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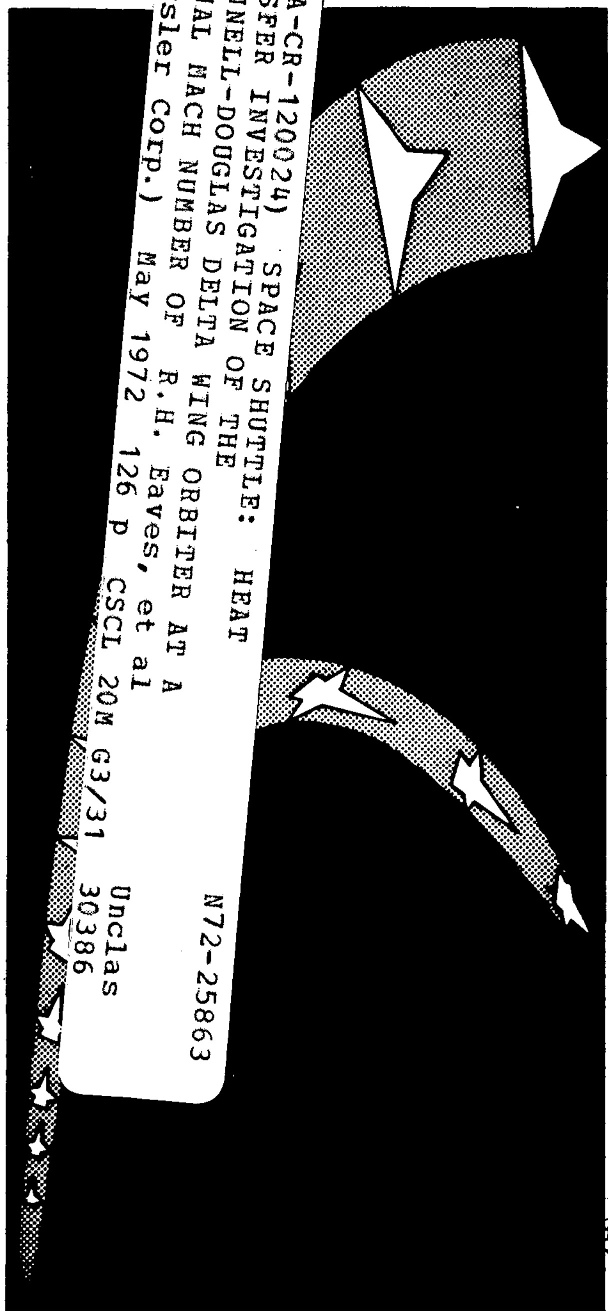
DMS-DR-1200
CR120,024
VOLUME I
MAY 1972



—SPACE SHUTTLE—

HEAT TRANSFER INVESTIGATION OF THE Mc DONNELL-DOUGLAS DELTA WING ORBITER AT A NOMINAL MACH NUMBER OF 10.5

by

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VKF HYPERVELOCITY
WIND TUNNEL F

Arnold Engineering Development Center

SADSAC SPACE SHUTTLE
AEROTHERMODYNAMIC
DATA MANAGEMENT SYSTEM

CONTRACT NAS8-4016
MARSHALL SPACE FLIGHT CENTER

This document should be referenced as CR-120,024

SPACE DIVISION CHRYSLER CORPORATION

NASA Series Number: H-1008

DMS-DR-1206
CR - 120,024
VOLUME I
May, 1972

SADSAC/SPACE SHUTTLE

WIND TUNNEL TEST DATA REPORT

CONFIGURATION: McDonnell-Douglas Orbiter - 0.011 Scale Model

TEST PURPOSE: Heat Transfer Investigation of Space Shuttle Orbiter Vehicle at a Mach Number of 10.5 and Flight Reynolds Numbers Based on Model Length

TEST FACILITY: AEDC-VKF Tunnel F

TESTING AGENCY: NASA - MSFC

TEST NO. & DATE: AEDC VT 1162 - F00; May 4 - June 4, 1971

FACILITY COORDINATOR: Mr. L. L. Trimmer - ARO INC. AEDC

PROJECT ENGINEER(S): Mr. R. H. Eaves - ARO INC. AEDC

Mr. T. D. Buchanan - ARO INC. AEDC

Mr. John Warmbrod - NASA-MSFC

Details of illustrations in this document may be better studied on microfiche

DATA MANAGEMENT SERVICES

LIAISON: NA

DATA OPERATIONS: J. R. Ziler

RELEASE APPROVAL: FOR N. D. Kemp, Supervisor
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CONTRACT NAS 8-4016 AMENDMENT 158 DRL 297-84a

This report has been prepared by Chrysler Corporation Space Division under a Data Management Contract to the NASA. Chrysler assumes no responsibility for the data presented herein other than its display characteristics.

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FOREWORD

The work reported herein was sponsored by Marshall Space Flight Center (MSFC), National Aeronautics and Space Administration (NASA). The results of tests were obtained by ARO, Inc. (a subsidiary of Sverdrup & Parcel and Associates, Inc.), contract operator of the Arnold Engineering Development Center (AEDC), Air Force Systems Command (AFSC), Arnold Air Force Station, Tennessee.

An extensive experimental investigation was conducted at various wind tunnels of the von Karman Gas Dynamics Facility (VKF), AEDC, on various space shuttle configurations for various Mach numbers over a large Reynolds number range. This report contains heat transfer results for the McDonnell Douglas delta wing orbiter which was tested in the VKF, Hypervelocity Wind Tunnel F. An additional SADSAC report is available from the VKF-Tunnel F facility which documents test results from two delta wing configurations.

ABSTRACT

Heat transfer tests for the McDonnell Douglas delta wing orbiter were conducted at the Arnold Engineering Development Center (AEDC), von Karman Gas Dynamics Facility (VKF) in the Hypervelocity Wind Tunnel F. A 1.1 percent scale model was tested at a Mach number of approximately 10.5 over an angle of attack range from 10 to 60 degrees over a length Reynolds number range from 5×10^6 to 24×10^6 during the time period from May 4 to June 4, 1971. Heat transfer results were obtained from model surface heat gage measurements and thermographic phosphor paint. Limited pressure measurements were obtained.

TABLE OF CONTENTS

FIGURES AND TABLES

NOMENCLATURE

ALPHA	Model angle of attack, deg.
C_∞	Form of Chapman-Rubesin viscosity coefficient, $(\mu_w/\mu_\infty)(T_\infty/T_w)$
H	Model heat transfer coefficient, $Q/(TO-T_w)$, Btu/ft^2-sec-^{o}R
HO	Stagnation enthalpy, Btu/lbm
HREF or h_{ref}	Reference heat transfer coefficient, $QO/(TO- T_w)$, Btu/ft^2-sec-^{o}R
H_w	Enthalpy at model wall temperature (T_w), Btu/lbm
ℓ or L	Axial length of model, 21.35 in. (See Figure 3)
M-INF, MACH, or M_∞	Free-stream Mach number
p	Pressure, psia
P-INF or p_∞	Free-stream pressure, psia
PO	Reservoir pressure, psia
POP	Pitot pressure measured at the test section, psia
POT1,2,3	Survey rake pressure, psia
Q-INF	Free-stream dynamic pressure, psia
Q or $\dot{q}$	Model heat transfer rate, Btu/ft^2-sec.
QO or $\dot{q}_{ref}$	Stagnation heat transfer rate based on a hemisphere radius of 0.132 inches for the MDAC-DWO model. A 1-foot sphere radius scaled to 0.011 model scale (MDAC-DWO model scale) corresponds to a radius of 0.132 in.
r_n	Model profile nose radius, 0.225 in.
RE/FT or Re_∞/ft.	Reynolds number based on free-stream conditions and a 1-foot length
RE/L, RE-L, or $Re_{\infty,\ell}$	Reynolds number based on free-stream conditions and model length (21.35 in.)
RHO-INF	Free-stream density, lbm/ft^3

STO	Stagnation Stanton number, QO/(RHO-INF)(U-INF)(HO- H_w)
TIME or T	Test section time, milliseconds
T-INF or T_∞	Free-stream temperature, ^oR
TO	Reservoir temperature, ^oR
T_w	Temperature at model wall, ≈540^oR
U-INF	Free-stream velocity, ft/sec.
V-INF	Hypersonic viscous parameter, $M_\infty(C_\infty)^{1/2}/(Re_{\infty,\ell})^{1/2}$
x or X	Axial distance from the model nose, positive downstream, in. (See Figure 3)
y or Y	Lateral distance from the vertical centerline, positive out right wing, in. (See Figure 3)
y_{max} or YMAX	Local semi-span at a given model station, in. (See Figure 3)
z'	The height to a given point measured from the bottom of the model at a given station, in. (See Figure 3)
z'_{max}	Local model height at a given station (excluding vertical tail), in. (See Figure 3)
α	Angle of attack, deg.
μ_w	Gas viscosity at model wall
μ_∞	Gas viscosity in free stream

INSTRUMENTATION CODE

Examples

QT19A
- Heat Transfer
- Station 1900
- The "A" Ray Off Top Centerline
- Top Surface

PB5
- Pressure
- Station 500
- Bottom Surface

QW15.5R
- Heat Transfer Rate
- Station 1550
- Reference Location (another gage at same distance off centerline)
- Wing (top) Surface

See Figures 3 and 4 for gage layout and Table I for gage locations

I. INTRODUCTION

Heat transfer tests of the McDonnell Douglas delta wing orbiter were sponsored by the Marshall Space Flight Center (MSFC) at Arnold Engineering Development Center (AEDC). A 1.1 percent scale model was tested in Tunnel F at the AEDC-von Karman Gas Dynamics Facility (VKF), during the time period from May 4 to June 4, 1971. The purpose of this test was to obtain heat-transfer distributions over the complete orbiter configuration at flight Reynolds numbers and to investigate the onset of transition and the transition zone over a large Reynolds number range. Heat transfer results were obtained from detailed instrumentation measurements and a thermographic phosphor paint technique. Limited pressure measurements were obtained during the tunnel entry. Data were obtained at a Mach number of approximately 10.5 over a Reynolds number range from 5.0×10^6 to 24.0×10^6, based on model length. Limited results were obtained at Mach Number 11.5 for a lower Reynolds number range. The model was tested over an angle of attack range from 10 to 60 degrees with phosphor paint results either on the side, top, or bottom surface for selected runs.

II. APPARATUS

2.1 Wind Tunnel.

The Hypervelocity Wind Tunnel F (Figure 1) is an electric-arc-heated impulse hypersonic wind tunnel of the hotshot type developed at AEDC. The test gas, nitrogen or air, is initially confined in an arc chamber by a diaphragm located near the throat of a convergent-divergent nozzle. For the present tests, nitrogen was used as the test gas. The gas is heated and compressed by an electric arc discharge resulting in rupture of the diaphragm and subsequent expansion through a 4-degree half-angle conical nozzle to a maximum diameter of 108 inches. Testing is possible at either the maximum diameter for Mach numbers from 13 to 22 or at the 54-inch diameter station for Mach numbers from 10 to 17. Useful runs times between 50 and 200 msec. are obtained. The present tests were conducted at the 54-inch diameter station with a useful run time of approximately 100 msec. utilizing the 4-cubic-foot arc chamber.

2.2 Model.

A 1.1 percent scale model of the McDonnell Douglas (MDAC) delta wing orbiter (DWO) mounted on the support sting in Tunnel F is shown in Figure 2. The axial model length exposed on the lower surface centerline, including the elevon and body flap, is 21.35 inches. The body flap and elevon were at 0-degree deflection and fabricated as a continuous surface with the fuselage lower surface. There were no breaks or gaps where the full-scale body flap and elevon hinge lines are located. In addition, the vertical tail and rudder were fabricated as one continuous surface in the undeflected position. The model fabrication consisted of a stainless steel lower surface up to the model reference plane (See Figures 2 and 3) with the fuselage upper body and vertical fin made of a Fiberglas® composition. A complete layout of the model showing all instrumentation locations is shown in Figure 3. The model was constructed at AEDC from loft lines supplied by McDonnell Douglas (Drawing No. 255BJ00050, Rev. B). Cross-sections at all instrumented stations are illustrated in Figure 4. The model dimensions corresponding to the instrumented cross-section views are tabulated in Table I. The SADSAC number tabulated in Table I corresponds to the gage location on magentic tape. For two selected runs a three-point pitot survey was obtained at Station 2000. Details of the survey rake are illustrated in Figure 5. In addition, the model geometry is illustrated in SADSAC format in Appendix I.

2.3 Instrumentation.

Model heat transfer rates were measured with slug calorimeters and coaxial surface thermocouples. The slug calorimeters have a thin-film platinum resistance thermometer to sense the temperature of an aluminum disk which is exposed to the heat flux to be measured. The calorimeters are optimized to measure a given range of heat transfer by appropriate selection of the aluminum disk thickness. The coaxial surface thermocouple is comprised of an electrically insulated chromel wire enclosed in a constantan cylindrical jacket. A thin film junction is made between the chromel and constantan at the surface. In practical measurement applications, the surface thermocouple behaves as a homogeneous, one-dimensional, semi-infinite solid. The instrument provides an electromotive force (E.M.F.) directly proportional to surface temperature which may be related by theory to the incident heat flux. All heat-transfer gages were bench calibrated prior to their installation into the model. The precision of these calibrations is estimated to be ±3 percent. Post test calibrations were made for the majority of gages with calibration repeatability being within ±3 percent.

To monitor the tunnel conditions, two 1.0-inch diameter hemisphere cylinders instrumented with slug calorimeters were installed in the test section at an appropriate distance from the model to eliminate shock interference. A pitot probe was located near each hemisphere cylinder to measure the normal shock stagnation pressure. The reservoir pressure and pitot pressures were measured with strain-gage type transducers developed at the AEDC-VKF. Detailed information concerning the heat-transfer and pressure instrumentation can be found in Reference 1.

Model flow-field Schlieren photographs were obtained during the test. A typical photograph is shown in Figure 6 with the model at 10 degrees angle of attack.

2.4 Phosphor Paint Requirements.

The following is a discussion of the equipment used to obtain the thermographic phosphor paint data.

2.4.1 Ultraviolet Light Sources.

The ultraviolet light needed to excite the phosphorescence of the paint was generated by an Osram Xenon gas bulb XBO 1600w powered by an Ingersoll Product d.c. supply.

Three units were used for these tests. Each unit had a heat-absorbing glass and filter to eliminate all but the 3650 A (black light) wave length light.

2.4.2 Camera.

Four view-cameras with 4- x 5-inch Polaroid backs were used to record the pictures: two with 145mm lens were located on the side of the tunnel and two with 163mm lens were on the bottom. Each camera had a set of filters to pass only the 5000 to 6000 A light emitted by the paint. Type 57 Polaroid (ASA 3000) film was used to record the image.

2.4.3 Microdensitometer.

The optical density distributions of the pictures were read and recorded on a magnetic tape by a P-1000 Photoscan^R manufactured by Optronics International. The Photoscan is owned by the Biology Division of Oak Ridge National Laboratory. The data on the magnetic tapes were input to the VKF CDC 1604B computer which was used to create contour mappings of heat-transfer rate.

III. PROCEDURES

3.1 Test Techniques.

3.1.1 Model Installation.

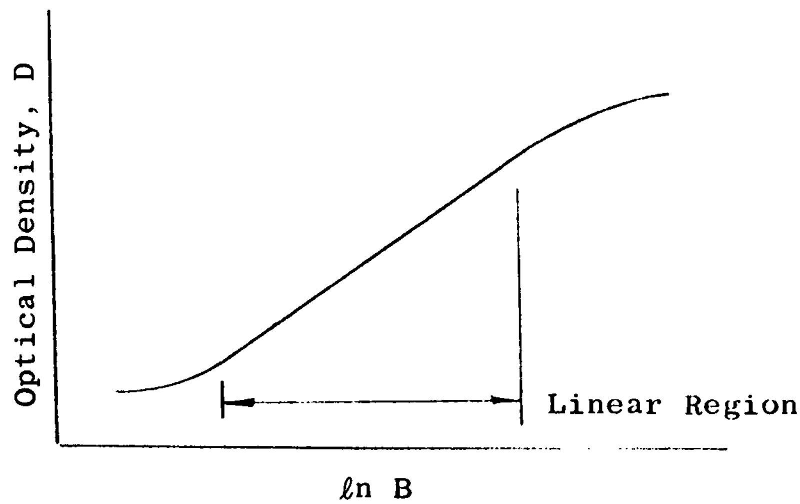
The McDonnell-Douglas delta wing orbiter was tested over an angle of attack range from 10 to 60 degrees. Two tunnel runs were required to provide a continuous Reynolds number variation from 24 x 10^6 to 5 x 10^6 based on model length at a fixed angle of attack. Typically, the high Reynolds number range run was made with the model lower surface up, and the low Reynolds number range run was made with the model lower surface down at the same model angle of attack. This procedure provided camera coverage for the phosphor paint technique on the model top, side, and lower surface at the same angle of attack. The painted surface locations are summarized in Table II.

The sector angle range at the 54-inch diameter test section is ±20 degrees. Consequently, a prebend was required for the high angles of attack. In addition, the model sting had an effective 20-degree insert angle. The two sting arrangements used for these tests are illustrated in Figures 7 and 8. For angles of attack up to and including 40 degrees, the sting arrangement illustrated in Figure 7 was used. For angles of attack equal to and greater than 40 degrees, the installation shown in Figure 8 was used. Both sting installations were used at 40 degrees angle of attack.

3.1.2 Testing with Phosphor Paint.

The test section set-up with the shuttle model is shown in Figure 9. The locations of the Osram u-v light sources and still cameras are depicted. It was necessary to locate the two side cameras at the downstream end of the Schlieren windows to allow Schlieren optical coverage. The Osram light on the top of the tunnel had to be reflected onto the model because of the limited space between the tunnel and an overhead I-beam support for the Schlieren system.

The phosphorescent paint technique consists of photographing the painted model surface and measuring the optical density of the recorded image. The optical density of a photographic image is a function of the logarithm of the intensity of the exposure, for a given exposure time (Reference 2), as illustrated by the figure below.



Thus, if the exposure from the phosphorescent paint falls within the linear region (i.e., logarithmically linear), the optical density (D) is given by

$$D = A \ln B + C$$

From the paint characteristics

$$\ln B = \ln f_1(I) + f_2(I, T_w);$$

therefore,

$$D = A \ln f_1(I) + Af_2(I, T_w) + C$$

where I is the u-v light intensity, B is the emitted light intensity (brightness) of the paint, and A and C are constants. For small changes in intensity (I), the functional relation f_2 is given by

$$f_2(I, T_w) \propto T_w$$

When using the phosphorescent technique in the wind tunnel, the procedure is to take a photograph of the model before the tunnel run (i.e., a tare) and then take another picture during the run. It is necessary that both pictures be taken in the "linear" region of the optical density curve. When the optical density of the tare photograph is subtracted from the optical density of the run photograph,

$$D - D_i \propto (T_w - T_{wi})$$

where the subscript i indicates the initial conditions; i.e., the tare photograph taken before the run.

It can be shown that the quantity $(T_w - T_{wi})$ is proportional to the heat-transfer rate to the model surface, for $T_w << T_{aw}$, and relatively short heating times ($\lesssim$ 1 second) regardless of whether the "heat-transfer model" assumed for the technique is a semi-infinite slab (either a relatively thick layer of paint or a thin layer of paint mounted on a thick layer of material) or an infinite plate. This, of course, means that the optical density difference, $D - D_i$, is then proportional to the model heat-transfer rate.

$$D - D_i = \Delta D \propto \dot{q}$$

The best way of evaluating the constant of proportionality is to measure a few heat-transfer rates with standard heat transfer instrumentation at the same time the paint data are taken. Heat-transfer rate as determined from gages gives a calibration for the paint, so the paint data yield the detailed heat-transfer rate distribution over the model.

3.1.2.1 Wall Material.

The phosphor paint is applied as a thin coating to the model; therefore, the model wall material must be selected to give an observable temperature rise for the expected heat-transfer rate. The wall material selection, many times, is based on other things such as strength; hence, when the model material is not suitable to the paint technique, coatings are applied to produce the proper surface properties.

3.1.2.2 Phosphor Application.

The phosphor paint is a mixture of the phosphor material and a binder. The phosphor material is a fine grain powder ($\sim 10\mu$ average size) of ZCdS (zinc-cadium-sulfate) with silver and nickel additives whose concentration control the temperature range of the phosphorescence. The binder can be any transparent or translucent liquid which can be sprayed. Normally, clear dope or epoxy is used.

3.2 Test Conditions.

A summary of the test conditions is given in Table II. A complete tabulation of all pertinent tunnel conditions is given in the Appendixes. In summary, the majority of tests were conducted at an approximate Mach number of 10.5 over a Reynolds number range from 5×10^6 to 24×10^6 based on model length.

3.3 Data Reduction.

3.3.1 Model Instrumentation and Tunnel Conditions.

A complete description of the data reduction equations for the heat-transfer and pressure transducers is given in Reference 1. The method of determining flow conditions is briefly summarized as follows: instantaneous values of PO and POP are measured and an instantaneous value of $\dot{Q}O$ is inferred from a direct measurement of a shoulder heat rate on a 1.0-inch diameter hemisphere cylinder heat probe. Velocity, hence enthalpy (HO), is calculated from measured values of POP, $\dot{Q}O$, and the heat probe radius, using Fay-Riddell theory, Reference 3. With values of PO, POP, and HO known, the remaining flow conditions (M_∞, Re_∞/ft., etc.) are calculated as described in References 4 and 5. The HREF (heat transfer coefficient) value reported herein is based on the inferred $\dot{Q}O$ value as described above. Since the Fay-Riddell equation is used to calculate HO with a known value of $\dot{Q}O$, the value of HREF tabulated herein is consistent with a Fay-Riddell value for the given test conditions. For the short run times experienced in a hotshot tunnel, the model wall temperature ratio (T_w/TO) varied between 0.15 and 0.30, which approximates the condition of practical interest of reentry vehicles.

3.3.2 Thermographic Phosphor Paint.

The optical density distributions on the tare and run pictures are read and recorded by the scanning microdensitometer. The tare density is subtracted from the run density on the VKF-CDC 1604B digital computer, and the density differences are plotted on a CRT plotter (one density difference per plot). Each plot (i.e., density difference) is assigned a color and copied by hand in that color so that a color composite of all the plots is made. The boundaries of the colors are retraced, and the reference heat gages and model outline are located on this tracing.

The heat gage measurements and the optical density differences are plotted to obtain a relationship between the two. The relationship gives the heat-transfer values corresponding to the color regions. These values are noted on the color tracing, thereby resulting in a contour mapping of the heat-transfer rates on the model.

The model image is distorted by the viewing angle of the camera. This distorted view is reflected in the final contour mapping presented in Appendix IV. However, all plots from the paint results are in a true normal projection, since the heat transfer gage locations were used to scale the centerline and span results that are plotted herein.

IV. DATA PRESENTATION

The following data presentation is presented in the Appendixes:

I. Model Component Description (SADSAC Format)

II. Tabulation of Gage Measurements and Tunnel Conditions

III. Selected Top and Bottom Surface Centerline Plots of Gage Measurement Results

IV. Selected Plots of Heat-Transfer Results Using the Phosphor Paint Technique

Table III, Page 25-a presents a summary index of the above plotted data.

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2. Todd, H. N. and Zakier, R. D., Sensitometry, Rochester Institute of Technology, 1962.

3. Fay, J. A. and Riddell, F. R., "Theory of Stagnation Point Heat Transfer in Dissociated Air," Journal of Aerospace Sciences, Vol. 25, No. 2, pp. 73-85, 121, February 1958.

4. Grabau, Martin, Smithson, H. K., Jr., and Little, Wanda J., "A Data Reduction Program for Hotshot Tunnels Based on the Fay-Riddell Heat-Transfer-Rate Using Nitrogen at Stagnation Temperatures from 1500 to 5000°K," AEDC-TR-64-50 (AD601070), June 1964.

5. Griffith, B. J. and Lewis, C. H., "A Study of Laminar Heat Transfer to Spherically Blunted Cones and Hemisphere-Cylinders at Hypersonic Conditions," AEDC-TDR-63-102 (AD408568), June 1963. Also AIAA Journal, Vol. 2, No. 3, pp. 438-444, March 1964.

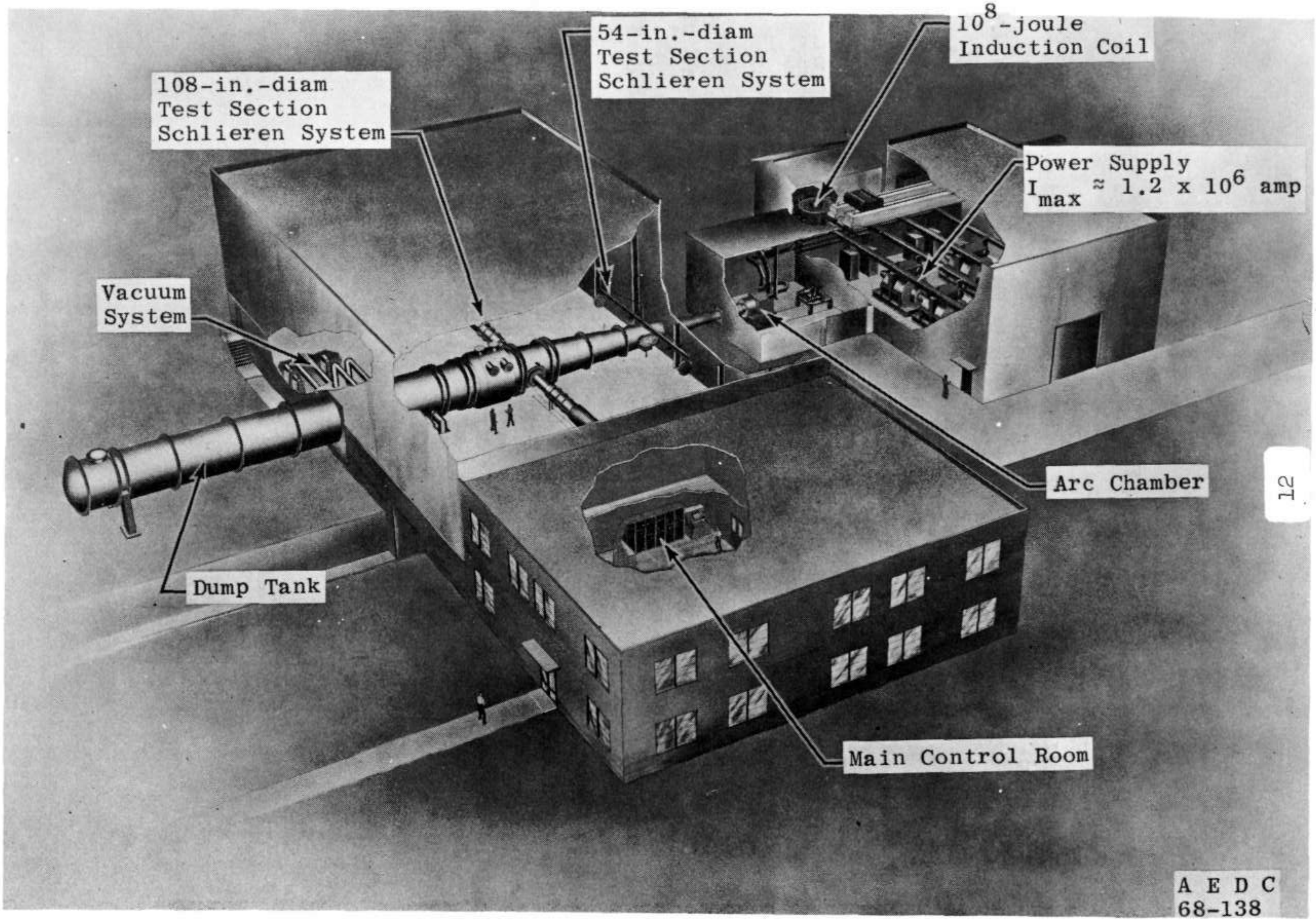


Fig. 1 AEDC-VKF Tunnel F Plant

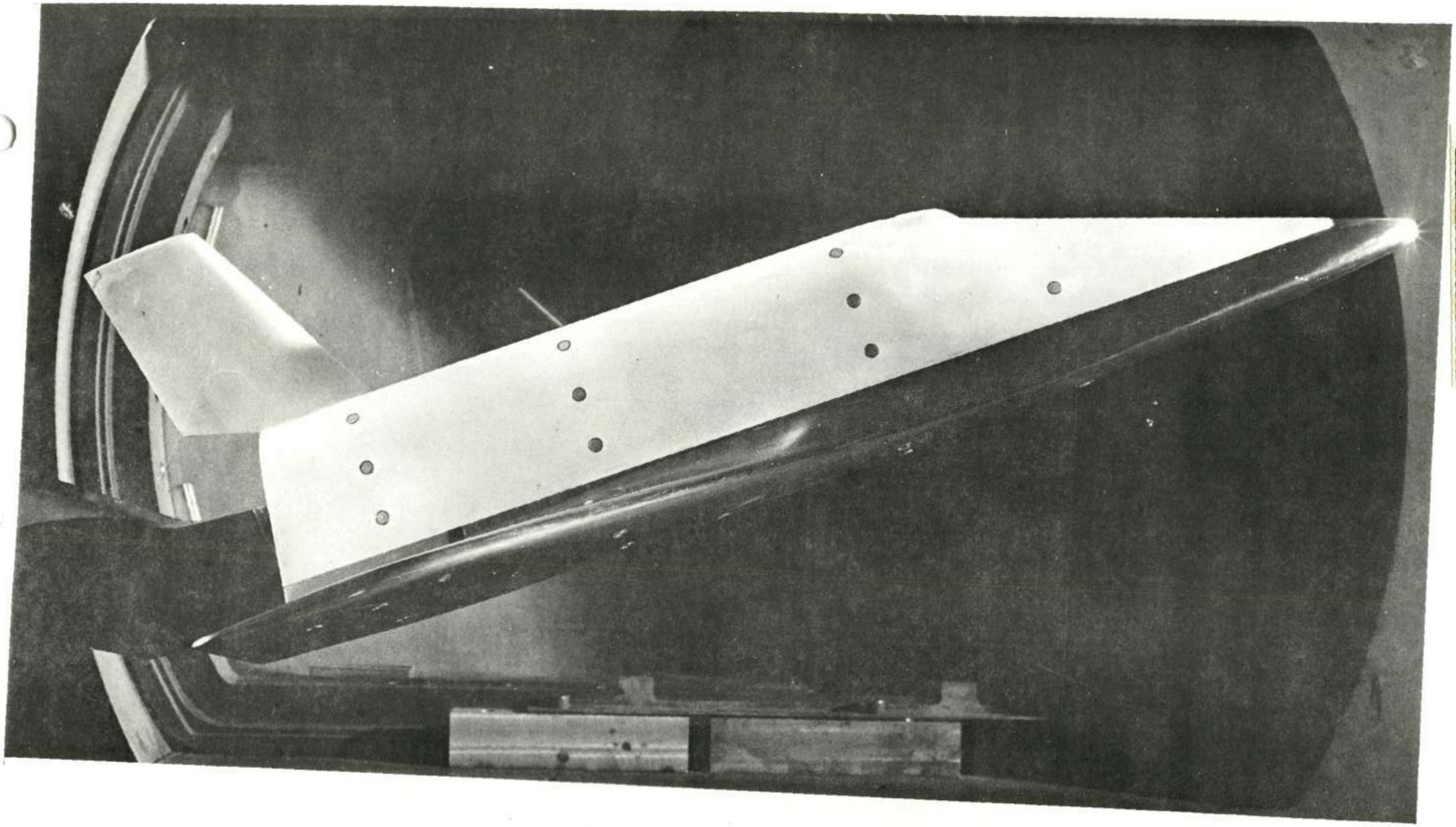
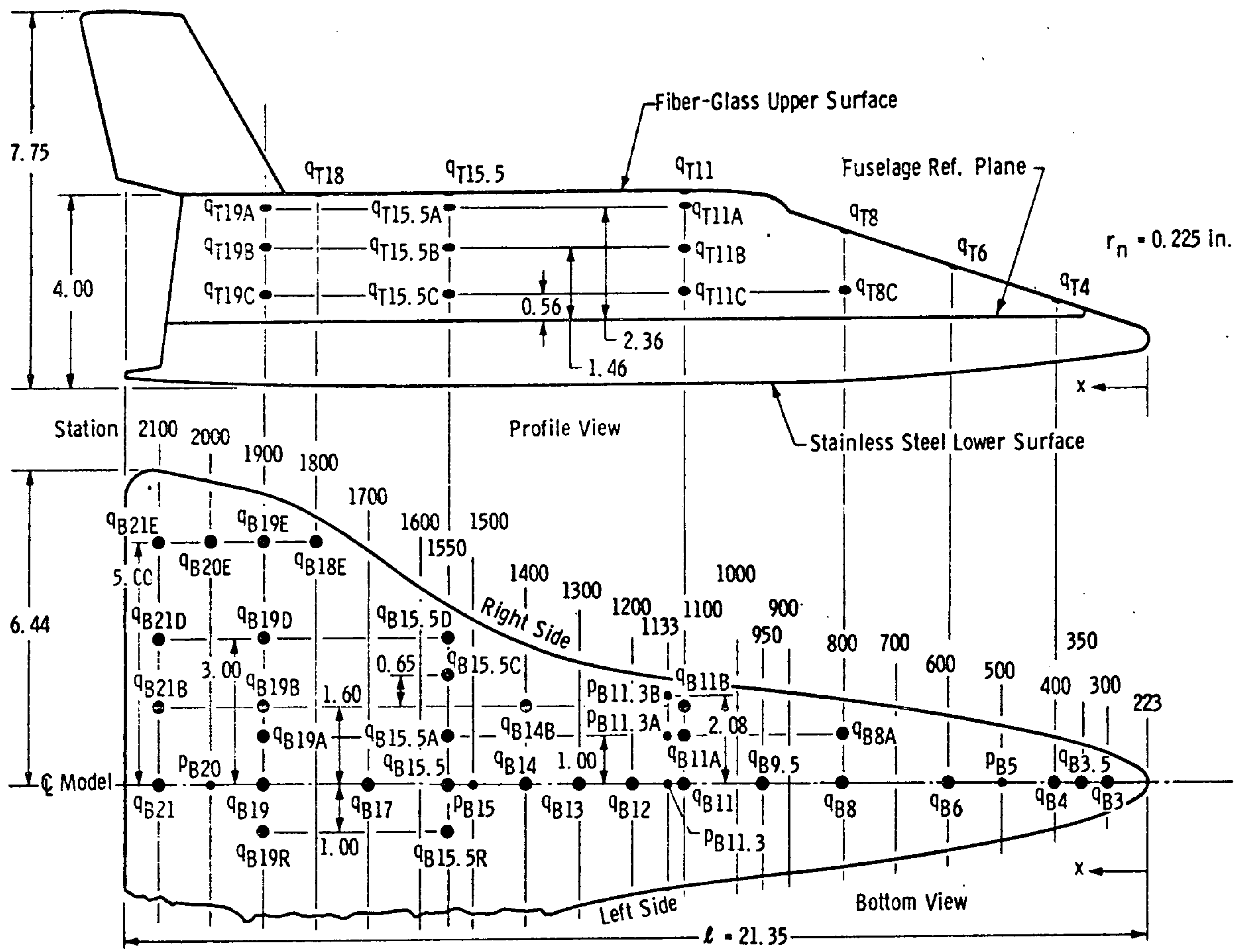


Fig. 2 Photograph of the McDonnell Douglas delta wing Orbiter (1.1 percent scale)



All Dimensions in Inches

Configuration No. 1

Model Scale: 0.011

McDonnell Douglas Delta Wing Orbiter Model

Fig. 3 Instrumentation Layout for the Tunnel F MDAC-DWO Model

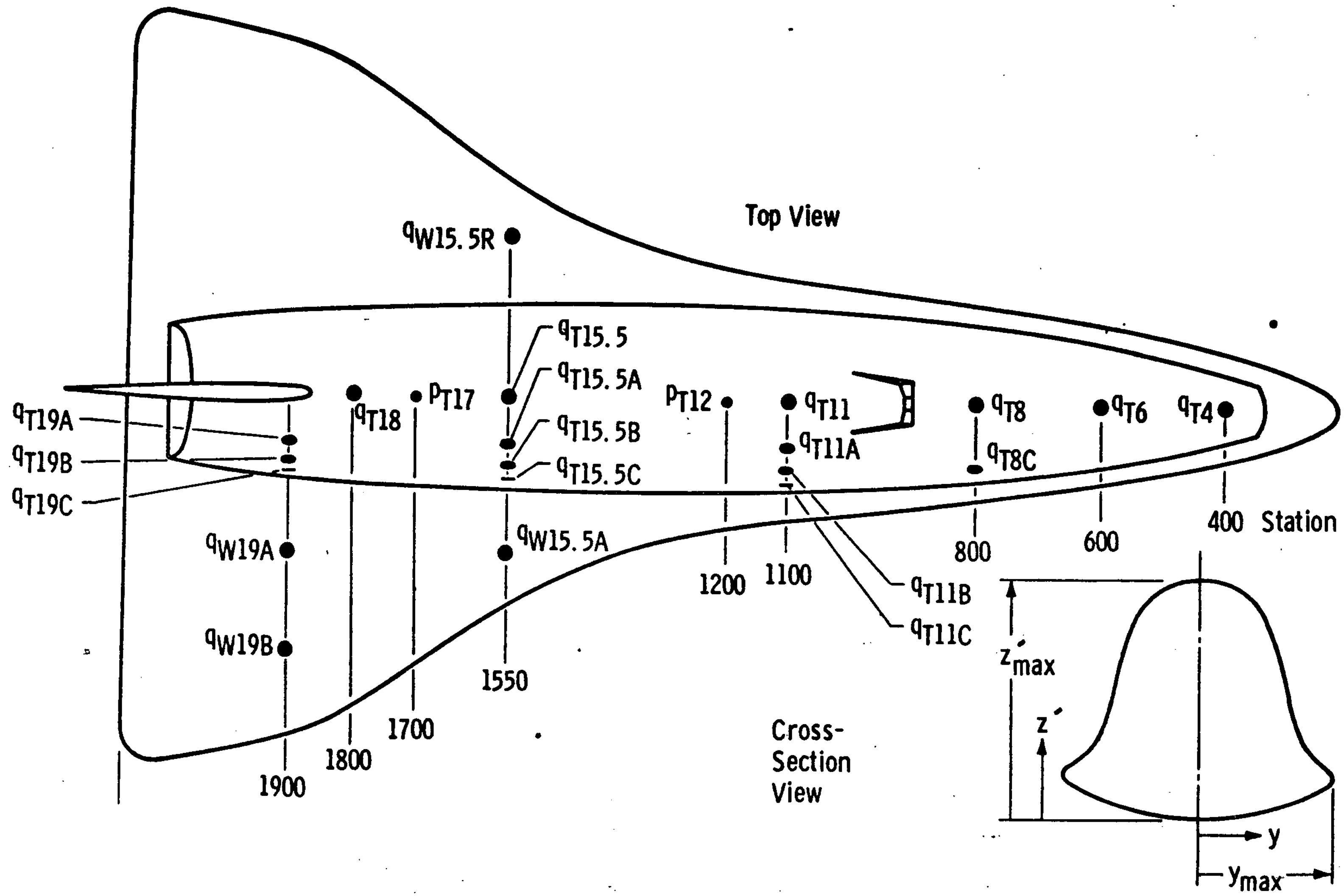


Fig. 3 Concluded

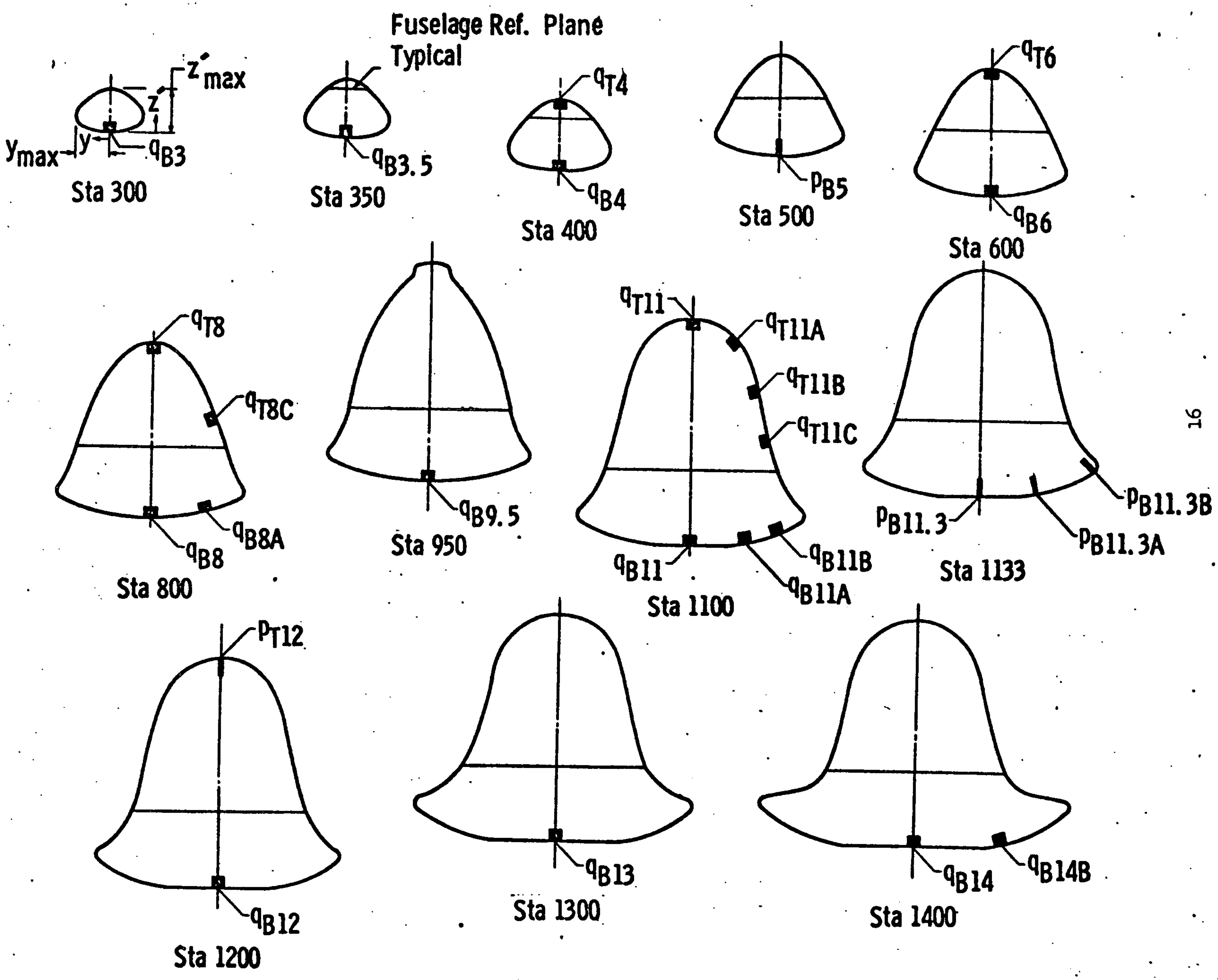
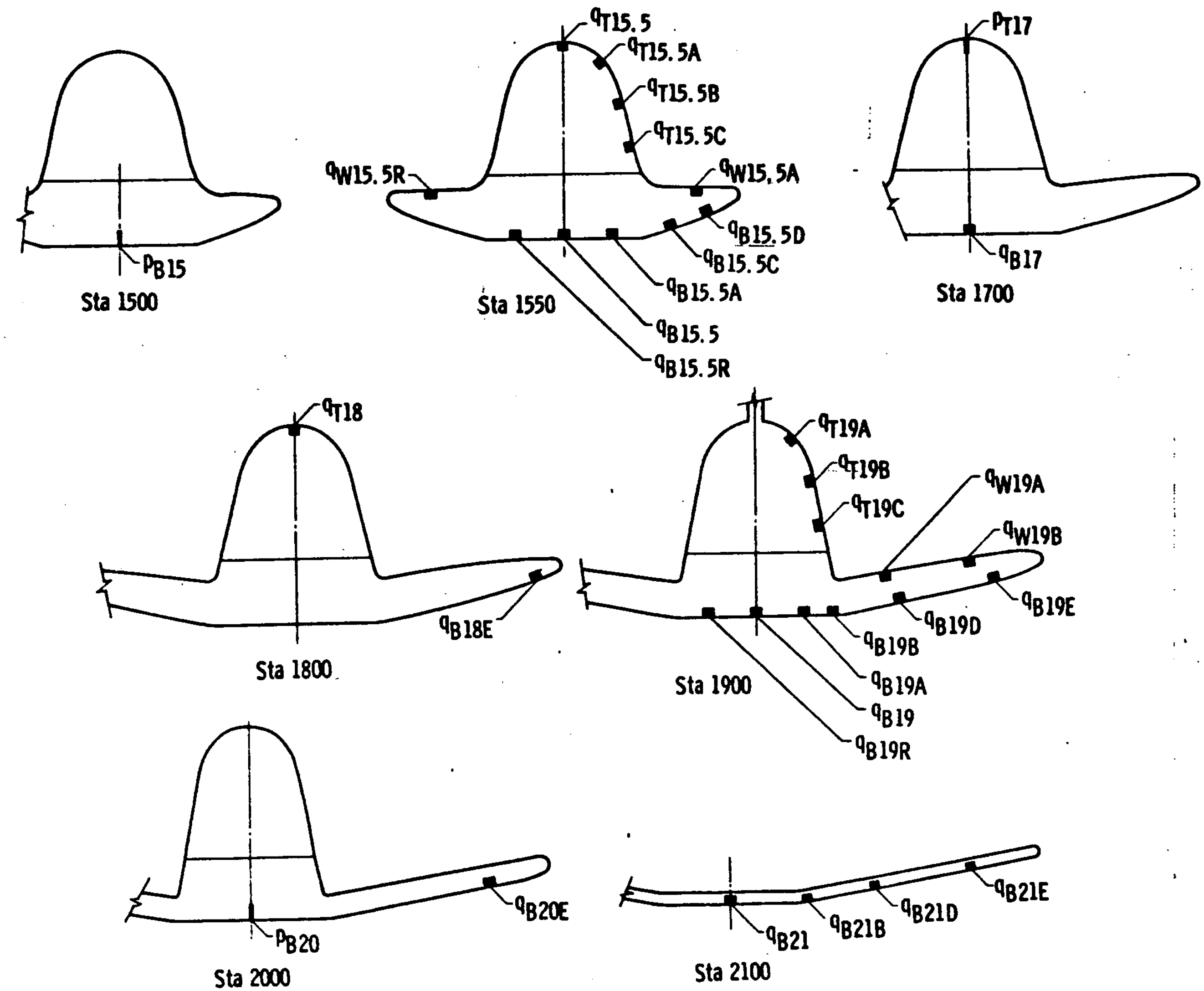
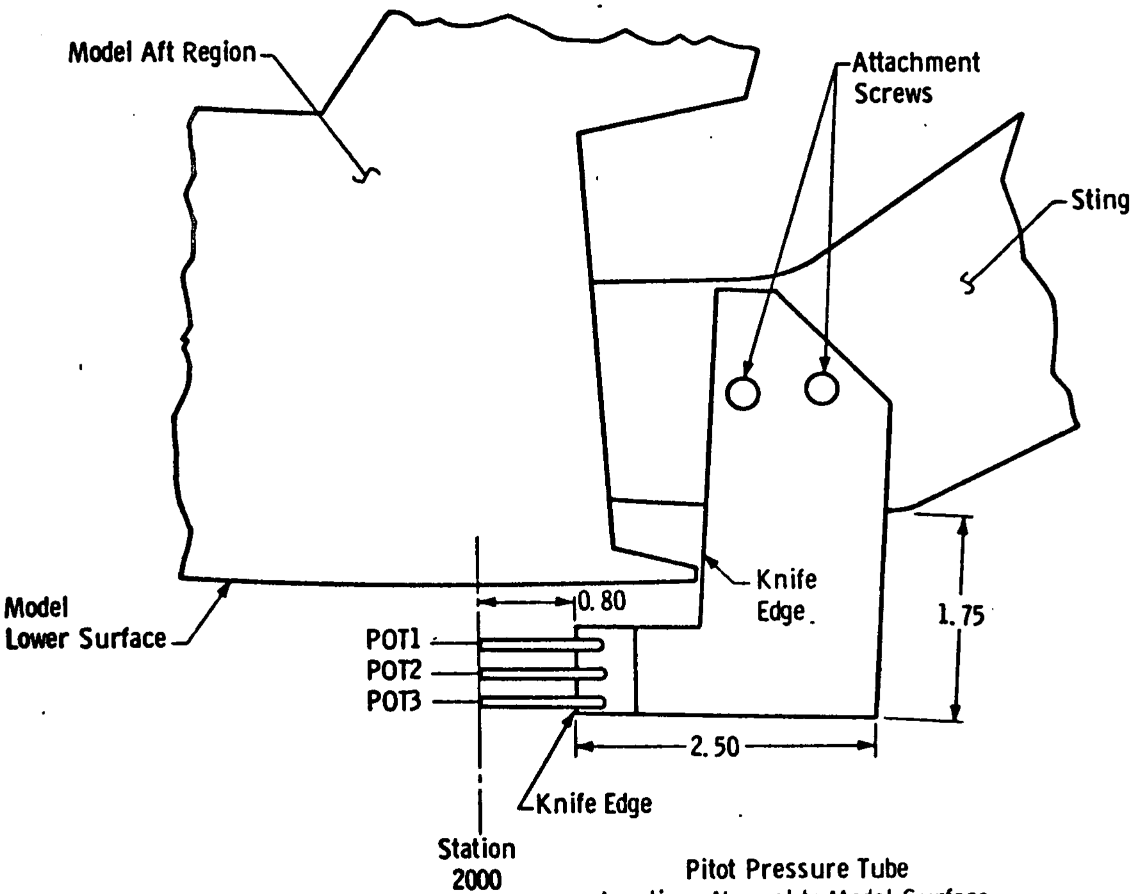


Fig. 4 Instrumented Cross-Section Views for the Tunnel F MDAC-DWO Model



All Contours Obtained from McDonnell Douglas Loft Lines.
Dwg. No. 255BJ00050 Rev. "B" of Delta Wing Orbiter.

Fig. 4 Concluded



Pitot Pressure Tube Locations Normal to Model Surface

POT1 - 0.50 in.
POT2 - 0.75 in.
POT3 - 1.00 in.

Note: 1. Survey rake is located along model centerline at Station 2000, $x/\ell = 0.916$, and $y = 0$.

