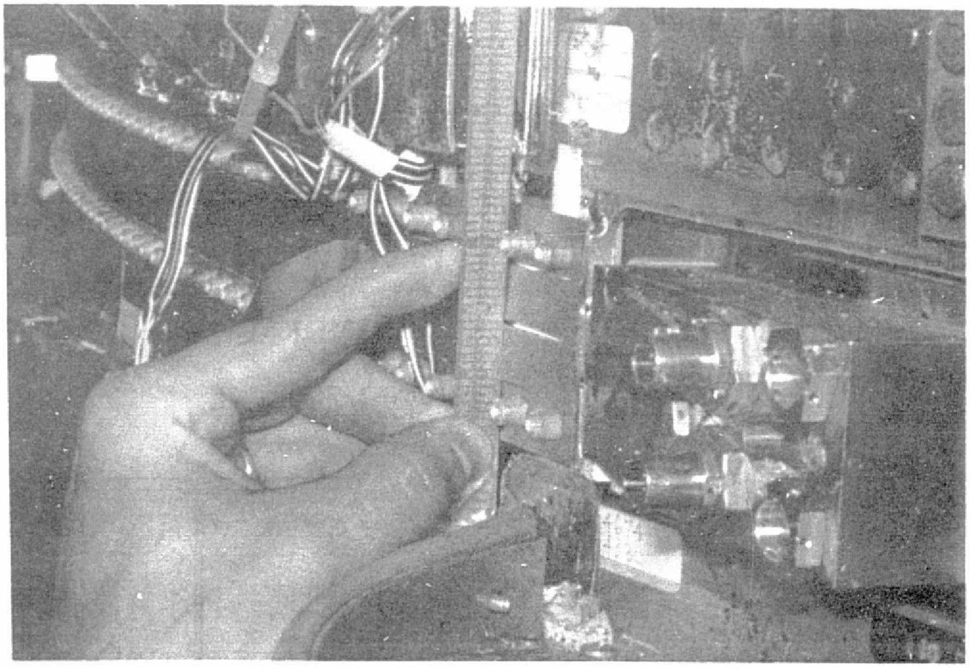


FIGURE 14. FRANGIBLE DOUBLER DEFORMATION.

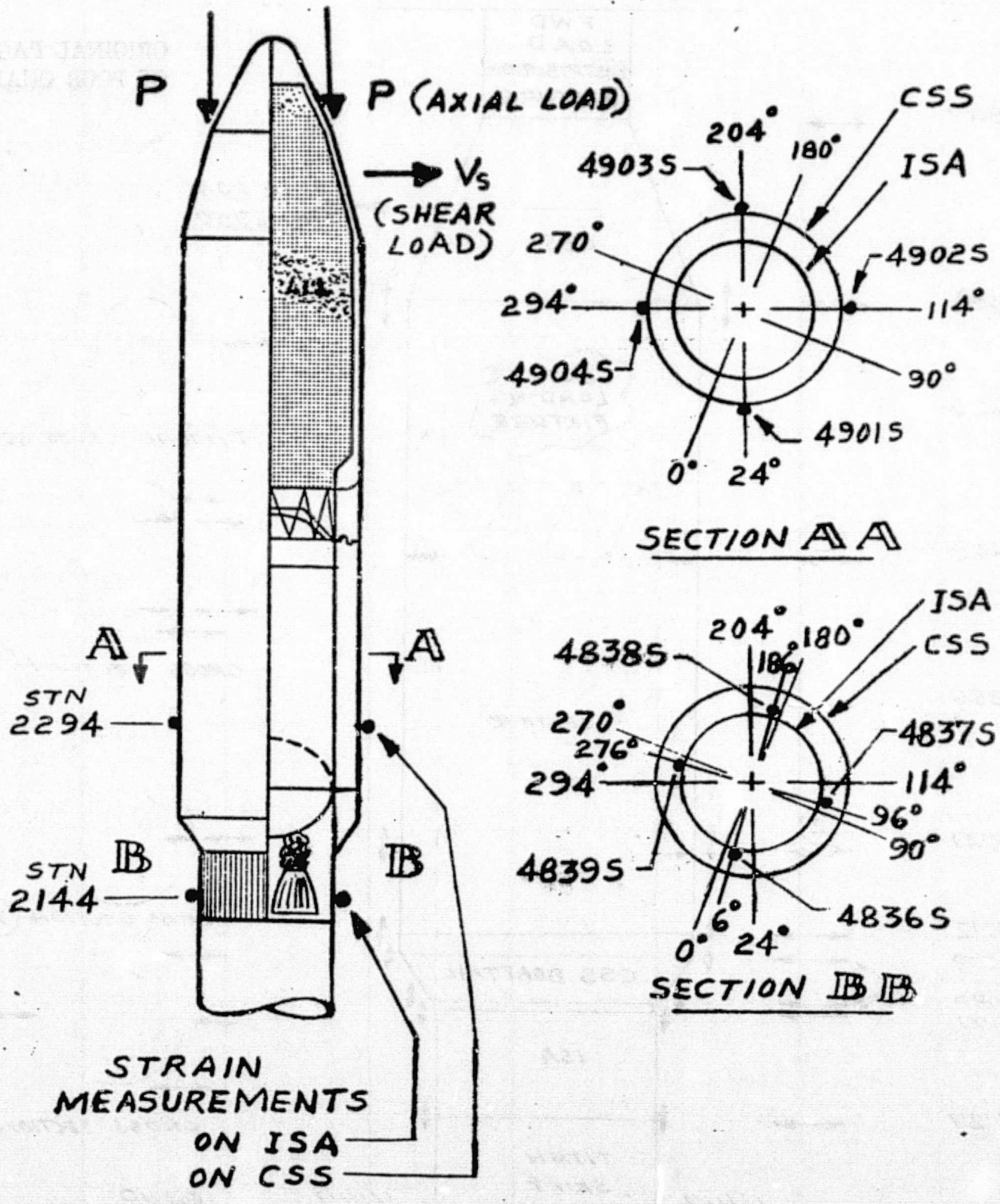


FIGURE 15. FLIGHT SIMULATED STRUCTURAL STRAIN MEASUREMENT LOCATIONS ON CSS AND ISA.

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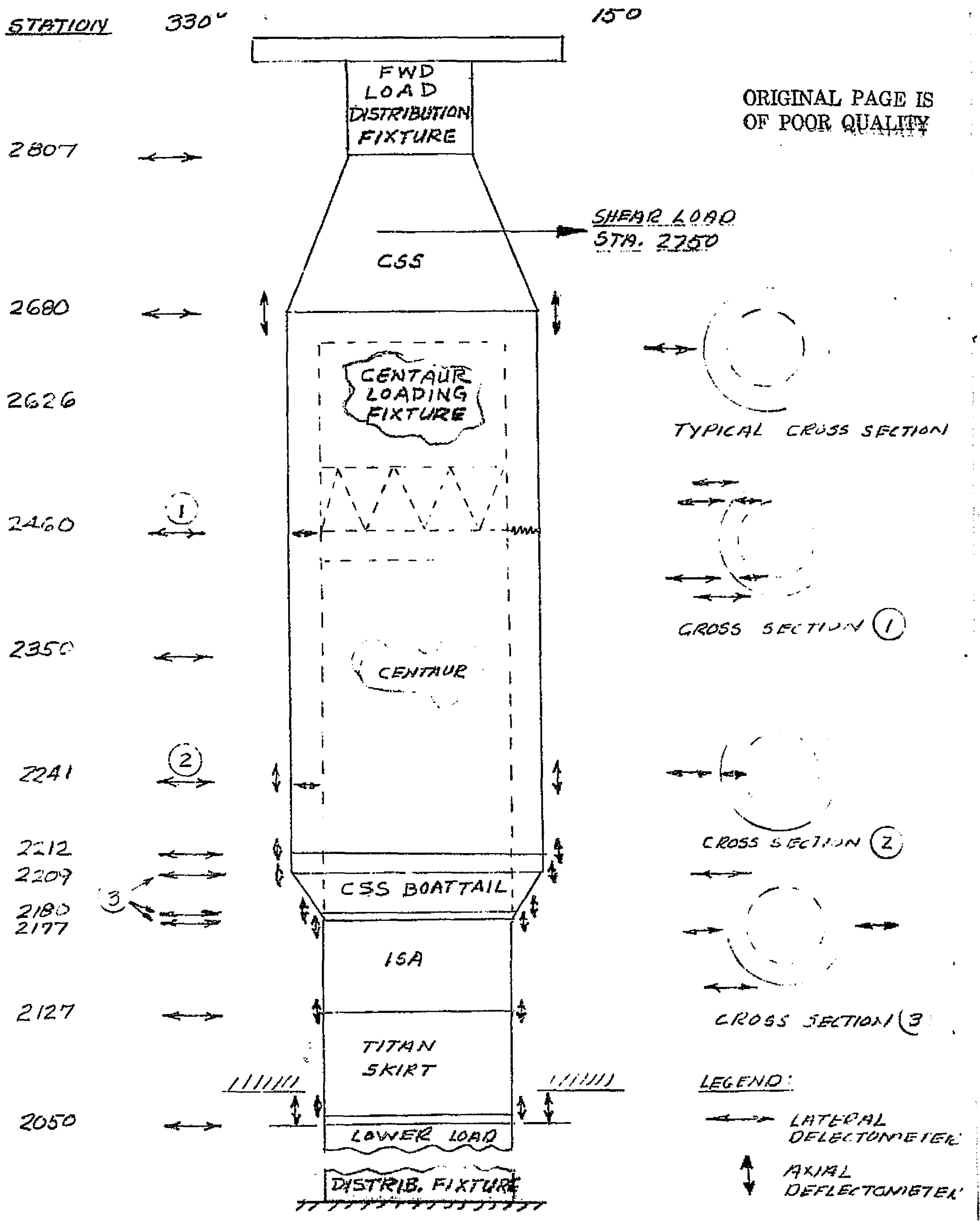

FIGURE 16. DEFLECTION INSTRUMENTATION PLAN.

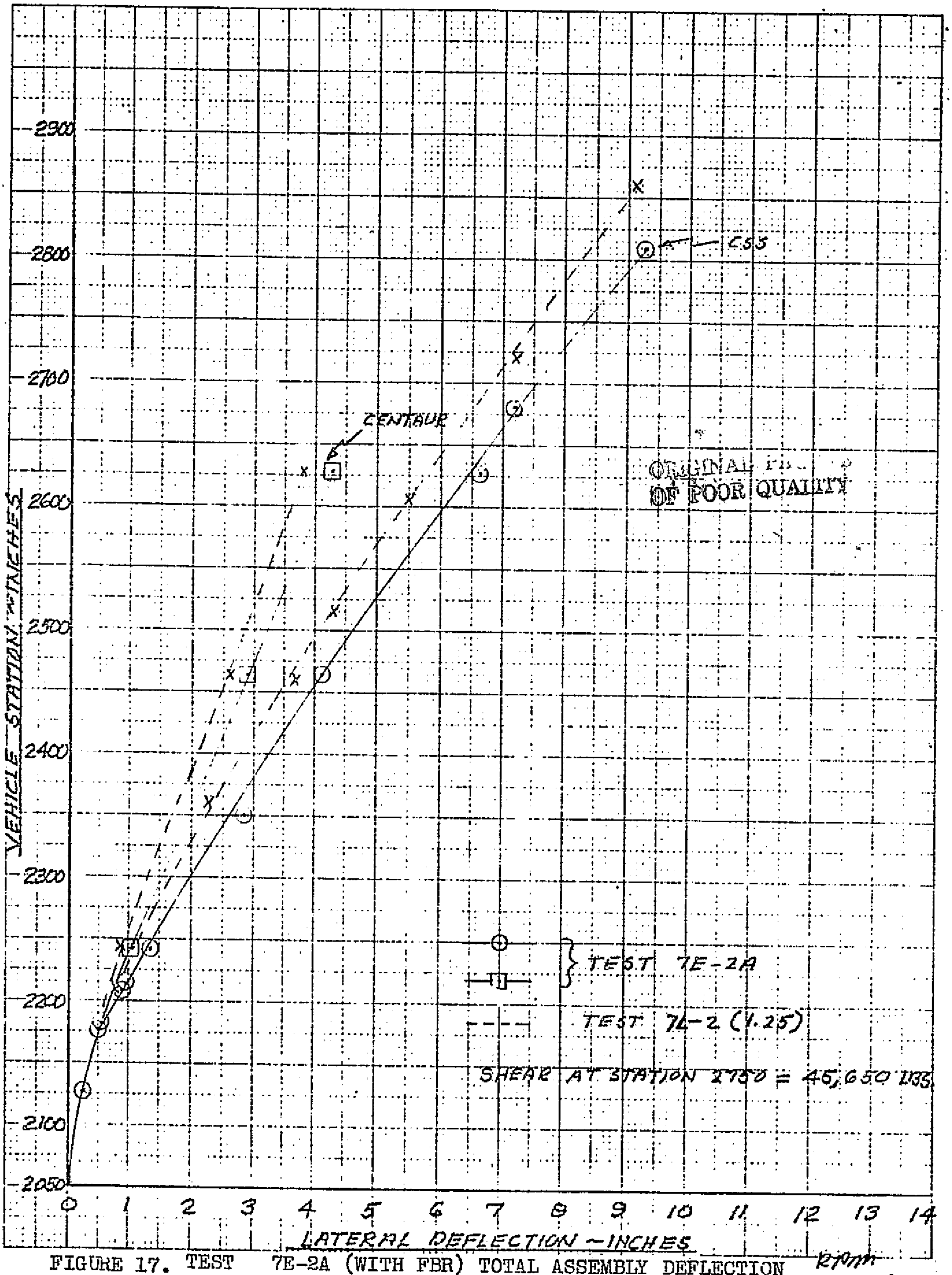

FIGURE 17. TEST 7E-2A (WITH FBR) TOTAL ASSEMBLY DEFLECTION VS. VEHICLE STATION @ MAXIMUM LOAD.

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6-10-75

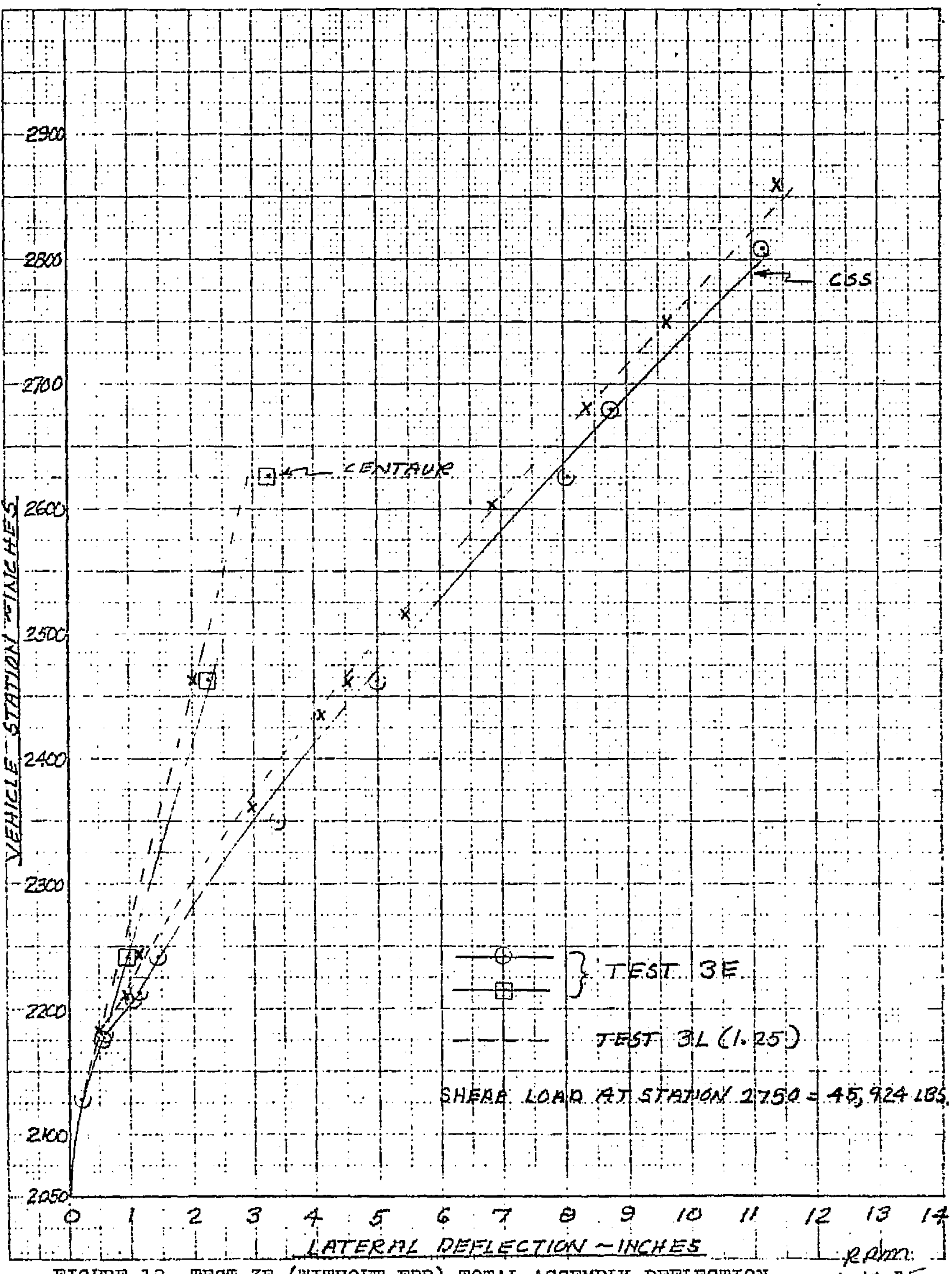

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FIGURE 18. TEST 3E (WITHOUT FBR) TOTAL ASSEMBLY DEFLECTION VS. VEHICLE STATION AT MAXIMUM LOAD.

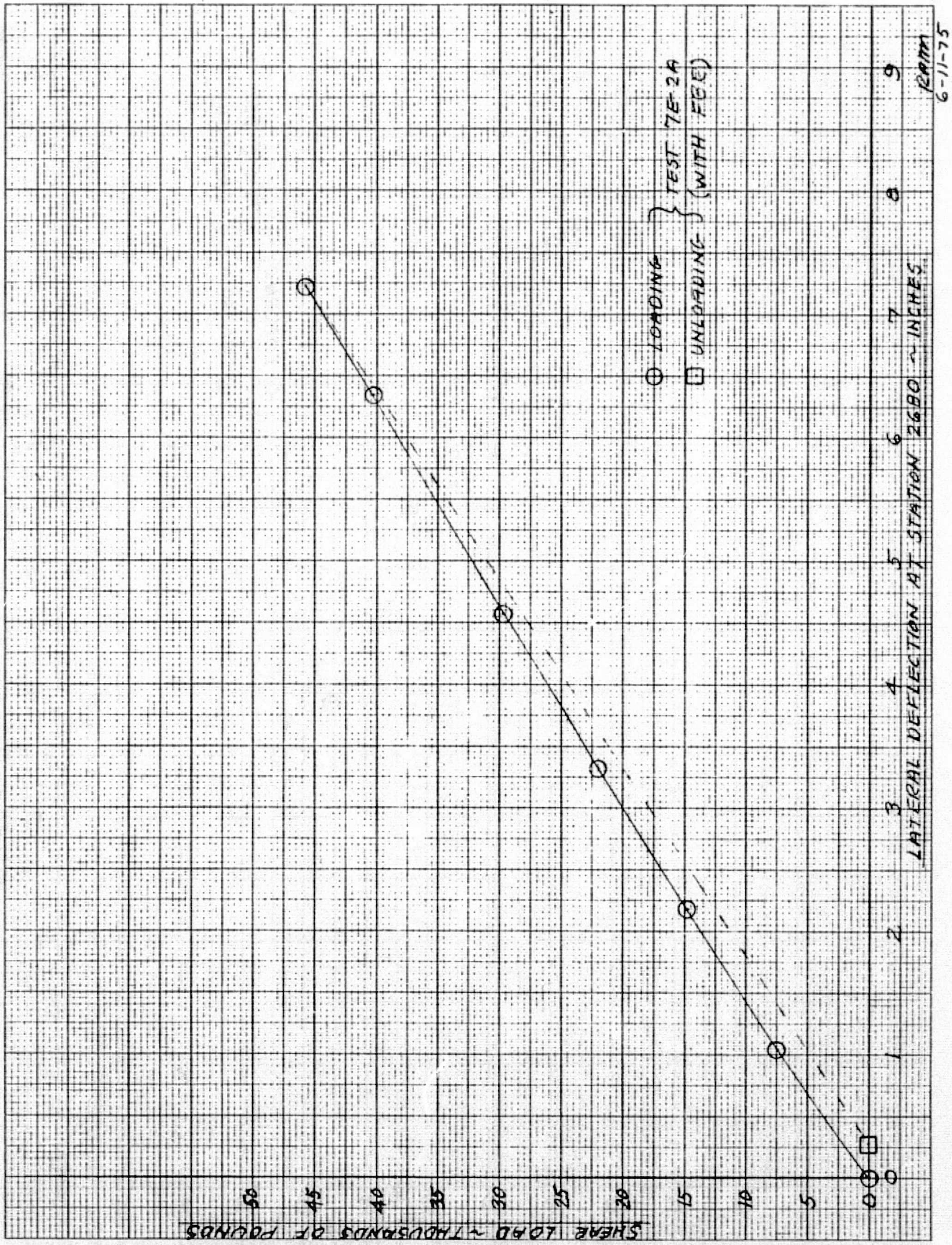

FIGURE 19. TEST 7E-2A (WITH FEE) LATERAL DEFLECTION AT STATION 2680 VS. SHEAR LOAD.

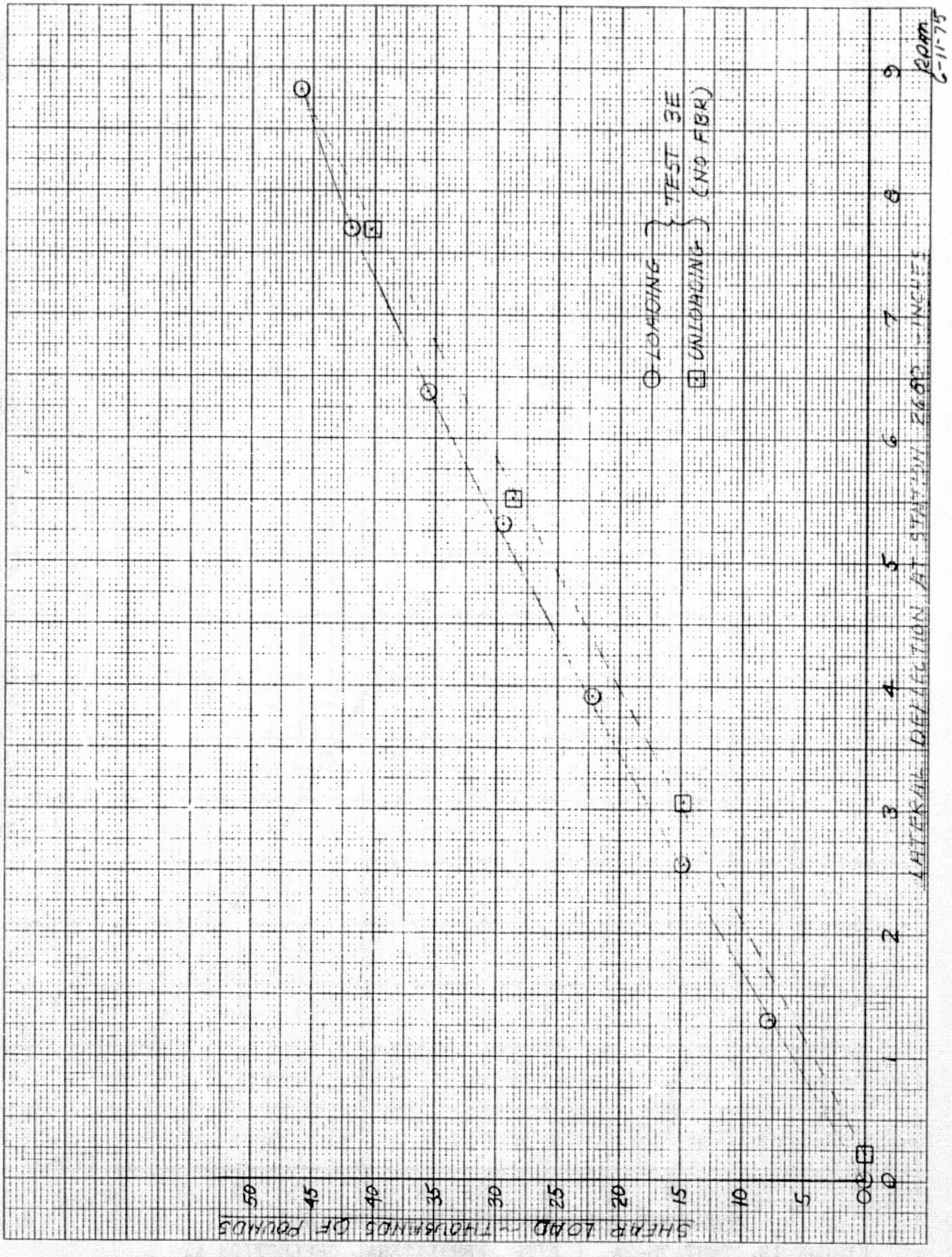

FIGURE 20. TEST 3E (WITHOUT FBR) LATERAL DEFLECTION AT STATION 2680 VS SHEAR LOAD

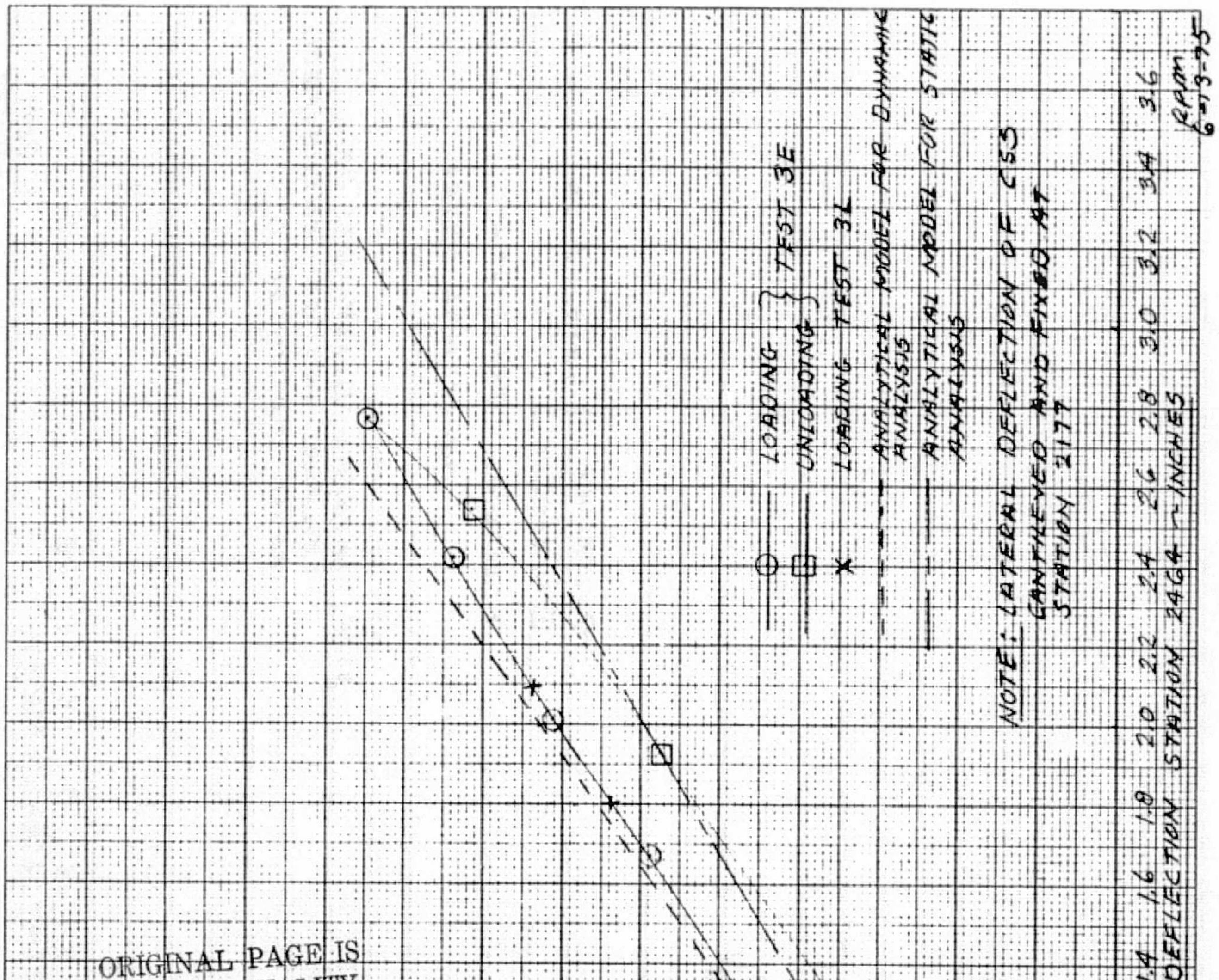

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FIGURE 21. TEST 3E CSS LATERAL DEFLECTION AT STATION 2464 VS. SHEAR LOAD

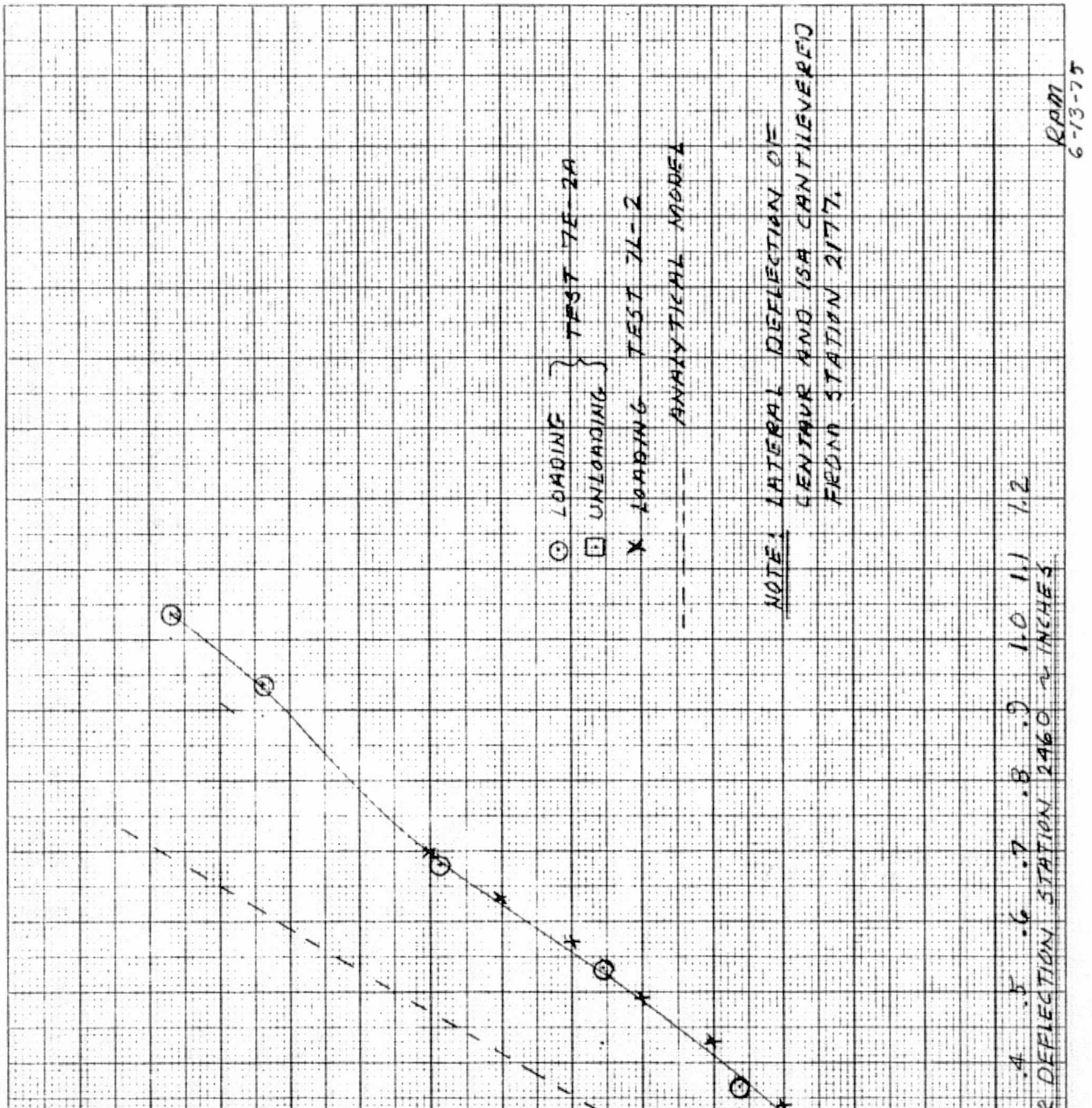


FIGURE 22. TEST 7E-2A CENTAUR LATERAL DEFLECTION AT STA. 2464 VS. FBR LOAD

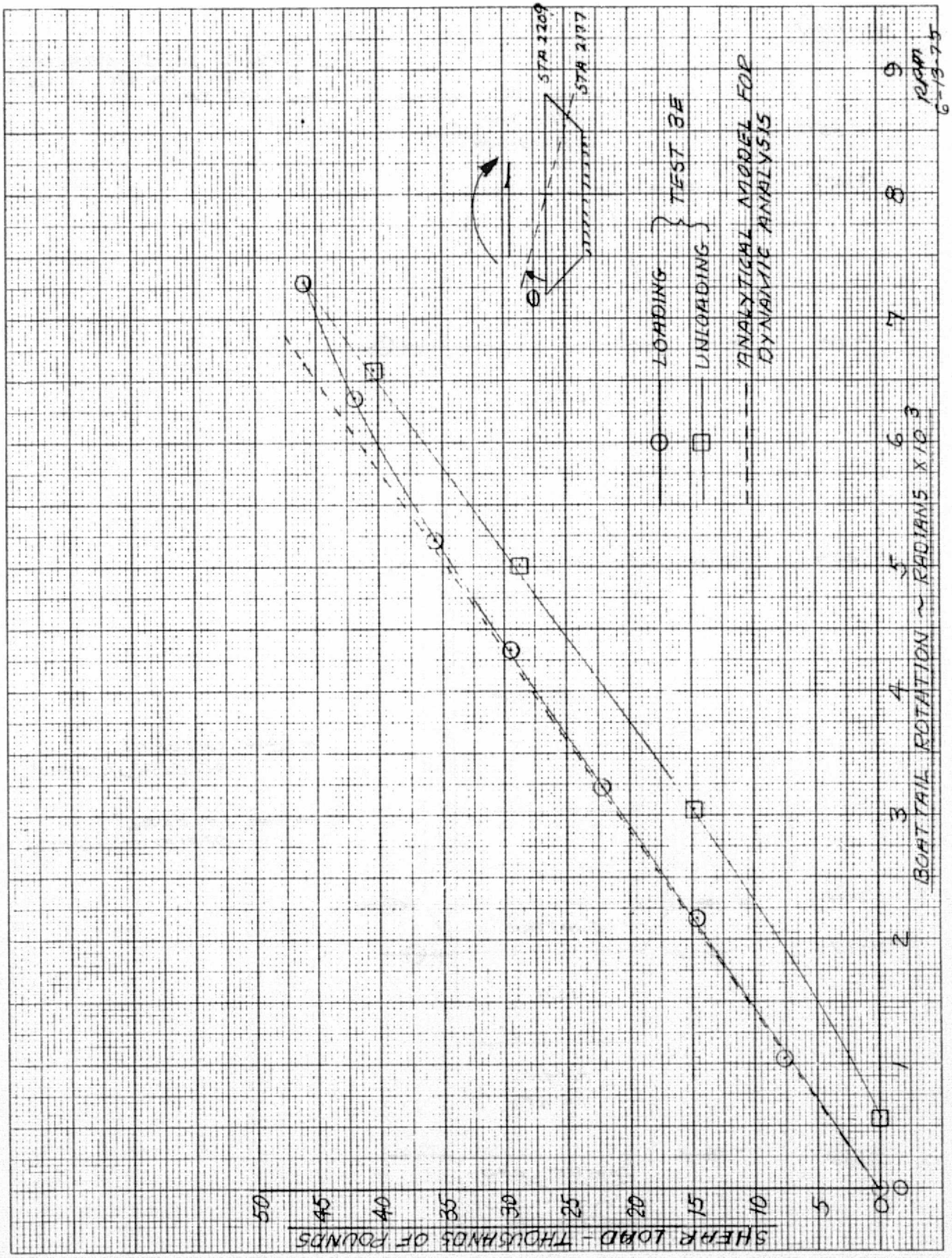


FIGURE 23. TEST 3E BOATTAIL PLANE ROTATION VS. SHEAR LOAD

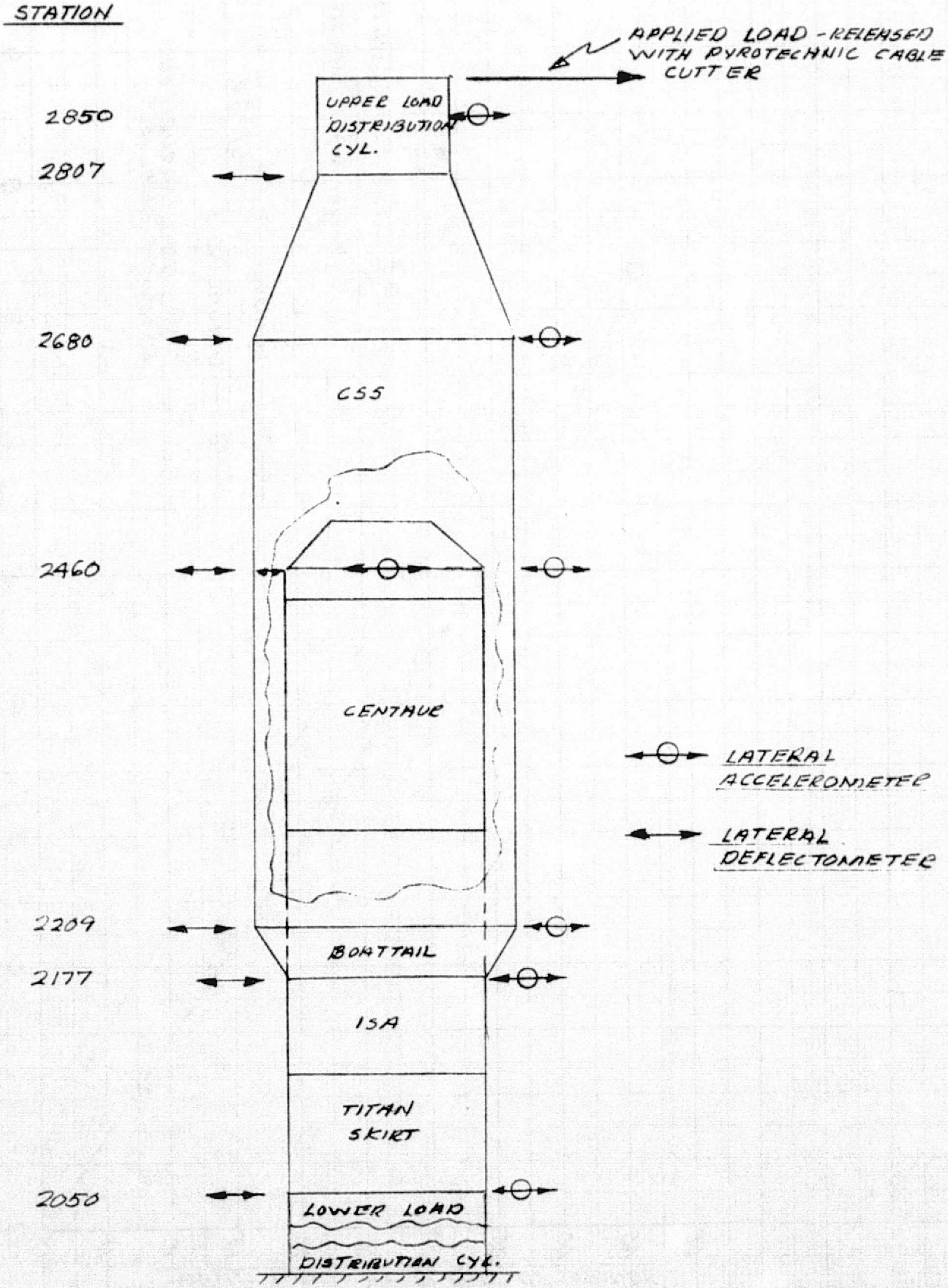
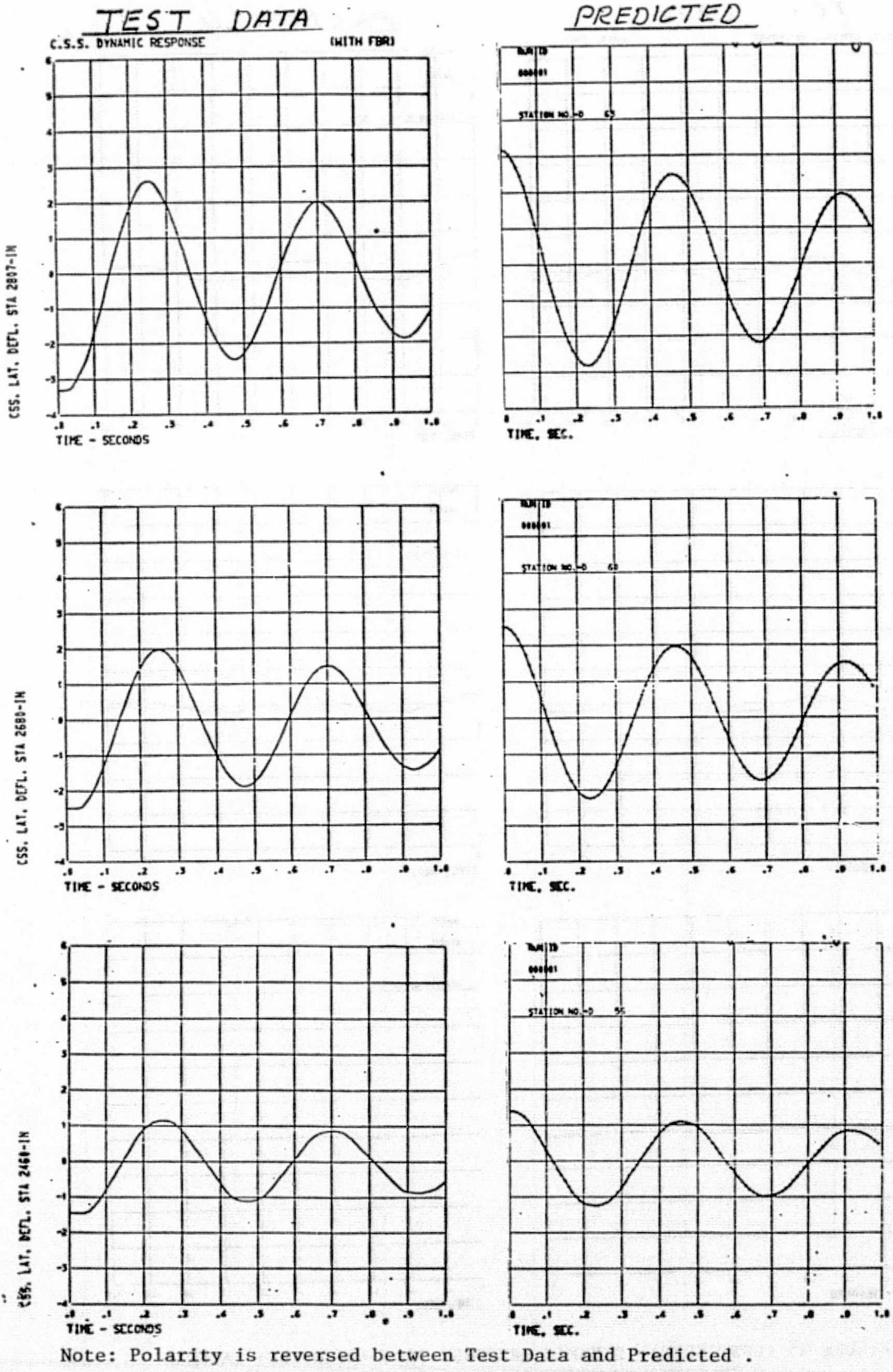


FIGURE 24. DYNAMIC RESPONSE TEST CONFIGURATION AND INSTRUMENTATION



Note: Polarity is reversed between Test Data and Predicted .

FIGURE 25. DYNAMIC RESPONSE TEST (WITH FBR) LATERAL DISPLACEMENT RESPONSE COMPARED WITH PREDICTED.

