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INSTRUCTION MANUAL

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EQUIPMENT TO SIMULATE AERODYNAMIC HEATING AND ACOUSTICAL ENVIRONMENTS ON SPACE SHUTTLE THERMAL PROTECTION SYSTEM SPECIMENS

NASA CR#103017

For

George C. Marshall Space Flight Center
Huntsville, Alabama

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DRAWINGS

1.0 Introduction

This manual describes the equipment, specifications, and operating procedure for test equipment related to simulating aerodynamic heating and acoustical environments on Space Shuttle Thermal Protection System specimens. The subject equipment was designed and built by RESEARCH, INCORPORATED for the George C. Marshall Space Flight Center, Huntsville, Alabama, under their contract number NAS 8-26297.

The project engineers at RESEARCH, INCORPORATED were Mr. George Olson and Mr. A. F. Kitchar.

2.0 General Description

This manual describes the equipment, specifications, and operation of a Radiant Heating Array and Space Shuttle Thermal Protection System Support Frame to Simulate Aerodynamic Heating. There are two sets of equipment. One set for testing Thermal Protection Systems (i.e., TPS) in a atmospheric pressure environment and in a vacuum environment. The other is for testing TPS specimens in an acoustical environment.

2.1 Equipment for Atmosphere and Vacuum Environment

The equipment for testing TPS specimens in an atmosphere and vacuum environment is shown completely assembled in drawings SA3904 and SA3905. It consists of (a) a TPS Fixture for Vacuum to hold and purge the specimen, (b) a 24.00 x 24.00 to 28.00 x 28.00 inch square high performance Radiant Heat Unit to generate up to 33.8 $KW/ft.^2$ on the TPS specimen surface, (c) a cooling Shutter Assembly to reduce incident heat flux density and cool the TPS specimen during cooling profiles, and (d) an Adjustable Stand to support the equipment and adjust the distance between the radiant unit emitter opening with respect to the TPS specimen surface.

A Thermal Protection System specimen, 36.00 x 36.00 inches square can be placed into the fixture and then sealed around the peripheral edges with a clamp ring. The radiant unit centered directly above it will irradiate the TPS specimen surface from near zero to 33.8 $KW/ft.^2$ radiant heat flux density depending upon the voltage applied to the radiant heat emitters. Therefore, by adjusting the voltage to the radiant heat unit, it is possible to dynamically program the incident heat flux or the TPS specimen skin temperature in regions A, B, C, D, and E as shown on drawing SA3634. For programming reducing incident heat flux or rapid specimen cooling, a cooling shutter is provided for regions F and G. Therefore, when reducing incident heat flux or specimen cooling rate is beyond the capability of the radiant unit at zero dissipated power (i.e., at zero applied voltage to the radiant heat emitters), a heat absorbing blackened water cooled shutter panel can be quickly introduced between the radiant unit emitters and the specimen surface. When this panel is introduced, the incident heat flux will drop to a minimum and the TPS specimen surface will cool at its maximum radiant heat loss rate as shown on drawing SA3918.

This equipment, operation, and specifications is described in detail in the following sections.

Section	Description
3.0	The Radiant Unit
4.0	The Shutter Assembly
5.0	The Adjustable Support Stand
6.0	The TPS Fixture for Vacuum Chamber

2.2 Equipment for Acoustical Environments

The equipment for testing TPS specimens in an acoustical environment consists of a special TPS Fixture for the Reverberation Room as shown on drawing SA3919. A Thermal Protection System specimen can be clamped in its 36.00 x 36.00 inch square opening. When fixtured, the TPS specimen can be subjected to an acoustical environment.

The details for operating and using the TPS Fixture for Reverberation are described in Section 7.0.

3.0 The Radiant Unit

3.1 Function

The radiant unit is designed to irradiate rectangular areas located at its emitter opening. Specimens placed at this opening will be heated by the radiant heat energy emitted from the radiant unit.

The radiant unit is shown mounted in an adjustable support frame on drawings SA3904 and SA3905. Drawing SA3906 shows the electrical and water connections on the top side. Drawing SA3907 shows a view into the emitter opening of the unit with about 50% of the radiant heat emitter lamps installed. Drawings SA3909 through SA3912 show the detailed construction of the unit. Drawings SA3916 and SA3917 indicate the performance characteristics of the radiant unit.

3.2 Description of Radiant Unit

The radiant unit consists of a uniform array of 90 standard tubular quartz tungsten filament radiant heat emitter lamps number 1200 T3/CL/HT. The radiant energy emitted from these lamps is directed toward the emitter opening by a specular aluminum water cooled reflector as shown on drawings SA3909 and SA3910. The lamps are supported in a ceramic tube projecting through the reflector. The tube provides an insulated conduit passage for the flexible lamp electrical leads to connections at the cooler back side of the unit.

The edges of the radiant unit have replaceable 4.35 inch long reflectors to create a finite radiant heat cavity with minimum edge losses and to yield a near uniform incident radiant heat flux on a target surface located at the emitter opening. The emitter opening created by these edge reflectors is 28.00 x 28.00 inches as shown on drawings SA3909 and SA3910. Therefore, smaller emitter openings such as 24.00 x 24.00 inches could be realized wuth suitable edge reflectors.

The entire unit is water cooled to remove heat gained due to the inefficiency of the reflector surfaces in the radiant cavity. Therefore, water must be provided to circulate in the main reflector body, the main frame of the unit, and two of the edge reflectors as shown on drawing SA3912.

The radiant unit is divided into six equal independent zones as shown on drawing SA3912. These zones may be connected in various ways to accommodate the desired heat flux profile at the emitter opening.

The entire unit is contained in a sturdy water cooled aluminum main frame. The top side is open and accessible for easy lamp terminal connection, for input power connection, and for cooling "in" and "out" connections as shown on drawing SA3912.

3.3 Radiant Unit Specifications

3.3.1 General Specifications

3.3.1.1 Emitter size at lamp plane: 24.00 x 24.00 inches.

3.3.1.2 Emitter opening size at edge reflector emitter opening: 28.00 x 28.00 inches.

3.3.1.3 Emitter element (i.e., lamp): Standard General Electric Lamp #1200 T3/CL/HT.

3.3.1.4 Number of zones: six equal zones as per drawing SA3912.

3.3.1.5 Number of emitters (i.e., lamps) per zone: 15 lamps.

3.3.1.6 Maximum power dissipated per zone at 230 volts RMS: 31.2 KW.

3.3.1.7 Power circuit: all lamps connected in parallel per zone per drawing SA3912.

3.3.1.8 Total number of emitters (i.e., lamps): 90 lamps.

3.3.1.9 Maximum total power dissipated at 230 volts RMS: 187.2 KW.

3.3.1.10 Maximum allowable applied voltage potential: 230 volts RMS, 322 volts peak (reference Section 3.4.1).

3.3.1.11 Unit cooling provision: clean, de-ionized water at 75°F or less flowing at the rate of 4.0 gallons per minute or more with an inlet pressure of approximately 50 psig. Plumb water into 37° flare fitting labled "IN" and out of like fitting to atmospheric pressure labled "OUT" located on top side of radiant unit as shown on drawing SA3912.

3.3.1.12 Power connection: Power input connections are provided on the power distribution bus bar located on the top side of the radiant unit as shown on drawing SA3912. Place flexible electrical connector into .295 inch diameter hole provided on the bus bar and lock with set screw, item D39084-28 shown on drawing SA3910.

3.3.1.13 Orientation: For optimum lamp life, the radiant unit should be operated with the lamp filament axis in a horizontal position.

3.3.1.14 Weight: 160 pounds, approx.

3.3.1.15 Mounting: The radiant unit has four mounting tabs with .56 inch diameter holes located on the upper surface of the main frame as shown on drawings SA3910, SA3911, and SA3912.

3.3.2 Performance Specifications

3.3.2.1 Maximum incident radiant heat flux density at a 24.00 x 24.00 inch emitter opening (i.e., on a 24.00 x 24.00 inch specimen surface): 33.8 KW/foot^2.

3.3.2.2 Maximum incident radiant heat flux density at a 28.00 x 28.00 inch emitter opening shown on drawings SA3909 and SA3910: Approximately 32.0 KW/foot^2 in the center regions falling off somewhat in and near the 2.00 inch margin region.

3.3.2.3 Maximum allowable specimen temperature: 2550°F for short periods of approximately 50 seconds when used to simulate dynamic temperature profiles like shown on drawing SA3634.

3.3.2.4 Operating environment: At atmospheric air pressure and at 0.01 mm Hg vacuum (reference Section 3.4.1).

3.3.2.5 Specimen: Specimen should have an emissivity greater than 0.7, be insulated on the non-irradiated surface to reduce heat losses, and have low outgassing characteristics at all operating temperatures.

3.3.2.6 Response rate: The response rate for the tungsten radiant heat source is quite rapid due to its low thermal mass. Typical response rates are shown on drawing SA1633.

3.3.2.7 Run duration: The unit is designed for dynamic heating run durations up to 1600 seconds having program cycles like or similar to that shown on drawing SA3634.

3.3.2.8 Equilibrium specimen temperature: Resultant specimen equilibrium temperature depends upon the voltage applied to the radiant unit and the particular heat losses of the specimen. Drawing SA3916 shows the approximate resultant equilibrium temperatures attained on an oxidized stainless steel specimen.

3.3.2.9 Specimen heating rate: Specimen heating rate will depend upon specimen characteristics and heat losses. Drawing SA3917 shows resultant specimen heating rates for a particular specimen.

3.4 Power and Control

3.4.1 Corona and Flashover Considerations

The power and control requirements need special consideration when operating the radiant unit in a vacuum environment. Corona and flashover between electrically polarized surfaces can develop at relatively low voltages in a vacuum operation compared to atmospheric air pressure operation. The pressure at which breakdown can occur is primarily a function of the environmental pressure and the distance between polarized surfaces. Experimental data documented by the Space Technology Laboratories, Incorporated, Los Angeles, California in their report number STL/TR-59-0000-09931, dated 17 December 1959, by W. H. Krebs and A. C. Reed, titled "Low Pressure Electrical Discharge Studies" indicates that the minimum breakdown voltage is 385 volts peak in dry air shown by curve B of drawing SA3636. The atmosphere composition also has an effect as shown by the the example of curve C for "wet" air. The operator must be aware of chamber pressure and atmosphere composition changes while voltage is applied to the radiant unit in order to avoid corona and flashover. The atmosphere composition may change due to outgassing of test article specimen materials when heated, or outgassing of some other material in the chamber.

For these reasons, the maximum allowable voltage potential to be applied anywhere in the vacuum is limited to a potential below that of curve C on drawing SA3636 (i.e., 322 volts peak, 230 volts RMS). This means that the 60 cycle wave form must be smooth and not produce electrical noise spikes in excess of the 322 volt peak. Also due to (a) the uncertainties of localized chamber atmosphere, (b) experience of others, and (c) the need for general radiant array safety, the radiant array should not be energized unless the operator is absolutely certain that favorable conditions exist. If these uncertainties can not be resolved prior to a full scale test, a small voltage breakdown test should be made by energizing at least one lamp in one zone prior to the test.

3.4.2 Power

The incident radiant heat energy on the specimen surface located at the emitter opening depends upon the power dissipated by the radiant array. The power dissipated is a function of applied radiant emitter (i.e., lamp) voltage. The total power dissipated can be determined by finding the power dissipated by one lamp at a particular voltage and multiplying it by the number of lamps employed. Drawing SA3691 shows the voltage characteristics for standard tungsten filament tubular quartz lamps with respect to 100% of the rated power and voltage. The 1200 T3/CL/HT lamp rating is 1200 watts at 144 volts RMS.

For example, at 72 volts, the lamp operates at $\frac{72 \times 100}{144} = 50\%$

of rated voltage. The curve on drawing SA3691 shows that the lamp dissipates 33.5% of its rated power at 50% voltage; therefore, the power dissipated is 1200 x .335 = 402 watts. If 90 lamps are employed, the total power dissipated is 90 x 402 = 36,180 watts.

3.5 Lamp Replacement Procedure

Lamps may be replaced with standard tubular quartz tungsten filament lamp number 1200 T3/CL/HT.

3.5.1 Lamp Installation

To install lamps, it is necessary to have accessibility to both sides of the radiant heat unit. Install according to the following procedure:

3.5.1.1 Carefully remove new lamp from its wrapping. The lamp should always be handled with clean hands, free from oil or other contaminants. While handling, do not touch the quartz lamp envelope in order to prevent quartz devitrification at elevated temperatures. Therefore, the lamp must be handled at the metal covered endseal region only.

3.5.1.2 Straighten the lamp leads so that they are perpendicular to the lamp axis.

3.5.1.3 Place lamp endseals in the clip, item D39084-22 shown on drawing SA3910.

3.5.1.4 Insert both ends of lamp lead with clip into ceramic lamp support from reflector side. Push clip and leads into ceramic lamp support until the lamp lead projects out the back side of the ceramic support and the lamp clip latches over the back side of the ceramic lamp support.

3.5.1.5 Connect lamp lead end to adjacent screw on bus bar. While tightening terminal screw, maintain about .06 inch of slack in the lamp lead wire. Do not install lamps with tight lead wires.

3.5.2 Lamp Removal

To remove lamps, it is necessary to have accessibility to both sides of the radiant heating unit. Remove according to the following procedure.

3.5.2.1 Disconnect lamp lead wires from terminal screws on bus bar on back side of the radiant unit.

3.5.2.2 Unlatch lamp clips from the edge of the lamp support ceramic.

3.5.2.3 Push lamp clips and lead wires through lamp support tube about 3/4 of an inch.

3.5.2.4 Pull disconnected lamp leads and clip out of ceramic lamp support tube from reflector side of the radiant unit.

3.6 Operators Check List

The following check list should be integrated into the master operating procedure for the entire system. These conditions must be satisfied before the radiant unit is energized to effectively operate the equipment.

3.6.1 Reflector surfaces of radiant unit are clean and specular. ____________

3.6.2 Lamps of radiant unit are clean and in good operating condition. ____________

3.6.3 Water is passing through the radiant heating unit at the rate of 4.0 gallons per minute or more. ____________

3.6.4 Water is passing through left shutter assembly at the rate of 3.0 gallons per minute or more. ______________

3.6.5 Water is passing through right shutter assembly at the rate of 3.0 gallons per minute or more. ______________

3.6.6 Left shutter is fully retracted from the radiant unit cavity. ______________

3.6.7 Right shutter is fully retracted from the radiant unit cavity. ______________

3.6.8 The shutters can be extended when the lamps are de-energized. ______________

3.6.9 The shutter will be retracted from the radiant cavity when the lamps are energized. ______________

3.6.10 The environment is at atmospheric pressure or at 0.01 mm Hg "dry" air vacuum. ______________

3.6.11 The shutter limit switches function properly. ______________

3.6.12 Applied voltage will not exceed 322 volts peak, 230 volts RMS 60 cycle as described in Section 3.4.1. ______________

3.7 Reflector Care

The reflector of the radiant unit is water cooled specular aluminum. The reflector has been made specular by mechanical polishing techniques. For optimum efficiency, the reflector surface should be maintained in a clean specular condition. However, during testing, the TPS specimen may outgas and contaminate the reflector surface. Such contamination is usually evident as a film deposit condensed on the reflector surface and can be easily removed by carefully wiping the contaminated surfaces.

To clean the reflector, use a soft tissue moistened with warm household 10% ammonia water and wipe clean. The wiping action should be gentle and not a buffing action.

If the reflector is severely contaminated and can not be restored by wiping, it should be disassembled and repolished.

4.0 The Shutter Assembly

4.1 Function

The shutter assembly is designed to absorb the radiant energy emitted from the specimen surface. This will accelerate the specimen cooling rate during a cooling or reducing heat flux portion of a test program. This is done by inserting a radiant heat absorbing water cooled shutter between the radiant heat emitter sources (i.e., the lamps) of the radiant unit and the exposed surface of the specimen. Therefore, when during the cooling or reducing heat flux portion of the test program, the specimen cooling rate is insufficient, the heat absorbing shutters are inserted. When the shutter is inserted, the incident heat flux on the specimen surface immediately drops to near zero (i.e., approximately 65 watts per square foot neglecting heated specimen reflection contribution) and the specimen cools at near the maximum possible rate. If the specimen cools excessively, the shutters are quickly retracted in about 1.7 seconds, exposing the radiant unit to add the lost heat. Therefore, the specimen cooling profile of the test program can be reasonably simulated by the repeated insertions and retractions of the shutter. Drawing SA3918 shows a typical specimen cooling rate with and without the shutter.

Drawings SA3904, SA3905, and SA3908 show the shutter assembly attached to the radiant unit. Drawings SA3913, SA3914, and SA3915 show the construction details.

4.2 Description of Shutter Assembly

Two shutter assemblies attach to the radiant unit as shown on drawings SA3904 and SA3908. The shutter panel projects through a gap on each side of the radiant unit as shown on drawing SA3913. Each shutter extends toward the center of the radiant unit covering the radiant emitter lamps and main reflectors view to the specimen surface. The shutter panel has a series circuit water passage and is mounted to a frame with a series of clips, item D39105-29. The needle bearing cam followers, item D39105-25, guide the shutter as it moves in the tracks, item D39150-21-53 when actuated by the pneumatic cylinder, item D39150-35.

Cooling water to and from the shutter panel is provided through the two flexible hoses, item D39150-46 as shown on drawing SA3915.

Specifications for the shutter assembly are given in the following Section 4.3.

4.3 Shutter Assembly Specifications

4.3.1 General Specifications

4.3.1.1 Number of shutter assemblies required: 2.

4.3.1.2 Shutter stroke: adjustable from 11.80 to 11.95 inches per side as shown on drawing SA3913.

4.3.1.3 Shutter stroke adjustment: adjust insertion cushion stops, item D39150-39 shown on drawing SA3915.

4.3.1.4 Shutter actuator: pneumatic cylinder, item D39150-35 as shown on drawing SA3915.

4.3.1.5 Shutter control: controlled by remote electric solenoid air valve, item D39150-48 connected as shown on drawing SA3913. Valve input pressure should be approximately 9 psig.

4.3.1.6 Shutter panel: blackened stainless steel with series flow water passages to remove heat radiated from specimen surface when inserted into the radiant cavity.

4.3.1.7 Shutter panel surface finish: Epoxy black paint CAT-A-LAK black of 0.9 emissivity.

4.3.1.8 Orientation: Shutter panel must be horizontal ±5°.

4.3.1.9 Weight: approximately 70 pounds per shutter assembly.

4.3.1.10 Operating restriction: shutter panel must be in the retracted position (i.e., out of the radiant cavity) when the lamps are energized.

4.3.1.11 Water requirement: clean water at 75°F or cooler flowing at the rate of 3.0 gallons per minute or more plumbed into flared fitting ports provided on the sides of the unit as shown on drawings SA3913, SA3914, and SA3915.

4.3.1.12 Limit switch: A magnetic proximity limit switch, item D39150-8, shown on drawing SA3914 is provided to open or close contacts when the shutter panel is fully retracted. This switch should be connected to an indicator to inform operator of the shutter position so that power will not be applied to the radiant unit when the shutter is extended into the radiant cavity.

4.3.1.13 Mounting: Shutter assembly is mounted to the main frame of the radiant unit by six bolts, item D39150-1-2-3 as shown on drawing SA3914 and SA3908. It is maintained in this fixed position by four "roll" pins, item D39150-49, shown on drawing SA3913.

4.3.2 Performance Specifications

4.3.2.1 Shutter insertion time: approximately 1.8 seconds.

4.3.2.2 Shutter retraction time: approximately 1.7 seconds.

4.3.2.3 Specimen cooling rate with shutter inserted: Tests indicate that a particular specimen will cool as shown on drawing SA3918.

