AD

Research and Development Technical Report

ECOM–01604–F

FOR

SHELTER, ELECTRICAL EQUIPMENT S-250 (XE-2)/G

FINAL REPORT

NOVEMBER 1967

BY

ERNEST DI PAOLO

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UNITED STATES ARMY ELECTRONICS COMMAND · FORT MONMOUTH, N.J.

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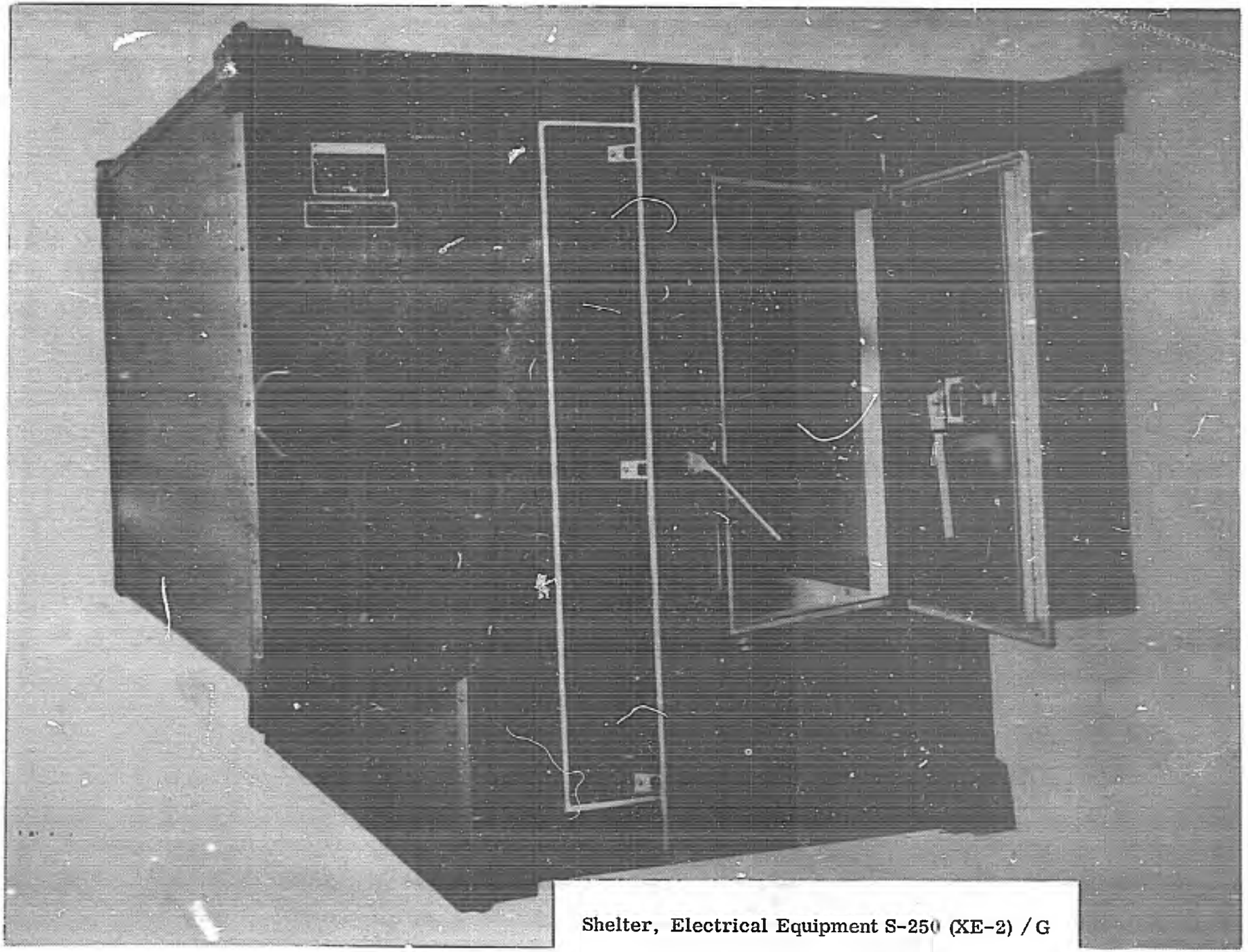

Shelter, Electrical Equipment S-250 (XE-2) / G

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FIGURES

1. Purpose - The purpose or aim of this contract was to design, develop, and environmentally test a new shelter employing lightweight construction and having RFI capability of 60 db attenuation in the frequency range from 150 KC to 10,000 MC, capable of being transported by the newly developed 1-1/4 ton M-561, M-715 and XM-705 vehicles. Additionally, Government format manufacturing drawings were to be prepared and used for the fabrication of procurement models of the S-250(XE-2)/G Shelter.

The tasks, as originally contemplated, were as follows:

a. Craig design effort (layout and initial design).

b. Preparation of Craig manufacturing drawings for one Advance Development Model

c. Fabrication of Advance Development Model No. 1.

d. Preparation and submission of running set of drawings.

e. Testing of Advance Development Model No. 1.

f. Fabrication of twelve each Advance Development Models (No. 2).

g. Fabrication of four each Procurement Models.

h. Submission of final set of drawings.

1.1 Craig Design Effort - The initial Craig design effort began on June 30, 1965, calling for a release to manufacturing by July 20, 1965. The design parameters for the S-250(XE-2)/G were contained in Specification SCL-4608A. The design parameters were similar to those contained in SCL 4608 which was the criteria document from which Craig originally designed the S-250 Shelter on Contract No. DA-36-039-AMC-03749(E) in 1963. That shelter utilized a foamed-in-place construction for the core material. Specification SCL-4608A contained three critical design areas. These areas were:

a. Weight of 600 lbs. maximum.

b. RFI Shielding requirement of 60 db attenuation with no protrusions inside the shelter.

c. The use of slab polyurethane foam in lieu of foamed-in-place.

1.2 Preparation of Craig Manufacturing Drawings - The Craig design effort employed many of the features developed under Contract No. DA-36-039-AMC-03749(E), thereby aiding the timely release of drawings for the fabrication of Advance Development Model No. 1.

1.3 Fabrication of Advance Development Model No. 1 - On July 21, 1965, Craig submitted a list of hard-to-obtain material items for which approval to procure was requested from the Contracting Officer. This was approved via telegram on August 25, 1965, and the fabrication of the Advance Development Model No. 1 began, calling for the shelter to be ready for testing on October 8, 1965, with the testing to be completed by November 8, 1965.

During this period of performance Modification No. 1 to the contract was made calling for additional mounting provisions in the door end panel of the shelter.

1.4 Preparation and Submission of Running Set of Drawings - The Craig effort to prepare a running set of drawings began on August 24, 1965, calling for submission at the time that the Advance Development Model No. 1 Shelter was submitted for testing (October 8, 1965).

On September 16 and 17, 1965, representatives from Fort Monmouth visited Craig Systems for the purpose of reviewing progress for the running set of drawings. Due to an unanticipated delay, Craig indicated that only one-half of the drawings would be available on October 8 and the balance would be available on October 14 and 15. Actual shipment of the complete set of running drawings was accomplished on October 21, 1965.

1.5 Testing of Advance Development Model No. 1 - Actual testing of the Advance Development Model No. 1 began on October 9, 1965, and was completed on November 18, 1965. The unit was refurbished and ready for shipment on November 24, 1965.

On December 14, 1965, Craig was notified by the Contracting Officer's Technical Representative that the test results of the Advance Development Model No. 1 had been evaluated and that it had been determined that the test results did not sufficiently demonstrate compliance with the technical requirements in the following areas:

a. Structural strength of the knee panels.

b. Wall and floor insert test requirement.

c. Dimensional tolerance

d. Weight

As a result of these comments, Craig was informed that Advance Development Model No. 1 was not acceptable and that the unit be resubmitted for testing. This letter also indicated, for information only, that action was being initiated to incorporate three changes having to do with the thermal barriers, ability of the door to withstand additional static and dynamic requirements, and the requirement for flatness and squareness of panels. This letter also informed Craig that these three changes would be incorporated into the Advance Development Model No. 1 Shelter to be resubmitted for testing.

On January 11, 1966, Amendment No. 2 to Specification SCL 4608A was received by Craig Systems. This specification change increased the allowable weight from 600 to 650 lbs. and incorporated the three anticipated changes mentioned above.

On January 21, 1966, Craig Systems submitted its response to the changes noted in Amendment No. 2 to SCL 4608A.

On January 26, 1966, a meeting was held at Fort Monmouth with representatives of Craig Systems, DCASR-Boston, and USAEC personnel to discuss the status of the contract and in particular, Craig's proposal of January 21, 1966. As a result of this meeting, Craig was requested to submit a proposal on or before 2 February 1966 encompassing the agreements reached during the meeting at Fort Monmouth on 26 January 1966.

As a result of the several meetings and negotiations, Modification No. 4 to the contract was issued. This modification modified the technical and delivery requirements of the contract and in summary, provided for the following:

a. Acceptance by Fort Monmouth of Advance Development Model No. 1 as submitted.

b. Preparation of a new Advance Development Model containing all the changes previously discussed. The new Advance Development Model would be known as Item 2a. This unit would be subjected to a complete test program as had been conducted on Advance Development Model No. 1.

The balance of 11 units of Item 2 would now be known as Advance Development Models and would not be subjected to a complete test program. The technical requirements were also modified as a result of the negotiations.

The delivery schedule was revised calling for the new Advance Development Model to be completely tested by 20 June 1966.

During the manufacture of this unit, a change in the wheel-well dimensions of the shelter was made and Modification No. 6 was issued revising the width of the shelter and increasing the allowable weight to 670 lbs. Since some of the panels were obsoleted as a result of this change it was necessary to fabricate additional parts and revise the delivery of the Advance Development Model to 25 September 1966.

The new Advance Development Model was subjected to testing beginning 20 July 1966 through August 31, 1966, with the COTR informing Craig that the Advance Development Model (2a) was acceptable and that authorization to begin fabrication of Item 2b was granted.

1.6 Fabrication of Twelve Each Advance Development Model (No. 2) - Based on Modification No. 4 to the Contract the twelve Advance Development Models were changed to two separate items, Item 2a-Advance Development Model (tested unit) and eleven each Advance Development Models. The fabrication of the eleven units known as Item 2b was authorized and the units were released to manufacturing to be manufactured in accordance with running set of drawings.

1.7 Fabrication of Four Each Procurement Models - Based on the acceptance of Item 2b, authorization was granted to fabricate the four procurement models which were fabricated in accordance with the running set of drawings. One of these four units was subjected to a limited testing program which proved satisfactory after a retest of the Drop Test portion of the testing program.

1.8 Submission of Final Set of Drawings - The final set of drawings were submitted on 30 June 1967, completing the Craig effort under Contract No. DA-28-043-AMC-01604(E).

2. Abstract - Electrical Equipment Shelter S-250(XE-2)/G is an aluminum lightweight shelter fabricated of aluminum outer and inner skins with polyurethane slab insulation bonded to the aluminum skin to form a sandwich panel approximately

1-1/2" thick. Aluminum hat members within the panels provide mounting for equipment. The door is provided with a door within a door. The inner door provides a means of escape from the inside.

The S-250 Shelter weighs 670 lbs. and has a payload capacity of 1900 lbs. when transported by 1-1/4 ton vehicles.

The development of the S-250 Shelter was accomplished under Contract No. DA-28-043-AMC-01604(E) issued on 30 June 1965. Under this contract an Advance Development Model was designed and successfully tested. The configuration of this accepted unit was the basis for the preparation of a complete set of manufacturing drawings suitable for reprocurement. These drawings were further used for the actual fabrication of procurement models. The final set of drawings was submitted to USAEC on 30 June 1967.

The major accomplishments under this development contract were the successful design of a light weight, high strength-to-weight ratio, RF shielded shelter capable of withstanding worldwide environmental conditions. The S-250 Shelter was type classified STD "A" on 27 April 1966.

3. Reports - There follows herein Craig Test Report No. 010-B describing the testing and results of testing conducted on the Advance Development Model S-250(XE-2)/G Shelter, Contract Item 2a.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT NO. 010-B

Work Order 6010

INTRODUCTION

Testing of the S-250 shelter at Craig Systems' facility began July 25, 1966 and was completed August 30, 1966. Testing was performed on a shelter produced under Item 2a of Contract DA-28-043-AMC-01604(E).

Witnessing either part of all of the tests were:

1. Joseph Roma, Project Engineer, R&D Directorate, USAECOM
2. Ken Maloon, Prod. & Procurement Directorate, USAECOM, Shelter Branch
3. Walter Andersen, QAR-DCASR, Boston
4. Fred Christopher, QAR-DCASR, Boston
5. Robert S. Smith, Director of Quality Control, Craig Systems Corporation
6. Richard M. Corsetti, Project Engineer, Craig Systems
7. Webster Brown, Test Engineer, Craig Systems

All applicable charts, graphs, and data sheets are attached to the individual test report that they cover. Included is an index of the individual tests.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST INDEX W.O. 6010

Test Report Number	Test Name
010-B-1	Adhesion Shear Strength Test
010-B-2	Water Absorption Test
010-B-3	Cylinder Impact Test
010-B-4	Tensile Test (Specimen Tests)
010-B-5	Moisture Resistance Test
010-B-6	Heat Transfer Test
010-B-7	High Temperature Test
010-B-8	Low Temperature Test
010-B-9	Railroad Transport
010-B-10	Sling Drop
010-B-11	Skid Bearing Test
010-B-12	Three-Point Support
010-B-13	Flat & Rotational Drop Tests
010-B-14	Towing Test
010-B-15	Lifting Test
010-B-16	Deep Fording Test
010-B-17	Roof Test
010-B-18	Door Test
010-B-19	Lifting Eyes Test
010-B-20	Towing Eyes Test

Craig Systems, Inc.
LAWRENCE, MASS.

QUALITY CONTROL DEPARTMENT

TEST INDEX W.O. 6010

Test Report Number	Test Name
010-B-21	Folding Steps Test
010-B-22	Wall Insert Test
010-B-23	Floor Insert Test
010-B-24	Lift and Tiedown Assembly Test
010-B-25	Watertightness Test
010-B-26	Shielding Effectiveness Test

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-1

1. **TITLE:** Adhesion Shear Strength Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 4, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2, dated Dec. 9, 1965

4. **REQUIREMENT:** Specification Paragraph 4.1.1
A typical panel section, one (1) foot square shall be provided in order that the shear strength test can be performed. The test shall be performed by placing the panel section in a tensile testing machine with one of the aluminum skins attached to one (1) set of testing machine jaws and the other skin attached to the other set of jaws. The bonding area between the outer skin and the core material shall have a minimum shear strength of 10 psi. The test shall be to destruction, with the rate of application of load constant at one (1) inch per minute maximum. The plane of failure shall be entirely within the core material.

5. **EQUIPMENT REQUIRED AND USED:**

Craig Test Fixtures
Dillon Dynamometer 0 to 5,000 pounds
Model L, Serial No. AN3579
Date of Calibration - Aug. 1, 1966

6 **TEST RESULTS:** Specimen Dimensions
Length - 12 inches
Width - 12 inches
Thickness - 1.5 inches
Shear Area - 144 sq. in.
Load at Failure - 1475 lbs.
Shear Strength (psi) - 10.24

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-1

7. **CONCLUSION**: The specimen met the requirement of this test.

Reported by: W. J. Brown

Approved: W. J. Brown

Quality Control R. S. Smith

Engineering P. Corsetti

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-E-2

1. **TITLE:** Water Absorption Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed July 28, 1966 through Aug. 2, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2, dated Dec. 9, 1965

4. **REQUIREMENT:** Specification Paragraph 4.1.2
A sample of core material one-foot square and three inches thick shall be weighed to within .01 pounds and then shall be subjected to 98% relative humidity for 120 hours. At the completion of this test, the core material shall be weighed and shall not have gained more than 0.1 pounds of water.

5. **EQUIPMENT REQUIRED:** Craig Laboratory Humidity Chamber
Dry and Wet Bulb Thermometers
Scales: Harvard Trip balance by Ohaus Scale Corp.
Calibrated 7/15/66

6. **TEST RESULTS:**

Date Exposure Started - 7/28/66, 8:20 a.m.
Initial Specimen Weight - 240.5 grms
Date Exposure Ended - 8/2/66
Final Specimen Weight - 284.0 grams
Total Exposure (hours) - 120
Moisture Absorption - .096 lbs.

Attached are checks made on R.H. during the test.

7. **CONCLUSIONS:** The test specimen met the requirement of this test.

Reported by: W. J. Brown
W.J. Brown

Approved by:
Quality Control R. S. Smith

Engineering

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-3

1. **TITLE:** Cylinder Impact Test
S-250(XK-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 10, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2, dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.1.3)
A 24-inch square specimen of both the wall and roof construction, having no support from internal structural member, shall be subjected to impact as follows: A 70-pound steel cylinder three inches in diameter and hemispherical at one end shall be dropped vertically 30 inches so that the hemispherical end of the weight strikes the center of the outer skin of the section on a horizontal plane. The specimen shall be supported along its four edges by a framework backed by concrete. The frame shall be made of four pieces of 2 inch by 4 inch (nominal) lumber, rigidly bolted together to form a square 24 inches on a side (outside dimension), 4 inches (nominal) high, so that the frame rests on the 2 inch (Nominal) faces. The panel specimens shall have the four edge surfaces bound with skin material and shall be bolted to the frame with a minimum of two 1/4 inch diameter bolts per edge.

5. **EQUIPMENT:** Craig Test Frame
Craig Test Structure (sling and instant release hook)
Steel Cylinder (70 pounds including 3 in. dia. polished hemispherical nose piece)

6. **TEST RESULTS:**

Weight of ram - 70 pounds
Drop distance - 30 inches

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-3

6. **TEST RESULTS** (Continued):

Inspection after test

Panel #1 (wall)	Panel #2 (roof)
Outer skin - no fracture	No fracture
Inner skin - no deformation	No deformation

7. **CONCLUSIONS**: The specimens met the requirements of this test.

Reported by: W. J. Brown
W.J. Brown

Approved by:

Quality Control R.S. Smith

Engineering: R. Corsetti

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-4

1. **TITLE:** Tensile Test (Specimen Tests)
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 15, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2, dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.1.4)
If, in the construction of the shelter, bonding is employed to join skins to other skins, to structural members, or to thermal barriers, this test shall be performed. A sample lap joint consisting of two one-inch strips of aluminum (typical of those gauges used as skins), overlapped one-half inch shall be prepared, bonded together with the same bonding material, of the same proportions, as that employed in the construction of the shelter. This sample shall be tested in a tensile testing machine. The test shall be performed at an ambient temperature of $68^{\circ} \pm 2^{\circ}F$. The adhesive shall have a minimum shear strength of the fully-cured adhesive of 1400 psi.

5. **EQUIPMENT REQUIRED:**

1. Detroit Testing Machine
Model PT Serial No. 1711
Date of Calibration - 7/11/66

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-4

6. TEST RESULTS:

Adhesive Identification: 1C30820/V 140
Curing Condition: Similar to panels
Sample Description: As required
Conditioning: 14 days at R.T.

Specimen No.	Load at Failure Lbs.	Test Temp. F.
1	720	R.T. 75
2	850	"
3	800	"
4	800	"
5	850	"

Ave. - 804
PSI - 1608

7. CONCLUSION:

The specimen met the requirements of this test.

Reported by: W. J. Brown
Approved by: W. J. Brown
Quality Control R. S. Smith
Engineering R. M. Corsetti

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-5

1. **TITLE:** Moisture Resistance Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed July 25, 1966 through August 6, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2, dated Dec. 9, 1965
MIL-STD-170(Sig C) dated 12/20/54

4. **REQUIREMENT:** (Specification Paragraph 4.3.2.2)
Moisture Resistance -
   a. Dry at 130° ± 5°F for 24 hours.
   b. Condition at 77° ± 5°F and 40 to 50 percent relative humidity for 24 hours.
   c. Subject to continuous cycling for five 48-hour cycles. Temperature, relative humidity, and period of time for each portion of the cycle shall conform to MIL-STD-170.
   d. After cycling has been completed, condition the equipment for 24 hrs. at 77°±5°F and 40 to 60 percent relative humidity. There shall be no visible evidence of damage or malfunction of doors, latches, and hinges at the completion of this test.

5. **EQUIPMENT REQUIRED AND USED:**
Craig Environmental Test Chamber #1774 (Front section only used. Rear section was partitioned and sealed off from the front section.)
Bristol Controller Model TE-2T500FFFS2-1A
Calibration date 7/15/66.

6. **PROCEDURE:**

6.1 Moisture Resistance

6.1.1 Condition the equipment for 24 hrs. at room ambient conditions.

6.1.2 Install the shelter in Test Chamber #1774 and subject it to five continuous 48 hour cycles. Temperature, relative humidity, and period of time for each portion of the cycle shall conform to MIL-STD-170.

6.1.3 After cycling has been completed, condition the equipment for 24 hours at room ambient conditions.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report No. 010-B-5

7. **TEST RESULTS:** Shelter doors were operated, panels were sounded and visual tests were made following each 48 hour cycle and at the end of the test.

There was no evidence of damage to the shelter or malfunction of the doors, latches, hinges, hardware, etc.

8. **CONCLUSION:** The shelter met the requirements of this test.

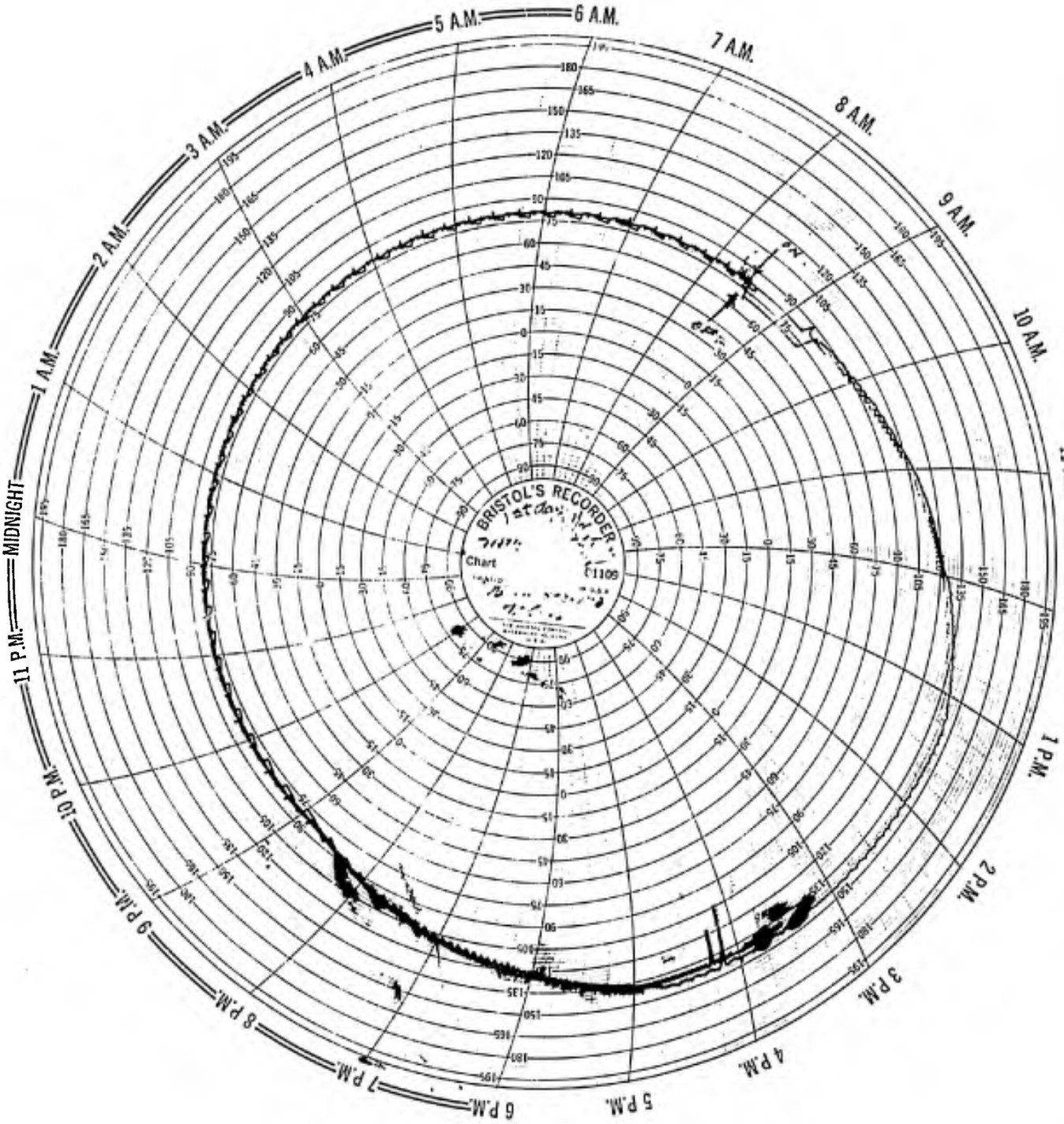
Data sheets and charts #01109, as provided by the Bristol Controller Recording Equipment, are attached A time-log of operations, notes, etc. was also kept.

