

UNCLASSIFIED

AD 273 897

*Reproduced
by the*

**ARMED SERVICES TECHNICAL INFORMATION AGENCY
ARLINGTON HALL STATION
ARLINGTON 12, VIRGINIA**

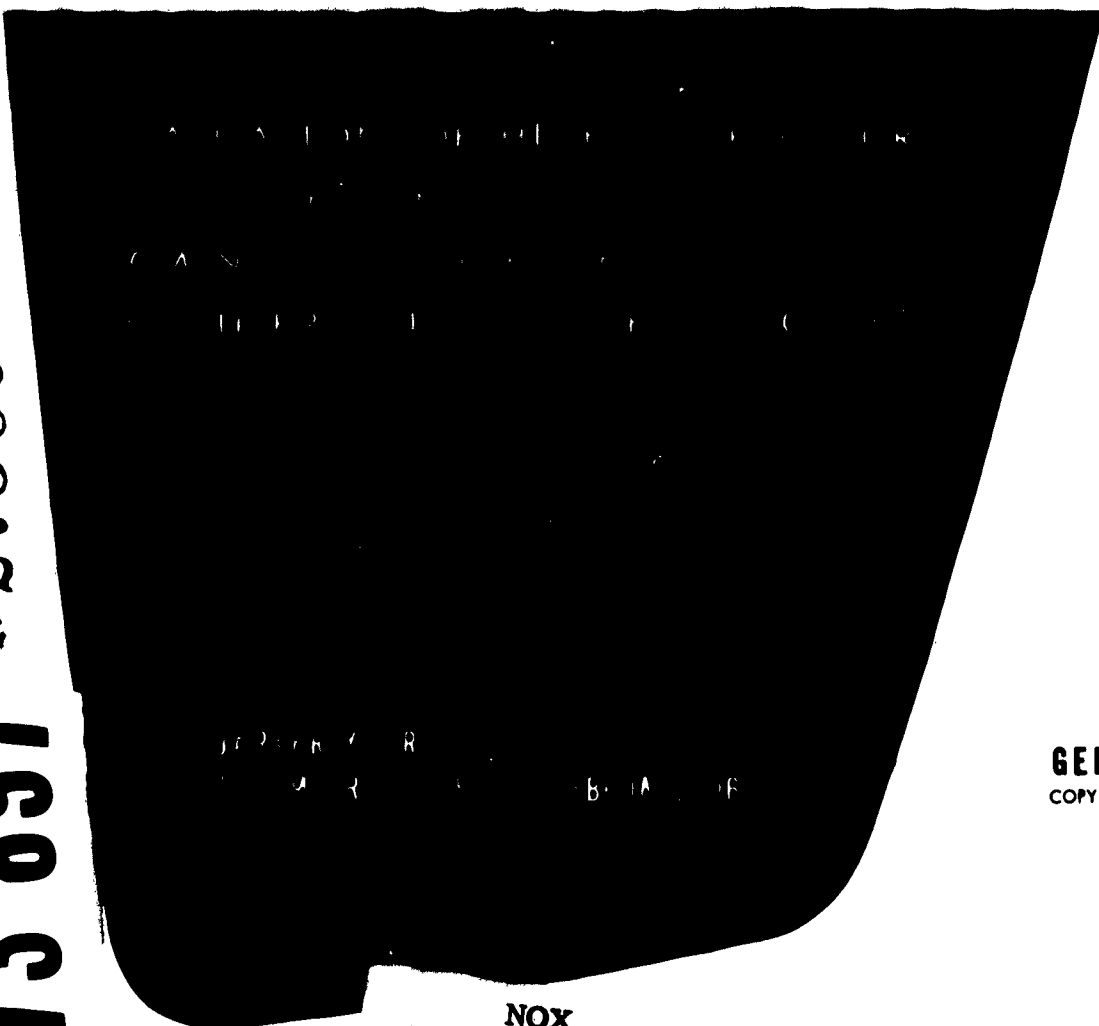


UNCLASSIFIED

**Best
Available
Copy**

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

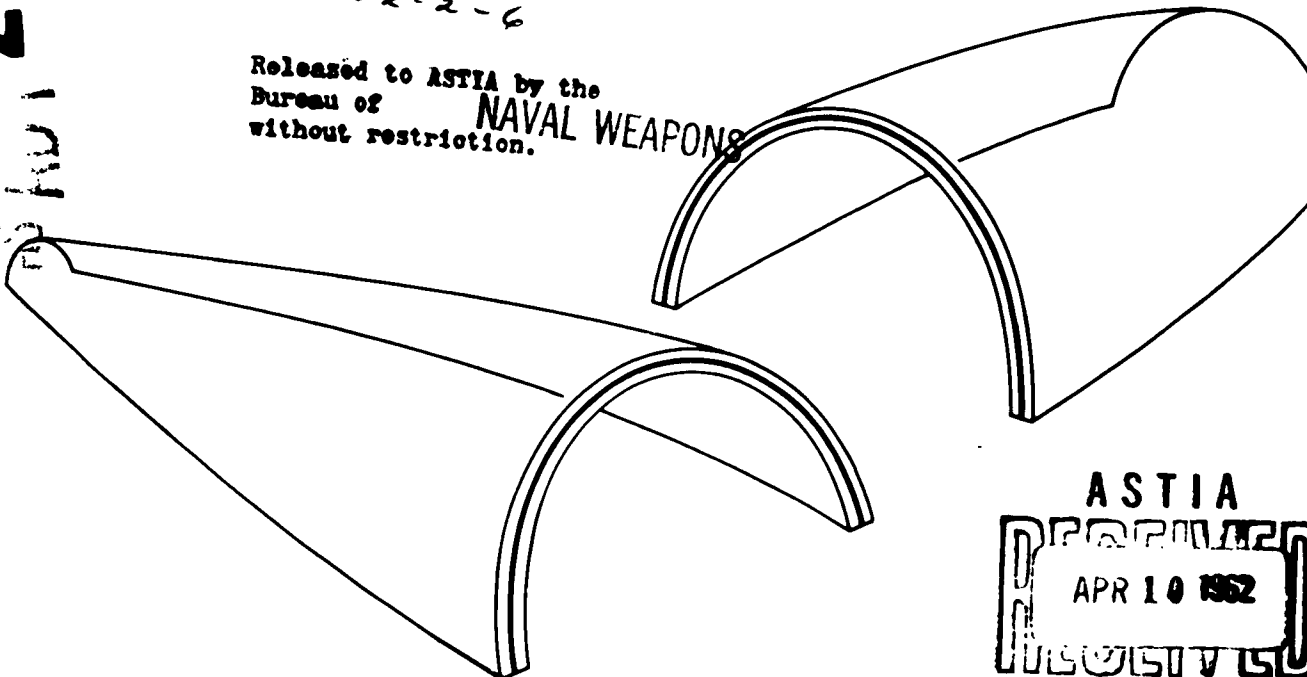
273 897 273897



GER 10613
COPY NO. _____

NOX
62-2-6

Released to ASTIA by the
Bureau of
without restriction. **NAVAL WEAPONS**



ASTIA
RECEIVED
APR 10 1962
ASTIA

GOODYEAR AIRCRAFT CORPORATION

AKRON 15, OHIO

GOOD YEAR
GOODYEAR AIRCRAFT CORPORATION
AKRON, OHIO

**EVALUATION OF HIGH-TEMPERATURE CAST-IN-PLACE
TRANSPARENT PLASTIC LAMINATES SUITABLE FOR
CANOPIES ON SUPERSONIC FIGHTER AIRCRAFT**

Prepared under Bureau of Naval Weapons

Contract NOa(s) 59-6146-C

Quarterly Progress Report No. 9

9 November 1961 through 8 February 1962

Goodyear Aircraft Corporation

Akron 15, Ohio

BY:

APPROVED.

470-108 (1-59)M

FOREWORD

During May, 1961 all work on this program was stopped and placed on a "stop hold" status because of funding limitations. Work was discontinued for approximately 5 months and the "Stop hold" was not cancelled, allowing work to be resumed, until mid-November, 1961. This, then, is the first report since May, 1961 on the program status and covers all work accomplished since November 1961 when work was resumed.

ABSTRACT

The purpose of this three-phase program is to evaluate the Goodyear Aircraft Corporation developed THERMO-SHIELD* concept for a high-temperature resistant transparent plastic laminate possessing a cast-in-place interlayer material. The THERMO-SHIELD laminates under evaluation in this program are of three-ply construction with a 0.250-inch thick load-bearing face sheet of stretched MIL-P-8184 (Plexiglas 55**), a 0.125-inch thick castable interlayer designated Goodyear Aircraft Corporation code F-3 interlayer, and a 0.250-inch thick thermal-barrier face sheet. Materials under consideration as possible thermal barriers in the early part of the program included "regular grade" and "laminating-grade as cast" MIL-P-8184A (Plexiglas 55)¹, Sierracin 880***, Sierracin 890 ***, Selectron 400 ****, Polymer K **, plate glass, an epoxy material developed by Midwest Research Institute, polycarbonate, and Corning Glass Works' Code 1723 high-temperature, low expansion glass. Phase I screening tests reduced the field of potential thermal barriers to "laminating-grade as cast" Plex 55 and epoxy, both being nearly equal in performance. However, because the epoxy material is still in the developmental stage, "as cast" Plex 55 has been selected as the thermal-barrier material for Phase III testing.

The optical and fabrication feasibility study of full-scale THERMO-SHIELD canopies was successfully demonstrated in Phase II of the program.

During the work period just ended, the entire Phase III test setup was finished, all pilot testing to check out test equipment and test procedures was performed and the first gradient temperature destruction test on a full scale THERMO-SHIELD canopy was completed with very successful results. A boundary layer air temperature of 455°F with an associated canopy outboard thermal barrier outer surface temperature of 400°F was reached before the initial failure was experienced.

The canopy was pressurized throughout the test at 8.6 psi and the outboard thermal barrier was above 260°F (boundary layer air above 310° F) continuously for 6½ hours before a delamination type failure at the thermal barrier to interlayer interface, occurred at 400°F outboard surface temperature.

*TM, Goodyear Aircraft Corporation

** TM, Rohm and Haas Co.

***TM, Sierracin Corporation.

****TM, Pittsburgh Plate Glass Company

1 - MIL-P-8184 material (Plexiglas 55) either stretched or "as cast", is hereafter referred to as Plex 55

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
FOREWORD	11
ABSTRACT	111
I INTRODUCTION	1
II PROGRESS COMMENTARY	
9 November 1961 thru 8 February 1962	4
Phase I Commentary	4
Phase II - Part I Commentary - Canopy Fabrication	
Feasibility Study	4
A. General	4
B. Chronological History of Canopies Laminated	
in Phase II	4
C. Optical Quality of THERMO-SHIELD Canopies	8
Phase II - Part II Commentary - Windshield Side Panel	
Fabrication Feasibility Study	10
Phase III Commentary - Full Scale Static Testing	
of the Forward Canopy Configuration	11
A. General	11
B. Test Facilities	12
C. Refrigeration System for Internal Canopy Air	13
D. Test Stand	16
E. Test Canopies	16
F. Instrumentation	19
G. Test Specification for Test No. 1 - Gradient	
Temperature Destruction Test	24
H. Pilot Test History - Test No. 1 - Gradient	
Temperature Destruction Test	29
I. Test No. 1 - Gradient Temperature Destruction	
Test	41
J. Test No. 1 - Strain Gage, Deflection Beam and	
Linear - Motion Potentiometer Data Reduction	46
III WORK SCHEDULED FOR NEXT PERIOD	50
LIST OF REFERENCES	51

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Phase III Test Equipment Setup	14
2	Canopy Test Stand in Place in Test Chamber	15
3	Thermo-Shield Test Canopy Ready for Installation in Test Stand	18
4	Phase III Canopy Instrumentation Block Diagram	20
5	Test Stand Showing Cantilever Beam Deflection Instrumentation	22
6	Test Stand with Canopy and Instrumentation in Position .	23
7	Test Stand and Canopy Ready for Phase III Testing . . .	25
8	Fully Instrumented THERMO-SHIELD Canopy Undergoing Test at 380°F	26
9	Schematic Diagram of Thermocouple Code Identification System for Phase III Testing	30
10	Test Canopies Showing Delaminations Which Occurred During Testing	34
11	Schematic Diagram Showing Relative Positions of all Strain Gages and Code Identification System	47

LIST OF TABLES

<u>Table</u>		<u>Page</u>
I	Chronological History of Laminated Canopies	7
II	Chronological Pilot Test History (No. 5 Canopy)	33
III	Thermocouple Data - Pilot Testing and Test No. 1 Sheet 1	35
IV	Thermocouple Data- Pilot Testing and Test No. 1 Sheet 2	36

LIST OF TABLES (continued)

<u>Table</u>		<u>Page</u>
V	Thermocouple Data - Pilot Testing and Test No. 1 Sheet 3	37
VI	Thermocouple Data - Pilot Testing and Test No. 1 Sheet 4	38
VII	Thermocouple Data - Pilot Testing and Test No. 1 Sheet 5	39
VIII	Comparison of Canopy Face Sheet Temperatures at Time of Failure - Pilot Testing	40
IX	Chronological Test History - Test No. 1	42
X	Comparison of Canopy Face Sheet Temperatures at Time of Failure - Test No. 1	44
XI	Strain Gage Preliminary Data - Test No. 1	48
XII	Beam Deflection and Linear Motion Potentiometer Preliminary Data - Test No. 1	49

SECTION I - INTRODUCTION

This is the ninth progress report in a program to evaluate high-temperature cast-in-place transparent plastic laminates suitable for canopies on supersonic fighter aircraft. The program is divided into three sections as follows:

Phase I - Thermal and structural evaluation of proposed material composites

Phase II - Fabrication feasibility study

Phase III - Full-scale evaluation testing of components produced in Phase II.