4.3.2.4 Incident radiant heat on specimen surface with shutter inserted: approximately 65 watts per square foot neglecting specimen reflection contribution.

4.3.2.5 Operating environment: At atmospheric air pressure to a vacuum level of 0.01 mm Hg.

5.0 The Adjustable Support Stand

5.1 Function

The adjustable support stand provides an integrated mounting structure for (a) the radiant unit with shutter assembly and (b) the TPS fixture for vacuum as shown on drawings SA3904 and SA3905. The entire stand with these items can be suspended from above by the main lifting eye bolts or rest on the ready room floor for servicing as shown on drawing SA3905. The radiant unit with shutter assembly is centered over the TPS fixture 36.00 x 36.00 inch cavity opening and can be adjusted and locked at various vertical positions.

5.2 Description of Adjustable Support Stand

The adjustable support stand is an open frame stainless steel I beam weldment designed for use in a vacuum environment. The unit rests on the floor by four corner legs. It can be lifted at the four corner main lifting eye bolts, provided the cross bars, item E39051-6 shown on drawing SB3920 and SA3905 are in place.

The structural contribution of these cross bars is required during lifting.

The radiant unit with shutter assembly can be adjusted to fix the radiant unit emitter opening from 0.13 to 10.00 inches from the TPS specimen surface. This adjustment is made with the four independent one inch Acme thread rods and nuts near the corners as shown on drawing SA3904.

5.3 Height Adjustment Procedure for Radiant Unit in Stand

The following procedure can be employed to change or adjust the distance between the TPS specimen surface and the radiant unit emitter opening.

5.3.1 Loosen the locknuts on Acme screws shown on drawing SA3904.

5.3.2 Lift radiant unit/shutter assembly off the lower adjustment nuts via the four radiant heat unit eye bolts shown on drawing SA3905.

5.3.3 Calculate height, h, of top of nut above top of specimen.

$$h = D + t - .12$$

h = Height of top of adjustment nut above I beam in which Acme thread is welded, inches.

D = Desired distance between TPS specimen surface and radiant unit emitter opening, inches.

t = Total thickness of TPS specimen skin and coping seal under split ring clamp, inches.

5.3.4 Set top of adjustment nut at calculated height, h.

5.3.5 Lower radiant unit/shutter assembly and remove hoist.

5.3.6 Lock radiant unit/shutter assembly down with the locknuts provided.

5.4 Procedure for Removing or Replacing Radiant Unit

The following procedure should be employed to remove or replace the radiant unit with shutter assembly in the adjustable support stand.

5.4.1 Remove the four main lifting eye bolts and lift off the two cross bars as shown on drawing SA3905.

5.4.2 Remove the lock nuts from Acme vertical adjustment threads as shown on drawing SA3904.

5.4.3 Attach a hoist with sling straps to the four radiant heat unit eye bolts shown on drawing SA3905. The hoist must be capable of lifting approximately 750 pounds.

5.4.4 Lift radiant unit/shutter assembly straight up off of the stand and move it aside for servicing. Rest the removed radiant unit/shutter assembly on four sturdy support blocks located at the four vertical height adjustment tabs.

5.4.5 To replace the unit, reverse steps 1 through 4.

CAUTION: Do not attempt to lift the stand or any part of it by the main lifting eye bolts unless the two cross bars are in place as shown on drawing SA3905.

6.0 The TPS Fixture for Vacuum Chamber

6.1 Description of Fixture

The TPS fixture for the vacuum chamber is designed to hold the TPS specimen during testing in a vacuum environment of 0.01 mm Hg. The specimen of various thicknesses from 4.75 to 10.38 inches can be sealed in the 36.00 x 36.00 inch cavity opening so that its internal passages can be purged with flowing gaseous nitrogen. The bottom surface of the TPS specimen is exposed to the view of a liquid nitrogen cooled black stainless steel series passage cryopanel. TPS specimen instrumentation leads can be connected through the five penetration ports on one side of the fixture.

Drawing SA3904 shows the TPS fixture mounted in the stand. Drawing SA3905 shows a view of it exposing the nitrogen purging ports, the instrumentation penetration ports, andthe cryopanel ports. Drawings SB3912a and SB3912b show the construction details.

6.2 Specifications of TPS Fixture for Vacuum Chamber

6.2.1 Cavity opening size: 36.12 x 36.12 ±.06 inches as shown on drawing SB3921b.

6.2.2 TPS specimen thickness accommodation range: from 4.75 to 10.38 inches thick including simulated tank wall.

6.2.3 TPS specimen skin seal provision: TPS specimen skin is sealed between the split ring clamp, item D38979-2 and the peripheral flange of the fixture as shown in Section A-A of drawing SB3921a. User will provide coping insert strip and sealing gasket to match specimen skin configuration.

6.2.4 TPS specimen back side sealing provision: The back side of the specimen is clamped against the rubber sealing gasket, item D38979-8 shown in Section B-B of drawing SB3921a. An effective seal with an approximate leakage rate of 3 cfm at 2 pounds per square inch pressure differential is realized when the clamp bar, item D38979-9 is adjusted properly with respect to the bottom surface of the specimen (reference Section 6.3.4).

6.2.5 Nitrogen purging provision: Gaseous nitrogen enters through a port on the side of the fixture, item D38979-31 as shown on drawing SB3921a into a manifold, then through the selected three orifices in the fixture wall, across the fixture to like exit orifices, manifold, and port. This passage system should handle up to 200 cfm gaseous nitrogen flow.

6.2.6 Nitrogen purging port adjustment: There are five inlet ports and three exhaust ports on opposed surfaces of the TPS specimen cavity wall as shown on drawing SB3921a. Each set is manifolded to one side of the fixture and marked "in" or "out" respectively. The ports are interchangeable with plugs to provide proper purge for all specimens within the design range of the fixture.

Port row elevation depends upon the TPS specimen thickness as follows.

TPS Specimen thickness, inches	Port Row Configuration Top Row	Bottom Row
0 to 8	open	plugged
8 to 10.38	plugged	open

6.2.7 Bottom cryopanel: a series passage, blackened, stainless steel panel having a CAT-A-LAK epoxy paint coating with an emissivity of 0.9 capable of passing up to 150 pounds per hour liquid nitrogen at about 15 pounds per square inch differential pressure.

6.2.8 Instrumentation lead penetration provision: Three type DM5623-37PP connectors are provided on a removable service plate, item D38979-26 as shown on drawing SB3921a. Two instrumentation pipes are also provided just above the cryopanel surface. There are two sets of instrumentation pipes; one for sealing the lower chamber, the other for opening the chamber to evacuation.

6.3 TPS Specimen Insertion Procedure

The following basic procedure can be employed to place the TPS specimen into the fixture.

6.3.1 Remove radiant unit/shutter assembly from the adjustable stand as described in Section 5.4.

6.3.2 Loosen the 34 bolts on the clamp ring and swing two sides open.

6.3.3 Measure the thickness of the specimen and select the proper gaseous nitrogen purging position as described in Section 6.2.6.

6.3.4 Adjust the position of the bottom specimen sealing surface by fastening the sixteen guide blocks, item D38979-12 in Section B-B of drawing SB3921a at the proper elevation level of the six rows of threaded holes on the inside surface of the fixture. The elevation level depends upon the TPS specimen thickness ranges as follows.

Elevation Level, where bottom row is level number 1	Specimen Thickness Range (with 0.5 inch thick cope and seal on top of peripheral fixture flange)	
	Smallest, in.	Largest, in.
1	9.46	10.82
2	8.26	9.62
3	7.06	8.42
4	5.86	7.22
5	4.66	6.02
6	3.46	4.82

Then make fine adjustments of the sealing gasket level via the adjustment linkages shown in Section B-B of drawing SB3921a.

6.3.5 Place ports and plugs in proper locations using the special spanner wrench provided.

6.3.6 Place coping on top of fixture flange and align.

6.3.7 Place specimen in fixture.

6.3.8 Close clamp ring and bolt in place.

6.3.9 Replace radiant unit/shutter assembly (reference Section 5.4).

6.3.10 Adjust height of radiant unit/shutter assembly (reference Section 5.3).

6.3.11 Lift into vacuum chamber using hoist and four main eye bolts.

6.3.12 To remove specimen, reverse procedure without adjustment of support bars.

7.0 The TPS Fixture for Reverberation Room

7.1 Function

The TPS fixture for testing in the reverberation room is designed to hold 36.00 x 36.00 inch TPS specimens during sonic environment testing in door location number 98 of the NASA Building 4619 test facility. The fixture replaces the upper right hand quadrant of this door.

The TPS test specimen can be inserted and fastened into the 36.00 x 36.00 inch cavity to be subjected to sonic levels up to 149 decibels for up to 50 seconds.

Drawing SA3919 shows the fixture and drawings SB3922 and SB3923 show the construction details.

7.2 Description of TPS Fixture for Reverberation Room

The TPS fixture for the reverberation room is a massive hot rolled steel weldment of approximately 2000 pounds. It forms a 66.62 inch high x 56.38 inch wide door quadrant with hinge pins on the right side to fit the existing hinge sockets. There is a 36.00 x 36.00 inch opening in the center to accept the TPS test article inserted from the reverberation room side. TPS test articles ranging from 4.75 to 10.38 thick rest against an adjustable support bar along the inside walls of the cavity and can be clamped in place around the peripheral edges with the split stainless steel clamping ring as shown on drawing SA3919.

A 3.00 x 3.00 inch opening is provided on the left wall of the cavity to route TPS specimen instrumentation lead wires as shown on drawing SB3922.

7.3 TPS Specimen Installation Procedure

The following procedure can be employed to install a specimen in the TPS fixture for reverberation room.

7.3.1 Loosen the 34 clamping bolts on hinged split clamping ring and open the ring for acceptance of the specimen as shown on drawing SA3919.

7.3.2 Measure the thickness of the specimen and adjust the location of the bottom specimen support bars accordingly. The support bars are adjusted by wrenching the 16 fine adjustment nuts on the inside wall of the cavity as shown on drawing SA3919.

7.3.3 Insert specimen back plate and fasten it to the bottom support bars through holes provided.

7.3.4 Pass leading end of specimen instrumentation leads through 3.00 x 3.00 inch opening then insert the specimen and matching edge coping.

7.3.5 Swing hinged clamping ring over specimen coping flange and clamp in place with the 34 clamping bolts.

7.3.6 Make final bottom specimen support bar adjustment from specimen back side opening and tighten fine adjustment locking nuts as shown on drawing SA3919.

7.4 TPS Specimen Removal Procedure

The following procedure can be employed to remove the specimen from the TPS fixture for the reverberation room.

7.4.1 Loosen the 34 clamping bolts on the hinged split clamping ring and swing the ring out as shown on drawing SA3919.

7.4.2 Disconnect specimen instrumentation leads if required.

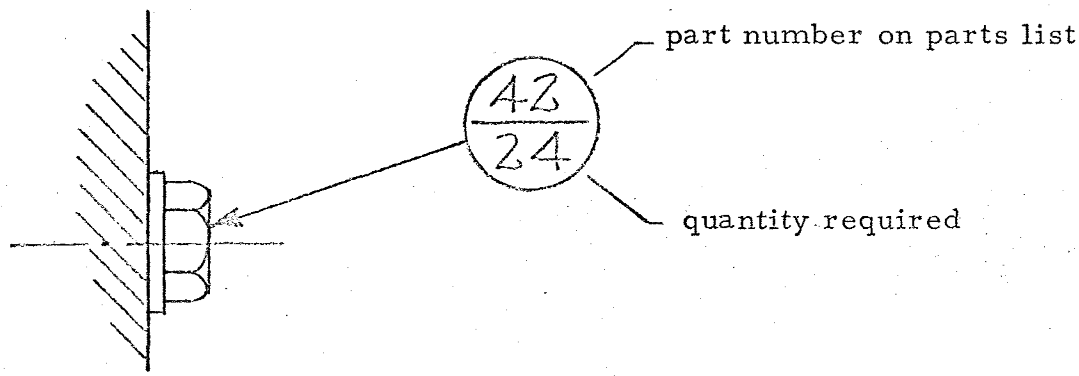
7.4.3 Remove specimen edge coping and then the specimen.

7.4.4 Unfasten specimen back plate from the peripheral support bars and remove it.

7.4.5 Close the clamping ring and partially secure it for idle periods.

8.0 Parts List

All components and parts for the major system assemblies are given on the related parts list. Each parts list has the same number as that of the drawing and is, therefore, considered a part of it. Each part on the assembly drawing is labeled with a number that corresponds to one of the items on the parts list, thus



Drawing Call-Out Example for Item D39084-42 Shown on Drawing D39084, Sheet 2

The following parts list comprises the top main assembly drawings shown in the "Drawings" portion of this manual. Parts lists and drawings for small sub assemblies are not shown. They are provided with the complete set of "as built" drawings in the NASA files.

Parts List Drawing Number corresponding to Assembly Drawing Number	Title	Corresponding Manual Drawing Numbers
D39084, rev. A sheets 5, 6, 7	Radiant Unit Assembly	SA3909, SA3910, SA3911, SA3912
D39150, rev. A sheets 4, 5, 6	Shutter Assembly	SA3913, SA3914 SA3915
E39051, rev. A sheet 2	Vacuum Test Fixture for TPS Samples	SB3920
D38979, rev. A sheets 2 and 3	TPS Fixture for Vacuum Chamber	SB3921a
D38980, rev. B sheet 2	Support Frame Weldment, Vacuum	SB3921b

E39009, rev. A sheets 2 and 3	TPS Fixture for Reverberation Room	SB3922
E39010 rev. B sheet 2	TPS Fixture Weldment for Reverberation Room	SB3923

J.O.	DUE
QTY.	STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
21	INSULATOR STRIP, LATERAL	RI	B39072	2			
20	WASHER-PLAIN; #8, STAINLESS STEEL			72			
19	SCREW-ROUND HEAD, #8-32NCX1.00 LONG, STAINLESS STEEL			72			
18	STANDOFF-INSULATOR	RI	B39059	36			
17	INSULATOR STRIP, LONG - SLOTTED	RI	D39071-1	1			
16	NUT-HEX;#1/4-20NC, STAINLESS STEEL			22			
15	BOLT-HEX HEAD;#1/4-20NCX.50 LONG; STAINLESS STEEL			4			
14	BRACKET	RI	A39074	2			
13	BOLT-HEX HEAD; #1/4-20NCX 1.63 LONG, STAINLESS STEEL			6			
12	WASHER-SPLIT LOCK #1/4, STAINLESS STEEL			62			
11	SUPPORT BAR	RI	B39060	1			
10	WASHER-LOCK EXTERNAL TOOTH; #10; STAINLESS STEEL			16			
9	SCREW-TRUSS HEAD; #8-32NCX1.00 LONG, STAINLESS STEEL			16			
8	ELBOW, 90°, 5/16 FRARED TUBE 37°X1/8NPT ALUM ALLOY		MS20822-5D	8			
7	TUBING, ALUM 3003,5/16ODX.035 WALL X42 IN. LONG			1			
6	TUBING ALUM, 3003,5/16ODX .035 WALL X60" LONG			1			
5	TUBING, ALUM 3003, 5/16 ODX .035 WALL X24" LONG			2			
4	FRAME-SHORT WELDMENT° RIGHT	RI	D39061-2	1			
3	FRAME-SHORT WELDMENT, LEFT	RI	D39061-1	1			
2	NUT, 5/16 TUBING OD, ALUM. ALLOY		AN818-5D	18			
1	TUBING, ALUMINUM 3003, 5/16 ODX.035 WALL X. 18"LONG			3			

DRAFTSMAN	USED ON	TITLE	INVENTORY NUMBER	REV
AHO	5862	RADIANT UNIT ASSEMBLY	D39084	A
DATE 9-4-70				

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS — SHEET 5 OF 7

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
42	BOLT-HEX HEAD, #1/4-20NCX 1.00 LONG, STAINLESS STEEL			44			
41	EDGE REFLECTOR WELDMENT ASSEMBLY	RI	D39062	2			
40	LAMP-RADIANT HEAT; RATED 1200 WATTS AT 144 VOLTS	GENERAL ELECTRIC	1200T3/CLHT	90			
39	SUPPORT TUBE	RI	A39050	180			
38	EDGE REFLECTOR	RI	C39064	2			
37	BOLT-HEX HEAD, #1/4-20NC .50 LONG, STAINLESS STEEL			8			
36	WASHER-SPLIT LOCK #1/4, STAINLESS STEEL			8			
35	FRAME, LONG WELDMENT ASSEMBLY	RI	D39056	2			
34	INSULATOR STRIP, SHORT	RI	B39073	2			
33	HOLDER, SINGLE° SUPPORT TUBE	RI	C39066	4			
32	WASHER-PLAIN, #10, STAINLESS STEEL			16			
31	SCREW-TRUSS HEAD, #10-24 NC X .37 LONG, STAINLESS STEEL			16			
30	REFLECTOR ASSEMBLY	RI	D39667	6			
29	MANIFOLD ASSEMBLY	RI	D39055	2			
28	SCREW-ALLEN, SET°CUP POINT; #1/4-20NCX.50 LONG, STAINLESS STEEL			12			
27	BUS BAR ASSEMBLY - OPPOSITE	RI	C39081-2	6			
26	BUS BAR ASSEMBLY - SHOWN	RI	C39081-1	6			
25	SCREW, TRUSS HEAD #8-32 NCX .88 LONG, STAINLESS STEEL			180			
24	SCREW-BINDER HEAD, UNDER CUT; #8-32NCX.37 LONG, STAINLESS STEEL			180			
23	HOLDER, DOUBLE, SUPPORT TUBE	RI	C39065	4			
22	CLIP, LAMP MOUNTING	RI	A39085	180			

DRAFTSMAN: ASK
DATE: 9-4-70
USED ON: 5862
TITLE: RADIANT UNIT ASSEMBLY
INVENTORY
NUMBER: D39084
REV: A

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 6 OF 7

J.O.	DUE
QTY.	STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
55	WASHER - SPLIT LOCK #8 STAINLESS STEEL			180			
54	FITTING	RI	A39458	4			
53	ORIFICE	RI	A39454	6			
50	GUSSET - LEFT	RI	B39057-1	2			
49	SCREW - FLAT HEAT 82°, #1/4-20NC X .50 LONG STAINLESS STEEL			28			
48	BOLT - HEX HEAD, #1/4-20NC X .25 LONG, STAINLESS STEEL			24			
47	WASHER - SPLIT LOCK, #5/16, STAINLESS STEEL			12			
46	BOLT HEX HEAD, #5/16-18NC X 1.25 LONG STAINLESS STEEL			12			
45	GUSSET - RIGHT	RI	B39057-2	2			
44	INSULATOR STRIP, LONG - PLAIN	RI	D39071-2	2			
43	SLEEVE, 5/16 TUBING OD, ALUM ALLOY		MS20819-5	18			