2. Maximum thickness of rake exposed to flow is 0.25 in.

Fig. 5 Details of the Pitot Pressure Survey Rake for the Tunnel F MDAC-DWO Model

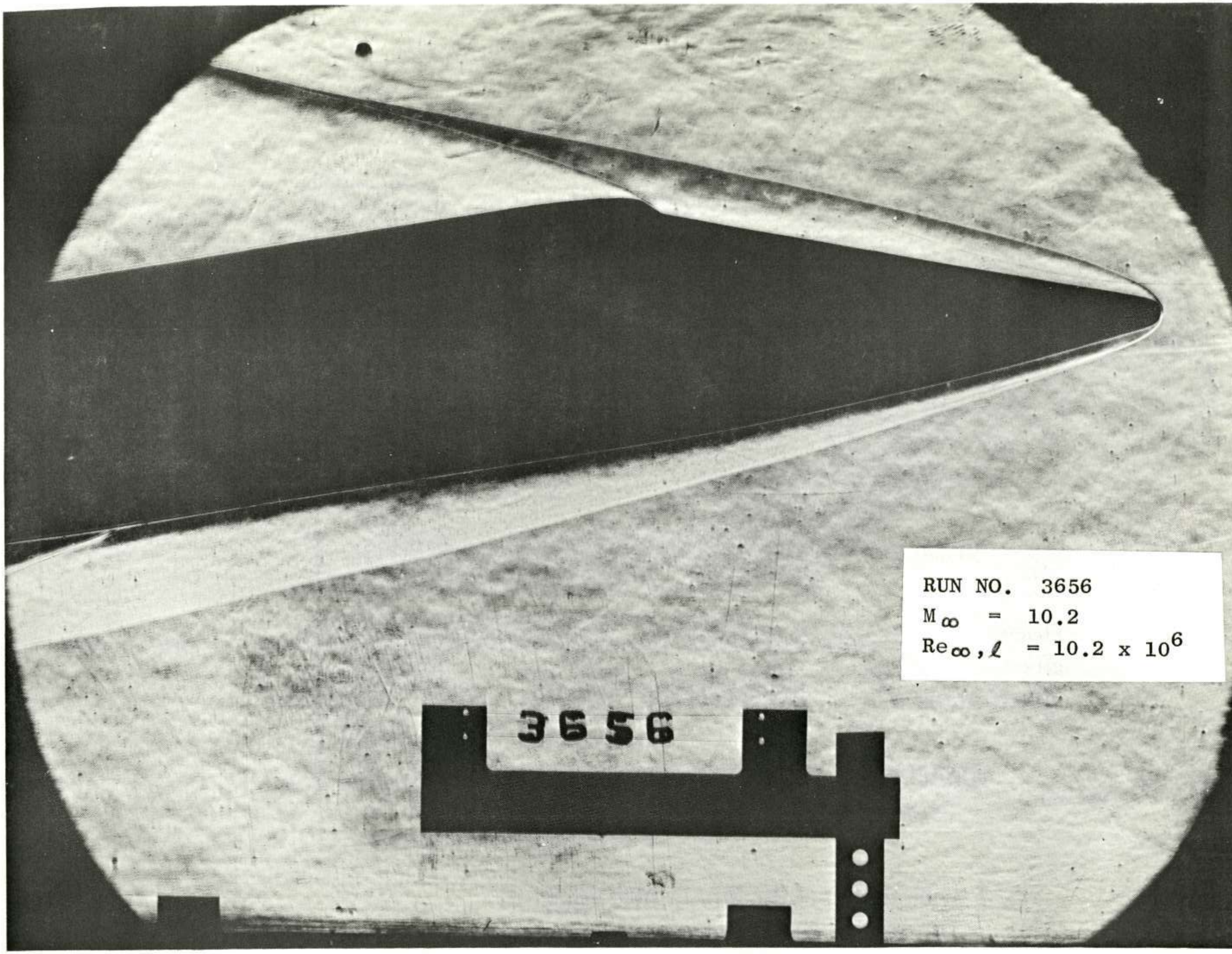


Fig. 6 Schlieren Photograph of the MDAC-DWO Model in Tunnel F at 10 deg angle of attack.

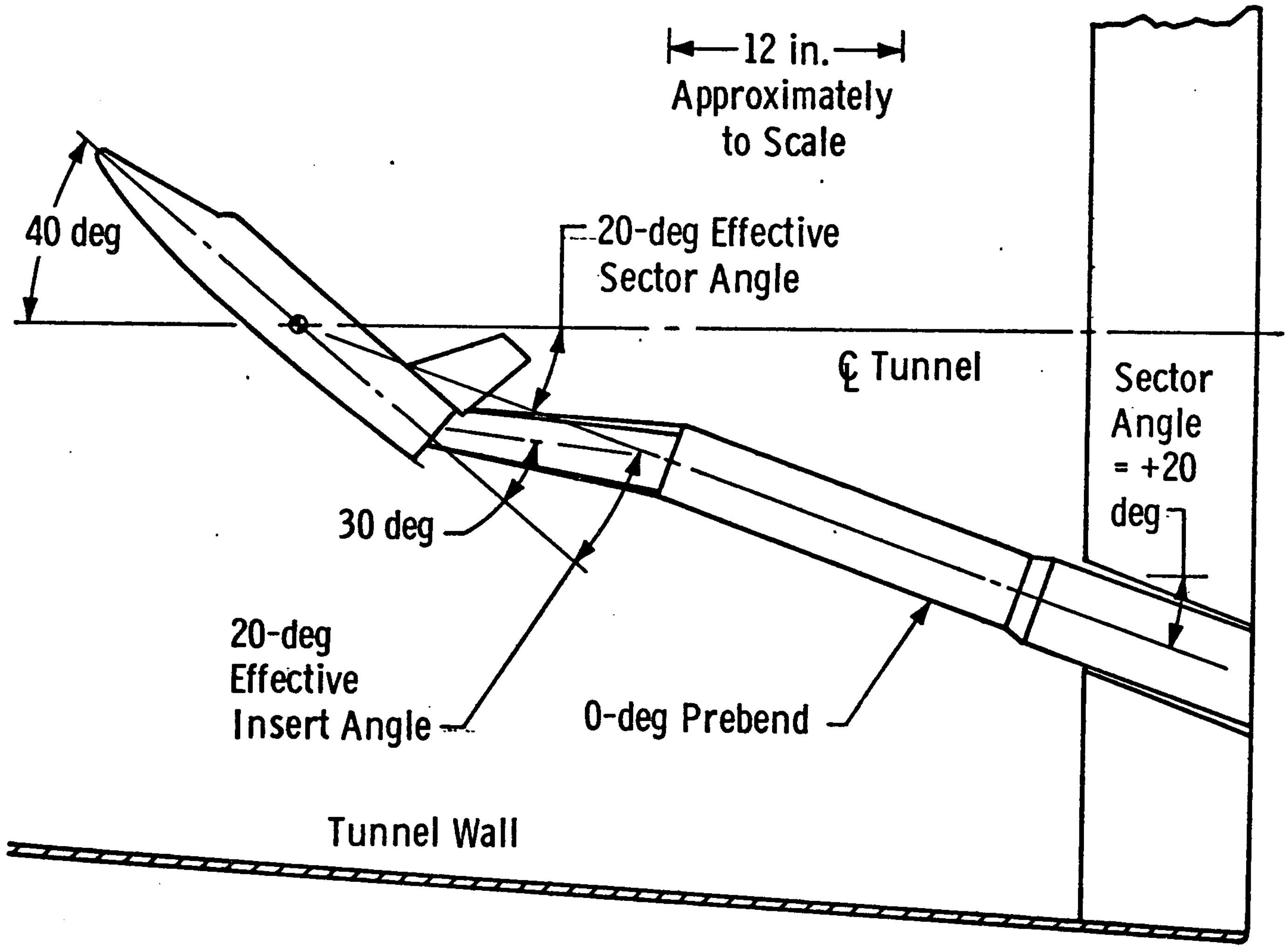


Fig. 7 Installation of the MDAC-DWO Model in Tunnel F at 40 deg Angle of Attack

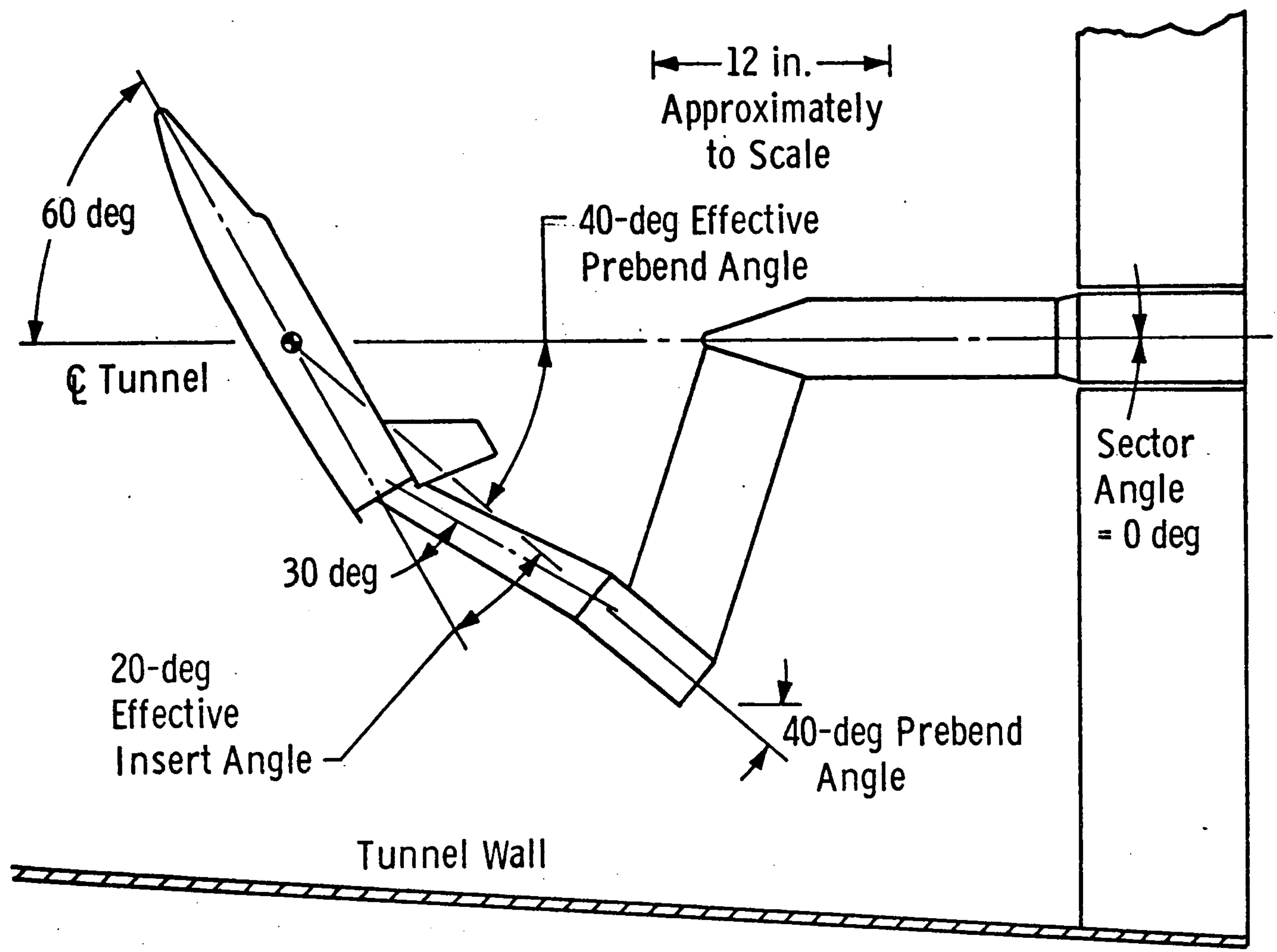


Fig. 8 Installation of the MDAC-DWO Model in Tunnel F at 60 deg Angle of Attack

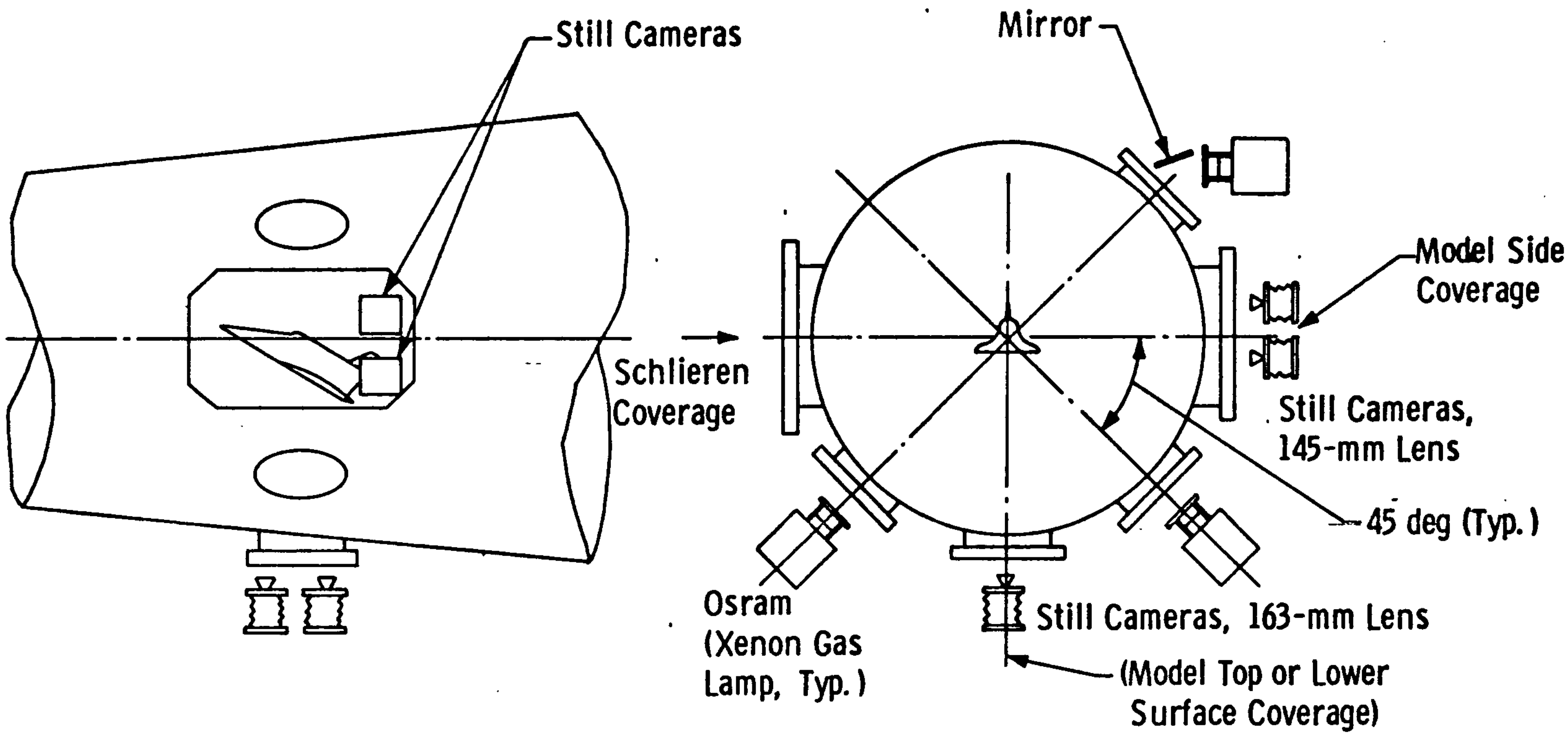


Fig. 9 Equipment Set-Up for the Phosphor Paint Technique

TABLE I

INSTRUMENTATION LOCATIONS FOR THE TUNNEL F MDAC-DWO MODEL

Pressure Sensors, Lower Surface

SADSAC No.	Station	Gage	x, in.	x/ℓ	y, in.	y/y_{max}
1	500	PB5	3.05	0.143	0	0
2	1133	PB11.3	10.00	0.469	0	0
3		PB11.3A	10.00	0.469	1.00	0.465
4		PB11.3B	10.00	0.469	2.08	0.967
5	1500	PB15	14.05	0.658	0	0
6	2000	PB20	19.55	0.916	0	0

Pressure Sensors, Top Surface

SADSAC No.	Station	Gage	x, in.	x/ℓ	y, in.	y/y_{max}
7	1200	PT12	10.75	0.503	0	0
8	1700	PT17	16.25	0.761	0	0

Pressure Sensors, Flow Field

SADSAC No.	Station	Gage	YP, in.
9	2000	POT1	0.50
10		POT2	0.75
11		POT3	1.00

Heat Transfer Sensors, Lower Surface

SADSAC No.	Station	Gage	x, in.	x/ℓ	y, in.	y/y_{max}	z, in.	z/z_{max}
1	300	QB3	0.85	0.040	0	0	0	0
2	350	QB3.5	1.40	0.065	0	0	0	0
3	400	QB4	1.95	0.091	0	0	0	0
4	600	QB6	4.15	0.194	0	0	0	0
5	800	QB8	6.35	0.297	0	0	0	0
6		QB8A	6.35	0.297	1.00	0.59	0.13	0.042
7	950	QB9.5	8.00	0.374	0	0	0	0
8	1100	QB11	9.65	0.452	0	0	0	0
9		QB11A	9.65	0.452	1.00	0.48	0.05	0.012
10		QB11B	9.65	0.452	1.60	0.77	0.20	0.050
11	1200	QB12	10.75	0.503	0	0	0	0
12	1300	QB13	11.85	0.555	0	0	0	0
13	1400	QB14	12.95	0.606	0	0	0	0
14		QB14B	12.95	0.606	1.60	0.56	0.06	0.015
15	1550	QB15.5	14.60	0.684	0	0	0	0
16		QB15.5R	14.60	0.684	1.00	0.27	0	0
17		QB15.5A	14.60	0.684	1.00	0.27	0	0
18		QB15.5C	14.60	0.684	2.25	0.62	0.18	0.045
19		QB15.5D	14.60	0.684	3.00	0.82	0.45	0.112
20	1700	QB17	16.25	0.761	0	0	0	0
21	1800	QB18E	17.35	0.813	5.00	0.91	1.23	0.305
22	1900	QB19	18.45	0.864	0	0	0	0
23		QB19R	18.45	0.864	1.00	0.17	0	0
24		QB19A	18.45	0.864	1.00	0.17	0	0
25		QB19B	18.45	0.864	1.60	0.27	0	0
26		QB19D	18.45	0.864	3.00	0.50	0.24	0.060
27		QB19E	18.45	0.864	5.00	0.84	0.66	0.165
28	2100	QB21	20.65	0.967	0	0	0	0
29		QB21B	20.65	0.967	1.60	0.25	0.04	0.17
30		QB21D	20.65	0.967	3.00	0.47	0.27	1.13
31		QB21E	20.65	0.967	5.00	0.78	0.62	2.58

TABLE I

(Concluded)

Heat Transfer Sensors, Top Surface

SADSAC No.	Station	Gage	x, in.	x/ℓ	y, in.	y/y_{max}	z, in.	z/z_{max}
32	400	QT4	1.95	0.091	0	0	1.27	1.00
33	600	QT6	4.15	0.194	0	0	2.25	1.00
34	800	QT8	6.35	0.297	0	0	3.13	1.00
35		QT8C	6.35	0.297	1.18	0.69	1.84	0.59
36	1100	QT11	9.65	0.452	0	0	4.02	1.00
37		QT11A	9.65	0.452	0.81	0.389	3.67	0.91
38		QT11B	9.65	0.452	1.22	0.587	2.77	0.69
39		QT11C	9.65	0.452	1.43	0.687	1.87	0.47
40	1550	QT15.5	14.60	0.684	0	0	4.02	1.00
41		QT15.5A	14.60	0.684	0.81	0.221	3.67	0.91
42		QT15.5B	14.60	0.684	1.22	0.333	2.77	0.69
43		QT15.5C	14.60	0.684	1.43	0.391	1.87	0.47
44		QW15.5A	14.60	0.684	2.75	0.751	1.03	0.25
45		QW15.5R	14.60	0.684	2.75	0.751	1.03	0.25
46	1800	QT18	17.35	0.813	0	0	4.02	1.00
47	1900	QT19A	18.45	0.864	0.80	0.134	3.63	0.91
48		QT19B	18.45	0.864	1.20	0.200	2.73	0.69
49		QT19C	18.45	0.864	1.37	0.229	1.83	0.46
50		QW19A	18.45	0.864	2.70	0.451	0.85	0.21
51		QW19B	18.45	0.864	4.43	0.741	1.11	0.28

TABLE II

TEST SUMMARY FOR THE TUNNEL F MDAC-DWO MODEL

α, Deg.	Run	~ M_∞	~$Re_{\infty,\ell}$	Model Orientation‡	Phosphor Paint Area	Final Paint Picture
10.0	3654	10.0	8-22 x 10^6	U	1, 3	1, 3
10.0	3656	10.2	8 x 10^6	D	1, 2, 3	side
20.0	3650	10.4	6-10 x 10^6	D	1, 2, 3	3
20.0	3651	10.7	10-20 x 10^6	D	1, 2, 3	2, 3
20.0	3652*	10.3	9 x 10^6	U	1, 3	1, 3
25.0	3667	11.2	2-6 x 10^6	D	1, 2, 3	2
30.0	3653	10.4	7-20 x 10^6	U	1,3	1, 3
30.2	3655	10.5	5-17 x 10^6	D	1, 2, 3	2, 3
40.5	3657	10.4	9-11 x 10^6	U	1, 3	1, 3
40.2	3661	10.5	6-13 x 10^6	D	1, 2, 3	2
45.0	3660	11.9	7-10 x 10^6	D	1, 2, 3	3
45.2	3662	11.4	2-5 x 10^6	D	1, 2, 3	2
45.0	3663	11.8	3-9 x 10^6	D	1, 2, 3	2
51.0	3659	10.7	7-22 x 10^6	U	1, 3	1, 3
50.2	3664	10.5	5-9 x 10^6	D	1, 2, 3	2, 3
60.5	3658*	10.6	6-24 x 10^6	U	1, 3	-
60.2	3665	10.4	5-11 x 10^6	D	1, 2, 3	3

‡Model Orientation: D - Model Lower Surface Down Toward Tunnel Floor

U - Model Lower Surface Up Toward Tunnel Ceiling

*Three point Pitot Survey

Phosphor Paint Legend:
1 - Fuselage Top and Wing Top
2 - Entire Lower Surface
3 - Fuselage Side and Vertical Tail

TABLE III.

SUMMARY DATA PLOT INDEX

MODEL CONFIGURATION	PLOTTED DATA	PAGE	REYNOLDS NUMBER, Re/L X 10^6															ANGLE OF ATTACK-DEGREES							
			2	3	4	5	6	7	8	9	10	11	13	17	20	22	24	10	20	25	30	40	45	50	60
MDAC-ORBITER	A	52										X							X						
		52					X												X						
		53													X				X						
		53									X								X						
		54								X									X						
		55													X						X				
		55							X												X				
		56														X		X							
		56								X								X							
		57												X							X				
		57				X															X				
		58							X									X							
		59										X										X			
		59								X												X			
		60															X								X
		60					X																		X
		61														X								X	
		61						X																X	
		62									X												X		
		62						X															X		
		63											X									X			
		63					X															X			
		64				X																	X		
		64	X																				X		
		65									X												X		
		65		X																			X		
		66								X														X	
		66				X																		X	
		67										X													X
		67				X																			X
		68					X													X					
MDAC-ORBITER	A	68	X																	X					
MDAC-ORBITER	B	69					X					X							X						
		69									X				X				X						
		70								X									X		X				
MDAC-ORBITER	B	70							X						X						X				

TABLE III
SUMMARY DATA PLOT INDEX
(Continued)

MODEL CONFIGURATION	PLOTTED DATA	PAGE	REYNOLDS NUMBER, Re/L X 10^6															ANGLE OF ATTACK-DEGREES							
			2	3	4	5	6	7	8	9	10	11	13	17	20	22	24	10	20	25	30	40	45	50	60
MDAC-ORBITER	B	71								X						X		X							
↓	↓	71				X								X							X				
		72							X									X							
		72								X		X										X			
		73					X										X								X
		73						X								X								X	
		74						X			X												X		
		74					X						X									X			
		75	X			X																	X		
		75		X						X													X		
		76				X				X														X	
		76				X						X													X
MDAC-ORBITER	B	77	X				X													X					
ORB. SIDE	C	79					X												X						
SIDE	D	80					X												X						
BOTTOM	C	81									X								X						
SIDE	C	82									X								X						
SIDE	D	83									X								X						
TOP	C	84								X									X						
SIDE	C	85								X									X						
SIDE	D	86								X									X						
TOP	C	87								X											X				
SIDE	D	88								X											X				
SIDE	D	89								X											X				
TOP	C	90						X										X							
SIDE	C	91						X										X							
SIDE	D	92						X										X							
BOTTOM	C	93				X															X				
SIDE	C	94				X															X				
SIDE	D	95				X															X				
SIDE	C	96									X							X							
SIDE	D	97									X							X							
TOP	C	98								X												X			
↓ SIDE	C	99								X												X			
ORB. SIDE	D	100								X												X			

TABLE III
SUMMARY DATA PLOT INDEX
(Concluded)

MODEL CONFIGURATION	PLOTTED DATA	PAGE	REYNOLDS NUMBER Re/L X 10^6															ANGLE OF ATTACK-DEGREES							
			2	3	4	5	6	7	8	9	10	11	13	17	20	22	24	10	20	25	30	40	45	50	60
ORB. TOP	C	101						X																X	
SIDE	C	102						X																X	
SIDE	D	103						X																X	
SIDE	C	104							X														X		
SIDE	D	105							X														X		
BOTTOM	C	106					X															X			
BOTTOM	D	107					X															X			
BOTTOM	C	108	X																				X		
BOTTOM	D	109	X																				X		
BOTTOM	C	110			X																		X		
BOTTOM	D	111			X																		X		
BOTTOM	C	112				X																		X	
SIDE	C	113				X																		X	
SIDE	D	114				X																		X	
SIDE	C	115				X																			X
SIDE	D	116				X																			X
BOTTOM	C	117	X																	X					
ORB. BOTTOM	D	118	X																	X					

A: GAGE C: PAINT

B: PRESSURE D: PAINT-GAGE

APPENDIX I

MODEL COMPONENT DESCRIPTION (SADSAC FORMAT)

MODEL COMPONENT DESCRIPTION
(SADSAC FORMAT)

MODEL COMPONENT: BODY - MDAC Orbiter

GENERAL DESCRIPTION: Basic fuselage contours including canopy.

model scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Length (ft.)	156.4	1.720
Max. Width	27.1	.298
Max. Depth	30.3	.333
Fineness Ratio		
Area (ft^2)		
Max. Cross-Sectional	627.4	.0759
Planform	3790.0	.459
Wetted	12520.0	1.515
Base	447.0	.0541

NOTE: All units are ft. or sq. ft.
This data includes both sides of the vehicle.

MODEL COMPONENT: Elevon - MDAC Orbiter

GENERAL DESCRIPTION: Model Scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area , ft^2	963.0	.117
Span (equivalent) , ft.	73.7	.811
Inb'd equivalent chord , ft.	12.8	.141
Outb'd equivalent chord , ft.	12.8	.141
Ratio Elevator chord/horizontal tail chord		
At Inb'd equiv. chord		
At Outb'd equiv. chord		
Sweep Back Angles, degrees		
Leading Edge	0.0	0.0
Tailing Edge	0.0	0.0
Hingeline	0.0	0.0
Area Moment (Normal to hinge line)		

NOTE: All units are ft., sq. ft., or degrees.
This data includes both sides of vehicle.

MODEL COMPONENT: Body Flap - MDAC Orbiter

GENERAL DESCRIPTION: Model Scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area , ft^2	140.88	.0170
Span (equivalent) , ft.	23.81	.262
Inb'd equivalent chord , ft.	5.333	.0587
Outb'd equivalent chord , ft.	12.80	.141
Ratio Elevator chord/horizontal tail chord		
At Inb'd equiv. chord		
At Outb'd equiv. chord		
Sweep Back Angles, degrees		
Leading Edge	0.0	0.0
Tailing Edge	0.0	0.0
Hingeline	0.0	0.0
Area Moment (Normal to hinge line)		

NOTE: All dimensions in ft., sq. ft., or degrees.
This data includes both sides of vehicle.

MODEL COMPONENT: WING - MDAC Orbiter

GENERAL DESCRIPTION: Model Scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:

	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area , ft^2		
Planform	5330.	.645
Wetted		
Span (equivalent) ft.	97.5	1.073
Aspect Ratio	1.68	1.68
Rate of Taper		
Taper Ratio	0.230	.230
Diehedral Angle, degrees	10.0	10.0
Incidence Angle, degrees	2.0	2.0
Aerodynamic Twist, degrees	0	0
Toe-In Angle	0	0
Cant Angle	0	0
Sweep Back Angles, degrees		
Leading Edge	55.0	55.0
Trailing Edge	0	0
0.25 Element Line	47.0	47.0
Chords: (ft.)		
Root (Wing Sta. 0.0)	90.43	.995
Tip, (equivalent)	20.80	.229
MAC	63.30	.696
Fus. Sta. of .25 MAC		
W.P. of .25 MAC		
Airfoil Section		
Root	0010-64	0010-64
Tip	0012-64	0012-64
EXPOSED DATA		
Area Ft^2	3147.3	.381
Span, (equivalent) ft.	70.5	.776
Aspect Ratio	1.47	1.47
Taper Ratio		
Chords , (ft.)		
Root	71.25	.784
Tip	20.80	.229
MAC	52.20	.574
Fus. Sta. of .25 MAC		
W.P. of .25 MAC		

NOTE: All units are ft., sq. ft. or degrees.
This data includes both sides of the vehicle.

MODEL COMPONENT: Vertical Tail - MDAC - Orbiter

GENERAL DESCRIPTION: Model Scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area , ft^2		
Planform	580.0	.702
Wetted		
Span (equivalent), ft.	27.5	.303
Aspect Ratio	1.30	1.30
Rate of Taper		
Taper Ratio	.638	.638
Diehedral Angle, degrees	0	0
Incidence Angle, degrees	0	0
Aerodynamic Twist, degrees	0	0
Toe-In Angle	0	0
Cant Angle	0	0
Sweep Back Angles, degrees		
Leading Edge	30.0	30.0
Trailing Edge	13.4	13.4
0.25 Element Line	26.2	26.2
Chords: (ft.)		
Root (Wing Sta. 0.0)	25.75	.283
Tip, (equivalent)	16.42	.181
MAC	21.43	.236
Fus. Sta. of .25 MAC		
W.P. of .25 MAC		
Airfoil Section		
Root	0009-64	0009-64
Tip	0009-64	0009-64
EXPOSED DATA		
Area ft^2	580.	.702
Span, (equivalent), ft.	27.5	.303
Aspect Ratio	1.30	1.30
Taper Ratio	.638	.638
Chords (ft.)		
Root	25.75	.283
Tip	16.42	.181
MAC	21.43	.236
Fus. Sta. of .25 MAC		
W.P. of .25 MAC		

MODEL COMPONENT: Rudder - MDAC Delta Wing Orbiter

GENERAL DESCRIPTION: Model Scale: 0.011

DRAWING NUMBER: 255 BJ 00050, Rev. B

DIMENSIONS:

	FULL-SCALE	MODEL SCALE
Area , $ft.^2$	213.9	.0259
Span (equivalent) , ft.	27.5	.303
Inb'd equivalent chord , ft.	9.50	.105
Outb'd equivalent chord , ft.	6.10	.0671
Ratio Elevator chord/horizontal tail chord		
At Inb'd equiv. chord	.369	.369
At Outb'd equiv. chord	.369	.369
Sweep Back Angles, degrees		
Leading Edge	30.0	30.0
Tailing Edge	13.38	13.38
Hingeline	19.95	19.95
Area Moment (Normal to hinge line)		

NOTE: All units are ft., sq. ft., or degrees

APPENDIX II

TABULATION

OF GAGE MEASUREMENTS AND TUNNEL CONDITIONS

RUN 3650 NASA-SIS TEST
MOAC= DWO

TEST CONDITIONS TEST GAS NITROGEN Q-0, ST-0, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 20.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/SQFT-SEC	STO	HREF BTU/SQFT SEC R	POP PSIA
95	.110690	.002918	99.1	5181	10.44	8.448	5.9462	10.5797	.00299	5654	2069	5.605E 02	158.0	.02448	.10330	15.569
100	.103904	.002558	106.1	5356	10.43	7.912	5.0309	8.5512	.00325	5411	2218	5.988E 02	166.4	.02611	.09917	14.590
105	.099146	.002353	110.1	5444	10.41	7.519	4.5335	8.0063	.00342	5180	2294	6.189E 02	170.6	.02745	.09725	13.870
110	.094554	.002268	108.9	5417	10.41	7.177	4.3961	7.8218	.00347	4964	2274	6.128E 02	164.2	.02789	.09465	13.237
120	.088835	.002148	108.0	5365	10.36	6.667	4.1578	7.3978	.00355	4516	2237	6.012E 02	153.6	.02851	.09054	12.294
128	.085591	.002055	108.8	5354	10.30	6.350	3.9390	7.0085	.00362	4217	2233	5.991E 02	149.1	.02913	.08810	11.709
136	.079948	.001826	114.2	5465	10.26	5.879	3.4026	6.0540	.00389	3920	2329	6.245E 02	152.9	.03122	.08545	10.844

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3B	PB15	PB20	PT12
95	.22931	.08486	.13746	.11367	.00263
100	.22649	.08369	.13487	.11058	.00270
105	.22476	.08354	.13472	.11099	.00283
110	.22513	.08525	.13554	.10945	.00289
120	.22319	.08198	.13022	.10889	.00275
128	.22168	.08218	.12960	.10687	.00291
136	.22071	.08072	.13030	.10475	.00311

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5B	QB15.5A
95	.11843	.13797	.14131	.16789	.16967	.05541	.11553	.10353	.13105	.09882	.11226	.16564	.12156	.14157	.14923
100	.11806	.12102	.11984	.13527	.15963	.05118	.10764	.09683	.12011	.08372	.10804	.15333	.11924	.13633	.14517
105	.11219	.10356	.09801	.09710	.13334	.04863	.09003	.08390	.11035	.07765	.09384	.13964	.12051	.13623	.13816
110	.11307	.09960	.09243	.07438	.11561	.04743	.07664	.07353	.10314	.07803	.08233	.12873	.12158	.13842	.12948
120	.10651	.09050	.08407	.05325	.09239	.03964	.05761	.05551	.09415	.06766	.06243	.11028	.11329	*****	.10885
128	.10429	.09214	.08427	.05194	.08988	.03782	.05200	.05033	.08276	.06288	.05130	.09014	.09952	*****	.08565
136	.10820	.09405	.08585	.05172	.08612	.03804	.04951	.04722	.07824	.05930	.04272	.08168	.08532	*****	.07887

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
95	.15572	.21083	.14372	.25735	.11595	.10587	.09407	.13013	.11819	.16467	.09876	.06924	.06197	.07178	.01017
100	.17167	.18533	.13915	.22350	.11188	.10143	.09214	.12347	.11389	.16065	.09478	.06463	.05987	.07014	.01061
105	.16919	.14672	.13749	.20331	.11073	.10112	.09127	.11249	.10942	.15302	.09165	.05884	.05621	.06902	.01132
110	.16304	.13965	.13916	.17829	.10796	.10228	.09043	.10294	.10993	.14779	.09150	.05563	.05696	.06806	.01173
120	.09461	.11398	.12891	.13962	.10009	*****	.08228	.08355	.11038	.10921	.08961	.04124	.05800	.06475	.01324
128	.07569	.09888	.11401	.12812	.08993	*****	.06805	.07334	.10497	.08109	.08098	.03690	.05664	.06467	.01361
136	.07323	.09140	.09424	.12089	.07439	*****	.05958	.05722	.08591	.06502	.06971	.03179	.05557	.05257	.01276

TIME	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QW15.5A	QW15.5B	QT18	QT19A	QT19C	QW19A	QW19B
95	.01214	.00923	.00351	.00286	.00563	.01121	.00537	.00103	.00055	.00067	.00603	.00213	.00140	.00046	.00058
100	.01226	.00968	.00384	.00294	.00579	.01104	.00556	.00109	.00061	.00076	.00549	.00202	.00145	.00043	.00049
105	.01252	.00984	.00420	.00302	.00570	.01131	.00534	.00111	.00071	.00080	.00595	.00205	.00135	.00046	.00036
110	.01226	.01000	.00408	.00292	.00557	.01106	.00516	.00106	.00052	.00067	.00578	.00160	.00139	.00032	.00042
120	.01173	.01014	.00444	.00307	.00585	.01088	.00505	.00140	.00073	.00081	.00587	.00208	.00155	.00032	.00030
128	.01131	.01046	.00463	.00310	.00567	.01080	.00591	.00113	.00065	.00069	.00565	.00176	.00163	.00033	.00039
136	.01142	.01049	.00471	.00304	.00554	.01015	.00469	.00097	.00052	.00076	.00513	.00164	.00178	.00027	.00030

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3651 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS   TEST GAS NITROGEN   Q-0, ST-0, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 20.000 DEG.   ANGLE OF YAW 0 DEG.   ANGLE OF ROLL 0 DEG.   MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
45	.183246	.005138	93.1	5246	10.90	15.251	11.2757	20.0623	.00227	11325	2048	5.726E 02	219.1	.01852	.14531	28.122
57	.157452	.004309	95.4	5319	10.92	13.147	9.3571	16.6487	.00249	10124	2122	5.885E 02	208.8	.02003	.13197	24.240
66	.154018	.004230	95.1	5259	10.82	12.613	9.1114	16.2115	.00250	9328	2083	5.756E 02	200.8	.02043	.13015	23.257
78	.135980	.003466	102.5	5434	10.77	11.036	7.1606	12.7405	.00281	8327	2241	6.149E 02	204.7	.02259	.12034	20.362
88	.127549	.003197	104.2	5449	10.71	10.233	6.5116	11.5857	.00293	7629	2263	6.185E 02	198.9	.02355	.11543	18.881
110	.107183	.002721	102.9	5375	10.63	8.476	5.5375	9.8527	.00316	6229	2220	6.022E 02	173.7	.02536	.10340	15.633
125	.096692	.002642	95.6	5168	10.60	7.611	5.5662	9.9037	.00314	5487	2057	5.569E 02	148.5	.02570	.09789	14.026

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB15	PB20	PT12
45	.22136	.12820	.08346	.12536	.10845	.00263
57	.22375	.12657	.08368	.13161	.10581	.00249
66	.21876	.12389	.08248	.12762	.10789	.00242
78	.21934	.12699	.08394	.13269	.10837	.00260
88	.21650	.12539	.08352	.12955	.10648	.00279
110	.21789	.12300	.07614	.13156	.10965	.00279
125	.22633	.12214	.07958	.12838	.10937	.00274

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5B	QB15.5A
45	.19406	.18277	.19844	.19164	.15513	.13823	.12985	.11552	.12402	.12009	.11270	.16523	.12073	.13124	.13610
57	.17107	.17438	.18379	.17109	.15208	.12298	.11801	.10601	.12872	.11546	.09909	.16667	.11816	.12817	.13699
66	.16265	.17776	.18306	.16482	.15140	.11714	.11312	.10141	.12958	.11667	.09600	.16952	.12210	.13460	.13789
78	.13424	.17293	.17623	.15449	.14587	.11167	.10259	.09245	.12407	.11897	.08988	.15940	.11849	.13498	.13347
88	.12406	.16689	.16560	.14796	.14534	.09665	.10067	.09355	.13141	.11202	.09403	.16093	.12171	.13698	.13556
110	.11319	.13140	.12074	.12193	.14550	.04802	.09734	.09019	.12648	.09580	.08737	.15312	.12362	.13077	.13714
125	.11523	.12101	.11215	.11663	.14745	.04383	.09723	.09205	.11679	.08653	.08866	.14251	.12795	.13094	.13954

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19B	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
45	.14748	.23705	.13565	.29681	.11305	.10445	.09290	.12447	.11779	.17748	.09890	.06640	.06319	.08153	.00527
57	.14614	.22616	.13707	.27800	.11577	.10275	.08974	.12849	.11487	.16591	.09792	.06619	.05946	.07481	.00646
66	.14827	.23052	.13758	.27748	.11387	.10157	.09062	.12968	.11732	.16348	.09775	.06528	.06035	.07308	.00721
78	.14745	.23267	.13051	.26091	.10355	.09472	.08779	.12416	.11461	.15517	.09377	.06611	.05631	.06783	.00711
88	.15165	.22851	.12643	.25554	.10196	.09170	.08939	.12683	.11471	.15757	.09067	.06589	.05454	.06973	.00783
110	.13444	.18129	.12484	.21971	.09733	.08507	.08877	.11838	.10523	.14766	.08797	.05913	.05288	.06190	.00857
125	.12491	.15488	.12632	.19367	.09816	.08613	.08872	.11753	.10876	.15190	.08767	.05934	.05399	.06229	.00910

TIME	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A	QT19C
45	.00926	.01824	.00346	.00331	.01032	.01655	.00462	.00134	.01007	.00398	.00060	.00078	.00574	.00192	.00124
57	.01026	.01549	.00337	.00346	.01011	.01560	.00449	.00123	.01047	.00381	.00074	.00083	.00577	.00199	.00126
66	.01057	.01492	.00352	.00349	.00982	.01497	.00437	.00127	.01056	.00375	.00074	.00082	.00548	.00221	.00129
78	.01026	.01095	.00333	.00275	.00748	.01275	.00441	.00122	.01046	.00335	.00082	.00081	.00542	.00228	.00132
88	.01045	.01047	.00353	.00285	.00640	.01166	.00422	.00132	.01153	*****	.00087	.00073	.00536	.00242	.00140
110	.01095	.01026	.00401	.00281	.00512	.00987	.00426	.00127	.01112	*****	.00085	.00075	.00523	.00228	.00133
125	.01156	.01040	.00419	.00292	.00500	.01019	.00419	.00131	.01152	*****	.00085	.00085	.00495	.00240	.00143

TIME	QW19A	QW19B
45	.00078	.00067
57	.00075	.00060
66	.00076	.00070
78	.00068	.00064
88	.00066	.00071
110	.00057	.00066
125	.00062	.00074

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3652 NASA-STS TEST
PDAC- DWO

TEST CONDITIONS — TEST GAS NITROGEN — Q=0, ST=0, AND HREF BASED ON .132 INCH RADIUS

ANGLE OF ATTACK 20.000 DEG. — ANGLE OF YAW 0 DEG. — ANGLE OF ROLL 0 DEG. — MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
115	.138300	.002837	127.3	5905	10.32	10.310	5.0398	8.9671	.00319	6889	2576	7.043E 02	245.0	.02608	.11932	19.040

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3D	PB20	PO12	PO13
115	.2017	.1217	.0769	.1053	2.9716	3.2783

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5R	QB15.5A
115	.10624	.10239	.10477	.10300	.13758	.05650	.09780	.09181	.11700	.09070	.09253	.15400	.11527	.14400	.13900

TIME	QB15.5C	QB15.5D	QB17	QB19	QB19A	QB19B	QB19D	QB19F	QB21D	QB21E	QT4	QT6	QT8	QT8C	QT11
115	.12319	.17100	.13069	.09760	.04460	.11400	.10700	.15430	.05580	.05800	.01000	.00989	.01290	.00874	.00475

TIME	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5R	QT18	QT19A	QT19C	QW19A
115	.00280	.00514	.01121	.00487	.00111	.00974	.00288	.00071	.00089	.00647	.00186	.00169	.00050

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3653 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 30.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
83	.132288	.005218	91.2	5048	10.60	14.339	11.2462	20.0099	.00221	9380	1909	5.313E 02	186.9	.01785	.13654	26.417
87	.179906	.004892	96.1	5147	10.53	13.971	10.2109	18.1678	.00230	9037	1997	5.525E 02	199.0	.01887	.13653	25.748
92	.177344	.004449	104.1	5312	10.44	13.536	8.8446	15.7368	.00245	8652	2141	5.890E 02	212.1	.01971	.13264	24.961
98	.162780	.003806	111.7	5493	10.43	12.386	7.2930	12.9760	.00270	8128	2299	6.300E 02	225.0	.02168	.12791	22.853
105	.151017	.003433	114.9	5565	10.42	11.467	6.4794	11.5294	.00286	7631	2365	6.467E 02	225.0	.02296	.12332	21.162
111	.146532	.003232	118.4	5612	10.35	10.978	5.9691	10.6206	.00296	7188	2410	6.581E 02	228.7	.02405	.12229	20.263
124	.124843	.002665	122.4	5710	10.35	9.369	4.8445	8.6196	.00329	6347	2502	6.812E 02	221.5	.02659	.11291	17.298
135	.113620	.002363	125.6	5758	10.31	8.450	4.2217	7.5115	.00351	5717	2551	6.930E 02	215.3	.02829	.10710	15.602

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB20	PT12
83	.35649	.25771	.14303	.22002	.00271
87	.35155	.25234	.14367	.21795	.00285
92	.35454	.25303	.14530	.21941	.00291
98	.36162	.25876	.14628	.21841	.00264
105	.36330	.24893	.14578	.22043	.00255
111	.36405	.25876	.14519	.22208	.00282
124	.34765	.25560	.14337	.21500	.00308
135	.36572	.25050	.14265	.22082	.00274

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5B	QB15.5A
83	.20962	.30190	.35971	.36397	.27100	.21390	.23471	.21432	.24760	.22654	.19829	.28062	.21823	.24152	.23217
87	.20346	.27453	.34782	.36361	.27716	.20451	.23604	.21358	.24609	.23180	.19315	.26937	.20590	.23588	.22754
92	.17938	.22261	.31235	.34994	.27437	.18790	.22508	.20172	.23977	.22985	.18394	.26097	.20344	.23579	.22168
98	.15780	.16430	.23202	.32466	.26832	*****	.21080	.18770	.23379	.21979	.16905	.26063	.20325	.23538	.22097
105	.16224	.13859	.14816	.30508	.25645	*****	.20148	.18019	.22929	.20697	.16259	.25147	.20699	.22944	.21441
111	.16641	.13373	.12074	.29486	.24684	*****	.19560	.17539	.22142	.17830	.15714	.25278	.20722	.22139	.20737
124	.16323	.13954	.11314	.24214	.23592	*****	.17829	.16099	.21291	*****	.13884	.24306	.20393	.21708	.20101
135	.16129	.13575	.11445	.19513	.22383	*****	.16416	.14978	.19222	*****	.13226	.22226	.19076	*****	.18947

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19B	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
83	.26140	.42622	.24548	.39513	.21035	.20624	.16790	.22352	.21071	.31010	.20044	.13955	.15957	.18118	.02091
87	.26034	.42540	.24195	.40069	.20064	.19932	.16345	.21678	.21576	.31595	.19834	.14029	.15763	.18255	.02113
92	.24935	.40267	.23563	.38105	.19204	.19622	.15970	.21404	.21121	.30588	.19248	.13303	.14496	.17107	.02142
98	.23304	.36780	.22812	.34982	.19584	.19242	.15548	.20840	.19848	.28668	.18663	.12409	.12739	.15442	.02147
105	.22506	.34728	.22205	.33385	.17812	.18173	.15308	.19722	.19077	.27876	.17928	.11979	.11779	.14609	.02148
111	.22109	.32599	.21465	.32184	.16962	.17255	.15128	.18874	.18920	.27706	.17215	.11767	.11459	.14462	.02164
124	.20438	.28576	.20334	.27212	.16071	.15934	.14695	.17747	.17295	.25637	.15667	.10804	.09830	.13277	.02145
135	*****	*****	.19152	*****	.14829	.15050	.13826	.16853	*****	*****	.14622	.10303	.09101	*****	.02125

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A
83	.02649	.02636	.00902	.00648	.00210	.00991	.01633	.00751	.00316	.01061	.00179	.00067	.00069	.00557	.00240
87	.02653	.02671	.00901	.00644	.00191	.00964	.01579	.00636	.00292	.00824	.00191	.00059	.00072	.00465	.00181
92	.02660	.02726	.00914	.00626	.00204	.00907	.01600	.00520	.00304	.00723	.00183	.00067	.00069	.00443	.00168
98	.02697	.02733	.00915	.00583	.00194	.00818	.01511	.00425	.00283	.00630	.00204	.00077	.00072	.00430	.00142
105	.02727	.02737	.00920	.00566	.00190	.00790	.01422	.00401	.00289	.00619	.00193	.00072	.00073	.00422	.00127
111	.02657	.02595	.00923	.00548	.00195	.00796	.01349	.00411	.00314	.00607	.00207	.00061	.00069	.00399	.00115
124	.02619	.02712	.00945	.00491	.00210	.00761	.01193	.00405	.00292	.00566	.00218	.00075	.00071	.00409	.00107
135	.02523	.02624	.00937	.00483	.00199	.00714	.01117	.00396	.00307	.00517	.00209	.00066	.00075	.00379	.00099

TIME	QT19B	QT19C	QW19A	QW19B
83	.00106	.00072	.00130	.00171
87	.00098	.00066	.00133	.00165
92	.00100	.00059	.00131	.00150
98	.00101	.00074	.00128	.00147
105	.00111	.00071	.00121	.00146
111	.00102	.00062	.01150	.00121
124	.00099	.00067	.00119	.00118
135	.00103	.00075	.00117	.00124

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3654 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS   TEST GAS NITROGEN   Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 10.000 DEG.   ANGLE OF YAW 0 DEG.   ANGLE OF ROLL 0 DEG.   MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
53	.194816	.009579	91.2	5174	10.87	16.103	12.3311	21.9401	.00216	11604	1984	5.569E 02	216.2	.01769	.14965	29.685
64	.183524	.005079	94.4	5207	10.75	14.847	10.9174	19.4247	.00227	10409	2028	5.646E 02	211.7	.01858	.14232	27.372
70	.183468	.004613	103.9	5389	10.61	14.445	9.3241	16.5899	.00243	9830	2188	6.054E 02	228.7	.01950	.13874	26.646
74	.169936	.004057	109.4	5938	10.62	13.417	8.0008	14.2354	.00262	9440	2316	6.393E 02	239.3	.02107	.13474	24.762
86	.150295	.003536	111.0	5561	10.59	11.792	6.9021	12.2806	.00282	8356	2349	6.448E 02	230.6	.02294	.12745	21.764
95	.131776	.002976	115.6	5484	10.60	10.367	5.6997	10.1395	.00310	7619	2460	6.735E 02	229.5	.02513	.11956	19.142
110	.116685	.002569	118.6	5712	10.52	9.040	4.8208	8.5773	.00335	6567	2497	6.807E 02	217.4	.02708	.11106	16.691

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3B	PB20	PT12
53	.08675	.03303	.02986	.00171
64	.08793	.03226	.02988	.00164
70	.08813	.03450	.02966	.00168
74	.08627	.03376	.02921	.00174
86	.08453	.03427	.02940	.00179
95	.08815	.03391	.02959	.00204
110	.08626	.03423	.03011	.00206