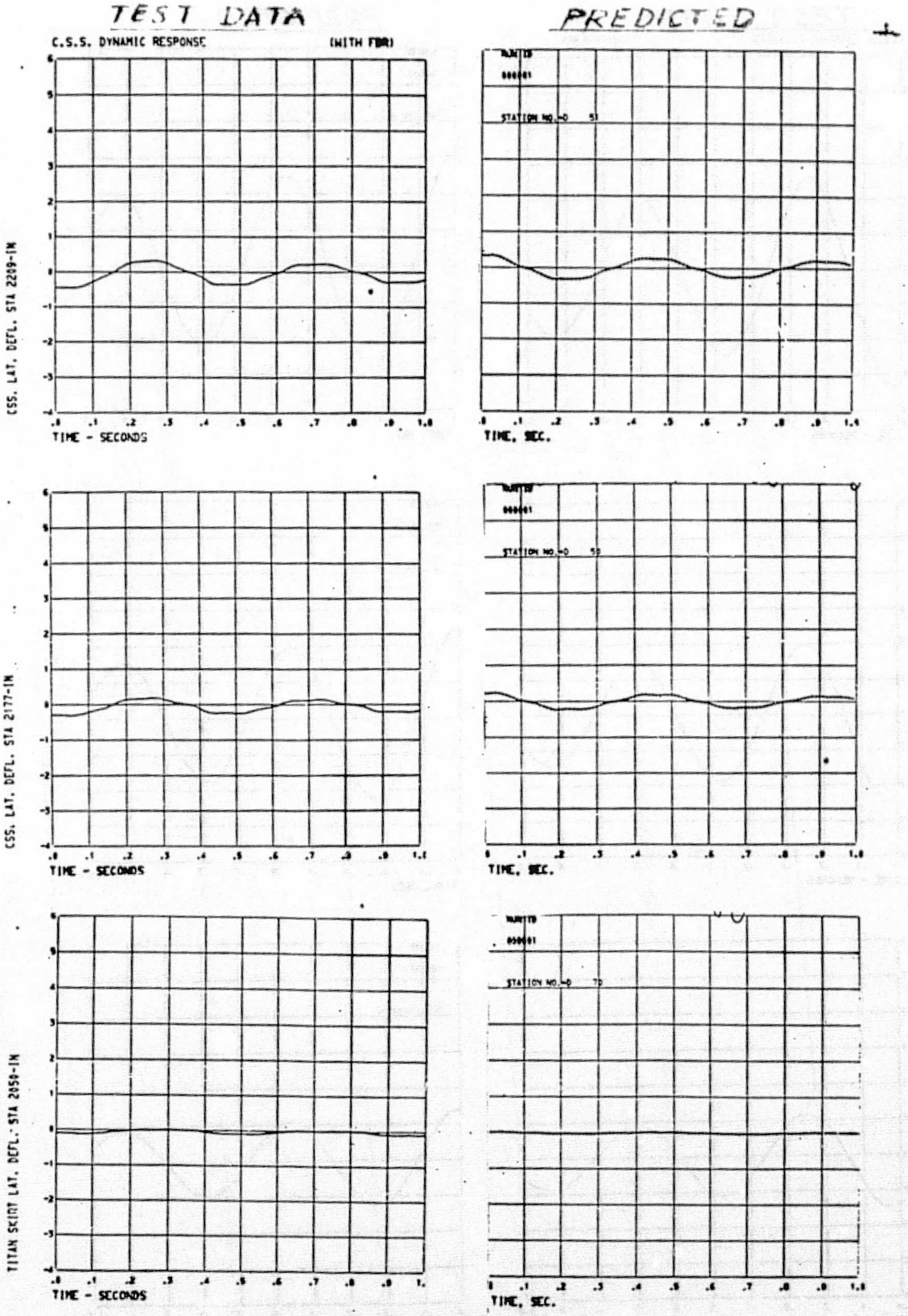


FIGURE 25 (CONTINUED). DYNAMIC RESPONSE TEST (WITH FBR) LATERAL DISPLACEMENT RESPONSE COMPARED WITH PREDICTED.

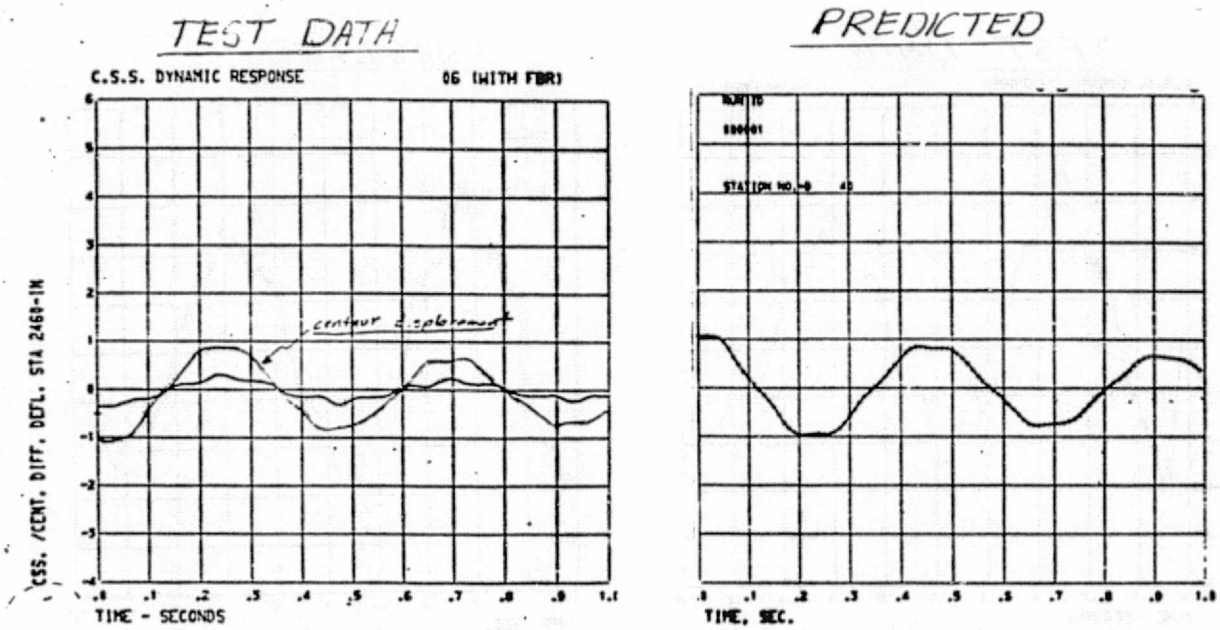


FIGURE 25 (CONCLUDED). DYNAMIC RESPONSE TEST (WITH FBR) LATERAL DISPLACEMENT RESPONSE COMPARED WITH PREDICTED.

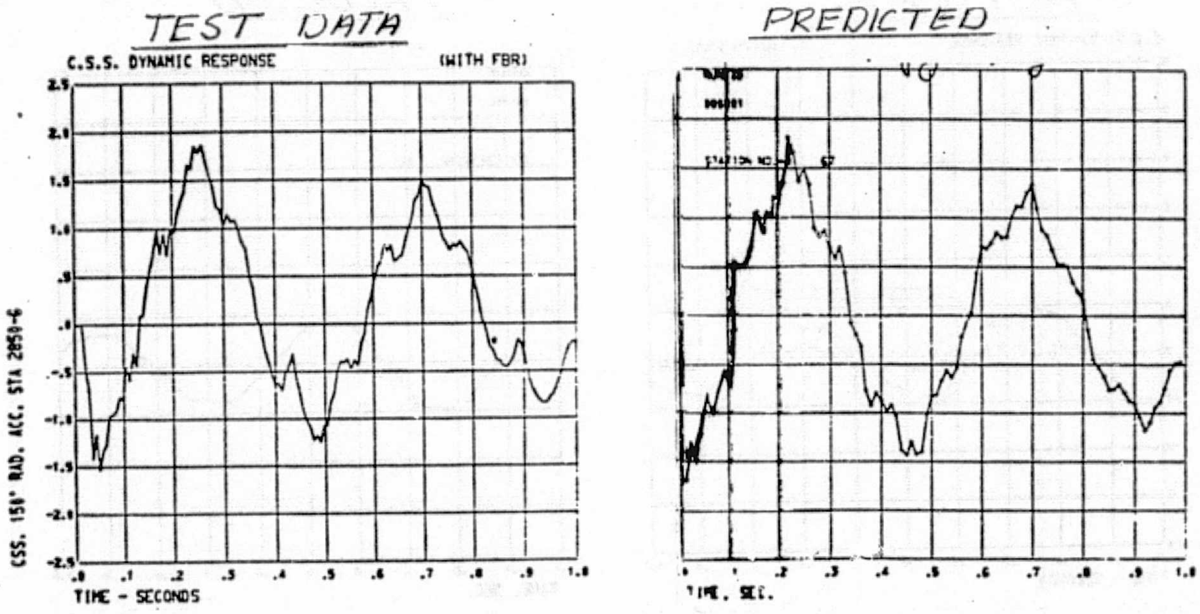


FIGURE 26. DYNAMIC RESPONSE TEST (WITH FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

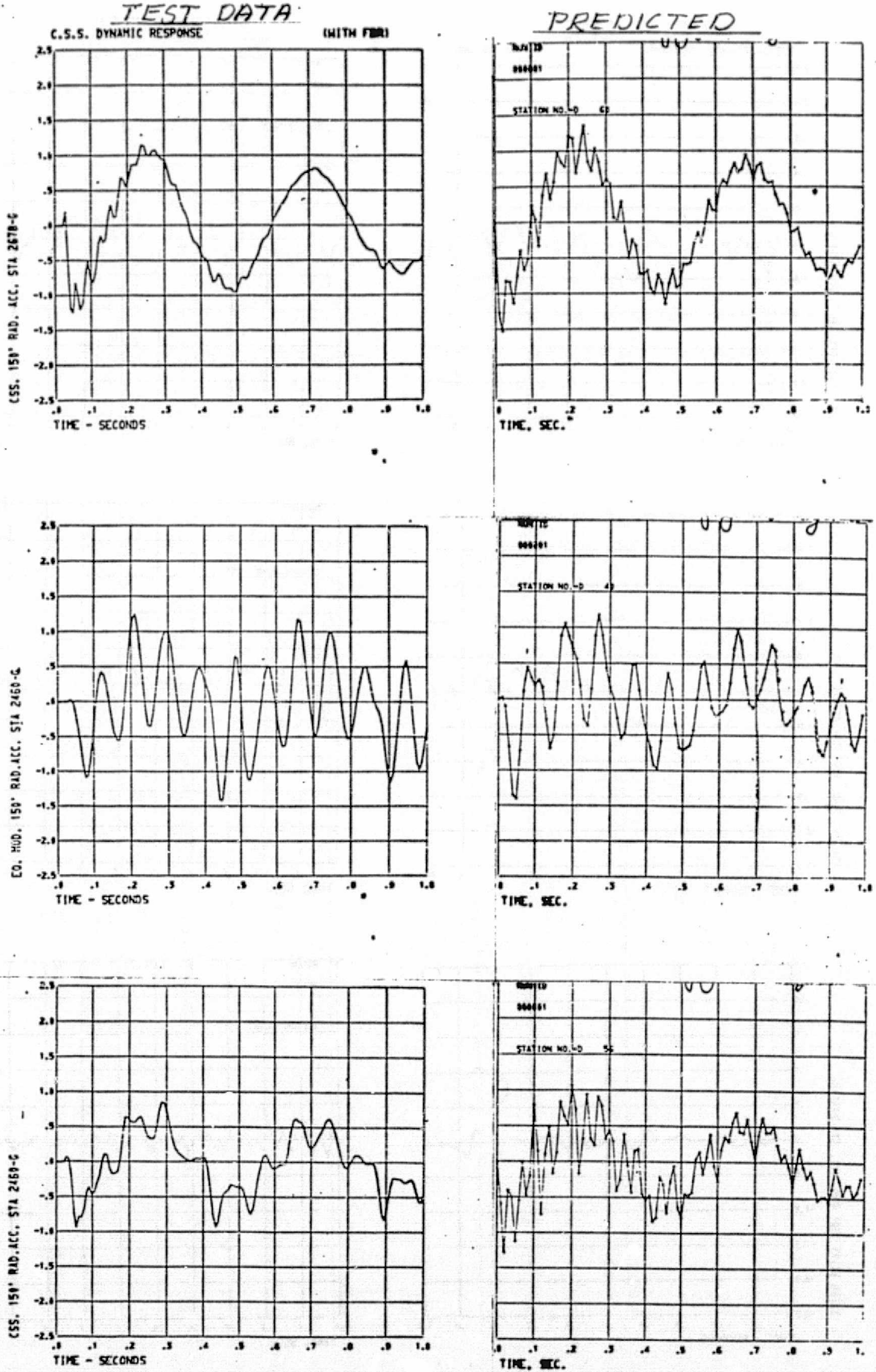


FIGURE 26. (CONTINUED). DYNAMIC RESPONSE TEST (WITH FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

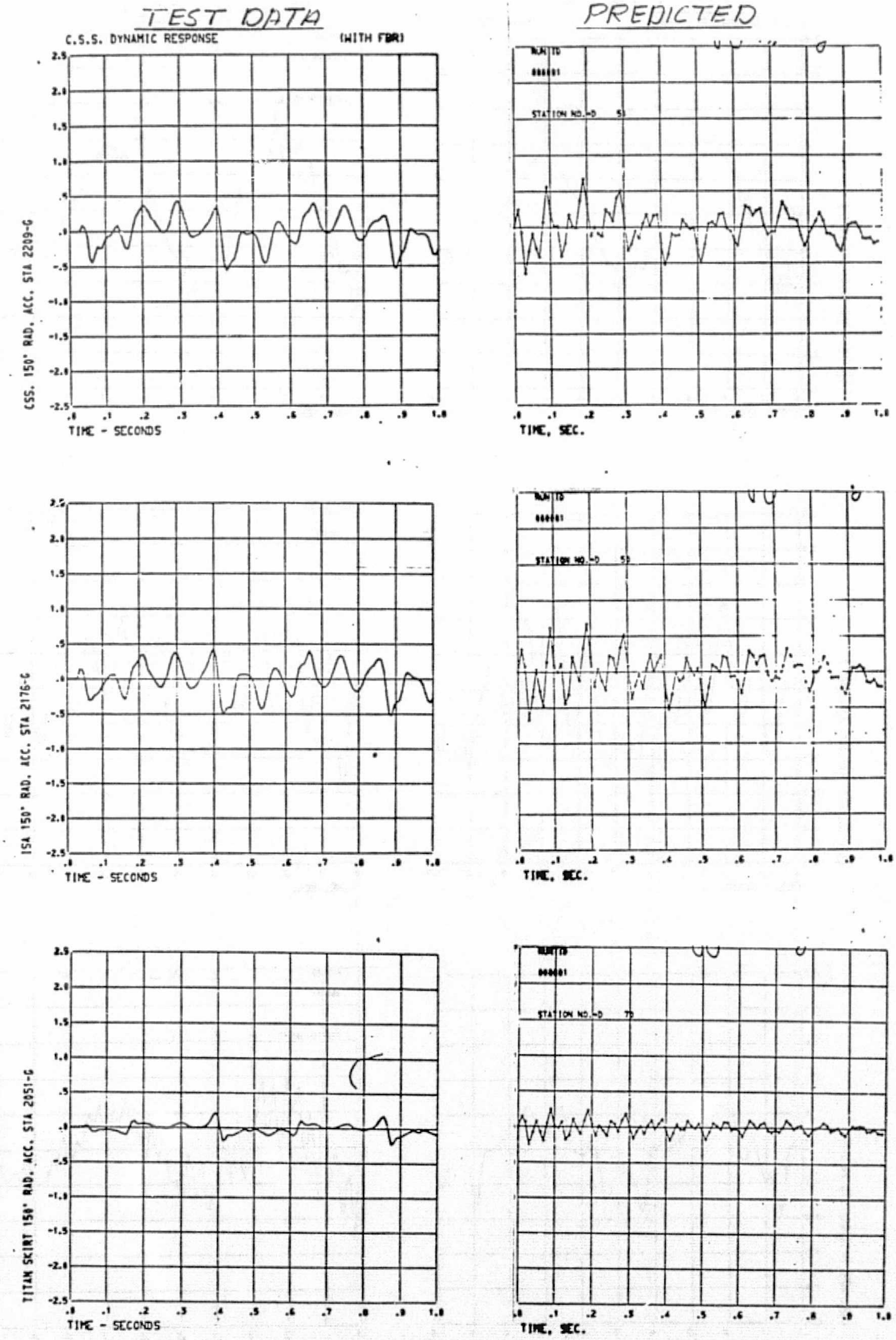
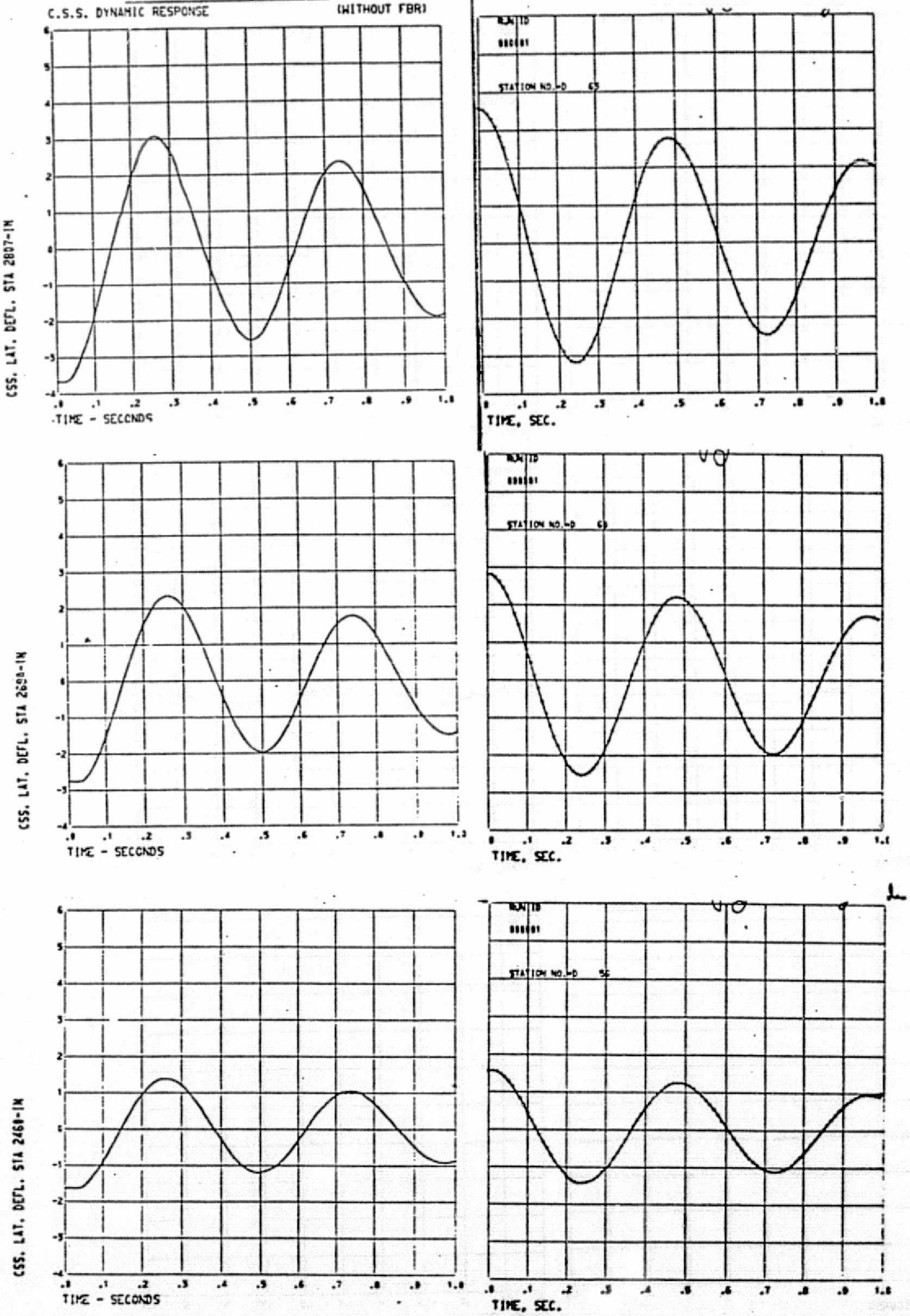


FIGURE 26 (CONCLUDED). DYNAMIC RESPONSE TEST (WITH FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

TEST DATA

PREDICTED



NOTE: POLARITY IS REVERSED BETWEEN TEST AND PREDICTED

FIGURE 27. DYNAMIC RESPONSE TEST (WITHOUT FBR) LATERAL DISPLACEMENT RESPONSE COMPARED WITH PREDICTED.

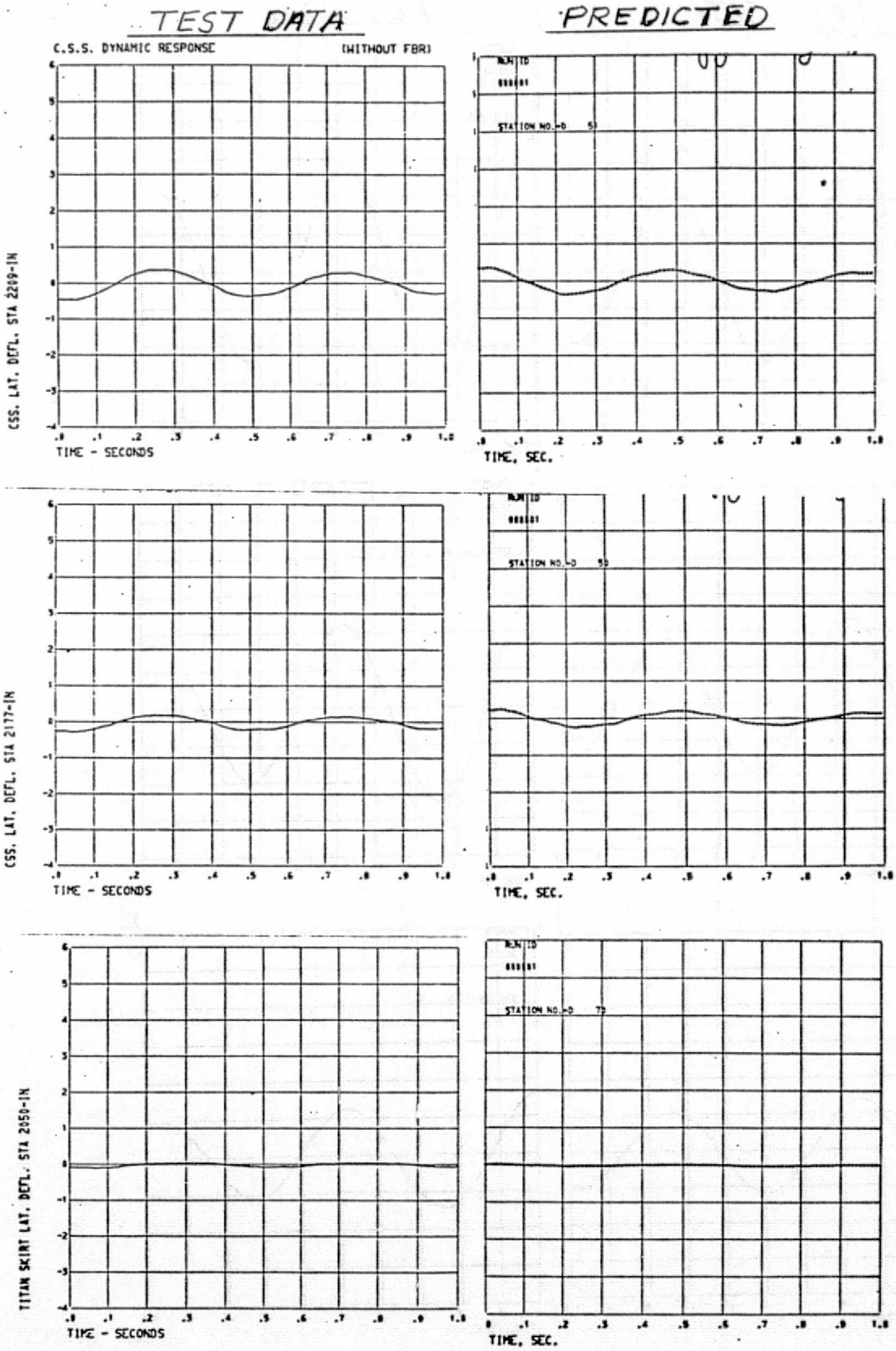


FIGURE 27. (CONCLUDED). DYNAMIC RESPONSE TEST (WITHOUT FBR) LATERAL DISPLACEMENT RESPONSE COMPARED WITH PREDICTED.

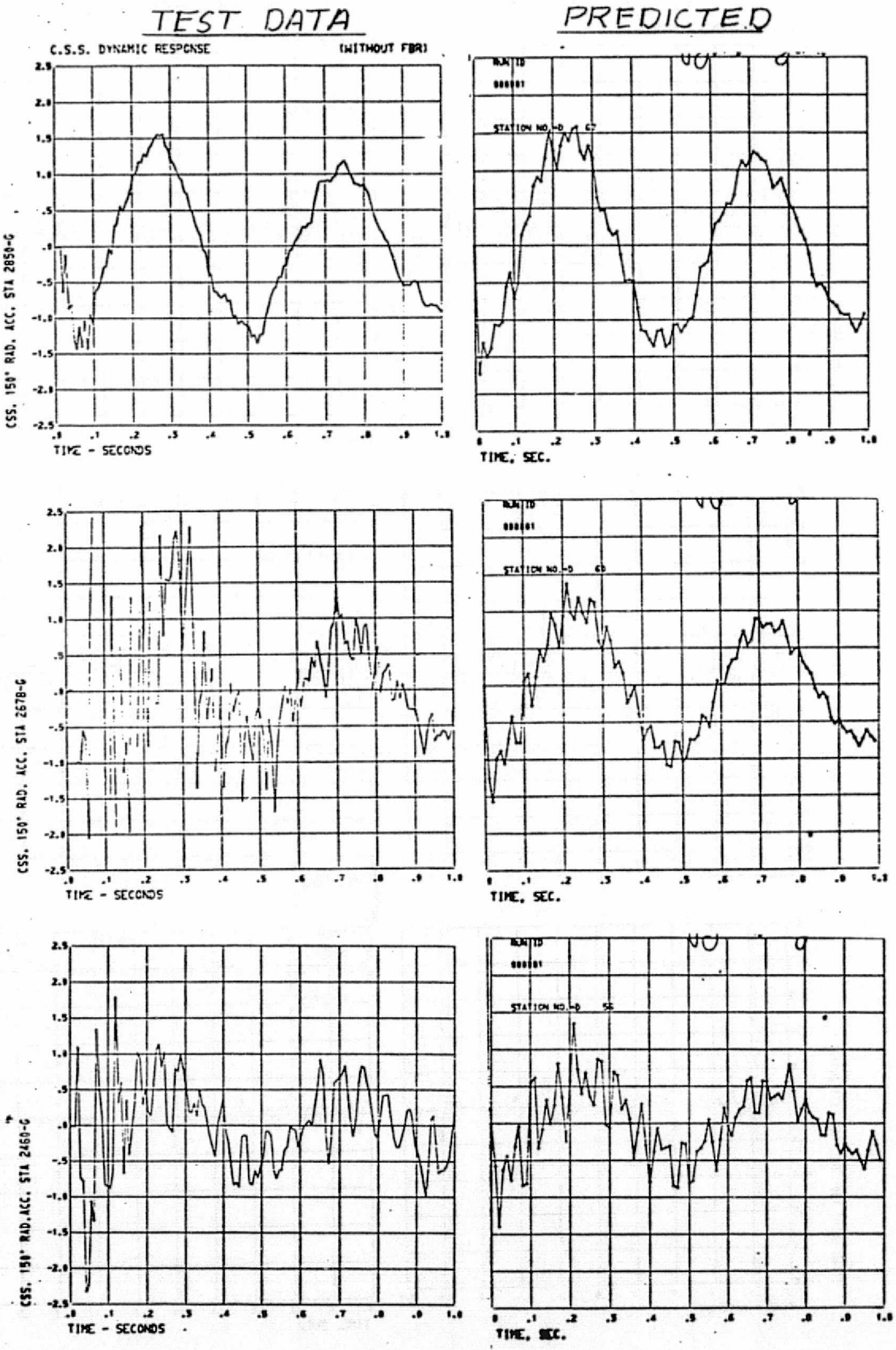


FIGURE 28. DYNAMIC RESPONSE TEST (WITHOUT FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

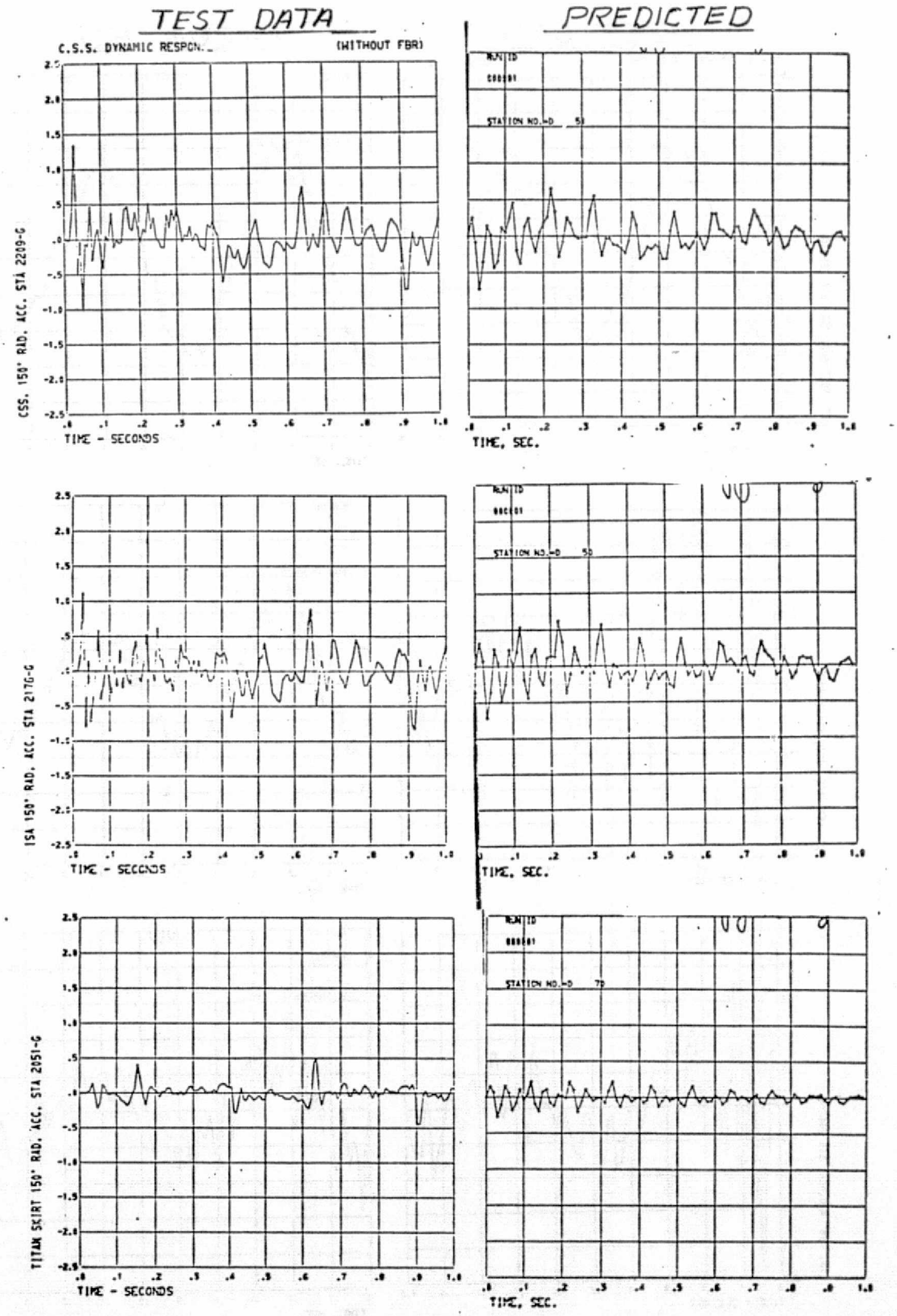


FIGURE 28 (CONTINUED). DYNAMIC RESPONSE TEST (WITHOUT FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

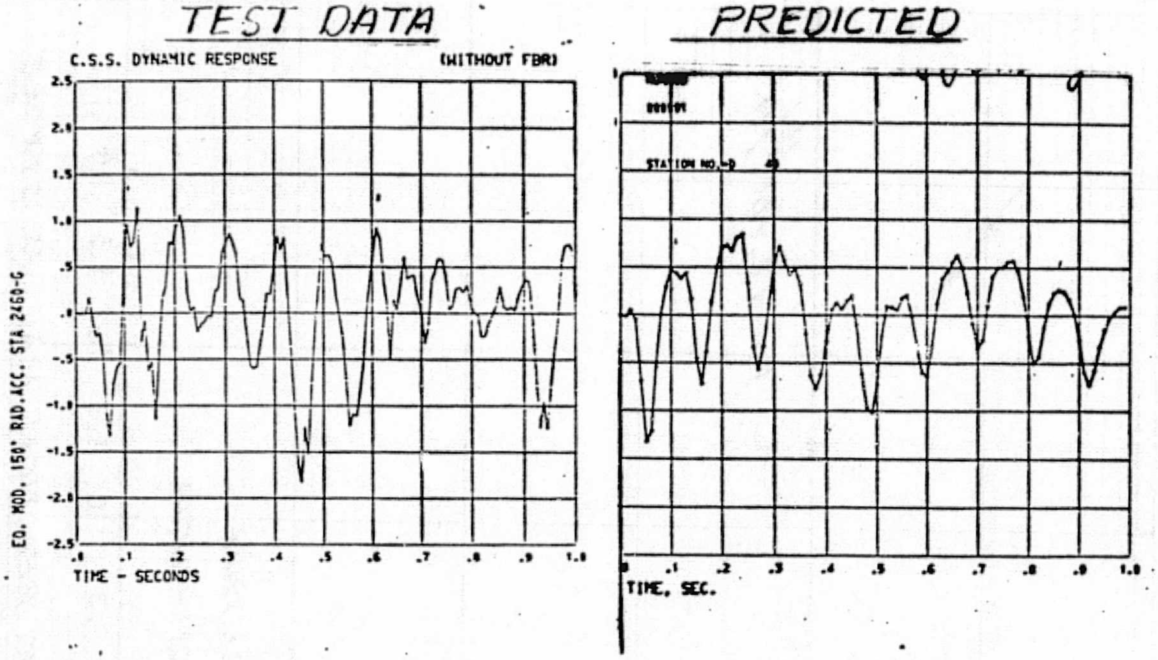


FIGURE 28 (CONCLUDED). DYNAMIC RESPONSE TEST (WITHOUT FBR) LATERAL ACCELERATION RESPONSE COMPARED WITH PREDICTED.

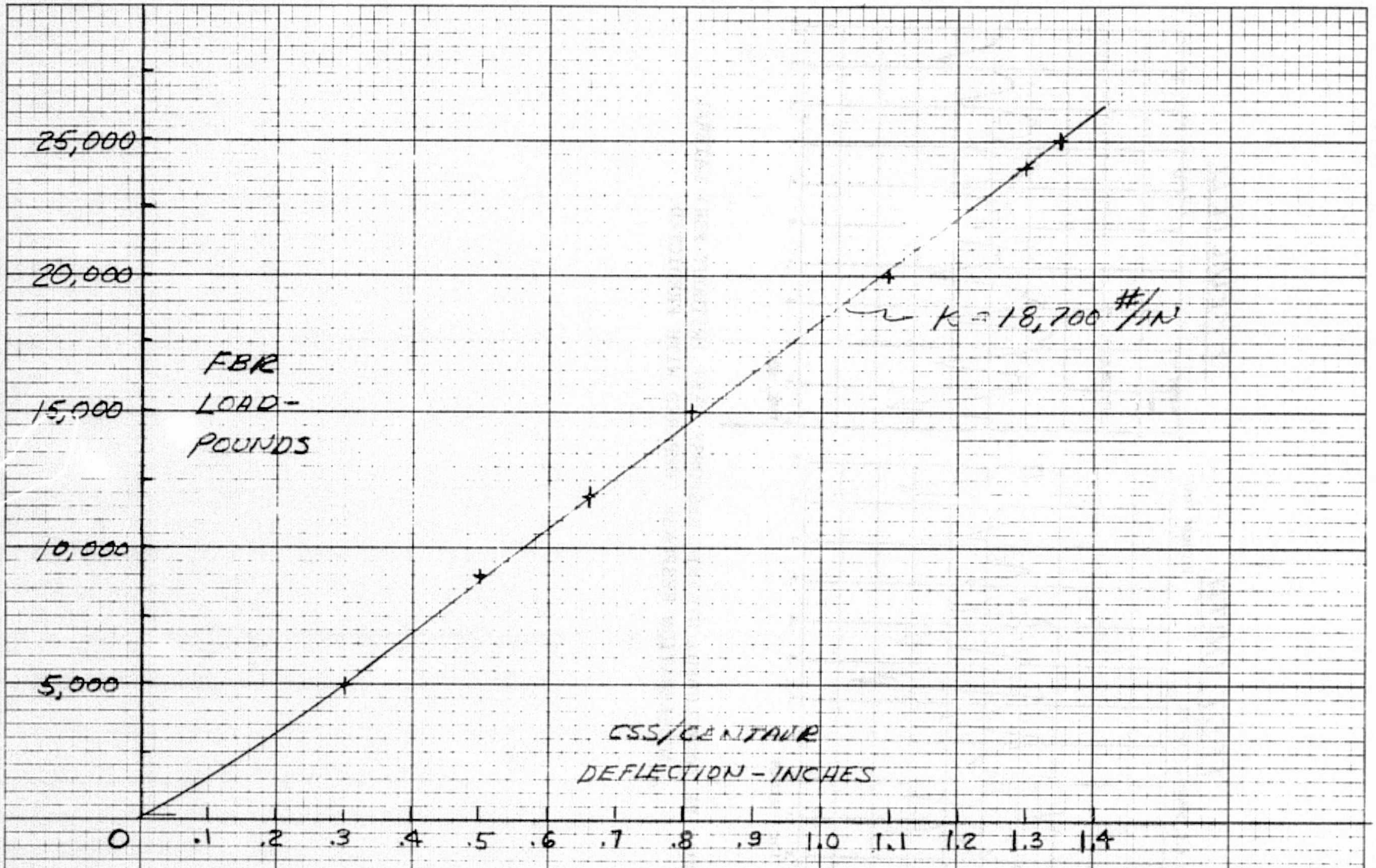


FIGURE 29. FORWARD BEARING REACTION LOAD VS. STROKE
TEST 7E-2B

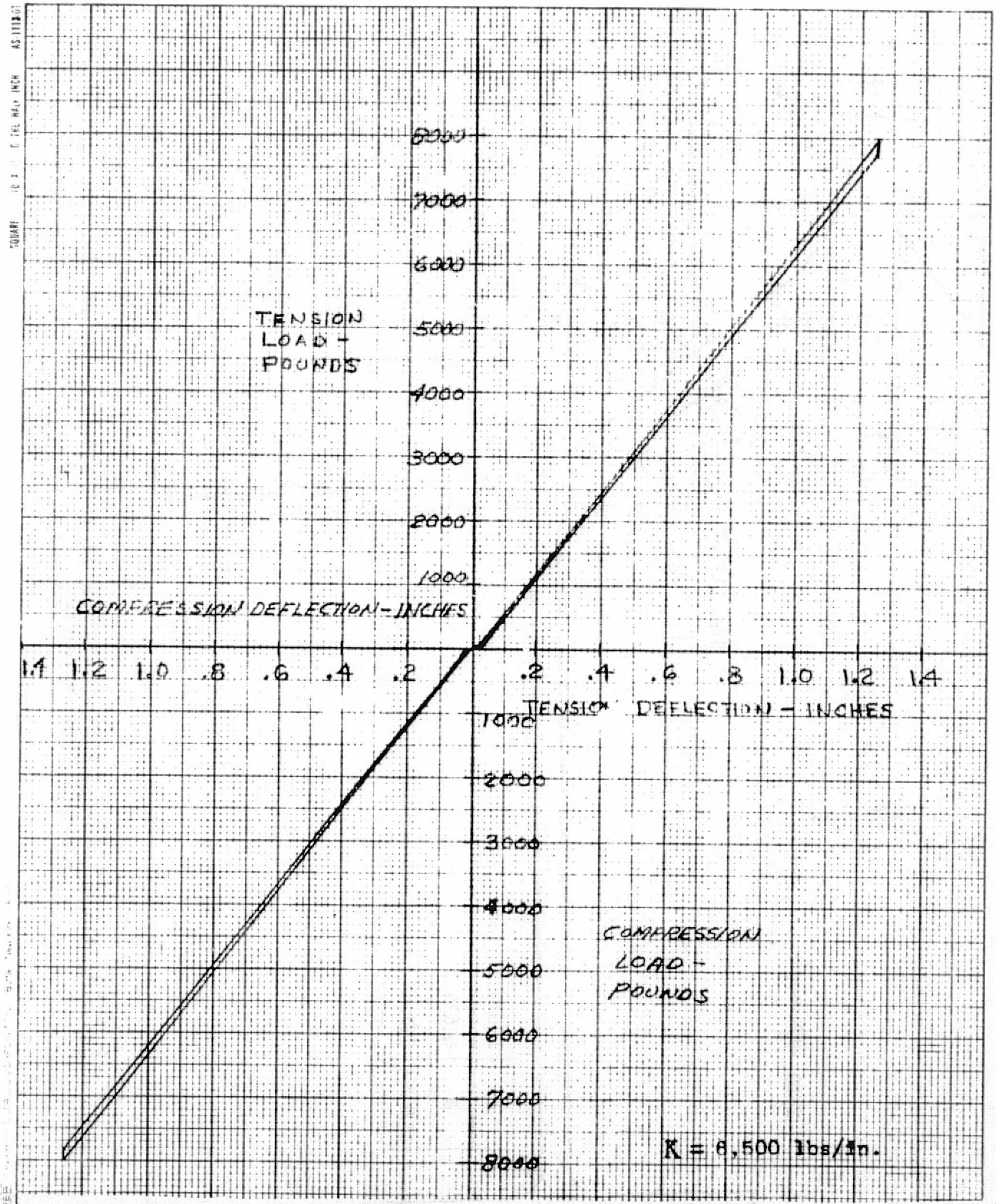
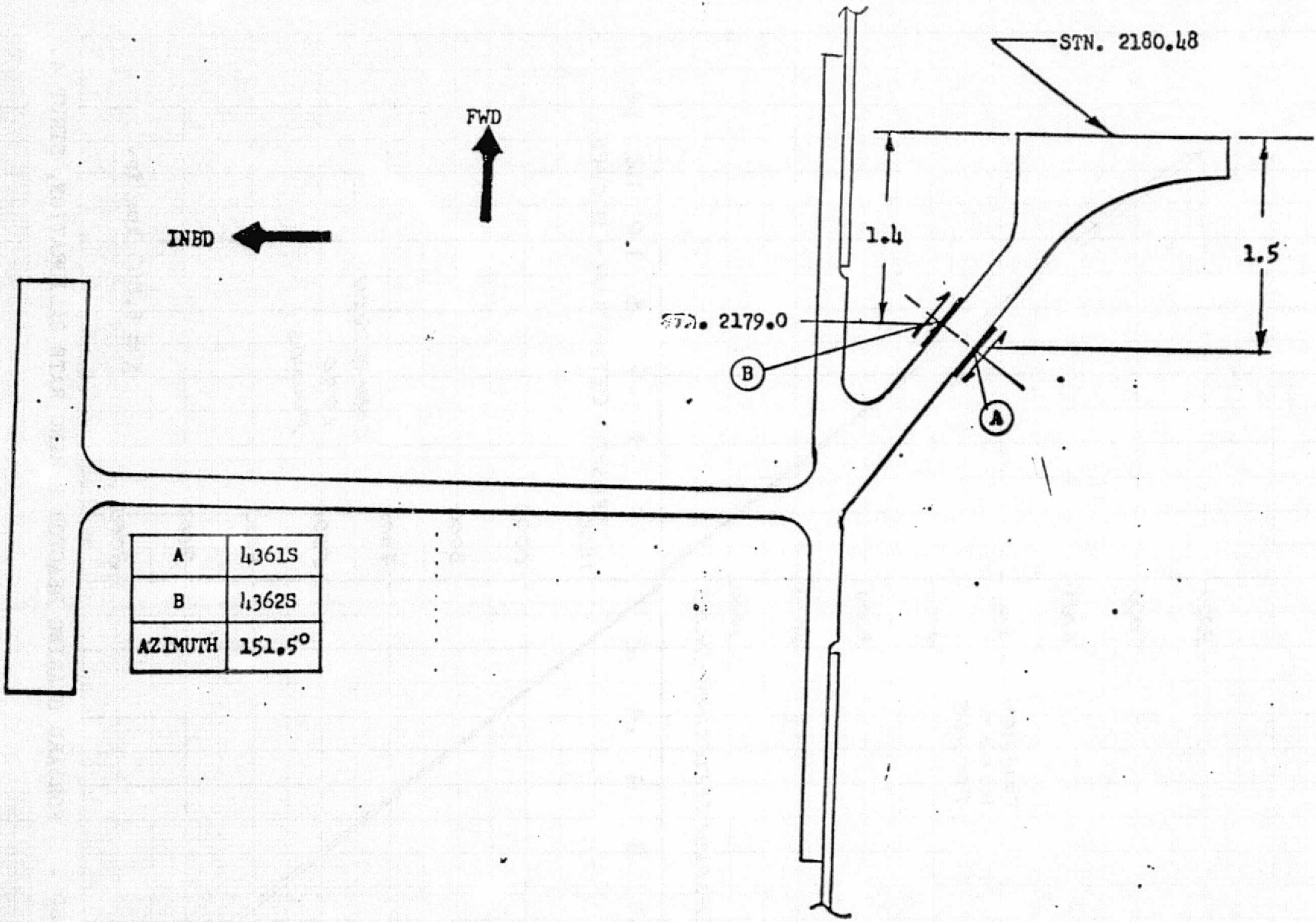


FIGURE 30. FORWARD BEARING REACTOR SPRING RATE CALIBRATION, STRUT 4.



A	4361S
B	4362S
AZIMUTH	151.5°

FIGURE 31. STRAIN GAGE LOCATIONS ON ISA/CSS SUPPORT RING DIAGONAL.