Reported by: W. J. Brown
W. J. Brown

Approved by:

Quality Control R. S. Smith

Engineering R. Calcott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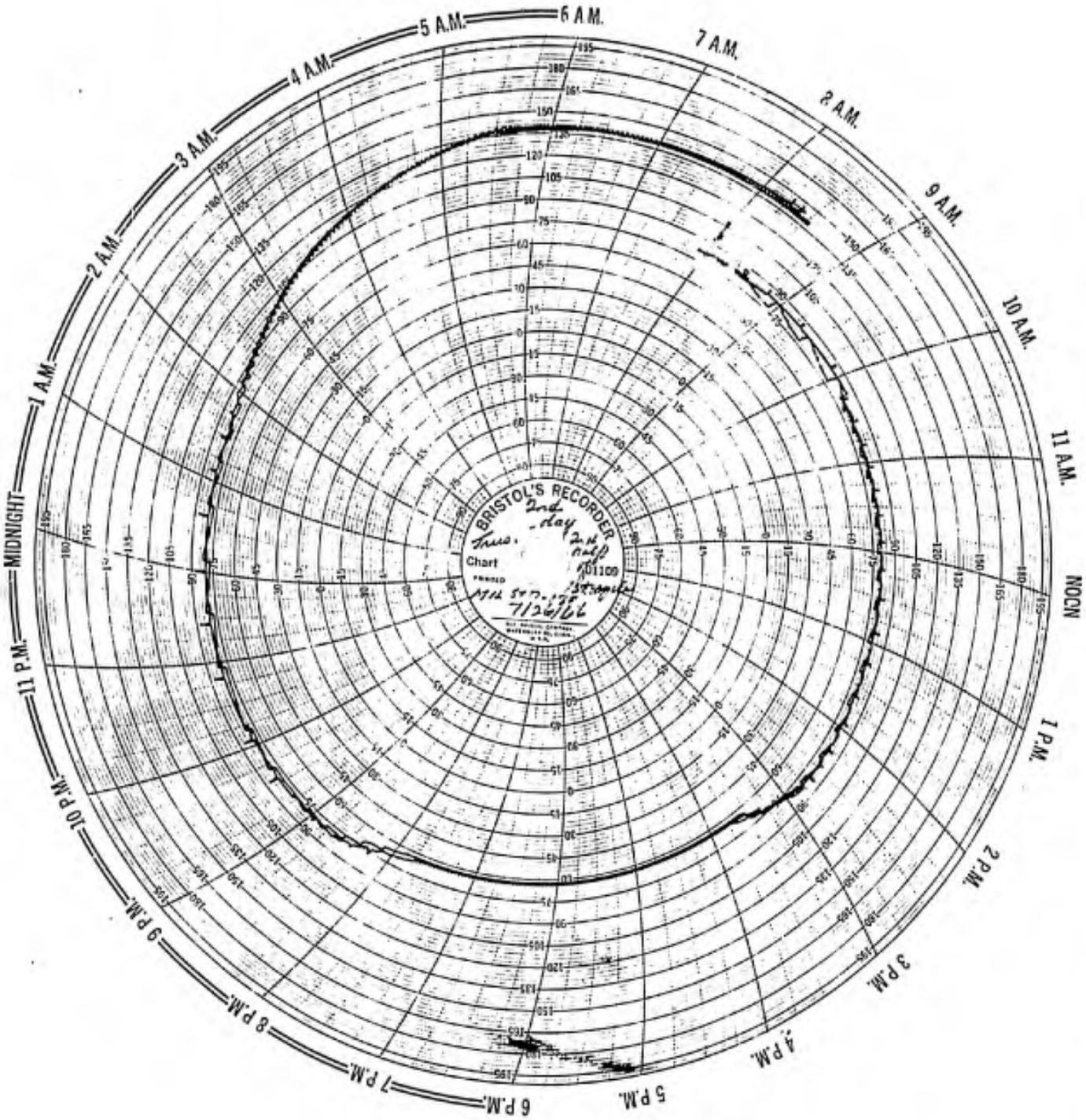
BRISTOL'S RECORDER
Chart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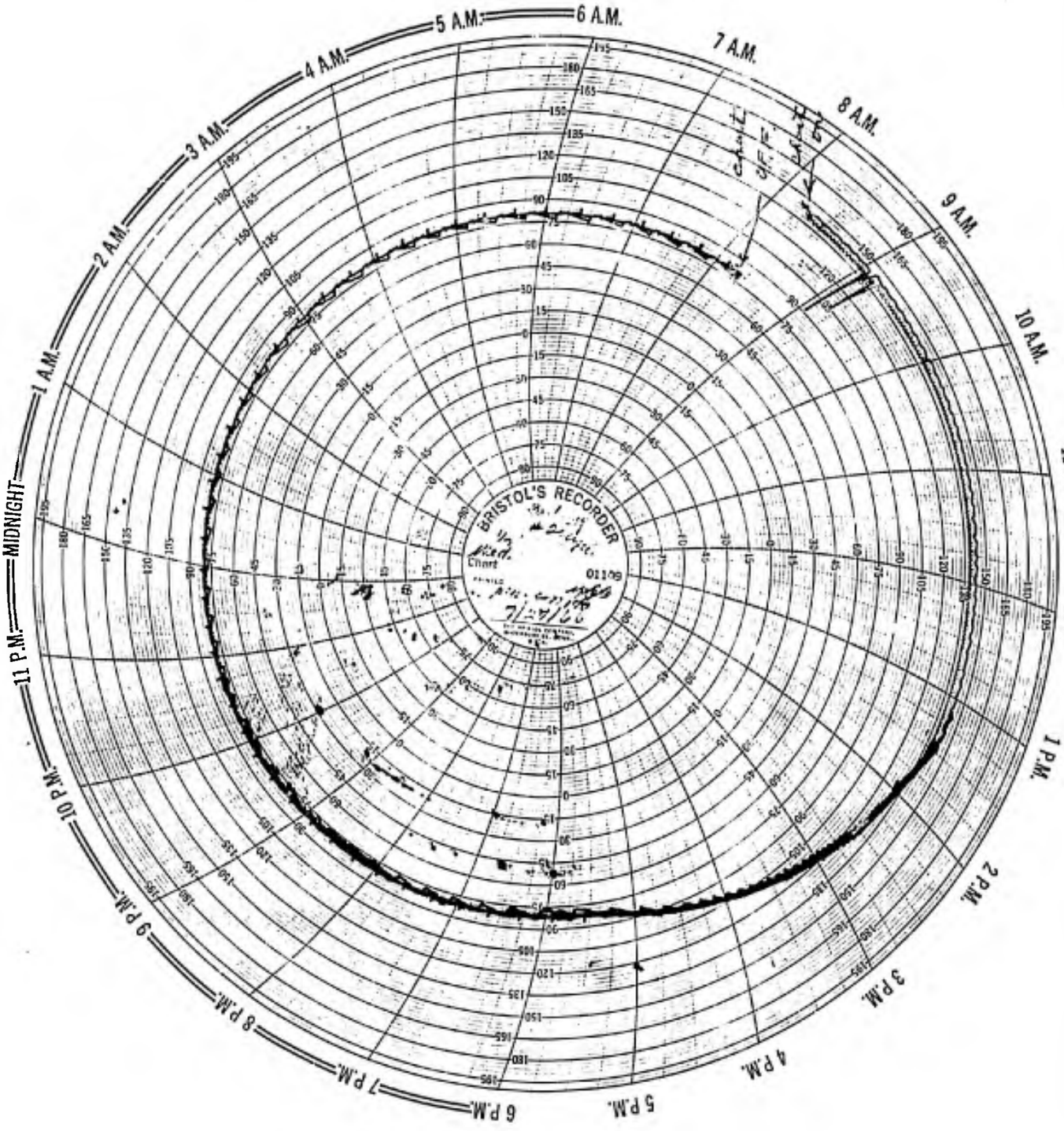
BRISTOL'S RECORDER
Chart
7/26/66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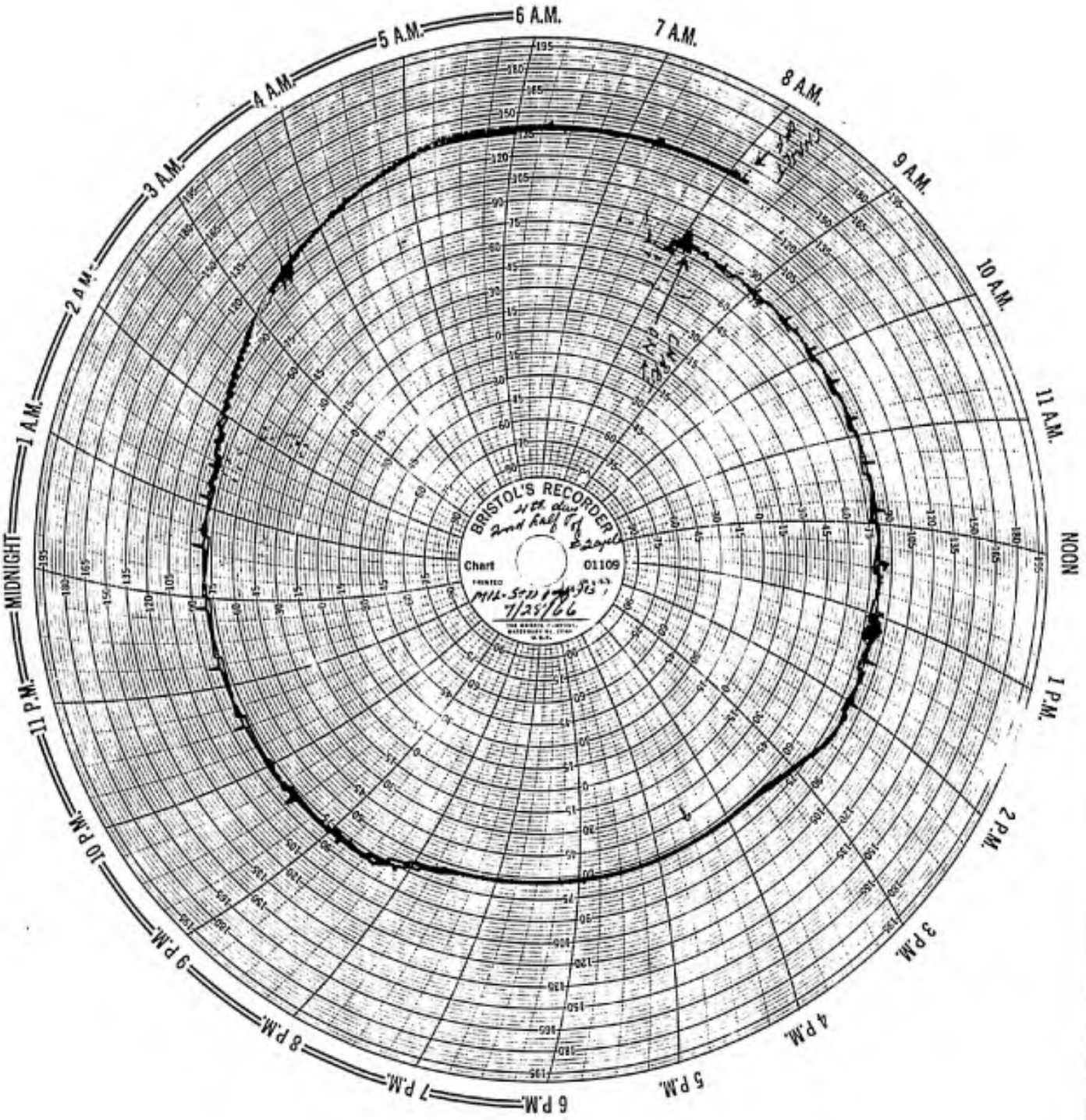
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BRISTOL'S RECORDER
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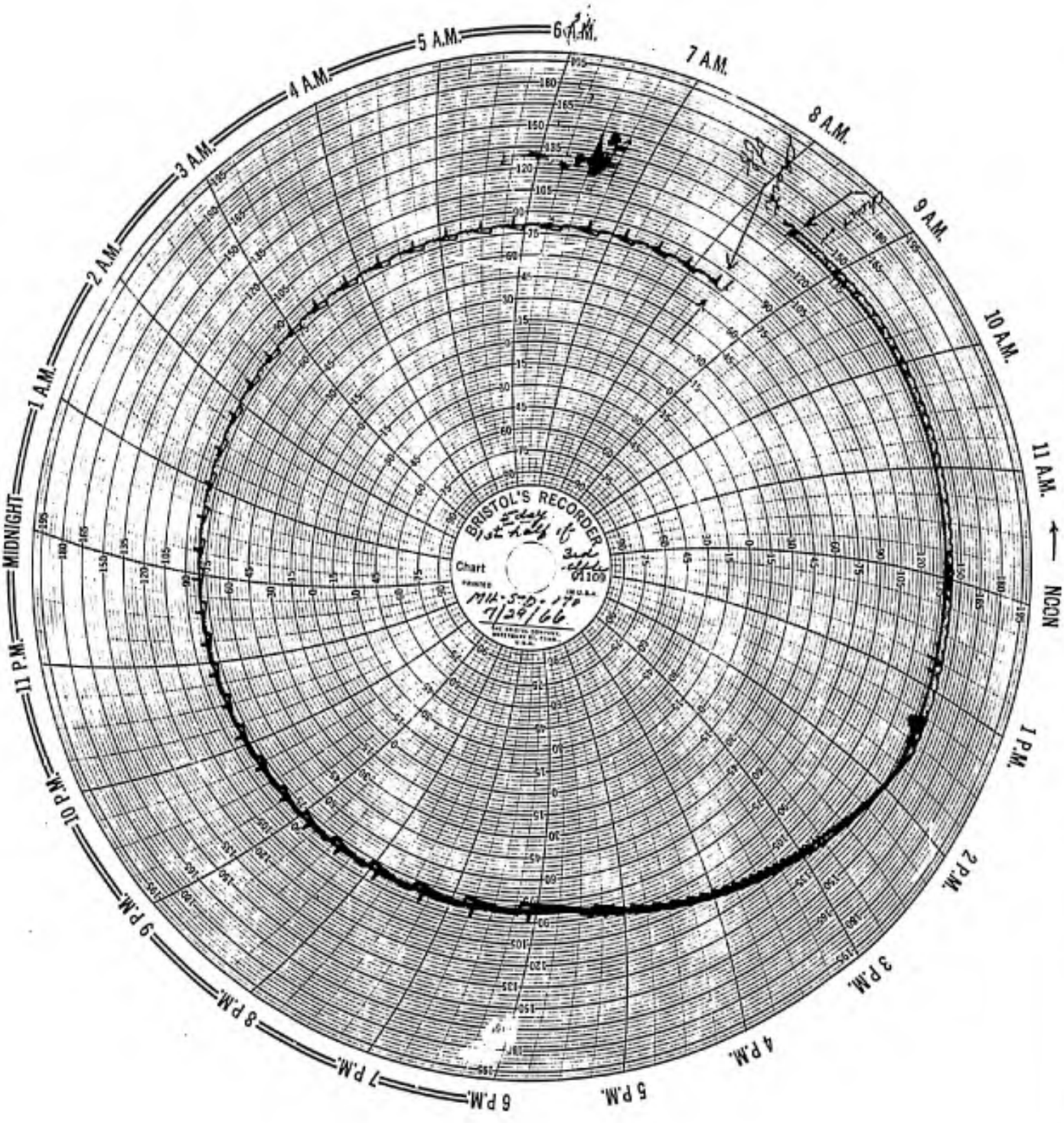
01109
7/25/66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BRISTOL'S RECORDER
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MU-5-D-170
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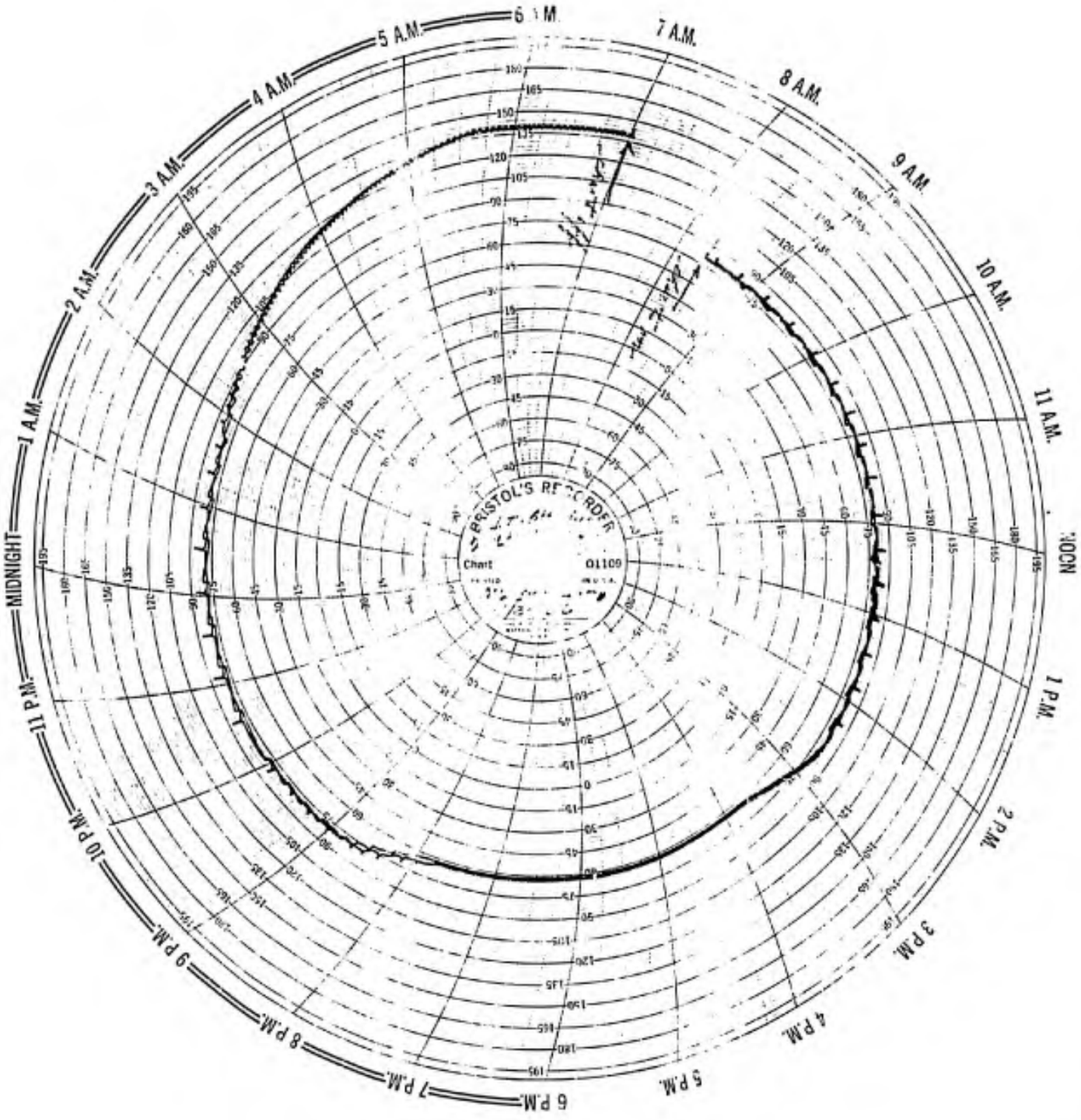
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BRISTOL'S RECORDER
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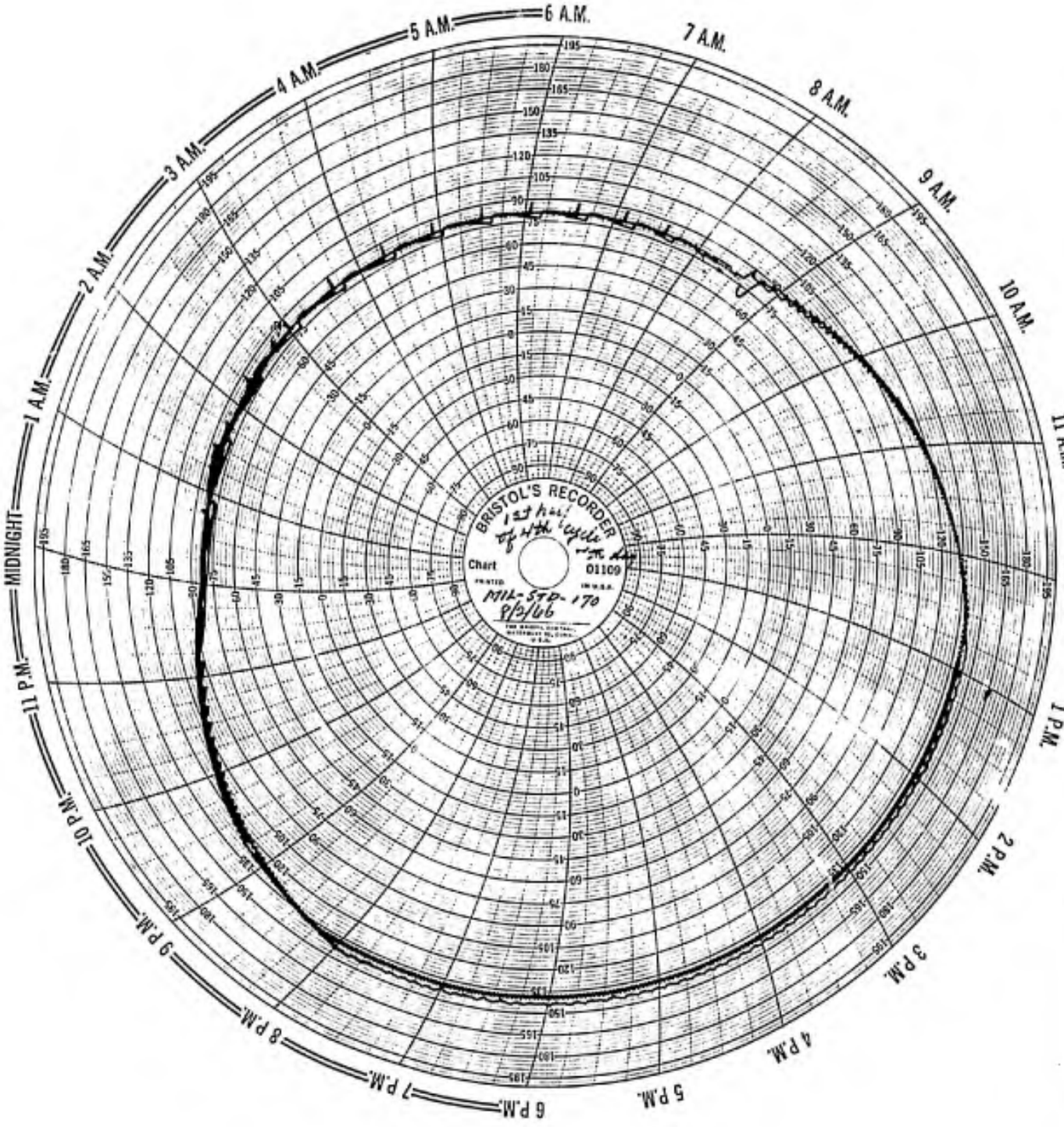
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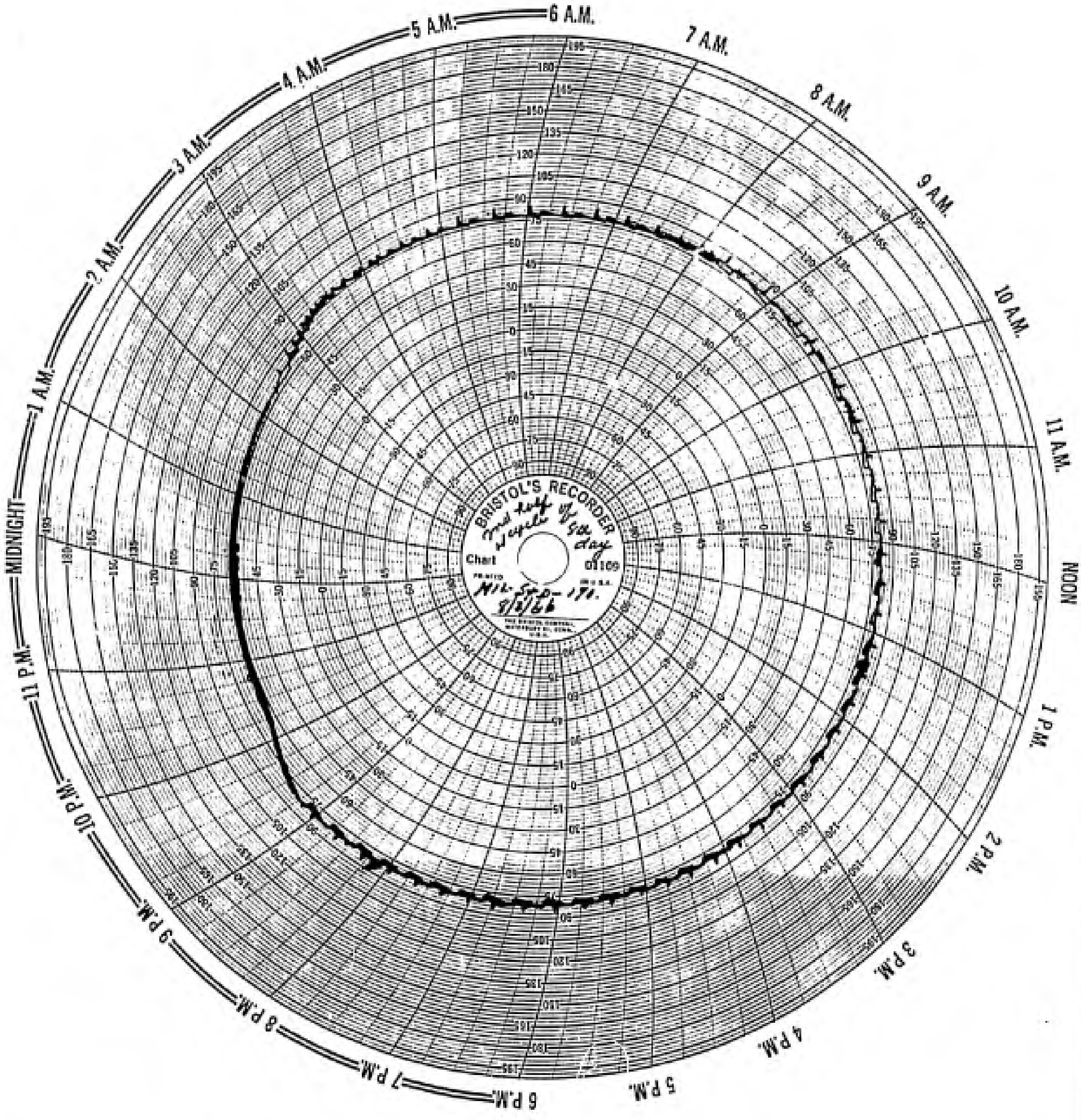
BRISTOL'S RECORDER
Chart
01109
MIL-STD-170
8/3/66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10 A.M.
11 A.M.
NOON
1 P.M.
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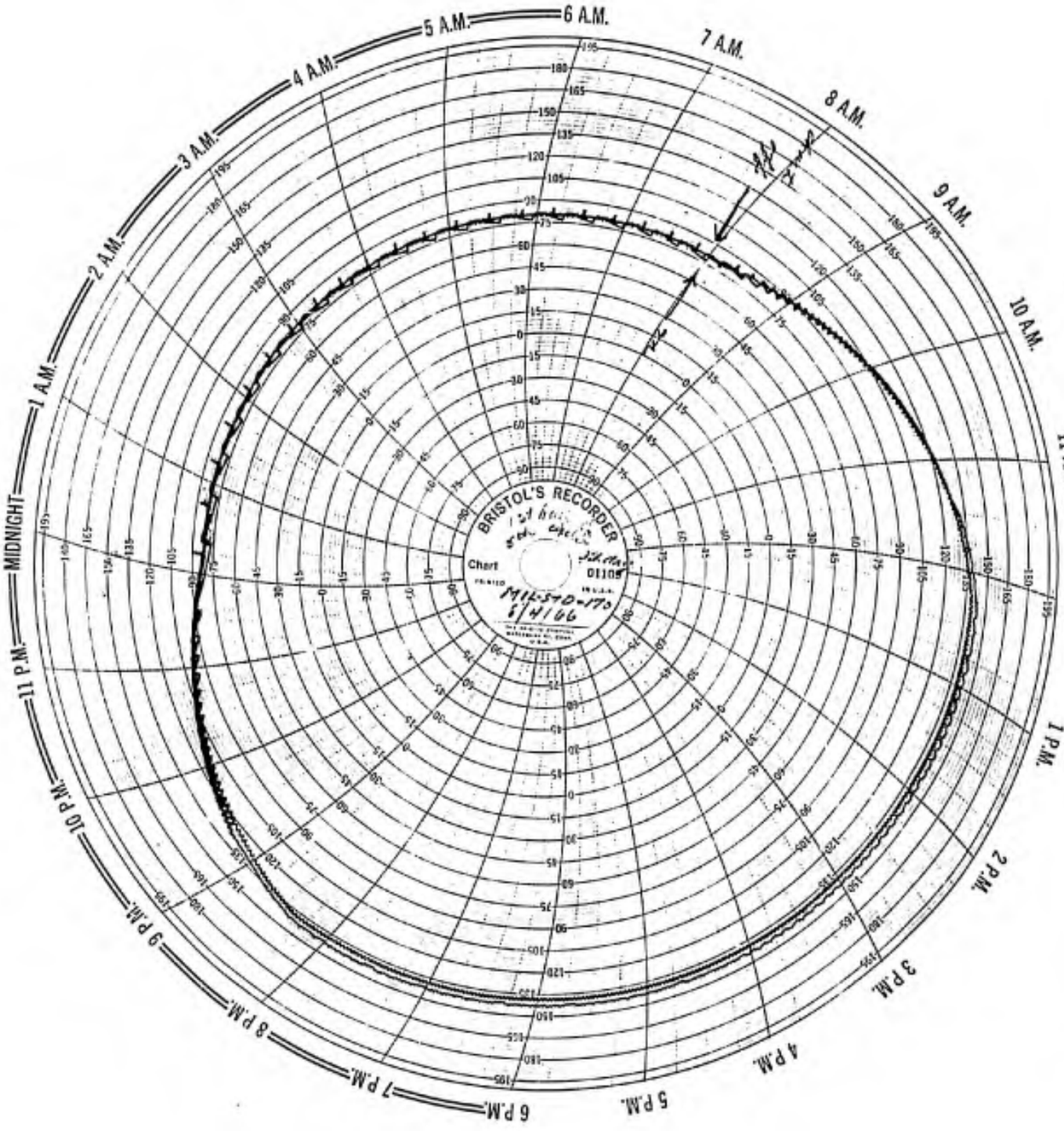
BRISTOL'S RECORDER
Chart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9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
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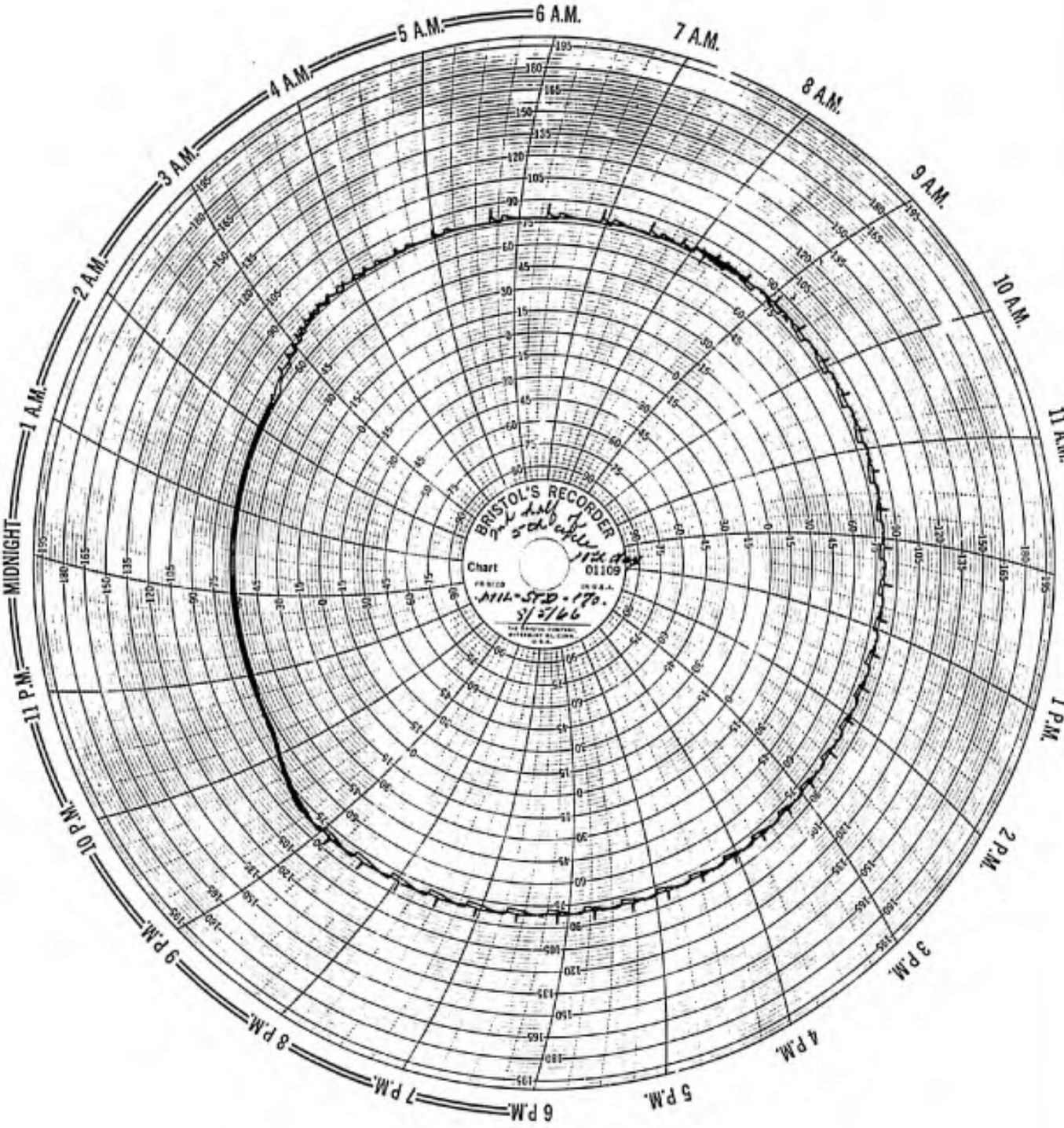
BRISTOL'S RECORDER
Chart
MIL-STD-1775
6/4/66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7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
BRISTOL'S RECORDER
Chart
01109
MIL-STD-170.
5/5/66