Phase I of the program was concerned with the thermal and structural evaluation of different types of THERMO-SHIELD* composites. Each type of composite was of three-ply construction with the following make-up:

1. The 0.250-inch thick load-bearing face sheet common to all test composites was hot-stretched, crack-propagation resistant, transparent plastic, conforming to Specification MIL-P-8184A prior to hot-stretching, with an initial minimum toughness ("K" factor) of 2500 lb/in.^{1.5} at 73.5° F.
2. The 0.125-inch thick interlayer common to all test composites was GAC code F-3 interlayer, a transparent flexible, high-temperature resistant castable resin system.
3. The thermal barrier face sheet was varied for each different type of

*TM, Goodyear Aircraft Corporation Akron Ohio

SECTION I - INTRODUCTION

test composite for screening and evaluation purposes. All thermal barriers were .250" thick, with one exception which is noted.

Potential thermal barrier materials tested are listed below:

- a. Sierracin 880
- b. "laminating-grade as cast" MIL-P-8184
- c. "regular grade as cast" MIL-P-8184
- d. Plate glass
- e. Sierracin 890
- f. Selectron 400
- g. Polymer K (.200" thick)

In addition to the thermal barrier face sheets listed, three other potential thermal barrier materials, only recently available, were given preliminary Phase I screening. These materials were (1) Midwest Research Institute's high-temperature epoxy formulation, (2) Corning Glass Works' code 1723 high-temperature alumino-silicate glass, and (3) polycarbonate extruded sheets.

All Phase I testing has now been completed, with Epoxy and MIL-P-8184A "laminating grade" as cast sheet being the only two thermal barrier materials to successfully withstand the rigors of all screening tests. Because the epoxy material is still in the developmental stage and cannot be obtained in large enough sheet sizes to fabricate the Phase III test canopies, "laminating grade as cast" Plex 55 was selected for use as the thermal barrier face sheet of the THERMO-SHIELD canopies to undergo Phase III static testing.

SECTION I - INTRODUCTION

Phase II of the program encompasses a fabrication feasibility study of full-size prototype THERMO-SHIELD canopies and windshield side panels of McDonnell F-4H design. Thus far, it has been demonstrated that full scale canopies can be laminated with acceptable optical quality.

Phase III involves the static testing of three of the optically satisfactory full size canopies which were laminated in Phase II.

The types of tests planned in Phase III are (1) two gradient temperature destruction tests and (2) a long time cyclic test.

To date, one of the two gradient temperature destruction tests has been completed. Initial test results indicate that the THERMO-SHIELD Canopy concept will be capable of withstanding gradient temperature conditions some what higher than anticipated.

SECTION II - PROGRESS COMMENTARY

9 November 1961 thru 8 February 1962

Phase I Commentary

A. GENERAL DISCUSSION

The last portion of Phase I testing was completed and the associated test data presented in progress report No. 8 (reference GER 10379).

Phase II - Part I Commentary

Canopy Fabrication Feasibility Study

A. GENERAL

The crazing problem which was discussed in report No. 8 has been solved and eliminated. All Phase III test canopies have now been laminated and fabricated, and the results reported herein conclude the canopy fabrication portion of Phase II.

B. CHRONOLOGICAL HISTORY OF CANOPIES LAMINATED IN PHASE II
(Continued from GER 10379, pages 10 through 15)

For a period of time while the program was on "stop hold", small castings were attempted on a laboratory basis in an effort to solve the crazing problem and at the same time conserve material. However, despite numerous attempts, the crazing phenomenon experienced in the full size canopies could not be simulated or reproduced in the laboratory castings. Because of these laboratory results, it was concluded that the crazing phenomenon was peculiar to the size, shape, and contour of the full size canopy and windshield scale panel, and therefore the laboratory size castings were necessarily terminated.

SECTION II - PROGRESS COMMENTARY

Immediately upon resumption of work in mid-November, the annealing temperature and cycle used on the No. 4 canopy were experimentally varied and the No. 5 canopy was laminated. Crazing again developed. The No. 3 wind-side panel also crazed after still another annealing variation. However, the next change in annealing procedures, coupled with a change in method of support of the side panel during the interlayer cure cycle, resulted in the No. 4 side panel being laminated with no sign of crazing. The annealing temperature, cycle and method of support used on the No. 4 side panel were then duplicated on the No. 5 side panel and again no sign of crazing occurred. Again repeating the same annealing temperature, cycle and method of support, the No. 6 canopy was successfully laminated without crazing.

Crazing developed again in the No. 7 canopy, even though all pertinent processing associated with the No. 6 canopy was thought to be exactly duplicated (later proved not to be the case.) The No. 8 canopy was free from crazing with the exception of one small area which developed crazing in the top or crown section of the canopy at the point of maximum draw.

It was discovered at this point that in spite of exactly duplicating annealing procedures and method of support on the No. 6, 7 and 8 canopies and No. 4 and 5 side panels, the processing time between final annealing and laminating had been inadvertently and significantly increased on the No. 7 canopy. This was also true for the No. 8 canopy, but to a much lesser degree, with a corresponding reduction in the amount of crazing

SECTION II - PROGRESS COMMENTARY

which resulted. By using the processing time associated with the No. 6 canopy between annealing and laminating and by again using the No. 6 canopy annealing temperature and cycle, both the No. 9 and No. 10 canopies were laminated successfully without crazing. Laminating of canopies was terminated at this point, as the required number of canopies for test purposes had been fabricated. A tabular account of the canopies laminated in Phase II is seen in Table I.

SECTION II - PROGRESS COMMENTARY

Table I - Chronological History of Laminated Canopies

Serial No.	Condition	Optical condition with respect to grid line distortion & deviation	Remarks
1.	Crazed	Marginal	Cut into pieces for interlayer thickness check
2.	Did not craze	Reasonably good except for "buckles" at side rails	Cut into pieces for interlayer thickness check
3.	Crazed	Good - Slight band distortions in forward & aft hoop areas	
4.	Crazed	Good - Slight band distortions in forward and aft hoop areas	Destroyed in pilot testing
5.	Crazed	Good	Used to complete pilot testing
6.	Did not craze	Meets requirements of McDonnell optical spec.	To be used for second half of gradient temperature destruction test starting at 300°F
7.	Crazed	Meets requirements of McDonnell optical spec. except for crazing	Cut into pieces for interlayer thickness check
8.	Slight crazing	Meets requirements of McDonnell optical spec. except for crazing	Used for first half of gradient temperature destruction test starting at 260°F
9.	Did not craze	Meets requirements of McDonnell optical spec.	To be used for long time cycle test
10.	Did not craze	Meets requirements of McDonnell optical spec.	Back up canopy for either destruction test or cycle test

SECTION II - PROGRESS COMMENTARY

C. OPTICAL QUALITY OF THERMO-SHIELD CANOPIES

The optical quality of the No. 6 thru No. 10 canopies was very good and can be considered to be slightly better than the optical quality reported previously for the No. 3 and No. 4 canopies.

However, even though the test canopies are optically acceptable from a distortion and deviation standpoint, it should be realized that the optical quality of laminated transparencies must necessarily be somewhat inferior to that of a similar monolithic transparency because of thickness variation within the laminate and also because the indices of refraction of the laminate face sheets and interlayer are not matched.

Three of the crazed canopies were cut into sections after laminating to determine the uniformity of the F-3 interlayer thickness. It was found that the interlayer thickness increased progressively toward the center area of each canopy. Checks of the air gap between these canopy shells before laminating indicated a rather uniform nominal thickness of .125". Since the thickness of the interlayer after laminating had gradually increased to at least .200" in the crown area of the canopy, it is reasoned that the hydrostatic head created by the interlayer resin during laminating caused the unrestrained canopy shells to spread apart during the cure cycle in direct proportion to the variation in hydrostatic head at different levels in the canopy. Also contributing to the problem is the fact that the modulus of the Plexiglas 55 shells decreases slightly at the interlayer curing temperature, thus making the shells more susceptible to deflection under the pressure forces of the hydrostatic head.

SECTION II - PROGRESS COMMENTARY

Even though optics in the canopies are very good, particularly in the side areas, it is felt that optical quality has been reduced in the upper side and top areas of the canopies because of the gradual increase in interlayer thickness toward the top centerline. This increase in interlayer thickness can be eliminated, however, should the optical requirements of the part in question demand it.

All canopies in this feasibility study program were laminated without the aid of any tooling casting fixtures or special laminating equipment. By utilizing matched male and female holding fixtures with an indexing system to control interlayer thickness during the laminating operation, the varying interlayer thickness due to the hydrostatic resin head could be virtually eliminated. Such laminating tooling would be well within the state of the art, being nothing more than a female forming fixture with a male plug cast from the female mold surface. Such a system would control interlayer thickness precisely and should result in laminated parts of excellent optical quality.

SECTION II - PROGRESS COMMENTARY

Phase II - Part II Commentary

Windshield Side Panel Fabrication Feasibility Study

The laminating history of five windshield side panels has been briefly mentioned in relation to the crazing problem. In no case has a laminated side panel even approached the degree of optical quality required for a panel with such stringent optical requirements (79° angle of incidence from pilot's eye position). However, the optical quality of the assembled side panels prior to the laminating operation has been for the most part within acceptable limits.

Interlayer thickness checks after laminating have revealed even more extreme increases in the interlayer thickness than was the case with the canopies. It is a virtual certainty that the optical quality required for a laminated side panel cannot be achieved without the aid of a laminating fixture (such as described for use with the canopies) to precisely maintain a uniform interlayer thickness.

To verify this supposition, one more side panel will be laminated to complete this portion of Phase II. However, it will not be "laminated" in the strict sense associated with castable interlayers. A sheet of cured F-3 interlayer of uniform thickness has been prepared for insertion between two side panel shells to form a three ply sandwich. Tests in the past on experimental panels prepared in a similar manner have shown that a pseudo type adhesion can be obtained between the outer face sheets and F-3 interlayer sheet by subjecting the sandwich to the F-3 interlayer curing temperature and at the same time

SECTION II - PROGRESS COMMENTARY

applying vacuum and autoclave pressures of 20 psi. Although the resulting interlayer adhesion to the face sheets is inadequate for structural purposes, such laminates can be used for optical studies.

Therefore, if this technique can be applied successfully to the side panel, it should be possible to optically evaluate a side panel with a uniform interlayer thickness. In this manner it could then be rationalized whether or not laminating fixtures could be employed to precisely control the F-3 interlayer thickness to achieve a THERMO-SHIELD side panel with acceptable optical quality.

Phase III Commentary

Full-Scale Static Testing of the Forward Canopy Configuration

A. GENERAL

The setup of all test facilities and test instrumentation was recently finished. Pilot testing was then accomplished and Test No. 1 was completed just prior to the close of the work period. The following discussion pertains to the details of the test setup, instrumentation, test procedures, pilot testing, Test No. 1, data reduction and a brief analysis of initial test results.

B. TEST FACILITIES

The setup of the test oven and refrigeration equipment described in report No. 8 was completed soon after the start of the report period. The crazed No. 4 canopy was trimmed and fabricated for pilot test purposes so as to avoid damaging a good test canopy if anything should go wrong during initial test equipment and systems checkout. After extensive preliminary checkout and testing of all equipment, it became apparent that the heat exchanger unit for the test oven did not have sufficient capacity to attain the required test temperatures. At the time the test oven was designed, this heat exchanger unit had been available and was, by engineering analysis, rated at sufficient capacity (BTU's/hr) to provide the heat flux and temperatures required by Phase III test specifications. However, in the actual test setup, heat losses from convection and from hot air expansion in the heat transfer ducting to the test chamber resulted in insufficient boundary layer air at the canopy to raise the outboard thermal barrier surface of the canopy to the required test temperatures. Attempts to correct the situation were unsuccessful and it was decided to move the test setup into an existing oven (of proven high temperature capabilities) which was made available by necessity in the GAC Plastics production area. The canopy interior refrigeration system and the entire instrumentation system of thermocouple recorders, strain gage oscillograph recorders, power supplies and bridge balance boxes were moved intact to the new test area. The new test oven was modified to accommodate the strain gage compensating window, observation windows, and the ducting for the refrigeration

SECTION II - PROGRESS COMMENTARY

equipment. The new setup, after relocation, is seen in Figures 1 and 2. The new test oven is capable of attaining temperatures of 500°F and has a burner output rating of 500,000 BTU/hr.

A five horsepower circulating fan supplies 10,500 cubic feet of air per minute (CFM) to the oven chamber which is 10 feet wide, 15 feet long and 7 feet high. The oven air velocity approximately 1 inch from the canopy surface has been measured by means of an anemotherm and found to be in the range of 120-250 feet per minute (FPM).

A zone check of the empty oven chamber established that a uniform temperature distribution existed within the oven of $\pm 2^\circ\text{F}$ over the temperature range from 100°F to 500°F.

C. REFRIGERATION SYSTEM FOR INTERNAL CANOPY AIR

The purpose of this cooling system is to maintain the closed system internal air at a temperature which would simulate actual high speed (Mach 2.5+) flight conditions. The capacity of the system was determined by thermodynamic calculation to maintain the inlet air at an h_{s1} (internal surface heat removal rate) which would match known conditions of high performance aircraft. The resulting test data has demonstrated the suitability of the refrigeration system.

The mechanical refrigeration system for the inside air of the canopy consists of an air compressor and evaporator coils. Refrigerated air is circulated thru the canopy at approximately 390 FPM and 76 CFM. The cooling system is of the recirculating type and thus is pressurized to 8.6 psi while in operation as a result of the canopy itself being pressurized.