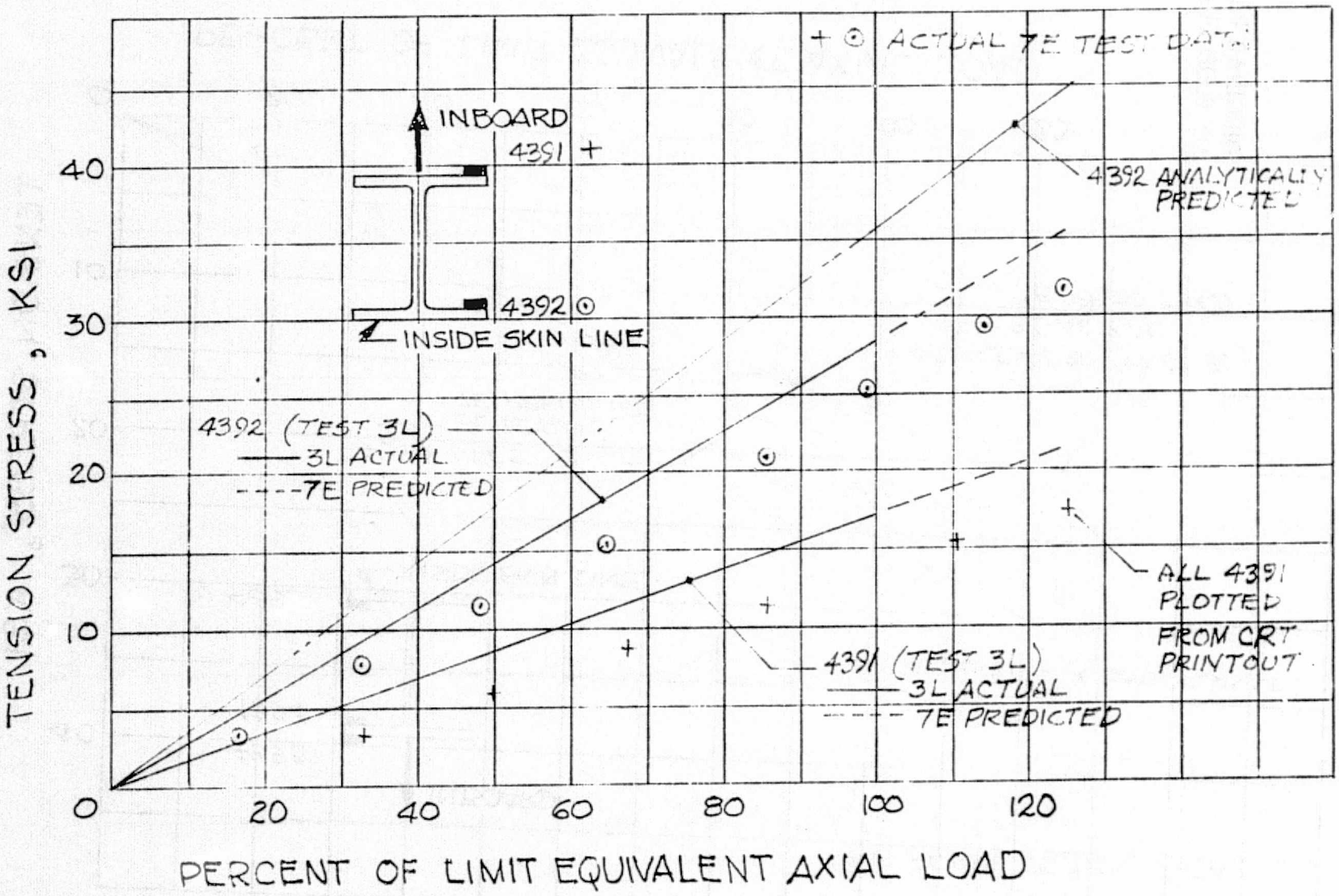


FIGURE 32. TEST CONDITION 7E-2A, STRINGER 20, 4 INCHES AFT OF STATION 2127.43.

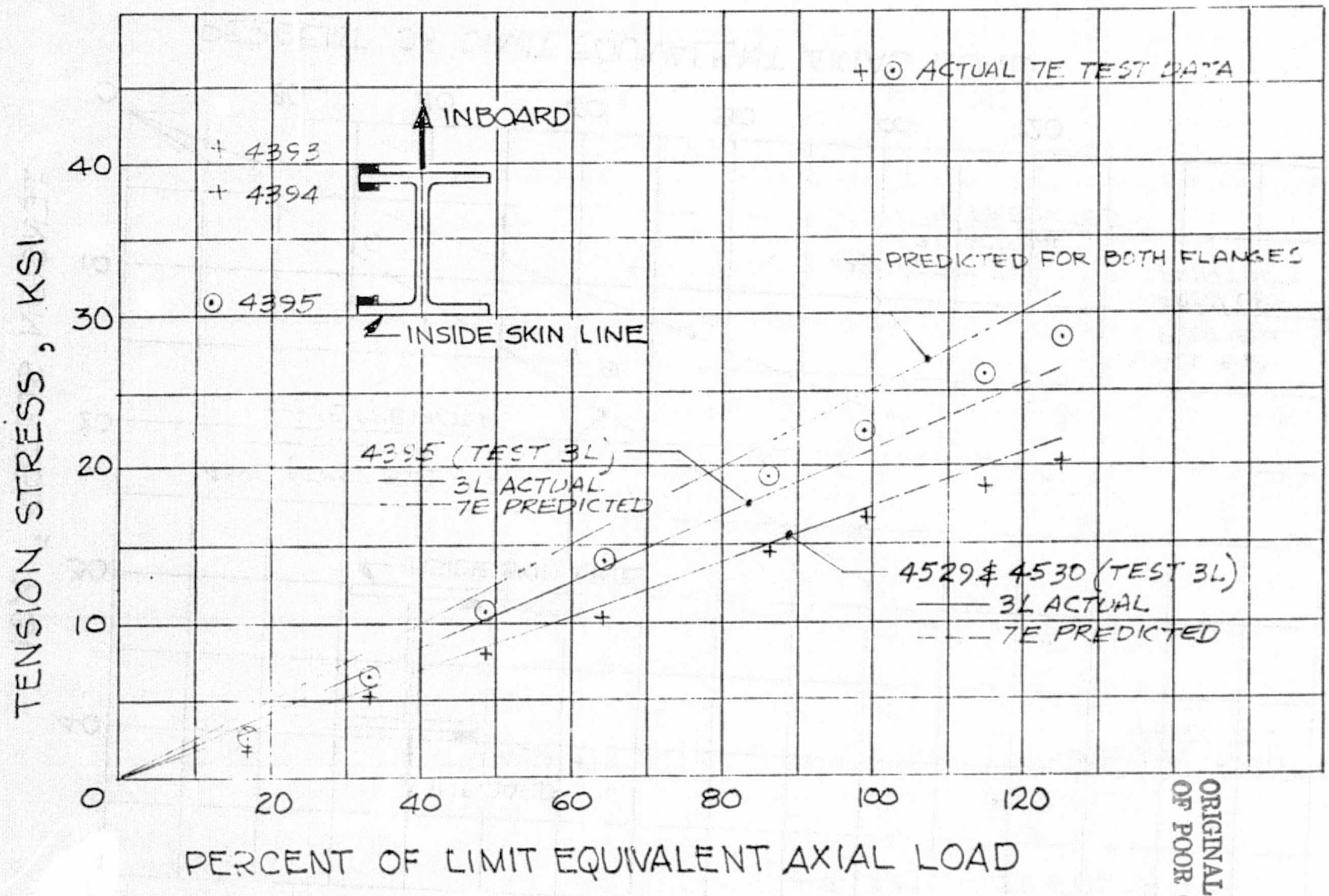


FIGURE 33. TEST CONDITION 7E-2A, STRINGER 20, 17.4 INCHES AFT OF STATION 2127.43.

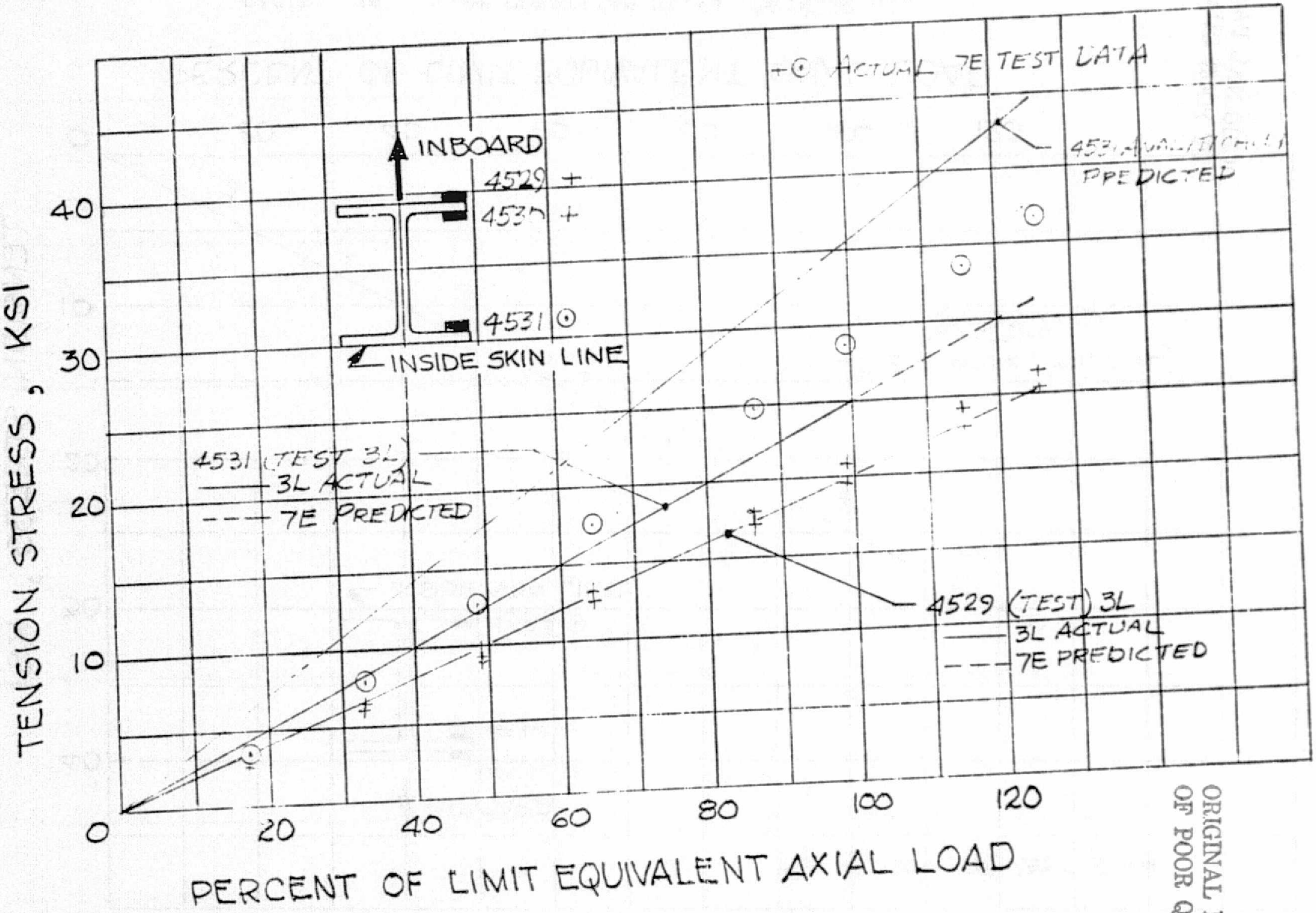


FIGURE 34. TEST CONDITION 7E-2A, STRINGER 21, 9 INCHES AFT OF STATION 2127.43.

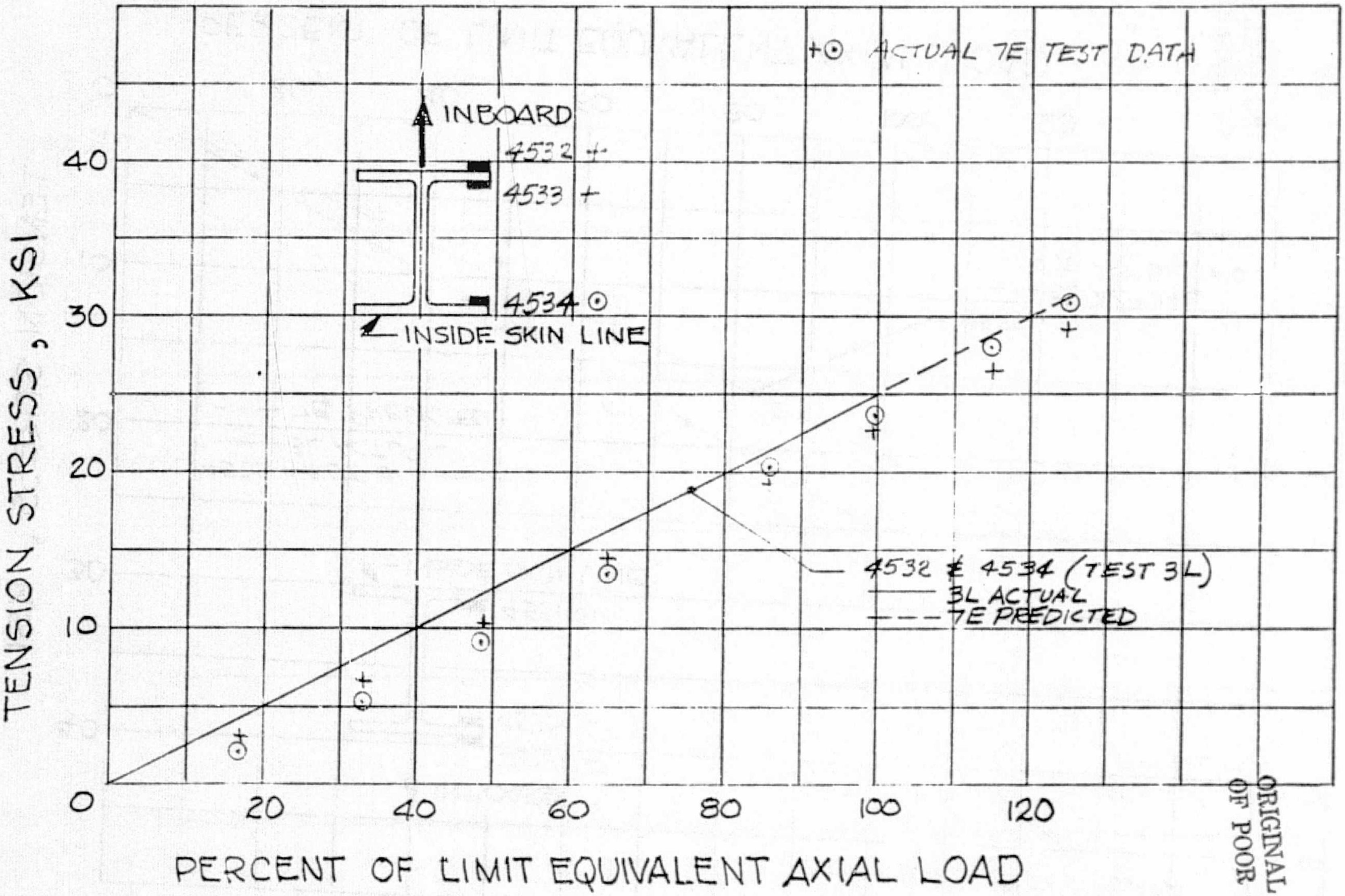


FIGURE 35. TEST CONDITION 7E-2A, STRINGER 21, 17.4 INCHES AFT OF STATION 2127.43.

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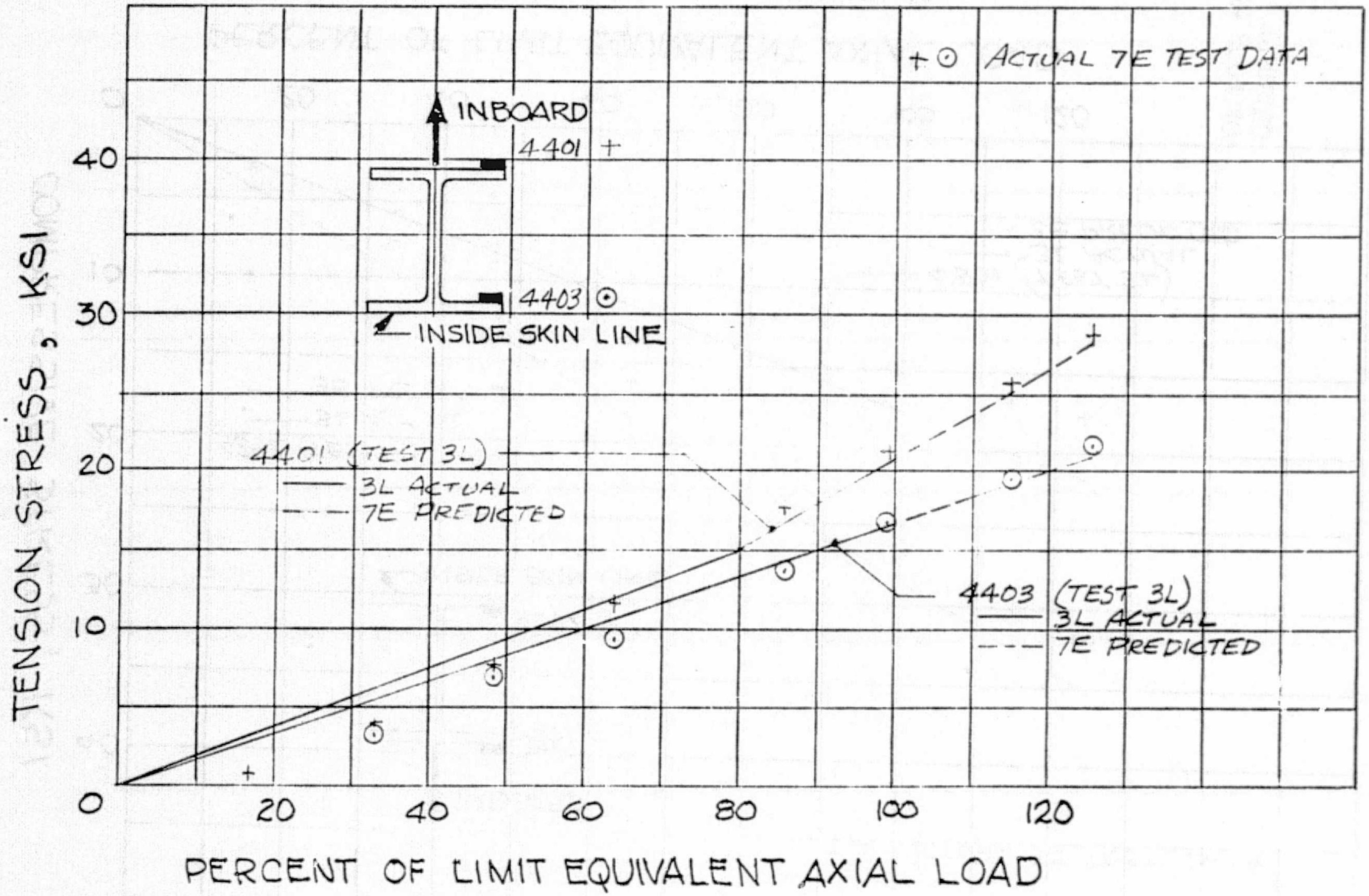

FIGURE 36. TEST CONDITION 7E-2A, STRINGER 3, 17.4 INCHES AFT OF STATION 2127.43.

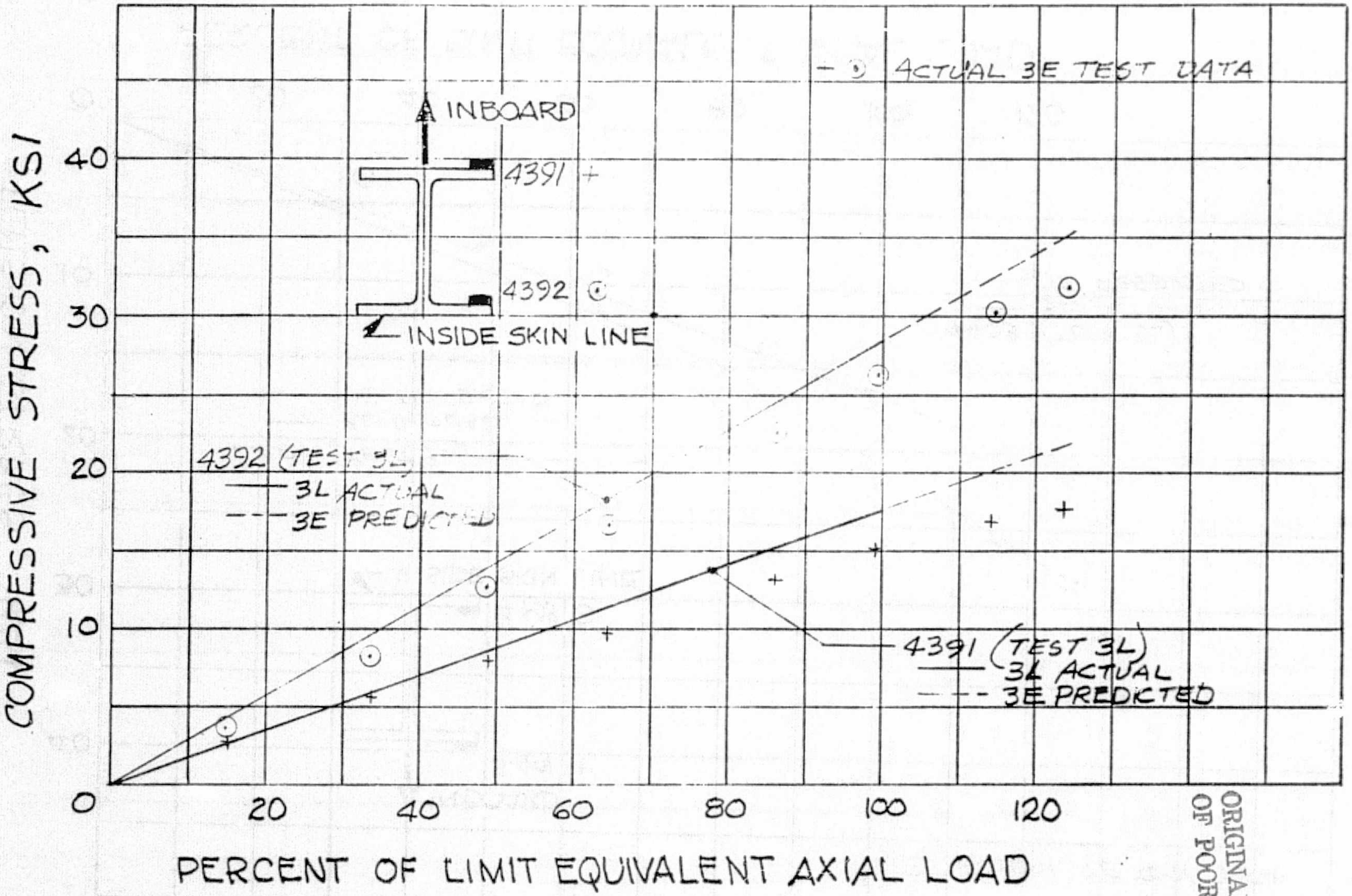

FIGURE 37. TEST CONDITION 3E, STRINGER 20, 4 INCHES AFT OF STATION 2127.43.

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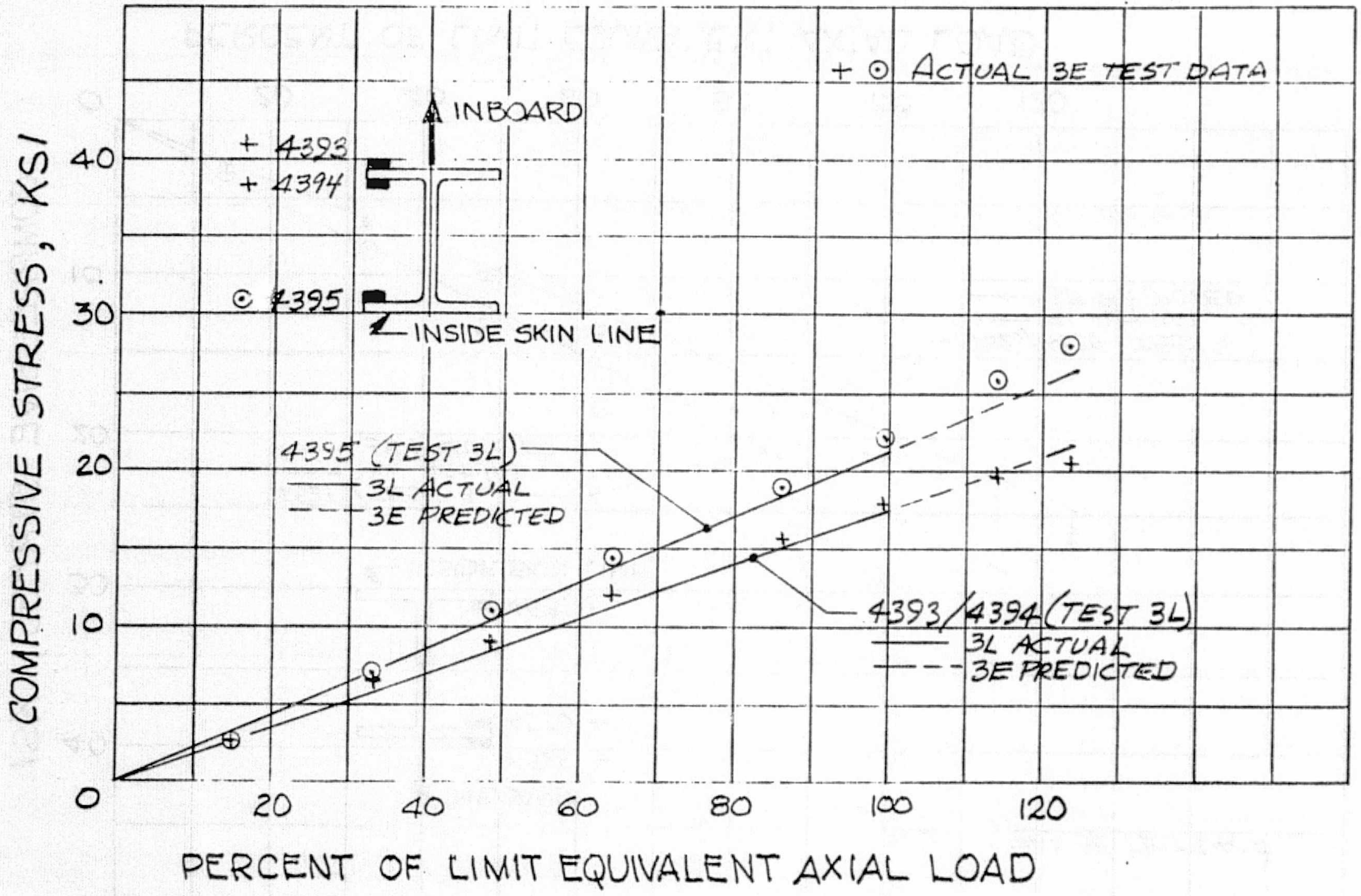

FIGURE 38. TEST CONDITION 3E, STRINGER 20, 17.4 INCHES AFT OF STATION 2127.43.

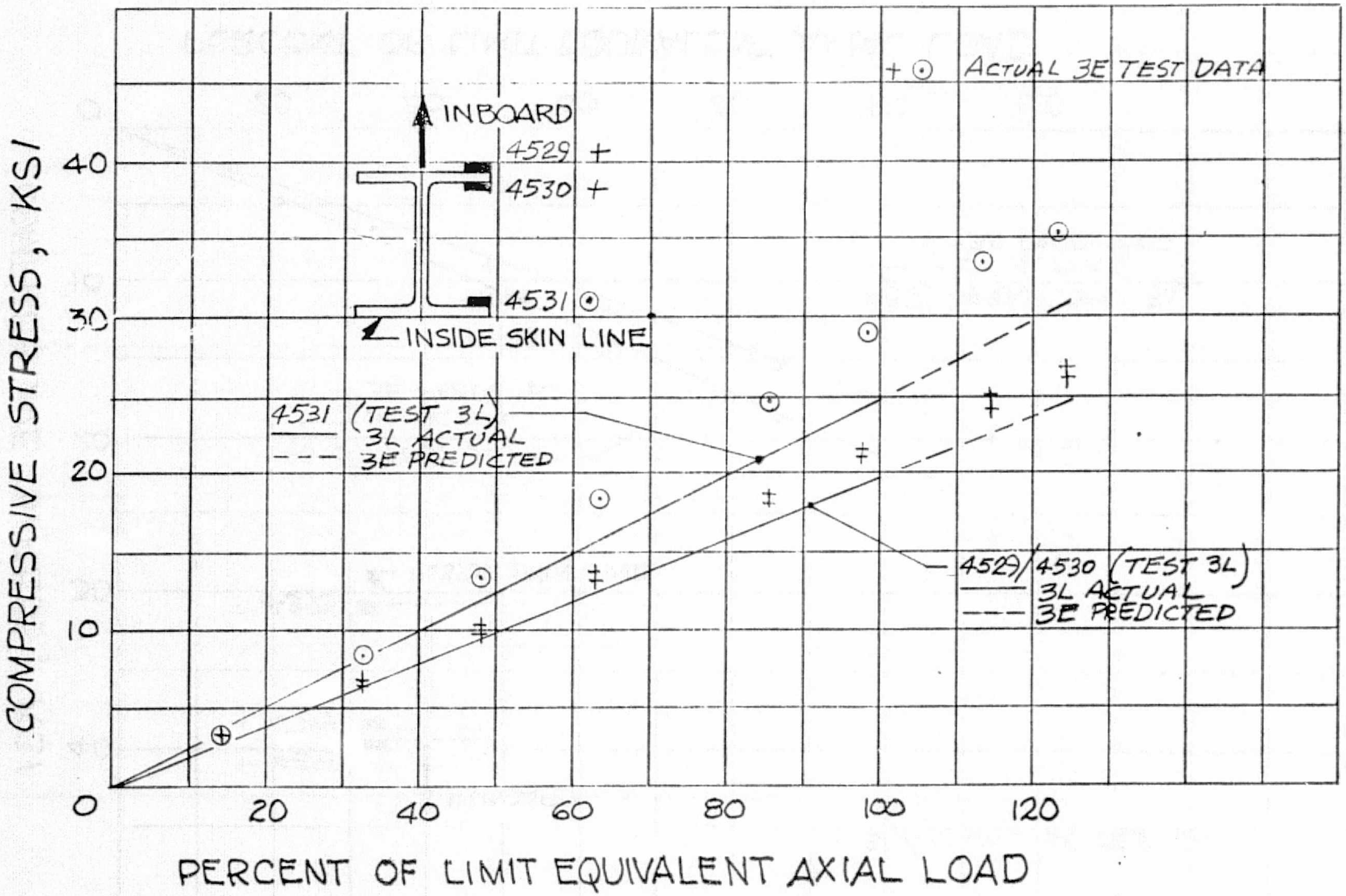

FIGURE 39. TEST CONDITION 3E, STRINGER 21,
9 INCHES AFT OF STATION 2127.43.

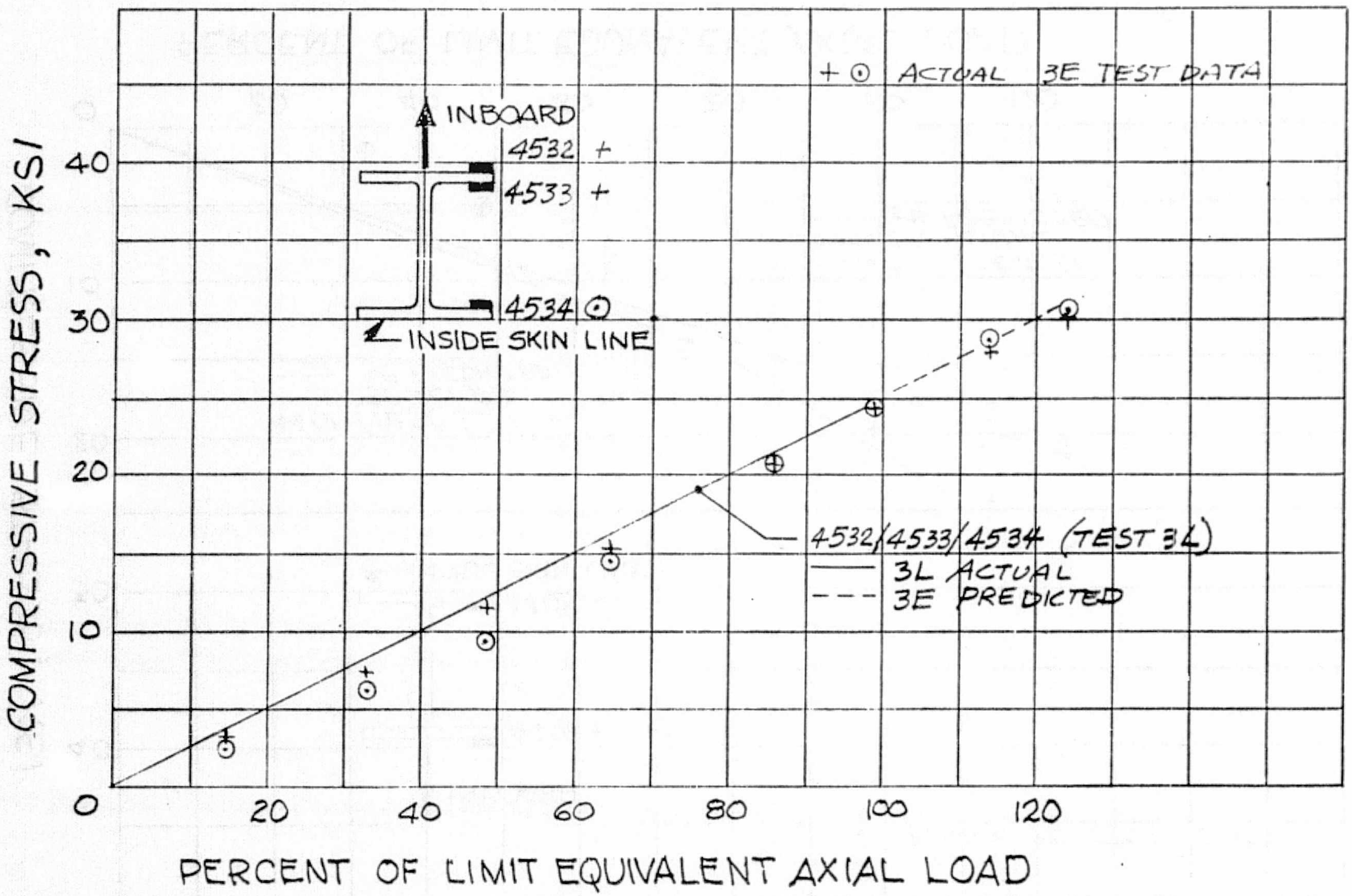

FIGURE 40. TEST CONDITION 3E, STRINGER 21,
17.4 INCHES AFT OF STATION 2127.43.

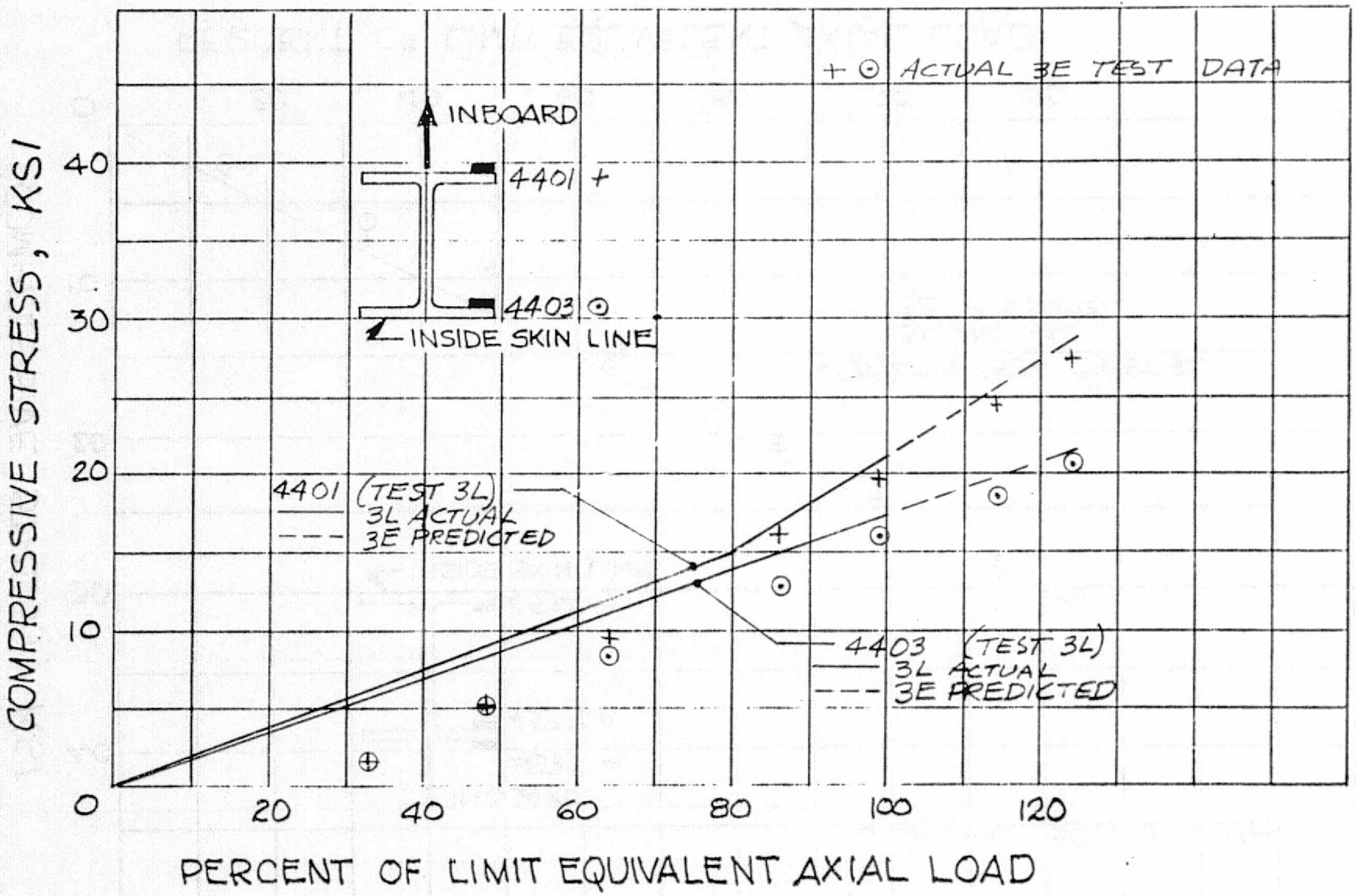

FIGURE 41. TEST CONDITION 3E, STRINGER 3, 17.4 INCHES AFT OF STATION 2127.43.

APPENDIX A

LIST OF INSTRUMENTS
FOR
CSS STATIC ULTIMATE LOAD STRUCTURAL TESTS

Abbreviations used in this listing are as follows:

Meas. No.	Measurement number
CSS	Centaur Standard Shroud
I	Internal mounting
E	External mounting
Cent. Titan	Centaur, Titan components
Mat'l	Material
Stn. No. (Inches)	Station number (inches)
Azim. (Deg)	Azimuth (degrees)
Direction	Mounting direction or orientation
A	Acceleration
L	Applied Load
D	Deflection
P	Pressure
S	Strain
T	Temperature
W	Wind Indication
X	Liquid Level
Long.	Longeron or longitudinal

P21Q3	CSS skin corrugation peak (P) number (21) in Quadrant (Q) number (3) on exterior surface. Also used for interior measurements located opposite skin peak.
V17Q1	Skin corrugation valley (V) similar to peak numbering system
Ring	Framing ring
S-12	ISA stringer number as: Stringer 12 (GDC hardware)
Cir	Circumferencial
Ax	Axial
Rad	Radial
Tan	Tangential

MEAS. NO.		LOCATION/DESCRIPTION	DIRECTION	TYPE	RECORDING RANGE
163	W	WIND DIRECTION			0-360°
164	W	WIND SPEED			0-50 MPH
200	E	PYRO FIRING VOLTAGE			100 mv
321	P	AXIAL CYLINDER DIFFERENTIAL PRESS.	352		± 1800 PSID
322	P	AXIAL CYLINDER DIFFERENTIAL PRESS.	82		"
323	P	AXIAL CYLINDER DIFFERENTIAL PRESS.	172		"
324	P	AXIAL CYLINDER DIFFERENTIAL PRESS.	262		"
325	P	SHROUD SHEAR LOAD CYLINDER DIFFERENTIAL PRESS. (STA. 2750)			± 3000 PSID
326	P	PAYLOAD SHEAR LOAD CYLINDER DIFFERENTIAL PRESSURE			± 1000 PSID
327.	P	CENTAUR TANK STRETCH PRESSURE			0-1500 PSIA
328	P	SHROUD COUNTERBALANCE STRETCH PRESSURE			"
332	P	SHROUD SHEAR LOAD CYLINDER DIFFERENTIAL PRESS. (STA. 2868)			± 3000 PSID
403	T	LIQUID TEMP. LH_2 FILL & DRAIN LINE NEAR CENTAUR			30- 560°R
405	P	AFT SHROUD/TANK ANNULUS PRESS.			0-5 PSID
406	P	AFT SHROUD/TANK ANNULUS PRESS.			.01-1 PSID
406	P	AFT SHROUD/TANK ANNULUS PRESS.			.01- 1 PSID
408	P	LH_2 TANK TO EQUIPMENT MODULE DELTA P			± 30 PSID
409	P	LH_2 TANK TO SHROUD ANNULUS DIFFERENTIAL PRESSURE			"

MEAS. NO.		LOCATION/DESCRIPTION	DIRECTION	TYPE	RECORDING RANGE
425	P	CSS EQUIP. & P/L SEC. PURGE ORIFICE INLET PRESS.			0-500 PSIA
501	P	LH_2 TANK ULLAGE PRESSURE			0-50 PSIA
503	P	LO_2 TANK ULLAGE PRESSURE			0-50 PSIA

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
880	1	X				FWD SEAL CABLE		359	CIR		0-1500 LBS- TENS.
881	L	X				FWD SEAL CABLE		1	CIR		0-1500 LBS.TENS.
882	L	X				"		181	"		"
883	L	X				"		179	"		"
981	A		X			CSS	2677.2	150	RAD	10 HZ.	± 3 g
982	A			X		EQUIP. MODULE	2460.0	150	RAD	"	± 2 g
983	A		X			CSS	"	150	RAD	"	± 2 g
984	A				X	ISA	2177.5	150	RAD	"	± 1 g
985	A				X	TITAN SKIRT	2054.8	150	RAD	"	± 1 g
986	A		X			CSS	2209	150	RAD	"	± 1 g
987	A		X			CSS	2849.8	150	RAD	"	± 4 g

MEAS. NUMBER		DESCRIPTION/LOCATION CSS I	E	CENT. TITAN I	E	HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)	DIRECTION	TYPE	RECORDING RANGE
988	A		X			CSS	2849.8	240	RAD	"	± 1 g
989	A					BLDG.	2778.7	330°	RAD		± 2 g
4254	S		X			P49Q2	2505.3	151	AX	POISSON	± 8000 ue
4255A	S	X				"	"	"	AX	UNI-AXIAL	"
4255P	S	X				"	"	"	CIR	"	"
4290	S		X			LONG	2414.3	158	AX	POISSON	± 8000 ue
4291	S		X			"	"	"	AX	"	"
4295	S	X				LONG	2265.3	162	AX	POISSON	± 8000 ue
4296	S	X				"	"	162	AX	"	± 8000 ue
4326	S		X			RING	2213.0	161.1	AX	UNI-AXIAL	± 8000 ue
4327	S	X				"	"	161.1	AX	"	"
4387	S			X		SF-3	2129.0	333	AX	POISSON	± 8000 ue
4388	S			X		"	"	"	"	"	"
4391	S			X		S-20	2123.3	145	AX	POISSON	± 8000 ue
4392	S			X		"	"	"	AX	"	"
4393	S			X		S-20	2109.9	145	AX	POISSON	± 8000 ue
4394	S			X		"	"	"	"	"	"
4395	S			X		"	"	"	"	"	"

MEAS. NUMBER		DESCRIPTION/LOCATION CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)	DIRECTION	TYPE	RECORDING RANGE
		I	E	I	E						
4401	S			X		S-3	2109.9	335	AX	POISSON	± 8000 ue
4403	S			X		S-3	2109.9	335	AX	POISSON	± 8000 ue
4463	S				X	FBR	2460.0	50	LONG	DOUBLE POISSON	± 2600 ue
4464	S				X	"	"	110	"	"	"
4465	S				X	"	"	170	"	"	"
4466	S				X	"	"	230	"	"	"
4467	S				X	"	"	290	"	"	"
4468	S				X	"	"	350	"	"	"
4529	S			X		S-21	2118.3	155	AX	POISSON	± 8000 ue
4530	S			X		"	"	"	AX	"	"
4531	S			X		"	"	"	AX	"	"

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
4800	S				X	TRUSS STRUT	2484.0	330	LONG	POISSON	± 8000 ue
4801	S				X	"	"	"	"	"	"
4802	S				X	"	"	240	"	"	"
4803	S				X	"	"	"	"	"	"
4804	S				X	STUB ADAPTER	2455.4	326		R1	"
4805	S				X	"	"	"		R2	"
4806	S				X	"	"	"		R3	"
4810	S				X	STUB ADAPTER	2438.7	326		R1	± 8000 ue
4811	S				X	"	"	"		R2	"
4812	S				X	"	"	"		R3	"
4816	S				X	STUB ADAPTER	2455.4	236		R1	± 8000 ue
4817	S				X	"	"	"		R2	"
4818	S				X	"	"	"		R3	"
4822	S				X	STUB ADAPTER	2438.7	236		R1	± 8000 ue
4823	S				X	"	"	"		R2	"
4824	S				X	"	"	"		R3	"
4828	S				X	S.A. S-A55B	2438.7	329	AX	POISSON	± 8000 ue
4829	S				X	"	"	"	AX	"	"
4830	S		X			RING	2209.5	173.5	CIR	UNI-AXIAL	"

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
4831	S		X			"	"	353.5	CIR	"	"
4832	S		X			"	"	161.[illegible]	CIR	"	"
4816	S				X	STUB ADAPTER	2455.4	236		R1	± 8000 ue
4817	S				X	"	"	"		R2	"
4818	S				X	"	"	"		R3	"
4822	S				X	STUB ADAPTER	2438.7	236		R1	± 8000 ue
4823	S				X	"	"	"		R2	"
4824	S				X	"	"	"		R3	"
4828	S				X	S.A. S-A55B	2438.7	329	AX	POISSON	± 8000 ue
4829	S				X	"	"	"	AX	"	"
4830	S		X			RING	2209.5	173.5	CIR	UNI-AXIAL	"
4831	S		X			"	"	353.5	CIR	"	"
4832	S		X			"	"	161.[illegible]	CIR	"	"

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
4913	S		X			RING	2209.0	353.9	AX	UNI-AXIAL	± 8000 ue
4914	S	X				"	"	"	AX	"	"
4917A	S	X				P4102	2339.0	141	AX	UNI-AXIAL	± 8000 ue
4917P	S	X				"	"	"	CIR	"	"
4918	S		X			"	"	"	AX	POISSON	"
4919	S	X				RING	2213.0	173.5	AX	UNI-AXIAL	"
4920	S		X			"	"	"	"	"	"
4921	S		X			"	"	"	CIR	"	"
4922	S		X			STRINGER 31	2143.9	151.0	AX	POISSON	"
4923	S		X			"	"	"	"	"	"
5256	D		X			CSS	2679.2	330	RAD		14 INCHES
5257	D		X			"	2678.0	150	AX		3 INCHES
5258	D		X			"	2678.0	330	AX		3 INCHES
5263	D		X			CSS	2463.7	60	TAN		12 INCHES
5264	D		X			"	2463.7	240	TAN		"
5265	D	X				CSS CENTAUR	2463.7	60	TAN		5 INCHES
5266	D	X				"	2463.7	240	TAN		"

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
5280	D		X			CSS	2241.0	330	RAD		4.0 INCHES
5281	D		X			"	2213.0	150	RAD		-2.0 INCHES
5282	D		X			"	2213.0	330	RAD		2.0 INCHES
5286	D		X			RING	2209.0	150	RAD		- 2.0 INCHES
5290	D		X			RING	2209.0	330	RAD		2.0 INCHES
5291	D		X			"	2209.0	150	AX		- 2.0 INCHES
5292	D		X			"	2209.0	330	AX		2.0 INCHES
5294	D		X			ISA	2181.0	150	RAD		- 2.0 INCHES
5295	D		X			"	2181.0	330	RAD		2.0 INCHES
5297	D		X			ISA	2181.0	150	AX		-1.0 INCH
5298	D		X			"	2181.0	330	AX		1.0 INCH
5299	D		X			"	2181.0	60	TAN		2.0 INCHES
5300	D		X			"	2181.0	240	TAN		"
5305	D		X			ISA	2127.0	330	RAD		1.0 INCHES
5310	D		X			TITAN SKIRT	2052.9	153	AX		-1.0 INCH
5311	D		X			"	"	333	AX		1.0 INCH
5371	D		X				2208.5	60	TAN		2.0 INCHES

MEAS. NUMBER		DESCRIPTION/LOCATION CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)	DIRECTION	TYPE	RECORDING RANGE
		I	E	I	E						
5372	D		X				"	240	TAN		"
5407	D		X			CSS	2463.7	60	TAN		12 INCHES
5408	D		X			"	"	240	TAN		"
5439	D		X			L-DISTR. CYL. TO TOWER	2036.4	150	AX		-0.5 INCHES
5440	D		X			"	"	330	AX		0.5 INCH
5447	D		X				2212	150	AX		2.0 INCHES
5448	D		X				2212	330	AX		2.0 INCHES
5449	D		X				2177	150	AX		-1.0 INCHES
5450	D		X				2177	330	AX		1.0 INCH
5451	D		X				2808	330	RAD		20.0 INCHES
5453	D		X				2626	330	RAD		14 INCHES
5454	D	X					2626	330	RAD		-12 INCHES
5456	D		X				2350.	330	RAD		6.0 INCHES
5458	D	X					2241	330	RAD		-2.0 INCHES
5459	D		X				2177	60	TAN		2.0 INCHES
5460	D		X				2177	240	TAN		"
5461	D		X				2177	150	RAD		-2.0 INCHES
5462	D		X				2177	330	RAD		2.0 INCH

MEAS. NUMBER		DESCRIPTION/LOCATION							DIRECTION	TYPE	RECORDING RANGE
		CSS		CENT. TITAN		HARDWARE PIECE (MAT'L)	STN. NO. (INCHES)	AZIM. (DEG.)			
		I	E	I	E						
5463	D		X				2050	330	RAD		0.5 INCHES
5464	D		X			CSS	2807	150	RAD	10 Hz.	± 6 IN.
5465	D		X			CSS	2680	150	RAD	"	± 5 IN.
5466	D		X			CSS	2460	150	RAD	"	± 3 IN.
5467	D	X				CSS-CENTAUR	2460	330	RAD	"	± 2 IN.
5468	D		X			CSS	2209	150	RAD	"	± 1 IN.
5469	D		X			CSS	2177.	150	RAD	"	± 1 IN.
5470	D		X			TITAN SKIRT	2050	150	RAD	"	± 0.5 IN.