ATTACHMENT TEST REPORT #010-B-5

Environmental Test (Moisture Resistance)

Date	Time	Remarks
7/25/66	9 a.m.	Test started. (CO_2 tank read 11,200#) Distilled water bottle filled.
"	10 a.m.	Dry bulb reading 94°F. Wet bulb reading 93°F.
"	11:30 a.m.	Dry bulb reading 118°F. Wet bulb reading 117°F.
"	11:50 a.m.	Heat #2 toggle switch put on.
"	12 p.m.	Dry bulb 126°F. Wet bulb 125°F.
"	12:45 p.m.	Dry bulb 138°F. Wet bulb 136°F.
"	2:10 p.m.	Dry bulb 146°F. Wet bulb 143°F.
"	3:15 p.m.	Dry bulb 145°F. Wet bulb 142°F.
"	4 p.m.	Dry bulb 146°F. Wet bulb 142°F.
"	4:30 p.m.	Auto. heat #1 and #2 switches off.
7/26/66	8:15 a.m.	Check showed chamber operated OK during night. (changed chart) Checked steam boiler (operating OK). Checked CO_2 (vol. 10,200# pressure 295) - OK
"	9 a.m.	Dry bulb 83°F. Wet bulb 81°F.
"	10 a.m.	Dry bulb 82°F. Wet bulb 81°F.
"	12:30 p.m.	Dry bulb 82°F. Wet bulb 81°F.
"	3:40 p.m.	Dry bulb 64°F. Wet bulb 63°F.
"	4:20 p.m.	Auto. heat #1 put on.
"	4:25 p.m.	Dry bulb 64°F. Wet bulb 63°F.
7/27/66	8:05 a.m.	Night operation OK, changed chart and put auto. heat switch #2 on.
"	8:10 a.m.	Checked steam boiler, was OK.
"	8:25 a.m.	Checked CO_2 (vol. 9400#) pressure 290 - OK.
"	8:30 a.m.	Dry bulb 144°F. Wet bulb 141°F
"	10:10 a.m.	Dry bulb 144°F. Wet bulb 141°F.
"	11 a.m.	Cramer Min. Meter Reading - 290.4
"	1:30 p.m.	Auto. heat switches #1 and #2 turned off
"	3:10 p.m.	Dry bulb 117°F. Wet bulb 114°F.
"	4:15 p.m.	Dry bulb 100°F. Wet bulb 98°F.
"	4:17°p.m.	CO_2 check OK; boiler check OK.
7/28/66	8:05 a.m.	Boiler check OK.
"	8:10 a.m.	CO_2 check OK. (Vol. 8,000#. Pressure 295 - OK)
"	8:15 a.m.	Chart changed. (Test chamber operating OK)
"	8:30 a.m.	Cramer Min. Meter Reading 488.8
"	9:30 a.m.	Dry bulb 81°F. Wet bulb 79°F.
"	11 a.m.	Dry bulb 81°F. Wet bulb 80°F.
"	12:50 p.m.	Entered chamber and checked shelter. (Sounding tests and straight edge tests on panels) All tests OK.

Date	Time	Remarks
7/28/66	3:30 p.m.	Dry bulb 66°F. Wet bulb 66°F.
"	3:30 p.m.	Boiler check OK.
"	4:25 p.m.	Auto. heat switch #1 put on.
7/29/66	8:10 a.m.	Auto. heat switch #2 put on.
"	8:11 a.m.	Chart changed. (Test chamber operating OK)
"	8:12 a.m.	Dry bulb 143°F. Wet bulb 141°F.
"	8:45 a.m.	CO_2 check OK. (Vol. 7200#) Pressure 290 - OK.
"	10:30 a.m.	Dry bulb 143°F. Wet bulb 140°F.
"	12:45 p.m.	Resealed dry and wet bulb chamber.
"	1:30 p.m.	Auto. heat switches #1 and #2 turned off.
"	2:45 p.m.	Dry bulb 124°F. Wet bulb 121°F.
"	2:45 p.m.	Cramer Min. Meter Reading 609.2
"	3:30 p.m.	Boiler check OK.
"	4:25 p.m.	Dry bulb 98°F. Wet bulb 95°F.
7/30/66 (Sat.)	8:10 a.m.	Changed chart. Test chamber operated OK during the night.
"	8:20 a.m.	Boiler check OK.
"	8:25 a.m.	CO_2 check OK (Vol. 5850, pressure 300)
"	8:30 a.m.	Cramer Min. Meter Reading 801.0
"	8:35 a.m.	Opened chamber and checked shelter - OK.
"	8:40 a.m.	Dry bulb 82°F. Wet bulb 81°F.
"	9:45 a.m.	Dry bulb 81°F. Wet bulb 80°F.
"	7:15 p.m.	Dry bulb 63°F. Wet bulb 62°F.
"	7:45 p.m.	Auto. heat switch #1 turned on.
	7:45 p.m.	Checked boiler, CO_2 tank - Both OK.
7/31/66 (Sun.)	7:00 a.m.	Removed chart.
	7:05 a.m. to	Shut down test at end of 3rd cycle. Shut off steam boiler, CO_2 tank and opened chamber and
"	7:15 a.m.	shelter doors.
"	7:20 a.m.	Cramer Min. Meter Reading 924.2
"	7:20 a.m.	CO_2 tank showed vol. 5,000, pressure 295.
	7:20 a.m.	Immediate visual inspection of shelter showed: 1. No moisture, condensate inside, no bulging of panel skins inside or outside. Coin test sounded good - OK.
8/1/66	8:20 a.m.	Rechecked shelter condition after 24 hours of room conditioning. Found it to be OK. Interior of panels and exterior had not been harmed.

Date	Time	Remarks
8/2/66	8:05 a.m.	Boiler started.
"	8:10 a.m.	CO_2 valve turned on. Vol 5,000#, Pressure 295
"	8:25 a.m.	Steam line bled of condensate.
"	8:35 a.m.	Steam valve to chamber opened. 1 turn plus 1 notch on wheel.
"	8:40 a.m.	Controllers turned on, circulating fan put on, new chart on and 4th cycle of test started. Checked wet bulb for saturation of cotton sleeve. Auto. heat 1 and CO_2 A1 toggle switches put in on position. Closed shelter doors and test chamber doors prior to starting test.
"	8:55 a.m.	Cramer Min. Meter Reading - 925.5
"	9:20 a.m.	Test proceeding satisfactory.
"	9:22 a.m.	Dry bulb 93°F. Wet bulb 92°F.
"	10:55 a.m.	Dry bulb 117°F. Wet bulb 116°F.
"	12:30 p.m.	Heat #2 toggle switch put on.
"	1:20 p.m.	Dry bulb 144°F. Wet bulb 141°F.
"	3:30 p.m.	Dry bulb 145°F. Wet bulb 141°F.
"	8 p.m.	Auto. heat #1 and heat #2 switches off.
8/3/66	8 a.m.	Changed chart. Dry bulb 81°F. Wet bulb 79°F.
"	8:15 a.m.	Checked boiler and CO_2 supply, both OK. CO_2 Vol. 3850, Pressure 295
"	8:50 a.m.	Opened chamber and checked shelter. Coin and straight edge check OK. Visually shelter was OK all over.
"	9:35 a.m.	Opened humidity control box and checked saturation of cotton sleeve.
"	11:00 a.m.	Dry bulb 82°F. Wet bulb 81°F.
"	12:45 p.m.	Dry bulb 81°F. Wet bulb 81°F.
"	2:30 p.m.	Dry bulb 81°F. Wet bulb 80°F.
"	3:30 p.m.	Cramer Min. Meter Reading 1116
"	4:10 p.m.	Dry bulb 81°F. Wet bulb 81°F.
8/4/66	8:05 a.m.	Auto. heat #1 toggle switch turned on.
"	8:15 a.m.	Checked boiler and CO_2 supply OK.
"		CO_2 tank filled this a.m. Reading 12,100# Cramer Min. Meter Reading 1225.8
"	9:25 a.m.	Dry bulb 98°F. Wet bulb 97°F.
"	10:50 a.m.	Dry bulb 120°F. Wet bulb 119°F.
"	11:20 a.m.	Heat #2 toggle switch put on.
"	2:00 p.m.	Dry bulb 143°F. Wet bulb 140°F.
"	4:00 p.m.	Dry bulb 144°F. Wet bulb 141°F. Heat #2 toggle switch turned off.

Date	Time	Remarks
8/5/66	8:05 a.m.	Auto. heat #1 toggle switch off.
"	8:10 a.m.	Checked boiler and CO_2 supply - OK. CO_2 Vol. 11,200# Pressure 290
"	8:50 a.m.	Dry bulb 82°F. Wet bulb 80°F.
"	11:00 a.m.	Dry bulb 81°F. Wet bulb 79°F.
"	1:00 p.m.	Cramer Min. Meter Reading 1402.0
"	3:30 p.m.	Dry bulb 83°F. Wet bulb 81°F.
8/6/66	8:00 a.m.	Dry bulb 83°F. Wet bulb 81°F.
"	8:05 a.m.	Shut test down and opened chamber and shelter doors.
"	8:10 a.m.	CO_2 Vol. 10,300#, Pressure 295
"	8:15 a.m.	Shelter inspected. Coin sound test OK; straight edge test OK. Moisture inside shelter - None Cramer Min. Meter Reading - 1520.2

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-6

1. **TITLE:** Heat Transfer Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 8, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.2.3)
Heat Transfer - The shelter shall be placed in a temperature controlled room which shall maintain a constant temperature environment of -40°F outside the shelter. An electrical heat source which has sufficient power to maintain a stabilized temperature inside the shelter of not less than 100°F above the outside temperature shall be placed in the shelter. Air circulation shall be sufficient to provide temperature uniformities inside and outside the shelter within 5°F, as measured by thermocouples placed as specified by the COTR. Under the conditions, the electrical power input shall equal the heat loss, and the average inside and outside temperatures and the inside area of the shelter shall be used in calculating the overall coefficient of heat transfer which shall be no greater than 0.40 BTU per hour per square foot per degree Fahrenheit.

5. **EQUIPMENT REQUIRED AND USED:**

Craig Environmental Test Chamber #1774 (front section only, partitioned off from rear section)
Bristol Controller (Model TE-2T500FFFS2-1A)
Calibration dated 7/15/66
Leads and Northrup Double Range Potentiometer Indicator Model 8657-C
Craig Thermocuple Switch Panel
12 Copper-Constantan Thermocouples
2 heaters - Chromalox Model #6 (3000 watts each)
Kilowattmeter - Weston Model 432
Percentage timer - Cramer Model 610E-60S
Craig Wiring Harness and Control Panel

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-6

6. PROCEDURE:

6.2 Heat Transfer Test

6.2.1 Install the shelter in Test Chamber #1774 and connect the following equipment:

(1) Locate six copper constantan thermocouples inside the shelter on the side walls a minimum of 12" from any surface as shown in Figure 2.

(2) Locate four copper constantan thermocouples outside the shelter on the side walls a minimum of 6" from any surface as shown in Figure 2.

(3) Wire the above thermocuples to the switch panel and connect the switch panel to the potentiometer indicator. An icewater bath may be used for the reference junction.

(4) Install two Chromalox heaters inside shelter and connect with wiring harness through switch panel and kilowattmeter to 120 volt AC supply as shown in Figure 1.

(5) Calculate inside area of shelter and record on data sheet page 11.

(6) Insulate and seal all openings to prevent circulation of air from inside to outside of the shelter.

6.2.2 Reduce chamber temperature to -40°F in three hours. During and after pulldown, monitor temperature inside shelter and maintain at 65°F.

6.2.3 Maintain chamber temperature at -40°F and shelter inside temperature at 65°F until no further change in electrical power input is required to produce these conditions.

6.2.4 Take four temperature readings at 15 minute intervals and record on data sheet. Record the power input at each interval.

6.2.5 Average the recorded temperatures and calculate the Ufactor in the space provided.

7. TEST RESULTS:

$U = 0.314$ Btu/Hr/°F/Ft^2

Crane Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

Test Report #010-B-6

8. **CONCLUSION**: The shelter met the requirements of this test.

Legend:

U - Overall heat transfer factor in Btu/Hr/Sq. Ft/°F
W - Power Input in Watts
.293 - Conversion Factor in Watt hours
△T - Temperature Differential in °F
A - Inside area of shelter in sq. ft.

Data sheets and chart #01109, as provided by the Bristol Controller Recording Equipment, are attached along with diagrams showing the heater and thermocouple junction locations.