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5B	QB15.5A
53	.06818	.07745	.07685	.08177	.08048	.01591	.05559	.04951	.05994	.03157	.04506	.07688	.05010	.06804	.07203
64	.06832	.06969	.06779	.07171	.07847	.01636	.05348	.04750	.05726	.03007	.04374	.07622	.05005	.06833	.06558
70	.06678	.06504	.06292	.06544	.07340	.01568	.04980	.04405	.05065	.03091	.04153	.06610	.04769	.06886	.06413
74	.06415	.06174	.05881	.06053	.06871	.01513	.04640	.04180	.04550	.02893	.03893	.05987	.04763	.06810	.06244
86	.05804	.05226	.04477	.03959	.05449	.01512	.03787	.03524	.03438	.02788	.03292	.04407	.04774	.05831	.04785
95	.05810	.05224	.04392	.03387	.04664	.01590	.03236	.03019	.02940	.02920	.03101	.03539	.04531	.05109	.03368
110	.05397	.04979	.04250	.03018	.04348	.01690	.03074	.02995	.02926	.03010	.02880	.03311	.04210	.04007	.03055

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
53	.05984	.11452	.06403	.22620	.04950	.04485	.04087	.05870	.06937	.12227	.03630	.02550	.02407	.03281	.01982
64	.05853	.10337	.05983	.22257	.04666	.04282	.03946	.05270	.06862	.12688	.03533	.02552	.02358	.03190	.02051
70	.04655	.08842	.05898	.22888	.04525	.04304	.03880	.04794	.07238	.12584	.03442	.02354	.02499	.03176	.02203
74	.03751	.07939	.05901	.22608	.04435	.04178	.03849	.04196	.07080	.12229	.03326	.02131	.02429	.03038	.02228
86	.02408	.07111	.05575	.18341	.04105	.03659	.03468	.02528	.06184	.11822	.03111	.01283	.02307	.02829	.02275
95	.02178	.07130	.05016	.07622	.03736	.03253	.02874	.01588	.05419	.11868	.02918	.00987	.02388	.02733	.02228
110	.02054	.06820	.04488	.05981	.03389	.02771	.02452	.01446	.04327	.09562	.02728	.00814	.01964	.01572	.02178

TIME	QT6	QT8	QT8C	QT11	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QT18	QT19A	QT19B	QT19C
53	.02163	.02430	.00695	.00339	.01364	.00416	*****	.00410	.00821	*****	.00180	.00787	*****	*****	*****
64	.02353	.02583	.00671	.00356	.01080	.00415	*****	.00424	.00855	*****	.00187	.00764	*****	*****	.00462
70	.02564	.02669	.00708	.00384	.00792	.00416	.00419	.00353	.00709	.01174	.00185	.00797	.00118	.00592	.00483
74	.02567	.02649	.00718	.00383	.00624	.00382	.00425	.00300	.00520	.01158	.00181	.00768	.00119	.00587	.00474
86	.02454	.02611	.00757	.00392	.00540	.00393	.00411	.00258	.00352	*****	.00198	.00673	.00105	.00527	.00436
95	.02381	.02583	.00811	.00436	.00493	.00423	.00372	.00251	.00297	*****	.00209	.00624	.00084	.00431	.00370
110	.02371	.02658	.00826	.00441	.00478	.00392	.00331	*****	.00238	*****	.00218	.00543	.00063	.00279	.00335

TIME	QW19A	QW19B
53	.00036	.00208
64	.00047	.00206
70	.00046	.00212
74	.00043	.00189
86	.00050	.00190
95	.00042	.00187
110	.00040	.00193

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3655 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 30.200 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
65	.141985	.004361	85.0	4956	10.56	11.089	9.7023	17.2629	.00237	7261	1770	4.918E 02	147.5	.01945	.11994	20.412
69	.136883	.003796	94.2	5086	10.51	10.588	7.9882	14.2130	.00260	7007	1971	5.396E 02	164.7	.02102	.11512	19.508
75	.125711	.003034	108.2	5438	10.49	9.674	5.9403	10.5693	.00301	6662	2269	6.170E 02	192.7	.02416	.11140	17.846
81	.117660	.002685	114.5	5579	10.46	9.011	5.0984	9.0714	.00324	6297	2391	6.496E 02	203.6	.02634	.10996	16.630
89	.111755	.002426	120.3	5686	10.40	8.458	4.4673	7.9485	.00344	5882	2486	6.751E 02	207.9	.02784	.10682	15.613
96	.105022	.002145	127.9	5835	10.35	7.874	3.8119	6.7823	.00370	5510	2617	7.114E 02	215.4	.02980	.10372	14.543
108	.093474	.001887	129.3	5863	10.34	6.998	3.3336	5.9314	.00396	4960	2647	7.183E 02	205.7	.03180	.09763	12.925
134	.074776	.001546	126.3	5776	10.31	5.564	2.7555	4.9027	.00434	3946	2587	6.973E 02	176.2	.03500	.08609	10.273

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3	PB11.3A	PB11.3B	PB20
65	.36719	.25544	.27234	.15340	.23412
69	.37698	.25778	.26882	.15200	.23763
75	.37964	.26007	.27006	.15009	.23569
81	.36596	.25652	.27198	.14649	.23856
89	.36715	.25805	.27222	.14678	.24047
96	.37542	.25936	.26523	.14755	.23822
108	.35618	.26057	.27077	.14632	.23471
134	.36102	.25748	.26545	.14816	.23413

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5R	QB15.5A
65	.22327	.28986	.34800	.32057	.28527	.21750	.23268	.19596	.21742	.20822	.21031	.27425	.19365	.21579	.20593
69	.19669	.25591	.33435	.31307	.27444	.20925	.22208	.18673	.21046	.20600	.20439	.26583	.18578	.21072	.19903
75	.16364	.18754	.29656	.29203	.24448	.18048	.19759	.17146	.20108	.18798	.18904	.25207	.17614	.19966	.19713
81	.14264	.13198	.25932	.27610	.22067	.15824	.18320	.16444	.20081	.17913	.17554	.25062	.18042	.21154	.20406
89	.13964	.10844	.18173	.25382	.20924	.14625	.17223	.15672	.19599	.17326	.16203	.24190	.17995	.22318	.20102
96	.14301	.10791	.12310	.23668	.20945	.14136	.16495	.15161	.19153	.16991	.15729	.23094	.17492	.20997	.19539
108	.14374	.10940	.09844	.21486	.20115	.12607	.15537	.14853	*****	.17013	.14672	.19035	.18139	.19040	.19755
134	.14713	.10917	.10277	.17237	.17904	*****	.14187	.13912	*****	*****	.13805	*****	.17926	*****	.19207

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
65	.27035	.37716	.19921	.37481	.19703	.17220	.15516	.21240	.21293	.26956	.18701	.13529	.14848	.15851	.02196
69	.26823	.37801	.18994	.35711	.18884	.16498	.15205	.21249	.20862	.26349	.17835	.13242	.14098	.15243	.02135
75	.24841	.34531	.18216	.32199	.17977	.15545	.14867	.20465	.18677	.24676	.16791	.12021	.11955	.13830	.02143
81	.22959	.31368	.18803	.30305	.17792	.15455	.15276	.19868	.17330	.23661	.16614	.11291	.10657	.13078	.02092
89	.21530	.28533	.18639	.28919	.16927	.14808	.14980	.18912	.16359	.22539	.15683	.10704	.09785	.12345	.02061
96	.20490	.26559	.18162	.27545	.16046	.14214	.14321	.17924	.15619	.21583	.14817	.10160	.09146	.11730	.02027
108	.19641	.24668	.18279	.26154	.15623	.13754	.14233	.17335	.15053	.20498	.14392	.09704	.08366	.11275	.02042
134	*****	*****	.16910	*****	.14196	.12886	.13572	*****	*****	*****	.13308	.09340	.07152	*****	.02076

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5R	QT18	QT19A
65	.03169	.02546	.00985	.00671	.00219	.01065	.01349	.00477	.00320	.00355	.00167	.00061	.00078	.00529	.00138
69	.03135	.02628	.00941	.00626	.00204	.00950	.01312	.00476	.00353	.00354	.00163	.00069	.00077	.00492	.00137
75	.02975	.02612	.00909	.00569	.00196	.00818	.01184	.00423	.00346	.00361	.00159	.00067	.00077	.00479	.00134
81	.02872	.02591	.00915	.00542	.00203	.00736	.01147	.00395	.00334	.00349	.00149	.00058	.00078	.00482	.00128
89	.02824	.02575	.00886	.00501	.00194	.00679	.01194	.00409	.00337	.00363	.00167	.00060	.00077	.00477	.00114
96	.02737	.02534	.00839	.00489	.00189	.00689	.01249	.00399	.00337	.00380	.00173	.00069	.00086	.00458	.00113
108	.02682	.02444	.00814	.00424	.00204	.00699	.01200	.00408	.00332	.00376	.00162	.00059	.00074	.00419	.00106
134	.02590	.02322	.00826	.00400	.00216	.00684	.01113	.00376	.00339	.00352	.00153	.00060	.00075	.00352	.00104

TIME	QT19C	QW19A	QW19B
65	.00081	.00142	.00149
69	.00086	.00141	.00142
75	.00072	.00125	.00115
81	.00078	.00114	.00109
89	.00068	.00110	.00109
96	.00075	.00109	.00108
108	.00082	.00103	.00105
134	.00075	.00104	.00103

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3656 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 10.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
70	.132074	.002702	127.6	5722	10.16	9.541	4.7195	8.3972	.00327	5971	2520	6.852E 02	225.3	.02642	.11377	17.614

PRESSURE DATA (PRESSURE / POP)

TIME	PB11.3	PB11.38	PB15	PB20
70	.04323	.02918	.03985	.02907

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5R	QB15.5A
70	.05553	.04594	.04541	.02972	.04302	.02028	.03104	.02963	.03397	.03057	.03052	.03660	.03692	.04043	.03316

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
70	.02285	.07086	.04529	.07757	.03725	.02547	.02521	.01704	.04406	.09772	.02849	.00928	.01583	.01936	.02002

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5R	QT19	QT19A
70	.02012	.02303	.00933	.00421	.00815	.00464	.00494	.00387	.00196	.00268	.00549	.00250	.00426	.00682	.00069

TIME	QT19B	QW19A	QW19B
70	.00250	.00028	.00203

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3657 NASA-STS TEST
PDAC- OWO DI

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 40.500 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
78	.179644	.003558	131.8	5931	10.36	13.496	6.2359	11.0952	.00290	8998	2654	7.347E 02	294.6	.02323	.13937	24.936
82	.167606	.003452	126.8	5852	10.42	12.747	6.2070	11.0438	.00292	8692	2590	7.149E 02	276.0	.02350	.13463	23.547
94	.148505	.003195	121.4	5721	10.42	11.276	5.8674	10.4396	.00300	7661	2493	6.833E 02	244.1	.02429	.12497	20.821
108	.126100	.002863	115.0	5587	10.45	9.636	5.4171	9.6383	.00314	6655	2394	6.515E 02	211.4	.02552	.11403	17.784
118	.115692	.002728	110.7	5476	10.44	8.821	5.2557	9.3513	.00318	6052	2309	6.259E 02	188.0	.02556	.10625	16.274

PRESSURE DATA (PRESSURE / POP)

TIME	PB11.3	PB11.3B	PB15	PB20
78	.46030	.23321	.42316	.39476
82	.46095	.23982	.42773	.38949
94	.45102	.23675	.43659	.39057
108	.45013	.24103	.42113	.40643
118	.45639	.23778	.43934	.39368

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5B	QB15.5A
78	.28834	.32568	.38684	.31804	.28343	.19193	.24780	.23014	.26930	.23316	.22144	.28305	.24259	.24425	.22992
82	.28192	.32247	.38040	.31010	.28124	.19120	.24603	.22774	.27305	.23068	.21917	.28812	.24647	.24868	.23204
94	.22384	.28340	.36212	.29637	.27464	.18752	.23264	.21841	.25776	.22749	.21531	.28291	.23830	.24397	.22549
108	.20595	.21764	.32518	.28251	.27181	.18513	.23502	.20855	.25289	.22807	.21444	.28045	.22686	*****	.23125
118	.19038	.17822	.26358	.25962	.26457	.17943	.22728	.20220	.24932	.22667	.20509	.27136	.23180	*****	.22373

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
78	.25759	.28409	.23205	.35205	.23335	.19928	.21136	.24561	.21935	.28919	.23671	.14556	.15760	.20777	.02469
82	.25720	.27979	.23400	.34493	.23240	.19761	.20849	.24288	.21828	.28507	.23583	.14462	.15541	.20476	.02442
94	.24612	.26693	.21890	.33181	.22479	.19985	.20413	.23285	.20949	.27475	.23012	.14617	.14282	.19845	.02316
108	.24388	.25765	.21892	.32577	.21869	.19721	.19876	.22919	.20650	.27124	.23414	.15020	.13144	.19179	.02477
118	.23858	.24713	.20990	.30900	.21061	.18612	.18735	.22181	.19812	.26407	.21820	.14396	.11672	.18304	.02493

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A
78	.03049	.01863	.00897	.00415	.00208	.01087	.01218	.00672	.00320	.00150	.00085	.00088	.00091	.00317	.00136
82	.03057	.01836	.00898	.00416	.00199	.01075	.01181	.00673	.00309	.00140	.00086	.00092	.00088	.00309	.00140
94	.03013	.01857	.00909	.00424	.00233	.01051	.01238	.00681	.00300	.00154	.00083	.00087	.00092	.00338	.00146
108	.03079	.01869	.00923	.00419	.00237	*****	.01213	.00683	.00275	.00149	.00090	.00083	.00103	.00315	.00150
118	.03151	.01890	.00940	.00380	.00235	*****	.01158	.00679	.00270	.00146	.00093	.00093	.00098	.00322	.00154

TIME	QT19B	QW19B
78	.00159	.00170
82	.00156	.00169
94	.00155	.00162
108	.00157	.00157
118	.00151	.00147

RUN 3658 NASA-STS TEST
MOAC- OWO

TEST CONDITIONS   TEST GAS NITROGEN   Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 60.500 DEG.   ANGLE OF YAW 0 DEG.   ANGLE OF ROLL 0 DEG.   MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
71	.209368	.006160	88.8	5806	10.66	16.644	13.5339	24.0802	.00202	10833	1855	5.222E 02	195.6	.01633	.14881	30.660
74	.200397	.005534	94.6	5158	10.64	15.876	11.7578	20.9200	.00217	10512	1988	5.545E 02	213.3	.01775	.14730	29.262
77	.187824	.004882	100.5	5330	10.67	14.955	10.0875	17.9483	.00235	10290	2133	5.921E 02	224.8	.01885	.14107	27.583
85	.172618	.004197	107.4	5497	10.64	13.675	8.3683	14.8893	.00257	9615	2280	6.297E 02	236.3	.02064	.13580	25.235
92	.167276	.003808	114.7	5614	10.51	12.942	7.2608	12.9189	.00273	8861	2388	6.575E 02	248.1	.02215	.13426	23.890
99	.150382	.003167	124.0	5848	10.53	11.679	5.8188	10.3532	.00305	8400	2588	7.133E 02	263.4	.02453	.12840	21.575
107	.142545	.002796	133.2	5991	10.41	10.821	4.9004	8.7190	.00329	7632	2721	7.495E 02	270.9	.02627	.12424	19.997
114	.133813	.002545	137.3	6083	10.41	10.154	4.3908	7.8122	.00347	7292	2803	7.727E 02	269.9	.02728	.11926	18.769
120	.127147	.002316	143.4	6175	10.35	9.525	3.8873	6.9165	.00367	6787	2889	7.967E 02	272.7	.02876	.11609	17.610
130	.112928	.002011	146.6	6253	10.36	8.479	3.3409	5.9444	.00396	6210	2963	8.168E 02	266.3	.03100	.10988	15.681

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3	PB11.38	PB15	PB20	PT12	POT1	POT2	POT3
71	.9297	.7806	.3985	.7317	.7769	.0061	1.4363	1.4278	1.3983
74	.9347	.7775	.3995	.7478	.7771	.0061	1.4428	1.4409	1.4123
77	.9345	.7755	.3997	.7369	.7777	.0062	1.4675	1.4340	1.4152
85	.9265	.7815	.4088	.7411	.7780	.0065	1.4530	1.4094	1.4234
92	.9219	.8005	.4150	.7379	.7904	.0067	1.4648	1.3978	1.4472
99	.9311	.7936	.4358	.7466	.7836	.0071	1.4906	1.3830	1.4487
107	.9236	.8005	.4214	.7511	.7785	.0073	1.4931	1.3934	1.4834
114	.9119	.8007	.4221	.7498	.7936	.0071	1.5022	1.4197	1.5005
120	.9233	.7995	.4205	.7379	.7712	.0073	1.5227	1.3929	1.5023
130	.9207	.7868	.4269	.7476	.7857	.0077	1.5191	1.3939	1.4553

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14B	QB15.5	QB15.5R	QB15.5A
71	.30575	.28217	.29011	.49061	.39392	.38513	.39857	.37734	.36472	.34561	.37955	.35336	.34764	.31702	.33719
74	.28073	.26145	.27626	.48086	.37887	.36590	.38429	.36501	.35062	.33164	.35690	.35551	.34250	.31418	.32863
77	.27368	.24709	.26689	.47425	.36829	.34965	.37311	.35418	.34366	.32418	.33862	.36131	.34061	.31244	.32418
85	.26675	.23050	.22923	.42749	.34304	.29923	.35333	.33400	.33606	.31067	.30692	.37892	.33916	.30580	.32564
92	.25411	.22523	.22201	.40575	.32514	.24360	.33710	.32315	.31674	.30796	.30951	.37245	.33619	.29096	.30445
99	.24952	.22421	.21929	.35681	.29616	.18324	.31786	.29740	.30777	.28755	.29120	.36892	.32949	.28578	.29894
107	.24885	.20360	.19333	.27902	.26076	.08483	.29216	.26438	.27402	.26179	.26653	.35457	.31089	.24602	.28761
114	.25355	.20825	.20393	.26079	.25988	.08644	.28797	.25780	.26506	.25560	.26220	.34630	.28317	.23248	.27819
120	.24445	.20580	.20256	.24531	.24733	.08761	.27485	.24646	.25094	.23636	.25480	.33364	.26430	*****	.26805
130	.24054	.20237	.19304	.19525	.21049	.08265	.23313	.22009	.22147	.20016	.23853	.32122	.26248	*****	.26038

TIME	QB15.5C	QB15.5D	QB17	QB18E	QB19	QB19R	QB19A	QB19B	QB19D	QB19E	QB21E	QT4	QT6	QT8	QT8C
71	.32719	.50865	.32382	.40277	.31755	.32939	.30712	.35691	.34810	.49306	.41177	.01191	.01791	.01502	.00801
74	.31863	.49482	.31305	.38833	.31369	.32185	.30171	.34945	.33441	.47623	.39811	.01083	.01649	.01472	.00809
77	.31418	.49225	.31201	.38281	.31300	.32998	.30521	.34418	.32919	.46815	.39325	.01060	.01600	.01406	.00803
85	.30564	.47310	.31064	.37723	.30931	.32196	.30246	.33708	.31278	.44902	.37957	.01141	.01557	.01338	.00789
92	.28445	.46083	.29506	.36001	.29166	.30076	.28657	.32091	.30900	.43572	.36569	.01166	.01448	.01263	.00771
99	.27894	.43017	.28701	.32908	.28308	.29147	.28320	.31075	.29056	.41371	.33746	.01295	.01372	.01222	.00775
107	.26761	.39600	.27067	.30823	.26610	.26933	.26844	.28323	.26537	.38800	.30579	.01349	.01315	.01146	.00649
114	.26019	.38584	.25966	.30405	.25551	.25316	.25664	.27515	.26192	.37893	.29538	.01443	.01300	.01155	.00615
120	.25305	.36944	.24698	.29232	.24300	.24290	.24693	.26756	.25354	.36752	.27975	.01470	.01289	.01075	.00673
130	.24538	.32414	.23868	.27342	.22690	.22876	.23124	.25187	.23289	.34525	.25209	.01623	.01312	.01055	.00622

TIME	QT11	QT11A	QT11B	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5R	QT18	QT19A	QT19B
71	.00658	.00195	.01894	.00347	.00315	.00504	.00356	.00322	.00314	.00398	.00394	.00403
74	.00629	.00192	.01789	.00337	.00320	.00474	.00346	.00293	.00322	.00376	.00388	.00397
77	.00590	.00187	.01705	.00325	.00323	.00435	.00344	.00259	.00299	.00366	.00385	.00386
85	.00558	.00182	.01532	.00309	.00328	.00355	.00331	.00242	.00241	.00337	.00375	.00375
92	.00536	.00172	.01333	.00290	.00328	.00311	.00274	.00225	.00242	.00309	.00383	.00368
99	.00508	.00150	.01244	.00266	.00334	.00251	.00184	.00224	.00214	.00267	.00379	.00364
107	.00446	.00136	.00112	.00237	.00341	.00242	*****	.00203	.00214	.00245	.00372	.00352
114	.00411	.00127	.00102	.00242	.00352	.00230	*****	*****	.00202	.00239	.00361	.00347
120	.00404	.00118	.00944	.00233	.00355	.00222	*****	*****	*****	.00237	.00356	.00340
130	.00393	.00113	.00869	.00228	.00365	.00207	*****	*****	*****	.00235	.00349	.00336

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3659 NASA-SIS TEST
MDAC- DWO

TEST CONDITIONS   TEST GAS NITROGEN   Q=0, ST=0, AND HREF BASED ON .132 INCH RADIUS

ANGLE OF ATTACK 51.000 DEG.   ANGLE OF YAW 0 DEG.   ANGLE OF ROLL 0 DEG.   MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/SQFT-SEC	STO	HREF BTU/SQFT SEC R	POP PSIA
61	.212685	.005907	94.0	5170	10.70	17.027	12.6539	22.5145	.00210	11411	1987	5.569E 02	222.2	.01719	.15364	31.386
63	.202486	.005318	99.4	5318	10.70	16.221	11.0824	19.7184	.00225	11153	2113	5.893E 02	232.4	.01803	.14774	29.917
87	.166898	.004561	95.6	5164	10.64	13.219	9.6401	17.1522	.00239	9004	2027	5.602E 02	197.5	.01958	.13278	24.366
93	.150693	.003875	101.6	5345	10.64	11.935	7.9426	14.1319	.00264	8393	2169	5.954E 02	202.6	.02119	.12439	22.012
103	.135937	.003364	105.5	5449	10.62	10.735	6.7549	12.0187	.00286	7693	2256	6.169E 02	202.9	.02294	.11822	19.804
113	.126569	.002887	115.2	5610	10.58	9.737	5.4427	9.6839	.00314	6827	2410	6.567E 02	214.8	.02552	.11488	17.973
124	.104518	.002483	115.2	5645	10.55	8.533	4.7407	8.4348	.00339	6267	2445	6.647E 02	204.5	.02747	.10732	15.752
135	.097657	.002194	116.2	5661	10.53	7.563	4.1640	7.4089	.00361	5616	2466	6.685E 02	194.2	.02924	.10083	13.999

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB20	PT12
61	.86633	.59637	.32939	.57444	.00453
63	.86675	.60342	.33037	.58124	.00463
87	.83827	.59361	.34583	.58901	.00474
93	.84473	.59847	.35528	.60206	.00517
103	.83925	.60371	.35921	.61542	.00540
113	.83146	.60122	.35076	.60375	.00532
124	.83520	.59768	.35159	.61136	.00551
135	.84084	.59364	.35832	.60923	.00580

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14	QB14B	QB15.5A	QB15.5C
61	.25360	.33214	.46245	.57203	.34958	.37073	.36159	.35970	.37998	.33210	.36751	.36740	.36942	.35111	.35337
63	.25385	.30675	.44072	.55574	.38511	.34981	.36739	.34915	.37401	.32093	.35101	.36532	.37230	.34387	.33991
87	.24093	.28319	.42145	.49575	.37938	.32477	.37317	.35690	.38770	.33853	.34495	.37036	.41643	.36043	.36139
93	.24675	.26410	.39021	.48592	.38290	.36086	.37655	.35656	.36873	.33580	.34649	.35992	.41194	.35621	.36538
103	.24899	.23815	.30995	.46296	.37159	.25746	.37063	.35114	.35581	.33139	.34067	.36521	.41032	.34178	.34857
113	.24455	.21711	.22362	.44046	.35152	*****	.35254	.32037	.33093	.31741	.31105	.34626	.38219	.31989	.32034
124	.23943	.20595	.16271	.39557	.32919	*****	.33028	.29646	.30746	.30626	.29819	.33732	.37392	.30209	.29927
135	.24994	.19911	.18366	.33347	.31404	*****	.31668	.28425	.29241	.28934	.29329	.32129	.35798	.29373	.28539

TIME	QB15.5D	QB17	QB18F	QB19	QB19B	QB19A	QB19C	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4	QT6
61	.49614	.35830	.43413	.34712	.31976	.31230	.38939	.33882	.43787	.31374	.25244	.33654	.36790	.02463	.01971
63	.47547	.35593	.41797	.34352	.30754	.30799	.38242	.32460	.41880	.30716	.24169	.32062	.35575	.02334	.01860
87	.49578	.34193	.43638	.32845	.31002	.33968	.36777	.32572	.42586	.30307	.24003	.30230	.36246	.02483	.01919
93	.50193	.33605	.43672	.33102	.28593	.30457	.36094	.32225	.42961	.29789	.23558	.29371	.36316	.02480	.01958
103	.47486	.32715	.41044	.32401	.27856	.29420	.34614	.31671	.41395	.29942	.23735	.27661	.34163	.02625	.02061
113	.42701	.30695	.37700	.29907	.27584	.28092	.33256	.29649	.37704	.27873	.22463	.24502	.29612	.02580	.01973
124	.38869	.29536	.34743	.29589	.26635	.27002	.30740	.27653	.35350	.25352	.20819	.20911	.26724	.02529	.01989
135	.35002	.27544	.32167	.26182	.24716	.24965	.28444	.25387	.32544	.24010	.19981	.18947	.23877	.02400	.01977

TIME	QT8	QT12C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT19A	QT19B	QT19C
61	.01671	.00816	.00585	.00191	.01433	.01112	.00629	.00499	.00437	.00261	.00147	.00202	.00312	.00417	.00286
63	.01582	.00791	.00541	.00188	.01376	.01094	.00608	.00487	.00402	.00253	.00192	.00196	.00305	.00406	.00277
87	.01640	.00791	.00481	.00154	.01342	.00823	.00601	.00444	.00252	.00195	.00155	.00167	.00275	.00348	.00275
93	.01603	.00799	.00488	.00160	.01279	.00762	.00598	.00422	.00228	.00185	.00145	.00160	.00271	.00342	.00286
103	.01511	.00755	.00440	.00159	.01246	.00700	.00586	.00395	.00183	.00161	.00131	.00148	.00263	.00335	.00265
113	.01422	.00771	.00445	.00158	.01197	.00620	.00591	.00370	.00142	.00135	.00114	.00142	.00250	.00344	.00264
124	.01367	.00640	.00421	.00159	.01099	.00551	.00583	.00331	.00099	.00107	.00102	.00115	.00225	.00321	.00259
135	.01258	.00632	.00419	.00160	.01108	.00475	.00571	.00292	.00085	.00083	.00094	.00106	.00202	.00318	.00249

TIME	QW19A	QW19B
61	.00340	.00363
63	.00340	.00368
87	.00342	.00317
93	.00331	.00321
103	.00290	.00322
113	.00268	.00287
124	.00232	.00177
135	.00193	.00179

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC GUISHOT TUNNEL F

RUN 3660 NASA-STS TEST
MDAC- UWO

TEST CONDITIONS TEST GAS NITROGEN Q-0, ST-0, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 45.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
106	.079024	.002312	89.3	5591	11.87	7.792	5.6414	10.0375	.00349	9341	2342	6.462E 02	188.1	.02839	.10437	14.390
112	.074112	.002097	92.7	5703	11.88	7.318	4.9989	8.8942	.00371	8990	2438	6.723E 02	192.4	.03002	.10136	13.519
118	.069204	.001906	94.8	5776	11.90	6.856	4.5213	8.0446	.00391	8626	2503	6.896E 02	192.8	.03151	.09822	12.668
129	.064995	.001864	94.1	5742	11.88	6.414	4.2911	7.6349	.00401	8045	2482	6.815E 02	183.5	.03234	.09450	11.851
137	.062060	.001689	96.0	5784	11.84	6.092	3.9657	7.0560	.00416	7643	2522	6.916E 02	182.5	.03349	.09206	11.257

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB15	PB20
106	.74527	.55036	.27529	.56690	.47443
112	.74447	.56173	.28064	.56708	.47876
118	.74420	.54379	.28024	.56220	.47823
129	.73521	.54412	.27700	.54869	.47523
137	.73178	.55248	.28098	.54828	.47648

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB12	QB14B	QB15.5C	QB15.5D	QB17
106	.21618	.20181	.30912	.34181	.30242	.19162	.29940	.25881	.25677	.23901	.23549	.32333	.26912	.29889	.23397
112	.21413	.19333	.25512	.32267	.29078	.18043	.28849	.24956	.24533	.23220	.22350	.30550	.26072	.28604	.22655
118	.21490	.19837	.20939	.30818	.28358	.16975	.28165	.24335	.24505	.22670	.21985	.30149	.25412	.27315	.23111
129	.21344	.18847	.17042	.28578	.27805	.16094	.27346	.23843	.23909	.22400	.21474	.29415	.24995	.26097	.23234
137	.21418	.18578	.15406	.25791	.26913	.14560	.26257	.22505	.23460	.21455	.20961	.28749	.23725	.24000	.22412

TIME	QB18E	QB19H	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4	QT6	QT8	QT8C	QT11
106	.32322	.20909	.22459	.24872	.21471	.26505	.25143	.19612	.17020	.21822	.02468	.01987	.01136	.00715	.00329
112	.30881	.20270	.21581	.23365	.20765	.25323	.23635	.18822	.16135	.20720	.02433	.02034	.01104	.00726	.00294
118	.29763	.19817	.21245	.23228	.20240	.24239	.23963	.18436	.15521	.19801	.02336	.02044	.01133	.00741	.00302
129	.28988	.19313	.20047	.22700	.19984	.23588	.23290	.18344	.14993	.19298	.02459	.02081	.01077	.00748	.00306
137	.27460	.18414	.19978	.22346	.19624	.21953	.22126	.16993	.13322	.18111	.02390	.02062	.01148	.00737	.00305

TIME	QT11A	QT11B	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A	QT19B	QT19C	QW19A	QW19B
106	.00167	.01065	.00596	.00193	.00071	.00074	.00076	.00075	.00280	.00170	.00274	.00223	.00198	.00200
112	.00169	.01045	.00592	.00188	.00063	.00068	.00079	.00069	.00230	.00160	.00272	.00215	.00203	.00190
118	.00183	.01038	.00617	.00182	.00057	.00063	.00074	.00076	.00250	.00140	.00276	.00211	.00204	.00180
129	.00189	.00989	.00609	.00185	.00053	.00067	.00077	.00075	.00200	.00150	.00245	.00209	.00205	.00172
137	.00193	.01069	.00621	.00179	.00048	.00062	.00073	.00076	.00210	.00150	.00247	.00190	.00208	.00176

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3661 NASA-STS TEST
MDAC- DWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 40.200 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
60	.136111	.003573	99.5	5244	10.55	10.597	7.3380	13.0561	.00272	7228	2101	5.737E 02	183.1	.02221	.11731	19.535
74	.118649	.002859	108.4	5450	10.50	9.156	5.6007	9.9651	.00310	6391	2282	6.197E 02	188.6	.02491	.10827	16.891
86	.109308	.002613	108.7	5434	10.45	8.321	5.0875	9.0520	.00324	5756	2278	6.163E 02	178.3	.02602	.10262	15.348
94	.100044	.002373	110.1	5472	10.46	7.664	4.5951	8.1757	.00341	5395	2314	6.251E 02	174.8	.02740	.09855	14.138
112	.092430	.002015	106.8	5418	10.52	6.380	3.9827	7.0863	.00368	4656	2277	6.125E 02	154.7	.02958	.08905	11.768
130	.071590	.001747	107.0	5407	10.48	5.507	3.4378	6.1167	.00395	4026	2276	6.101E 02	142.8	.03174	.08231	10.157

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB15	PB20
60	.57369	.47169	.23971	.44879	.35397
74	.57688	.47371	.23642	.45362	.35307
86	.57758	.47263	.23504	.44855	.34594
94	.57775	.46718	.23484	.44557	.33979
112	.57562	.46405	.23906	.43655	.34113
130	.57743	.46760	.24409	.43549	.34336

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB12	QB13	QB14B	QB15.5	QB15.5C
60	.19173	.21486	.37870	.34870	.29032	.20395	.25821	.24496	.26561	.23891	.21403	.22944	.30763	.22547	.27734
74	.20843	.18522	.19370	.35395	.28984	.18139	.25315	.24125	.26292	.22738	.21174	.23094	.30452	.20965	.26645
86	.19887	.16784	.14378	.33366	.28490	.17570	.24892	.23411	.26607	.22196	.20376	.23198	.31737	.20644	.26306
94	.20179	.16956	.13887	.31977	.28633	.16912	.24646	.22845	.25432	.21882	.20278	.22950	.30975	.20107	.25705
112	.19903	.16770	.13757	.27532	.28078	.09159	.24259	.22168	.25725	.21450	.19547	.22684	.31498	.19540	.24530
130	.20245	.16953	.14234	.24555	.27448	.06058	.23233	.21227	.23958	.19756	.19072	.22018	.27896	.18376	.23884

TIME	QB15.5D	QB17	QB18E	QB19	QB19B	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4	QT6
60	.31025	.22970	.35217	.25280	.21677	.21949	.26380	.26082	.28809	.24090	.17871	.18879	.22644	.02704	.02489
74	.29449	.23168	.32240	.23125	.20320	.22039	.26467	.23479	.26812	.23635	.16764	.15376	.20526	.02698	.02548
86	.28389	.23656	.30686	.22203	.19812	.22017	.26205	.22115	.26334	.22311	.16448	.13589	.19478	.02781	.02628
94	.27075	.23233	.30451	.21578	.19754	.21143	.25042	.21395	.26190	.21208	.16165	.12563	.18854	.02703	.02558
112	.25249	.23576	.28510	.20526	.18759	.20160	.23579	.20152	.25615	.20712	.14927	.11528	.17093	.02611	.02495
130	.23566	.22553	.27890	.19888	.18437	.18440	.21656	.19136	.24998	.18901	.14339	.09874	.16402	.02573	.02487

TIME	QT8	QT8C	QT11	QT11A	QT11B	QT15.5	QT15.5A	QT15.5C	QW15.5A	QW15.5B	QT18	QT19B	QT19C	QW19A	QW19B
60	.01454	.00667	.00417	.00159	.00922	.00572	.00240	.00060	.00065	.00060	.00298	.00178	.00164	.00130	.00192
74	.01442	.00719	.00393	.00177	.00944	.00581	.00231	.00061	.00068	.00064	.00301	.00172	.00160	.00138	.00166
86	.01481	.00727	.00386	.00190	.00978	.00579	.00225	.00065	.00071	.00061	.00319	.00171	.00157	.00146	.00150
94	.01513	.00714	.00372	.00207	.01005	.00580	.00218	.00071	.00070	.00066	.00417	.00169	.00150	.00153	.00138
112	.01687	.00710	.00342	.00223	.00925	.00611	.00215	.00070	.00073	.00069	.00375	.00156	.00130	.00159	.00120
130	.01814	.00718	.00318	.00228	.00913	.00637	.00205	.00074	.00077	.00072	.00415	.00139	.00100	.00164	.00110

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3662 NASA-SIS TEST
MDAC- DWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 45.200 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
70	.042230	.001223	90.2	5453	11.52	3.919	2.8786	5.1218	.00474	4431	2292	6.159E 02	122.3	.03805	.06981	7.233
77	.038631	.001098	91.9	5530	11.57	3.622	2.5748	4.5812	.00504	4253	2358	6.334E 02	122.6	.04041	.06747	6.685
92	.036223	.000951	99.5	5692	11.45	3.322	2.1188	3.7699	.00549	3823	2498	6.716E 02	129.4	.04445	.06607	6.134
105	.035203	.000821	112.0	5944	11.27	3.129	1.6987	3.0224	.00604	3483	2715	7.331E 02	141.4	.04834	.06503	5.782
114	.031241	.000695	119.1	6162	11.33	2.805	1.3810	2.4571	.00673	3305	2901	7.876E 02	145.7	.05278	.06172	5.187
127	.029325	.000608	125.9	6290	11.24	2.594	1.1833	2.1054	.00722	3024	3015	8.211E 02	148.4	.05642	.05994	4.799
137	.028007	.000542	134.9	6449	11.14	2.433	1.0104	1.7978	.00774	2789	3159	8.638E 02	153.8	.06023	.05874	4.502

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3	PB11.3A	PB11.3B	PB20
70	.69375	.56017	.53769	.26478	.44414
77	.70643	.55543	.52843	.26280	.44097
92	.71327	.56376	.52049	.26782	.44977
105	.70288	.56517	.53531	.27017	.44962
114	.69314	.57887	.54008	.27562	.45670
127	.70855	.56783	.54652	.27712	.46116
137	.71060	.55558	.53328	.27674	.45890

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB12	QB13	QB14	QB14B	QB15.5
70	.20394	.14918	.15271	.20301	.22262	.05751	.21098	.20649	.22028	.17407	.18219	.18886	.19833	.22963	.18732
77	.22795	.18981	.17364	.20444	.22226	.05592	.21026	.19810	.22172	.15210	.17741	.19026	.19745	.23226	.18330
92	.21962	.18198	.16363	.18069	.19516	.05600	.18455	.17741	*****	.11809	.16008	*****	*****	*****	.17098
105	.22951	.18430	.16411	.16314	.16618	.05794	.16204	.14592	*****	.10048	.15406	*****	*****	*****	.16822
114	.23366	.18521	.16482	.15428	.14617	.06044	.13115	.14538	*****	.09607	.14896	*****	*****	*****	.17092
127	.22480	.18126	.16055	.12630	.12632	.06103	.09572	.10223	*****	.09298	.12422	*****	*****	*****	.15874
137	.22187	.18325	.16181	.10372	.11309	.06049	.08419	.08062	*****	.09488	.09938	*****	*****	*****	.12332

TIME	QB15.5B	QB15.5A	QB15.5C	QB15.5D	QB17	QB18E	QB15B	QB19A	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4
70	.21127	.21257	.20494	.22733	.20778	.25687	.17355	.15847	.18016	.24094	.18733	.14063	.13316	.18583	.02059
77	.21526	.21944	.20522	.22207	.20034	.25042	.16687	.15922	.17368	.23347	.18248	.13342	.12484	.18343	.02028
92	*****	.20688	.19102	.19972	*****	.22412	.15269	*****	.16277	.20939	*****	.12335	.11695	.16317	.01954
105	*****	*****	.17880	.18316	*****	.20211	.14663	*****	.15709	.19501	*****	.11767	.10818	.15122	.01963
114	*****	*****	.16500	.15154	*****	.16625	.13469	*****	.14880	.16973	*****	.11311	.10238	.12964	.01845
127	*****	*****	.11603	.10248	*****	.12572	.10748	*****	.09247	.11736	*****	.10094	.06026	.07080	.01851
137	*****	*****	.08995	.09560	*****	.12086	.09282	*****	*****	.10923	*****	*****	*****	.05627	.01789

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT15.5	QT15.5B	QT15.5C	Q*15.5A	Q*15.5B	QT18	QT19A	QT19B	QT19C
70	.02124	.01022	.00595	.00239	.00184	.00847	.00591	.00071	.00051	.00096	.00086	.00239	.00159	.00210	.00168
77	.02123	.01062	.00583	.00242	.00182	.00795	.00563	.00073	.00057	.00088	.00084	.00245	.00145	.00185	.00160
92	.02160	.01093	.00587	.00229	.00190	.00739	.00553	.00070	.00065	.00084	.00080	.00251	.00123	.00158	.00148
105	.02182	.01110	.00586	.00229	.00198	.00712	.00542	.00081	.00072	.00075	.00078	.00244	.00119	.00147	.00132
114	.02197	.01105	.00575	.00227	.00195	.00692	.00529	.00082	.00078	.00076	.00077	.00247	.00098	.00125	.00123
127	.02208	.01157	.00596	.00224	.00200	.00694	.00542	.00077	.00085	.00065	.00072	.00278	.00088	.00126	.00106
137	.02172	.01239	.00617	.00230	.00216	.00700	.00558	.00086	.00092	.00058	.00074	.00321	.00082	.00119	.00092

TIME	QW19A	QW19B
70	.00204	.00139
77	.00206	.00126
92	.00202	.00102
105	.00204	.00090
114	.00207	.00088
127	.00197	*****
137	.00183	*****

N 3663 NASA-STS TEST
MDAC- DWQ

TEST CONDITIONS TEST GAS NITROGEN Q-0, ST-0, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 45.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
84	.077959	.002159	94.3	5711	11.70	7.592	5.0923	9.0604	.00365	9028	2446	6.745E 02	196.9	.02953	.10331	14.025
90	.070997	.001773	104.6	6011	11.79	6.909	3.9714	7.0662	.00413	8613	2701	7.473E 02	215.7	.03299	.09983	12.775
98	.065465	.001528	111.9	6207	11.77	6.347	3.3011	5.8734	.00453	8133	2874	7.970E 02	222.9	.03544	.09551	11.743
108	.058906	.001314	117.1	6352	11.77	5.716	2.7760	4.9392	.00494	7565	3006	8.347E 02	225.3	.03852	.09137	10.580
118	.053426	.001134	123.1	6516	11.78	5.190	2.3382	4.1602	.00534	7107	3155	8.782E 02	229.8	.04179	.08789	9.610
126	.049730	.001019	127.4	6631	11.78	4.832	2.0656	3.6752	.00573	6768	3261	9.095E 02	232.2	.04429	.08532	8.949
136	.043622	.000891	127.9	6699	11.98	4.311	1.8181	3.2349	.00616	6392	3325	9.276E 02	225.1	.04750	.08080	7.986

PRESSURE DATA (PRESSURE / POP)

TIME	PH5	PH11.3	PH11.3A	PH11.3B	PH15	PH20
84	.70398	.56369	.54843	.28182	.53936	.50008
90	.70394	.58329	.55000	.28071	.54103	.50215
98	.70062	.58733	.55510	.28068	.54294	.50283
108	.69830	.57948	.56446	.27913	.54426	.50286
118	.69481	.58270	.56378	.27575	.54224	.50495
126	.69296	.58933	.56559	.27619	.54166	.50025
136	.69554	.58544	.57214	.27880	.54279	.49876

HEAT TRANSFER DATA (H / HREF)

TIME	QH3	QH3.5	QH4	QH6	QH8	QH8A	QH9.5	QH11	QH11A	QH11B	QH13	QH14	QH14B	QH15.5	QH15.5B
84	.21830	.18367	.24471	.31757	.28797	.16059	.25353	.23131	.23603	.21422	.23362	.25332	.27233	.25264	.23215
90	.21162	.17725	.19358	.28874	.26727	.15420	.23706	.21644	.22633	.20204	.22155	.24090	.25806	.24288	.22598
98	.20820	.17432	.15619	.25483	.25441	.14217	.22766	.20879	.22439	.19837	.21819	.24038	.26045	.23067	.22038
108	.21072	.17396	.15135	.23750	.24391	.10384	.21329	.19947	.22277	.19247	.20999	.23452	.25650	.22590	.21959
118	.21030	.17396	.15202	.20624	.22903	.08214	.19957	.19034	.21519	.18539	.19154	.22519	.24540	.21438	.20105
126	.21100	.17259	.15131	.17721	.21319	.06576	.18658	.18248	.21130	.17205	.18454	.21531	.23946	.20604	.19768
136	.21932	.17866	.15511	.15123	.20045	.06103	.18273	.18009	.20582	.15472	.17270	.20029	.23074	.19836	.17295

TIME	QH15.5A	QH15.5C	QH15.5D	QH17	QH18E	QH18B	QH19A	QH19B	QH19D	QH19E	QH21	QH21B	QH21D	QH21E	QT4
84	.22433	.25011	.29323	.24416	.29568	.22642	.20152	.23743	.21907	.27334	.23229	.16202	.16425	.21527	.02444
90	.21598	.23870	.27137	.23325	.27620	.20993	.18665	.22639	.20446	.25482	.22347	.15320	.15029	.19922	.02324
98	.21428	.23239	.26018	.23300	.26155	.19703	.18057	.22043	.19806	.24242	.21177	.14627	.13729	.18425	.02251
108	.21463	.22976	.24983	.22524	.25222	.18436	.17475	.21972	.18987	.22881	.20096	.14082	.12850	.17382	.02205
118	.21253	.22132	.23792	.21652	.23842	.17147	.16476	.21243	.17935	.21724	.18526	.13483	.11838	.16310	.02124
126	.21454	.21333	.22053	.20604	.22499	.16222	.16065	.20973	.17247	.20796	.17572	.12741	.11258	.15479	.02084
136	.20742	.21243	.22618	.19879	.21840	.15505	.15231	.18835	.16305	.20032	.16530	.12535	.11076	.14866	.02038

TIME	QT6	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A	QT19B
84	.02049	.01213	.00826	.00345	.00171	.01153	.00802	.00639	.00238	.00059	.00067	.00064	.00366	.00140	.00250
90	.02133	.01193	.00795	.00333	.00187	.01076	.00797	.00629	.00213	.00056	.00069	.00069	.00350	.00130	.00230
98	.02194	.01181	.00754	.00292	.00192	.01041	.00732	.00603	.00184	.00047	.00072	.00068	.00330	.00110	.00230
108	.02315	.01164	.00694	.00288	.00212	.01057	.00693	.00605	.00172	.00048	.00079	.00072	.00325	.00120	.00220
118	.02328	.01137	.00642	.00278	.00207	.00952	.00529	.00570	.00123	.00052	.00069	.00071	.00298	.00130	.00200
126	.02395	.01115	.00551	.00294	.00214	.00992	.00521	.00577	.00126	.00049	.00077	.00075	*****	.00120	.00200
136	.02331	.01118	.00571	.00300	.00218	.00891	.00438	.00558	.00112	.00044	.00071	.00074	*****	.00130	.00180

TIME	QT19C	QW19A	QW19B
84	.00199	.00177	.00168
90	.00191	.00182	.00141
98	.00189	.00186	.00124
108	.00172	.00193	.00126
118	.00169	.00195	.00120
126	.00164	.00191	.00115
136	.00155	.00201	.00106

C.2

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3664 NASA-STS TEST
MDAC- DW8

TEST CONDITIONS TEST GAS NITROGEN Q-0, ST-0, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 50.200 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
84	.106284	.002531	109.7	5508	10.55	8.281	4.9530	8.8126	.00331	6008	2335	6.328E 02	186.6	.02682	.10396	15.280
94	.096478	.002148	117.3	5666	10.49	7.437	4.0434	7.1942	.00365	5441	2473	6.699E 02	194.4	.02979	.10057	13.730
132	.069251	.001513	119.4	5657	10.38	5.222	2.7910	4.9659	.00434	3783	2488	6.684E 02	162.4	.03548	.08337	9.640

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3A	PB11.3B	PB15	PB20	PT12
84	.80600	.62000	.32671	.62936	.58500	.00591
94	.79400	.61600	.32814	.61300	.58377	.00606
132	.78100	.61937	.33105	.61833	.58100	.00596

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB12	QB13	QB14	QB14B	QB15.5
84	.24486	.20607	.30148	.35886	.30440	.22756	.31737	.26734	.26307	.26305	.23985	.26200	.26711	.32900	.23457
94	.23290	.19664	.25699	.31631	.28294	.18824	.29332	.24484	.25946	.24144	.23013	.24300	.26629	.32000	.23198
132	.24065	.20622	.18053	.21018	.25512	*****	.25368	.21556	.24731	.22480	.20660	.23000	.25036	.31000	.22735

TIME	QB15.5C	QB15.5D	QB17	QB19E	QB19R	QB19A	QB19B	QB19D	QB19E	QB21	QB21B	QB21D	QB21E	QT4	QT6
84	.28679	.36471	.23076	.29663	.21984	.23700	.27507	.25955	.31404	.23475	.18668	.17120	.27679	.02580	.01681
94	.26612	.31381	.22259	.28667	.22009	.22500	.26348	.24477	.29115	.23160	.18160	.15556	.24647	.02510	.01660
132	.27884	.25804	.22294	.25890	.20114	.19400	.24759	.21220	.25788	.22709	.15819	.12967	.19494	.02520	.01630

TIME	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5B	QT18	QT19A	QT19B
84	.01100	.00783	.00486	.00198	.01240	.00611	.00563	.00387	.00082	.00085	.00089	.00087	.00318	.00186	.00283
94	.01080	.00772	.00459	.00191	.01210	.00529	.00540	.00354	.00069	.00075	.00079	.00071	.00286	.00162	.00272
132	.01030	.00749	.00432	.00211	.01240	.00599	.00563	.00309	.00057	.00069	.00071	.00078	.00258	.00152	.00291

TIME	QT19C	QW19A	QW19B
84	.00251	.00272	.00173
94	.00237	.00252	.00105
132	.00218	.00262	.00155

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

N 3665 NASA-SIS TEST
MDAC- DWO.