MEAS. NO.		LOCATION/DESCRIPTION	DIRECTION	TYPE	RECORDING RANGE
5701	D	SHROUD SHEAR LOAD CYLINDER DISPLACEMENT STATION 2750	RAD		0-20 INCHES
5702	D	PAYLOAD SHEAR LOAD CYLINDER DISPLACEMENT	RAD		0-20 INCHES
5703	D	AXIAL LOAD CYLINDER DISPLACEMENT 352°	AX		0-10 INCHES
5704	D	AXIAL LOAD CYLINDER DISPLACEMENT 82°	AX		"
5705	D	AXIAL LOAD CYLINDER DISPLACEMENT 172°	AX		"
5706	D	AXIAL LOAD CYLINDER DISPLACEMENT 262°	AX		"
5714	D	CENTAUR CENTERLINE TO BUILDING DEFLECTION -X	N S	LASER	0- 15 INCHES
5715	D	CENTAUR CENTERLINE TO BUILDING DEFLECTION -Y	E W	"	0- 10 INCHES
5721	D	SHROUD SHEAR LOAD CYLINDER DISPLACEMENT STATION 2868	RAD		0-20 INCHES

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APPENDIX B

by H. E. Ledyard

Differences in Configuration between the Proof Flight Structures and the Test Specimen

PROOF FLIGHT CSS DESIGN CHANGES NOT RETROFITTED TO TEST CSS

1. "T" section cross braces in the nose cone at Station 2867 (test CSS has angle braces).

2. Radioactive Thermionic Generator (RTG) cutout, 15" x 12" at Station 2649 to 2664, azimuth 90° (test CSS has no cutout).

3. Air conditioning door cutout at Station 2670(117°), 3/8" narrower than test CSS cutout (test CSS cutout at Station 2656(131°).

4. 2.2" diameter encapsulation bulkhead lanyard disconnect cutouts at Station 2502(92° and 54°)(test CSS has no cutouts).

5. Flight vent holes - forward vents at Station 2471 and aft vents including those for the Titan skirt at Station 2221 (non-flight vent holes on the test CSS).

6. Five aft purge seal access doors, i.e., additional door at Station 2241(135°)(test CSS has four doors).

7. Lock bolts incorporated at the split lines, Station 2687 (test CSS has rivets).

8. Flight CSS has strengthened ring at Station 2523 and an additional ring at Station 2251.

9. Boost pump door redesigned to be solid with full length stiffeners throughout (test CSS has no door).

10. Flight CSS RTG cutout has channel stiffener on inboard surface of panel doubler.

11. Flight CSS forward and aft thermal shields have strengthened tie-down tabs.

12. FBR bearing block assembly and fitting assembly fabricated using steel (test CSS has aluminum).

13. Lock bolts at range safety command antenna splice on flight CSS (test CSS has rivets).

TEST PECULIAR FEATURES NOT ON PROOF FLIGHT CSS

1. A removable notched dome ring installed at Station 2867.

2. A removable axial load application ring installed at the transition of the 25° and 15° cone at Station 2806.

3. Three 4-inch diameter holes and associated doublers incorporated in the payload area at Station 2626.

4. Removable plate segments installed at three places at Stations 2732, 2753, and 2777 in the 15° cone.

OTHER TEST CONFIGURATION DIFFERENCES OR CHANGES

1. The encapsulation bulkhead not installed.

2. The T-4 panel not installed and the T-4 chute replaced with the Design Evaluation Test unit.

3. Radius blocks installed on the Centaur tank at Station 2240 (219 ring).

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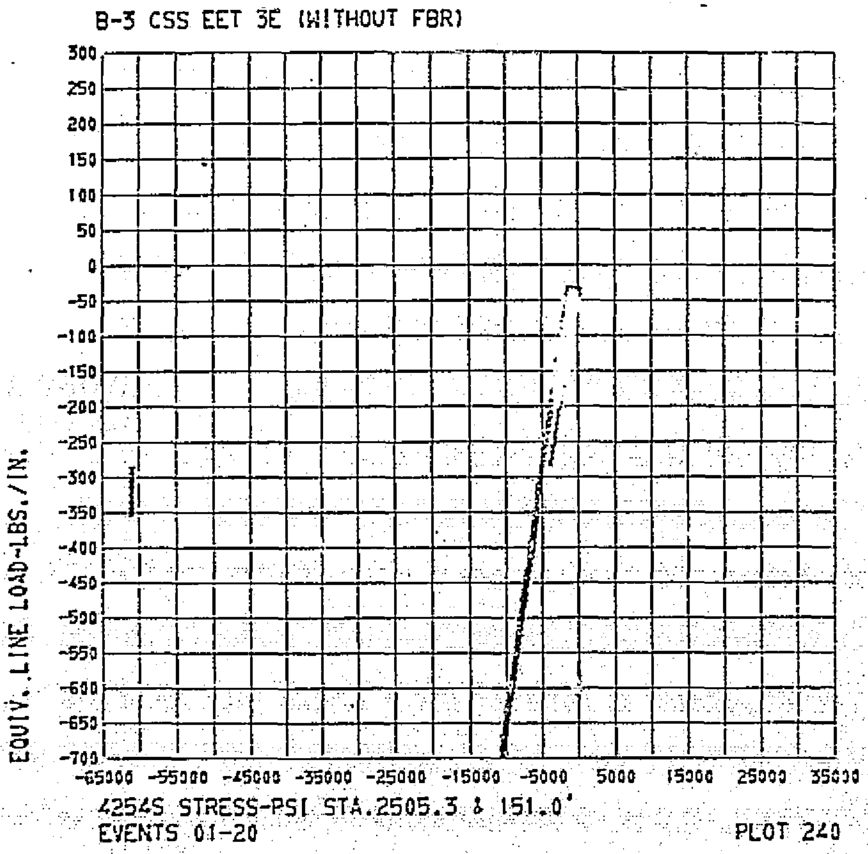
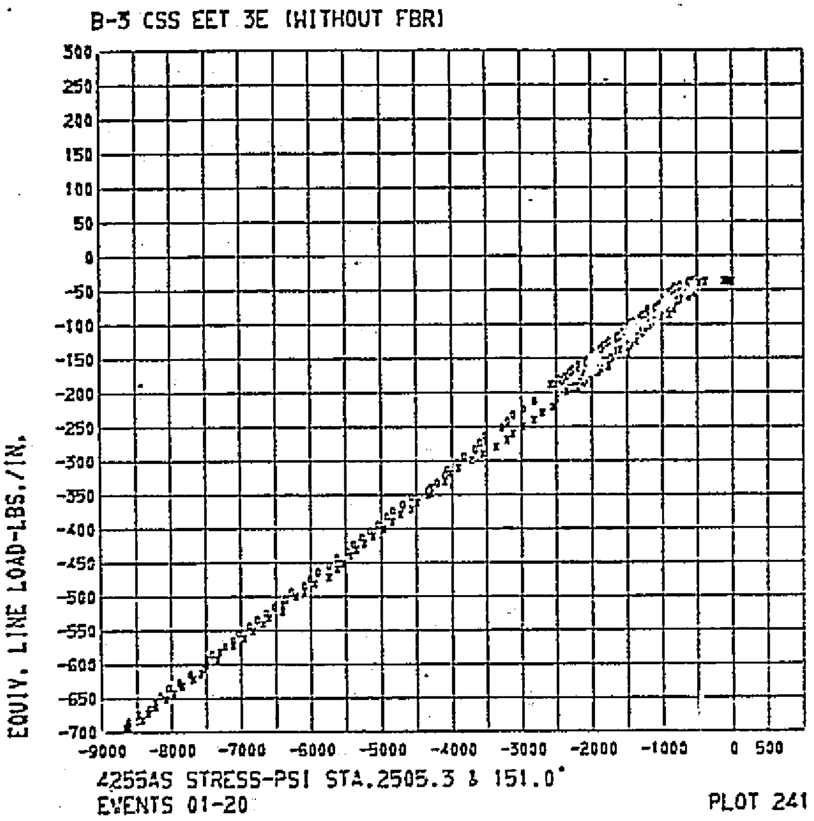
APPENDIX C

by G. S. Sarvay

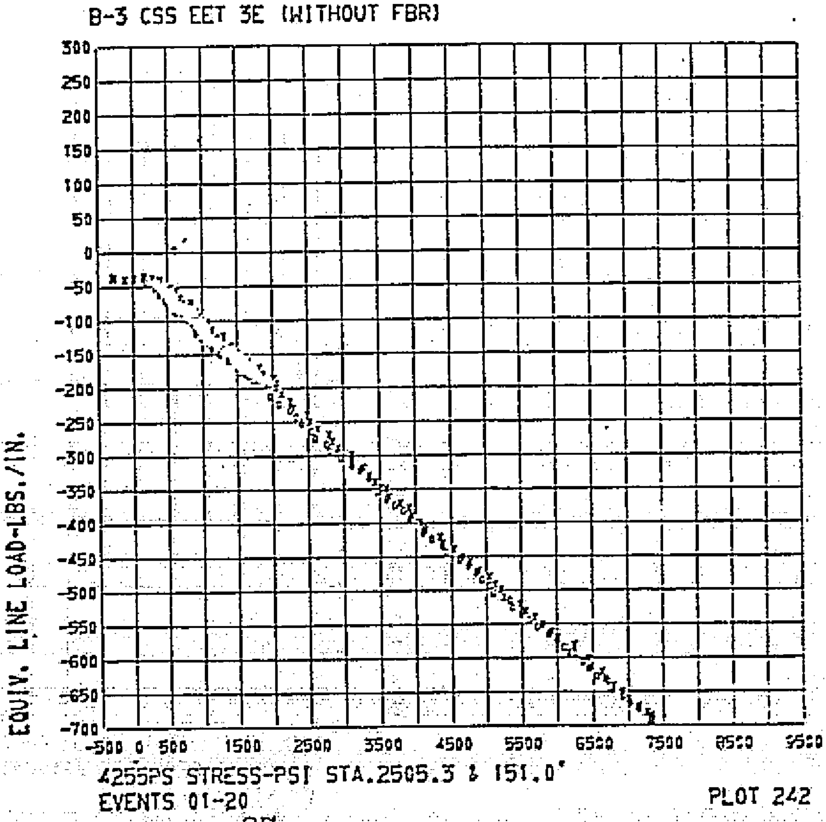
Summary of Stress Data for Tests 3E and 7E-2A

In this summary test 3E stress values (lbs/sq.in.) for the measurements located on the CSS structure are plotted versus equivalent line load (lbs/in.). Test 7E-2A stress measurements are plotted versus applied shear load (lbs).



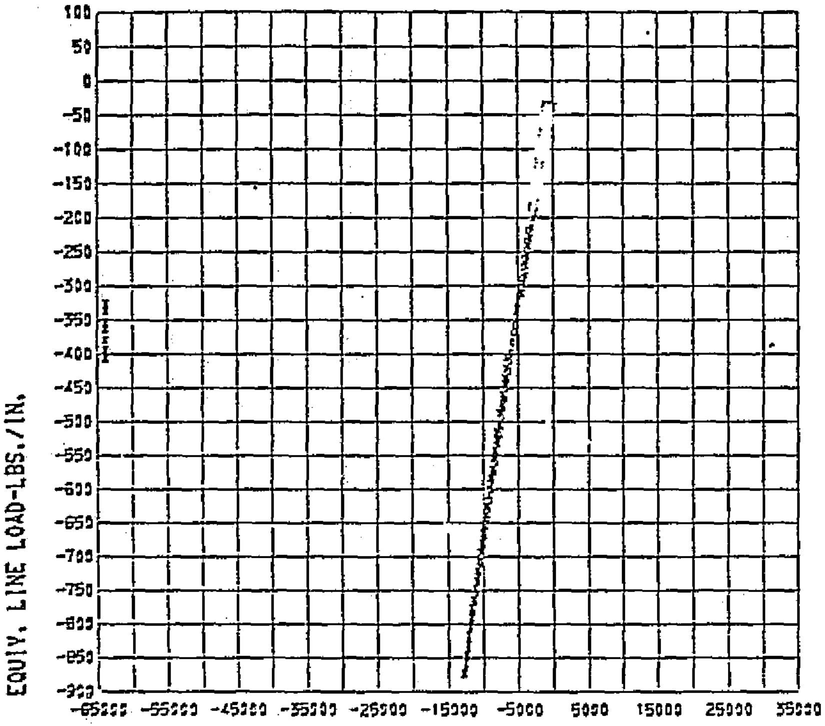


PLOT 241



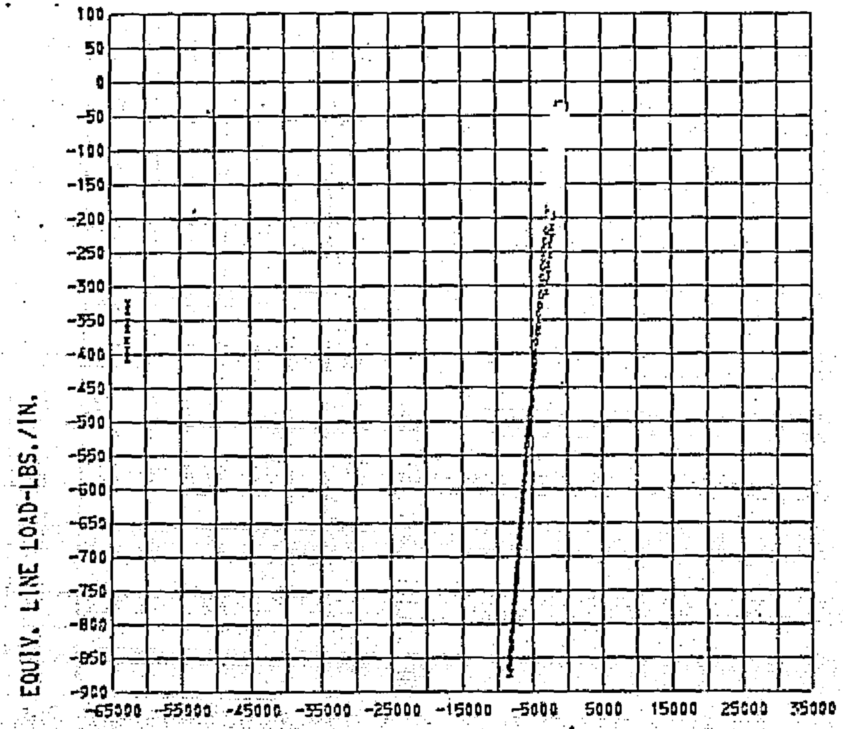
PLOT 242

B-3 CSS EET 3E (WITHOUT FBR)



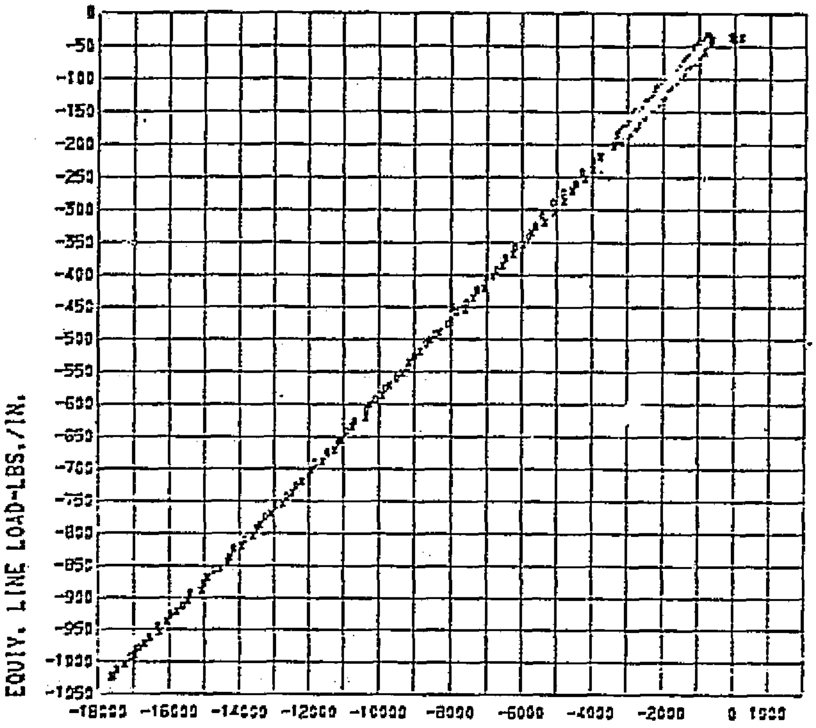
4290S STRESS-PSI STA.2414.3 1 158.0'
EVENTS 01-20 PLOT 243

B-3 CSS EET 3E (WITHOUT FBR)



4291S STRESS-PSI STA.2414.3 1 158.0'
EVENTS 01-20 PLOT 244

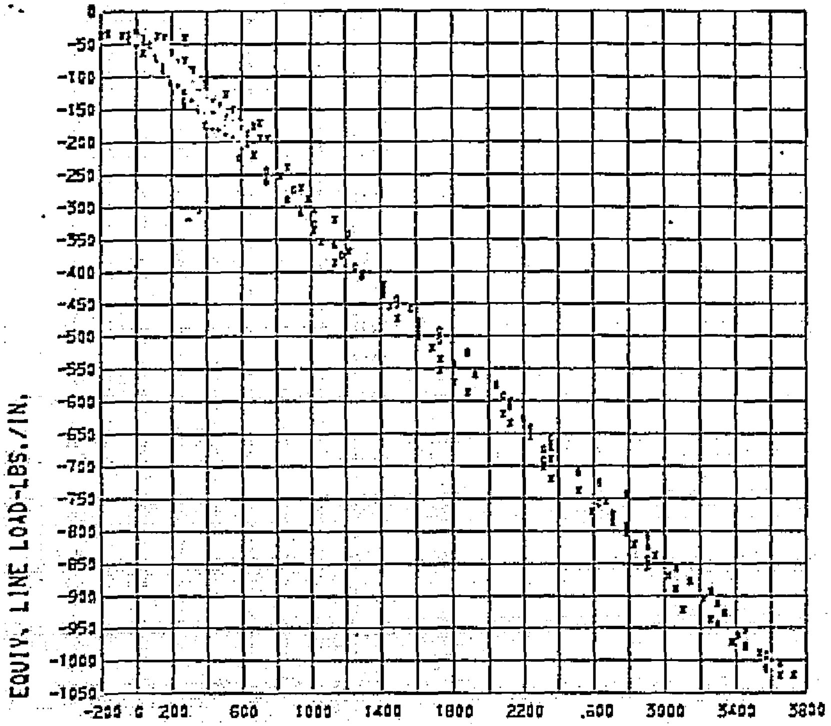
B-3 CSS EET 3E (WITHOUT FBR)



4917AS STRESS-PSI STA.2339 ⊥ 141.0°
EVENTS 01-20

PLOT 245

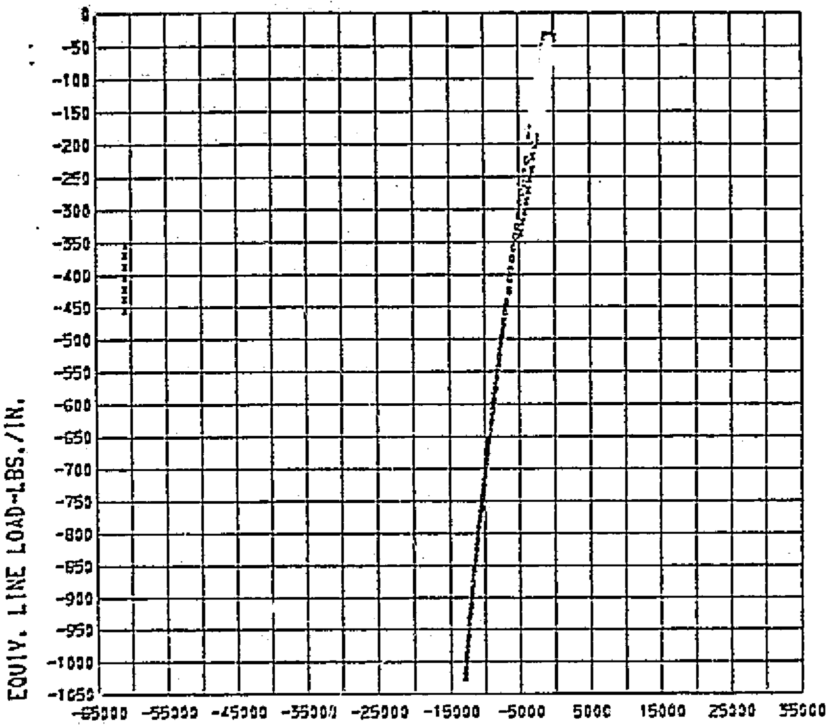
B-3 CSS EET 3E (WITHOUT FBR)



4917PS STRESS-PSI STA.2339 ⊥ 141.0°
EVENTS 01-20

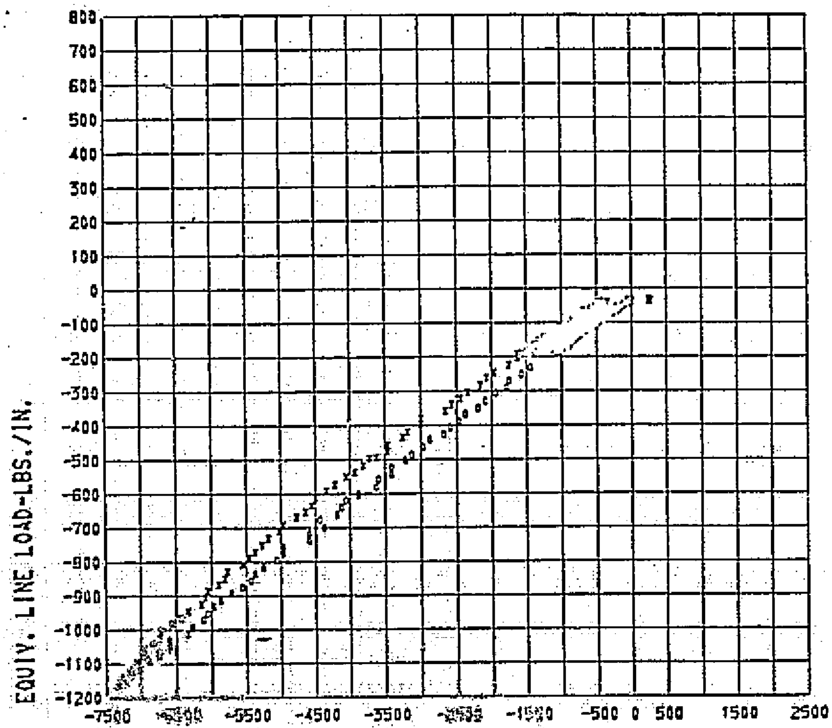
PLOT 246

B-3 CSS EET 3E (WITHOUT FBR)



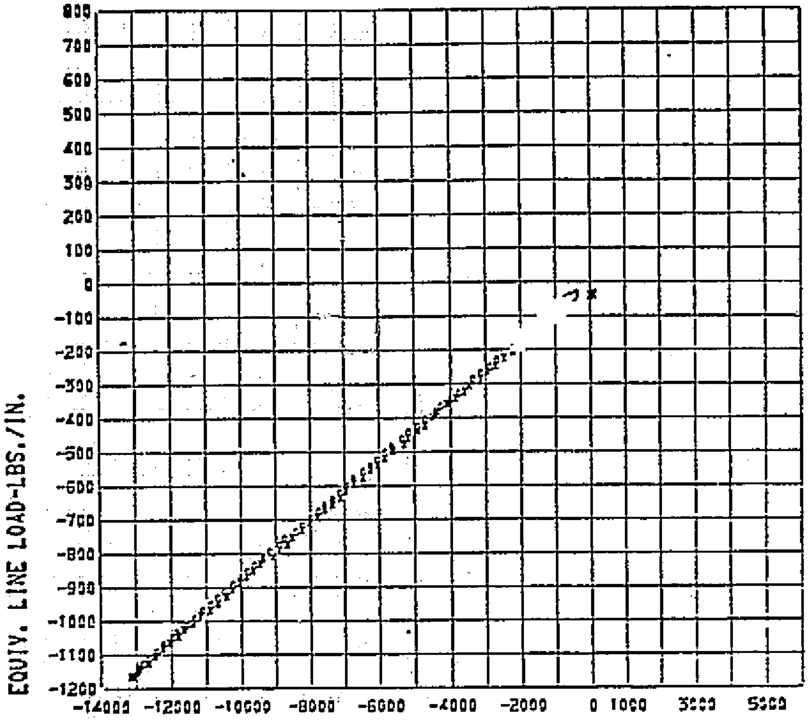
49185 STRESS-PSI STA.2339 ⅈ 141.0'
EVENTS 01-20 PLOT 247

B-3 CSS EET 3E (WITHOUT FBR)



42999 STRESS-PSI STA.2265.3 ⅈ 162.0'
EVENTS 01-20 PLOT 248

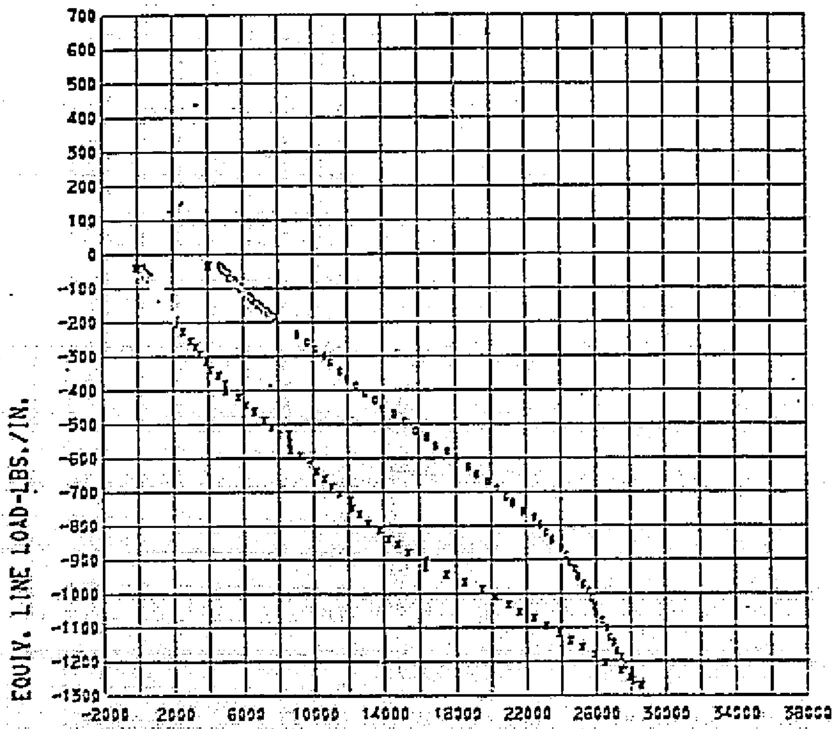
B-3 CSS EET 3E (WITHOUT FBR)



4296S STRESS-PSI STA.2265.3 ∠ 162.0°
EVENTS 01-20

PLOT 249

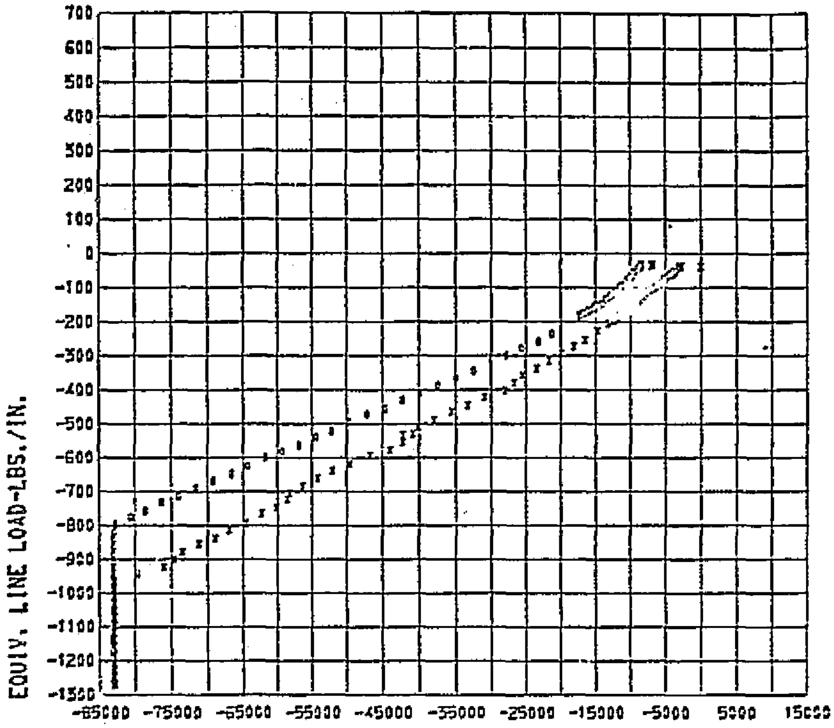
B-3 CSS EET 3E (WITHOUT FBR)



4834S STRESS-PSI STA.2213 ∠ 161.1°
EVENTS 01-20

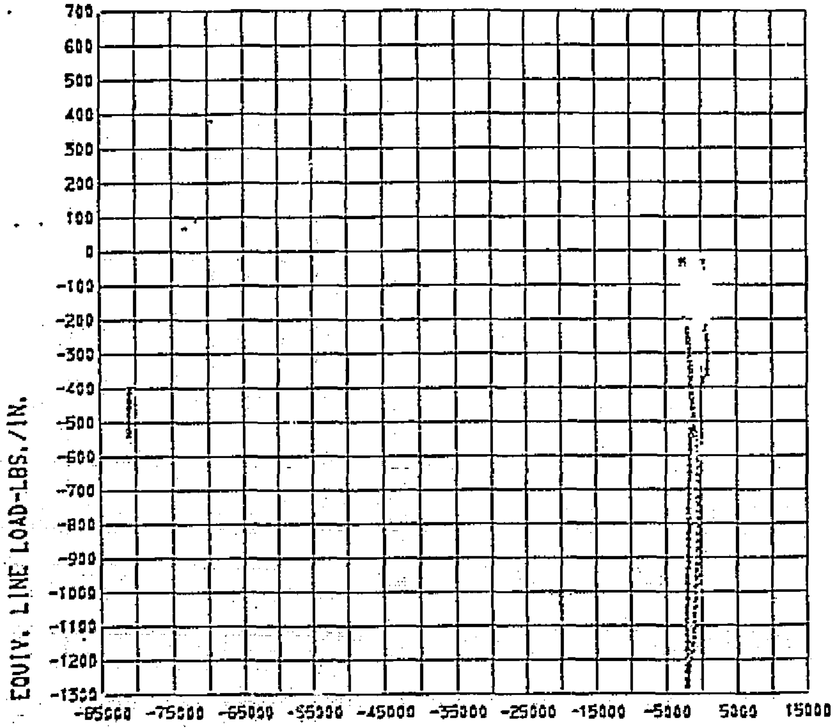
PLOT 250

B-3 CSS EET 3E (WITHOUT FBR)



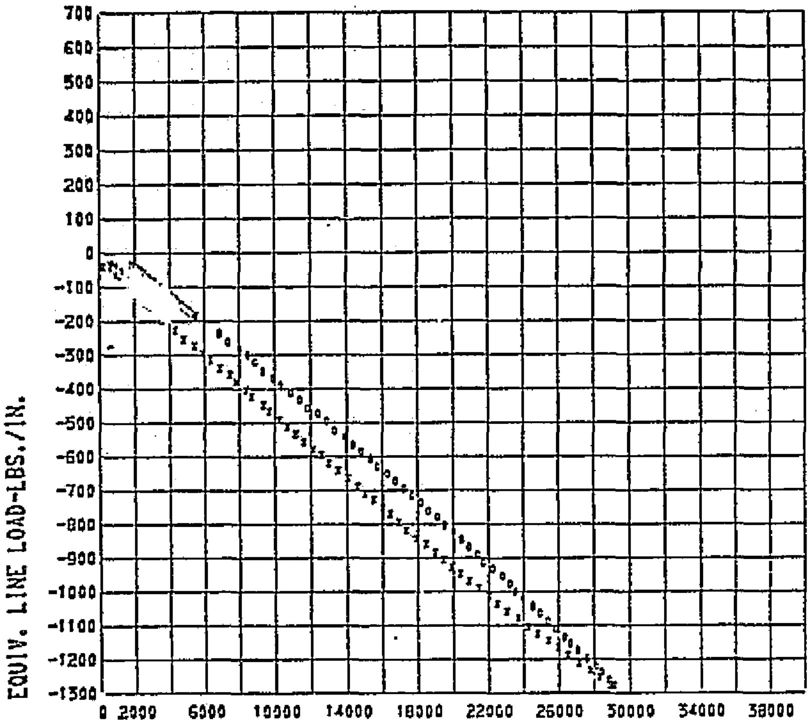
4326S STRESS-PSI STA.2213 ℄ 161.1'
EVENTS 01-20 PLOT 251

B-3 CSS EET 3E (WITHOUT FBR)



4327S STRESS-PSI STA.2213 ℄ 161.1'
EVENTS 01-20 PLOT 252

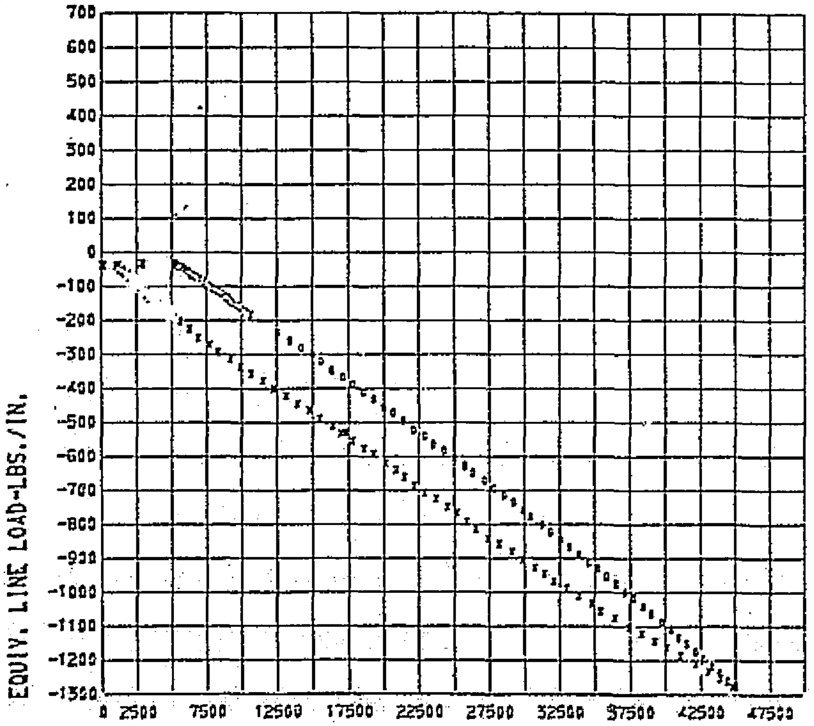
B-3 CSS EET 3E (WITHOUT FBR)



48325 STRESS-PSI STA.2209 Φ 161.3'
EVENTS 01-20

PLOT 257

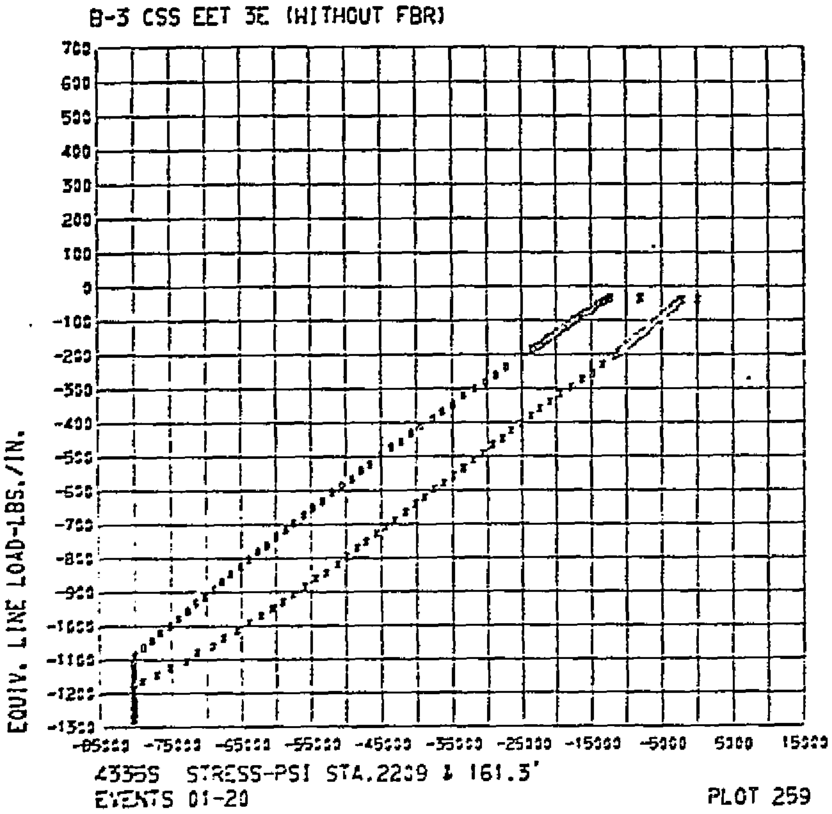
B-3 CSS EET 3E (WITHOUT FBR)



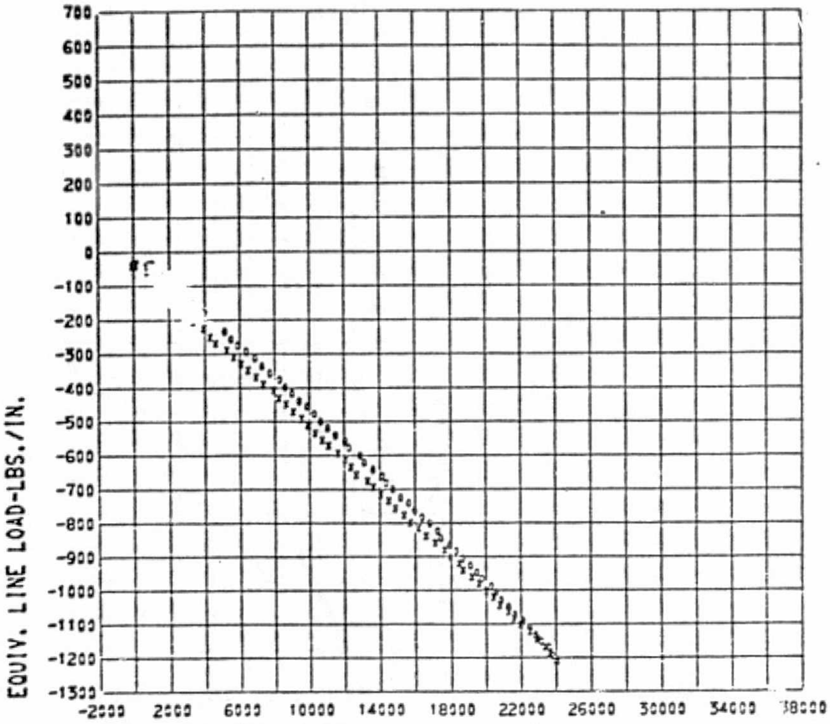
43345 STRESS-PSI STA.2209 Φ 161.3'
EVENTS 01-20

PLOT 258

C-2


B-3 CSS EET 3E (WITHOUT FBR)
EQUIV. LINE LOAD-LBS./IN.
700
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
-1200
-1300
-85000
-75000
-65000
-55000
-45000
-35000
-25000
-15000
-5000
5000
15000
43555 STRESS-PSI STA.2209 & 161.5'
EVENTS 01-20
PLOT 259