Reported by: W. J. Brown
W. J. Brown

Approved by:

Quality Control R. S. Smith

Engineering P. M. Cronin

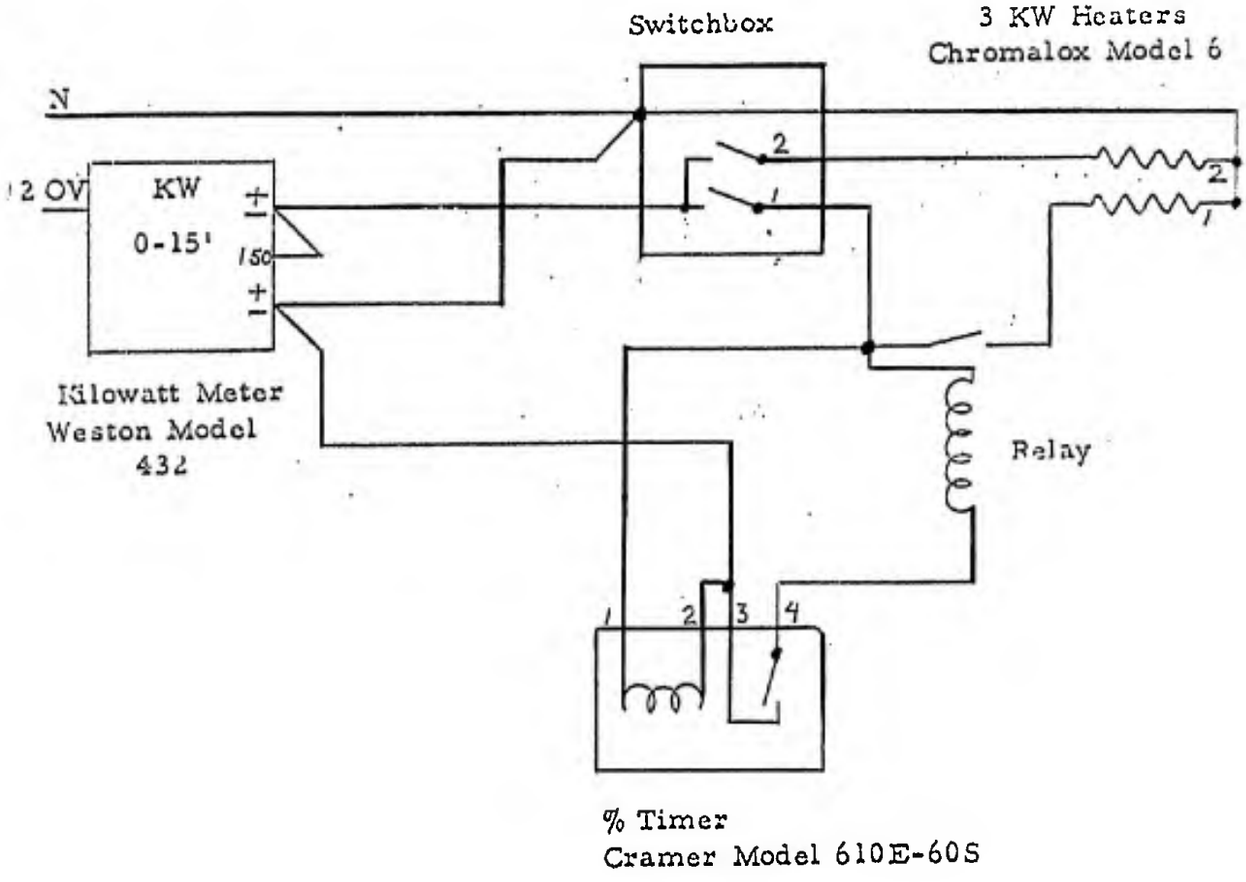
Craig ES 278

FIGURE 1

HEATER WIRING DIAGRAM

FOR

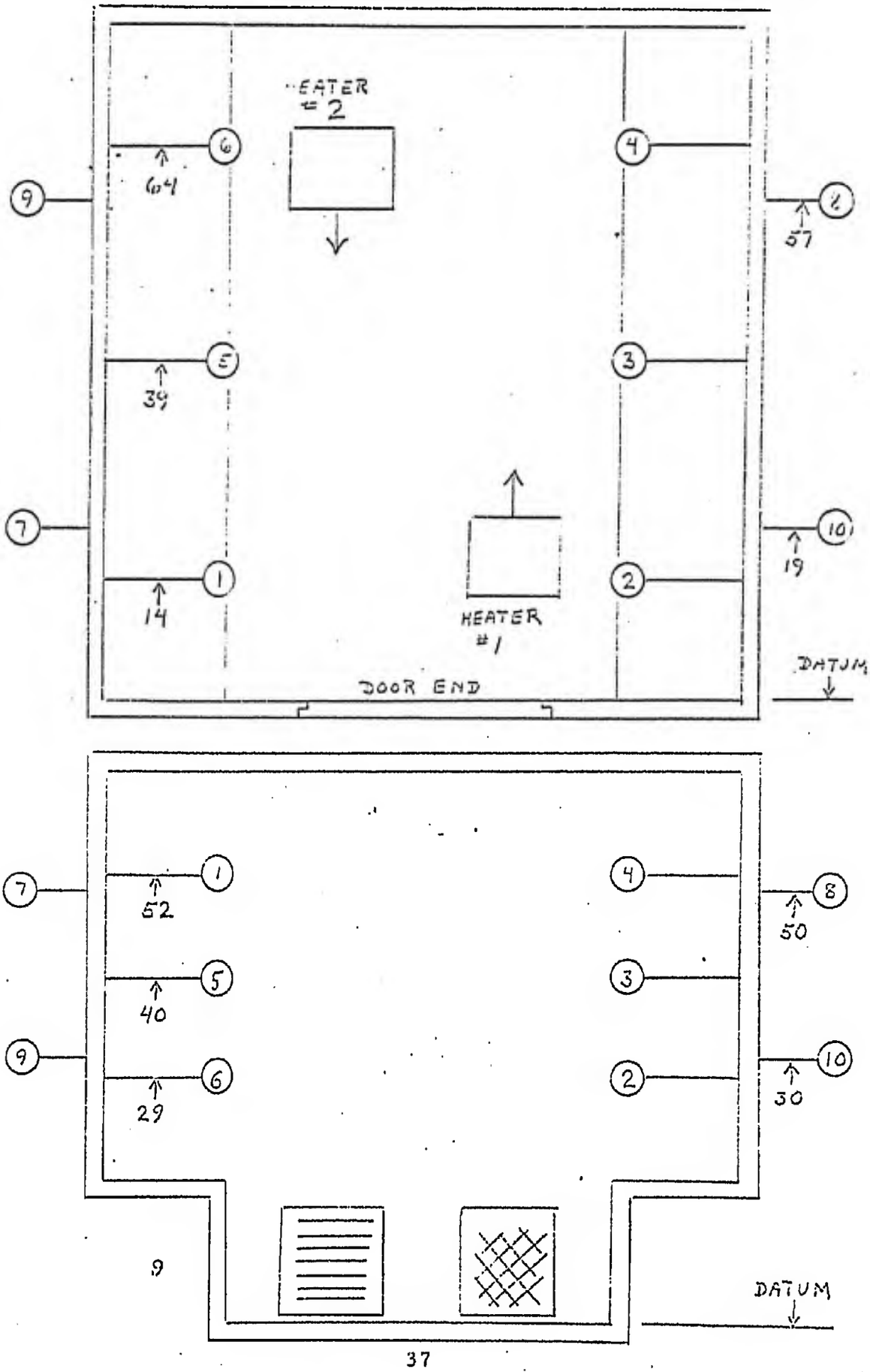
HEAT TRANSFER TEST



Craig ES 278

FIGURE 2

THERMOCOUPLE LOCATIONS
for
HEAT TRANSFER TEST



HEAT TRANSFER TEST

TEST DATA SHEET NO. 1

TEMPERATURES RECORDED

Date	Time		17:45	18:00	18:15	18:30		
			OUTSIDE					
	Bristol		-37	to	-40			
	Thermo	7	-41	-41	-42	-39		
	Couples	8	-42	-41	-42	-39		
		9	-45	-41	-42	-39		
		10	-45	-41	-42	-39		
	Total		173	164	168	156	Total	Average
	Average		-43	-41	-42	-39	165	-41
			INSIDE					
		1	66	68	64	66		
		2	64	64	61	64		
		3	65	66	64	65.5		
		4	65	66	64	65.5		
		5	65	66	64	65.5		
		6	64.5	66	64	65.5		
	Total		389.5	39.6	38.1	392.0	Total	Average
	Average		64.9	66.0	63.5	65.3	259.7	64.9

TEMPERATURE DIFFERENTIAL=

Watts	2140	2140	2140	2140	8560	2140

$$U = \frac{W}{.293 \times A \times T}$$

$$U = \frac{2140}{.293 \times 220. \times 105.9}$$

$$U = 0.314$$

U = Overall heat transfer factor in BTU/HR/^{o}F/FT^{2}
W = Power Input in Watts
.293 = Conversion factor in watt hours
T= Temperature differential in F
A = Area of shelter in Ft^{2}

SOLAR RADIATION CHECK

DATA SHEET NO. 2

Measurement No.	Millivolts	Location
1	16.0	Under lamp
2	16.2	Under lamp
3	14.8	Under lamp - outer bank
4	13.8	Between lamps
5	11.5	Between lamps
6	12.9	Between lamps
Total	85.2	
Average	14.2 x 25.42 = 360.96	BTU/Hr/Ft^2

WIND VELOCITY CHECK

DATA SHEET NO. 3

Measurement No.	Ft/Min
1	655
2	665
3	500
Total	1820
Average	606.6

Shall not exceed 616 ft/min (7 MPH)

ENVIRONMENTAL TEST DATA SHEET

Para. 4. 2 Heat transfer Test.

DATE – 8.8.60 – SPEC. [illegible] W.O. [illegible]

Start ↘ 2 10 P.M. 2280 watts – 2200 w [illegible]

TIME	17:15		17:30		17:45		[illegible]		18:15		18:30					
DRY BULB	–39		–39		–39		–37		–39		–39					
WET BULB																
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1	.80	69	.8	69	.75	66.	.78	68	.70	64.	.75	66				
2	.72	65	.71	64.5	.68	64	.70	64	.63	61	.68	64				
3	.78	68	.75	66	.73	65	.75	66	.70	64.	.74	65.5				
4	.78	68	.78	68	.73	65	.75	66	.70	64.	.74	65.5				
5	.80	69	.78	68	.73	65	.75	66	.70	64.	.74	65.5				
6	.80	69	.75	66	.71	64.5	.75	66	.70	64.	.74	65.5				
7	-1.4	-37	-1.51	-42	-1.49	-41	-1.49	-41	-1.51	-42	-1.45	-39				
8	-1.43	-38	-1.50	-42	-1.51	-42	-1.49	-41	-1.51	-42	-1.45	-39				
9	-1.45	-39	-1.50	-42	-1.55	-45	-1.49	-41	-1.51	-42	-1.45	-39				
10	-1.45	-39	-1.50	-42	-1.55	-45	-1.48	-41	-1.50	-42	-1.45	-39				
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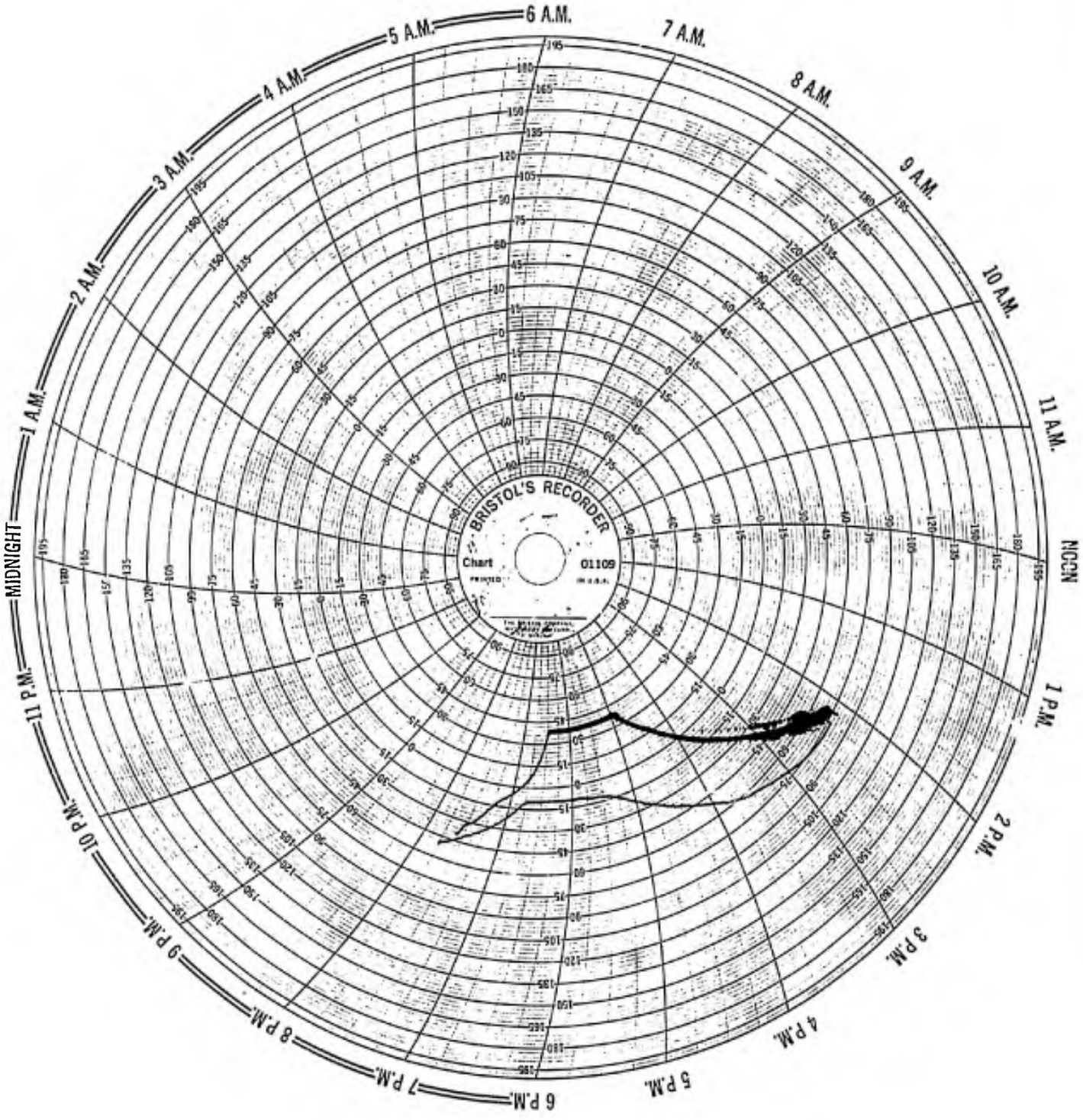
REF JCT																

(For notes see over)

CO_2 - Vol. 10,200 lbs Jr. = 290 # (2:08 PM) 8/8/66 Start

CO_2 - Vol. 5,000 " tr = 295 # (8:00 AM) 8/9/66 AM after end of test

CO_2 - used 2,200 lbs.


MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
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9 A.M.
10 A.M.
11 A.M.
NOON
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2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
BRISTOL'S RECORDER
Chart
01109

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-7

1. **TITLE:** High Temperature Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 10, 1966 through August 16, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amend. #2 dated Dec 9, 1965
MIL-STD-169(Sig C)

4. **REQUIREMENT:** (Specification Paragraph 4.3.2.4)
High Temperature - The shelter, with doors closed, shall be placed in a chamber with air maintained at 120°F to 125°F. The air shall be recirculated with a velocity not exceeding seven miles per hour in the vicinity of the shelter. After the outside shelter skin has stabilized between 120°F and 125°F, the doors and their hinges and latches shall operate freely. The full solar load shall then be applied to the roof. If the end or side walls are constructed of different composition, type, or density of core material than the roof, each different wall shall also be subjected to the full solar load simultaneously with the roof or in a separate cycling. The solar load shall be applied as rapidly as possible using at least twenty-eight number 1000T3, 230 volt bulbs (as made by G.E., Sylvania, or equal) per panel. The bulbs shall be arranged in four rows of seven bulbs each, or more as required, and shall operate within 10 percent of their rated voltage. The solar load shall be applied a period of four hours after all portions of the outside skin of the panel being tested have reached a minimum temperature of 195°F. After completion of the four-hour solar load, the air temperature shall be raised so that all portions of the inside skin shall be between 160°F to 165°F. The shelter temperature shall then be reduced as rapidly as possible to 77° ± 10°F.

The above cycle shall be repeated three times. There shall be no core growth, delamination, buckling, or deterioration of structural strength during or as a result of the testing.

TEST REPORT #010-B-7

5. **EQUIPMENT REQUIRED AND USED:**

Craig Environmental Test Chamber #1774 (Front and rear dividing partition and seal removed as entire chamber is required for High Temperature Test. Divider is re-installed for Low Temperature Test.) Calibration dated 7/15/66.
Lead and Northrup Double Range Potentiometer Indicator Model 8657-C
Craig Thermocouple Switch Panel
12 Copper-Constantan Thermocouples
Pyrheliometer, Eppley 50 Junction
Craig test stand for mounting Eppley cell
5" Biram Davis Anemometer-Super-Sensitive Wind Gauge
Craig Wiring Harness and Control Panel

6. **PROCEDURE:**

6.1 High Temperature Test

6.1.1 Thermocouple locations. Locate 10 thermocouples on the shelter roof as shown in Figure 3. Nine thermocouples to be attached to the outside skin and one to be located in the free air six inches above the roof in the geometric center and shielded from radiation. Locate two thermocouples on the inside skin on the side walls as shown.

6.1.2 Solar Loading - The solar source shall be twenty-eight 1000-T3 lamps spaced proportionately over an area of 8' x 12'. Prior to running the first cycle, the solar intensity must be checked using the following procedure:

(1) Locate the 50 junction Eppley cell with the detecting element at the height of the object undergoing test.
(2) Record readings in table as follows:
   a. Three each directly under lamps of which one shall be on an outer bank.
   b. Three each between lamps.
   c. Average the readings in the space provided. Results shall be within 10% of 360 Btu/Hr/ft^2.
(3) Place shelter in chamber with chamber doors closed. Check wind velocity as follows and record results in table.

6. **PROCEDURE:** (cont'd)

a. Locate anemometer in three random positions on the shelter roof and measure wind velocity for 60 seconds in each position.
b. Average the readings in the space provided. Results shall not exceed 616 Ft/min (7 mph).

6.1.3 Solar exposure and high temperature. Perform the solar exposure and high temperature tests as follows:

(1) Place the shelter in the rear of the test chamber clear of the solar radiation with the doors closed and the floor drain plug removed. Raise chamber temperature to 120°F to 125°F in less than four hrs.
(2) Maintain in the above condition until the shelter outside roof skin temperature has stabilized at 120°F to 125°F. After stabilization is reached, check that doors and latches operate freely.
(3) Move shelter to solar exposure location and immediately apply the full solar load of 360 Btu/Hr/Ft^2 with a wind velocity not exceeding 7 mph. Maintain this condition for four hours after the roof skin temperature has stabilized. Ambient temperature inside chamber to be 120°F to 125°F. The free air thermocouple located six inches above the roof shall be the determinant for chamber ambient temperature regulation.
(4) At the conclusion of the four hour period and while at 120°F to 125°F, return the shelter to the rear of the chamber clear of the solar radiation.
(5) Raise chamber ambient temperature to 160°F to 165°F in less than four hours and maintain in this condition until the inside skin temperature has stabilized.
(6) After the above condition has been satisfied, open the chamber door and move the shelter to ambient room conditions as quickly as possible and operate shelter doors.
(7) Maintain at room ambient conditions for a minimum of four hours.
(8) Repeat steps 1 through 7 until three cycles have been completed.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-7

7. **TEST RESULTS:** Three cycles performed of High Temperature Test. Checks made during the cycling and following each test revealed no shelter damage such as delamination of core to skin material, buckling, or deterioration of the structural strength of the shelter as a result of these tests. The doors, latches, hinges, hardware, etc. showed no malfunction, all operating freely at each test.

8. **CONCLUSION:** The shelter met the requirements of these tests.

Data sheets, charts #01109, notes, etc. as records of these tests are attached. Also included is the thermocouple junction location diagram, the Solar Radiation Check and the Wind Velocity Check.

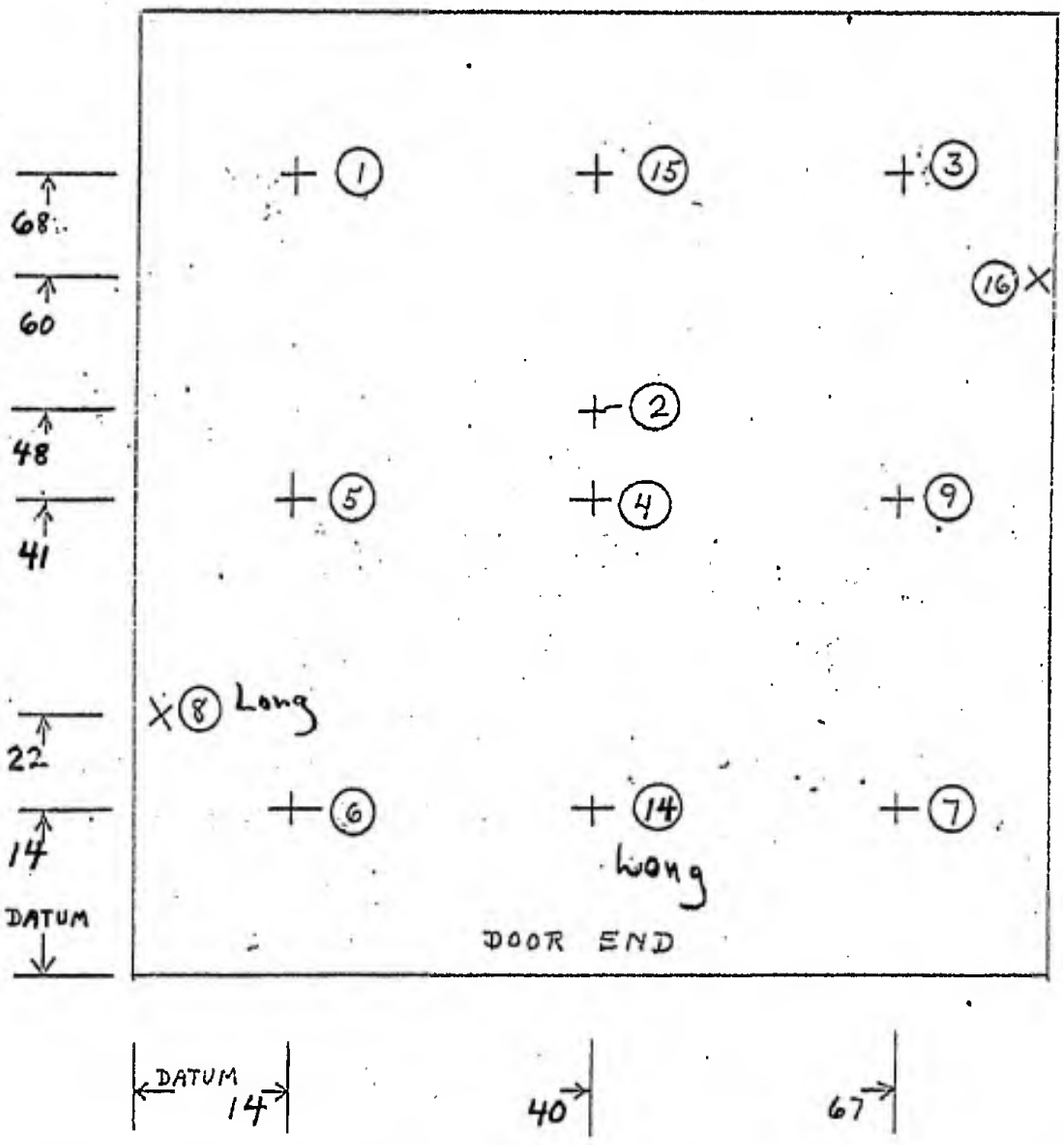
Approved by:

Quality Control R. S. Smith

Engineering F. M. Corsetti

FIGURE 3

THERMOCOUPLE LOCATIONS
for
HIGH TEMPERATURE TEST



Notes: Thermocouples #16 and # 8 to be attached to inner skin on side walls as shown 40 inches from floor.
Thermocouple #4 to be located in free air shielded from radiaton.
All others attached to outside skin on roof as shown.