TEST CONDITIONS   TEST GAS NITROGEN   Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 60.200 DEG.   ANGLE OF YAW 0 DEG.   ANGLE OF ROLL 0 DEG.   MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
75	.122235	.003056	104.5	5337	10.48	9.387	6.0825	10.8223	.00297	6388	2189	5.945E 02	180.6	.02403	.10952	17.310
95	,099763	.002197	118.6	5452	10.41	7.568	4.0795	7.2584	.00360	5336	2464	6.670E 02	194.9	.02944	.10130	13.970
135	.065922	.001425	120.8	5685	10.38	4.967	2.6128	4.6488	.00449	3621	2513	6.752E 02	160.6	.03661	.08140	9.170

PRESSURE DATA (PRESSURE / POP)

TIME	PB5	PB11.3	PB11.3A	PB11.3B	PB15	PB20	PT12
75	.96737	.80900	.77100	.42100	.78937	.74600	.00699
95	.96973	.81600	.78300	.43700	.79766	.74900	.00716
135	.96185	.79000	.75400	.43300	.80374	.73800	.00723

HEAT TRANSFER DATA (H / HREF)

TIME	QB3	QB3.5	QB4	QB6	QB8	QB8A	QB9.5	QB11	QB11A	QB11B	QB12	QB14	QB14B	QB15.5	QB15.5R
75	.22253	.19417	.20342	.45727	.30927	.22883	.30793	.28333	.27600	.25861	.25473	.29000	.37500	.26221	.29200
95	.23257	.20138	.19528	.34179	.26650	.14488	.26862	.24151	.26300	.24364	.21121	.27800	.36800	.22596	.26400
135	.24007	.20706	.20981	.17845	.21225	.08594	.20533	.20146	.19800	.19657	.18669	.22600	.29600	.21681	.25106

TIME	QB15.5A	QB15.5C	QB15.5D	QB17	QB18E	QB19R	QB19A	QB19B	QB19D	QB19E	QB21B	QB21D	QB21E	QT4	QT6
75	.30100	.28210	.35416	.27100	.26931	.23171	.24900	.33700	.28497	.33441	.21898	.26694	.32581	.01320	.01370
95	.25700	.26069	.31746	.26100	.24234	.22662	.22900	.29500	.23926	.28849	.19382	.20755	.28295	.01830	.01330
135	.20200	.24027	.25293	.20500	.20292	.18924	.18800	.22100	.20136	.23618	.16379	.12351	.22167	.02170	.01310

TIME	QT8	QT8C	QT11	QT11A	QT11B	QT11C	QT15.5	QT15.5A	QT15.5B	QT15.5C	QW15.5A	QW15.5R	QT18	QT19A	QT19B
75	.01090	.00853	.00537	.00159	.01480	.00657	.00318	.00310	.00163	.00145	.00157	.00146	.00256	.00413	.00465
95	.01010	.00761	.00433	.00141	.01310	.00589	.00289	.00329	.00141	.00133	.00124	.00133	.00266	.00416	.00470
135	.00873	.00699	.00390	.00133	.01140	.00456	.00301	.00307	.00119	.00096	.00095	.00101	.00249	.00385	.00443

TIME	QT19C	QW19A	QW19B
75	.00397	.00417	.00224
95	.00368	.00349	.00210
135	.00324	.00282	*****

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389
VON KARMAN GAS DYNAMICS FACILITY
HYPERSONIC HOTSHOT TUNNEL F

RUN 3667 NASA-STS TEST
MDAC- OWO

TEST CONDITIONS TEST GAS NITROGEN Q-O, ST-O, AND HREF BASED ON .132 INCH RADIUS
ANGLE OF ATTACK 25.000 DEG. ANGLE OF YAW 0 DEG. ANGLE OF ROLL 0 DEG. MODEL LENGTH 21.351 INCHES

TIME MSEC	P-INF PSIA	RHO-INF LBM/CU-FT	T-INF DEG R	U-INF FT/SEC	M-INF	Q-INF PSIA	RE/FT X10-6	RE-L X10-6	V-INF	PO PSIA	TO DEG R	HO BTU/LBM	QO BTU/ SQFT-SEC	STO	HREF BTU/ SQFT SEC R	POP PSIA
50	.053701	.001482	94.7	5529	11.40	4.885	3.3719	5.5994	.00434	5210	2348	6.339E 02	142.6	.03480	.07886	9.017
55	.052455	.001228	111.5	5985	11.37	4.745	2.5679	4.5689	.00496	5288	2727	7.428E 02	177.3	.03959	.08108	8.770
62	.051724	.000936	144.3	6623	11.06	4.430	1.6749	2.9801	.00597	4786	3293	9.115E 02	222.9	.04620	.08097	8.202
75	.044666	.000739	157.8	6950	11.10	3.851	1.2695	2.2571	.00688	4453	3596	1.003E 03	237.2	.05309	.07763	7.135
90	.039111	.000699	146.2	6725	11.16	3.409	1.2530	2.2294	.00697	3965	3393	9.392E 02	205.9	.05438	.07218	6.313
99	.036163	.000633	149.2	6796	11.16	3.152	1.1227	1.9976	.00736	3721	3460	9.589E 02	203.1	.05722	.06955	5.836
110	.032858	.000563	152.5	6863	11.15	2.859	.9873	1.7567	.00784	3420	3526	9.782E 02	198.2	.06074	.06637	5.297
137	.028148	.000475	154.7	6869	11.08	2.417	.8221	1.4628	.00854	2845	3538	9.799E 02	182.6	.06610	.06091	4.478

PRESSURE DATA (PRESSURE / POP)

TIME	PB11.3	PB11.3A	PB15	PB20
50	.20361	.17733	.19987	.16426
55	.20155	.17561	.19794	.16646
62	.19987	.17492	.20086	.16792
75	.19913	.17674	.20092	.16592
90	.20436	.17169	.19716	.16426
99	.20579	.17251	.19748	.16610
110	.20350	.17114	.19926	.16474
137	.20849	.17453	.20424	.17165

HEAT TRANSFER DATA (H / HREF)

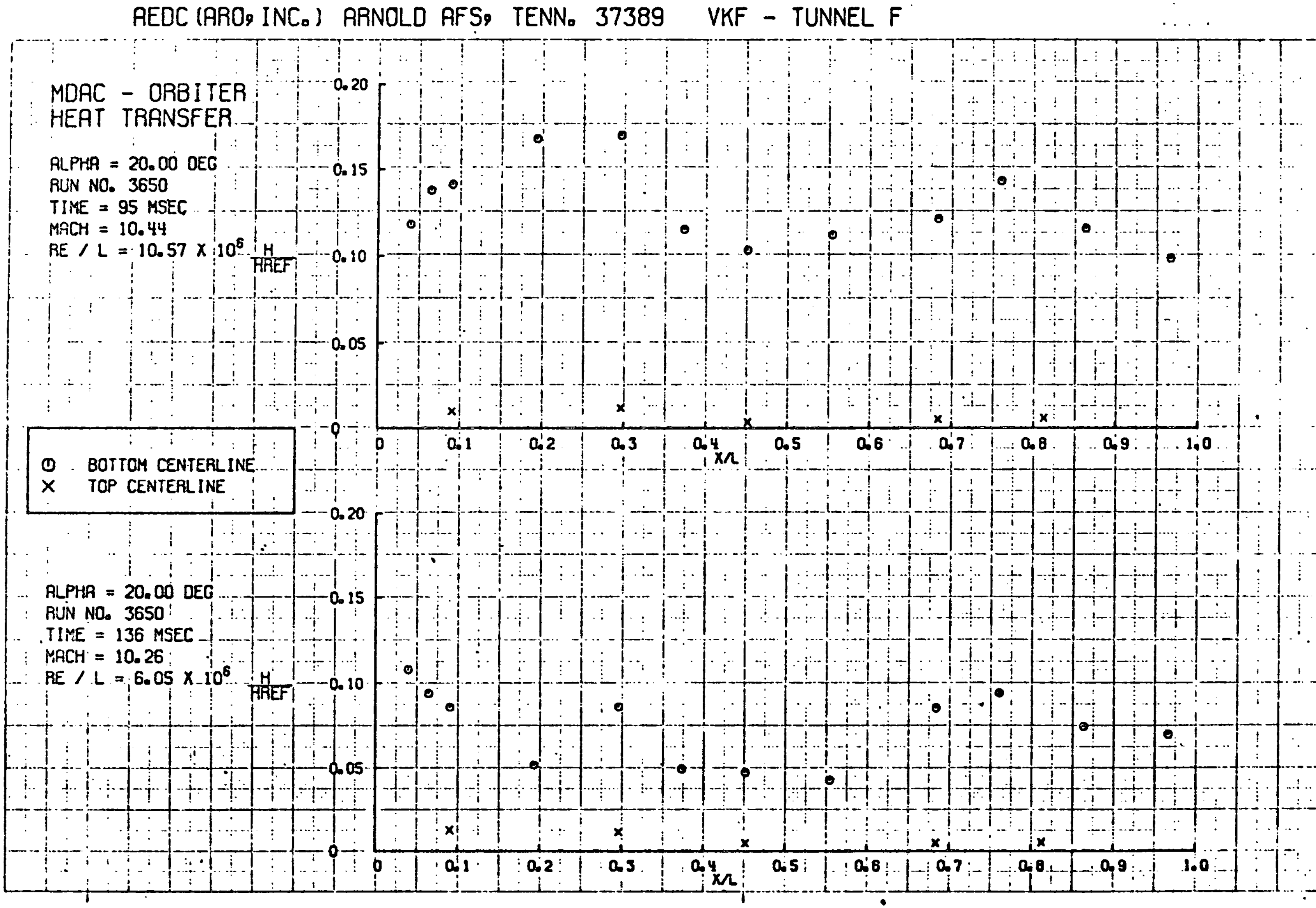
TIME	QB4	QB6	QB8A	QB9.5	QB11	QB11A	QB11B	QB13	QB14	QB14B	QB15.5	QB15.5R	QB15.5A	QB15.5C	QB15.5D
50	.10668	.05863	.07078	.04713	.04407	.12240	.09893	.11094	.11622	.13178	.14364	.10253	.12642	.12084	.15379
55	.10633	.06219	.04262	.04640	.03554	.08632	.07046	.09717	.10050	.09501	.13799	.07981	.08953	.07864	.11728
62	.10220	.06086	.03536	.04592	.03485	.06834	.05362	.08547	.09201	.05954	.11992	.04934	.05599	.05353	.08201
75	.09705	.05819	.03608	.04277	.03393	.06507	.05012	.08337	.06796	.05413	.09192	.04992	.05229	.05227	.07749
90	.09859	.05711	.03755	.04119	.03202	.06540	.05166	.07751	.06845	.05345	.08678	.04946	.05172	.05274	.07545
99	.10265	.05669	.03957	.04279	.03290	.06441	.04922	.06481	.05279	.05253	.06935	.04889	.05165	.05535	.07800
110	.10173	.05548	.03955	.04274	.03247	.06337	.04878	.05151	.04254	.05341	.04774	.04674	.04986	.05466	.07565
137	.10233	.05957	.04199	.04237	.03219	.06407	.04763	*****	.03586	.05265	.03232	.04541	.04829	.05573	.07984

TIME	QB18E	QB19	QB19R	QB19B	QB19D	QB19E	QB21	QB21D	QT4	QT6	QT8	QT8C	QT11	QT11A	QT11B
50	.19673	.11078	.10603	.11990	.09314	.13932	.12065	.04914	.01778	.02274	.01846	.01019	.00336	.00250	.00740
55	.14346	.10660	.08499	.08308	.05412	.10469	.11195	.02539	.01578	.02051	.01688	.00966	.00324	.00247	.00695
62	.09341	.09700	.05648	.05230	.03141	.06768	.10385	.01443	.01367	.01808	.01534	.00938	.00318	.00246	.00664
75	.08677	.08238	.03718	.04555	.03140	.06203	.08839	.01424	.01170	.01543	.01344	.00956	.00295	.00252	.00629
90	.08157	.07958	.02953	.04475	.03111	.05863	.08254	.01596	.01152	.01496	.01324	.00921	.00303	.00256	.00596
99	.08436	.07004	.02956	.04615	.03309	.05948	.07354	.01536	.01115	.01397	.01267	.00917	.00287	.00255	.00607
110	.08274	.04540	.02902	.04537	.03305	.05749	.05187	.01493	.01089	.01277	.01175	.00900	.00281	.00256	.00619
137	.08885	.03233	.02999	.04555	.03179	.06079	.02516	.01556	.00990	.01076	.01021	.00918	.00274	*****	.00591

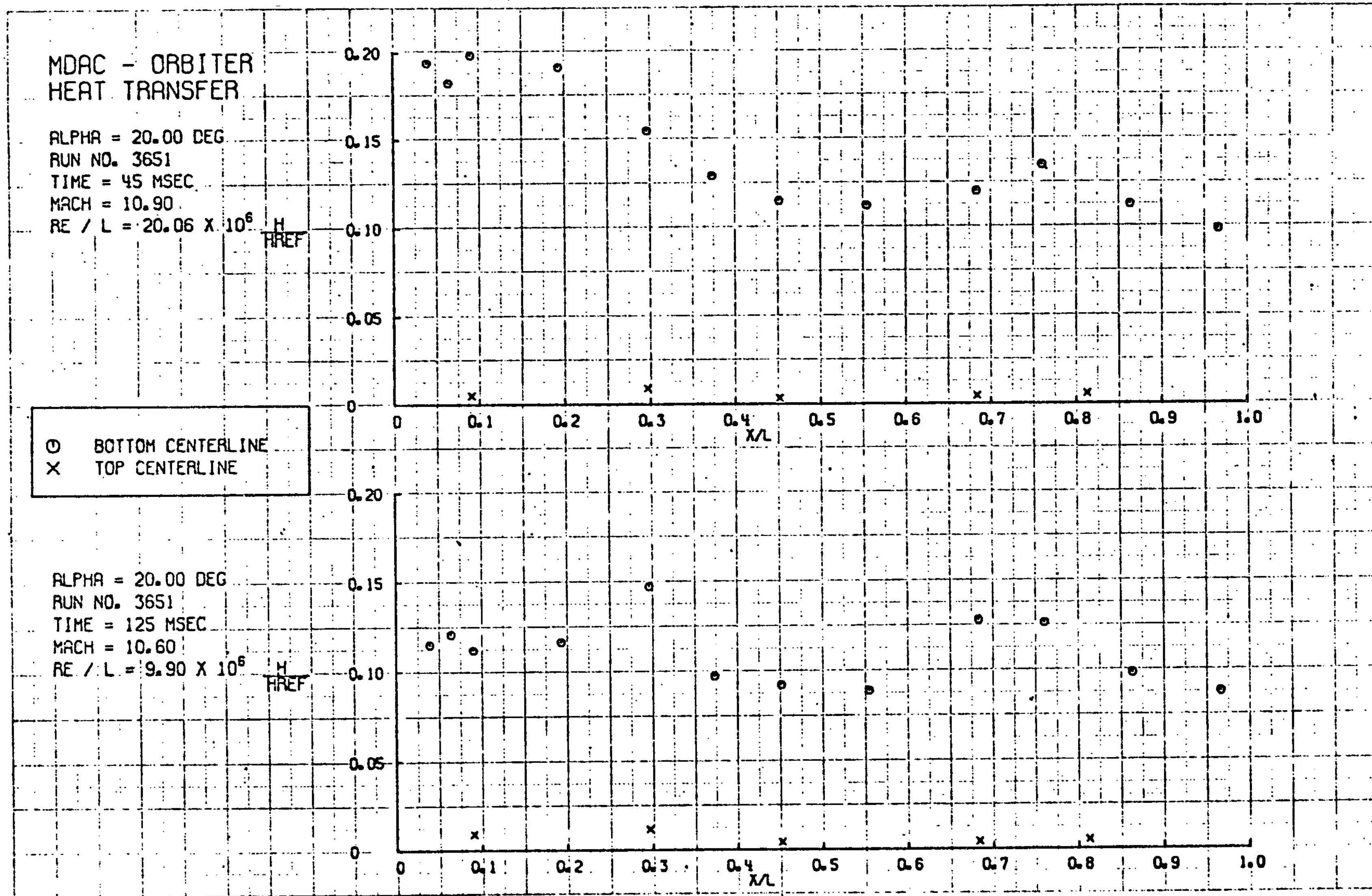
TIME	QT11C	QT15.5	QT15.5A	QT15.5B	QW15.5A	QW15.5R	QT18	QT19A	QT19B	QT19C	QW19A	QW19B
50	.01138	.00351	.00289	.00973	.00071	.00082	.00353	.00112	.00110	.00048	.00083	.00085
55	.01009	.00323	.00287	.00922	.00068	.00083	.00331	.00109	.00105	.00046	.00080	.00081
62	.00889	.00285	.00247	.00953	.00064	.00085	.00302	.00106	.00097	.00045	.00073	.00079
75	.00761	.00261	.00199	.00685	.00062	.00090	.00267	.00100	.00088	.00043	.00068	.00075
90	.00741	.00247	.00207	.00642	.00061	.00095	.00250	.00095	.00075	.00043	.00065	.00071
99	.00723	.00233	.00203	.00625	.00062	.00102	.00253	.00092	.00068	.00044	.00064	.00069
110	.00682	.00229	.00212	.00610	.00058	.00111	.00251	.00087	.00060	.00041	.00066	.00066
137	.00672	.00230	.00218	.00598	.00059	.00123	.00260	.00079	.00062	.00042	.00063	.00063

APPENDIX III

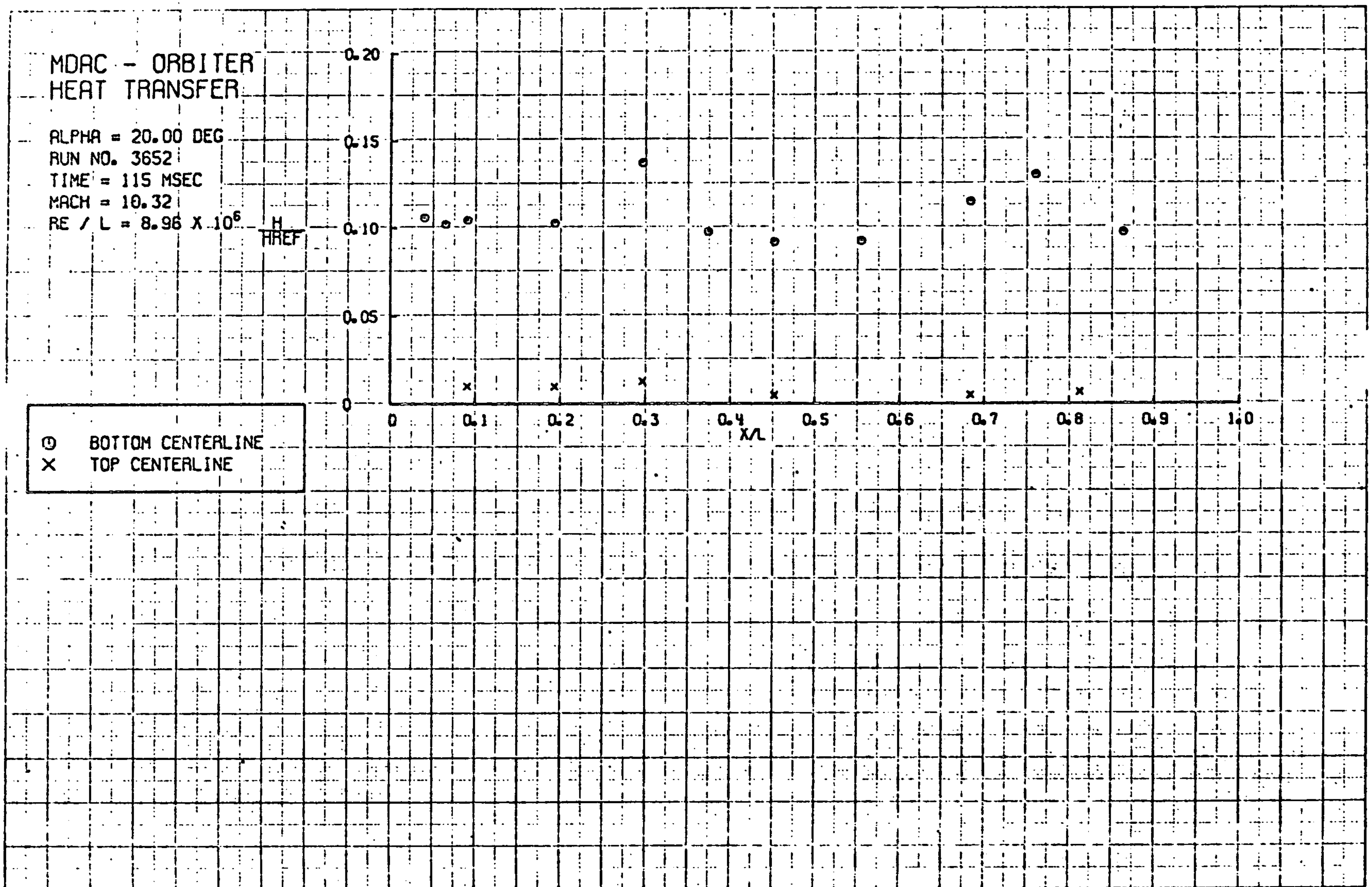
SELECTED TOP AND BOTTOM SURFACE CENTERLINE PLOTS OF GAGE MEASUREMENT RESULTS


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F
MDAC - ORBITER
HEAT TRANSFER
ALPHA = 20.00 DEG
RUN NO. 3650
TIME = 95 MSEC
MACH = 10.44
RE / L = 10.57 X 10^6
H/HREF
0.20
0.15
0.10
0.05
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
X/L
BOTTOM CENTERLINE
TOP CENTERLINE
ALPHA = 20.00 DEG
RUN NO. 3650
TIME = 136 MSEC
MACH = 10.26
RE / L = 6.05 X 10^6
H/HREF

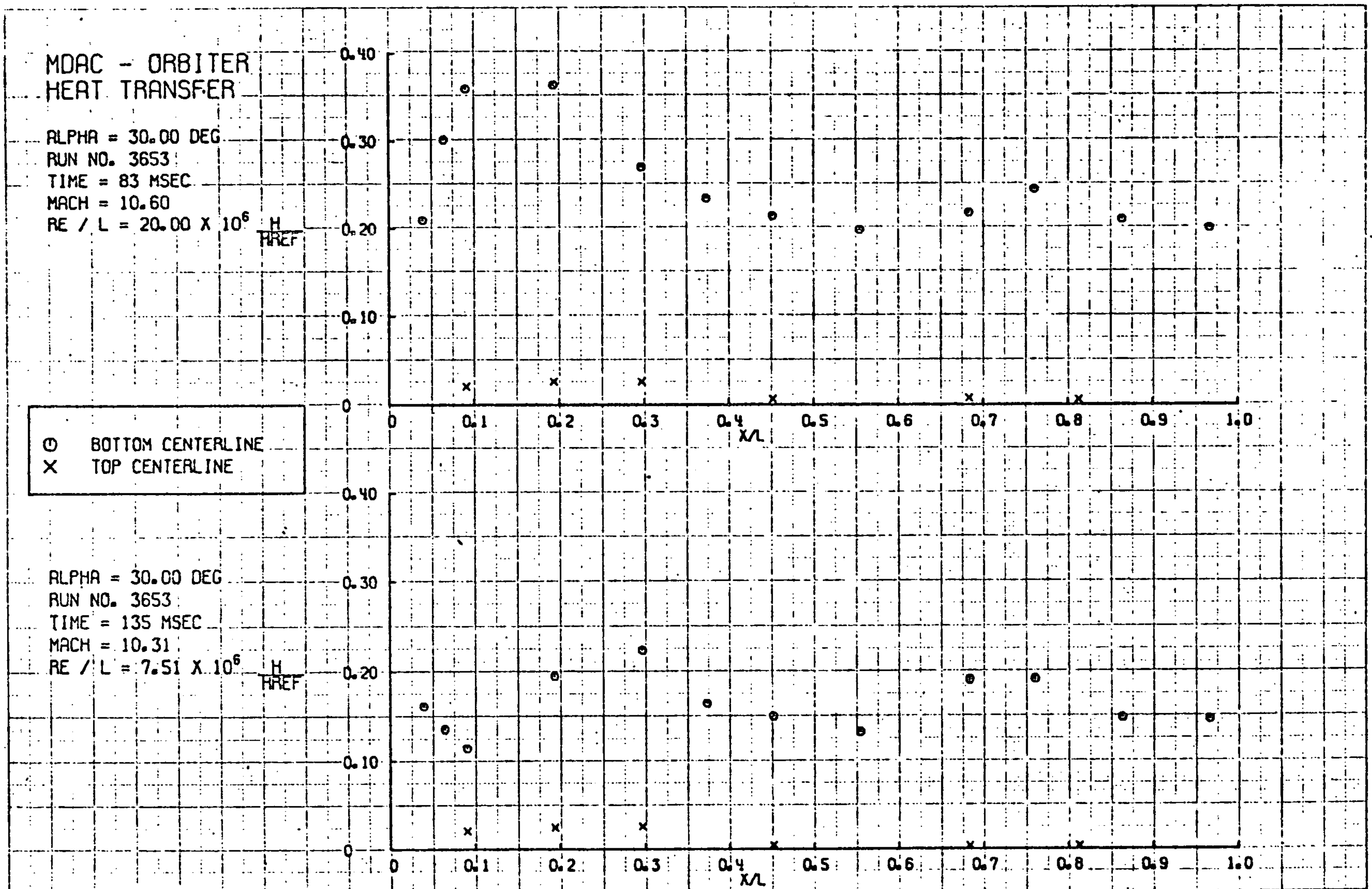
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



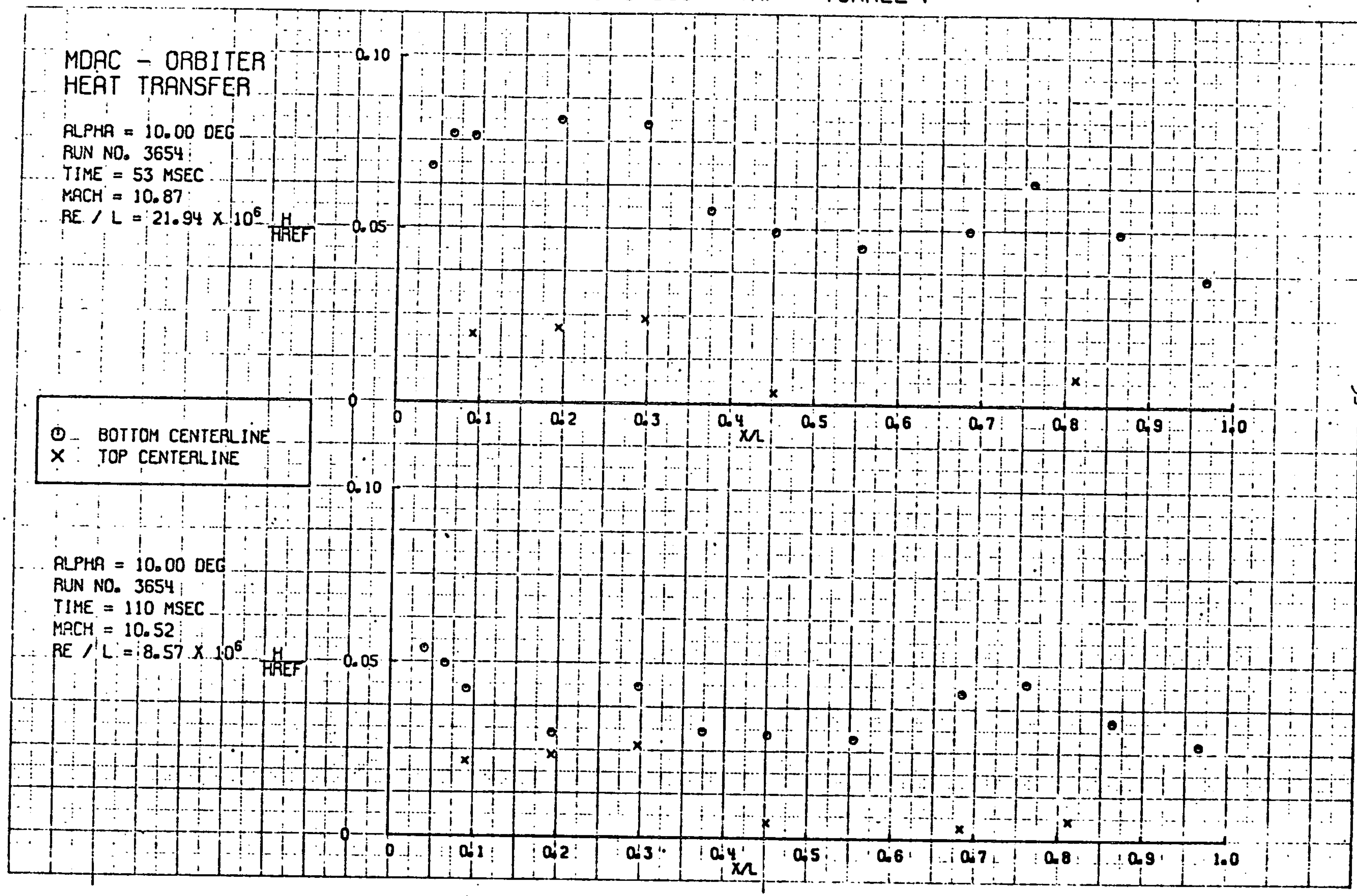
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

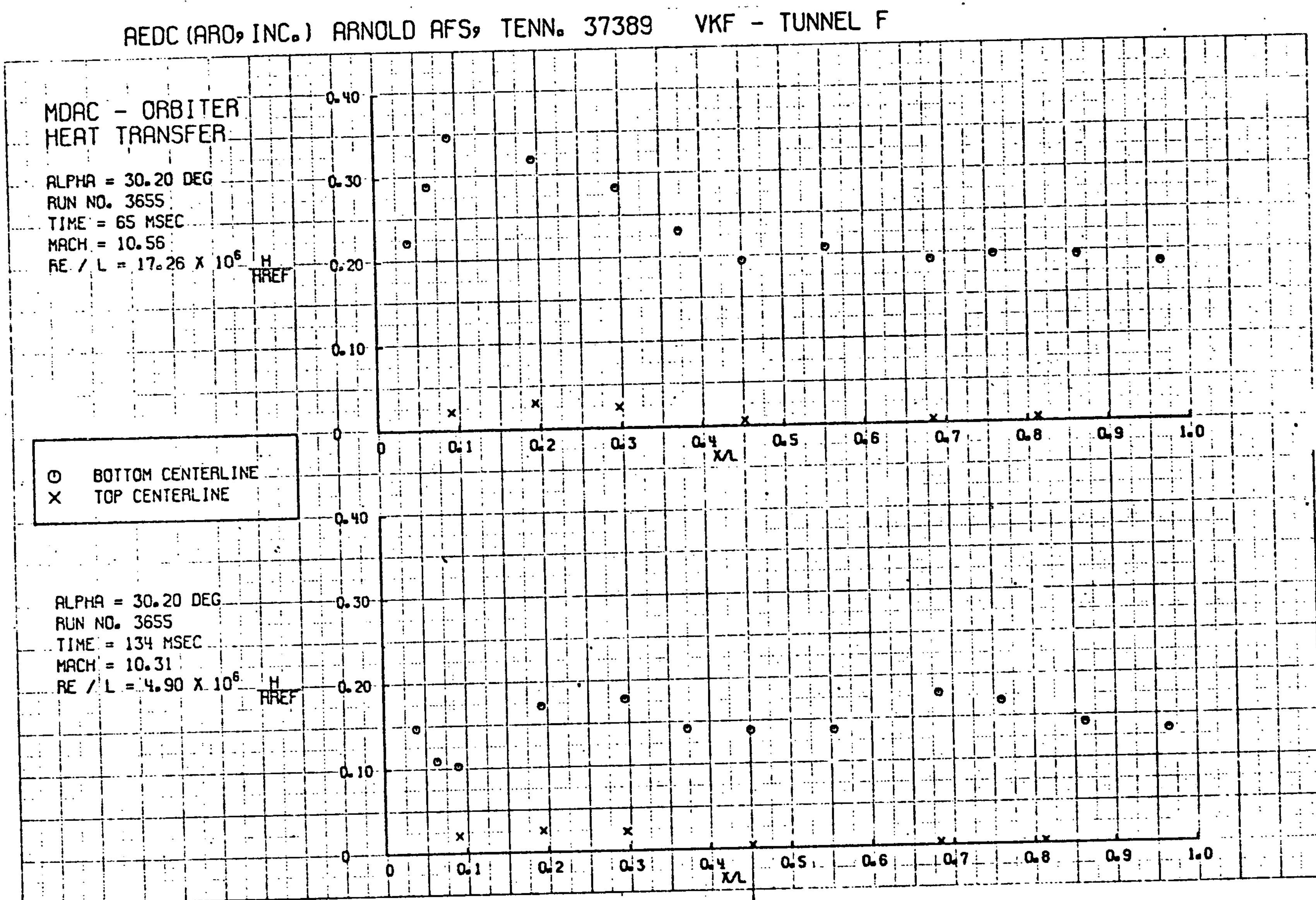


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

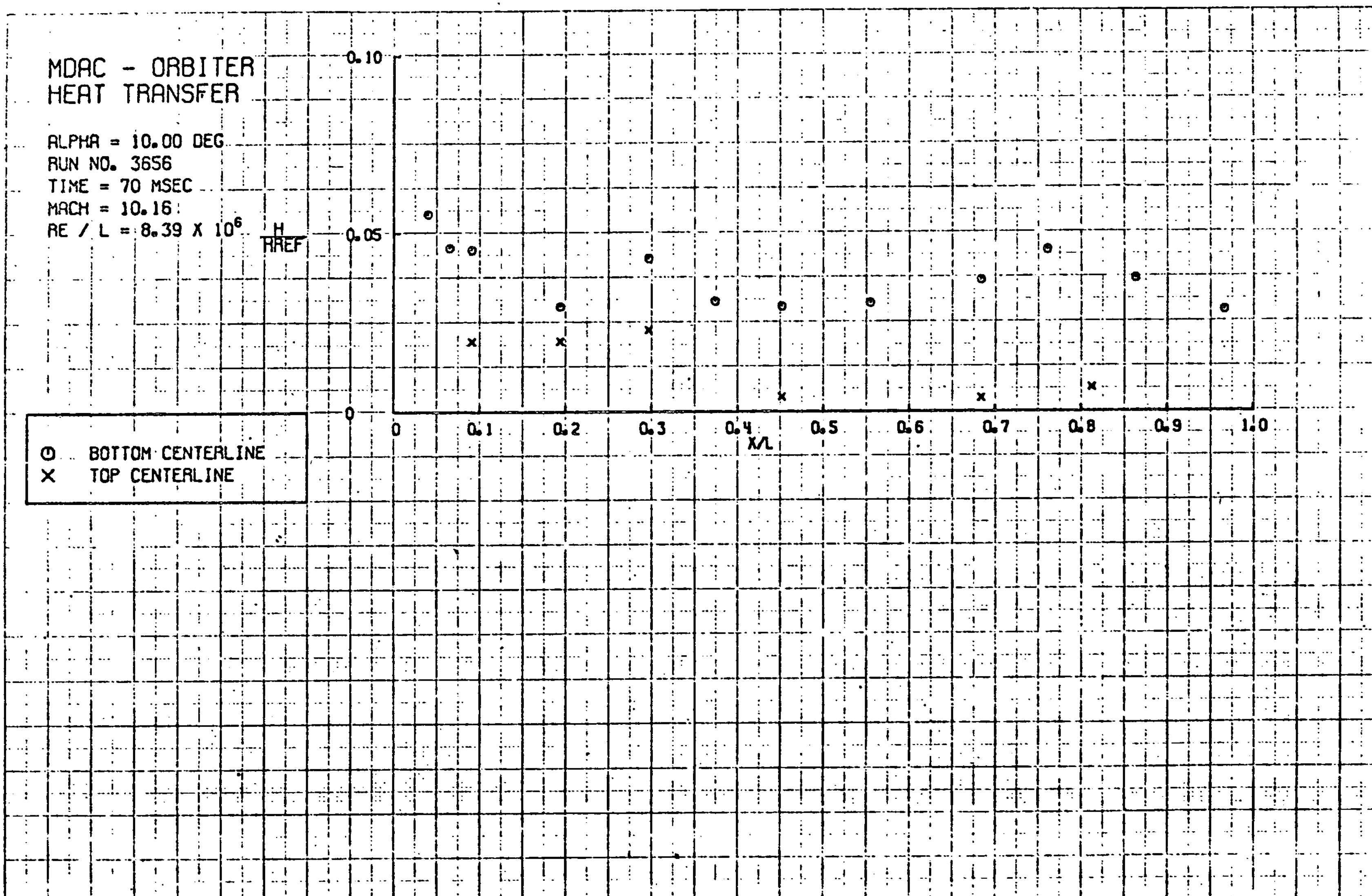


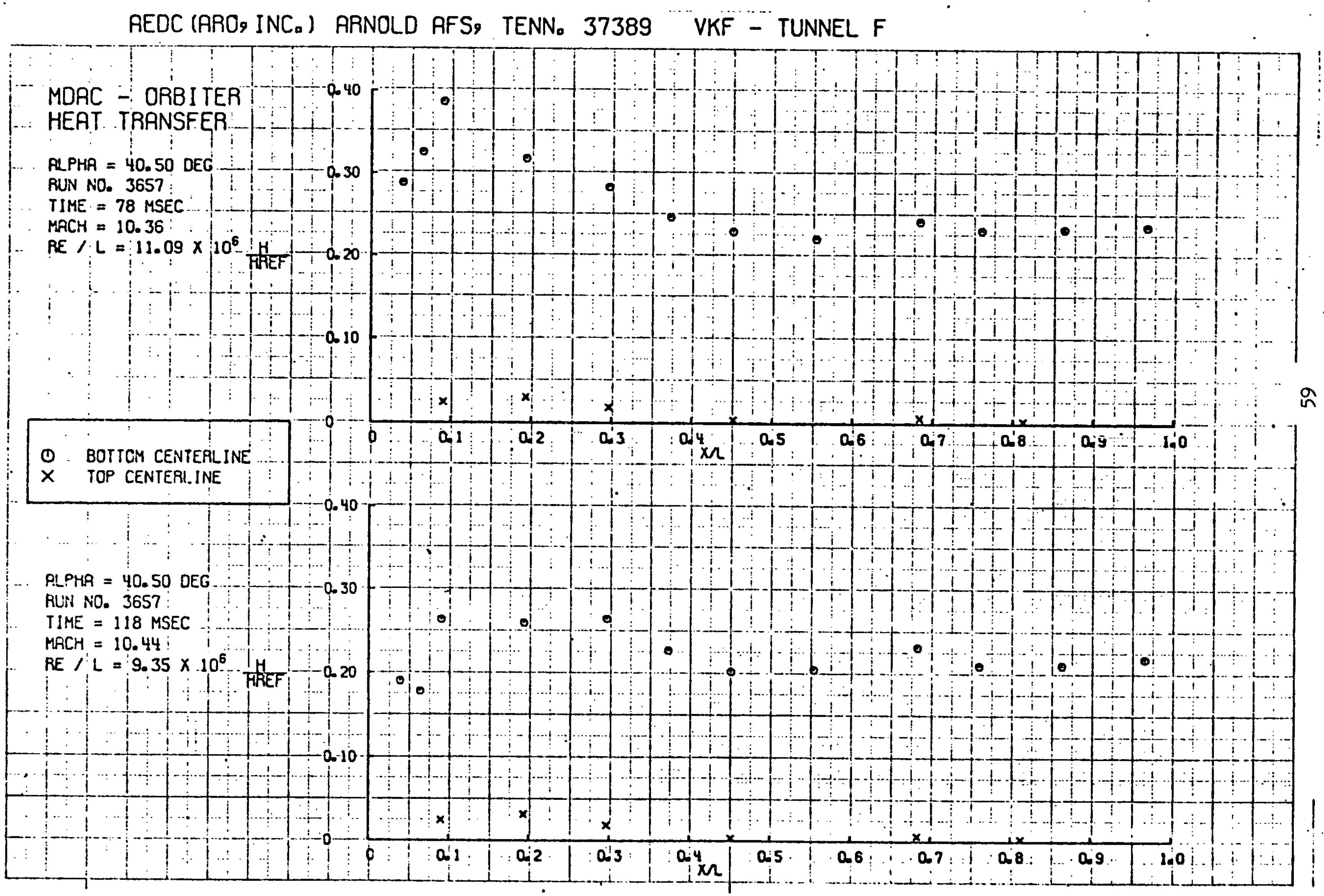
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

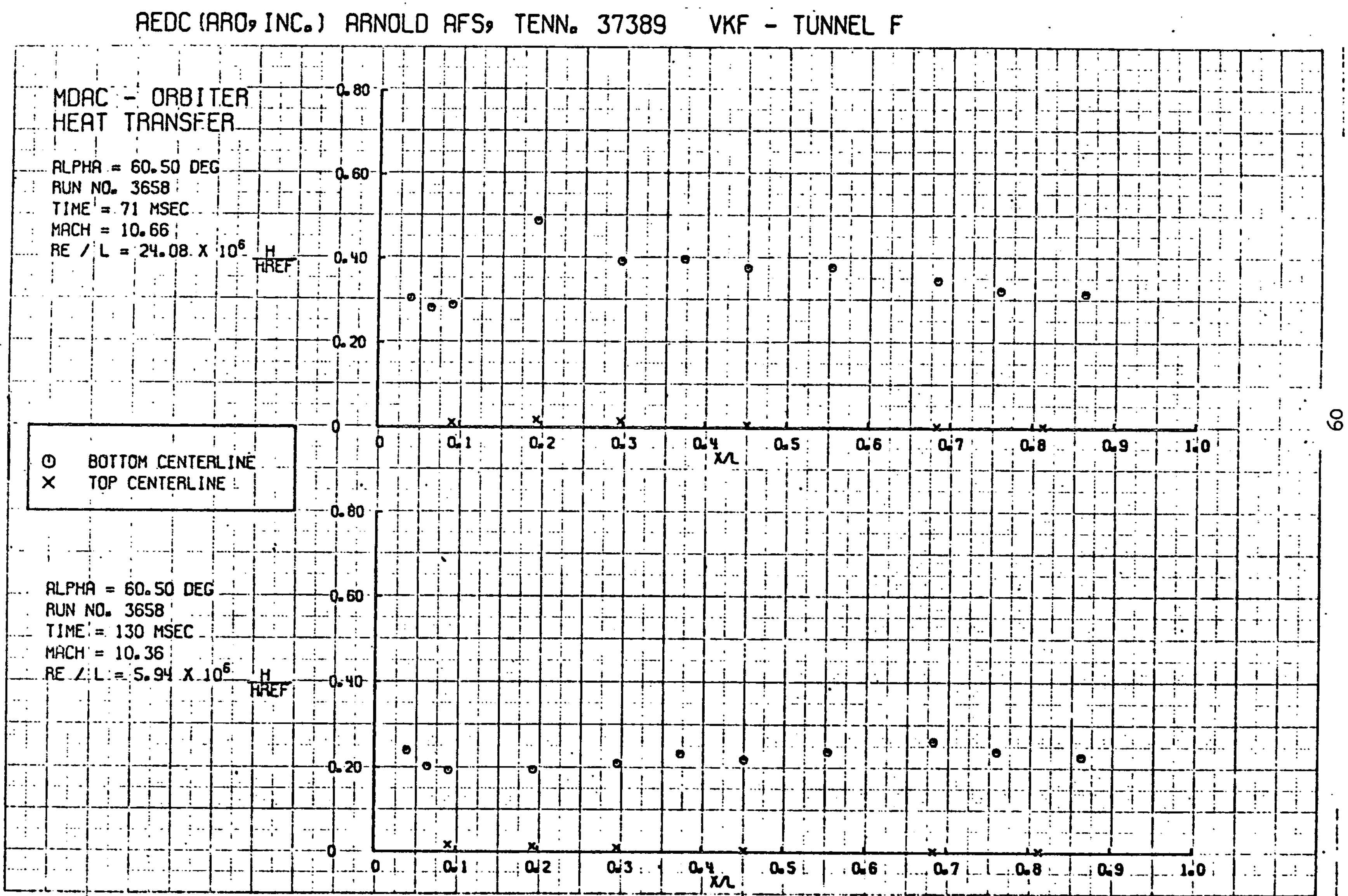



AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F
MDAC - ORBITER
HEAT TRANSFER
ALPHA = 30.20 DEG
RUN NO. 3655
TIME = 65 MSEC
MACH = 10.56
RE / L = 17.26 X 10^6
H/HREF
0 0.10 0.20 0.30 0.40
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
X/L
⊙ BOTTOM CENTERLINE
× TOP CENTERLINE
ALPHA = 30.20 DEG
RUN NO. 3655
TIME = 134 MSEC
MACH = 10.31
RE / L = 4.90 X 10^6
H/HREF
0 0.10 0.20 0.30 0.40
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
X/L

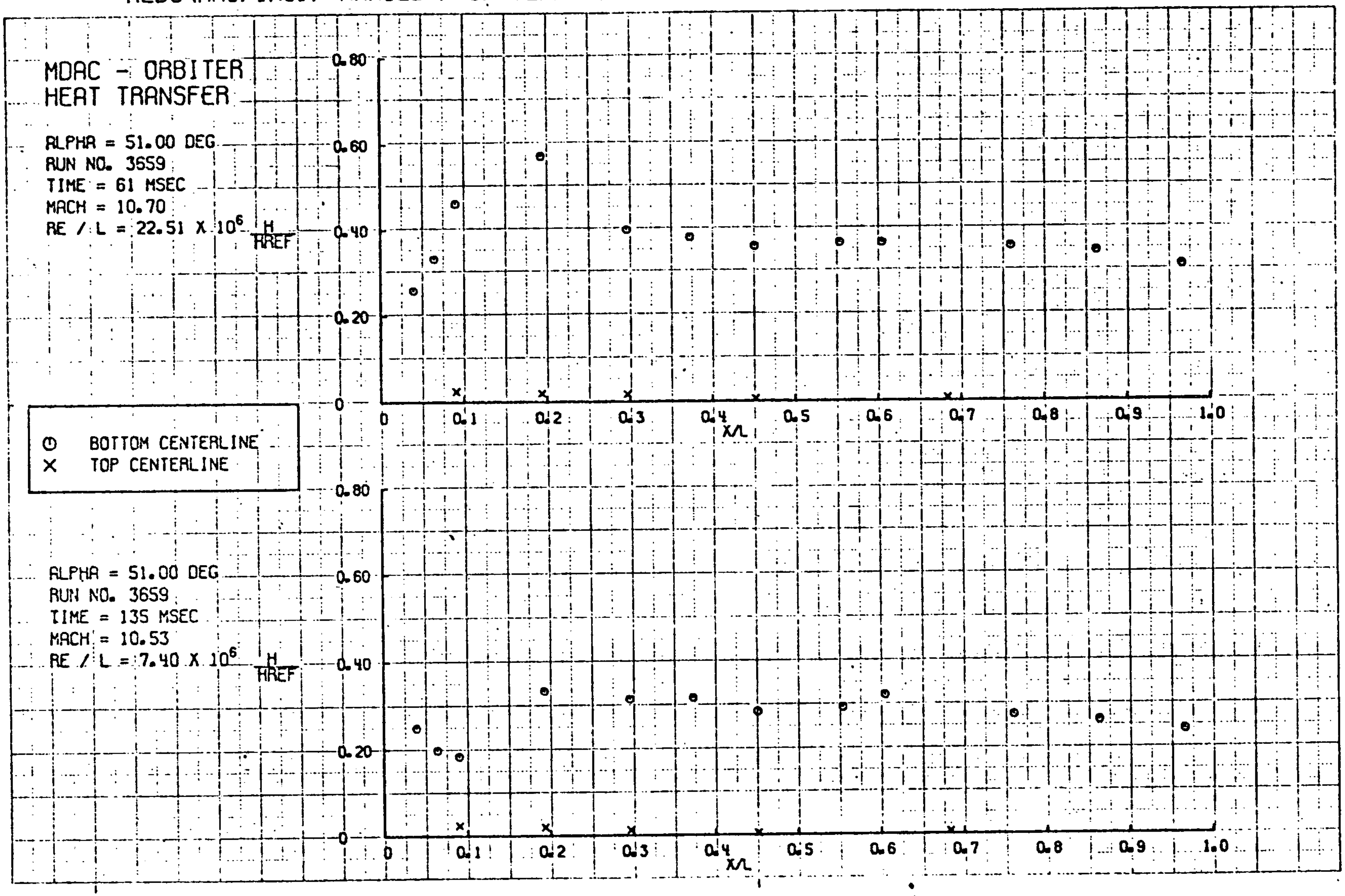
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



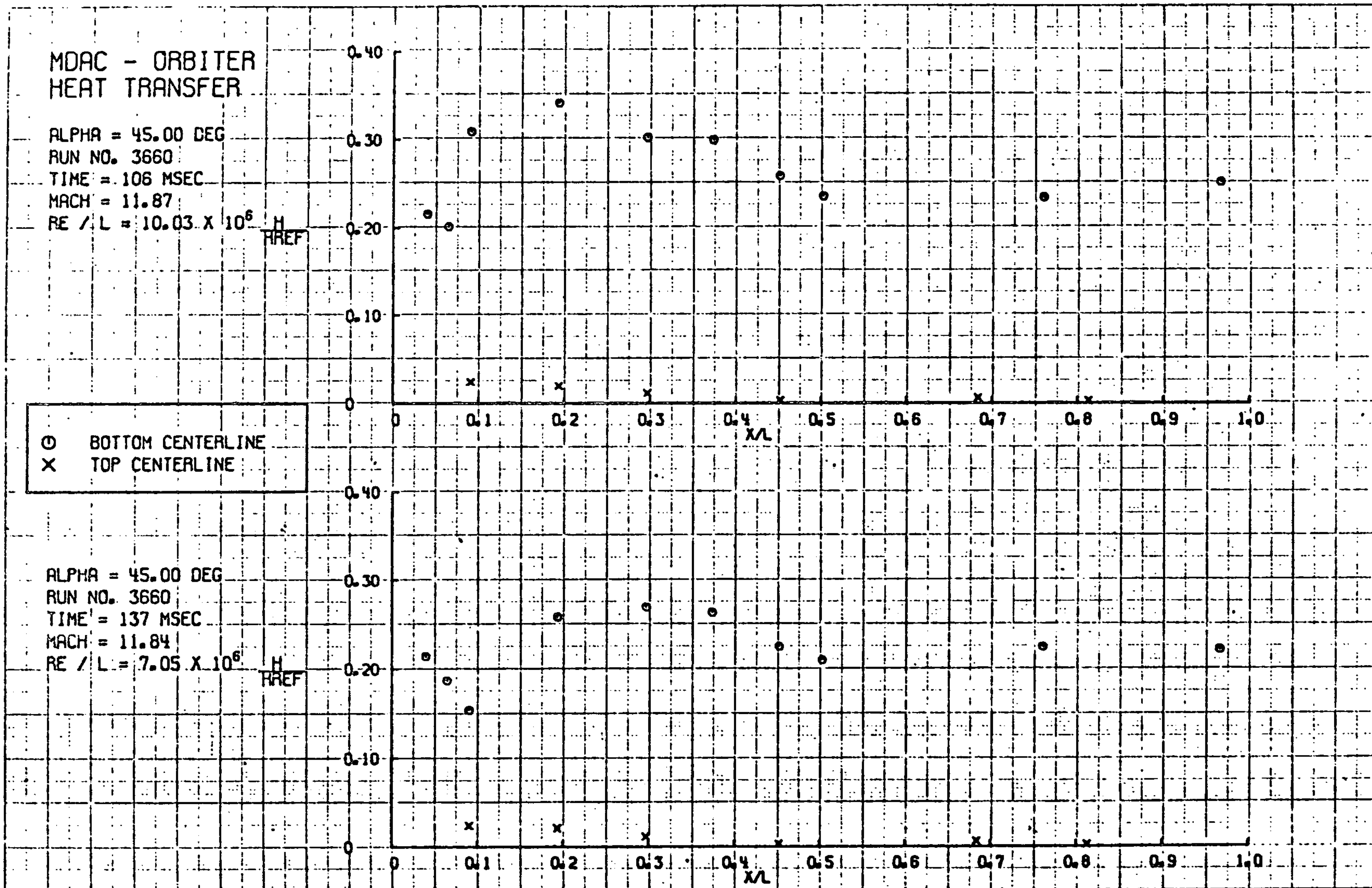

AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F
MDAC - ORBITER
HEAT TRANSFER
ALPHA = 40.50 DEG
RUN NO. 3657
TIME = 78 MSEC
MACH = 10.36
RE / L = 11.09 X 10^6
H/HREF
0
0.10
0.20
0.30
0.40
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
X/L
BOTTOM CENTERLINE
TOP CENTERLINE
ALPHA = 40.50 DEG
RUN NO. 3657
TIME = 118 MSEC
MACH = 10.44
RE / L = 9.35 X 10^6
H/HREF