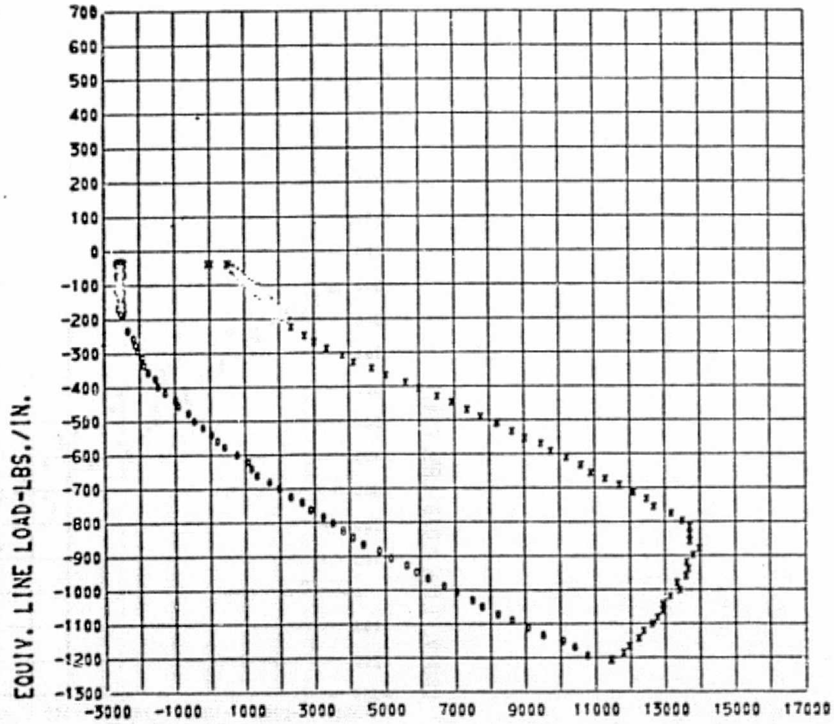
B-3 CSS EET 3E (WITHOUT FBR)



4830S STRESS-PSI STA.2209 ℄ 173.5°
EVENTS 01-20

PLOT 264

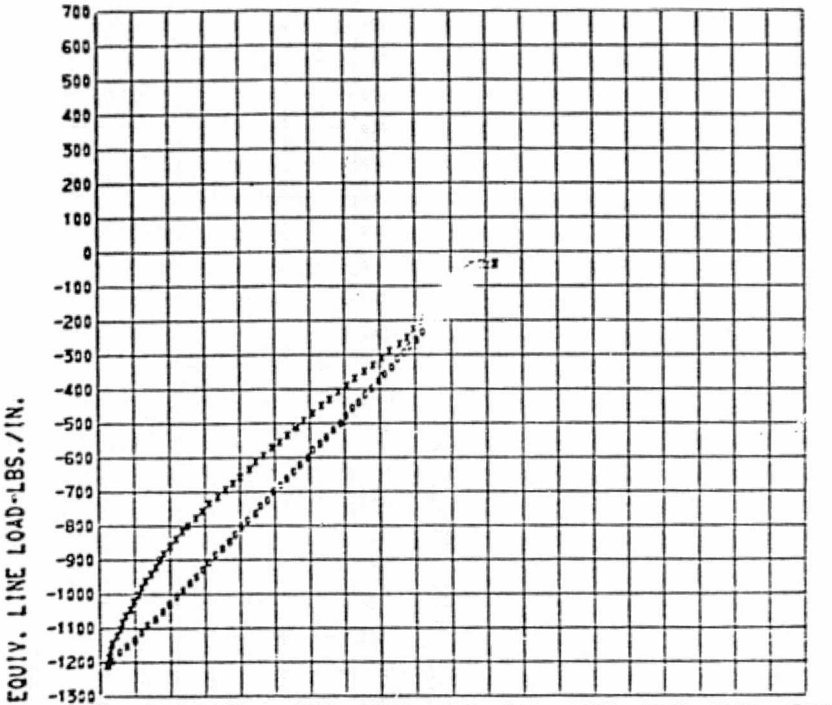
B-3 CSS EET 3E (WITHOUT FBR)



4674S STRESS-PSI STA.2209 ℄ 173.5°
EVENTS 01-20

PLOT 265

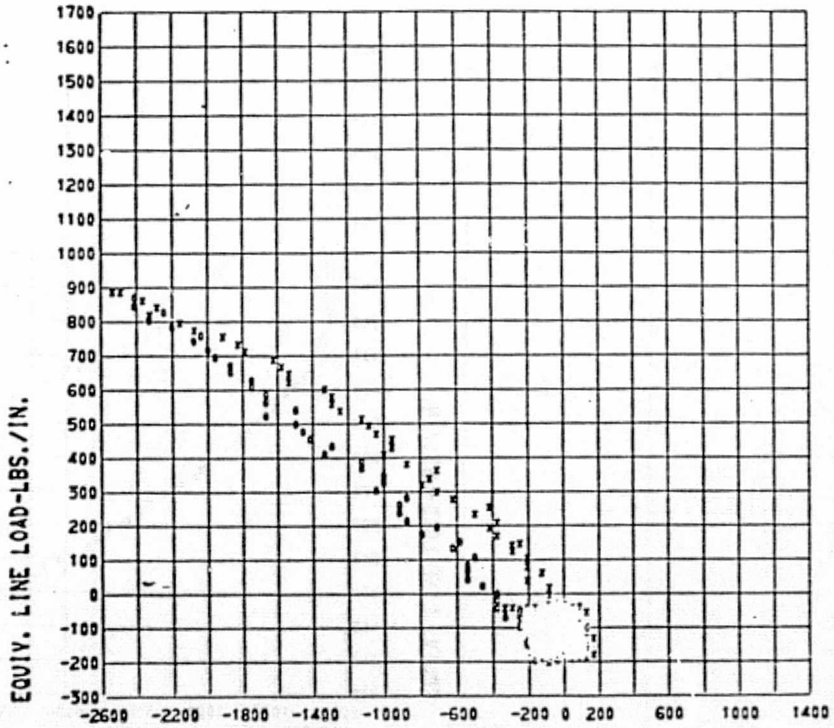
B-3 CSS EET 3E (WITHOUT FBR)



4675S STRESS-PSI STA.2209 ⅄ 173.5°
EVENTS 01-20

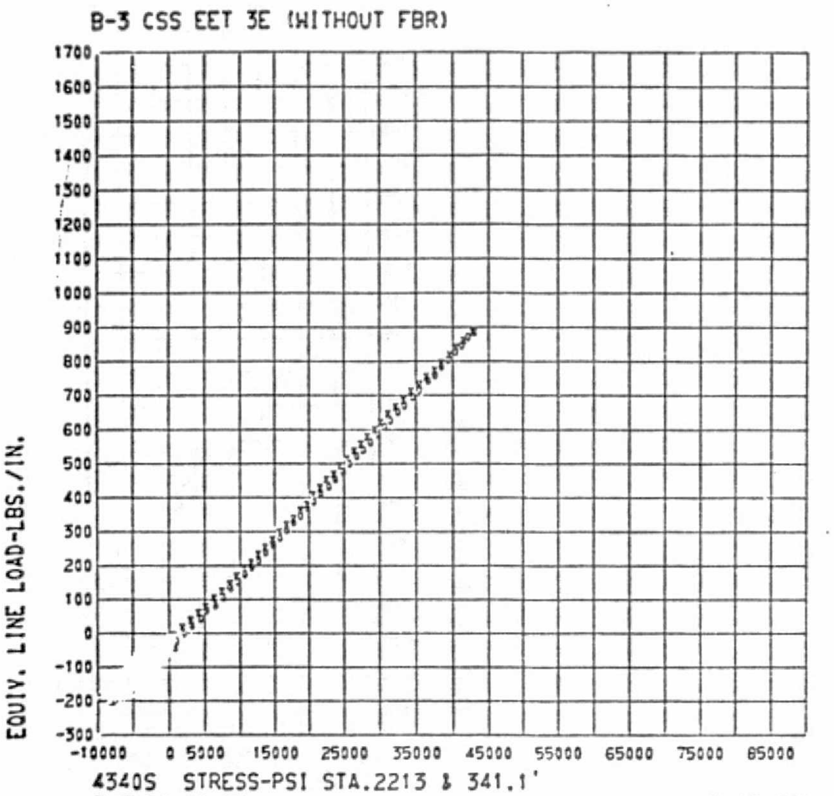
PLOT 266

B-3 CSS EET 3E (WITHOUT FBR)



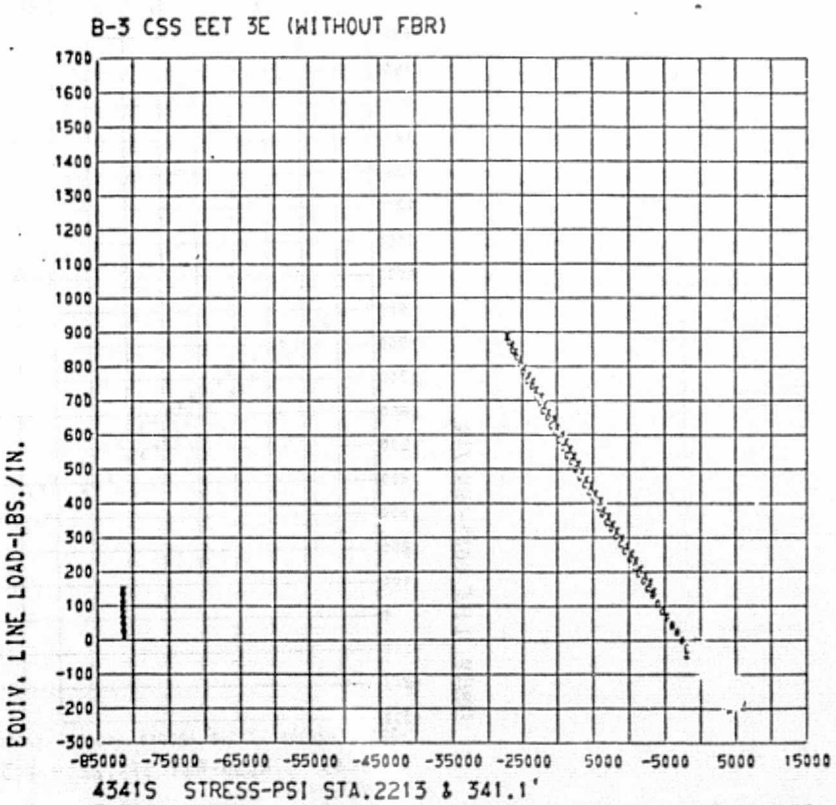
4835S STRESS-PSI STA.2213 ⅄ 341.1°
EVENTS 01-20

PLOT 271



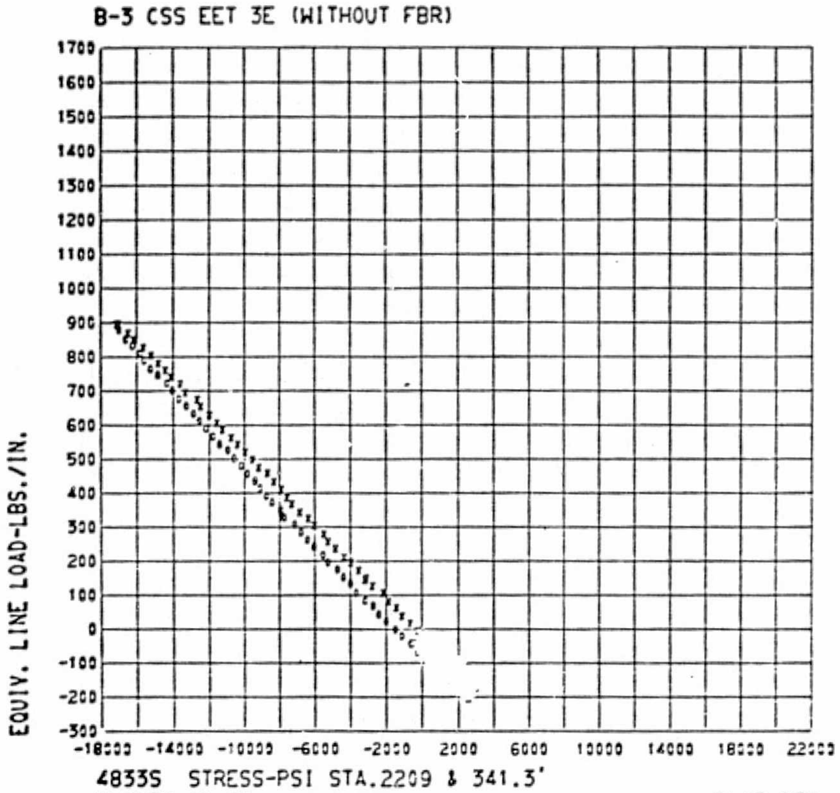
EVENTS 01-20

PLOT 272



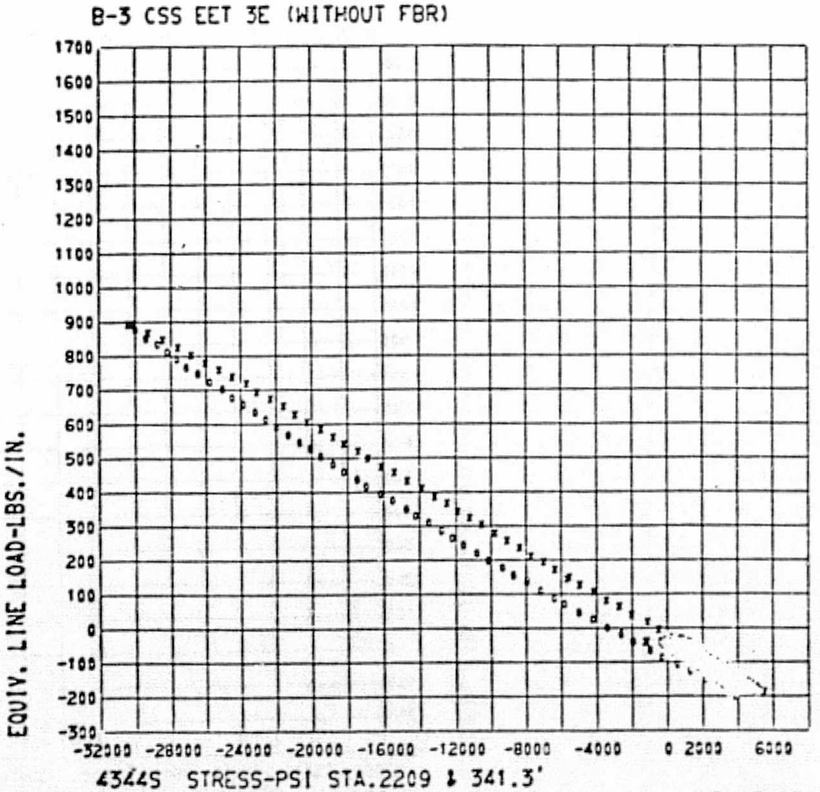
EVENTS 01-20

PLOT 273



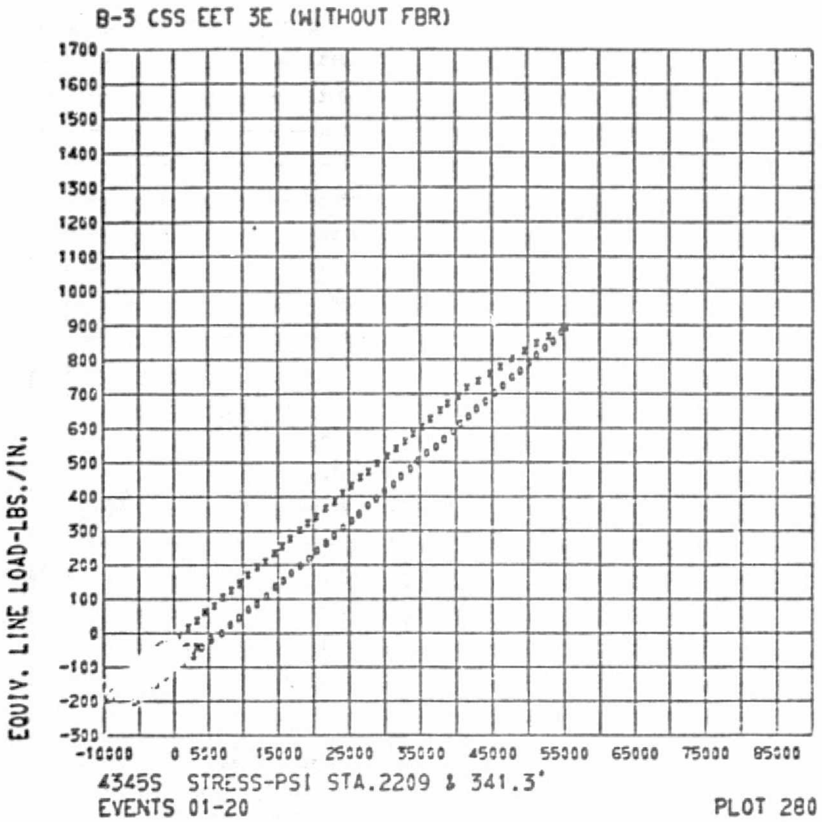
EVENTS 01-20

PLOT 278

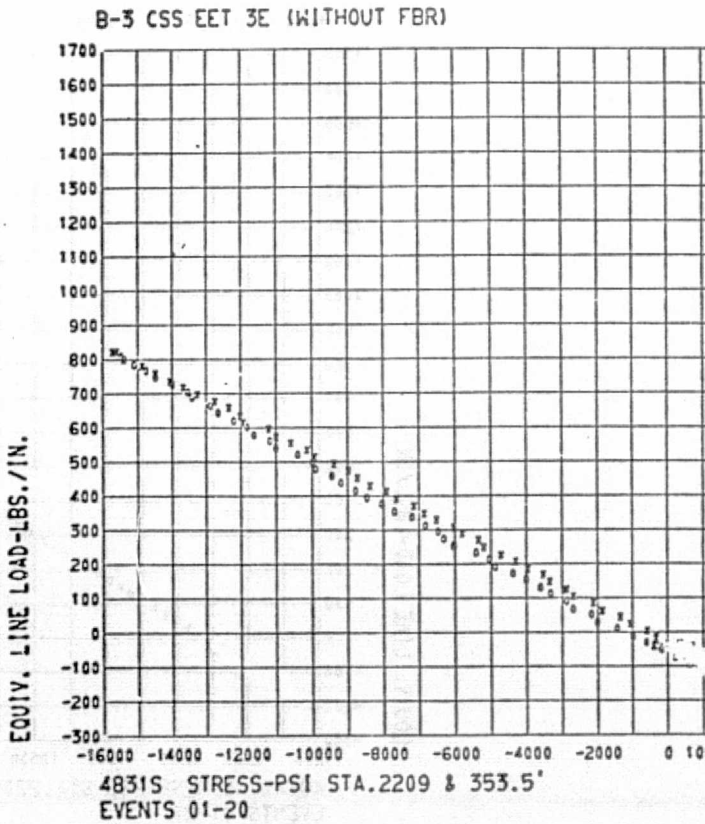


EVENTS 01-20

PLOT 279

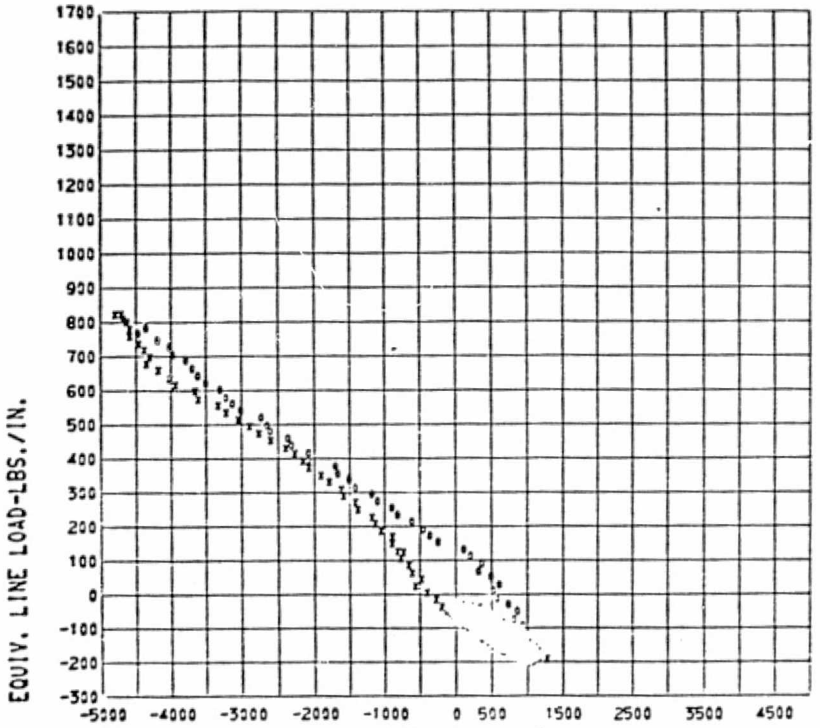


PLOT 280



PLOT 285

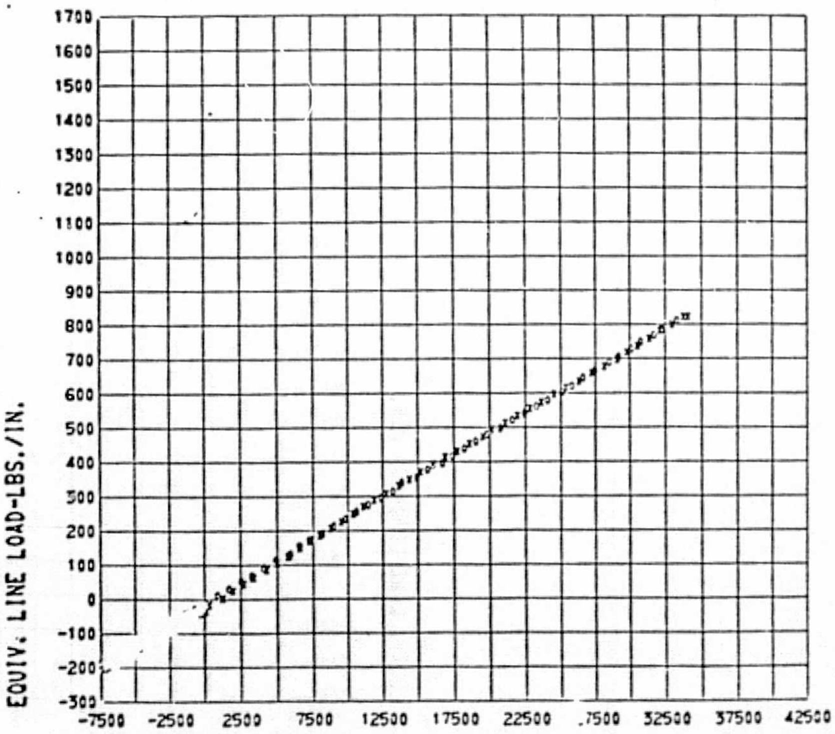
B-3 CSS EET 3E (WITHOUT FBR)



4913S STRESS-PSI STA.2209 ℄ 353.5'
EVENTS 01-20

PLOT 286

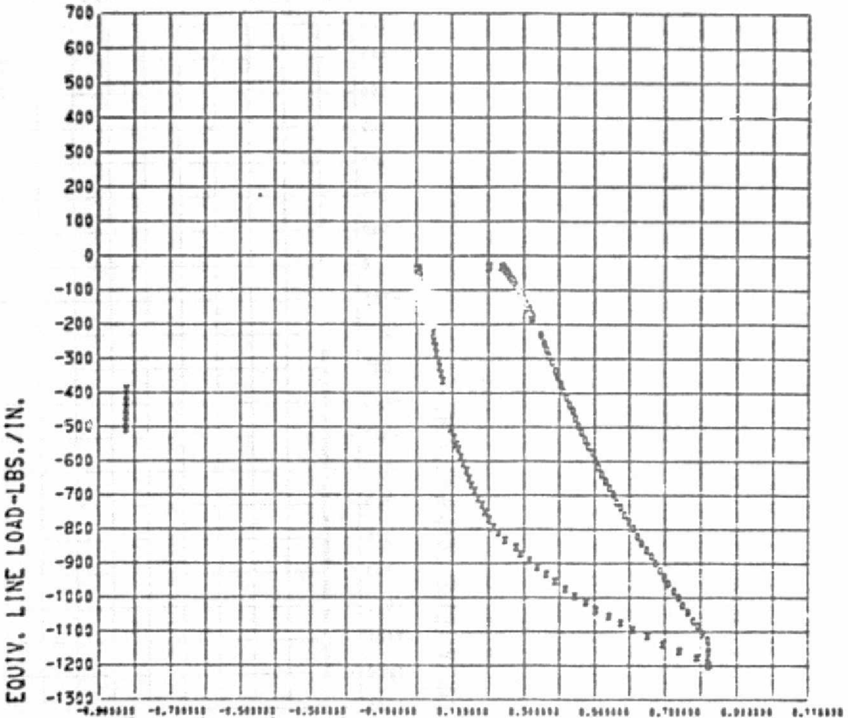
B-3 CSS EET 3E (WITHOUT FBR)



4914S STRESS-PSI STA.2209 ℄ 353.5'
EVENTS 01-20

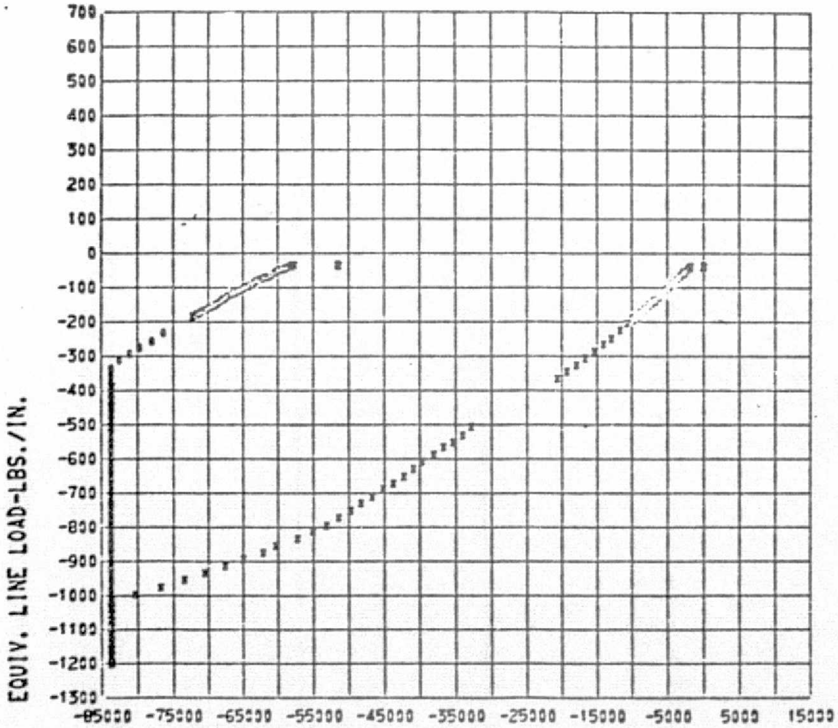
PLOT 287

B-3 CSS EET 3E (WITHOUT FBR)



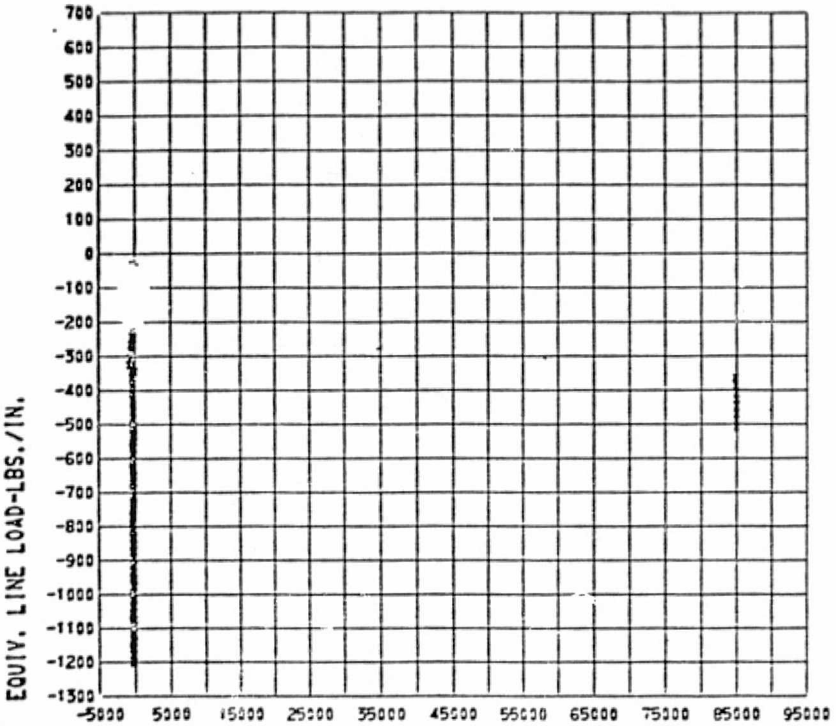
4919S STRESS-PSI STA.2213 & 173.5°
EVENTS 01-20 PLOT 292

B-3 CSS EET 3E (WITHOUT FBR)



4920S STRESS-PSI STA.2213 & 173.5°
EVENTS 01-20 PLOT 293

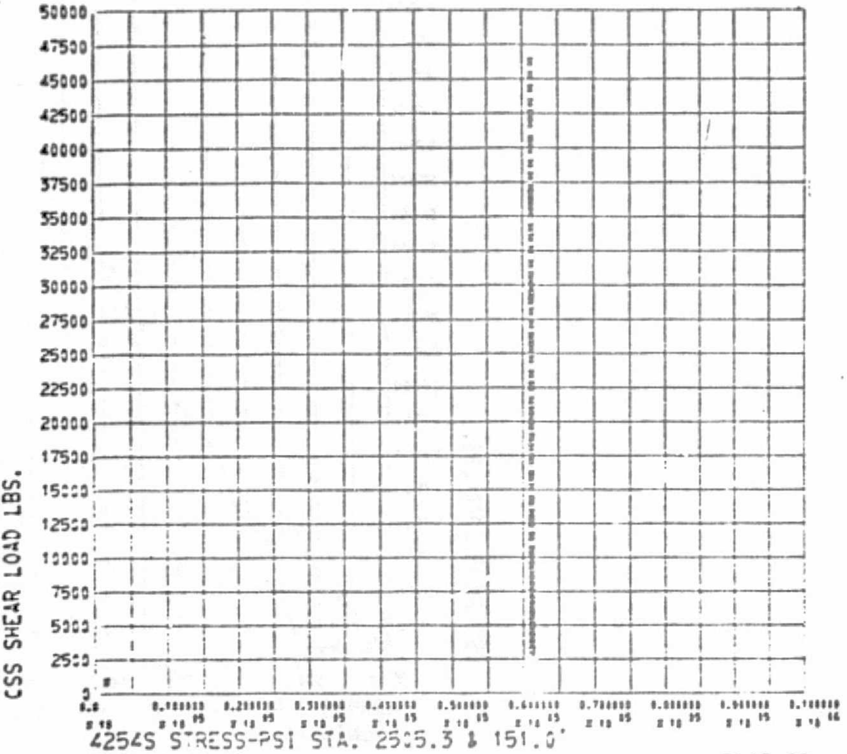
B-3 CSS EET 3E (WITHOUT FBR)



4921S STRESS-PSI STA.2213 ℄ 173.5°
EVENTS 01-20

PLOT 294

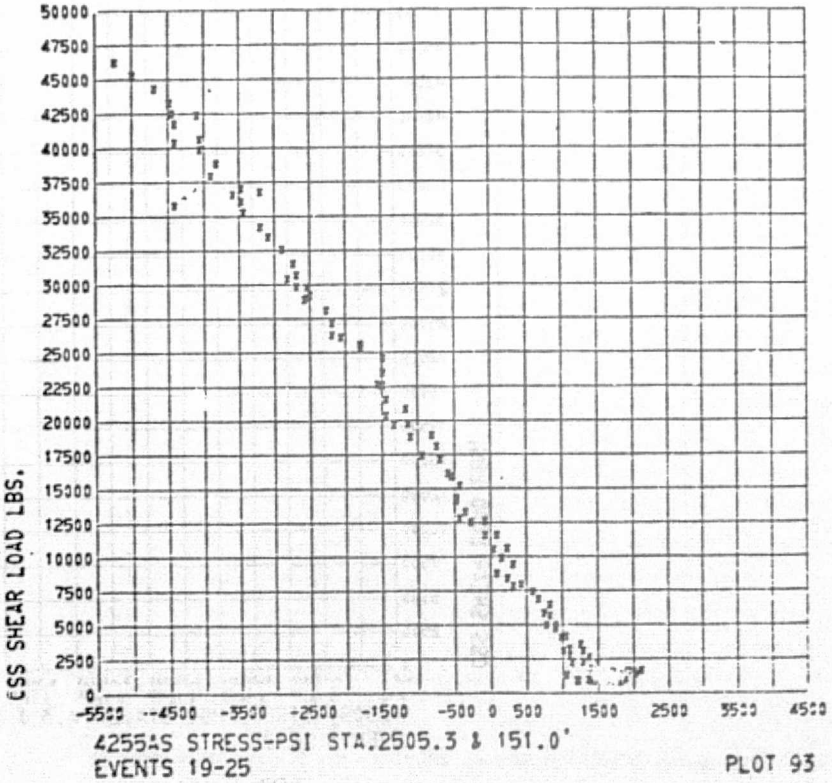
B-3 CSS EET 7E-2A (WITH FBR)



EVENTS 19-25

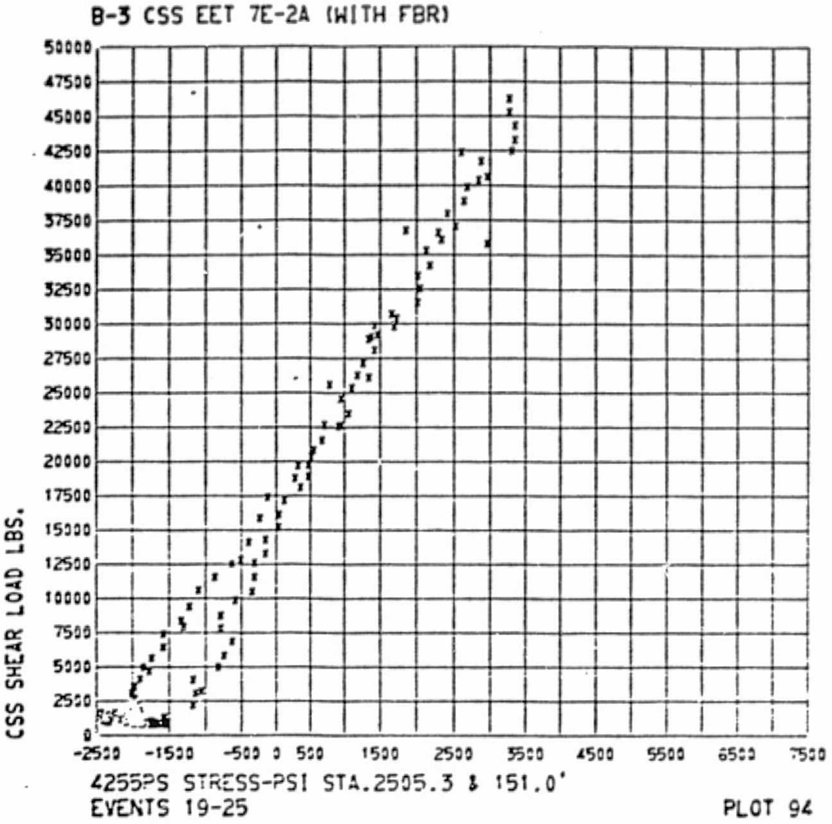
PLOT 92

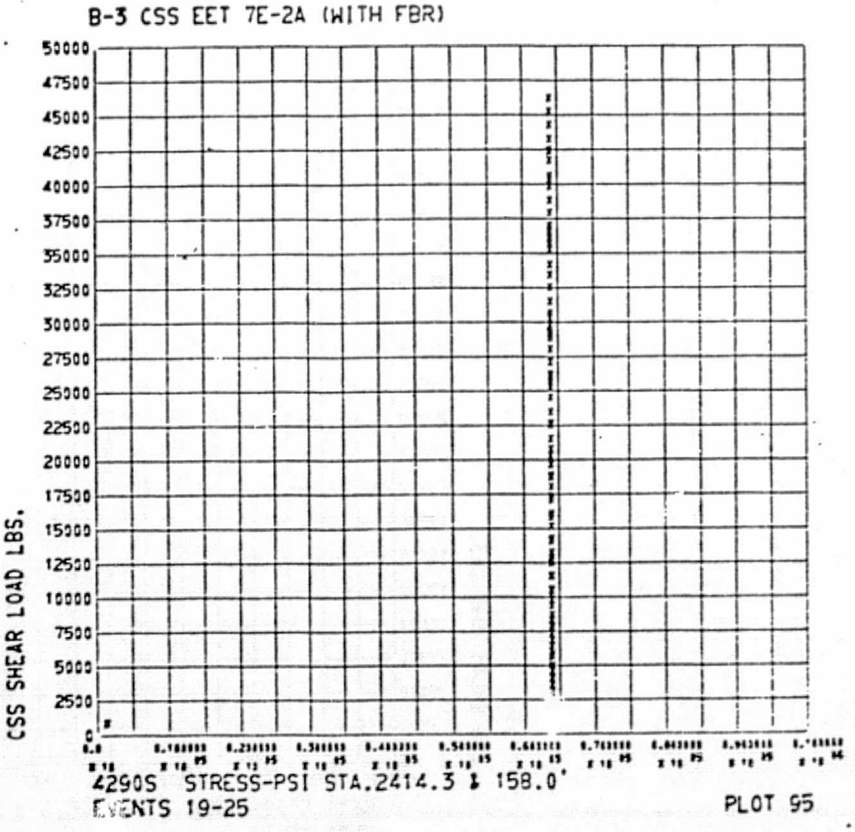
B-3 CSS EET 7E-2A (WITH FBR)

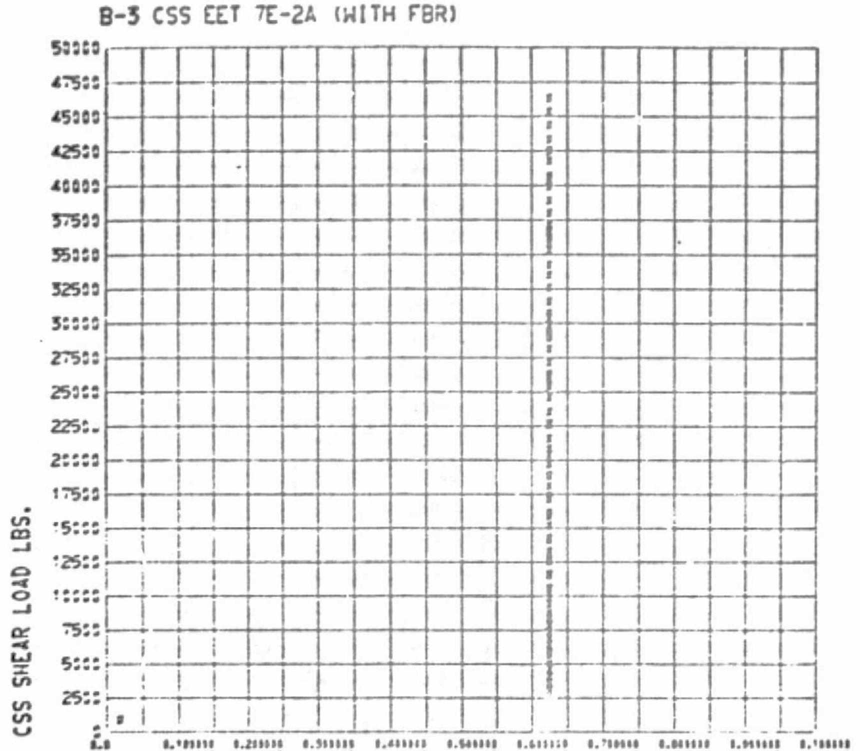


EVENTS 19-25

PLOT 93


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-2500
-1500
-500
0
500
1500
2500
3500
4500
5500
6500
7500
4255PS STRESS-PSI STA.2505.3 & 151.0'
EVENTS 19-25
PLOT 94


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
0.0
4290S STRESS-PSI STA.2414.3 & 158.0'
EVENTS 19-25
PLOT 95



429:S STRESS-PSI STA.2414.3 & 158.0'
EVENTS 19-25 PLOT 96

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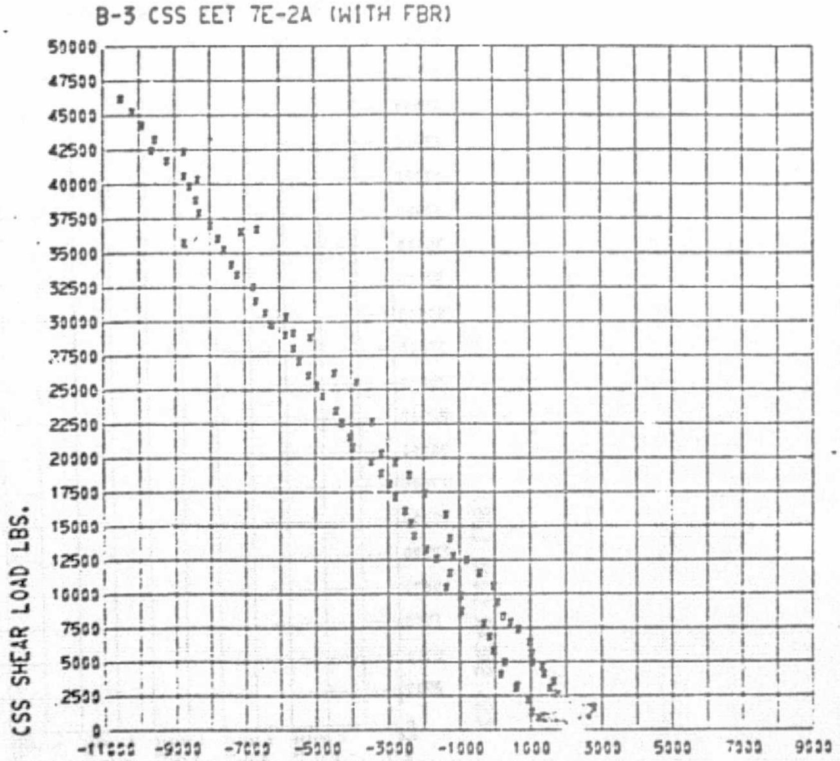
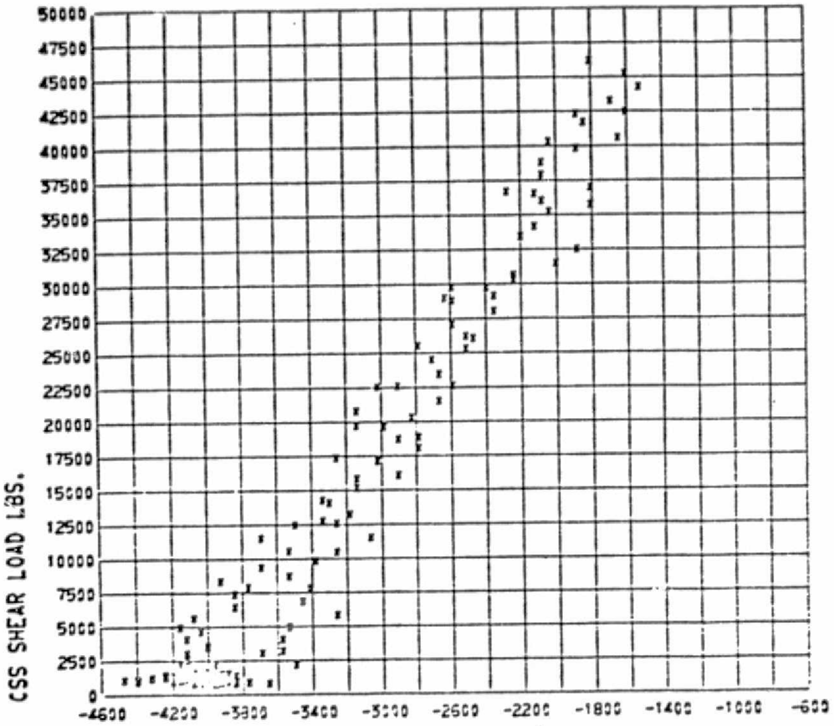


4917AS STRESS-PSI STA.2339 & 141.0'
EVENTS 19-25 PLOT 97

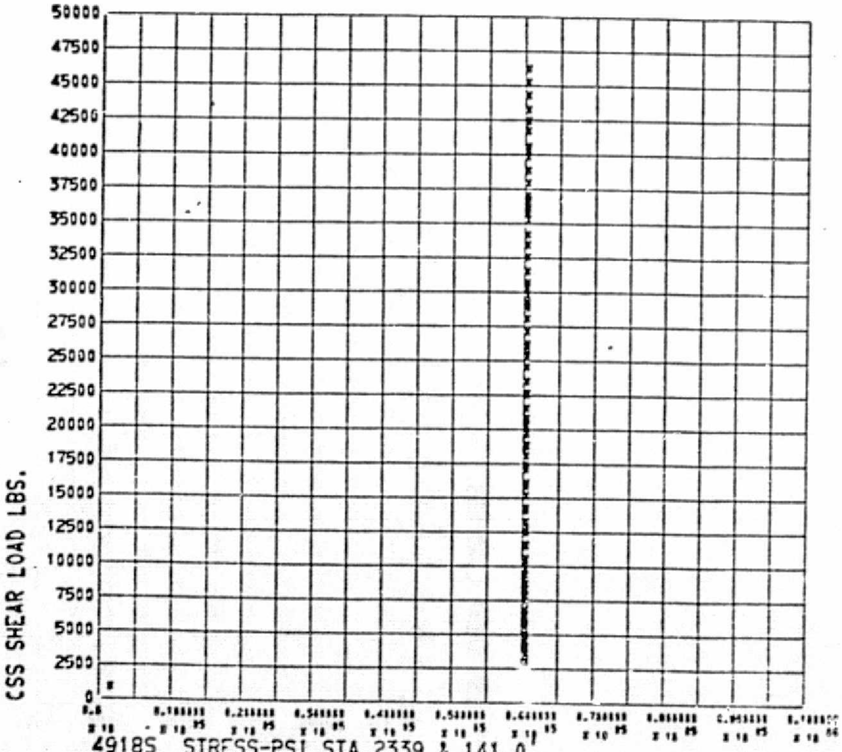
B-3 CSS EET 7E-2A (WITH FBR)