ENVIRONMENTAL TEST DATA SHEET

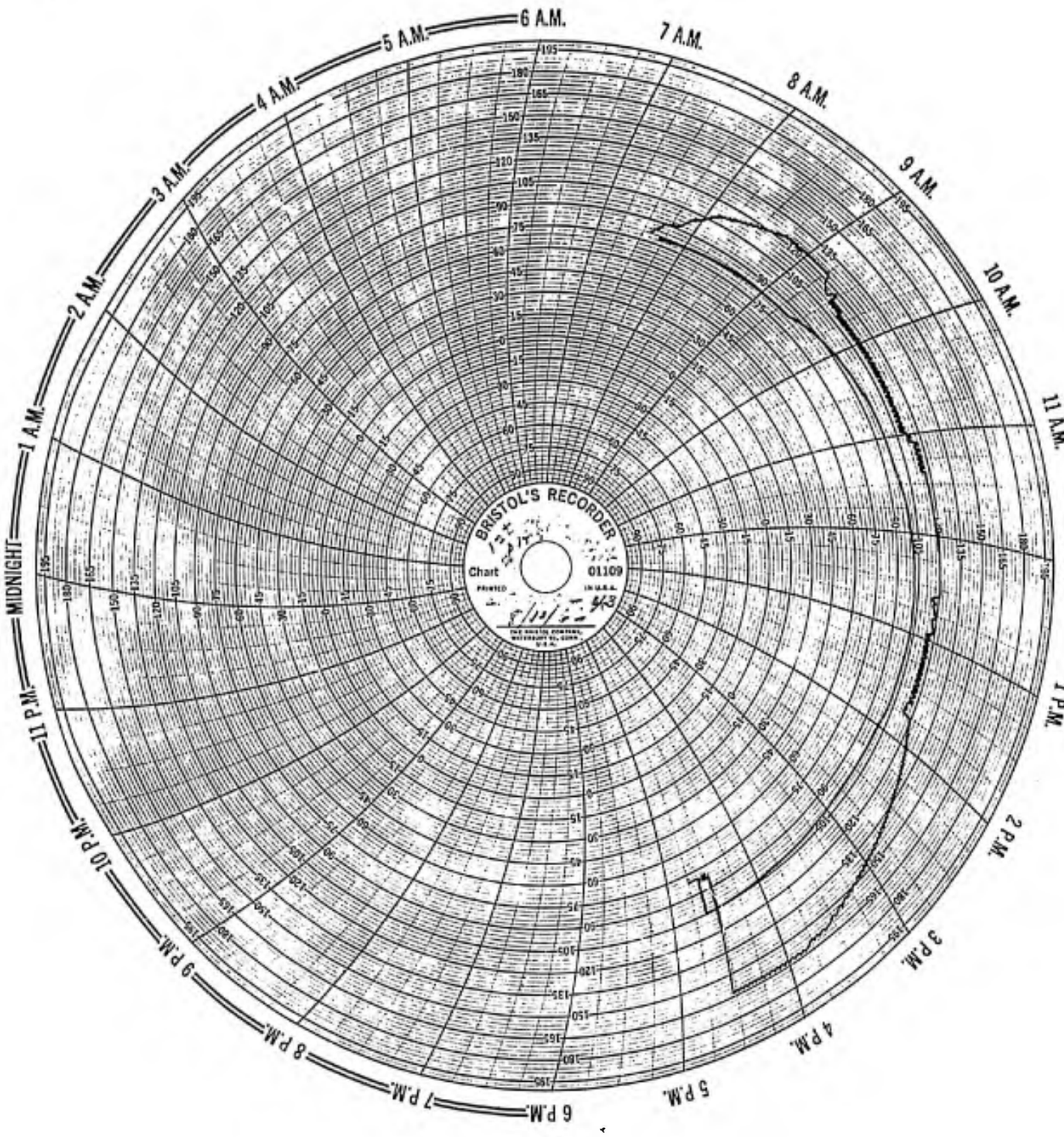
(Vol 3 ...)
4.3 High Temperature Test
ES 278

DATE 5-10-66 SPEC. SCL-1809A W.O. 6313

TIME	9:37 AM		9:52 AM		10:22 AM		11:30 A.M.		12:5 P.M.		1 ...		[illegible]			
DRY BULB	—		—		—		—		—		—		—		—	
WET BULB	—	F	—	F.	—	F.	—	F.	—	F.	—	F	—	F	—	F
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1	3.3	174.	3.38	177	3.30	174.	3.25	172	3.50	182	3.35	176.				
2	3.1	166	3.21	[illegible]	3.13	167.	3.10	[illegible]	3.30	174	3.15	168.				
3	3.16	168	3.21	170	3.18	167.	3.10	136	3.13	167	3.15	168.				
4	2.14	126	2.10	125	2.00	121.	2.00	124	2.10	125	2.05	123				
5	3.25	172	3.40	178	3.27	173.	3.30	174	3.45	180	3.30	174.				
6	3.45	180.	3.50	182	3.27	173.	3.50	182.	3.55	184	3.45	180				
7	3.35	[illegible]	3.12	167	3.00	162	3.30	170	3.10	166.	3.26	172				
8	2.00	121	2.15	125	2.05	123	2.00	121.	2.20	127.	2.15	125.	2.50	127.	2.54	153.
9	3.19	169	3.20	162	3.12	167	3.25	172	3.00	162	3.24	174.				
10																
11																
12																
13																
14	3.46	[illegible]	3.40	175.	3.50	182	3.60	186.	3.42	179	3.20	156.				
15	2.93	157	2.85	156	2.83	155	3.00	162.	3.00	162.	[illegible]	160.				
16	2.01	121	2.11	125	2.10	125	2.08	124	2.25	131.	[illegible]	129.				
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
REF TCT			1.35	[illegible]												

INSIDE (8)
INSIDE (15, 16)

[illegible] (See [illegible])


MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
BRISTOL'S RECORDER
Chart
01109

ENVIRONMENTAL TEST DATA SHEET

(2nd cycle of
4.3 High Temperature Test)

DATE 8 [illegible] SPEC. SCL-4608A W.O. 6010

Start
[illegible]

TIME 7:43 AM	9:45 AM		10:30 AM		11:15 A.M.		12:50 [illegible]		1:50 PM		3:30 [illegible]		4:[illegible]		5-2 50 [illegible] PM	
DRY BULB	—		—		—		—		—		—		—		—	
WET BULB	—		—		—		—		—		—		—		—	
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1	3.34	172	3.30	174	3.4[illegible]	17[illegible]	3.3[illegible]	1[illegible]	3.31	17[illegible]						
2	3.00	162	3.15	[illegible]	3.3[illegible]	172.	3.[illegible]2	171.	3.[illegible]	[illegible]						
AMBIENT 3	3.11	166	3.10	166	3.32	175	3.22	171	3.23	17[illegible]						
4	2.30	121	2.05	123	2.10	125	2.10	125	2.10	125						
5	3.15	168	3.[illegible]	[illegible]	3.32	1[illegible]5	3.23	175	3.[illegible]	176						
6	3.3[illegible]	174	3.4[illegible]	[illegible]	3.5[illegible]	18[illegible]	[illegible]	17[illegible]	3.52	18[illegible]						
INSIDE 7	3.2[illegible]	173.	3.40	17[illegible]	3.30	17[illegible]	[illegible]	176.	3.3[illegible]	[illegible]						
8	1.2[illegible]	11[illegible]	2.00	12[illegible]	2.1[illegible]	[illegible]	[illegible]	[illegible]	2.15	12[illegible]	2.30	133.	2.70	155	2.71	150
9	3.11	166	3.28	16[illegible]	3.23	171	3.11	16[illegible]	3.25	13[illegible]						
10																
11																
12																
13																
14	3.35	176.	3.41	178	3.54	183.	3.4[illegible]	181	[illegible]	178.						
INSIDE 15	2.90	158	2.85	156	3.[illegible]	162	2.9[illegible]	15[illegible]	[illegible]	155.						
16	1.80	117	3.06	123	2.18	128	2.18	12[illegible]	2.15	12[illegible]						
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
REF JCT	1.1	[illegible]	1.1	82.	1.08	81										

[illegible] Data — (see [illegible])

7:30 P.M. 8/16/62

	Prior to Start of test (2nd. cycle)	After 2nd cycle	
1)	CO_2 - Vol - 6100 lbs.	CO_2 - Vol = 4000 lbs.	CO_2 used = 2100 lbs.
	- P_2 - 295 lbs.	- P_2 = 890 lbs.	

2.) 9:20 A.M. Temp. control cam stopped. Temp. was 122 F.

3.) 9:30 A.M. Chamber entered + shelter moved forward to full solar load position. (door operation checked - O.K.)

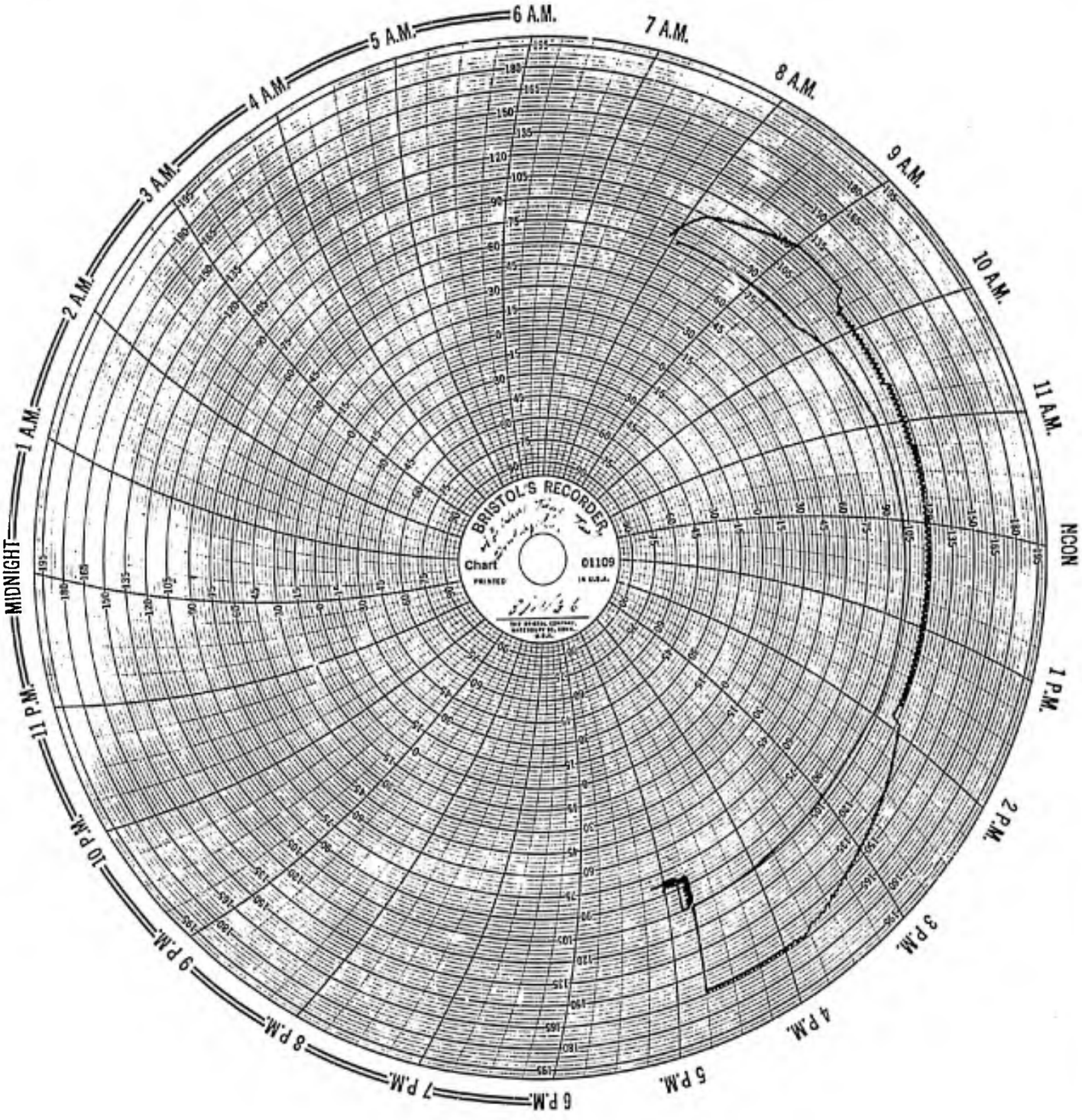
4.) 10:30 A.M. Cam moved to slightly higher temperature position.

5.) 1:46 P.M. Moved shelter to rear of chamber. CO_2 toggles off, cam started to raise ambient temperature to 160 F to 165 F.

6.) 4:20 P.M. Shut-down test. Opened chamber and removed shelter. Both shelter-doors opened. They operated satisfactorily.

#8 couple - M.V. 2.71 = 150. F.

52


6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
BRISTOL'S RECORDER
Chart
01109

ENVIRONMENTAL TEST DATA SHEET

DATE _____ SPEC. _____ W.O. _____

TIME			10[illegible] AM.		11[illegible] AM		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
DRY BULB	—		—		—		—		—		—		—		—	
WET BULB	—		—		—		—		—		—		—		—	
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1	[illegible]	164	3.31	174	3.40	178.	3.40	176.	3.35	176.						
2	2.80	154	3.20	170.	3.22	171.	3.22	171.	3.21	170						
3	3.02	163	3.20	170.	3.22	171.	3.22	171.	3.18	169						
4	2.05	123	2.10	125	2.06	123.	2.10	125.	2.05	123						
5	3.25	164	3.34	175	3.40	178.	3.36	176.	3.38	177.						
6	3.15	168	3.45	180	3.48	181.	3.36	176.	3.38	177.						
7	3.15	168	3.25	172	3.32	174.	3.36	172.	3.21	170.						
8	1.30	112	1.98	120	2.13	126.	2.16	127.	2.18	128.	2.10	125.	2.60	146.	2.61	146.
9	2.96	160	3.09	165	3.08	165	3.15	168.	3.00	162						
10																
11																
12																
13																
14	3.31	170	3.32	175	3.50	182.	3.50	182.	3.40	178.						
15	2.74	152	2.80	154	2.96	160	2.92	158.	2.93	158.						
16	1.89	112	2.00	121	2.16	121.	2.16	129.	2.20	129						
17																
18																
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20																
21																
22																
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24																
25																
26																
27																
28																
29																
30																
REF JCT	[illegible]		[illegible]		[illegible]											

CO_2 - 7.2 = 1176 A.M.
9,133 lbs.

7:30 A.M. 8/24/66
Prior to start of test (1st cycle)
1.) CO_2 Acc. = 12,250 cub.
Ps. = 300 "

After 3rd cycle
CO_2 Acc. 10,425 lbs.
Ps. 295. "

CO_2 used = 1825 lbs

2) 9:25 A.M. Temp. Control Cam stopped. Temp. was 122. F.

3) 9:30 A.M. Shelter brought forward and full solar load turned on (Manual toggles Heat #1 & Heat #2) + (CO_2 auto. #1 and #2 toggle switches put on).

4) 1:40 P.M. Full solar load shut-off. CO_2 shut-off and shelter moved to rear of chamber with long thermocouple leads #9 & #14 brought out. (Plywood shield put in position.)

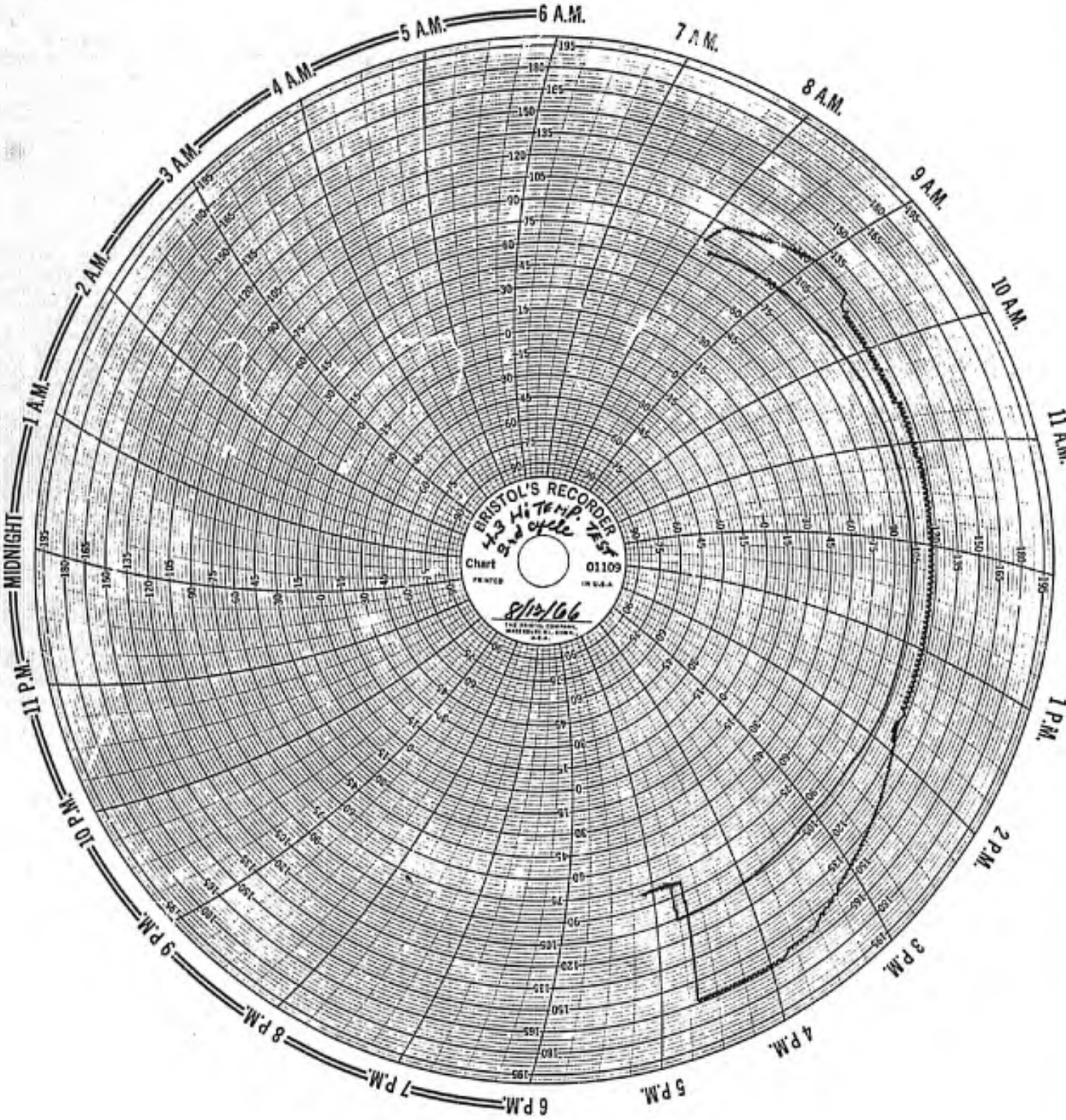
5) 1:52 P.M. Started control cam with Auto Heat #1 and Auto Heat #2 toggle switches on for temperature rise to 160 F. to 165 F.

6) 4:45 P.M. Shut test down. Opened chamber and removed shelter opened both shelter doors which operated normally.

7) 4:45 P.M. Shelter inspected by R. Smith. His verbal report was that the shelter was in very condition following the 3 test cycles of high temperature and solar exposure.

MB.

55


6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
BRISTOL'S RECORDER
43 Hi Temp. Test
2nd cycle
Chart
01109
8/12/66

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-8

1. TITLE: Low Temperature Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 10, 1966 through August 16, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4308A, Amend. #2 dated Dec. 9, 1965
MIL-STD-169(Sig C)

4. REQUIREMENT: (Specification Paragraph 4.3.2.5)
Low Temperature - The closed shelter shall be subjected to three cycles of the low temperature portion of MIL-STD-169 (Steps 5 through 10). The doors, latches, and hinges shall operate freely when tested on step 7. There shall be no change in the core material, and no delaminating, buckling, or deteriorating of the structural strength of the shelter as a result of this test.

5. EQUIPMENT REQUIRED AND USED:

Craig Environmental Test Chamber #1774
Calibration dated 7/15/66.
Lead and Northrup Double Range
Potentiometer Indicator Model 8657-C
Craig Thermocouple Switch Panel
12 Copper-Constantan Thermocouples

6. PROCEDURE:

6.1 Low Temperature Test
Install shelter in test chamber #1774 at room ambient conditions and attach two thermocouples to the inside skin on the side walls. Close the shelter doors and subject to the following low temperature cycle (ref. MIL-STD-169). The floor drain plug must be removed for this test.
(1) Reduce chamber temperature at 39° per hour to -80°F.
(2) Maintain at -80°F for 24 hours or to practical thermal equilibrium, whichever occurs first. The

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-8

6. PROCEDURE: (cont'd)

thermocouples located on side walls may be used to determine thermal equilibrium.

(3) Raise chamber temperature at 39° per hour to -65°F.

(4) Maintain at -65°F until practical thermal equilibrium is attained. At the conclusion of this period and while at the test temperature, check that the doors and latches operate properly.

7. TEST RESULTS: Three cycles performed per Paragraph 4.4 of ES 278, Low Temperature Test.
Checks made during the cycling and following each test revealed no shelter damage such as delamination of core to skin material, buckling, or deterioration of the structural strength of the shelter as a result of these tests. The doors, latches, hinges, hardware, etc. showed no malfunction, all operating freely at each test.

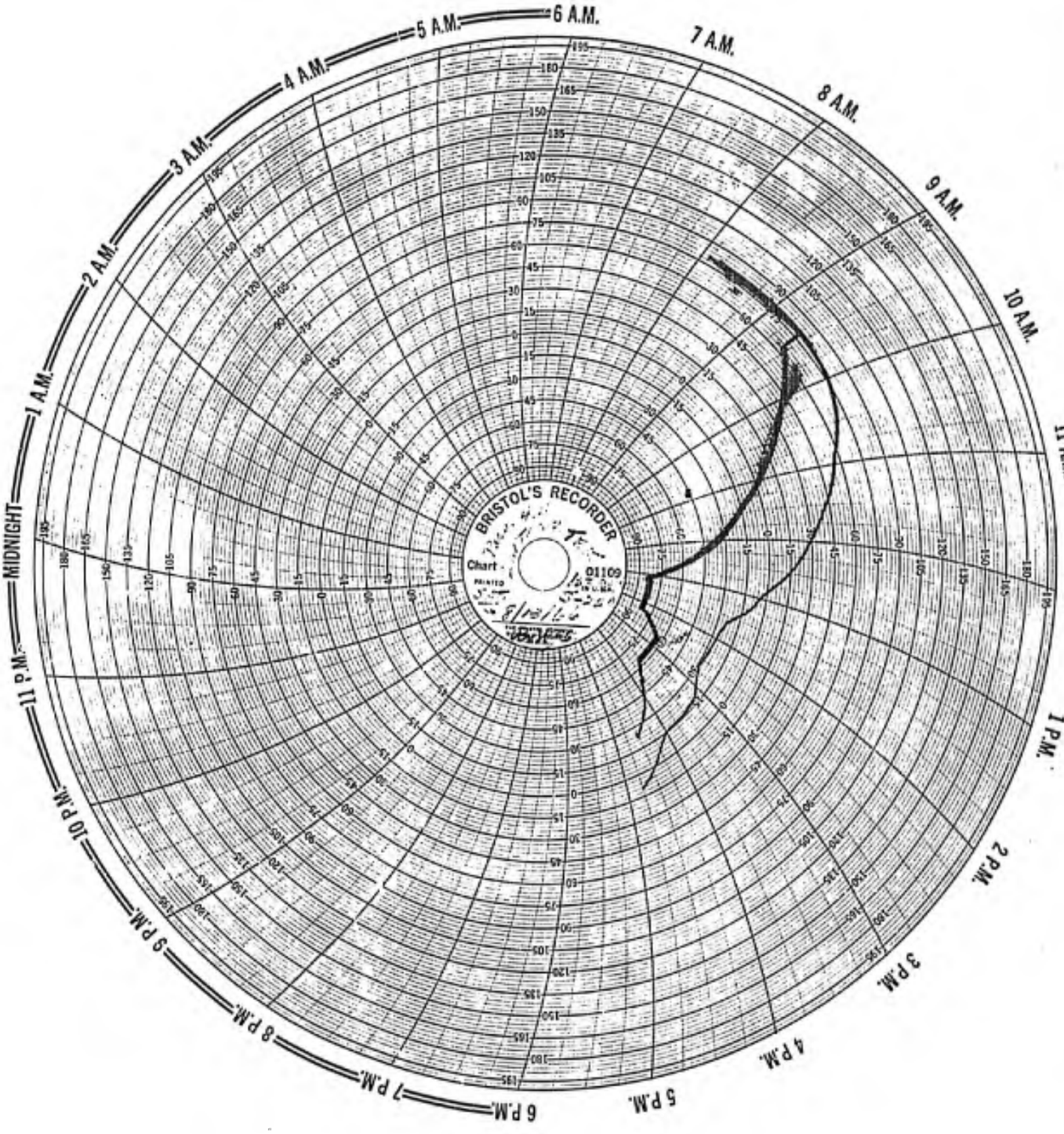
8. CONCLUSION: The shelter met the requirements of these tests.