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F
MDAC - ORBITER
HEAT TRANSFER
ALPHA = 60.50 DEG
RUN NO. 3658
TIME = 71 MSEC
MACH = 10.66
RE / L = 24.08 X 10^6
H/HREF
BOTTOM CENTERLINE
TOP CENTERLINE
ALPHA = 60.50 DEG
RUN NO. 3658
TIME = 130 MSEC
MACH = 10.36
RE / L = 5.94 X 10^6
H/HREF
X/L
0 0.20 0.40 0.60 0.80
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0

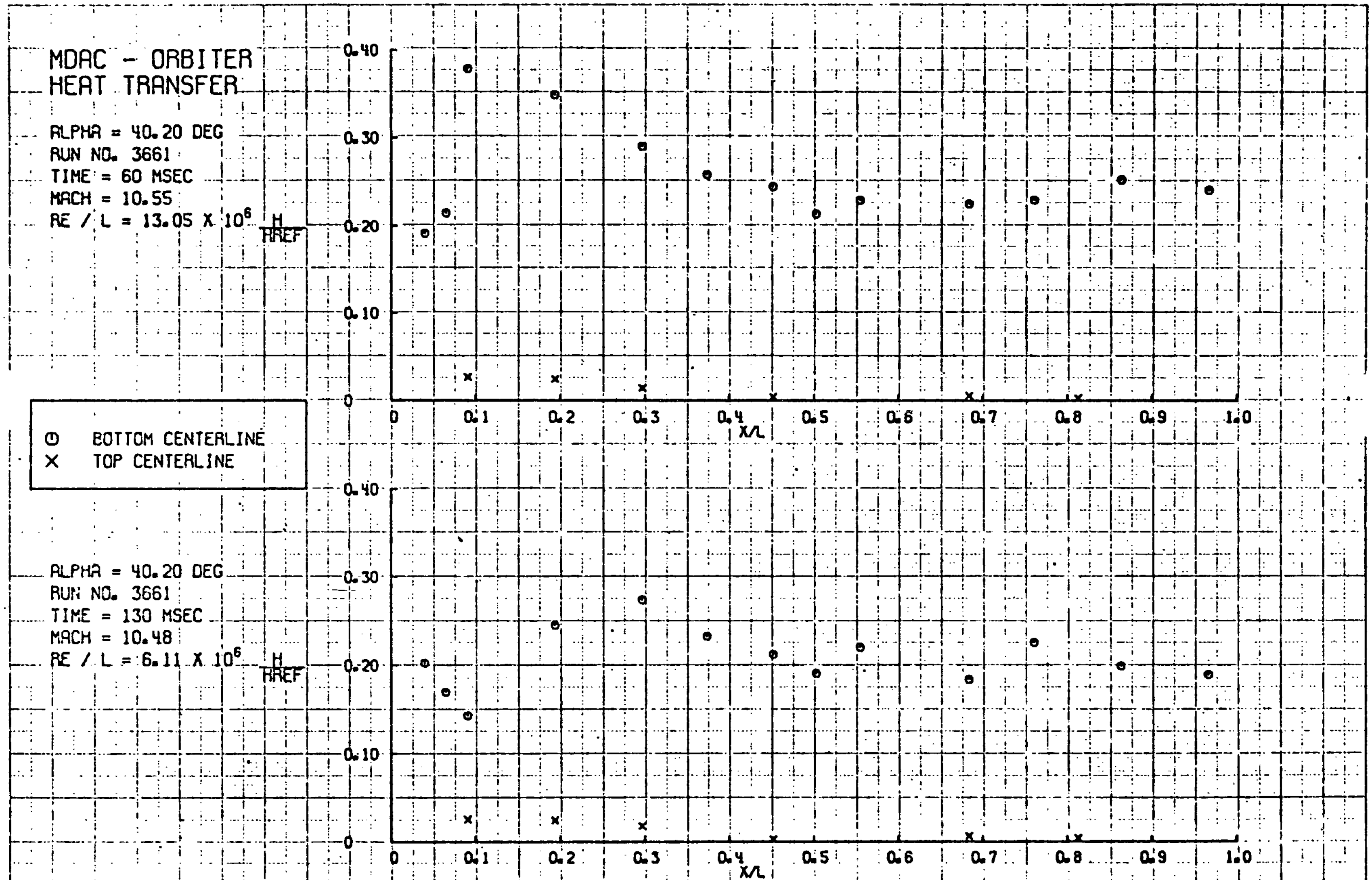
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

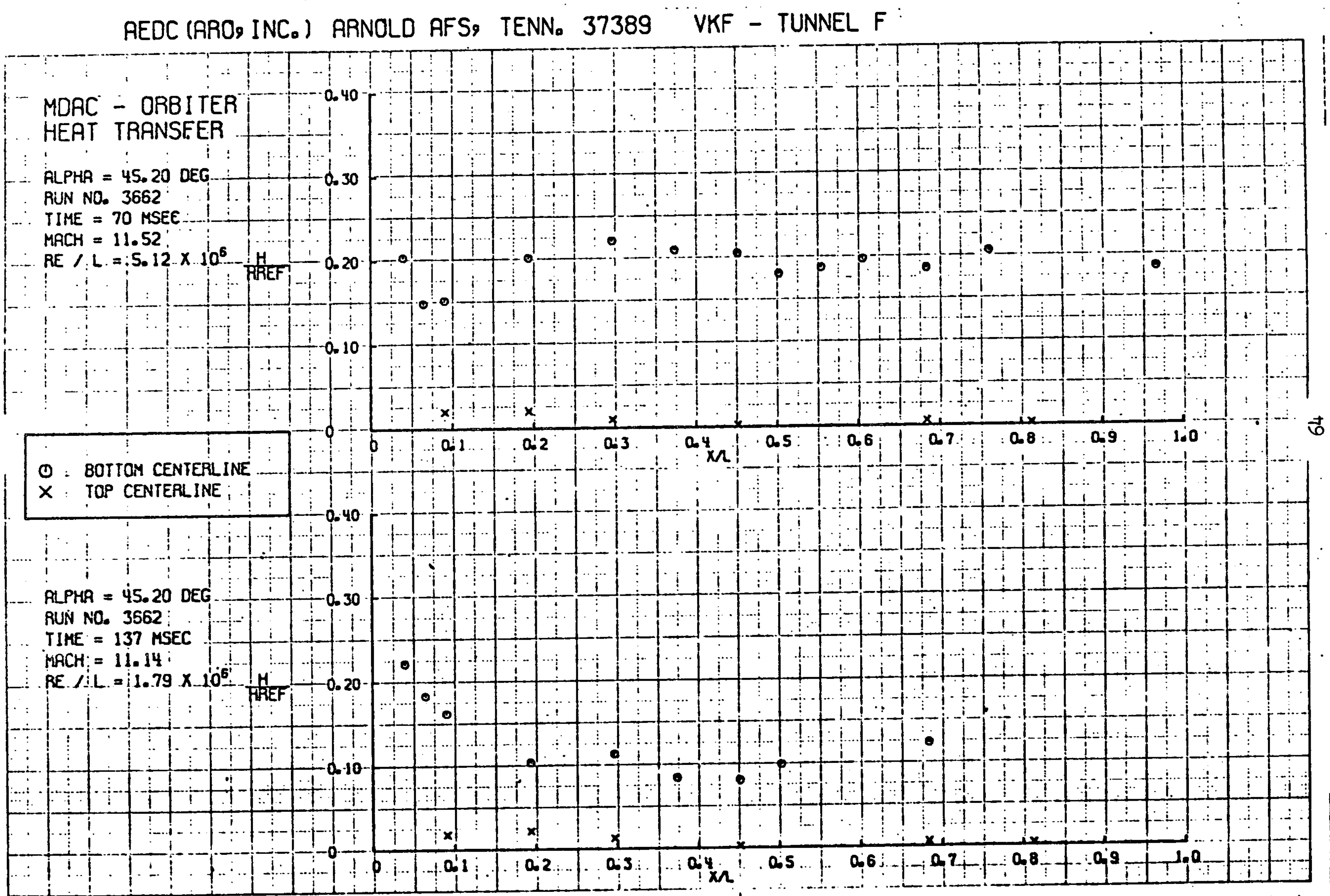


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389   VKF - TUNNEL F

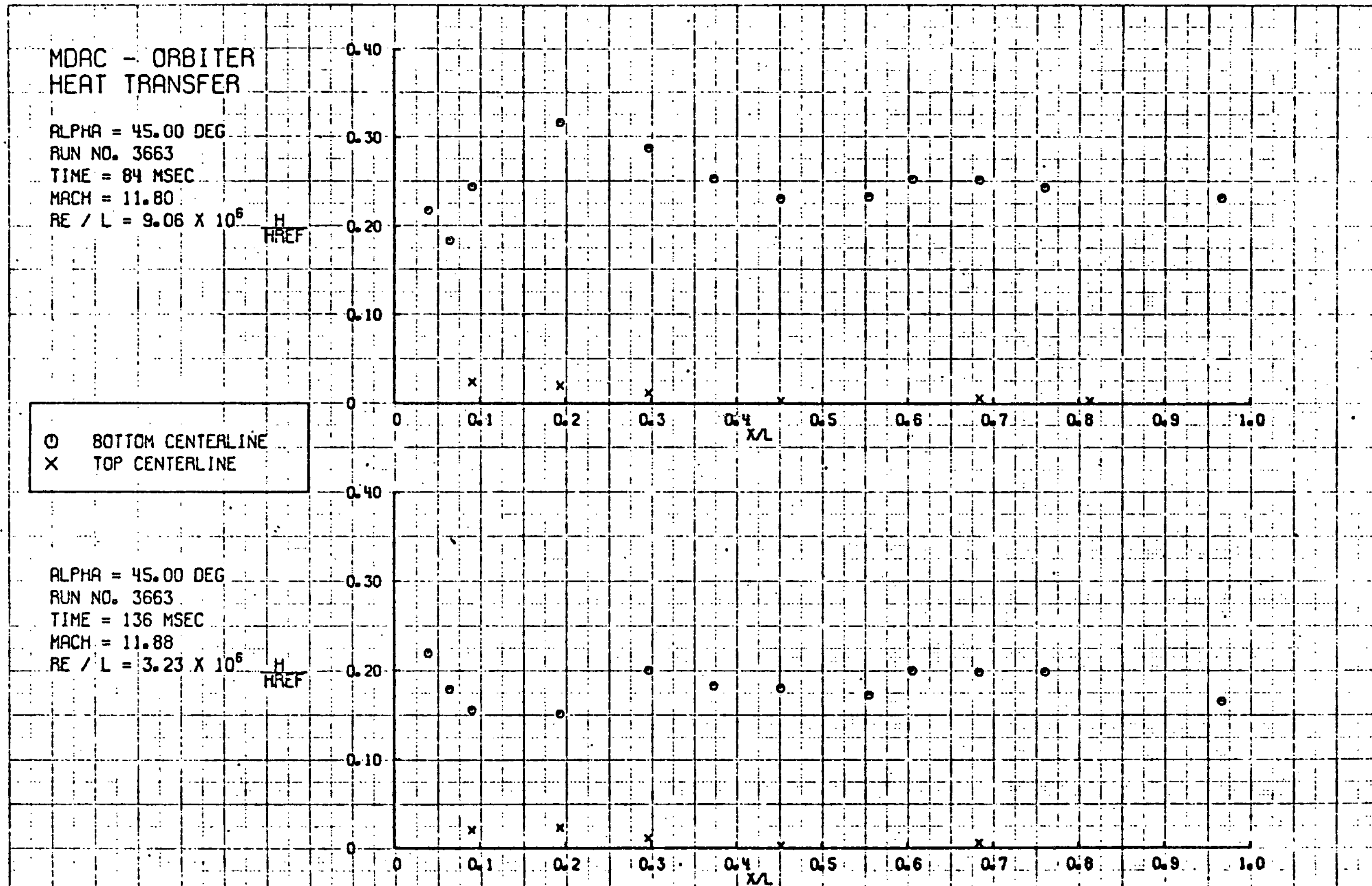


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

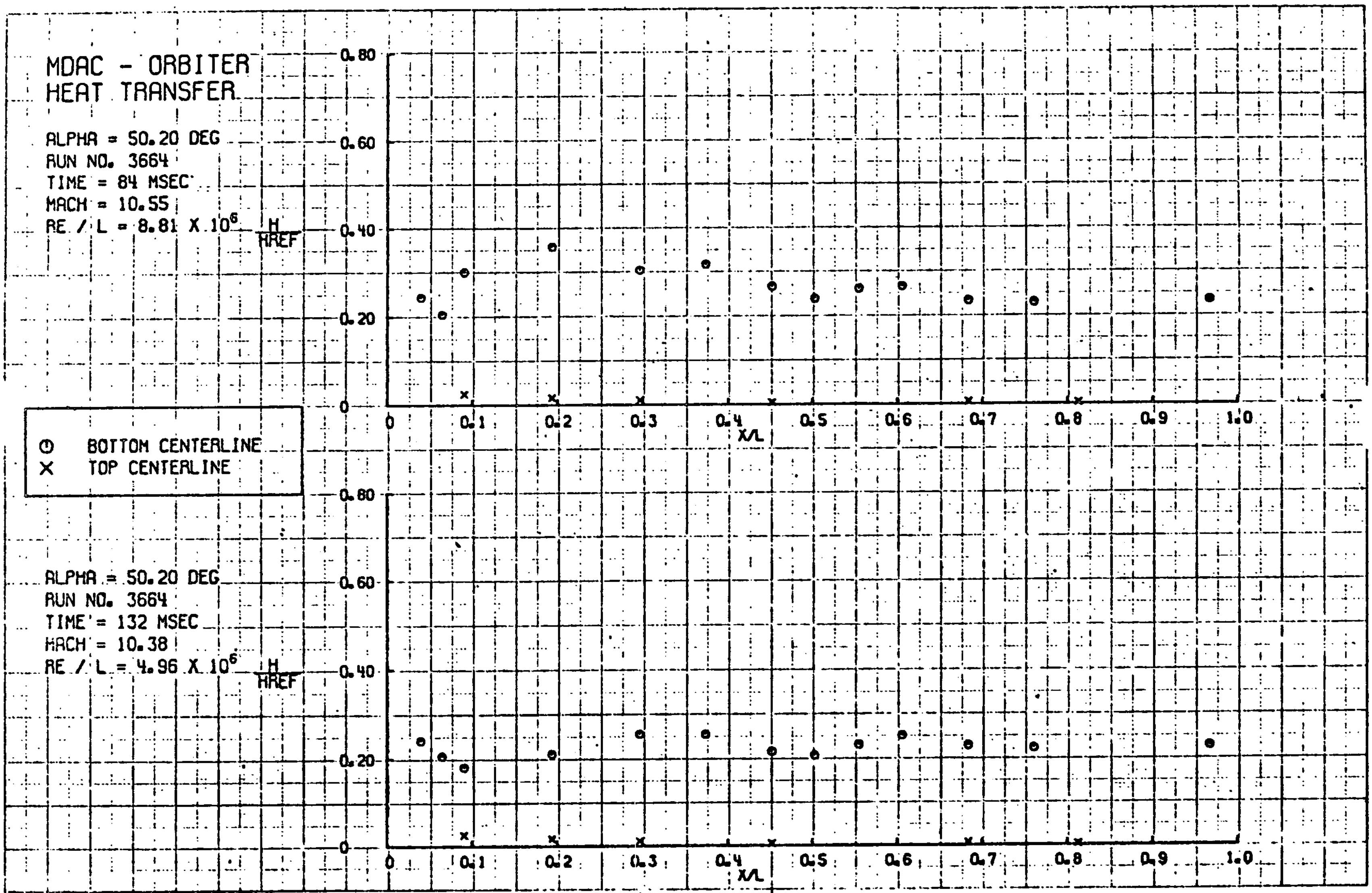



AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F
MDAC - ORBITER
HEAT TRANSFER
ALPHA = 45.20 DEG
RUN NO. 3662
TIME = 70 MSEC
MACH = 11.52
RE / L = 5.12 X 10^6
H/HREF
X/L
⊙ BOTTOM CENTERLINE
× TOP CENTERLINE
ALPHA = 45.20 DEG
RUN NO. 3662
TIME = 137 MSEC
MACH = 11.14
RE / L = 1.79 X 10^6
H/HREF
X/L

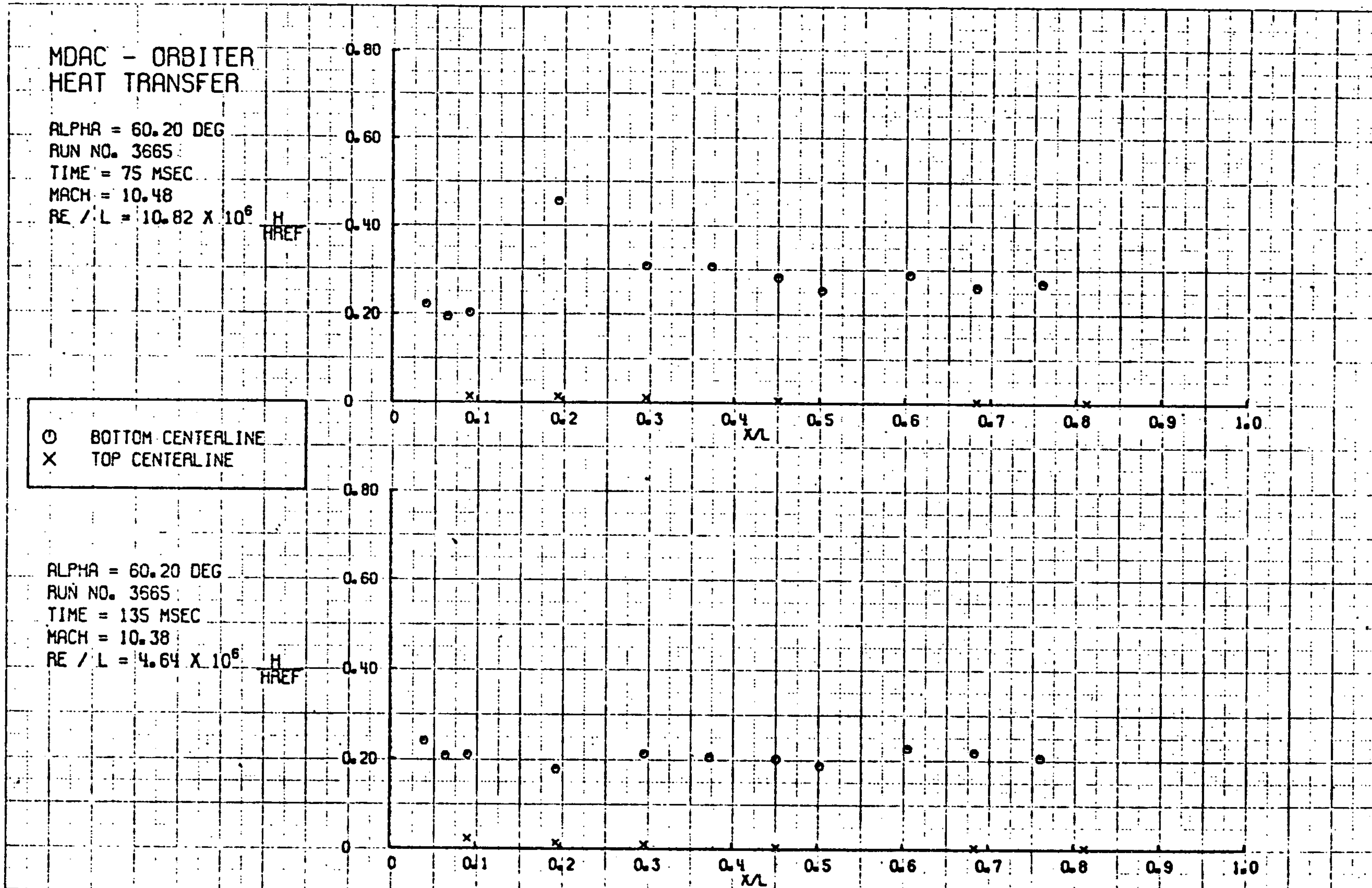
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



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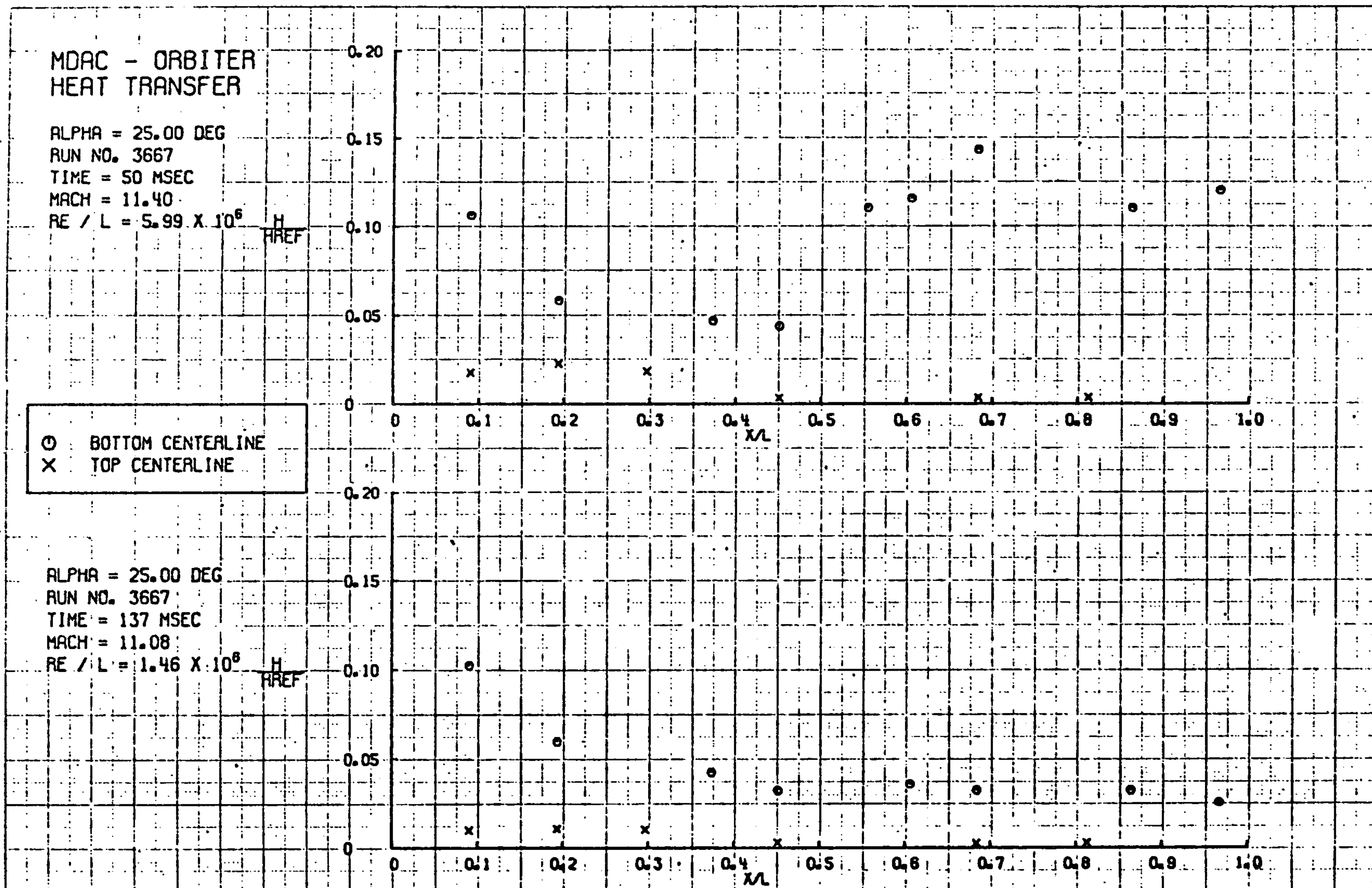
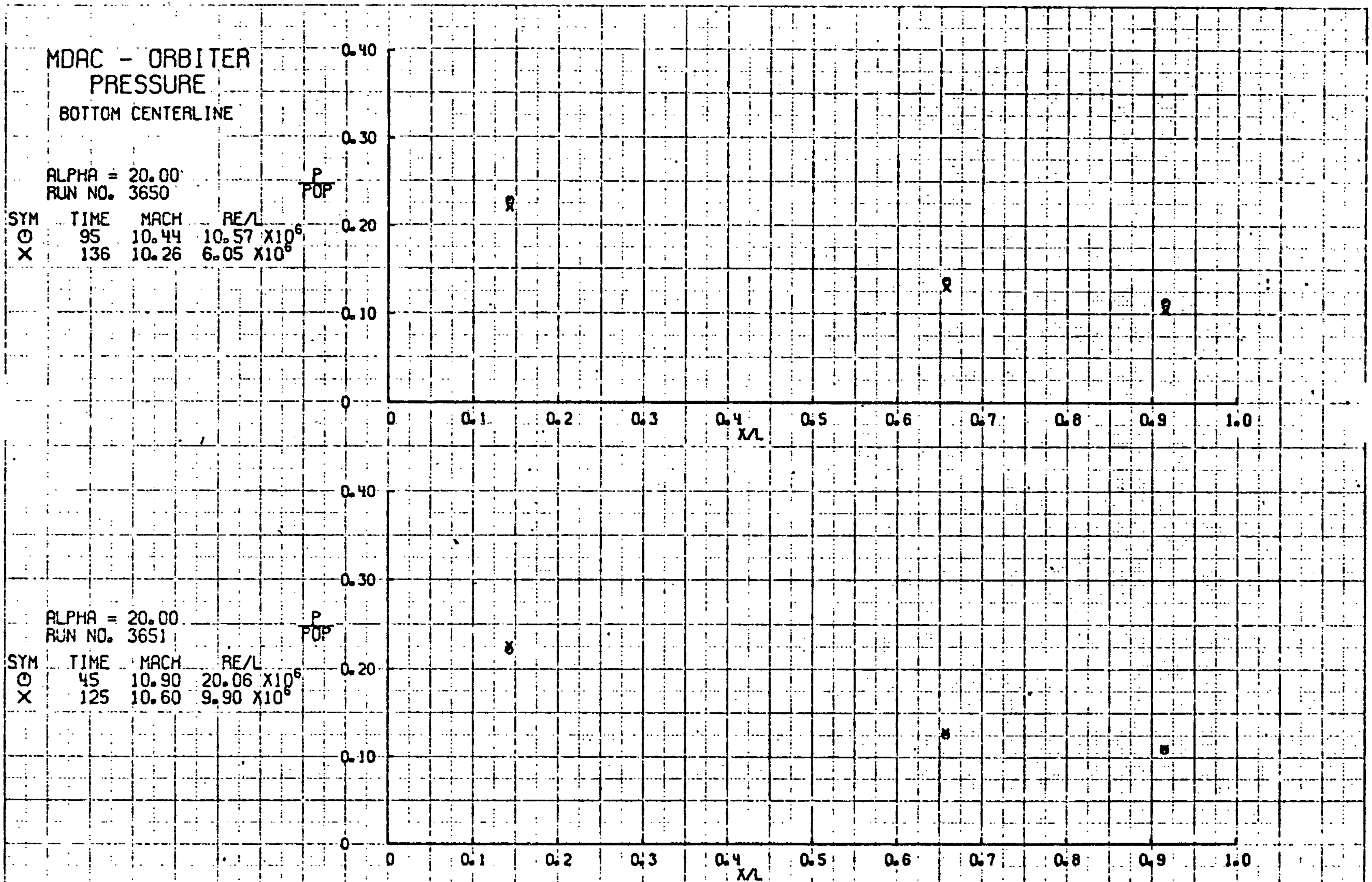


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



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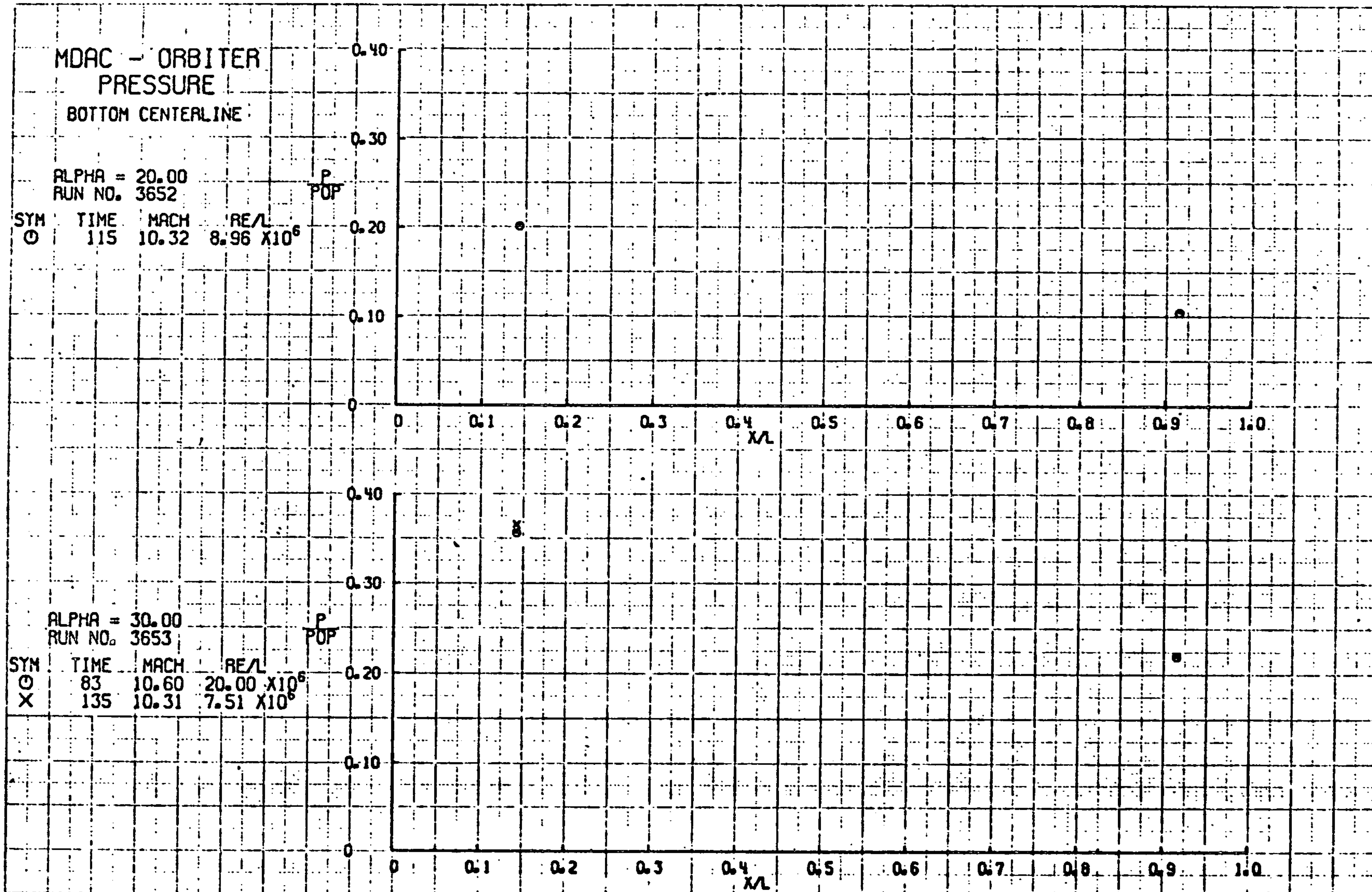
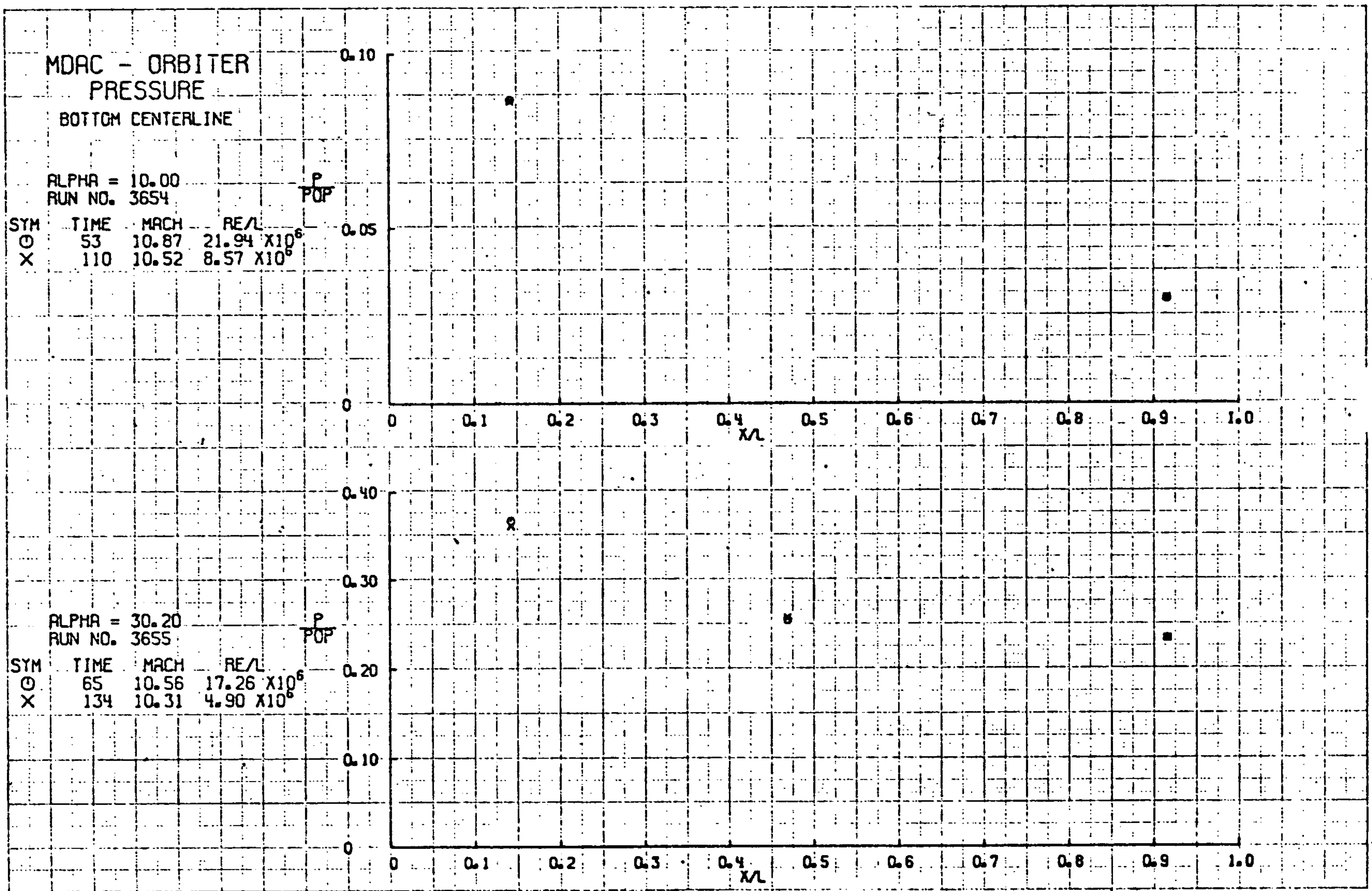


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



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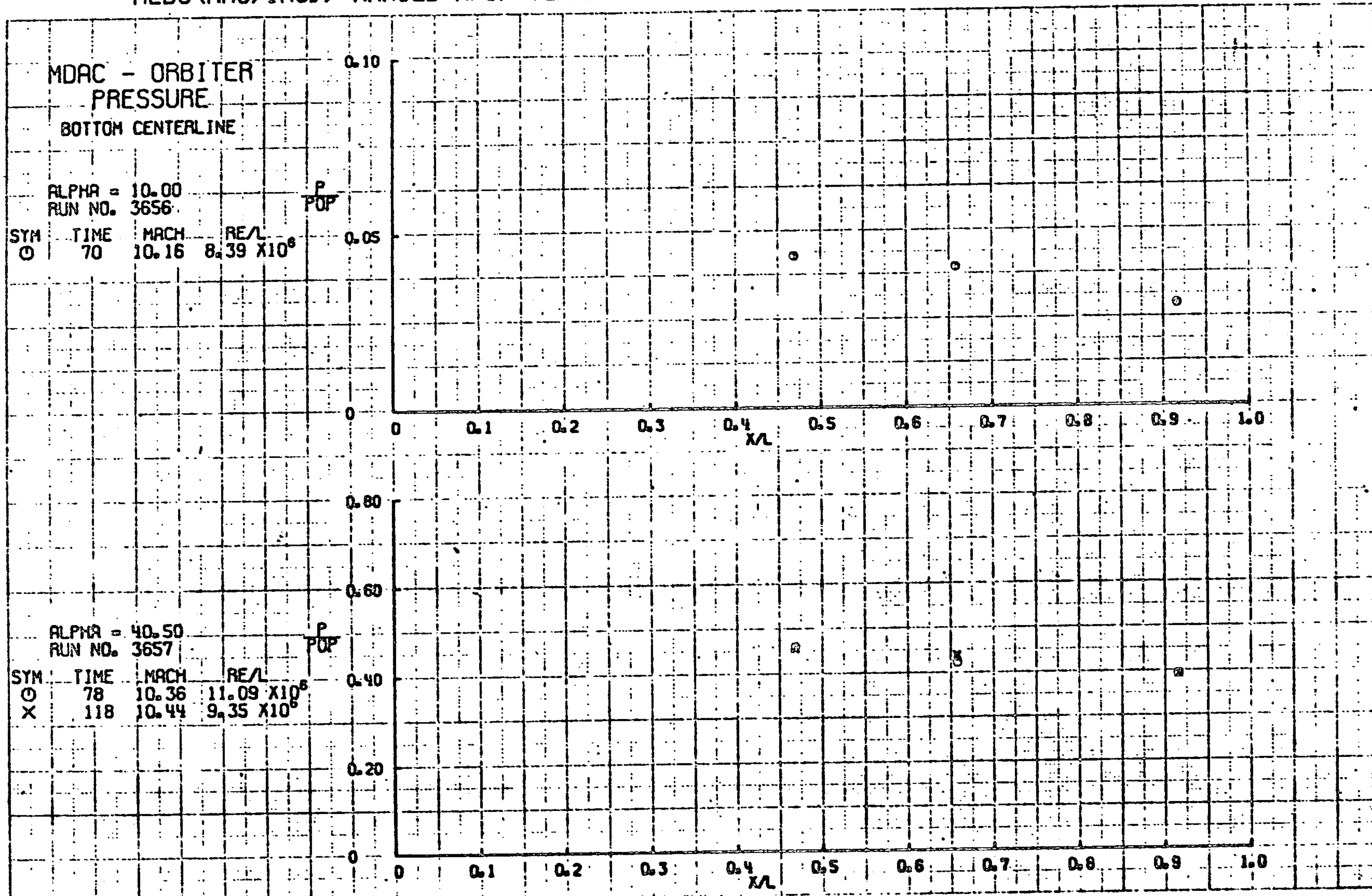
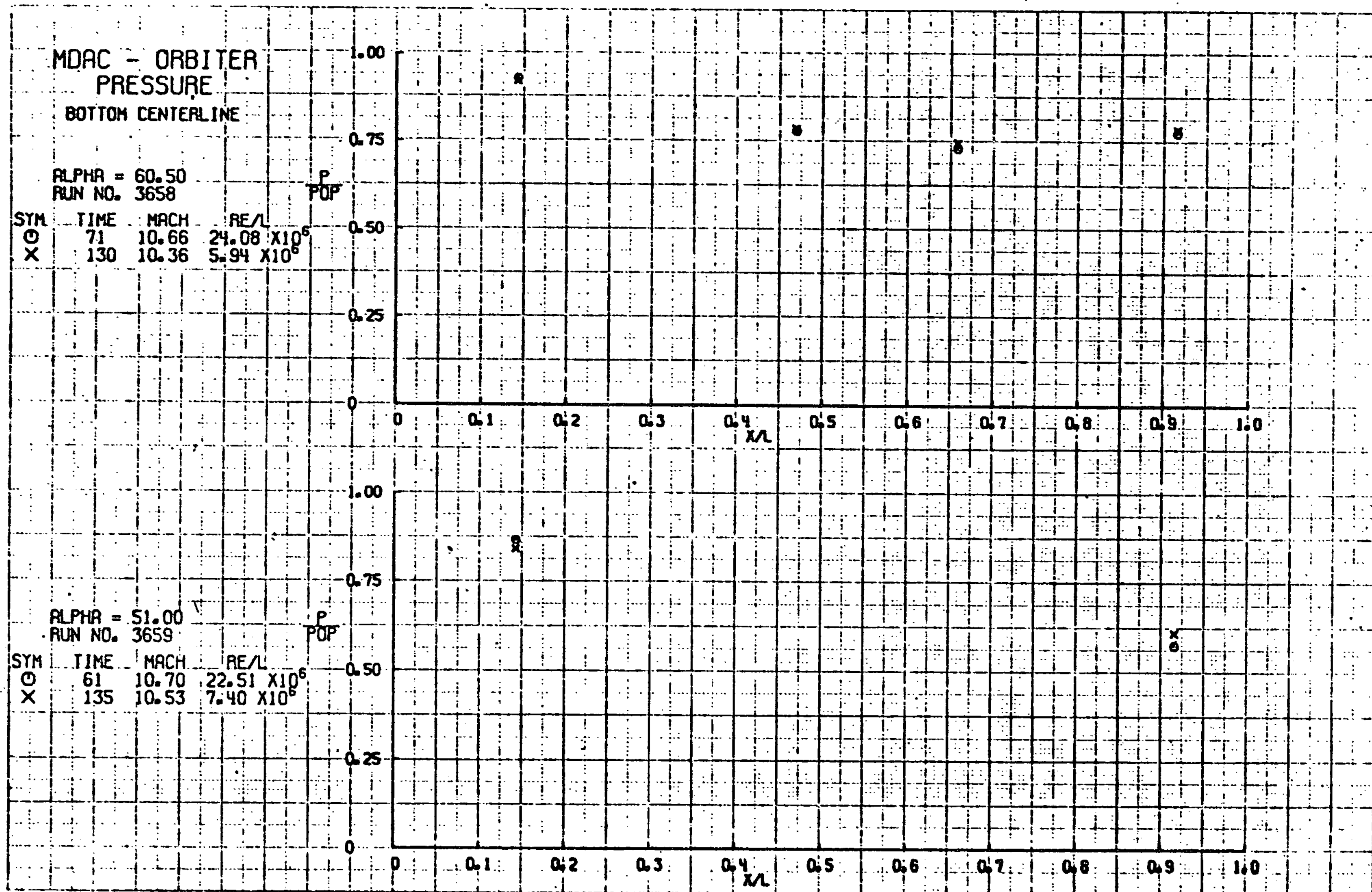
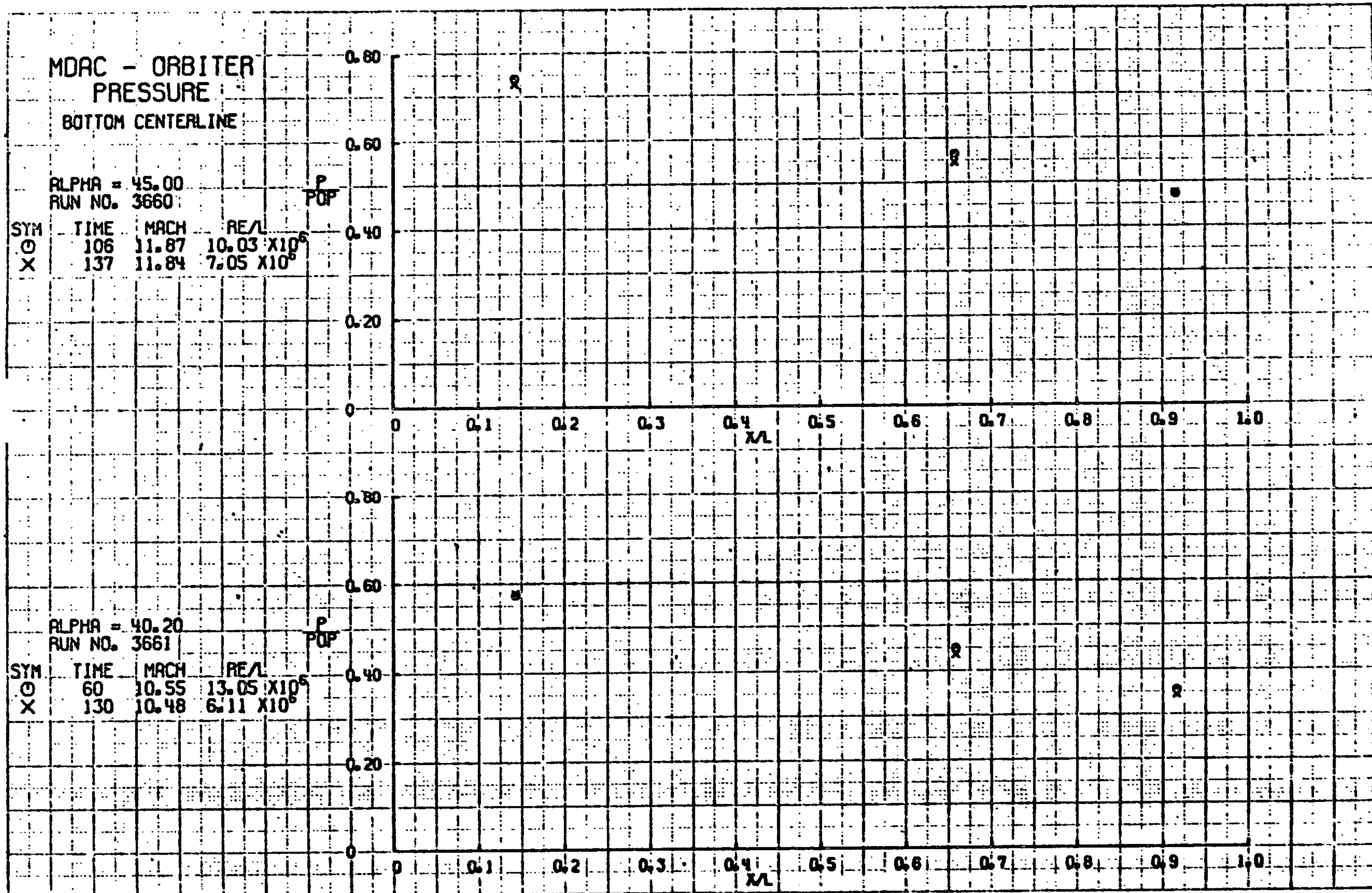


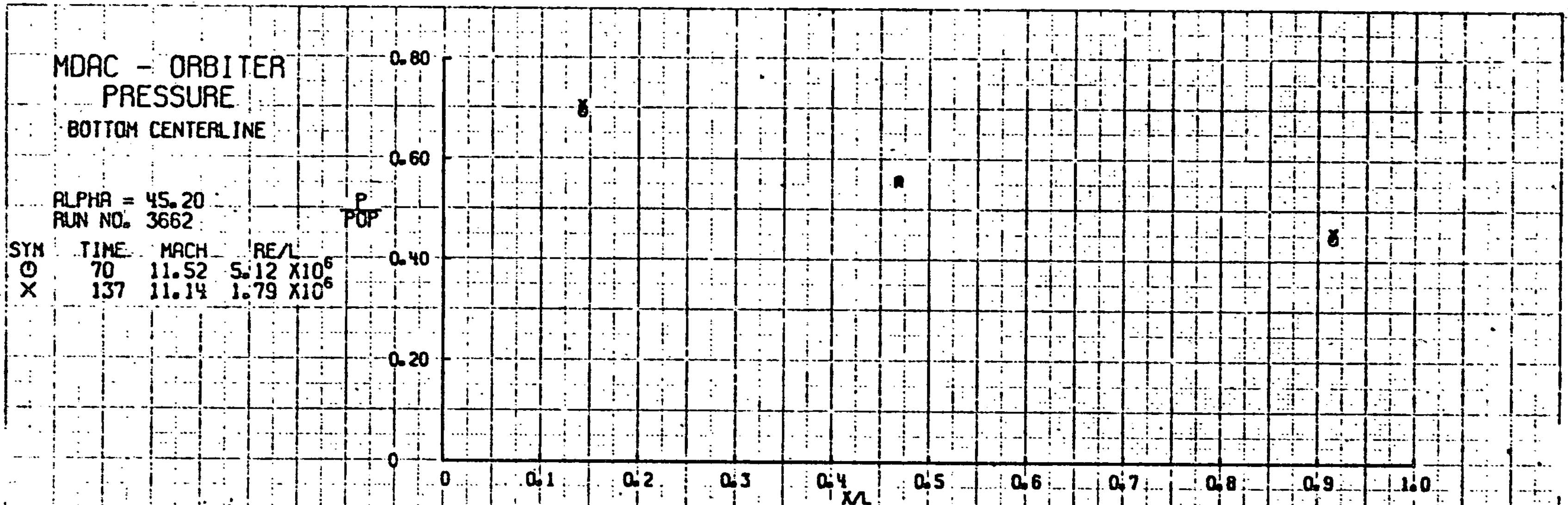
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