DRAFTSMAN	USED ON	TITLE	INVENTORY	NUMBER	REV
AFK	5862	RADIANT UNIT ASSEMBLY		D39084	A
DATE 9-4-70					

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS — SHEET 7 OF 7

3

J.O.	QTY.	DUE	STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
21	TRACK - BOTTOM	RI	B39154-2	2			
20	WASHER-LOCK-SPLIT;#1/4; STAINLESS STEEL			63			
19	BOLT-HEX HD;#1/4-20NCX.75 LONG;STAINLESS STEEL			44			
18	WASHER-LOCK-SPLIT, #10			18			
17	SCREW-TRUSS HD;#10-24NCX.50 LONG, STAINLESS STEEL			16			
16	GUSSET	RI	A39160	2			
15	END	RI	D39152	1			
14	ELBOW, 90°, 1/2"TUBING & 3/8-18 MALE NPT, ALUMINUM	SOUTHWEST AIRMOTIV	MS20822-8D	2			
13	BUSHING-REDUCER, 3/4-14 MALE NPT TO 3/8-18 FEMALE NPT, ALUMINUM	SOUTHWEST AIRMOTIV	A912-8D	2			
12	ACTUATOR-MAGNETIC	REED SWITCH CO	9-0	1			
11	WASHER-LOCK EXT TOOTH; #6, STAINLESS STEEL			6			
10	NUT-HEX; #6-32NC; STAINLESS STEEL			2			
9	SCREW-TRUSS HD;#6-32NCX1.00 LONG;STAINLESS STEEL			4			
8	SWITCH, MAGNETIC REED, 115 VOLTS AC, 1.5 AMP, SCREW TERMINALS	REED SWITCH CO	V29-SORO	1			
7	BRACKET-SWITCH	RI	A39159	1			
6	WASHER-PLAIN; #10; STAINLESS STEEL			2			
5	SCREW-TRUSS HD, #10-24NCX.50 LONG;STAINLESS STEEL			2			
4	SIDE	RI	D39151	2			
3	NUT-HEX; #5/16-24NF; STAINLESS STEEL			14			
2	WASHER-PLAIN, #5/16; STAINLESS STEEL			12			
1	BOLT-HEX HD, #5/16-24NFX1.75 LONG;STAINLESS STEEL			6			

DRAFTSMAN	USED ON		TITLE	INVENTORY	NUMBER	REV
AFK	5862		SHUTTER ASSEMBLY		D39150	A
DATE 9-10-70						

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 4 OF 6

J.O.	DUE
QTY.	STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
42	NUT-HEX; #1/4-20 NC; STAINLESS STEEL			4			
41	BOLT HEX HD; #1/4-20NCX.75 LONG; STAINLESS STEEL			4			
40	ROD	RI	A39164	2			
39	SPRING PLUNGER, HEX NOSE; 5/8-11NC THD;STAINLESS STEEL	VLIER	SSH-62N	2			
38	NUT-HEX; #5/8-11 NC; STAINLESS STEEL			2			
37	NUT-HEX;#1/2-20 NF; STAINLESS STEEL			2			
36	BAR	RI	A39163	1			
35	AIR CYLINDER-1-3/4" BORG-12 INCH STROKE-STAINLESS ROD	BIMBA	2412-DP	1			
34	WASHER-PLAIN; 1 INCH; STAINLESS STEEL			2			
33	NUT-HEX; #1-14 NF; STAINLESS STEEL			2			
32	SCREW-SET-CUP-POINT-ALLEN; #1/4-20NCX.25 LONG; STAINLESS STEEL			20			
31	COIL-REFLECTOR	RI	B39155	1			
30	BOLT-HEX HD;#1/4-20NCX.87 LONG;STAINLESS STEEL			10			
29	CLEAT	RI	A39162	11			
28	FRAME	RI	D39153	1			
27	TIE ROD - SHORT	RI	A39161-1	1			
26	PLATE COIL, 14 GA STAINLESS, 26X23" NOMINAL;BLACK FINISH CAT-A-LAC	TRANTER MFG INC	60ED	1			
25	CAM FOLLOWER-NEEDLE BEARING, .75 DIA ROLLER	TORINGTON CO.	CR-12	4			
24	NUT-HEX; #3/8-24 UNF; STAINLESS STEEL			4			
23	WASHER-PLAIN; #3/8, STAINLESS STEEL			4			
22	SCREW-FLAT HD; #10-24 NCX.75 LONG:STAINLESS STEEL			2			

DRAFTSMAN	USED ON	TITLE	INVENTORY	NUMBER	REV
AFK	5862	SHUTTER ASSEMBLY		D39150	A
DATE 9-10-70					

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 5 OF 6

5

J.O.		DUE
QTY.		STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
55	TRACT - TOP	RA	B39154-1	2			
54	SPRING	RI	A39456	1			
53	ROLL PIN: .06 DIA X .25 LONG, STAINLESS STEEL			1			
52	NUT	RI	A39455	1			
51	ROLL PIN: .12 DIA X .50 LONG STAINLESS STEEL			4			
50	SCREW - TRUSS HEAD, #10-24NC X .75 LONG STAINLESS STEEL			2			
49	ROLL PIN: .19 DIA X 1.00 LONG STAINLESS STEEL			4			
48	AIR VALVE	ALLEN AIR	243-SV-PKOP	1			
47	TIE ROD - LONG	RI	A39161-2	1			
46	HOSE ASSEMBLY;#601 HOSE, BRAIDED STAINLESS COVER, AN818-8D	SOUTHWEST AIRMOTIVE	601-000-8D-40	2			
45	BULKHEAD UNION, 1/2" TUBE; ALUMINUM ALLOY	SOUTHWEST AIRMOTIVE	AN832-8D	2			
44	BRACE WELDMENT ASSEMBLY	RI	B39156	1			
43	WASHER-PLAIN; #1/4, STAINLESS STEEL			14			

DRAFTSMAN	USED ON	TITLE	INVENTORY	NUMBER	REV
AFK	5862	SHUTTER ASSEMBLY		D39150	A
DATE 9-10-70					

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 6 OF 6

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
15	BOLT HEX HEAD 1/2-20 X 2 1/2			4			
14	NUT 1/2-20 CASTLE STAINLESS			4			
13	NUT 1/2-13 304 S.S.			8			
12	WASHER BEVEL		A39070	8			
11	LOCK WASHER, SPLIT 1/2" 304 S.S.			4			
10	NUT 1/2-20 304 SS (300 SERIES MUST)			4			
9	CAP SCREW-HEX Hd 1/2-20x2 304 S.S.			4			
8	NUT 1" ACME 304 S.S -			6			
7	EYE BOLT 304 S.S. 1/2-13NC	McMaster Carr	3032Y44	8			
6	CROSS BEAM		B39046	2			
5	ARRAY SUPPORT FRAME - WELDMENT		D39069	1			
4	MAIN FRAME WELDMENT		E39068	1			
3	T.P.S. FIXTURE VACUUM		D38979	1			
2	RADIANT UNIT ASS'Y		D39084	1			
1	SHUTTER ASS'Y		D39150	2			

J.O. | DUE | QTY. | STOCK

DRAFTSMAN: [illegible] 5864 | USED ON

DATE: 9-8-70

TITLE: VACUUM TEST FIXTURE FOR T.P.S. SAMPLES NAS8 26927

INVENTORY NUMBER: E39051 | REV: A

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS — SHEET 2 OF 2

ADJUSTABLE FRAME

J.O. | DUE | QTY. | STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
21	CAP SCREW 1/4-20 x 1 SS			22			
20	LOCK WASHER SPLIT SS 1/4"			8			
19	HINGE BRACKET	R.I.	B38994	4			
18	LOCK WASHER SPLIT S.S. 1/2"			34			
17	CAPTIVE SCREW	R.I.	A38993	34			
16	JAM NUT 3/8-24 S.S.			32			
15	SOCKET HD CAP SCREW SS 10-32 X .75			16			
14	SOCKET HD CAP SCREW S.S. 10-32 X 1.75			32			
13	SHOULDER SCREW S.S. 10-32 x 1/4	WINFRED M. BERG	PL-17	16			
12	BLOCK - CLEVIS	R.I.	A38992	16			
11	CLAMP SIDE	R.I.	A38991	16			
10	CLEVIS, ADJUST	R.I.	A38990	16			
9	SPECIMEN SUPPORT BAR	R.I.	C38989	4			
8	SEAL .03-.06 NEOPRENE SHEET 38X38 REQUIRED. CUT AT ASS'Y			1			
7	INSULATION SHIELD FRONT	R.I.	C39098	1			
6	" " SIDE RIGHT	R.I.	C38986-2	1			
5	" " BACK	R.I.	C38987	1			
4	INSULATION SHIELD BOTTOM	R.I.	D38985	1			
3	INSULATION SHIELD SIDE (LEFT)	R.I.	C38986-1	1			
2	CLAMP PLATE WELDMENT	R.I.	D38981	2			
1	SUPPORT FRAME WELDMENT	R.I.	D38980	1			

DRAFTSMAN: [illegible] DATE: 9-15-70 USED ON: 5863

TITLE: TPS FIXTURE - VACUUM. NAS 8-26927

INVENTORY NUMBER: D38979 REV: A

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LIST OF MATERIALS

SHEET 2 OF 3

J.O.	DUE
QTY.	STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
31	TUBE FITTING 1¼NPT PIPE TO 1½" JIC 37° FLARE TUBE		AN816-24 SORC (STYLE)	2			
30	SHOULDER SCREW 10-32 x ¼	WINFRED M. BERG	PL-21	16			
29	PORT ADAPTER - PLUG		B39091-1	8			
28	PORT ADAPTER - PORT		B39091-2	8			
27	KAOLIN FIBER INSULATION 1" TK. 2300°F	BABCOCK-WILCOX	KAOWOOL	AS REQD			
26	INSTRUMENTATION ENTRANCE PLATE	R.I	C39097	1			
25	PIPE, INSTRUMENT	R.I.	B39096	2			
24	INSTRUMENT CAP	R.I.	A39095	2			
23	PHILLIPS HD CAP SCREW 10-32 x 5/16			56			
22	THERMOCOUPLE PASS THROUGH	DEUTSCH	DM5623-37PP	5			

DRAFTSMAN	USED ON	TITLE	INVENTORY	NUMBER	REV
	5863	TPS FIXTURE - VACUUM		D38979	A
DATE		NAS 8-26 927			

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 3 OF 3

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	J.O. QTY.	DUE STOCK
13	MANIFOLD END	R.I.	A39093-3	2		
12	MANIFOLD EDGE	R.I.	A39093-2	4		
11	MANIFOLD SIDE	R.I.	A39093-1	2		
10	MANIFOLD ADAPTER - ENTRANCE	R.I.	C39092-2	1		
9	MANIFOLD ADAPTER - EXHAUST	R.I.	C39092-1	1		
8	CRYOPANEL 304SS BLACK 1SIDE	PLATE-COIL	60D36-35	1		
7	PLATE, LOWER, INSTRUMENT ACCESS.	R.I.	B39094	1		
6	TOP, BAR	R.I.	B38984	4		
5	BOX PLATE, FRONT	R.I.	C38983-2	1		
4	BOX PLATE, BACK	R.I.	C38983-1	1		
3	BOX PLATE, PURGE OUTLET	R.I.	C39089	1		
2	BOX PLATE, PURGE INLET	R.I.	C39090	1		
1	BASE PLATE	R.I.	C38982	1		

P | PULL | INVENTORY

DRAFTSMAN: RAG
DATE: 8-17-70
USED ON: 5863
TITLE: SUPPORT FRAME WELDMENT VACUUM
INVENTORY NUMBER: D38980
REV:

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 2 OF 2

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
21	DAMPING MATERIAL	MOSITES RUBBER	3/16 × 4 × 4	1			
20	" "	"	3/16 × 1 × 66 3/4	1			
19	" "	"	3/16 × 1 3/4 × 63 3/4	1			
18	" "	"	3/16 × 4 7/8 × 65	1			
17	" "	"	3/16 × 1 3/4 × 56 1/2	1			
16	" "	"	3/16 × 1 × 56 1/2	1			
15	DAMPING MATERIAL	MOSITES RUBBER	3/16 × 4 7/8 × 54 3/4	1			
14	LOCKWASHER 1/4			16			
13	LOCKWASHER 1/2			34			
12							
11	HEX BOLT 3/4-16 × 1" LG (DRILL FOR SAFETY WIRE)			12			
10	SAFETY WIRE						
9	HEX BOLT 1/4-20 × 3/4 (DRILL FOR SAFETY WIRE)			16			
8	NUT 3/4 ACME (DRILL FOR SAFETY WIRE)			16			
7	PLUG	R.I.	A39024	4			
6	CAPTIVE BOLT	R.I.	A38993	34			
5	SUPPORT PLATE ASS'Y	R.I.	B39082	4			
4	HINGE BLOCK	R.I.	B39087	4			
3	CLAMP PLATE - WELDMENT	R.I.	D38981	2			
2	SPECIMEN SUPPORT CHANNEL	R.I.	B39083	4			
1	T.P.S. FIXTURE WELDMENT REVERBERATION	RI	E39010	1			

S.O. | DUE
QTY. | STOCK

DRAFTSMAN	USED ON	TITLE	INVENTORY NUMBER	REV
RAG DATE 9-2-70	5863	T.P.S. FIXTURE REVERBERATION NAS8-26927	E39009	B

R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 2 OF 3

J.O. | DUE

QTY. | STOCK

ITEM	DESCRIPTION	MFR.	PART NO.	QTY.	P	PULL	INVENTORY
24	DAMPING MATERIAL	R.I.	A39088	1			
23	" "	MOSITES RUBBER	1/4 x 1 5/8 x 63 3/4	1			
22	DAMPING MATERIAL	MOSITES RUBBER	1 x 2 3/4 x 65	1			

DRAFTSMAN: RAG
DATE: 9-9-70
USED ON: 5863
TITLE: T.P.S. FIXTURE REVERBERATION NAS8-26927
INVENTORY NUMBER: E39009
REV: B

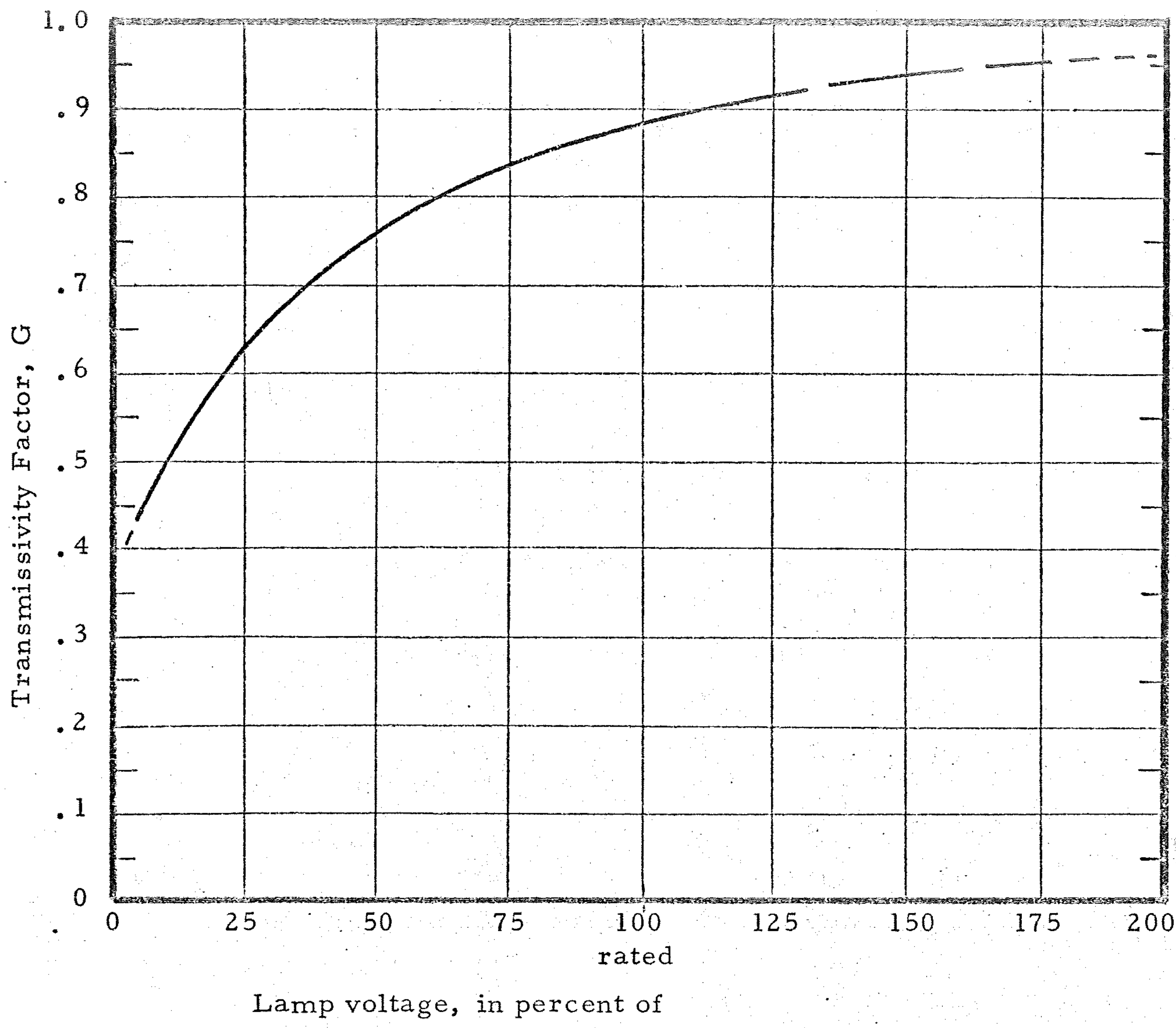
R·I CONTROLS — A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

LIST OF MATERIALS

SHEET 3 OF 3

DRAWINGS

R · I CONTROLS
A DIVISION OF RESEARCH, INCORPORATED
P.O. BOX 6164, MINNEAPOLIS, MINNESOTA 55424

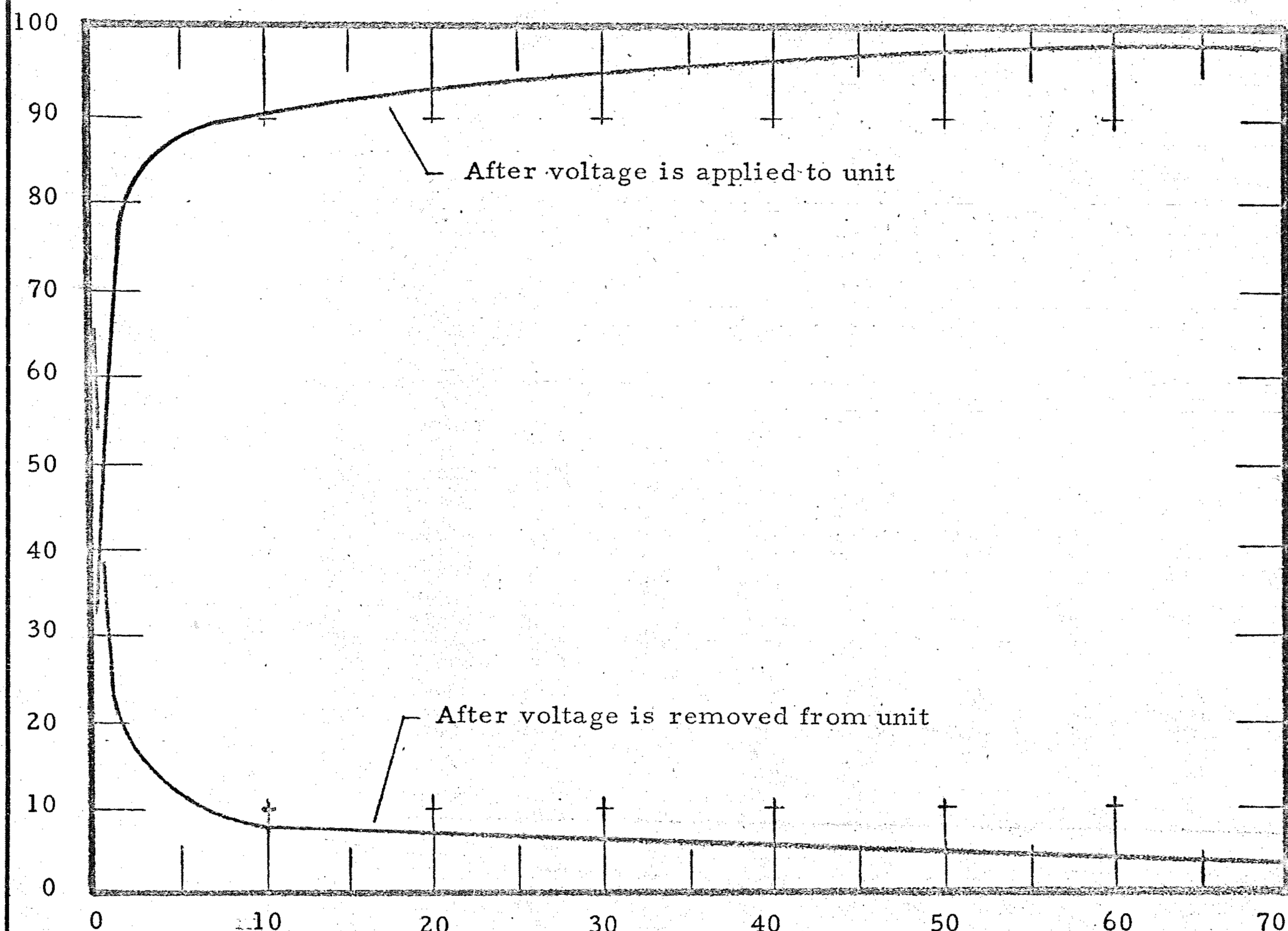


The transmissivity factor is an indication of the radiating efficiency of the standard 3/8" dia. tubular quartz tungsten filament radiant heating lamp having a 2500°K rated filament temperature. When G=1 all energy passes through the quartz envelope as radiant heat, so the lamp would have 100% efficiency. For G less than 1 means that the energy that is not transmitted through the envelope as radiation is absorbed by the quartz, the filament electrodes, and filament supports.