Data sheets, charts #01109, notes, etc. as records of these tests are attached.

Approved by:

Quality Control R S Smith

Engineering R M Crouch


6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
BRISTOL'S RECORDER
Chart
01109

1st Cold Spec.

ES-275

ENVIRONMENTAL TEST DATA SHEET

DATE [illegible] SPEC. [illegible] W.O. [illegible]

TIME	9 25 AM		1 30 PM		2 30 PM		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
DRY BULB	-83F		-81F		-82.5F		-66		-64		-64		-50		-37	
WET BULB	—		—		—		—		—		—		—		—	
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1																
2																
3																
Free air → 4	-2.20	-85	-2.30	-85	-2.31	-86	-2.00	-68.5	-2.00	-68.5	-1.98	-66	-1.80	-57	-1.30	-37
5																
6																
7																
Inside left side (front) 8	-1.90	-63	-2.15	-77	-2.21	-83	-2.18	-79	-2.12	-75	-2.10	-74	-2.02	-70	-1.72	-53
9																
10																
11																
12																
13																
14																
15																
Inside right side rear 16	-1.90	-63	-2.15	-77	-2.20	-80	-2.20	-80	-2.12	-75	-2.10	-74	-2.02	-70	-1.72	-53
17																
18																
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24																
25																
26																
27																
28																
29																
30																
REF JCT																

For notes – see over

By D.V. Brown

1) 8[th] AM. Prior to start of test
CO_2 – Vol. – 16,400 lbs.
O_2 – 290 lbs.
Camera Min. Mitis – 000.0

After 1st cycle
CO_2 – Vol. – 7100 lbs
P_2 – 300 lbs.
– 226.5 min. or 3.78 hrs.

CO_2 used = 3,300 lbs

2) Start of test. 9[22] AM. Rear compartment had been sealed off and chamber door had extra seal around the bottom edge. Fans were removed from supply box to rear circulating fan.

3.) At ——— 10[20] P.M. Control cam stopped as Dry bulb temp. and ± couple (fan air) had reached – 80 F. (actually slightly lower.)

4) At ——— 2[20] P.M. Control cam started to raise temperature to – 65 F. (positioned cam at spot opposite on climb side of low flat section.)

5) At ——— 3[00] P.M. Control cam stopped as Dry bulb temp. had reached – 65.F.

6) At ——— 3[45] P.M Control cam started to bring temperature gradually up to room ambients temp. at 39° per hour.

7) At ——— 5[10] P.M. Chamber door opened, shutter doors opened – Oil and test was shut-down.

Int. gauge - S-250 Low Temp. Test, emergency No. 1.

Date	Time		M.V.	Temp. F	Remarks
8/13/66.	2:00 PM	#4.	-2.51	-85.	
		CHART D.B.	—	-82.	
		#8.	-2.21	-80	
		#16.	-2.20	-80	
"	3:00 PM	#4.	-2.00	-68.5	
		CHART D.B.	—	-66.	
		#8.	-2.18	-78.5	
		#16.	-2.20	-80.	
"	3:30 PM	#4.	-2.00	-68.5	
		CHART D.B.	—	-64.	
		#8.	-2.12	-75.	
		#16.	-2.12	-75.	
"	3:45 PM	#4	-1.98	-66	
		CHART D.B.	—	-64	
		#8.	-2.10	-74	
		#16.	-2.10	-74	
"	4:00 PM	#4	-1.80	-57	
		CHART D.B.	—	-58	
		#8.	-2.02	-70	
		#16.	-2.02	-70	
"	4:30 PM	#4	-1.30	-32	
		CHART DB	—	-32	
		#8	-1.72	-53	
		#16	-1.72	-53	

W. Brown.

Spec. SCL - 4608A

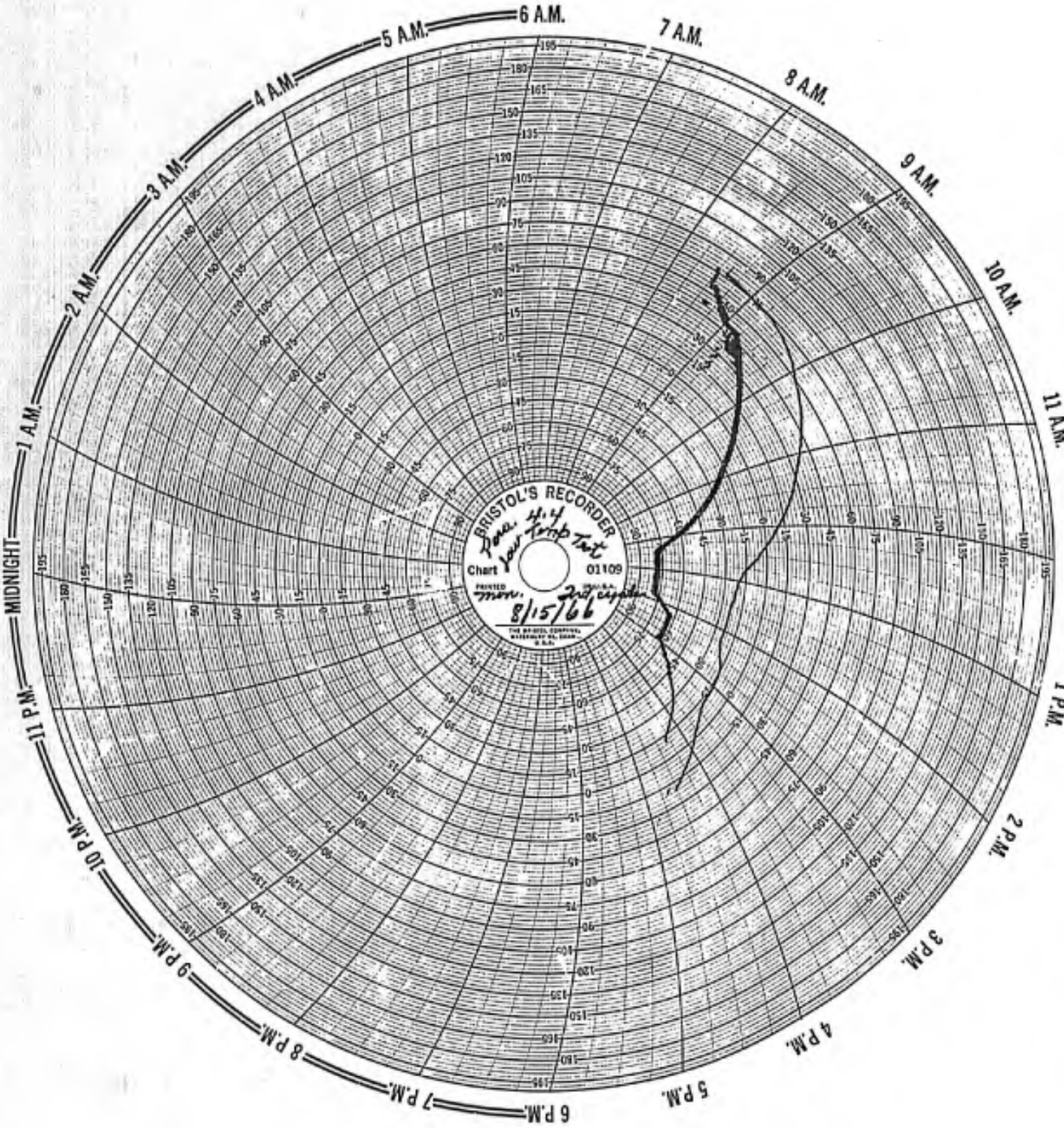
Para. 9.4. Low Temperature Test

1st cycle - S-250 shelter. W.O. 6010

Date	Time	Couple no.	M.V.	Temp. F.
5/13/66	9:25 AM. start	all @ R.T.		78.
"	9 [illegible]	4.	.2	46.
		8.	.74	66.
	"	16	.74	66
"	10:35 AM.	4.	-.25	20.
		8.	.20	41.
		- chart D.B.	—	21.
		16.	.20	41.
"	11:00 AM.	4.	-.55	6.
		chart D.B.	-	7.
		8.	0.	32.
		16.	0	32.
"	11:30 AM.	4.	-.90	-11
		chart D.B.	-	-12
		8	-.45	11.
		16	-.43	12.
"	11:55 AM.	4	-1.25	-29.
		chart D.B	—	-29
		8.	-.80	-7.
		16.	-.80	-7.
"	12:30 PM	4.	-1.75	-55
		chart DB.	--	-54
		8	-1.28	-31
		16.	-1.26	-30
"	1:00 P.M.	4	-2.10	-74.
		chart DB	—	-70.
		8	-1.58	-46.
		16	-1.56	-45.
"	1:30 P.M.	4.	-2.20	-86. } Cam. Stopped
		chart D.B	—	-83. }
		8.	-1.90	-63
		16.	-1.90	-63.
"	2:00 P.M.	4.	-2.20	-85
		chart D.B	—	-81
		8.	-2.15	-77
		16.	-2.15	-77
"	2:10 P.M.	8	-2.20	-79
		16	-2.20	-79

(con't on pg 2)

Couples - #8 & #16 junction inside shelter.
Couple - #4. " in free air position above shelter.


6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
BRISTOL'S RECORDER
Chart
01109
PRINTED
8/15/66

Tij 2B

Lit cycle - S-250 Low temperature test, cont from pg 1:B

Date	Time	Couple no.	M.V.	Temp F.	REMARKS
6/13/66	1 30 PM	4	-2.20	-80	
		chart D.B.	—	-80.	
		8.	-2.10	-74.	
		16.	-2.10	-74.	
"	1 45 PM	4	-2.22	-81.	
		chart D.B.	—	-80	
		8.	-2.15	-77.	
		16.	-2.15	-77.	
"	[illegible] PM	4	-2.25	-82	
		chart D.B.	—	-80	control [illegible]
		8.	-2.20	-80	
		16.	-2.20	-80	started
"	2 15 PM	4.	-2.1[illegible]	-74.	
		chart D.B.	—	-69.	TM
		8.	-2.20	-80.	at 2 25 control
		16	-2.20	-80.	cam stopped.
"	2 45 PM	4	-1.95	-66	
		chart D.B.	—	-65	
		8.	-2.10	-74	
		16.	-2.10	-74	
"	3 05 PM	4	-1.96	-66.	
		chart D.B	—	-64.	control cam
		8.	-2.00	-69.	
		16.	-2.00	-69.	started. [illegible]
"	3 35 PM	4.	-1.60	-47	
		chart D.B.	—	-45	
		8.	-1.92	-64.	
		16.	-1.92	-64.	
"	4 05 PM	4.	-1.77	-25.	
		chart D.B.	—	-24.	
		8.	-1.60	-47	
		16.	-1.60	-47.	
"	4 15 PM	4.	-1.00	-17	at 4 10 PM.
		chart D.B	—	-16	removed chamber
		8	-1.45	-39	
		16.	-1.45	-39	door seals

By: W. Beason

Spec. AL-460 A.

Para. 4.4 Low Temperature Test

Run file - 5-250 shelter W.O. 6010.

Date	Time	Couple No.	M.V.	Temp. F.	REMARKS
			→	→	
3/5/46	8 45 AM.	all	—	77.	
"	9 15 AM.	chart D.B.	4. .3	46.	
			—	47.	
			8. .7	64.	
			16. .7	64.	
"	9 45 AM.	chart D.B.	4. -.15	25.	
			—	24.	
			8. .30	46.	
			16. .20	46.	
"	10 15 AM.	chart D.B.	4. -.40	13.	
			—	10.	
			8. .00	32.	
			16. .00	32.	
"	10 45 AM.	chart D.B.	4 -.90	-17.	
			—	-12.	
			8 -.35	15	
			16 -.85	15	
"	11 10 AM.	chart D.B.	4. -1.10	-22.	
			—	-25	
			8 -.70	-2.	
			16 -.70	-2	
"	11 45 AM.	chart D.B.	4. -1.50	-42.	
			—	-42	
			8. -1.08	-20.	
			16 -1.08	-20.	
"	12 30 P.M.	chart D.B.	4. -2.05	-72	
			—	-72	
			8 -1.66	-50	(at 12 30 P.M.)
			16 -1.66	-50	← Cam S/stopped
"	12 45 P.M.	chart D.B.	4 -2.20	-80.	
			—	-80	
			8. -1.85	-60.	
			16 -1.82	-59.	
"	1 00 P.M.	chart D.B.	4. -2.20	-80.	
			—	-80.	
			8. -2.00	-69	
			16. -2.00	-69	
"	1 15 P.M.	chart D.B.	4 -2.22	-80.	
			—	-80.	
			8. -2.06	-72.	
			16. -2.06	-72.	

couples # 8 & # 16. junctions inside shelter
couple # 4. junction in free air position above shelter -

1) 8[05] A.M. Prior to start of test.
CO_2 - Vol. - 7100 lbs. | After [illegible]
- Ps. - 3000 lbs. | CO_2 - Vol. - 3800 lbs
— Ps. - 265 lbs | CO_2 used = 3300 lbs.

2) Start of Test 8[45] A.M. following sealing the chamber door.

3) At 9[15] A.M. Corrected chart position for exact Time. (was 15 min. slow)

4) At 12[35] P.M. Control cam stopped as chamber was at -80. F.

5) At 2[01] P.M. Control cam started to raise temperature to -65. F. (positioned cam on climb side of low flat section at approximately 75. F line.)

6) At 2[25] P.M. Control cam stopped as Dry bulb temp. had dropped to -65 F.

7) At 3[20] P.M. Control cam started to bring temperature slowly up to room ambient temp. at 39 degrees per hour.

8) At 4[30] P.M. Chamber door opened, shelter door opened OK. and test shut-down.

Cramus min. meter reading was 217. 8 min.

67

2nd Cold Cycle

ENVIRONMENTAL TEST DATA SHEET

ES-278

DATE 8/15/66 SPEC. SCL 4608A W.O. 6010 -5-250

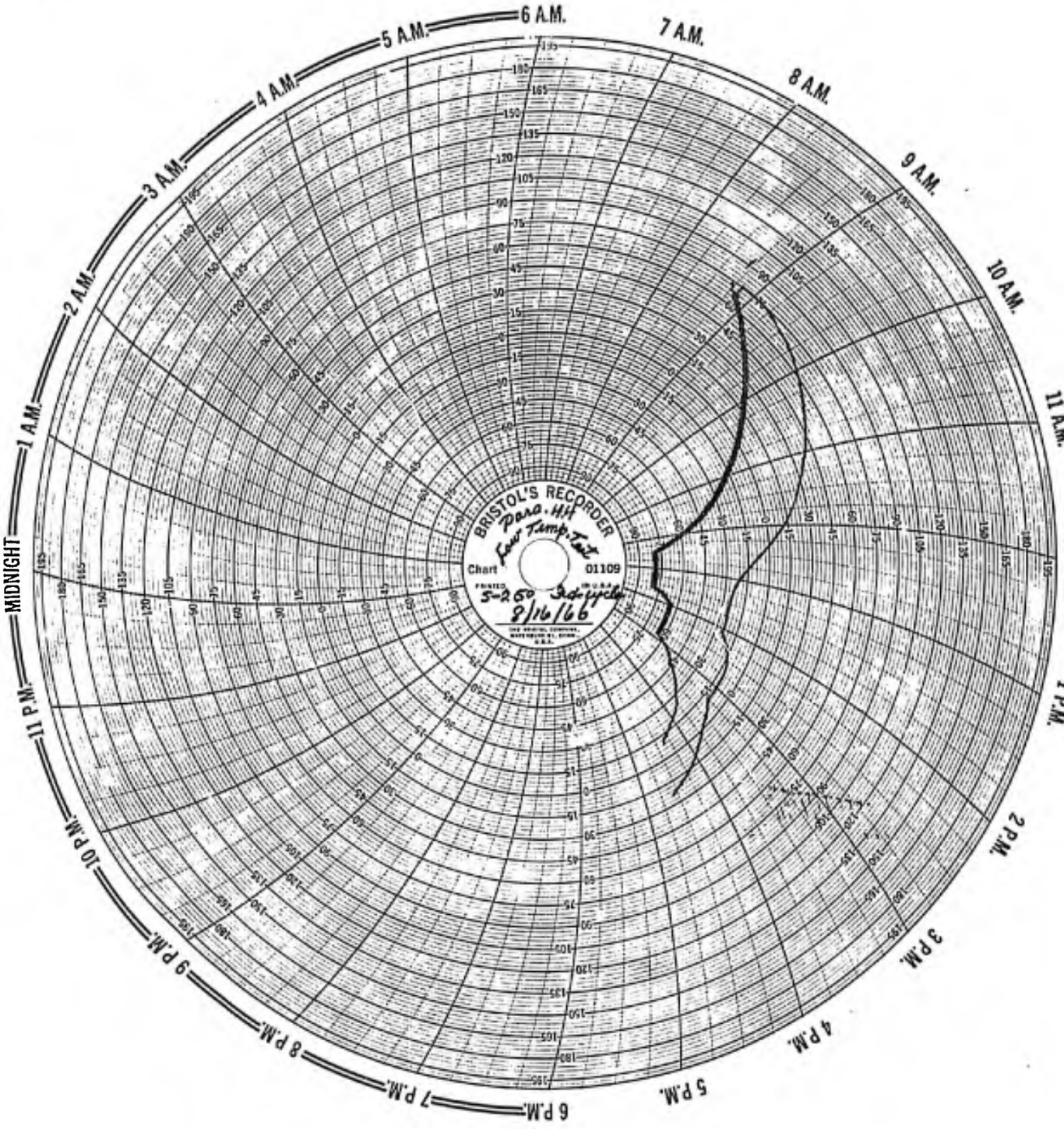
Para 4.4 Low Temperature Test

Start - 8:45 AM

THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
TIME	12:45 PM		1:15 PM		1:45 PM		2:00 PM		2:15 PM		2:45 PM		3:00 PM			
DRY BULB	-80.		-80		-80		-80		-69		-65		-64		-	
WET BULB	-		—		—		—		-		—					
1																
2																
3																
Free air 4	-2.20	-80	-2.22	-80	-2.22	-81	-2.25	-82.	-2.10	-74	-1.95	-66	-1.96	-66.		
5																
6																
7																
Inside Left side Front 8	1.85	-60	-2.06	-72	-2.15	-77	-2.20	+80	-2.20	-80	-2.10	-74	-2.00	-69		
9																
10																
11																
12																
13																
14																
15																
Inside Right side Rear 16	-1.82	-59	-2.06	-72	-2.15	-77	-2.20	-80	-2.20	-80.	-2.10	-74	-2.00	-69		
17																
18																
19																
20																
21																
22																
23																
24																
25																
26																
27																
28																
29																
30																
REF JCT									—							

For notes see over -

By - W. Benson


MIDNIGHT
1 A.M.
2 A.M.
3 A.M.
4 A.M.
5 A.M.
6 A.M.
7 A.M.
8 A.M.
9 A.M.
10 A.M.
11 A.M.
NOON
1 P.M.
2 P.M.
3 P.M.
4 P.M.
5 P.M.
6 P.M.
7 P.M.
8 P.M.
9 P.M.
10 P.M.
11 P.M.
BRISTOL'S RECORDER
Para. Hit
Fast Temp. Test
Chart
01109
5-250
8/16/66

Spec. L.C.L.-4608-A.

Para. 4.4 Low Temperature Test

3rd cycle - S-250 Shelter D.O. 6010.

Date	Time	Couple no.	M.V.	Temp F.	REMARKS.
5/16/66	8 35 AM	all	R.T.	77.	
"	9 15 AM	4	.30	46.	
		Chart D.B.	—	45	
		8	.70	64.	
		16	.70	64.	
"	10 30 AM.	4	-.60	3.	
		Chart D.B	—	0.	
		8	-.12	26.	
		16	-.12	26	
"	11 25 AM.	4	-1.20	-27.	
		Chart DB.	—	-28.	
		8.	- .80	- 6.	
		16.	- .80	- 6.	
"	12 00 N.	4	-1.68	- 51	
		Chart D.B	—	- 53	
		8.	-1.22	- 27	
		16.	-1.22	- 27	
"	12 30 P.M.	4.	-2.12	- 75	
		Chart D.B.	—	- 75	
		8.	- 1.60	- 47	
		16.	- 1.60	- 47	
"	12 45 P.M.	4	- 2.20	- 80	at 12 40 P.M. Control cam stopped.
		Chart D.B.	—	- 81.	
		8.	- 1.80	- 58.	
		16.	- 1.78	- 57.	
"	1 00 P.M.	4.	- 2.22	- 80.	
		Chart D.B.	—	- 81	
		8.	- 1.90	- 63	
		16.	- 1.90	- 63	
"	1 25 P.M.	4.	- 2.22	- 80	
		Chart DB.	—	- 80	
		8.	- 2.10	- 74	
		16.	- 2.10	- 74	
"	1 45 P.M	4	- 2.20	- 80	
		Chart DB.	——	- 80	
		8	- 2.12	- 75	
		16	- 2.12	- 75	

Couple #8 + #16 junctions located on inside wall skin of shelter.
Couple # 4 junction in free-air position above shelter.

2nd. Cycle -5-250 shells Low Temp. test (cont from pg 1-C)

Date	Time	Couple no	M.V.	Temp F.	REMARKS
8/16/66	2 00 P.M.	4	-2.00	- 69.	
		chart D.B	-	- 66.	
		8	-2.10	- 74.	
		16	-2.10	- 74	
8/16/66	2 15 P.M.	4	- 1.95	- 66	2 15 PM. Control Cam stopped
		chart D.B.	-	- 65.	
		5	- 2.05	- 71.	
		16	- 2.05	- 71.	
"	2 30 P.M.	4.	- 1.95	- 66.	
		chart D.B.	-	- 65.	
		8.	- 2.05	- 71.	
		16.	- 2.05	- 71.	
"	2 45 P.M.	4	- 1.96	- 66.	
		chart D.B	-	- 65.	
		8.	- 2.00	- 69.	
		16.	- 2.00	- 69.	
"	3 00 P.M.	4.	- 1.95	- 66.	(3:00 P.M. Control Cam started
		chart D.B.	-		
		8.	- 2.00	- 69.	
		16.	- 2.00	- 69.	
"	3 30 P.M.	4.	- 1.44	- 39.	
		chart D.B.	-	- 37	
		8	- 1.80	- 58	
		16.	- 1.80	- 58	
"	4 00 P.M.	4.	- 1.00	- 17.	
		chart D.B.	-	- 16	
		8.	- 1.40	- 37.	
		16.	- 1.40	- 37.	
"	4 30	4	-	-	
		chart D.B	-	-	
		8.	-	-	
		16.	-	-	

By J. W. Brown

ENVIRONMENTAL TEST DATA SHEET

DATE [illegible] SPEC. [illegible] W.O. [illegible]

TIME 8 40 AM	12 [illegible] PM		1 [illegible] PM		[illegible]		2 15 [illegible]		[illegible]		[illegible]		[illegible]			
DRY BULB	-81		-80		-80		-65		[illegible]		-60		-65			
WET BULB	—		—		—		—		—		—		—		—	
THERMO-COUPLES	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP	M.V.	TEMP
1																
2																
3																
4	-2.21	-80	-2.22	-80°	-2.23	-80	[illegible]	[illegible]	-1.75	-63	[illegible]	[illegible]	-1.95	66°		
5																
6																
7																
8	-1.80	-56°	-2.10	-74	-2.12	-75	-2.06	[illegible]	[illegible]	-71	[illegible]	[illegible]	-2.08	-69		
9																
10																
11																
12																
13																
14																
15																
16	-1.78	-57	-2.10	-74	-2.12	-75	[illegible]	-71.	-2.15	[illegible]	-2.00	-69.	-2.08	-69		
17																
18																
19																
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29																
30																
REF JCT																

Handwritten notes beside the thermocouple numbers:

- Row 4: "Free air →"
- Row 8: "Inside left front →"
- Row 16: "Inside right rear →"

[illegible]

1) 8:40 AM. Prior to start of test (3)
CO_2 - Vol. - *13,500.0+ lbs. | After 3rd cycle
- Pr. - 2,900. lbs. | CO_2 - Vol. - 9800 lbs. CO_2 used
Asme Min. Water 2,000.0 - | - Pr. - 290 lbs. = 3%
Asme Min. Water - 20%.