Figure 1. Phase III Test Equipment Setup

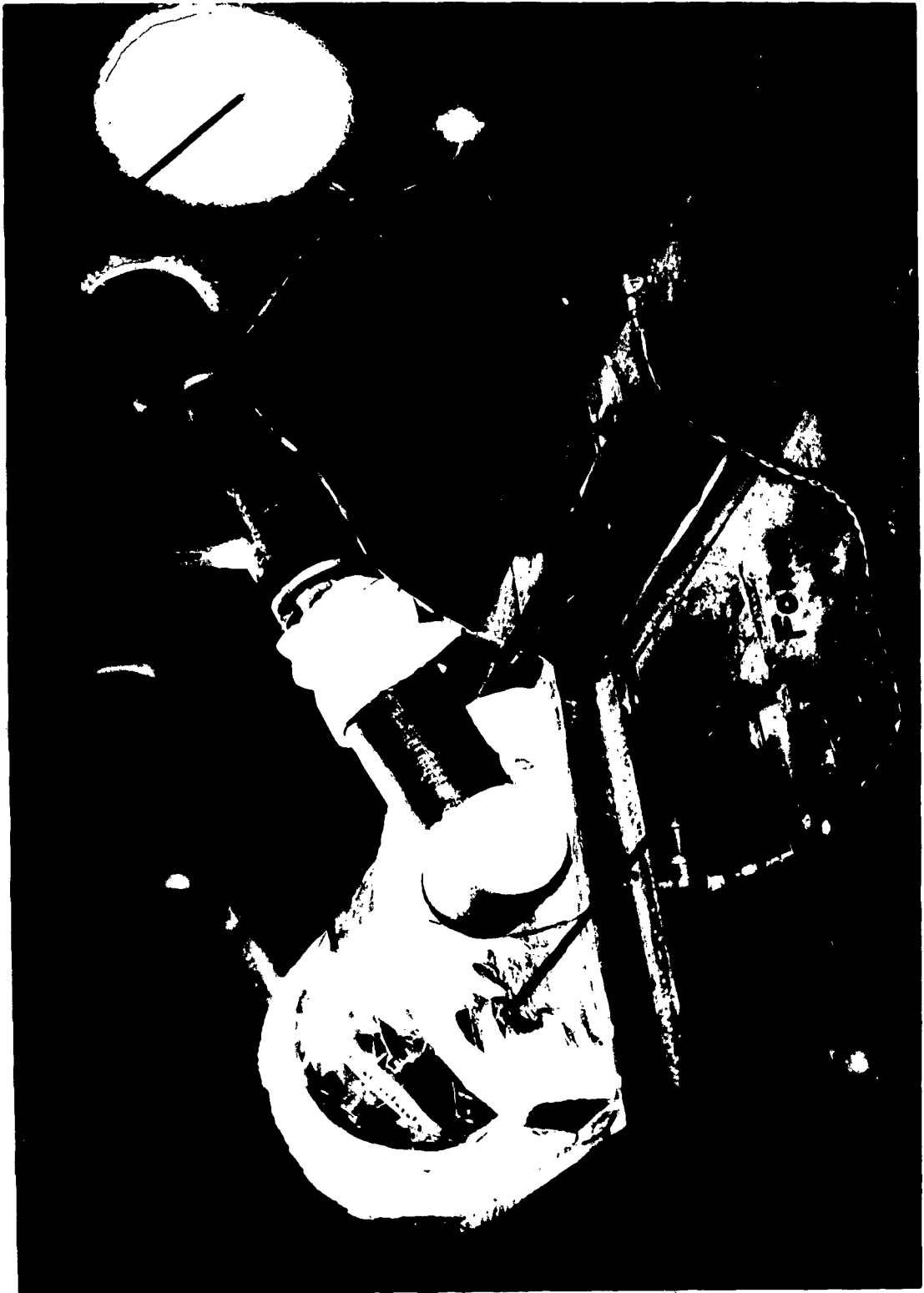


Figure 2. Canopy Test Stand In Place In Test Chamber

SECTION II - PROGRESS COMMENTARY

The pressurization system is controlled by a differential pressure controller and a solenoid pressure relief valve to prevent accidental overpressuring of the canopy and refrigeration system.

D. TEST STAND

The canopy test stand, complete with a canopy installed and instrumented, was seen in Figure 2. The bulkheads of the test stand have been insulated with Fluro-Carbon blown Polyurethane foam and the side rail and hoop areas of the canopy have been faired in with asbestos insulating cement. The access manhole in the bottom of the test stand is also covered with insulation during testing, as are the inlet and exhaust refrigeration ducts leading into the test stand bulkheads. Provisions have been made to slowly circulate cold water through the base of the test stand to prevent the side rail edge attachment from overheating during testing and, thus simulate the heat sink of a typical canopy frame and airplane structure. Instrumentation wiring inside the pressurized canopy and refrigeration system has been routed through the refrigeration ducting and exits to the recording equipment through a potted, pressure tight seal. External instrumentation wiring is routed thru an insulated hole in the oven wall directly below the strain gage compensating window (not shown in Figure 2. Window was replaced with insulation for Pilot testing).

E. TEST CANOPIES

As mentioned previously, all canopies required for Phase III testing have been laminated. These units have been trimmed to size, routed, and all edge attachment holes drilled per drawing 61QS281 (reference GER 10379, p 31). All test canopies have been fully strain gaged and wired, including the No. 9 cyclic test canopy and No. 10 backup canopy.

SECTION II - PROGRESS COMMENTARY

GER 10631
1111 1 10

A test canopy (No. 9) is seen in Figure 3, immediately prior to installation and bolting into the test stand. Close observation of Figure 3 will show:

- (1) The right side thermal barrier clamping plates in position (note forward, center and aft cutouts at top edge of plates to allow cantilever arms on the linear motion potentiometers to extend under the edge of the thermal barrier cutback.
- (2) Step rout in as cast Plex 55 thermal barrier where aluminum hoops and loading straps fit (reference GER 10379 pages 33 and 34).
- (3) Elongated holes in lower side rail (center two are circular) for slotted edge attachment inserts and bolts.
- (4) Small circular holes in side rail above elongated holes where thermal barrier clamping plates bolt to canopy.
- (5) Orientation of the Baldwin type PA-3 strain gages at the forward, center and aft hoop sections.
- (6) Orientation of the Baldwin type PA-3 strain gages in the longitudinal direction along the side rail.

Due to excessive air leakage during pressurization to 8.6 psi, the rubber diaphragm used to seal off all openings around the side rail bolt holes and hoops was discarded in favor of a pressure sealing compound (Thiokol type- Proseal PR-1221). All large openings are first filled with zinc

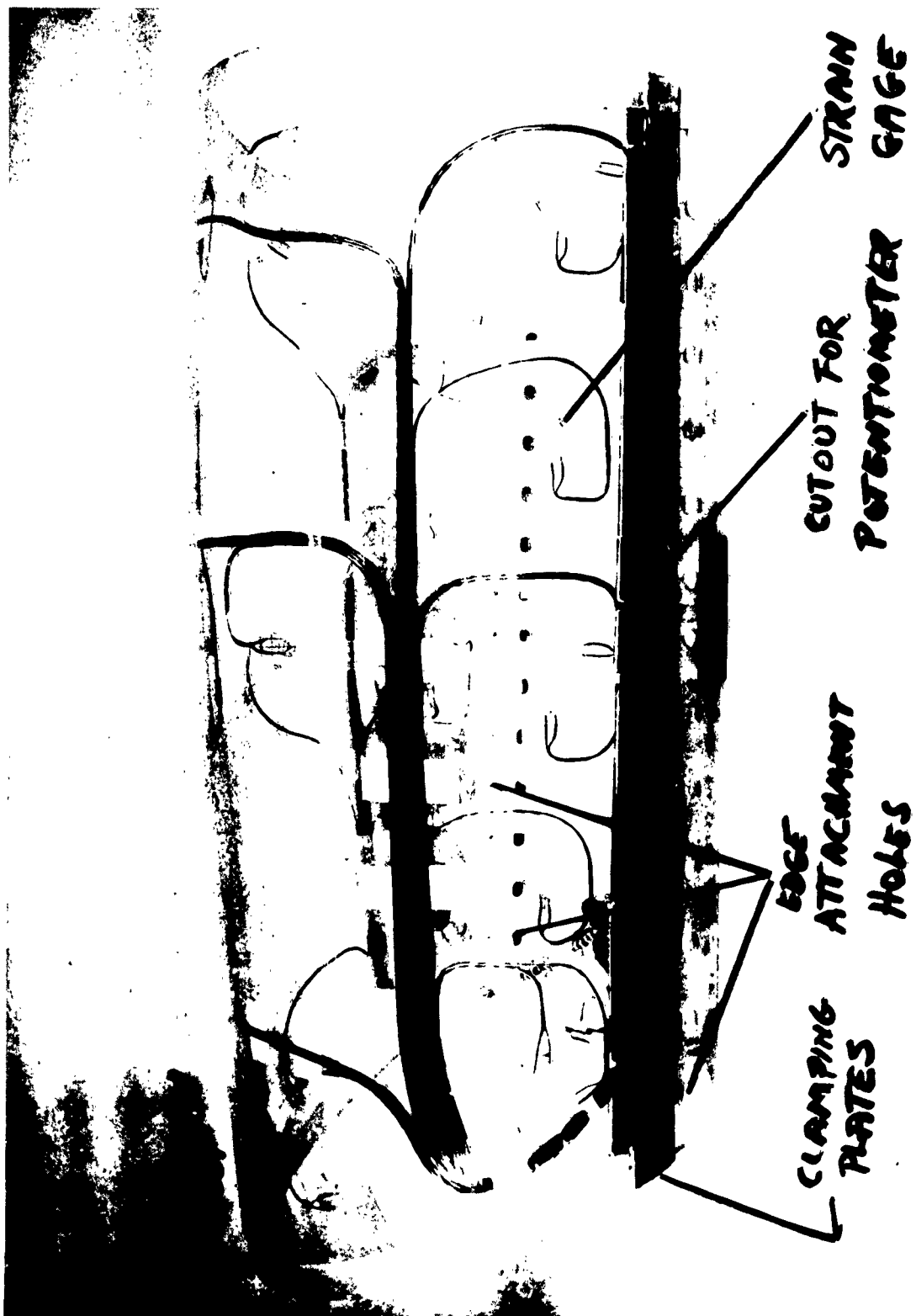


Figure 3. THERMO-SHIELD Test Canopy ready for Installation in Test Stand

SECTION II - PROGRESS COMMENTARY

chromate sealing putty. Pro-Seal PR-1221 sealing compound is then applied over the zinc chromate putty and all other openings to completely seal any openings which could cause leakage and loss of pressure during testing. This sealing system has been satisfactorily used on all testing performed to date.

F. INSTRUMENTATION

The instrumentation system consists of recording equipment to monitor and permanently record temperatures, deflections and strains of the test canopies.

- (1) Temperatures are recorded at 100 different points by means of No. 30 gage iron-constantan thermocouples on a Brown Automatic temperature recording system. A complete sequence of 100 readings can be recorded in $2\frac{1}{2}$ minutes by the system.
- (2) Canopy deflections (normal to the surface) are measured by the cantilever beam method. The cantilever beams utilize strain gages which are externally powered by precision bridge power supplies. Signals are subsequently routed through a network of bridge balance boxes, with the output signals being recorded on light sensitive film in an oscillograph. The film is then developed and the data reduced. A block diagram type schematic of this portion of the instrumentation is seen in Figure 4.