4917PS STRESS-PSI STA.2339 & 141.0'
EVENTS 19-25

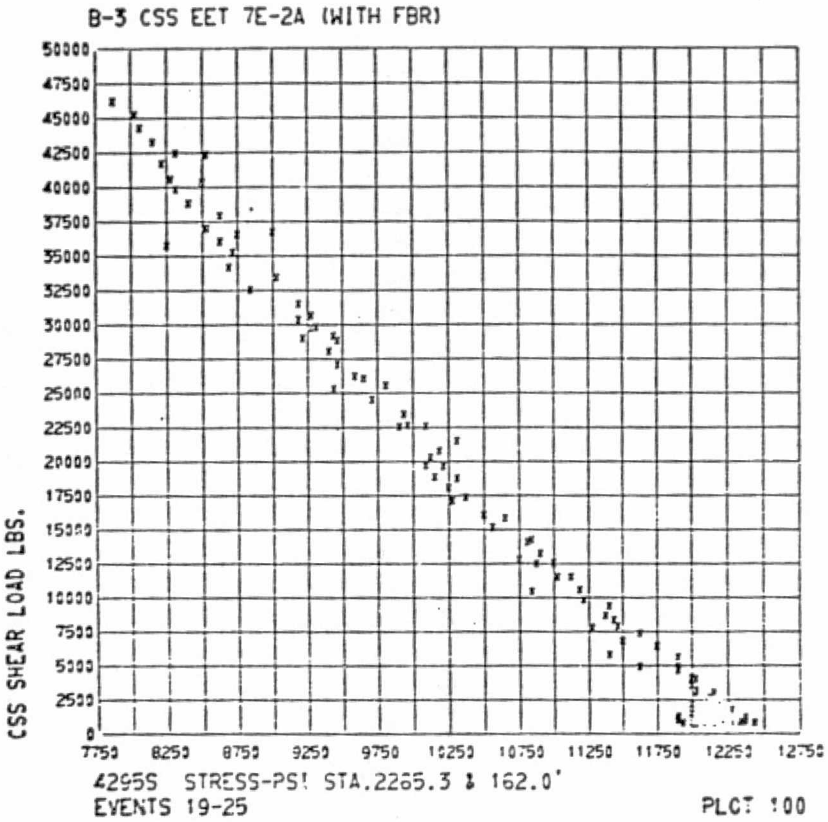
PLOT 98

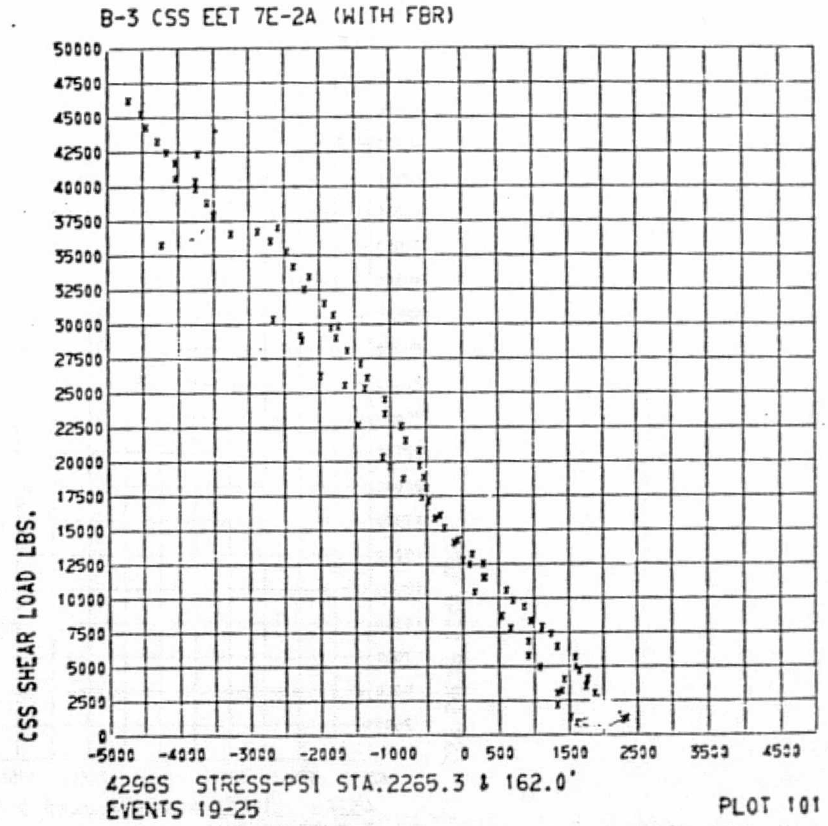
B-3 CSS EET 7E-2A (WITH FBR)



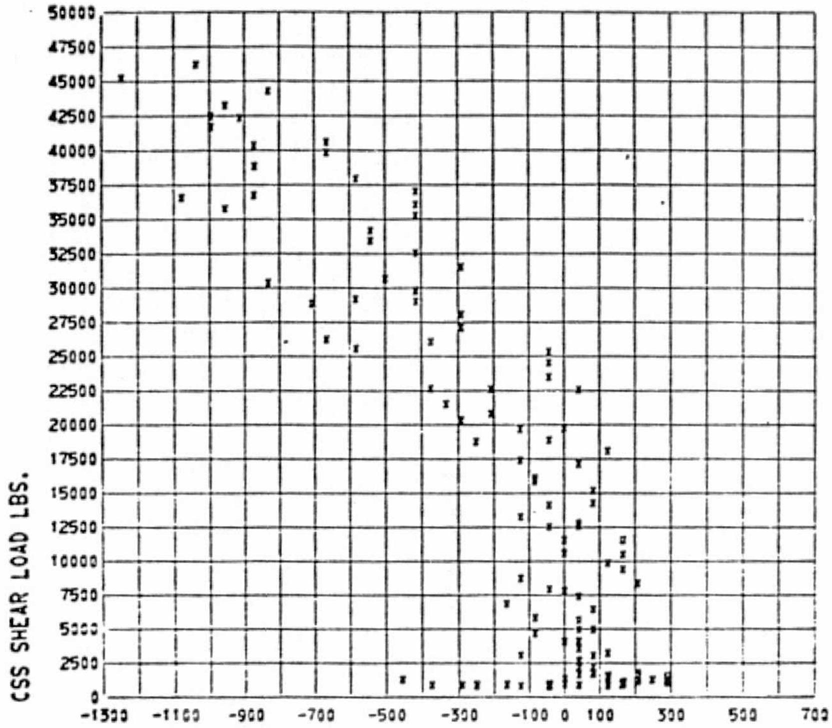
4918S STRESS-PSI STA.2339 & 141.0'
EVENTS 19-25

PLOT 99


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
7750
8250
8750
9250
9750
10250
10750
11250
11750
12250
12750
4295S STRESS-PSI STA.2265.3 & 162.0'
EVENTS 19-25
PLOT 100


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-5000
-4000
-3000
-2000
-1000
0
500
1500
2500
3500
4500
4296S STRESS-PSI STA.2265.3 & 162.0'
EVENTS 19-25
PLOT 101

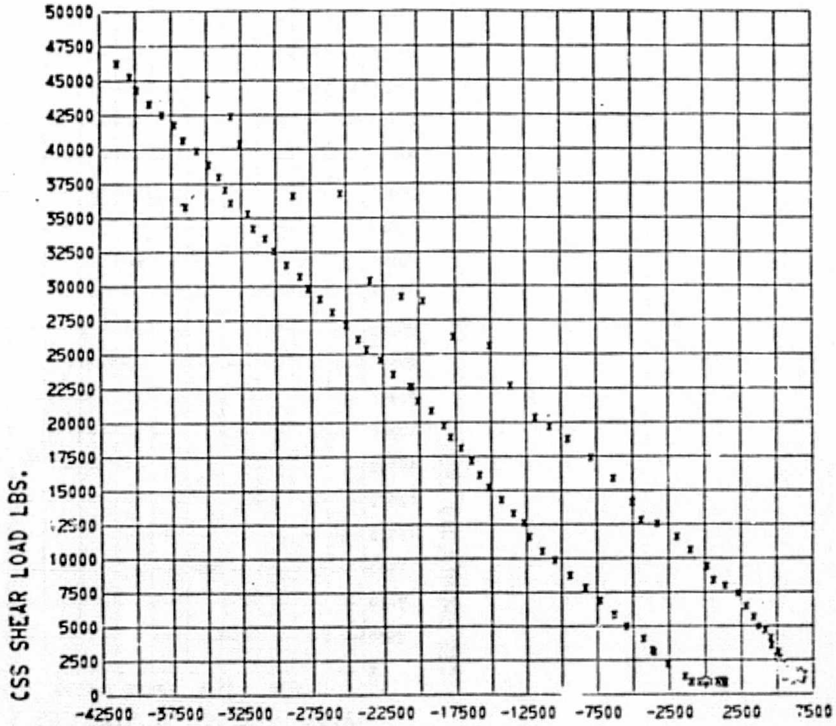
B-3 CSS EET 7E-2A (WITH FBR)



4834S STRESS-PSI STA.2213 & 161.1'
EVENTS 19-25

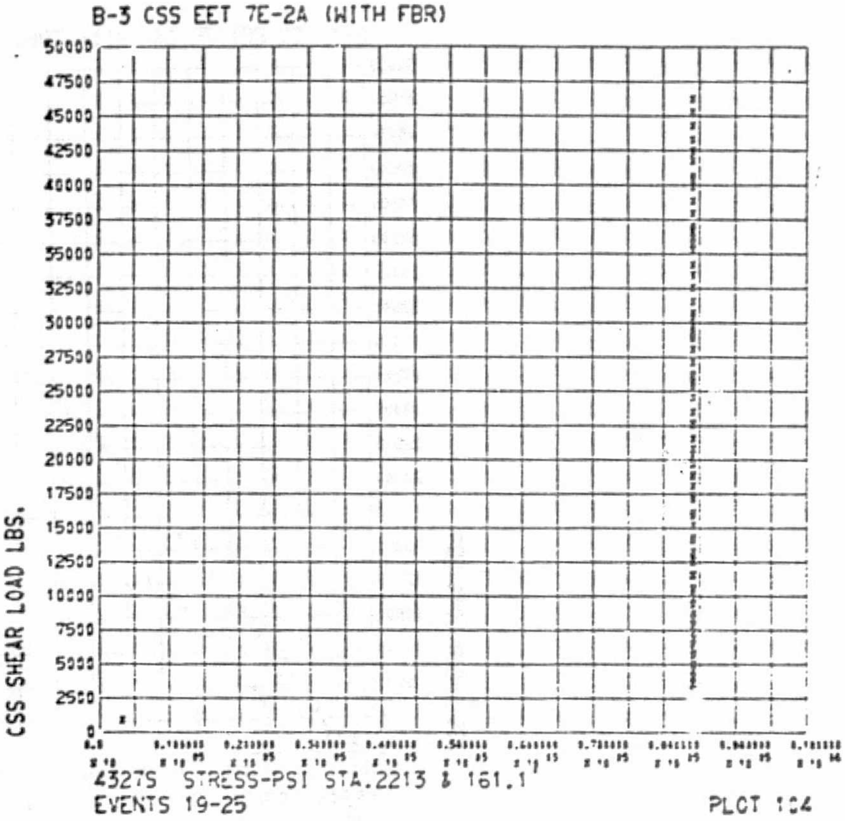
PLOT 102

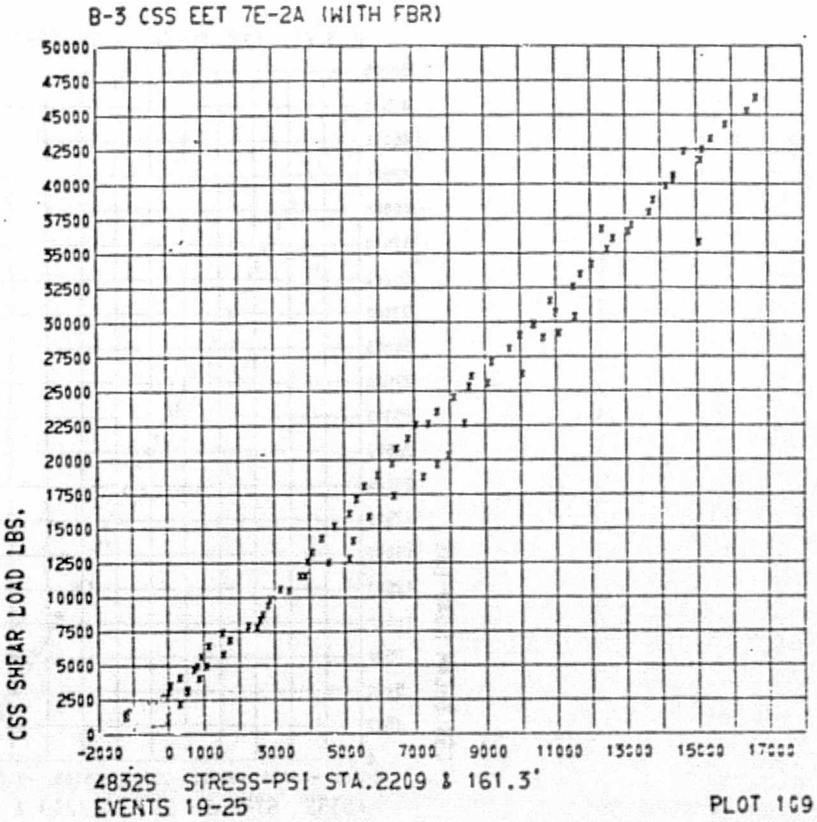
B-3 CSS EET 7E-2A (WITH FBR)

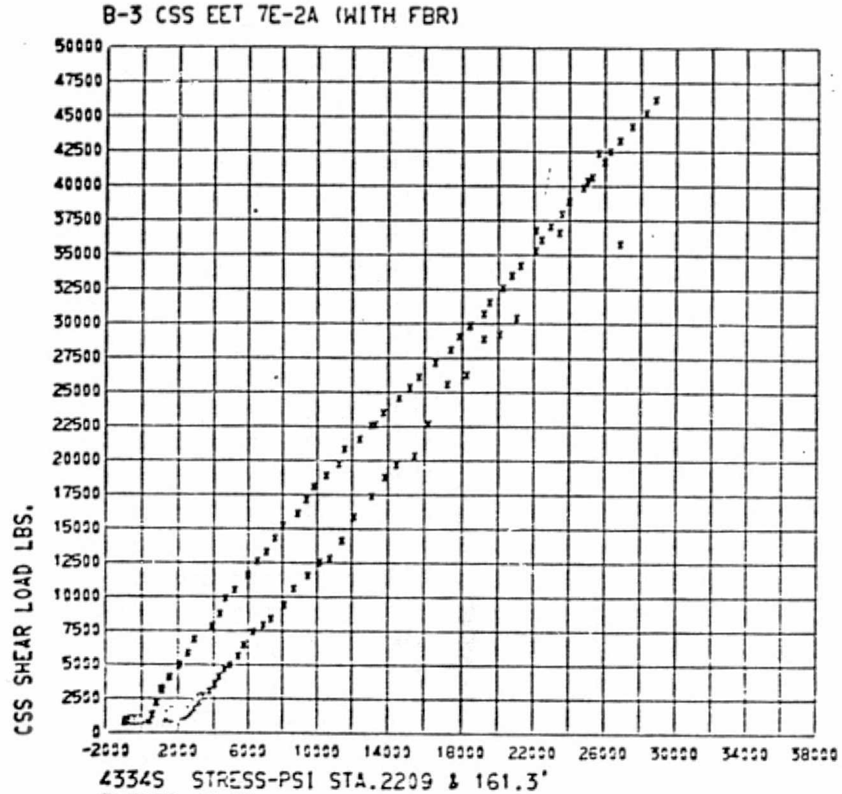


4326S STRESS-PSI STA.2213 & 161.1'
EVENTS 19-25

PLOT 103

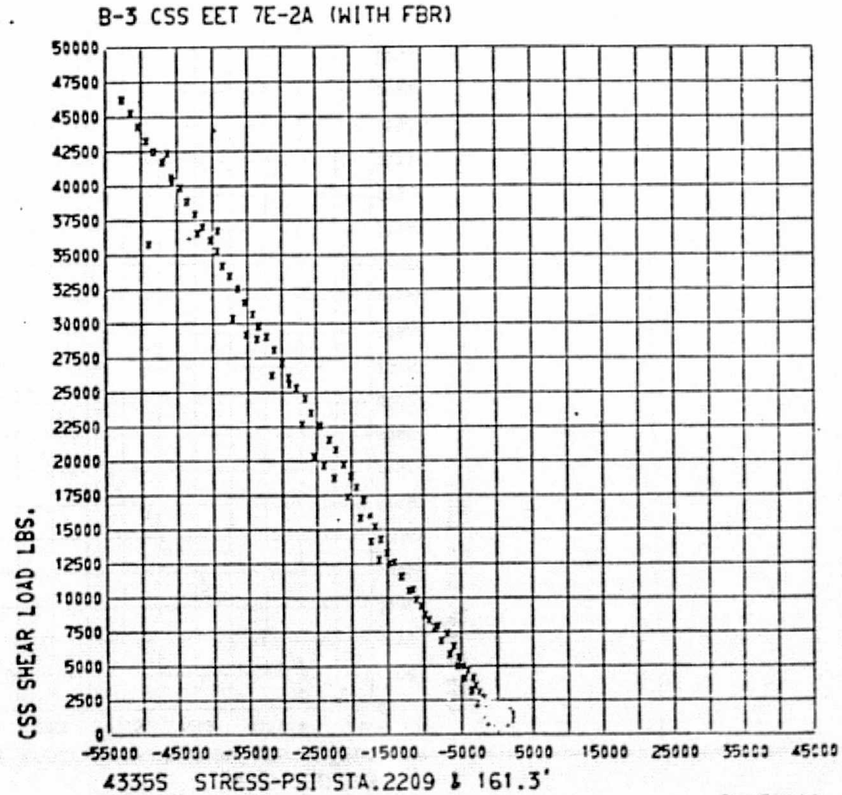

B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
0.0 x10
0.108000 x10 05
0.216000 x10 05
0.324000 x10 05
0.432000 x10 05
0.540000 x10 05
0.648000 x10 05
0.756000 x10 05
0.864000 x10 05
0.972000 x10 05
0.108000 x10 06
4327S STRESS-PSI STA.2213 & 161.1°
EVENTS 19-25
PLOT 104


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-2000
0 1000
3000
5000
7000
9000
11000
13000
15000
17000
4832S STRESS-PSI STA.2209 & 161.3°
EVENTS 19-25
PLOT 109



EVENTS 19-25

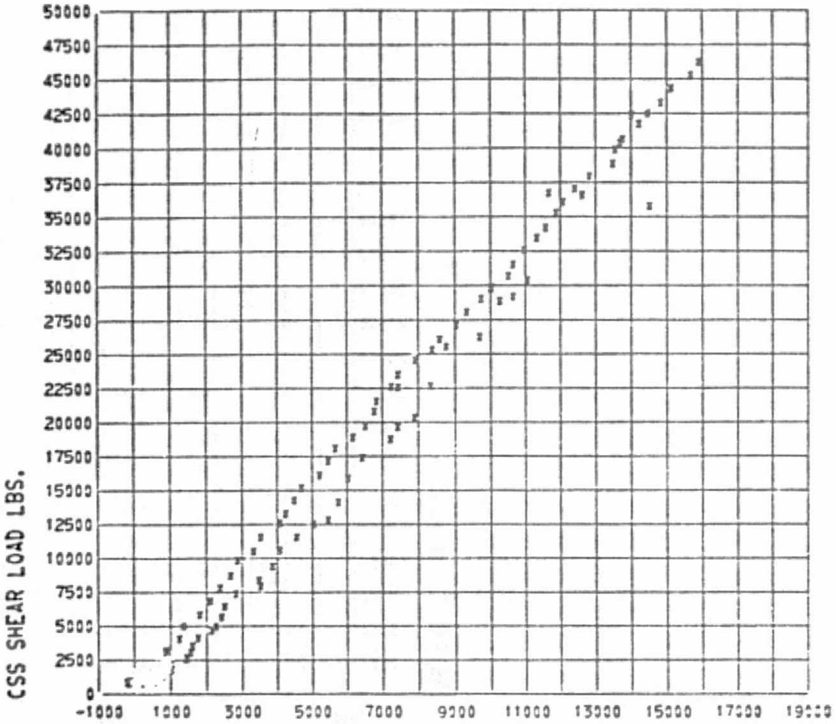
PLOT 110



EVENTS 19-25

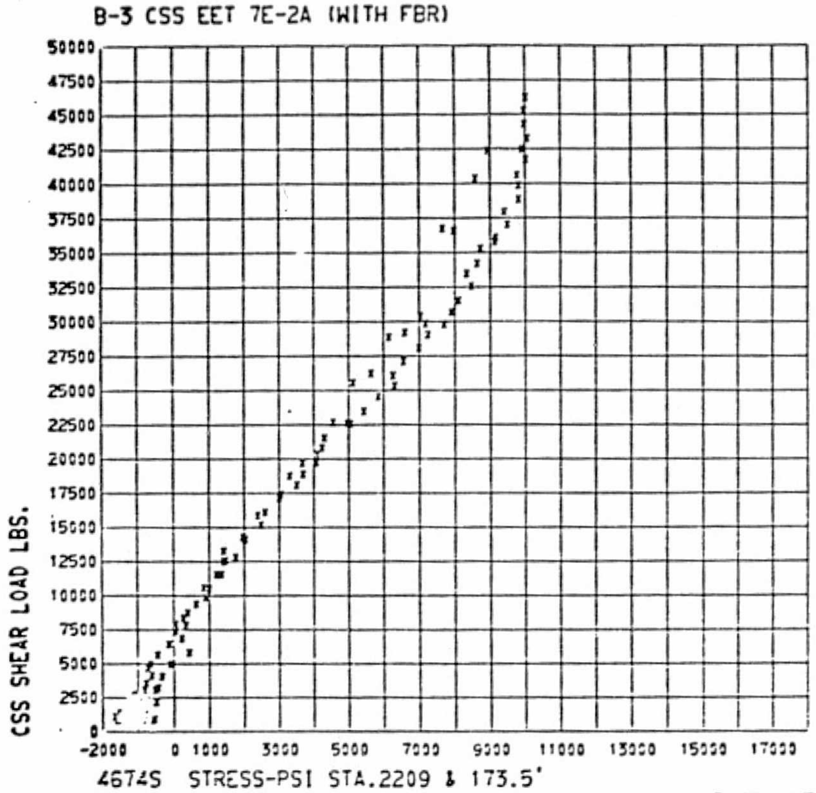
PLOT 111

B-3 CSS EET 7E-2A (WITH FBR)



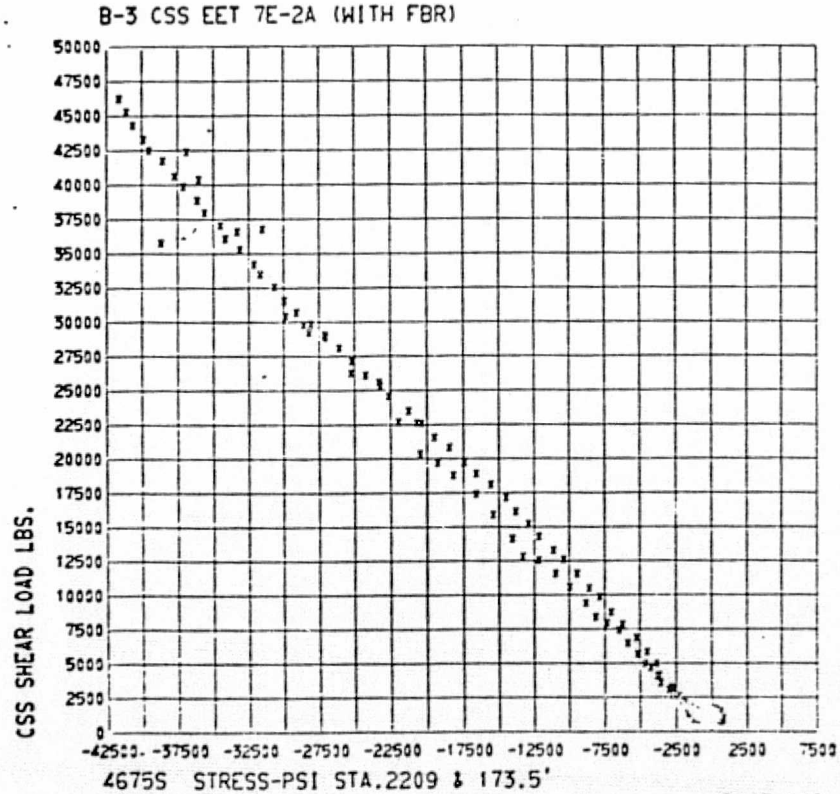
4830S STRESS-PSI STA.2209 & 173.5'
EVENTS 19-25

PLOT 116



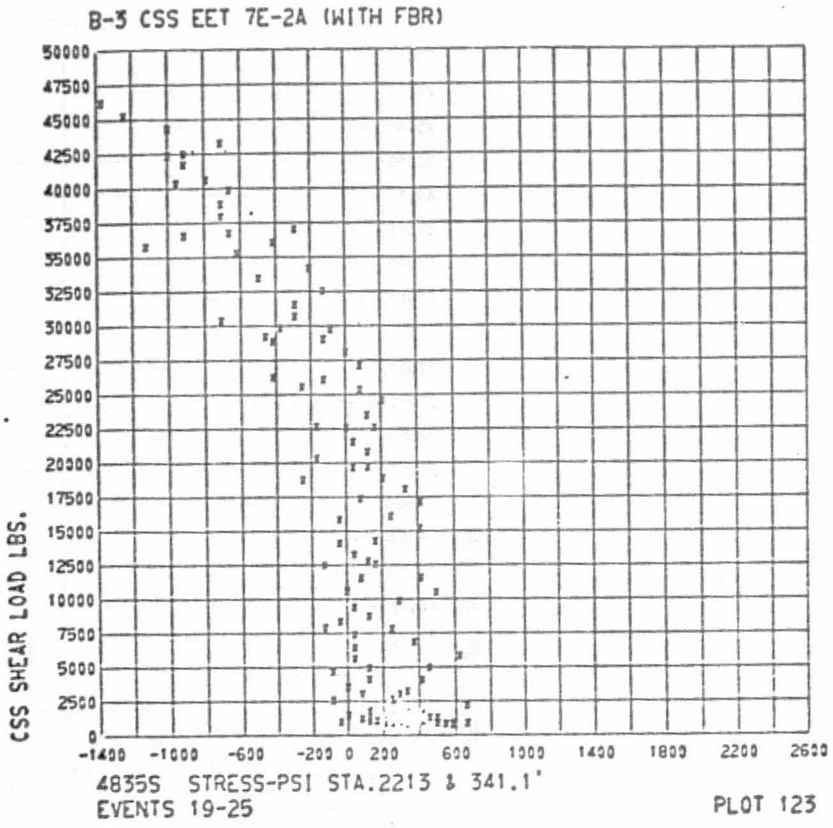
EVENTS 19-25

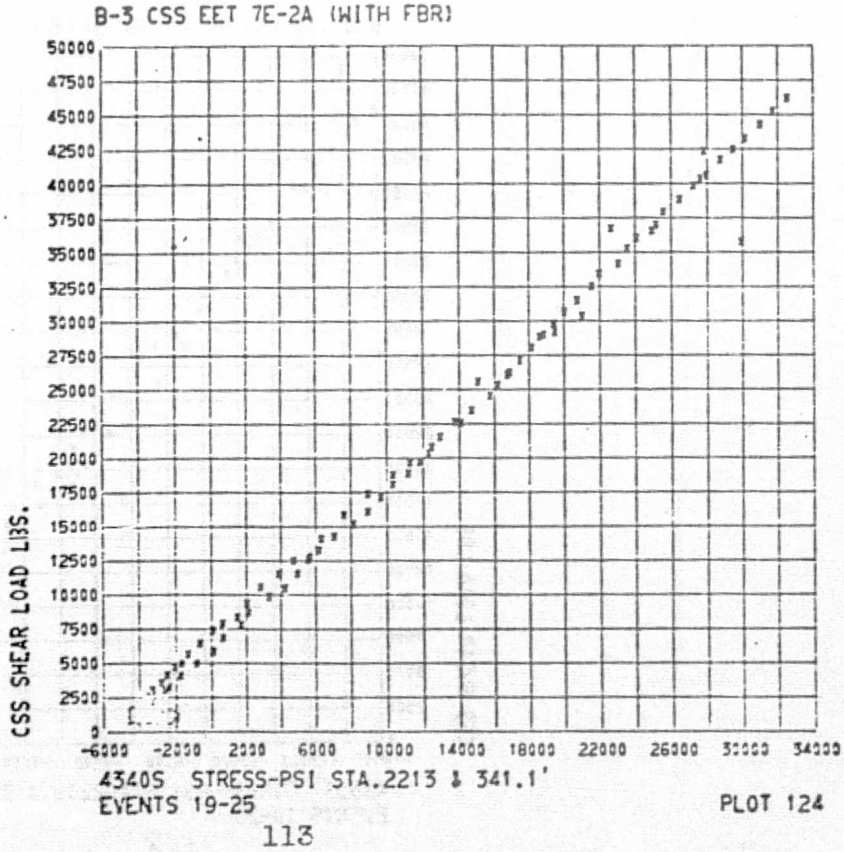
PLOT 117

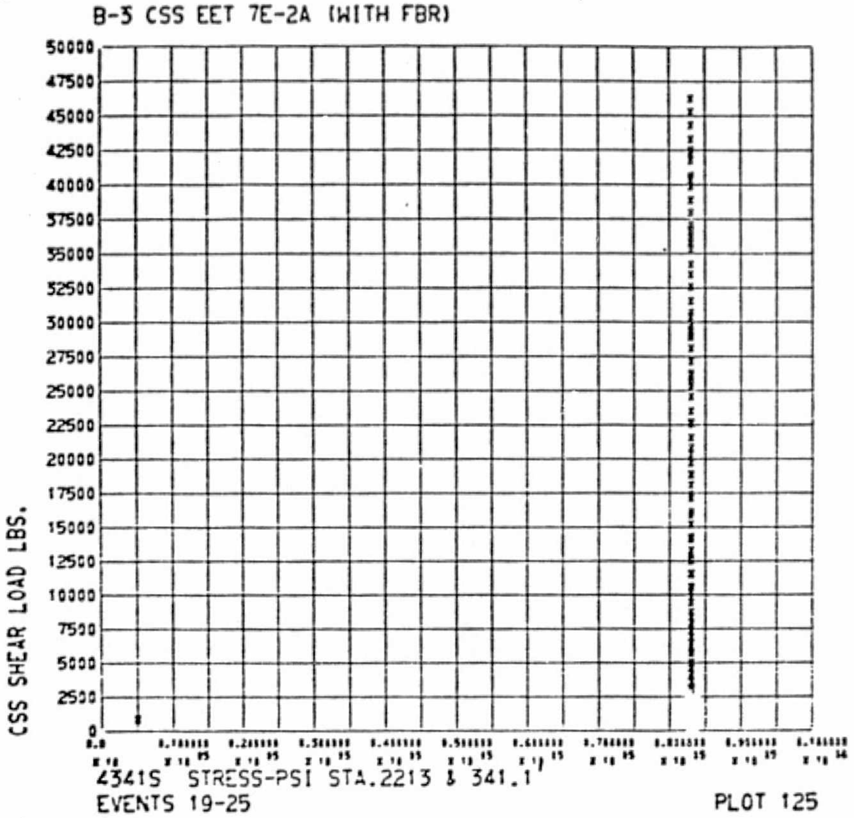


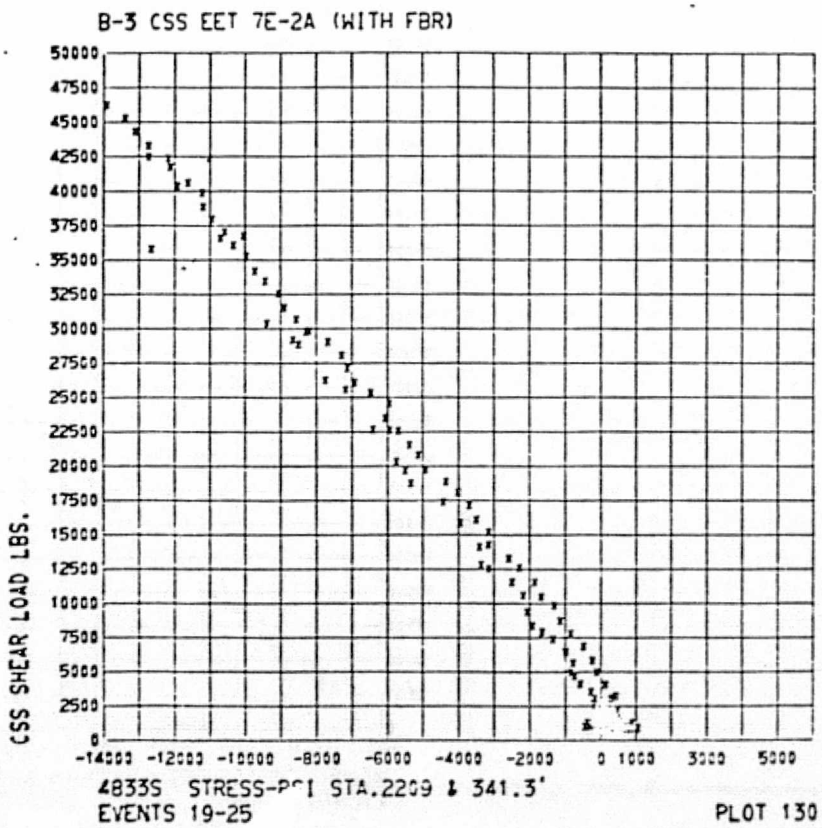
EVENTS 19-25

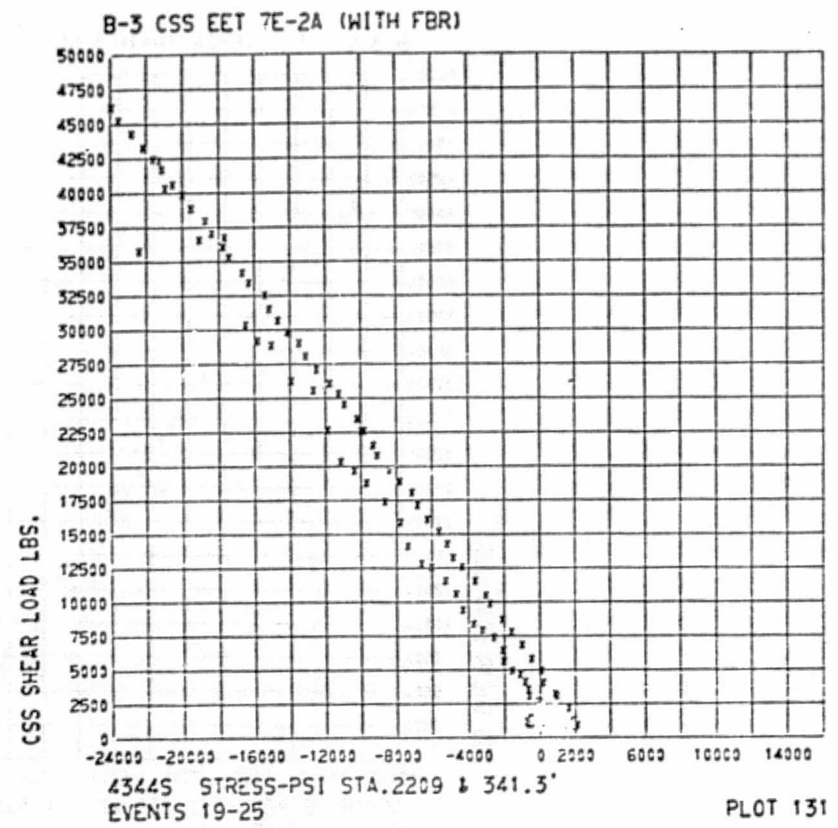
PLOT 118

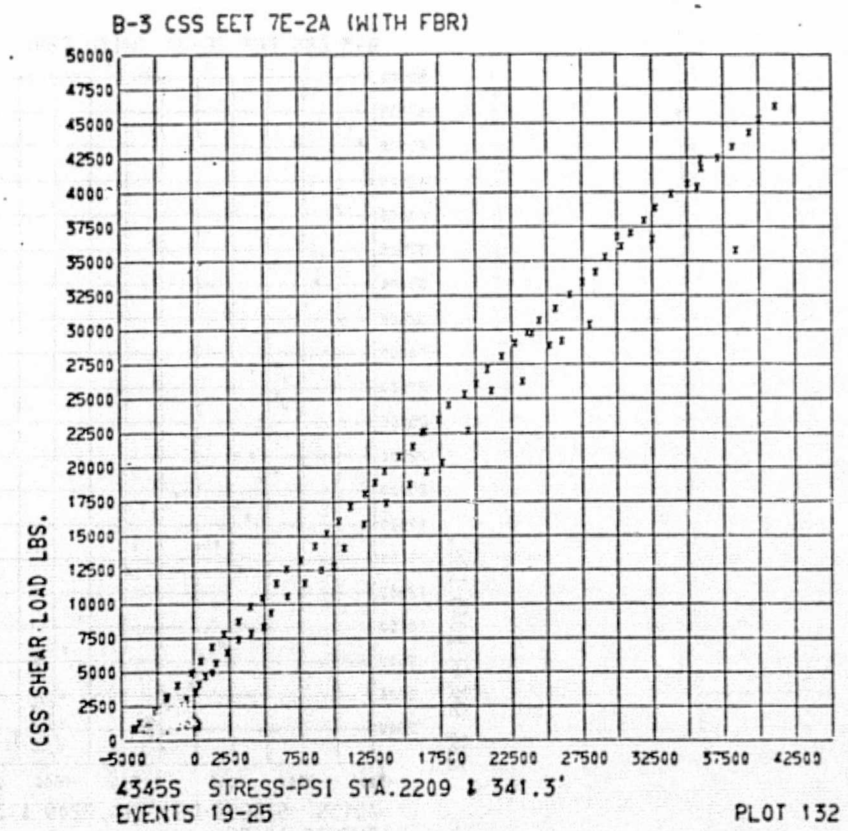

B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-1400
-1000
-600
-200
0
200
600
1000
1400
1800
2200
2600
4835S STRESS-PSI STA.2213 & 341.1'
EVENTS 19-25
PLOT 123


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-6000
-2000
2000
6000
10000
14000
18000
22000
26000
30000
34000
4340S STRESS-PSI STA.2213 & 341.1'
EVENTS 19-25
PLOT 124

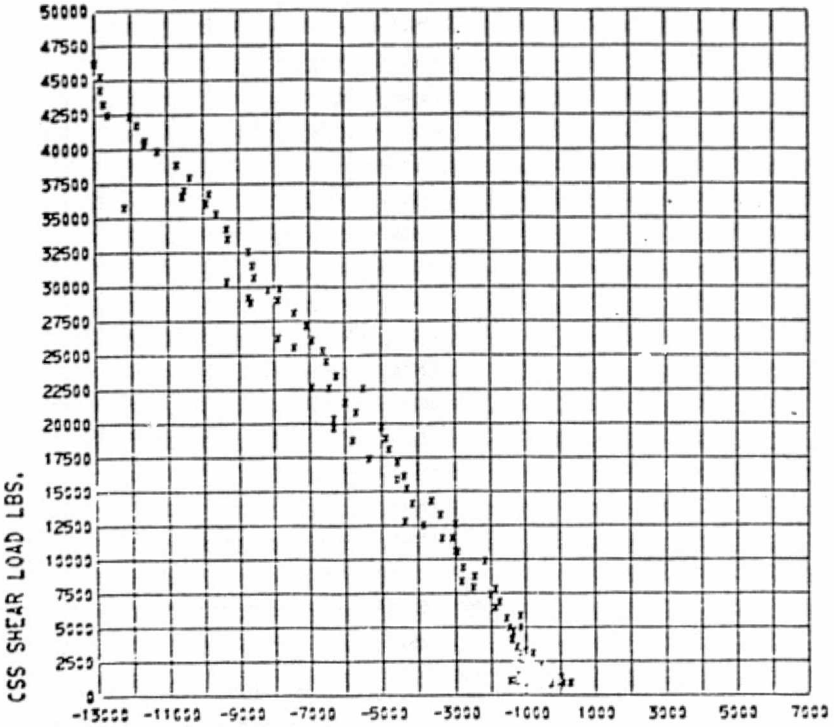

B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
0.0
43415 STRESS-PSI STA.2213 & 341.1
EVENTS 19-25
PLOT 125


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-14000
-12000
-10000
-8000
-6000
-4000
-2000
0
1000
3000
5000
48335 STRESS-PSI STA.2209 & 341.3'
EVENTS 19-25
PLOT 130


B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-24000
-20000
-16000
-12000
-8000
-4000
0
2000
6000
10000
14000
4344S STRESS-PSI STA.2209 ℄ 341.3'
EVENTS 19-25
PLOT 131

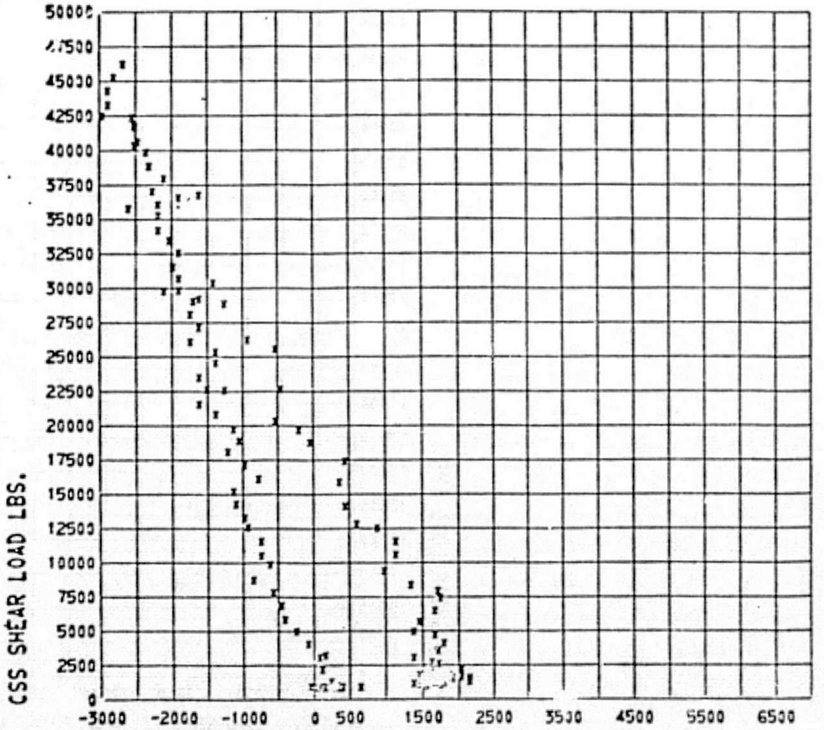

B-3 CSS EET 7E-2A (WITH FBR)
CSS SHEAR LOAD LBS.
50000
47500
45000
42500
40000
37500
35000
32500
30000
27500
25000
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-5000
0
2500
7500
12500
17500
22500
27500
32500
37500
42500
4345S STRESS-PSI STA.2209 ℄ 341.3'
EVENTS 19-25
PLOT 132

B-3 CSS EET 7E-2A (WITH FBR)

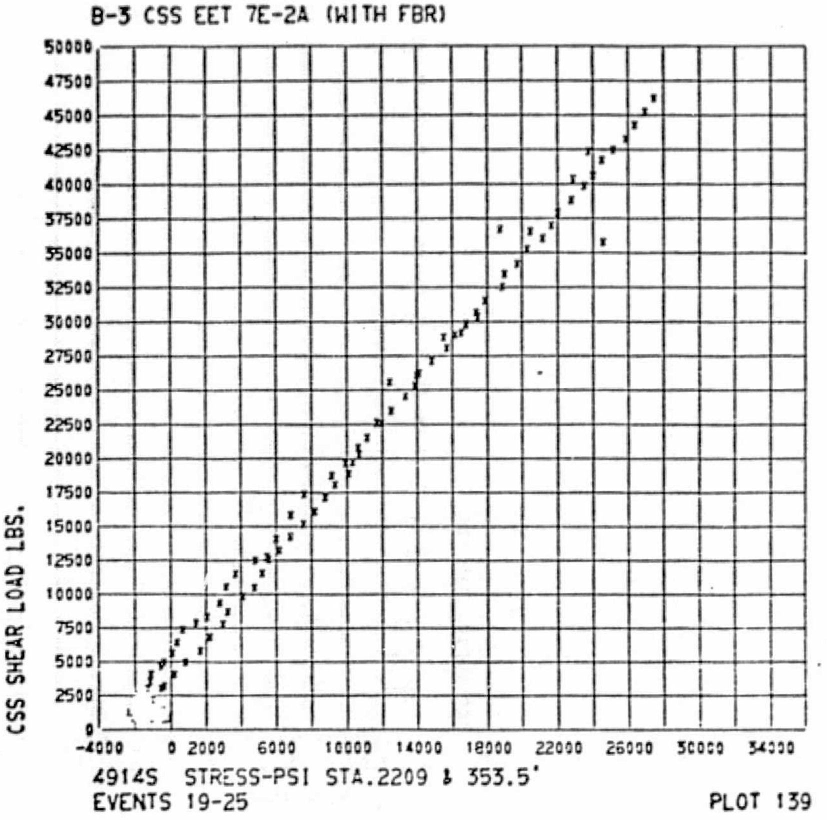


4831S STRESS-PSI STA.2209 & 353.5'
EVENTS 19-25 PLOT 137

B-3 CSS EET 7E-2A (WITH FBR)