2) Starts of test 8:55 AM. Shelter closed + Chamber doors sealed. R. Smith + ... checked shelter prior to start of the 3 cycle.

3) at 12:40 PM. Control cam stopped as chamber had reached - 80.F.

4) at 1:45 PM Control cam started to raise temperature to - 65 F. (+continued)

5) at 2:40 PM. Control cam stopped as temperature was at - 65 F.

6) At 3:00 PM Control cam started to bring temperature slowly up to room ambient temperature at a rate of 20. degrees per hour.

7) Doors of shelter checked by Inspector (Dept 15) at - 65 F in chamber (Doors operated satisfactorily.)

8) at 4:45 P.M. Chamber gradually opened after interior had reached about 40. F

9) Test shut-down at 4:50 P.M.

* Tank filled this A.M.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-9

1. **TITLE:** Railroad Transport
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 18 and 19, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.2)
Railroad Transport - The shelter shall be loaded in the manner normally used for shipment on a railroad flat car. The test shall be conducted on a flat stretch of track. A 165,000 pound car traveling at 9 miles per hour shall be impacted against the test car coupled to two other cars. These cars shall be stationary with brakes off. Four impacts shall be performed, two with the shelter positioned longitudinally to the flat car and two positioned laterally. The direction of each impact shall be selected by the Government. If blocking or tie-downs holding the shelter in place are torn loose by the impact, the test shall be repeated.

5. **EQUIPMENT REQUIRED:**

1 Railroad Switch Engine
1 Railroad Flat Car
2 Railroad Freight Cars
1 Railroad Car with total weight of 165,000 lbs.
1 Stop Watch
As required - Railroad torpedoes

6. **TESTING PROCEDURE AND RESULTS:**

Testing was conducted at the Lawrence Freight Terminal of the Boston & Maine Railroad. Equipment used included Boston & Maine switch engine No. 1119, one flat car loaded with the S-250 shelter, two other cars attached to the flat car with weights of 51,000 and 43,600 lbs. respectively, and a loaded freight

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-9

6. TESTING PROCEDURE AND RESULTS (cont'd)

car of lime with gross weight of 175,800 lbs.

Railroad torpedoes were positioned 100 ft. apart close to but before the impact point. Trial runs were made with an additional freight car to allow the railroad crew to get the engine settings that would give them approximately 9 miles per hour. Time measurements were taken in seconds to determine the speed of all runs.

The shoring of the shelter was performed in the normal manner for shipment. The direction of impact of the shelter during the longitudinal and lateral position was designated by the Government representative.

Measurements taken were as follows:

	Seconds	MPH
Longitudinal	7.70	8.9
	7.77	8.85
Lateral	7.00	9.75
	8.00	8.5

After each impact, inspection of the shoring and the shelter was performed with a detailed inspection at the completion of the fourth impact. There was no evidence of any physical effect on the shelter by the results of this test. Specific areas of inspection included around the lifting eyes at the changes in section from side to knee to floor panels and the door and end panels.

7. CONCLUSIONS: The shelter design met the requirements of this test.

Approved by:

Quality Control R S Smith

Engineering A. M Cornetti

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-10

1. **TITLE:** Sling Drop
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 22, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.3)
Sling Drop - The shelter shall be suspended approximately 1/2 inch from the ground by means of the lifting sling assembly at its fully extended height. The sling assembly and the shelter shall be dropped in free fall so that the assembly strikes the roof of the shelter. This test shall be repeated five times.

5. **EQUIPMENT REQUIRED:**

Concrete pad, power winch, quick release hook.

6. **TEST PROCEDURE AND RESULTS:**

The shelter was raised and sling released as specified in requirement (4) above. Results of the five drops were indentations in the roof skin, none of which ruptured or penetrated the aluminum skin.

7. **CONCLUSIONS:** Shelter design met the requirements of this test.

Approved by:

Quality Control [signature]

Engineering [signature]

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-11

1. **TITLE:** Skid Bearing Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 22, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.4)
Skid Bearing - The shelter shall be balanced on a 2 inch pipe anywhere along the skids.

5. **EQUIPMENT REQUIRED:**

Concrete pad, 2" diameter pipe, sling and power winch.

6. **TESTING PROCEDURE:**

The shelter with 1900# dummy load shall be balanced on a 2 inch pipe anywhere along the skids.

7. **TEST RESULTS:**

Shelter balanced properly along its length with stops made at locations specified by the witnessing Government representative. The only result and the effect on the skids from this test was a dimpling on the outside edge of the curbside skid caused by the shelter being in a "cocked" position when it was initially lowered to the 2 inch pipe.

8. **CONCLUSION:** The skids are acceptable to the requirements of the specification.

Approved by:

Quality Control R. S. Smith

Engineering R. D. Cornell

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-12

1. **TITLE:** Three-Point Support
   S-250(XE-2)/G Shelter - Item 2a
   Contract DA-28-043-AMC-01604(E)
   Performed August 22, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.8)
   Three-Point Support - The shelter shall be supported on any three bottom corners. In this position, the door shall operate freely.

5. **EQUIPMENT REQUIRED:**

   Concrete pad, power winch, sling, wooden blocks (3).

6. **TESTING PROCEDURE:**

   The shelter with a dummy payload of 1900# shall be supported on any three bottom corners. The door shall be opened and closed.

7. **TESTING RESULTS:**

   The door was opened and closed in the testing position without any evidence of binding. Latch functioned properly and secured door.

8. **CONCLUSION:** The shelter design met the requirements of this test.

Approved by:

Quality Control ____________

Engineering ____________

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-13

1. **TITLE:** Flat & Rotational Drop Tests
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 22, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraphs 4.3.3.6 & 4.3.3.7)
Flat Drop - The shelter shall be lifted to a height of 18 inches above a hard concrete surface (measured from the bottom of the skids) and shall be allowed to fall freely with the skids impacting onto the concrete. This test shall be performed once.

Rotational Drop - The shelter shall be placed on a hard concrete surface with a 4 inch by 4 inch member along one edge under the skids. The opposite edge shall be raised to a height of 18 inches above the concrete (measured from the bottom of the skids) and shall be allowed to fall freely onto the concrete. This test shall be performed once on each bottom edge for a total of four drops.

5. **EQUIPMENT REQUIRED:**

Concrete pad, sling, power winch with quick-release hook, rule, 4x4 timber.

6. **TEST PROCEDURE:**

a. Flat Drop - The shelter with a 1900# dummy load shall be lifted to a height of 18 inches above a hard concrete surface (measured from the bottom of the skids) and shall be allowed to fall freely with the skids impacting on to the concrete. This test shall be performed once.

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-13

6. **TEST PROCEDURE**: (con't'd)

b. Rotational Drop - The shelter with a 1900# dummy load shall be placed on a hard concrete surface with a 4 inch by 4 inch member along one edge under the skids. The opposite edge shall be raised to a height of 18 inches above the concrete (measured from the bottom of the skids) and shall be allowed to fall freely on to the concrete. This test shall be performed once on each bottom edge for a total of four drops.

7. **TEST RESULTS**: Testing was performed as specified above with no visual damage to the shelter body. There was one noticeable effect of the drop test on the skids. The outside edges of the lower part of the outboard skids for a distance of approximately 3 inches from the front and rear ends open slightly in the rubber retaining groove. Subsequent testing, including towing tests, did not amplify or change this opening. It was considered that this effect did not alter the functionability of the skid.

8. **CONCLUSION**: The shelter design met the requirements of this test.

NOTE: Future skids will incorporate heavier wall sections to preclude skid retaining groove opening under similar tests.

Approved by:

Quality Control R. S. Smith

Engineering A. M. Cornett

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-14

1. **TITLE:** Towing Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 23, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.8)
Towing - The shelter shall be towed for a minimum of 1400 feet in each direction (front and rear) on the skids at a speed of five miles per hour over rough terrain. As part of the towing test, four right angle turns in sand shall be made. The turns shall be made with the initial position of the longitudinal axis of the shelter perpendicular to the truck, and the towing eye of the truck directly in line with the leading edge of the shelter. The pull shall be on one towing eye of the shelter.

5. **EQUIPMENT:**

5.1 M-35 Military Truck
5.2 S-250 lifting and tie-down sling
5.3 Mobile Crane

6. **TESTING PROCEDURE:**

The shelter with a dummy payload of 1900# shall be towed for a minimum of 1400 feet in each direction (front and rear) on the skids at a speed of five miles per hour over rough terrain. As part of the towing test, four right angle turns in sand shall be made. The turns shall be made with the initial position of the longitudinal axis of the shelter perpendicular to the truck, and the towing eye of the truck directly in line with the leading edge of the shelter. The pull shall be on one towing eye of the shelter.

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TEST REPORT #010-B-14

7. **TEST RESULTS:** Testing was performed at Ouellette's Sand Pit in Methuen, Mass. with the 1400 feet towing performed in 3-1/2 cycles on a measured 400 ft. long section. After towing the 1400 feet in each direction, four right angle turns were made in the sand.

There was no evidence of any deformation either in the skids or the main shelter structure. Paint was worn off of the skids and off of the part of the exterior floor.

8. **CONCLUSION:** Shelter design met the requirement of this test.

Approved by:

Quality Control R. S. Smith

Engineering P. M. Connolly

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-15

1. **TITLE:** Lifting Test
   S-250(XE-2)/G Shelter - Item 3a
   Contract DA-28-043-AMC-01604(E)
   Performed August 22, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.3.9)
   Lifting - The shelter, with an additional 6250 pounds of weight uniformly distributed over the floor, shall be suspended by the four lifting eyes for a period of 30 minutes. During the test the shelter shall show no undue distortion.

5. **EQUIPMENT:**

   5.1 Plywood
   5.2 Lead weights
   5.3 Weighing Scale
   5.4 Special Test Structure

6. **TESTING PROCEDURE:**

   6.1 Locate shelter in special testing structure.
   6.2 Lift shelter into position and attach chains from testing structure to lifting eyes.
   6.3 Lower hoist so that all weight is suspended from lifting eyes.
   6.4 Install plywood insert on floor.
   6.5 Use weighing scale and/or count lead weights as they are placed into shelter and record, equally distribute over entire floor 6,250 pounds.
   6.6 Allow shelter to stand 30 minutes after total weight has been installed.
   6.7 Remove weights, lower shelter on to platform of test structure.

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-15

7. **TESTING RESULTS:** After removing the weight from the shelter, there was no evidence of permanent deformation or material weakness.

8. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R C Smith

Engineering A M Cowell

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-16

1. **TITLE:** Deep Fording Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 24, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** Specification Paragraph 4.3.3.10
Deep Fording - The shelter, secured by its tiedowns to a suitable platform serving as the sinking device, shall be immersed for a period of one hour in water to a depth of 32 inches above the bottom of the skids. There shall be no leakage during this test. No special fording kits or additional caulking, taping, etc., shall be used in the performance of this test.

5. **EQUIPMENT:** Special plywood tank 8 ft. x 8 ft. x 36 inches deep. Attaching hold-down hardware.

6. **TESTING PROCEDURE:**

6.1 Close shelter door and verify that drain plug is installed.
6.2 Place shelter in tank and tie it in place.
6.3 Fill tank with water to 32 inch level.
6.4 Allow shelter to remain in water 1 hour.
6.5 Remove shelter from tank and dry area around door (use air if necessary).

7. **TESTING RESULTS:**

After some false starts where water entered the shelter because of drain plug leaking (sand in the threads) and two areas where sealer was not complete, shelter remained immersed for 1 hour without any entrance of water.

Craig Systems, Inc.
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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-16

8. CONCLUSION: Shelter design met the requirements of this test.

Approved by

Quality Control R.S. Smith

Engineering P M Cornell

Craig Systems, Inc.
LAWRENCE, MASS
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-17

1. TITLE: Roof Test
S-250(XE-3)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 23, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. REQUIREMENT: (Specification Paragraph 4.3.4.1)
Roof - The shelter roof shall be loaded with a static load of 1860 pounds uniformly distributed over the entire roof area. During the test the shelter shall show no undue distortion.

5. EQUIPMENT:

5.1 Craig Systems Concrete Test Pad
5.2 1860 lbs. of lead weight
5.3 Plywood Panel

6. TESTING PROCEDURES:

Place plywood panel on shelter roof. Uniformly place lead weights on panel.

The shelter roof shall be loaded with a load of 1860 pounds of lead uniformly distributed over the entire roof area.

7. TESTING RESULTS:

With the load on the roof, it was noted by a dimensional check that the center of the roof deflected approximately 1/8 inch. After weights were removed, roof returned to a level condition.

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-17

8. CONCLUSION: Shelter design met the requirements of this test.

Approved by:

Quality Control R S Smith

Engineering P M Cowett

Craig Systems, Inc.
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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-18

1. **TITLE:** Door Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 28, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.4.2)
Door - A 200 pound load shall be placed separately on each door in its fully opened position. The load shall be located at the maximum distance from the hinge line.

5. **EQUIPMENT:**

5.1 Special Carrier for Weights
5.2 200 lbs. of lead weight

6. **TESTING PROCEDURE:**

6.1 Apply load as specified in 4. above.
6.2 Remove load and inspect for deformation and proper function of door and latch mechanism.

7. **TESTING RESULTS:**

After weights were removed, there was no deformation in the hinges and door, and latch mechanism functioned properly.

8. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R. S. Smith

Engineering P. M. Caswell

Craig Systems, Inc.
LAWRENCE, MASS.
QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-19

1. TITLE: Lifting Eyes Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-01604(E)
Performed August 25, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. REQUIREMENT: (Specification Paragraph 4.3.4.3)
Lifting Eyes - The shelter shall be firmly secured in a place, and a 5000 pound tensile load shall be applied to all four of the lifting eyes in each of the following directions: (a) upward, (b) downward, (c) horizontally in the plane of the eye, and (d) horizontally at right angles to the plane of the eye.

5. EQUIPMENT:

Special Testing Structure
Simplex Hydraulic (4 valve) Pump Model 3 HPB4089
Hydraulic Cylinder - Rogers #C2-3CK-1-3/4x14
(effective area 4.66 square inches)
Special Pressure Gage calibrated in pounds force for above cylinder
Attaching and Hold-down hardware

6. TESTING PROCEDURE:

6.1 Attach hydraulic cylinder to one of forward lifting eyes, and to test structure.
6.2 Attach holding hardware to opposite lifting eye (door end) and to test structure.
6.3 Apply force in an outward horizontal direction by means of the hydraulic cylinder.
6.4 When force reaches 5000 pounds, release pressure.
6.5 Inspect for permanent deformation or damage.
6.6 Disconnect cylinder and all attaching hardware.
6.7 Repeat for other two lifting eyes.
6.8 Repeat complete cycle for each direction on all lifting eyes (Reference 4. above).

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-19

7. **TESTING RESULTS:**

During and after all of the testing cycles were completed, there was no evidence of permanent deformation in the shelter or in the eyes.

8. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R L Smith

Engineering K W Smith

Craig Systems, Inc.
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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-20

1. TITLE: Towing Eyes Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-01604(E)
Performed August 25, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. REQUIREMENT: (Specification Paragraph 4.3.4.4)
Towing Eyes - The shelter shall be firmly secured in place and a 5000 pound tensile load shall be applied to all four of the towing eyes in each of the following directions: (a) upward, (b) downward, (c) horizontally in the plane of the eye, and (d) horizontally at right angles to the plane of the eye.

5. EQUIPMENT:
Special Testing Structure
Simplex Hydraulic (4 valve) Pump Model 3 HPB4089
Hydraulic Cylinder - Rogers #C2-3CK-1-3/4x14
(effective area 4.66 square inches)
Special Pressure Gage calibrated in pounds force for above cylinder
Attaching and Hold-down hardware

6. TESTING PROCEDURE:

6.1 Attach hydraulic cylinder to one of forward towing eyes, and to test structure.
6.2 Attach holding hardware to opposite towing eye (door end) and to test structure.
6.3 Apply force in an outward horizontal direction by means of the hydraulic cylinder.
6.4 When force reaches 5000 pounds, release pressure.
6.5 Inspect for permanent deformation or damage.
6.6 Disconnect cylinder and all attaching hardware.
6.7 Repeat for other two towing eyes.
6.8 Repeat complete cycle for each direction on all lifting eyes (Reference 4. above).

Note: This test performed in conjunction with Lifting Eyes Test.

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-20

7. TESTING RESULTS:

During and after all of the testing cycles were completed, there was no evidence of permanent deformation in the shelter or in the eyes.

8. CONCLUSION: Shelter design met the requirements of this test.

Approved by:

Quality Control R S Smith

Engineering P M Cowell

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-21

1. TITLE: Folding Steps Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 23, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. REQUIREMENT: (Specification Paragraph 4.3.4.5)
Folding Steps - A 400 pound load shall be applied on the outer section of the step.

5. EQUIPMENT:

5.1 Special fixture to carry 400 pounds of lead weight while attached to a Folding Step.

6. TESTING PROCEDURE AND RESULTS:

Special fixture was attached to the lower folding step. Four hundred pounds of lead weight were loaded into the fixture. Weight was then removed and shelter was inspected for any detrimental affect of the test.

There was no evidence of any permanent deformation or physical damage as a result of this test.

7. CONCLUSION: Shelter design met the requirements of this test.

Approved by:

Quality Control R S Smith

Engineering A J III Corneth

Craig Systems, Inc.
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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-22

1. TITLE: Wall Insert Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 25, 1966

2. PURPOSE: To test shelter design.

3. APPLICABLE SPECIFICATION: SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. REQUIREMENT: (Specification Paragraph 4.3.4.6)
Wall Insert - 5/16 inch steel rivnuts shall be installed in wall members on opposite walls of the shelter in locations selected by the COTR. No bonding material of any kind shall be employed to assist in securing the Rivnut in place. The inserts shall be connected together by suitable means and a 1200 pound tensile load applied from one to the other. After the load has been removed, there shall be no distortion of the shelter at the attachment location. Upon conclusion of this test, the Rivnut shall withstand 100 inch pounds of torque without turning.

5. EQUIPMENT:

5.1 Simplex Hydraulic (4 valve) Pump Model 3HPB4089
5.2 Hydraulic Cylinder - Rogers #C2-3CK-1-3/4x14 (effect. area 4.66 sq.in.
5.3 Special Pressure Gage calibrated in pounds force for above cylinder.
5.4 Attaching hardware
5.5 Torque Wrench

6. TESTING PROCEDURE AND RESULTS:

The Government representative selected locations in each side wall that were approximately the geometric center. 5/16 inch steel rivnuts were installed at these locations. Test was performed using the hydraulic cylinder attached between the two wall inserts. A tensile load of 1200 lbs. was applied and then released.

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-22

6. **TESTING PROCEDURE AND RESULTS:** (cont'd)

Bolts were inserted into the insert holes. The torque wrench was then used to exert 100 inch/lbs. of torque on the insert. The insert did not turn. There was no evidence of any distortion.

After test was completed, the Government representative observed that the hat-shaped supports which held the load in place during testing had not been removed. To insure that there would be no criticism of the test as performed, the hat-shaped pieces were removed from the shelter and tests were performed on the same inserts as described above. The results of this second test were the same as the first; that is, no permanent deformation resulting with the inserts able to take 100 inch/lbs. of torque without turning.

7. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R. J. Smith

Engineering W. M. Corneth

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TEST REPORT #010-B-23

1. **TITLE:** Floor Insert Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 25, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.4.7)
Floor Insert - A 5/16 inch steel rivnut shall be installed in a floor member in a location selected by the COTR. No bonding material of any kind shall be employed to assist in securing the rivnut in place. A 1200 pound tensile load shall be applied to the rivnut. After the load has been removed, there shall be no distortion of the shelter at the attachment location. Upon conclusion of this test, the rivnut shall withstand 100 inch pounds of torque without turning.

5. **EQUIPMENT:**

5.1 Simplex Hydraulic (4 valve) Pump Model 3HPB4089
5.2 Hydraulic Cylinder - Rogers #C2-3CK-1-3/4x14
(effective area 4.66 sq. inch)
5.3 Special Pressure Gage calibrated in pounds force for above cylinder.
5.4 Attaching hardware
5.5 Torque Wrench

6. **TESTING PROCEDURE AND RESULTS:**

The Government representative selected a location in the floor that was approximately the geometric center for the installation of the floor insert. Insert was installed. Hydraulic cylinder was then attached to the floor insert and supported across the knees of the shelter. A tensile load

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TEST REPORT #010-B-23

6. TESTING PROCEDURE AND RESULTS: (cont'd)

of 1200 lbs. was exerted on the floor insert. There was no distortion of the shelter. Testing the insert with a torque wrench on a bolt that was inserted into the rivnut. The insert took 100 inch pounds of torque without turning.

7. CONCLUSION: The shelter design met the requirements of this test.

Approved by:

Quality Control R.S. Smith

Engineering P.M. Corcoran

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TEST REPORT #010-B-24

1. **TITLE:** Lift and Tiedown Assembly Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed August 25, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENTS:** (Specification Paragraph 4.3.4.8)
Lift and Tiedown Assembly - The combination lift and tiedown assembly shall be subjected to a tensile load of 5500 pounds.

5. **EQUIPMENT:**

5.1 Simplex Hydraulic (4 valve) Pump Model #HPB4089
5.2 Hydraulic Cylinder - Rogers #C2-3CK-1-3/4x14
(effective area 4.66 sq. inches)
5.3 Special Pressure Gage calibrated in pounds force for above cylinder.
5.4 Attaching hardware
5.5 Torque Wrench

6. **TESTING PROCEDURE AND RESULTS:**

One leg of the lifting and tiedown assembly was selected by the Government representative for tests to these requirements. Tensile loading of 5500 lbs. was applied to this leg twice. First on the longer segment of the two-part leg and then to the complete length of the sling leg which included this longer segment. There was no slippage of the cable in its fittings nor was there any evidence of breaking strands in the cable.

7. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R.S. Smith

Engineering [illegible]

Craig Systems, Inc.
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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-25

1. **TITLE:** Watertightness Test
S-250(XE-2)/G Shelter - Item 2a
Contract DA-28-043-AMC-01604(E)
Performed July 20, 1966 and August 30, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraphs 4.3.5 and 4.3.2.1)
Watertightness - The watertightness test shall be performed a second time as outlined in 4.3.2.1.

Watertightness - Spray the surfaces of the shelter with water from Nozzles Model G29SQ or 6G29SQ, as made by Spraying Systems Co., Bellwood, Illinois, or equal. The nozzles shall operate at 40 pounds per square inch dynamic pressure measured adjacent to the nozzles, shall be approximately nineteen inches from the shelter, shall point directly at the shelter panel under test, and shall be located in a pattern to provide uniform coverage of the panel under test. Nine nozzles shall be used for each end panel and for each side or roof panel. All five exposed panels shall be tested for forty minutes each and more than one panel may be tested at one time, if desired. There shall be no visible evidence of leakage. No additional caulking, taping, etc., is permitted during this test.

5. **EQUIPMENT:**

Spider Fixture with nine (9) nozzles
Hose (connecting to fresh water source).
Water Testing Chamber.
Water Pressure Gage.
Attaching Hardware and Lifting Fixture.

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-25

6. TEST PROCEDURE: (All doors, ports and windows closed)

6.1 Place shelter in test chamber at room temperature.
6.2 Place nine nozzle spider approximately nineteen inches from panel to be tested.
6.3 Attach hose to spider and fresh water source.
6.4 Turn on water and verify gauge reading to be 40 psi ± 3 psi.
6.5 Spray panel under test for a total time of 40 minutes each.
6.6 Turn off water.
6.7 Test the vertical panels of shelter in any convenient sequence.
6.8 Disconnect spider from water source and position spider horizontally by attaching to lifting fixture.
6.9 Position spider above shelter as described in 6.2.
6.10 Repeat steps 6.3 through 6.7.