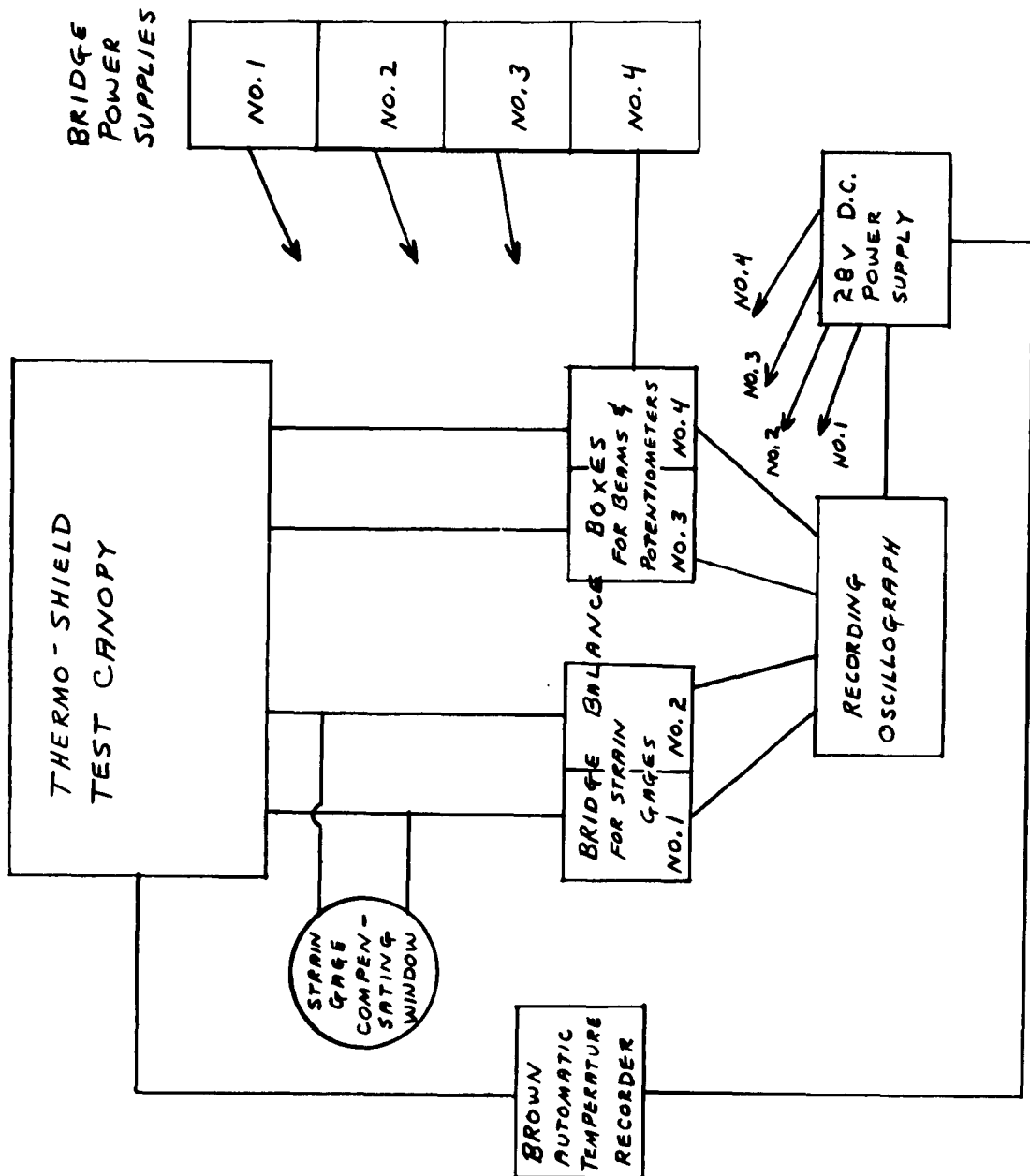


Figure 4. Phase III Canopy Instrumentation Block Diagram

(3) The strain gage readings are accomplished by using Baldwin type PA-3 post yield strain gages. The gages are electrically bridged and the output signals routed in the same manner as described above in item (2) for canopy deflections. Other details pertaining to the exact location points of all instrumentation, etc. were presented previously in GER 10379, pages 42-44.

Several of the cantilever beams used for measuring deflections can be seen in Figure 5. The beams are clipped to the supporting bridge structure by means of small c-clamps. After a test canopy has been installed and bolted in place, the bridge support structures are raised thru the access manhole and secured in place to the base of the test stand. The individual cantilever beams are then clipped in place, plugged into the electrical junction cables, adjusted to the canopy surface to ensure the proper amount of spring tension on the canopy surface and then calibrated. Also shown in Figure 5 are three of the six linear-motion potentiometers used to measure vertical displacement of the "as cast" Plex 55 thermal barrier shell with respect to the base of the test stand.

Figure 6 is similar to Figure 5, except that a canopy has now been placed in the test stand to show the relative positions of the instrumentation with respect to the canopy surface. Note the cantilever arms on the linear-motion potentiometers extending under the edge of the "as cast" Plex 55 thermal barrier.



Figure 5. Test Stand Showing Cantilever Beam Deflection Instrumentation



Figure 6. Test Stand With Canopy and Instrumentation in Position

SECTION II - PROGRESS COMMENTARY

Figure 7 shows the canopy bolted in place in the test stand with all asbestos insulation faired in place. The hoop loading straps are beneath the faired insulation and cannot be seen. Three cutouts have been provided in the side rail insulation for access to the linear-motion potentiometers. A baffle for distributing refrigerated air flow within the canopy can also be seen near the center of the canopy.

Figure 8 is a view through the observation window in the test oven during the latter stages of Test No. 1 (gradient temperature destruction test) when the canopy outboard surface was at 380°F. All instrumentation can be seen, including thermocouples and the forward, center and aft hoop baffles for internal air distribution.

- G. TEST SPECIFICATION FOR TEST NO. 1 - GRADIENT TEMPERATURE DESTRUCTION TEST
- All test requirements and conditions have been previously discussed and outlined in progress report No. 7 (reference GER 10378, pages 15 thru 18). However, it is the purpose of this section to review all pertinent test requirements and conditions in order to gain a clearer understanding of the discussion to follow pertaining to the results of pilot testing and Test No. 1.

During a meeting held on January 17, 1961 at GAC between BuWeps and GAC personnel, the following general outline of procedure was established for Phase III testing:

- (1) Goodyear Aircraft Proposal (GAP) 8225 remains the basic program guide for Phase III testing.



Figure 7. Test Stand and Canopy ready for Phase III Testing

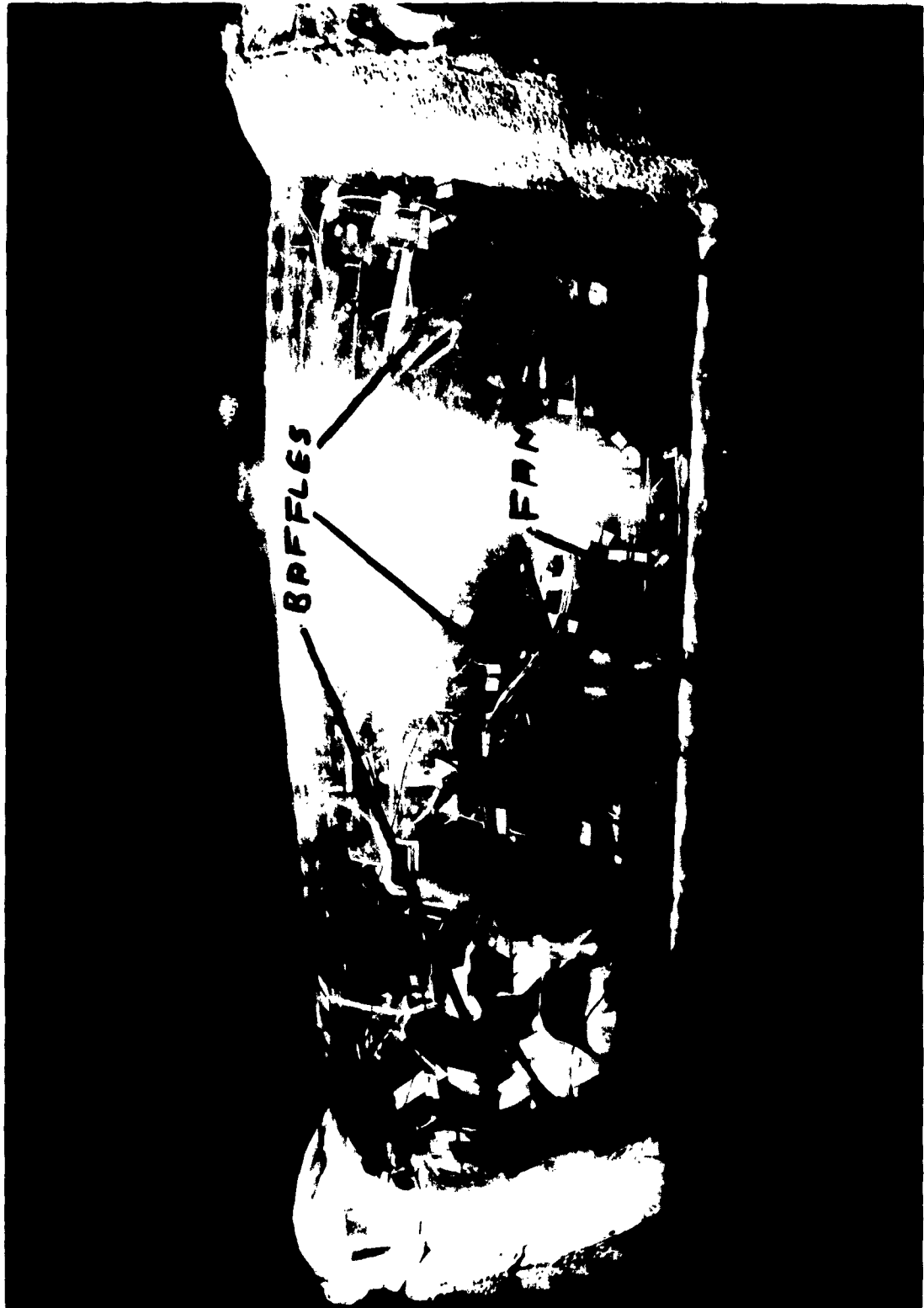


Figure 8. Fully Instrumented THERMO-SHIELD Canopy Undergoing Test at 3800F

SECTION II - PROGRESS COMMENTARY

- (2) 0.250-inch thick "laminating-grade as cast" Plex 55 will be used for the outboard thermal barrier material for all test canopies. This decision was based on NRL wind tunnel tests (reference GER 10378, page 9) and the comprehensive Phase I evaluation screening tests conducted by GAC.
- (3) Though GAP 8225 states that only two canopies will be tested, BuWeps and GAC personnel concur that testing may involve three or four canopies instead of two.
- (4) Requirements for Test No. 1 - Gradient Temperature Destruction Test

The purpose of test No. 1 is to determine the apparent limiting temperature gradient at which a THERMO-SHIELD canopy can sustain short-time applications of limit load without failure. The test will consist of stabilizing the canopy at successively higher temperatures while under limit load for 20 minutes at each temperature. Failure will be determined by visual observation of such phenomena as delamination, crazing, interlayer cracking, material shrinkage or "shrink back", yellowing, orange peel, etc. The three percent material creep limitation suggested by GAP 8225 will not apply, principally because it has been determined that this parameter cannot be measured accurately under the specified test conditions and with existing test instrumentation. Likewise, midplane or interlayer temperature control as suggested by GAP 8225 will not apply. Instead, inboard and outboard temperatures will be controlled and interlayer temperatures will be computed. Other test details will be as follows:

SECTION II - PROGRESS COMMENTARY

- (a) Outboard or thermal-barrier surface temperature will be stabilized successively at temperatures of 260°F, 270°F, 280°F, 290°F, 300°F, 310°F, - - - to failure.
- (b) Inboard surface temperature will be maintained throughout the entire test at approximately 130°F and will not exceed 160°F. The 160°F temperature may be encountered due to the natural temperature gradient at the higher test temperatures.
- (c) The temperature of the edge attachment area will be controlled at approximately 110°F and is not to exceed 130°F.
- (d) Cockpit air pressure will be 8.6 psi.
- (e) The canopy will be stabilized successively at each temperature and held for 20 minutes at 8.6 psi and limit load. The canopy will be de-pressurized after the required time at each test temperature, and deflection readings, etc. will be recorded before the temperature is raised to the next increment. The canopy will not be returned to room temperature until failure occurs.
- (f) Strain gage transducers will be used to measure deflections on the inside of the canopies at forward center and aft hoop sections.
- (g) Strain gage readings will not be recorded on the outside of the canopies because of the temperature limitations of available strain gages. On the inside of the canopies, the strain gages will not be exposed to temperatures above 160°F and can, therefore, be cemented to the inside surface of the stretched Plex 55.

Strain gages cemented to the outside surface could be the source of premature failure at the high test temperatures expected.

(h) Temperature readings will be taken by means of thermocouples at all points of instrumentation and also at any other points of specific interest.

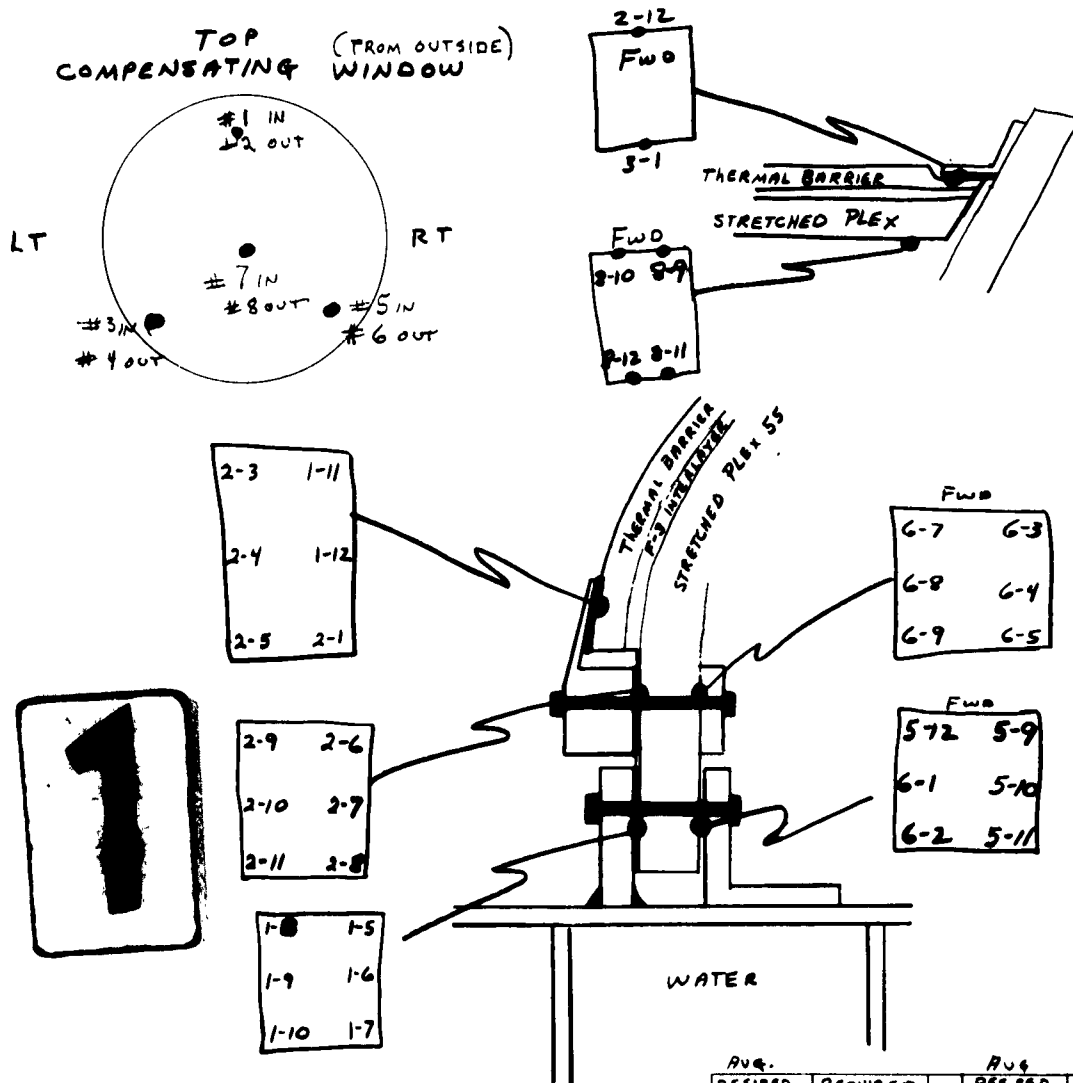
(i) Strain and deflection readings, etc. will also be recorded after completion of cycling until the canopy and test stand have cooled to room temperature.