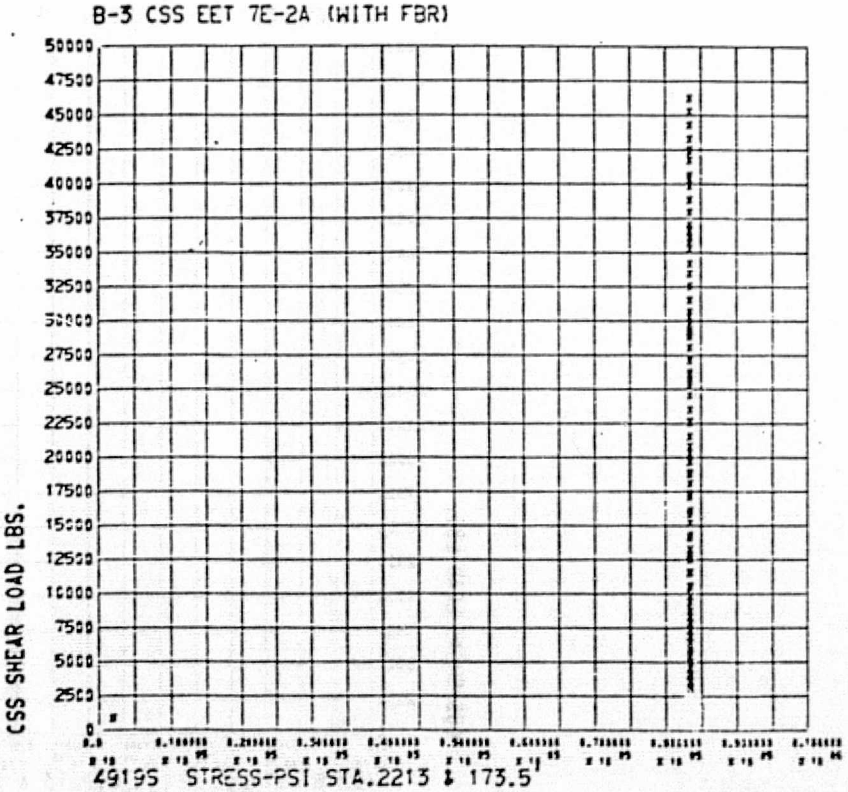


4913S STRESS-PSI STA.2209 & 353.5'
EVENTS 19-25 PLOT 138


B-3 CSS EET 7E-2A (WITH FBR)

49145 STRESS-PSI STA.2209 & 353.5'
EVENTS 19-25

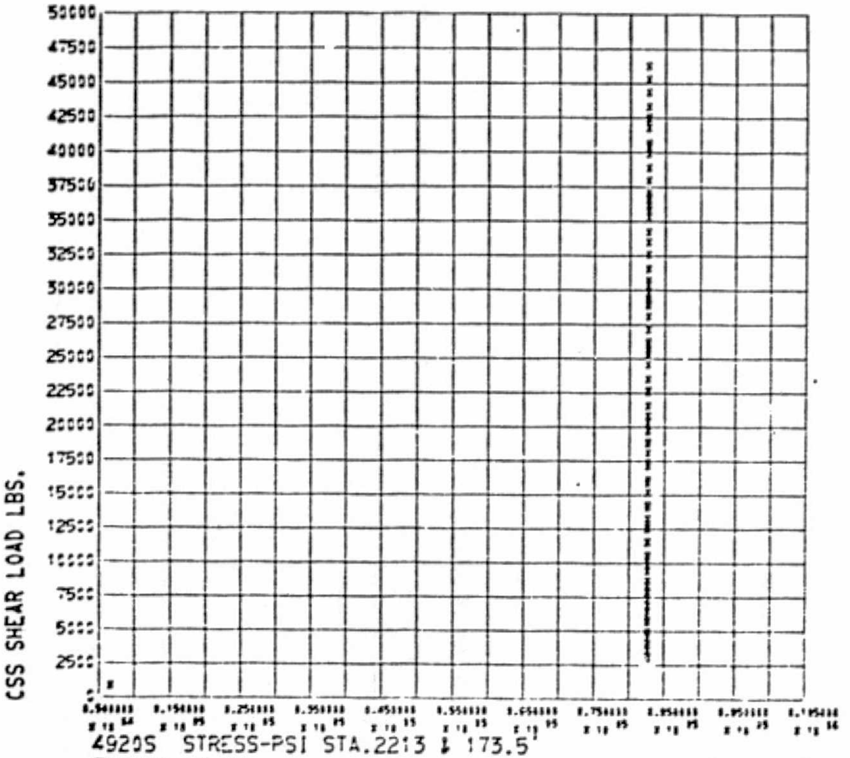
PLOT 139


B-3 CSS EET 7E-2A (WITH FBR)

49195 STRESS-PSI STA.2213 & 173.5'
EVENTS 19-25

PLOT 144

B-3 CSS EET 7E-2A (WITH FBR)

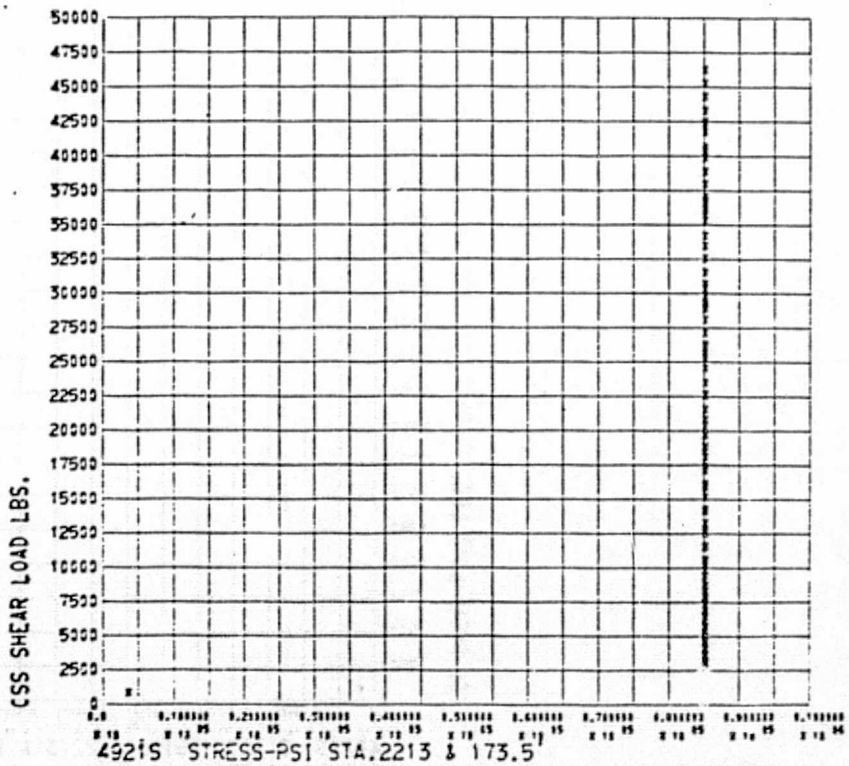


4920S STRESS-PSI STA.2213 ℄ 173.5'

EVENTS 19-25

PLOT 145

B-3 CSS EET 7E-2A (WITH FBR)



4921S STRESS-PSI STA.2213 ℄ 173.5'

EVENTS 19-25

PLOT 146

APPENDIX D

Summary of Deflection Data from the Real-Time Monitoring System for Tests 3E and 7E-2A and for Tests DR 1 and DR 2

The deflection data is included in this summary of the real-time data as displayed on the CRT display screen and played back on the printer/plotter system in the control room.

```
B-3 CSS DYNAMIC RESPONSE    04-08-74   098  19  29  03   860   ON-LINE       ZF
DR I   WITHOUT FBR.(TBL 01)            DAY  HR MIN SEC  MSEC
RUN 1   START
                                        501P  20.524  #A  LH2 TANK ULL PRESS
                                        503P  30.124  #A  LOX TANK ULL PRESS

 327P  338.39  #A  CENTAUR TANK STRETCH  540P  14.424  #A  CENTAUR INT BLKHD
 328P  12.799  #A  SHROUD CABLE STRETCH  541P  9.6245  #D  CENT INT BLKHD DP

 332P  .00000  #D  SHROUD LD CYL DEL P
                                        4465L  .00000  #   FBR STRUT 170°
                                        4466L  .00000  #   FBR STRUT 230°
 215L  390.00  #   FORWARD LOAD FIX     4467L -.527-3  #   FBR STRUT 290°
5721D -2.7452  I   SHEAR LOAD DEFL.     4468L  .00060  #   FBR STRUT 350°
                                        4463L  .00000  #   FBR STRUT  50°
5464D -0.1200  I   CSS DEFL STA 2807    4464L  .00000  #   FBR STRUT 110°
5465D -.09001  I   CSS DEFL STA 2680
5466D -.05550  I   CSS DEFL 2460 150°   FBRT  -.193-3  $=  FBR TOTAL LOAD
5467D -.01899  I   CSS DEFL 2460 330°
5468D -.01849  I   CSS DEFL STA 2209
5469D -.00999  I   CSS DEFL STA 2177
5470D -.00424  I   TITN DEFL STA 2050
```

ORIGINAL PAGE IS
OF POOR QUALITY

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B-3 CSS DYNAMIC RESPONSE    04-08-74   098  19  44  31   915   ON-LINE       ZF
DR I   WITHOUT FBR.(TBL 01)            DAY  HR MIN SEC  MSEC
RUN 1  MAXIMUM  LOAD
                                        501P  20.524  #A  LH2 TANK ULL PRESS
                                        503P  30.124  #A  LOX TANK ULL PRESS

 327P  14.399  #A  CENTAUR TANK STRETCH  540P  14.412  #A  CENTAUR INT BLKHD
 328P  13.599  #A  SHROUD CABLE STRETCH  541P  9.6123  #D  CENT INT BLKHD DP

 332P -516.00  #D  SHROUD LD CYL DEL P
                                        4465L  .00000  #   FBR STRUT 170°
                                        4466L  .00000  #   FBR STRUT 230°
 215L  10500.  #   FORWARD LOAD FIX     4467L -.00128  #   FBR STRUT 290°
5721D  2.5900  I   SHEAR LOAD DEFL.     4468L  .00000  #   FBR STRUT 350°
                                        4463L  .00000  #   FBR STRUT  50°
5464D -3.7922  I   CSS DEFL STA 2807    4464L  .00000  #   FBR STRUT 110°
5465D -2.8452  I   CSS DEFL STA 2680
5466D -1.6756  I   CSS DEFL 2460 150°   FBRT  -.469-3  $=  FBR TOTAL LOAD
5467D -0.7921  I   CSS DEFL 2460 330°
5468D -0.4695  I   CSS DEFL STA 2209
5469D -0.2655  I   CSS DEFL STA 2177
5470D -.08251  I   TITN DEFL STA 2050
```

```
DR 1     4-8-74     RUN 1  RELEASE  098   19   45   32    283    ON-LINE          ZF
                                    DAY   HR  MIN  SEC   MSEC
  5464D      5465D      5466D      5467D      5468D      5469D       215L       TIME
    I          I          I          I          I          I          #        MIN SEC
 .00000     .00249     .00449    -.01299     .00149     .500-3     20.000      45  32
 .00899     .01500     .00899    -.01299     .00299    -.00099     .00000      45  30
 .00299     .00499     .00599    -.01400     .00299     .500-3     10.000      45  28
-.01799    -.01249    -.00449    -.01600     .500-3    -.00149     .00000      45  27
 .00599     .00750     .00299    -.01099     .500-3    -.00249     10.000      45  25
 .00599     .00750     .00599    -.00999     .00299     .500-3     10.000      45  24
-.04800    -.03500    -.01350    -.02000    -.00399    -.00149     10.000      45  22
-.02100    -.01500    -.00899    -.01799    -.00299    -.00399     10.000      45  21
 .03000     .02250     .01500    -.00700     .00349    -.00149     .00000      45  19
 .00299     .00499     .00149    -.01199     .00000    -.00299     10.000      45  17
 .00599     .00999     .00599    -.00700     .500-3    -.00449     .00000      45  16
-.01799    -.01249    -.00599    -.01099    -.00399    -.00649     10.000      45  14
 .04800     .03500     .02100     .00499     .00549    -.500-3     10.000      45  12
-.02399    -.02000    -.00750    -.01699    -.00399    -.00599     .00000      45  09
-0.1590    -0.1225    -.06750    -.04600    -.01950    -.01249     10.000      45  07
 0.5790     0.4575     0.2730     0.1070     .08000     .05050     .00000      45  06
-3.7801    -2.8426    -1.6726    -0.7921    -0.4685    -0.2650     6150.0      45  04
-3.7861    -2.8426    -1.6740    -0.7911    -0.4685    -0.2650     10570.      45  03
-3.7922    -2.8452    -1.6770    -0.7881    -0.4695    -0.2660     10520.      45  00
-3.7922    -2.8452    -1.6770    -0.7881    -0.4695    -0.2665     10480.      44  59
```

```
 B-5 CSS DYNAMIC RESPONSE     04-08-74    098   19   47   51    126    ON-LINE       ZF
 DR 1  WITHOUT FBR.(TBL 01)               DAY   HR  MIN  SEC   MSEC
 RUN 1   POST RELEASE
                                            501P   20.549   #A   LH2 TANK ULL PRESS
                                            503P   30.124   #A   LOX TANK ULL PRESS

 327P   340.79   #A   CENTAUR TANK STRETCH  540P   14.412   #A   CENTAUR INT BLKHD
 328P   14.399   #A   SHROUD CABLE STRETCH  541P   9.5996   #D   CENT INT BLKHD DP

 332P   2.9999   #D   SHROUD LD CYL DEL P
                                           4465L   .00000   #    FBR STRUT 170'
                                           4466L   .00000   #    FBR STRUT 230'
 215L   10.000   #    FORWARD LOAD FIX     4467L  -.447-3   #    FBR STRUT 290'
5721D   2.5149   I    SHEAR LOAD DEFL.     4468L   .00000   #    FBR STRUT 350'
                                           4463L   .00000   #    FBR STRUT  50'
5464D   .01199   I    CSS DEFL STA 2807    4464L   .00000   #    FBR STRUT 110'
5465D   .01249   I    CSS DEFL STA 2680
5466D   .00750   I    CSS DEFL 2460 150'   FBRT   -.163-3   $=   FBR TOTAL LOAD
5467D  -.01199   I    CSS DEFL 2460 330'
5468D   .00249   I    CSS DEFL STA 2209
5469D   .00499   I    CSS DEFL STA 2177
5470D   .00700   I    TITN DEFL STA 2050
```

```
B-3 CSS DYNAMIC RESPONSE     04-09-74    099  19  29  13    118   ON-LINE       ZF
DR 2    WITH  FBR.(TBL 01)               DAY  HR MIN SEC  MSEC
RUN 1   START
                                          501P  20.699  #A  LH2 TANK ULL PRESS
                                          503P  33.248  #A  LOX TANK ULL PRESS

 327P  333.18  #A  CENTAUR TANK STRETCH   540P  14.412  #A  CENTAUR INT BLKHD
 328P  12.799  #A  SHROUD CABLE STRETCH   541P  12.462  #D  CENT INT BLKHD DP

 332P -1.5000  #D  SHROUD LD CYL DEL P
                                         4465L  10.128  #   FBR STRUT 170'
                                         4466L  20.179  #   FBR STRUT 230'
 215L  90.000  #   FORWARD LOAD FIX      4467L  10.031  #   FBR STRUT 290'
5721D -.00399  I   SHEAR LOAD DEFL.      4468L  10.128  #   FBR STRUT 350'
                                         4463L  .00000  #   FBR STRUT  50'
5464D -.00299  I   CSS DEFL STA 2807     4464L -9.7696  #   FBR STRUT 110'
5465D -.00249  I   CSS DEFL STA 2680
5466D  .00000  I   CSS DEFL 2460 150'    FBRT   27.205  $=  FBR TOTAL LOAD
5467D  .00000  I   CSS DEFL 2460 330'
5468D  .00000  I   CSS DEFL STA 2209
5469D  .00000  I   CSS DEFL STA 2177
5470D  .750-3  I   TITN DEFL STA 2050
```

```
B-3 CSS DYNAMIC RESPONSE     04-09-74    099  19  49  28    720   ON-LINE       ZF
DR 2    WITH  FBR.(TBL 01)               DAY  HR MIN SEC  MSEC
RUN 1   MAX. LOAD
                                          501P  24.074  #A  LH2 TANK ULL PRESS
                                          503P  33.974  #A  LOX TANK ULL PRESS

 327P  12.799  #A  CENTAUR TANK STRETCH   540P  14.412  #A  CENTAUR INT BLKHD
 328P  14.399  #A  SHROUD CABLE STRETCH   541P  9.7496  #D  CENT INT BLKHD DP

 332P -460.50  #D  SHROUD LD CYL DEL P
                                         4465L  1448.5  #   FBR STRUT 170'
                                         4466L  2058.5  #   FBR STRUT 230'
 215L  10430.  #   FORWARD LOAD FIX      4467L  802.53  #   FBR STRUT 290'
5721D  5.6949  I   SHEAR LOAD DEFL.      4468L -1397.7  #   FBR STRUT 350'
                                         4463L -2090.3  #   FBR STRUT  50'
5464D -3.3181  I   CSS DEFL STA 2807     4464L -644.75  #   FBR STRUT 110'
5465D -2.4901  I   CSS DEFL STA 2680
5466D -1.4535  I   CSS DEFL 2460 150'    FBRT   6403.2  $=  FBR TOTAL LOAD
5467D -0.3430  I   CSS DEFL 2460 330'
5468D -0.4415  I   CSS DEFL STA 2209
5469D -0.2855  I   CSS DEFL STA 2177
5470D -.09101  I   TITN DEFL STA 2050
```

```
DR 2      4-9-74    RUN 1 WITH   FBR       099   19   49   59    688    ON-LINE         ZF
RELEASE                                    DAY   HR  MIN  SEC   MSEC
  5464D      5465D       5466D       5467D       5468D       5469D        215L       TIME
    I          I           I          ·I           I           I            #        MIN SEC
 -.02100    -.01749     -.00750      .00099     -.00249     -.00949      10.000      49  59
 -.00599    -.00499     -.00149      .00099     -.00149     -.00849      10.000      49  57
 -.03000    -.02499     -.01350      .00099     -.00449     -.00999      10.000      49  56
  .03300     .01999      .01199      .00099      .00099     -.00700      20.000      49  54
  .00599     .00499      .00145      .00099     -.00099     -.00750      .00000      49  53
 -.03300    -.03000     -.01649      .00099     -.00499     -.00849      10.000      49  51
  .02699     .01500      .00599      .00599      .00249     -.00399      20.000      49  49
  0.1320     .09501      .05700      .00999      .01199     -.00199      10.000      49  47
 -0.2130    -0.1625     -.09301     -.01799     -.02900     -.02499      10.000      49  45
 -0.1020    -.06750     -.03900     -.00700     -.01049     -.01249      20.000      49  44
 -0.1920    -0.1850     -0.1260     -.01099     -.07501     -.07901      20.000      49  42
 -3.3150    -2.4875     -1.4520     -0.3430     -0.4415     -0.2855      10430.      49  40
 -3.3150    -2.4875     -1.4520     -0.3430     -0.4415     -0.2855      10420.      49  38
 -3.3181    -2.4901     -1.4535     -0.3430     -0.4415     -0.2855      10420.      49  36
 -3.3181    -2.4901     -1.4535     -0.3430     -0.4415     -0.2855      10410.      49  35
 -3.3181    -2.4901     -1.4535     -0.3430     -0.4415     -0.2855      10450.      49  33
 -3.3150    -2.4875     -1.4535     -0.3430     -0.4415     -0.2855      10430.      49  31
 -3.3181    -2.4901     -1.4535     -0.3430     -0.4415     -0.2855      10430.      49  29
 -3.3181    -2.4901     -1.4535     -0.3430     -0.4415     -0.2855      10430.      49  27
 -3.3241    -2.4976     -1.4565     -0.3450     -0.4430     -0.2865      10410.      49  22
```

```
B-3 CSS DYNAMIC RESPONSE     04-09-74    099   19   49   41    657    ON-LINE         ZF
DR 2      WITH  FBR.(TBL 01)             DAY   HR  MIN  SEC   MSEC
RUN 1  POST RELEASE
                                          501P   24.074   #A   LH2 TANK ULL PRESS
                                          503P   33.949   #A   LOX TANK ULL PRESS

327P   12.799   #A   CENTAUR TANK STRETCH  540P   14.412   #A   CENTAUR INT BLKHD
328P   13.599   #A   SHROUD CABLE STRETCH  541P   9.7374   #D   CENT INT BLKHD DP

332P   119.99   #D   SHROUD LD CYL DEL P
                                          4465L   759.71   #    FBR STRUT 170'
                                          4466L   918.21   #    FBR STRUT 230'
215L  -10.000   #    FORWARD LOAD FIX     4467L   280.87   #    FBR STRUT 290'
5721D  5.6900   I    SHEAR LOAD DEFL.     4468L  -729.28   #    FBR STRUT 350'
                                          4463L  -1035.1   #    FBR STRUT  50'
5464D -1.9051   I    CSS DEFL STA 2807    4464L  -332.15   #    FBR STRUT 110'
5465D -1.4875   I    CSS DEFL STA 2680
5466D -0.8971   I    CSS DEFL 2460 150'   FBRT    3082.3   $=   FBR TOTAL LOAD
5467D -0.1760   I    CSS DEFL 2460 330'
5468D -0.3050   I    CSS DEFL STA 2209
5469D -0.2255   I    CSS DEFL STA 2177
5470D -.07976   I    TITN DEFL STA 2050
```

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TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74   130  17  29  42   874   ON-LINE       ZF
FORMAT NO. 1 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C  900.28  $     4391S  3224.1  #P   5454D -.06301  I    5451D -0.1650  I
4327C  2984.7  $     4392S -2696.1  #P  2464DD  .00262  I    5256D -0.1680  I
3267A  1942.5  $     4393S -1177.7  #P   5458D  .03200  I    5453D -0.1470  I
4334C -1203.9  $     4395S -2014.4  #P  22130D -.01450  I    2464D -0.1620  I
4335C  444.95  $     4401S  774.90  #P  22090D -.01249  I    5456D -.04650  I
3345A -379.46  $     4403S -433.92  #P  21810D  .00949  I    5280D -.06000  I
4919C  3282.5  $     4529S -1859.5  #P  21770D -.02150  I    5282D -.05100  I
4920C  8125.7  $     4531S -2566.2  #P  2678AX -0.1867  %   2209LD -.05050  I
9192A  5704.0  $     4532S -2355.2  #P  2212AX -.07301  %   2181LD -.04000  I
4674C -1570.3  $     4534S -1611.5  #P  2209AX -.06501  %   2177LD -.04100  I
4675C  360.57  $     4463L  282.82  #   2181AX -.05688  %    5305D -.02650  I
6745A -604.87  $     4464L  1286.3  #   2177AX -0.1142  %    5463D -.03000  I
4340C -2794.1  $     4465L  651.53  #     201L  50.000  #   2678RD  .00158  I
4341C  5399.7  $     4466L -111.54  #     202L -75.000  #   2212RD  .591-3  I
3401A  1302.8  $     4467L  715.81  #     203L  .00000  #   2209RD  .523-3  I
4344C  1309.6  $     4468L  468.28  #     204L -125.00  #   2181RD  .902-3  I
4345C -2117.5  $     FBRTL -484.93  #    AXPSL -150.00  #   2177RD -.168-3  I
3445A -403.90  $     5297D -0.1137  I     206L  175.00  #   2053RD  .138-4  I
4913C -96.320  $      541P  6.3874  #D   5701D -.02000  I   2036RD -.256-3  I
4914C -919.75  $      540P  14.549  #A    216L -50.000  #   2626CD -0.2100  I
9134A -508.03  $      503P  45.248  #A   5702D -13.970  I   2464CD -0.1646  I
5294D  .03900  I      501P  33.873  #A   5298D  .00000  I   2241CD -.02800  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74   130  17  38  02   877   ON-LINE       ZF
FORMAT NO. 1 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C  233.47  $     4391S  216.96  #P   5454D -.00149  I    5451D  .00499  I
4327C  47.064  $     4392S  123.97  #P  2464DD -.00149  I    5256D  .00000  I
3267A  140.26  $     4393S  247.96  #P   5458D  .00000  I    5453D  .00000  I
4334C -355.03  $     4395S -123.98  #P  22130D  .00000  I    2464D -.00149  I
4335C -169.76  $     4401S -340.93  #P  22090D  .00000  I    5456D -.00299  I
3345A -262.39  $     4403S -185.96  #P  21810D  .00000  I    5280D -.00099  I
4919C  .00000  $     4529S  92.984  #P  21770D  .00000  I    5282D  .00000  I
4920C  .00000  $     4531S  .00000  #P  2678AX  .00000  %   2209LD  .00000  I
9192A  .00000  $     4532S  .00000  #P  2212AX  .00000  %   2181LD  .00000  I
4674C -384.28  $     4534S -154.97  #P  2209AX  .00000  %   2177LD  .00000  I
4675C -105.39  $     4463L -80.808  #   2181AX -.250-3  %    5305D  .500-3  I
6745A -244.83  $     4464L -176.72  #   2177AX -.250-3  %    5463D  .00000  I
4340C -311.45  $     4465L -101.79  #     201L  250.00  #   2678RD  .00000  I
4341C -78.441  $     4466L  20.280  #     202L  50.000  #   2212RD  .00000  I
3401A -194.94  $     4467L  40.324  #     203L  .00000  #   2209RD  .00000  I
4344C -0.9020  $     4468L  101.79  #     204L  .00000  #   2181RD  .396-5  I
4345C -2.2269  $     FBRTL  52.783  #    AXPSL  300.00  #   2177RD  .411-5  I
3445A -1.5644  $     5297D -.500-3  I     206L  425.00  #   2053RD  .00600  I
4913C -524.09  $      541P  6.3874  #D   5701D -.02000  I   2036RD  .320-5  I
4914C -154.22  $      540P  14.487  #A    216L -10.000  #   2626CD -.00149  I
9134A -339.15  $      503P  45.273  #A   5702D  .00000  I   2464CD  .014-9  I
5294D  .00000  I      501P  33.793  #A   5298D  .00000  I   2241CD -.00099  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74   130  17  44  27   361   ON-LINE      ZF
FORMA  1. 1 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSI
4326C -[illegible]93.6  $   4391S -526.90  #P   5454D -.00149  I    5451D  .00000  I
4327C  15.688  $   4392S -681.87  #P  2464DD  .00149  I    5256D -.00700  I
3267A -1288.9  $   4393S -588.90  #P   5458D  .00000  I    5453D -.01049  I
4334C  1309.6  $   4395S -557.90  #P  22130D  .00000  I    2464D  .00149  I
4335C -2208.5  $   4401S -588.90  #P  22090D  .00000  I    5456D -.00750  I
3345A -449.37  $   4403S -557.90  #P  21810D  .00000  I    5280D  .00099  I
4919C  .00000  $   4529S -681.87  #P  21770D  .00000  I    5282D  .00000  I
4920C  .00000  $   4531S -469.50  #P  2678AX -.02024  %   2209LD  .00000  I
9192A  .00000  $   4532S -526.90  #P  2212AX -.00774  %   2181LD  .00000  I
4674C  956.37  $   4534S -495.90  #P  2209AX -.00800  %   2177LD  .00000  I
4675C -1737.0  $   4463L -30.303  #   2181AX -.00249  %    5305D  .00099  I
6745A -390.31  $   4464L -127.63  #   2177AX -.00099  %    5463D  .250-3  I
4340C -2532.2  $   4465L  10.179  #     201L  5500.0  #   2678RD  .230-3  I
4341C -62.752  $   4466L -40.562  #     202L  5425.0  #   2212RD  .907-4  I
3401A -1297.5  $   4467L -40.326  #     203L  5425.0  #   2209RD  .940-4  I
4344C  1787.6  $   4468L  .00000  #     204L  5625.0  #   2181RD  .396-4  I
4345C -1963.2  $   FBRTL  28.144  #    AXPSL  21975.  #   2177RD  .164-4  I
3445A -87.761  $   5297D -.00499  I     206L  375.00  #   2053RD  .00000  I
4913C  509.93  $    541P  6.2873  #D   5701D  .01999  I   2036RD  .00000  I
4914C -1813.6  $    540P  14.474  #A    216L  20.000  #   2626CD -.01199  I
9134A -651.84  $    503P  45.324  #A   5702D  .00000  I   2464CD  .00000  I
5294D  .00000  I    501P  33.824  #A   5298D  .00000  I   2241CD  .00099  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74   130  17  50  24   167   ON-LINE      ZF
FORMAT NO. 1 LOAD APPLICATION (UP)     DAY  HR MIN SEC  MSEC
4326C -11004.  $   4391S -3222.8  #P   5454D -0.2985  I    5451D  1.7501  I
4327C -15.688  $   4392S -5050.5  #P  2464DD  0.1453  I    5256D  1.3894  I
3267A -5509.7  $   4393S -3811.5  #P   5458D -.02150  I    5453D  1.2950  I
4334C  6321.0  $   4395S -4679.0  #P  22130D  .08900  I    2464D  0.8461  I
4335C -10075.  $   4401S  2914.0  #P  22090D  .07350  I    5456D  0.6075  I
3345A -1876.7  $   4403S  3441.1  #P  21810D  .03200  I    5280D  0.3420  I
4919C  .00000  $   4529S -4028.2  #P  21770D -.02549  I    5282D  0.2640  I
4920C  .00000  $   4531S -5288.0  #P  2678AX -0.1143  %   2209LD  0.2075  I
9192A  .00000  $   4532S -4245.2  #P  2212AX -.06626  %   2181LD  0.1732  I
4674C  2887.3  $   4534S -4028.2  #P  2209AX -.07225  %   2177LD  0.1705  I
4675C -6914.0  $   4463L -969.62  #   2181AX -.03462  %    5305D  0.1415  I
6745A -2013.1  $   4464L -1030.8  #   2177AX -.00724  %    5463D  .06075  I
4340C  4334.7  $   4465L  590.43  #     201L  5550.0  #   2678RD  .00129  I
4341C -94.128  $   4466L  922.84  #     202L  5500.0  #   2212RD  .775-3  I
3401A  2120.2  $   4467L  443.59  #     203L  5650.0  #   2209RD  .849-3  I
4344C -3343.1  $   4468L -783.78  #     204L  5750.0  #   2181RD  .549-3  I
4345C  4431.0  $   FBRTL  3266.0  #    AXPSL  22450.  #   2177RD  .712-3  I
3445A  544.06  $   5297D -.06926  I     206L  7425.0  #   2053RD  .315-4  I
4913C -1650.2  $    541P  6.3498  #D   5701D  2.9501  I   2036RD  .425-3  I
4914C  2962.1  $    540P  14.499  #A    216L  .00000  #   2626CD  0.9966  I
9134A  655.96  $    503P  45.324  #A   5702D  .00000  I   2464CD  0.7007  I
5294D -0.1260  I    501P  33.849  #A   5298D  .00000  I   2241CD  0.3205  I
```

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TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74    130  17  56  23   313   ON-LINE      ZF
FORMAT NO. 1 LOAD APPLICATION (UP)        DAY  HR MIN SEC  MSEC
4326C -18627.  $     4391S -5886.7  #P   5454D -0.6856  I     5451D  3.5750  I
4327C  31.376  $     4392S -9571.5  #P  2464DD  0.3521  I     5256D  2.8210  I
3267A -9298.0  $     4393S -6877.7  #P   5458D -.07101  I     5453D  2.6144  I
4334C  12073.  $     4395S -9602.5  #P  22130D  0.1070  I     2464D  1.6950  I
4335C -18204.  $     4401S  6790.7  #P  22090D  .09101  I     5456D  1.1955  I
3345A -3065.0  $     4403S  7411.2  #P  21810D  .04000  I     5280D  0.6370  I
4919C  .00000  $     4529S -7961.5  #P  21770D -.02700  I     5282D  0.5080  I
4920C  .00000  $     4531S -11072.  #P  2678AX -0.1653  %    2209LD  0.4412  I
9192A  .00000  $     4532S -8488.0  #P  2212AX -.07576  %    2181LD  0.3382  I
4674C  6005.0  $     4534S -8488.0  #P  2209AX -.09026  %    2177LD  0.3292  I
4675C -14002.  $     4463L -2343.0  #   2181AX -.07201  %     5305D  0.2315  I
6745A -3998.7  $     4464L -1256.5  #   2177AX -.00999  %     5463D  .07975  I
4340C  11505.  $     4465L  1547.5  #     201L  5600.0  #    2678RD  .00306  I
4341C -156.88  $     4466L  2322.6  #     202L  5450.0  #    2212RD  .00229  I
3401A  5674.2  $     4467L  927.56  #     203L  5475.0  #    2209RD  .00252  I
4344C -8931.0  $     4468L -1475.8  #     204L  5600.0  #    2181RD  .00114  I
4345C  12158.  $     FBRTL  7294.0  #    AXPSL  22300.  #    2177RD  .00160  I
3445A  1613.9  $     5297D -0.1440  I     206L  14775.  #    2053RD  .201-3  I
4913C -2889.7  $      541P  6.3999  #D   5701D  5.0000  I    2036RD  .657-3  I
4914C  7327.2  $      540P  14.524  #A    216L -20.000  #    2626CD  1.9291  I
9134A  2218.7  $      503P  45.273  #A   5702D  .00999  I    2464CD  1.3428  I
5294D -0.2790  I      501P  33.773  #A   5298D  .00000  I    2241CD  0.5660  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)   05-10-74    130  18  02  38   100   ON-LINE      ZF
FORMA   O. 1 LOAD APPLICATION (UP)        DAY  HR MIN SEC  MS
4326C -25252.  $     4391S -8612.0  #P   5454D -1.0845  I     5451D  5.4048  I
4327C -94.128  $     4392S -14059.  #P  2464DD  0.5682  I     5256D  4.2629  I
3267A -12673.  $     4393S -9726.5  #P   5458D -0.1310  I     5453D  3.9376  I
4334C  18790.  $     4395S -13626.  #P  22130D  0.1359  I     2464D  2.5470  I
4335C -26189.  $     4401S  11197.  #P  22090D  0.1120  I     5456D  1.8015  I
3345A -3699.2  $     4403S  10638.  #P  21810D  .05050  I     5280D  0.9431  I
4919C  .00000  $     4529S -11490.  #P  21770D -.02150  I     5282D  0.7565  I
4920C  .00000  $     4531S -16540.  #P  2678AX -0.1608  %    2209LD  0.6803  I
9192A  .00000  $     4532S -12914.  #P  2212AX -.07376  %    2181LD  0.5020  I
4674C  9910.0  $     4534S -13718.  #P  2209AX -.09576  %    2177LD  0.4840  I
4675C -21575.  $     4463L -3564.5  #   2181AX -.07213  %     5305D  0.3084  I
6745A -5832.5  $     4464L -1747.3  #   2177AX -.01049  %     5463D  .09376  I
4340C  17905.  $     4465L  2240.0  #     201L  5625.0  #    2678RD  .00548  I
4341C -298.06  $     4466L  3631.5  #     202L  5500.0  #    2212RD  .00406  I
3401A  8803.5  $     4467L  1431.7  #     203L  5550.0  #    2209RD  .00437  I
4344C -14454.  $     4468L -2351.0  #     204L  5700.0  #    2181RD  .00229  I
4345C  18999.  $     FBRTL  11135.  #    AXPSL  22375.  #    2177RD  .00254  I
3445A  2273.1  $     5297D -0.2170  I     206L  22000.  #    2053RD  .433-3  I
4913C -4126.0  $      541P  6.4624  #D   5701D  6.7598  I    2036RD  .862-3  I
4914C  11339.  $      540P  14.499  #A    216L -60.000  #    2626CD  2.8530  I
9134A  3607.0  $      503P  45.248  #A   5702D -.03000  I    2464CD  1.9788  I
5294D -0.4290  I      501P  33.923  #A   5298D  .07275  I    2241CD  0.8121  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)    05-10-74    130  18  06  01   086   ON-LINE      ZF
FORMAT NO. 1 LOAD APPLICATION (UP)        DAY  HR MIN SEC  MSEC
4326C -33120.  $    4391S -11057.  #P  5454D -1.5090  I    5451D  7.4248  I
4327C -78.441  $    4392S -18760.  #P 2464DD  0.7866  I    5256D  5.8519  I
3267A -16599.  $    4393S -13192.  #P  5458D -0.1855  I    5453D  5.4038  I
4334C  25729.  $    4395S -17647.  #P 22130D  0.1860  I    2464D  3.4845  I
4335C -35438.  $    4401S  16538.  #P 22090D  0.1610  I    5456D  2.4629  I
3345A -4954.2  $    4403S  13991.  #P 21810D  .05850  I    5280D  1.2849  I
4919C  .00000  $    4529S -15265.  #P 21770D -.01400  I    5282D  1.0329  I
4920C  .00000  $    4531S -22348.  #P 2678AX -0.1578  %   2209LD  0.9403  I
9192A  .00000  $    4532S -17462.  #P .2212AX -.07101 %   2181LD  0.6865  I
4674C  13864.  $    4534S -18946.  #P 2209AX -.09876  %   2177LD  0.6583  I
4675C -28996.  $    4463L -5048.0  #  2181AX -.06763  %    5305D  0.4000  I
6745A -7565.5  $    4464L -2267.5  #  2177AX -.00975  %    5463D  0.1082  I
4340C  24345.  $    4465L  3177.0  #    201L  5650.0  #   2678RD  .00826  I
4341C -266.68  $    4466L  5275.5  #    202L  5625.0  #   2212RD  .00596  I
3401A  12039.  $    4467L  1906.3  #    203L  5550.0  #   2209RD  .00635  I
4344C -20373.  $    4468L -3205.6  #    204L  5475.0  #   2181RD  .00363  I
4345C  26276.  $    FBRTL  15736.  #   AXPSL  22300.  #   2177RD  .00356  I
3445A  2951.5  $    5297D -0.2972  I    206L  29650.  #   2053RD  .696-3  I
4913C -5240.2  $     541P  6.3874  #D  5701D  8.5796  I   2036RD  .00114  I
4914C  16479.  $     540P  14.537  #A   216L -30.000  #   2626CD  3.8950  I
9134A  5619.5  $     503P  45.324  #A  5702D -.03000  I   2464CD  2.6980  I
5294D -0.5990  I     501P  33.949  #A  5298D  0.1620  I   2241CD  1.0995  I
```

TEST 7E-2A

```
B-3 CSS EET 7E (WITH FBR)    05-10-74    130  18  14  16   287   ON-LINE      ZF
FORMAT NO. 1 LOAD APPLICATION (UP)        DAY  HR MIN SEC  MSEC
4326C -43570.  $    4391S -15296.  #P  5454D -2.0760  I    5451D  10.319  I
4327C -203.93  $    4392S -26301.  #P 2464DD  1.0785  I    5256D  8.1372  I
3267A -21887.  $    4393S -16781.  #P  5458D -0.2535  I    5453D  7.5039  I
4334C  35228.  $    4395S -24138.  #P 22130D  0.2725  I    2464D  4.8389  I
4335C -47712.  $    4401S  23436.  #P 22090D  0.2520  I    5456D  3.4170  I
3345A -6240.7  $    4403S  18899.  #P 21810D  .06950  I    5280D  1.7730  I
4919C  .00000  $    4529S -20093.  #P 21770D  .00249  I    5282D  1.4375  I
4920C  .00000  $    4531S -30614.  #P 2678AX -0.1312  %   2209LD  1.3157  I
9192A  .00000  $    4532S -23922.  #P 2212AX -.07051  %   2181LD  0.9538  I
4674C  17655.  $    4534S -26301.  #P 2209AX -0.1080  %   2177LD  0.9171  I
4675C -38724.  $    4463L -6692.5  #  2181AX -.06313  %    5305D  0.5275  I
6745A -10534.  $    4464L -2875.8  #  2177AX -.00599  %    5463D  0.1254  I
4340C  33726.  $    4465L  4287.2  #    201L  5625.0  #   2678RD  .01190  I
4341C -533.34  $    4466L  6950.7  #    202L  5275.0  #   2212RD  .00857  I
3401A  16597.  $    4467L  2672.2  #    203L  5425.0  #   2209RD  .00905  I
4344C -20065.  $    4468L -4192.5  #    204L  5500.0  #   2181RD  .00555  I
4345C  37684.  $    FBRTL  20798.  #   AXPSL  21825.  #   2177RD  .00507  I
3445A  4410.2  $    5297D -0.4132  I    206L  40150.  #   2053RD  .00107  I
4913C -7480.7  $     541P  6.4372  #D  5701D  11.269  I   2036RD  .00156  I
4914C  23337.  $     540P  14.524  #A   216L -20.000  #   2626CD  5.4280  I
9134A  7928.2  $     503P  45.224  #A  5702D -.00999  I   2464CD  3.7606  I
5294D -0.8536  I     501P  33.923  #A  5298D  0.2870  I   2241CD  1.5195  I
```

TEST 7E-2A

```
 B-3 CSS EET 7E (WITH FBR)   05-10-74   130  18  16  11    160   ON-LINE        ZF
 FORMAT NO. 1 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C -49872.   $    4391S -17647.  #P   5454D -2.3580   I     5451D  11.784   I
4327C -329.43   $    4392S -29698.  #P  2464DD  1.2278   I     5256D  9.2959   I
3267A -24601.   $    4393S -18389.  #P   5458D -0.2915   I     5453D  8.5679   I
4334C  39952.   $    4395S -27536.  #P  22130D  0.3260   I     2464D  5.5244   I
4335C -54184.   $    4401S  27292.  #P  22090D  0.3095   I     5456D  3.9000   I
3345A -7115.5   $    4403S  21758.  #P  21810D  .07800   I     5280D  2.0209   I
4919C  .00000   $    4529S -23706.  #P  21770D  .01849   I     5282D  1.6440   I
4920C  .00000   $    4531S -34790.  #P  2678AX -0.1128   %    2209LD  1.5095   I
9192A  .00000   $    4532S -27011.  #P  2212AX -.06876   %    2181LD  1.0890   I
4674C  18788.   $    4534S -29728.  #P  2209AX -0.1112   %    2177LD  1.0482   I
4675C -41754.   $    4463L -7529.7  #   2181AX -.06325   %     5305D  0.5935   I
6745A -11482.   $    4464L -3001.7  #   2177AX -.00599   %     5463D  0.1357   I
4340C  39104.   $    4465L  4929.2  #     201L  5575.0   #    2678RD  .01366   I
4341C -643.12   $    4466L  7803.7  #     202L  5350.0   #    2212RD  .00993   I
3401A  19231.   $    4467L  2974.8  #     203L  5375.0   #    2209RD  .01047   I
4344C -33314.   $    4468L -4792.5  #     204L  5425.0   #    2181RD  .00654   I
4345C  43882.   $    FBRTL  25462.  #    AXPSL  21725.   #    2177RD  .00581   I
3445A  5284.7   $    5297D -0.4757  I     206L  45550.   #    2053RD  .00126   I
4913C -8578.5   $     541P  6.4123  #D   5701D  12.609   I    2036RD  .00178   I
4914C  26587.   $     540P  14.512  #A    216L  .00000   #    2626CD  6.2099   I
9134A  9004.5   $     503P  45.273  #A   5702D -.03000   I    2464CD  4.2964   I
5294D -0.9811   I     501P  33.949  #A   5298D  0.3492   I    2241CD  1.7295   I
```

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TEST 7E-2A