DATE	ORIGINATOR	REFERENCE	NUMBER	
9-13-65	AFKitchar	QUARTZ LAMP TRANSMISSIVITY FACTOR	SA 1523	

CONTROLS DIVISION
RESEARCH, INCORPORATED
P.O. BOX 6164 MINNEAPOLIS, MINN. 55424

RADIANT ENERGY OUTPUT FROM UNIT, PERCENT ±4%

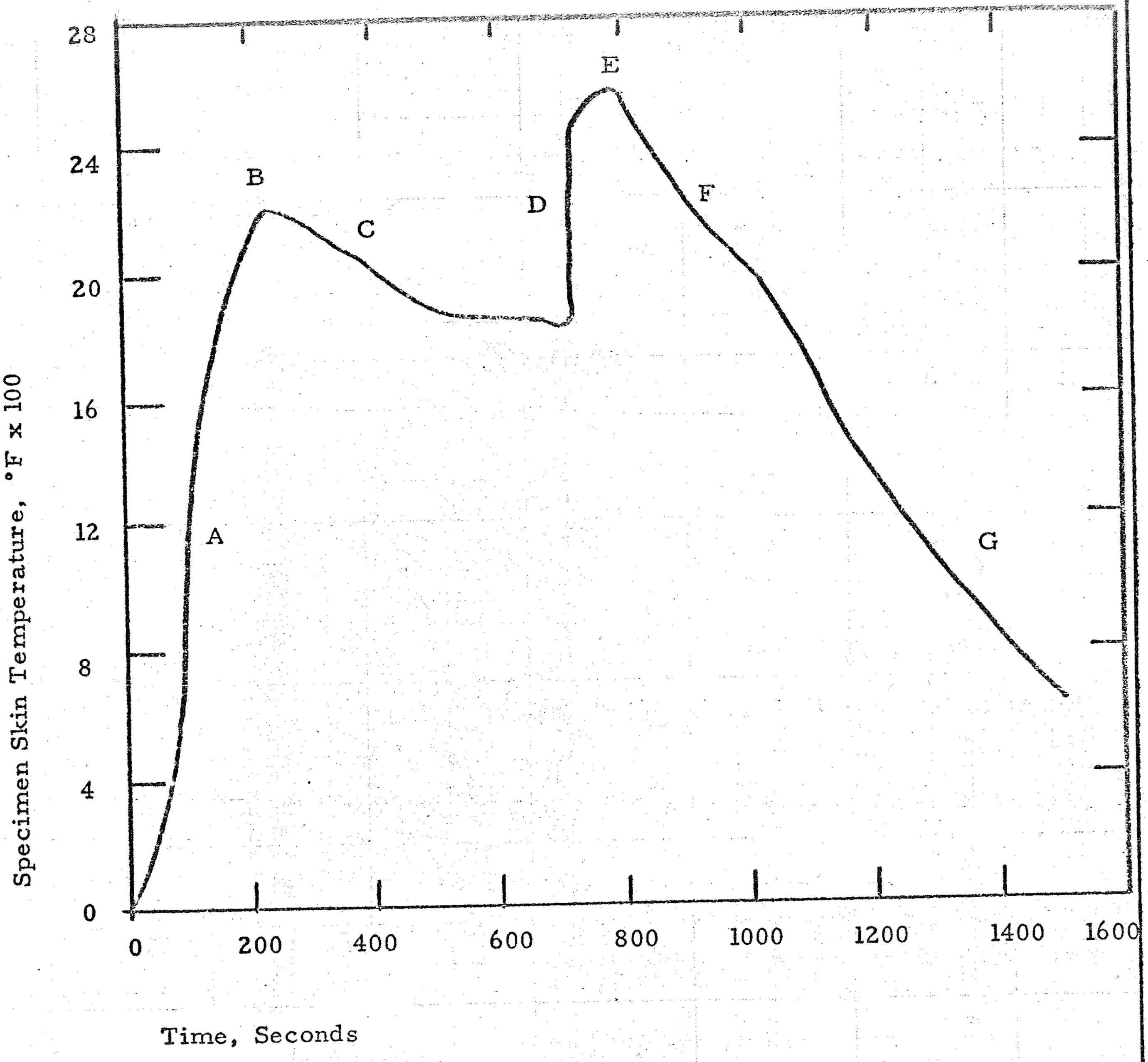


Time, seconds

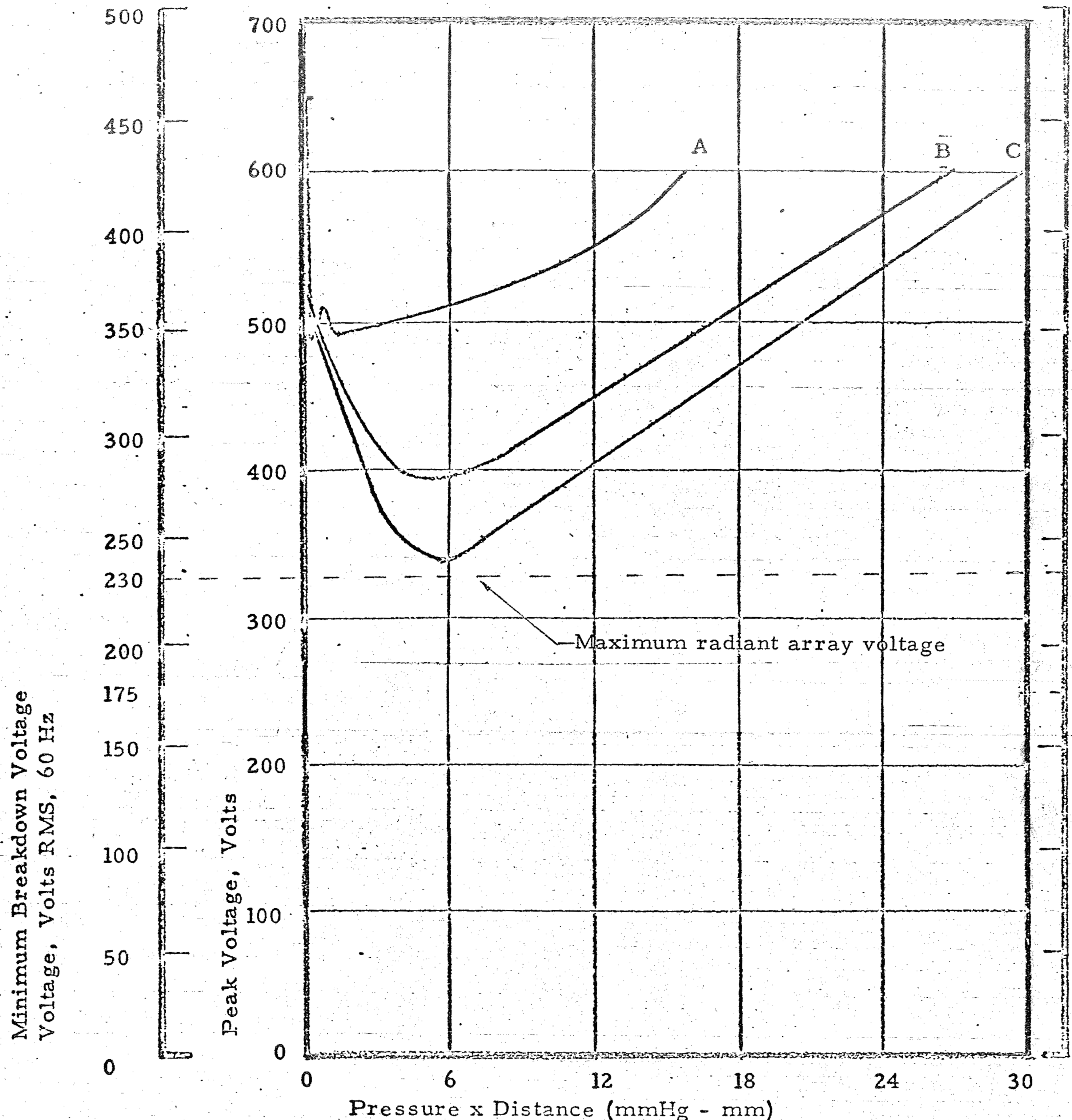
These curves show the response rates of a standard Model 5236-5, 5236-10, and 5236-16 when operated in a cold wall shroud space chamber. Reference data sheet 504.15A for a description of the Model 5236 radiant heating unit.

DATE	ORIGINATOR	REFERENCE	NUMBER
5/27/66	A. F. Kitchar	RESPONSE OF MODEL 5236 RADIANT HEATING UNIT	SA 1633

R-I CONTROLS DIVISION
RESEARCH INC
BOX 24064 MINNEAPOLIS, MINNESOTA USA 55424



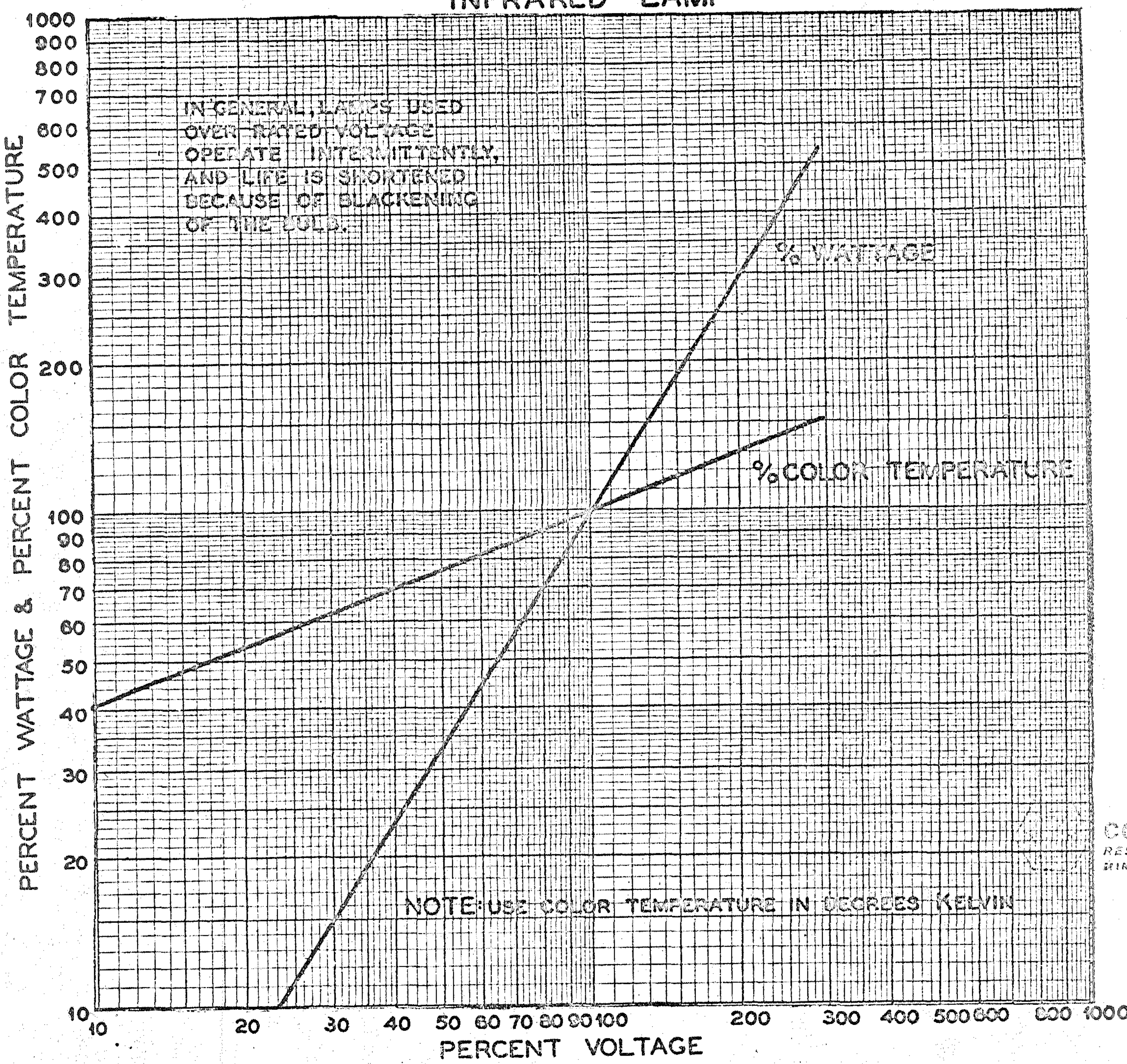
DATE	ORIGINATOR	REFERENCE	NUMBER	
5-19-70	A. F. Kitchar	T.P.S. SKIN TIME-TEMPERATURE PROGRAM	SA3634	060



A. Pointed stainless steel electrodes in dry air (non-uniform field).
B. Parallel plane stainless steel electrodes in dry air (uniform field).
C. Parallel plane stainless steel electrodes in "wet" air at approximately 95% relative humidity at 70°F (uniform field).

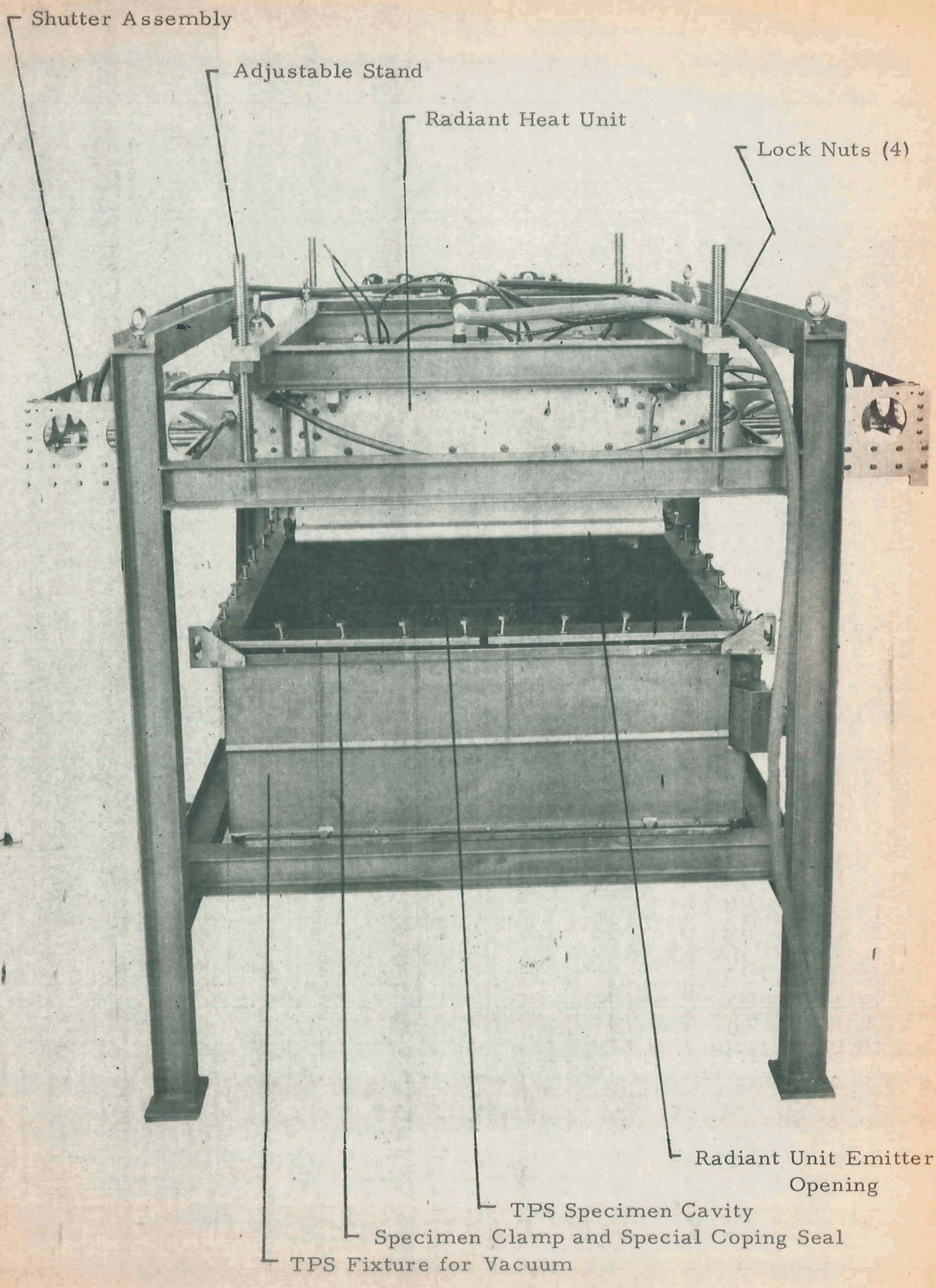
Minimum Breakdown Voltages in Air at Various Pressure Distances