H. PILOT TEST HISTORY -- TEST NO. 1 - GRADIENT TEMPERATURE DESTRUCTION TEST (NO. 5 THERMO-SHIELD CANOPY)

Figure 9 shows the position, relative location, and identification code of all thermocouples which will be monitored in Test No. 1 and the long time cyclic test.

After determining that the canopy could be successfully pressurized to 8.6 psi without significant leakage, pilot testing was commenced. Instrumentation for this test was limited to the complete thermocouple monitoring system and one longitudinal row of strain gages along the top centerline of the canopy.

Runs No. 1 thru 14 on the No. 5 pilot test canopy were performed over a period of several days to "bug out" and become familiar with the functionality of the test setup, oven and refrigeration characteristics, and instrumentation performance.



FWD BULKHEAD INB'D 3-2
AFT BULKHEAD INB'D 3-4
TEST STAND SURFACE (RT) 3-5
TEST STAND SURFACE (LT) 3-6

BUREAU OF NAVAL WEAPONS
THERMO-SHIELD CANOPY
TEST PROGRAM

AVG. DESIRED OUTB'D SURFACE TEMP	REQUIRED OVEN SETTING	AVG. DESIRED OUTB'D SURFACE TEMP	REQUIRED OVEN SETTING
260°F	310°F	390°F	445
270°	317	400°	455
280°	328	410°	
290°	343		
300°	355		
310°	360		
320°	370		
330°	385		
340°	400°		
350°			
360°	415		
370°	430 475		
380°	445 491		

OUT
LINE

3-11
7-2

4-2
7-5

OUT AIR
1-4

LEFT
5-8
7-11

INSIDE
AIR

4-11
8-2

5-4
8-7

PL
OF

SECTION II - PROGRESS COMMENTARY

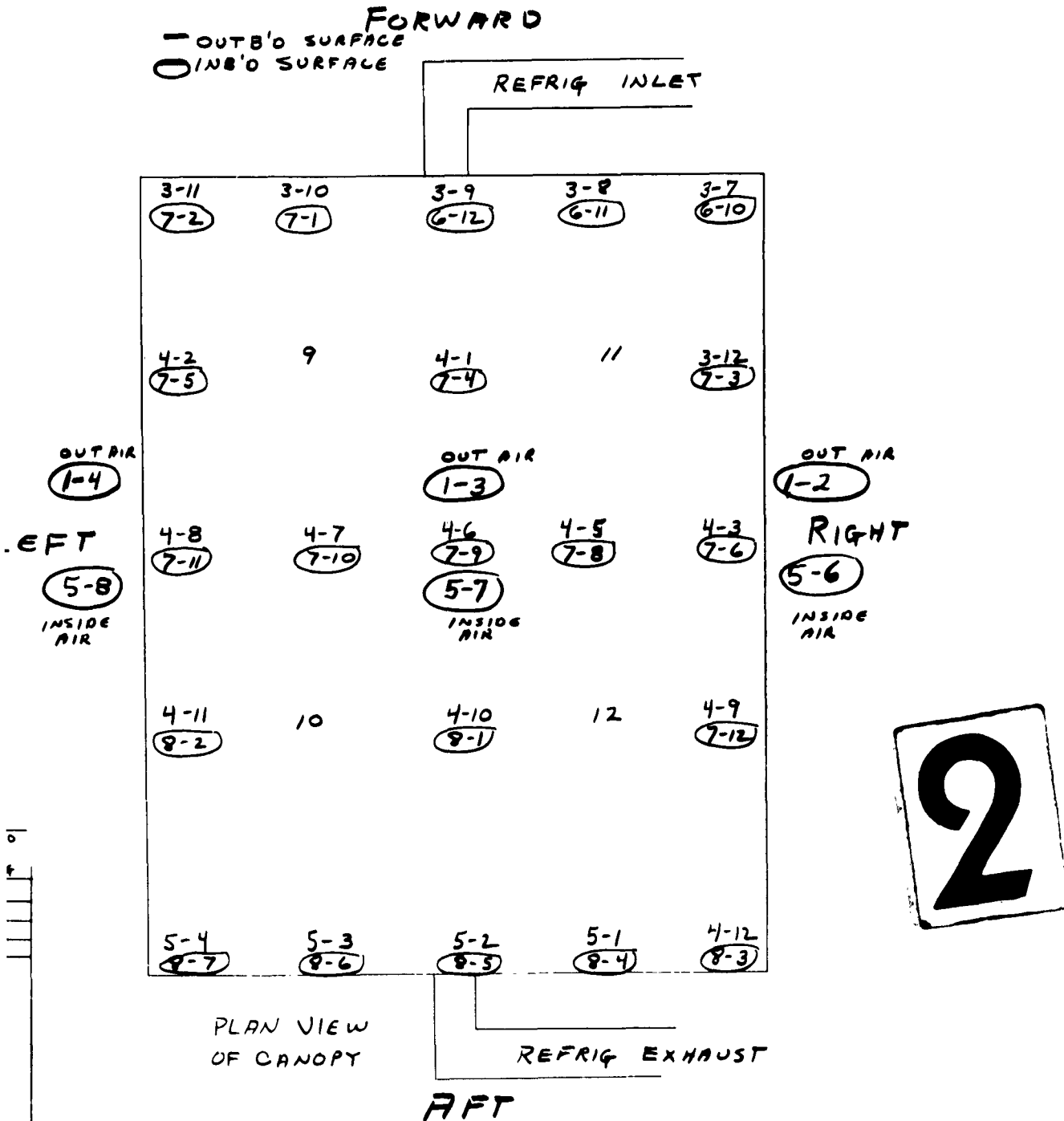


Figure 9 - Schematic Diagram of Thermocouple Code Identification System for Phase III Testing

Pilot runs No. 15 thru 25 were then conducted in one continuous test sequence similar to that which would be performed in Test No. 1 in order to gain temperature soak time characteristics and to thoroughly evaluate the adequacy of the test oven and refrigeration system under actual test conditions.

Following in Table II, page 33, is a brief chronological test history for the completion of pilot testing with the No. 5 canopy.

Figure 10 shows the locations of the initial delaminations in the No. 5 canopy and the size to which they had grown at the time testing was terminated.

All thermocouple data collected in pilot testing and Test No. 1 has been tabulated in Tables III thru VII. Verbal descriptions as well as code number identification is included at the top of each column. Each test run, representing 20-25 minutes (after stabilization at a test temperature), is identified in the extreme left hand column of each Table.

General observations based on correlating all test temperatures for the pilot test are itemized below. Various temperatures at each point of delamination are seen in Table VIII. (All interface temperatures have been calculated and are based on inboard and outboard surface temperatures and the resulting temperature gradients established in the laminate by the surface temperatures).

SECTION II - PROGRESS COMMENTARY

- (1) All delaminations were seen to start at the inner face between the outboard as cast Plex 55 face sheet and the F-3 interlayer.
- (2) No "shrink back" in the structural face sheet of stretched Plex 55 resulted, even though the stretched Plex 55 inner face temperature in some areas eventually reached 272°F with a corresponding inboard surface temperature of 175°F.
- (3) No failure was catastrophic and 8.6 psi pressure was still being maintained in the canopy at the conclusion of testing.
- (4) The average outboard surface temperature of the canopy was within $\pm 12^{\circ}\text{F}$ of nominal test run temperatures. This temperature spread is larger than the $\pm 2^{\circ}\text{F}$ spread which existed in the zone check of the empty test chamber.

However, the air distribution and circulation is adequate even though the installation of the massive canopy test stand and refrigeration ducting in the chamber did slightly disrupt air distribution and circulation.

5. The wide spread in inboard temperatures of the stretched Plex 55 (reference thermocouple code points 6-10 thru 8-7) was due to several hot spots on the interior surface of the canopy caused by inadequate circulation of the refrigeration air.

<u>Time</u>	<u>Start of Run No.</u>	<u>End of Run No.</u>	<u>Test Oven Temp. (boundary layer air)</u>	<u>Outboard Surface Temperature</u>	<u>Remarks</u>
10:37-11:19AM					Oven warmup
11:19	15		300°F	260°F	
11:42		15			
11:50	16		317	270°F	
12:10 PM		16			
12:36	17		328	280°F	
12:58		17			
1:00	18		343	290°F	
1:20		18			
1:23	19		355	300°F	
1:43		19			
1:47	20		360	310°F	
2:10		20			
2:15	21		370	320°F	
2:32		21			
2:40					Est. Start of #1 delam. at top edge of forward hoop
2:43	22		385	330°F	
2:50					Start of #2 & #3 delaminations. The #1 delam. was first discovered but had been present for some time
3:05					
3:09		22			
3:14	23		400	340°F	
3:20					4th Delam. started
3:34		23			
3:38	24		415	350°F	
3:58					Start of #6 delamination
4:12		24			
4:20	25		445	380°F	
4:41		25			Stop test

Table II - Chronological Pilot Test History (No. 5 Canopy)



Figure 10. Test Canopies Showing Delaminations Which Occurred During Testing.

TEST RUN #	TEST	START	REF	OUTER STRETCHED REF AT EDGE ATTACHMENT										OUTER INTERNAL BRIDGE MIND TONGUE OF										OUTER STRETCHED REF AT EDGE ATTACHMENT									
				MOLES, GROUND, STEEL, RAIL										MOLES, GROUND, STEEL, RAIL										MOLES, GROUND, STEEL, RAIL									
				1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10	2-11										
NO. 1	150°F. PRESSURE	311	318	65	70	OPEN	70	71	72	74	74	74	72	-	73	73	73	69	70	68	68	62	60										
NO. 2	150°F. PRESSURE	312	319	162	90	OPEN	88	89	90	90	90	90	90	-	85	90	90	85	85	85	85	85	85										
NO. 3	150°F. PRESSURE	313	320	164	73	OPEN	72	72	73	73	73	73	73	-	106	106	106	106	106	106	106	106	106										
NO. 4	300°F. PRESSURE	323	330	302	102	OPEN	102	102	104	105	105	105	105	-	96	102	102	89	89	89	89	89	89										
NO. 5	300°F. PRESSURE	324	331	303	111	OPEN	110	110	112	112	112	112	112	-	99	105	105	91	91	91	91	91	91										
NO. 6	300°F. PRESSURE	325	332	304	72	OPEN	55	76	74	61	84	98	91	-	105	110	107	83	83	83	83	83	83										
NO. 7	300°F. PRESSURE	326	333	305	60	OPEN	54	63	63	57	91	102	99	-	105	107	107	86	86	86	86	86	86										
NO. 8	300°F. PRESSURE	327	334	306	104	OPEN	100	111	116	111	119	111	112	-	112	117	122	103	103	103	103	103	103										
NO. 9	300°F. PRESSURE	328	335	307	98	OPEN	90	99	104	102	127	124	124	-	128	135	137	117	117	117	117	117	117										
NO. 10	300°F. PRESSURE	329	336	308	56	OPEN	53	66	66	61	92	114	98	-	110	120	118	88	88	88	88	88	88										
NO. 11	300°F. PRESSURE	330	337	309	110	OPEN	111	115	116	116	126	132	139	-	141	143	142	121	121	121	121	121	121										
NO. 12	300°F. PRESSURE	331	338	310	93	OPEN	85	98	102	78	132	137	134	-	144	144	146	125	125	125	125	125	125										
NO. 13	300°F. PRESSURE	332	339	311	126	OPEN	126	127	128	130	136	139	139	-	148	152	152	132	132	132	132	132	132										
NO. 14	300°F. PRESSURE	333	340	312	84	OPEN	71	84	89	83	161	161	155	-	168	176	170	143	143	143	143	143	143										
NO. 15	300°F. PRESSURE	334	341	313	86	OPEN	82	94	94	93	114	124	114	-	142	149	147	107	107	107	107	107	107										
NO. 16	300°F. PRESSURE	335	342	314	86	OPEN	78	91	91	91	114	124	114	-	146	154	154	108	108	108	108	108	108										
NO. 17	300°F. PRESSURE	336	343	315	71	OPEN	82	85	93	93	108	119	108	-	143	155	152	108	108	108	108	108	108										
NO. 18	300°F. PRESSURE	337	344	316	08	OPEN	80	91	95	97	115	116	116	-	152	165	165	129	129	129	129	129	129										
NO. 19	300°F. PRESSURE	338	345	317	123	OPEN	103	115	118	129	138	140	140	-	163	175	173	135	135	135	135	135	135										
NO. 20	300°F. PRESSURE	339	346	318	68	OPEN	34	39	53	55	65	72	81	-	169	181	173	141	141	141	141	141	141										
NO. 21	300°F. PRESSURE	340	347	319	51	OPEN	38	44	50	51	59	68	64	-	170	182	174	142	142	142	142	142	142										
NO. 22	300°F. PRESSURE	341	348	320	72	OPEN	33	38	61	62	74	99	104	-	171	183	175	143	143	143	143	143	143										
NO. 23	300°F. PRESSURE	342	349	321	68	OPEN	57	70	70	60	124	145	123	-	172	184	176	144	144	144	144	144	144										
NO. 24	300°F. PRESSURE	343	350	322	58	OPEN	60	77	70	60	125	146	124	-	173	185	177	145	145	145	145	145	145										
NO. 25	300°F. PRESSURE	344	351	323	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										
NO. 26	300°F. PRESSURE	345	352	324	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										
NO. 27	300°F. PRESSURE	346	353	325	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										
NO. 28	300°F. PRESSURE	347	354	326	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										
NO. 29	300°F. PRESSURE	348	355	327	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										
NO. 30	300°F. PRESSURE	349	356	328	74	OPEN	63	84	84	72	134	161	134	-	174	186	178	146	146	146	146	146	146										