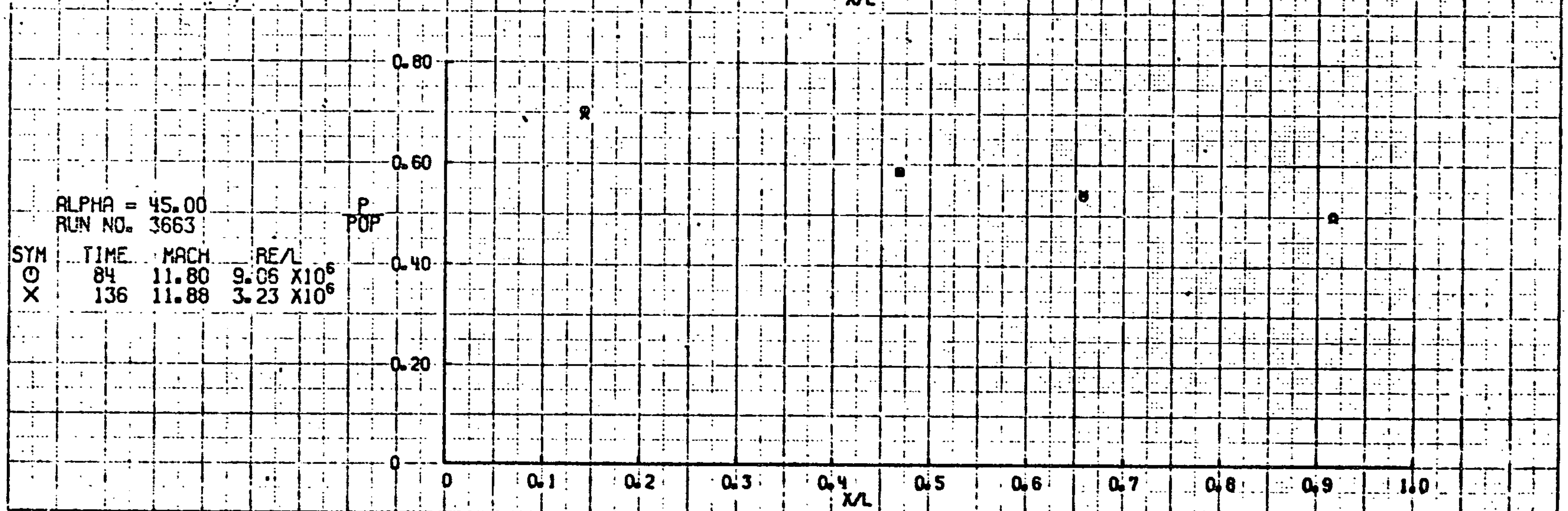


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

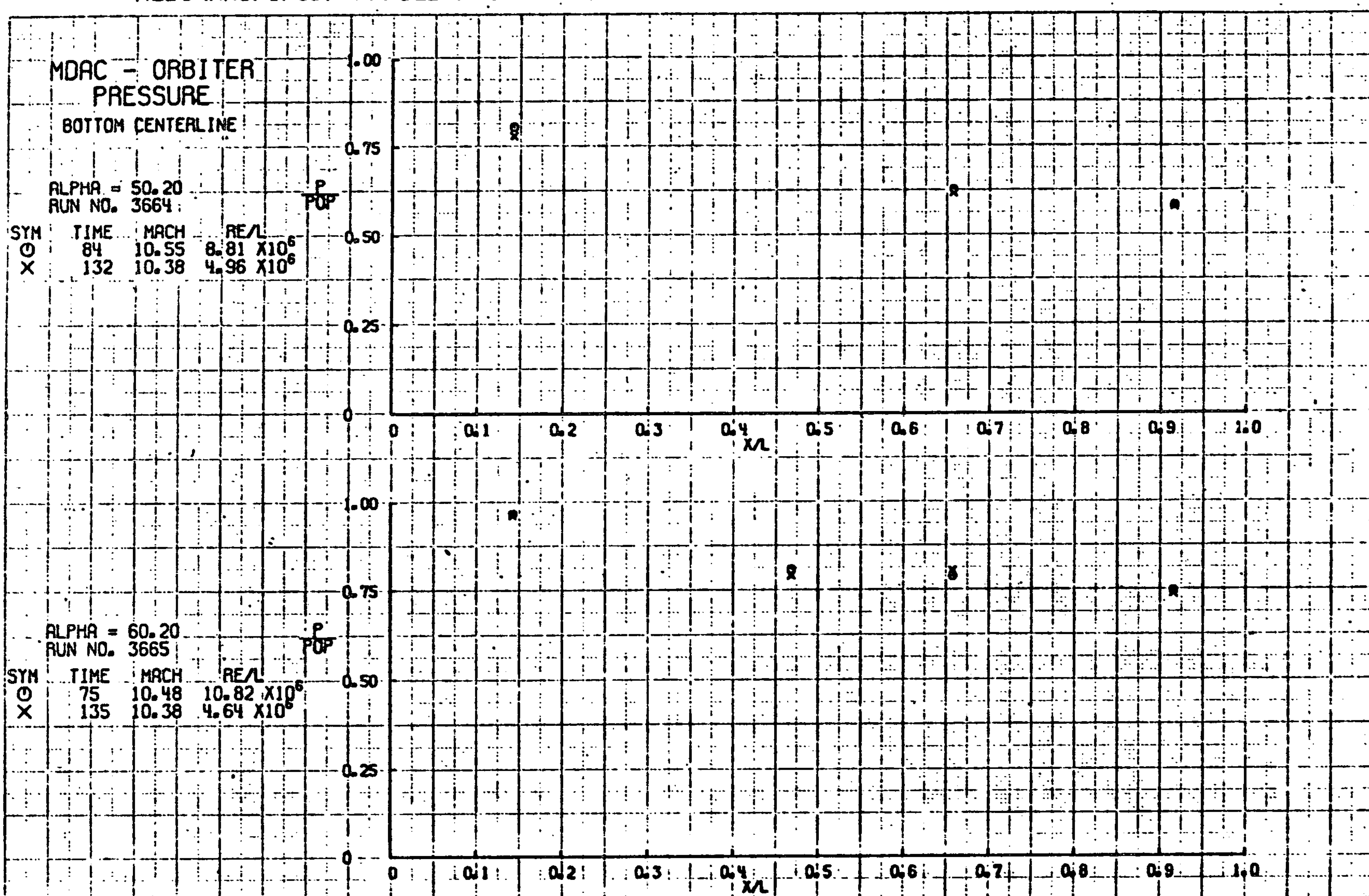


AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F

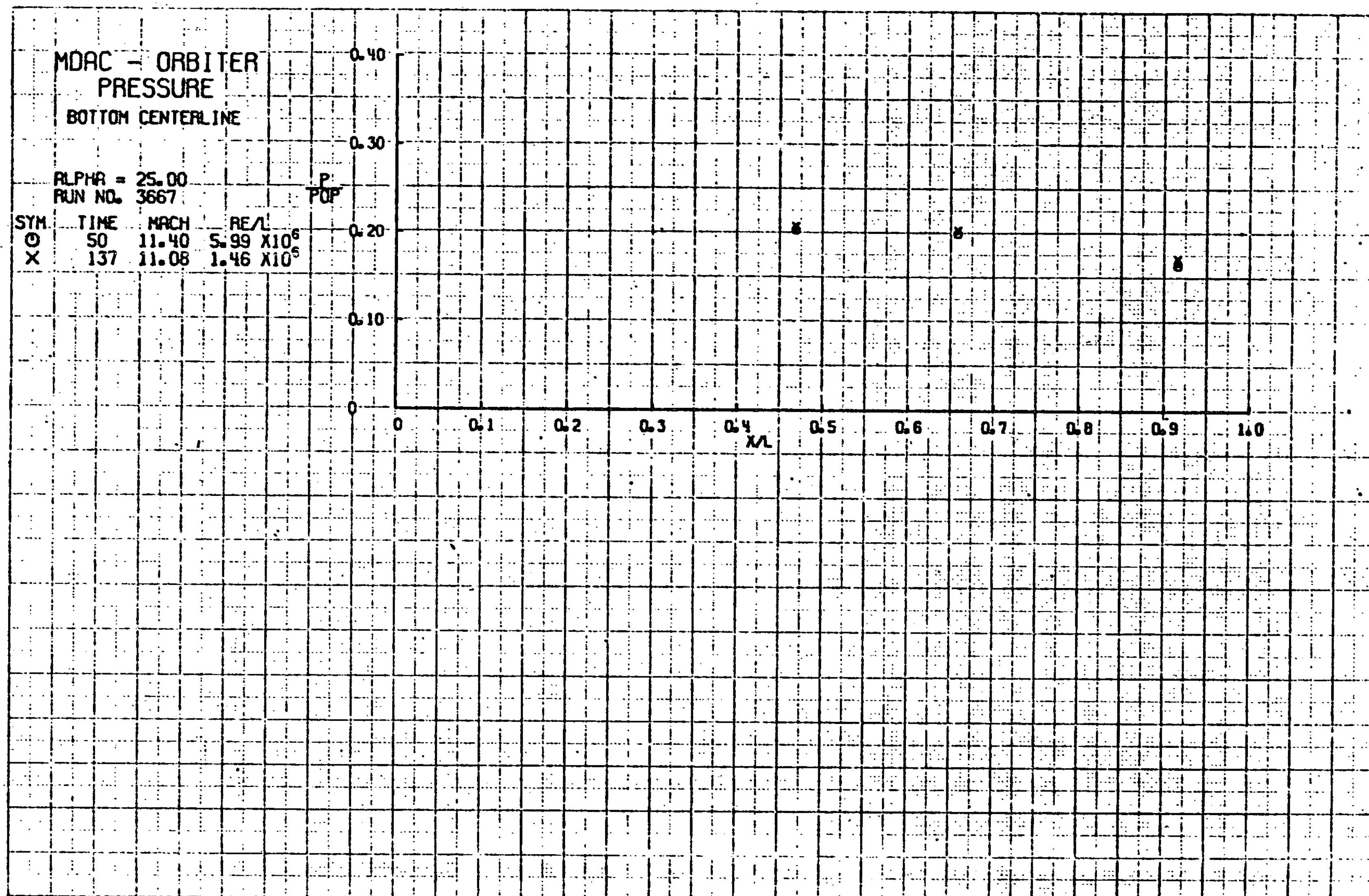




AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



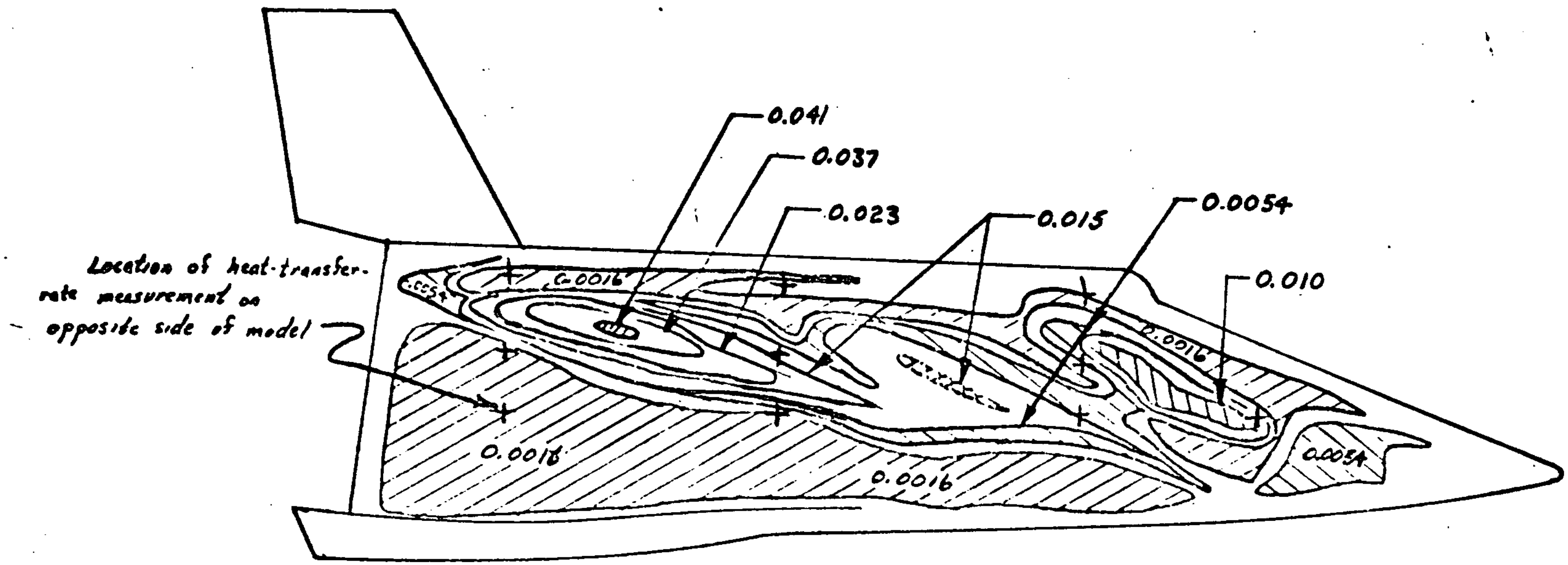
AEDC (ARO, INC.) ARNOLD AFS, TENN. 37389 VKF - TUNNEL F



APPENDIX IV

SELECTED PLOTS OF HEAT-TRANSFER RESULTS USING THE PHOSPHOR PAINT TECHNIQUE

Note: These contours and model geometry are shown in the camera view.



Run 3650
$\alpha = 20$ deg
$M_\infty = 10.3$
$Re_{\infty,\ell} = 6.1 \times 10^6$, t = 136 msec.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.002

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

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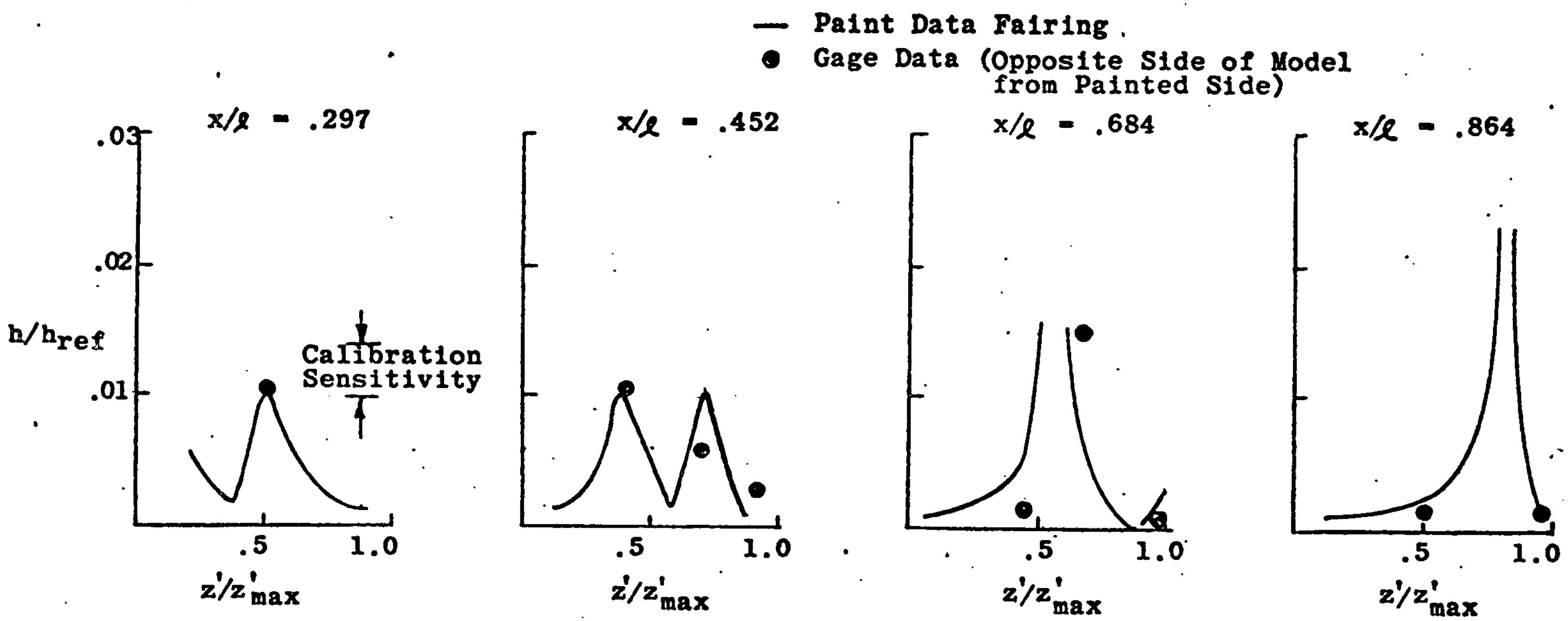
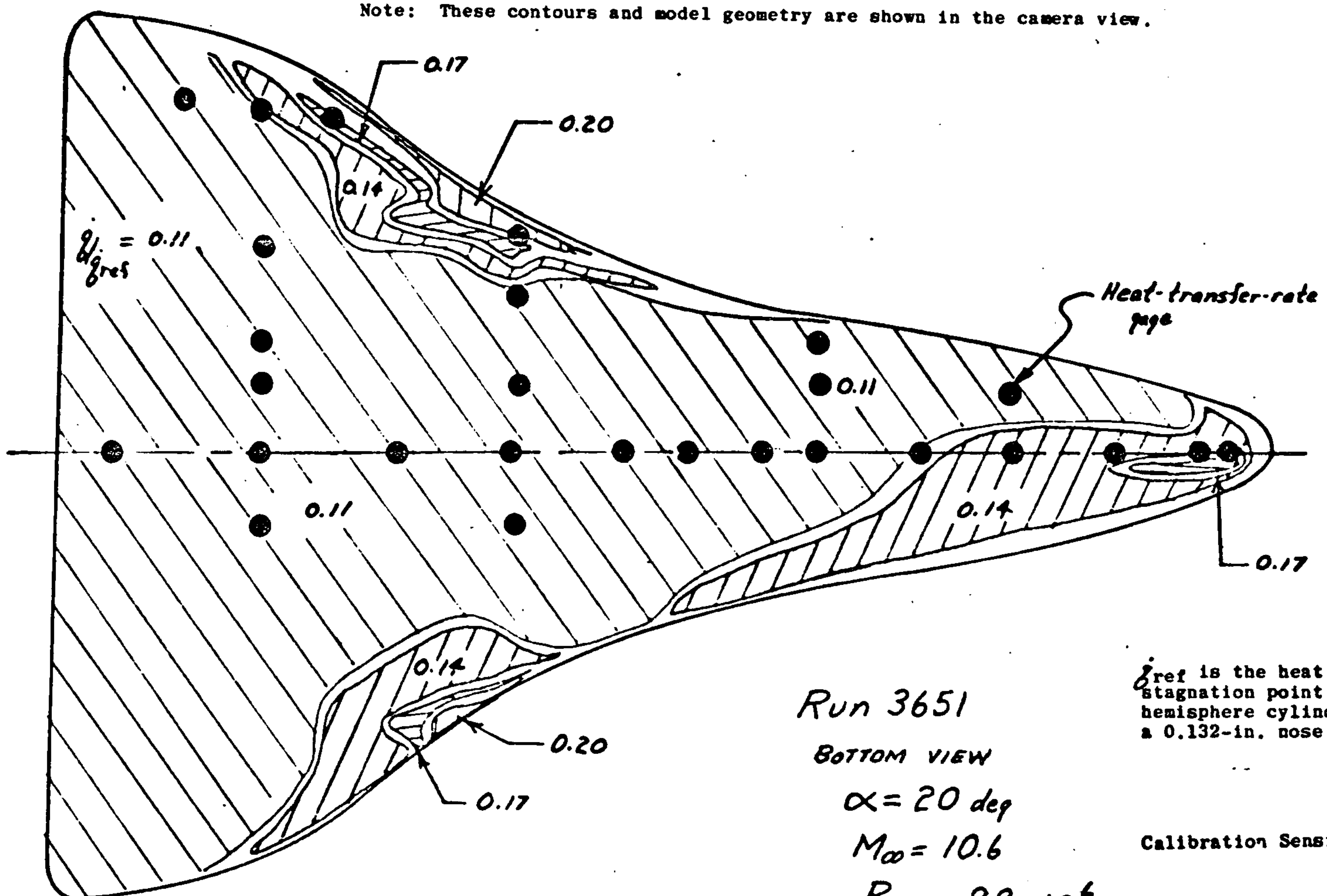


Side Elevation Distributions

Run 3650, α = 20 deg, $Re_{\infty,\ell}$ = 6.1×10^6, M_∞ = 10.3

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Run 3651

BOTTOM VIEW

$\alpha = 20$ deg

$M_\infty = 10.6$

$Re_{\infty,\ell} = 9.9 \times 10^6$

$t = 125$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.03

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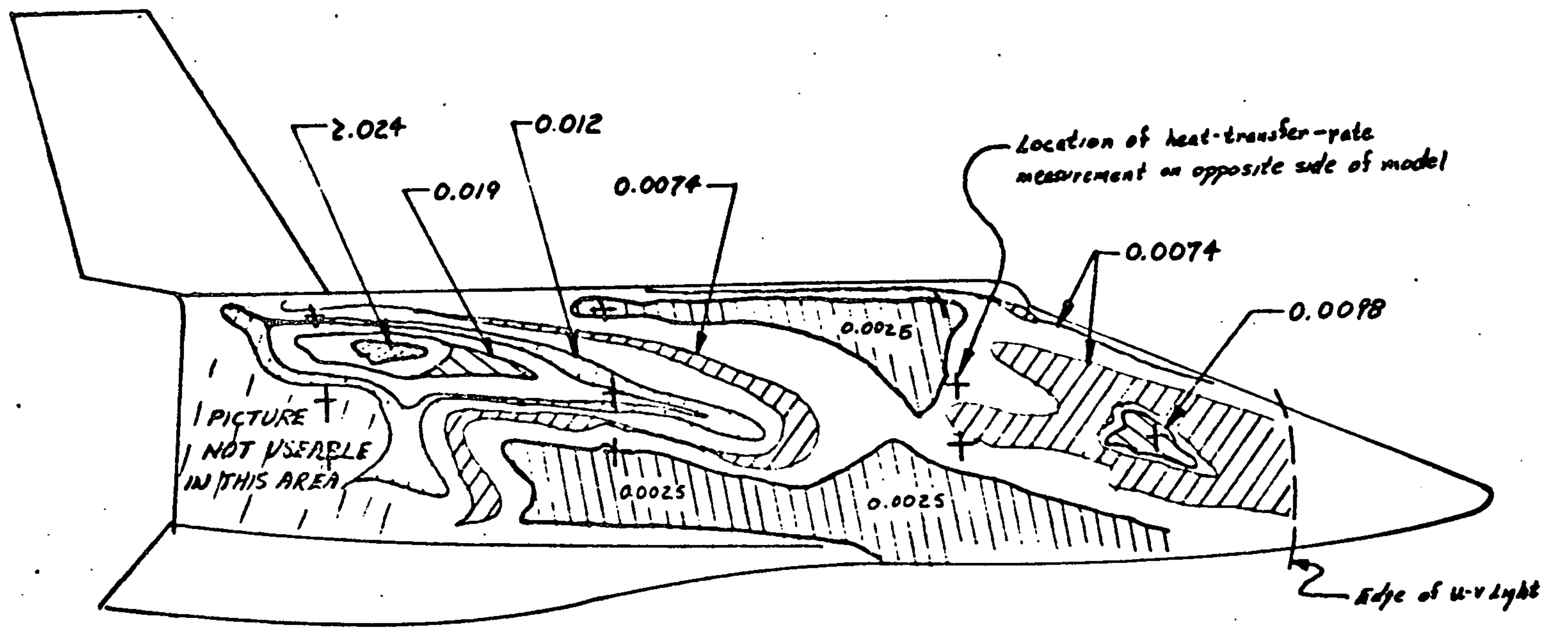
Note: These contours and model geometry are shown in the camera view.



Run 3651

$\alpha = 20$ deg

$M_o = 10.6$

$R_{e_{\infty,\ell}} = 9.9 \times 10^6$, $t = 125$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0013

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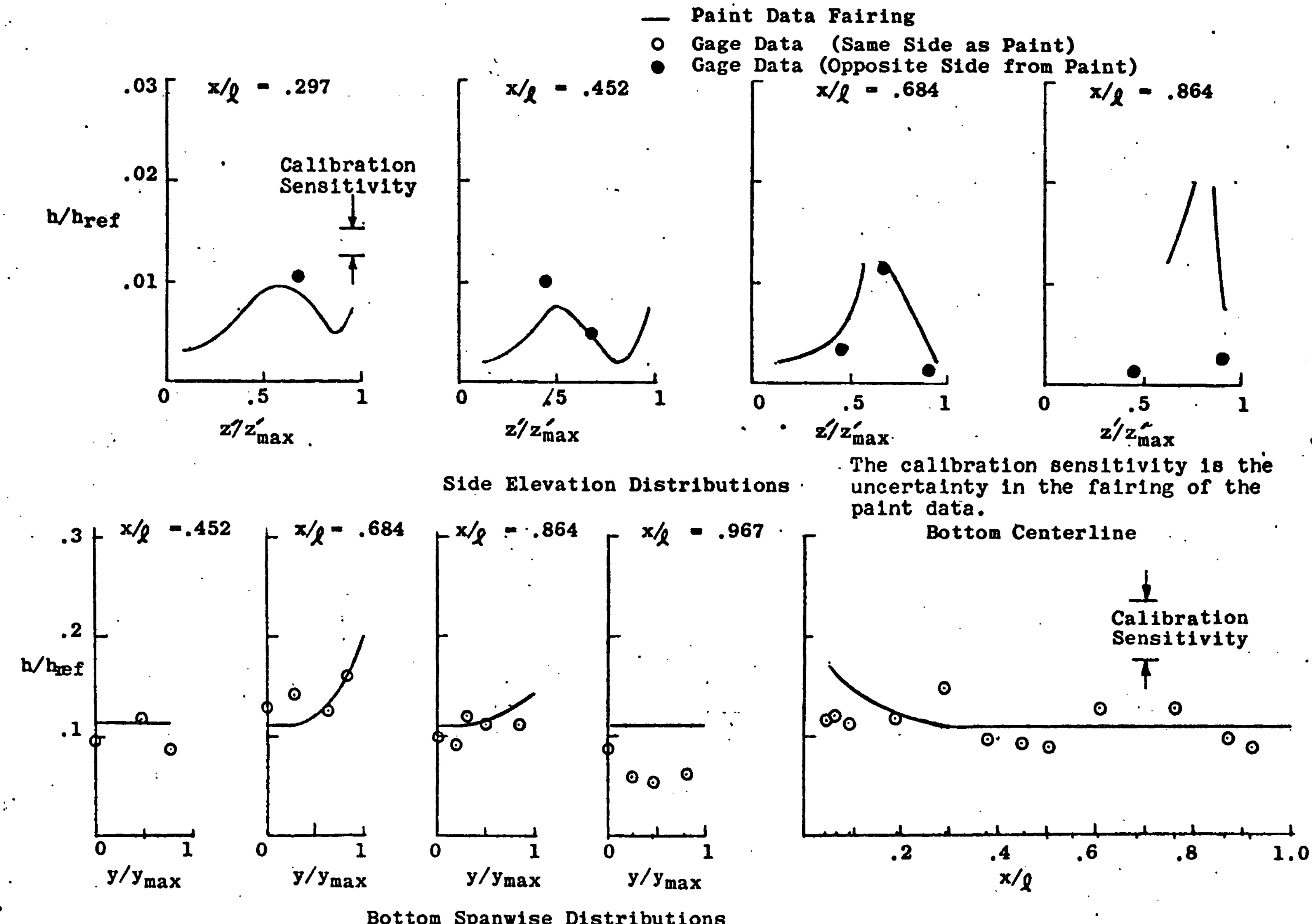
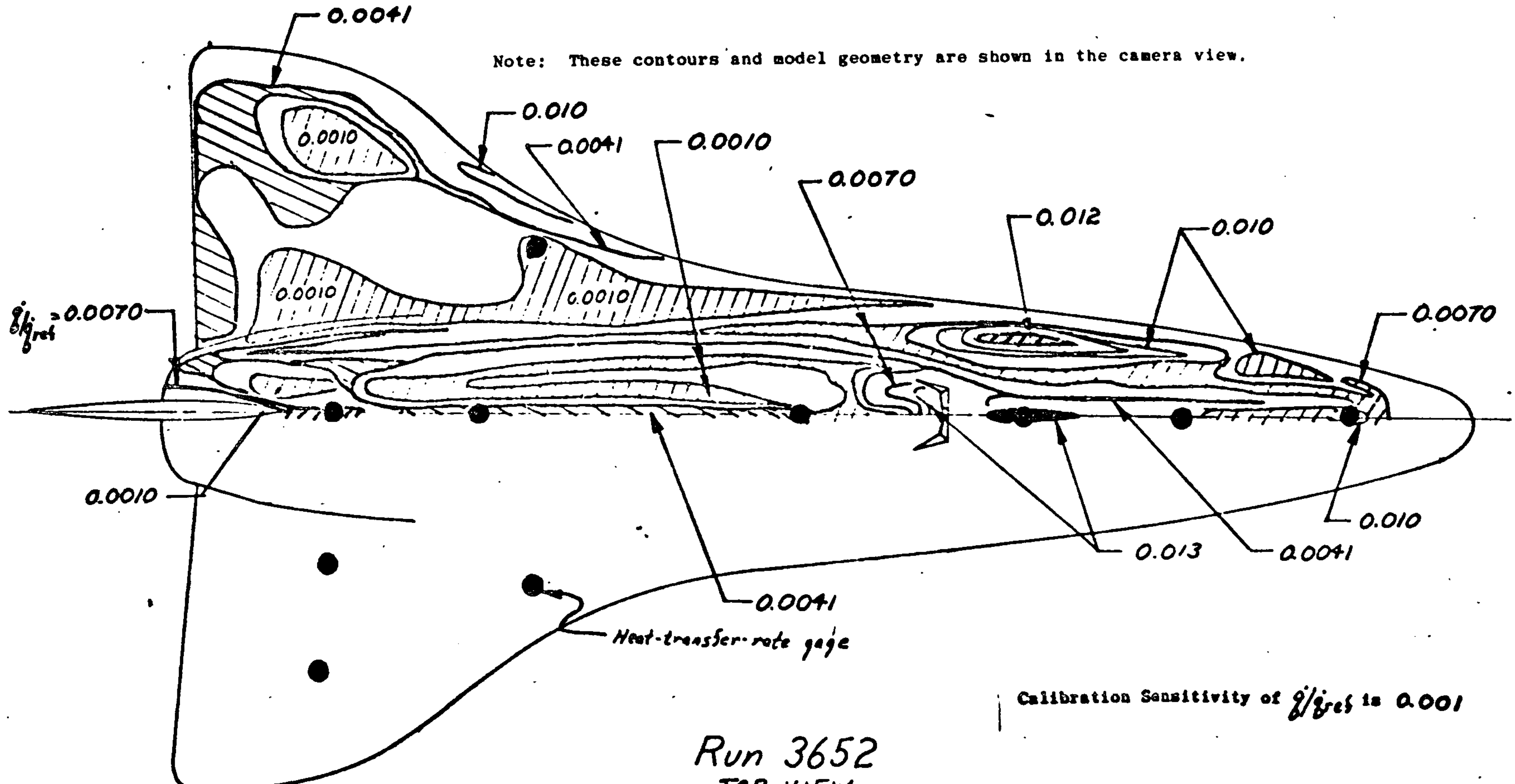


Run 3651, α = 20 deg $Re_{\infty,\ell}$ = 9.9x10^6, M_∞ = 10.6



Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

Run 3652
TOP VIEW

$\alpha = 20$ deg

$M_\infty = 10.3$

$R_{e_{\infty,\ell}} = 9.0 \times 10^6$, $t = 115$ msec

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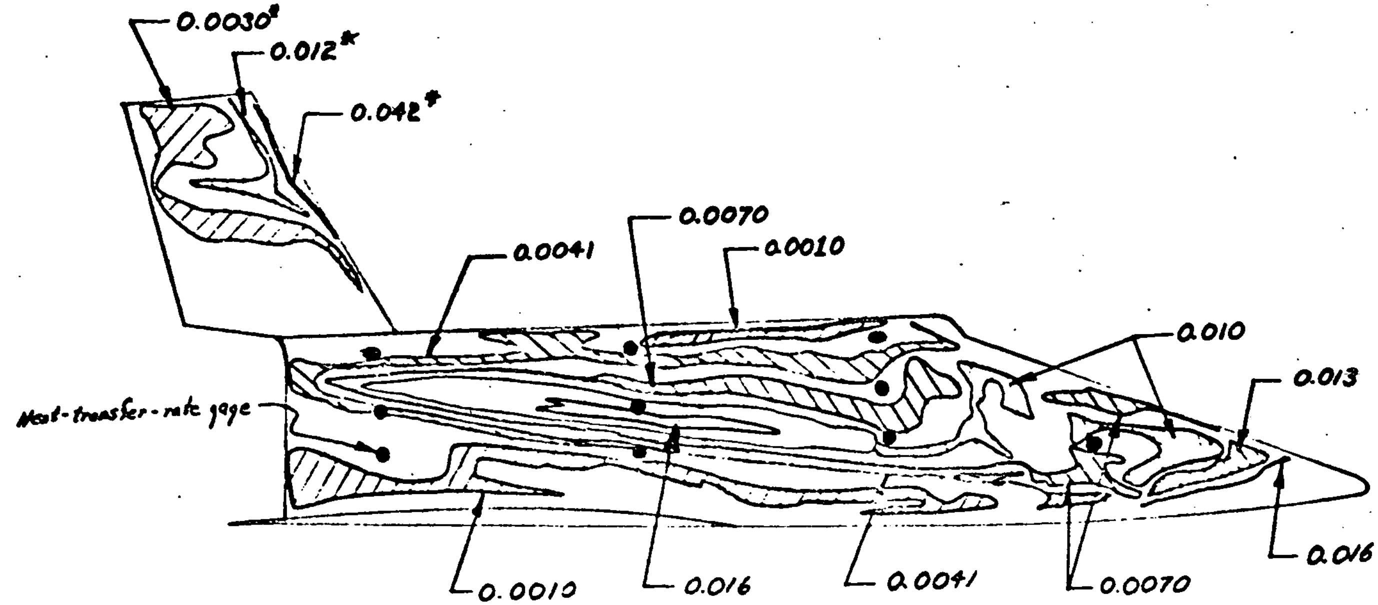
$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Note: These contours and model geometry are shown in the camera view.

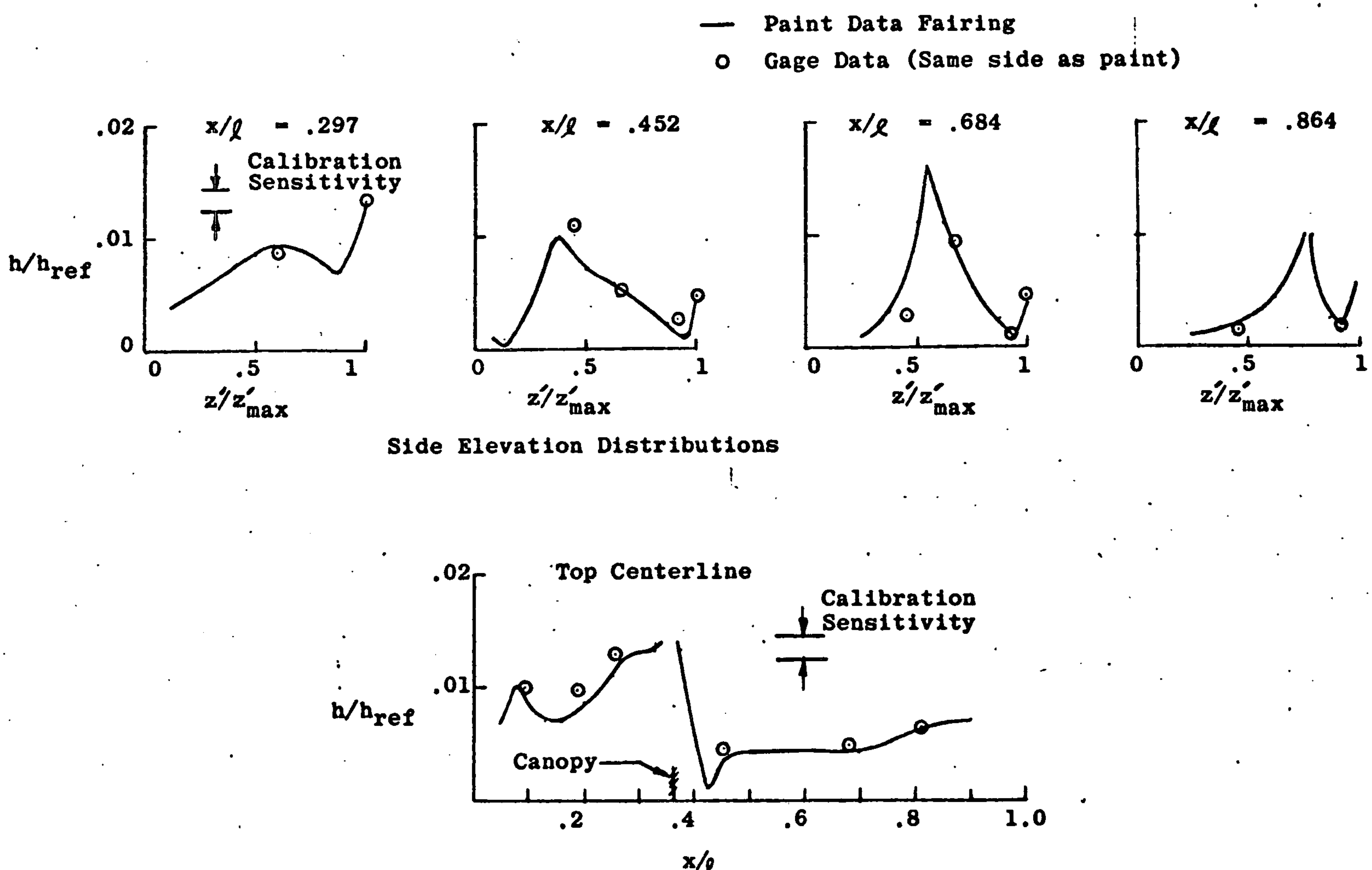


Run 3652
$\alpha = 20$ deg
$M_\infty = 10.3$
$Re_{\infty,\ell} = 9.0 \times 10^6$
$t = 115$ msec

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

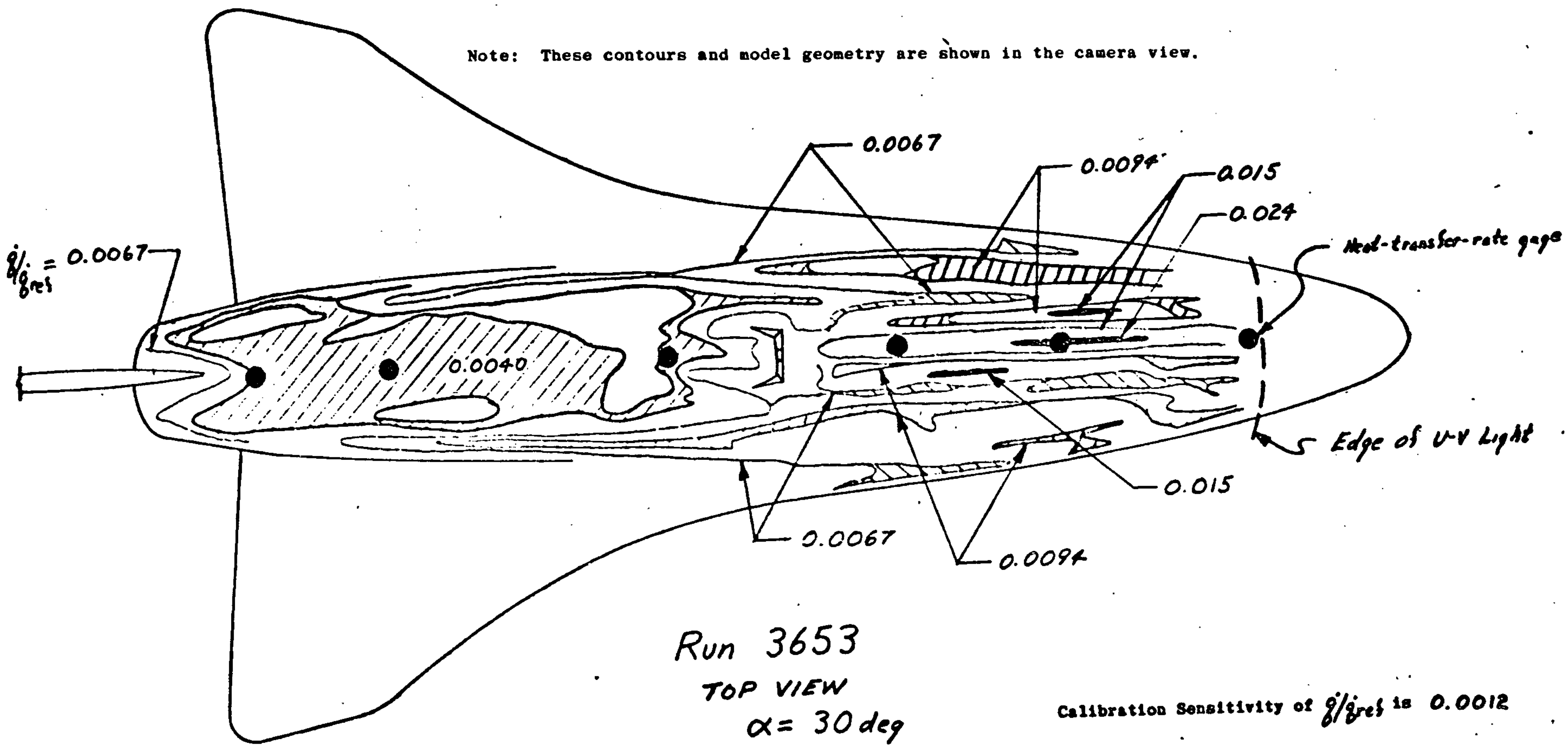
* The Vertical fin was painted with a higher temperature-range phosphor than the fuselage, and a relation between $\dot{q}/\dot{q}_{ref}$ and ΔD was obtained from the lab calibration of the paint and its behavior relative to the calibration of the paint used on the fuselage.



Run 3652, α = 20 deg, $Re_{\infty \ell}$ = 9.0×10^6, M_∞ = 10.3

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Run 3653
TOP VIEW
$\alpha = 30$ deg
$M_\infty = 10.4$
$Re_{\infty,\ell} = 8.6 \times 10^6$, $t = 124$ msec

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0012

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

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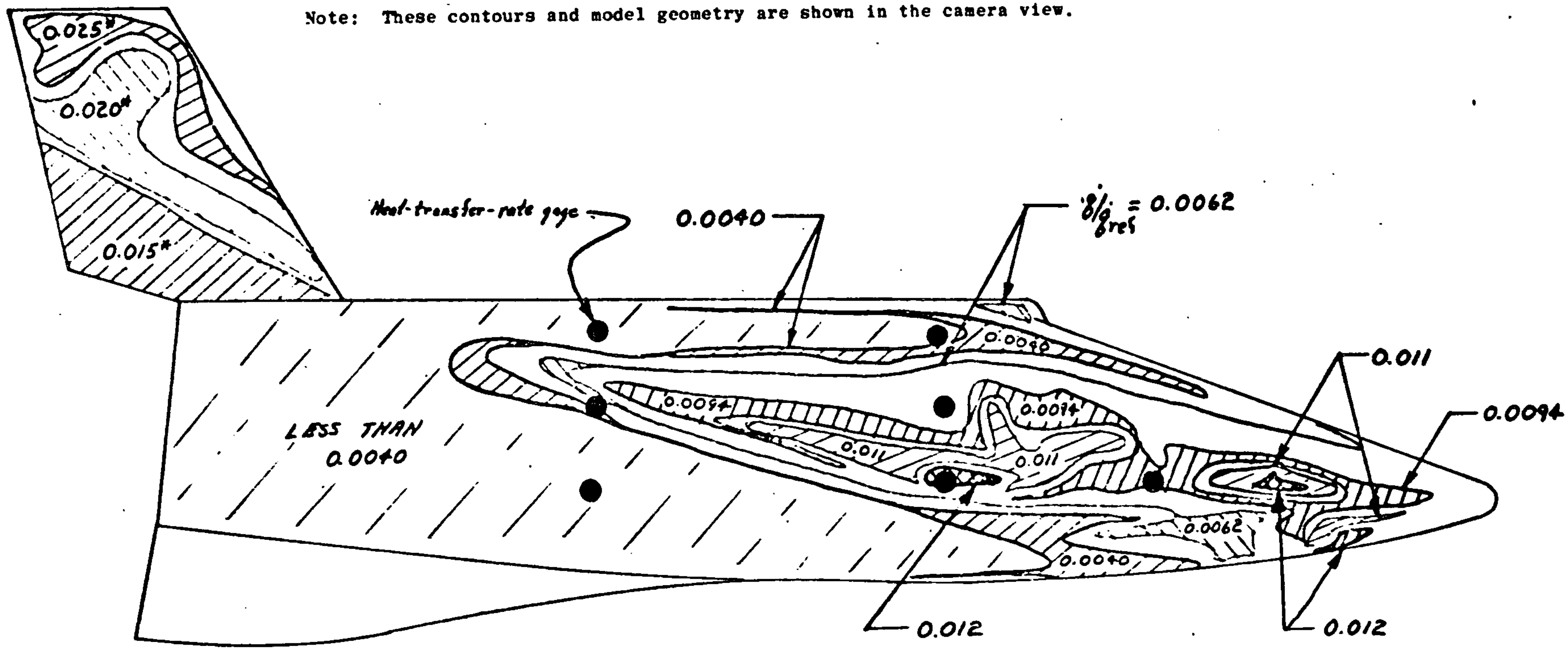
Note: These contours and model geometry are shown in the camera view.



Run 3653

$\alpha = 30$ deg

$M_\infty = 10.4$

$Re_{\infty,\ell} = 8.6 \times 10^6$, $t = 124$ msec

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0012

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

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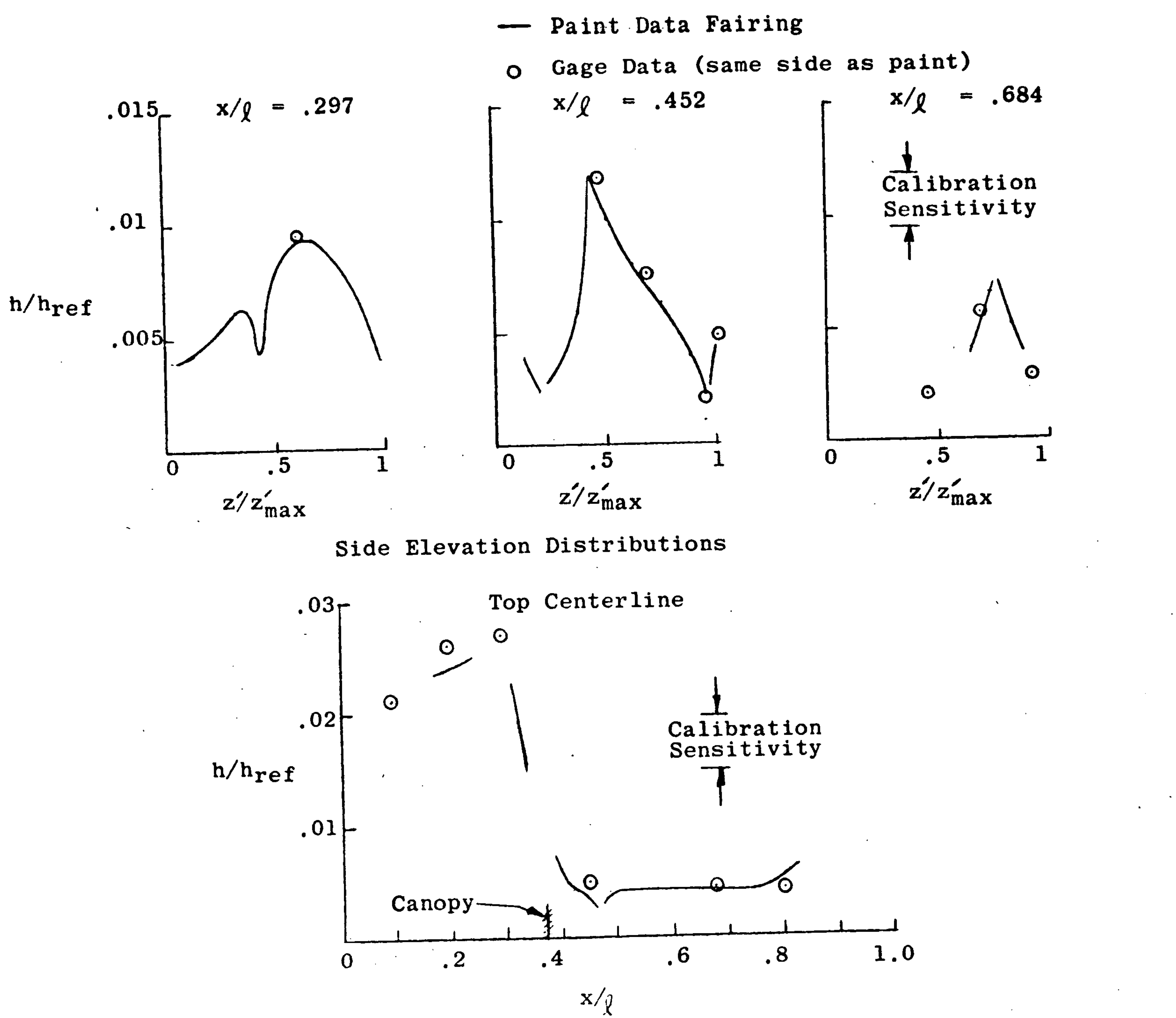
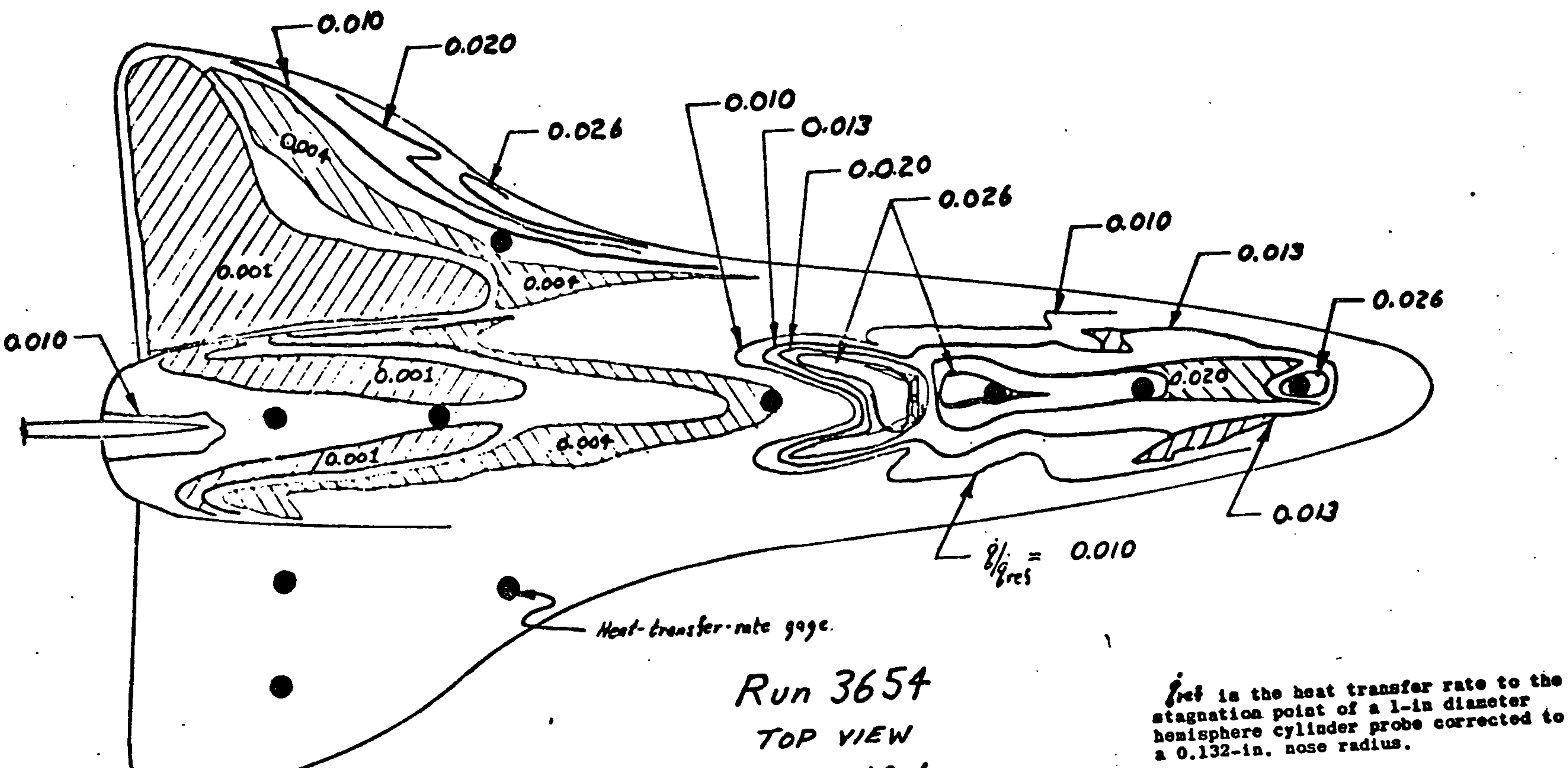
* The Vertical fin was painted with a higher temperature-range phosphor than the fuselage, and a relation between $\dot{q}/\dot{q}_{ref}$ and ΔD was obtained from the lab calibration of the paint and its behavior relative to the calibration of the paint used on the fuselage.