VOLTAGE CHARACTERISTICS FOR TUBULAR QUARTZ INFRARED LAMP



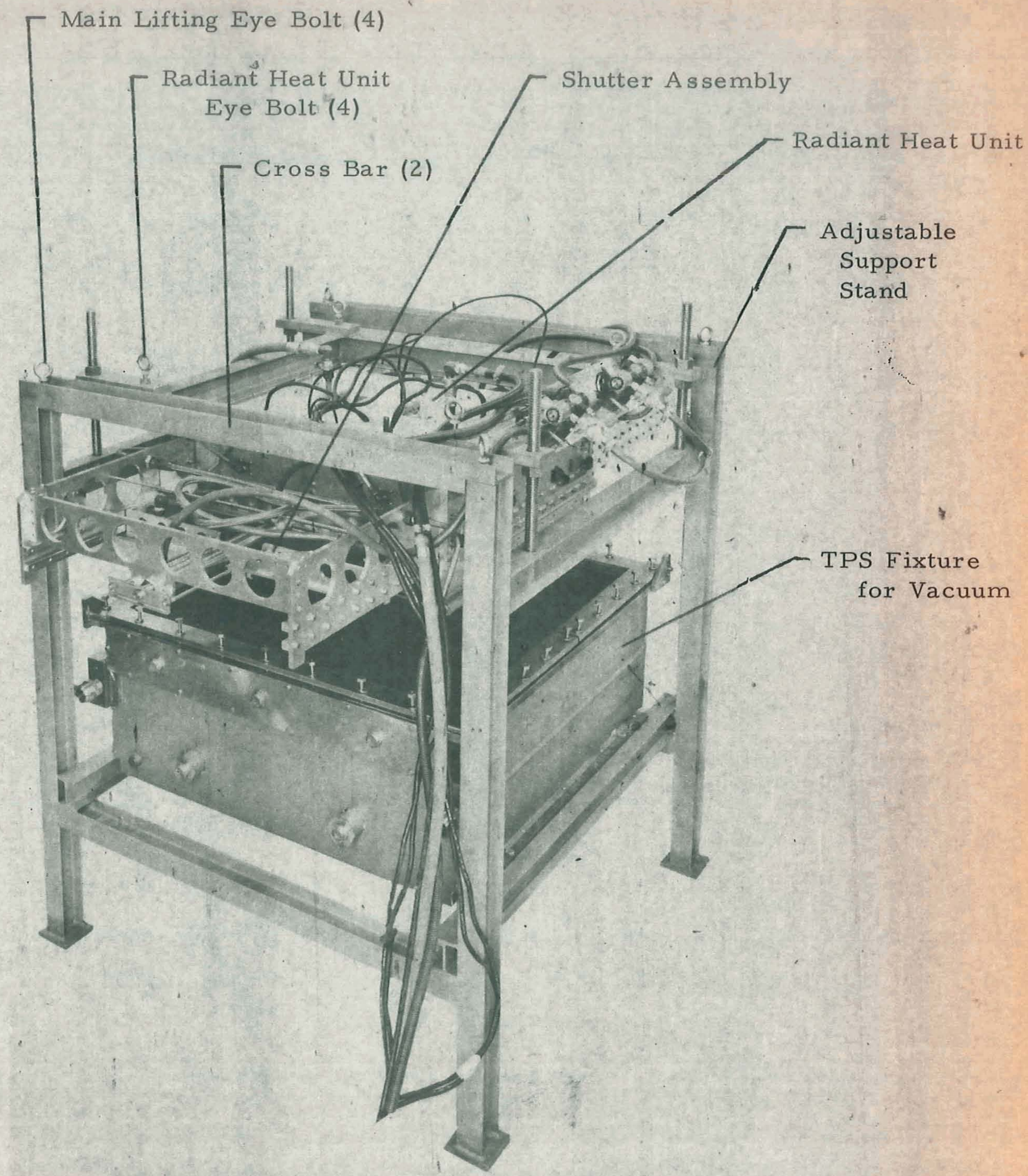
CONTROLS DIVISIC
RESEARCH, INCORPORATED
MINNEAPOLIS 24, MINNESOTA

SA3691



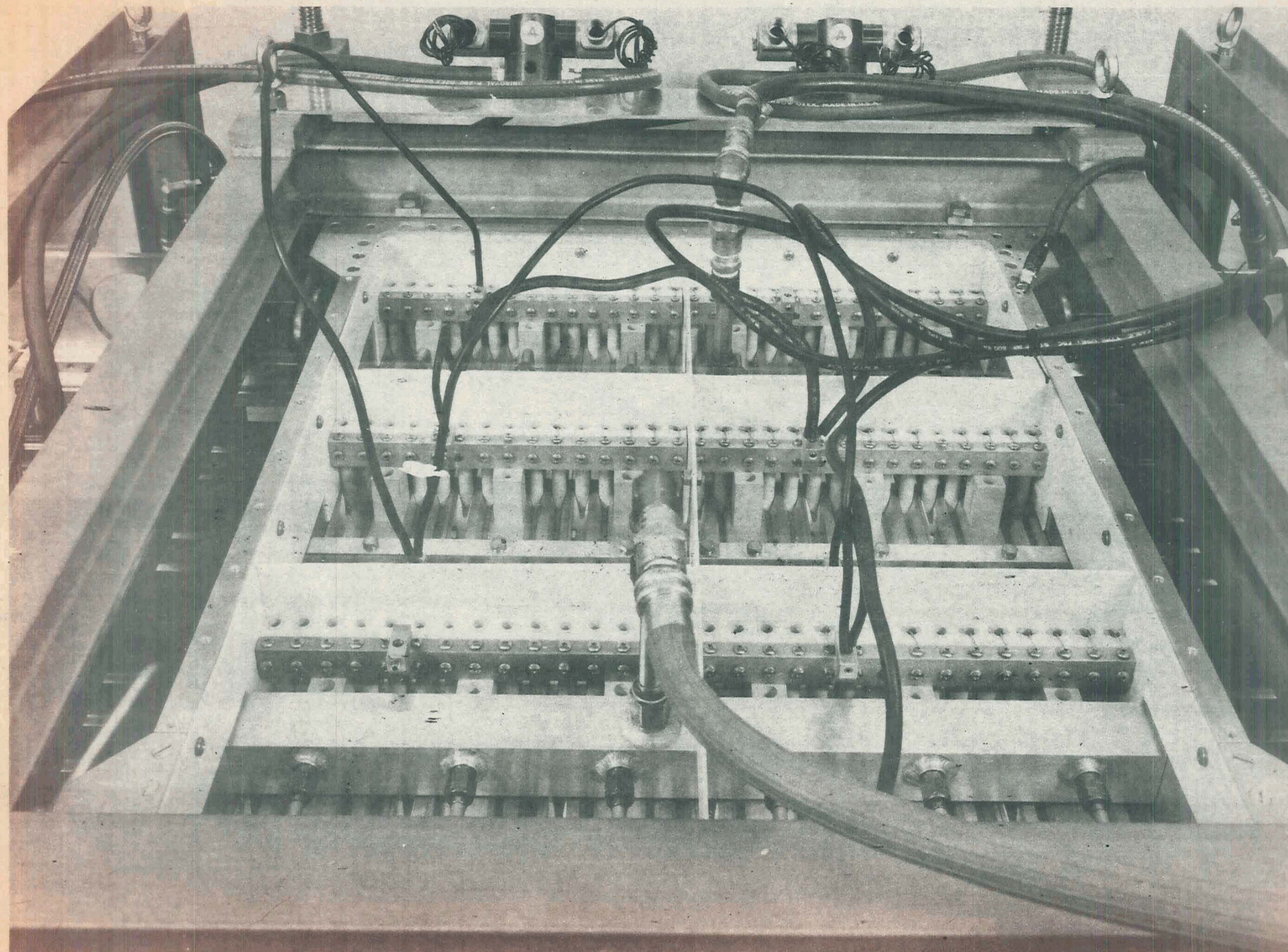
END VIEW OF VACUUM CHAMBER
RADIANT HEAT TEST SYSTEM

SA3904



CORNER VIEW OF VACUUM CHAMBER
RADIANT HEAT TEST SYSTEM

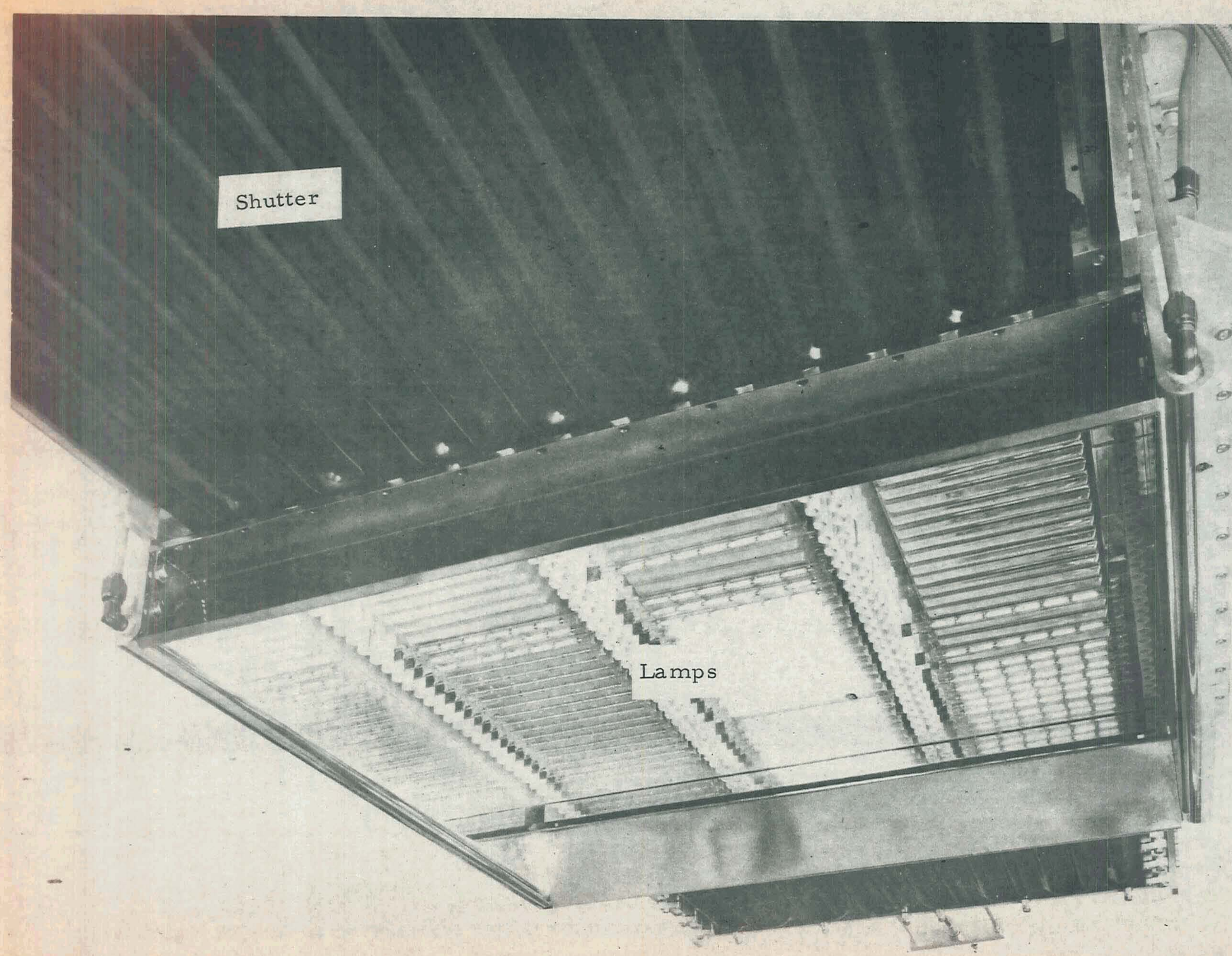
SA3905



TOP VIEW OF RADIANT HEAT UNIT SHOWING ELECTRICAL AND WATER CONNECTIONS

SA3906

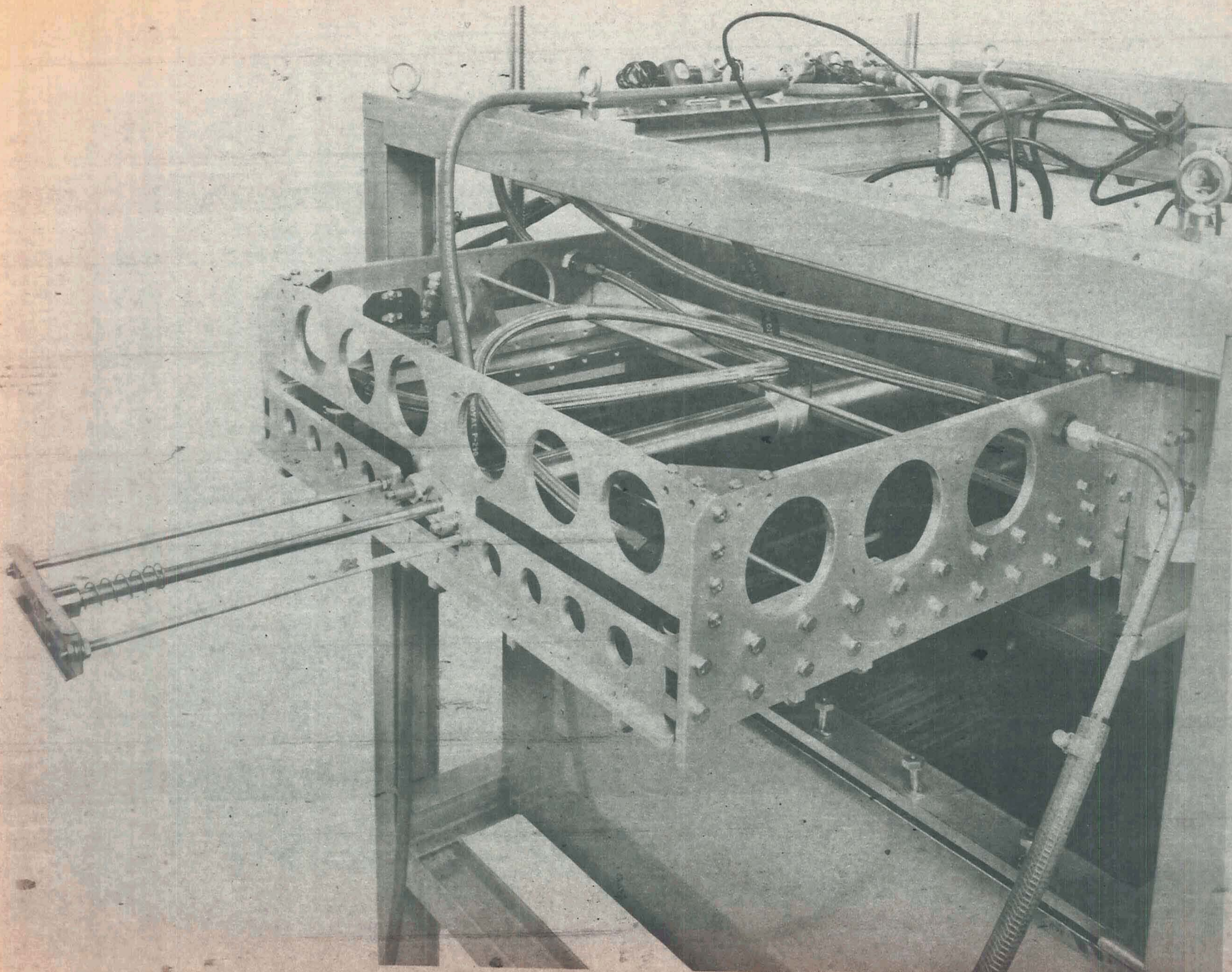
SA3906



EMITTER OPENING VIEW OF RADIANT UNIT WITH SHUTTERS RETRACTED

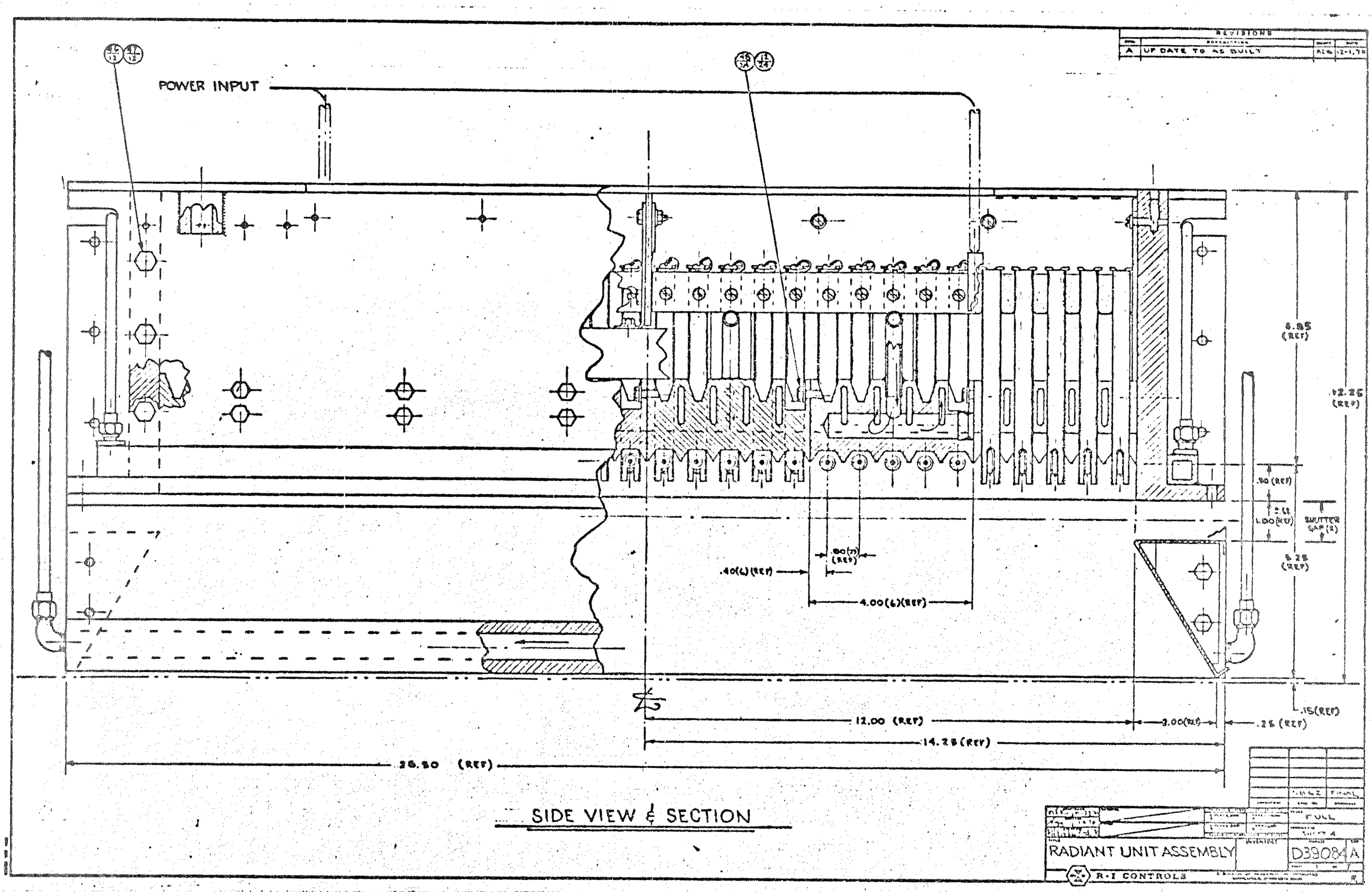
SA3907

SA3907



SHUTTER ASSEMBLY VIEW; INSERTED POSITION

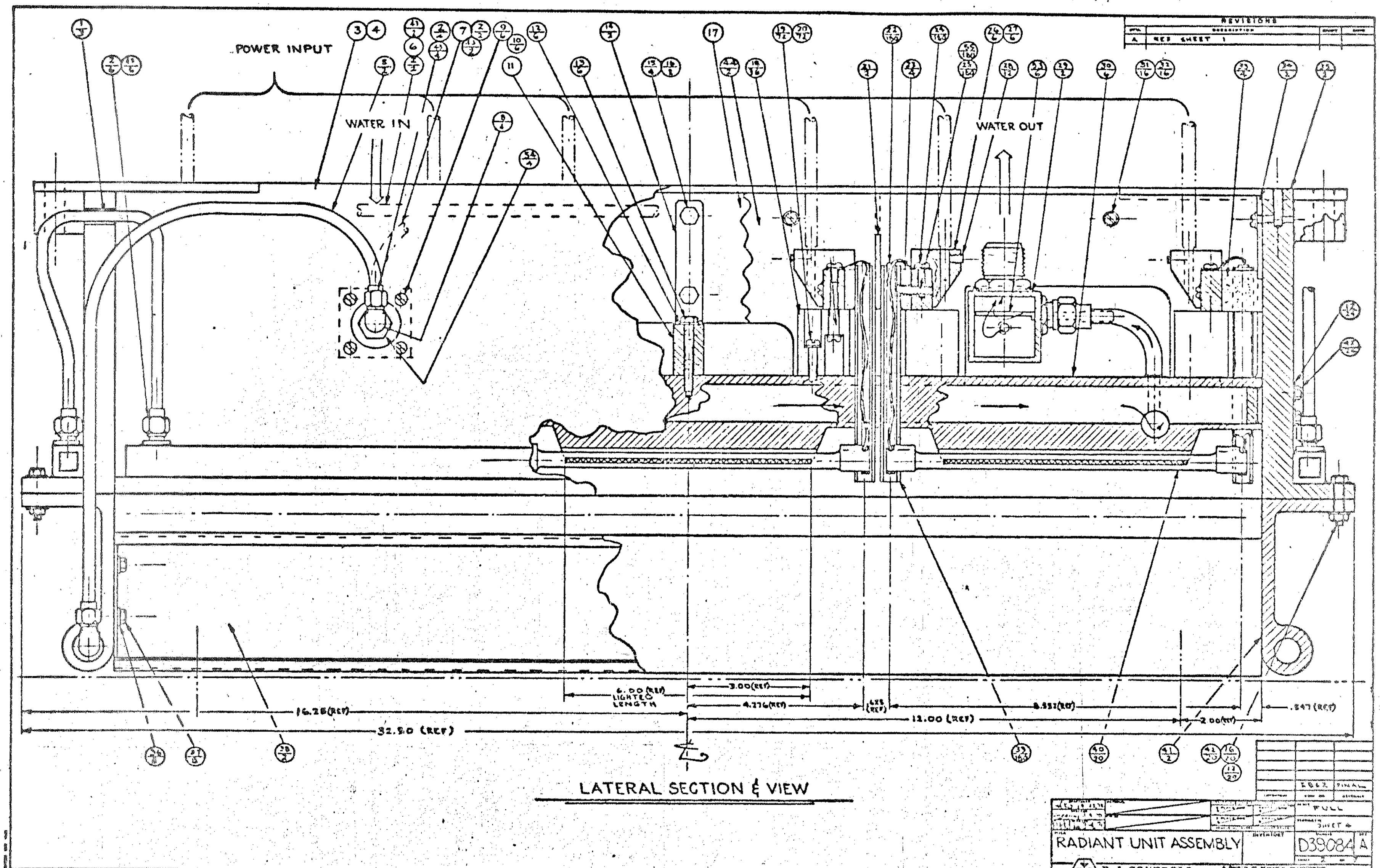