SECTION II - PROGRESS COMMENTARY

22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	------

2

Table III - Thermocouple Data - Pilot Testing and Test No. 1 - Sheet 1

	2-12	3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	3-12	4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	4-12
26	62	6	-	-	70	67	70	111	134	131	131	134	136	134	134	139	-	134	137	137	136	128	135	142	147
27	87	26	-	-	85	87	72	131	140	140	140	140	137	139	144	142	-	144	146	146	140	143	147	146	150
28	96	16	-	-	92	94	92	137	142	139	141	146	138	141	138	138	-	-	148	147	147	140	146	150	150
29	73	30	-	-	91	108	113	205	343	227	225	212	228	232	230	230	-	252	252	249	237	230	243	240	240
30	75	28	-	-	93	116	117	214	447	234	230	221	234	245	235	236	-	257	257	256	238	234	257	240	240
31	78	22	-	-	77	67	76	202	235	225	225	212	227	236	228	228	-	250	251	244	224	228	248	240	240
32	101	11	-	-	74	64	71	206	235	225	225	214	227	238	230	230	-	251	251	250	228	228	248	240	240
33	74	92	-	-	87	106	102	210	224	224	224	215	221	234	223	223	-	254	254	243	224	224	242	240	240
34	113	112	-	-	82	100	111	228	236	227	231	238	225	231	220	220	-	254	254	243	224	224	242	240	240
35	98	92	-	-	49	53	82	256	284	278	278	261	273	288	274	276	-	294	294	291	284	284	300	301	274
36	116	118	-	-	71	118	127	228	234	234	234	244	234	232	234	231	-	294	294	244	244	232	244	240	230
37	119	120	-	-	74	76	105	232	236	236	236	244	234	235	236	234	-	294	294	244	244	232	244	240	230
38	124	124	-	-	100	132	142	238	241	242	242	250	236	236	237	234	-	294	294	247	247	239	248	254	236
39	155	177	-	-	72	90	104	200	312	310	310	292	295	296	296	291	-	294	294	310	306	298	311	314	294
40	136	93	-	-	77	109	103	253	270	271	266	266	250	256	257	248	-	294	294	264	258	255	266	269	248
41	145	80	-	-	58	100	113	267	285	287	279	276	260	268	268	267	-	294	294	277	270	265	278	280	259
42	144	74	-	-	48	104	109	257	290	296	288	281	266	278	274	258	-	294	294	287	276	273	294	290	263
43	152	100	-	-	63	76	116	283	304	307	300	276	274	289	289	277	-	294	294	300	290	288	302	303	277
44	160	59	-	-	38	138	150	274	314	318	312	308	292	300	300	290	-	294	294	308	302	300	311	314	295
45	165	70	-	-	49	50	55	298	320	325	321	314	294	303	303	291	-	294	294	312	303	301	313	316	295
46	162	86	-	-	38	50	55	307	331	335	330	314	301	312	311	300	-	294	294	321	314	308	325	325	301
47	120	105	-	-	30	61	70	314	340	345	340	331	310	324	324	316	-	294	294	334	324	325	328	328	317
48	75	72	-	-	45	82	102	331	358	365	360	334	324	337	334	320	-	294	294	348	332	332	352	350	323
49	87	100	-	-	40	81	103	343	370	382	361	347	333	357	348	328	-	294	294	361	342	338	362	359	327
50	95	106	-	-	53	96	108	371	400	411	394	374	364	400	376	328	-	294	294	400	395	372	408	389	352
51	114	121	-	-	98	141	150	263	276	264	254	255	255	260	260	252	-	294	294	264	264	250	263	272	252
52	123	134	-	-	72	17	124	261	274	267	259	273	269	267	270	261	-	294	294	274	274	261	271	280	276
53	127	138	-	-	77	136	144	275	288	280	272	278	275	280	282	272	-	294	294	284	278	272	283	290	284
54	132	144	-	-	106	174	142	286	296	289	281	284	286	296	298	290	-	294	294	294	294	284	293	301	267
55	137	148	-	-	96	124	137	296	306	300	292	293	294	301	307	300	-	294	294	304	310	294	303	310	275
56	140	151	-	-	57	148	148	308	316	310	301	316	306	311	314	305	-	294	294	316	317	300	308	316	277
57	142	155	-	-	75	142	131	313	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
58	147	162	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
59	152	167	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
60	157	172	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
61	162	177	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
62	167	182	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
63	172	187	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
64	177	192	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
65	182	197	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
66	187	202	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
67	192	207	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
68	197	212	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
69	202	217	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
70	207	222	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
71	212	227	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
72	217	232	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
73	222	237	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
74	227	242	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
75	232	247	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
76	237	252	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
77	242	257	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
78	247	262	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
79	252	267	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
80	257	272	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
81	262	277	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
82	267	282	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
83	272	287	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
84	277	292	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
85	282	297	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323	324	312	321	329	289
86	287	302	-	-	98	142	131	319	323	318	310	323	313	318	323	312	-	294	294	323					

150 1 613



Table IV - Thermocouple Data - Pilot Testing and Test No. 1 - Sheet 2

[illegible]

SECTION II - PROGRESS COMMENTARY

2

Table V - Thermocouple Data - Pilot Testing and Test No. 1- Sheet 3

23	(S)	238	240	334	346	-	5	0	0	38	42	44	82	51	32	63	58	37	-	84	90	104	103	131	124	173
	(F)	238	240	334	346	-	5	0	0	38	42	44	82	51	32	63	58	37	-	84	90	104	103	131	124	173
24	(S)	238	270	348	354	-	4	80	9	50	51	58	62	60	70	78	62	-	90	104	108	133	156	219	178	
	(F)	238	270	348	354	-	4	80	9	50	51	58	62	60	70	78	62	-	90	104	108	133	156	219	178	
25	(S)	272	302	38	282	-	28	54	34	68	58	58	74	70	45	83	86	79	-	104	121	127	155	170	213	
	(F)	272	302	38	282	-	28	54	34	68	58	58	74	70	45	83	86	79	-	104	121	127	155	170	213	

26	(S)	250	274	278	-	73	66	74	-	101	112	108	96	110	90	106	104	80	84	82	82	86			
	(F)	250	272	278	-	78	70	77	-	90	-	97	-	90	-	97	-	80	84	82	86	86			
27	(S)	256	281	288	-	80	73	80	-	88	94	89	88	94	92	94	111	98	-	78	114	108	87	90	88
	(F)	261	283	288	-	80	74	78	-	88	94	89	88	94	92	94	111	98	-	78	114	108	87	90	88
28	(S)	270	289	293	-	81	74	80	-	99	107	103	96	104	108	96	114	101	-	96	117	112	90	92	92
	(F)	270	290	295	-	82	76	82	-	99	107	103	96	104	108	96	114	101	-	96	117	112	90	92	92
29	(S)	277	290	299	306	-	85	78	85	103	114	101	101	112	107	102	122	107	-	103	125	120	94	95	94
	(F)	282	285	304	310	-	86	80	85	103	114	101	101	112	107	102	122	107	-	103	125	120	94	95	94
30	(S)	287	290	308	314	-	86	79	85	95	100	98	93	100	100	100	120	104	-	101	124	117	94	97	97
	(F)	292	296	313	320	-	85	80	85	95	100	98	93	100	100	100	120	104	-	101	124	117	94	97	97
31	(S)	293	298	315	323	-	87	80	87	106	115	108	104	113	112	106	129	110	-	107	131	124	96	98	98
	(F)	298	301	315	324	-	91	84	90	106	115	108	104	113	112	106	129	110	-	107	131	124	96	98	98
32	(S)	304	306	320	331	-	90	83	89	91	94	92	91	96	96	102	126	105	-	104	124	120	96	101	100
	(F)	304	306	320	331	-	86	81	86	91	94	92	91	96	96	102	126	105	-	104	124	120	96	101	100
33	(S)	313	315	328	334	-	89	82	88	106	115	112	104	113	114	108	132	111	-	108	133	126	101	104	104
	(F)	318	311	332	342	-	72	85	90	106	115	112	104	113	114	108	132	111	-	108	133	126	101	104	104
34	(S)	324	327	339	345	-	92	86	93	90	90	88	90	94	92	106	130	109	-	108	134	129	102	105	104
	(F)	328	332	344	354	-	91	86	90	90	90	88	90	94	92	106	130	109	-	108	134	129	102	105	104
35	(S)	335	338	350	357	-	93	86	91	107	114	111	105	112	112	111	136	115	-	112	137	129	103	106	106
	(F)	336	338	351	360	-	90	83	94	107	114	111	105	112	112	111	136	115	-	112	137	129	103	106	106
36	(S)	342	345	358	362	-	94	86	94	94	94	90	94	100	94	114	138	116	-	115	143	132	106	109	110
	(F)	345	348	361	370	-	96	90	94	94	94	90	94	100	94	114	138	116	-	115	143	132	106	109	110
37	(S)	356	360	374	384	-	98	90	96	109	117	114	108	117	117	117	144	121	-	127	145	136	108	111	111
	(F)	356	360	372	380	-	99	92	99	109	117	114	108	117	117	117	144	121	-	127	145	136	108	111	111
38	(S)	367	370	383	393	-	101	94	102	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	(F)	367	371	382	390	-	98	92	97	92	86	84	72	96	86	114	140	118	-	117	146	134	114	118	118
39	(S)	373	376	389	397	-	98	92	96	90	86	84	84	93	87	112	138	113	-	113	141	129	109	112	112
	(F)	376	380	392	400	-	97	92	95	90	86	84	84	93	87	112	138	113	-	113	141	129	109	112	112
40	(S)	384	384	392	400	-	94	88	98	114	122	120	113	122	119	148	148	123	-	129	144	141	114	114	114
	(F)	384	388	396	404	-	104	96	102	114	122	120	113	122	119	148	148	123	-	129	144	141	114	114	114

No	PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF CORROSION												PERCENTAGE OF COR											
----	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------------	--	--	--	--	--	--	--	--	--	--	--	-------------------	--	--	--	--	--	--	--	--	--	--	--