7. TEST RESULTS: There was no entrance of water during the test.

8. CONCLUSION: The shelter design met the requirements of this test.

Approved by:

Quality Control R. S. Smith

Engineering L. M. Cornish

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QUALITY CONTROL DEPARTMENT

TEST REPORT #010-B-26

1. **TITLE:** Shielding Effectiveness Test
   S-250(XE-2)/G Shelter - Item 2a
   Contract DA-28-043-AMC-01604(E)
   Performed August 29, 1966

2. **PURPOSE:** To test shelter design.

3. **APPLICABLE SPECIFICATION:** SCL-4608A, Amendment #2 dated Dec. 9, 1965

4. **REQUIREMENT:** (Specification Paragraph 4.3.6)
   Shielding Effectiveness - The shelter shall be tested to determine its attenuation to electric and magnetic fields and to plane waves in the frequency range from 0.15 to 10,000 mc with the doors closed. Testing shall be conducted in accordance with the basic methods of MIL-STD-285. The shelter shall attain a minimum attenuation of 60 db throughout the prescribed frequency range.

5. **TEST PROCEDURE AND RESULTS:**

   See attachment of Testing Report No. 552 from Sanders Associates.

6. **CONCLUSION:** Shelter design met the requirements of this test.

Approved by:

Quality Control R. S. Smith

Engineering A. P. M. Cowan

ELECTROMAGNETIC INTERFERENCE EVALUATION

OF A

CRAIG SYSTEMS, MODEL S-250 (XE-4)/G SHIELDED ENCLOSURE

AUGUST 29, 1966

TEST REPORT NO. 554

PREPARED FOR:

CRAIG SYSTEMS, INC.
360 MERRIMACK STREET
LAWRENCE, MASSACHUSETTS

PREPARED BY:

SANDERS ASSOCIATES, INC.
95 CANAL STREET
NASHUA, NEW HAMPSHIRE

ADMINISTRATIVE DATA

PURPOSE: To evaluate the shielding effectiveness of a Craig Systems Shielded Enclosure Model S-250 (XE-2)/G.

DATE TEST BEGAN. August 29, 1966

DATE TEST COMPLETED: August 29, 1966

MANUFACTURER: Craig Systems, Inc.

TYPE OR MODEL: S-250 (XE-2)/G Serial No. 6010-2 CONTRACT NO.:

TEST SAMPLE SPECIFICATION OR DWG. NO.:

QUANTITY OF ITEMS TESTED: 1 (One)

SECURITY CLASSIFICATION OF TEST SAMPLE: Unclassified

INTERFERENCE SPECIFICATION: MIL-STD-285

TEST CONDUCTED BY: R. Burke, Technician

TEST APPROVED BY: H. Kicza, EMI Measurement Supervisor (Actin.)

DISPOSITION OF TEST SAMPLES: Retained at Craig Systems, Inc.

DEVIATIONS APPLICABLE TO INTERFERENCE CONTROL REQUIREMENTS: As modified by Craig Systems Specification ES-334B

TEST PROCEDURE

The shielding effectiveness of a Craig Systems Shielded Enclosure Model S-250(XE-2)/G was measured in accordance with the procedures outlined in Specification MIL-STD-285 as modified by Craig Systems Specification ES-334B.

The attenuation of the enclosure to Magnetic Field Radiation was measured at 150Kc at the center of the door and at the center of each side of the shelter. The 12" loop antennas were placed in a vertical plane and were located 12 inches from the inside and outside walls of the enclosure.

The attenuation of the enclosure to Electric Field Radiation was measured at 150Kc, 1Mc and 18Mc at each vertical corner and both sides of the main door. A 41 inch vertical rod antenna was used and was located 12 inches from the inside and outside walls of the enclosure.

The attenuation of the enclosure to Plane Wave Radiation was measured at 400Mc, 1000Mc and 10,000Mc at the center of each side of the enclosure. Horizontally polarized dipoles and horn antennas were used. The antennas were located 36 inches from the inside and outside walls of the enclosure.

A 90db reference was set during the reference measurements except at 150Kc where a reference level of 75db was used.

The test sample and test locations are shown in Figure 1.

TEST RESULTS

The attenuated level for each test location is given on Data Sheets 1 and 2. The attenuation of the enclosure is equal to the free space reference level minus the shielded level. The minimum attenuation of the enclosure was 60db at 14Kc, magnetic field, measured at the door.

CONCLUSIONS

Craig Systems Shielded Enclosure Model S-250(XE-2)/G Serial No. 6010-2 complies with the 60db requirement as outlined in Craig Systems Specification ES334-B.

R. Burke, Technician

H. Kicza, Acting EMI Measurement Supervisor

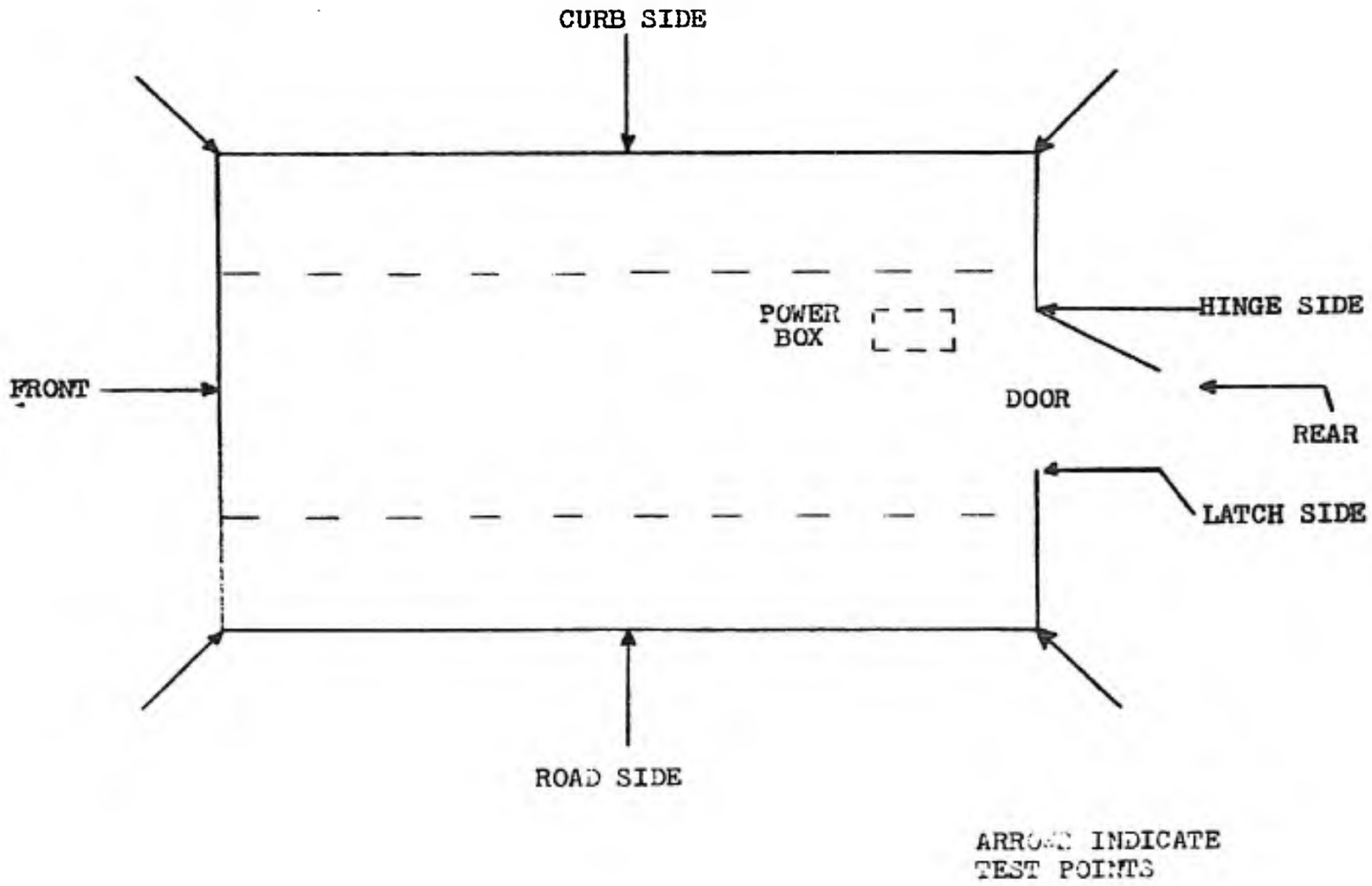

FIGURE 1 TEST SAMPLE AND TEST LOCATIONS

SANDERS ASSOCIATES, INC., NASHUA, N. H.

Data Sheet No 1

ELECTROMAGNETIC SHIELDING EVALUATION

MANUFACTURER Craig Systems
MODEL NO. S-250 (XF-2/G
SERIAL NO. 6.16
CONTRACT NO. THRMB

DATE 8/29/66
REPORT NO. 552
SPECIFICATION Mil. Std. 285
TEST ENGINEER

FREQUENCY	ANTENNA SEPARATION	FREE SPACE REF. (dbμ)	SHIELDED LEVEL(dbμ)	ATTENUATION DB	MAX. ATT. DB	LOCATION	ANTENNA TYPE
150KC	26"	75	15	60		Rear	Loop
150 KC	26"	75	<0	>75		Front	Loop
150 KC	26"	75	<0	>75		Curbside	Loop
150 KC	26"	75	<0	>75		Road Side	Loop
150 KC	26"	75	<0	>75		Latch Side	Rod
	26"	75	<0	>75		Hinge Side	
	26"	75	<0	>75		Curb rear	
	26"	75	<0	>75		Curb front	
	26"	75	<0	>75		Road front	
↓	26"	75	<0	>75		Road Rear	↓
1 MC	26"	90	<0	>90		Latch side	Rod
	26"	90	<0	>90		Hinge side	
	26"	90	<0	>90		Curb rear	
	26"	90	<0	>90		Curb front	
	26"	90	<0	>90		Road front	
↓	26"	90	<0	>90		Road rear	↓
18MC	26"	90	4	86		Latch side	Rod
	26"	90	6	84		Hinge side	
	26"	90	7	83		Curb rear	
	26"	90	11	79		Curb front	
	26"	90	11	79		Road front	
	26"	90	9	81		Road rear	↓

NOTES: Specification Limit - 60DB

Late Sheet No. 2

SANDERS ASSOCIATES, INC., NASHUA, N. H.

ELECTROMAGNETIC SHIELDING EVALUATION

MANUFACTURER Craig Systems
MODEL NO. S-250 (XE-2)
SERIAL NO. 6010-2
CONTRACT NO. JHRIIIB

DATE 8/29/66
REPORT NO. 552
SPECIFICATION Mil-Std-285
TEST ENGINEER R. Burke

FREQUENCY	ANTENNA SEPARATION	FREE SPACE REF. (dbμ)	SHIELDED LEVEL (dbμ)	ATTENUATION DB	MAX. ATT. DB	LOCATION	ANTENNA TYPE
400 MC	74"	90	<0	>90		Rear	Spare
400 MC	74"	90	<0	>90		Curbside	Spare
400 MC	74"	90	<0	>90		Front	Spare
400 MC	74"	90	<0	>90		Roadside	Spare
1GC	74"	90	12	78		Rear	Spare
1GC	74"	90	<0	>90		Curbside	Spare
1GC	74"	90	<0	>90		Front	Spare
1GC	74"	90	<0	>90		Roadside	Spare
10GC	74"	90	23	67		Rear	Horn
10GC	74"	90	<0	>90		Curbside	Horn
10GC	74"	90	<0	>90		Front	Horn
10GC	74"	90	<0	>90		Roadside	Horn

NOTES: Specification Limit 60DB

TEST EQUIPMENT AND FACILITIES

TR # 552

equip used	Description	Manufacturer	Type	Serial	Cal. Date
X	Field Intensity Meter	Empire Devices	NF-105	2020	8/66
X	"	"	NF-105/TA	2020	8/66
X	"	"	NF-105/T2	3348	4/66
X	"	"	NF-105/T3	1746	4/66
X	"	Polarad	FIM-2	292	4/66
X	"	"	FIMX2	269	4/66
X	Signal Generator	Hewlett Packard	606A	038-03786	5/66
X	Power Oscillator	A.I.L.	124	12410	6/66
X	Antenna Kit	Empire Devices	VA105	195	---
X	"	"	AC105	---	---
X	A.P.S. - 4 Radar	Sanders Associates	---	---	---

4. Factual Data - In the initial design of the S-250(XE-2)/G Shelter great emphasis was placed upon lightweight construction. To this end many design approaches which ultimately proved futile were incorporated into the Advance Development Model No. 1. The rejection of the first unit based on inadequate strength of knee panels, inadequate insert capability, dimensional tolerances and weight presented the major difficulty in this program. Each of these areas were corrected such that the resubmitted unit successfully met all of the previous deficiencies. The strength of the knee panels was reinforced by an external angle, the wall and floor insert torque requirements were increased by the substitution of wood thermal barriers rather than high density foam barriers. Dimensional tolerances were pin pointed by further definitiond requirements and the weight problem was eliminated by increasing the allowable specification weight. The resubmitted unit demonstrated compliance with these specifications and also gave a firm basis for the preparation of Government format drawings.

5. Conclusions - It is concluded that the S-250(XE-2)/G Shelter as successfully tested under Contract Item 2a complies with Specification SCL-4608A with Amendment No. 2. Subsequent production testing indicates that units manufactured in accordance with the running set of drawings does yield a shelter which in all aspects meets specification requirements. Some 50 additional shelters have been manufactured by Craig Systems to these drawings and it is felt that the drawings fully represent the tested and approved unit.

6. Recommendations - It is recommended that future consideration be given to two possible areas of improvement. These are:

1. The use of extrusions in lieu of formed members.

   NOTE: This would require an increase in the allowable weight of the shelter.

2. A simplified door with a possible consideration of eliminating the inner door.

It should be noted that in June of 1967 Craig Systems was awarded a contract by USAEC for a production quantity of S-250/G Shelters which will take into account the recommendations noted as 1 above. It is felt, however, that further investigation is warranted under 2 above.

7. Identification of Key Technical Personnel - The following key technical personnel have contributed to the success of the S-250(XE-2)/G Shelter program.

ERNEST Di PAOLO

SENIOR PROJECT ENGINEER

Ernie, as Senior Project Engineer, is extremely well qualified in the broad scope and range of engineering activities at Craig Systems and, in particular, with shelter design, transit case design, and antenna mast design.

BACKGROUND

He spent 14 years with the United Show Machinery Corporation as the Engineering Supervisor of the Construction Department, with the responsibility of designing and construction production and test facilities for components used in aircraft, missile and tank systems.

He joined Craig in 1949 and was engaged in the design and development of the following shelters:

S-57/GR used with Radio Direction Finder
AN/CRD-6
S-62 FR used with VHF Omni-directional Radio Range System
AN/FRN-12
S-73/TRC-32 used with Transportable Radio Set
AN/TRC-32
Helicop-Hut, LM 257, used to house Battery Control Center and field maintenance shops for HAWK Missile System

Helicop-Hut, LM 500, used to house Long Range Auto-theodolite and associated equipment for the JUPITER Program
Programmer Test Station (PTS) and Improved Programmer Test Station (IPTS) for PERSHING Weapon System
OMSS and SMSS Shelter configurations for CHAPARRAL Weapon System Test Equipment
LFE Shelters
Radar and Operations
HAWK PCP Shelters
Alden Weather Finding Station
22' Long CSS (Computer System Shelter)
DAS (Data Analysis Shelter) for UNIVAC's TSS (Tactical Surface System)
22' Long Shelter, Electrical Equipment for Litcom (Westrex) Systems, Inc.

Ernie has also had considerable experience in the development and production of storage and shipping containers for electronic test equipment, missiles, components, and optical devices.

Ernie is a Registered Professional Engineer (Massachusetts).

EDUCATION

He received his B.S. in Architectural Engineering degree from M.I.T. in 1934.

ROBERT S. SMITH

DIRECTOR OF QUALITY CONTROL

Bob, as Director of Quality Control at Craig Systems is responsible for maintaining high standards of inspection and quality of all plant processes and fabrication. At Craig, he implements and supervises cont rols and procedures for inspection and quality control operations, including special processes such as spot welding, welding, adhesive bonding, plastic foaming, soldering, cleaning, prepaint and paint finishing, and environmental testing.

With over ten years of experience at Craig, Bob was responsible for quali ty control on a wide variety of projects including Project TWO WHEELS and Project FOUR WHEELS, Air Traffic Control, and the THOR, JUPITER, MATADOR, PERSHING and HAWK Guided Missiles, which covered structures as well as facility installation. Bob holds ham radio license KIGVB.

The broad scope of his present duties, together with his previous experience in other firms, is a distinct asset in moving with Craig into the field of expanded product center areas of fabricated structures and related activities.

BACKGROUND

Bob's earlier experience was obtained as Quality Control Manager for Electrol, Inc., and Kaiser Motors Corporation. His experience includes responsibility for quality functions on servos, aircraft landing gear and actuators. He has eight years experience in all types of inspection functions on quality control engineering, product engineering, metallurgical laboratory, heat treating and plating operations. He worked extensively on the R-1300-1, -2, -3 and -4 military aircraft engines and the commercial engine L-226.

In 1955, as Quality Control Manager for Electrol, Inc., Kingston, New York, he directed inspection and Quality Control functions relative to commercial and military aircraft hydraulic equipment. Products included hydraulic servos, valves, hydraulic actuators, and aircraft landing gear.

In 1948, and subsequent seven years at Kaiser Motors Corporation, Engine Division, Detroit, Michigan, Bob's assignments on automotive and aircraft engines in Engineering and Quality Control were culminated in the position of Quality Control Manager, with supervisory responsibility over the Metallurgical Laboratory, heat treating and plating operations, as well as Quality Control Department.

In 1940, he joined the U. S. Air Force where his services were utilized in Aircraft Maintenance and Inspection. As an Aircraft Mechanic and Instructor of Aircraft Mechanics, Bob was involved in maintenance and inspection of all aircraft utilized in the Air Force at that time. Final assignment was Crew Chief on a B-29 aircraft stationed on Guam.

EDUCATION

B.S. in Mechanical Engineering from the University of Illinois in 1948. Elected to Mechanical Engineering Honorary Society, Pi Tau Sigma. Bob also attended the University of Minnesota, College of Engineering, and Wayne State University Law School. Participated as Student and Instructor in numerous Courses in the field of Quality Control and Reliability.

WEBSTER J. BROWN

Senior Chemical Engineer

BACKGROUND

Web has held engineering positions with the General Electric Company for approximately thirty years, being a member during this period of the Thomson Laboratory, the Wire and Insulation Department, the Motor and Generator Department and the Industrial Heat Department. He served while with the General Electric Company as Process, Product and Production Engineer over the years.

In 1959, Web joined Anaconda Wire and Cable Company, where he had a project assignment to obtain uniformity of magnet wire processing and product quality at the company's several magnet wire plants.

From 1961 to 1965, he was associated with Mohawk Development Service, Inc. and had several project assignments in the wire and insulation field where the work took him to both United States and foreign locations. He has engineered the erection, the processing and the training of the operators and mill staff in production of magnet wire. At Durgapur, India, a complete wire mill was built and put into operation under his guidance.

EDUCATION

B.S. in Chemistry from Colby College in 1929. Engineering I & II - General Electric Company. Management I & II - General Electric Company. Extension Courses in S.A.I., E.P. and Principles of Foremanship.

DONALD VANCE

Project Engineer

BACKGROUND

Don's former experience obtained as Design Engineer for Fenwal Electronics, Inc., where duties included design and development of electronic packaging techniques for the company's prime product, thermistors. Previous to this, Don worked as a Components Engineer at National Radio Company, Inc., for 7-1/2 years. Duties at National Radio consisted of design and development of mechanical components, primary captive hardware inserts and military specification knobs. Qualified product listing experience was achieved as a result of the military specification knob program.

Don presently holds a commission of First Lieutenant Signal Corp, U.S.A.R.

EDUCATION

Received his B.S. in M.E. Degree from Norwich University in 1958.

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WARREN TIBBETTS
TEST ENGINEER

Warren has been employed at Craig Systems Corporation since 1951 where his abilities have been used in many ways.

As Supervisor of Production Control, he devised and inst alled a control system for the manufacturing of electrical, mechanical and sheet metal production.

As Assistant to the Supervisor of Research & Development, he was responsible for the development of poured-in-place polyurethane foam panels, Polyester glass lay up and epoxy cements as well as the development of the Helicop Hut, a shelter used to house electronic equipment for the Armed Services.

As Manager of Helicop Hut Manufacturing, he was responsible for the engineering, development, manufacturing and methods of this shelter, using cemented and poured-in-place polyurethane foam panels.

As Supervisor and Technical Liaison of the HAWK system for NATO, he was responsible for the documentation of drawings, methods, etc. at the Craig Plant in Lawrence. He also helped to set up and put into production the manufacture of shelters at the Fokker Aircraft Plant in Dordrecht in the Netherlands.

As Manager of the Prototype Division of Research & Development, he was responsible for the development of new products, also in the testing of shelters, masts and transporters according to MIL specifications both at our Lawrence Plant and at the Aberdeen Proving Grounds in Aberdeen, Maryland.

BACKGROUND

From 1943 to 1951, Warren was employed at the International Shoe Machinery Corporation. Cambridge, Massachusetts, where he was responsible for engineering, drafting, manufacturing and service of shoe machinery. He also held positions of Assistant Treasurer, Sales & Service Manager for the United States and Canada.

From 1940 to 1943, Warren was employed at Atwood & Morrial Company in Salem, Massachusetts, as Production Manager of one-third of the business responsible for the manufacture of turbine control valves and relief valves.

From 1927 to 1940, Warren was employed at the United Shoe Machinery Corporation in the Research Division as a draftsman, as a machine designer, and as a member of the test division, which was responsible for the testing and evaluation of all machines, devices, etc. used in the manufacture of shoes and allied products.

EDUCATION

High School at Brockton, Massachusetts

Wentworth Institute - Boston, Massachusetts

Warren has taken numerous courses in chemical handling and epoxy cements, polyurethane foams and Value Engineering.

CHARLES E. WATT, JR.

Assistant Chief Mechanical Engineer

Since 1959, Charles' career in the shelter and van installation field has been closely concerned with the design and selection of air conditioning and ventilating equipment, including air distribution system design and heat transfer design for various shelter applications. He had direct responsibility on the MSQ-18 system for the U. S. Marine Corps.

Charles was previously employed by the Cambridge Corporation and Robinson Boiler Works as a Project Engineer where he designed equipment components and systems for the storage, pumping, and transport of liquified gases, such as liquid oxygen, nitrogen, and hydrogen for military and commercial applications. He also was supervisor of an Advanced Development Laboratory responsible for the development and product improvement of heat transfer applications, thermodynamics, pressure and vacuum vessels, and super-efficient heat insulation systems incorporating high vacuum in

combination with reflective insulations. Charles has experience in high capacity heat exchanger design and test site instrumentation.

He received his B.S. in M.E. degree from Lowell Technical Institute in 1952. He has done graduate work in advanced structural design and high vacuum techniques at Northeastern University and Boston University.

Charles served two years in the U.S. Navy as an Executive Officer aboard ship. He is currently a Lt. (J.G.) in the U. S. Navy on a Standby Reserve basis.

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13. ABSTRACT

Electrical Equipment Shelter S-250(XE-2)/G is an aluminum, lightweight shelter fabricated of aluminum outer and inner skins with polyurethane slab insulation bonded to the aluminum skin to form a sandwich panel approximately 1-1/2" thick. Aluminum hat members within the panel provide mounting for equipment. The door is provided with a door within a door. The inner door provides a means of escape from the inside.

The S-250 Shelter weighs 670 pounds and has a payload capacity of 1900 pounds when transported by 1-1/4 ton vehicles.

The development of the S-250 Shelter was accomplished under Contract DA28-043 AMC-01604(E) issued 30 June 1965. Under this contract an Advance Development Model was designed and successfully tested. The configuration of this accepted unit was the basis for the preparation of a complete set of manufacturing drawings suitable for reprocurement. These drawings were further used for the actual fabrication of procurement models. The final set of drawings was submitted to USAEC on 30 June 1967.

The major accomplishments under this development were the successful design of a lightweight, high strength-to-weight ratio, RF shielded shelter capable of withstanding worldwide environmental conditions. The S-250 Shelter was type classified STD "A" on 27 April 1966.

END.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

Security Classification