SA3908



RADIANT UNIT SIDE VIEW AND SECTION

SA3909

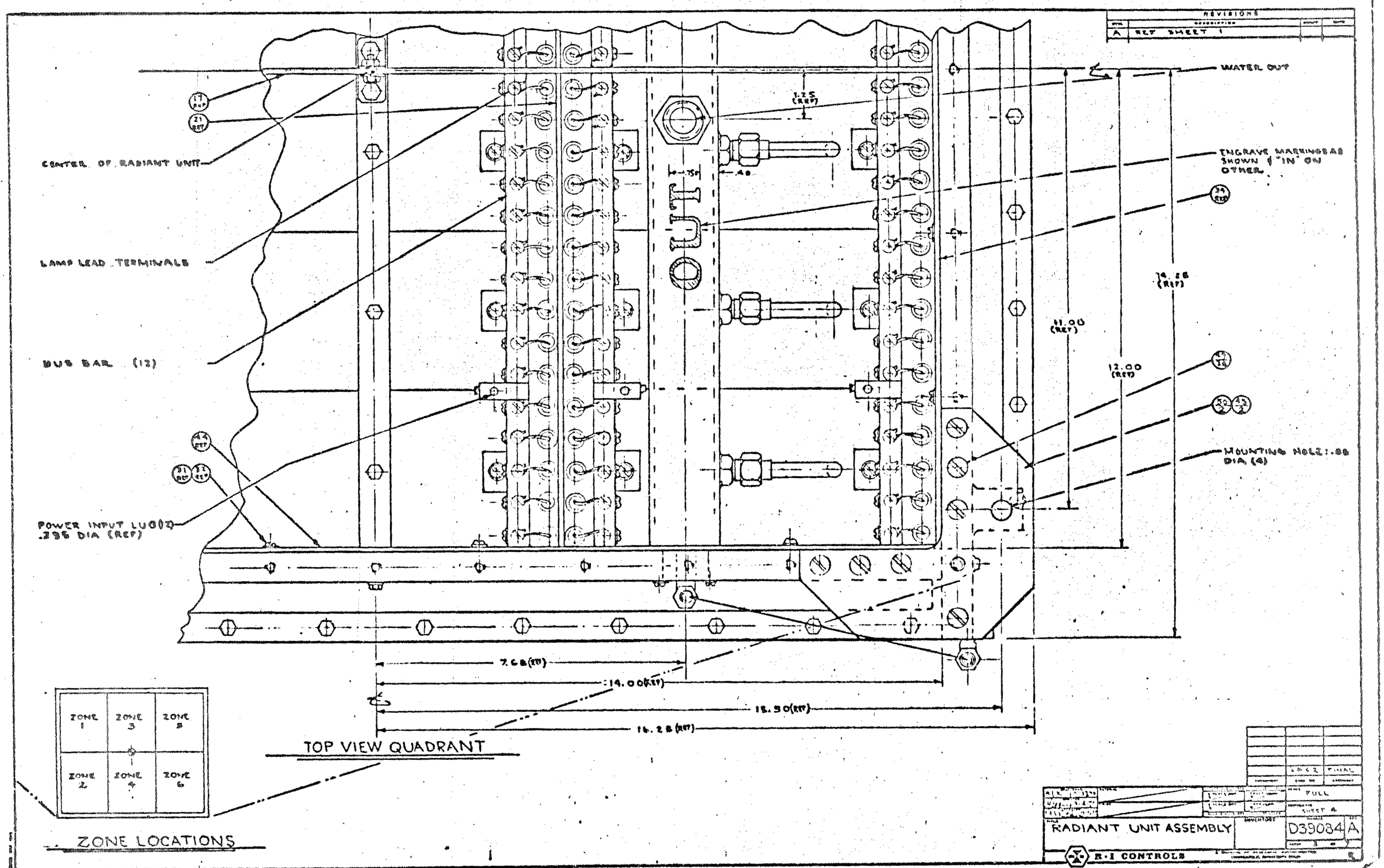
SA3909



RADIANT UNIT LATERAL SECTION AND VIEW

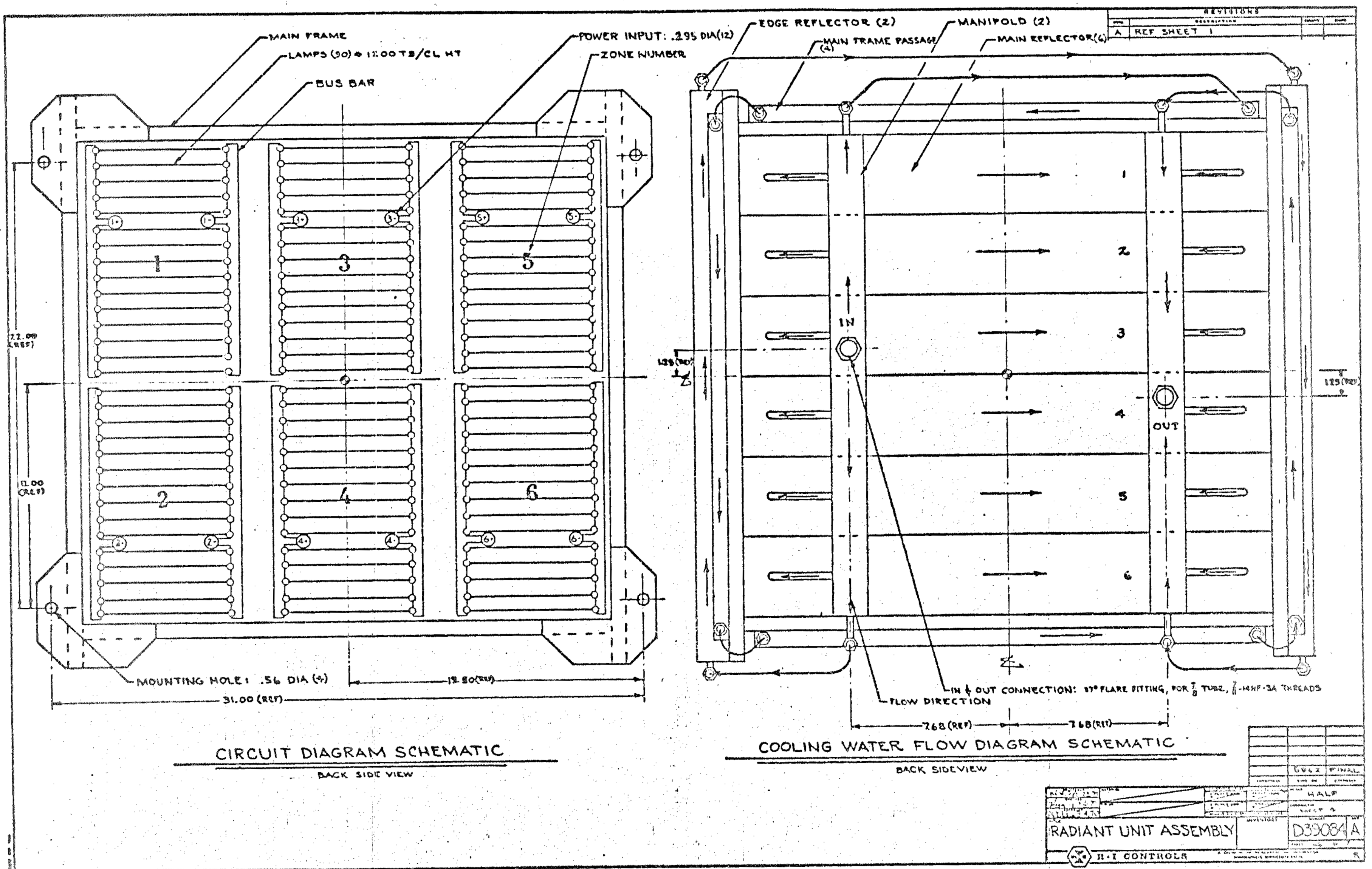
SA3910

SA3910



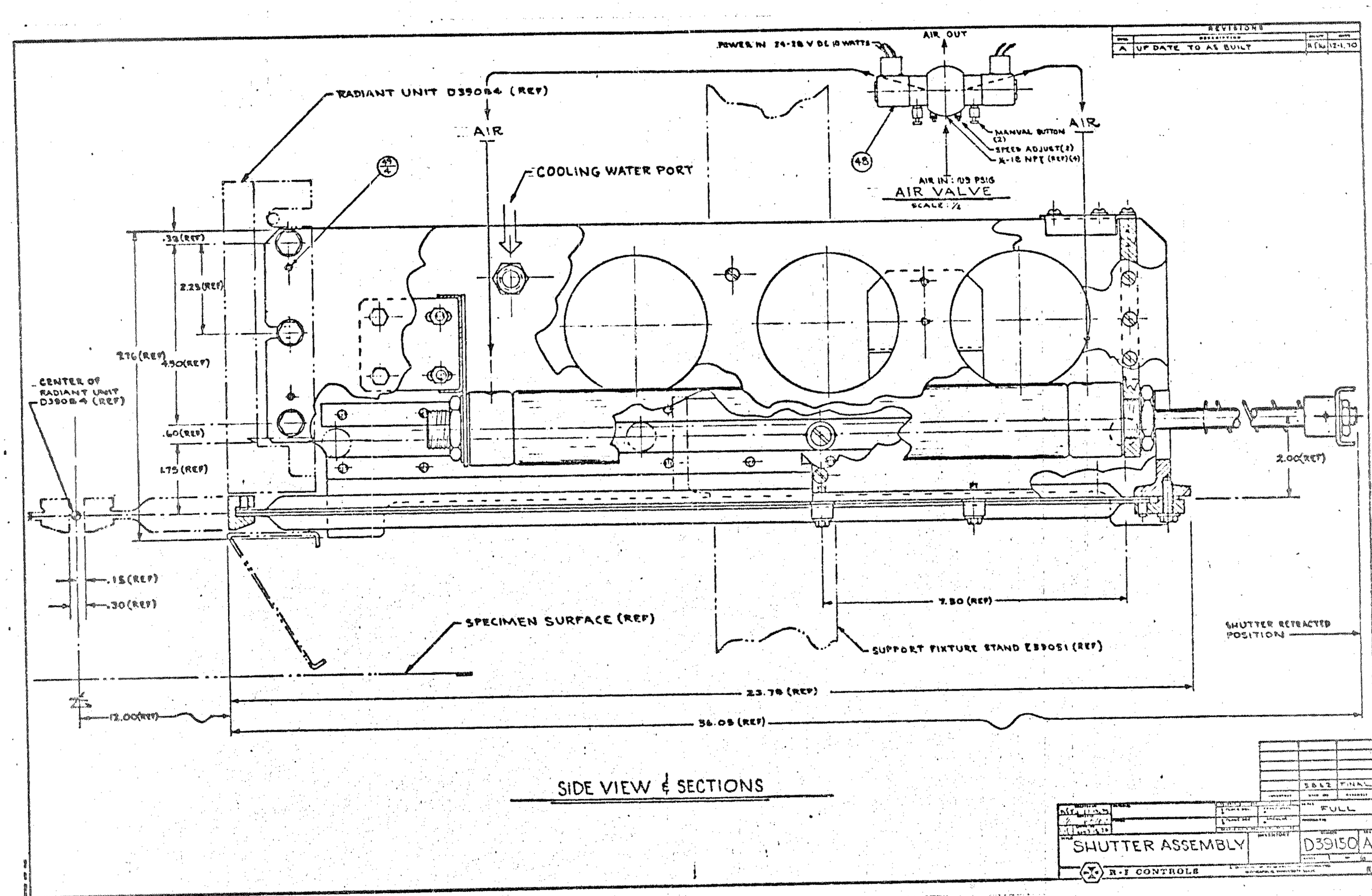
RADIANT UNIT TOP VIEW QUADRANT

SA3911

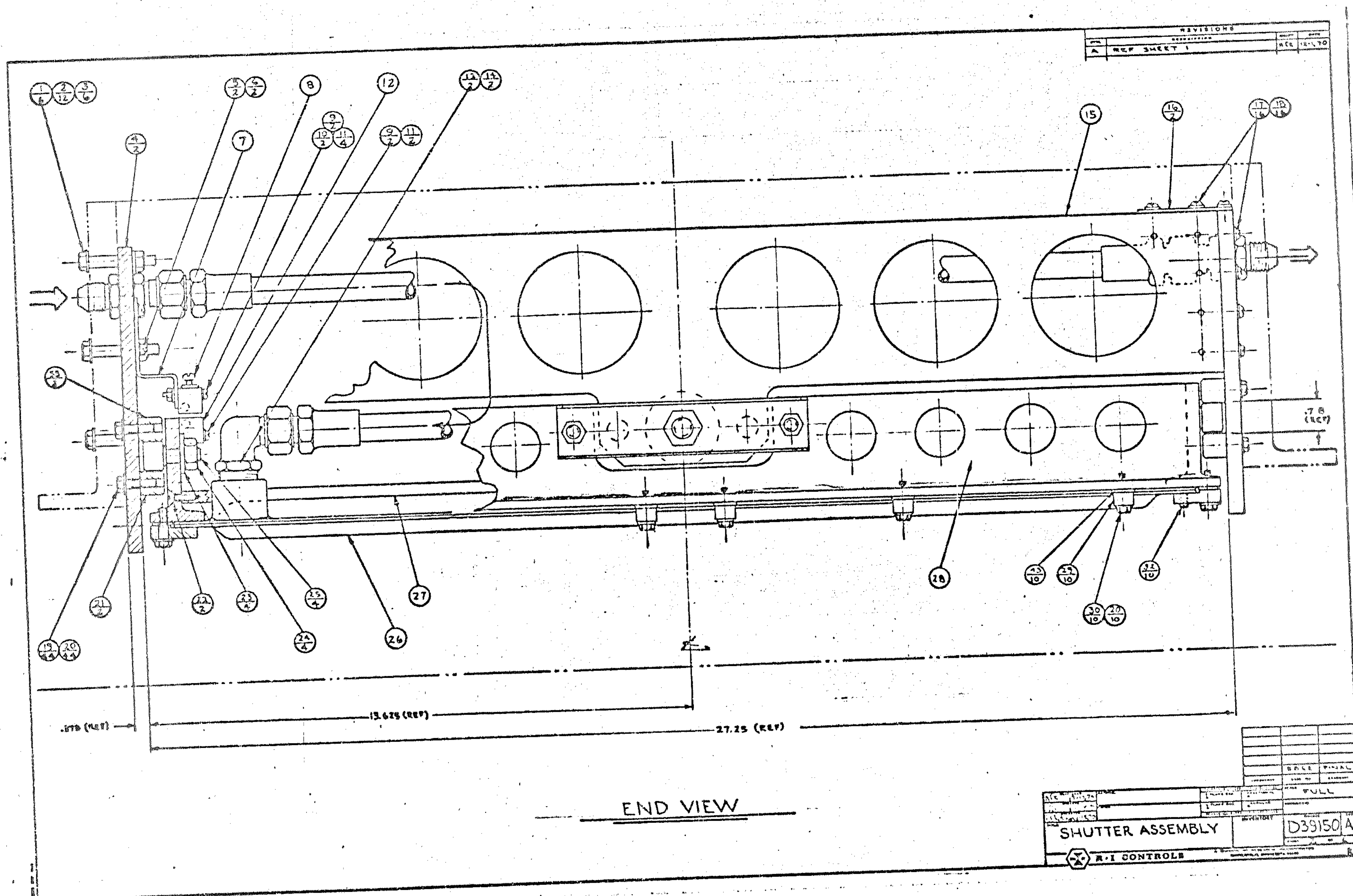


RADIANT UNIT ZONING CIRCUIT AND WATER FLOW DIAGRAM

SA3912

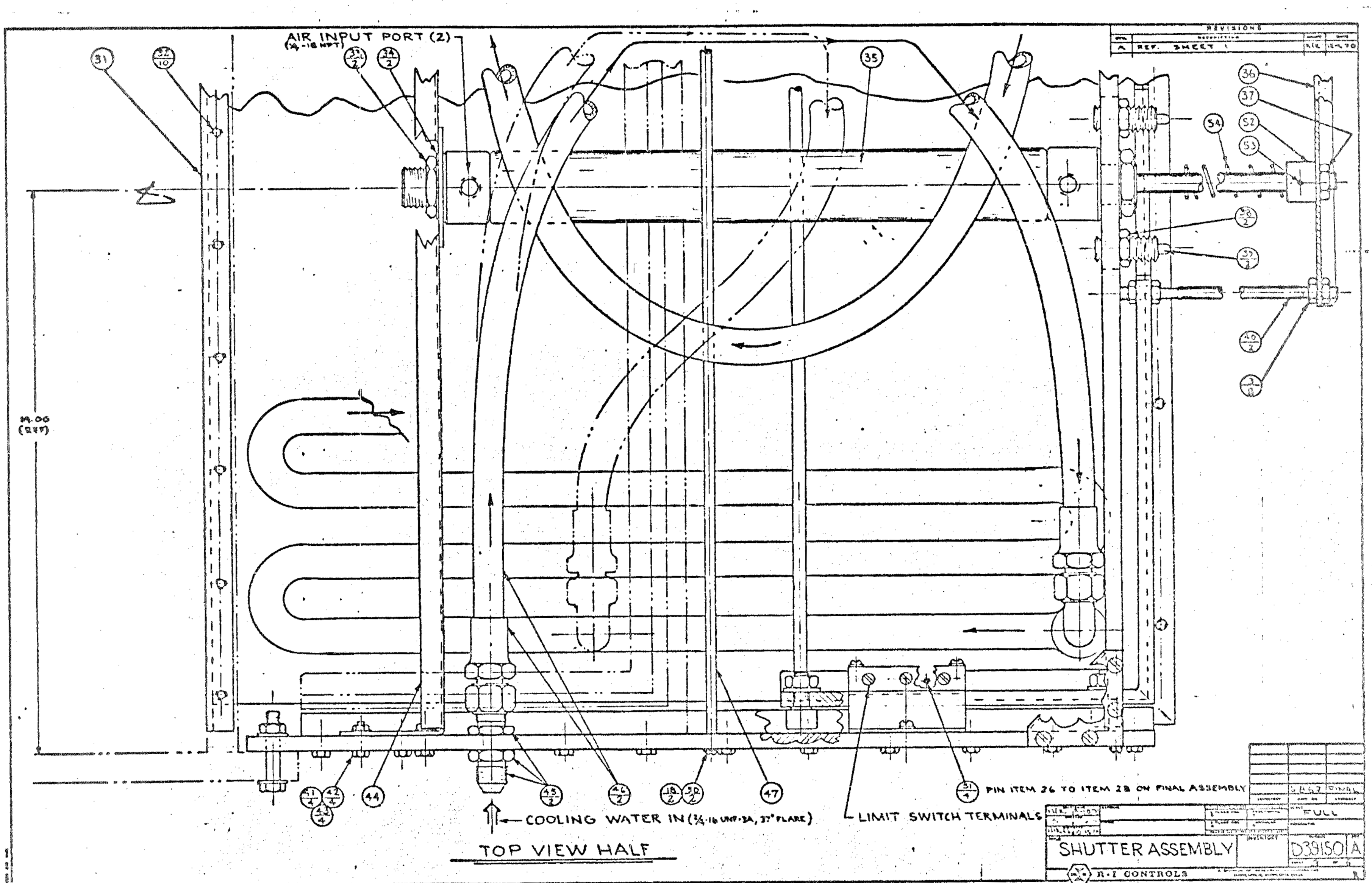


SHUTTER ASSEMBLY SIDE VIEW AND SECTION

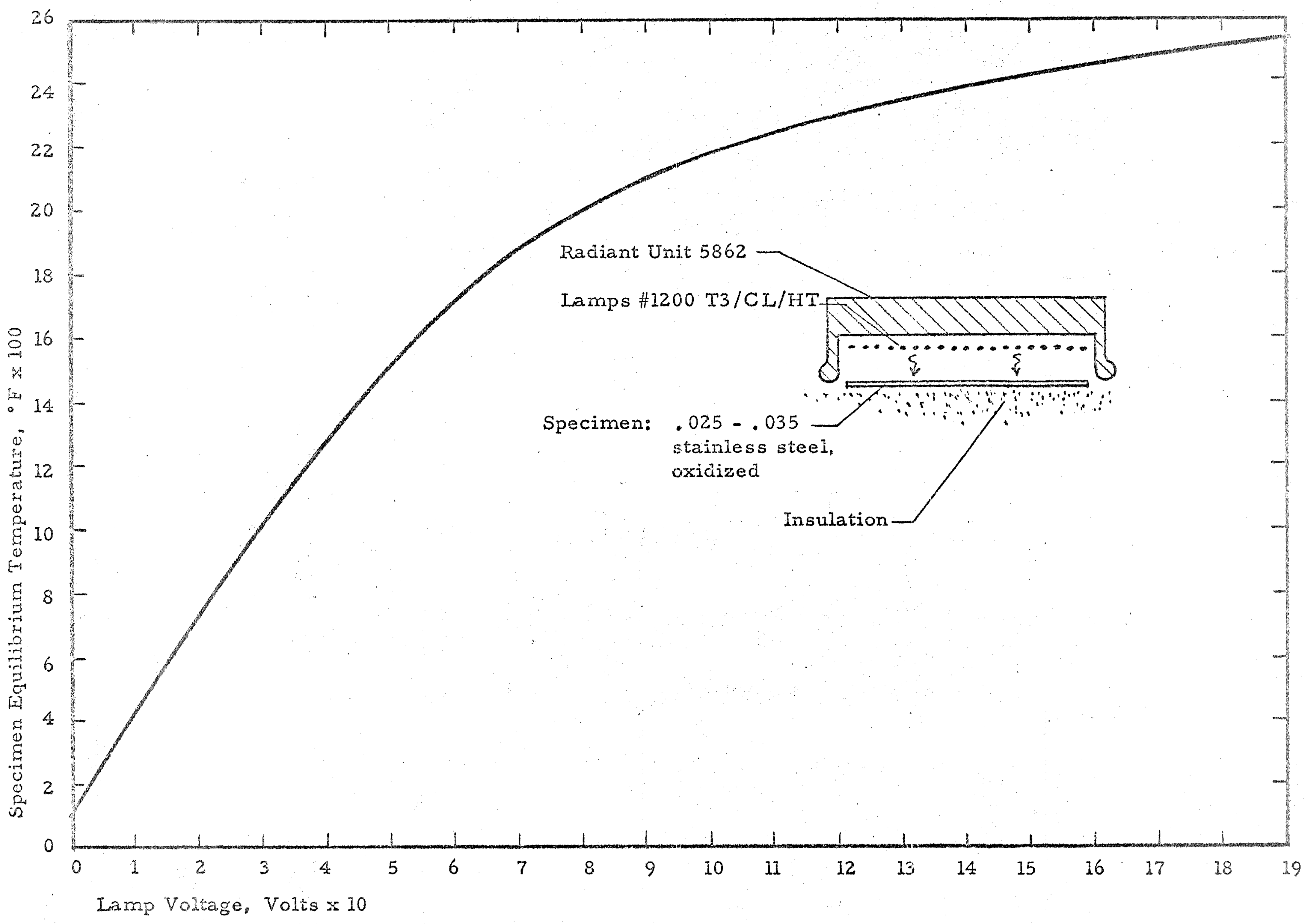


SHUTTER ASSEMBLY END VIEW

SA3914

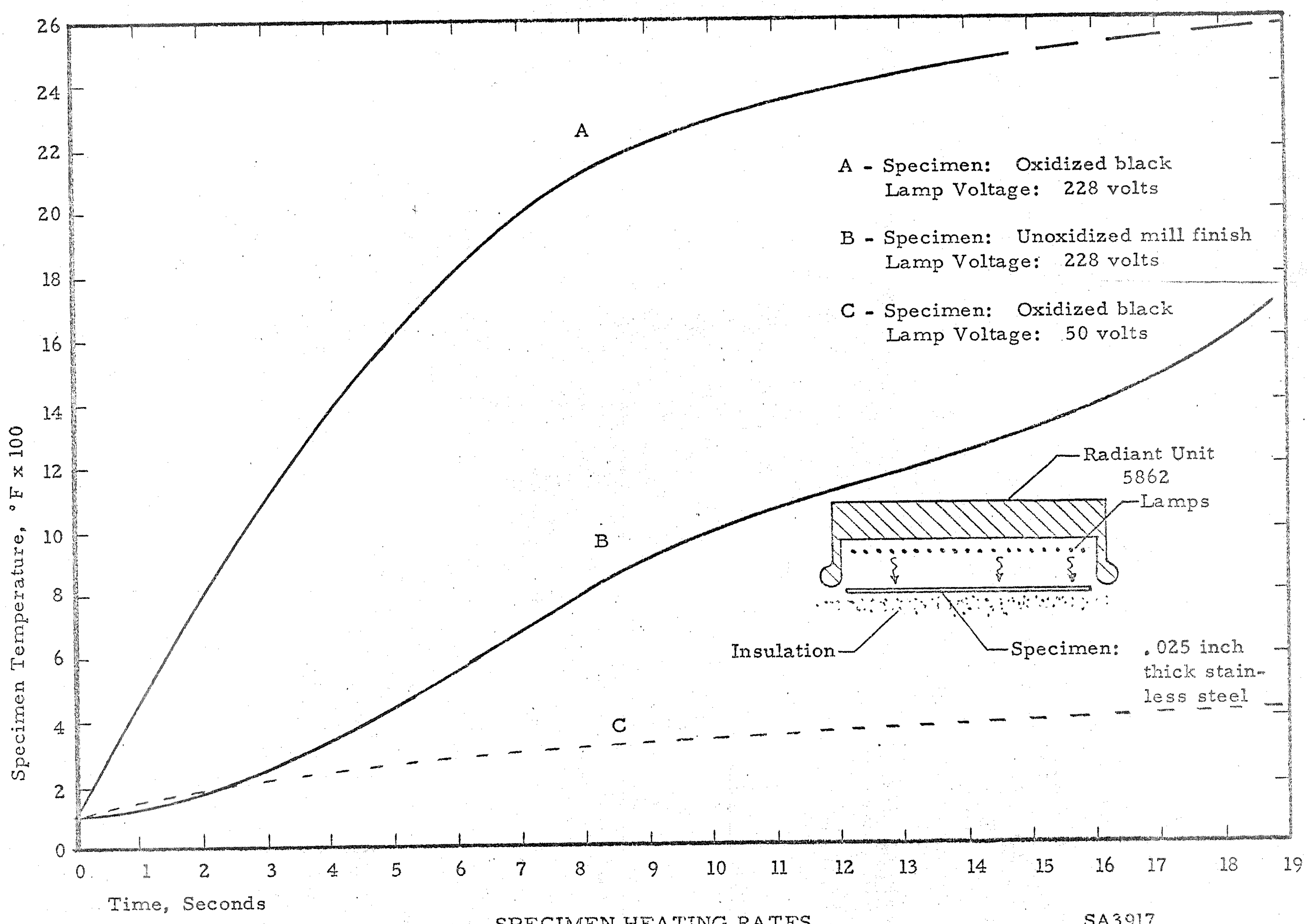


SHUTTER ASSEMBLY TOP VIEW



SPECIMEN EQUILIBRIUM TEMPERATURE AT VARIOUS VOLTAGES

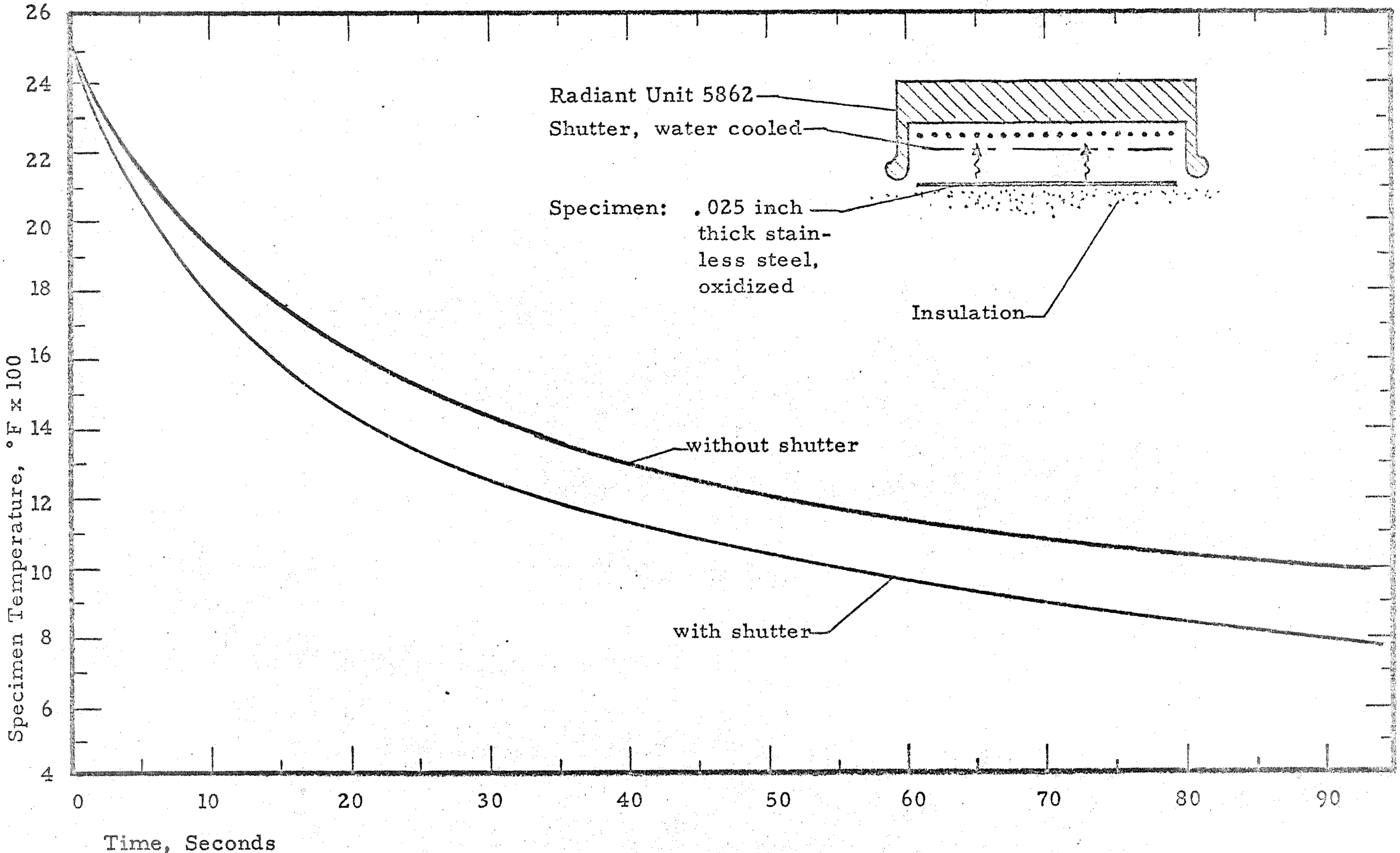
SA3916