Run 3653, $\alpha = 30$ deg, $Re_{\infty,\ell} = 8.6 \times 10^6$, $M_\infty = 10.4$

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Run 3654
TOP VIEW
$\alpha = 10$ deg
$M_\infty = 10.5$
$Re_{\infty,\ell} = 7.3 \times 10^6$, $t = 133$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0007

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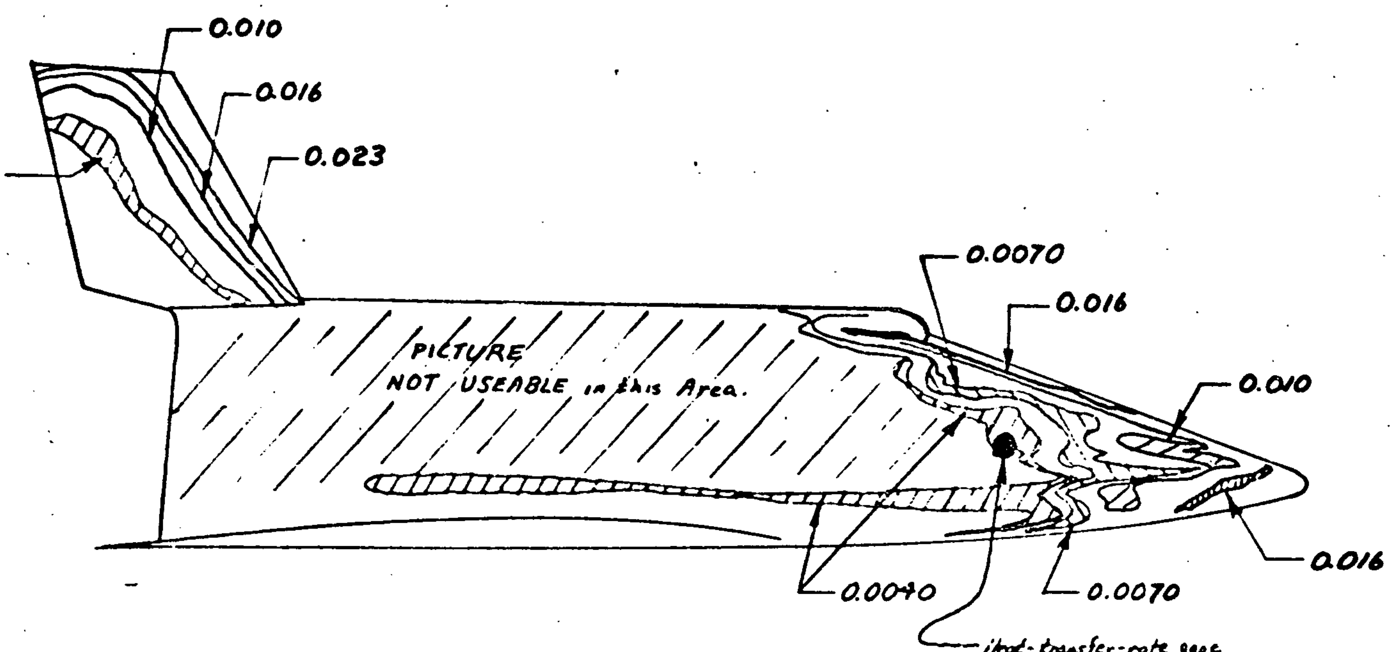
Note: These contours and model geometry are shown in the camera view.



$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

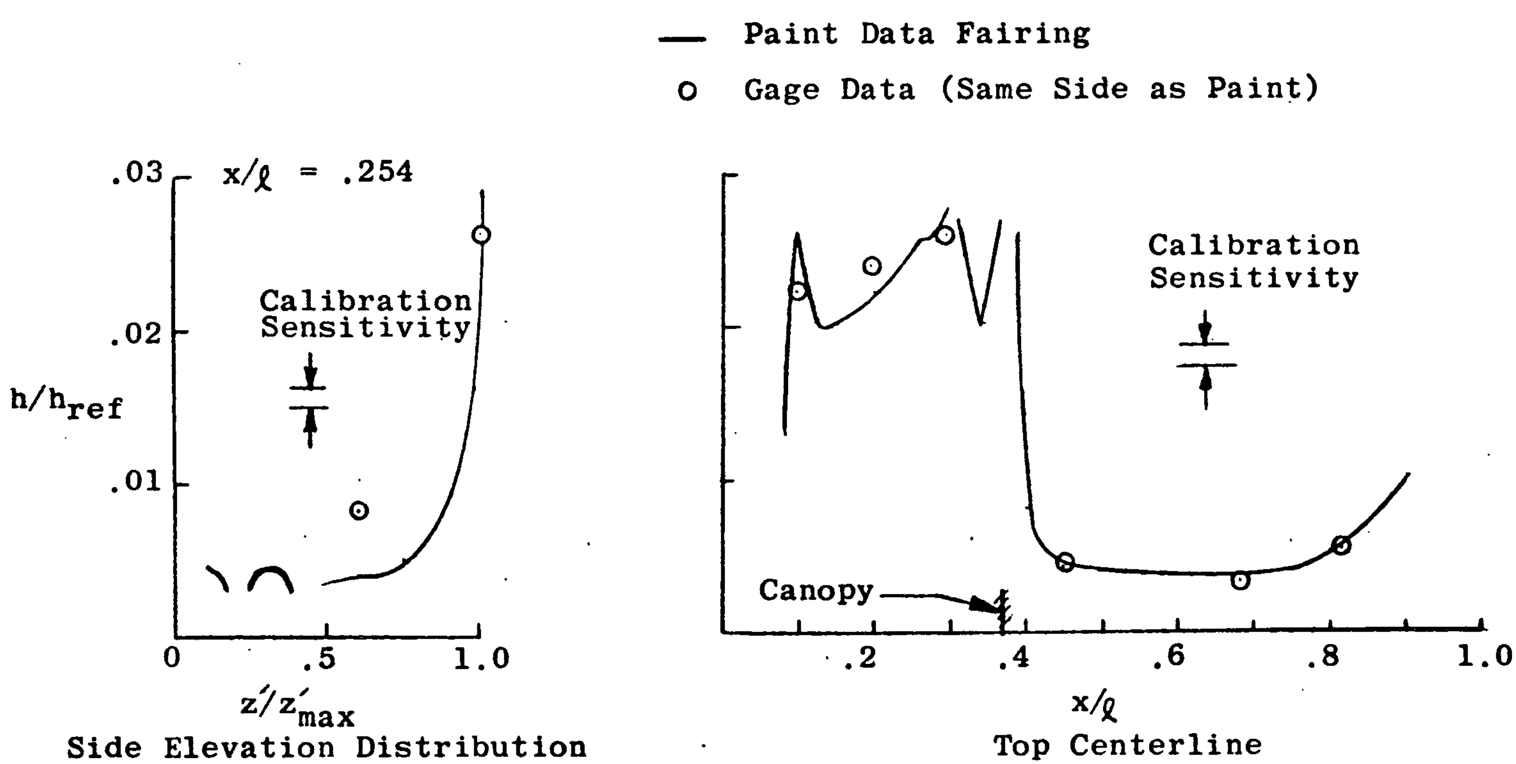
Run 3654

$\alpha = 10°$

$M_\infty = 10.5$

$Re_{\infty,\ell} = 7.3 \times 10^6$, $t = 133$ msec

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0007



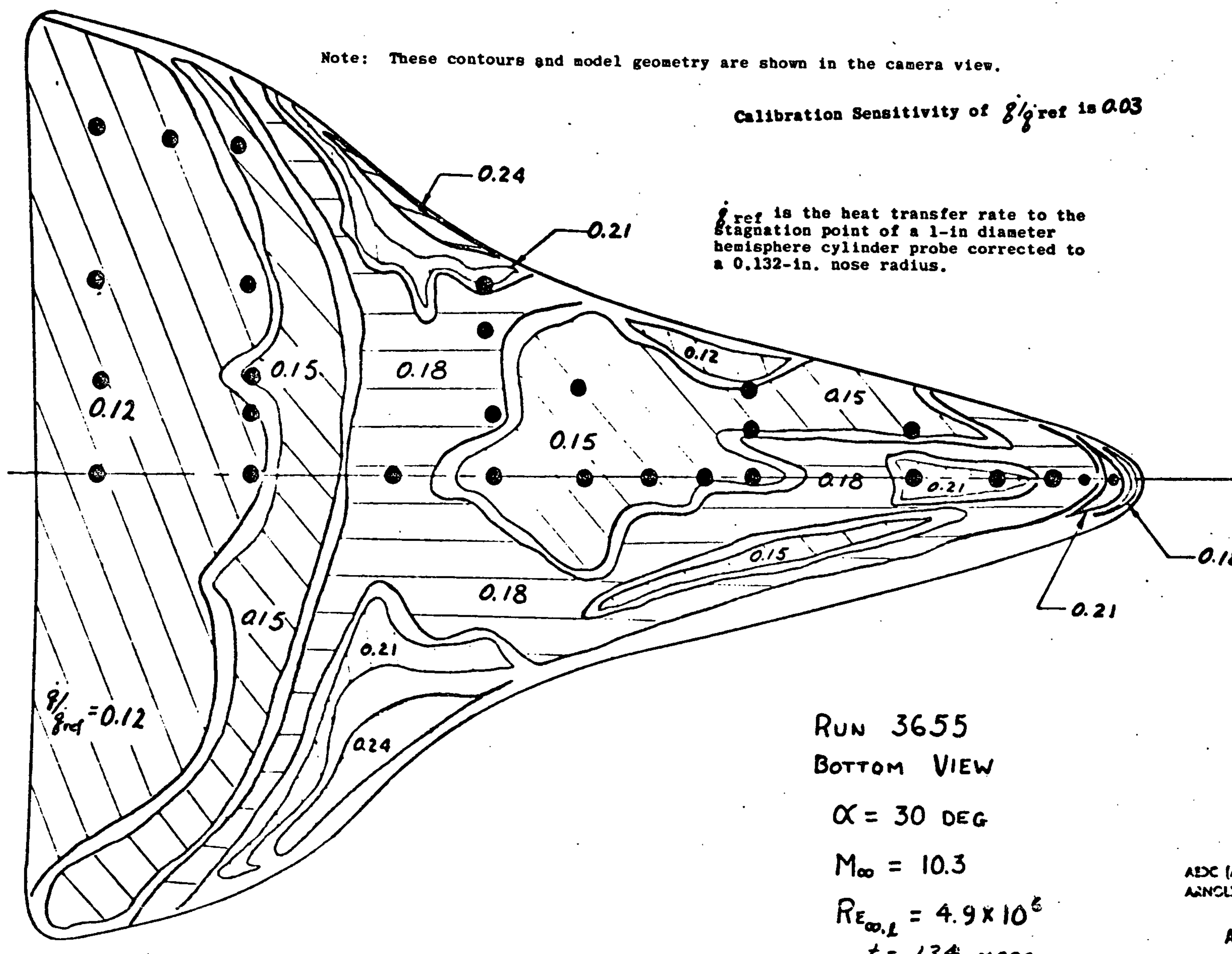
Run 3654, α = 10 deg, $Re_{\infty,\ell}$ = 7.3×10^6, M_∞ = 10.5

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.03

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.



Run 3655
Bottom View
α = 30 deg
M_∞ = 10.3
$Re_{\infty,\ell}$ = 4.9×10^6
t = 134 msec

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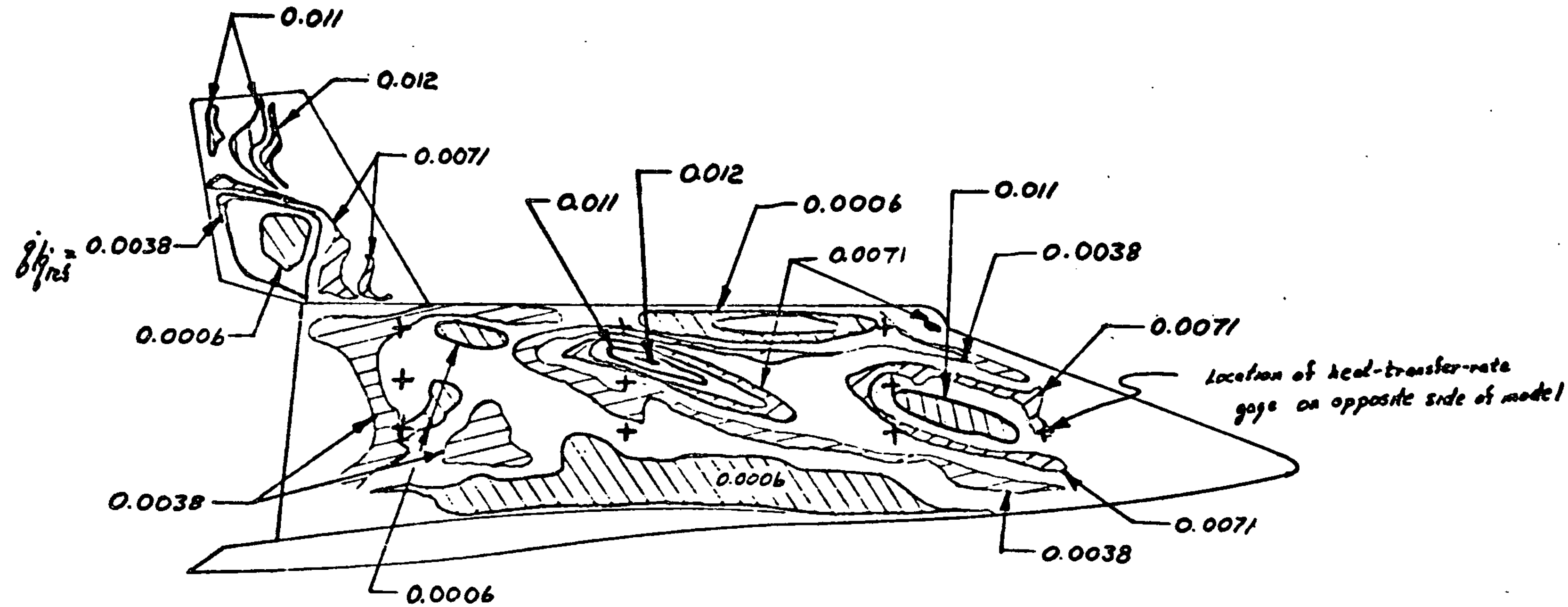
Note: These contours and model geometry are shown in the camera view.



Run 3655

$\alpha = 30$ deg.

$M_\infty = 10.3$

$Re_{\infty,\ell} = 4.9 \times 10^6$, $t = 134$ msec

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

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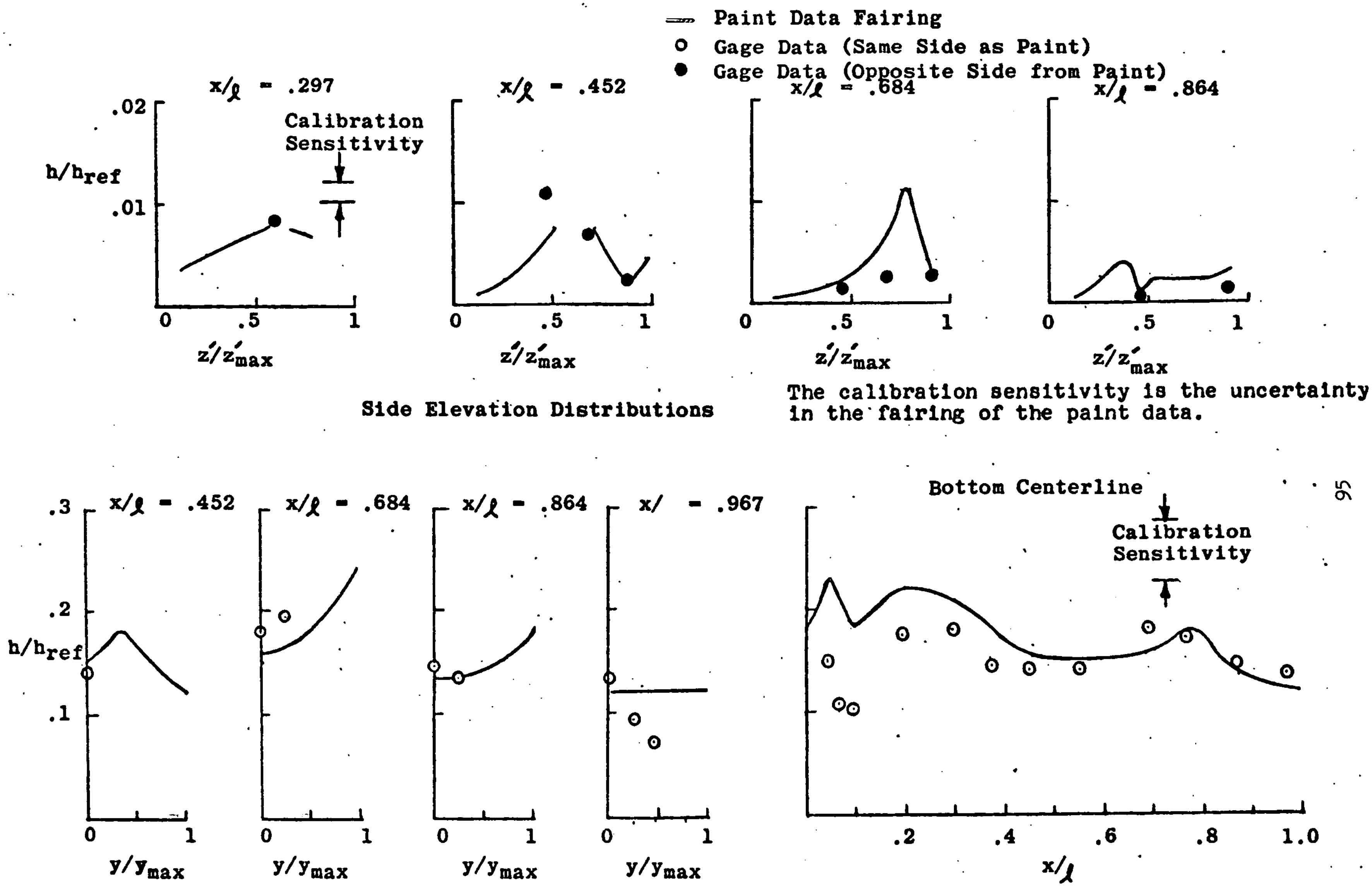
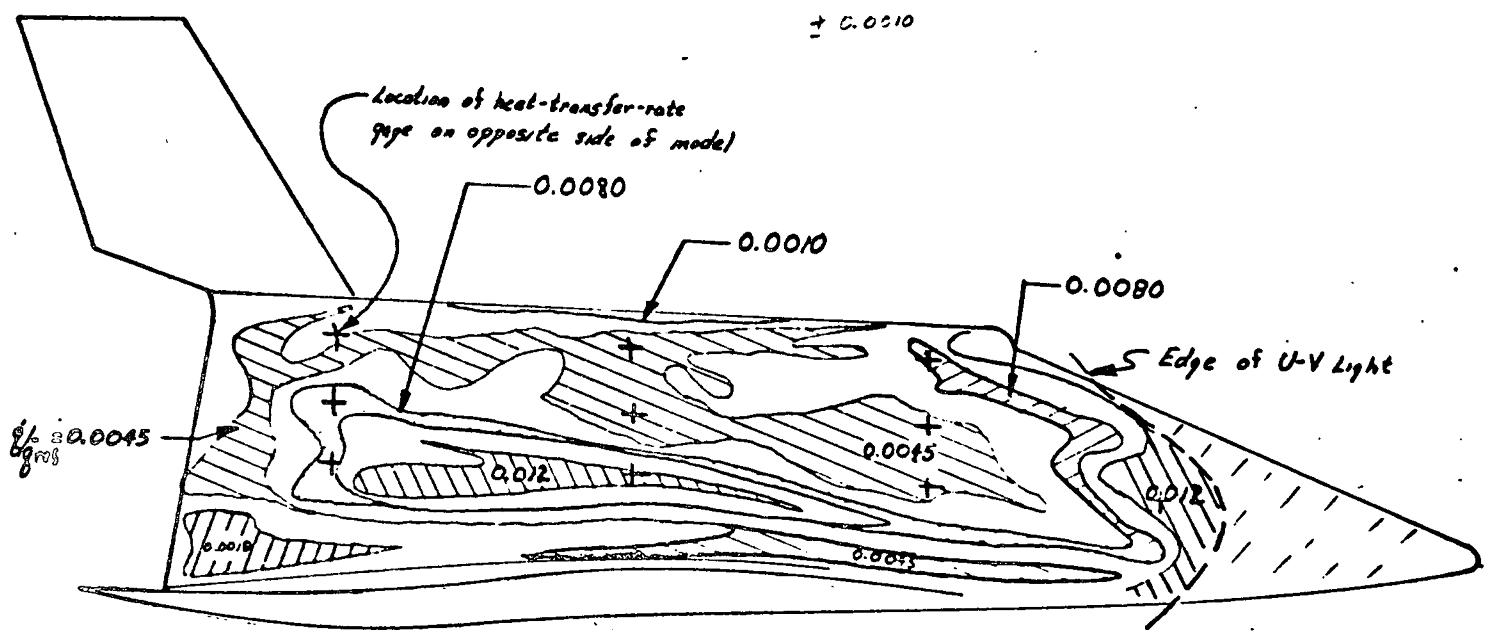


Run 3655, α = 30 deg, $Re_{\infty,\ell} = 4.9 \times 10^6$, $M_\infty = 10.3$

Note: These contours and model geometry are shown in the camera view.



$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

$\dot{q}/\dot{q}_{ref}$ for calibration of paint contours was read at t = 70 msec since gage data were not available at time picture was taken.

Run 3656

$\alpha = 10\ deg$

$M_\infty = 10.2$

$Re_{\infty,\ell} = 10.2 \times 10^6$, $t = 133$ msec

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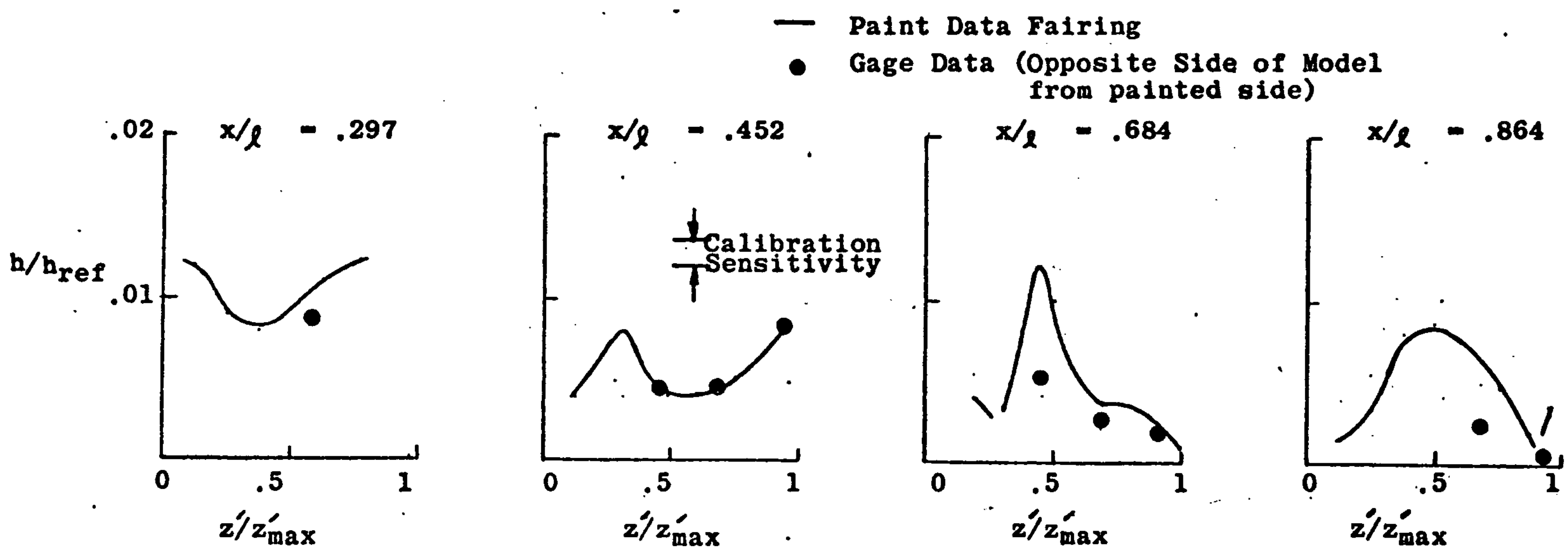
Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0008

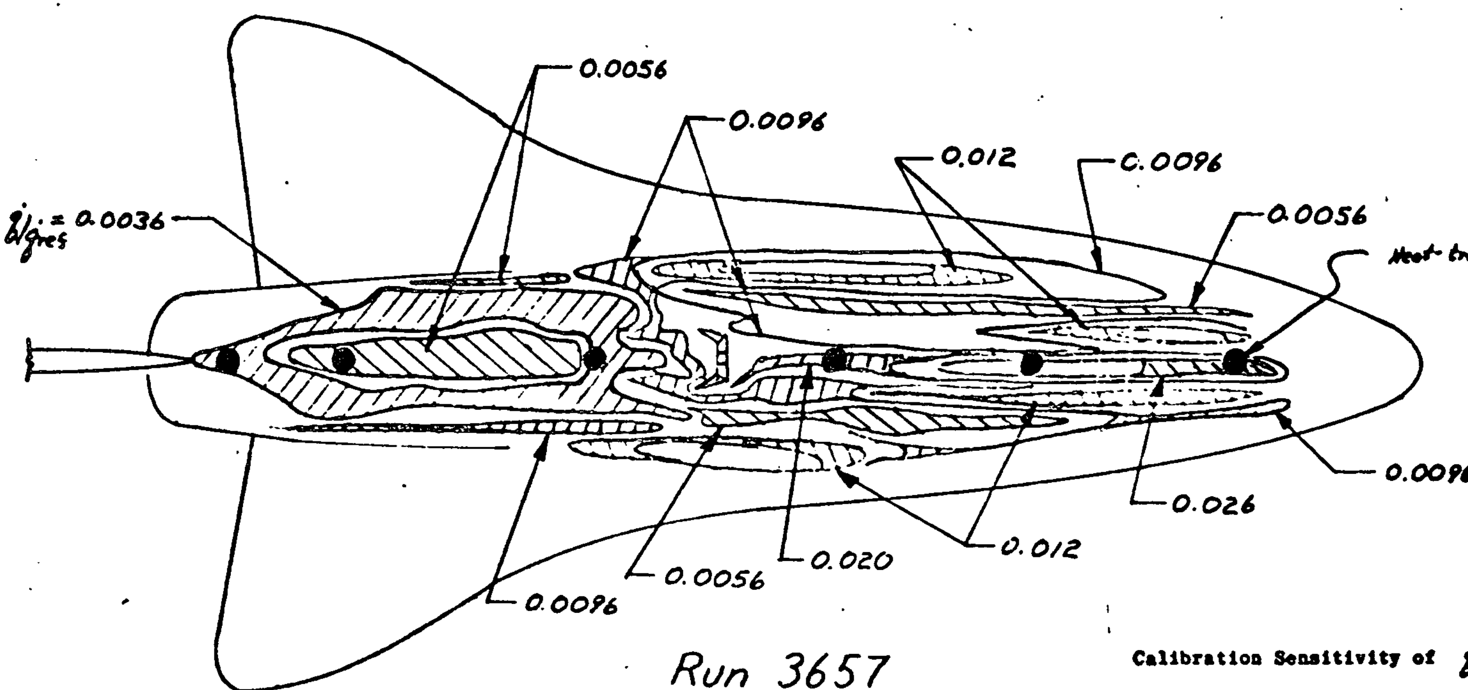


Side Elevation Distributions

Run 3656, α = 10 deg, $Re_{\infty,\ell}$ = 10.2×10^6, M_∞ = 10.2

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

Run 3657
TOP VIEW
$\alpha = 40$ deg
$M_\infty = 10.4$
$Re_{\infty,\ell} = 9.4 \times 10^6$, $t = 118$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

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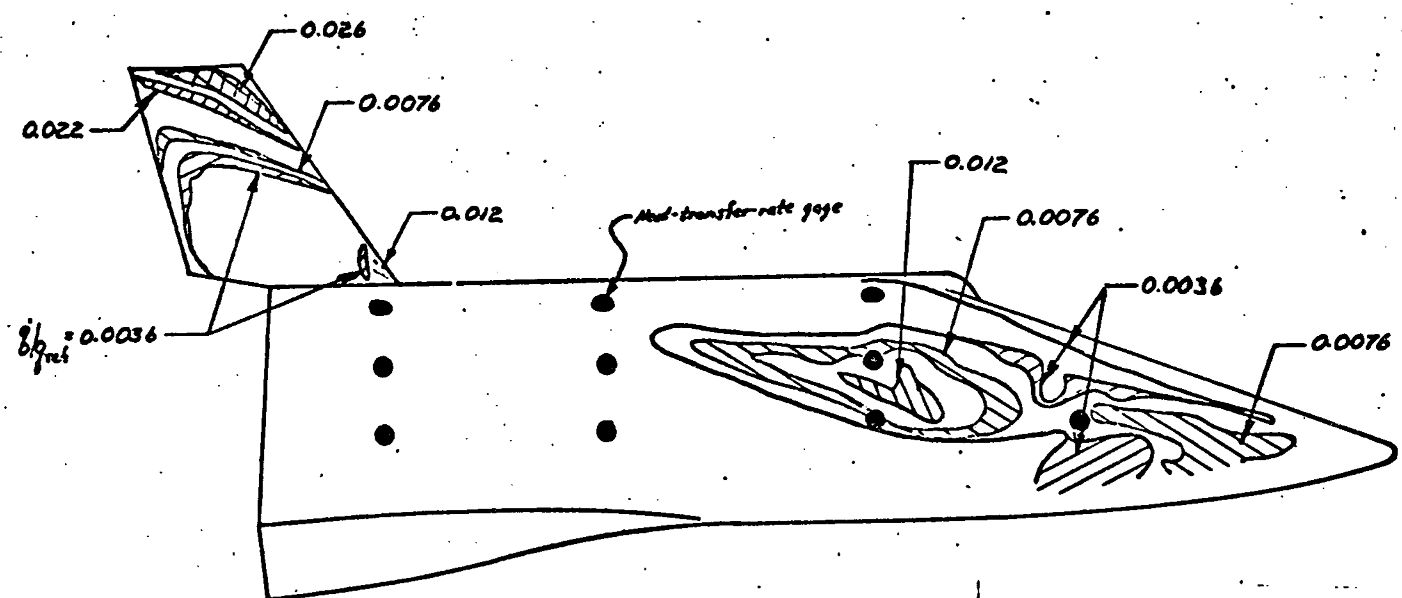
Note: These contours and model geometry are shown in the camera view.



Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Run 3657

$\alpha = 40$ deg

$M_\infty = 10.4$

$Re_{\infty,\ell} = 9.4 \times 10^6$, t = 118 msec

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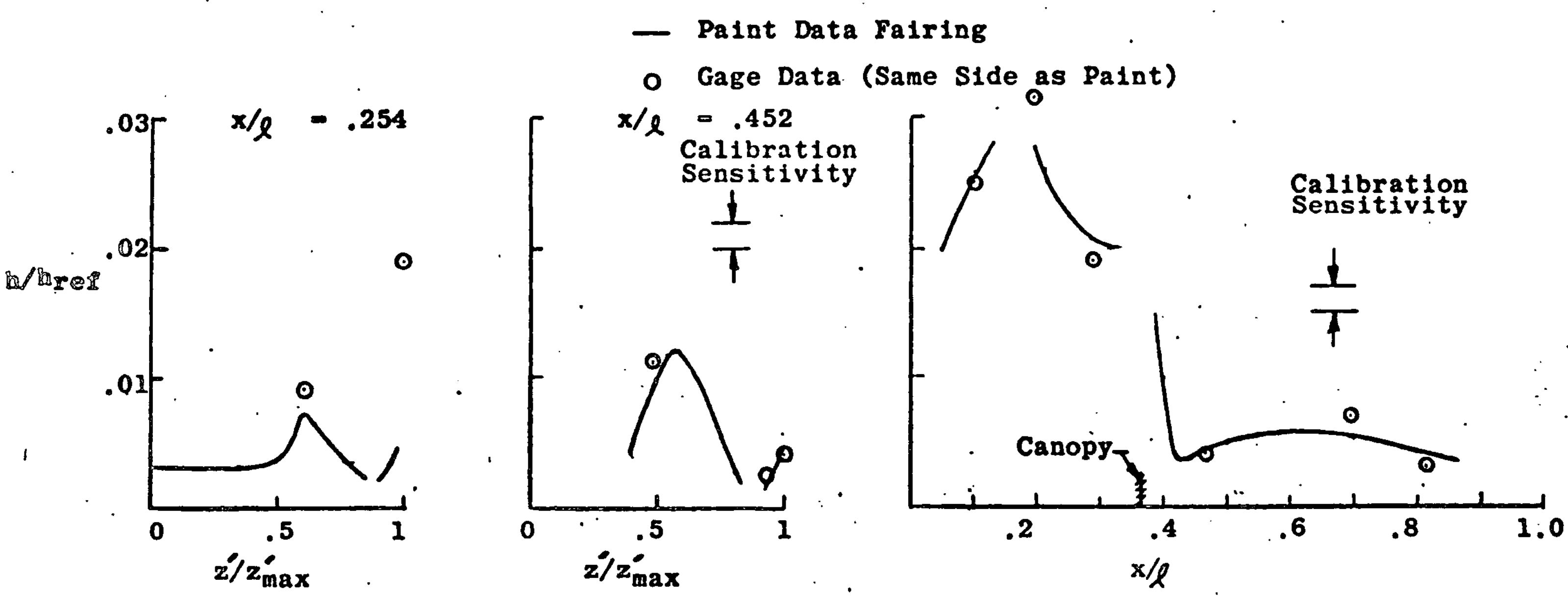


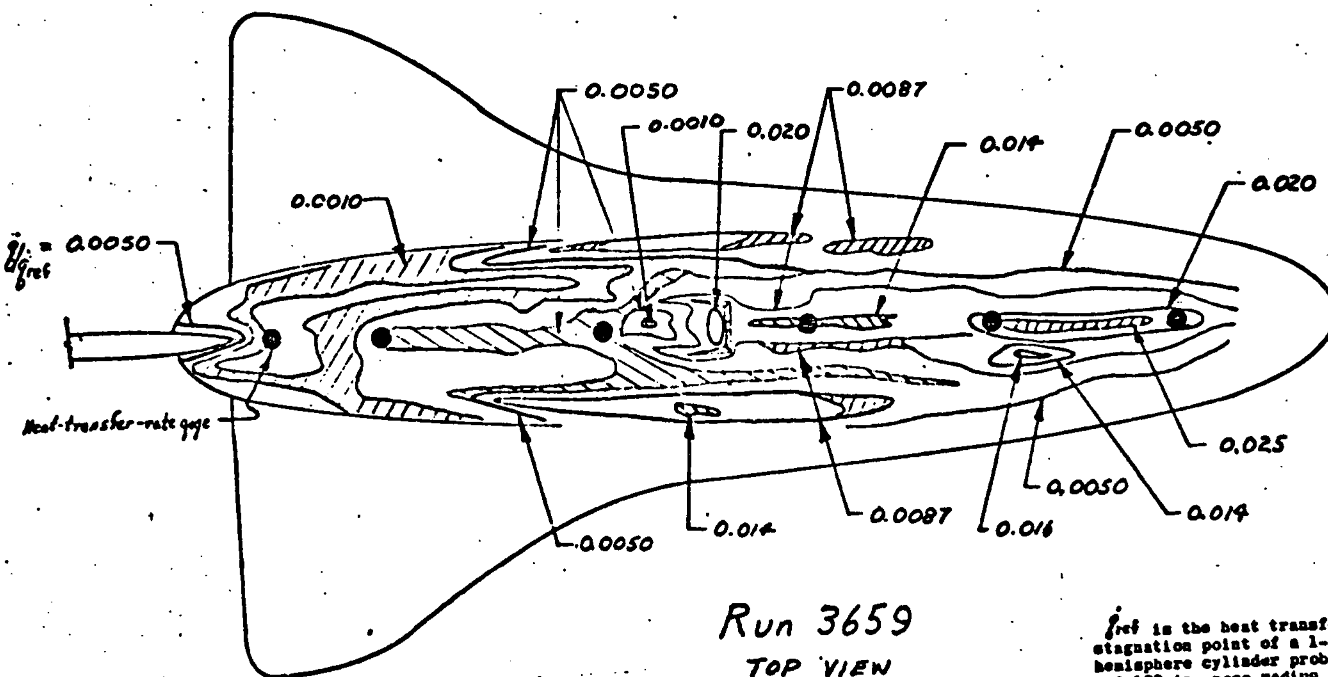
Side Elevation Distributions

Top Centerline

Run 3657, α = 40 deg, $Re_{\infty,\ell}$ = 9.4×10^6, M_∞ = 10.4

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Run 3659

TOP VIEW

$\alpha = 50$ deg

$M_\infty = 10.5$

$Re_{\infty,\ell} = 7.4 \times 10^6$, $t = 135$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

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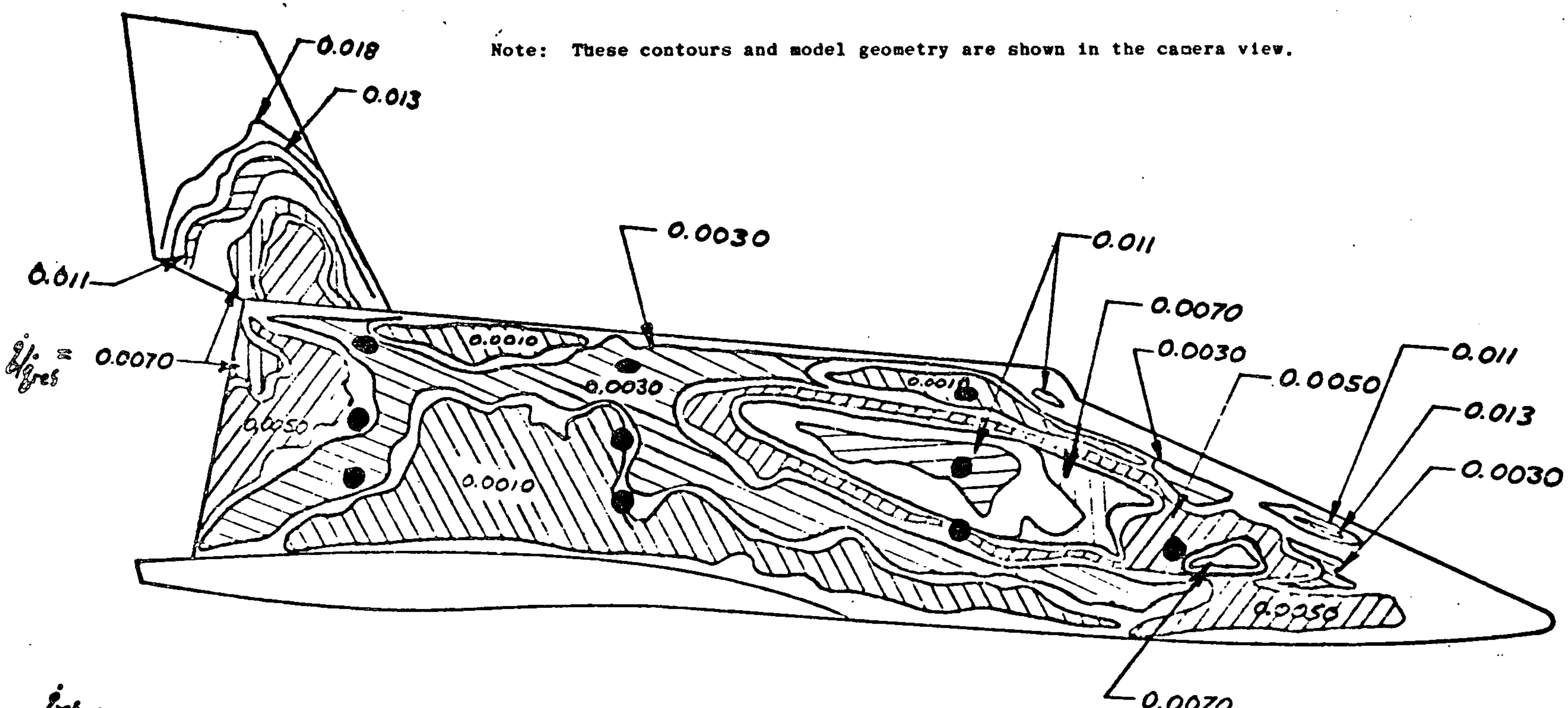
Note: These contours and model geometry are shown in the camera view.



$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

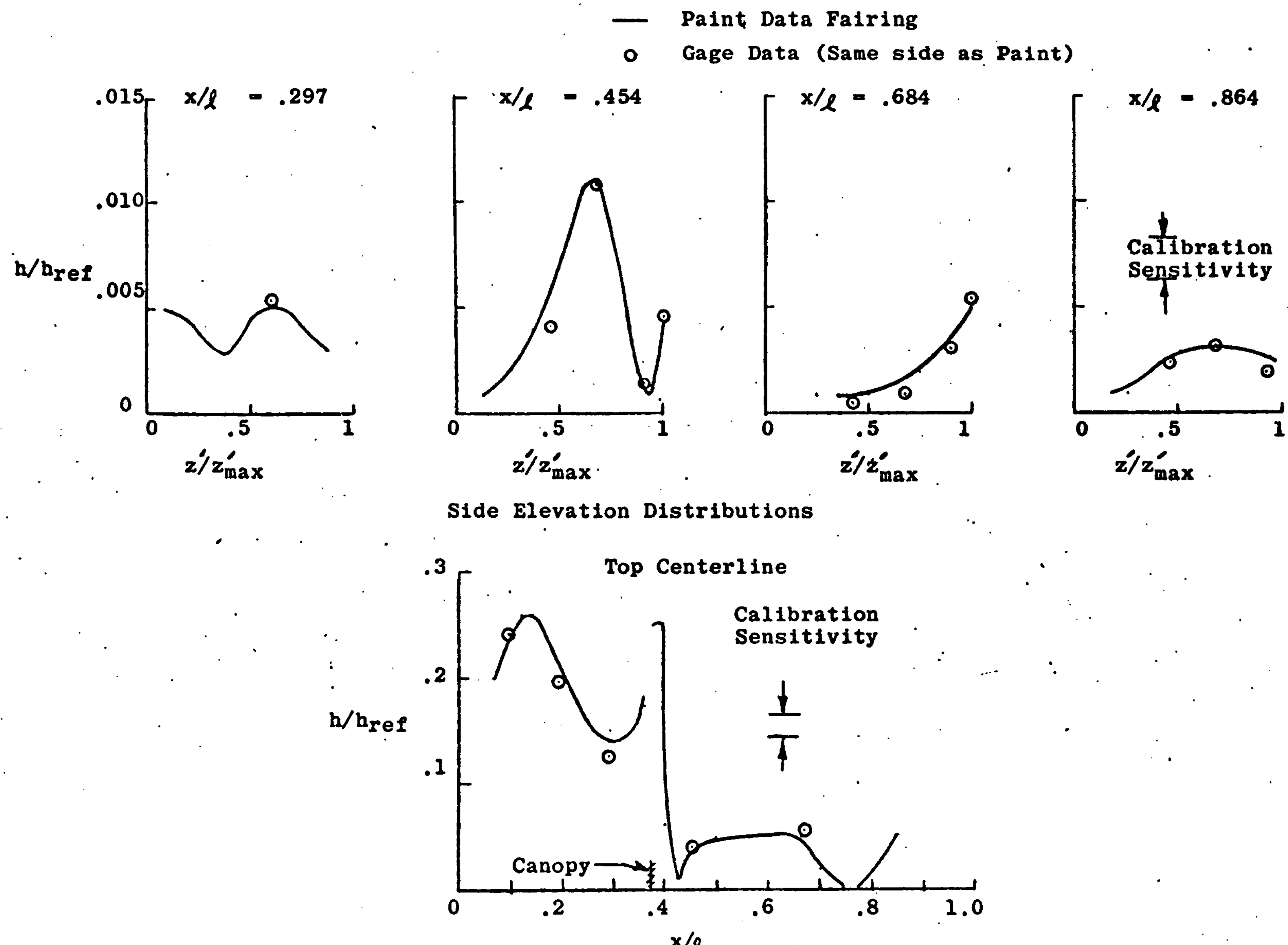
Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

Run 3659

$\alpha = 50$ deg.