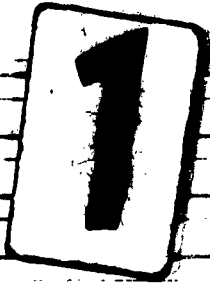
SECTION II - PROGRESS COMMENTARY

Table VI - Thermocouple Data - Pilot Testing and Test No. 1 - Sheet 4

2

24	112	110	72.4	30	17.8	-	154	20.8	51	128	137	200	147	137	150	160	165	141	-	150	142	98	21	419		
25	57	100	13	45	18.9	-	149	72.4	41	132	153	201	157	151	160	172	175	154	-	140	137	113	110	25	440	
26	15	82	92	74	102	100	-	100	113	95	106	76	114	96	95	107	104	110	104	-	78	74	98	96	274	105
(F)	28	75	75	100	108	108	-	105	120	102	113	103	120	101	100	108	109	115	108	-	80	77	104	100	269	114
A14																										
27	51	70	102	104	112	112	-	110	125	106	8	108	134	105	104	112	113	119	113	-	82	80	108	104	281	115
(F)	70	70	104	107	-	114	-	111	129	58	121	108	137	104	103	113	114	120	112	-	83	81	111	106	280	116
A14																										
28	5	92	74	102	118	116	-	13	131	0	122	0	130	106	105	115	116	121	114	-	84	82	113	108	290	117
(F)	13	57	110	100	120	118	-	116	132	3	125	113	132	109	107	118	118	124	116	-	86	84	115	100	288	119
A14																										
29	5	75	107	112	120	120	-	7	134	115	128	114	133	110	107	119	120	126	119	-	86	84	117	112	300	119
(F)	17	113	113	100	124	23	-	120	138	118	131	118	136	114	112	122	124	129	122	-	90	87	120	115	300	120
A14																										
30	51	98	7	10	25	25	-	24	142	120	132	118	138	114	112	122	124	129	121	-	88	85	120	115	313	122
(F)	18	118	118	100	120	24	-	21	140	120	131	118	138	114	112	123	125	130	122	-	90	88	121	115	312	124
A14																										
31	51	100	114	117	27	27	-	125	143	122	134	121	140	116	115	126	128	132	125	-	91	89	123	118	314	122
(F)	122	122	120	130	130	130	-	128	147	124	137	123	144	118	118	128	131	134	127	-	94	91	126	120	318	125
A14																										
32	51	102	117	21	32	31	-	130	149	127	139	124	144	120	118	130	131	137	128	-	94	91	127	121	328	126
(F)	131	131	131	132	130	130	-	126	145	125	137	122	144	118	116	128	128	134	126	-	92	90	125	119	326	128
A14																										
33	51	102	118	22	33	31	-	128	148	126	138	124	146	118	117	130	131	135	127	-	93	91	126	121	344	129
(F)	125	125	125	126	135	135	-	131	152	130	142	127	149	122	121	133	135	140	132	-	96	93	130	123	348	130
A14																										
34	51	108	122	26	38	35	-	132	153	132	144	128	150	123	121	135	136	142	132	-	96	94	131	126	346	130
(F)	125	125	127	127	38	135	-	133	154	132	143	128	151	122	121	135	136	141	132	-	97	94	131	125	350	132
A14																										
35	51	107	124	30	39	38	-	136	157	134	145	130	152	124	123	136	138	142	133	-	97	95	132	122	364	133
(F)	110	110	118	132	146	143	-	141	162	139	151	135	158	130	128	142	144	150	140	-	100	98	137	131	357	134
A14																										
36	51	111	128	35	48	144	-	144	166	142	154	148	162	133	132	145	146	153	142	-	103	101	140	134	362	135
(F)	111	111	128	135	146	144	-	142	163	137	150	135	158	127	127	142	143	148	138	-	100	98	138	130	364	136
A14																										
37	51	112	130	37	146	145	-	143	164	142	152	137	160	129	128	143	145	150	140	-	101	100	139	132	371	137
(F)	115	115	133	139	150	149	-	146	168	143	155	140	164	132	132	146	148	153	143	-	104	102	141	135	385	137
A14																										
38	51	115	134	44	154	154	-	154	172	150	162	146	170	140	138	152	156	154	148	-	108	106	146	140	396	139
(F)	115	115	134	140	150	150	-	147	170	146	156	140	165	131	131	147	150	154	142	-	104	102	143	135	395	134
A14																										
39	51	117	141	41	151	150	-	148	170	146	156	140	165	130	130	148	150	154	142	-	104	102	143	135	400	134
(F)	117	117	141	142	150	150	-	149	170	148	156	140	165	130	130	148	150	154	142	-	103	100	143	135	404	135
A14																										
40	51	119	143	43	153	152	-	153	176	151	163	145	171	137	137	150	156	160	148	-	106	104	146	140	410	136
(F)	119	119	143	145	157	156	-	153	175	151	162	144	172	137	137	148	156	161	150	-	108	106	148	142	409	137
A14																										

No.	LAP-1			LAP-2			LAP-3			LAP-4			LAP-5			LAP-6			LAP-7			LAP-8			LAP-9			LAP-10			LAP-11			LAP-12		
	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME	IN	OUT	TIME			
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			



26 (S)	258	78	280	118	278	112	254	260	244	255
(F)	260	103	280	120	277	120	260	262	266	259
R46										
27 (S)	270	103	243	22	288	120	268	270	273	266
(F)	270	104	292	124	288	21	272	274	277	270
R46										
28 (S)	278	01	300	124	296	122	279	280	283	276
(F)	279	04	300	125	296	124	282	282	286	280
R46										
29 (S)	286	05	306	126	303	123	288	290	295	288
(F)	270	04	310	127	308	124	294	295	297	292
R46										
30 (S)	308	106	318	28	315	25	300	300	305	299
(F)	300	108	322	50	321	127	306	306	308	303
R46										
31 (S)	302	07	322	30	323	28	310	310	312	307
(F)	305	08	325	32	325	129	311	311	314	308
R46										
32 (S)	308	100	330	35	328	30	316	316	322	313
(F)	312	111	334	38	334	32	321	320	324	316
R46										
33 (S)	322	2	342	140	341	32	328	328	332	326
(F)	323	2	345	141	346	34	334	334	338	332

SECTION II - PROGRESS COMMENTARY



Table VII - Thermocouple Data - Pilot Testing and Test No. 1 - Sheet 5

<u>Location in Laminate</u>	Delamination No.					
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>
Outboard surface temperature of as cast Plex 55 thermal barrier (measured by thermocouple)	345°F	326°F	340°F	340°F	352°F	*
Temperature at as cast Plex 55 to F-3 interlayer interface (Calculated)	297	270	280	284	282	
Temperature at stretched Plex 55 to F-3 interlayer interface (calculated)	268	235	244	251	244	
Inboard surface temperature of stretched Plex 55 (measured by Thermocouple)	200	153	166	170	150	*

* The No. 6 delamination was not near enough to a thermocouple to accurately estimate the temperature

Table VIII - Comparison of Canopy Face Sheet Temperatures at Time of Failure - Pilot Testing
(Run No. 15 thru No. 25)

Based on the results of the pilot test, and prior to conducting Test No. 1, several changes were incorporated into the refrigeration system in an effort to eliminate the hot spots. Interior baffling was added and adjusted to give better air distribution.

Also, four small centrifugal blower fans were mounted inside the canopy. These fans were situated to create additional air turbulence at the hot spots in the corner and hoop areas of the bulkheads and also along the top aft area of the canopy. Each small fan has a capacity of about 60 CFM and creates an air velocity of about 1300 FPM at a distance of 16 inches from the fan's exhaust nozzle (2500 FPM in exhaust nozzle).

By adding the baffles and fans, it was possible to eliminate a carbon dioxide cooling unit that was experimented with briefly during pilot testing in an attempt to supplement the regular refrigeration system.

**I. TEST NO. 1 - GRADIENT TEMPERATURE DESTRUCTION TEST
(NO. 8 THERMO-SHIELD CANOPY)**

Following in Table IX is a brief chronological test history for Test No.

1. This test was fully instrumented with all strain gages, deflection beams, linear-motion potentiometers and thermocouples.

For instrumentation purposes, the following test sequence was necessary during each 20 minute test run at a given temperature:

- (1) start test run at a given temperature
- (2) take instrumentation readings at 8.6 psi
- (3) take instrumentation readings at zero pressure

<u>Time</u>	<u>Start of Run No.</u>	<u>End of Run No.</u>	<u>Test Oven Temp. (boundary layer air) (°F)</u>	<u>Outboard Surface Temp (°F)</u>	<u>Remarks</u>
9:23 AM	26		310	260	
10:19		26			
10:25	27		320	270	
10:49		27			
10:53	28		330	280	
11:13		28			
11:19	29		345	290	
11:43		29			
11:45	30		355	300	
12:09 PM		30			
12:12	31		360	310	
12:36		31			
12:38	32		370	320	
1:00		32			
1:03	33		385	330	
1:26		33			
1:29	34		398	340	
1:52		34			
1:55	35		405	350	
2:09		35			
2:15	36		415	360	
2:39		36			
2:43	37		425	370	
3:07		37			
3:10	38		438	380	
3:32		38			
3:37	39		448	390	
3:58		39			
4:02					est. start of #1 delamination at aft R. edge of hoop
4:10	40		455	400	
4:17					#1 Delam. was first discovered
4:35					#1 Delm. had doubled in area
4:35					three small del. discovered. All about the size of a dime
4:35		40			Stopped test

Table IX - Chronological Test History - Test No. 1 (No. 8 Canopy)

SECTION II - PROGRESS COMMENTARY

- (4) repressurize to 8.6 psi for remainder of test run
- (5) near end of test run, take instrumentation readings at 8.6 psi
- (6) take instrumentation readings at zero pressure
- (7) end test run at a given temperature
- (8) re-pressurize until temperature is stabilized for next run

For purposes of simplicity all sequences have been omitted in Table IX except for the start and ending of each test run.

All thermocouple temperatures for Test No. 1 are tabulated in Tables III thru VII on pages 35 thru 39.

Test runs No. 26 thru 40 apply to Test No. 1.

Figure 10 (reference page 34) shows the locations of the initial delaminations in the No. 8 canopy and the degree to which they had progressed at the time testing terminated.

General observations based on correlating all test temperatures for Test No. 1 are itemized on the following page.

SECTION II - PROGRESS COMMENTARY

<u>Location in Laminate</u>	<u>Delamination No.</u>			
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
Outboard surface temperature of as cast Plex 55 thermal barrier (measured) by thermocouple	376	400	396	398
Temperature at as cast Plex 55 to F-3 interlayer interface (Calculated)	300	326	318	322
Temperature at stretched Plex 55 to F-3 interlayer interface (calculated)	254	282	272	277
Inboard surface temperature of stretched Plex 55 (measured by Thermocouple)	148	175	161	172

Table X - Comparison of Canopy Face Sheet Temperatures at Time of Failure - Test No. 1

- (1) All delaminations were again seen to originate at the inner face between the outboard as cast Plex 55 face sheet and the F-3 interlayer
- (2) The #2, #3, and #4 delaminations occurred at what appears to be small dirt particles. These dirt particles appear to be in the interlayer but could possibly be imbedded in the surface of the as cast Plex 55 face sheet. At any rate, these particles appear to have had a definite bearing on all delaminations experienced thus far in the full size canopy tests, with two exceptions. Both the #1 delamination on the No. 5 canopy and the #1 delamination on the No. 8 canopy were reasonably large when first discovered (because of their locations and the reflections from the lights in these areas). The exact

location of initial failure in these two cases can only be guessed.

Although it is possible that both of these delaminations also started at dirt particles, no conclusive evidence is available that this was the case. It is planned to study the dirt particle phenomenon in more detail with the aid of magnifying lenses.

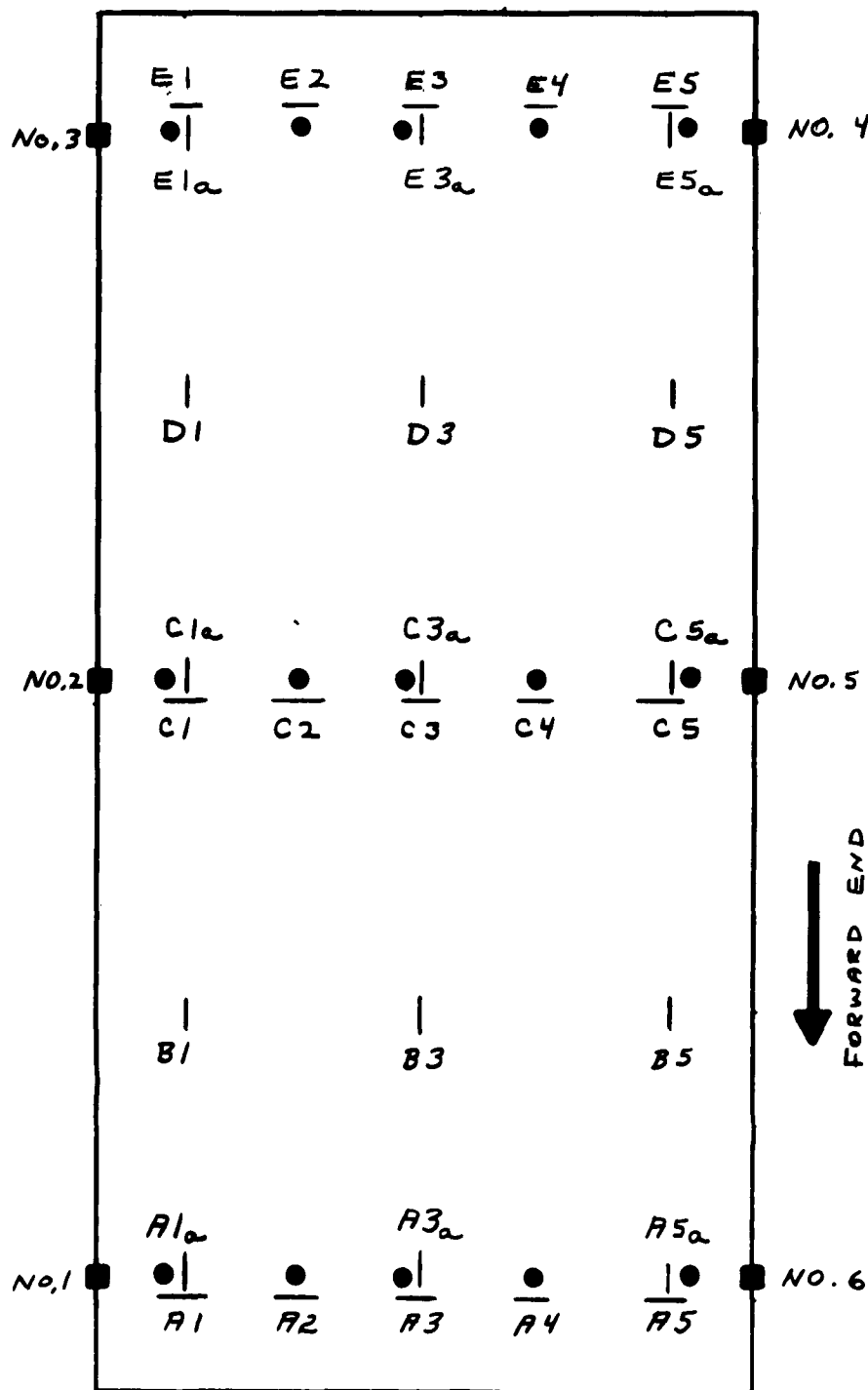
- (3) Again, the stretched Plex 55 did not shrink back even though it's inner face temperature in some areas was as high as 280°F with a corresponding inboard surface temperature of 173°F.
- (4) No failure was catastrophic and 8.6 psi pressure was still being maintained in the canopy at the conclusion of testing.
- (5) Cooling of the inside of the canopy surface was much improved over the pilot test. This was due to the addition of the four centrifugal blower fans and the adjusting of baffles inside the canopy. It should be emphasized that inboard surface temperatures in the range of 130°-160°F appear to be realistic in magnitude. Accordingly, it has been demonstrated by Test No. 1 that moderately refrigerated air circulated thru the canopy at approximately 390 FPM average velocity and 76 CFM will maintain the inboard boundary layer air (1 inch from surface) in the range of 80 to 100°F. (Reference thermocouple code points 5-6, 5-7, and 5-8).