SPECIMEN HEATING RATES

SA3917

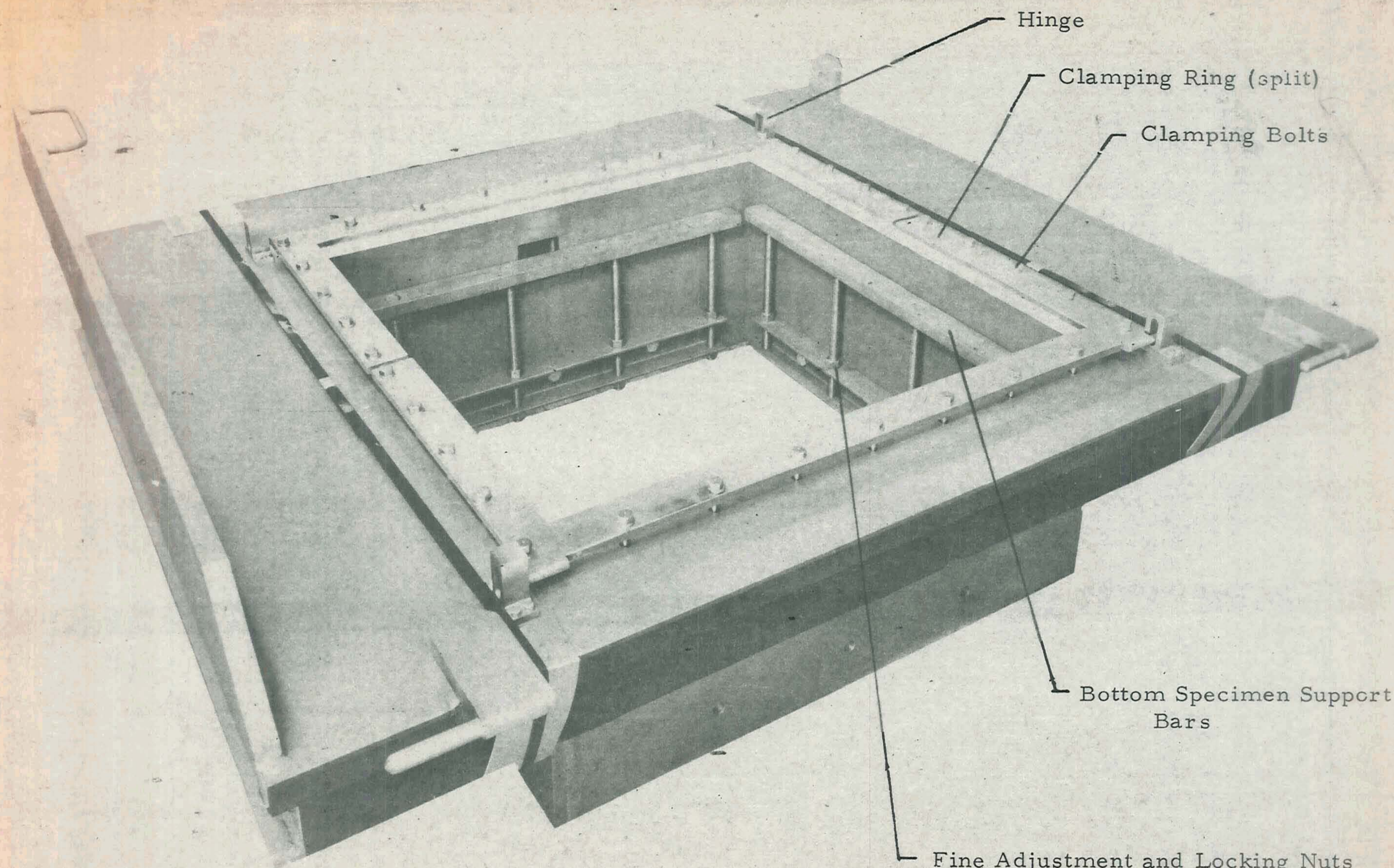
SA3917



SPECIMEN COOLING WITH AND WITHOUT SHUTTER

SA3918

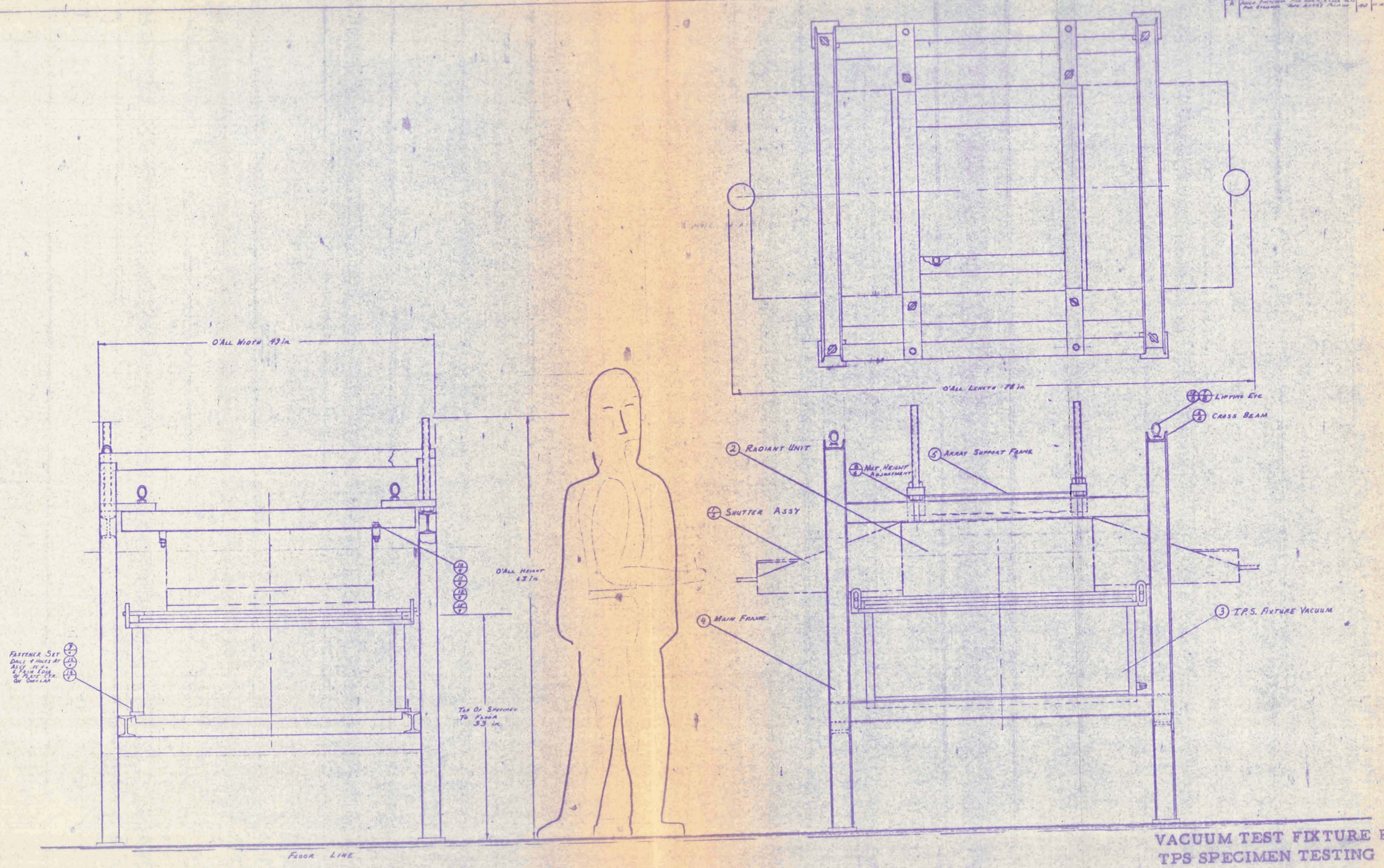
SA3918



VIEW OF TPS FIXTURE FOR REVERBERATION ROOM

SA3919

SA3919

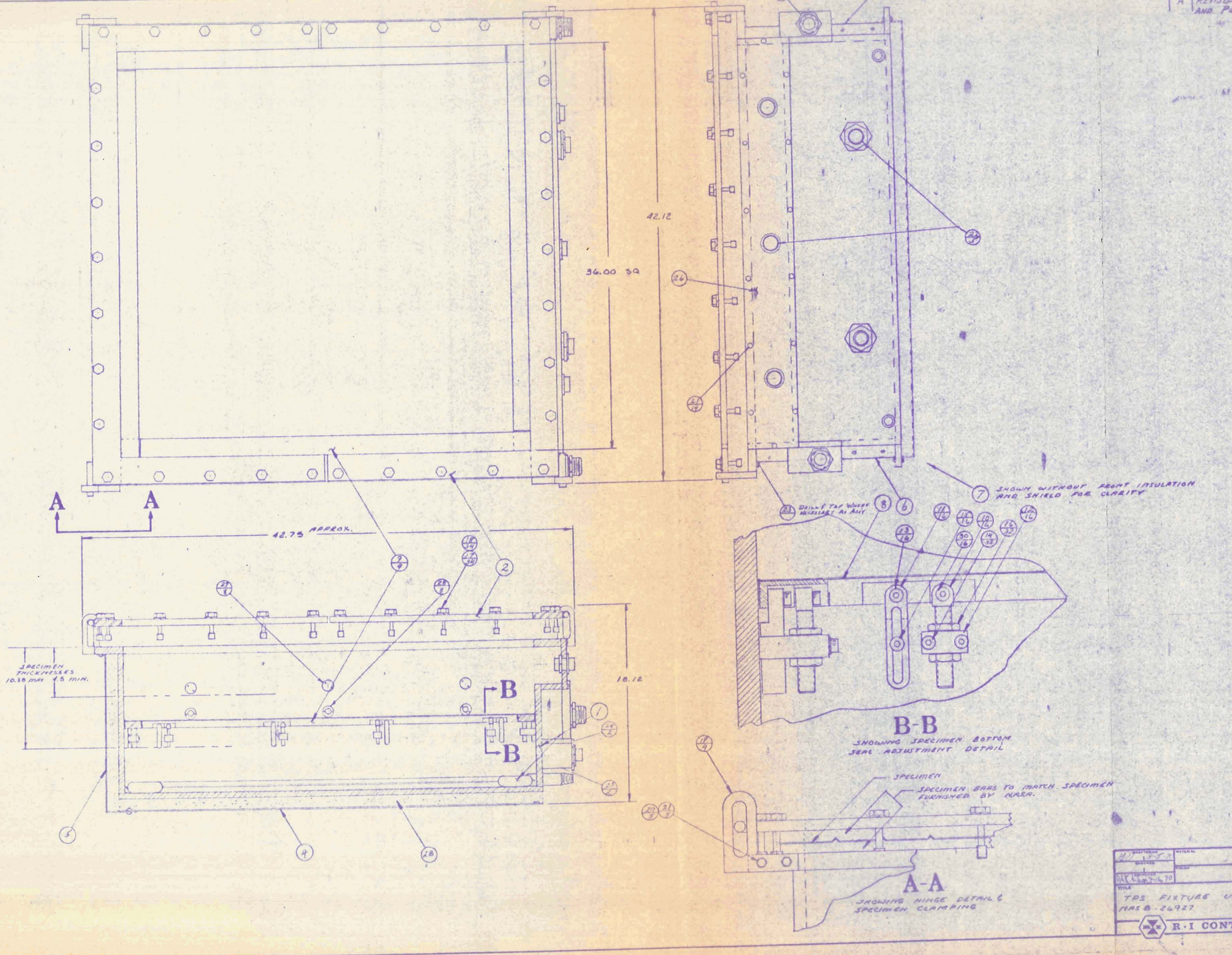


VACUUM TEST FIXTURE FOR TPS SPECIMEN TESTING

SB3920

VACUUM TEST FIXTURE FOR T.P.S. SAMPLES

REV.	DESCRIPTION	DRAFT.	DATE
A	REVISED PER DESIGN REVIEW 17-20 AUG AND PHASE DISCUSSIONS 1-8 SEP 70		15 SEP 70



TPS FIXTURE FOR VACUUM CHAMBER

SB3921a

TPS FIXTURE VACUUM

NAS 8-26927

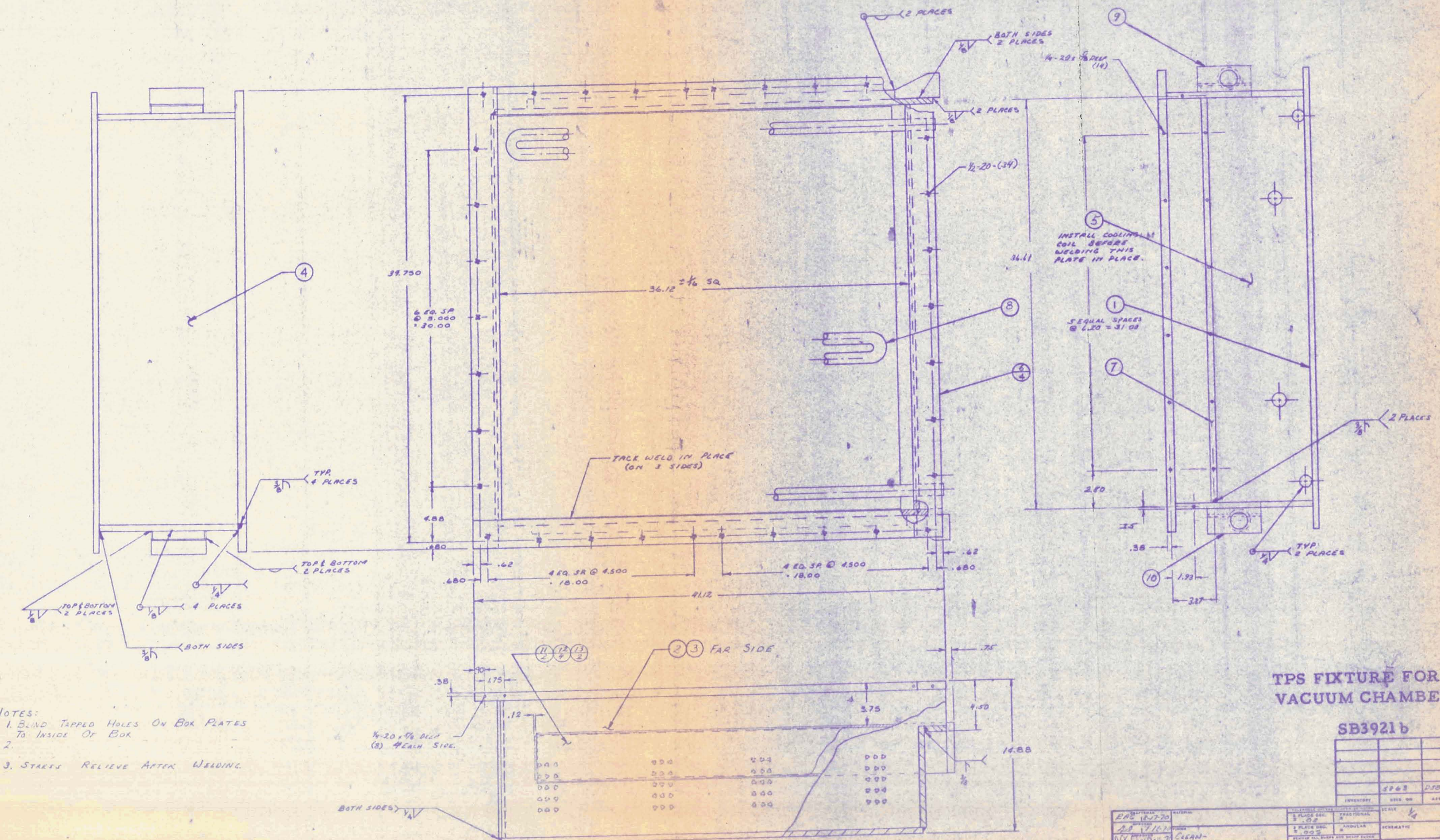
VACUUM

D38979 — REV A

R-I CONTROLS

A DIVISION OF RESEARCH, INCORPORATED, MINNEAPOLIS, MINNESOTA 55424

REVISIONS			