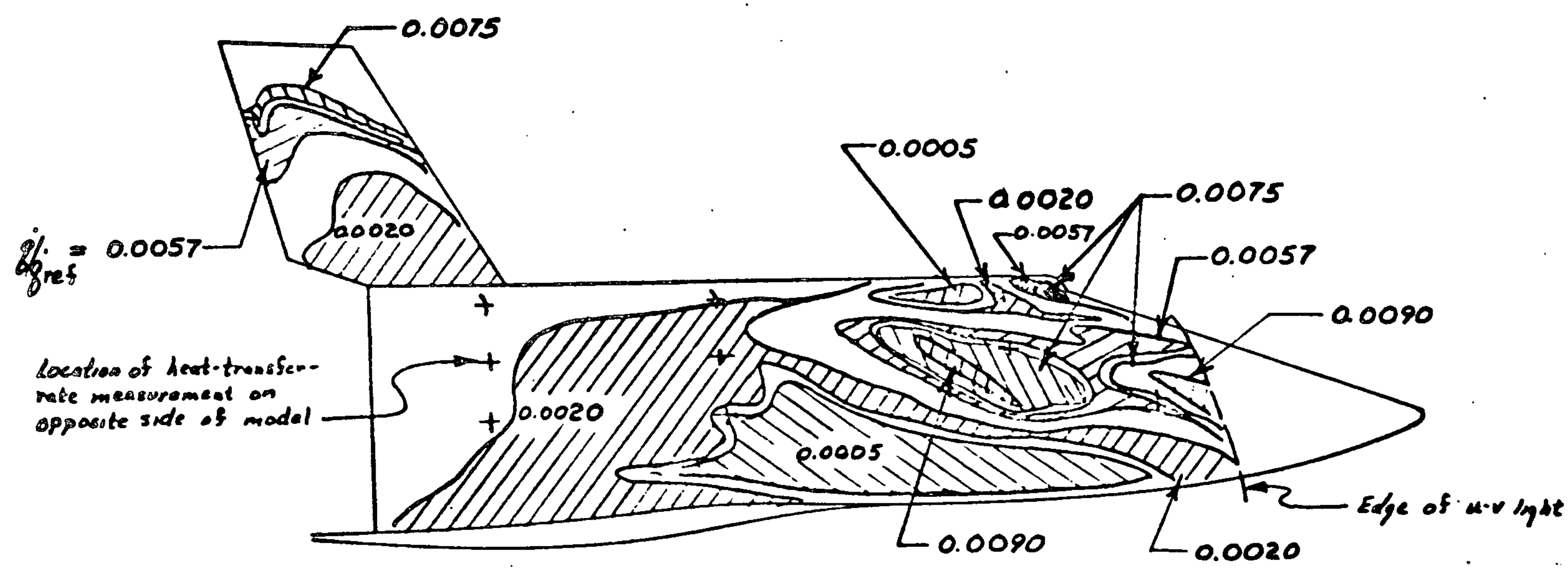
$M_\infty = 10.5$

$Re_{\infty,\ell} = 7.4 \times 10^6$, $t = 135$ msec



Run 3659, α = 50 deg, $Re_{\infty,\ell}$ = 7.4x10^6, M_{∞} = 10.5
The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



Run 3660

$\alpha = 45$ deg

$M_\infty = 11.9$

$Re_{\infty,\ell} = 7.6 \times 10^6$

$t = 129$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.001

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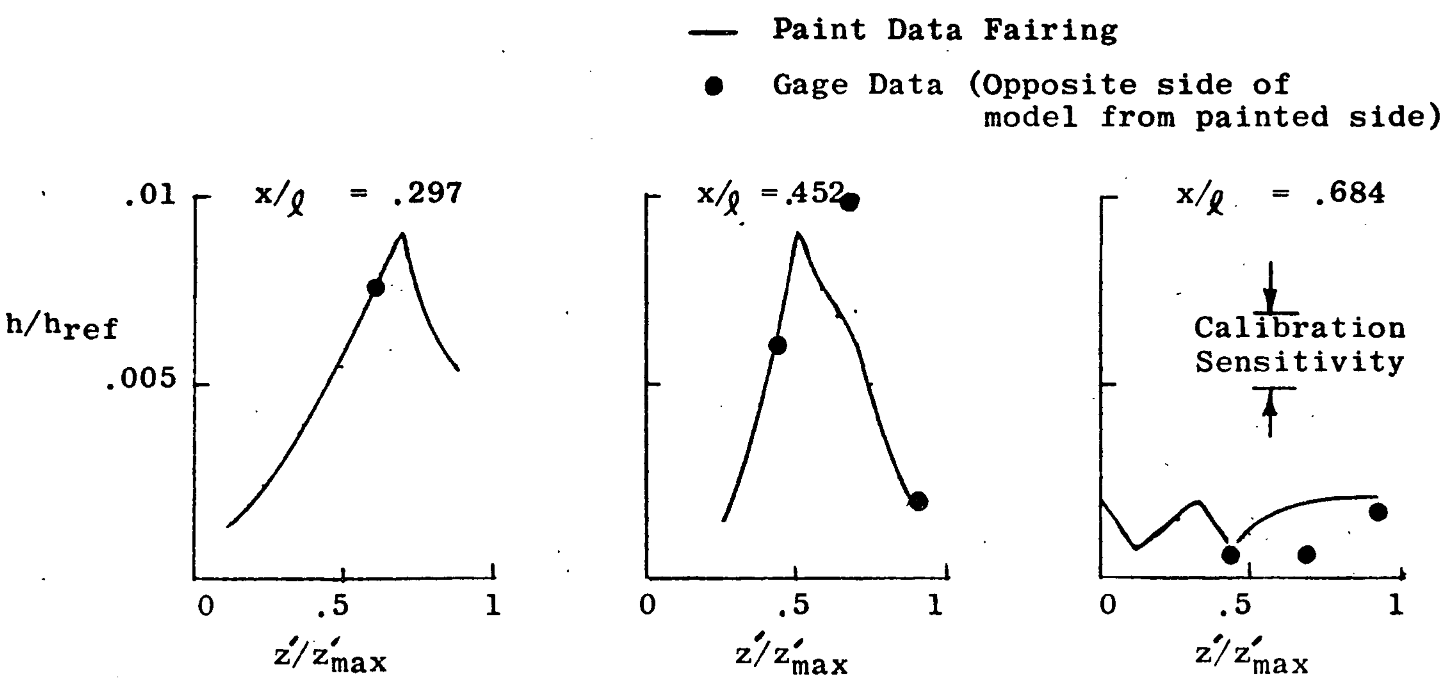
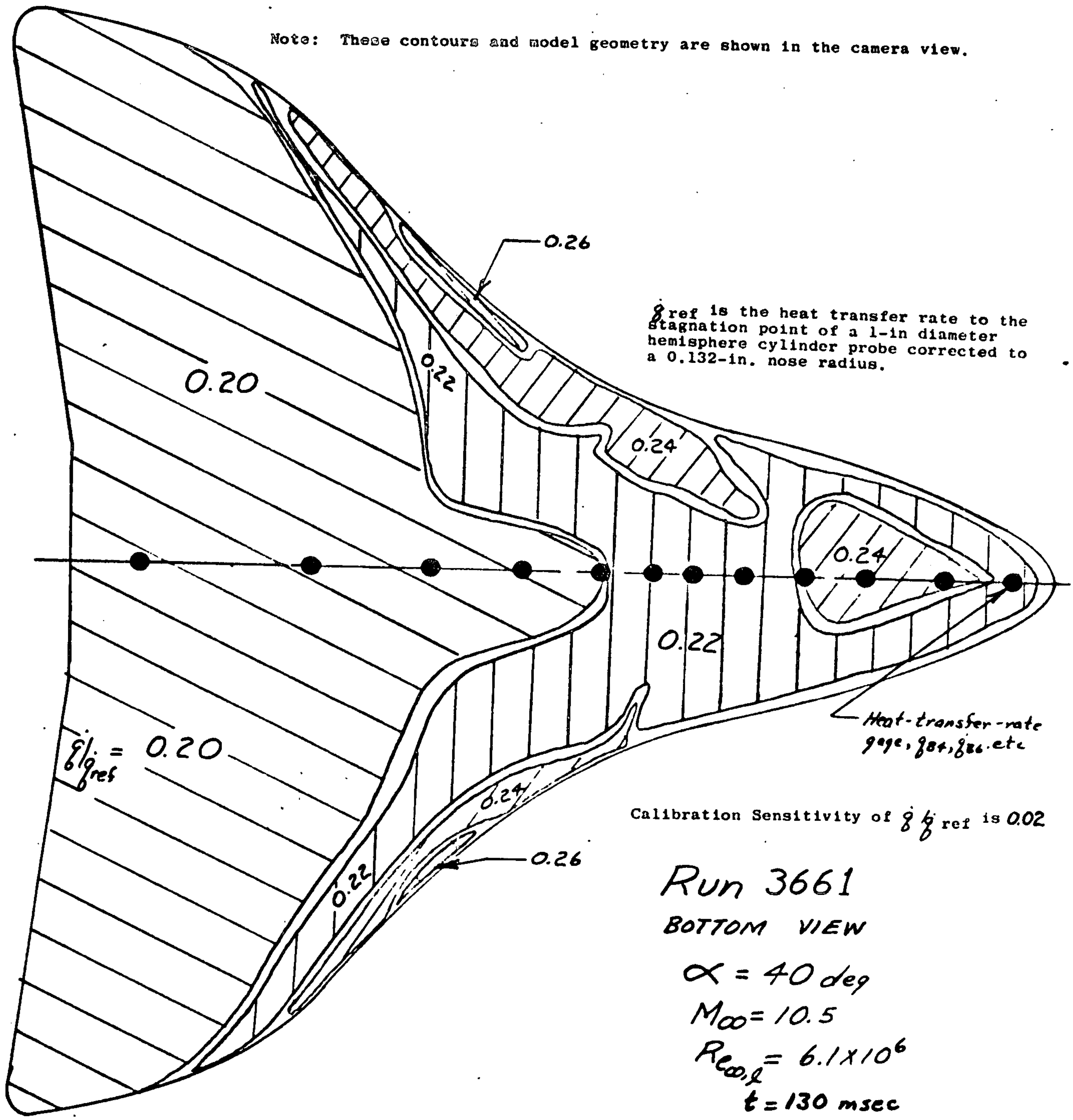


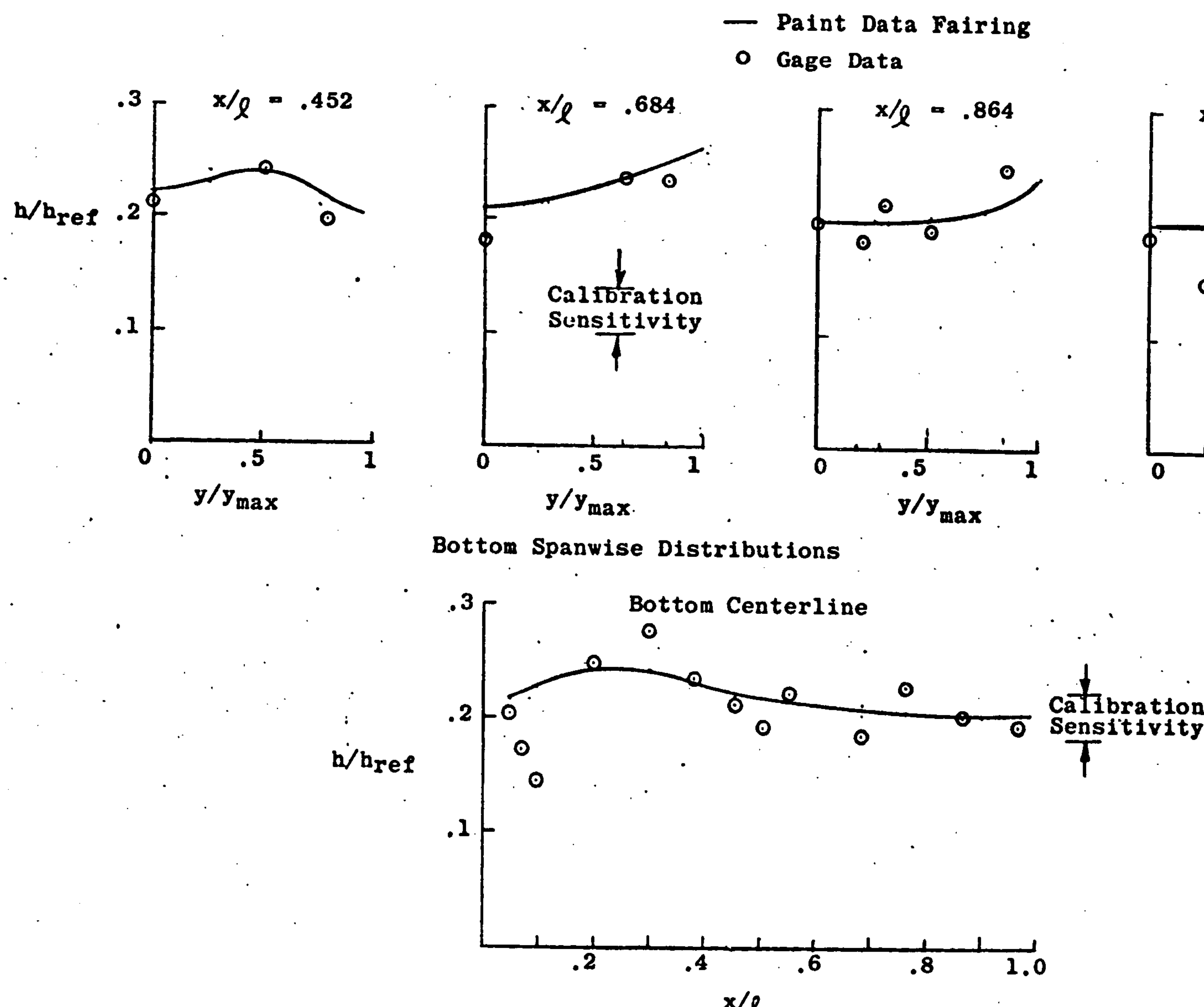
Side Elevation Distributions

Run 3660, α = 45 deg, $Re_{\infty,\ell} = 7.6 \times 10^6$, $M_\infty = 11.9$

The calibration sensitivity is the uncertainty in the fairing of the paint data.


Note: These contours and model geometry are shown in the camera view.
0.26
$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.
0.20
0.22
0.24
0.24
0.22
$\dot{q}/\dot{q}_{ref}$ = 0.20
Heat-transfer-rate gage, $\dot{q}_{84}$, $\dot{q}_{86}$, etc.
0.24
Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.02
0.26
0.22
Run 3661
BOTTOM VIEW
α = 40 deg
M_∞ = 10.5
$Re_{\infty,\ell}$ = 6.1X10^6
t = 130 msec

C.3

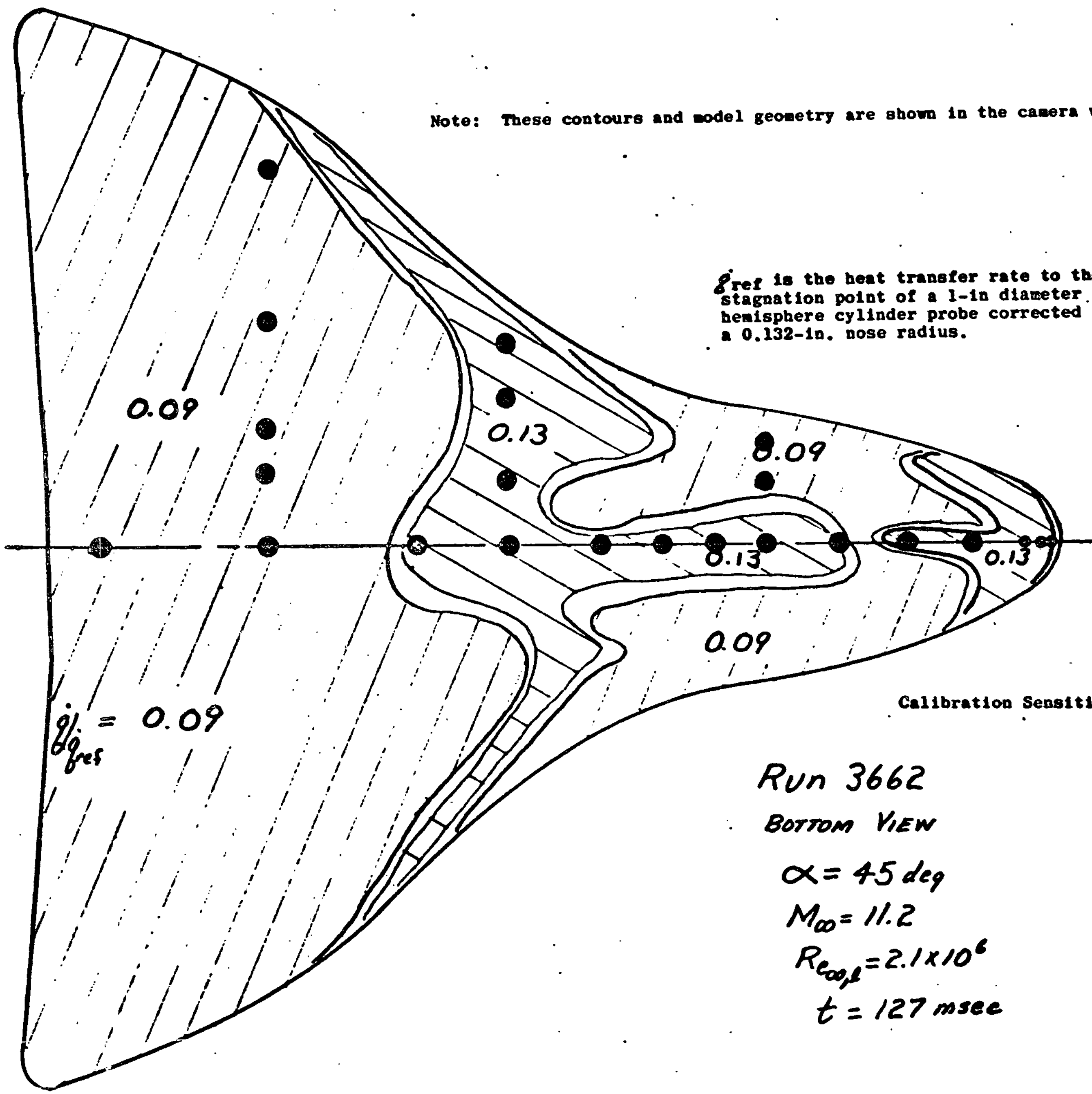


Run 3661, $\alpha = 40$ deg, $Re_{\infty,\ell} = 6.1 \times 10^6$, $M_\infty = 10.5$

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.



Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.02

Run 3662

BOTTOM VIEW

$\alpha = 45$ deg

$M_\infty = 11.2$

$Re_{\infty,\ell} = 2.1 \times 10^6$

$t = 127$ msec

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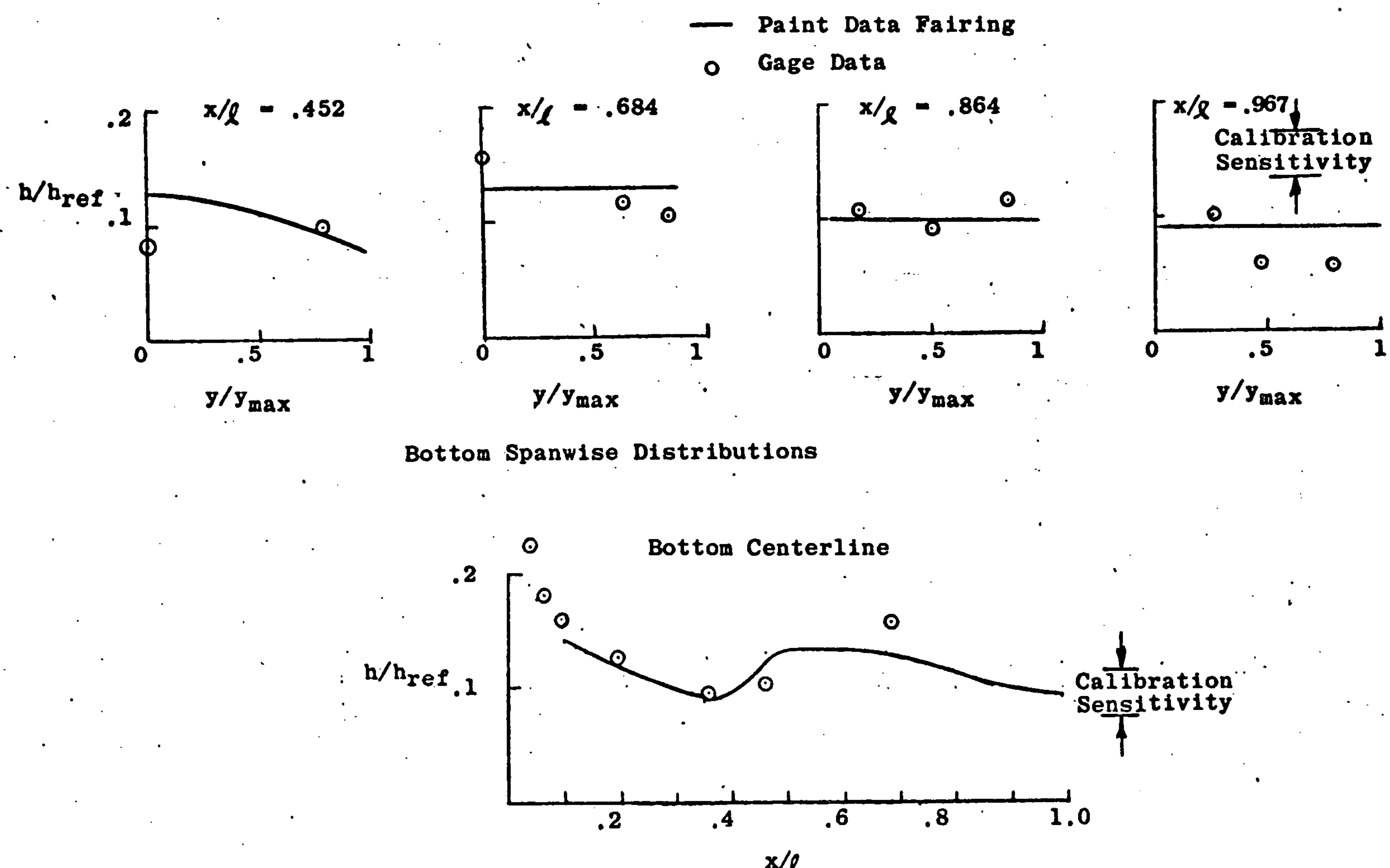
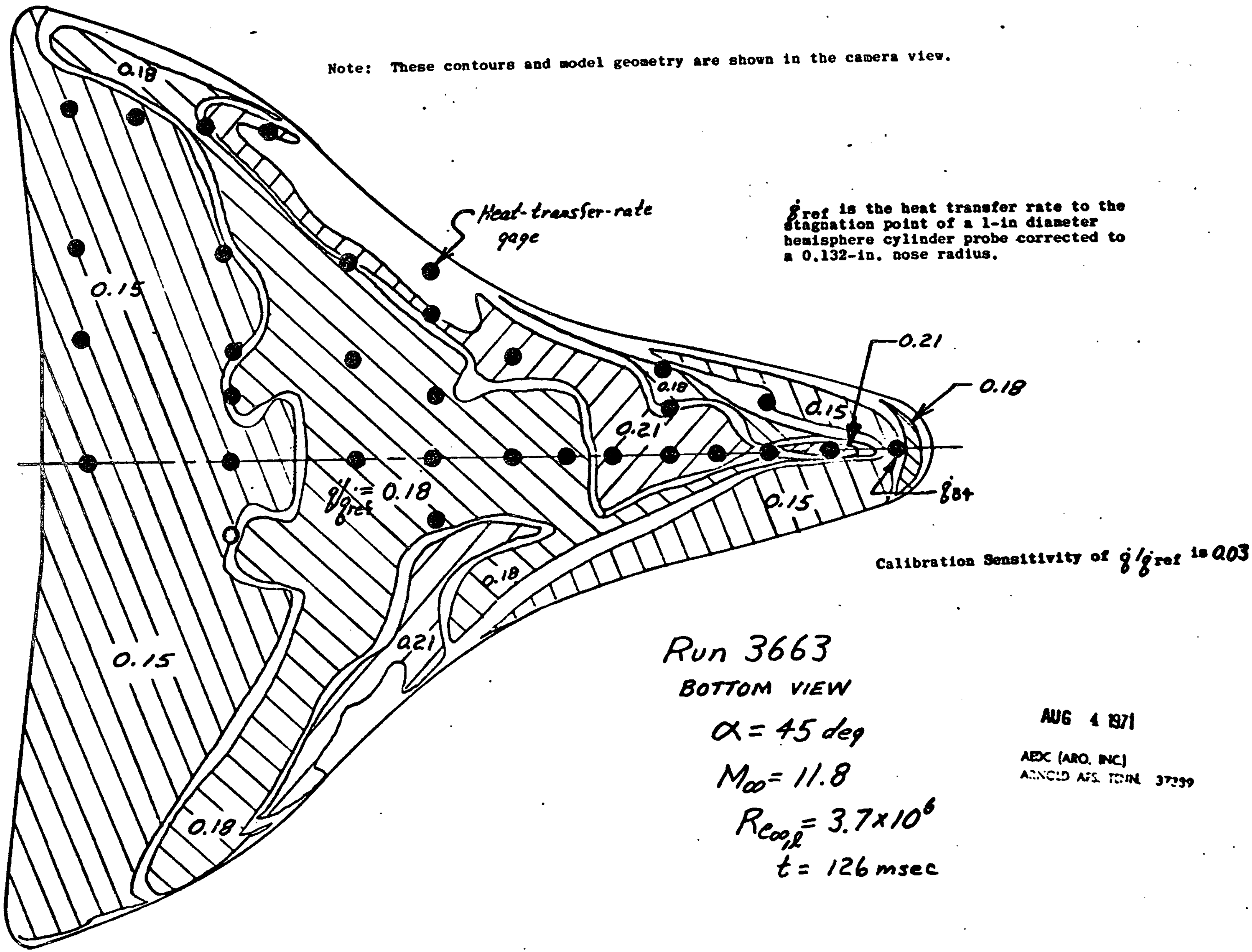


Run 3662, α = 45 deg, $Re_{\infty,\ell}$ = 2.1×10^6, M_∞ = 11.2

The calibration sensitivity is the uncertainty in the fairing of the paint data.


Note: These contours and model geometry are shown in the camera view.
$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.
Heat-transfer-rate gage
0.18
0.15
0.15
$\dot{q}/\dot{q}_{ref} = 0.18$
0.21
0.18
0.21
0.18
0.15
0.21
0.18
0.15
0.15
0.18
$\dot{q}_{84}$
Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.03
Run 3663
BOTTOM VIEW
$\alpha = 45$ deg
$M_\infty = 11.8$
$Re_{\infty,\ell} = 3.7 \times 10^6$
$t = 126$ msec
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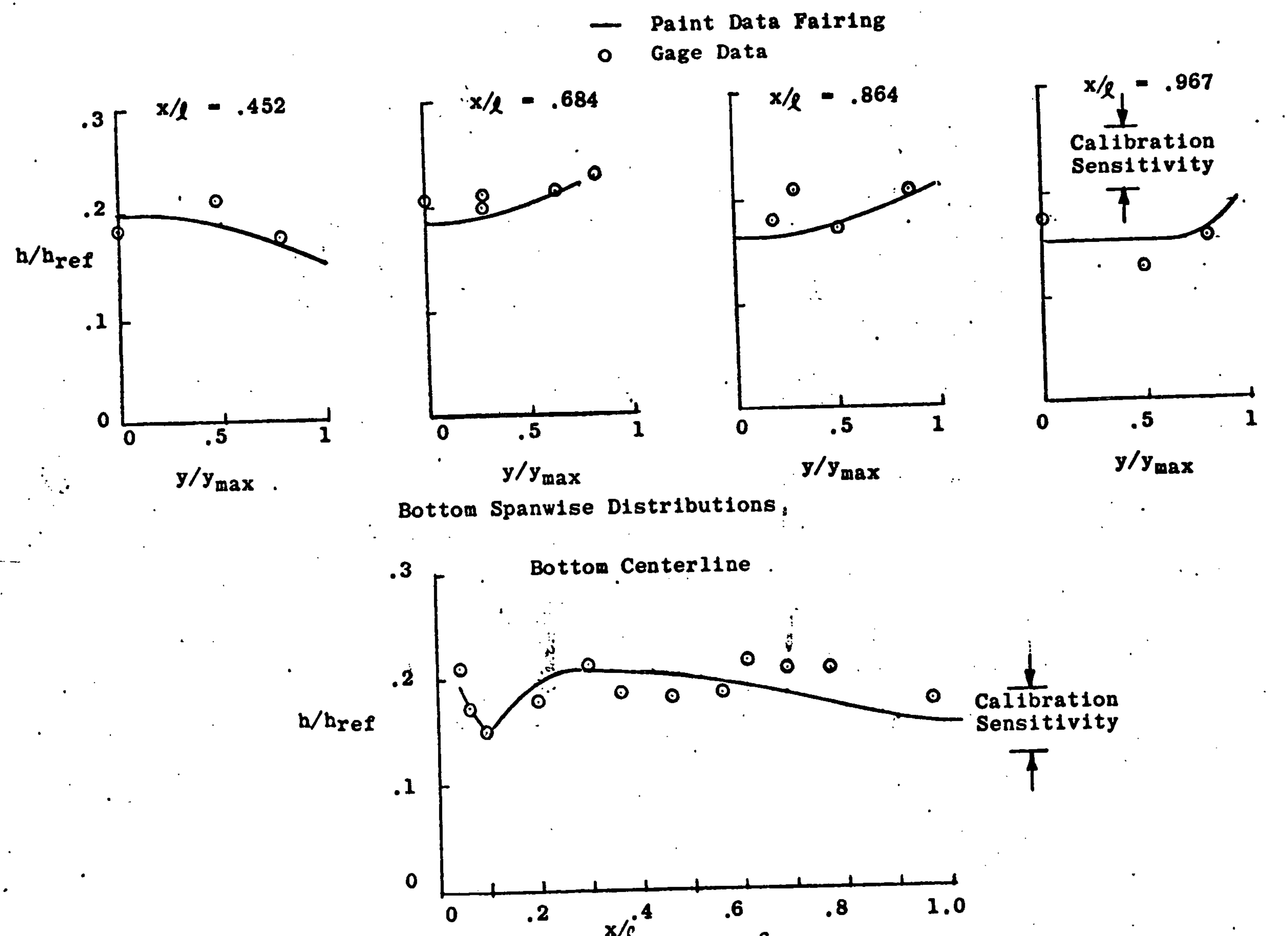
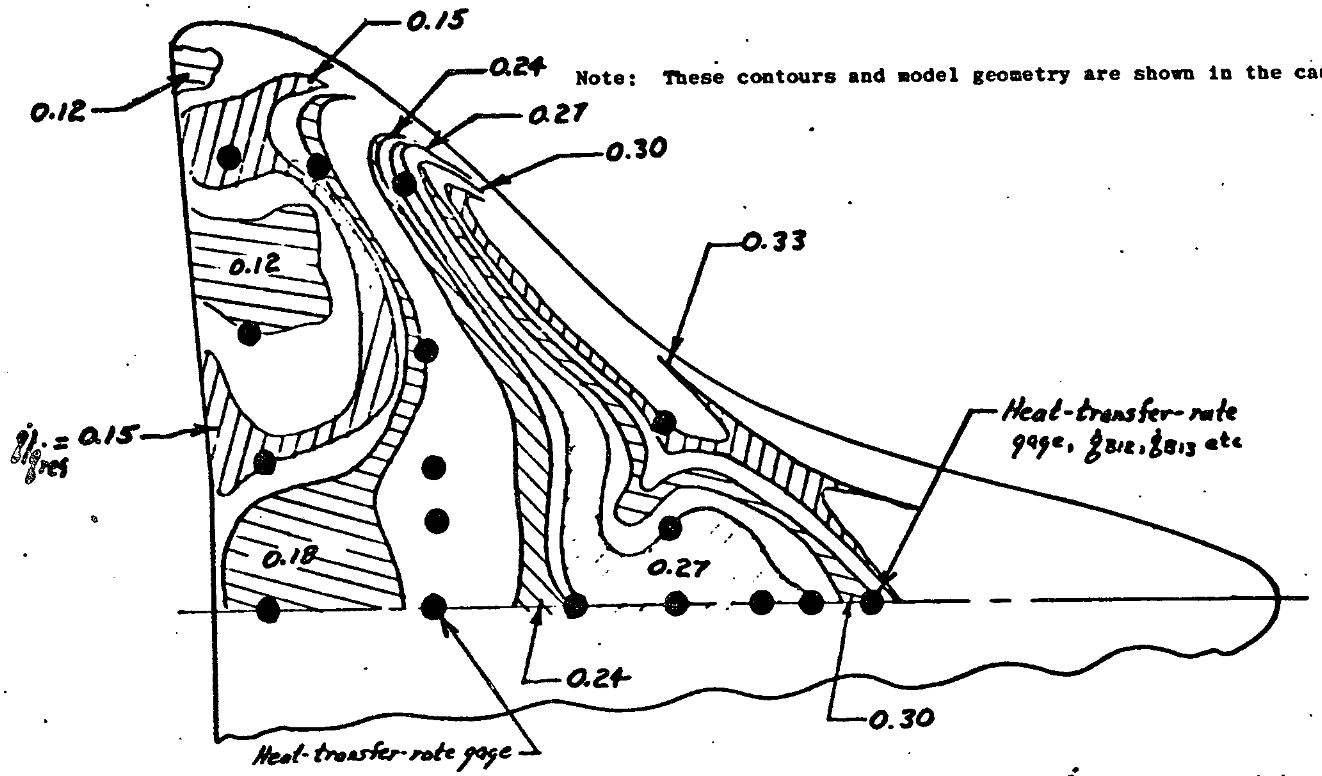


Run 3663, α = 45 deg, $Re_{\infty,\ell}$ = 3.7×10^6, M_∞ = 11.8

The calibration sensitivity is the uncertainty in the fairing of the paint data.



Note: These contours and model geometry are shown in the camera view.

Run 3664

BOTTOM VIEW

$\alpha = 50$ deg

$M_{\infty} = 10.4$

$Re_{\infty,\ell} = 5.0 \times 10^6$

$t = 132$ msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.03

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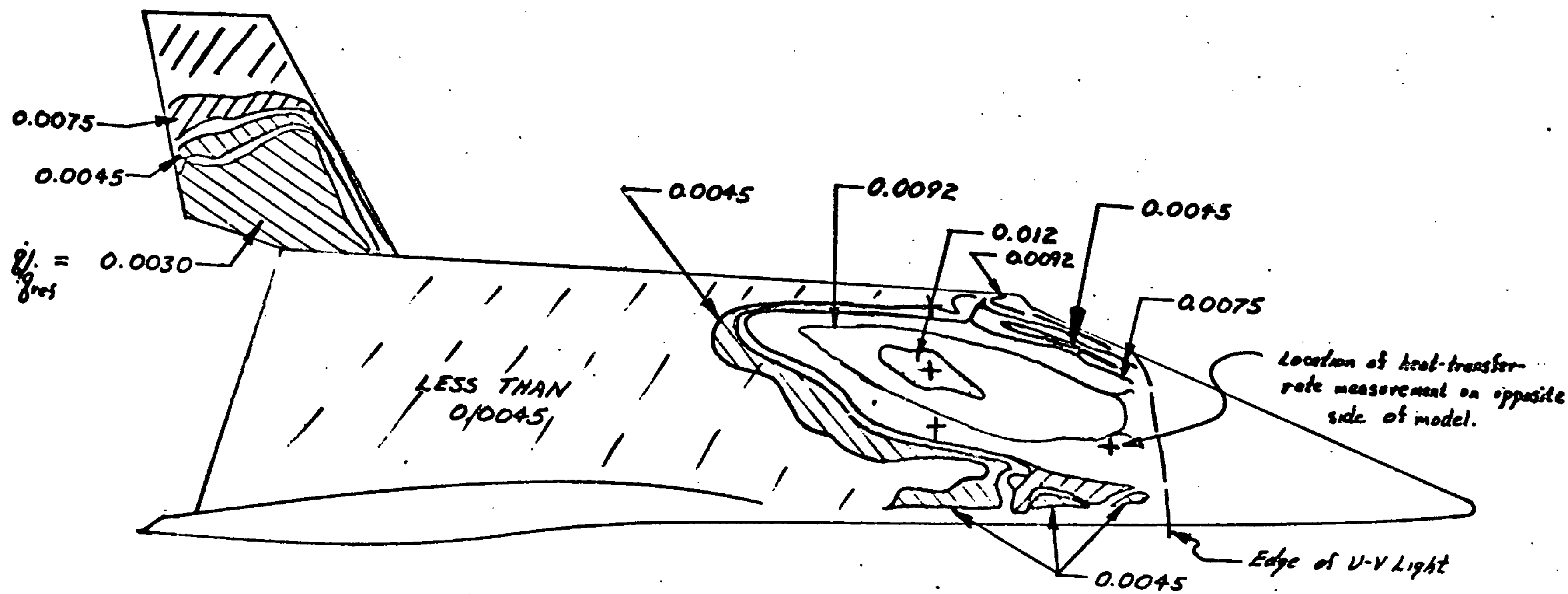
Note: These contours and model geometry are shown in the camera view.



$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0008

Run 3664

$\alpha = 50$ deg

$M_\infty = 10.4$

$Re_{\infty,\ell} = 5.0 \times 10^6$, $t = 132$ msec

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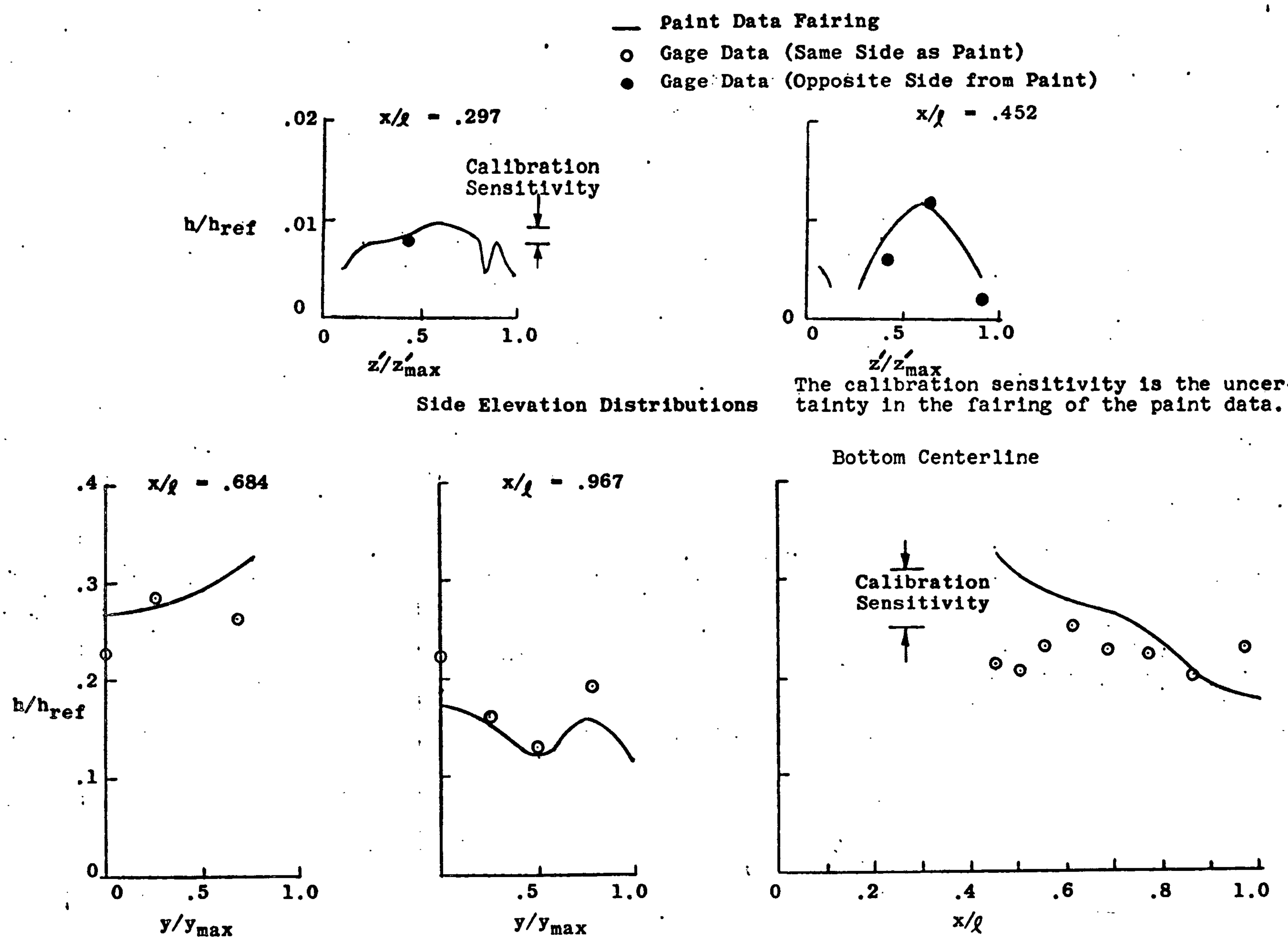


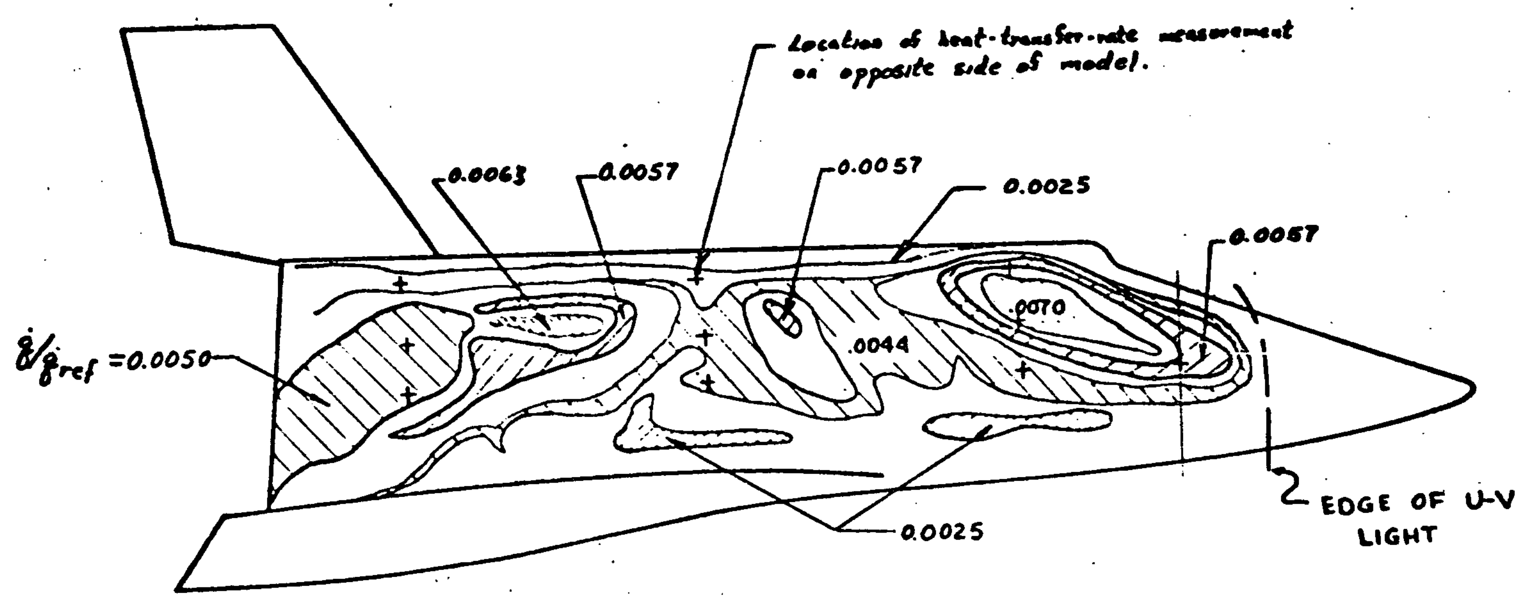
Side Elevation Distributions

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Bottom Spanwise Distributions

Run 3664, α = 50 deg, $Re_{\infty,\ell} = 5.0 \times 10^6$, M_∞ = 10.4

Note: These contours and model geometry are shown in the camera view.



Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is 0.0007

RUN 3665

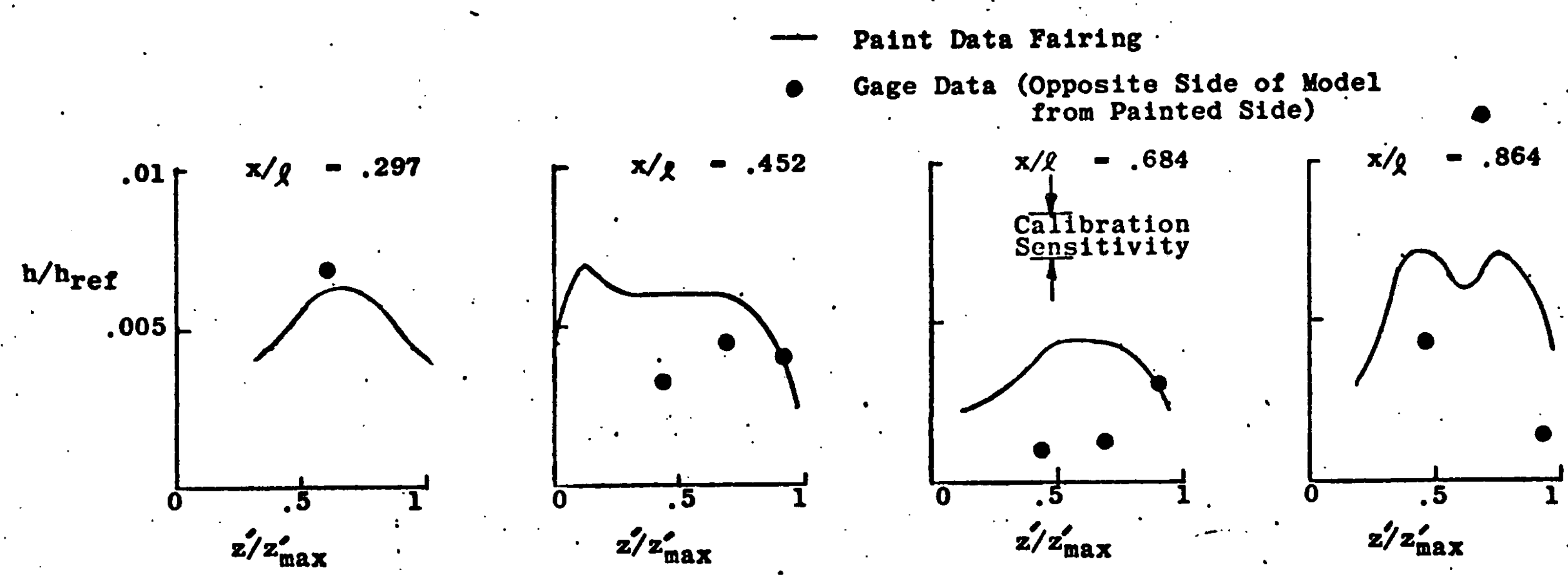
α = 60 DEG

M_∞ = 10.4

$Re_{\infty,\ell}$ = 4.6×10^6

t = 135 msec

$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

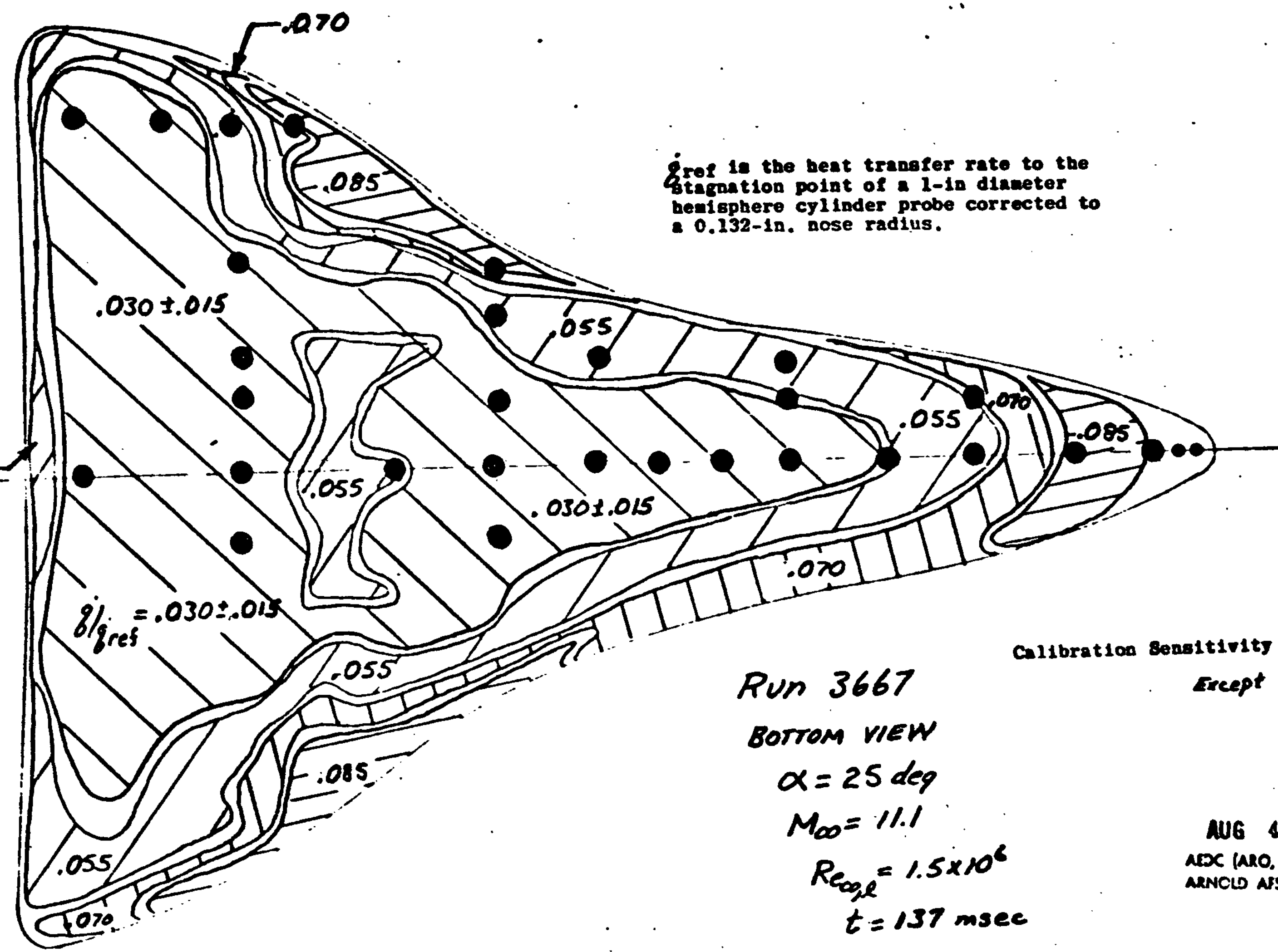


Side Elevation Distributions

Run 3665, α = 60 deg, $Re_{\infty,\ell} = 4.6 \times 10^6$, $M_\infty = 10.4$

The calibration sensitivity is the uncertainty in the fairing of the paint data.

Note: These contours and model geometry are shown in the camera view.



$\dot{q}_{ref}$ is the heat transfer rate to the stagnation point of a 1-in diameter hemisphere cylinder probe corrected to a 0.132-in. nose radius.

Calibration Sensitivity of $\dot{q}/\dot{q}_{ref}$ is .0075, *Except as noted.*

Run 3667

BOTTOM VIEW

α = 25 deg

M_∞ = 11.1

$Re_{\infty,\ell}$ = 1.5×10^6

t = 137 msec

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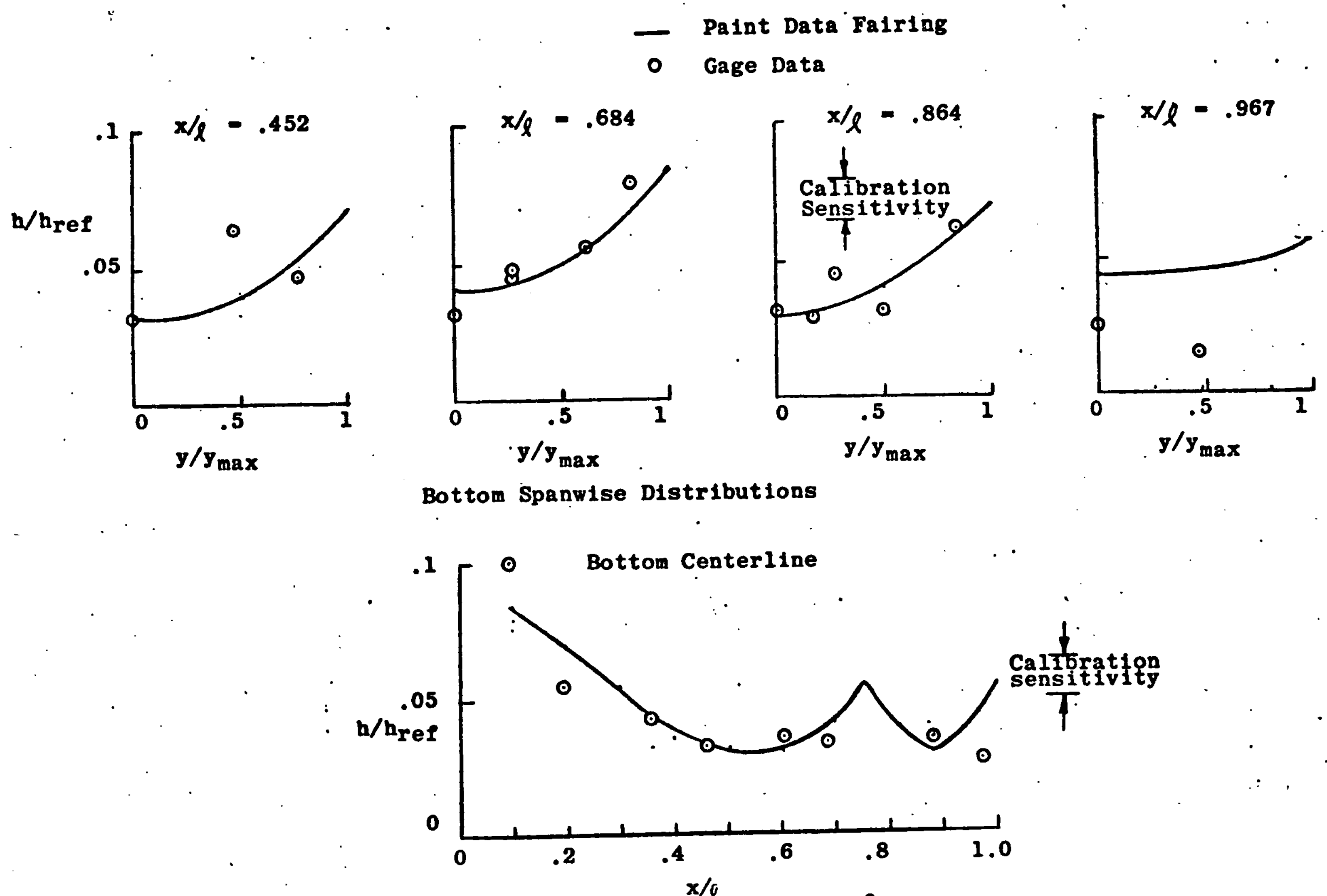

Run 3667, α = 25 deg, $Re_{\infty,\ell}$ = 1.5×10^6, M_∞ = 11.1

The calibration sensitivity is the uncertainty in the fairing of the paint data.