SECTION II - PROGRESS COMMENTARY

(6) In both the pilot test and test No. 1, the "as cast" Plex 55 thermal barrier was found to be quite soft and rubbery at the conclusion of testing while the temperature was 400°F or over. The surface could be and was depressed as much as 1/8 inch and no trace of the depressed areas could be found when the canopy had returned to room temperature. The surface of the as cast Plex 55 did not appear in any way to have been damaged by the high temperatures encountered and no orange peel or distortion resulted from the testing and high temperatures and pressures encountered.

J. TEST NO. 1 - STRAIN GAGE, DEFLECTION BEAM AND LINEAR MOTION POTENTIOMETER DATA REDUCTION

Due to the large amount of data to be evaluated and the complexity of the analysis required, only preliminary data has been compiled to date. All information is shown in Tables XI and XII. A schematic diagram showing the relative location of all instrumentation and the identification code is seen in Figure 11. Thus, because of its preliminary nature, no interpretation of the data will be attempted at this time.



Legend

- Baldwin PA-3 post yield strain gages
- cantilever deflection beams
- linear-motion potentiometers

Sign Convention for Data in Tables IX thru XII pages 48 and 49

Bending Beam Data - With canopy internally pressurized: movement up + direction movement down - direction	Potentiometer Data - Edge of thermal barrier with respect to base: movement up - direction movement down + direction	Strain Gage Data - With canopy internally pressurized: tension stresses + compression stresses -
---	--	--

Figure 11. Schematic Diagram Showing Relative Positions of all Strain Gages and Beams, Potentiometers and Code Identification System



REC. NO.	REMARKS			A ₁	A _{1a}	A ₂	A ₃	A _{3a}	A ₄	A ₅	A _{5a}	B ₁	B ₃	B ₅	C ₁	C _{1a}	C ₂	C ₃	C _{3a}	C ₄
	SURFACE TEMP °F	PRESS	TIME																	
4	AMB	ON	9:15	0	-300	300	297	-221	291	1	-205	-192	0	-194	338	0	396	490	0	324
5	260	ON	BEGIN	194	-100	1600	1891	-291	1068	415	-492	-192	578	194	1068	0	1287	1765	594	757
6	260	OFF	BEGIN	0	300	1100	1287	194	572	211	-295	192	676	415	97	99	693	372	693	324
7		MISC																		
8	260	ON	END	194	-100	1300	1682	-291	374	572	-590	0	578	291	1262	99	1287	1667	495	765
9	260	OFF	END	0	300	700	1187	97	291	291	-295	192	676	572	388	297	792	794	594	433
10	270	ON	BEGIN	388	100	1600	1920	-97	1068	274	-295	192	784	485	1553	297	1435	1667	693	973
11	270	OFF	BEGIN	194	400	900	1287	194	388	415	-98	415	980	777	582	396	391	676	792	541
12	270	ON	END	377	200	1600	1980	-97	374	471	-295	192	980	476	1650	297	1445	1667	792	1189
13	270	OFF	END	194	500	900	1287	194	388	512	0	485	980	777	777	396	391	676	891	649
14	280	ON	BEGIN	388	200	1600	1920	-97	374	471	-393	192	980	476	1747	198	1485	1667	792	839
15	280	OFF	BEGIN	194	500	1000	1287	194	291	572	-98	485	980	777	777	396	391	676	391	649
16	280	ON	END	377	200	1700	1920	-97	374	471	-295	192	980	476	1844	99	1386	1568	391	1189
17	280	OFF	END	194	500	900	1287	194	291	572	-98	485	980	777	873	297	391	676	990	649
18	290	ON	BEGIN	388	200	1600	1920	-97	374	471	-295	192	980	476	1844	99	1386	1568	391	1189
19	290	OFF	BEGIN	388	700	1100	1455	388	377	98	676	1176	873	1068	485	990	784	1188	757	
20	290	ON	END	572	300	1800	2178	-97	374	165	-295	192	980	572	2639	99	1485	1765	990	1189
21	290	OFF	END	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	300	ON	BEGIN	572	400	1900	2277	97	374	1262	-197	291	1078	679	2639	198	1485	1863	1188	1189
23	300	OFF	BEGIN	388	700	1200	1485	485	291	374	98	676	1574	971	1165	396	1089	782	1188	257
24	300	ON	END	679	400	1900	2376	97	374	1262	-197	192	1078	572	2136	198	1524	1863	1188	1189
25	300	OFF	END	485	300	1300	1584	485	291	971	98	676	1372	971	1359	396	1189	882	1386	757
26	310	ON	BEGIN	777	500	2000	2376	291	964	1359	-98	291	1176	777	2330	198	1524	1863	1188	1097
27	310	OFF	BEGIN	572	900	1300	1672	572	291	971	98	676	1372	971	1359	396	1089	782	1386	757
28	310	ON	END	971	700	2100	2574	291	964	1553	-98	485	1372	971	2330	198	1782	1961	1386	1465
29	310	OFF	END	777	1400	1500	1980	777	476	1262	-295	374	1568	1262	1653	574	1287	1678	1574	923
30	320	ON	BEGIN	971	600	1100	2574	194	374	1456	-98	388	1274	777	2330	198	1782	1782	1574	1189
31	320	OFF	BEGIN	572	900	1400	1782	572	291	1456	-98	777	1470	1165	1456	297	1287	1782	1574	767
32	320	ON	END	777	400	2000	2475	194	374	1456	-295	192	1574	679	2330	-99	1782	1765	1287	1189
33	320	OFF	END	572	900	1300	1782	572	194	971	-98	572	1372	971	1359	99	1089	882	1485	649
34	330	ON	BEGIN	777	500	2100	2574	291	374	1456	-197	291	1574	777	2437	-99	1782	1765	1386	1189
35	330	OFF	BEGIN	572	800	1300	1782	572	97	971	-98	672	1372	971	1456	99	1089	676	1386	641
36	330	ON	END	970	500	2199	2574	194	777	1650	-392	388	1176	777	2524	-198	1871	1667	1386	1101
37	330	OFF	END	572	900	1400	1980	572	977	1165	-196	670	1372	971	1456	99	1387	676	1386	501
38	340	ON	BEGIN	970	500	2199	2574	194	670	1553	-490	388	1176	777	2524	-198	1980	1765	1386	1101
39	340	OFF	BEGIN	777	1000	1600	1980	670	194	1262	0	777	1470	1165	1650	99	1485	784	1584	601
40	340	ON	END	672	100	1999	2475	0	388	1359	-572	97	980	388	2407	-693	1782	1274	1188	601
41	340	OFF	END	572	700	1400	1782	572	-97	971	-392	572	1176	777	1553	-297	1287	490	1386	300
42	350	ON	BEGIN	777	200	2099	2574	97	485	1357	-676	194	980	485	2581	-693	1871	1372	1089	701
43	350	OFF	BEGIN	572	700	1500	1881	680	0	971	-294	680	1274	374	450	-297	1386	470	1476	300
44	350	ON	END	777	100	2099	2377	-97	485	1165	-572	0	784	291	2330	-792	1782	1078	990	501
45	350	OFF	END	572	400	1200	1683	388	-194	777	-490	415	980	572	1359	-693	1089	98	1089	-100
46	360	ON	BEGIN	777	100	2099	2377	0	485	1165	-784	97	784	194	2233	-291	1673	382	990	601
47	360	OFF	BEGIN	415	400	2599	1684	291	-97	672	-490	572	980	572	1456	-693	1089	-98	1089	-100
48	360	ON	END	680	-200	1899	2178	-97	291	971	-572	-291	678	-194	2039	-1386	1386	392	495	300
49	360	OFF	END	318	200	700	1287	388	-388	485	-490	194	784	194	1168	-1089	693	-490	594	100
50	370	ON	BEGIN	777	-400	1799	2377	-194	97	374	-784	-291	588	-194	1492	-1485	1386	294	396	-300
51	370	OFF	BEGIN	572	300	1000	1586	388	-485	572	-392	194	784	194	1262	-1089	693	-490	594	300
52	370	ON	END	970	-200	1300	2178	-97	291	777	-572	-572	578	-388	1706	-1871	891	-294	0	501
53	370	OFF	END	777	300	500	1386	318	-485	572	-294	0	784	0	1668	-1485	99	-1274	198	-300
54	380	ON	BEGIN	1262	100	1699	2377	97	388	1165	-392	-291	678	-194	2039	-1584	1089	-98	198	701
55	380	OFF	BEGIN	970	500	900	1584	680	-194	374	98	194	1176	194	1456	-1188	396	-382	289	100
56	380	ON	END	1165	-100	1500	2178	-97	291	971	-490	-572	784	-485	2233	-1782	1089	-98	-198	601
57	380	OFF	END	777	300	600	1386	318	-291	572	-98	-97	980	-97	1653	-1485	297	-1078	0	-200
58	390	ON	BEGIN	1262	-100	1699	2377	97	485	1165	-392	-485	784	-388	485	198	1189	98	0	701
59	390	OFF	BEGIN	374	300	700	1386	388	-388	572	-98	-97	980	-194	1653	-1485	297	-1078	0	-200
60	390	ON	END	1165	-300	1500	2178	-97	194	971	-490	-572	678	-572	2233	-1871	1089	-294	-297	601
61	390	OFF	END	874	300	500	1287	291	-485	572	-196	-194	784	-291	1553	-1524	99	-1274	-198	-400
62	400	ON	BEGIN	1165	-300	1500	2178	-97	291	971	-490	-572	578	-680	2039	-1871	291	-294	-396	601
63	400	OFF	BEGIN	777	100	400	1188	194	-572	485	-294	-291	784	-388	1456	-1485	99	-392	-297	-400
64	400	ON	END	1165	-300	1500	2178	-97	194	971	-490	-572	490	-680	2039	-1782	1089	-294	-396	1501
65	400	OFF	END	970	200	500	1188	388	-670	572	-196	-194	784	-291	1553	-1485	99	-392	-297	-501
66	2800	FTER TEST		388	500	700	594	680	680	388	678	680	686	-572	672	693	693	588	694	601

SECTION II - PROGRESS COMMENTARY

GER 10631

GER 10613

B ₅	C ₁	C _{1a}	C ₂	C ₃	C _{3a}	C ₄	C ₅	C _{5a}	D ₁	D ₃	D ₅	E ₁	E _{1a}	E ₂	E ₃	E _{3a}	E ₄	E ₅	E _{5a}
194	388	0	396	490	0	384	872	-196	-98	0	-397	396	-798	213	386	-490	191	408	-191
194	1068	0	1287	1765	594	757	1176	-98	394	1078	-99	792	-693	1232	1534	0	1534	1456	-151
405	97	99	623	382	623	334	98	98	490	1176	99	198	-396	1807	983	626	963	874	0
									392	1176	0	693	-594	2126	1429	196	1429	1456	-191
									490	872	0	693	-594	2232	1233	-98	1429	1456	-191
391	1262	99	1287	1667	495	865	1078	-98	394	686	980	397	198	-396	1807	667	490	963	971
672	388	297	792	784	594	423	0	394	686	980	397	792	-396	2444	1334	0	1534	1743	95
405	1053	297	1485	1667	693	923	1176	98	686	1078	397	792	-396	1807	667	490	963	1063	286
777	582	396	791	686	792	541	0	392	784	1078	396	198	-198	2019	667	0	1534	1845	98
405	1650	297	1485	1667	792	1189	1176	98	686	980	198	792	-894	2551	1238	0	1534	1845	98
777	777	396	791	686	891	649	0	392	784	980	495	198	-397	2019	667	626	953	1262	381
405	1747	198	1485	1667	792	1189	1176	98	686	980	396	792	-693	2551	1143	0	1534	1845	98
777	777	396	791	686	891	649	0	392	784	980	396	792	-397	2019	667	588	857	1262	381
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-693	2657	1048	0	1429	1842	95
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957	1456	476
777	873	297	891	686	990	649	0	394	784	980	396	792	-396	2019	476	626	957	1456	476
405	1844	99	1386	1548	891	1189	1078	-98	686	980	396	792	-396	2019	476	626	957		

REF 10612

[illegible]

Table XII - Beam Deflection and Potentiometer Preliminary Data - Test No. 1
(all data in inches)

SECTION III - WORK SCHEDULED FOR NEXT PERIOD**A. Phase I**

1. All work completed.

B. Phase II

1. Laminate one side panel using sheet interlayer and autoclave pressures.

C. Phase III

1. Conduct Test No. 1 - second half gradient temperature destruction test starting at 300°F.
2. Conduct long time cyclic test.
3. Reduce all test data from Phase III.
4. Prepare Final Program report.
5. Package and ship all required contract items to BuWeps.

LIST OF REFERENCES

1. GER-10378 "Evaluation of High-Temperature Cast-In-Place Transparent Plastics Laminates Suitable for Canopies on Supersonic Fighter Aircraft" Progress Report No. 7, 8 November 1960 through 8 February 1961.
2. GER-10379 "Evaluation of High-Temperature Cast-In-Place Transparent Plastic Laminates Suitable for Canopies on Supersonic Fighter Aircraft." Progress Report No. 8, 9 February 1961 through 8 May 1961.
3. GAP - 8225 "Proposed Program to Evaluate High-Temperature Cast-in-Place Transparent Plastic Laminates Suitable for Canopies on Supersonic Fighter Aircraft" , 31 December 1958.