SYM.	DESCRIPTION	DRAFT.	DATE
A	Revised For Design Review 8-19-70 Pull Part Changed Added Notes.	C.S.O.	9-10-70
B	Deleted Note 2 - Added ½-20 cutout	R.D.	12-12-70



NOTES:
1. BLIND TAPPED HOLES ON BOX PLATES TO INSIDE OF BOX
2.
3. STRESS RELIEVE AFTER WELDING

TPS FIXTURE FOR VACUUM CHAMBER

SB3921b

5963	D38979
INVENTORY	USED ON / ASSEMBLY
SCALE	¼
TITLE	SUPPORT FRAME WELDMENT
FINISH	CLEAN
NUMBER	D38980
REV	B

Vacuum

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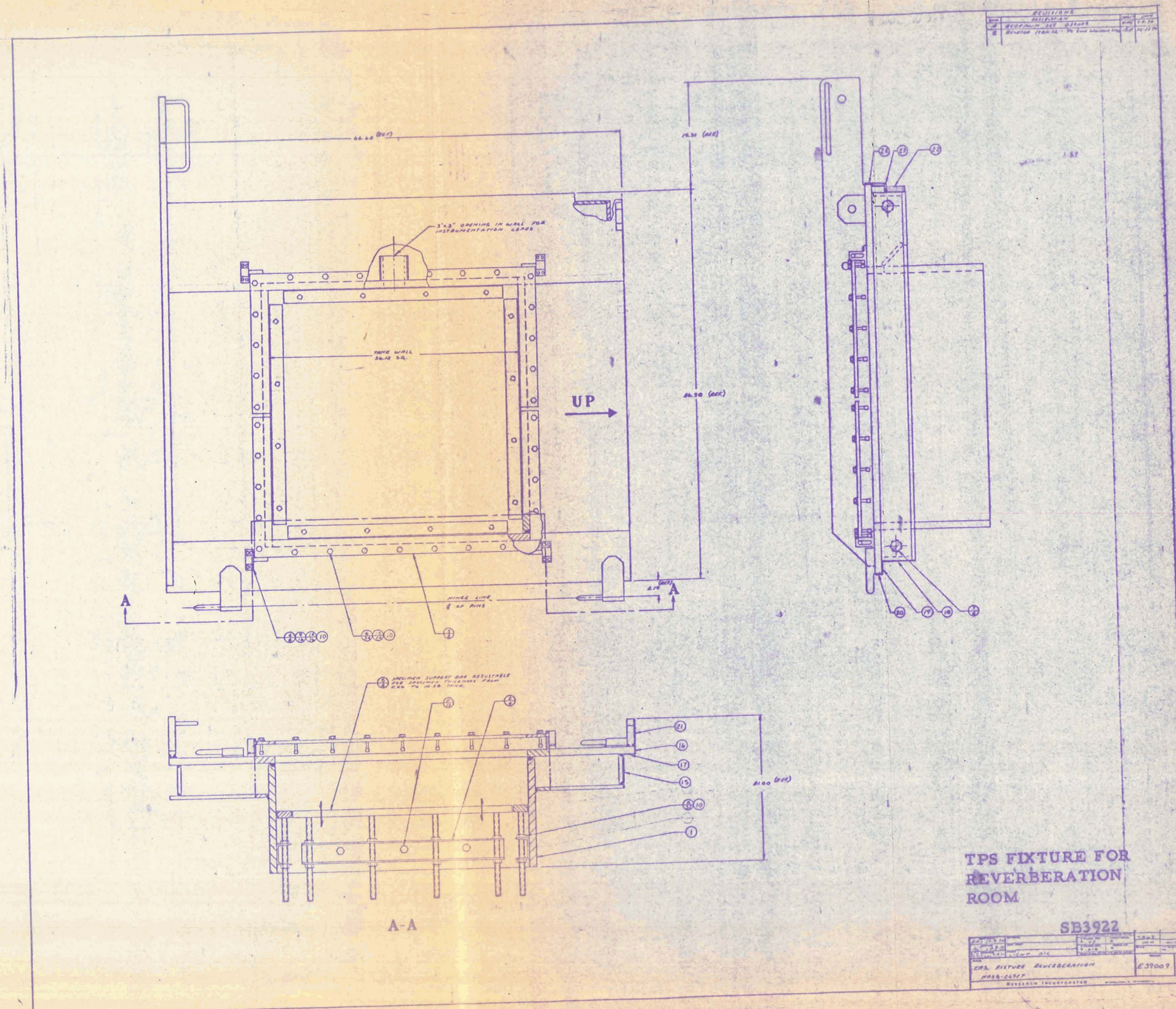
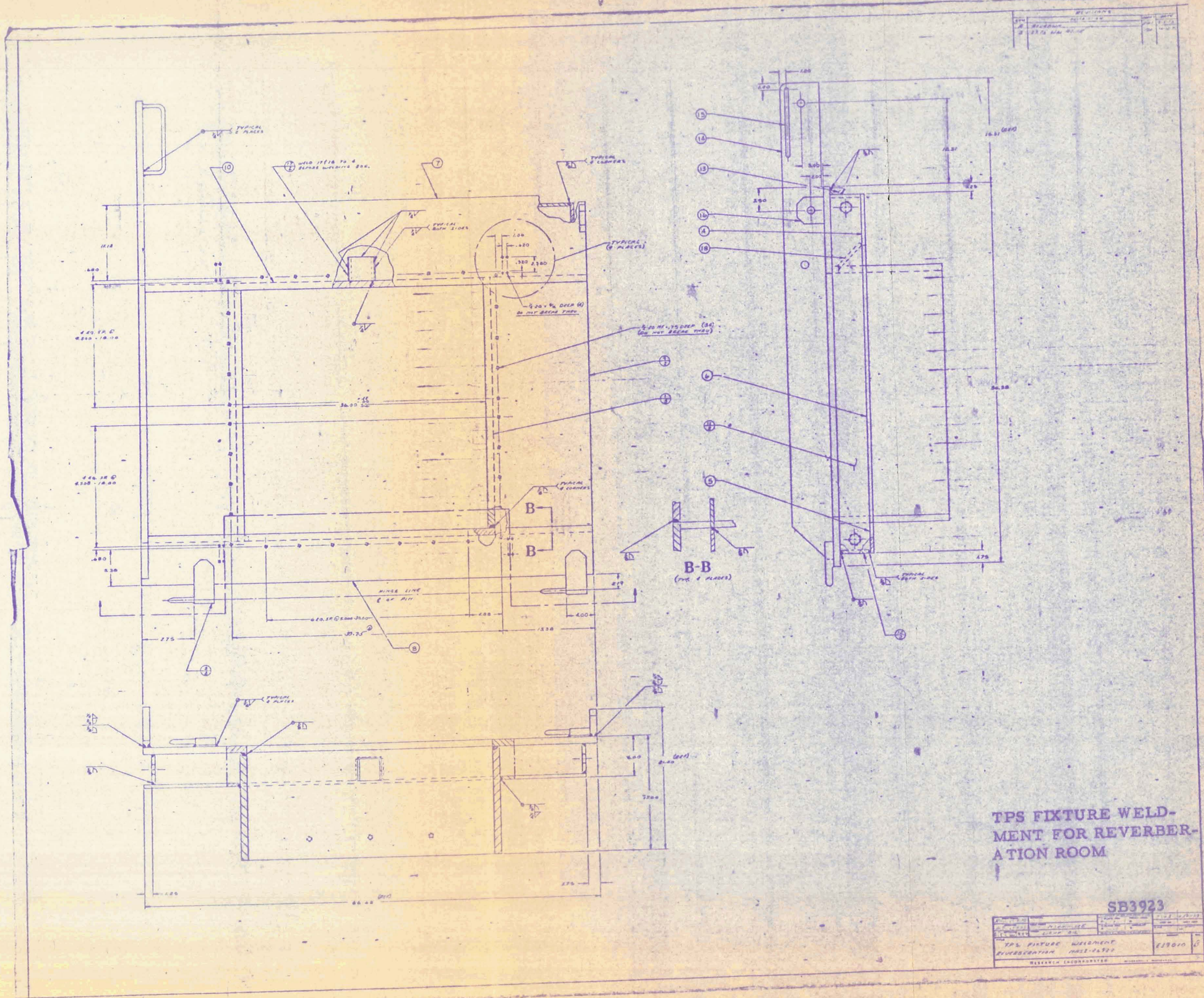

3"x3" OPENING IN WALL FOR INSTRUMENTATION LEADS
UP
A
A
HINGE LINE
A-A
TPS FIXTURE FOR
REVERBERATION
ROOM
SB3922
E39009



TPS FIXTURE WELDMENT FOR REVERBERATION ROOM