```
 B-3 CSS EET 7E (WITH FBR)   05-10-74   130  18  21  16    052   ON-LINE        ZF
 FORMAT NO. 1 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C  5502.5   $    4391S  836.87  #P   5454D -0.2265   I     5451D  1.0299   I
4327C  94.128   $    4392S  185.96  #P  2464DD  0.1430   I     5256D  0.8085   I
3267A  2798.3   $    4393S  588.90  #P   5458D -.06150   I     5453D  0.7560   I
4334C  1582.2   $    4395S -30.995  #P  22130D  0.1210   I     2464D  0.5280   I
4335C  463.78   $    4401S  588.90  #P  22090D  0.1369   I     5456D  0.3705   I
3345A  1023.0   $    4403S  1456.8  #P  21810D  .05000   I     5280D  0.2370   I
4919C  .00000   $    4529S  1177.8  #P  21770D  .02349   I     5282D  0.1745   I
4920C  .00000   $    4531S  1690.3  #P  2678AX -.04350   %    2209LD  0.1014   I.
9192A  .00000   $    4532S  1456.8  #P  2212AX -.04575   %    2181LD  .08826   I
4674C -384.20   $    4534S  836.87  #P  2209AX -.04950   %    2177LD  .06875   I
4675C  76.554   $    4463L -717.12  #   2181AX -.01474   %     5305D  .06900   I
6745A -153.85   $    4464L -471.25  #   2177AX  .00849   %     5463D  .01649   I
4340C -0.9199   $    4465L  570.06  #     201L  25.000   #    2678RD  .494-3   I
4341C -94.128   $    4466L  486.75  #     202L  850.00   #    2212RD  .535-3   I
3401A -47.523   $    4467L  100.81  #     203L  800.00   #    2209RD  .582-3   I
4344C -1617.8   $    4468L -682.00  #     204L  625.00   #    2181RD  .233-3   I
4345C  2177.2   $    FBRTL  2178.7  #    AXPSL  2300.0   #    2177RD  .493-3   I
3445A  279.73   $    5297D -.02950  I     206L  525.00   #    2053RD  .414-3   I
4913C  1290.1   $     541P  6.5124  #D   5701D  1.9801   I    2036RD  .367-3   I
4914C -505.93   $     540P  14.499  #A    216L  20.000   #    2626CD  0.5295   I
9134A  392.10   $     503P  45.248  #A   5702D -.03400   I    2464CD  0.3850   I
5294D -.02200   I     501P  33.898  #A   5298D  .00000   I    2241CD  0.1755   I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   18   14   39    799
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY   HR  MIN  SEC   MSEC
4326C  604.87  $    4391S  681.90  #P   5454D  5.9520  I     5451D  0.3250  I
4327C -865.65  $    4392S -402.92  #P  2464DD -4.9803  I     5256D  0.2415  I
3267A -735.28  $    4393S -247.96  #P   5458D  1.9921  I     5453D  1.6380  I
4334C  369.65  $    4395S -154.97  #P  22130D  1.9776  I     2464D  1.3620  I
4335C -1045.0  $    4401S -92.984  #P  22090D  1.9766  I     5456D  0.1140  I
3345A -337.67  $    4403S  30.994  #P  21810D  1.9806  I     5280D  0.4770  I
4919C  976.93  $    4529S -185.96  #P  21770D  1.9676  I     5282D  .07350  I
4920C -403.26  $    4531S -281.70  #P  2678AX  1.5986  %    2209LD  .08826  I
9192A  286.84  $    4532S -309.95  #P  2212AX  1.0632  %    2181LD  .08050  I
4674C  123.82  $    4534S -278.95  #P  2209AX  1.0324  %    2177LD  .07875  I
4675C -149.76  $                       2181AX  0.5427  %     5305D  .05700  I
6745A -12.969  $    5294D  1.9160  I   2177AX -.00849  %     5463D  .03975  I
4340C  1786.3  $    5297D  0.9956  I     201L -25.000  *    2678RD -.01580  I
4341C -351.32  $    5298D  .09000  I     202L -50.000  *    2212RD -.01063  I
3401A  717.53  $                         203L  .00000  *    2209RD -.01094  I
4344C  246.28  $    4922S  .00000  #P    204L  25.000  *    2181RD -.00717  I
4345C  788.87  $    4923S  157.27  #P   AXPSL -50.000  *    2177RD  .493-4  I
3445A  517.56  $                         206L  675.00  *    2053RD -.256-4  I
4913C -893.25  $                        5701D  0.1600  I    2036RD  .246-3  I
4914C  1529.0  $     540P  14.374  #A                       2626CD  7.5899  I
9134A  317.90  $     503P  30.249  #A   5265D  4.9925  I    2464CD  6.3418  I
LINEL -52.039  *     501P  20.474  #A   5266D  4.9674  I    2241CD  2.4690  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   18   15   33    881                ZF
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY   HR  MIN  SEC   MSEC
4326C -47.064  $    4391S  61.988  #P   5454D  .00000  I     5451D  .00000  I
4327C -47.064  $    4392S  61.988  #P  2464DD  .00149  I     5256D  .00349  I
3267A -47.064  $    4393S -30.995  #P   5458D  .00000  I     5453D  .00000  I
4334C  61.683  $    4395S  .00000  #P  22130D  .00000  I     2464D  .00000  I
4335C -75.441  $    4401S -30.995  #P  22090D  .00000  I     5456D -.00149  I
3345A -6.8783  $    4403S  .00000  #P  21810D  .00000  I     5280D -.00099  I
4919C  152.80  $    4529S  92.984  #P  21770D  .007-9  I     5282D  .00000  I
4920C  15.680  $    4531S -31.300  #P  2678AX  .00000  %    2209LD  .00000  I
9192A  84.246  $    4532S  30.994  #P  2212AX -.250-3  %    2181LD  .00000  I
4674C -169.07  $    4534S  .00000  #P  2209AX  .250-3  %    2177LD  .00000  I
4675C -120.92  $                       2181AX -.125-3  %     5305D  .00000  I
6745A -145.00  $    5294D  .00000  I   2177AX  .00000  %     5463D  .00000  I
4340C  62.291  $    5297D  .00000  I     201L -25.000  *    2678RD  .00000  I
4341C  15.608  $    5298D -.250-3  I     202L -50.000  *    2212RD -.292-5  I
3401A  38.988  $                         203L -50.000  *    2209RD -.294-5  I
4344C -200.59  $    4922S -30.995  #P    204L -50.000  *    2181RD -.198-5  I
4345C -16.648  $    4923S  62.910  #P   AXPSL -175.00  *    2177RD  .00000  I
3445A -108.62  $                         206L  525.00  *    2053RD  .00000  I
4913C  30.616  $                        5701D -.04000  I    2036RD  .00000  I
4914C -152.00  $     540P  14.374  #A                       2626CD  .00000  I
9134A -60.691  $     503P  30.249  #A   5265D  .00000  I    2464CD -.00149  I
LINEL -48.431  *     501P  20.499  #A   5266D  .00000  I    2241CD -.00099  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  18  21  10   104            ZF
FORMAT NO. 5 LOAD APPLICATION (UP)     DAY  HR MIN SEC  MSEC
4326C  78.441  $    4391S -216.96  #P  5454D  .00000  I   5451D  .00000  I
4327C -78.441  $    4392S -216.96  #P 2464DD -.250-3  I   5256D  .01400  I
3267A -78.441  $    4393S -185.96  #P  5458D -.500-3  I   5453D  .00700  I
4334C -30.616  $    4395S -216.96  #P 22130D  .00249  I   2464D -.00149  I
4335C  15.534  $    4401S -402.92  #P 22090D  .00000  I   5456D  .00599  I
3345A -7.5410  $    4403S -340.93  #P 21810D  .00199  I   5280D  .00000  I
4919C  15.688  $    4529S -247.96  #P 21770D -.00949  I   5282D  .500-3  I
4920C  202.10  $    4531S -219.10  #P 2678AX  .00000  %  2209LD  .500-3  I
9192A  108.89  $    4532S -340.93  #P 2212AX  .00000  %  2181LD  .00000  I
4674C -246.28  $    4534S -278.95  #P 2209AX  .500-3  %  2177LD  .00174  I
4675C -15.534  $                      2181AX  .375-3  %   5305D -.00099  I
6745A -130.91  $    5294D  .00199  I  2177AX  .00000  %   5463D -.250-3  I
4340C  31.376  $    5297D  .250-3  I    201L  .00000  *  2678RD  .00000  I
4341C  77.082  $    5298D  .500-3  I    202L -50.000  *  2212RD  .00000  I
3401A  54.228  $                        203L  .00000  *  2209RD  .00000  I
4344C -77.222  $    4922S -278.95  #P   204L -25.000  *  2181RD  .198-5  I
4345C -31.069  $    4923S -125.82  #P  AXPSL -75.000  *  2177RD  .00000  I
3445A -54.144  $                        206L  550.00  *  2053RD  .197-5  I
4913C -46.603  $                       5701D  .06000  I  2036RD  .801-4  I
4914C -183.07  $      540P  14.374 #A                    2626CD  .00700  I
9134A -114.83  $      503P  30.249 #A  5265D -.00124  I  2464CD -.00124  I
LINEL -49.181  #      501P  20.449 #A  5266D -.00124  I  2241CD -.500-3  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  18  22  05   867            ZF
FORMAT NO. 5 LOAD APPLICATION (UP)     DAY  HR MIN SEC  MSEC
4326C -2794.1  $    4391S -650.87  #P  5454D  .00149  I   5451D  .04500  I
4327C  232.60  $    4392S -867.81  #P 2464DD -.01037  I   5256D  .03850  I
3267A -1280.7  $    4393S -774.84  #P  5458D -.500-3  I   5453D  .03500  I
4334C  1495.1  $    4395S -681.87  #P 22130D  .007-9  I   2464D  .014-9  I
4335C -2206.1  $    4401S -774.84  #P 22090D -.01199  I   5456D  .01500  I
3345A -355.45  $    4403S -712.87  #P 21810D -.00099  I   5280D -.00099  I
4919C  731.34  $    4529S -805.84  #P 21770D -.02599  I   5282D  .500-3  I
4920C -1957.0  $    4531S -938.96  #P 2678AX -.01274  %  2209LD  .250-3  I
9192A -612.84  $    4532S -960.78  #P 2212AX -.00149  %  2181LD  .00624  I
4674C  771.78  $    4534S -743.84  #P 2209AX  .250-3  %  2177LD  .00724  I
4675C -1918.9  $                      2181AX -.625-3  %   5305D  .00000  I
6745A -573.59  $    5294D -.00149  I  2177AX  .250-3  %   5463D  .00000  I
4340C -1755.0  $    5297D -.00174  I    201L  25.000  *  2678RD  .340-4  I
4341C  1112.7  $    5298D  .500-3  I    202L -75.000  *  2212RD  .175-4  I
3401A -321.10  $                        203L  .00000  *  2209RD -.294-5  I
4344C  1001.1  $    4922S -805.84  #P   204L -75.000  *  2181RD  .178-4  I
4345C -1467.6  $    4923S -534.71  #P  AXPSL -125.00  *  2177RD -.411-5  I
3445A -233.19  $                        206L  425.00  *  2053RD -.197-5  I
4913C  447.32  $                       5701D  .00999  I  2036RD  .101-3  I
4914C -1331.1  $      540P  14.374 #A                    2626CD  .03650  I
9134A -441.92  $      503P  30.274 #A  5265D -.00249  I  2464CD  .01037  I
LINEL -46.277  *      501P  20.449 #A  5266D -.00375  I  2241CD -.00149  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   18  27  31    458              ZF
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C   3272.  $    4391S -2479.2  #P  5454D  .00449  I   5451D  .04500  I
4327C  1471.5  $    4392S -3377.7  #P 2464DD -.00637  I   5256D  .00700  I
3267A -5900.2  $    4393S -2634.1  #P  5458D  .00000  I   5453D  .02100  I
4334C  7231.0  $    4395S -2417.2  #P 22130D -.500-3  I   2464D  .014-9  I
4335C -11311.  $    4401S -2696.1  #P 22090D -.04000  I   5456D  .00299  I
3345A -2039.8  $    4403S -2696.1  #P 21810D  .00099  I   5280D  .00000  I
4919C  4341.0  $    4529S -2851.0  #P 21770D -.01099  I   5282D  .500-3  I
4920C -11175.  $    4531S -3160.7  #P 2678AX -0.1743  %  2209LD  .00149  I
9192A -3417.0  $    4532S -3377.7  #P 2212AX -.05325  %  2181LD  .00674  I
4674C  3582.1  $    4534S -2448.2  #P 2209AX -.05625  %  2177LD  .00774  I
4675C -8497.5  $                      2181AX -.03125  %   5305D  .500-3  I
6745A -2457.6  $    5294D  .00000  I  2177AX -.01374  %   5463D  .00000  I
4340C -10351.  $    5297D -.03400  I    201L  20475.  #  2678RD  .553-4  I
4341C  6801.2  $    5298D -.02850  I    202L  20350.  #  2212RD  .497-4  I
3401A -1775.0  $                        203L  20550.  #  2209RD -.294-5  I
4344C  7136.0  $    4922S -2758.1  #P   204L  20500.  #  2181RD  .436-4  I
4345C -9502.5  $    4923S -2012.8  #P  AXPSL  81872.  #  2177RD  .946-4  I
3445A -1183.1  $                        206L  375.00  #  2053RD -.197-5  I
4913C  2410.6  $                       5701D -.07001  I  2036RD  .109-3  I
4914C -7337.0  $      540P  14.399 #A                    2626CD  .02549  I
9134A -2463.1  $      503P  30.199 #A  5265D -.00499  I  2464CD  .00637  I
LINEL -200.52  #      501P  20.399 #A  5266D -.00624  I  2241CD  .00000  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   18  32  39    123              ZF
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C -27853.  $    4391S -5112.5  #P  5454D -0.6721  I   5451D  1.9651  I
4327C  2672.0  $    4392S -7899.7  #P 2464DD  0.3862  I   5256D  1.5154  I
3267A -12590.  $    4393S -6041.7  #P  5458D -.05550  I   5453D  1.4175  I
4334C  15411.  $    4395S -6785.0  #P 22130D  .00149  I   2464D  0.8956  I
4335C -23025.  $    4401S  1022.8  #P 22090D -.04250  I   5456D  0.6315  I
3345A -3806.2  $    4403S  1270.8  #P 21810D  .01199  I   5280D  0.3010  I
4919C  10907.  $    4529S -6382.2  #P 21770D -.00549  I   5282D  0.2420  I
4920C -19237.  $    4531S -8196.5  #P 2678AX -0.1908  %  2209LD  0.2372  I
9192A -4164.7  $    4532S -7249.5  #P 2212AX -.05950  %  2181LD  0.1707  I
4674C  7889.5  $    4534S -5948.7  #P 2209AX -.06876  %  2177LD  0.1685  I
4675C -17627.  $                      2181AX -.03750  %   5305D  0.1050  I
6745A -4868.7  $    5294D -0.1535  I  2177AX -.02499  %   5463D  .03425  I
4340C -46.603  $    5297D -0.1022  I    201L  20525.  #  2678RD  .00246  I
4341C  45.707  $    5298D  .02725  I    202L  20325.  #  2212RD  .00159  I
3401A -0.4479  $                        203L  20550.  #  2209RD  .00170  I
4344C -77.222  $    4922S -6103.7  #P   204L  20525.  #  2181RD  .00102  I
4345C -31.069  $    4923S -4339.7  #P  AXPSL  81924.  #  2177RD  .674-3  I
3445A -54.144  $                        206L  7625.0  #  2053RD  .473-4  I
4913C -169.07  $                       5701D  2.6700  I  2036RD  .242-3  I
4914C -393.85  $      540P  14.362 #A                    2626CD  0.7455  I
9134A -281.46  $      503P  30.274 #A  5265D -0.3912  I  2464CD  0.5092  I
LINEL -363.59  #      501P  20.449 #A  5266D -0.3962  I  2241CD  0.2455  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  18  48  03   847                  ZF
FORMAT NO. 5 LOAD APPLICATION (UP)     DAY  HR MIN SEC  MSEC
4[illegible] -44896.  $    4391S -7590.0  #P  5454D -1.4055        5451D  3.9100  I
4327C -88716.  $    4392S -[illegible]450.  #P 2464DD  0.8041   I    5256D  3.0589  I
3267A -66804.  $    4393S -[illegible]9.0  #P  5458D -0.1315   I    5453D  2.8210  I
4334C  24016.  $    4395S -10902.  #P 22130D  .02449   I    2464D  1.7971  I
4335C -33806.  $    4401S  5022.7  #P 22090D -.02700   I    5456D  1.2585  I
3345A -4894.0  $    4403S  5239.7  #P 21810D  .02399   I    5280D  0.6030  I
4919C -61442.  $    4529S -9881.0  #P 21770D  .00199   I    5282D  0.4840  I
4920C -61904.  $    4531S -13541.  #P 2678AX -0.1856   %   2209LD  0.4670  I
9192A -61674.  $    4532S -11552.  #P 2212AX -.05200   %   2181LD  0.3215  I
4674C  13185.  $    4534S -9540.5  #P 2209AX -.07476   %   2177LD  0.3147  I
4675C -26948.  $                      2181AX -.03550   %    5305D  0.1855  I
6745A -6881.0  $    5294D -0.2940  I  2177AX -.02449   %    5463D  .05325  I
4340C  9794.5  $    5297D -0.1755  I    201L  20500.   *   2678RD  .00516  I
4341C -92576.  $    5298D  0.1045  I    202L  20375.   *   2212RD  .00338  I
3401A -41392.  $                        203L  20650.   *   2209RD  .00366  I
4344C -7622.7  $    4922S -63184.  #P   204L  20600.   *   2181RD  .00222  I
4345C  9762.0  $    4923S -64280.  #P  AXPSL  81924.   *   2177RD  .00150  I
3445A  1069.6  $                        206L  14700.   *   2053RD  .216-3  I
4913C -1671.5  $                       5701D  4.7899   I   2036RD  .461-3  I
4914C  5436.7  $     540P  14.362  #A                      2626CD  1.4154  I
9134A  1882.6  $     503P  30.249  #A  5265D -0.8126   I   2464CD  0.9931  I
LINEL -520.96  #     501P  20.499  #A  5266D -0.8226   I   2241CD  0.4715  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  19  03  53   455                  ZF
FORMAT NO. 5 LOAD APPLICATION (UP)     DAY  HR MIN SEC  MSEC
4326C -62064.  $    4391S -10036.  #P  5454D -2.1375   I    5451D  5.9801  I
4327C  2464.0  $    4392S -17214.  #P 2464DD  1.2289   I    5256D  4.6934  I
3267A -29800.  $    4393S -12573.  #P  5458D -0.2035   I    5453D  4.3259  I
4334C  32107.  $    4395S -14925.  #P 22130D  .05850   I    2464D  2.7690  I
4335C -45114.  $    4401S  10110.  #P 22090D -.00549   I    5456D  1.9320  I
3345A -6503.0  $    4403S  8652.0  #P 21810D  .02699   I    5280D  0.9261  I
4919C  17683.  $    4529S -14090.  #P 21770D  .01099   I    5282D  0.7450  I
4920C -49824.  $    4531S -19538.  #P 2678AX -0.1777   %   2209LD  0.7135  I
9192A -16069.  $    4532S -16162.  #P 2212AX -.05225   %   2181LD  0.4850  I
4674C  17668.  $    4534S -15544.  #P 2209AX -.08201   %   2177LD  0.4740  I
4675C -36280.  $                      2181AX -.03387   %    5305D  0.2640  I
6745A -9305.5  $    5294D -0.4525  I  2177AX -.02100   %    5463D  .06800  I
4340C  19043.  $    5297D -0.2537  I    201L  20525.   *   2678RD  .00794  I
4341C -13520.  $    5298D  0.1860  I    202L  20325.   *   2212RD  .00530  I
3401A  2761.6  $                        203L  20600.   *   2209RD  .00565  I
4344C -15376.  $    4922S -14554.  #P   204L  20525.   *   2181RD  .00348  I
4345C  19819.  $    4923S -9902.5  #P  AXPSL  81972.   *   2177RD  .00243  I
3445A  2221.5  $                        206L  22125.   *   2053RD  .421-3  I
4913C -4035.3  $                       5701D  6.8700   I   2036RD  .673-3  I
4914C  11381.  $     540P  14.374  #A                      2626CD  2.1884  I
9134A  3673,1  $     503P  30.249  #A  5265D -1.2350   I   2464CD  1.5400  I
LINEL -689.65  *     501P  20.474  #A  5266D -1.2500   I   2241CD  0.7225  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   19   11   06    237                    ZF
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326    78676.  $     4391S -12728.  #P   5454D -2.8877  I      5451D  8.1098  I
4327C  4114.0   $     4392S -22130.  #P  2464DD  1.6665  I      5256D  6.3733  I
3267A -37280.   $     4393S -15389.  #P   5458D -0.2800  I      5453D  5.8590  I
4334C  40624.   $     4395S -18915.  #P  22130D  0.1109  I      2464D  3.7635  I
4335C -57200.   $     4401S  15450.  #P  22090D  .04100  I      5456D  2.6205  I
3345A -8287.5   $     4403S  12221.  #P  21810D  .03200  I      5280D  1.2629  I
4919C  30030.   $     4529S -17833.  #P  21770D  .02449  I      5282D  1.0164  I
4920C -66480.   $     4531S -24969.  #P  2678AX -0.1766  %     2209LD  0.9656  I
9192A -18224.   $     4532S -20522.  #P  2212AX -.05000  %     2181LD  0.6545  I
4674C  21521.   $     4534S -20677.  #P  2209AX -.08951  %     2177LD  0.6373  I
4675C -44084.   $                        2181AX -.03287  %      5305D  0.3440  I
6745A -11281.   $     5294D -0.6140  I   2177AX -.01925  %      5463D  .08075  I
4340C  27668.   $     5297D -0.3387  I     201L  20500.  *     2678RD  .01091  I
4341C -19208.   $     5298D  0.2730  I     202L  20375.  *     2212RD  .00729  I
3401A  4230.2   $                          203L  20600.  *     2209RD  .00778  I
4344C -22999.   $     4922S -18853.  #P    204L  20600.  *     2181RD  .00484  I
4345C  29976.   $     4923S -12635.  #P   AXPSL  82072.  *     2177RD  .00346  I
3445A  3489.1   $                          206L  29475.  *     2053RD  .625-3  I
4913C -6336.2   $                         5701D  8.8399  I     2036RD  .912-3  I
4914C  18037.   $      540P  14.387  #A                        2626CD  2.9715  I
9134A  5850.5   $      503P  30.249  #A   5265D -1.6688  I     2464CD  2.0969  I
LINEL -855.06   #      501P  20.449  #A   5266D -1.6913  I     2241CD  0.9831  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   19   17   42    467                    ZF
FORMAT NO. 5 LOAD APPLICATION (UP)      DAY  HR MIN SEC  MSEC
4326C -85964.   $     4391S -14956.  #P   5454D -3.4846  I      5451D  9.7896  I
4327C  5727.7   $     4392S -26239.  #P  2464DD  2.0073  I      5256D  7.7000  I
3267A -40118.   $     4393S -17462.  #P   5458D -0.3420  I      5453D  7.0839  I
4334C  47894.   $     4395S -22284.  #P  22130D  0.1560  I      2464D  4.5508  I
4335C -67692.   $     4401S  19613.  #P  22090D  .08750  I      5456D  3.1663  I
3345A -9899.0   $     4403S  15078.  #P  21810D  .04200  I      5280D  1.5250  I
4919C  46396.   $     4529S -20862.  #P  21770D  .03950  I      5282D  1.2299  I
4920C -85584.   $     4531S -29429.  #P  2678AX -0.1766  %     2209LD  1.1632  I
9192A -19593.   $     4532S -24107.  #P  2212AX -.04925  %     2181LD  0.7848  I
4674C  22550.   $     4534S -24571.  #P  2209AX -.09476  %     2177LD  0.7646  I
4675C -48140.   $                        2181AX -.03262  %      5305D  0.4065  I
6745A -12798.   $     5294D -0.7396  I   2177AX -.01675  %      5463D  .09075  I
4340C  34602.   $     5297D -0.4057  I     201L  20500.  *     2678RD  .01321  I
4341C -23630.   $     5298D  0.3405  I     202L  20350.  *     2212RD  .00884  I
3401A  5486.5   $                          203L  20575.  *     2209RD  .00944  I
4344C -28910.   $     4922S -22161.  #P    204L  20550.  *     2181RD  .00591  I
4345C  37914.   $     4923S -14833.  #P   AXPSL  81972.  *     2177RD  .00422  I
3445A  4503.0   $                          206L  35574.  *     2053RD  .796-3  I
4913C -8358.0   $                         5701D  10.369  I     2036RD  .00107  I
4914C  23335.   $      540P  14.362  #A                        2626CD  3.5995  I
9134A  7489.0   $      503P  30.249  #A   5265D -2.0125  I     2464CD  2.5436  I
LINEL -992.00   *      501P  20.474  #A   5266D -2.0412  I     2241CD  1.1829  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  19  20  10   068                 ZF
FORMAT NO. 5 LOAD APPLICATION (UP)       DAY  HR MIN SEC  MSEC
4326C -   68.   $     4391S -16750.  #P  5454D -4.2031  I       51D  11.734  I
4327C  7524.2   $     4392S -30037.  #P 2464DD  2.4250  I     5256D  9.2363  I
3267A -38322.   $     4393S -19162.  #P  5458D -0.4215  I     5453D  8.4873  I
4334C  56226.   $     4395S -25837.  #P 22130D  0.2290  I     2464D  5.4448  I
4335C -81388.   $     4401S  24183.  #P 22090D  0.1565  I     5456D  3.7860  I
3345A -12580.   $     4403S  18215.  #P 21810D  .05100  I     5280D  1.8240  I
4919C  71812.   $     4529S -24015.  #P 21770D  .06950  I     5282D  1.4715  I
4920C -94284.   $     4531S -33856.  #P 2678AX -0.1552  %    2209LD  1.3832  I
9192A -11235.   $     4532S -27938.  #P 2212AX -.05200  %    2181LD  0.9268  I
4674C  22624.   $     4534S -28648.  #P 2209AX -0.1032  %    2177LD  0.9018  I
4675C -51244.   $                       2181AX -.04100  %     5305D  0.4720  I
6745A -14309.   $     5294D -0.8821  I  2177AX -.01400  %     5463D  0.1012  I
4340C  42312.   $     5297D -0.4985  I    201L  20525.  #    2678RD  .01570  I
4341C -28537.   $     5298D  0.4165  I    202L  20350.  #    2212RD  .01070  I
3401A  6888.2   $                         203L  20525.  #    2209RD  .01145  I
4344C -36012.   $     4922S -25621.  #P   204L  20500.  #    2181RD  .00725  I
4345C  47702.   $     4923S -17187.  #P  AXPSL  81900.  #    2177RD  .00509  I
3445A  5845.7   $                         206L  41800.  #    2053RD  .964-3  I
4913C -10164.   $                        5701D  12.149  I    2036RD  .00127  I
4914C  28854.   $      540P  14.374  #A                      2626CD  4.2844  I
9134A  9345.0   $      503P  30.249  #A  5265D -2.4326  I    2464CD  3.0197  I
LINEL -1131.8   #      501P  20.474  #A  5266D -2.4687  I    2241CD  1.4024  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  19  22  05   269                 ZF
FORMAT NO. 5 LOAD APPLICATION (UP)       DAY  HR MIN SEC  MSEC
4326C -83080.   $     4391S -17369.  #P  5454D -4.7806  I     5451D  13.244  I
4327C  8521.0   $     4392S -32075.  #P 2464DD  2.7722  I     5256D  10.422  I
3267A -37280.   $     4393S -19719.  #P  5458D -0.4745  I     5453D  9.5757  I
4334C  62128.   $     4395S -28246.  #P 22130D  0.2850  I     2464D  6.1513  I
4335C -80328.   $     4401S  27541.  #P 22090D  0.2150  I     5456D  4.2688  I
3345A -9098.5   $     4403S  20577.  #P 21810D  .03150  I     5280D  2.0479  I
4919C  93328.   $     4529S -26023.  #P 21770D  0.1024  I     5282D  1.6510  I
4920C -94284.   $     4531S -36598.  #P 2678AX -0.1166  %    2209LD  1.5480  I
9192A -475.81   $     4532S -30377.  #P 2212AX -.06000  %    2181LD  1.0279  I
4674C  22092.   $     4534S -30871.  #P 2209AX -0.1190  %    2177LD  0.9979  I
4675C -52372.   $                       2181AX -.06451  %     5305D  0.5150  I
6745A -15139.   $     5294D -1.0070  I  2177AX -.01374  %     5463D  0.1089  I
4340C  47822.   $     5297D -0.6030  I    201L  20525.  #    2678RD  .01731  I
4341C -31800.   $     5298D  0.4740  I    202L  20350.  #    2212RD  .01221  I
3401A  8012.2   $                         203L  20575.  #    2209RD  .01307  I
4344C -41022.   $     4922S -27474.  #P   204L  20625.  #    2181RD  .00853  I
4345C  56334.   $     4923S -10694.  #P  AXPSL  82072.  #    2177RD  .00577  I
3445A  7656.7   $                         206L  45924.  #    2053RD  .00108  I
4913C -11215.   $                        5701D  13.480  I    2036RD  .00142  I
4914C  32475.   $      540P  14.374  #A                      2626CD  4.7955  I
9134A  10630.   $      503P  30.249  #A  5265D -2.7701  I    2464CD  3.3793  I
LINEL -1224.8   #      501P  20.424  #A  5266D -2.8164  I    2241CD  1.5735  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   19   22   23    966                  ZF
FORMAT NO. 6 LOAD REMOVAL (DOWN)         DAY  HR MIN SEC  '  'C
4326C   3188.   $     4391S -16967.   #P   5454D -4.7596   I     5451D  13.179   I
4327C  8410.5   $     4392S -31488.   #P  2464DD  2.7841   I     5256D  10.359   I
3267A -37390.   $     4393S -19317.   #P   5458D -0.4770   I     5453D  9.5161   I
4334C  61584.   $     4395S -27845.   #P  22130D  0.2840   I     2464D  6.1543   I
4335C -80404.   $     4401S  27137.   #P  22090D  0.2144   I     5456D  4.2478   I
3345A -9409.5   $     4403S  20204.   #P  21810D  .02250   I     5280D  2.0518   I
4919C  93300.   $     4529S -25683.   #P  21770D  0.1065   I     5282D  1.6530   I
4920C -94316.   $     4531S -35912.   #P  2678AX -0.1158   %    2209LD  1.5482   I
9192A -507.18   $     4532S -29883.   #P  2212AX -.06150   %    2181LD  1.0269   I
4674C  21305.   $     4534S -30439.   #P  2209AX -0.1205   %    2177LD  0.9968   I
4675C -51476.   $                         2181AX -.06763   %     5305D  0.5155   I
6745A -15085.   $     5294D -1.0110   I   2177AX -.01400   %     5463D  0.1092   I
4340C  46946.   $     5297D -0.6105   I     201L  20500.   *    2678RD  .01734   I
4341C -31284.   $     5298D  0.4752   I     202L  20400.   *    2212RD  .01225   I
3401A  7831.7   $                           203L  20550.   *    2209RD  .01311   I
4344C -40534.   $     4922S -27135.   #P    204L  20425.   *    2181RD  .00861   I
4345C  55584.   $     4923S -18411.   #P   AXPSL  81872.   *    2177RD  .00579   I
3445A  7526.0   $                           206L  45224.   *    2053RD  .00109   I
4913C -11045.   $                          5701D  13.389   I    2036RD  .00143   I
4914C  31911.   $      540P  14.349   #A                        2626CD  4.7569   I
9134A  10433.   $      503P  30.224   #A   5265D -2.7626   I    2464CD  3.3703   I
LINEL -1208.7   #      501P  20.524   #A   5266D -2.8089   I    2241CD  1.5750   I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74   135   19   23   56    126                  ZF
FORMAT NO. 6 LOAD REMOVAL (DOWN)         DAY  HR MIN SEC  MSEC
4326C -83696.   $     4391S -15110.   #P   5454D -4.3352   I     5451D  11.960   I
4327C  8682.5   $     4392S -28771.   #P  2464DD  2.5363   I     5256D  9.3901   I
3267A -37506.   $     4393S -18204.   #P   5458D -0.4485   I     5453D  8.6309   I
4334C  57158.   $     4395S -25065.   #P  22130D  0.2144   I     2464D  5.5784   I
4335C -81248.   $     4401S  23809.   #P  22090D  0.1620   I     5456D  3.8491   I
3345A -12044.   $     4403S  17749.   #P  21810D  .01199   I     5280D  1.8690   I
4919C  89380.   $     4529S -23304.   #P  21770D  .08601   I     5282D  1.5024   I
4920C -94284.   $     4531S -32048.   #P  2678AX -0.1537   %    2209LD  1.4102   I
9192A -2449.8   $     4532S -26980.   #P  2212AX -.06375   %    2181LD  0.9343   I
4674C  17890.   $     4534S -27227.   #P  2209AX -0.1220   %    2177LD  0.9068   I
4675C -45948.   $                         2181AX -.06713   %     5305D  0.4715   I
6745A -14029.   $     5294D -0.9241   I   2177AX -.01249   %     5463D  0.1067   I
4340C  41372.   $     5297D -0.5628   I     201L  20550.   *    2678RD  .01630   I
4341C -27991.   $     5298D  0.4285   I     202L  20375.   *    2212RD  .01124   I
3401A  6691.5   $                           203L  20575.   *    2209RD  .01203   I
4344C -36226.   $     4922S -24447.   #P    204L  20500.   *    2181RD  .00785   I
4345C  49464.   $     4923S -16622.   #P   AXPSL  82000.   *    2177RD  .00545   I
3445A  6619.5   $                           206L  40350.   *    2053RD  .00107   I
4913C -9564.0   $                          5701D  12.349   I    2036RD  .00143   I
4914C  27665.   $      540P  14.362   #A                        2626CD  4.2959   I
9134A  9051.0   $      503P  30.249   #A   5265D -2.5188   I    2464CD  3.0421   I
LINEL -1099.3   #      501P  20.474   #A   5266D -2.5601   I    2241CD  1.4204   I
```

TEST 3E

```
 B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  19  27  40   048             ZF
 FORMAT NO. 6 LOAD REMOVAL (DOWN)       DAY  HR MIN SEC  MSEC
4326   84800.  $    4391S -10376.  #P  5454D -3.2776  I    5451D  8.9899  I
4327C  8493.0  $    4392S -21759.  #P 2464DD  1.9333  I    5256D  7.0454  I
3267A -38152.  $    4393S -14863.  #P  5458D -0.3520  I    5453D  6.4924  I
4334C  45860.  $    4395S -18729.  #P 22130D  0.1215  I    2464D '4.2133  I
4335C -69032.  $    4401S  15668.  #P 22090D  .07050  I    5456D  2.9010  I
3345A -11614.  $    4403S  12097.  #P 21810D -.00999  I    5280D  1.4159  I
4919C  70808.  $    4529S -17369.  #P 21770D  .04300  I    5282D  1.1314  I
4920C -94268.  $    4531S -23065.  #P 2678AX -0.1818  %   2209LD  1.0707  I
9192A -11728.  $    4532S -20059.  #P 2212AX -.06601  %   2181LD  0.7118  I
4674C  10845.  $    4534S -19286.  #P 2209AX -0.1122  %   2177LD  0.6898  I
4675C -34150.  $                      2181AX -.06000  %    5305D  0.3670  I
6745A -11652.  $    5294D -0.7101  I  2177AX -.01625  %    5463D  .08651  I
4340C  27761.  $    5297D -0.4285  I    201L  20500.  #   2678RD  .01248  I
4341C -19530.  $    5298D  0.3084  I    202L  20350.  #   2212RD  .00847  I
3401A  4115.7  $                        203L  20575.  #   2209RD  .00901  I
4344C -25208.  $    4922S -18080.  #P   204L  20450.  #   2181RD  .00584  I
4345C  34414.  $    4923S -12258.  #P  AXPSL  81872.  #   2177RD  .00400  I
3445A  4603.2  $                        206L  28725.  #   2053RD  .954-3  I
4913C -6030.0  $                       5701D  9.6099  I   2036RD  .00126  I
4914C  17197.  $     540P  14.362  #A                     2626CD  3.2149  I
9134A  5583.7  $     503P  30.249  #A  5265D -1.9126  I   2464CD  2.2801  I
LINEL -837.81  #     501P  20.499  #A  5266D -1.9451  I   2241CD  1.0639  I
```

TEST 3E

```
 B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135  19  32  28   769             ZF
 FORMAT NO. 6 LOAD REMOVAL (DOWN)       DAY  HR MIN SEC  MSEC
4326C -55124.  $    4391S -5143.5  #P  5454D -1.9576  I    5451D  5.2500  I
4327C  5382.5  $    4392S -12728.  #P 2464DD  1.1790  I    5256D  4.1054  I
3267A -24871.  $    4393S -9540.5  #P  5458D -0.2245  I    5453D  3.7976  I
4334C  31268.  $    4395S -10902.  #P 22130D  .04550  I    2464D  2.4809  I
4335C -48828.  $    4401S  5829.0  #P 22090D -.00899  I    5456D  1.7055  I
3345A -8779.5  $    4403S  5550.0  #P 21810D -.01749  I    5280D  0.8311  I
4919C  52574.  $    4529S -9943.0  #P 21770D  .00649  I    5282D  0.6605  I
4920C -94300.  $    4531S -12479.  #P 2678AX -0.1878  %   2209LD  0.6340  I
9192A -20862.  $    4532S -11521.  #P 2212AX -.07101  %   2181LD  0.4212  I
4674C  3845.1  $    4534S -9912.0  #P 2209AX -.09901  %   2177LD  0.4075  I
4675C -20342.  $                      2181AX -.05775  %    5305D  0.2330  I
6745A -8248.5  $    5294D -0.4255  I  2177AX -.02325  %    5463D  .06300  I
4340C  10648.  $    5297D -0.2702  I    201L  20525.  #   2678RD  .00747  I
4341C -8442.5  $    5298D  0.1547  I    202L  20375.  #   2212RD  .00499  I
3401A  1103.1  $                        203L  20600.  #   2209RD  .00530  I
4344C -11406.  $    4922S -10252.  #P   204L  20500.  #   2181RD  .00336  I
4345C  16229.  $    4923S -7168.5  #P  AXPSL  82000.  #   2177RD  .00225  I
3445A  2411.5  $                        206L  14900.  #   2053RD  .676-3  I
4913C -1243.6  $                       5701D  6.2099  I   2036RD  .872-3  I
4914C  4944.2  $     540P  14.362  #A                     2626CD  1.8400  I
9134A  1850.3  $     503P  30.249  #A  5265D -1.1562  I   2464CD  1.3018  I
LINEL -527.28  #     501P  20.474  #A  5266D -1.1750  I   2241CD  0.6065  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135   19   40   57    047                ZF
FORMAT NO. 6 LOAD REMOVAL (DOWN)       DAY  HR MIN SEC  MSEC
4326C   5449.   $    4391S -619.87  #P  5454D -0.3630  I    5451D  0.8450  I
4327C  850.90   $    4392S -3656.5  #P 2464DD  0.2448  I    5256D  0.6265  I
3267A -7799.0   $    4393S -2851.0  #P  5458D -.05550  I    5453D  0.6020  I
4334C  14449.   $    4395S -2758.1  #P 22130D -.00849  I    2464D  0.4095  I
4335C -24616.   $    4401S -2665.1  #P 22090D -.04250  I    5456D  0.2685  I
3345A -5083.2   $    4403S -2510.2  #P 21810D -.03200  I    5280D  0.1359  I
4919C  36926.   $    4529S -2293.3  #P 21770D -.01749  I    5282D  0.1000  I
4920C -81388.   $    4531S -1971.6  #P 2678AX -0.2096  %   2209LD  0.1027  I
9192A -22230.   $    4532S -2789.1  #P 2212AX -.08076  %   2181LD  .06775  I
4674C -1352.7   $    4534S -2014.4  #P 2209AX -.09126  %   2177LD  .06225  I
4675C -5992.0   $                      2181AX -.05413  %    5305D  .03650  I
6745A -3672.3   $    5294D -.08251  I  2177AX -.02599  %    5463D  .01374  I
4340C -9003.5   $    5297D -0.1012  I    201L  20575.  *   2678RD  .00122  I
4341C  4877.0   $    5298D -.00700  I    202L  20400.  *   2212RD  .00100  I
3401A -2063.1   $                        203L  20650.  *   2209RD  .00104  I
4344C  5503.2   $    4922S -2944.0  #P   204L  20500.  *   2181RD  .747-3  I
4345C -5386.0   $    4923S -2264.5  #P  AXPSL  82124.  *   2177RD  .469-3  I
3445A  58.804   $                        206L  225.00  *   2053RD  .260-3  I
4913C  2147.7   $                       5701D  0.2000  I   2036RD  .272-3  I
4914C -7143.5   $     540P  14.362  #A                     2626CD  0.2390  I
9134A -2497.7   $     503P  30.249  #A  5265D -0.2325  I   2464CD  0.1646  I
LINEL -197.62   *     501P  20.499  #A  5266D -0.2362  I   2241CD  .08050  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135   19   47   26    986                ZF
FORMAT NO. 6 LOAD REMOVAL (DOWN)       DAY  HR MIN SEC  MSEC
4326C -7602.0   $    4391S  867.87  #P  5454D -0.3045  I    5451D  0.6900  I
4327C -983.90   $    4392S -898.81  #P 2464DD  0.1976  I    5256D  0.5390  I
3267A -4293.0   $    4393S -805.84  #P  5458D -.04500  I    5453D  0.5040  I
4334C  6763.5   $    4395S -836.81  #P 22130D -.00549  I    2464D  0.3360  I
4335C -13233.   $    4401S -805.84  #P 22090D -.01400  I    5456D  0.2310  I
3345A -3234.7   $    4403S -588.90  #P 21810D -.03200  I    5280D  0.1099  I
4919C  27320.   $    4529S -526.90  #P 21770D -.02950  I    5282D  .08701  I
4920C -65050.   $    4531S -156.50  #P 2678AX -.05588  %   2209LD  .08750  I
9192A -18865.   $    4532S -650.87  #P 2212AX -.03175  %   2181LD  .05900  I
4674C -2579.6   $    4534S -464.92  #P 2209AX -.03425  %   2177LD  .05350  I
4675C -353.78   $                      2181AX -.02725  %    5305D  .03349  I
6745A -1466.6   $    5294D -.07351  I  2177AX -.01199  %    5463D  .01374  I
4340C -699.50   $    5297D -.06075  I    201L  .00000  *   2678RD  .813-3  I
4341C -869.75   $    5298D  .00624  I    202L  .00000  *   2212RD  .699-3  I
3401A -784.62   $                        203L  .00000  *   2209RD  .708-3  I
4344C -369.20   $    4922S -1115.7  #P   204L  .00000  *   2181RD  .531-3  I
4345C  2138.2   $    4923S -1006.5  #P  AXPSL  .00000  *   2177RD  .230-3  I
3445A  884.56   $                        206L  125.00  *   2053RD  .175-3  I
4913C  15.534   $                       5701D  0.1600  I   2036RD  .266-3  I
4914C -1167.0   $     540P  14.374  #A                     2626CD  0.1995  I
9134A -575.78   $     503P  30.249  #A  5265D -0.1900  I   2464CD  0.1383  I
LINEL -39.771   *     501P  20.474  #A  5266D -0.1962  I   2241CD  .06500  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135   19  50  54    596                    ZF
FORMAT NO. 6 LOAD REMOVAL (DOWN)          DAY  HR MIN SEC  MSEC
4326C [illegible]271.0  $     4391S  1549.8  #P  5454D -0.2445   I    5451D  0.2900  I
4327C -1326.5  $     4392S  278.95  #P 2464DD  0.1411   I    5256D  0.2310  I
3267A -3798.7  $     4393S  30.994  #P  5458D -.03000   I    5453D  0.2065  I
4334C  3618.5  $     4395S -30.995  #P 22130D  .00099   I    2464D  .09601  I
4335C -8887.5  $     4401S -247.96  #P 22090D  .00099   I    5456D  .06150  I
3345A -2634.3  $     4403S -61.990  #P 21810D -.02300   I    5280D -.00899  I
4919C  23050.  $     4529S  309.95  #P 21770D -.00599   I    5282D -.02250  I
4920C -58042.  $     4531S  563.40  #P 2678AX -.00299   %   2209LD -.02074  I
9192A -17496.  $     4532S  340.93  #P 2212AX -.00724   %   2181LD -.03900  I
4674C -2921.8  $     4534S  278.95  #P 2209AX -.00349   %   2177LD -.04250  I
4675C  1350.3  $                       2181AX -.01324   %    5305D -.04450  I
6745A -785.71  $     5294D  .02150  I  2177AX -.00349   %    5463D -.03650  I
4340C  869.37  $     5297D -.04075  I    201L -25.000   *   2678RD  .630-3  I
4341C -1982.1  $     5298D  .01424  I    202L -25.000   *   2212RD  .553-3  I
3401A -556.37  $                         203L  150.00   *   2209RD  .517-3  I
4344C -1524.1  $     4922S -340.93  #P   204L  125.00   *   2181RD  .436-3  I
4345C  3682.3  $     4923S -440.35  #P  AXPSL  225.00   *   2177RD  .139-3  I
3445A  1079.1  $                         206L  225.00   *   2053RD  .132-3  I
4913C -62.587  $                        5701D  .09000   I   2036RD -.163-3  I
4914C -427.15  $      540P  14.374  #A                      2626CD -.03800  I
9134A -244.86  $      503P  30.249  #A  5265D -0.1500   I   2464CD -.04512  I
LINEL -42.445  *      501P  20.499  #A  5266D -0.1562   I   2241CD -.03900  I
```

TEST 3E

```
B-3 CSS EET 3E (WITHOUT FBR) 05-15-74  135   19  52  27    473
FORMAT NO. 6 LOAD REMOVAL (DOWN)          DAY  HR MIN SEC  MSEC
4326C -7014.5  $     4391S  2293.8  #P  5454D  5.7059   I    5451D  0.6100  I
4327C -2283.0  $     4392S -216.96  #P 2464DD -4.8421   I    5256D  0.4585  I
3267A -4648.7  $     4393S -154.97  #P  5458D  1.9626   I    5453D  1.8375  I
4334C  3895.6  $     4395S -216.96  #P 22130D  1.9791   I    2464D  1.4565  I
4335C -9977.5  $     4401S -309.95  #P 22090D  1.9796   I    5456D  0.1710  I
3345A -3040.7  $     4403S -92.984  #P 21810D  1.9591   I    5280D  0.4700  I
4919C  24046.  $     4529S  154.96  #P 21770D  1.9631   I    5282D  .05050  I
4920C -58240.  $     4531S  250.39  #P 2678AX  1.5956   %   2209LD  .06775  I
9192A -17097.  $     4532S -30.995  #P 2212AX  1.0562   %   2181LD  .04025  I
4674C -2720.8  $     4534S -61.990  #P 2209AX  1.0287   %   2177LD  .03475  I
4675C  1413.6  $                       2181AX  0.5298   %    5305D  .01199  I
6745A -653.59  $     5294D  1.9391  I  2177AX -.01199   %    5463D  .00324  I
4340C  2547.1  $     5297D  0.9553  I    201L  50.000   *   2678RD -.01517  I
4341C -2349.1  $     5298D  0.1045  I    202L -25.000   *   2212RD -.01008  I
3401A  99.078  $                         203L  150.00   *   2209RD -.01042  I
4344C -1262.4  $     4922S -402.92  #P   204L  75.000   *   2181RD -.00674  I
4345C  4578.2  $     4923S -346.00  #P  AXPSL  250.00   *   2177RD  .189-3  I
3445A  1658.0  $                         206L  325.00   *   2053RD  .106-3  I
4913C -940.78  $                        5701D  0.2000   I   2036RD  .866-4  I
4914C  1070.7  $      540P  14.374  #A                      2626CD  7.5435  I
9134A  65.011  $      503P  30.249  #A  5265D  4.8424   I   2464CD  6.2983  I
LINEL -44.740  *      501P  20.474  #A  5266D  4.8111   I   2241CD  2.4325  I
```